



February 10, 2015

## PRELIMINARY FOUNDATION INVESTIGATION REPORT

**HIGHWAY 11 CULVERTS, TOWNSHIPS OF MACAULAY AND STEPHENSON  
RESURFACING OF HIGHWAY 11  
FROM MUSKOKA ROAD 117 NORTHERLY TO STEPHENSON ROAD 12, 21.9 KM  
MINISTRY OF TRANSPORTATION, ONTARIO  
GWP 5462-09-00**

**Submitted to:**

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REPORT

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# **PART A**

**PRELIMINARY FOUNDATION INVESTIGATION REPORT  
HIGHWAY 11 CULVERTS, TOWNSHIPS OF MACAULAY AND STEPHENSON  
RESURFACING OF HIGHWAY 11  
FROM MUSKOKA ROAD 117 NORTHERLY TO STEPHENSON ROAD 12  
MINISTRY OF TRANSPORTATION, ONTARIO  
GWP 5462-09-00**



## **1.0 INTRODUCTION**

Golder Associates Ltd. (Golder) has been retained by AECOM Canada Ltd. (AECOM) on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for the replacement of seven culverts (GWP 5462-09-00) as part of the rehabilitation of Highway 11 in the Townships of Macaulay and Stephenson between Huntsville and Bracebridge, Ontario. The proposed rehabilitation of Highway 11 extends for 21.9 km, from Muskoka Road 117 northerly to Stephenson Road 12. The culverts addressed in this report are located along Highway 11 between Muskoka Road 117 and South Mary Lake Road. The general locations of the culverts are shown on the Index Plan, Drawing 1 and are summarized in Table 1, following the text of this report.

The original Terms of Reference and the Scope of Work for the foundation investigation are outlined in MTO's Request for Proposal, dated June 2011. Golder's proposal for foundation engineering services associated with the culverts is contained in Section 6.8 of AECOM's Technical Proposal for this assignment. The work has been carried out in accordance with Golder's Supplementary Specialty Plan for foundation engineering services for this project, dated June 26, 2014. The drawings showing the proposed culvert alignments were provided to Golder by AECOM on October 14, 2014.

This report addresses the investigation carried out for the seven culverts in GWP 5462-09-00, which were identified as potential culvert replacements. Separate reports detail the foundation investigations for the proposed structural culvert at Unnamed Creek (MTO Site No. 42-342/C) and the remaining culverts under GWP 5195-10-00.

The purpose of this investigation is to obtain subsurface information specific to the culvert locations, by methods of borehole drilling, bedrock coring, in situ testing and laboratory testing on selected soil samples and rock core samples. The boreholes for the culverts were located in the field by Golder and were surveyed relative to stakes and/or nail pins installed by exp. Services Inc. (exp.), a professional surveying company retained by AECOM. The culvert locations and elevations at the investigation locations were also surveyed in the field by exp.

## **2.0 SITE DESCRIPTION**

The seven culverts identified for potential replacement are located on Highway 11 in the Townships of Macaulay and Stephenson, between Muskoka Road 117 and South Mary Lake Road. The existing culvert locations and details (size, length, type, etc.) are summarized in Table 1.

In general, the topography of this section of the overall project limits consists of rolling terrain, including sparsely or densely populated treed areas and numerous bedrock outcrops separated by valleys and swamps containing areas of standing water and various types of vegetation and organic soils. The ground surface at the borehole and DCPT locations advanced within the limits of the study area, including through the existing Highway 11 embankments, varies between Elevations 326.5 m and 280.2 m, referenced to Geodetic datum. Section 4.0 of this report presents a description of the topography in the vicinity of each culvert.

## **3.0 INVESTIGATION PROCEDURES**

The fieldwork for the investigation associated with the proposed replacement of the seven culverts was carried out between June 18 and August 8, 2014, during which period a total of thirty-six (36) boreholes and thirty-six



(36) Dynamic Cone Penetration Tests (DCPTs) were advanced at, or in the immediate vicinity of, the culvert alignments. The locations of the boreholes and DCPTs advanced for each culvert are summarized below and in Table 1 and are shown on Drawings A1 to G1 in Appendices A to G.

The field investigation was carried out using a track mounted CME55, a truck mounted CME55, a truck mounted CME75 and portable equipment supplied and operated by Landcore Drilling of Sudbury, Ontario, as well as portable equipment supplied and operated by George Downing Estate Drilling Ltd of Grenville-Sur-La-Rouge, Quebec.

The boreholes were advanced through the overburden using 108 mm inside diameter hollow-stem augers, or NW casing with wash boring techniques. In general, soil samples were obtained at intervals of depth of about 0.75 m, 1.5 m and 3.0 m, using a 50 mm 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 generally employed a full-weight hammer lifted manually and dropped from the SPT height. At one borehole location where portable equipment was used, as noted on the Record of Borehole sheet, a half-weight hammer was used and the SPT 'N'-values were corrected to half the number of blows recorded. On the drill rigs, bedrock coring at selected boreholes and to penetrate through blast rock fill zones at some boreholes was carried out using an 'NQ' core barrel,. Coring by portable equipment was carried out using a 'BQ' core barrel. All open boreholes were backfilled with bentonite upon completion in accordance with Ontario Regulation 903 (Wells) (as amended).

The boreholes and DCPTs were advanced to depths generally penetrating 3 m into competent material below the culvert invert, terminating on refusal to further auger, casing and/or split spoon advancement or upon drilling into bedrock.

The groundwater conditions and water levels in the open boreholes were observed during the drilling operations and are described on the Record of Borehole sheets in Appendices A to G.

A sample of the creek water was obtained during the field investigation at each culvert location, using appropriate sampling protocols and submitted to a specialist analytical laboratory under chain of custody procedures for testing for a suite of parameters. The results of the analytical testing are summarized in Table 2, following the text of this report.

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 and rock core. The soil samples and rock core were identified in the field, placed in appropriate containers, labelled and transported to our Sudbury geotechnical laboratory where the samples and core underwent further visual examination and laboratory testing. All of the laboratory tests were carried out to MTO Laboratory Standards and/or ASTM Standards, as appropriate. Classification testing (water content, organic content, Atterberg limits and grain size distribution) was carried out on selected soil samples. The results of the laboratory testing on the various samples are provided in Appendices A to G.

Classification of the rock mass quality of the bedrock with respect to the Rock Quality Designation (RQD) is described based on Table 3.10 of the Canadian Foundation Engineering Manual (CFEM, 2006)<sup>1</sup>. The degree of weathering of the bedrock samples (e.g. fresh to slightly weathered) and the strength classification of the intact

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<sup>1</sup>Canadian Geotechnical Society, 2006. Canadian Foundation Engineering Manual, 4th Edition.



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rock mass based on field identification (e.g. strong) are described in accordance with the International Society for Rock Mechanics (ISRM, 1985)<sup>2</sup> standard classification system. Laboratory Unconfined Compressive Strength (UCS) testing was carried out on select samples of the bedrock and the uniaxial compressive strength of the bedrock is described as per Table 3.5 of the CFEM (2006)<sup>3</sup>.

Survey stakes and/or nail pins were installed by exp. at selected locations prior to the commencement of drilling at the respective sites. The as-drilled borehole locations, in stations and offsets, were measured in reference to the applicable stakes and/or nail pins installed by exp. and were subsequently converted into MTM NAD 83 coordinates in AutoCAD. Borehole elevations were surveyed by a member of our technical staff in reference to the ground surface elevations at applicable survey stakes and/or nail pins installed by exp. The borehole locations given on the Record of Borehole sheets and shown on Drawings A1 to G1 are positioned relative to MTM NAD 83 northing and easting coordinates and the ground surface elevations are referenced to Geodetic datum. The borehole locations, ground surface elevations and depths drilled are as follows:

Culvert Location	Borehole / DCPT	Location (m)		Ground Surface Elevation (m)	Depth of Borehole / DCPT (m)
		Northing	Easting		
STA 20+014 to STA 20+069 (Township of Macaulay)	C3-01	4997364.3	319636.3	284.0	11.3
	C3-02	4997376.3	319664.2	294.2	21.9
	C3-03	4997373.7	319688.7	288.1	9.8
	C3-04	4997402.4	319711.3	292.7	18.9 / 27.4
	C3-05	4997427.2	319740.0	281.5	11.3
	C3-DC01	4997366.1	319635.9	283.9	9.4
	C3-DC02	4997368.6	319664.3	294.1	21.3
	C3-DC03	4997378.6	319689.9	287.7	10.6
	C3-DC04A	4997396.4	319710.9	292.7	10.3
	C3-DC04B	4997394.0	319711.4	292.7	21.6
	C3-DC05A	4997421.6	319740.0	281.1	8.8
	C3-DC05B	4997427.2	319739.0	280.2	9.4
STA 21+675 to STA 21+751 (Township of Macaulay)	C4-01	4999103.6	319610.0	290.9	11.3 / 16.8
	C4-02	4999075.7	319627.1	297.2	10.0
	C4-03	4999061.1	319638.9	302.6	20.4
	C4-04	4999054.8	319652.5	302.1	15.5 / 16.5 <sup>1</sup>
	C4-05	4999034.8	319686.3	302.2	14.8 / 15.4 <sup>1</sup>
	C4-05A	4999032.8	319685.9	302.1	25.0 / 29.2
	C4-06	4999033.3	319714.3	288.2	8.2
	C4-DC01	4999106.7	319614.3	291.5	9.7
	C4-DC02	4999068.2	319621.1	297.1	12.1
	C4-DC03	4999068.1	319639.0	302.6	19.1

<sup>2</sup> International Society for Rock Mechanics Commission on Test Methods, 1985. Int. J. Rock Mech. Min. Sci. & Geomech. Abstr. Vol 22, No. 2, pp. 51-60.

<sup>3</sup> Canadian Geotechnical Society, 2006. Canadian Foundation Engineering Manual, 4th Edition.



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CULVERTS, GWP 5462-09-00**

Culvert Location	Borehole / DCPT	Location (m)		Ground Surface Elevation (m)	Depth of Borehole / DCPT (m)
		Northing	Easting		
	C4-DC04	4999060.8	319652.9	302.1	24.4
	C4-DC05	4999043.8	319686.2	302.2	11.1
	C4-DC06	4999026.6	319716.7	288.2	9.0
STA 21+912 (Township of Macaulay)	C5-01	4999269.9	319620.8	302.5	6.4 <sup>2</sup>
	C5-02	4999262.1	319635.1	306.7	10.9 <sup>2</sup>
	C5-03	4999263.4	319657.3	302.9	7.5 <sup>2</sup>
	C5-DC01	4999262.8	319620.0	300.9	2.0
	C5-DC02	4999268.1	319635.0	306.9	8.5
	C5-DC03	4999267.7	319658.7	303.2	4.8
STA 22+740 to STA 22+771 (Township of Macaulay)	C7-01	5000137.3	319588.8	291.2	4.5
	C7-02	5000131.0	319622.6	307.7	26.2 <sup>2</sup>
	C7-03	5000114.1	319632.3	307.8	20.4 / 21.0
	C7-04	5000106.6	319660.9	307.1	23.0 <sup>2</sup>
	C7-05	5000113.7	319667.7	307.2	12.1
	C7-06	5000092.7	319702.9	290.0	0.6
	C7-06A	5000092.7	319703.8	290.1	2.6
	C7-06B	5000098.2	319701.2	290.2	5.5
	C7-DC01	5000137.7	319588.3	291.3	3.2
	C7-DC02	5000119.0	319622.6	307.8	9.1
	C7-DC03	5000124.6	319631.8	307.7	8.8
	C7-DC04	5000112.6	319660.7	307.2	10.4
	C7-DC05	5000101.7	319669.1	307.0	8.4
	C7-DC06	5000096.7	319702.8	290.1	3.4
STA 23+836 to STA 23+864 (Township of Macaulay)	C8-01	5001189.4	319579.5	315.8	6.2 <sup>2</sup>
	C8-02	5001187.8	319605.7	326.3	16.6 <sup>2</sup>
	C8-03	5001193.2	319629.1	320.9	12.6 <sup>2</sup>
	C8-04	5001194.6	319653.2	326.4	20.3 <sup>2</sup>
	C8-05	5001220.6	319685.3	315.6	5.0 / 5.3
	C8-DC01A	5001188.7	319579.6	316.1	3.2
	C8-DC01B	5001187.7	319579.6	316.2	3.1
	C8-DC02	5001195.0	319615.5	326.4	16.2
	C8-DC03	5001187.2	319629.2	321.0	9.6
	C8-DC04	5001202.6	319653.3	326.5	8.2
	C8-DC05	5001217.4	319683.4	315.6	4.4
STA 10+743 (Township of Stephenson)	C9-01	5002619.6	319567.9	304.1	4.0 <sup>2</sup>
	C9-02	5002620.2	319583.3	311.6	13.5 <sup>2</sup>
	C9-03	5002605.1	319607.1	306.8	8.4 <sup>2</sup>
	C9-DC01	5002622.1	319566.4	304.1	1.5





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Culvert Location	Borehole / DCPT	Location (m)		Ground Surface Elevation (m)	Depth of Borehole / DCPT (m)
		Northing	Easting		
	C9-DC02	5002614.7	319583.4	311.7	9.6
	C9-DC03	5002594.0	319605.0	309.1	4.1
STA 12+927 (Township of Stephenson)	C11-01	5004836.0	319505.5	305.3	5.2
	C11-02	5004823.0	319519.4	310.4	15.8 <sup>2</sup>
	C11-03	5004810.5	319544.1	307.1	8.7
	C11-04	5004784.9	319567.6	310.0	13.7 <sup>2</sup>
	C11-05	5004777.8	319585.1	303.3	4.6
	C11-DC01	5004836.9	319505.6	305.3	7.5
	C11-DC02	5004831.2	319518.8	310.4	15.0
	C11-DC03	5004807.0	319543.0	307.1	6.9
	C11-DC04	5004791.9	319567.3	310.0	3.5
	C11-DC05	5004775.9	319584.9	303.2	3.9

Notes: 1. Penetration into culvert.

2. Includes between 1.3 m and 3.6 m lengths of bedrock coring.

## 4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

### 4.1 Regional Geology

As delineated in *The Physiography of Southern Ontario*<sup>4</sup>, this section of Highway 11 lies within the physiographic region known as the “Number 11 Strip”, with portions of Highway 11 in contact with the “Georgian Bay Fringe” region. The Number 11 Strip is a narrow belt that extends from Gravenhurst to North Bay and is characterized by deposits of sand, silt and clay, together with more recent swamp deposits between rock knobs and ridges. The bedrock in the area is typically highly deformed gneiss of the Moon River Domain of the Central Gneiss Belt, a subdivision of the Grenville Structural Province (Geology of Ontario, 1991)<sup>5</sup>.

### 4.2 General Overview of Local Subsurface Conditions

The detailed subsurface soil and groundwater conditions as encountered in the boreholes advanced during this investigation, together with the results of the laboratory tests carried out on selected soil and rock core samples, are presented on the Record of Borehole and Drillhole sheets and the laboratory test sheets in Appendices A to G. The stratigraphic boundaries shown on the Record of Borehole and Drillhole sheets are inferred from non-continuous sampling, observations of drilling progress and in situ testing and are approximate. 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.

<sup>4</sup> Chapman, L.J. and D. F. Putnam, 1984. *The Physiography of Southern Ontario*, Ontario Geological Survey, Special Volume 2, Third Edition. Accompanied by Map P. 2715, Scale 1:600,000.

<sup>5</sup> Geology of Ontario. 1991. Ontario Geological Society, Special Volume 4, Part 2. Eds. P.C. Thurston, H.R. Williams, R.H. Sutcliffe and G.M. Stott. Ministry of Northern Development and Mines, Ontario.



The inferred subsurface stratigraphy as encountered in the boreholes advanced for the seven culverts are shown in profile on Drawings A1 to G1. In general, the stratigraphy encountered at the various areas investigated is similar. However, the overburden (soil materials) thickness is variable, ranging from 0.6 m to about 29.2 m. The stratigraphy generally consists of:

- surficial layers of peat or topsoil fill;
- embankment fill (including asphalt in places);
- non-cohesive deposits of sand to silt;
- non-cohesive deposits of sand and gravel to gravel, containing cobbles and boulders in some areas, over inferred bedrock; and,
- gneiss bedrock.

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

### **4.3 Culvert STA 20+014 to 20+069 (Township of Macaulay)**

The plan and profile along the centreline of the skewed culvert between approximately STA 20+014 and 20+069 in Township of Macaulay showing the borehole locations and interpreted stratigraphy are presented on Drawing A1. The height of the embankment at this location is up to about 12 m and the existing concrete culvert is about 119 m long with dimensions of 1220 mm wide by 1220 mm high. A total of five boreholes and seven DCPTs were completed to investigate the subsurface conditions at the culvert location: two boreholes (C3-01 and C3-05) and three companion DCPTs (C3-DC01, C3-DC05A and C3-DC05B) were advanced near the ends of the culvert; and three boreholes (C3-02, C3-03 and C3-04) and four DCPTs (C3-DC02, C3-DC03, C3-DC04A and C3-DC04B) were advanced through the roadway embankments along the alignment of the culvert. In general, the topography in the area of the culvert consists of densely treed rolling terrain transitioning to a low-lying area at the location of the culvert.

#### **4.3.1 West Embankment Fill (SBL)**

Embankment fill 13.4 m and 7.2 m thick was encountered from ground surface at Elevations 294.2 m and 288.1 m in Boreholes C3-02 and C3-03, respectively. The upper portion of fill consists of a 0.7 m thick layer of gravel, some sand, and a 0.2 m thick layer of silty sandy topsoil in Boreholes C3-02 and C3-03, respectively. Underlying the gravel deposit and silty sandy topsoil, a 12.7 m and 5.8 m thick layer of silt and sand to silty sand to sand deposit was encountered at Elevations 293.5 m and 287.9 m in Boreholes C3-02 and C3-03, respectively. Underlying the sand and silt to sand deposit in Borehole C3-03 a 1.2 m thick layer of sand and gravel was encountered at Elevation 282.1 m.

The SPT 'N'-values measured within the west embankment fill range between 2 blows and 24 blows per 0.3 m of penetration, indicating a very loose to compact relative density.

The natural water content measured on nine samples of the sand and silt to sand fill range from about 13 per cent to 30 per cent.



The results of the grain size distribution test completed on five samples of the sand to sand and silt fill are shown on Figure A1 in Appendix A.

#### **4.3.2 East Embankment Fill (NBL)**

Embankment fill 13.3 m thick was encountered from ground surface at Elevation 292.7 m in Borehole C3-04. The east embankment fill consists of a 0.7 m thick layer of sand and gravel mixed with asphalt to a depth of 0.2 m. A 12.6 m thick deposit of silt and sand, trace clay, trace organics fill was encountered directly below the sand and gravel fill at Elevation 292.0 m.

The SPT 'N'-values measured within the east embankment fill range between 12 blows and 58 blows per 0.3 m of penetration, indicating a compact to very dense relative density.

The natural water content measured on one sample of the sand and gravel fill is about 6 per cent and the natural water content measured on six samples of the sand to sand and silt fill range from about 15 per cent to 29 per cent. The organic content measured on two samples of the fill are about 1 per cent and 2 per cent.

The results of the grain size distribution tests completed on three samples of the sand to sand and silt fill are shown on Figure A2 in Appendix A.

An Atterberg limits test was carried out on one sample of the silt and sand fill and indicates that the fill is non-plastic.

#### **4.3.3 Peat**

A 0.1 m thick deposit of fibrous peat was encountered at ground surface in Boreholes C3-01 and C3-05, at Elevations 284.0 m and 281.5 m, respectively.

#### **4.3.4 Silt to Sand**

A deposit of grey to brown silt to silty sand to silt and sand to sand, trace gravel, trace clay, trace organics in places was encountered below the fill in Boreholes C3-02 to C3-04 and below the peat deposit in Boreholes C3-01 and C3-05. The top of the deposit was encountered between Elevations 283.9 m and 279.4 m and the thickness of the deposit ranges between 2.6 m and 11.2 m. In Borehole C3-02 a 1.4 m thick interlayer of brown sand and gravel was encountered at Elevation 279.3 m between the silt to sand and silty sand to sand portions of the deposit.

The SPT 'N'-values measured within the silt to sand deposit typically range between 2 blows and 41 blows per 0.3 m of penetration indicating a very loose to dense relative density, with the lower SPT 'N'-values being measured within the upper zone of the silt to sand deposit. One SPT 'N'-value measured within the sand and gravel interlayer is 15 blows per 0.3 m of penetration indicating a compact relative density.

The natural water content measured on eighteen samples of the silt to sand deposit range from about 17 per cent to 36 per cent. The organic content measured on two samples of silt to sand deposit are about 1 per cent and 2 per cent, both samples which also yielded the higher natural water content.



The results of the grain size distribution tests completed on ten samples of the sand to silt deposit are shown on Figure A3 in Appendix A.

An Atterberg limits test was carried out on one sample of the silt and sand portion of the deposit and indicates that the deposit is non-plastic.

#### **4.3.5 Refusal**

Refusal to further dynamic cone penetration test was encountered in DCPTs C3-DC01 and C3-DC03 to C3-DC05B at depths ranging from 8.8 m to 27.4 m below existing ground surface, between Elevations 282.4 m and 265.3 m.

### **4.4 Culvert STA 21+675 to 21+751 (Township of Macaulay)**

The plan and profile along the centreline of the skewed culvert extending from approximately STA 21+675 and 21+751 in Township of Macaulay showing the borehole locations and interpreted stratigraphy are presented on Drawing B1. The height of the embankment at this location is up to about 13 m and the existing concrete culvert is about 128 m long with dimensions of 1830 mm wide by 1830 mm high. A total of seven boreholes and six DCPTs were completed to investigate the subsurface conditions at the culvert location: two boreholes (C4-01 and C4-06) and two companion DCPTs (C4-DC01 and C4-DC06) were advanced near the ends of the culvert; and five boreholes (C4-02 to C4-05 and C4-05A) and four DCPTs (C4-DC02 to C4-DC05) were advanced through the roadway embankments along the alignment of the culvert. In general, the topography in the area of the culvert consists of densely treed areas with exposed bedrock outcrops located to the south of the culvert transitioning to low-lying area at the location of the culvert ends.

#### **4.4.1 West Embankment Fill (SBL)**

Embankment fill between 7.9 m and 17.2 m thick was encountered in the west embankment between Elevations 302.6 m and 297.2 m in Boreholes C4-02 to C4-04. In Borehole C4-03, the upper 1.4 m thick layer of fill is comprised of sand and gravel. Underlying the sand and gravel fill and from ground surface in Boreholes C4-02 and C4-04, the fill is comprised of silt and sand to sand, trace clay, trace organics. Borehole C4-04 penetrated the culvert at a depth of 15.4 m below ground surface, corresponding to Elevation 286.7 m, was terminated, the hole in the culvert roof was sealed with a rubber plug and the borehole was backfilled with a cement grout-gravel mixture for a thickness of 1.5 m over the rubber plug, bentonite to ground surface.

Two SPT 'N'-values measured within the upper sand and gravel fill are 18 blows and 28 blows per 0.3 m of penetration, indicating a compact relative density. The SPT 'N'-values measured within the silt to sand to sand fill range between 0 blows (i.e. weight of hammer) and 52 blows per 0.3 m of penetration, indicating a very loose to very dense relative density.

The natural water content measured on sixteen samples of the silt and sand to sand fill ranges from about 11 per cent to 36 per cent. The organic content measured on four samples of the fill range from about 3 per cent and 5 per cent.



The results of the grain size distribution test completed on nine samples of the silt and sand to sand fill are shown on Figure B1 in Appendix B.

#### **4.4.2 East Embankment Fill (NBL)**

Embankment fill 14.6 m and 13.7 m thick was encountered from the ground surface at Elevations 302.2 m and 302.1 m in Boreholes C4-05 and C4-05A, respectively. The upper 5.8 m and 8.4 m thick layer of fill in the respective boreholes is comprised of sand and gravel underlain by a 7.3 m and 5.3 m thick layer of rock fill at Elevations 296.4 m and 293.7 m. In Boreholes C4-05 and C4-05A, the rock fill is underlain by a 1.5 m and 4.1 m thick layer of silt and sand fill at Elevations 289.1 m and 288.4 m, respectively. The near surface zone of the sand and gravel to sandy gravel fill contains pieces of asphalt and an approximately 0.4 m thick boulder was cored through at Elevation 298.7 m.

Borehole C4-05 penetrated the culvert at Elevation 287.6 m and was terminated, the hole in the culvert roof was sealed with a rubber plug and the borehole was backfilled with a cement grout-gravel mixture for a thickness of 1.5 m over the rubber plug, bentonite to near ground surface and topped with a layer of cold patch asphalt.

The SPT 'N'-values measured within the sand and gravel to sandy gravel fill range between 6 blows and 34 blows per 0.3 m of penetration, indicating a loose to dense relative density. Advancement of the borehole through the zone of rock fill in Boreholes C4-05 and C4-05A was accomplished by coring, with split-spoon sampling where possible. The SPT 'N'-values within the rock fill zone range from 0 blows (weight of hammer) and 7 blows per 0.3 m of penetration inferred indicative of voids and loose soils within the rock fill mass. The SPT 'N'-value measured within the silt and sand fill underlying the rock fill range between 6 blows and 11 blows per 0.3 m of penetration, indicating a loose to compact relative density.

The natural water content measured on three samples of the sand and gravel to sandy gravel fill range from about 4 per cent to 9 per cent. The natural water content measured on three samples of the silt and sand fill range from about 22 per cent to 27 per cent. The organic content of a sample of the silt and sand fill is about 4 per cent.

The results of the grain size distribution test completed on two samples of the sand and gravel to sandy gravel fill are shown on Figure B2 in Appendix B. The results of the grain size distribution test completed on three samples of the silt and sand fill are shown on Figure B3 in Appendix B.

#### **4.4.3 Sandy Peat to Peat**

A 0.1 m and 0.7 m thick deposit of fibrous sandy peat to peat was encountered at ground surface at Elevations 290.9 m and 288.2 m in Boreholes C4-01 and C4-06, respectively.

One SPT 'N'-value measured within the peat is 9 blows per 0.3 m of penetration, suggesting a loose consistency.

#### **4.4.4 Sand and Gravel**

A 2.2 m thick deposit of sand and gravel was encountered below the embankment fill in Borehole C4-03 at Elevation 285.4 m.



One SPT 'N'-value measured within the sand and gravel deposit is 81 blows per 0.3 m of penetration, indicating a very dense relative density.

#### **4.4.5 Silt to Sand**

A deposit of grey to brown silt to sandy silt to sand and silt to sand, trace to some gravel, trace clay, and trace organics near ground surface was encountered below the fill in Boreholes C4-02 and C4-05A, below the peat deposit in Boreholes C4-01 and C4-06 and below the sand and gravel deposit in Borehole C4-03. The top of the deposit was encountered between Elevations 290.8 m and 285.4 m. The silt to sand deposit was 2.1 m thick in Borehole C4-02 where it was fully penetrated, and between 1.0 m and 11.3 m thick in Boreholes C4-01, C4-03, C4-05A and C4-06 where the boreholes were terminated within the deposit.

The SPT 'N'-values measured within the silt to sand deposit range between 0 blows (i.e. weight of hammer) and 34 blows per 0.3 m of penetration indicating a very loose to dense relative density.

The natural water content measured on sixteen samples of the silt to sand deposit range from about 21 per cent and 39 per cent. The organic content measured on two samples of the deposit are 0.4 per cent and about 4 per cent.

The results of the grain size distribution tests completed on nine samples of the silt to silt and sand portions of the deposit are shown on Figure B4 in Appendix B.

An Atterberg limits test was carried out on one sample of the silt to sand portion of the deposit and indicates that the deposit is non-plastic.

#### **4.4.6 Refusal**

Refusal to further spilt spoon and casing advancement or DCPT penetration was encountered in Boreholes C4-02 and C4-05A and DCPTs C4-DC01 to C4-DC06 at depths between 9.0 m and 29.2 m below ground surface, between Elevations 291.1 m and 272.9 m, with the shallower depth to refusal occurring on inferred rock fill.

### **4.5 Culvert STA 21+912 (Township of Macaulay)**

The plan and profile along the centreline of the culvert at approximately STA 21+912 in Township of Macaulay showing the borehole locations and interpreted stratigraphy are presented on Drawing C1. The height of the embankment at this location is up to about 7 m and the existing concrete culvert is about 30 m long, extending through the west embankment, with dimensions of 1220 mm wide by 1220 mm high. A total of three boreholes and three DCPTs were completed to investigate the subsurface conditions at the culvert location: two boreholes (C5-01 and C5-03) and two companion DCPTs (C5-DC01 and C5-DC03) were advanced near the ends of the culvert; and one borehole (C5-02) and one DCPT (C5-DC02) were advanced through the roadway embankment on the culvert alignment. In general, the topography in the area of the culvert consists of exposed bedrock in proximity to the east end of the culvert the Highway 11 median. A densely treed area with scattered boulders on the ground surface is present at the toe of embankment near the west end of the culvert.





#### **4.5.1 West Embankment Fill (SBL)**

Embankment fill between 1.4 m and 7.5 m thick was encountered at ground surface in Boreholes C5-01 to C5-03 between Elevations 306.7 m and 302.5 m. In Borehole C5-02 the upper portion of fill consists of a 2.1 m thick layer of silty sand to sand and gravel, trace clay, underlain by a 2.5 m thick layer of rock fill encountered at Elevation 304.6 m. In Boreholes C5-01 and C5-03, a 0.2 m and 0.1 m thick layer of topsoil covers the embankment fill. Underlying the rock fill in Borehole C5-02 and the topsoil fill in Boreholes C5-01 and C5-03 a 1.2 m to 2.9 m thick layer of silty sand to sand, trace to some gravel, trace clay, trace organics was encountered between Elevations 302.1 m and 302.8 m.

The SPT 'N'-values measured within the silty sand to sand and gravel fill range between 5 blows and 13 blows per 0.3 m of penetration, indicating a loose to compact relative density. SPT 'N'-values of 100 blows per 0.13 m of penetration and 100 blows per 0.23 m of penetration were measured within the rock fill layer at contacts with the rock fill pieces. The SPT 'N'-values measured within the silty sand to sand fill range between 2 blows and 15 blows per 0.3 m of penetration, indicating a very loose to compact relative density.

The natural water content measured on one sample of the silty sand to sand and gravel fill is about 11 per cent, and the natural water content measured on two samples of the silty sand to sand fill is about 18 per cent and 24 per cent.

The results of the grain size distribution test completed on one sample of the silty sand to sand and gravel fill are shown on Figure C1 and the results of the grain size distribution test completed on two samples of the lower silty sand to sand fill are shown on Figure C2 in Appendix C.

#### **4.5.2 Silt**

A deposit of grey silt, trace sand, trace clay was encountered below the fill in Boreholes C5-01 and C5-03. The top of the deposit was encountered at Elevations 301.1 m and 301.5 m and the thicknesses of the deposit is 1.3 m and 2.3 m at the respective boreholes.

The SPT 'N'-values measured within the silt deposit typically range between 8 blows and 12 blows per 0.3 m of penetration, indicating a loose to compact relative density; however, one SPT 'N'-value of 18 blows per 0.25 m of penetration was measured in Borehole C5-01 upon contact with the underlying boulder deposit.

The natural water content measured on two samples of the silt deposit are about 27 per cent and 30 per cent.

The results of the grain size distribution test completed on two samples of the silt deposit are shown on Figure C3 in Appendix C.

An Atterberg limits test was carried out on one sample of the silt deposit and indicates that the deposit is non-plastic.

#### **4.5.3 Sand and Gravel**

A 0.7 m thick deposit of grey sand and gravel was encountered underlying the silt deposit in Borehole C5-03 at Elevation 299.2 m.



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

#### **4.5.4 Boulders**

A 0.3 m deposit of boulders was encountered underlying the silt deposit in Borehole C5-01 at Elevation 299.8 m.

#### **4.5.5 Bedrock / Refusal**

Bedrock was encountered in Boreholes C5-01 to C5-03 between Elevations 299.5 m, and 298.5 m and core samples between 3.1 m and 3.4 m long were obtained. Based on a review of the bedrock core samples, the bedrock consists of fine to coarse grained, fresh to moderately weathered, pinkish grey gneiss.

The Total Core Recovery (TCR) for the core samples ranges from 98 per cent to 100 per cent and the Solid Core Recovery (SCR) ranges from 83 per cent to 100 per cent. The Rock Quality Designation (RQD) measured on the recovered bedrock core samples in the boreholes ranges between 46 per cent and 100 per cent, and is generally greater than 69 per cent, indicating the rock is of poor to excellent quality and generally of fair to excellent quality, according to Table 3.10 in CFEM (2006)<sup>1</sup>.

One Unconfined Compressive Strength (UCS) test (ASTM D7012) was carried out on a core sample of the gneiss bedrock obtained in Borehole C5-03 and measured a uniaxial compressive strength of 59 MPa, as detailed in Table C1. Based on the laboratory UCS test, in accordance with Table 3.5 in CFEM (2006)<sup>1</sup>, the gneiss bedrock is classified as strong ( $R_4$ , 50 MPa < UCS < 100 MPa).

Refusal to further dynamic cone penetration was encountered in DCPTs C5-DC01 to C3-DC03 at depths ranging from 2.0 m to 8.5 m below existing ground surface, between Elevations 298.9 m to 298.4 m.

### **4.6 Culvert STA 22+740 to 22+771 (Township of Macaulay)**

The plan and profile along the centreline of the skewed culvert between approximately STA 22+740 and 22+771 in Township of Macaulay showing the borehole locations and interpreted stratigraphy are presented on Drawing D1. The height of the embankment at this location is up to about 18 m and the existing concrete culvert is about 109 m long with dimensions of 1220 mm wide by 1830 mm high across the SBL embankment upstream of the Highway 11 median catch basin and dimensions of 1830 mm wide by 1830 mm high across the NBL embankment downstream. A total of eight boreholes and six DCPTs were completed to investigate the subsurface conditions at the culvert location: four boreholes (C7-01, C7-06, C7-06A and C7-06B) and two companion DCPTs (C7-DC01 and C7-DC06) were advanced near the ends of the culvert; and four boreholes (C7-02, C7-03, C7-04 and C7-05) and four DCPTs (C7-DC02, C7-DC03, C7-DC04 and C7-DC05) were advanced through the roadway embankments along the alignment of the culvert. In general, the topography in the vicinity of the culvert consists of densely treed areas transitioning to a low-lying area at the location of the culvert.



#### **4.6.1 West Embankment Fill (SBL)**

A layer of asphalt up to 65 mm thick was encountered at ground surface in Boreholes C7-02 and C7-03 at Elevations 307.7 m and 307.8 m, respectively. Underlying the asphalt in Boreholes C7-02 and C7-03, embankment fill 17.9 m and 19.3 m thick, respectively, was encountered at Elevation 307.7 m. The embankment fill consists of a 0.7 m and 0.6 m thick layer of sand and gravel in Boreholes C7-02 and C7-03, respectively, underlain by a 9.2 m and 8.5 m thick layer of silt and sand to silty sand to sand, trace gravel at Elevations 307.0 m and 307.1 m, in turn underlain by a 5.3 m and 2.4 m thick layer of rock fill at Elevations 297.8 m and 298.6 m. The rock fill is underlain by a 2.7 m and 7.8 m thick layer of silty sand and/or silt to silt to silt sand at Elevations 292.5 m and 296.2 m in Boreholes C7-02 and C7-03, respectively. In Borehole C7-03, a 0.3 m thick seam of organic sand was encountered at Elevation 296.2 m within the silty sand fill layer.

Two SPT 'N'-values measured within the upper sand and gravel fill are 14 blows and 40 blows per 0.3 m of penetration, indicating a compact to dense relative density. The SPT 'N'-values measured within the silt and sand to sand fill range between 12 blows and 45 blows per 0.3 m of penetration, indicating a compact to dense relative density. The SPT 'N'-values measured within the layers of silty sand or silt to silt and sand fill typically range between 2 blows and 39 blows per 0.3 m of penetration, indicating a loose to very dense relative density.

The natural water content measured on seven samples of the silt and sand to sand fill range from about 6 per cent to 17 per cent and the natural water content measured on five samples of the silty sand to silt and sand fill range from about 13 per cent to 31 per cent. The organic content measured on one sample of the organic sand seam within the silty sand fill is about 10 per cent.

The results of the grain size distribution tests completed on four samples of the silt and sand fill are shown on Figure D1 in Appendix D, and on three samples of the silt to silty sand fill are shown on Figure D2 in Appendix D.

#### **4.6.2 East Embankment Fill (NBL)**

A layer of asphalt 0.1 m and 0.3 m thick was encountered at ground surface in Boreholes C7-04 and C7-05 at Elevations 307.1 m and 307.2 m, respectively. Underlying the asphalt in Boreholes C7-04 and C7-05, embankment fill 17.7 m and 12.1 m thick was encountered at Elevations 307.0 m and 306.9 m, respectively. The upper portion of the fill consists of a 5.4 m and 1.8 m thick layer of gravelly sand to sand and gravel in Boreholes C7-04 and C7-05, respectively, underlain by a 6.7 m and 10.0 m thick layer of rock fill at Elevations 301.6 m and 305.1 m in Boreholes C7-04 and C7-05, respectively. In Borehole C7-05, the core barrel was damaged while advancing through the rock fill and the borehole had to be abandoned before fully penetrating the layer. Within the rock fill in Borehole C7-04, a 1.9 m thick sandy gravel interlayer was encountered at 297.7 m. The rock fill in Borehole C7-04 is in turn underlain by 1.1 m thick layer of sand and gravel fill and a 4.5 m thick layer of silt fill encountered at Elevation 294.9 m.

The SPT 'N'-values measured within the gravelly sand to sand and gravel fill range between 5 blows and 23 blows per 0.3 m of penetration, indicating a loose to compact relative density. The SPT 'N'-values measured within the sandy gravel interlayer are 15 blows and 37 blows per 0.3 m of penetration, indicating a compact to dense relative density. The SPT 'N'-value measured within the sand and gravel fill and silt fill underlying the rock fill range between 14 blows and 24 blows per 0.3 m of penetration, indicating a compact relative density.



The natural water content measured on three samples of the gravelly sand to sand and gravel fill range from about 4 per cent to 7 per cent, and on one sample of the sandy gravel interlayer within the rock fill is about 16 per cent. The natural water content measured on one sample of the sand and gravel fill and three samples of the silt fill are about 16 per cent and between 26 per cent and 27 per cent, respectively.

The results of the grain size distribution tests completed on two samples of the gravelly sand to sand and gravel fill are shown on Figure D3 in Appendix D. The results of the grain size distribution test completed on one sample of the sandy gravel interlayer within the rock fill and on two samples of the silt fill are shown on Figures D4 and D5, respectively, in Appendix D.

#### **4.6.3 Sandy Peat to Peat**

A 0.1 m to 0.6 m thick deposit of fibrous sandy peat to peat was encountered at ground surface in Boreholes C7-01 and C7-06 to C7-06B, between Elevations 291.2 m and 290.0 m.

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

#### **4.6.4 Silt to Silt and Sand**

A deposit of grey silt to sand and silt, some gravel, trace clay, trace organics was encountered below the fill in Borehole C7-02 and below the peat deposit in Borehole C7-01. The top of the deposit was encountered at Elevations 291.1 m and 289.8 m and the thickness of the deposit is 2.0 m and 3.0 m in Boreholes C7-01 and C7-02, respectively.

The SPT 'N'-values measured within the silt to silt and sand deposit range between 1 blow and 29 blows per 0.3 m of penetration indicating a very loose to compact relative density.

The natural water content measured on two samples of the silt to silt and sand deposit are about 28 per cent and 29 per cent. The organic content measured on one sample of the silt and sand portions of the deposit is about 1 per cent.

The results of the grain size distribution tests completed on two samples of the silt to silt and sand deposit are shown on Figure D6 in Appendix D.

#### **4.6.5 Sand**

A deposit of brown to grey sand, some silt, trace to some gravel, trace organics was encountered below the fill in Borehole C7-04 and below the peat deposit in Boreholes C7-06A and C7-06B. The top of the deposit was encountered between Elevations 290.2 m and 289.3 m and the thickness between 0.9 m and 3.6 m.

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

The natural water content measured on two samples of the sand deposit is about 21 per cent and 31 per cent.



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

A deposit of brown to grey sand to sand and gravel, some silt, trace clay was encountered below the fill in Borehole C7-03, below the silt and sand deposit in Borehole C7-02 and below the sand deposit in Borehole C7-04. The top of the deposit was encountered between Elevations 288.4 m and 286.3 m and the thickness of the deposit ranges between 0.9 m and 2.3 m.

Two SPT 'N'-values measured within the sand to sand and gravel deposit are 10 blows and 68 blows per 0.3 m of penetration indicating a compact to very dense relative density.

The natural water content measured on two samples of the sand to sand and gravel deposit is about 9 per cent and 10 per cent.

The result of the grain size distribution test completed on one sample of the sand to sand and gravel deposit is shown on Figure D7 in Appendix D.

#### **4.6.7 Gravel and Cobbles**

A deposit of gravel and cobbles was encountered underlying the silt to silt and sand deposit in Borehole C7-01 and below the sand deposits in Boreholes C7-06A and C7-06B between Elevations 289.1 m and 286.6 m. Boreholes C7-01, C7-06A and C7-06B were terminated within the gravel and cobbles deposit, penetrating the deposit between 1.5 m and 2.4 m.

#### **4.6.8 Bedrock / Refusal**

Bedrock was encountered in Boreholes C7-02 and C7-04 at Elevations 284.5 m and 285.4 m, respectively, and core samples 3.0 m and 1.3 m long were obtained. Based on a review of the bedrock core samples, the bedrock consists of fine to medium grained, fresh to severely weathered, pinkish grey gneiss.

The Total Core Recovery (TCR) for the core samples ranges from 99 per cent to 100 per cent and the Solid Core Recovery (SCR) ranges from 48 per cent to 100 per cent. The Rock Quality Designation (RQD) measured on the recovered bedrock core samples ranges between 52 per cent and 100 per cent indicating the rock is of fair to excellent quality, according to Table 3.10 in CFEM (2006)<sup>1</sup>.

Refusal to further spilt spoon advancement or DCPT penetration was encountered in Boreholes C7-03 and C7-06 and DCPTs C7-DC01 to C7-DC06 at depths between 0.6 m and 21.0 m below ground surface, between Elevations 298.9 m and 286.8 m.

### **4.7 Culvert STA 23+836 to 23+864 (Township of Macaulay)**

The plan and profile along the centreline of the skewed culvert between approximately STA 23+836 and 22+864 in Township of Macaulay showing the borehole locations and interpreted stratigraphy are presented on Drawing E1. The height of the embankment at this location is up to about 11 m and the existing concrete culvert is estimated to be about 122 m long with dimensions of 1220 mm wide by 1220 mm high. A total of five boreholes and six DCPTs were completed to investigate the subsurface conditions at the culvert location: two boreholes (C8-01 and C8-05) and three companion DCPTs (C8-DC01A, C8-DC01B and C8-DC05) were advanced near the ends of the culvert; and three boreholes (C8-02, C8-03 and C8-04) and three DCPTs



(C8-DC02, C8-DC03 and C8-DC04) were advanced through the roadway embankments along the alignment of the culvert. In general, the topography in the area of the culvert consists of densely treed areas with exposed rock cuts within 200 m north and south of the culvert location.

#### **4.7.1 West Embankment Fill (SBL)**

Embankment fill 11.8 m and 5.6 m thick was encountered at ground surface in Boreholes C8-02 and C8-03 at Elevations 326.3 m and 320.9 m, respectively. In Borehole C8-02 the upper portion of fill consists of a 1.1 m thick layer of sand and gravel, containing trace asphalt; whereas, in Borehole C8-03 a 0.1 m thick layer of topsoil fill was encountered at ground surface, underlain by a 10.7 m and 5.5 m thick layer of silt and sand to silty sand to sand at Elevations 325.2 m and 320.8 m, respectively. In Borehole C8-02 a 0.8 m thick interlayer of sandy peat fill interlayer was encountered at Elevation 322.9 m between the sand to silt and sand layers.

The SPT 'N'-value measured within the sand and gravel fill is 17 blows per 0.3 m of penetration, indicating a compact relative density. The SPT 'N'-values measured within the silt and sand to sand fill range between 0 blows (i.e. weight of rods) and 21 blows per 0.3 m of penetration, indicating a very loose to compact relative density.

The natural water content measured on one sample of the sand and gravel fill is about 3 per cent. The natural water content measured on eight samples of the silt and sand to sand fill range from about 19 per cent to 34 per cent. The natural water content measured on one sample of the sandy peat fill interlayer is about 42 per cent. The organic content measured on one sample of silt and sand to sand fill is about 3 per cent.

The results of the grain size distribution tests completed on four samples of the silt and sand portions of the fill deposit are shown on Figure E1 in Appendix E.

#### **4.7.2 East Embankment Fill (NBL)**

Embankment fill 10.4 m thick was encountered from ground surface in Borehole C8-04 at Elevation 326.4 m. The embankment fill consists of a 0.7 m thick layer of sand and gravel, underlain by a 3.9 m thick layer of sand and a 5.8 m thick layer of rock fill which was encountered at Elevation 321.8 m. Sand and gravel fill was noted within the rock fill layer in the samples taken between the rock fill fragments.

The SPT 'N'-value measured within the sand and gravel fill is 18 blows per 0.3 m of penetration, and within the sand fill range between 14 blows and 29 blows per 0.3 m of penetration, indicating a compact relative density. Two SPT 'N'-values measured within the sand and gravel fill within the rock fill are 22 blows and 36 blows per 0.3 m of penetration, indicating a compact to dense relative density.

The natural water content measured on one sample of the sand and gravel fill layers overlying and within the rock fill is about 4 per cent and 2 per cent, respectively. The natural water content measured on two samples of the sand fill is about 13 per cent and 17 per cent.

#### **4.7.3 Sandy Peat**

A 3.1 m and 1.6 m thick deposit of fibrous sandy peat was encountered at ground surface in Borehole C8-05 and below the west embankment fill in Borehole C8-03, at Elevations 315.6 m and 315.3 m, respectively.





The SPT 'N'-values measured within the sandy peat at the toe of the embankment range between 0 blows (i.e. weight of hammer) and 2 blows per 0.3 m of penetration, suggesting a very loose consistency. One SPT 'N'-value measured within the peat below the west embankment is 7 blows per 0.3 m of penetration, suggesting a loose consistency.

#### **4.7.4 Silt to Sand**

A deposit of grey to brown silt to sandy silt to silt and sand to silty sand to sand, trace to some gravel, trace clay, trace organics was encountered from ground surface in Borehole C8-01, below the fill in Boreholes C8-02 and C8-04 and below the peat deposit in Boreholes C8-03 and C8-05. The top of the deposit was encountered between Elevations 316.0 m and 312.6 m and the thickness of the deposit ranges from 0.6 m to 6.4 m in Boreholes C8-01 to C8-05.

The SPT 'N'-values measured within the silt to sand deposit generally range between 6 blows and 28 blows per 0.3 m of penetration, 21 blows per 0.23 m of penetration, at contact with the bedrock surface, indicating a generally loose to compact relative density.

The natural water content measured on nine samples of the silt to sand deposit ranges from about 16 per cent to 32 per cent.

The results of the grain size distribution tests completed on six samples of the silt to sand deposit are shown on Figure E2 in Appendix E.

#### **4.7.5 Gravelly Sand to Sand and Gravel**

A 1.3 m thick deposit of grey gravelly sand to sand and gravel was encountered below the silt and sand deposit in Borehole C8-05 at Elevation 311.9 m.

Two SPT 'N'-values measured within the gravelly sand to sand and gravel deposit are 20 blows per 0.3 m of penetration and 22 blows per 0.23 m of penetration indicating a compact relative density.

The natural water content measured on one sample of the gravelly sand to sand and gravel deposit is about 10 per cent.

The result of the grain size distribution test completed on one sample of the gravelly sand to sand and gravel deposit is shown on Figure E3 in Appendix E.

#### **4.7.6 Bedrock / Refusal**

Bedrock was encountered in Boreholes C8-01 to C8-04 between Elevations 313.2 m, and 309.6 m and core samples between 2.3 m and 3.5 m long were obtained. Based on a review of the bedrock core samples, the bedrock consists of fine to medium grained, fresh to moderately weathered, pinkish grey gneiss.

The Total Core Recovery (TCR) for the core samples is 100 per cent and the Solid Core Recovery (SCR) ranges from 48 per cent to 100 per cent. The Rock Quality Designation (RQD) measured on the recovered bedrock core samples range between 41 per cent and 100 per cent, and is generally greater than 63 per cent, indicating



that the rock is of poor to excellent quality and generally of fair to excellent quality, according to Table 3.10 in CFEM (2006)<sup>1</sup>.

One Unconfined Compressive Strength (UCS) test (ASTM D7012) was carried out on a core sample of the gneiss bedrock obtained in Borehole C8-04 and measured a uniaxial compressive strength of 104 MPa, as detailed in Table E1. Based on the laboratory UCS test, in accordance with Table 3.5 in CFEM (2006)<sup>1</sup>, the gneiss bedrock is classified as very strong ( $R_5$ ,  $100 \text{ MPa} < \text{UCS} < 250 \text{ MPa}$ ).

Refusal to further penetration was encountered in a DCPT immediately adjacent to Borehole C8-05 and in DCPTs C8-DC01 to C8-DC05 at depths ranging between 3.1 m and 16.2 m below ground surface, between Elevations 318.3 m and 310.2 m.

## **4.8 Culvert STA 10+743 (Township of Stephenson)**

The plan and profile along the centreline of the culvert at approximately STA 10+743 in Township of Stephenson showing the borehole locations and interpreted stratigraphy are presented on Drawing F1. The height of the embankment at the culvert location is up to about 6 m and the existing concrete culvert is about 43 m long with dimensions of 1220 mm wide by 1220 mm high. A total of three boreholes and three DCPTs were completed to investigate the subsurface conditions at the culvert location: two boreholes (C9-01 and C9-03) and two companion DCPTs (C9-DC01 and C9-DC03) were advanced near the ends of the culvert; and one borehole (C9-02) and one DCPT (C9-DC02) was advanced through the roadway embankment along the alignment of the culvert. In general, the topography in the area of the culvert consists of exposed rock cuts immediately east of the Highway 11 alignment and terrain sloping downwards westerly.

### **4.8.1 West Embankment Fill (SBL)**

Embankment fill between 0.8 m and 8.7 m thick was encountered from ground surface in Boreholes C9-01 to C9-03 between Elevations 311.6 m and 304.1 m. The embankment fill is comprised of a 0.2 m thick surface layer of topsoil in Borehole C9-03 and a 0.4 m and a 1.3 m thick layer of sand and gravel at Boreholes C9-02 and C9-03 at Elevation 311.6 m and 306.6 m, respectively. From ground surface in Borehole C9-01 and underlying the sand and gravel fill in Boreholes C9-02 and C9-03, a 0.8 m to 8.3 m thick layer of silt and sand to sand was encountered between Elevations 311.2 m and 304.1 m.

The SPT 'N'-values measured within the sand and gravel fill range between 1 blow and 24 blows per 0.3 m of penetration, indicating a very loose to compact relative density. The SPT 'N'-values measured within the silt and sand to sand fill generally range between 2 blows and 42 blows per 0.3 m of penetration, indicating a very loose to dense relative density.

The natural water content measured on one sample of the sand and gravel fill is about 27 per cent. The natural water content measured on six samples of the silt and sand to sand fill range from about 8 per cent to 29 per cent.

The results of the grain size distribution test completed on four samples of the silt and sand to sand fill are shown on Figure F1 in Appendix F.

Atterberg limits tests were carried out on two samples of the silt and sand to sand fill and indicate that the fill is non-plastic.



#### **4.8.2 Silt to Gravelly Silt and Sand**

A deposit of grey silt to gravelly silt and sand, trace clay was encountered underlying the fill in Boreholes C9-02 and C9-03. The top of the deposit was encountered at Elevations 302.9 m and 303.8 m and the thickness of the deposit is 1.7 m and 2.0 m in Boreholes C9-02 and C9-03, respectively.

The SPT 'N'-values measured within the silt to gravelly silt and sand deposit range between 13 blows and 47 blows per 0.3 m of penetration, indicating a compact to dense relative density.

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

The results of the grain size distribution test completed on one sample of the silt to gravelly silt and sand portions of the deposit is shown on Figure F2 in Appendix F.

#### **4.8.3 Boulders**

A 1.4 m thick deposit of boulders was encountered underlying the silt and sand to sand fill in Borehole C9-01 at Elevation 303.3 m.

#### **4.8.4 Bedrock / Refusal**

Bedrock was encountered in Boreholes C9-01 to C9-03 between Elevations 301.9 m and 301.2 m and core samples between 1.8 m and 3.4 m long were obtained. Based on a review of the bedrock core samples, the bedrock consists of very fine to coarse grained, slightly weathered, pinkish grey gneiss.

The Total Core Recovery (TCR) for the core samples ranges between 97 per cent and 100 per cent and the Solid Core Recovery (SCR) ranges from 31 per cent to 96 per cent. The Rock Quality Designation (RQD) measured on the recovered bedrock core samples ranges between 21 per cent and 89 per cent, and is generally greater than 62 per cent, indicating the rock is of very poor to excellent quality and generally of fair to excellent quality, according to Table 3.10 in CFEM (2006)<sup>1</sup>.

One Unconfined Compressive Strength (UCS) test (ASTM D7012) was carried out on a core sample of the gneiss bedrock obtained in Borehole C9-01 and measured a uniaxial compressive strength of about 182 MPa, as detailed in Table F1. Based on the laboratory UCS test, in accordance with Table 3.5 in CFEM (2006)<sup>1</sup>, the gneiss bedrock is classified as very strong ( $R_5, 100 \text{ MPa} < \text{UCS} < 250 \text{ MPa}$ ).

Refusal to further penetration was encountered in DCPTs C9-DC01 to C9-DC03 at depths between 1.5 m and 9.6 m below ground surface, between Elevations 305.0 m and 302.1 m.

### **4.9 Culvert STA 12+927 (Township of Stephenson)**

The plan and profile along the centreline of the skewed culvert at approximately STA 12+927 in Township of Stephenson showing the borehole locations and interpreted stratigraphy are presented on Drawing G1. The height of the embankment at this location is up to about 3 m high and the existing concrete culvert is about 98 m long with dimensions of 1220 mm wide by 1220 mm high. A total of five boreholes and five DCPTs were completed to investigate the subsurface conditions at the culvert location: two boreholes (C11-01 and C11-05) and two companion DCPTs (C11-DC01 and C11-DC05) were advanced near the ends of the culvert; and three



boreholes (C11-02, C11-03 and C11-04) and three DCPTs (C11-DC02, C11-DC03 and C11-DC04) were advanced through the roadway embankments along the alignment of the culvert. In general, the topography in the area of the culvert consists of relatively flat terrain with moderate to dense tree cover.

#### **4.9.1 West Embankment Fill (SBL)**

Embankment fill 5.0 m and 3.7 m thick was encountered from ground surface in Boreholes C11-02 and C11-03 in the west embankment at Elevations 310.4 m and 307.1 m, respectively. The embankment fill is comprised of a 0.1 m thick layer of topsoil underlain by a 3.6 m thick layer of sand in Borehole C11-03 and a 5.0 m thick layer of sand to sand and gravel, trace to some silt, trace clay in Borehole C11-02.

The SPT 'N'-values measured within the sand to sand and gravel fill range between 0 blows (i.e. weight of hammer) and 42 blows per 0.3 m of penetration, indicating a very loose to dense relative density.

The natural water content measured on six samples of the sand to sand and gravel fill ranges from about 2 per cent to 25 per cent.

The results of the grain size distribution tests completed on four samples of the sand to sand and gravel fill are shown on Figure G1 in Appendix G.

#### **4.9.2 East Embankment Fill (NBL)**

Embankment fill 8.1 m thick was encountered at ground surface in Borehole C11-04 at Elevation 310.0 m. The embankment fill consists of a 1.5 m thick layer of sand and gravel, underlain by a 6.6 m thick layer of silt and sand to sand, trace gravel, trace clay fill.

Two SPT 'N'-values measured within the sand and gravel fill are 8 blows and 28 blows per 0.3 m of penetration, indicating a loose to compact relative density. The SPT 'N'-values measured within the silt and sand to sand fill range between 4 blows and 24 blows per 0.3 m of penetration, indicating a loose to compact relative density.

The natural water content measured on three samples of the sand to sand and silt fill ranges from about 18 per cent to 26 per cent.

The results of the grain size distribution tests completed on two samples of the sand to sand to silt fill are shown on Figure G2 in Appendix G.

#### **4.9.3 Peat to Sandy Peat**

A 0.1 m thick deposit of fibrous peat to sandy peat was encountered at ground surface in Boreholes C11-01 and C11-05, at Elevations 305.3 m and 303.3 m, respectively.

#### **4.9.4 Silt to Sand**

A deposit of grey to brown silt to silt and sand to silty sand to sand, trace to some clay, trace gravel was encountered below the embankment fill in Boreholes C11-02 to C11-04 and below the peat deposit in



Boreholes C11-01 and C11-05. The top of the deposit was encountered between Elevations 305.4 m and 301.9 m and the thickness of the deposit is between 2.1 m and 5.2 m.

The SPT 'N'-values measured within the silt to sand range between 1 blow and 30 blows per 0.3 m of penetration indicating a loose to compact relative density.

The natural water content measured on eleven samples of the sand to silt deposit ranges from about 21 per cent to 28 per cent.

The results of the grain size distribution tests completed on eight samples of the silt to sand deposit are shown on Figure G3 in Appendix G.

Atterberg limits tests were carried out on three samples of the silt to sand and indicate that the deposit is non-plastic.

#### **4.9.5 Silty Gravelly Sand to Sand and Gravel**

A deposit of grey to brown silty gravelly sand to sand and gravel, trace clay was encountered below the sand to silt deposit in Boreholes C11-01 to C11-03 and C11-05. The top of the deposit was encountered between Elevations 300.8 m and 298.8 m and the thickness of the deposit ranges between 0.1 m and 2.3 m but was not fully penetrated in Borehole C11-01. Boreholes C11-01, C11-03 and C11-05 were terminated upon refusal within the silty gravelly sand to sand and gravel deposit for between 0.1 m to 0.8 m.

Two SPT 'N'-values measured within the silty gravelly sand to sand and gravel are 24 blows and 28 blows per 0.3 m of penetration indicating a compact relative density with three SPT 'N'-values refusing further advance on contacts with gravel within the deposit and bedrock underlying the deposit.

The natural water content measured on two samples of the silty gravelly sand to sand and gravel deposit is 12 per cent.

The results of grain size distribution tests completed on two samples of the silty gravelly sand portion of the deposit are shown on Figure G4 in Appendix G.

#### **4.9.6 Bedrock / Refusal**

Bedrock was encountered in Boreholes C11-02 and C11-04 at Elevations 297.9 m, and 299.9 m and core samples 3.3 m and 3.6 m long were obtained. Based on a review of the bedrock core samples, the bedrock consists of fine to coarse grained, fresh, dark grey gneiss.

The Total Core Recovery (TCR) for the core samples is 100 per cent and the Solid Core Recovery (SCR) is 100 per cent. The Rock Quality Designation (RQD) measured on the recovered bedrock core samples in the boreholes is also 100 per cent, indicating the rock is of excellent quality, according to Table 3.10 in CFEM (2006)<sup>1</sup>.

Refusal to further spilt spoon and auger advancement or DCPT penetration was encountered in Boreholes C11-03 and C11-05 and DCPTs C11-DC01 to C11-DC05 at depths between 3.5 m and 15.0 m below ground surface, between Elevations 306.5 m and 295.4 m.



## 4.10 Groundwater Conditions

Based on the observed water levels in the open boreholes following completion of drilling, the measured depths and elevations of the groundwater levels at the culvert sites are as follows:

Culvert ID	Culvert Location	Groundwater Level During Drilling (Depth / Elevation)
C3	STA 20+014 to STA 20+069 (Township of Macaulay)	0.6 m to 11.9 m / 280.3 m to 288.3 m
C4	STA 21+675 to STA 21+751 (Township of Macaulay)	0.3 m to 9.0 m / 287.9 m to 296.4 m
C5	STA 21+912 (Township of Macaulay)	1.1 m to 5.8 m / 300.9 m to 301.8 m
C7	STA 22+740 to STA 22+771 (Township of Macaulay)	0.0 m to 15 m / 289.1 m to 296.4 m
C8	STA 23+836 to STA 23+864 (Township of Macaulay)	0.0 m to 10.3 m / 315.6 m to 318.6 m
C9	STA 10+743 (Township of Stephenson)	0.2 m to 5.3 m / 304.0 m to 306.3 m
C11	STA 12+927 (Township of Stephenson)	0.2 m to 5.3 m / 303.1 m to 306.0 m

The water level at the culvert sites is expected to fluctuate seasonally in response to changes in precipitation and snow melt, and is expected to be higher during the spring season.

## 5.0 CLOSURE

The field drilling program was supervised by Messr. Erik Giles, Indulis Dumpis, Matthew Thibeault and Trevor Moxam. This report was prepared by Matthew Thibeault, a geotechnical engineering intern and reviewed by Mr. Christopher Ng, P.Eng., a geotechnical engineer and Associate with Golder. Mr. Jorge Costa, P.Eng., Principal and Golder's Designated MTO Foundations Contact, conducted an independent review of the report.





## Report Signature Page

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ASTM International:

ASTM D1586	Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils
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ASTM D7012	Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens
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Ontario Water Resources Act:

Ontario Regulation 372/97 Amendment to Ontario Regulation 903



## LIST OF SYMBOLS

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

### I. GENERAL

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

### II. STRESS AND STRAIN

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

### III. SOIL PROPERTIES

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

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

### (a) Index Properties (continued)

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

### (b) Hydraulic Properties

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

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

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

### (d) Shear Strength

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

Notes: 1  
2

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



## LIST OF ABBREVIATIONS

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

### I. SAMPLE TYPE

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

### II. PENETRATION RESISTANCE

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

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

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

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

**PH:** Sampler advanced by hydraulic pressure

**PM:** Sampler advanced by manual pressure

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

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

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

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

### III. SOIL DESCRIPTION

#### (a) Non-Cohesive Soils

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

#### (b) Cohesive Soils Consistency

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

### IV. SOIL TESTS

w	water content
w <sub>p</sub>	plastic limit
w <sub>l</sub>	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test <sup>1</sup>
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement <sup>1</sup>
D <sub>R</sub>	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 <sub>4</sub>	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
$\gamma$	unit weight

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

### V. MINOR SOIL CONSTITUENTS

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



# LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

## WEATHERING STATE

**Fresh:** no visible sign of weathering

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

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

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

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

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

## BEDDING THICKNESS

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

## JOINT OR FOLIATION SPACING

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

## GRAIN SIZE

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

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

## CORE CONDITION

### Total Core Recovery (TCR)

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

### Solid Core Recovery (SCR)

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

### Rock Quality Designation (RQD)

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

## DISCONTINUITY DATA

### Fracture Index

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

### Dip with Respect to Core Axis

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

### Description and Notes

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

### Abbreviations

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



# TABLES





Table 1: Summary of Culvert Details

Culvert Location (Township)	Culvert ID	Approximate Height of Embankment <sup>1</sup> (m)	Existing Culvert			Approximate Invert Elevation <sup>2</sup>		Boreholes	Dynamic Cone Penetration Tests	Reference Appendix
			Type	Approximate Dimension	Approximate Length	West End of Culvert	East End of Culvert			
STA 20+014 to STA 20+069 (Macaulay)	C3	12	Concrete Box	1.2 m high by 1.2 m wide	119 m	282.0 m	280.7 m	5 Boreholes (C3-01 to C3-05)	7 DCPTs (C3-DC01 to C3-DC03, C3- DC04A, C3-DC04B, C3-05A and C3-DC05B)	A
STA 21+675 to STA 21+751 (Macaulay)	C4	13	Concrete Box	1.8 m high by 1.8 m wide	128 m	290.2 m	285.3 m	7 Boreholes (C4-01 to C4-05, C4-05A and C4-06)	6 DCPTs (C4-DC01 to C4-DC06)	B
STA 21+912 (Macaulay)	C5	7	Concrete Box	1.2 m high by 1.2 m wide	30 m	301.3 m	302.0 m	3 Boreholes (C5-01 to C5-03)	3 DCPTs (C5-DC01 to C5-DC03)	C
STA 22+740 to STA 22+771 (Macaulay)	C7	18	Concrete Box	1.2 m high by 1.8 m wide (SBL) / 1.8 m high by 1.8 m wide (NBL) <sup>3</sup>	109 m	290.4 m	290.2 m	8 Boreholes (C7-01 to C7-06, C7-06A and C7-06B)	6 DCPTs (C7-DC01 to C7-DC06)	D
STA 23+836 to STA 23+864 (Macaulay)	C8	11	Concrete Box	1.2 m high by 1.2 m wide	Unknown (Est. 122 m)	315.5 m	314.6 m	5 Boreholes (C8-01 to C8-05)	6 DCPTs (C8-DC01A, C8-DC01B and C8-DC02 to C8-DC05)	E
STA 10+743 (Stephenson)	C9	6	Concrete Box	1.2 m high by 1.2 m wide	43 m	304.2 m	305.2 m	3 Boreholes (C9-01 to C9-03)	3 DCPTs (C9-DC01 to C9-DC03)	F
STA 12+927 (Stephenson)	C11	3	Concrete Box	1.2 m high by 1.2 m wide	98 m	305.8 m	303.4 m	5 Boreholes (C11-01 to C11-05)	5 DCPTs (C11-DC01 to C11-DC05)	G

Notes: 1. Embankment height is relative to existing ground surface level near toe of embankment adjacent to culvert.  
2. Culvert invert elevations are estimated based on the top of culvert surveys provided by exp. and culvert dimensions provided by AECOM.  
3. Culvert size increases downstream of median catch basin.

Prepared by: MT  
Checked by: CN  
Reviewed by: JMAC



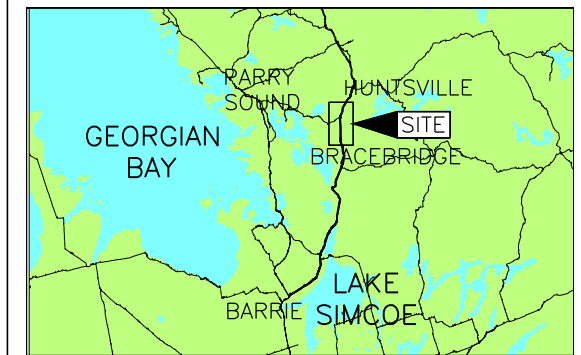


# **DRAWINGS**



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

SHEET



Base data accessed in digital format from MNR LIO, obtained 2013.

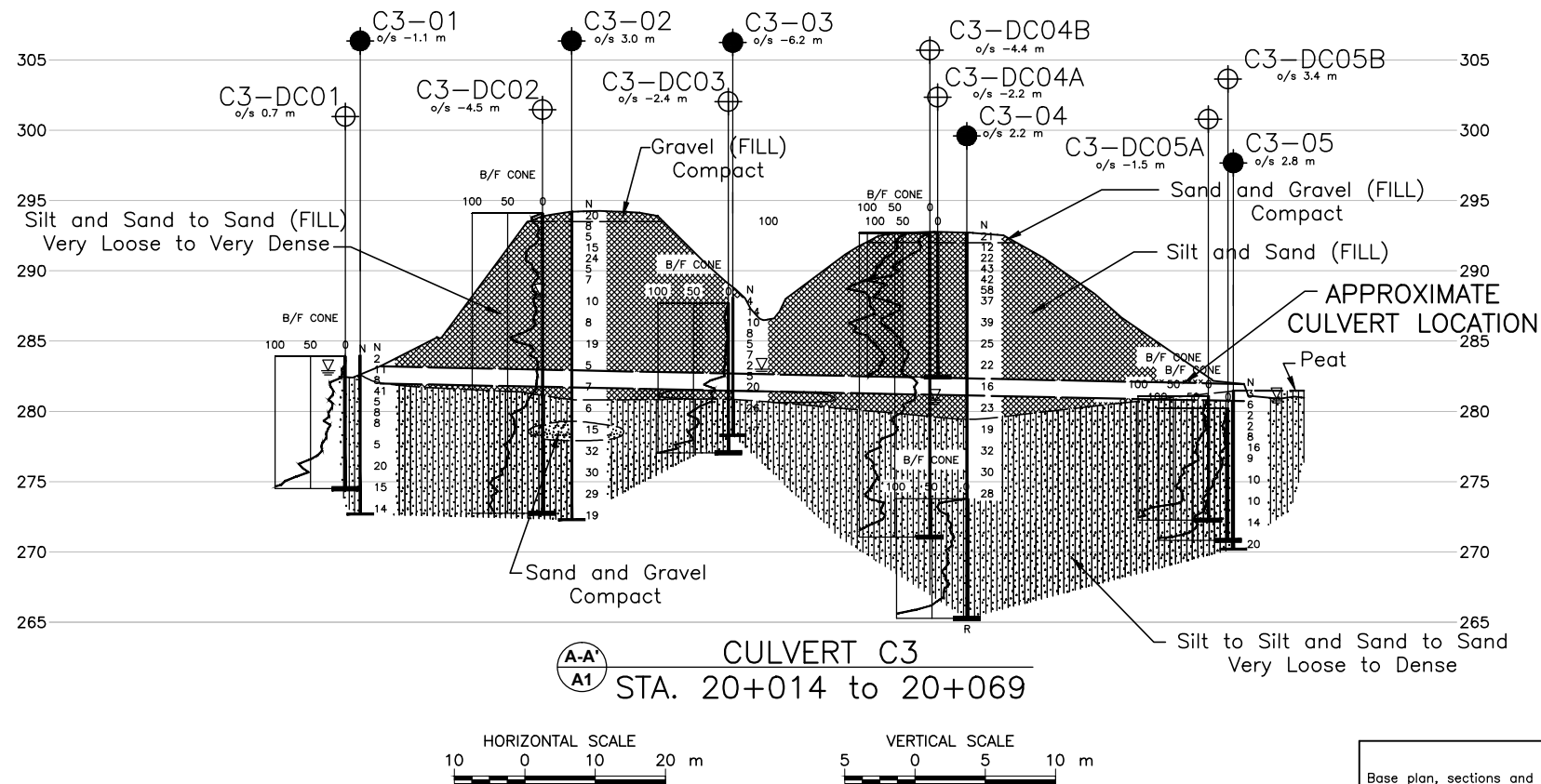
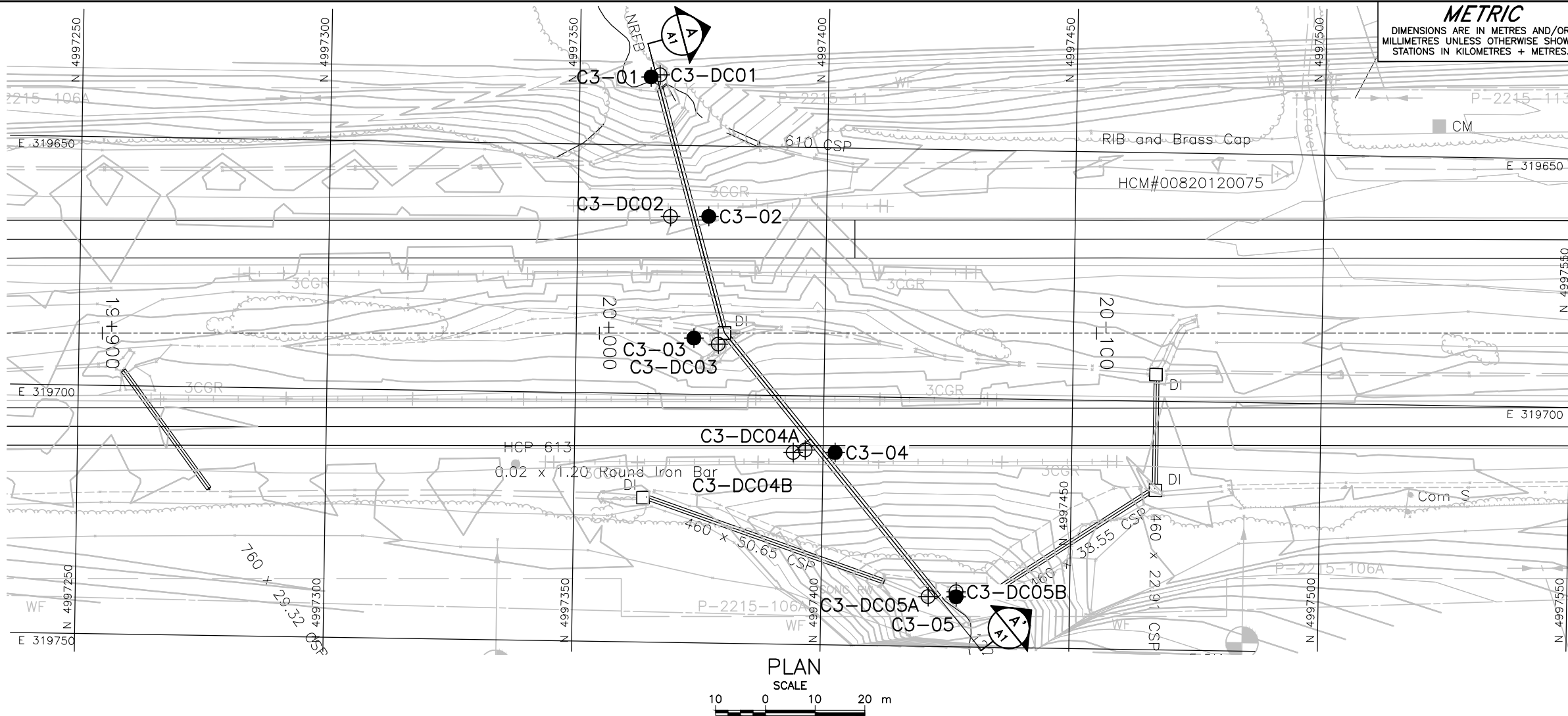
NO.	DATE	BY	REVISION	
<b>Geocres No. 31E-344</b>				
HWY. 11		PROJECT NO. 14-1111-0007		DIST. .
SUBM'D. MT	CHKD. CN	DATE: 11/13/2014		SITE:
DRAWN: MR	CHKD. CN	APPD. JMAC		DWG. 1



# APPENDIX A

Culvert STA 20+014 to STA 20+069 (Township of Macaulay)





## REFERENCE

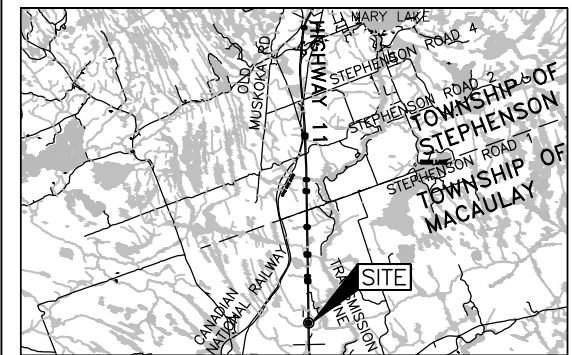
Base plan, sections and topographic data, provided in digital format by exp geomatics, drawing file nos. ntb-01407006.dwg and X-SECTIONS.dwg, received Oct 14, 2014.

CONT No.  
GWP No. 5462-09-00



HIGHWAY 11  
CULVERT STA. 20+014 TO STA. 20+069 (SBL AND NBL)  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



## LEGEND

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

## BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
C3-01	284.0	4997364.3	319636.3
C3-02	294.2	4997376.3	319664.2
C3-03	288.1	4997373.7	319688.7
C3-04	292.7	4997402.4	319711.3
C3-05	281.5	4997427.2	319740.0
C3-DC01	283.9	4997366.1	319635.9
C3-DC02	294.1	4997368.6	319664.3
C3-DC03	287.7	4997378.6	319689.9
C3-DC04A	292.7	4997396.4	319710.9
C3-DC04B	292.7	4997394.0	319711.4
C3-DC05A	281.1	4997421.6	319740.0
C3-DC05B	280.2	4997427.2	319739.0

## 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.

NO.	DATE	BY	REVISION
Geocres No. 31E-344			
HWY. 11	PROJECT NO. 14-1111-0007		DIST. .
SUBM'D. MT	CHKD. CN	DATE: 11/13/2014	SITE: .
DRAWN: MR/JFC	CHKD. CN	APPD. JMAC	DWG. A1

PROJECT 14-1111-0007		RECORD OF BOREHOLE No C3-01		SHEET 1 OF 1		METRIC															
G.W.P. 5462-09-00		LOCATION N 4997364.3 ; E 319636.3		ORIGINATED BY MT																	
DIST _____ HWY 11		BOREHOLE TYPE Portable Equipment, Wash Boring		COMPILED BY MT																	
DATUM Geodetic		DATE June 25, 2014		CHECKED BY CN																	
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ kN/m <sup>3</sup>	GR SA SI CL				
							20 40 60 80 100	20 40 60 80 100	W <sub>p</sub>	W	W <sub>L</sub>	10 20 30									
284.0	GROUND SURFACE		1A																		
0.0	PEAT (Fibrous) Black Wet		1B	SS	2																
	SILT and SAND to SAND, some silt, trace gravel, trace clay Very loose to dense Grey Wet		2	SS	11		283														
			3	SS	8		282														
			4	SS	41		281														3 78 19 0
			5	SS	5		280														
			6	SS	8		279														0 41 59 0
			7	SS	8		278														
			8	SS	5		277														0 57 41 2
			9	SS	20		276														
			10	SS	15		275														
			11	SS	14		274														
272.7	END OF BOREHOLE						273														
11.3	NOTE:  1. Water level in open borehole at a depth of 1.1 m below ground surface (Elev. 282.9 m) upon completion of drilling.																				

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PROJECT <u>14-1111-0007</u>		<b>RECORD OF BOREHOLE No C3-02</b>		SHEET 1 OF 2		<b>METRIC</b>	
G.W.P. <u>5462-09-00</u>		LOCATION <u>N 4997376.3; E 319664.2</u>		ORIGINATED BY <u>ID</u>			
DIST <u>          </u> HWY <u>11</u>		BOREHOLE TYPE <u>CME 75, 108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing</u>		COMPILED BY <u>MT</u>			
DATUM <u>Geodetic</u>		DATE <u>June 25, 2014</u>		CHECKED BY <u>CN</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT  w <sub>p</sub>	NATURAL MOISTURE CONTENT  w	LIQUID LIMIT  w <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED	+ FIELD VANE						● QUICK TRIAXIAL	× REMOULDED	WATER CONTENT (%)
294.2	GROUND SURFACE						20	40	60	80	100	10	20	30			
0.0	Gravel, some sand (FILL) Compact Brown Moist		1A	SS	20												
293.5			1B														
0.7	Asphalt mixed with sand and gravel encountered from surface to 0.2 m depth		2	SS	8												
	Silt and sand to silty sand, trace organics (FILL) Loose to compact Brown Moist		3	SS	5							○			1 75 24 0		
			4	SS	15												
			5	SS	24							○					
			6	SS	5												
			7	SS	7								○		OC = 2.5% 0 58 41 1		
			8	SS	10												
			9	SS	8								○		OC = 0.9% 0 78 21 1		
			10	SS	19												
			11	SS	5								○		OC = 0.4% 0 38 62 0		
			12	SS	7												
280.8																	
13.4	SILT and SAND Loose Brown Moist		13	SS	6								○				
279.3																	

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

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PROJECT 14-1111-0007		RECORD OF BOREHOLE No C3-02		SHEET 2 OF 2		METRIC																
G.W.P. 5462-09-00		LOCATION N 4997376.3 ; E 319664.2		ORIGINATED BY ID																		
DIST HWY 11		BOREHOLE TYPE CME 75, 108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing		COMPILED BY MT																		
DATUM Geodetic		DATE June 25, 2014		CHECKED BY CN																		
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ						
								20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W <sub>p</sub> W W <sub>L</sub> 10 20 30			kN/m <sup>3</sup>			GR SA SI CL			
14.9	SAND and GRAVEL Compact Brown Wet		14	SS	15		279															
277.9							278															
16.3	Silty SAND to SAND Compact to dense Grey to brown Wet		15	SS	32		277															
							276															
			16	SS	30		275															
							274															
			17	SS	29		274															
							273															
272.3	END OF BOREHOLE		18	SS	19																	
21.9	NOTE: 1. Water level in open borehole at a depth of 5.9 m below ground surface (Elev. 288.3 m) upon completion of drilling.																					

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PROJECT 14-1111-0007			RECORD OF BOREHOLE No C3-03			SHEET 1 OF 1			METRIC											
G.W.P. 5462-09-00			LOCATION N 4997373.7 ; E 319688.7			ORIGINATED BY EG														
DIST _____ HWY 11			BOREHOLE TYPE Portable Equipment, Wash Boring			COMPILED BY MT														
DATUM Geodetic			DATE July 17, 2014			CHECKED BY CN														
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								20	40	60	80	100						20	40	60
288.1	GROUND SURFACE																			
0.0	Silty sandy topsoil (FILL)		1A	SS	4															
0.2	Brown Moist		1B	SS																
	Silt and sand to sand, trace to some gravel, trace clay (FILL)		2A	SS	14															
	Very loose to compact		2B	SS																
	Brown to grey		3	SS	10															
	Moist to wet		4	SS	8															
			5	SS	5															
			6	SS	7															
			7	SS	2															
			8	SS	5															
282.1	Sand and gravel (FILL)		9	SS	20															
6.0	Compact Brown Wet																			
280.9	SILT and SAND, trace clay, trace organics		10	SS	26															
7.2	Compact Grey Wet																			
			11	SS	17															
278.3	END OF BOREHOLE																			
9.8	NOTE: 1. Water level in open borehole at a depth of 5.1 m below ground surface (Elev. 283.0 m) upon completion of drilling.																			


PROJECT <u>14-1111-0007</u>		<b>RECORD OF BOREHOLE No C3-04</b>		SHEET 1 OF 2		<b>METRIC</b>	
G.W.P. <u>5462-09-00</u>		LOCATION <u>N 4997402.4 ; E 319711.3</u>		ORIGINATED BY <u>ID</u>			
DIST <u>          </u> HWY <u>11</u>		BOREHOLE TYPE <u>CME 55, 108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing</u>		COMPILED BY <u>MT</u>			
DATUM <u>Geodetic</u>		DATE <u>June 26, 2014</u>		CHECKED BY <u>CN</u>			

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

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PROJECT		14-1111-0007		RECORD OF BOREHOLE		No C3-04		SHEET 2 OF 2		METRIC																
G.W.P.		5462-09-00		LOCATION		N 4997402.4 ; E 319711.3		ORIGINATED BY		ID																
DIST		HWY 11		BOREHOLE TYPE		CME 55, 108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing		COMPILED BY		MT																
DATUM		Geodetic		DATE		June 26, 2014		CHECKED BY		CN																
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT		LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)												
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80				100	W <sub>p</sub>	W	W <sub>L</sub>								
277.0	SILT, trace to some sand, trace clay Compact Grey Wet		14A	SS	32		277																			
15.7			14B																							
			15	SS	30											276										
			16	SS	28																					
273.8	END OF BOREHOLE Dynamic Cone Penetration Test (DCPT)						274																			
18.9																										
265.3	END OF DCPT REFUSAL TO FURTHER PENETRATION (100 Blows / 0.20 m) (HAMMER BOUNCING)						273																			
27.4																										
	NOTE:  1. Water level in open borehole at a depth of 11.9 m below ground surface (Elev. 280.8 m) upon completion of drilling.						272																			
							271																			
							270																			
							269																			
							268																			
							267																			
							266																			
265.3	END OF DCPT REFUSAL TO FURTHER PENETRATION (100 Blows / 0.20 m) (HAMMER BOUNCING)						266																			
27.4																										

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PROJECT 14-1111-0007			RECORD OF BOREHOLE No C3-05			SHEET 1 OF 1			METRIC							
G.W.P. 5462-09-00			LOCATION N 4997427.2 ; E 319740.0			ORIGINATED BY TM										
DIST _____ HWY 11			BOREHOLE TYPE Portable Equipment, Wash Boring			COMPILED BY MT										
DATUM Geodetic			DATE June 26, 2014			CHECKED BY CN										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
281.5	GROUND SURFACE						20	40	60	80	100					
281.5	PEAT (Fibrous)		1	SS	3											
	Sandy SILT to SILT and SAND, trace clay, trace organics Very loose to compact Brown to grey Moist to wet		2	SS	6											
			3	SS	2											
			4	SS	2											
			5	SS	8											
			6	SS	16											
			7	SS	9											
			8	SS	10											
			9	SS	10											
			10	SS	14											
			11	SS	20											
270.2	END OF BOREHOLE															
11.3	NOTE:  1. Water level in open borehole at a depth of 0.6 m below ground surface (Elev. 280.9 m) upon completion of drilling.															







PROJECT <u>14-1111-0007</u>		<b>RECORD OF DCPT No C3-DC02</b>		SHEET 2 OF 2		<b>METRIC</b>	
G.W.P. <u>5462-09-00</u>		LOCATION <u>N 4997368.6 ; E 319664.3</u>		ORIGINATED BY <u>ID</u>			
DIST <u>          </u> HWY <u>11</u>		BOREHOLE TYPE <u>CME 55, Dynamic Cone Penetration Test</u>		COMPILED BY <u>MT</u>			
DATUM <u>Geodetic</u>		DATE <u>June 25, 2014</u>		CHECKED BY <u>CN</u>			

SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT   NATURAL MOISTURE   LIQUID CONTENT   LIMIT			UNIT WEIGHT  γ  kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa				W <sub>p</sub>	W	W <sub>L</sub>	GR	SA	SI		CL				
						○ UNCONFINED			+	FIELD VANE	● QUICK TRIAXIAL	×	REMOULDED	WATER CONTENT (%)							
	— CONTINUED FROM PREVIOUS PAGE — Dynamic Cone Penetration Test (DCPT)						20	40	60	80	100										
							20	40	60	80	100										
																			</		

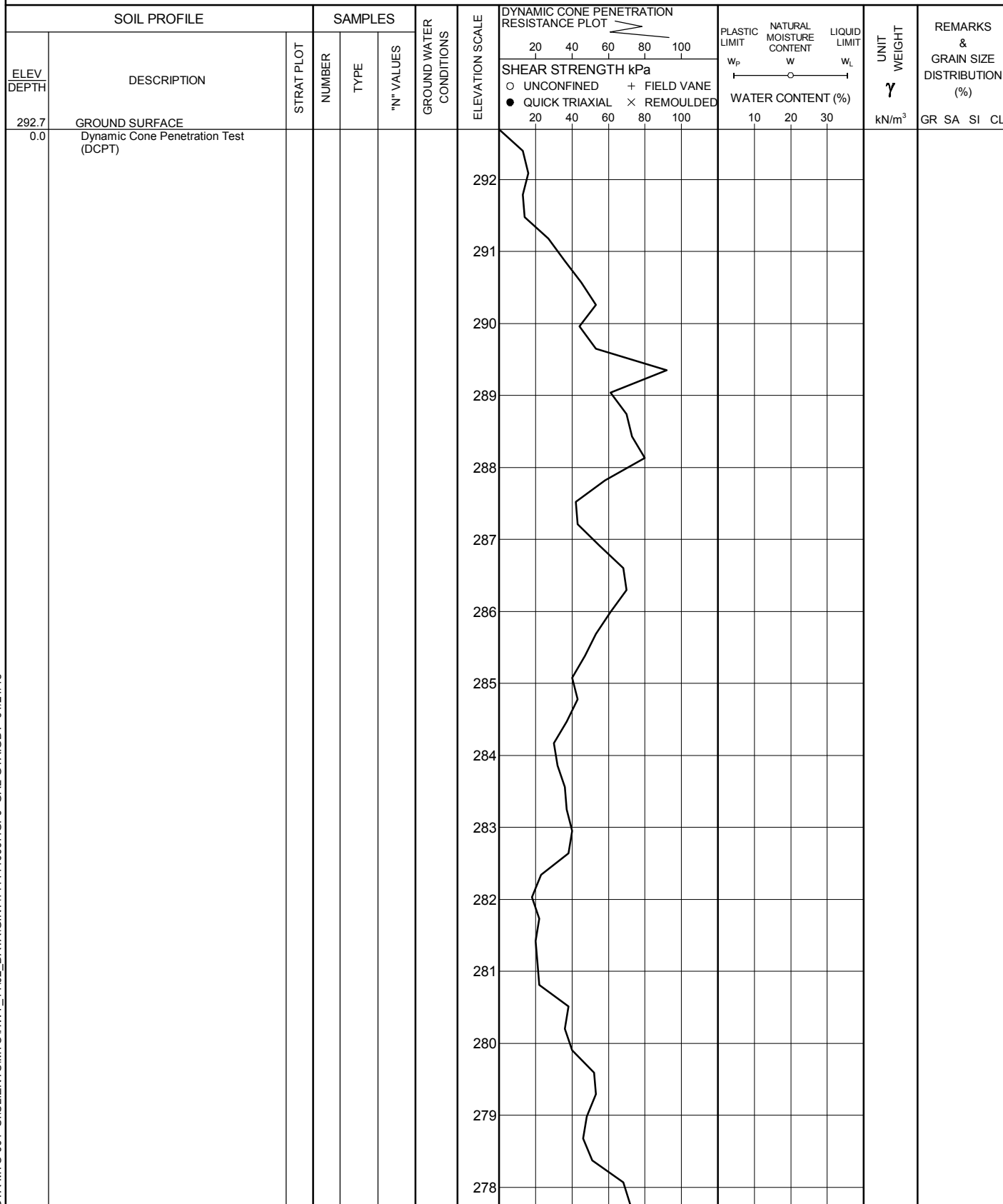
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PROJECT <u>14-1111-0007</u>		<b>RECORD OF DCPT No C3-DC03</b>		SHEET 1 OF 1		<b>METRIC</b>										
G.W.P. <u>5462-09-00</u>		LOCATION <u>N 4997378.6 ; E 319689.9</u>		ORIGINATED BY <u>EG</u>												
DIST <u>          </u> HWY <u>11</u>		BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>		COMPILED BY <u>MT</u>												
DATUM <u>Geodetic</u>		DATE <u>July 18, 2014</u>		CHECKED BY <u>CN</u>												
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
287.7 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)						20	40	60	80	100					
							20	40	60	80	100					
							20	40	60	80	100					
							20	40	60	80	100					
							20	40	60	80	100					
							20	40	60	80	100					
							20	40	60	80	100					
							20	40	60	80	100					
							20	40	60	80	100					
							20	40	60	80	100					
							20	40	60	80	100					
							20	40	60	80	100					
							20	40	60	80	100					
							20	40	60	80	100					
							20	40	60	80	100					
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							20	40	60	80	100					
							20	40	60	80	100					
							20	40	60	80	100					
							20	40	60	80						



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

PROJECT <u>14-1111-0007</u>		<b>RECORD OF DCPT No C3-DC04B</b>		SHEET 1 OF 2		<b>METRIC</b>	
G.W.P. <u>5462-09-00</u>		LOCATION <u>N 4997394.0 ; E 319711.4</u>		ORIGINATED BY <u>ID</u>			
DIST <u>          </u> HWY <u>11</u>		BOREHOLE TYPE <u>CME 55, Dynamic Cone Penetration Test</u>		COMPILED BY <u>MT</u>			
DATUM <u>Geodetic</u>		DATE <u>June 25, 2014</u>		CHECKED BY <u>CN</u>			



Continued Next Page

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

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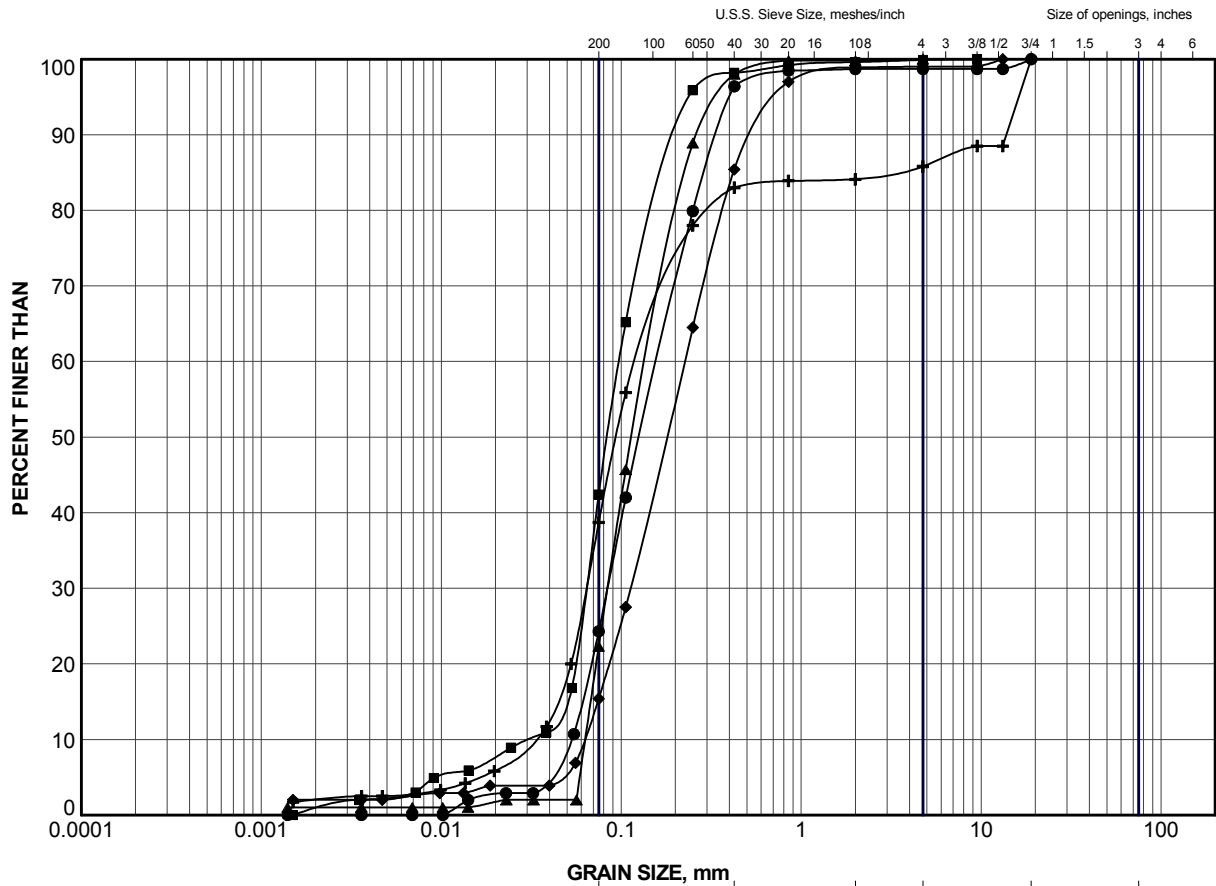
PROJECT <u>14-1111-0007</u>		<b>RECORD OF DCPT No C3-DC04B</b>		SHEET 2 OF 2		<b>METRIC</b>														
G.W.P. <u>5462-09-00</u>		LOCATION <u>N 4997394.0 ; E 319711.4</u>		ORIGINATED BY <u>ID</u>																
DIST <u>          </u> HWY <u>11</u>		BOREHOLE TYPE <u>CME 55, Dynamic Cone Penetration Test</u>		COMPILED BY <u>MT</u>																
DATUM <u>Geodetic</u>		DATE <u>June 25, 2014</u>		CHECKED BY <u>CN</u>																
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa												
	--- CONTINUED FROM PREVIOUS PAGE ---						<div style="display: flex; justify-content: space-between;"> <span>20 40 60 80 100</span> <span>20 40 60 80 100</span> </div> <div style="display: flex; justify-content: space-between;"> <span>○ UNCONFINED</span> <span>+ FIELD VANE</span> </div> <div style="display: flex; justify-content: space-between;"> <span>● QUICK TRIAXIAL</span> <span>× REMOULDED</span> </div>													
271.1	Dynamic Cone Penetration Test (DCPT)																			
21.6	END OF DCPT REFUSAL TO FURTHER PENETRATION (134 Blows / 0.30 m)  NOTE:  1. DCPT C3-DC04 B advanced 2.4 m south and 0.5 m east of DCPT C3-DC04 A.																			

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




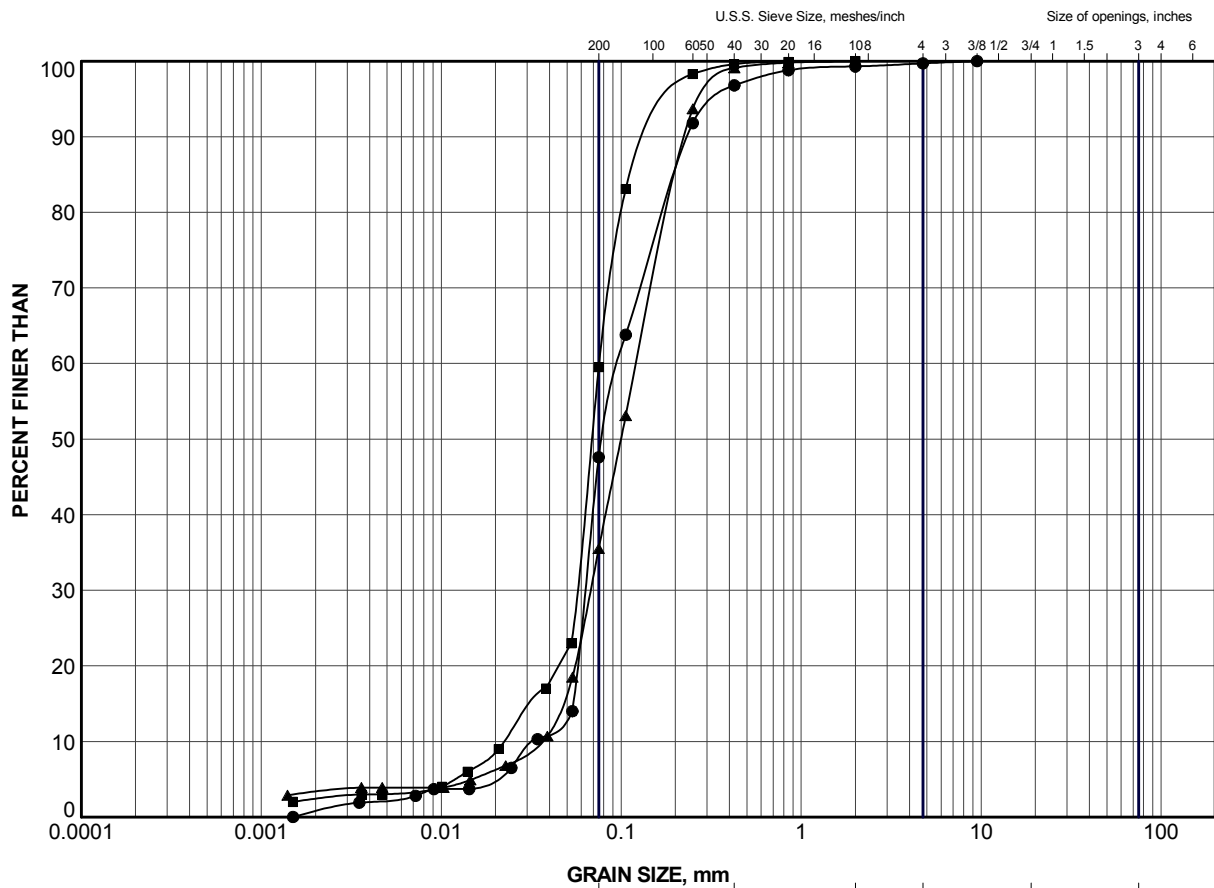


CLAY AND SILT	GRAVEL SIZE, mm					Cobble Size
	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

#### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C3-02	3	292.4
■	C3-02	7	289.3
▲	C3-02	9	286.3
+	C3-03	3	286.3
◆	C3-03	7	283.2


PROJECT						HIGHWAY 11 RESURFACING HIGHWAY 11 CULVERTS GWP 5462-09-00					
TITLE						GRAIN SIZE DISTRIBUTION SILT and SAND to SAND (FILL)					
PROJECT No.			14-1111-0007			FILE No.			14-1111-0007.GPJ		
DRAWN	TB	Nov 2014		SCALE	N/A	REV.					
CHECK	MT	Nov 2014									
APPR	CN	Nov 2014									
 <b>Golder Associates</b> SUDBURY, ONTARIO						<b>FIGURE A1</b>					

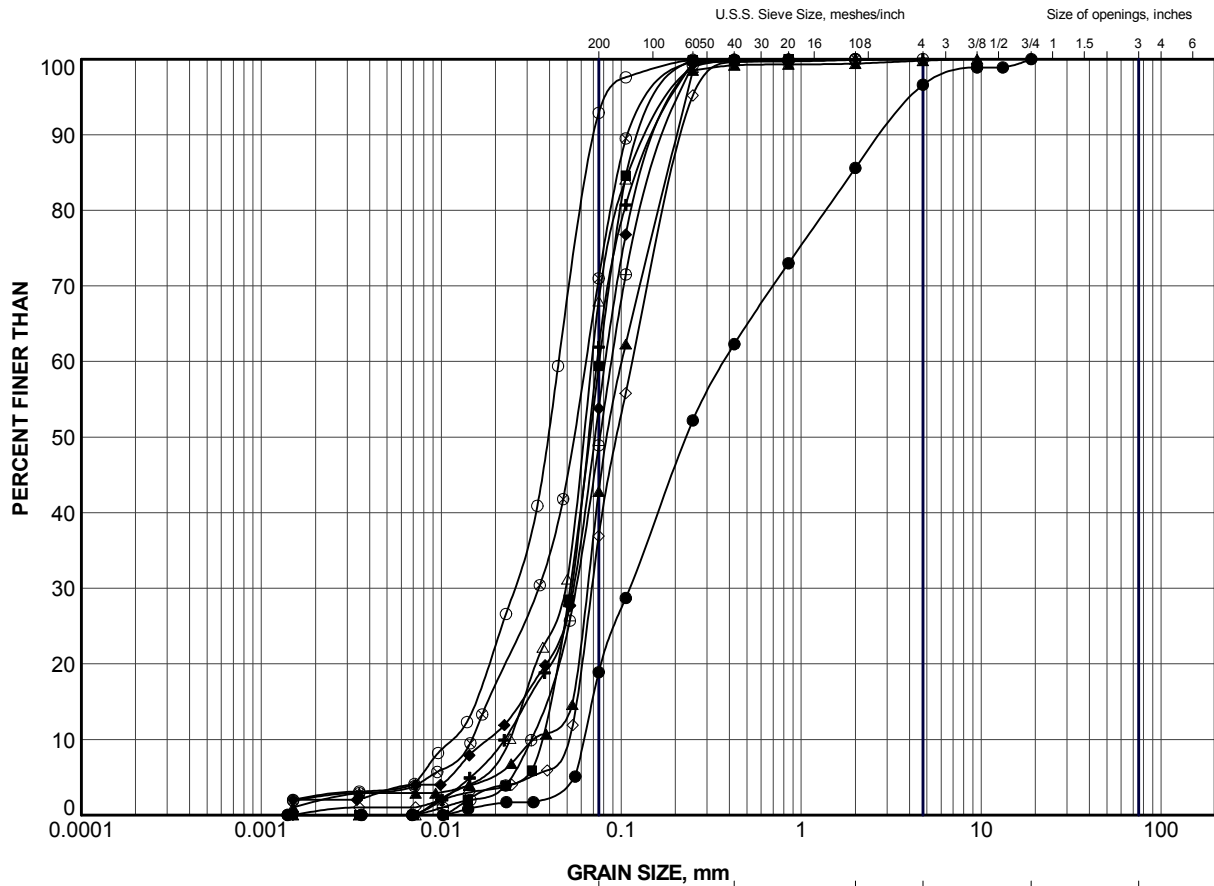


GRAIN SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

#### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C3-04	3	290.9
■	C3-04	7	287.8
▲	C3-04	9	284.8


PROJECT						HIGHWAY 11 RESURFACING HIGHWAY 11 CULVERTS GWP 5462-09-00					
TITLE						GRAIN SIZE DISTRIBUTION SILT and SAND (FILL)					
PROJECT No.			14-1111-0007			FILE No.			14-1111-0007.GPJ		
DRAWN	TB	Nov 2014		SCALE	N/A	REV.					
CHECK	MT	Nov 2014									
APPR	CN	Nov 2014									
 <b>Golder Associates</b> SUDBURY, ONTARIO						<b>FIGURE A2</b>					



CLAY AND SILT	GRAVEL SIZE, mm					Cobble Size
	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

#### LEGEND

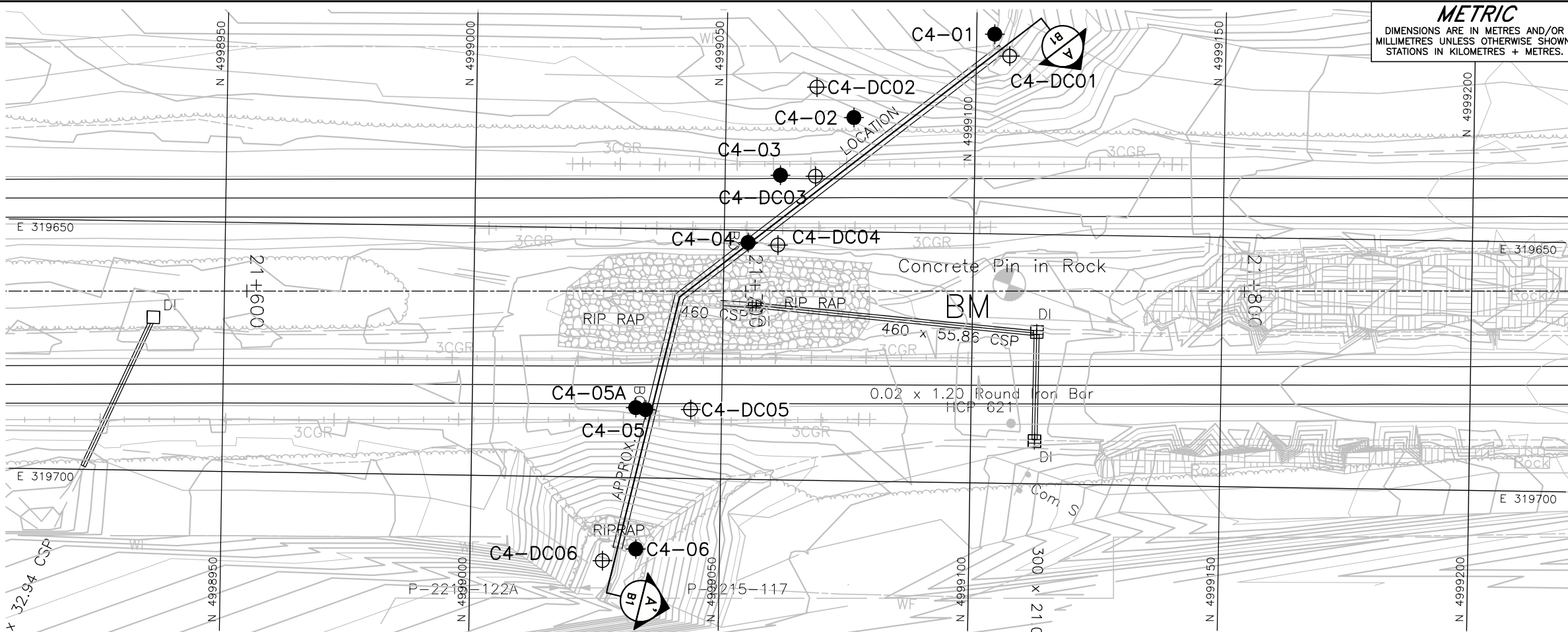
SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C3-01	4	281.4
■	C3-01	6	279.9
▲	C3-01	8	277.6
+	C3-02	13	280.2
◆	C3-03	11	278.6
◇	C3-04	13	278.7
○	C3-04	15	275.6
△	C3-05	3	279.7
⊗	C3-05	7	276.6
⊕	C3-05	9	273.6

PROJECT						HIGHWAY 11 RESURFACING HIGHWAY 11 CULVERTS GWP 5462-09-00					
TITLE						GRAIN SIZE DISTRIBUTION SILT to SAND					
PROJECT No.			14-1111-0007			FILE No.			14-1111-0007.GPJ		
DRAWN	TB	Nov 2014		SCALE	N/A	REV.					
CHECK	MT	Nov 2014									
APPR	CN	Nov 2014									
 <b>Golder Associates</b> SUDBURY, ONTARIO						<b>FIGURE A3</b>					



# **APPENDIX B**

**Culvert STA 21+675 to 21+751 (Township of Macaulay)**



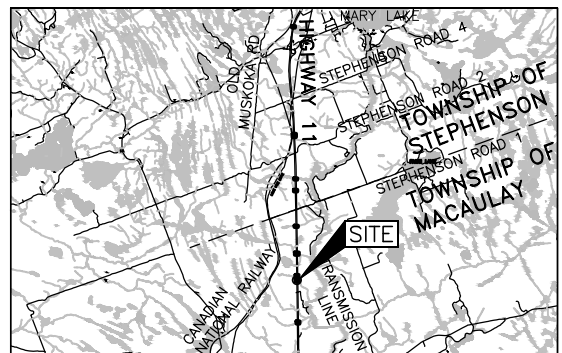
**METRIC**  
DIMENSIONS ARE IN METRES AND/OR  
MILLIMETRES UNLESS OTHERWISE SHOWN.  
STATIONS IN KILOMETRES + METRES.

CONT No.  
GWP No. 5462-09-00



HIGHWAY 11  
CULVERT STA. 21+675 TO STA. 21+751 (SBL AND NBL)  
BOREHOLE LOCATIONS AND SOIL  
STRATA

SHEET



KEY PLAN  
SCALE  
3 0 3 6 km

#### LEGEND

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

#### BOREHOLE CO-ORDINATES

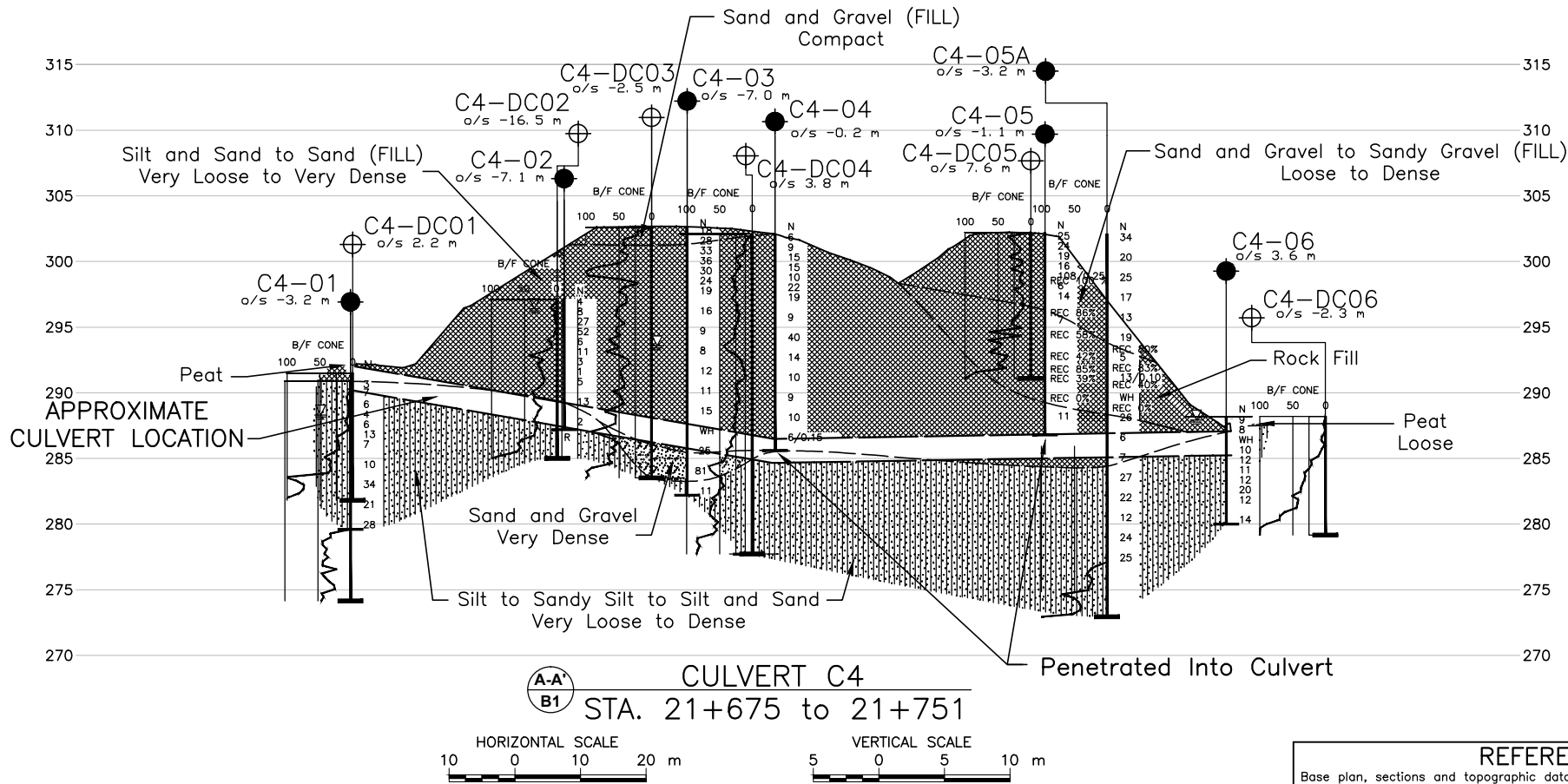
No.	ELEVATION	NORTHING	EASTING
C4-01	290.9	4999103.6	319610.0
C4-02	297.2	4999075.7	319627.1
C4-03	302.6	4999061.1	319638.9
C4-04	302.1	4999054.8	319652.5
C4-05	302.2	4999034.8	319686.3
C4-05A	302.1	4999032.8	319685.9
C4-06	288.2	4999033.3	319714.3
C4-DC01	291.5	4999106.7	319614.3
C4-DC02	297.1	4999068.2	319621.1
C4-DC03	302.6	4999068.1	319639.0
C4-DC04	302.1	4999060.8	319652.9
C4-DC05	302.2	4999043.8	319686.2
C4-DC06	288.2	4999026.6	319716.7

#### NOTES

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

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

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



#### REFERENCE

Base plan, sections and topographic data, provided in digital format by exp geomatics, drawing file nos. GWP51950000GWP54620900.dwg and X-SECTIONS.dwg, received Oct 27, 2014.

NO.	DATE	BY	REVISION

Geocres No. 31E-344



HWY. 11	PROJECT NO. 14-1111-0007	DIST. .
SUBM'D. MT	CHKD. CN	DATE: 11/13/2014
DRAWN: MR/JFC	CHKD. CN	APPD: JMAC
		DWG. B1



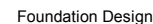


PROJECT 14-1111-0007		<b>RECORD OF BOREHOLE No C4-01</b>				SHEET 2 OF 2		<b>METRIC</b>								
G.W.P. 5462-09-00		LOCATION N 4999103.6; E 319610.0				ORIGINATED BY MT										
DIST _____ HWY 11		BOREHOLE TYPE Portable Equipment, Wash Boring				COMPILED BY MT										
DATUM Geodetic		DATE June 26, 2014				CHECKED BY CN										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
	--- CONTINUED FROM PREVIOUS PAGE ---						20	40	60	80	100					
	END OF BOREHOLE Dynamic Cone Penetration Test (DCPT)						20	40	60	80	100					
274.1																
16.8	END OF DCPT															
	NOTE:  1. Water level in open borehole at a depth of 2.6 m below ground surface (Elev. 288.3 m) upon completion of drilling.															

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PROJECT 14-1111-0007		RECORD OF BOREHOLE No C4-02		SHEET 1 OF 1		METRIC																
G.W.P. 5462-09-00		LOCATION N 4999075.7 ; E 319627.1		ORIGINATED BY EG																		
DIST _____ HWY 11		BOREHOLE TYPE Portable Equipment, Wash Boring		COMPILED BY MT																		
DATUM Geodetic		DATE July 17, 2014		CHECKED BY CN																		
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ kN/m <sup>3</sup>	GR SA SI CL					
							20 40 60 80 100	○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× REMOULDED	W <sub>p</sub>	W	W <sub>L</sub>								
297.2 0.0	GROUND SURFACE Silt and sand to sand, trace clay, trace organics (FILL) Very loose to very dense Grey to brown Moist to wet		1	SS	4		297															
			2	SS	8		296															
			3	SS	27		295															
			4	SS	52		294															
			5	SS	6		293															
			6	SS	11		292															
			7	SS	3		291															
			8	SS	1		290															
			9	SS	5		289															
			10A	SS	13		288															
			10B	SS	2																	
289.3 7.9	SILT and SAND, trace clay Very loose to compact Brown Wet																					
287.2 10.0	END OF BOREHOLE SPOON REFUSAL AND REFUSAL TO FURTHER CASING ADVANCEMENT  NOTE:  1. Water level in open borehole at a depth of 0.8 m below ground surface (Elev. 296.4 m) upon completion of drilling.																					

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

PROJECT 14-1111-0007		RECORD OF BOREHOLE No C4-03		SHEET 2 OF 2		METRIC											
G.W.P. 5462-09-00		LOCATION N 4999061.1 ; E 319638.9		ORIGINATED BY EG													
DIST _____ HWY 11		BOREHOLE TYPE CME 75, 108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing		COMPILED BY MT													
DATUM Geodetic		DATE June 26 and 27, 2014		CHECKED BY CN													
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ kN/m <sup>3</sup>	GR SA SI CL
							20 40 60 80 100	20 40 60 80 100	W <sub>p</sub>	W	W <sub>L</sub>	10 20 30					
	--- CONTINUED FROM PREVIOUS PAGE ---																
	Silt and sand, trace gravel, trace clay, trace organics (FILL) Very loose to compact Grey to brown Moist to wet		14	SS	WH		287									OC = 2.0%	
							286										
285.4			15A	SS	25												0 56 44 0
17.2	SAND and GRAVEL Very dense Grey Wet		15B				285										
							284										
283.2			16	SS	81												
19.4	SILT and SAND, trace to some gravel Compact Grey Wet						283										
282.2			17	SS	11												
20.4	END OF BOREHOLE  NOTE:  1. Water level in open borehole at a depth of 9.0 m below ground surface (Elev. 293.6 m) upon completion of drilling.																

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PROJECT <u>14-1111-0007</u>		<b>RECORD OF BOREHOLE No C4-04</b>		SHEET 1 OF 2		<b>METRIC</b>	
G.W.P. <u>5462-09-00</u>		LOCATION <u>N 4999054.8 ; E 319652.5</u>		ORIGINATED BY <u>ID</u>			
DIST <u>          </u> HWY <u>11</u>		BOREHOLE TYPE <u>CME 55, NW Casing</u>		COMPILED BY <u>MT</u>			
DATUM <u>Geodetic</u>		DATE <u>August 7 and 8, 2014</u>		CHECKED BY <u>CN</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT			UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			W <sub>p</sub>	W	W <sub>L</sub>			
								20 40 60 80 100								
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED								
						WATER CONTENT (%)										
302.1	GROUND SURFACE		1A				302									
0.0	Silt and sand, trace clay, trace organics (FILL) Loose to dense Brown to grey Moist to wet		1B	SS	6		301									
			2	SS	9											
			3	SS	15											
			4	SS	15											
			5	SS	10											
			6	SS	22											
			7	SS	19											

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

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PROJECT 14-1111-0007				RECORD OF BOREHOLE No C4-04				SHEET 2 OF 2				METRIC					
G.W.P. 5462-09-00				LOCATION N 4999054.8 ; E 319652.5				ORIGINATED BY ID									
DIST _____ HWY 11				BOREHOLE TYPE CME 55, NW Casing				COMPILED BY MT									
DATUM Geodetic				DATE August 7 and 8, 2014				CHECKED BY CN									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
	--- CONTINUED FROM PREVIOUS PAGE ---						20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>			
286.7			14	SS	6/0.15												
15.5	CONCRETE (CULVERT) VOID																
285.6																	
16.5	END OF BOREHOLE																
	NOTE:  1. Culvert was encountered and penetrated at a depth of 14.8 m (Elev. 287.4 m). Upon penetration of culvert, borehole C4-05 was terminated, culvert wall blocked with a rubber seal and borehole backfilled with cement, granular bentonite and soil cuttings.																

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PROJECT <u>14-1111-0007</u>		<b>RECORD OF BOREHOLE No C4-05</b>		SHEET 1 OF 2		<b>METRIC</b>	
G.W.P. <u>5462-09-00</u>		LOCATION <u>N 4999034.8 ; E 319686.3</u>		ORIGINATED BY <u>EG</u>			
DIST <u>          </u> HWY <u>11</u>		BOREHOLE TYPE <u>CME 75, NW Casing</u>		COMPILED BY <u>MT</u>			
DATUM <u>Geodetic</u>		DATE <u>July 23, 2014</u>		CHECKED BY <u>CN</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT			LIQUID LIMIT	UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w <sub>p</sub>	w	w <sub>L</sub>			GR	SA	SI	CL	
								20	40	60	80	100										○ UNCONFINED
302.2	GROUND SURFACE																					
0.0	Sand and gravel to sandy gravel, trace silt, containing pieces of asphalt (FILL) Loose to compact Brown to grey Moist		1	SS	25																	
			2	SS	24																	
			3	SS	19																	
			4	SS	16																	
			5	SS	108/0.25																	
	Boulder encountered at a depth of 3.5 m.		-	RC	REC 100%																	
			6	SS	6																	
		7	SS	14																		
296.4	Rock fill (FILL)		-	RC	REC 85%																	
5.8			8	SS	7																	
			-	RC	REC 58%																	
			-	RC	REC 42%																	
			-	RC	REC 85%																	
			-	RC	REC 39%																	
			-	RC	REC 0%																	
289.1	Silt and sand, trace gravel (FILL) Compact Grey to brown Wet		9	SS	11																	
13.1																						
287.6	CONCRETE (CULVERT)																					
14.8	VOID																					

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


GTA-MTO 001 S:\CLIENTS\MT\TOHWY\_11\02\_DATAGINT\1411110007.GPJ GAL-GTA.GDT 01/21/15



PROJECT 14-1111-0007		RECORD OF BOREHOLE No C4-05				SHEET 2 OF 2		METRIC								
G.W.P. 5462-09-00		LOCATION N 4999034.8 ; E 319686.3				ORIGINATED BY EG										
DIST _____ HWY 11		BOREHOLE TYPE CME 75, NW Casing				COMPILED BY MT										
DATUM Geodetic		DATE July 23, 2014				CHECKED BY CN										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
	--- CONTINUED FROM PREVIOUS PAGE ---						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					10 20 30				GR SA SI CL
286.8	VOID					287										
15.4	END OF BOREHOLE  NOTE:  1. Culvert was encountered and penetrated at a depth of 14.8 m (Elev. 287.4 m). Upon penetration of culvert, borehole C4-05 was terminated, culvert wall blocked with a rubber seal and borehole backfilled with cement, granular bentonite and soil cuttings.															

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PROJECT 14-1111-0007		RECORD OF BOREHOLE No C4-05A		SHEET 2 OF 3		METRIC														
G.W.P. 5462-09-00		LOCATION N 4999032.8 ; E 319685.9		ORIGINATED BY ID																
DIST _____ HWY 11		BOREHOLE TYPE CME 55, NW Casing		COMPILED BY MT																
DATUM Geodetic		DATE July 29 and 30, 2014		CHECKED BY CN																
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ kN/m³	GR SA SI CL			
							20 40 60 80 100	○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × REMOULDED	W <sub>p</sub>	W	W <sub>L</sub>	10 20 30							
--- CONTINUED FROM PREVIOUS PAGE ---																				
284.3	Silt and sand, trace to some gravel, trace organics, containing roots (FILL) Loose to compact Brown Wet		11	SS	6		287											0 40 60 0		
							286													
				12	SS	7		285									OC = 3.5%	0 61 38 1		
17.8	SILT to Sandy SILT Compact Grey Wet						284													
			13	SS	27		283													
			14	SS	22		282													
			15	SS	12		281													
			16	SS	24		280										0 17 82 1			
			17	SS	25		279													
277.1	END OF BOREHOLE Dynamic Cone Penetration Test (DCPT)						278										0 2 97 1			
25.0							277													
							276													
							275													
							274													
272.9							273													
29.2																				



Continued Next Page

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

GTA-MTO 001 S:\CLIENTS\MT\Hwy\_11\02\_DATA\GINT\1411110007.GPJ GAL-GTA.GDT 01/21/15

PROJECT <u>14-1111-0007</u>		<b>RECORD OF BOREHOLE No C4-05A</b>		SHEET 3 OF 3		<b>METRIC</b>																		
G.W.P. <u>5462-09-00</u>		LOCATION <u>N 4999032.8 ; E 319685.9</u>		ORIGINATED BY <u>ID</u>																				
DIST <u>          </u> HWY <u>11</u>		BOREHOLE TYPE <u>CME 55, NW Casing</u>		COMPILED BY <u>MT</u>																				
DATUM <u>Geodetic</u>		DATE <u>July 29 and 30, 2014</u>		CHECKED BY <u>CN</u>																				
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					W <sub>p</sub>	W			W <sub>L</sub>							
	--- CONTINUED FROM PREVIOUS PAGE ---						<div style="display: flex; justify-content: space-between;"> <span>20 40 60 80 100</span> <span>20 40 60 80 100</span> </div> <div style="display: flex; justify-content: space-between;"> <span>○ UNCONFINED   + FIELD VANE</span> <span>● QUICK TRIAXIAL   × REMOULDED</span> </div>																	
	END OF DCPT REFUSAL TO FURTHER PENETRATION (100 Blows / 0.20 m) (HAMMER BOUNCING)  NOTE:  1. Borehole dry to cave depth of 4.3 m below ground surface (Elev.297.8 m) upon completion of drilling.																							

GTA-MTO 001 S:\CLIENTS\MT\OH\HWY\_11\02\_DATA\GINT\1411110007.GPJ GAL-GTA.GDT 01/21/15

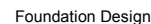
PROJECT		14-1111-0007		RECORD OF BOREHOLE No C4-06		SHEET 1 OF 1		METRIC									
G.W.P.		5462-09-00		LOCATION		N 4999033.3 ; E 319714.3		ORIGINATED BY									
DIST		HWY 11		BOREHOLE TYPE		Portable Equipment, NW Casing		COMPILED BY									
DATUM		Geodetic		DATE		July 14, 2014		CHECKED BY									
								CN									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)	
288.2	GROUND SURFACE							20	40	60	80	100					
0.0	Sandy PEAT, containing wood fragments		1	SS	9		288										
287.5	Loose Brown Wet		2	SS	8		287										
0.7	SILT and SAND, trace organics, trace gravel		3	SS	WH			286									
	Very loose to loose Brown Moist																
286.0	Peat seam encountered at a depth of 1.8 m		4	SS	10			285									
2.2	SILT to Sandy SILT, trace clay		5	SS	12			284									
	Compact Brown to grey Wet		6	SS	11			283									
			7	SS	12			282									
			8	SS	20			281									
			9	SS	12			280									
280.0	END OF BOREHOLE		10	SS	14												
8.2	NOTE:  1. Water level in open borehole at a depth of 0.3 m below ground surface (Elev. 287.9 m) upon completion of drilling.																

GTA-MTO 001 S:\CLIENTS\MT\OH\HWY\_11\02\_DATA\GINT\1411110007.GPJ GAL-GTA.GDT 01/21/15

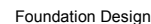
PROJECT <u>14-1111-0007</u>		<b>RECORD OF DCPT No C4-DC01</b>		SHEET 1 OF 1		<b>METRIC</b>	
G.W.P. <u>5462-09-00</u>		LOCATION <u>N 4999106.7 ; E 319614.3</u>		ORIGINATED BY <u>MT</u>			
DIST <u>          </u> HWY <u>11</u>		BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>		COMPILED BY <u>MT</u>			
DATUM <u>Geodetic</u>		DATE <u>June 26 and 27, 2014</u>		CHECKED BY <u>CN</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  γ  kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		w <sub>p</sub>	w	w <sub>L</sub>				
								○ UNCONFINED      + FIELD VANE	WATER CONTENT (%)							
							● QUICK TRIAXIAL      × REMOULDED									
291.5	GROUND SURFACE															
0.0	Dynamic Cone Penetration Test (DCPT)															

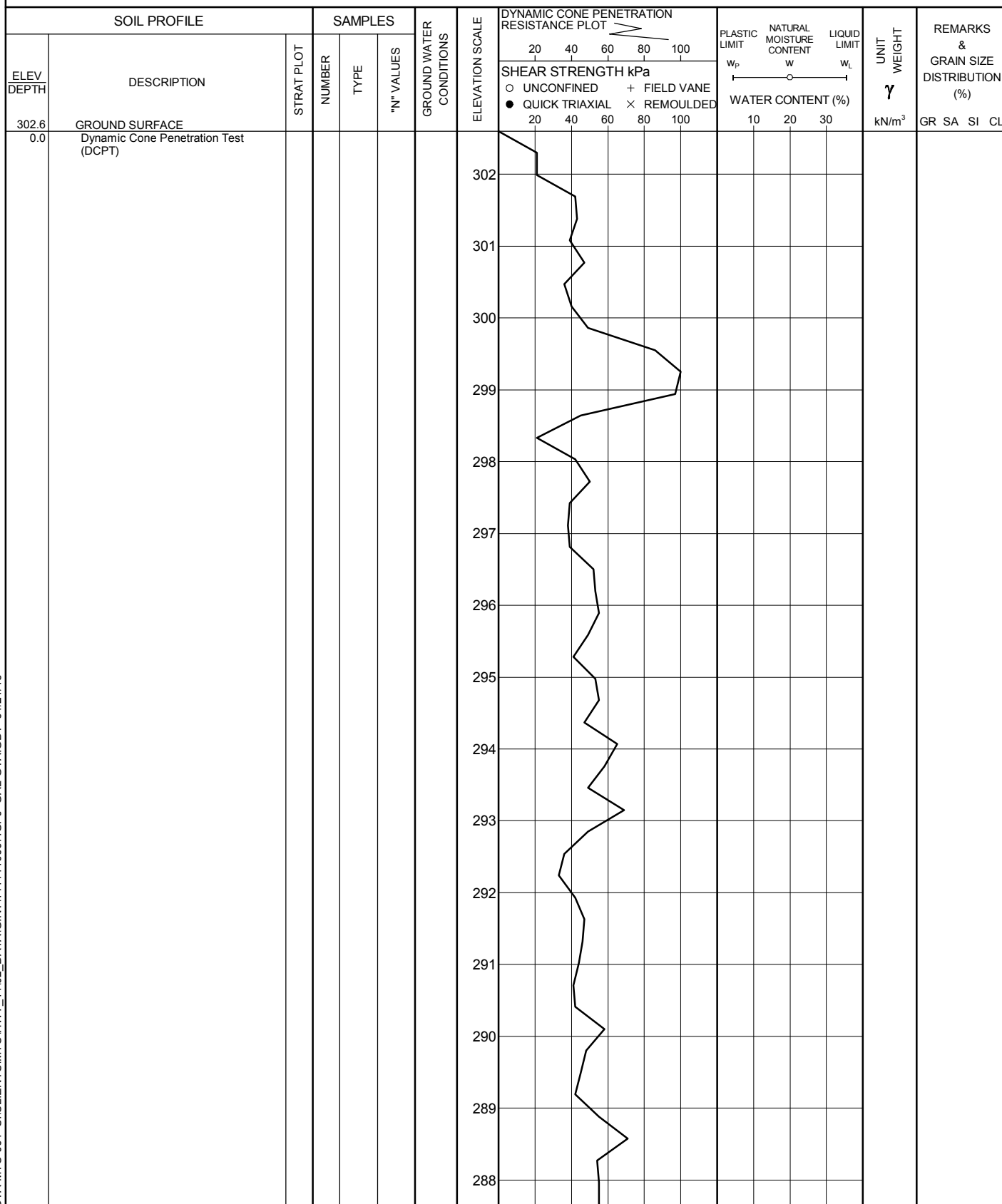
GTA-MTO 001 S:\CLIENTS\MT\Hwy\_11\02\_DATA\GINT\1411110007.GPJ GAL-GTA.GDT 01/21/15



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



PROJECT <u>14-1111-0007</u>		<b>RECORD OF DCPT No C4-DC03</b>		SHEET 1 OF 2		<b>METRIC</b>	
G.W.P. <u>5462-09-00</u>		LOCATION <u>N 4999068.1 ;E 319639.0</u>		ORIGINATED BY <u>EG</u>			
DIST <u>          </u> HWY <u>11</u>		BOREHOLE TYPE <u>CME 75, Dynamic Cone Penetration Test</u>		COMPILED BY <u>MT</u>			
DATUM <u>Geodetic</u>		DATE <u>June 26, 2014</u>		CHECKED BY <u>CN</u>			



Continued Next Page

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

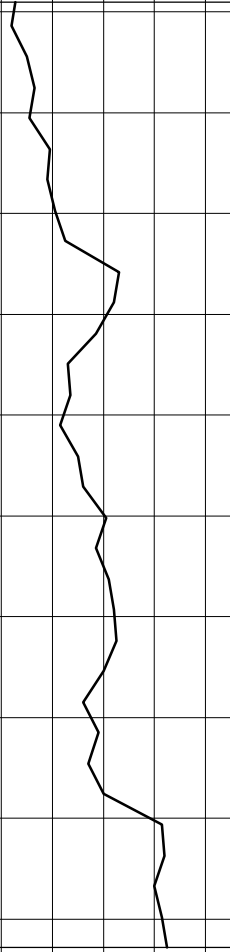
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PROJECT <u>14-1111-0007</u>				RECORD OF DCPT No <b>C4-DC03</b>				SHEET 2 OF 2				METRIC				
G.W.P. <u>5462-09-00</u>				LOCATION <u>N 4999068.1 ; E 319639.0</u>				ORIGINATED BY <u>EG</u>								
DIST <u>          </u> HWY <u>11</u>				BOREHOLE TYPE <u>CME 75, Dynamic Cone Penetration Test</u>				COMPILED BY <u>MT</u>								
DATUM <u>Geodetic</u>				DATE <u>June 26, 2014</u>				CHECKED BY <u>CN</u>								
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)			
	--- CONTINUED FROM PREVIOUS PAGE ---						20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
							○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × REMOULDED									
							20	40	60	80	100	10	20	30		
283.5	Dynamic Cone Penetration Test (DCPT)															
19.1	END OF DCPT REFUSAL TO FURTHER PENETRATION (100 Blows / 0.18 m)															

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PROJECT <u>14-1111-0007</u>				<b>RECORD OF DCPT No C4-DC04</b>				SHEET 2 OF 2				<b>METRIC</b>				
G.W.P. <u>5462-09-00</u>				LOCATION <u>N 4999060.8 ; E 319652.9</u>				ORIGINATED BY <u>ID</u>								
DIST <u>          </u> HWY <u>11</u>				BOREHOLE TYPE <u>CME 55, Dynamic Cone Penetration Test</u>				COMPILED BY <u>MT</u>								
DATUM <u>Geodetic</u>				DATE <u>August 7, 2014</u>				CHECKED BY <u>CN</u>								
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					W <sub>p</sub> W   W <sub>L</sub>			
	--- CONTINUED FROM PREVIOUS PAGE ---						<div style="display: flex; justify-content: space-between;"> <span>20   40   60   80   100</span> <span>20   40   60   80   100</span> </div> <div style="display: flex; justify-content: space-between;"> <span>○ UNCONFINED   + FIELD VANE</span> <span>● QUICK TRIAXIAL   × REMOULDED</span> </div>									
	Dynamic Cone Penetration Test (DCPT)															
277.7 24.4	END OF DCPT															

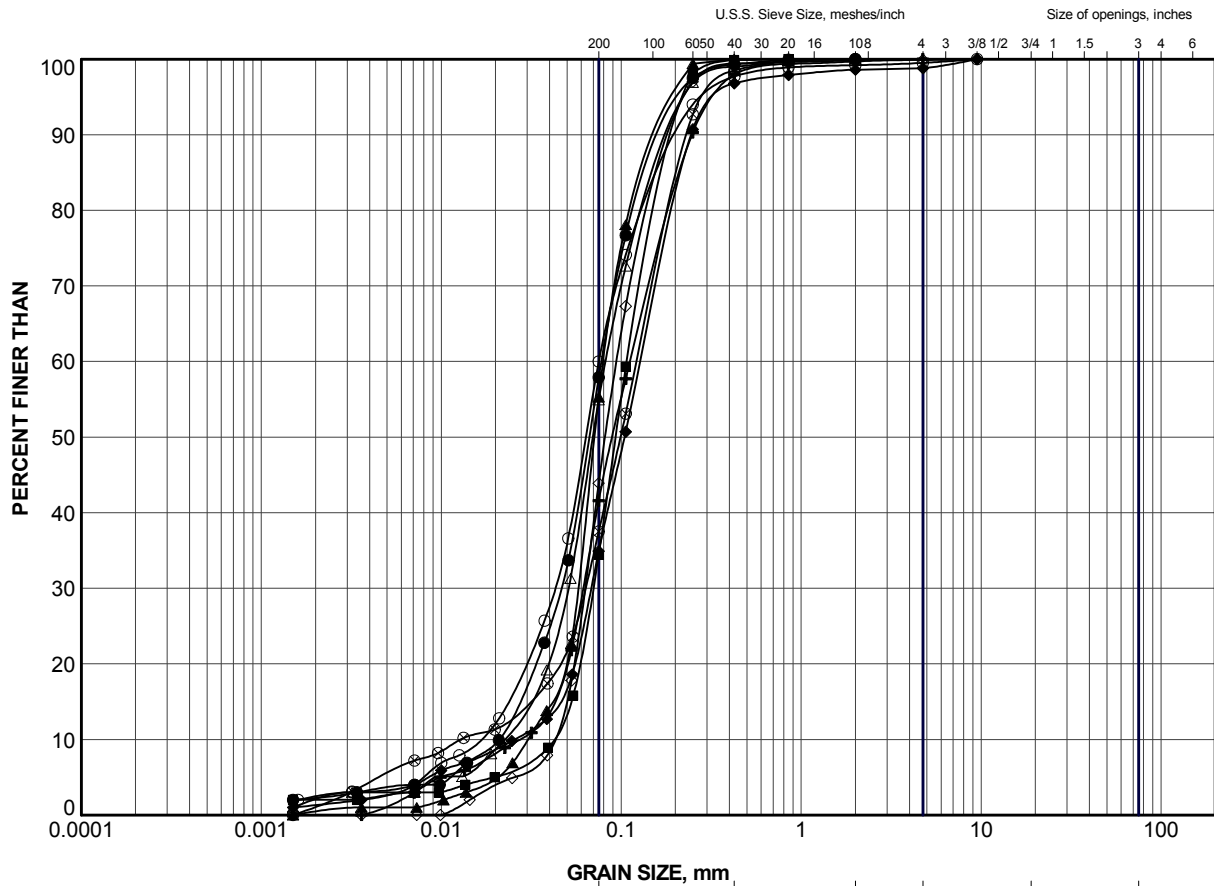
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PROJECT <u>14-1111-0007</u>		<b>RECORD OF DCPT No C4-DC05</b>		SHEET 1 OF 1		<b>METRIC</b>	
G.W.P. <u>5462-09-00</u>		LOCATION <u>N 4999043.8 ; E 319686.2</u>		ORIGINATED BY <u>EG</u>			
DIST <u>          </u> HWY <u>11</u>		BOREHOLE TYPE <u>CME 75, Dynamic Cone Penetration Test</u>		COMPILED BY <u>MT</u>			
DATUM <u>Geodetic</u>		DATE <u>July 23, 2014</u>		CHECKED BY <u>CN</u>			

SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE   LIQUID CONTENT			UNIT WEIGHT  γ  kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa			W <sub>p</sub>	W	W <sub>L</sub>				
									○ UNCONFINED   + FIELD VANE ● QUICK TRIAXIAL   × REMOULDED	WATER CONTENT (%)					
302.2 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)							<div><div><div></div><div>20</div><div>40</div><div>60</div><div>80</div><div>100</div></div><div><div></div><div>20</div><div>40</div><div>60</div><div>80</div><div>100</div></div></div>							
								302							
								301							
								300							
								299							
								298							
								297							
								296							
								295							
								294							
								293							
								292							
291.1 11.1	END OF DCPT REFUSAL TO FURTHER PENETRATION (100 Blows / 0.15 m)														

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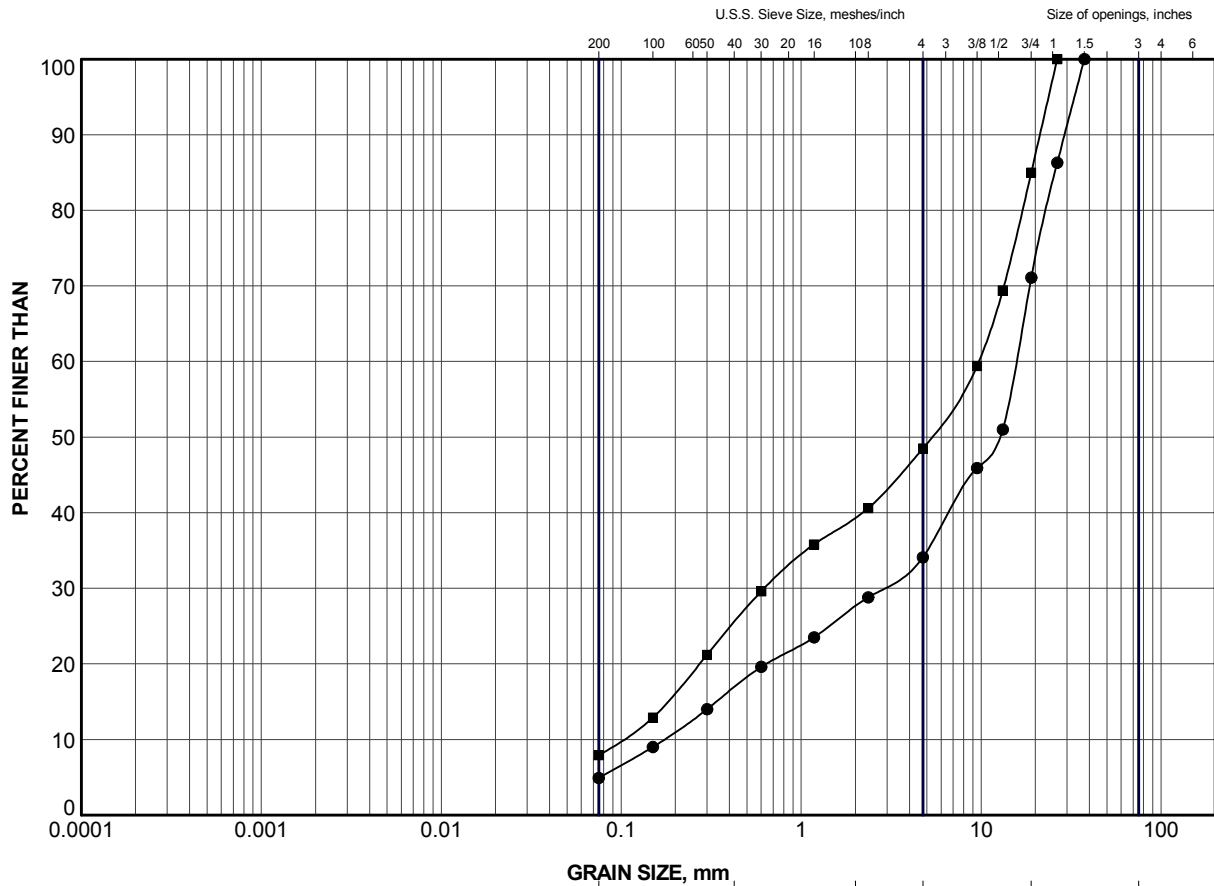


CLAY AND SILT	GRAVEL SIZE, mm					Cobble Size
	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

#### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C4-02	4	294.6
■	C4-02	8	291.6
▲	C4-03	3	300.8
+	C4-03	8	296.2
◆	C4-03	12	290.1
◇	C4-03	15A	285.6
○	C4-04	3	300.3
△	C4-04	8	295.7
⊗	C4-04	12	289.6


PROJECT						HIGHWAY 11 RESURFACING HIGHWAY 11 CULVERTS GWP 5462-09-00					
TITLE						GRAIN SIZE DISTRIBUTION SILT and SAND (FILL)					
PROJECT No.			14-1111-0007			FILE No.			14-1111-0007.GPJ		
DRAWN	TB	Nov 2014		SCALE	N/A	REV.					
CHECK	MT	Nov 2014									
APPR	CN	Nov 2014									
 <b>Golder Associates</b> SUDBURY, ONTARIO						<b>FIGURE B1</b>					

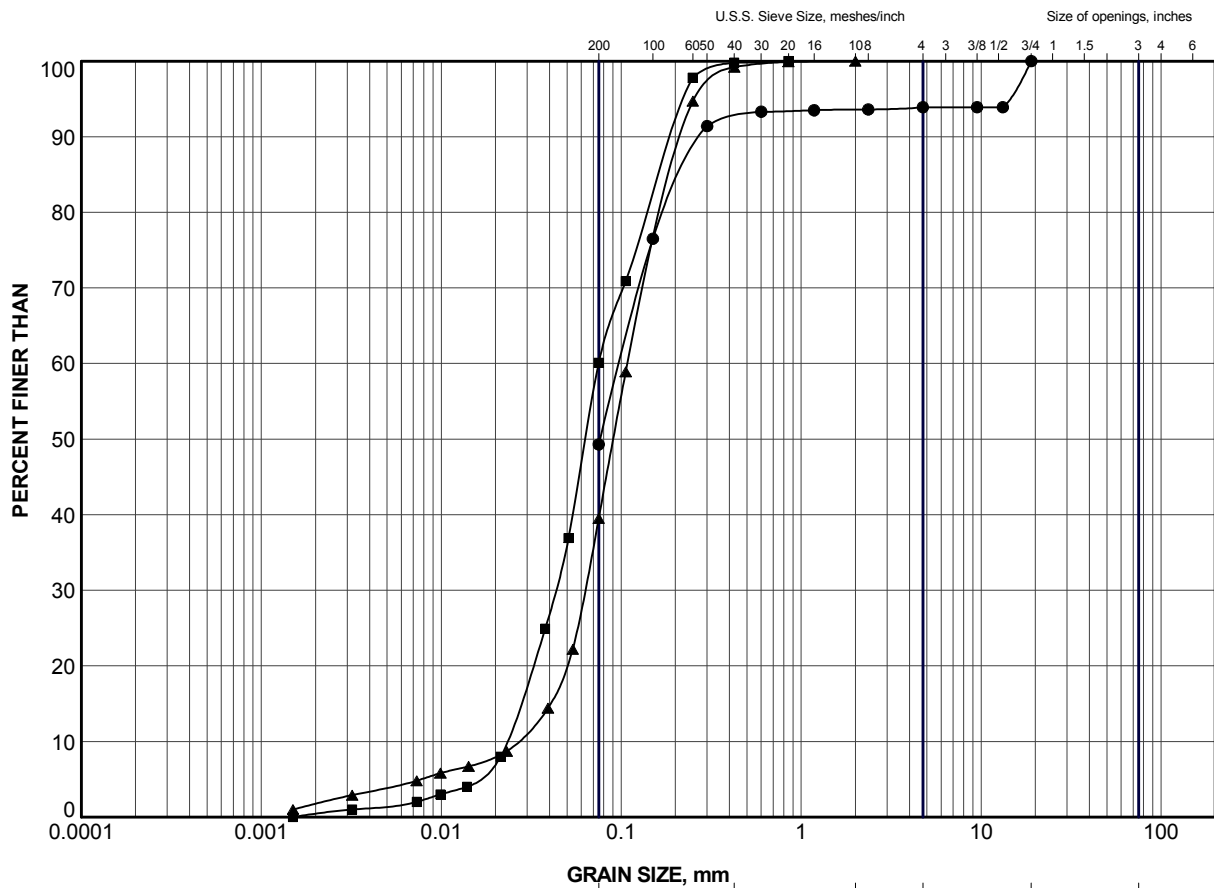


GRAIN SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

#### LEGEND


SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C4-05	3	300.4
■	C4-05	6	298.1

PROJECT						HIGHWAY 11 RESURFACING HIGHWAY 11 CULVERTS GWP 5462-09-00					
TITLE						<b>GRAIN SIZE DISTRIBUTION</b> SAND and GRAVEL to SANDY GRAVEL (FILL)					
PROJECT No.				14-1111-0007		FILE No.				14-1111-0007.GPJ	
DRAWN		TB		Nov 2014		SCALE		N/A		REV.	
CHECK		MT		Nov 2014							
APPR		CN		Nov 2014							
 <b>Golder Associates</b> SUDBURY, ONTARIO						<b>FIGURE B2</b>					

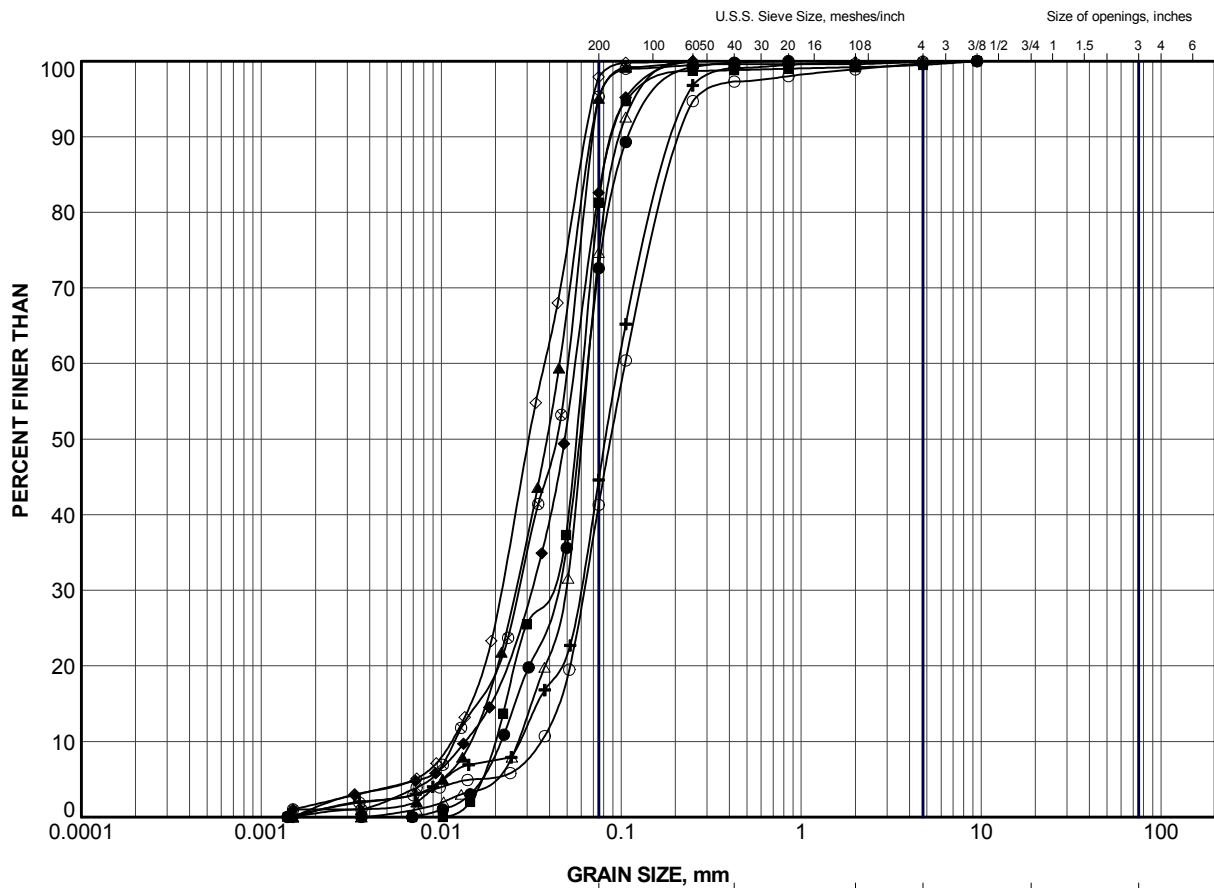


### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C4-05	9	288.2
■	C4-05A	11	286.6
▲	C4-05A	12	285.1

PROJECT					HIGHWAY 11 RESURFACING HIGHWAY 11 CULVERTS GWP 5462-09-00				
TITLE					GRAIN SIZE DISTRIBUTION SILT and SAND (FILL)				
PROJECT No.		14-1111-0007		FILE No.		14-1111-0007.GPJ			
DRAWN	TB	Nov 2014		SCALE	N/A	REV.			
CHECK	MT	Nov 2014		FIGURE B3					
APPR	CN	Nov 2014							
 <b>Golder Associates</b> SUDBURY, ONTARIO									





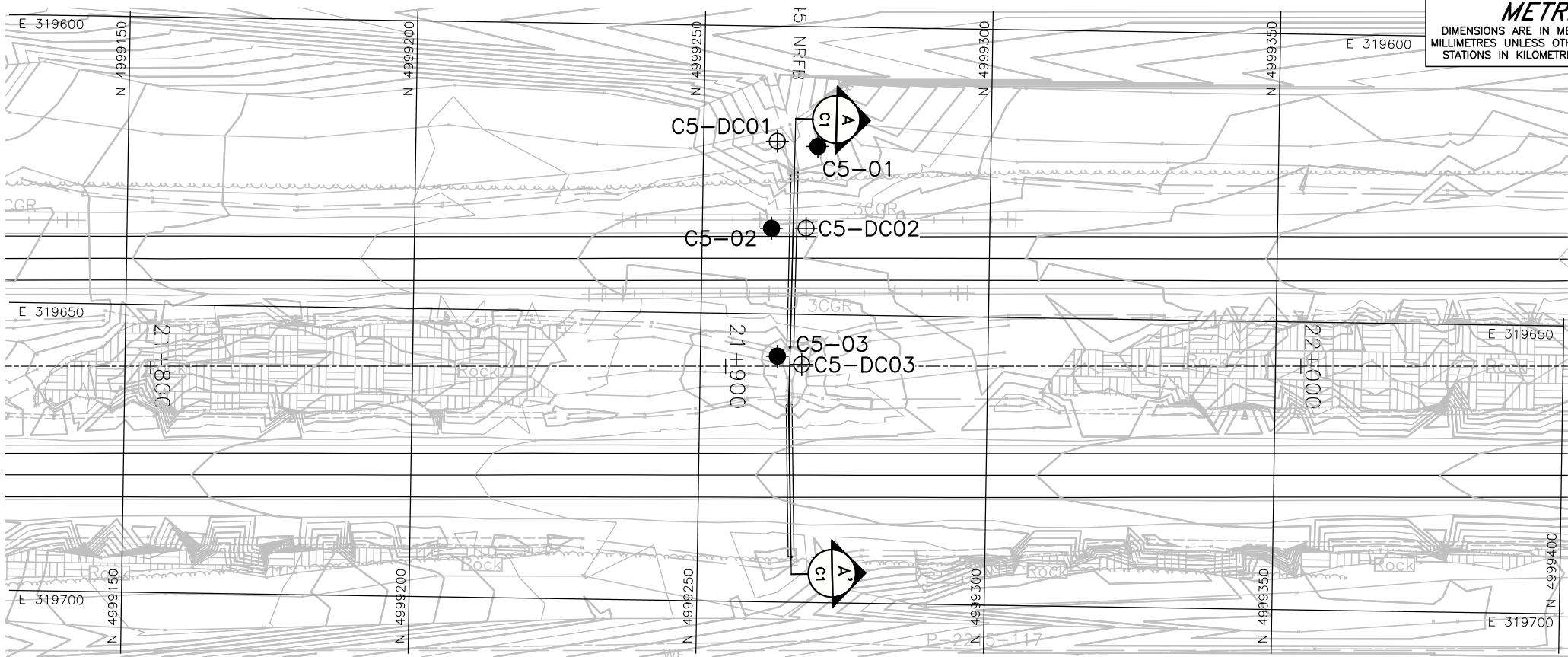
PROJECT					HIGHWAY 11 RESURFACING HIGHWAY 11 CULVERTS GWP 5462-09-00				
TITLE					GRAIN SIZE DISTRIBUTION SILT to SILT and SAND				
PROJECT No.		14-1111-0007		FILE No.		14-1111-0007.GPJ			
DRAWN	TB	Nov 2014		SCALE	N/A	REV.			
CHECK	MT	Nov 2014		FIGURE B4					
APPR	CN	Nov 2014							





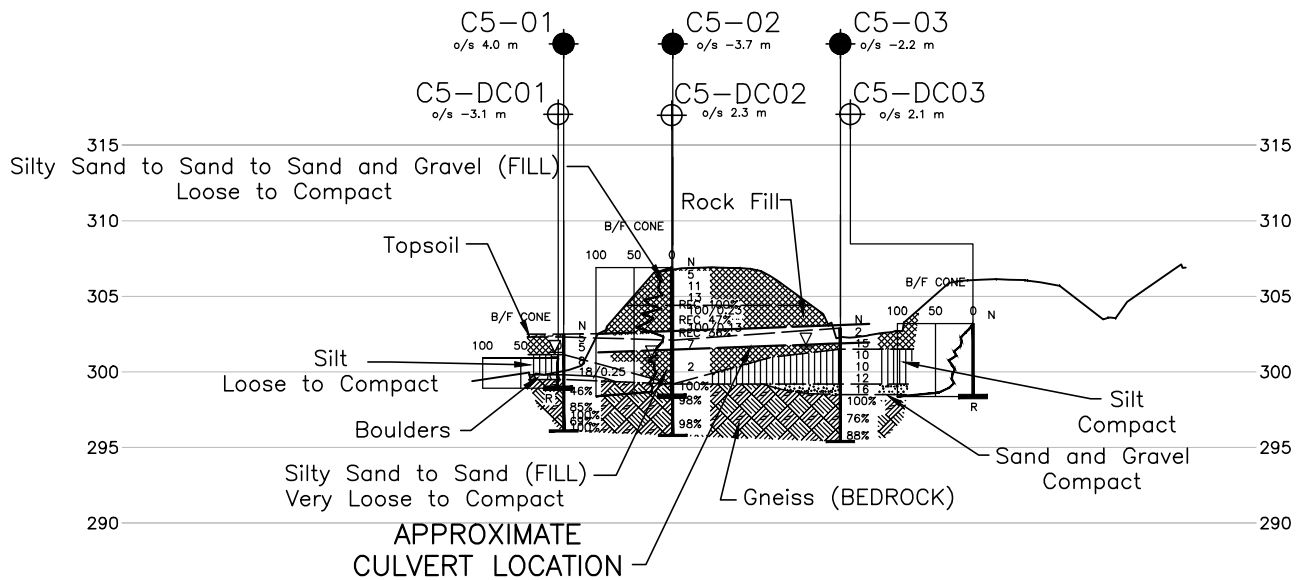
# **APPENDIX C**

**Culvert STA 21+912 (Township of Macaulay)**



PLAN

SCALE



A-A'  
C1

CULVERT C5  
STA. 21+912 (SBL)

HORIZONTAL SCALE



VERTICAL SCALE



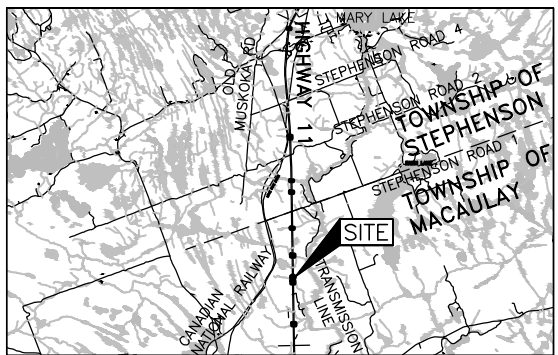
**METRIC**  
DIMENSIONS ARE IN METRES AND/OR  
MILLIMETRES UNLESS OTHERWISE SHOWN.  
STATIONS IN KILOMETRES + METRES.

CONT No.  
GWP No. 5462-09-00



HIGHWAY 11  
CULVERT STA. 21+912 (SBL)  
BOREHOLE LOCATIONS AND SOIL  
STRATA

SHEET



KEY PLAN

SCALE



LEGEND

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

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
C5-01	302.5	4999269.9	319620.8
C5-02	306.7	4999262.1	319635.1
C5-03	302.9	4999263.4	319657.3
C5-DC01	300.9	4999262.8	319620.0
C5-DC02	306.9	4999268.1	319635.0
C5-DC03	303.2	4999267.7	319658.7

NOTES

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

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

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

REFERENCE

Base plan, sections and topographic data, provided in digital format by exp geomatics, drawing file nos. ntb-01407006.dwg and X-SECTIONS.dwg, received Oct 14, 2014.

NO.	DATE	BY	REVISION
Geocres No. 31E-344			
HWY. 11	PROJECT NO. 14-1111-0007	DIST. .	
SUBM'D. MT	CHKD. CN	DATE: 6/14/2013	SITE: .
DRAWN: MR/JFC	CHKD. CN	APPD. JMAC	DWG. C1

PROJECT		14-1111-0007		RECORD OF BOREHOLE No C5-01		SHEET 1 OF 2		METRIC									
G.W.P.		5462-09-00		LOCATION		N 4999269.9 ; E 319620.8		ORIGINATED BY		TM							
DIST		HWY 11		BOREHOLE TYPE		Portable Equipment, Wash Boring		COMPILED BY		MT							
DATUM		Geodetic		DATE		June 27, 2014		CHECKED BY		CN							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
302.5	GROUND SURFACE																
0.0	Topsoil (FILL)		1	SS	5												
0.2	Silty sand, trace organics (FILL) Loose Brown Moist		2	SS	5												
301.1	SILT, trace sand Loose to compact Grey Wet		3	SS	8												
299.8			4	SS	18/0.25												
299.5	BOULDERS																
3.0	GNEISS (BEDROCK)		1	RC	REC 100%												
	Bedrock cored from depths of 3.0 m to 6.4 m.  For bedrock coring details refer to Record of Drillhole C5-01.		2	RC	REC 98%												
			3	RC	REC 100%												
			4	RC	REC 100%												
			5	RC	REC 100%												
296.1	END OF BOREHOLE																
6.4	NOTE:  1. Water level in open borehole at a depth of 1.2 m below ground surface (Elev. 301.3 m) upon completion of drilling.																

GTA-MTO 001 S:\CLIENTS\MT\TOHWY\_11\02\_DATA\GINT\1411110007.GPJ GAL-GTA.GDT 01/21/15

PROJECT: 1411110007

**RECORD OF DRILLHOLE: C5-01**

SHEET 2 OF 2

LOCATION: N 4999269.9 ;E 319620.8

DRILLING DATE: June 27, 2014

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: Portable Drilling Equipment

DRILLING CONTRACTOR: George Downing Estate Drilling Ltd.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	CORING LOG																		DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY		Diametral Point Load Index (MPa)	RMC -Q AVG
						COLOUR % RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	K <sub>v</sub> cm/sec	T °C	P °C	Q °C											
							TOTAL CORE %	SOLID CORE %																							
							JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate	BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage													PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular	PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break	BR - Broken Rock								
NOTE: For additional abbreviations refer to list of abbreviations & symbols.																															
4	BQ Thin-walled Coring June 27, 2014	Continued from Record of Borehole C5-01		299.5																											
		GNEISS Pinkish grey Fine to coarse grained Slightly weathered		3.1	1	GREY 100																									
5					2	GREY 100																									
6						3	GREY 100																								
						4	GREY 100																								
						5	GREY 100																								
6		END OF DRILLHOLE		296.1																											
7																															
8																															
9																															
10																															
11																															
12																															
13																															

DEPTH SCALE

1 : 50



LOGGED: TM

CHECKED: CN

PROJECT 14-1111-0007		RECORD OF BOREHOLE No C5-02		SHEET 1 OF 2		METRIC														
G.W.P. 5462-09-00		LOCATION N 4999262.1 ; E 319635.1		ORIGINATED BY EG																
DIST _____ HWY 11		BOREHOLE TYPE CME 75, 108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing		COMPILED BY MT																
DATUM Geodetic		DATE July 2, 2014		CHECKED BY CN																
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					WATER CONTENT (%) W <sub>p</sub> W W <sub>L</sub>			γ	GR	SA	SI	CL
306.7	GROUND SURFACE							20 40 60 80 100												
0.0	Silty sand to sand and gravel, trace clay (FILL) Loose to compact Brown Moist		1	SS	5		306													
			2	SS	11															
			3	SS	13		305													
304.6	Rock fill (FILL)		-	RC	REC 100%		304													
2.1			4	SS	100/0.23															
			-	RC	REC 47%		303													
			5	SS	100/0.10															
			-	RC	REC 36%		302													
302.1	Sand, some gravel, trace to some silt (FILL) Very loose to loose Brown Wet		6	SS	7		301													
4.6			7	SS	2		300													
							299													
299.2	GNEISS (BEDROCK)		1	RC	REC 100%		298													
7.5	Bedrock cored from depths of 7.5 m to 10.9 m.  For bedrock coring details refer to Record of Drillhole C5-02.		2	RC	REC 98%		297													
			3	RC	REC 100%		296													
295.8	END OF BOREHOLE																			
10.9	NOTE:  1. Water level in open borehole at a depth of 5.8 m below ground surface (Elev. 300.9 m) upon completion of drilling.																			

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PROJECT: 1411110007

**RECORD OF DRILLHOLE: C5-02**

SHEET 2 OF 2

LOCATION: N 4999262.1 ;E 319635.1

DRILLING DATE: July 2, 2014

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 75

DRILLING CONTRACTOR: Landcore Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR FLUSH % RETURN	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.										DISCONTINUITY DATA				Diametral Point Load Index (MPa)	RMC -Q AVG				
							RECOVERY			R.Q.D. %	FRACT. INDEX PER 0.3 m	TYPE AND SURFACE DESCRIPTION			Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY K <sub>v</sub> cm/sec								
							TOTAL CORE %	SOLID CORE %	B Angle			DIP w.r.t. CORE AXIS	DIP w.r.t. BEDDING													
							80	90						100												
		Continued from Record of Borehole C5-02		299.2																						
8	NQ Coring July 2, 2014	GNEISS Pinkish grey Fine to medium grained Fresh		7.5	1	GREY 100																				
					2	GREY 100																				
					3	GREY 100																				
11		END OF DRILLHOLE		295.8 10.9																						
12																										
13																										
14																										
15																										
16																										
17																										

DEPTH SCALE

1 : 50



LOGGED: EG

CHECKED: CN

GTA-RCK 023 S:\CLIENTS\MTOWHWY\_11\02\_DATA\GINT\1411110007\GPJ\_GAL-GTA.GDT 01/21/15

PROJECT 14-1111-0007		RECORD OF BOREHOLE No C5-03		SHEET 1 OF 2		METRIC											
G.W.P. 5462-09-00		LOCATION N 4999263.4 ; E 319657.3		ORIGINATED BY ID													
DIST _____ HWY 11		BOREHOLE TYPE CME 55, NW Casing		COMPILED BY MT													
DATUM Geodetic		DATE July 17 and 18, 2014		CHECKED BY CN													
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
302.9	GROUND SURFACE							20	40	60	80	100					
0.9	Topsoil (FILL) Sand, some silt, trace to some gravel, trace clay (FILL) Very loose to compact Brown to grey Wet		1	SS	2	▽	302										6 76 16 2
301.5			2	SS	15		301										
1.4	SILT, trace sand, trace clay Compact Grey Wet		3	SS	10		300										0 2 97 1
			4	SS	10												
			5	SS	12												
299.2							299										
3.7	SAND and GRAVEL Compact Grey Wet		6	SS	16												
298.5							298										RQD = 100%
4.4	GNEISS (BEDROCK)  Bedrock cored from depths of 4.4 m to 7.5 m.  For bedrock coring details refer to Record of Drillhole C5-03.		1	RC	REC 100%		297										RQD = 76%
			2	RC	REC 98%		296										RQD = 88%
			3	RC	REC 100%												
295.4																	
7.5	END OF BOREHOLE  NOTE:  1. Water level in open borehole at a depth of 1.1 m below ground surface (Elev. 301.8 m) upon completion of drilling.																

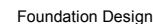
GTA-MTO 001 S:\CLIENTS\MT\HWY\_11\02\_DATA\GINT\1411110007.GPJ GAL-GTA.GDT 01/21/15





PROJECT		14-1111-0007		RECORD OF DCPT No C5-DC01		SHEET 1 OF 1		METRIC									
G.W.P.		5462-09-00		LOCATION		N 4999262.8 ; E 319620.0		ORIGINATED BY									
DIST		HWY 11		BOREHOLE TYPE		Portable Equipment, Dynamic Cone Penetration Test		COMPILED BY									
DATUM		Geodetic		DATE		July , 2014		CHECKED BY									
CN																	
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									
300.9	GROUND SURFACE						20	40	60	80	100						
0.0	Dynamic Cone Penetration Test (DCPT)																
298.9																	
2.0	END OF DCPT REFUSAL TO FURTHER PENETRATION (3 Blows / 0.15 m) (HAMMER BOUNCING)																
	NOTE: 1. DCPTs advanced 2.0 m west and 2.0 m south and west of C5-DC01 encountered refusal to further penetration at depths of 0.5 m and 0.8 m, respectively.																

GTA-MTO 001 S:\CLIENTS\MT\OH\HWY\_11\02\_DATA\GINT\1411110007.GPJ GAL-GTA.GDT 01/21/15



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



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

GTA-MTO 001 S:\CLIENTS\MTO\HWY\_11\02\_DATA\GINT\1411110007.GPJ GAL-GTA.GDT 01/21/15

Golder Associates Ltd.  
 6925 Century Avenue, Suite #100  
 Mississauga, Ontario, L5N 7K2  
 Telephone: (905) 567-4444  
 Fax: (905) 567-6561



**Table C1 - Unconfined Compressive Strength**

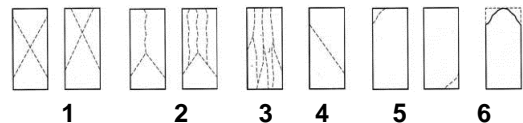
**PROJECT NO.:** 14-1111-0007  
**JOB NAME:** Highway 11 Culverts  
**TYPE OF UNIT:** Bedrock Core

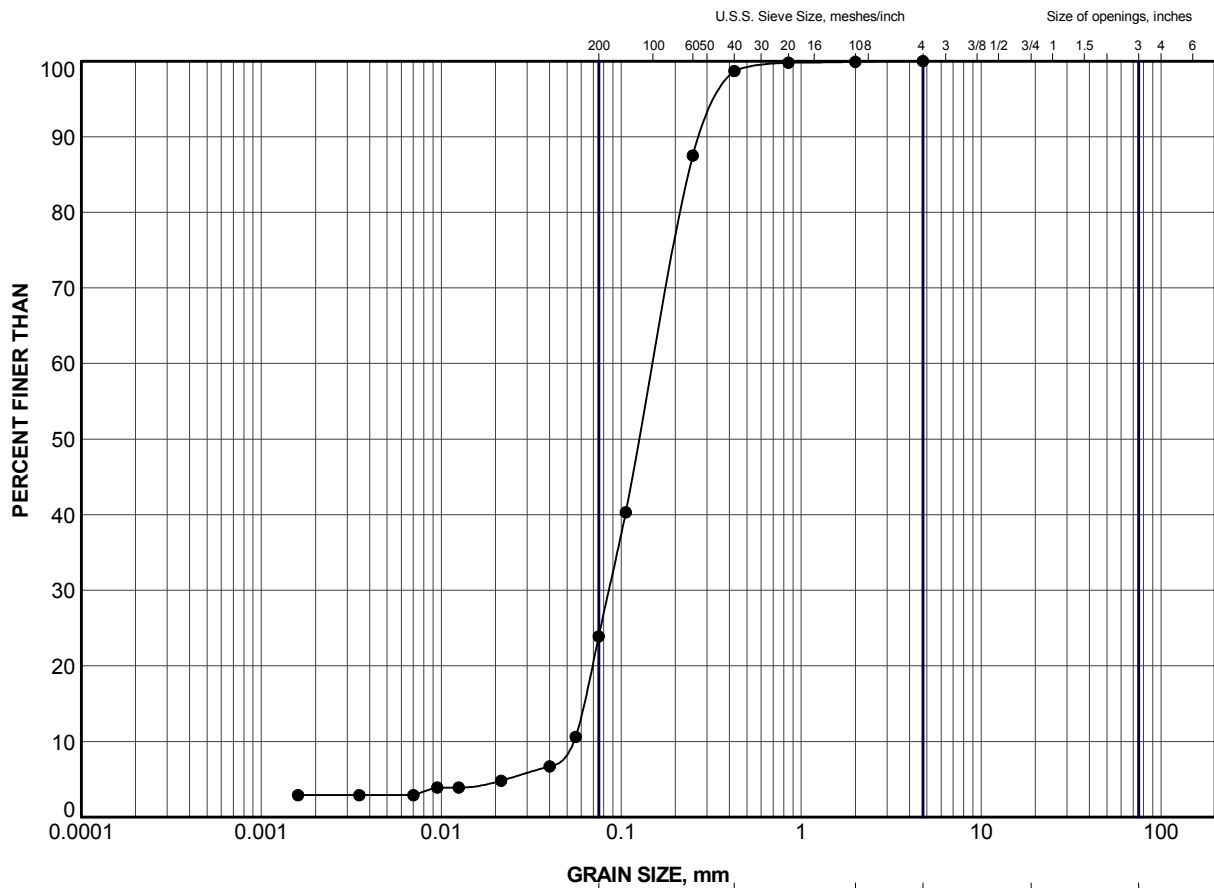
<b>GOLDER LAB NUMBER</b>	<b>G0834</b>
<b>BOREHOLE</b>	<b>C5-03</b>
<b>DATE TESTED</b>	<b>Sept. 5, 2014</b>
<b>DEPTH OF TESTED CORE (m)</b>	5.5
<b>LENGTH AS CUT (mm)</b>	105.0
<b>DIAMETER (mm)</b>	47.5
<b>DENSITY (kg/m3)</b>	2824
<b>COMPRESSIVE STRENGTH (KN)</b>	104.9
<b>CORRECTED STRENGTH (MPa)</b>	<b>59.2</b>
<b>TYPE OF FRACTURE</b>	<b>4</b>

Tested by: SA

Reviewed by : TG

*Type of Fracture*




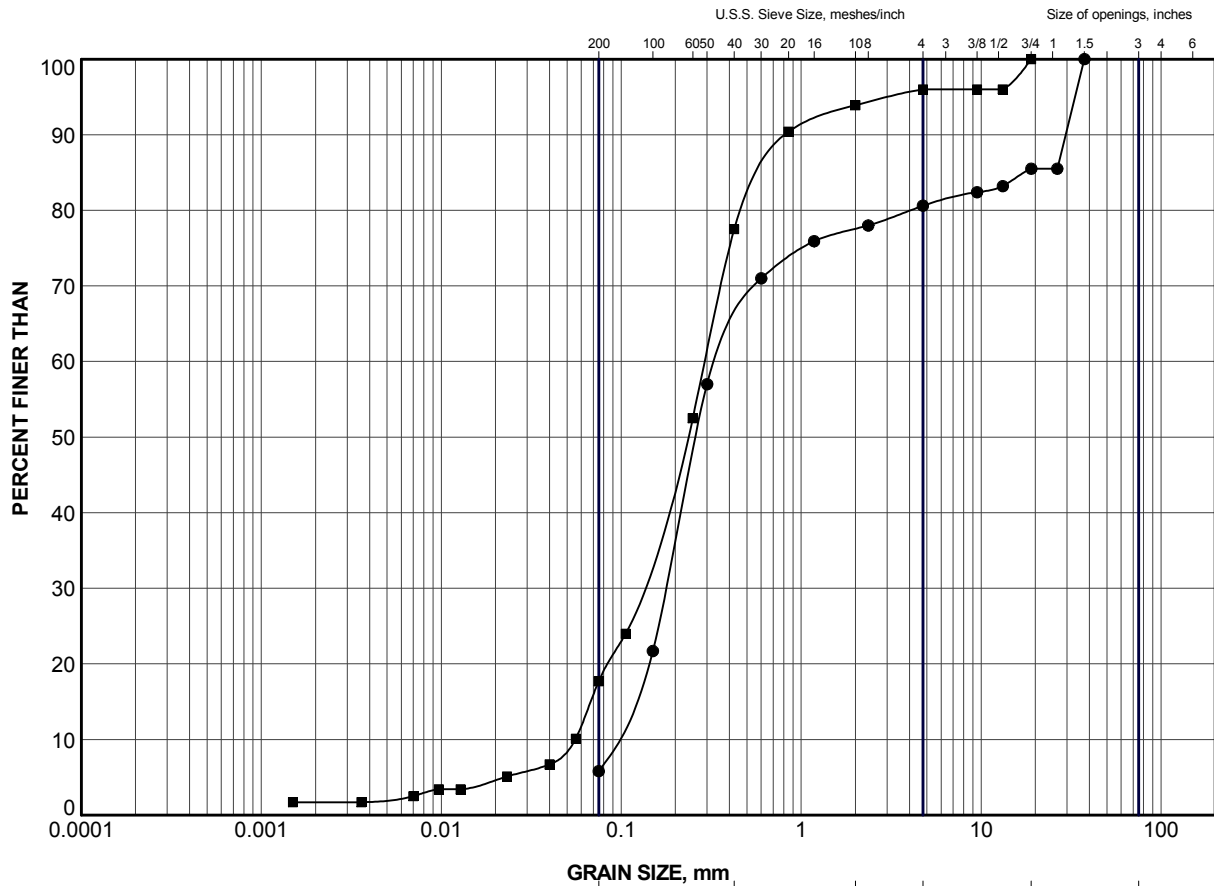


GRAIN SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

#### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C5-02	2	305.6

PROJECT						HIGHWAY 11 RESURFACING HIGHWAY 11 CULVERTS GWP 5462-09-00					
TITLE						GRAIN SIZE DISTRIBUTION SILTY SAND (FILL)					
PROJECT No.			14-1111-0007			FILE No.			14-1111-0007.GPJ		
DRAWN	TB	Oct 2014	SCALE	N/A	REV.						
CHECK	MT	Oct 2014									
APPR	CN	Oct 2014									
 <b>Golder Associates</b> SUDBURY, ONTARIO			<b>FIGURE C1</b>								



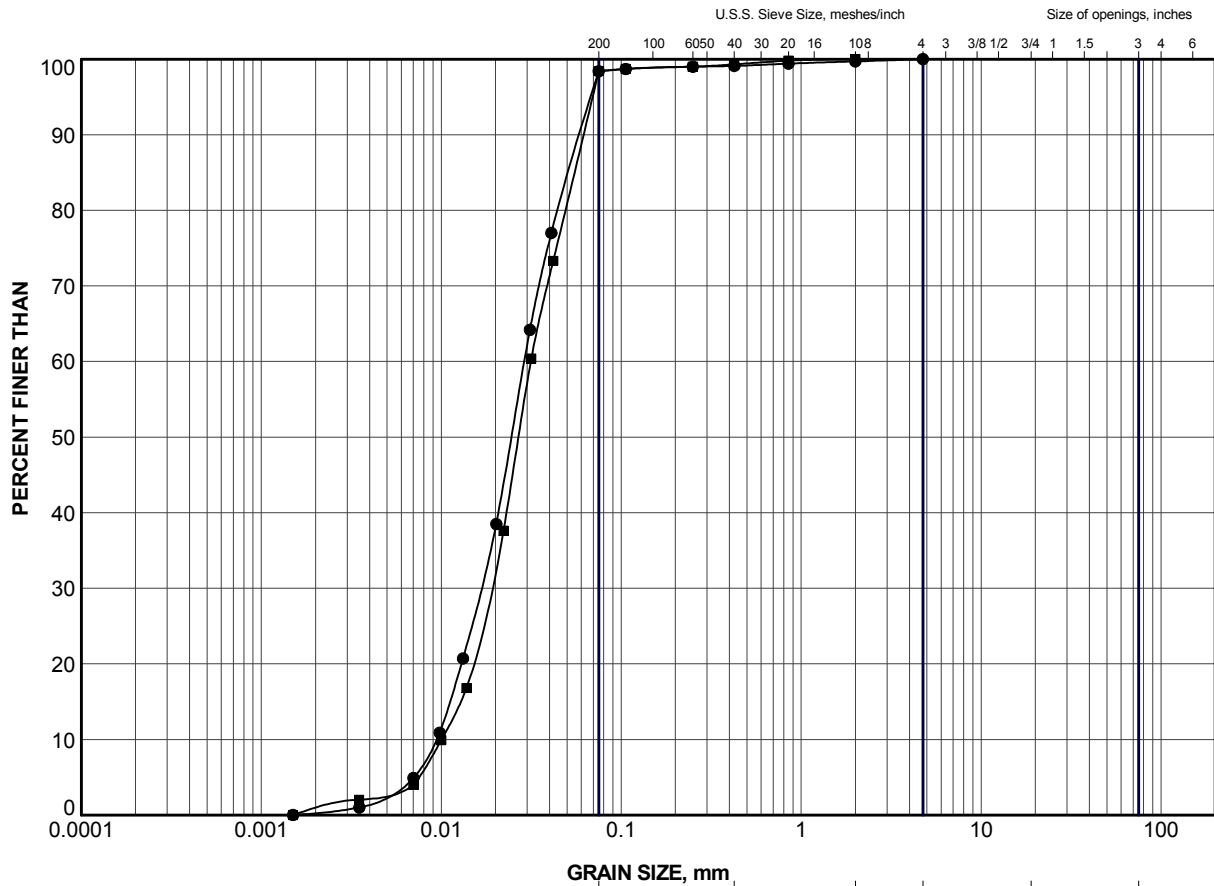
GRAIN SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

#### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C5-02	6	301.8
■	C5-03	2	301.8

PROJECT						HIGHWAY 11 RESURFACING HIGHWAY 11 CULVERTS GWP 5462-09-00					
TITLE						GRAIN SIZE DISTRIBUTION SAND (FILL)					
PROJECT No.			14-1111-0007			FILE No.			14-1111-0007.GPJ		
DRAWN	TB	Oct 2014	SCALE	N/A	REV.	FIGURE C2					
CHECK	MT	Oct 2014									
APPR	CN	Oct 2014									





CLAY AND SILT	GRAVEL SIZE, mm					Cobble Size
	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

#### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C5-01	4	300.0
■	C5-03	4	300.3

PROJECT						HIGHWAY 11 RESURFACING HIGHWAY 11 CULVERTS GWP 5462-09-00					
TITLE						GRAIN SIZE DISTRIBUTION SILT					
PROJECT No.			14-1111-0007			FILE No.			14-1111-0007.GPJ		
DRAWN	TB	Oct 2014	SCALE	N/A	REV.						
CHECK	MT	Oct 2014									
APPR	CN	Oct 2014									
						FIGURE C3					

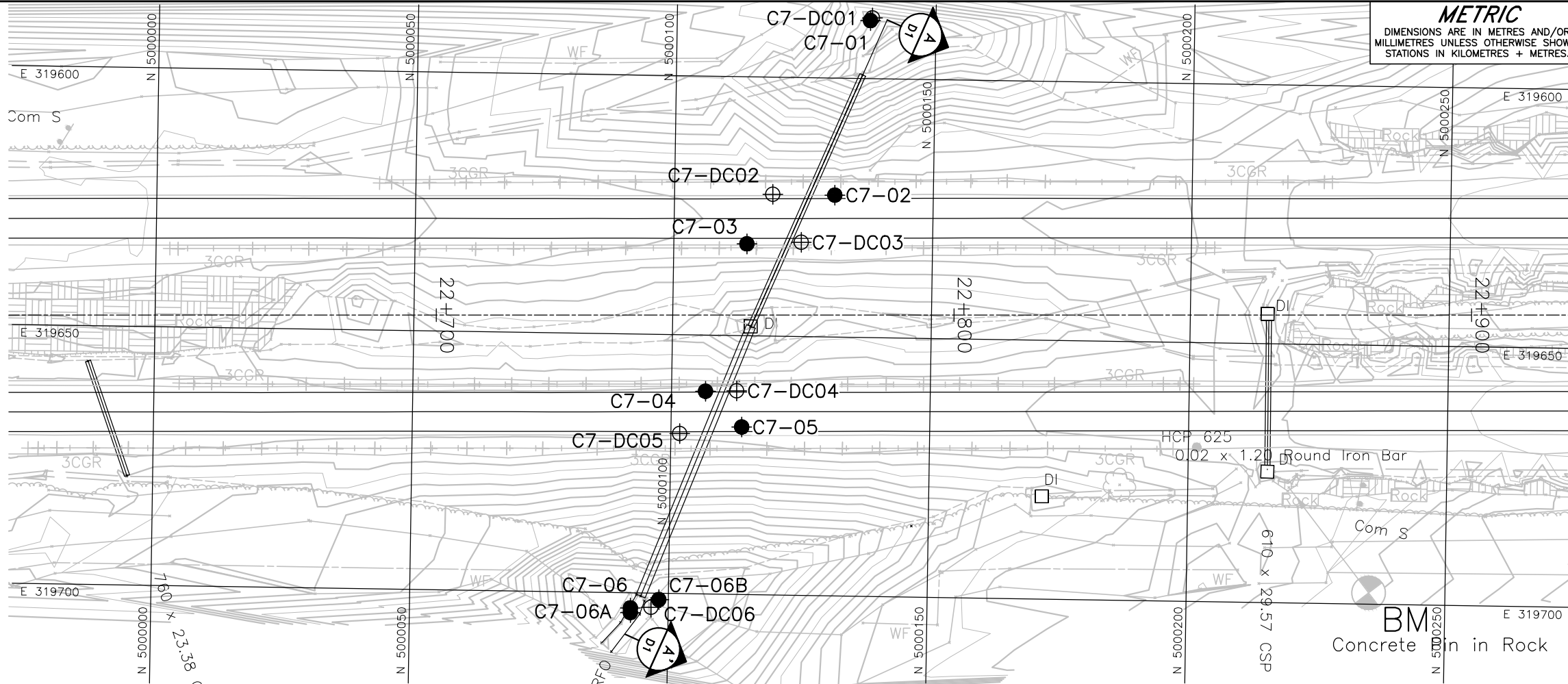




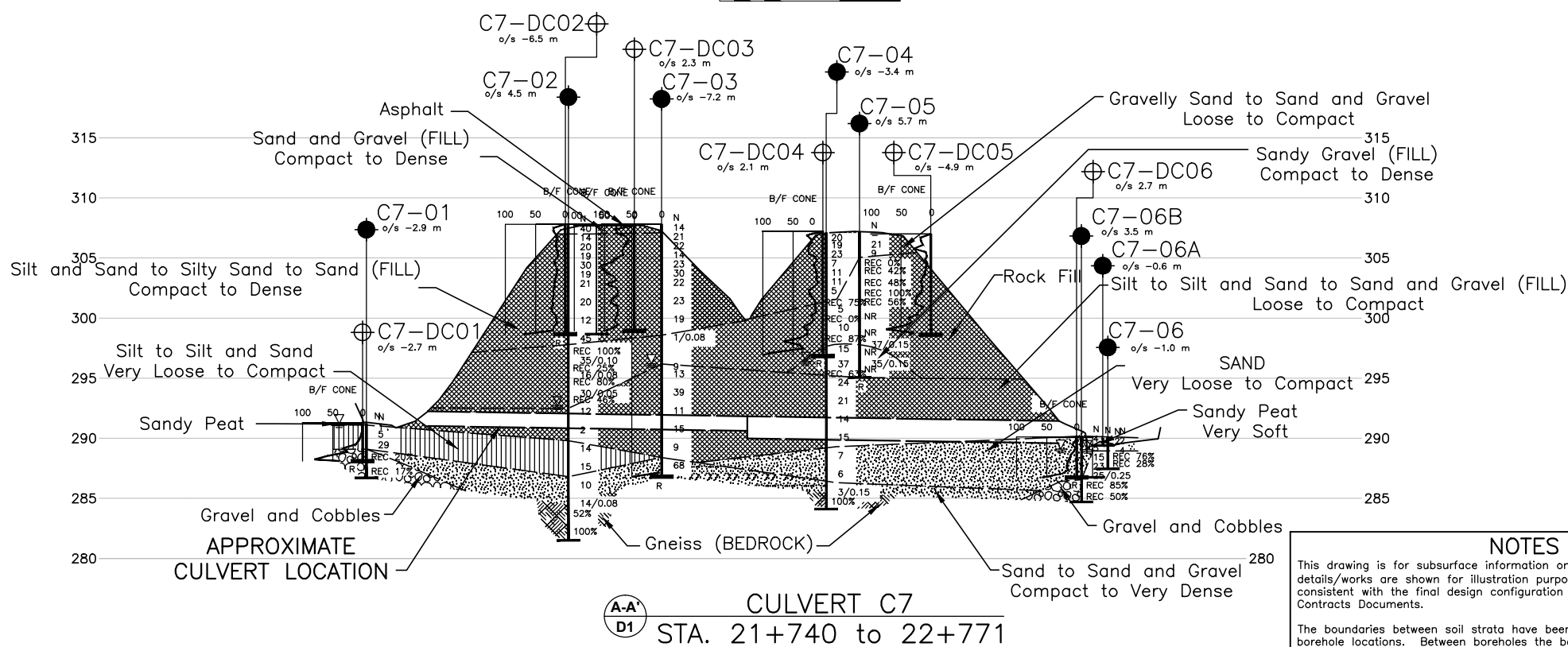


# APPENDIX D

Culvert STA 22+740 to 22+771 (Township of Macaulay)



PLAN  
SCALE  
10 0 10 20 m



#### NOTES

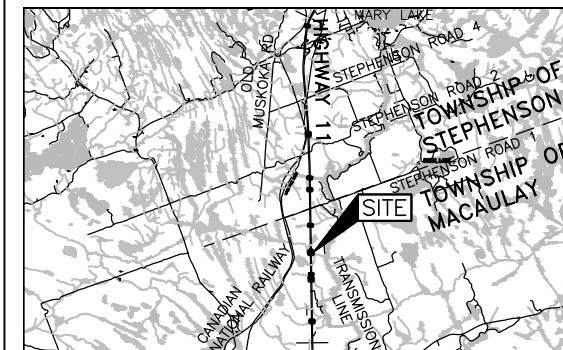
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

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

CONT No.  
GWP No. 5462-09-00

HIGHWAY 11  
CULVERT STA. 22+740 TO STA. 22+771 (SBL AND NBL)  
BOREHOLE LOCATIONS AND SOIL STRATA



KEY PLAN  
SCALE  
3 0 3 6 km

#### LEGEND

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

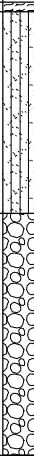
#### BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
C7-01	291.2	5000137.3	319588.8
C7-02	307.7	5000131.0	319622.6
C7-03	307.8	5000114.1	319632.3
C7-04	307.1	5000106.6	319660.9
C7-05	307.2	5000113.7	319667.7
C7-06	290.0	5000092.7	319702.9
C7-06A	290.1	5000092.7	319703.8
C7-06B	290.2	5000098.2	319701.2
C7-DC01	291.3	5000137.7	319588.3
C7-DC02	307.8	5000119.0	319622.6
C7-DC03	307.7	5000124.6	319631.8
C7-DC04	307.2	5000112.6	319660.7
C7-DC05	307.0	5000101.7	319669.1
C7-DC06	290.1	5000096.7	319702.8

#### REFERENCE

Base plan, sections and topographic data, provided in digital format by exp geomatics, drawing file nos. ntb-01407006.dwg and X-SECTIONS.dwg, received Oct 14, 2014.

NO.	DATE	BY	REVISION
1	11/13/2014	JMAC	1
Geocres No. 31E-344			
HWY. 11	PROJECT NO. 14-1111-0007		DIST. .
SUBM'D. MT	CHKD. CN	DATE: 11/13/2014	SITE: .
DRAWN: MR	CHKD. CN	APPD. JMAC	DWG. D1

PROJECT 14-1111-0007		RECORD OF BOREHOLE No C7-01				SHEET 1 OF 1		METRIC								
G.W.P. 5462-09-00		LOCATION N 5000137.3; E 319588.8				ORIGINATED BY MT										
DIST _____ HWY 11		BOREHOLE TYPE Portable Equipment, Wash Boring				COMPILED BY MT										
DATUM Geodetic		DATE July 9 and 10, 2014				CHECKED BY CN										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
291.2	GROUND SURFACE						20	40	60	80	100					
0.0	Sandy PEAT (Fibrous)		1	SS	1	291										
	SILT and SAND, some gravel		2	SS	5											
	Very loose to compact					290										
289.1	GRAVEL and COBBLES		3	SS	29											
2.1	Depth (m)    Thickness (mm)					289										
	2.1            75		-	RC	REC 20%											
	2.7            140															
	3.2            50															
	3.5            25															
	3.6            25															
	4.0            140															
286.7	END OF BOREHOLE					287										
4.5	NOTE:															
	1. Water level in open borehole at ground surface (Elev. 291.2 m) upon completion of drilling.															



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

PROJECT 14-1111-0007		RECORD OF BOREHOLE No C7-02		SHEET 2 OF 3		METRIC											
G.W.P. 5462-09-00		LOCATION N 5000131.0; E 319622.6		ORIGINATED BY ID													
DIST HWY 11		BOREHOLE TYPE CME 55, 108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing		COMPILED BY MT													
DATUM Geodetic		DATE July 4, 9, 10, 11, 14 and 15, 2014		CHECKED BY CN													
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ kN/m <sup>3</sup>	GR SA SI CL
							20 40 60 80 100	20 40 60 80 100	W <sub>p</sub>	W	W <sub>L</sub>	10 20 30					
292.5 15.2	--- CONTINUED FROM PREVIOUS PAGE ---  Silt and sand, trace to some gravel, trace clay (FILL) Very loose to compact Grey Wet  Sand and gravel seam encountered between depths of 15.2 m and 15.3 m depth  Trace organics encountered between depths of 15.2 m and 17.4 m depth		-	RC			292										
			14	SS	12		291										
			15	SS	2		290										0 48 51 1
289.8 17.9	SILT, trace sand, trace clay Compact Grey Wet		16	SS	14		289										
							288										
			17	SS	15		287										0 4 94 2
286.8 20.9	SAND to SAND and GRAVEL, trace to some silt Compact Grey Wet		18	SS	10		286										
							285										
284.5 23.2	GNEISS (BEDROCK)  Bedrock cored from depths of 23.2 m to 26.2 m.  For bedrock coring details refer to Record of Drillhole C7-02.		19	SS	14/0.08		284										RQD = 52%
			1	RC	REC 99%		283										
			2	RC	REC 100%		282										RQD = 100%
281.5 26.2	END OF BOREHOLE  NOTE:  1. Water level in open borehole at a depth of 15.0 m below ground surface (Elev. 292.7 m) upon completion of drilling.  2. Casing shoe damaged at 12.3 m, requiring borehole to be abandoned and advancement of an adjacent borehole to obtain soil information below 12.3 m depth.																

PROJECT: 1411110007

## RECORD OF DRILLHOLE: C7-02

SHEET 3 OF 3

LOCATION: N 5000131.0 ;E 319622.6

DRILLING DATE: July 15, 2014

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR: Landcore Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
							FLUSH	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	B Angle	DIP w.r.t. CORE AXIS	DISCONTINUITY DATA			HYDRAULIC CONDUCTIVITY			Diametral Point Load Index (MPa)	RMC -Q AVG																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
								TOTAL CORE %	SOLID CORE %					TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	K <sub>v</sub> cm/sec	10 <sup>0</sup>			10 <sup>1</sup>	10 <sup>2</sup>																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
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		GROUND SURFACE		284.5																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															

DEPTH SCALE

1 : 50



LOGGED: ID

CHECKED: CN

GTA-RCK 023 \\GOLDER.GDS\GALS\SUBBURY\CAD\PROJECTS\2014\14-1111-0007 GINT LAB FIGURES FOR MISSISSAUGA\GINT 2.17.2015\1411110007.GPJ GAL-GTA.GDT 2/17/15



PROJECT 14-1111-0007			RECORD OF BOREHOLE No C7-03			SHEET 2 OF 2			METRIC								
G.W.P. 5462-09-00			LOCATION N 5000114.1 ; E 319632.3			ORIGINATED BY ID											
DIST _____ HWY 11			BOREHOLE TYPE CME 55, NW Casing			COMPILED BY MT											
DATUM Geodetic			DATE August 6, 2014			CHECKED BY CN											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	--- CONTINUED FROM PREVIOUS PAGE ---							20	40	60	80	100					
	Silt to silt and sand, trace clay (FILL) Loose to dense Grey to brown Wet		14	SS	11		292										0 13 85 2
							291										
			15	SS	15		290										
							289										
			16	SS	9		288										
288.4	SAND and GRAVEL, trace to some silt, trace clay (FILL) Very dense Brown Wet		17	SS	68		287										43 46 10 1
287.4	END OF BOREHOLE Dynamic Cone Penetration Test (DCPT)																
286.8	END OF DCPT REFUSAL TO FURTHER PENETRATION (49 Blows / 0.30 m) (HAMMER BOUNCING)																
21.0	NOTE:  1. Water level in open borehole at a depth of 11.6 m below ground surface (Elev. 296.2 m) upon completion of drilling.																



PROJECT <u>14-1111-0007</u>		<b>RECORD OF BOREHOLE No C7-04</b>		SHEET 1 OF 3		<b>METRIC</b>	
G.W.P. <u>5462-09-00</u>		LOCATION <u>N 5000106.6 ; E 319660.9</u>		ORIGINATED BY <u>ID</u>			
DIST <u>          </u> HWY <u>11</u>		BOREHOLE TYPE <u>CME 55, NW Casing</u>		COMPILED BY <u>MT</u>			
DATUM <u>Geodetic</u>		DATE <u>July 31, August 1 and 5, 2014</u>		CHECKED BY <u>CN</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)	
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × REMOULDED									
307.1 0.0	GROUND SURFACE ASPHALT (90 mm) Gravelly sand to sand and gravel (FILL) Loose to compact Grey Moist		1	SS	20													
			2	SS	19													
			3	SS	23													
			4	SS	7													
			5	SS	11													
			6	SS	11													
			7	SS	5													
301.6 5.5	Rock fill (FILL)  Sample 8 and Sample 9 encountered voids within rock fill.			-	RC	REC 75%												
			8	SS	5													
			-	RC	REC 0%													
			9	SS	10													
			-	RC	REC 87%													
297.7 9.4	Sandy gravel, some silt, trace clay (FILL) Compact to dense Grey Moist		10	SS	15													
			11	SS	37													
295.8 11.3	Rock fill (FILL)		-	RC	REC 63%													
294.9 12.2	Sand and gravel (FILL) Compact Brown Moist		12	SS	24													
293.8 13.3	Silt, trace to some sand, trace clay (FILL) Compact Brown to grey Wet		13	SS	21													

Continued Next Page

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

GTA-MTO 001 \GOLDER\GDS\GAL\SUBBURY\CAD-GIS\CAD\PROJECTS\2014\14-1111-0007 GINT LAB FIGURES FOR MISSISSAUGA\GINT 2.17.2015\1411110007.GPJ GAL-GTA.GDT 2/17/15

PROJECT 14-1111-0007			RECORD OF BOREHOLE No C7-04			SHEET 2 OF 3			METRIC								
G.W.P. 5462-09-00			LOCATION N 5000106.6 ; E 319660.9			ORIGINATED BY ID											
DIST HWY 11			BOREHOLE TYPE CME 55, NW Casing			COMPILED BY MT											
DATUM Geodetic			DATE July 31, August 1 and 5, 2014			CHECKED BY CN											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	--- CONTINUED FROM PREVIOUS PAGE ---							20	40	60	80	100					
289.3	Silt, trace to some sand, trace clay (FILL) Compact Brown to grey Wet		14	SS	14												
			15	SS	15												
289.3	SAND, some silt Loose Brown Wet		16	SS	7												
286.3	SAND and GRAVEL Brown Wet		17	SS	6												
285.4			18	SS	3/0.15												
285.4	GNEISS (BEDROCK)																
284.1	Bedrock cored from depths of 21.7 m to 23.0 m.  For bedrock coring details refer to Record of Drillhole C7-04.		1	RC	REC 100%												RQD = 100%
284.1	END OF BOREHOLE																
23.0	NOTE:  1. Water level in open borehole at a depth of 10.7 m below ground surface (Elev. 296.4 m) upon completion of drilling.																

GTA-MTO 001 \GOLDER\GDS\GAL\SUDBURY\CAD-GIS\CAD\PROJECTS\2014\14-1111-0007 GINT LAB FIGURES FOR MISSISSAUGA\GINT 2.17.2015\1411110007.GPJ GAL-GTA.GDT 2/17/15

SHEET 3 OF 3

DATUM: Geodetic

DRILLING CONTRACTOR: Landcore Drilling Inc.

\\GOLDER.GDS\GAL\SUBBURY\CAD-GIS\CAD\PROJECTS\2014\14-1111-0007 GINT LAB FIGURES FOR MISSISSAUGA\GINT 2.17.2015\1411110007.GPJ GAL-GTA.GDT 2/17/15

CHECKED: CN

PROJECT 14-1111-0007		RECORD OF BOREHOLE No C7-05		SHEET 1 OF 1		METRIC														
G.W.P. 5462-09-00		LOCATION N 5000113.7 ; E 319667.7		ORIGINATED BY EG																
DIST _____ HWY 11		BOREHOLE TYPE CME 75, 108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing		COMPILED BY MT																
DATUM Geodetic		DATE July 4 and 7, 2014		CHECKED BY CN																
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ kN/m³	GR SA SI CL			
							20 40 60 80 100	○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × REMOULDED	W <sub>p</sub>	W	W <sub>L</sub>	20 40 60 80 100	10 20 30						
307.2	GROUND SURFACE																			
0.0	ASPHALT (300 mm)		1	AS	-		307													
0.3	Sand and gravel, some silt (FILL) Loose to compact Brown Moist		2	SS	21		306										35 49 (16)			
			3	SS	9															
305.1	Rock fill (FILL) (SPLIT-SPOON BOUNCING) Refusal at depths of 2.3 m, 3.0 m, 6.7 m and 7.6 m.		-	SS	-		305													
2.1			-	RC	REC 0%															
			-	SS	-		304													
			-	RC	REC 42%															
			-	RC	REC 48%		303													
			-	RC	REC 100%		302													
			-	RC	REC 56%		301													
			-	RC	NR		300													
			-	SS	-															
			-	RC	NR		299													
			4	SS	37/0.15		298													
			-	RC	NR		297													
			5	SS	35/0.15		296													
			-	RC	NR															
295.1	END OF BOREHOLE																			
12.1	NOTE:  1. Core barrel damaged at a depth of 12.1 m (Elev. 295.1 m), unable to penetrate further.  * NR - Not Recorded  2. Borehole dry upon completion of drilling.																			

GTA-MTO 001 S:\CLIENTS\MT\OH\HWY\_11\02\_DATA\GINT\1411110007.GPJ GAL-GTA.GDT 01/21/15



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

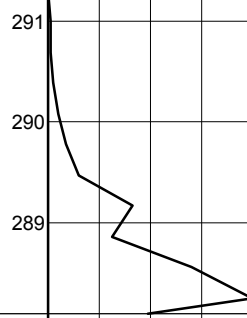
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PROJECT		14-1111-0007		RECORD OF BOREHOLE No C7-06A		SHEET 1 OF 1		METRIC									
G.W.P.		5462-09-00		LOCATION		N 5000092.7 ; E 319703.8		ORIGINATED BY									
DIST		HWY 11		BOREHOLE TYPE		Portable Equipment, Wash Boring, Manual Hammer		COMPILED BY									
DATUM		Geodetic		DATE		July 7, 2014		CHECKED BY									
								CN									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
290.1	GROUND SURFACE																
0.0	PEAT																
0.2	SAND, trace to some silt, trace organics Very loose Grey Moist to wet		1	SS	2												
289.0	GRAVEL and COBBLES		2	SS	4												
1.1	Depth (m)      Thickness (mm) 1.1                75 1.2                150 1.4                5 x 25 1.6                8 x 25 1.8                75		-	RC	REC 76%												
287.5			-	RC	REC 28%												
2.6	END OF BOREHOLE  NOTE:  1. Water level in open borehole at a depth of 1.0 m below ground surface (Elev. 289.1 m) upon completion of drilling.																

GTA-MTO 001 S:\CLIENTS\MT\OH\HWY\_11\02\_DATA\GINT\1411110007.GPJ GAL-GTA.GDT 01/21/15

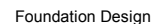
PROJECT 14-1111-0007		RECORD OF BOREHOLE No C7-06B		SHEET 1 OF 1		METRIC						
G.W.P. 5462-09-00		LOCATION N 5000098.2;E 319701.2		ORIGINATED BY MT								
DIST _____ HWY 11		BOREHOLE TYPE Portable Equipment, Wash Boring, Manual Hammer		COMPILED BY MT								
DATUM Geodetic		DATE July 8, 2014		CHECKED BY CN								
SOIL PROFILE		SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER			TYPE	"N" VALUES					
290.2	GROUND SURFACE											
0.0	PEAT (Fibrous)		1	SS	2							
	SAND, trace to some gravel, trace to some silt		2	SS	2							
	Loose to compact											
	Grey		3	SS	7							
	Wet		4	SS	11							
			5	SS	12/0.25							
286.6	GRAVEL and COBBLES											
3.6	Depth (m) Thickness (mm)		-	RC	REC 85%							
	3.6 8 x 25											
	3.8 125											
	3.9 75											
	4.0 125											
	4.1 4 x 25											
	4.4 125		-	RC	REC 50%							
	4.5 100											
	4.6 125											
284.7	4.8 6 x 50											
5.5	5.2 25											
	END OF BOREHOLE											
	NOTES:											
	1. Water level in open borehole at a depth of 1.1 m below ground surface (Elev. 289.1 m) upon completion of drilling.											
	2. Manual half-weight hammer used for all split spoon samples. SPT "N"-Values are corrected to approximately expected values that would be obtained using a standard weight hammer.											

GTA-MTO 001 S:\CLIENTS\MT\TOHWY\_11\02\_DATA\GINT\1411110007.GPJ GAL-GTA.GDT 01/21/15

PROJECT 14-1111-0007				RECORD OF DCPT No C7-DC01				SHEET 1 OF 1				METRIC												
G.W.P. 5462-09-00				LOCATION N 5000137.7 ; E 319588.3				ORIGINATED BY MT																
DIST _____ HWY 11				BOREHOLE TYPE Portable Equipment, Dynamic Cone Penetration Test				COMPILED BY MT																
DATUM Geodetic				DATE July 9, 2014				CHECKED BY CN																
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					W <sub>p</sub>	W			W <sub>L</sub>							
291.3	GROUND SURFACE						<div style="display: flex; justify-content: space-between;"> <span>20 40 60 80 100</span> <span>20 40 60 80 100</span> </div> <div style="display: flex; justify-content: space-between;"> <span>○ UNCONFINED</span> <span>+ FIELD VANE</span> </div> <div style="display: flex; justify-content: space-between;"> <span>● QUICK TRIAXIAL</span> <span>× REMOULDED</span> </div>																	
0.0	Dynamic Cone Penetration Test (DCPT)																							
288.1	END OF DCPT REFUSAL TO FURTHER PENETRATION (39 Blows/ 0.15 m) (HAMMER BOUNCING)																							
3.2																								

GTA-MTO 001 S:\CLIENTS\MT\OHwy\_11\02\_DATA\GINT\1411110007.GPJ GAL-GTA.GDT 01/21/15





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



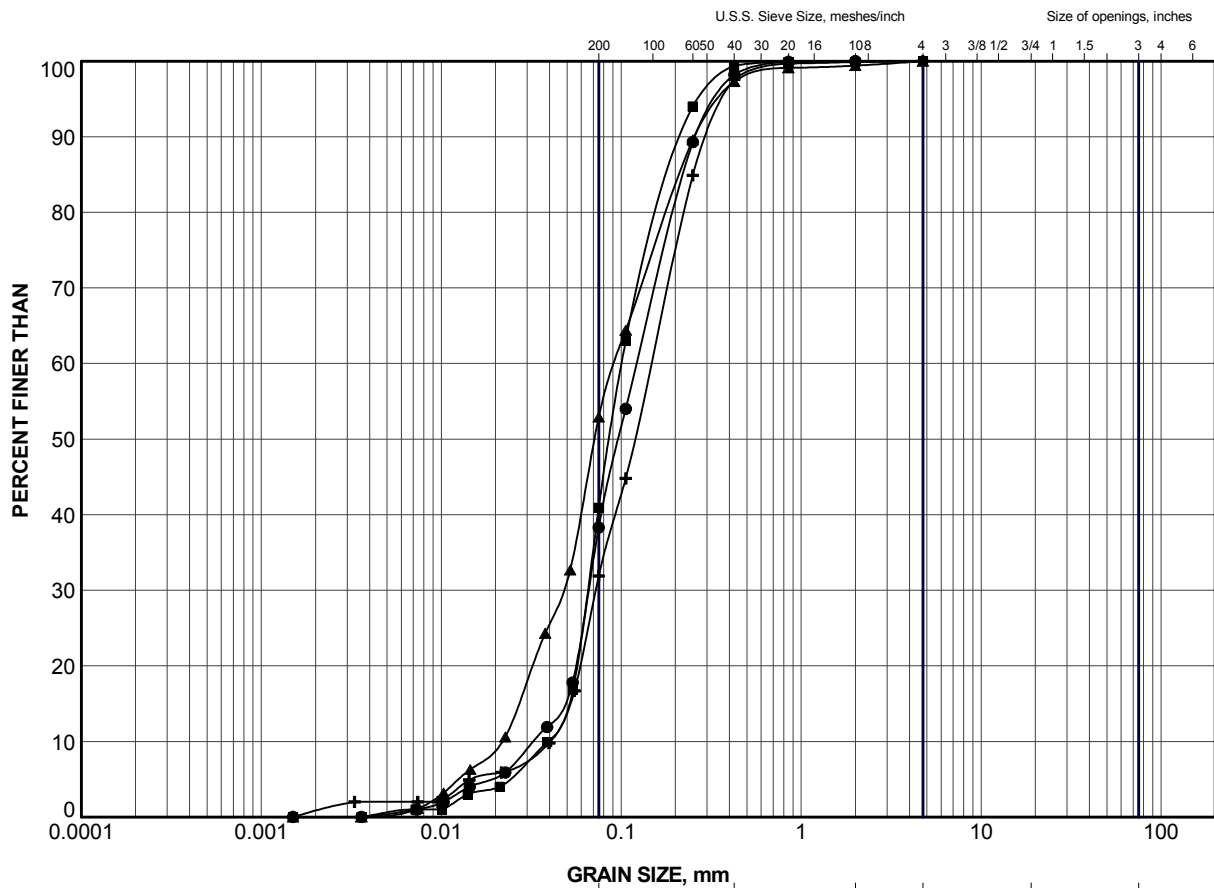


+3, ×3: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE



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


PROJECT 14-1111-0007		RECORD OF DCPT No C7-DC06				SHEET 1 OF 1		METRIC								
G.W.P. 5462-09-00		LOCATION N 5000096.7 ; E 319702.8				ORIGINATED BY MT										
DIST _____ HWY 11		BOREHOLE TYPE Portable Equipment, Dynamic Cone Penetration Test				COMPILED BY MT										
DATUM Geodetic		DATE July 4, 2014				CHECKED BY CN										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
290.1	GROUND SURFACE						20	40	60	80	100					
0.0	Dynamic Cone Penetration Test (DCPT)						20	40	60	80	100	10	20	30		
286.8	END OF DCPT REFUSAL TO FURTHER PENETRATION (57 Blows / 0.30 m) (HAMMER BOUNCING)						287									
3.4	NOTE:  1. DCPTs advanced 1.0 m west, 1.0 m north and 1.0 m north and west of C7-DC06 encountered refusal to further penetration at depths of 0.9 m, 1.4 m and 0.9 m respectively.															

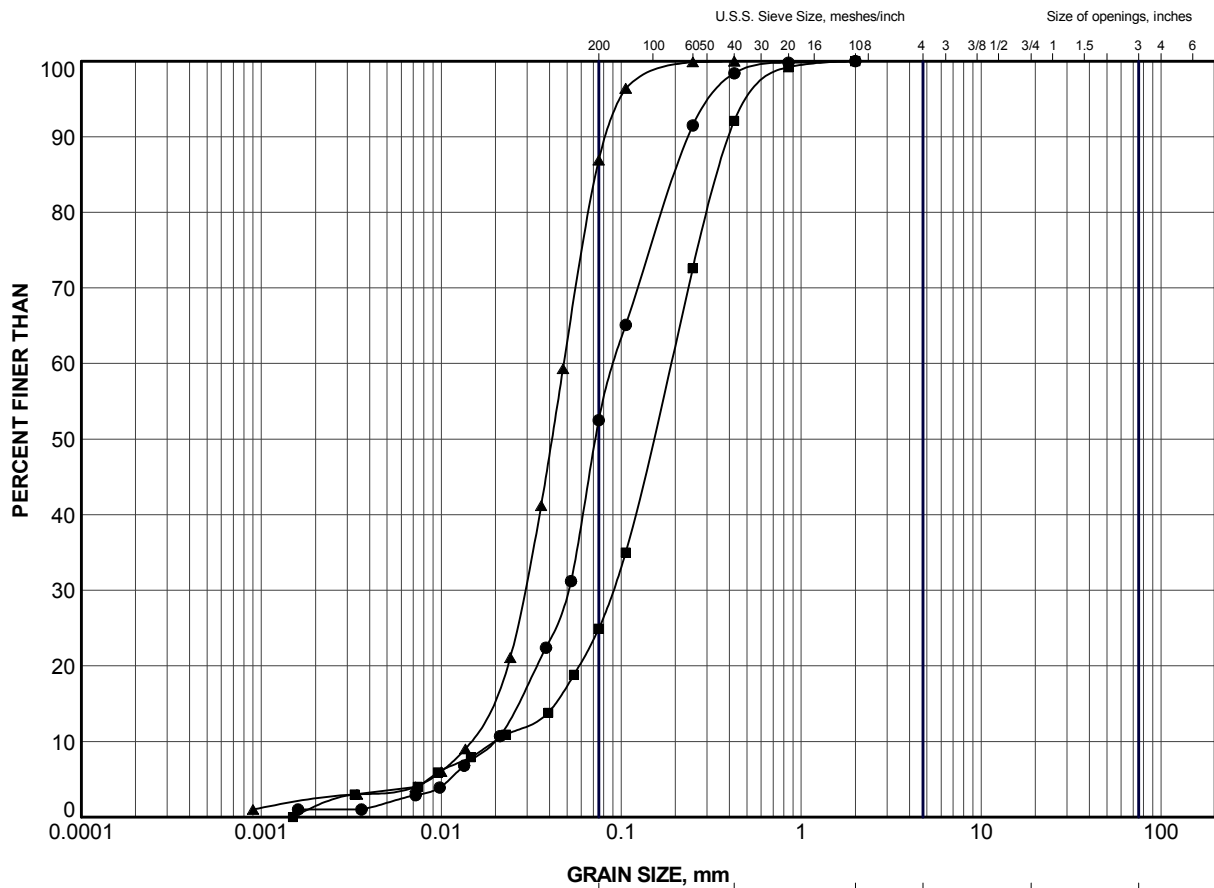


GRAIN SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

#### LEGEND


SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C7-02	2	306.6
■	C7-02	5	304.4
▲	C7-02	8	301.3
+	C7-03	7	302.9

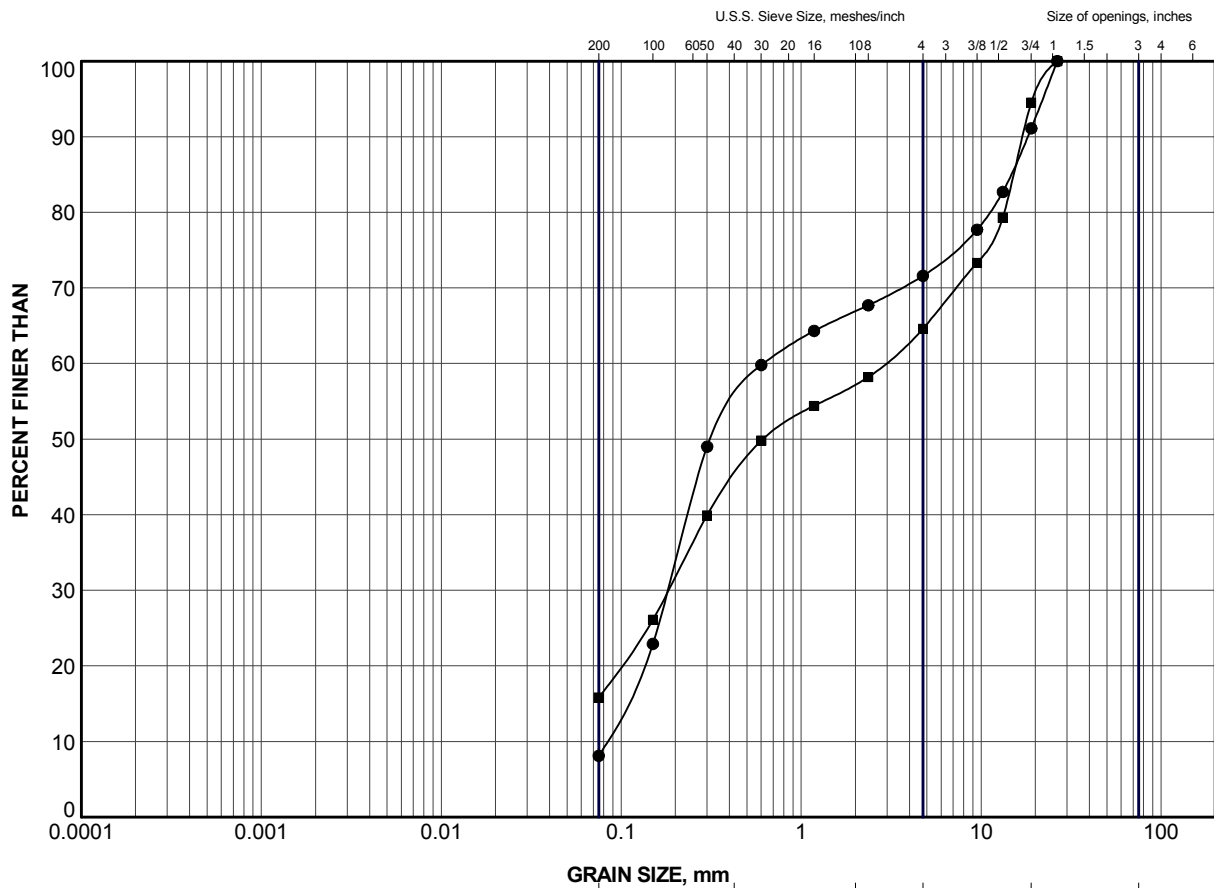
PROJECT						HIGHWAY 11 RESURFACING HIGHWAY 11 CULVERTS GWP 5462-09-00					
TITLE						GRAIN SIZE DISTRIBUTION SILT and SAND (FILL)					
PROJECT No.			14-1111-0007			FILE No.			14-1111-0007.GPJ		
DRAWN	TB	Nov 2014		SCALE	N/A	REV.					
CHECK	MT	Nov 2014									
APPR	CN	Nov 2014									
 <b>Golder Associates</b> SUDBURY, ONTARIO						<b>FIGURE D1</b>					



### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C7-02	15	290.6
■	C7-03	11A	296.0
▲	C7-03	14	292.3


PROJECT						HIGHWAY 11 RESURFACING HIGHWAY 11 CULVERTS GWP 5462-09-00					
TITLE						GRAIN SIZE DISTRIBUTION SILT to SILTY SAND (FILL)					
PROJECT No.			14-1111-0007			FILE No.			14-1111-0007.GPJ		
DRAWN	TB	Nov 2014				SCALE	N/A		REV.		
CHECK	MT	Nov 2014				FIGURE D2					
APPR	CN	Nov 2014									
 <b>Golder Associates</b> SUDBURY, ONTARIO											



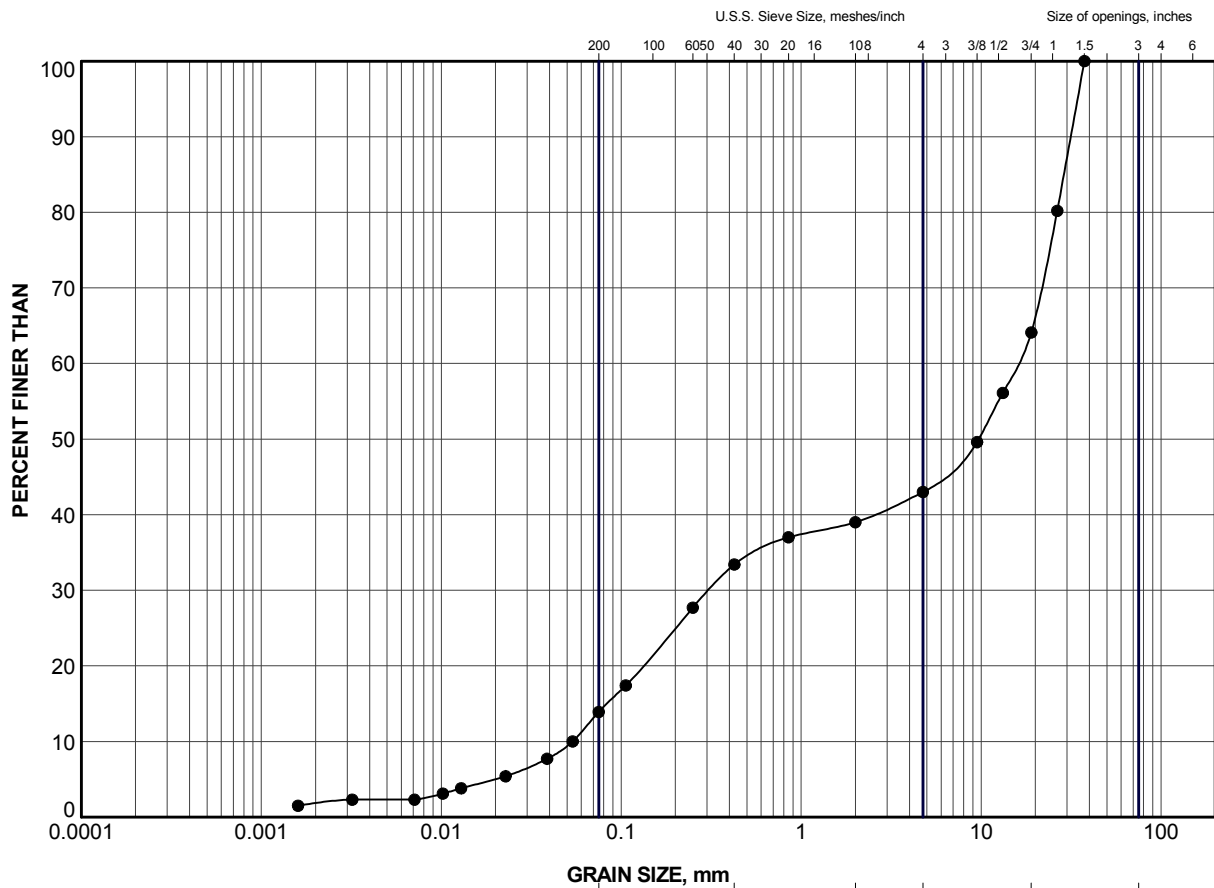
GRAIN SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

#### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C7-04	2	306.0
■	C7-05	2	306.1

PROJECT						HIGHWAY 11 RESURFACING HIGHWAY 11 CULVERTS GWP 5462-09-00					
TITLE						GRAIN SIZE DISTRIBUTION GRAVELLY SAND to SAND and GRAVEL (FILL)					
PROJECT No.			14-1111-0007			FILE No.			14-1111-0007.GPJ		
DRAWN	TB	Nov 2014		SCALE	N/A	REV.					
CHECK	MT	Nov 2014									
APPR	CN	Nov 2014									
 <b>Golder Associates</b> SUDBURY, ONTARIO						<b>FIGURE D3</b>					




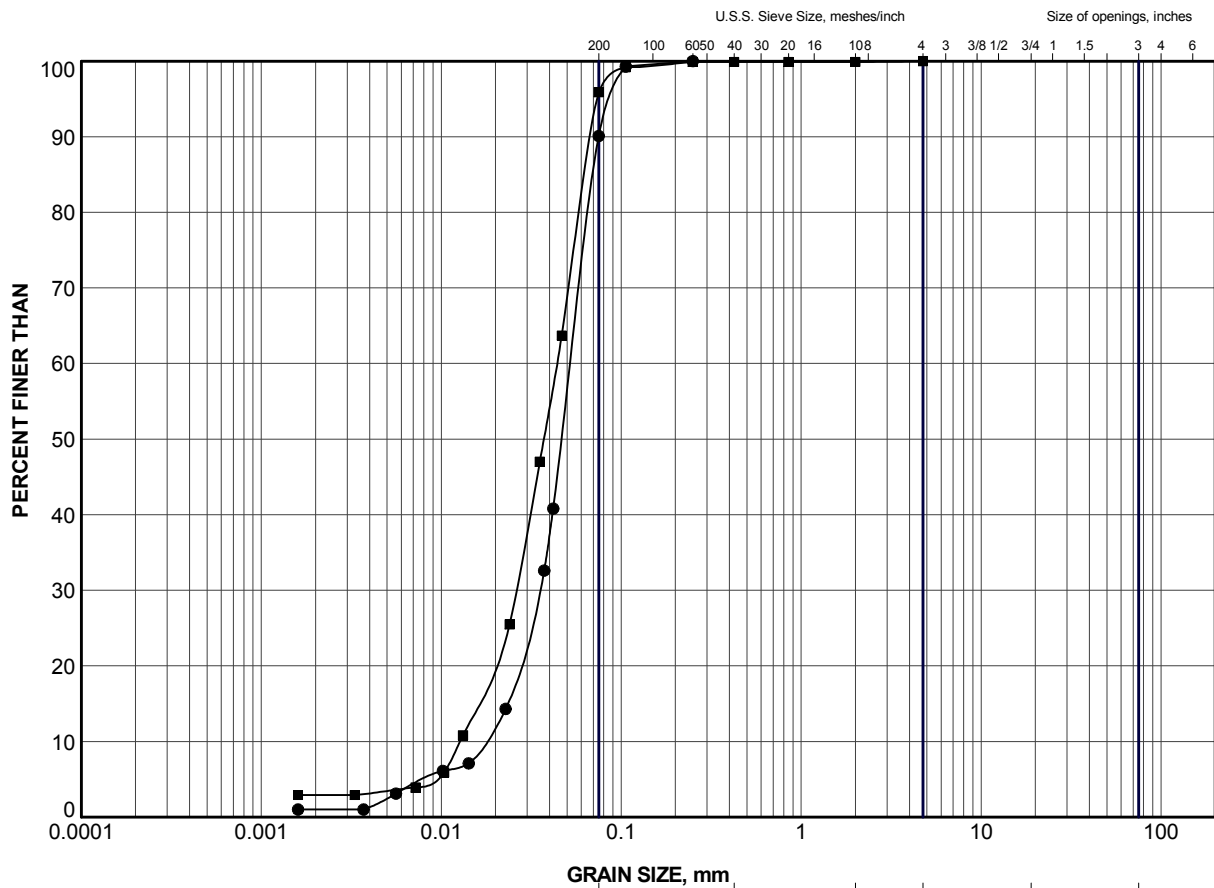


GRAIN SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

#### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C7-04	11	296.1


PROJECT						HIGHWAY 11 RESURFACING HIGHWAY 11 CULVERTS GWP 5462-09-00					
TITLE						GRAIN SIZE DISTRIBUTION SANDY GRAVEL (FILL)					
PROJECT No.			14-1111-0007			FILE No.			14-1111-0007.GPJ		
DRAWN	TB	Nov 2014		SCALE	N/A	REV.					
CHECK	MT	Nov 2014									
APPR	CN	Nov 2014									
 <b>Golder Associates</b> SUDBURY, ONTARIO						<b>FIGURE D4</b>					

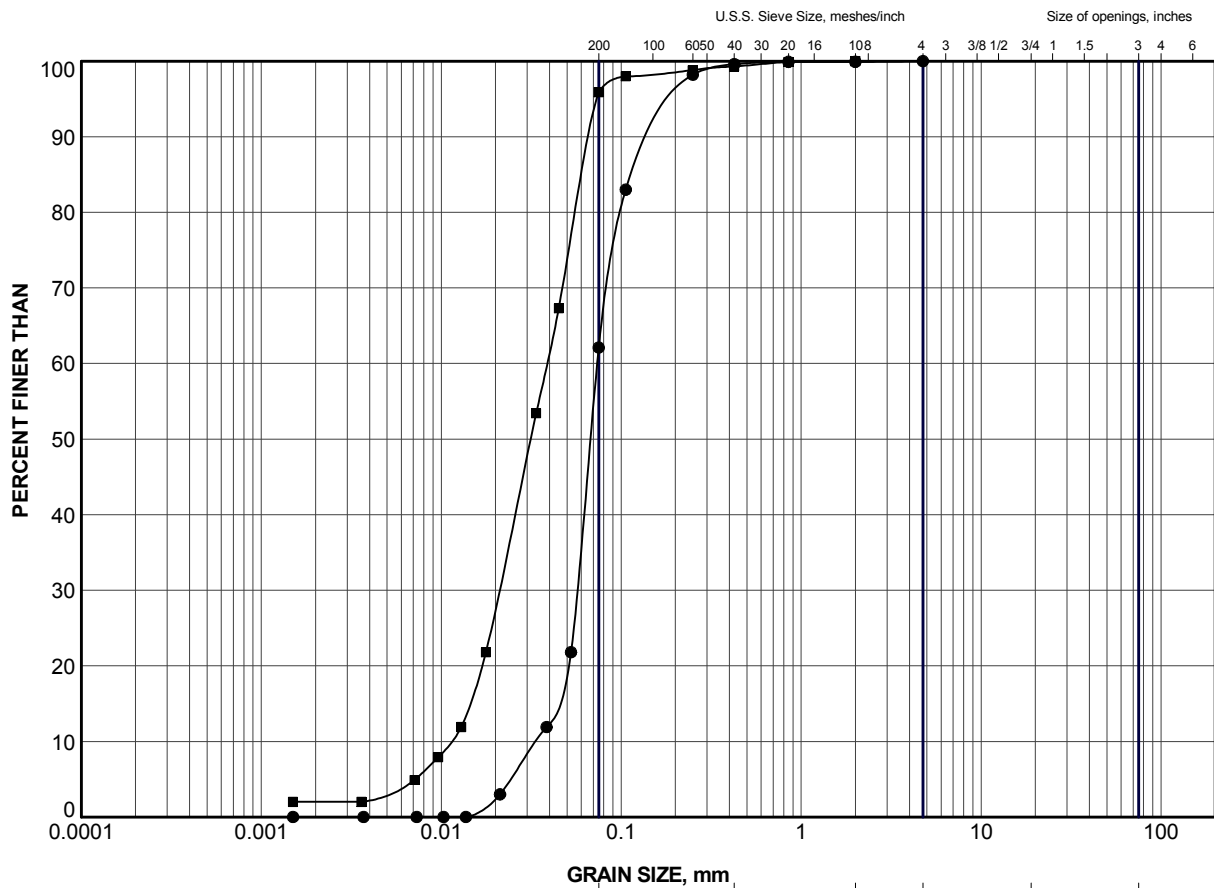


GRAIN SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

#### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C7-04	13	293.1
■	C7-04	15	290.0


PROJECT						HIGHWAY 11 RESURFACING HIGHWAY 11 CULVERTS GWP 5462-09-00					
TITLE						GRAIN SIZE DISTRIBUTION SILT (FILL)					
PROJECT No.			14-1111-0007			FILE No.			14-1111-0007.GPJ		
DRAWN	TB	Nov 2014		SCALE	N/A	REV.					
CHECK	MT	Nov 2014									
APPR	CN	Nov 2014									
 <b>Golder Associates</b> SUDBURY, ONTARIO						<b>FIGURE D5</b>					

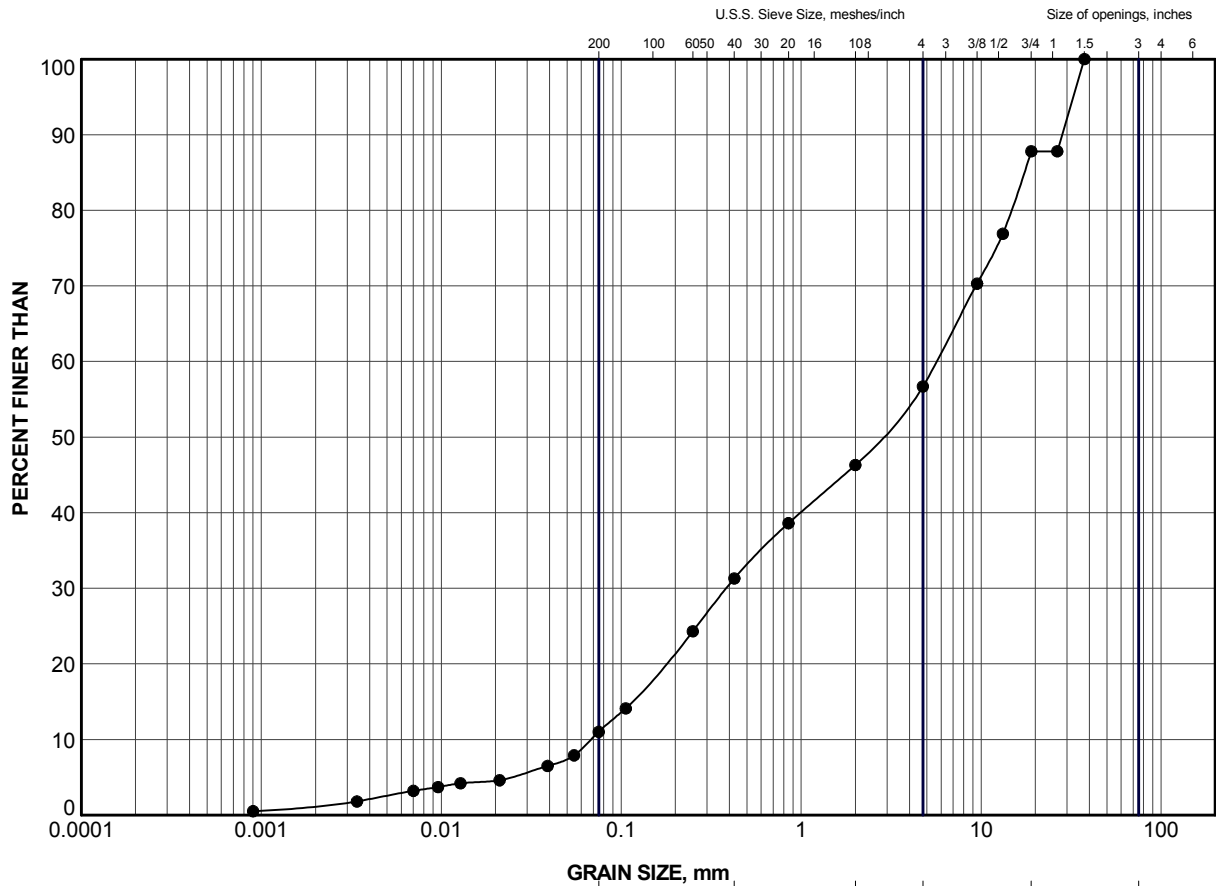


CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

#### LEGEND


SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C7-01	2	290.3
■	C7-02	17	287.6

PROJECT						HIGHWAY 11 RESURFACING HIGHWAY 11 CULVERTS GWP 5462-09-00					
TITLE						GRAIN SIZE DISTRIBUTION SILT to SILT and SAND					
PROJECT No.			14-1111-0007			FILE No.			14-1111-0007.GPJ		
DRAWN	TB	Nov 2014				SCALE	N/A	REV.			
CHECK	MT	Nov 2014				FIGURE D6					
APPR	CN	Nov 2014									
 <b>Golder Associates</b> SUDBURY, ONTARIO											



CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND			
SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C7-03	17	287.7

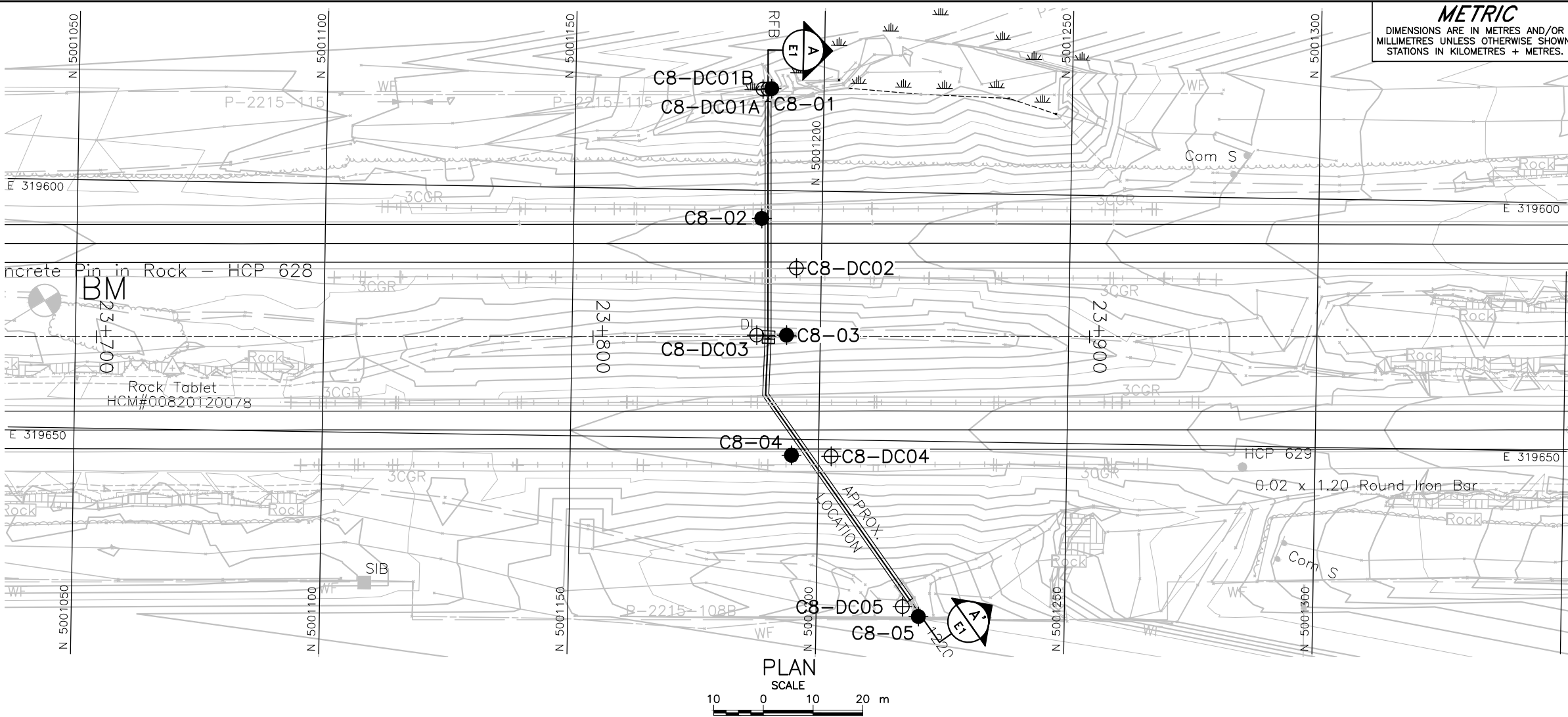
PROJECT						HIGHWAY 11 RESURFACING HIGHWAY 11 CULVERTS GWP 5462-09-00					
TITLE						GRAIN SIZE DISTRIBUTION SAND and GRAVEL					
			PROJECT No. 14-1111-0007			FILE No. 14-1111-0007.GPJ					
			DRAWN	TB	Nov 2014	SCALE	N/A	REV.			
			CHECK	MT	Nov 2014	FIGURE D7					
			APPR	CN	Nov 2014						

SUD-MTO GSD (NEW) GLDR\_LDN.GDT



# APPENDIX E

Culvert STA 23+836 to STA 23+864 (Township of Macaulay)

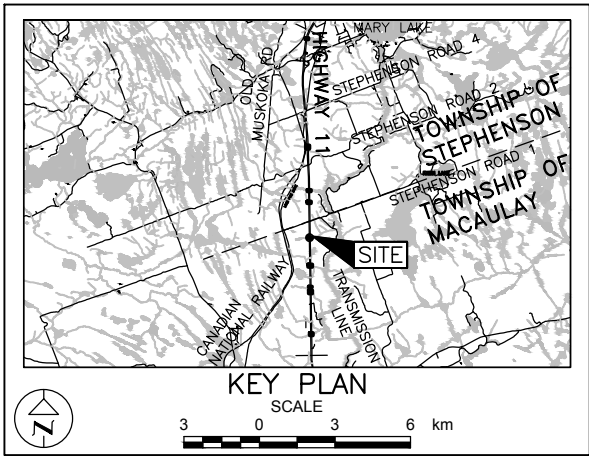


**METRIC**  
DIMENSIONS ARE IN METRES AND/OR  
MILLIMETRES UNLESS OTHERWISE SHOWN.  
STATIONS IN KILOMETRES + METRES.

CONT No.  
GWP No. 5462-09-00

HIGHWAY 11  
CULVERT STA. 23+836 TO STA. 23+864 (SBL AND NBL)  
BOREHOLE LOCATIONS AND SOIL  
STRATA

SHEET



LEGEND

Borehole - Current Investigation

Dynamic Cone Penetration Test

N Standard Penetration Test Value

16 Blows/0.3m unless otherwise stated  
(Std. Pen. Test, 475 j/blow)

REC % Recovery %

100% Rock Quality Designation (RQD)

WL upon completion of drilling

R Refusal

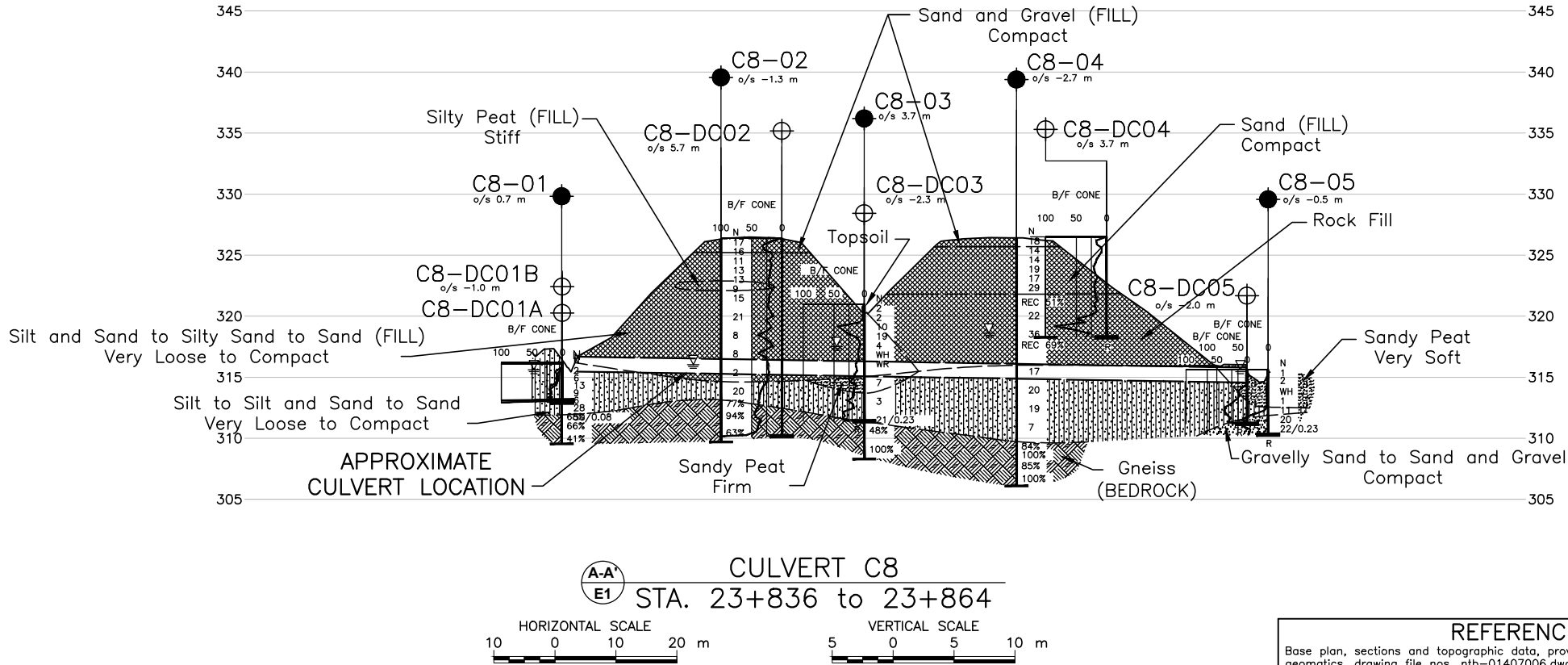
BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
C8-01	315.8	5001189.4	319579.5
C8-02	326.3	5001187.8	319605.7
C8-03	320.9	5001193.2	319629.1
C8-04	326.4	5001194.6	319653.2
C8-05	315.6	5001220.6	319685.3
C8-DC01A	316.1	5001188.7	319579.6
C8-DC01B	316.2	5001187.7	319579.6
C8-DC02	326.4	5001195.0	319615.5
C8-DC03	321.0	5001187.2	319629.2
C8-DC04	326.5	5001202.6	319653.3
C8-DC05	315.6	5001217.4	319683.4

**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.



**CULVERT C8**  
STA. 23+836 to 23+864

REFERENCE

Base plan, sections and topographic data, provided in digital format by exp geomatics, drawing file nos. ntb-01407006.dwg and X-SECTIONS.dwg, received Oct 14, 2014.

NO.	DATE	BY	REVISION
1	11/13/2014	JMAC	1

Geocres No. 31E-344

HWY. 11	PROJECT NO. 14-1111-0007	DIST. .
SUBM'D. MT	CHKD. CN	DATE: 11/13/2014
DRAWN: MR	CHKD. CN	APPD. JMAC
		DWG. E1

PROJECT <u>14-1111-0007</u>		<b>RECORD OF BOREHOLE No C8-01</b>		SHEET 1 OF 2		<b>METRIC</b>	
G.W.P. <u>5462-09-00</u>		LOCATION <u>N 5001189.4 ;E 319579.5</u>		ORIGINATED BY <u>TM</u>			
DIST <u>          </u> HWY <u>11</u>		BOREHOLE TYPE <u>Portable Equipment, Wash Boring</u>		COMPILED BY <u>MT</u>			
DATUM <u>Geodetic</u>		DATE <u>July 2 and 3, 2014</u>		CHECKED BY <u>CN</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								20 40 60 80 100					W <sub>p</sub> W W <sub>L</sub>				
315.8	GROUND SURFACE																
0.0	Silty SAND, trace organics Brown Very loose to compact Moist to wet		1	SS	2		315										0 76 24 0
			2	SS	6		314										
			3	SS	13		313										
			4	SS	9		312										
			5	SS	6		311										
312.8	Sandy SILT Compact Grey Wet		6	SS	28											0 20 80 0	
311.9			7	SS	50/0.08												
3.9	GNEISS (BEDROCK)		1	RC	REC 100%											RQD = 68%	
	Bedrock cored from depths of 3.9 m to 6.2 m.  For bedrock coring details refer to Record of Drillhole C8-01.		2	RC	REC 100%											RQD = 66%	
			3	RC	REC 100%											RQD = 41%	
309.6																	
6.2	END OF BOREHOLE  NOTE:  1. Water level in open borehole at a depth of 0.2 m below ground surface (Elev. 315.6 m) upon completion of drilling.																

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SHEET 2 OF 2

DATUM: Geodetic

DRILLING CONTRACTOR: George Downing Estate Drilling Ltd.

\\GOLDER.GDS\GAL\SUBBURY\CAD-GIS\CAD\PROJECTS\2014\14-1111-0007 GINT LAB FIGURES FOR MISSISSAUGA\GINT 2.17.2015\1411110007.GPJ GAL-GTA.GDT 2/17/15

CHECKED: CN





PROJECT <u>14-1111-0007</u>		<b>RECORD OF BOREHOLE No C8-02</b>		SHEET 1 OF 3		<b>METRIC</b>	
G.W.P. <u>5462-09-00</u>		LOCATION <u>N 5001187.8; E 319605.7</u>		ORIGINATED BY <u>EG</u>			
DIST <u>          </u> HWY <u>11</u>		BOREHOLE TYPE <u>CME 75, 108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing</u>		COMPILED BY <u>MT</u>			
DATUM <u>Geodetic</u>		DATE <u>July 3, 2014</u>		CHECKED BY <u>CN</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× REMOULDED						20	40	60
326.3	GROUND SURFACE																		
0.0	Sand and gravel, trace asphalt (FILL) Compact Brown Dry to moist		1	SS	17		326												
325.2	Sand, trace to some silt (FILL) Compact Grey Moist		2A	SS	16		325												
1.1			2B																
			3	SS	11		324												
			4	SS	13		323												
			5A	SS	13		322												
322.9	Silty peat (FILL) Stiff Brown Moist		5B				321												
322.1	Silt and sand, trace clay, trace organics (FILL) Very loose to compact Grey to brown Moist to wet		6A	SS	9		320												
4.2			6B					319											
			7	SS	15		318												
							317												
		8	SS	21	316														
					315														
					314														
		9	SS	8	313														
					312														
		10	SS	8															
		11	SS	2															
314.5	SILT and SAND, trace clay Compact Brown Wet						314												
11.8			12	SS	20														
313.2	GNEISS (BEDROCK)  Bedrock cored from depths of 13.1 m to 16.6 m.  For bedrock coring details refer to Record of Drillhole C8-02.						313												
13.1			1	RC	REC 100%														
			2	RC	REC 100%														

Continued Next Page

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

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PROJECT <u>14-1111-0007</u>		<b>RECORD OF BOREHOLE No C8-02</b>		SHEET 2 OF 3		<b>METRIC</b>										
G.W.P. <u>5462-09-00</u>		LOCATION <u>N 5001187.8 ; E 319605.7</u>		ORIGINATED BY <u>EG</u>												
DIST <u>          </u> HWY <u>11</u>		BOREHOLE TYPE <u>CME 75, 108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing</u>		COMPILED BY <u>MT</u>												
DATUM <u>Geodetic</u>		DATE <u>July 3, 2014</u>		CHECKED BY <u>CN</u>												
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					W <sub>p</sub> W   W <sub>L</sub>			
	--- CONTINUED FROM PREVIOUS PAGE ---						20   40   60   80   100 ○ UNCONFINED   + FIELD VANE ● QUICK TRIAXIAL   × REMOULDED					10   20   30 WATER CONTENT (%)				
309.7	GNEISS (BEDROCK)		3	RC	REC 100%	311										
16.6	Bedrock cored from depths of 13.1 m to 16.6 m.  For bedrock coring details refer to Record of Drillhole C8-02.					310										RQD = 63%
	END OF BOREHOLE															
	NOTE:  1. Water level in open borehole at a depth of 10.3 m below ground surface (Elev. 316.0 m) upon completion of drilling.															

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PROJECT: 1411110007

## RECORD OF DRILLHOLE: C8-02

SHEET 3 OF 3

LOCATION: N 5001187.8 ;E 319605.7

DRILLING DATE: July 3, 2014


DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 75

DRILLING CONTRACTOR: Landcore Drilling Inc.

GTA-RCK 023 \\GOLDER.GDS\GALS\SUBBURY\CAD\PROJECTS\2014\14-1111-0007 GINT LAB FIGURES FOR MISSISSAUGA\GINT 2.17.2015\1411110007.GPJ GAL-GTA.GDT 2/17/15

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.										DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY		Diametral Point Load Index (MPa)	RMC -Q AVG
							FLUSH	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	K <sub>v</sub> cm/sec	K <sub>h</sub> cm/sec					
								TOTAL CORE %	SOLID CORE %															
								80 90 95 100	80 90 95 100															
		GROUND SURFACE		313.2																				
	NQ Coring July 3, 2014	GNEISS Pinkish grey Fine grained Slightly to moderately weathered		13.1	1																			
14																								
				2																				
15																								
16																								
				3																				
		Highly fractured zone encountered from 15.5 m to 15.7 m depth.																						
		END OF DRILLHOLE		309.7 16.6																				
17																								
18																								
19																								
20																								
21																								
22																								
23																								

DEPTH SCALE

1 : 50



LOGGED: EG

CHECKED: CN

PROJECT 14-1111-0007		RECORD OF BOREHOLE No C8-03		SHEET 1 OF 2		METRIC															
G.W.P. 5462-09-00		LOCATION N 5001193.2; E 319629.1		ORIGINATED BY ID																	
DIST _____ HWY 11		BOREHOLE TYPE CME 55, 108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing		COMPILED BY MT																	
DATUM Geodetic		DATE July 16 and 17, 2014		CHECKED BY CN																	
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ	GR	SA	SI	CL	
320.9	GROUND SURFACE							20 40 60 80 100	20 40 60 80 100	10 20 30											
0.9	Topsoil (FILL) Silt and sand to silty sand (FILL) Very loose to compact Brown to grey Moist to wet		1	SS	2		320											1	66	32	1
			2	SS	2																
			3	SS	10		319														
			4	SS	19		318														
			5	SS	4		317														
			6	SS	WH		316														
			7	SS	WR																
315.3	Sandy PEAT (Fibrous) Firm Brown to black Wet		8	SS	7		315														
313.7	SAND, some silt, trace to some gravel Very loose to compact Grey Wet		9	SS	3		314														
			10	SS	21/0.23		313														
311.4	GNEISS (BEDROCK)						312														
9.5	Bedrock cored from depths of 9.5 m to 12.6 m.  For bedrock coring details refer to Record of Drillhole C8-03.		1	RC	REC 100%		311														
			2	RC	REC 100%		310														
							309														
308.3	END OF BOREHOLE																				
12.6	NOTE:  1. Water level in open borehole at a depth of 3.4 m below ground surface (Elev. 317.5 m) upon completion of drilling.																				

SHEET 2 OF 2

DATUM: Geodetic

DRILLING CONTRACTOR: Landcore Drilling Inc.

\\GOLDER.GDS\GAL\SUBBURY\CAD-GIS\CAD\PROJECTS\2014\14-1111-0007 GINT LAB FIGURES FOR MISSISSAUGA\GINT 2.17.2015\1411110007.GPJ GAL-GTA.GDT 2/17/15

CHECKED: CN

PROJECT <u>14-1111-0007</u>		<b>RECORD OF BOREHOLE No C8-04</b>		SHEET 1 OF 3		<b>METRIC</b>	
G.W.P. <u>5462-09-00</u>		LOCATION <u>N 5001194.6 ; E 319653.2</u>		ORIGINATED BY <u>ID</u>			
DIST <u>          </u> HWY <u>11</u>		BOREHOLE TYPE <u>CME 55, 108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing</u>		COMPILED BY <u>MT</u>			
DATUM <u>Geodetic</u>		DATE <u>June 27, July 2 and 3, 2014</u>		CHECKED BY <u>CN</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)	
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × REMOULDED							
326.4	GROUND SURFACE															
0.0	Sand and gravel (FILL) Compact Brown Moist		1A	SS	18											
325.7			1B													
0.7	Asphalt mixed with sand and gravel encountered from surface to a depth of 0.1 m		2	SS	14											
	Sand, some silt (FILL) Compact Light brown Moist		3	SS	14											
			4	SS	19											
			5	SS	17											
			6	SS	29											
321.8	Rock fill (FILL)		-	RC	REC 51%											
4.6			7	SS	22											
	Sample 7 and Sample 8 encountered sand and gravel matrix within rock fill.		8	SS	36											
			-	RC	REC 69%											
	Split-Spoon refusal at a depth of 9.3 m. (SPLIT-SPOON BOUNCING)															
316.0	SILT to Sandy SILT, trace gravel, trace sand, trace clay Loose to compact Grey Wet		9	SS	17											
10.4			10	SS	20											
			11	SS	19											

Continued Next Page

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

GTA-MTO 001 \\GOLDER\GDS\GAL\SUBBURY\CAD-GIS\CAD\PROJECTS\2014\14-1111-0007 GINT LAB FIGURES FOR MISSISSAUGA\GINT 2.17.2015\1411110007.GPJ GAL-GTA.GDT 2/17/15

PROJECT 14-1111-0007			RECORD OF BOREHOLE No C8-04			SHEET 2 OF 3			METRIC							
G.W.P. 5462-09-00			LOCATION N 5001194.6; E 319653.2			ORIGINATED BY ID										
DIST _____ HWY 11			BOREHOLE TYPE CME 55, 108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing			COMPILED BY MT										
DATUM Geodetic			DATE June 27, July 2 and 3, 2014			CHECKED BY CN										
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
	--- CONTINUED FROM PREVIOUS PAGE ---						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100									
309.6	SILT to Sandy SILT, trace gravel, trace sand, trace clay Loose to compact Grey Wet		12	SS	7		311									
16.8	GNEISS (BEDROCK)						310									
	Bedrock cored from depths of 16.8 m to 20.3 m.		1	RC	REC 100%		309									RQD = 84%
	For bedrock coring details refer to Record of Drillhole C8-04.		2	RC	REC 100%		308									RQD = 100%
			3	RC	REC 100%		307									RQD = 85%
			4	RC	REC 100%											RQD = 100%
306.1	END OF BOREHOLE															
20.3	NOTE:  1. Water level in open borehole at a depth of 7.8 m below ground surface (Elev. 318.6 m) upon completion of drilling.															

GTA-MTO 001 \GOLDER\GDS\GAL\SUDBURY\CAD-GIS\CAD\PROJECTS\2014\14-1111-0007 GINT LAB FIGURES FOR MISSISSAUGA\GINT 2.17.2015\1411110007.GPJ GAL-GTA.GDT 2/17/15

PROJECT: 1411110007

## RECORD OF DRILLHOLE: C8-04

SHEET 3 OF 3

LOCATION: N 5001194.6 ;E 319653.2

DRILLING DATE: July 3, 2014

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR: Landcore Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.										HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q AVG				
							FLUSH	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	B Angle	DIP w.r.t CORE AXIS DIP	DISCONTINUITY DATA						TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn
								TOTAL CORE %	SOLID CORE %														
								80 80															

UCS = 104 MPa

65 JN,IR,RO

DEPTH SCALE

1 : 50



LOGGED: ID

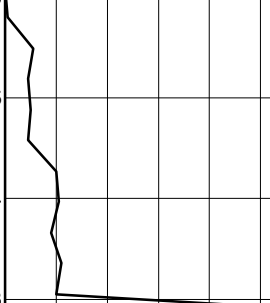
CHECKED: CN

GTA-RCK 023 \\GOLDER.GDS\GALS\SUBBURY\CAD\PROJECTS\2014\14-1111-0007 GINT LAB FIGURES FOR MISSISSAUGA\GINT 2.17.2015\1411110007.GPJ GAL-GTA.GDT 2/17/15



PROJECT 14-1111-0007		RECORD OF BOREHOLE No C8-05		SHEET 1 OF 1		METRIC									
G.W.P. 5462-09-00		LOCATION N 5001220.6; E 319685.3		ORIGINATED BY MT											
DIST _____ HWY 11		BOREHOLE TYPE Portable Equipment, Wash Boring		COMPILED BY MT											
DATUM Geodetic		DATE July 2, 2014		CHECKED BY CN											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
315.6	GROUND SURFACE														
0.0	Sandy PEAT (Fibrous) Very soft Black Wet		1	SS	1										
			2	SS	2										
			3	SS	WH										
			4	SS	1										
312.6															
3.1	Silty SAND Compact Grey Wet		5	SS	11										
311.9															
3.7	Gravelly SAND to SAND and GRAVEL Compact Grey Wet		6	SS	20										
			7	SS	22/0.23										
310.6															
310.3	END OF BOREHOLE SPOON REFUSAL (HAMMER BOUNCING) Dynamic Cone Penetration Test (DCPT)														
5.3	END OF DCPT REFUSAL TO FURTHER PENETRATION (33 Blows / 0.18 m) (HAMMER BOUNCING)														
	NOTE:  1. Water level in open borehole at ground surface (Elev. 315.6 m) upon completion of drilling.														

PROJECT <u>14-1111-0007</u>		<b>RECORD OF DCPT No C8-DC01A</b>		SHEET 1 OF 1		<b>METRIC</b>	
G.W.P. <u>5462-09-00</u>		LOCATION <u>N 5001188.7 ; E 319579.6</u>		ORIGINATED BY <u>TM</u>			
DIST <u>          </u> HWY <u>11</u>		BOREHOLE TYPE <u>Portable Equipment, Dynamic Cone Penetration Test</u>		COMPILED BY <u>MT</u>			
DATUM <u>Geodetic</u>		DATE <u>July 3, 2014</u>		CHECKED BY <u>CN</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  γ  kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W <sub>p</sub>	W	W <sub>L</sub>		
								○ UNCONFINED   + FIELD VANE	WATER CONTENT (%)					
							● QUICK TRIAXIAL   × REMOULDED	20   40   60   80   100	10   20   30					
316.1	GROUND SURFACE						316							
0.0	Dynamic Cone Penetration Test (DCPT)						315							
							314							
312.9	END OF DCPT REFUSAL TO FURTHER PENETRATION (100 Blows / 0.13 m)						313							
3.2														



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

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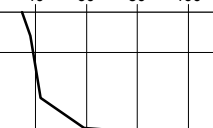
PROJECT <u>14-1111-0007</u>		<b>RECORD OF DCPT No C8-DC02</b>		SHEET 1 OF 2		<b>METRIC</b>	
G.W.P. <u>5462-09-00</u>		LOCATION <u>N 5001195.0 ; E 319615.5</u>		ORIGINATED BY <u>EG</u>			
DIST <u>          </u> HWY <u>11</u>		BOREHOLE TYPE <u>CME 75, Dynamic Cone Penetration Test</u>		COMPILED BY <u>MT</u>			
DATUM <u>Geodetic</u>		DATE <u>July 2, 2014</u>		CHECKED BY <u>CN</u>			

[illegible]

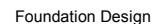
Continued Next Page

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

○ 3% STRAIN AT FAILURE

PROJECT 14-1111-0007		RECORD OF DCPT No C8-DC02				SHEET 2 OF 2		METRIC									
G.W.P. 5462-09-00		LOCATION N 5001195.0 ; E 319615.5				ORIGINATED BY EG											
DIST _____ HWY 11		BOREHOLE TYPE CME 75, Dynamic Cone Penetration Test				COMPILED BY MT											
DATUM Geodetic		DATE July 2, 2014				CHECKED BY CN											
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									
	--- CONTINUED FROM PREVIOUS PAGE ---						○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    × REMOULDED					WATER CONTENT (%)					
							20	40	60	80	100						
							20	40	60	80	100						
310.2	Dynamic Cone Penetration Test (DCPT)					311											
16.2	END OF DCPT REFUSAL TO FURTHER PENETRATION (100 Blows / 0.08 m)																

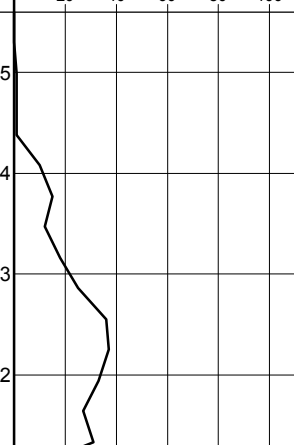
GTA-MTO 001 S:\CLIENTS\MT\Hwy\_11\02\_DATA\GINT\1411110007.GPJ GAL-GTA.GDT 01/21/15



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

PROJECT		RECORD OF DCPT No C8-DC04		SHEET 1 OF 1		METRIC					
14-1111-0007		G.W.P. 5462-09-00		LOCATION N 5001202.6 ; E 319653.3		ORIGINATED BY ID					
DIST _____ HWY 11		BOREHOLE TYPE CME 55, Dynamic Cone Penetration Test		COMPILED BY MT		CHECKED BY CN					
DATUM Geodetic		DATE June 27, 2014									
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT  SHEAR STRENGTH kPa ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    × REMOULDED	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE							"N" VALUES
326.5 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)										
318.3 8.2	END OF DCPT REFUSAL TO FURTHER PENETRATION (35 Blows / 0.30 m) (HAMMER BOUNCING)										

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PROJECT 14-1111-0007		RECORD OF DCPT No C8-DC05				SHEET 1 OF 1		METRIC								
G.W.P. 5462-09-00		LOCATION N 5001217.4 ; E 319683.4				ORIGINATED BY MT										
DIST _____ HWY 11		BOREHOLE TYPE Portable Equipment, Dynamic Cone Penetration Test				COMPILED BY MT										
DATUM Geodetic		DATE July 2, 2014				CHECKED BY CN										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
315.6	GROUND SURFACE						<div style="display: flex; justify-content: space-between;"> <span>20 40 60 80 100</span> <span>20 40 60 80 100</span> </div>					<div style="display: flex; justify-content: space-between;"> <span>10 20 30</span> </div>				GR SA SI CL
0.0	Dynamic Cone Penetration Test (DCPT)															
311.2	END OF DCPT REFUSAL TO FURTHER PENETRATION (16 Blows / 0.15 m) (HAMMER BOUNCING)															
4.4																

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Golder Associates Ltd.  
 6925 Century Avenue, Suite #100  
 Mississauga, Ontario, L5N 7K2  
 Telephone: (905) 567-4444  
 Fax: (905) 567-6561



**Table E1 - Unconfined Compressive Strength**

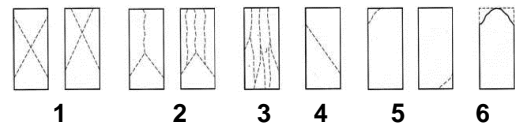
**PROJECT NO.:** 14-1111-0007  
**JOB NAME:** Highway 11 Culverts  
**TYPE OF UNIT:** Bedrock Core

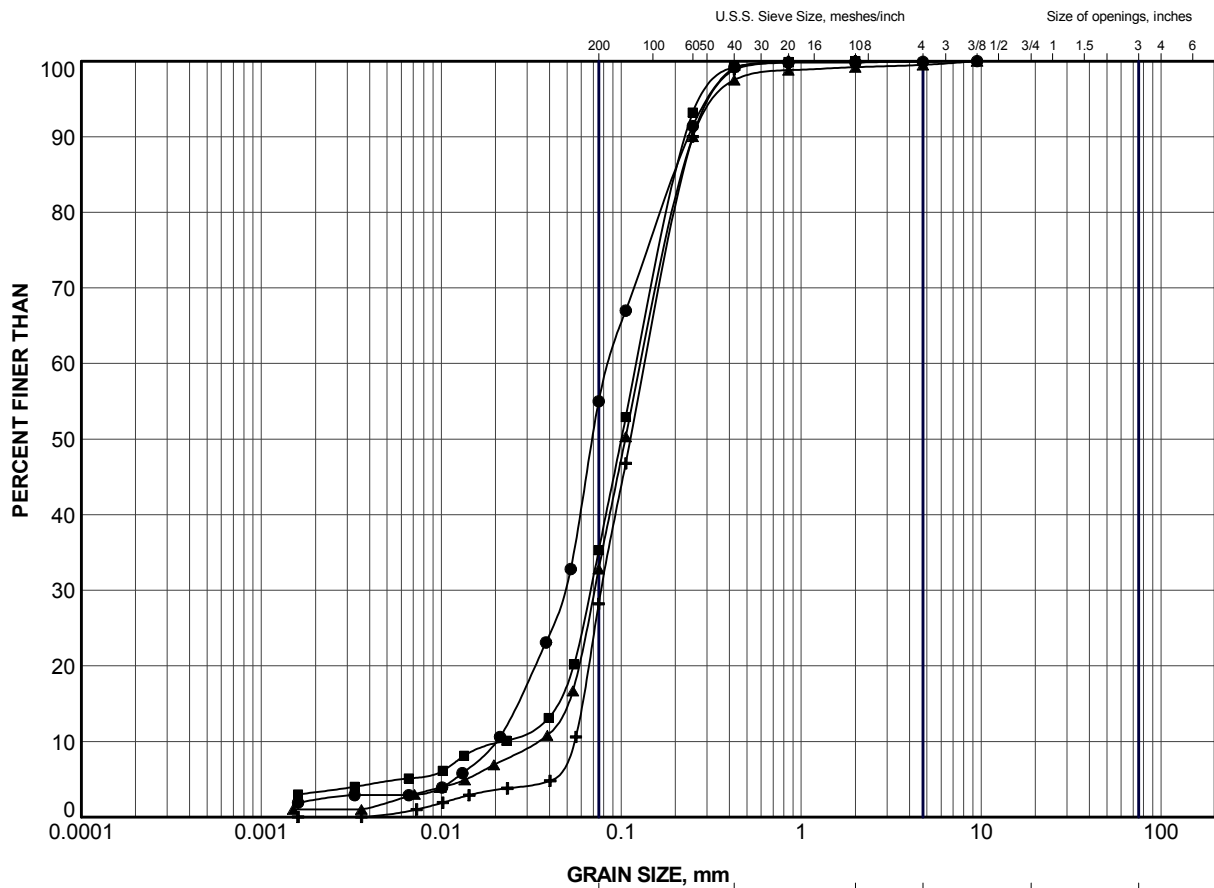
<b>GOLDER LAB NUMBER</b>	<b>G0836</b>
<b>BOREHOLE</b>	<b>C8-04</b>
<b>DATE TESTED</b>	<b>Sept. 5, 2014</b>
<b>DEPTH OF TESTED CORE (m)</b>	17.7
<b>LENGTH AS CUT (mm)</b>	104.0
<b>DIAMETER (mm)</b>	47.5
<b>DENSITY (kg/m3)</b>	2892
<b>COMPRESSIVE STRENGTH (KN)</b>	183.8
<b>CORRECTED STRENGTH (MPa)</b>	<b>103.7</b>
<b>TYPE OF FRACTURE</b>	<b>3</b>

Tested by: SA

Reviewed by : TG

*Type of Fracture*





#### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C8-02	7	321.4
■	C8-02	10	316.9
▲	C8-03	2	319.8
+	C8-03	6	316.8

PROJECT

HIGHWAY 11 RESURFACING  
HIGHWAY 11 CULVERTS  
GWP 5462-09-00

TITLE

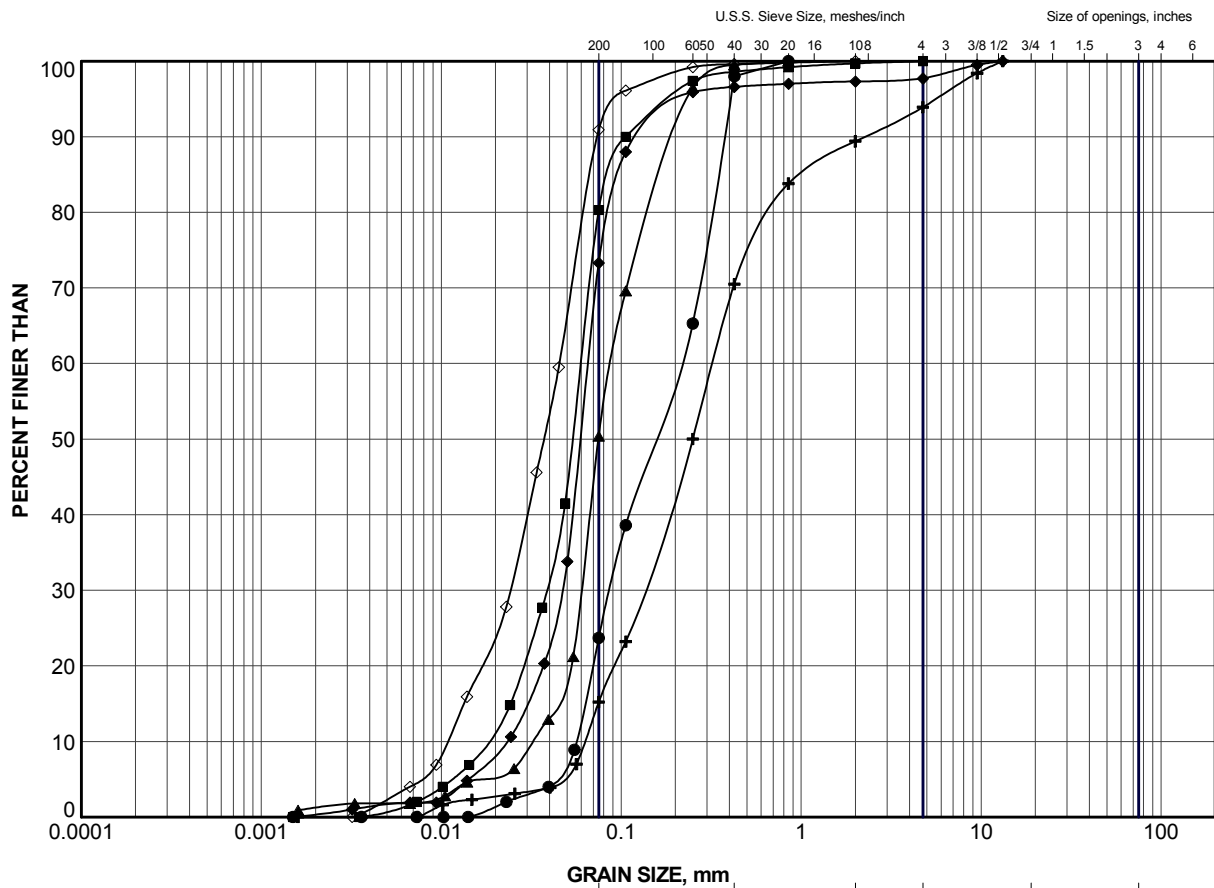
**GRAIN SIZE DISTRIBUTION**  
SILT and SAND (FILL)



**Golder  
Associates**  
SUDBURY, ONTARIO

PROJECT No.	14-1111-0007	FILE No.	14-1111-0007.GPJ
DRAWN	TB	Nov 2014	SCALE N/A
CHECK	MT	Nov 2014	REV.
APPR	CN	Nov 2014	


**FIGURE E1**

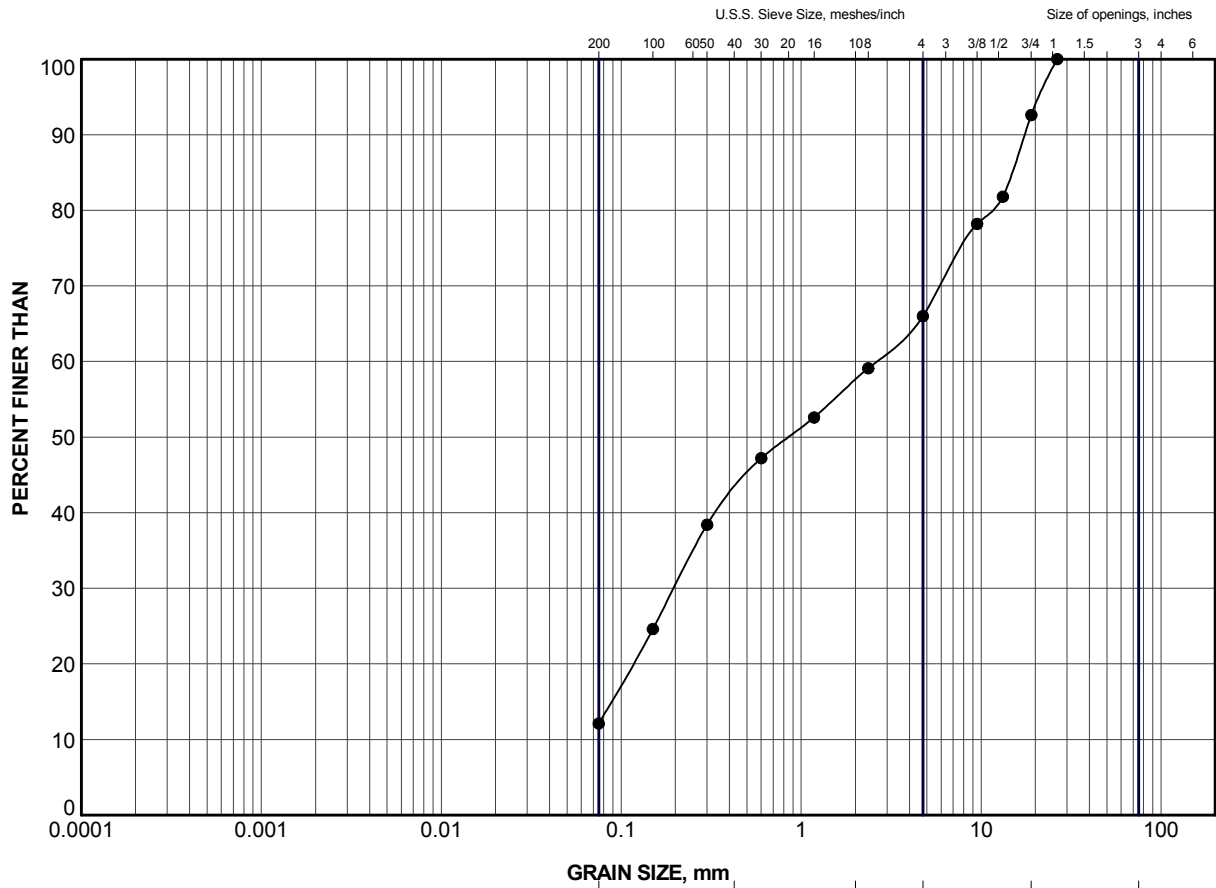


CLAY AND SILT	GRAVEL SIZE, mm					Cobble Size
	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

#### LEGEND


SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C8-01	2	314.9
■	C8-01	6	312.5
▲	C8-02	12	313.8
+	C8-03	10	311.6
◆	C8-04	9	315.4
◇	C8-04	12	310.9

PROJECT						HIGHWAY 11 RESURFACING HIGHWAY 11 CULVERTS GWP 5462-09-00					
TITLE						GRAIN SIZE DISTRIBUTION SILT to SAND					
PROJECT No.			14-1111-0007			FILE No.			14-1111-0007.GPJ		
DRAWN	TB	Nov 2014		SCALE	N/A	REV.					
CHECK	MT	Nov 2014									
APPR	CN	Nov 2014									
 <b>Golder Associates</b> SUDBURY, ONTARIO						<b>FIGURE E2</b>					



CLAY AND SILT	GRAIN SIZE, mm						Cobble Size	
	fine		medium		coarse			
	SAND SIZE			GRAVEL SIZE				

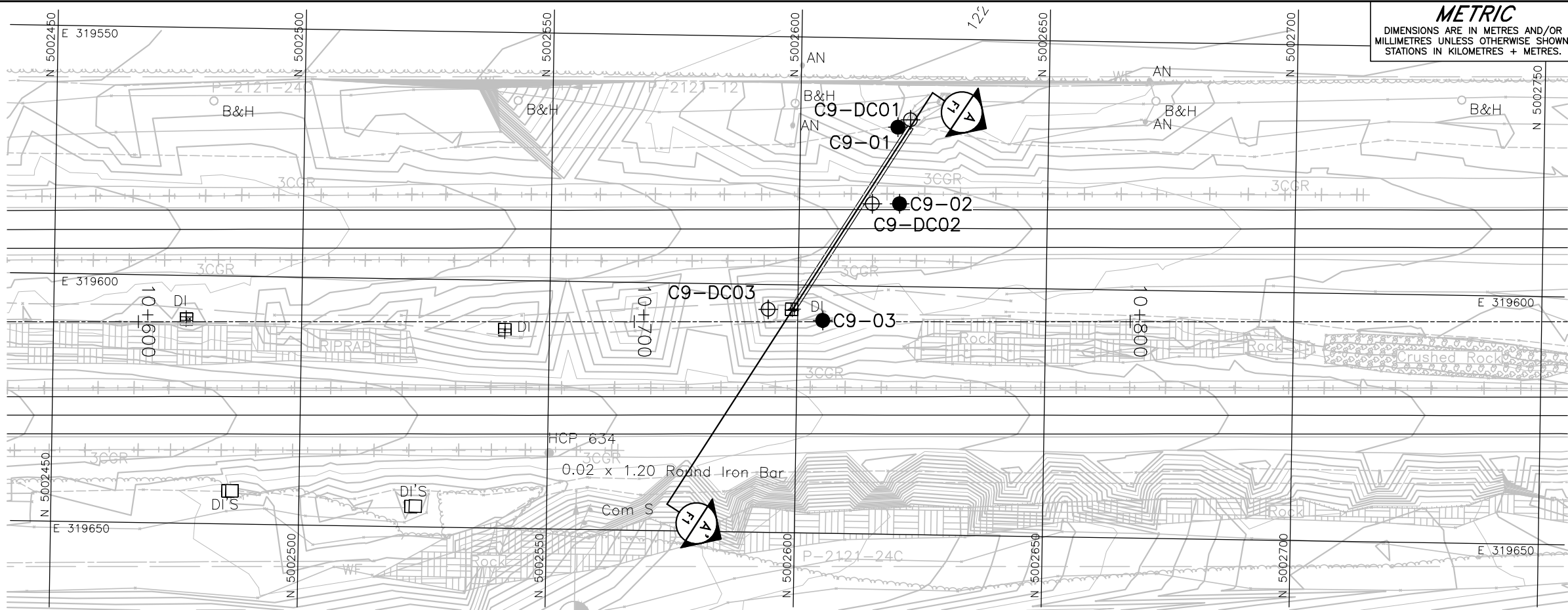
LEGEND			
SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C8-05	6	311.5

PROJECT					HIGHWAY 11 RESURFACING HIGHWAY 11 CULVERTS GWP 5462-09-00				
TITLE					GRAIN SIZE DISTRIBUTION SAND and GRAVEL				
		PROJECT No. 14-1111-0007			FILE No. 14-1111-0007.GPJ				
		DRAWN	TB	Nov 2014	SCALE	N/A	REV.		
		CHECK	MT	Nov 2014	FIGURE E3				
		APPR	CN	Nov 2014					



# APPENDIX F

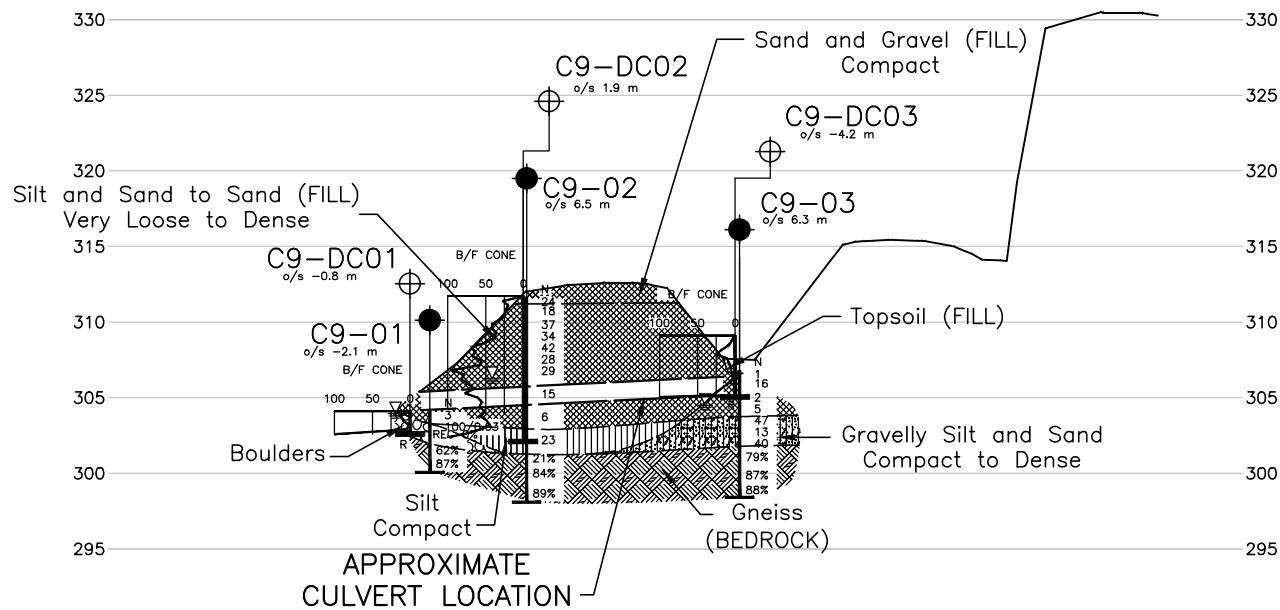
Culvert STA 10+743 (Township of Stephenson)



PLAN

SCALE

10 0 10 20 m



A-A' CULVERT C9  
STA. 10+743

HORIZONTAL SCALE

10 0 10 20 m

VERTICAL SCALE

5 0 5 10 m

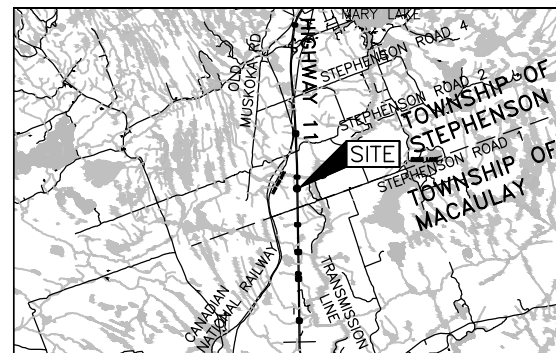
**METRIC**  
DIMENSIONS ARE IN METRES AND/OR  
MILLIMETRES UNLESS OTHERWISE SHOWN.  
STATIONS IN KILOMETRES + METRES.

CONT No. .  
GWP No. 5462-09-00



**HIGHWAY 11**  
CULVERT STA. 10+743 (SBL)  
**BOREHOLE LOCATIONS AND SOIL  
STRATA**

**SHEET**



KEY PLAN

SCALE

3 0 3 6 km

### LEGEND

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

### BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
C9-01	304.1	5002619.6	319567.9
C9-02	311.6	5002620.2	319583.3
C9-03	306.8	5002605.1	319607.1
C9-DC01	304.1	5002622.1	319566.4
C9-DC02	311.7	5002614.7	319583.4
C9-DC03	309.1	5002594.0	319605.0

### 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, sections and topographic data, provided in digital format by exp geomatics, drawing file nos. ntb-01407006.dwg and X-SECTIONS.dwg, received Oct 14, 2014.

NO.	DATE	BY	REVISION
Geocres No. 31E-344			
HWY. 11		PROJECT NO. 14-1111-0007	DIST. .
SUBM'D. MT	CHKD. CN	DATE: 11/13/2014	SITE: .
DRAWN: MR	CHKD. CN	APPD. JMAC	DWG. F1

PROJECT 14-1111-0007		RECORD OF BOREHOLE No C9-01				SHEET 1 OF 2		METRIC									
G.W.P. 5462-09-00		LOCATION N 5002619.6 ; E 319567.9				ORIGINATED BY EG											
DIST _____ HWY 11		BOREHOLE TYPE Portable Equipment, Manual Hammer				COMPILED BY MT											
DATUM Geodetic		DATE July 7 and 8, 2014				CHECKED BY CN											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
304.1	GROUND SURFACE							20	40	60	80	100					
0.0	Silt and sand, trace to some clay, trace gravel (FILL) Loose		1	SS	3	▽	304										
303.3	Brown to grey Moist to wet BOULDERS		2	SS	100/0.65		303										
0.8			-	RC	REC 0%												
301.9	GNEISS (BEDROCK)		1	RC	REC 100%		302										
2.2	Bedrock cored from depths of 2.2 m to 4.0 m.  For bedrock coring details refer to Record of Drillhole C9-01.		2	RC	REC 97%	301											
300.1	END OF BOREHOLE																
4.0	NOTE:  1. Water level in open borehole at a depth of 0.2 m below ground surface (Elev. 303.9 m) upon completion of drilling.																

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PROJECT 14-1111-0007		RECORD OF BOREHOLE No C9-02		SHEET 1 OF 2		METRIC											
G.W.P. 5462-09-00		LOCATION N 5002620.2; E 319583.3		ORIGINATED BY EG													
DIST _____ HWY 11		BOREHOLE TYPE CME 75, 108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing		COMPILED BY MT													
DATUM Geodetic		DATE June 19, 2014		CHECKED BY CN													
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ kN/m <sup>3</sup>	GR SA SI CL
							20 40 60 80 100	20 40 60 80 100	W <sub>p</sub>	W	W <sub>L</sub>	10 20 30					
311.6	GROUND SURFACE																
0.0	Sand and gravel (FILL)		1A	SS	24												
311.2	Compact Brown Moist		1B														
0.4	Silt and sand to sand, trace clay (FILL)		2	SS	18												
	Loose to dense Brown Moist to wet																
			3	SS	37												
			4	SS	34												
			5	SS	42												
			6	SS	28												
			7	SS	29												
			8	SS	15												
			9	SS	6												
302.9	SILT, trace clay																
8.7	Compact Grey Wet		10	SS	23												
301.2	GNEISS (BEDROCK)		1	RC	REC 100%												
10.4	Bedrock cored from depths of 10.4 m to 13.5 m.		2	RC	REC 99%												
	For bedrock coring details refer to Record of Drillhole C9-02.		3	RC	REC 100%												
298.1	END OF BOREHOLE																
13.5	NOTE:																
	1. Water level in open borehole at a depth of 5.3 m below ground surface (Elev. 306.3 m) upon completion of drilling.																

GTA-MTO 001 S:\CLIENTS\MT\OH\HWY\_11\02\_DATA\GINT\1411110007.GPJ GAL-GTA.GDT 01/21/15

PROJECT: 1411110007

**RECORD OF DRILLHOLE: C9-02**

SHEET 2 OF 2

LOCATION: N 5002620.2 ;E 319583.3

DRILLING DATE: June 14, 2014

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 75

DRILLING CONTRACTOR: Landcore Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	LEGEND																		NOTE: For additional abbreviations refer to list of abbreviations & symbols.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
						COLOUR FLUSH	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	HYDRAULIC CONDUCTIVITY		Diametral Point Load Index (MPa)	RMC -Q AVG																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
							TOTAL CORE %	SOLID CORE %									K <sub>v</sub> cm/sec	K <sub>h</sub> cm/sec																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
							JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate	BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage									PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular	PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break			BR - Broken Rock																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
		Continued from Record of Borehole C9-02		301.2 10.4																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																</

DEPTH SCALE

1 : 50



LOGGED: EG

CHECKED: CN

PROJECT		14-1111-0007		RECORD OF BOREHOLE No C9-03		SHEET 1 OF 2		METRIC									
G.W.P.		5462-09-00		LOCATION		N 5002605.1 ; E 319607.1		ORIGINATED BY ID									
DIST		HWY 11		BOREHOLE TYPE		CME 55, NW Casing		COMPILED BY MT									
DATUM		Geodetic		DATE		July 28, 2014		CHECKED BY CN									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
306.8	GROUND SURFACE							20	40	60	80	100					
0.0	Topsoil (FILL)		1	SS	1												
0.2	Sand and gravel, trace to some silt (FILL) Very loose to compact Brown Moist to wet		2	SS	16												
305.3																	
1.5	Sand, trace to some gravel, some silt (FILL) Very loose to loose Brown Wet		3	SS	2												
			4	SS	5												
303.8																	
3.0	Gravelly SILT and SAND, trace clay Compact to dense Grey Wet		5	SS	47												
			6	SS	13												
301.8			7	SS	40												
5.0	GNEISS (BEDROCK)																
	Bedrock cored from depths of 5.0 m to 8.4 m.  For bedrock coring details refer to Record of Drillhole C9-03.		1	RC	REC 100%												
			2	RC	REC 100%												
			3	RC	REC 100%												
298.4																	
8.4	END OF BOREHOLE																
	NOTE:  1. Water level in open borehole at a depth of 2.3 m below ground surface (Elev. 304.5 m) upon completion of drilling.																

GTA-MTO 001 S:\CLIENTS\MT\OH\HWY\_11\02\_DATA\GINT\1411110007.GPJ GAL-GTA.GDT 01/21/15

PROJECT: 1411110007

**RECORD OF DRILLHOLE: C9-03**

SHEET 2 OF 2

LOCATION: N 5002605.1 ;E 319607.1

DRILLING DATE: July 28, 2014

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR: Landcore Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.										DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY		Dipmetral Point Load Index (MPa)	RMC -Q AVG																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
							FLUSH	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	B Angle	DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jn	K, cm/sec	Dip	T	C	D																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
								TOTAL CORE %	SOLID CORE %																10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

DEPTH SCALE

1 : 50



LOGGED: ID

CHECKED: CN

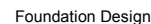
GTA-RCK 023 S:\CLIENTS\MTOWHY\_1102\_DATA\GINT\1411110007.GPJ GAL-GTA.GDT 01/21/15

PROJECT		14-1111-0007		RECORD OF DCPT No C9-DC01		SHEET 1 OF 1		METRIC										
G.W.P.		5462-09-00		LOCATION		N 5002622.1 ; E 319566.4		ORIGINATED BY										
DIST		HWY 11		BOREHOLE TYPE		Portable Equipment, Dynamic Cone Penetration Test		COMPILED BY										
DATUM		Geodetic		DATE		July 8, 2014		CHECKED BY										
								CN										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa										
							○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × REMOULDED					WATER CONTENT (%)						
304.1	GROUND SURFACE						20	40	60	80	100	10	20	30	γ	GR SA SI CL		
0.0	Dynamic Cone Penetration Test (DCPT)						304											
302.6							303											
1.5	END OF DCPT REFUSAL TO FURTHER PENETRATION (100 Blows / 0.28 m) (HAMMER BOUNCING)																	

GTA-MTO 001 S:\CLIENTS\MT\OH\HWY\_11\02\_DATA\GINT\1411110007.GPJ GAL-GTA.GDT 01/21/15



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



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

Golder Associates Ltd.  
 6925 Century Avenue, Suite #100  
 Mississauga, Ontario, L5N 7K2  
 Telephone: (905) 567-4444  
 Fax: (905) 567-6561



**Table F1 - Unconfined Compressive Strength**

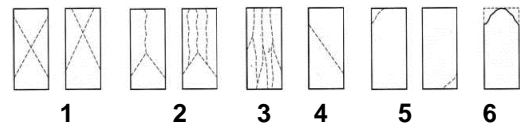
**PROJECT NO.:** 14-1111-0007  
**JOB NAME:** Highway 11 Culverts  
**TYPE OF UNIT:** Bedrock Core

<b>GOLDER LAB NUMBER</b>	<b>G0835</b>
<b>BOREHOLE</b>	<b>C9-01</b>
<b>DATE TESTED</b>	<b>Sept. 5, 2014</b>
<b>DEPTH OF TESTED CORE (m)</b>	<b>3.7</b>
<b>LENGTH AS CUT (mm)</b>	<b>99.0</b>
<b>DIAMETER (mm)</b>	<b>42.5</b>
<b>DENSITY (kg/m3)</b>	<b>2595</b>
<b>COMPRESSIVE STRENGTH (KN)</b>	<b>257.5</b>
<b>CORRECTED STRENGTH (MPa)</b>	<b>181.5</b>
<b>TYPE OF FRACTURE</b>	<b>3</b>

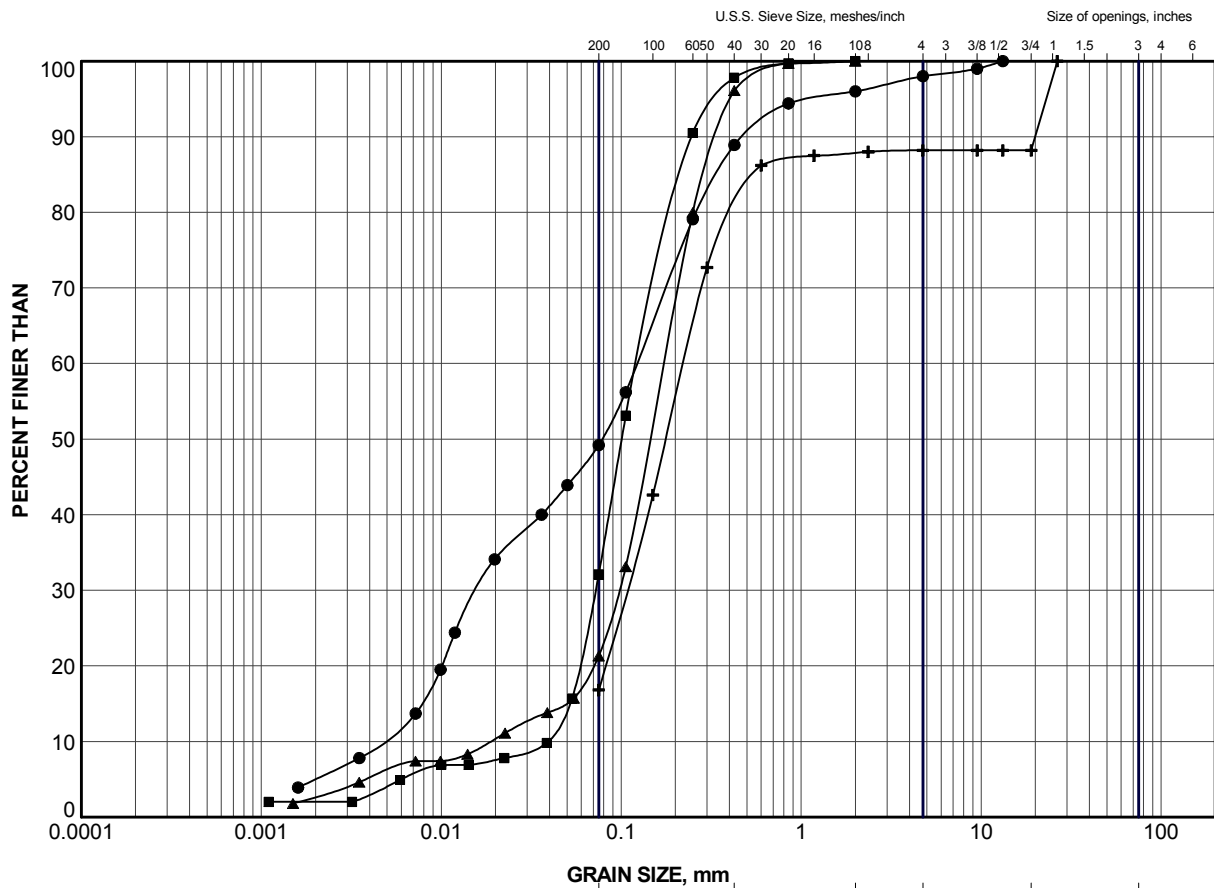
**Tested by:** SA

**Reviewed by :** TG

*Type of Fracture*







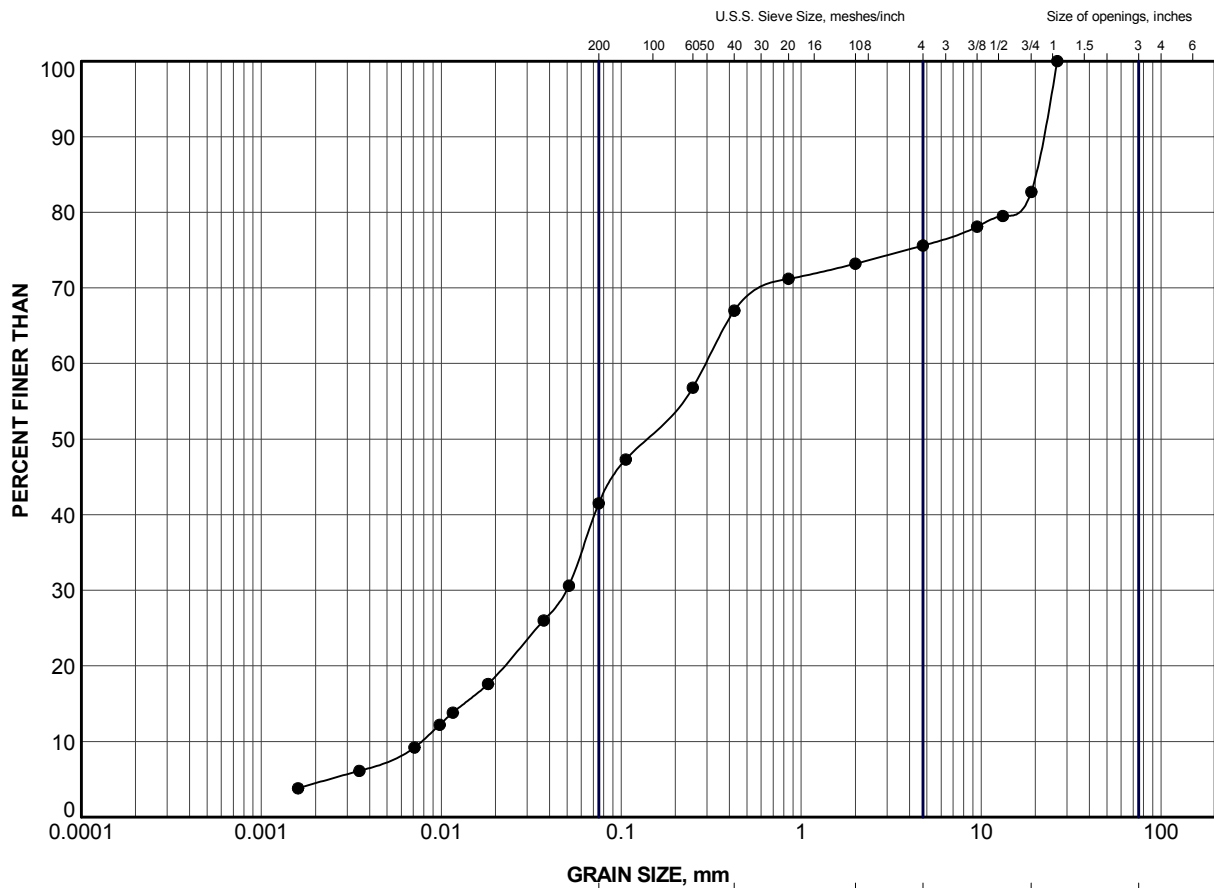
CLAY AND SILT	GRAVEL SIZE, mm					Cobble Size
	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

#### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C9-01	2	303.3
■	C9-02	5	308.3
▲	C9-02	9	303.7
+	C9-03	3	305.0

PROJECT						HIGHWAY 11 RESURFACING HIGHWAY 11 CULVERTS GWP 5462-09-00					
TITLE						GRAIN SIZE DISTRIBUTION SILT and SAND to SAND (FILL)					
PROJECT No.			14-1111-0007			FILE No.			14-1111-0007.GPJ		
DRAWN	TB	Nov 2014		SCALE	N/A	REV.					
CHECK	MT	Nov 2014									
APPR	CN	Nov 2014									
						FIGURE F1					





GRAIN SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

#### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C9-03	7	302.0

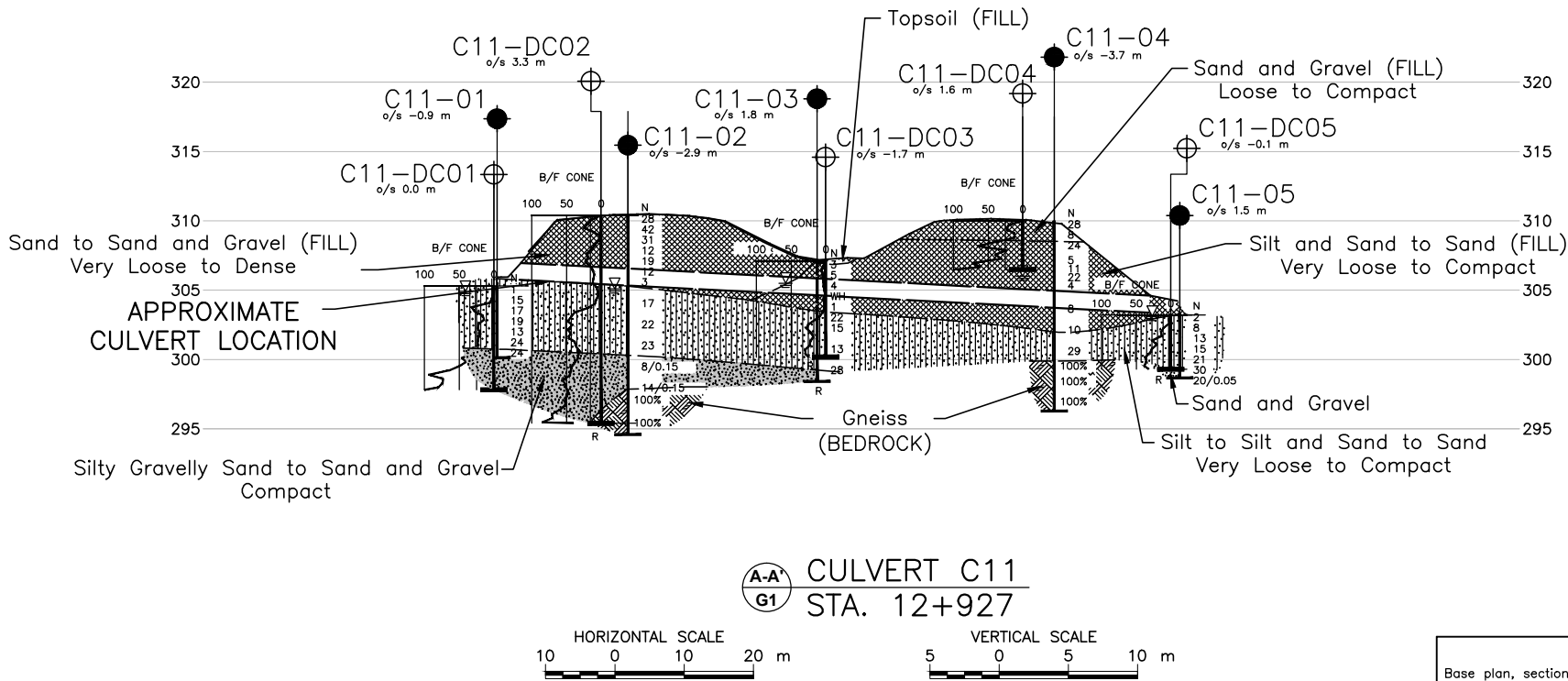
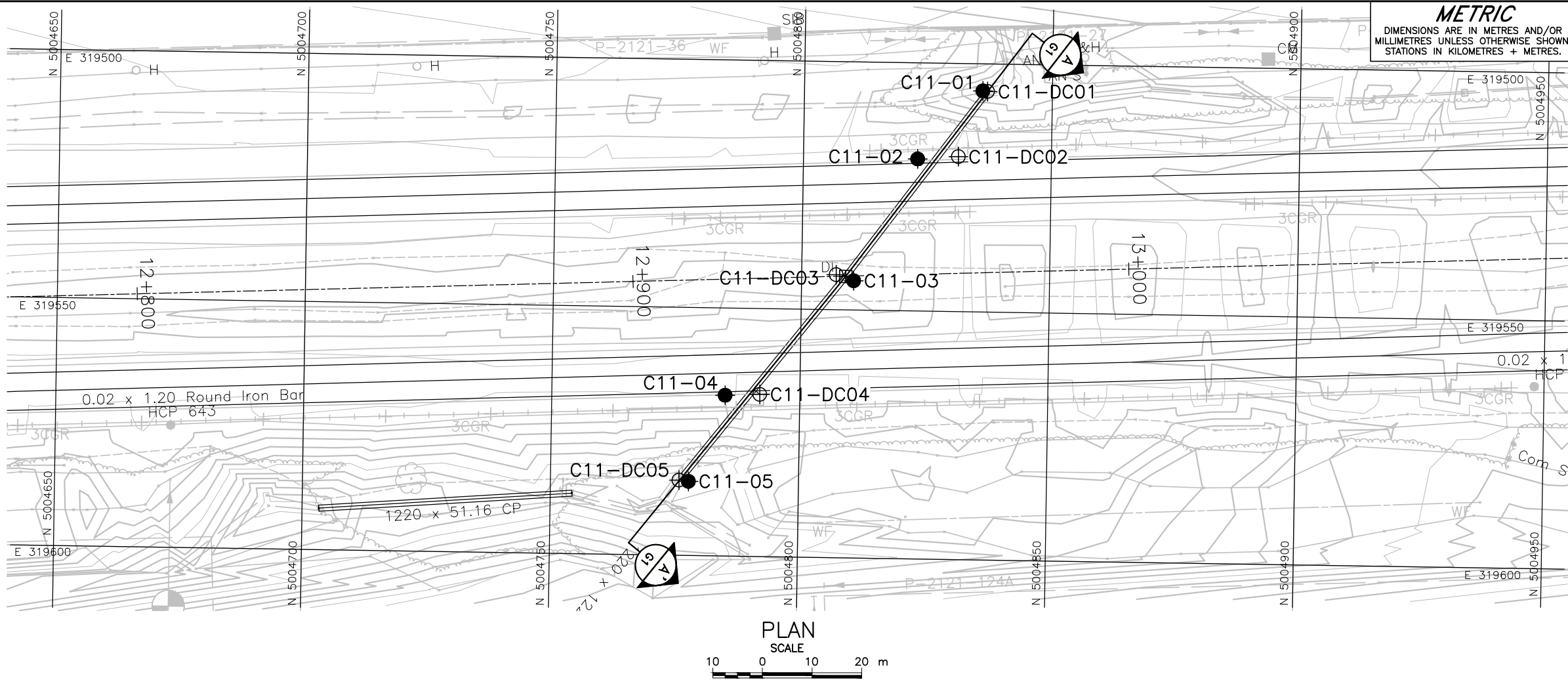
PROJECT						HIGHWAY 11 RESURFACING HIGHWAY 11 CULVERTS GWP 5462-09-00					
TITLE						GRAIN SIZE DISTRIBUTION GRAVELLY SILT and SAND					
PROJECT No.			14-1111-0007			FILE No.			14-1111-0007.GPJ		
DRAWN	TB	Nov 2014	SCALE	N/A	REV.	FIGURE F2					
CHECK	MT	Nov 2014									
APPR	CN	Nov 2014									





# APPENDIX G

Culvert STA 12+927 (Township of Stephenson)



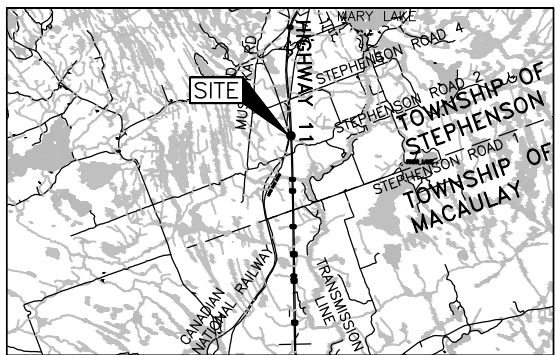
**CULVERT C11**  
**STA. 12+927**

#### REFERENCE

Base plan, sections and topographic data, provided in digital format by exp geomatics, drawing file nos. ntb-01407006.dwg and X-SECTIONS.dwg, received Oct 14, 2014.

CONT No.  
GWP No. 5462-09-00

HIGHWAY 11  
CULVERT STA. 12+927 (SBL AND NBL)  
BOREHOLE LOCATIONS AND SOIL  
STRATA



KEY PLAN  
SCALE  
3 0 3 6 km

#### LEGEND

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

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
C11-01	305.3	5004836.0	319505.5
C11-02	310.4	5004823.0	319519.4
C11-03	307.1	5004810.5	319544.1
C11-04	310.0	5004784.9	319567.6
C11-05	303.3	5004777.8	319585.1
C11-DC01	305.3	5004836.9	319505.6
C11-DC02	310.4	5004831.2	319518.8
C11-DC03	307.1	5004807.0	319543.0
C11-DC04	310.0	5004791.9	319567.3
C11-DC05	303.2	5004775.9	319584.9

#### 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.

NO.	DATE	BY	REVISION
Geocres No. 31E-344			
HWY. 11	PROJECT NO. 14-1111-0007		DIST. .
SUBM'D. MT	CHKD. CN	DATE: 11/13/2014	SITE: .
DRAWN: MR	CHKD. CN	APPD. JMAC	DWG. G1

PROJECT 14-1111-0007		RECORD OF BOREHOLE No C11-01				SHEET 1 OF 1		METRIC									
G.W.P. 5462-09-00		LOCATION N 5004836.0 ; E 319505.5				ORIGINATED BY EG											
DIST _____ HWY 11		BOREHOLE TYPE Portable Equipment, Wash Boring				COMPILED BY MT											
DATUM Geodetic		DATE July 10, 2014				CHECKED BY CN											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
305.3	GROUND SURFACE							20	40	60	80	100					
0.0	Sandy PEAT (Fibrous)		1A		1	▽	305										
0.1	Silty SAND		1B	SS													
304.6	Very loose Brown																
0.7	Moist SILT, trace to some clay, trace sand		2	SS	15												
	Compact Grey		3	SS	17												
	Moist to wet		4	SS	19												
			5	SS	13												
300.8	Silty Gravelly SAND, trace clay		6	SS	24		304										
4.5	Compact Grey						303										
	Wet						302										
300.1			7	SS	24		301										
5.2	END OF BOREHOLE																
NOTE: 1. Water level in open borehole at a depth of 0.4 m below ground surface (Elev. 304.9 m) upon completion of drilling.																	

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PROJECT <u>14-1111-0007</u>		<b>RECORD OF BOREHOLE No C11-02</b>		SHEET 1 OF 3		<b>METRIC</b>	
G.W.P. <u>5462-09-00</u>		LOCATION <u>N 5004823.0 ; E 319519.4</u>		ORIGINATED BY <u>ID</u>			
DIST <u>          </u> HWY <u>11</u>		BOREHOLE TYPE <u>CME 55, 108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing</u>		COMPILED BY <u>MT</u>			
DATUM <u>Geodetic</u>		DATE <u>June 23, 2014</u>		CHECKED BY <u>CN</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT			UNIT WEIGHT  $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								20 40 60 80 100							W <sub>p</sub>	W	W <sub>L</sub>
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED										
310.4	GROUND SURFACE																
0.0	Sand to sand and gravel, trace to some silt, trace clay (FILL) Very loose to dense Brown to grey Moist to wet		1	SS	28												
			2	SS	42												
			3	SS	31												
			4	SS	12												
			5	SS	19												
			6	SS	12												
			7A	SS	3												
305.4			7B														
5.0	SILT, trace to some clay, trace sand Compact Grey Wet																
			8	SS	17												
			9	SS	22												
			10	SS	23												
300.2																	
10.2	SAND and GRAVEL Compact Brown Wet		11	SS	8/0.15												
			12	SS	14/0.15												
297.9	GNEISS (BEDROCK)																
12.5	Bedrock cored from depths of 12.5 m to 15.8 m.  For bedrock coring details refer to Record of Drillhole C11-02.		1	RC	REC 100%												
			2	RC	REC 100%												

Continued Next Page

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

GTA-MTO 001 S:\CLIENTS\TOH\HWY\_11\02\_DATA\GINT\1411110007.GPJ GAL-GTA.GDT 01/21/15

PROJECT 14-1111-0007		RECORD OF BOREHOLE No C11-02				SHEET 2 OF 3		METRIC									
G.W.P. 5462-09-00		LOCATION N 5004823.0 ; E 319519.4				ORIGINATED BY ID											
DIST _____ HWY 11		BOREHOLE TYPE CME 55, 108 mm I.D. Continuous Flight Hollow Stem Augers, NW Casing				COMPILED BY MT											
DATUM Geodetic		DATE June 23, 2014				CHECKED BY CN											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL RQD = 100%
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	--- CONTINUED FROM PREVIOUS PAGE ---							20	40	60	80	100					
294.6			2	RC	REC 100%		295										
15.8	END OF BOREHOLE  NOTE:  1. Borehole caved to a depth of 5.3 m below ground surface (Elev. 305.1 m) upon completion of drilling.																

GTA-MTO 001 S:\CLIENTS\MT\OH\HWY\_11\02\_DATA\GINT\1411110007.GPJ GAL-GTA.GDT 01/21/15

PROJECT: 1411110007

**RECORD OF DRILLHOLE: C11-02**

SHEET 3 OF 3

LOCATION: N 5004823.0 ;E 319519.4

DRILLING DATE: June 23, 2014

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR: Landcore Drilling Inc.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	COLOUR % RETURN	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.										HYDRAULIC CONDUCTIVITY K, cm/sec	Diameter Point Load Index (MPa)	RMC -Q AVG	
							FLUSH	RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3 m	B Angle	DIP w.r.t CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja				Jn
								TOTAL CORE %	SOLID CORE %											
								88 88												

DEPTH SCALE

1 : 50



LOGGED: ID

CHECKED: CN

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PROJECT		14-1111-0007		RECORD OF BOREHOLE No C11-03		SHEET 1 OF 1		METRIC								
G.W.P.		5462-09-00		LOCATION		N 5004810.5 ; E 319544.1		ORIGINATED BY								
DIST		HWY 11		BOREHOLE TYPE		CME 55, 108 mm I.D. Continuous Flight Hollow Stem Augers		COMPILED BY								
DATUM		Geodetic		DATE		July 16, 2014		CHECKED BY								
								CN								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60						80
307.1	GROUND SURFACE															
0.1	Topsoil (FILL) Sand, some silt, trace clay, trace organics (FILL) Very loose to loose Brown to grey Moist to wet		1	SS	3											
			2	SS	5											
			3	SS	4											
			4	SS	WH											
			5	SS	1											
303.4																
3.7	SILT, trace sand, trace clay Compact Grey Wet		6	SS	22											
			7	SS	15											
			8	SS	13											
299.2			9A	SS	28											
7.9	Silty Gravelly SAND Compact Grey Wet		9B													
298.4																
8.7	END OF BOREHOLE SPOON AND AUGER REFUSAL (HAMMER BOUNCING)		10	SS												
	NOTE:  1. Water level measured at a depth of 1.6 m below ground surface (Elev. 305.5 m) upon completion of drilling.															

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<b>PROJECT</b> 14-1111-0007		<b>RECORD OF BOREHOLE No C11-04</b>		SHEET 1 OF 3		<b>METRIC</b>	
<b>G.W.P.</b> 5462-09-00		<b>LOCATION</b> N 5004784.9 ; E 319567.6		<b>ORIGINATED BY</b> EG			
<b>DIST</b> _____ <b>HWY</b> 11		<b>BOREHOLE TYPE</b> CME 75, NW Casing		<b>COMPILED BY</b> MT			
<b>DATUM</b> Geodetic		<b>DATE</b> June 20, 23 and 27, 2014		<b>CHECKED BY</b> CN			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT   NATURAL MOISTURE   LIQUID CONTENT   LIMIT			UNIT WEIGHT  γ  kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								○ UNCONFINED   + FIELD VANE ● QUICK TRIAXIAL   × REMOULDED					w <sub>p</sub> w   w <sub>L</sub>				
310.0	GROUND SURFACE						20	40	60	80	100						
0.0	Sand and gravel (FILL) Loose to compact Brown to grey Moist		1	SS	28	▽											
			2	SS	8												
308.5																	
1.5	Silt and sand to sand, trace gravel, trace clay (FILL) Very loose to compact Grey Moist to wet		3	SS	24												
			4	SS	5												
			5	SS	11												
			6	SS	22												
		7	SS	4													
		8	SS	8													

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

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PROJECT <u>14-1111-0007</u>	<b>RECORD OF BOREHOLE No C11-04</b>	SHEET 2 OF 3	<b>METRIC</b>
G.W.P. <u>5462-09-00</u>	LOCATION <u>N 5004784.9 ; E 319567.6</u>	ORIGINATED BY <u>EG</u>	
DIST <u>          </u> HWY <u>11</u>	BOREHOLE TYPE <u>CME 75, NW Casing</u>	COMPILED BY <u>MT</u>	
DATUM <u>Geodetic</u>	DATE <u>June 20, 23 and 27, 2014</u>	CHECKED BY <u>CN</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  γ  kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	w <sub>p</sub>	w	w <sub>L</sub>		GR	SA	SI	CL
	<div>— CONTINUED FROM PREVIOUS PAGE —</div> <div>END OF BOREHOLE</div> <div>NOTE:  1. Water level in open borehole at a depth of 4.0 m below ground surface (Elev. 306.0 m) upon completion of drilling.</div>																			

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SHEET 3 OF 3

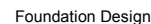
DATUM: Geodetic

DRILLING CONTRACTOR: Landcore Drilling Inc.

CHECKED: CN

PROJECT		14-1111-0007		RECORD OF BOREHOLE No C11-05		SHEET 1 OF 1		METRIC									
G.W.P.		5462-09-00		LOCATION		N 5004777.8 ; E 319585.1		ORIGINATED BY									
DIST		HWY 11		BOREHOLE TYPE		Portable Equipment, Wash Boring		COMPILED BY									
DATUM		Geodetic		DATE		June 20, 2014		CHECKED BY									
								CN									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
303.3	GROUND SURFACE																
0.0	PEAT (Fibrous)		1	SS	2												
	SILT and SAND, trace gravel, trace clay Very loose to loose Brown Moist to wet		2	SS	8												
301.6			3A														
1.7	SILT, some sand, trace clay Compact Grey Wet		3B	SS	13												5 47 45 3
			4	SS	15												0 18 80 2
			5	SS	21												
			6	SS	30												
298.8			7	SS	20/0.05												
4.6	SAND and GRAVEL Grey Wet  END OF BOREHOLE SPOON REFUSAL (HAMMER BOUNCING)  NOTE:  1. Water level in open borehole at a depth of 0.2 m below ground surface (Elev. 303.1 m) upon completion of drilling.																





METRIC

ORIGINATED BY ID

COMPILED BY MT

CHECKED BY CN

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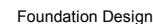
+ 3, × 3: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

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PROJECT <u>14-1111-0007</u>		<b>RECORD OF DCPT No C11-DC02</b>		SHEET 2 OF 2		<b>METRIC</b>											
G.W.P. <u>5462-09-00</u>		LOCATION <u>N 5004831.2; E 319518.8</u>		ORIGINATED BY <u>ID</u>													
DIST <u>          </u> HWY <u>11</u>		BOREHOLE TYPE <u>CME 55, Dynamic Cone Penetration Test</u>		COMPILED BY <u>MT</u>													
DATUM <u>Geodetic</u>		DATE <u>June 20, 2014</u>		CHECKED BY <u>CN</u>													
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					W <sub>p</sub>	W			W <sub>L</sub>
	--- CONTINUED FROM PREVIOUS PAGE ---																
15.0	END OF DCPT REFUSAL TO FURTHER PENETRATION (40 Blows / 0.08 m) (HAMMER BOUNCING)																

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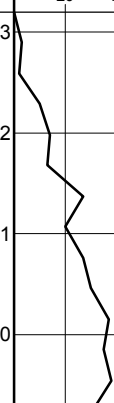


+ 3, × 3: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

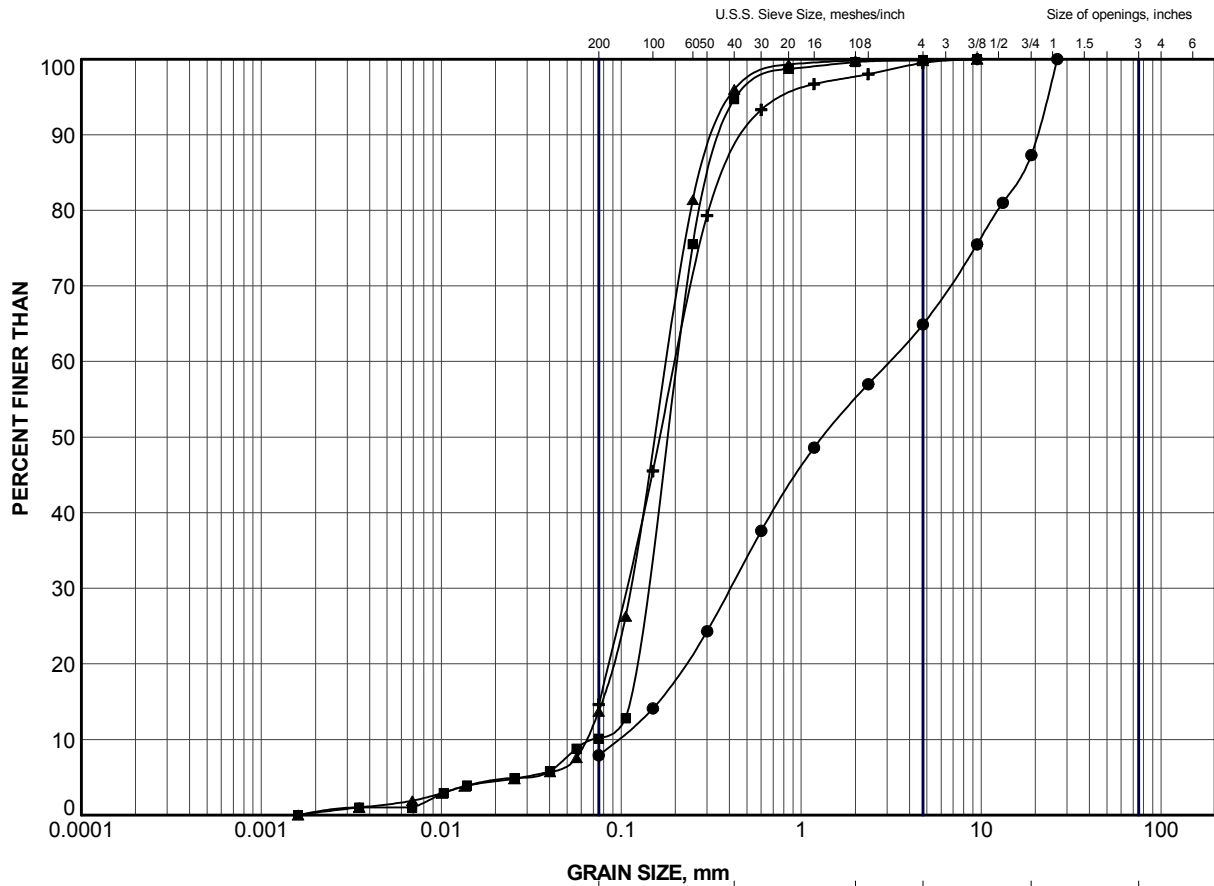


+ 3, × 3: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

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PROJECT		RECORD OF DCPT No C11-DC05				SHEET 1 OF 1		METRIC									
G.W.P. 14-1111-0007		LOCATION N 5004775.9 ; E 319584.9				ORIGINATED BY MT											
DIST _____ HWY 11		BOREHOLE TYPE Portable Equipment, Dynamic Cone Penetration Test				COMPILED BY MT											
DATUM Geodetic		DATE June 23, 2014				CHECKED BY CN											
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)
303.2	GROUND SURFACE						<div style="display: flex; justify-content: space-between;"> <span>20 40 60 80 100</span> <span>20 40 60 80 100</span> </div> <div style="display: flex; justify-content: space-between;"> <span>○ UNCONFINED</span> <span>+ FIELD VANE</span> </div> <div style="display: flex; justify-content: space-between;"> <span>● QUICK TRIAXIAL</span> <span>× REMOULDED</span> </div>					<div style="display: flex; justify-content: space-between;"> <span>10 20 30</span> </div>					
0.0	Dynamic Cone Penetration Test (DCPT)					303											
						302											
						301											
						300											
299.3	END OF DCPT REFUSAL TO FURTHER PENETRATION (32 Blows / 0.23 m) (HAMMER BOUNCING)																
3.9																	

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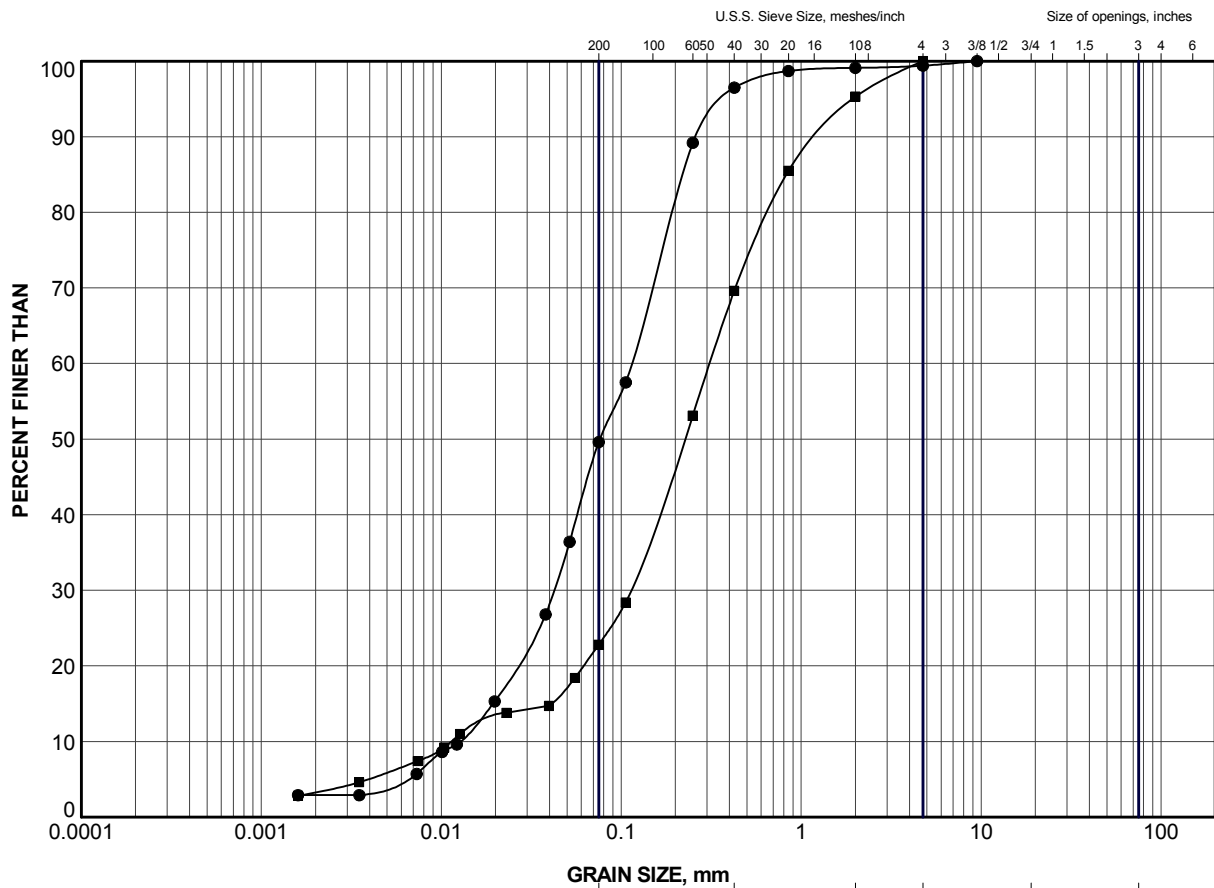


CLAY AND SILT	GRAVEL SIZE, mm					Cobble Size
	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

#### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C11-02	2	309.3
■	C11-02	6	306.3
▲	C11-03	2	306.0
+	C11-03	5	303.8


PROJECT					HIGHWAY 11 RESURFACING HIGHWAY 11 CULVERTS GWP 5462-09-00				
TITLE					GRAIN SIZE DISTRIBUTION SAND to SAND and GRAVEL (FILL)				
PROJECT No.		14-1111-0007		FILE No.		14-1111-0007.GPJ			
DRAWN	TB	Nov 2014		SCALE	N/A	REV.			
CHECK	MT	Nov 2014		FIGURE G1					
APPR	CN	Nov 2014							
Golder Associates		SUDBURY, ONTARIO							

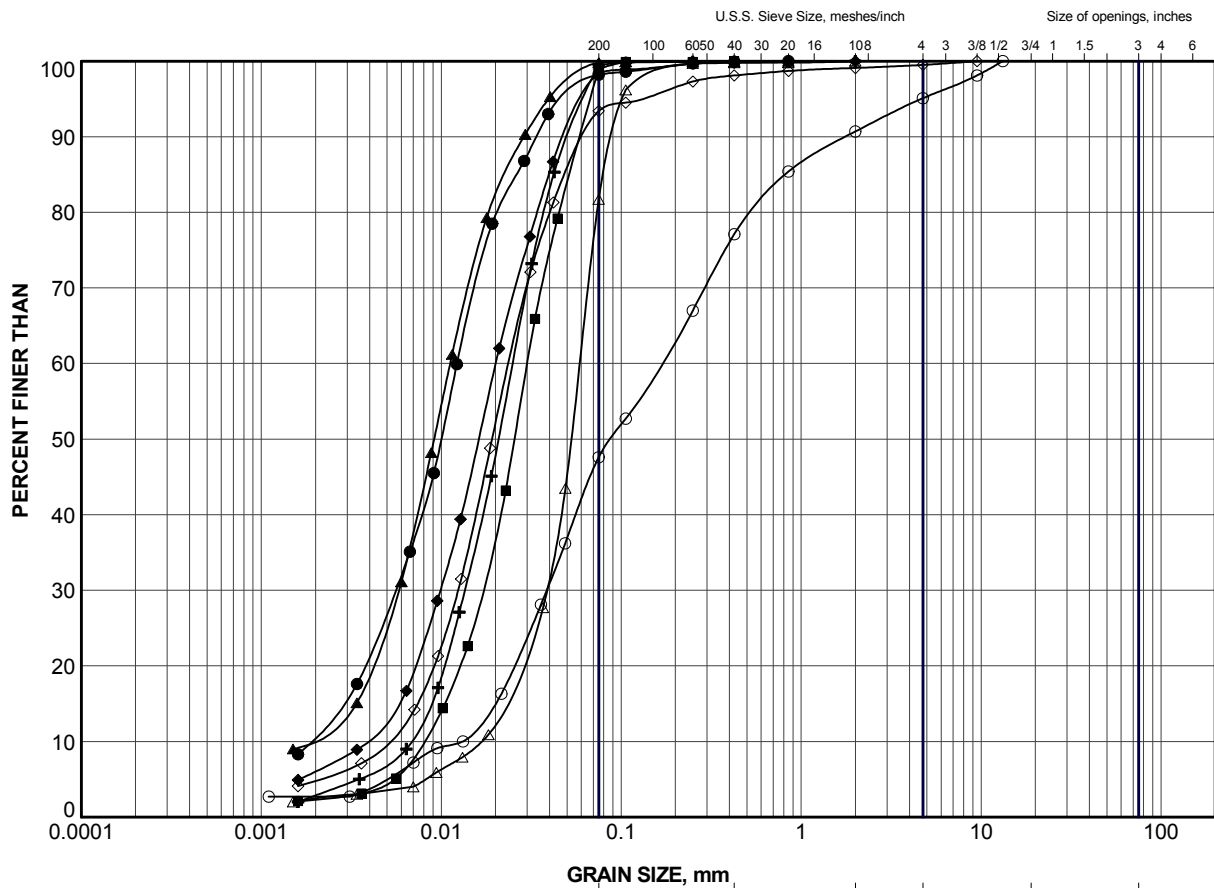


GRAIN SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

#### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C11-04	6	305.9
■	C11-04	9B	302.1

PROJECT						HIGHWAY 11 RESURFACING HIGHWAY 11 CULVERTS GWP 5462-09-00					
TITLE						GRAIN SIZE DISTRIBUTION SILT and SAND to SAND (FILL)					
PROJECT No.			14-1111-0007			FILE No.			14-1111-0007.GPJ		
DRAWN	TB	Nov 2014		SCALE	N/A	REV.					
CHECK	MT	Nov 2014									
APPR	CN	Nov 2014									
 <b>Golder Associates</b> SUDBURY, ONTARIO						<b>FIGURE G2</b>					



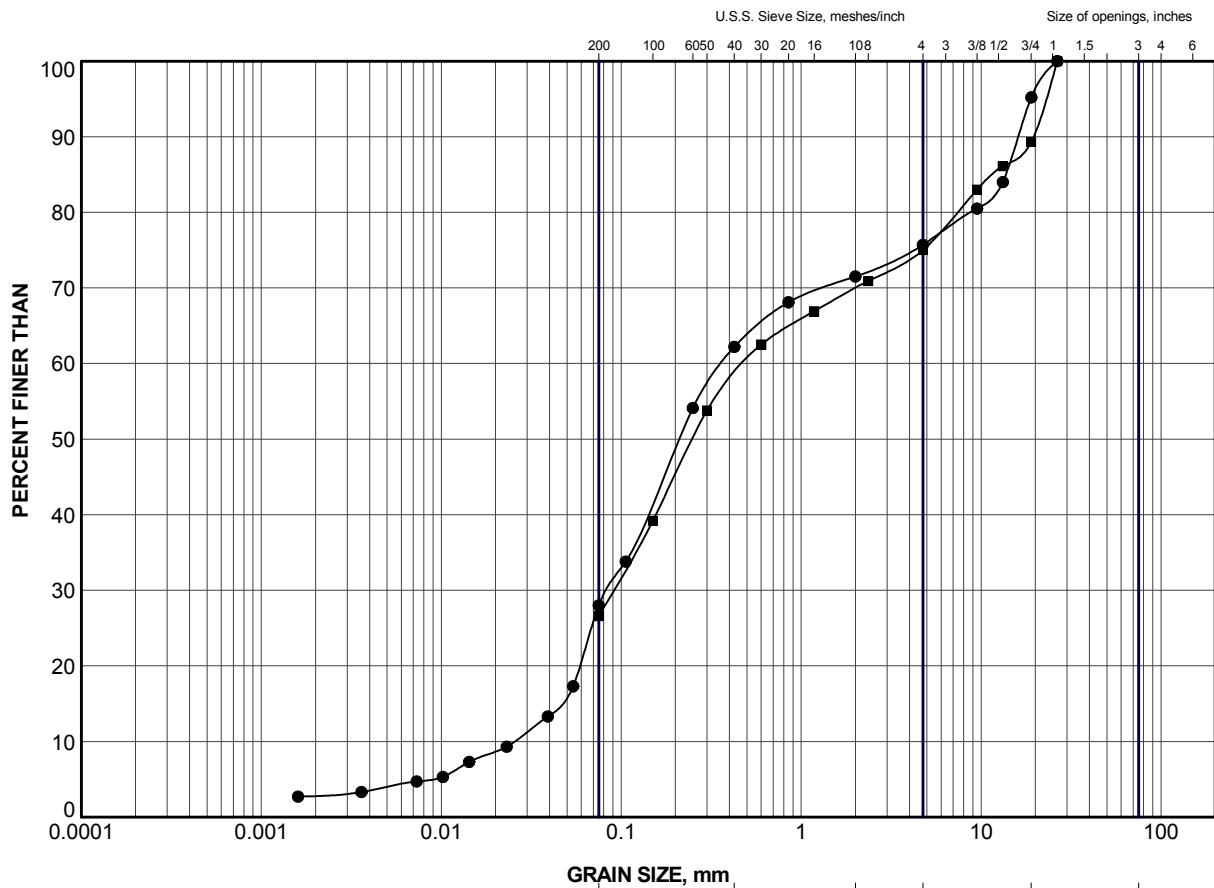
CLAY AND SILT	GRAVEL SIZE, mm					Cobble Size
	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

#### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C11-01	2	304.2
■	C11-01	4	302.7
▲	C11-02	8	304.0
+	C11-02	10	301.0
◆	C11-03	7	302.2
◇	C11-04	10	300.6
○	C11-05	3A	301.7
△	C11-05	4	300.7

PROJECT						HIGHWAY 11 RESURFACING HIGHWAY 11 CULVERTS GWP 5462-09-00					
TITLE						GRAIN SIZE DISTRIBUTION SILT to SILT and SAND					
PROJECT No.			14-1111-0007			FILE No.			14-1111-0007.GPJ		
DRAWN	TB	Nov 2014		SCALE	N/A	REV.					
CHECK	MT	Nov 2014									
APPR	CN	Nov 2014									
						FIGURE G3					






GRAIN SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

#### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C11-01	7	300.4
■	C11-03	9B	299.0

PROJECT						HIGHWAY 11 RESURFACING HIGHWAY 11 CULVERTS GWP 5462-09-00					
TITLE						GRAIN SIZE DISTRIBUTION SILTY GRAVELLY SAND					
PROJECT No.			14-1111-0007			FILE No.			14-1111-0007.GPJ		
DRAWN	TB	Nov 2014		SCALE	N/A	REV.					
CHECK	MT	Nov 2014									
APPR	CN	Nov 2014									
 <b>Golder Associates</b> SUDBURY, ONTARIO						<b>FIGURE G4</b>					

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

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