



February 10, 2015

PRELIMINARY FOUNDATION INVESTIGATION REPORT

HIGHWAY 11 CULVERTS, TOWNSHIP OF STEPHENSON
RESURFACING OF HIGHWAY 11
FROM MUSKOKA ROAD 117 NORTHERLY TO STEPHENSON ROAD 12, 21.9 KM
MINISTRY OF TRANSPORTATION, ONTARIO
GWP 5195-10-00

Submitted to:

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GEOCRETS NO.: 31E-343

Report Number: 14-1111-0007-3

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REPORT





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PART A

**PRELIMINARY FOUNDATION INVESTIGATION REPORT
HIGHWAY 11 CULVERTS, TOWNSHIP OF STEPHENSON
RESURFACING OF HIGHWAY 11
FROM MUSKOKA ROAD 117 NORTHERLY TO STEPHENSON ROAD 12
MINISTRY OF TRANSPORTATION, ONTARIO
GWP 5195-10-00**



1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by AECOM on behalf of Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for the rehabilitation or replacement of two culverts (GWP 5195-10-00) 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 South Mary Lake Road and Stephenson Road 12. The general locations of the culverts are shown on Drawing 1.

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 these 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 two culverts in GWP 5195-10-00, one of which has been identified for replacement and one which has been identified for potential rehabilitation. Separate reports will be submitted detailing the foundation investigations for the remaining culverts within the project limits.

The purpose of this investigation is to obtain subsurface information specific to the culvert locations, obtained by methods of borehole drilling, bedrock coring, in situ testing and laboratory testing on selected soil samples. The boreholes for these 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 ground surface elevations at the investigation locations were also surveyed in the field by exp.

2.0 SITE DESCRIPTION

The two culverts are located at approximately STA 17+255 and STA 17+285 on Highway 11 in the Township of Stephenson, between South Mary Lake Road and Stephenson Road 12. The existing culverts are constructed of Corrugated Steel Pipe (CSP) the details of which (width, height, length etc.) are summarized in Table 1, following the text of this report.

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.

3.0 INVESTIGATION PROCEDURES

The fieldwork for the investigation associated with the two culverts in GWP 5195-10-00 was carried out between June 16 and 18, July 8 and 9, and July 21 and 22, 2014, during which periods a total of eight boreholes and nine Dynamic Cone Penetration Tests (DCPTs) were advanced at, or in the immediate vicinity of, the culvert alignments, as summarized in Table 1 and as shown on Drawings A1 and B1 in Appendices A and B, respectively.



The field investigation was carried out using truck-mounted CME55 and CME 75 drill rigs 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 employed a full-weight hammer lifted manually and dropped from the SPT height. Rock coring was carried out using an 'NQ' core barrel to a depth of approximately 3 m beyond auger/casing refusal in one borehole and through a blast rock fill section in another borehole. 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 about 3 m below the culvert invert, terminating on refusal to further auger, casing and/or split spoon advancement likely on, or in proximity to, the bedrock surface, or upon drilling into probable 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 and B.

A sample of the creek water was obtained during the field investigation at the culvert locations, 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 A1 and B1, included in Appendices A and B, respectively.

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 and grain size distribution) was carried out on selected soil samples. The results of the laboratory testing are provided in Appendices A and B.

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)¹. The degree of weathering of the bedrock samples (i.e. fresh to slightly weathered – W1 to W2) and the strength classification of the intact rock mass based on field identification (i.e. strong – R4) are described in accordance with the International Society for Rock Mechanics (ISRM, 1985)² standard classification system.

Survey stakes and/or nail pins were installed by exp. at selected locations in the area of the culvert prior to the commencement of drilling. The as-drilled borehole locations, in stations and offsets, were measured in reference to the applicable stakes and/or nail pins 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

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

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



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 Drawing A1 and B1 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 17+255 (Township of Stephenson)	C12-01	5009118.0	319464.6	314.3	5.9 / 6.5
	C12-02	5009108.4	319480.1	320.3	15.9 / 21.3
	C12-03	5009106.8	319504.3	315.6	15.3
	C12-04	5009092.4	319525.5	319.9	18.9
	C12-05	5009094.5	319543.7	313.8	6.7
	C12-DC01	5009110.2	319462.0	314.9	5.7
	C12-DC02A	5009116.0	319482.3	320.4	3.2
	C12-DC02B	5009115.7	319484.0	320.4	2.9
	C12-DC03	5009100.2	319501.9	315.2	18.1
	C12-DC04	5009096.7	319526.3	319.8	21.5
	C12-DC05	5009088.4	319542.1	313.9	10.7
STA 17+285 (Township of Stephenson)	C12-06	5009136.2	319511.3	314.8	15.1*
	C12-07	5009125.9	319534.0	319.2	15.6
	C12-08	5009126.9	319553.5	314.4	5.2
	C12-DC06	5009130.3	319509.9	314.7	12.7
	C12-DC07	5009130.6	319534.9	319.3	14.2
	C12-DC08	5009119.0	319550.1	314.2	7.6

* Including 3.4 m of bedrock coring.

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

As delineated in *The Physiography of Southern Ontario*³, 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)⁴.

³ 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.

⁴ 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.



4.2 General Overview of Local Subsurface Conditions

The detailed subsurface soil and groundwater conditions as encountered in the boreholes advanced during this investigation, together with the results of the laboratory tests carried out on selected soil samples, are presented on the Record of Borehole and Drillhole sheets and the laboratory test sheets in Appendices A and B. 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.

The stratigraphy at the locations of the culverts consists of surficial layers of organic sand or peat, or of embankment fill, underlain by native non-cohesive soil deposits and bedrock. A detailed description of the subsurface conditions at the culvert crossings is 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 at STA 17+255

The plan and profile along the centreline of the culvert at STA 17+255 showing the borehole locations and interpreted stratigraphy are shown on Drawing A1. The height of the embankment at this location is about 6 m and the existing CSP culvert is about 83 m long with a diameter of 910 mm. A total of five boreholes and six DCPTs were completed to investigate the subsurface conditions at the culvert location: two boreholes (C12-01 and C12-05) and two companion DCPTs (C12-DC01 and C12-DC05) were advanced near the ends of the culvert; and three boreholes (C12-02 to C12-04) and four DCPTs (C12-DC02A, C12-DC02B, C12-DC03 and C12-DC04) were advanced through the SBL and NBL roadway embankments on the embankment shoulder and near the midpoint of the culvert. In general, the topography in the area of the culvert consists of low-lying areas, bedrock outcrops and treed areas.

4.3.1 Embankment Fill

Embankment fill 3.0 m to 8.7 m thick was encountered immediately adjacent to the culvert. The embankment fill consists of a 0.4 m to 0.7 m thick deposit of sand and gravel which was encountered at surface Elevations 320.3 m and 319.9 m in Boreholes C12-02 and C12-03A, respectively. Asphalt mixed with sand and gravel was encountered near the ground surface in Borehole 12-02. A 3.0 m to 7.5 m thick deposit of sand, some gravel, trace silt was encountered below the sand and gravel layer in C12-02 at Elevation 319.9 m and at ground surface in Borehole 12-03 at Elevation 315.6 m. A 0.9 m thick layer of rock fill was encountered directly within the sand fill layer in Borehole C12-02. A fill deposit of silty sand, trace gravel, trace clay was encountered below the sand and gravel deposit in Borehole C12-04 at Elevation 319.2 m and the thickness of the deposit is 8.0 m.

The SPT 'N'-values measured within the embankment fill range between 1 blow and 59 blows per 0.3 m of penetration indicating a very loose to dense relative density, but the fill deposit is generally compact to dense in relative density. A SPT 'N'-value measured in Boreholes C12-02 near the contact with the rock fill is 77 blows per 0.3 m of penetration, indicating a very dense relative density.



The natural water content measured on six samples of the fill deposit ranges from about 7 per cent to about 23 per cent.

The results of the grain size distribution tests completed on five samples of the silty sand to sand fill deposit are shown on Figure A1 in Appendix A.

4.3.2 Organic Sand to Peat

A deposit of black organic sand to sandy peat to peat was encountered at the ground surface in Boreholes C12-01 and C12-05 at Elevations 314.3 m and 313.8 m, and below the granular fill deposit in Boreholes C12-02 and C12-03 at Elevations 312.8 m and 312.6 m respectively. The thickness of the deposit encountered at the ground surface is 2.4 m and 2.2 m in the respective boreholes and the thickness of the deposit below the fill is 0.4 m.

The SPT 'N'-values measured within the organic sand range from 1 blow to 4 blows per 0.3 m of penetration indicating a very loose relative density. The SPT 'N'-values measured within the sandy peat to peat range from 0 blows (weight of hammer) to 2 blows per 0.3 m of penetration indicating a very soft relative density.

The natural water content measured on two samples of the organic sand are about 70 per cent and about 159 per cent. The natural water content measured on a sample of peat and two samples of sandy peat range from about 233 per cent and about 434 per cent.

The organic content measured on two samples of the organic sand are about 14 per cent and about 18 per cent.

4.3.3 Sand

A deposit of brown to grey sand, trace to some silt, trace to some gravel was encountered underlying the organic silt to peat deposit in Boreholes C12-01, C12-02, C12-03 and C12-05. The top of the deposit was encountered between Elevations 312.4 m and 311.6 m and the thickness of the deposit ranges from 2.3 m to 3.8 m.

The SPT 'N'-values measured within the sand deposit typically range from 6 blows and 27 blows per 0.3 m of penetration indicating a loose to compact relative density. SPT 'N'-values measured at the interface with the organic layer and at practical casing refusal are 1 blow and 2 blows per 0.3 m penetration to and 73 blows per 0.3 m penetration, respectively.

The natural water content measured on six samples of the sand deposit range from about 19 per cent to about 25 per cent.

The results of the grain size distribution tests completed on five samples of the sand deposit are shown on Figure A2 in Appendix A.

4.3.4 Sandy Silt to Silt and Sand

A deposit of brown to grey sandy silt, trace clay to silt and sand, trace clay was encountered underlying the sand deposit in Boreholes C12-02, C12-03 and C12-05, and below the fill deposit in Borehole C12-04. The top of the deposit was encountered between Elevations 311.2 m and 308.2m and the thickness of the deposit ranges from



1.1 m to 10.2 m. A 2.0 m thick pocket of grey sand was encountered below the silt and sand deposit in Borehole C12-03 at Elevation 302.3 m.

The SPT 'N'-values measured within the sandy silt to silt and sand deposit typically range from 2 blows to 29 blows per 0.3 m of penetration indicating a very loose to compact relative density. The SPT 'N'-values measured within the sand pocket were 15 blows per 0.3 m of penetration within the pocket, indicating a compact relative density.

The natural water content measured on seven samples of the sandy silt to silt and sand deposit ranged from about 22 per cent to 27 per cent.

The result of the grain size distribution tests completed on a sample of the sandy silt deposit and five samples of the silt and sand deposit are shown on Figures A3 and A4, respectively, in Appendix A.

4.3.5 Refusal

Refusal to casing and split-spoon advancement in Borehole C12-03 and to further DCPT penetration in and adjacent to Boreholes C12-01, and C12-02, and DCPTs C12-DC01 to C12-DC05 was encountered at depths ranging from 3.2 m to 21.5 m below ground surface, ranging from Elevations 317.5 m to 297.1 m.

4.3.6 Groundwater Conditions

The water level was measured in Boreholes C12-01 to C12-05 upon completion of drilling operations at depths between 2.8 m and 6.2 m below ground surface, ranging from Elevations 314.7 m to 310.4 m. Groundwater levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

4.4 Culvert at STA 17+285

The plan and profile along the centreline of the culvert at STA 17+285 showing the borehole locations and interpreted stratigraphy are shown on Drawing B1. The height of the embankment at this location is about 6 m and the existing CSP culvert is about 42 m long with a diameter of 910 mm. A total of three boreholes and three DCPTs were completed to investigate the subsurface conditions at the culvert location: two boreholes (C12-06 and C12-08) and two companion DCPTs (C12-DC06 and C12-DC08) were advanced near the ends of the culvert; and one borehole (C12-07) and one DCPT (C12-DC07) were advanced through the NBL roadway embankment near the midpoint of the culvert. In general, the topography in the area of the culvert consists of low-lying areas, bedrock outcrops and treed areas.

4.4.1 Topsoil

A 0.2 m thick deposit of topsoil fill was encountered at ground surface in Borehole C12-06 at Elevation 314.8 m.



4.4.2 Embankment Fill

Embankment fill comprised of an upper layer of sand and gravel at the embankment shoulder and comprised of silt and sand to sand at the toe of the embankment and below the upper layer was encountered at Boreholes C12-06 and C12-07. The embankment fill was encountered at surface Elevations 314.6 m and 319.2 m and the deposit is 3.2 m and 7.2 m thick at the respective boreholes.

The SPT 'N'-values measured within the embankment fill are 19 blows per 0.3 m of penetration in the sand and gravel layer and range from 2 blows to 31 blows per 0.3 m of penetration in the silt and sand to sand deposit, indicating an overall very loose to dense relative density.

The natural water content measured on five samples of the fill deposit ranges from about 5 per cent to about 24 per cent.

The results of the grain size distribution tests completed on four samples of the embankment fill deposit are shown on Figure B1 in Appendix B.

4.4.3 Sandy Peat to Organic Sand

A deposit of black sandy peat to organic sand was encountered at ground surface in Borehole C12-08 at Elevation 314.4 m. The organic deposit is comprised of an upper 0.7 m thick layer of sandy peat underlain by a 1.5 m thick layer of organic sand.

The SPT 'N'-values measured within the sandy peat to organic sand deposit range from 1 blow to 4 blows per 0.3 m of penetration indicating a very soft consistency and very loose relative density for the respective layers.

The natural water content and the organic content measured on a sample of the organic sand is about 52 per cent and about 7 per cent, respectively.

4.4.4 Sand

A 0.7 m to 3.0 m thick deposit of brown sand was encountered underlying the embankment fill in Boreholes C12-06 and C12-07 at surface Elevation 311.4 m and 312.0 m, respectively.

The SPT 'N'-values measured within the sand deposit are 16 blows and 18 blows per 0.3 m of penetration and 9 blows and 12 blows per 0.3 m of penetration at the interface with the overlying and underlying deposits, indicating essentially a compact relative density.

The natural water content of two samples of the sand deposit is about 11 per cent and 21 per cent.

The result of a grain size distribution test on a sample of the sand deposit is shown on Figure B2, in Appendix B.

4.4.5 Sandy Silt to Silt and Sand

A deposit of brown to grey sandy silt to silt and sand was encountered underlying the sand deposit in Boreholes C12-06 and C12-07 and underlying the organic sand deposit in Borehole C12-08. The surface of the deposit was encountered between Elevations 312.2 m and 309.0 m and the thickness of the deposit ranges between 3.0 m and 6.1 m.



The SPT 'N'-values measured within the sandy silt to silt and sand deposit range from 6 blow to 41 blows per 0.3 m of penetration indicating a loose to dense relative density. The natural water content measured on six samples of the sandy silt to silt and sand deposit range from about 19 per cent to 26 per cent.

The results of grain size distribution tests completed on two samples of the silt and sand portion of the deposit and two samples of the sandy silt portion of the deposit are shown on Figures B3 through B4, respectively, in Appendix B.

4.4.6 Silty Sand and Gravel / Sand and Gravel

A deposit of silty sand and gravel and sand and gravel was encountered underlying the sandy silt deposit in Boreholes C12-06 and C12-07, respectively. The top of the deposit is at Elevations 304.6 m and 304.4 m and the thickness of the deposit is 1.5 m and 0.8 m in the respective boreholes.

The SPT 'N'-values measured within the silty sand and gravel and within the sand and gravel deposits are 25 blows per 0.3 m of penetration and 43 blows per 0.23 m of penetration, indicating a compact to dense relative density.

The natural water content measured on one sample of the sand and gravel is about 15 per cent.

4.4.7 Bedrock / Refusal

Bedrock was encountered in Borehole C12-06 at Elevation 303.1 m and 3.4 m of core samples were obtained. Based on a review of the bedrock core samples, the bedrock consists of medium to coarse grained, fresh, 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 86 per cent to 89 per cent. The Rock Quality Designation (RQD) measured on the recovered bedrock core samples ranges between 76 per cent and 80 per cent, indicating the rock is of good quality, according to Table 3.10 in CFEM (2006)¹.

Refusal to casing and split-spoon advancement was encountered in Borehole C12-07 at a depth of 15.6 m below ground surface corresponding to Elevation 303.6 m. Refusal to further penetration was encountered in DCPTs C12-DC06 and C12-DC07 at depths of 12.7 m and 14.2 m below ground surface corresponding to Elevations 302.0 m and 305.1 m.

4.4.8 Groundwater Conditions

The water level was measured in Boreholes C12-06 to C10-08 upon completion of drilling operations at depths between 1.1 m and 7.5 m below ground surface, ranging from Elevations 313.7 m to 310.8 m, respectively. Groundwater levels in the area are subject to seasonal fluctuations and variations due to precipitation events.



5.0 CLOSURE

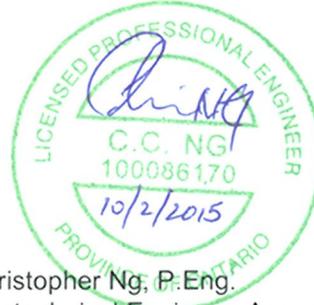
The field personnel supervising the drilling program were Messr. Indulis Dumpis, Erik Giles and Matthew Thibeault, EIT. This report was prepared by Ms. Madison Kennedy, B.A.Sc. and reviewed by Mr. Christopher Ng, P.Eng. and associate of Golder. Mr. Jorge M. A. Costa, P.Eng., Golder's Designated MTO Contact for this project and principal with Golder, carried out a quality control review of the report.



Report Signature Page

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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.

ASTM International:

ASTM D1586 Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils

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	(a)	Index Properties (continued)
π	3.1416	w	water content
$\ln x$,	natural logarithm of x	w_l or LL	liquid limit
\log_{10}	x or log x, logarithm of x to base 10	w_p or PL	plastic limit
g	acceleration due to gravity	I_p or PI	plasticity index = $(w_l - w_p)$
t	time	w_s	shrinkage limit
FoS	factor of safety	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)
II.	STRESS AND STRAIN	(b)	Hydraulic Properties
γ	shear strain	h	hydraulic head or potential
Δ	change in, e.g. in stress: $\Delta \sigma$	q	rate of flow
ε	linear strain	v	velocity of flow
ε_v	volumetric strain	i	hydraulic gradient
η	coefficient of viscosity	k	hydraulic conductivity (coefficient of permeability)
ν	Poisson's ratio	j	seepage force per unit volume
σ	total stress	(c)	Consolidation (one-dimensional)
σ'	effective stress ($\sigma' = \sigma - u$)	C_c	compression index (normally consolidated range)
σ'_{vo}	initial effective overburden stress	C_r	recompression index (over-consolidated range)
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)	C_s	swelling index
σ_{oct}	mean stress or octahedral stress = $(\sigma_1 + \sigma_2 + \sigma_3)/3$	C_α	secondary compression index
τ	shear stress	m_v	coefficient of volume change
u	porewater pressure	C_v	coefficient of consolidation (vertical direction)
E	modulus of deformation	C_h	coefficient of consolidation (horizontal direction)
G	shear modulus of deformation	T_v	time factor (vertical direction)
K	bulk modulus of compressibility	U	degree of consolidation
		σ'_p	pre-consolidation stress
III.	SOIL PROPERTIES	OCR	over-consolidation ratio = σ'_p / σ'_{vo}
(a)	Index Properties	(d)	Shear Strength
$\rho(\gamma)$	bulk density (bulk unit weight)*	τ_p, τ_r	peak and residual shear strength
$\rho_d(\gamma_d)$	dry density (dry unit weight)	ϕ'	effective angle of internal friction
$\rho_w(\gamma_w)$	density (unit weight) of water	δ	angle of interface friction
$\rho_s(\gamma_s)$	density (unit weight) of solid particles	μ	coefficient of friction = $\tan \delta$
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)	c'	effective cohesion
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)	C_u, S_u	undrained shear strength ($\phi = 0$ analysis)
e	void ratio	p	mean total stress $(\sigma_1 + \sigma_3)/2$
n	porosity	p'	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
S	degree of saturation	q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
		q_u	compressive strength $(\sigma_1 - \sigma_3)$
		S_t	sensitivity

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

Notes: 1 $\tau = c' + \sigma' \tan \phi'$
2 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 cm² pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

V. MINOR SOIL CONSTITUENTS

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

III. SOIL DESCRIPTION

(a) Non-Cohesive Soils

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

(b) Cohesive Soils Consistency

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

IV. SOIL TESTS

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

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



LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERING STATE

Fresh: no visible sign of weathering

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

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

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

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

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

BEDDING THICKNESS

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

JOINT OR FOLIATION SPACING

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

GRAIN SIZE

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

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

CORE CONDITION

Total Core Recovery (TCR)

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

Solid Core Recovery (SCR)

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

Rock Quality Designation (RQD)

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

DISCONTINUITY DATA

Fracture Index

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

Dip with Respect to Core Axis

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

Description and Notes

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

Abbreviations

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



TABLES



**PRELIMINARY FOUNDATION REPORT - HIGHWAY 11 RESURFACING
CULVERTS, GWP 5195-10-00**

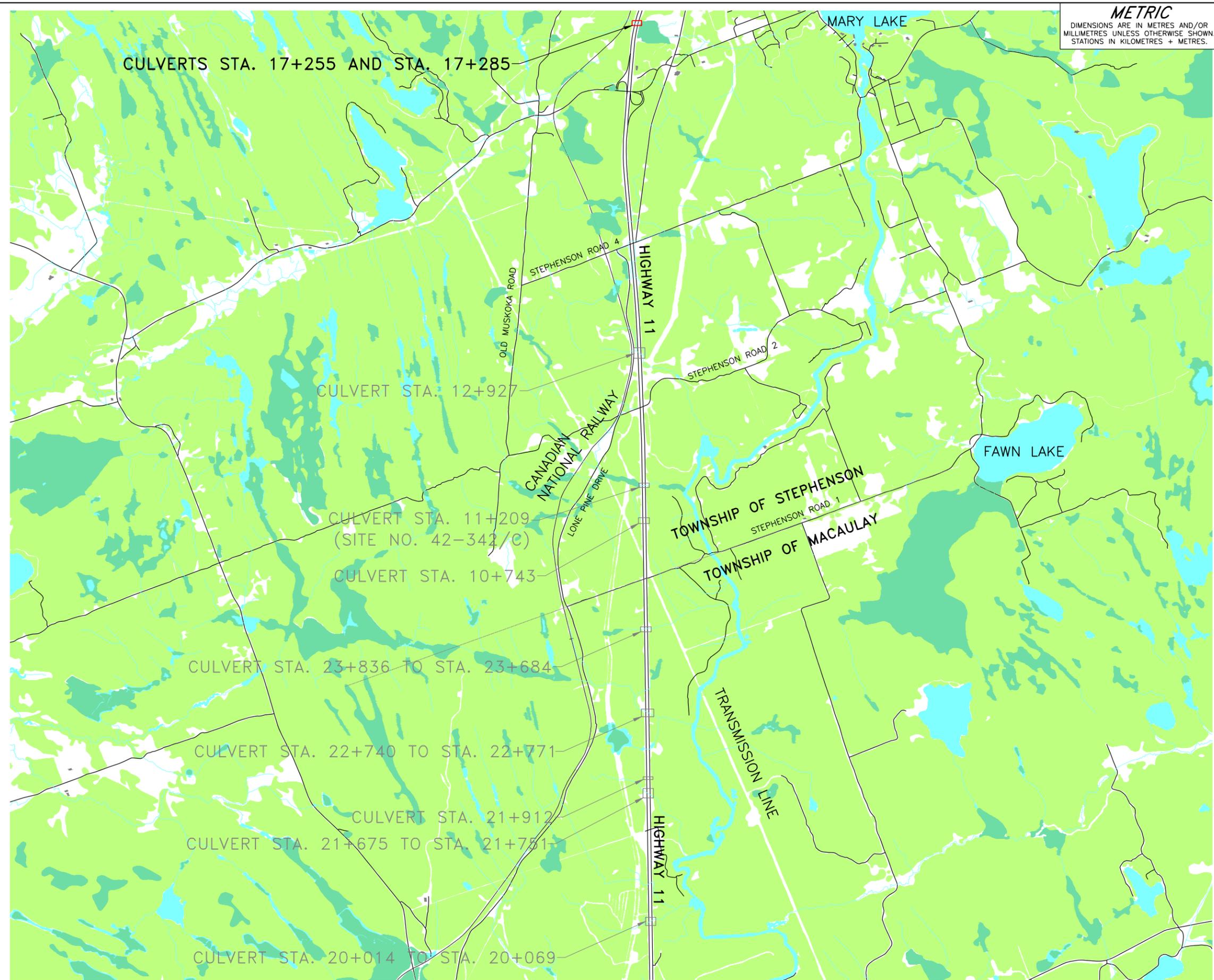
Table 1: Summary of Culvert Details

Culvert Location (Township)	Culvert ID	Approximate Height of Embankment ¹	Existing Culvert			Approximate Invert Elevation ²		Boreholes	Dynamic Cone Penetration Tests	Reference Appendix
			Type	Approximate Dimension	Approximate Length	West End of Culvert	East End of Culvert			
STA 17+255 (Stephenson)	C12	Up to 6 m	CSP	910 mm diameter	83 m	313.3 m	313.2 m	5 Boreholes (C12-01 to C12-05)	6 DCPTs (C12-DC01, C12-DC02A, C12-DC02B and C12-DC03 to C12-DC-05)	A
STA 17+285 (Stephenson)	C12	Up to 6 m	CSP	910 mm diameter	41 m	313.2 m	312.9 m	3 Boreholes (C12-06 to C12-08)	3 DCPTs (C12-DC06 to C12-DC08)	B

- Notes:
1. Embankment height is relative to existing ground surface level at the toe of embankment adjacent to the culvert.
 2. Culvert invert elevations are estimated based on the top of culvert surveys provided by exp. and culvert dimensions provided by AECOM.



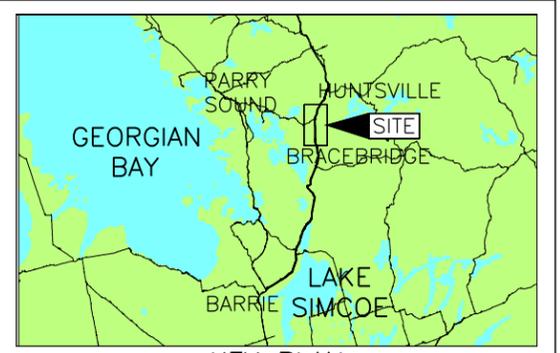
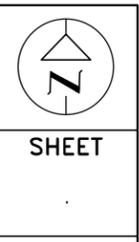
DRAWINGS



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

CONT No. _____
 GWP No. 5195-10-00

HIGHWAY 11
 CULVERTS
 INDEX PLAN



KEY PLAN
 NOT TO SCALE

P:\01_01\11110007_4204_Culverts\Report_3_C12\141110007_004-BC-0001.dwg
 PLOT DATE: 11/7/2014
 PLOT NAME: S:\Users\jv01\My...11\98_PROJECTS\141110007_4204_Culverts\Report_3_C12\141110007_004-BC-0001.dwg



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

NO.	DATE	BY	REVISION

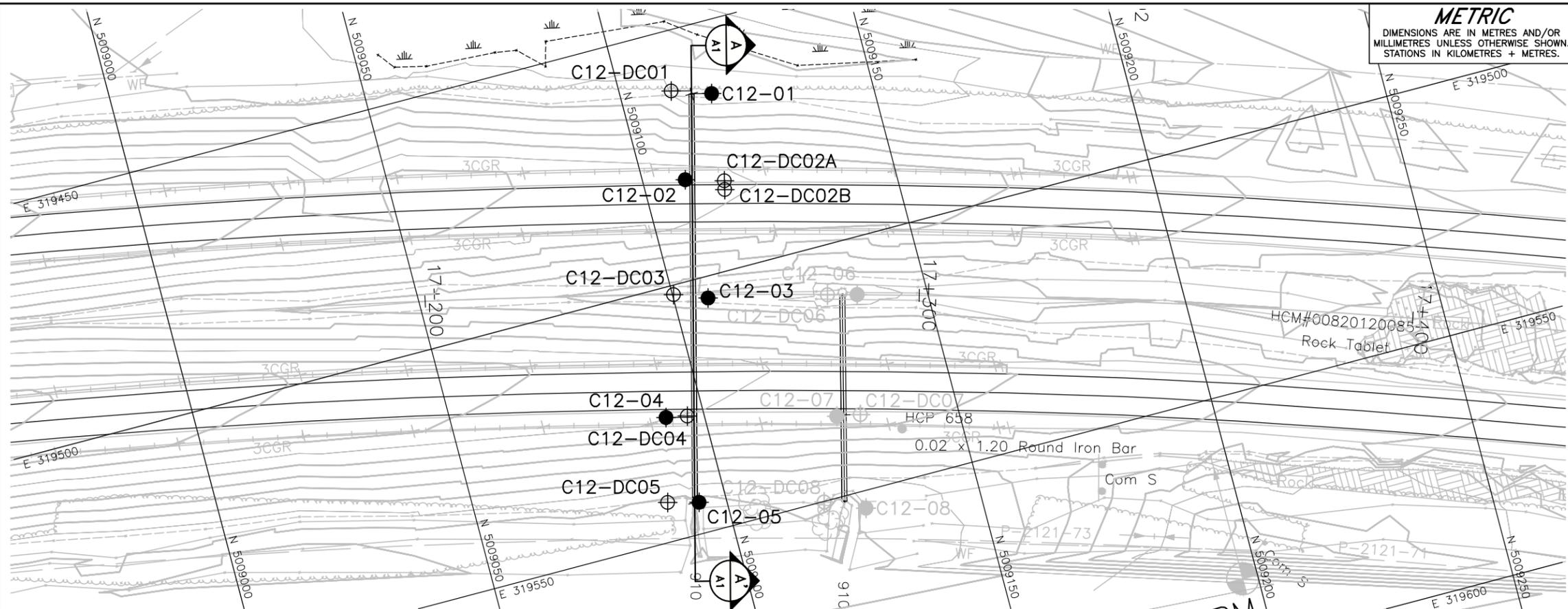
Geocres No. 31E-343

HWY.:	PROJECT NO.:	DIST.:
SUBM'D. MCK	CHKD. CN	DATE: 11/7/2014
DRAWN: MR	CHKD. CN	APPD. JMAC
		SITE: .
		DWG. 1



APPENDIX A

Culvert at STA 17+255 – Highway 11 – Township of Stephenson

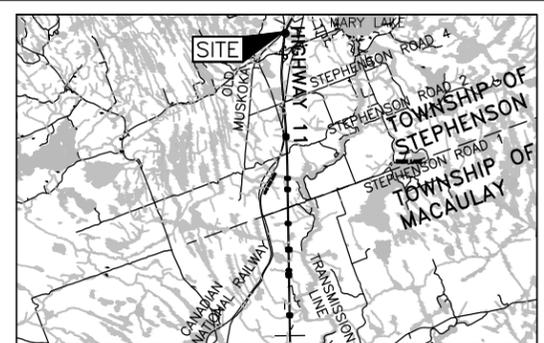


METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No. GWP No. 5195-10-00

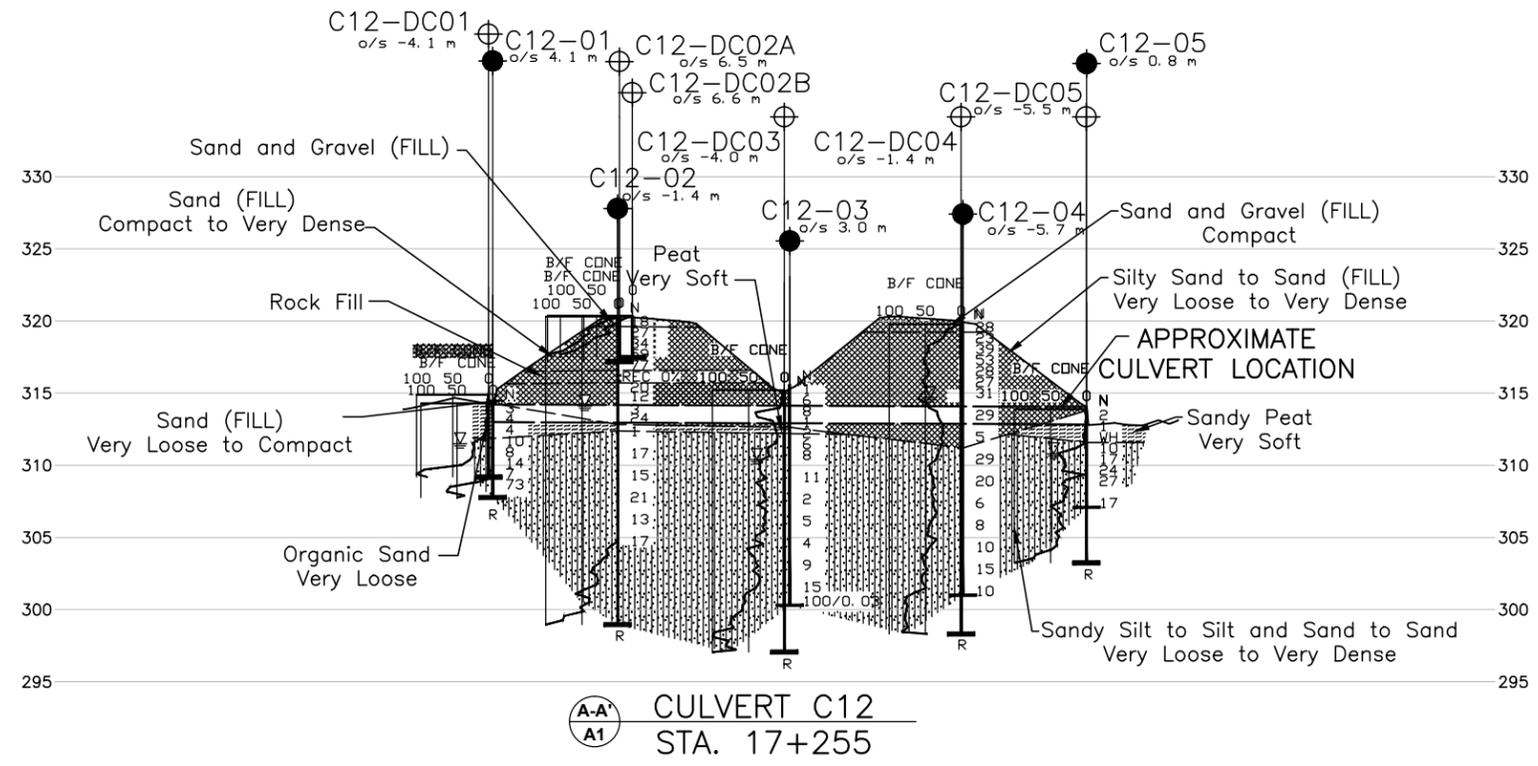
HIGHWAY 11
CULVERT STA. 17+255 (SBL AND NBL)
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



KEY PLAN
SCALE 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 0% Recovery %
 - ∇ WL upon completion of drilling
 - R Refusal



BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
C12-01	314.3	5009118.0	319464.6
C12-02	320.3	5009108.4	319480.1
C12-03	315.6	5009106.8	319504.3
C12-04	319.9	5009092.4	319525.5
C12-05	313.8	5009094.5	319543.7
C12-DC01	314.9	5009110.2	319462.0
C12-DC02A	320.4	5009116.0	319482.3
C12-DC02B	320.4	5009115.7	319484.0
C12-DC03	315.2	5009100.2	319501.9
C12-DC04	319.8	5009096.7	319526.3
C12-DC05	313.9	5009088.4	319542.1

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-343

HWY. 11	PROJECT NO. 14-1111-0007	DIST. .
SUBM'D. MCK	CHKD. CN	DATE: 11/7/2014
DRAWN: MR/JFC	CHKD. CN	APPD. JMAC
		DWG. A1

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.

PROJECT <u>14-1111-0007</u>	RECORD OF BOREHOLE No C12-01	SHEET 1 OF 1	METRIC
G.W.P. <u>5195-10-00</u>	LOCATION <u>N 5009118.0; E 319464.6</u>	ORIGINATED BY <u>MT</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>June 18, 2014</u>	CHECKED BY <u>CN</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
314.3	GROUND SURFACE															
0.0	ORGANIC SAND Very loose Black Moist	[Pattern]	1	SS	3											
		[Pattern]	2	SS	4											
		[Pattern]	3	SS	4											
311.9		[Pattern]	4A													
2.4	SAND, trace gravel, trace silt, trace clay Loose to very dense Grey Moist to wet	[Pattern]	4B	SS	10											
		[Pattern]	5	SS	8											2 90 6 2
		[Pattern]	6	SS	14											
		[Pattern]	7	SS	7											
308.4		[Pattern]	8	SS	73											8 87 (5)
5.9	END OF BOREHOLE Dynamic Cone Penetration Test (DCPT)															
307.8																
6.5	END OF DCPT REFUSAL TO FURTHER PENETRATION (50 Blows/0.13 m) (HAMMER BOUNCING)															
	NOTE: 1. Water level in open borehole at a depth of 2.8 m below ground surface (Elev. 311.5 m) upon completion of drilling.															

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PROJECT <u>14-1111-0007</u>	RECORD OF BOREHOLE No C12-02	SHEET 2 OF 2	METRIC
G.W.P. <u>5195-10-00</u>	LOCATION <u>N 5009108.4 ; E 319480.1</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>June 18, 2014</u>	CHECKED BY <u>CN</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
	--- CONTINUED FROM PREVIOUS PAGE ---					20 40 60 80 100	○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× REMOULDED						
304.5	Sandy SILT, trace clay Compact Grey Wet		15	SS	17	305										
15.9	END OF BOREHOLE					304										
303						303										
302						302										
301						301										
300						300										
299.0	END OF DCPT REFUSAL TO FURTHER PENETRATION (100 Blows/0.30 m)					299										
21.3	NOTE: 1. Water level in open borehole at a depth of 6.2 m below ground surface (Elev. 314.1 m) upon completion of drilling.															

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PROJECT <u>14-1111-0007</u>	RECORD OF BOREHOLE No C12-04	SHEET 1 OF 2	METRIC
G.W.P. <u>5195-10-00</u>	LOCATION <u>N 5009092.4 ; E 319525.5</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</u>	COMPILED BY <u>MT</u>	
DATUM <u>Geodetic</u>	DATE <u>June 17, 2014</u>	CHECKED BY <u>CN</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
319.9 0.0	GROUND SURFACE Sand and gravel (FILL) Compact Black to brown Dry to moist	[Cross-hatched]	1	SS	28											
319.2 0.7	Silty sand, trace gravel, trace clay (FILL) Loose to very dense Brown to grey Moist to wet	[Cross-hatched]	2	SS	23	319					o				3 74 21 2	
		[Cross-hatched]	3	SS	39	318										
		[Cross-hatched]	4	SS	53	317										
		[Cross-hatched]	5	SS	28	316					o					
		[Cross-hatched]	6	SS	27	315										
		[Cross-hatched]	7	SS	31	314										
		[Cross-hatched]	8	SS	29	313					o				1 79 20 0	
		[Cross-hatched]	9	SS	5	312										
311.2 8.7	SILT and SAND, trace clay Loose to compact Brown Wet	[Dotted]	10	SS	29	311						o			0 55 45 0	
		[Dotted]	11A	SS	20	310										
		[Dotted]	11B	SS	20	309										
		[Dotted]	12	SS	6	308					o				0 62 35 3	
		[Dotted]	13	SS	8	307										
		[Dotted]				306										
		[Dotted]				305										

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Continued Next Page

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

PROJECT <u>14-1111-0007</u>	RECORD OF BOREHOLE No C12-04	SHEET 2 OF 2	METRIC
G.W.P. <u>5195-10-00</u>	LOCATION <u>N 5009092.4 ; E 319525.5</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</u>	COMPILED BY <u>MT</u>	
DATUM <u>Geodetic</u>	DATE <u>June 17, 2014</u>	CHECKED BY <u>CN</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
	--- CONTINUED FROM PREVIOUS PAGE ---					20 40 60 80 100	○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× REMOULDED	WATER CONTENT (%)					
301.0	SILT and SAND, trace clay Loose to compact Brown Wet	[Strat Plot]	14	SS	10	304						○				
						303										
			15	SS	15	302										
						301										
18.9	END OF BOREHOLE															
	NOTE: 1. Water level in open borehole at a depth of 5.2 m below ground surface (Elev. 314.7 m) upon completion of drilling.															

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

PROJECT <u>14-1111-0007</u>	RECORD OF BOREHOLE No C12-05	SHEET 1 OF 1	METRIC
G.W.P. <u>5195-10-00</u>	LOCATION <u>N 5009094.5 ; E 319543.7</u>	ORIGINATED BY <u>EG</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 8, 2014</u>	CHECKED BY <u>CN</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						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	10 20 30	10 20 30	10 20 30		
313.8 0.0	GROUND SURFACE Sandy PEAT Very soft Brown Moist to wet	[Pattern]	1	SS	2											
		[Pattern]	2	SS	1									234.5		
		[Pattern]	3	SS	WH									433.7		
311.6 2.2	SAND, trace to some silt Compact Brown to grey Wet	[Pattern]	4	SS	10	▽										
		[Pattern]	5	SS	17								○		0 91 (9)	
		[Pattern]	6	SS	24											
		[Pattern]	7	SS	27											
308.2 5.6	SILT and SAND, trace clay Compact Grey Wet	[Pattern]	8	SS	17									○		0 57 40 3
307.1 6.7	END OF BOREHOLE NOTE: 1. Water level in open borehole at a depth of 3.0 m below ground surface (Elev. 310.8 m) upon completion of drilling.															

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

PROJECT <u>14-1111-0007</u>	RECORD OF DCPT No C12-DC01	SHEET 1 OF 1	METRIC
G.W.P. <u>5195-10-00</u>	LOCATION <u>N 5009110.2; E 319462.0</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 16, 2014</u>	CHECKED BY <u>CN</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
						20	40	60	80	100						
314.9 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)					314										
313						313										
312						312										
311						311										
310						310										
309.2 5.7	END OF DCPT REFUSAL TO FURTHER PENETRATION (85 Blows / 0.23 m) (HAMMER BOUNCING)															

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

PROJECT <u>14-1111-0007</u>	RECORD OF DCPT No C12-DC02A	SHEET 1 OF 1	METRIC
G.W.P. <u>5195-10-00</u>	LOCATION <u>N 5009116.0; E 319482.3</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 16, 2014</u>	CHECKED BY <u>CN</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
						20	40	60	80	100					
320.4 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)					320									
						319									
						318									
317.2 3.2	END OF DCPT REFUSAL TO FURTHER PENETRATION (100 Blows / 0.13 m) (HAMMER BOUNCING)									177					

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PROJECT <u>14-1111-0007</u>	RECORD OF DCPT No C12-DC02B	SHEET 1 OF 1	METRIC
G.W.P. <u>5195-10-00</u>	LOCATION <u>N 5009115.7 ; E 319484.0</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 16, 2014</u>	CHECKED BY <u>CN</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
320.4 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	10 20 30	10 20 30				
317.5 2.9	END OF DCPT REFUSAL TO FURTHER PENETRATION (100 Blows / 0.15 m) (HAMMER BOUNCING) NOTE: 1. DCPT C12-DC02B advanced 1.5 m north of DCPT C12-DC02A.					320	319	318								

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

PROJECT <u>14-1111-0007</u>	RECORD OF DCPT No C12-DC03	SHEET 1 OF 2	METRIC
G.W.P. <u>5195-10-00</u>	LOCATION <u>N 5009100.2; E 319501.9</u>	ORIGINATED BY <u>EG</u>	
DIST <u>HWY 11</u>	BOREHOLE TYPE <u>CME 55, Dynamic Cone Penetration Test</u>	COMPILED BY <u>MT</u>	
DATUM <u>Geodetic</u>	DATE <u>July 22, 2014</u>	CHECKED BY <u>CN</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
315.2 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)					315							
						314							
						313							
						312							
						311							
						310							
						309							
						308							
						307							
						306							
						305							
						304							
						303							
						302							
						301							

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Continued Next Page

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

PROJECT 14-1111-0007 **RECORD OF DCPT No C12-DC04** SHEET 2 OF 2 **METRIC**
 G.W.P. 5195-10-00 LOCATION N 5009096.7 ; E 319526.3 ORIGINATED BY ID
 DIST HWY 11 BOREHOLE TYPE CME 55, Dynamic Cone Penetration Test COMPILED BY MT
 DATUM Geodetic DATE June 18, 2014 CHECKED BY CN

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20	40					
	--- CONTINUED FROM PREVIOUS PAGE --- Dynamic Cone Penetration Test (DCPT)												
298.3 21.5	END OF DCPT REFUSAL TO FURTHER PENETRATION (47 Blows / 0.15 m) (HAMMER BOUNCING)												

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PROJECT 14-1111-0007 **RECORD OF DCPT No C12-DC05** SHEET 1 OF 1 **METRIC**
G.W.P. 5195-10-00 **LOCATION** N 5009088.4 ; E 319542.1 **ORIGINATED BY** EG
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 W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20	40						60	80	100	20	40	60
313.9 0.0	GROUND SURFACE Dynamic Cone Penetration Test (DCPT)																		
303.2 10.7	END OF DCPT REFUSAL TO FURTHER PENETRATION (100 Blows / 0.29 m)																		

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



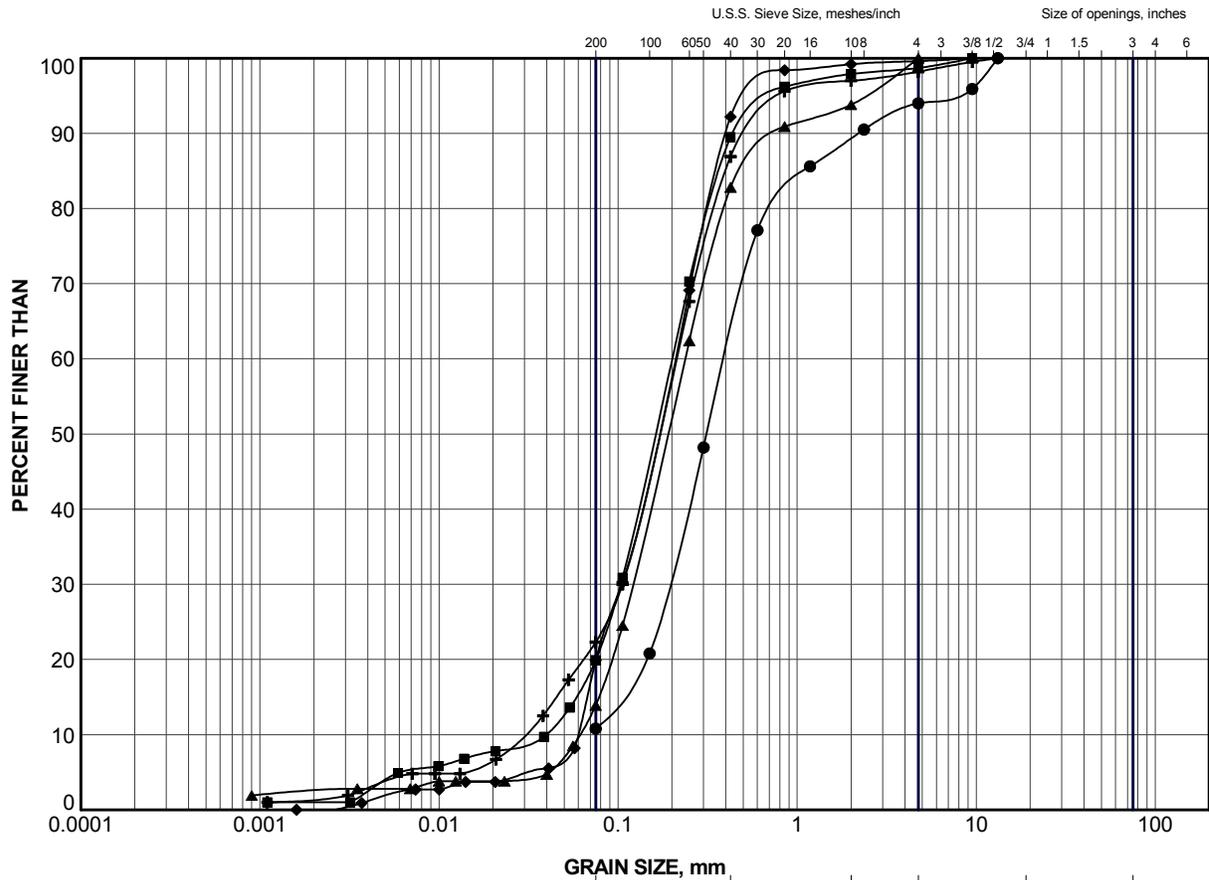
**PRELIMINARY FOUNDATION REPORT - HIGHWAY 11 RESURFACING
CULVERTS, GWP 5195-10-00**

Table A1: Summary of Analytical Testing of Surface Water

Culvert Location Highway 11 (Township)	Parameter (Units, Detection Limit)				
	Chloride (mg/L)	Sulfate (mg/L)	Conductivity (μ S/cm)	Resistivity (Ω -cm)	pH
STA 17+255 (Stephenson)	330 / 4	11 / 1	1200 / 1	840	6.36

Notes: 1. Samples obtained July 18, 2014
2. Analytical testing carried out by Maxxam

Prepared by: MCK
Checked by: CN
Reviewed by: JMAC



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

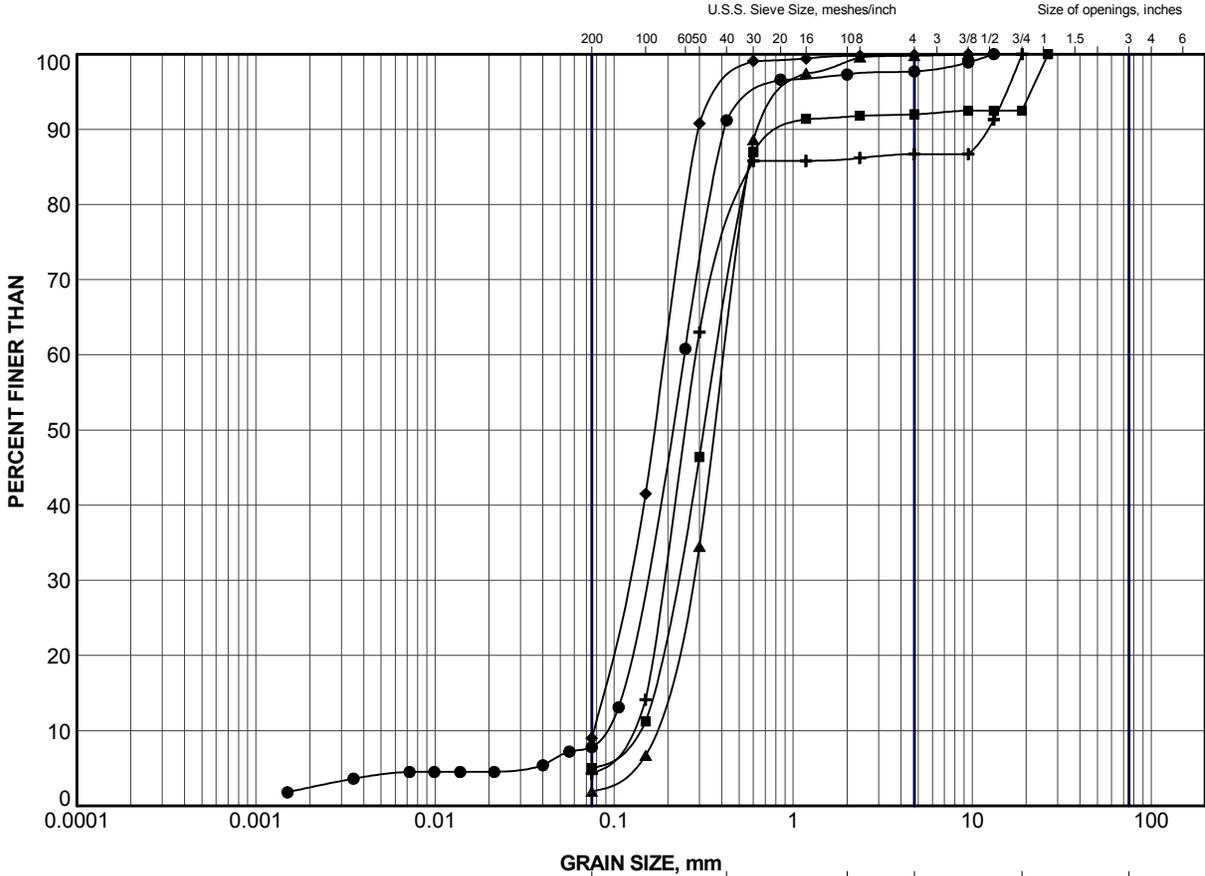
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C12-02	3	318.5
■	C12-02	7	314.8
▲	C12-03	2	314.5
+	C12-04	2	318.8
◆	C12-04	8	313.5

PROJECT					HIGHWAY 11 RESURFACING HIGHWAY 11 (SBL AND NBL) CULVERT 17+255				
TITLE					GRAIN SIZE DISTRIBUTION SILTY SAND to SAND (FILL)				
PROJECT No.		14-1111-0007			FILE No.		14-1111-0007.GPJ		
DRAWN	TB	Oct 2014			SCALE	N/A		REV.	
CHECK	MCK	Oct 2014			FIGURE A1				
APPR	CN	Oct 2014							



SUD-MTO GSD (NEW) GLDR_LDN.GDT



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

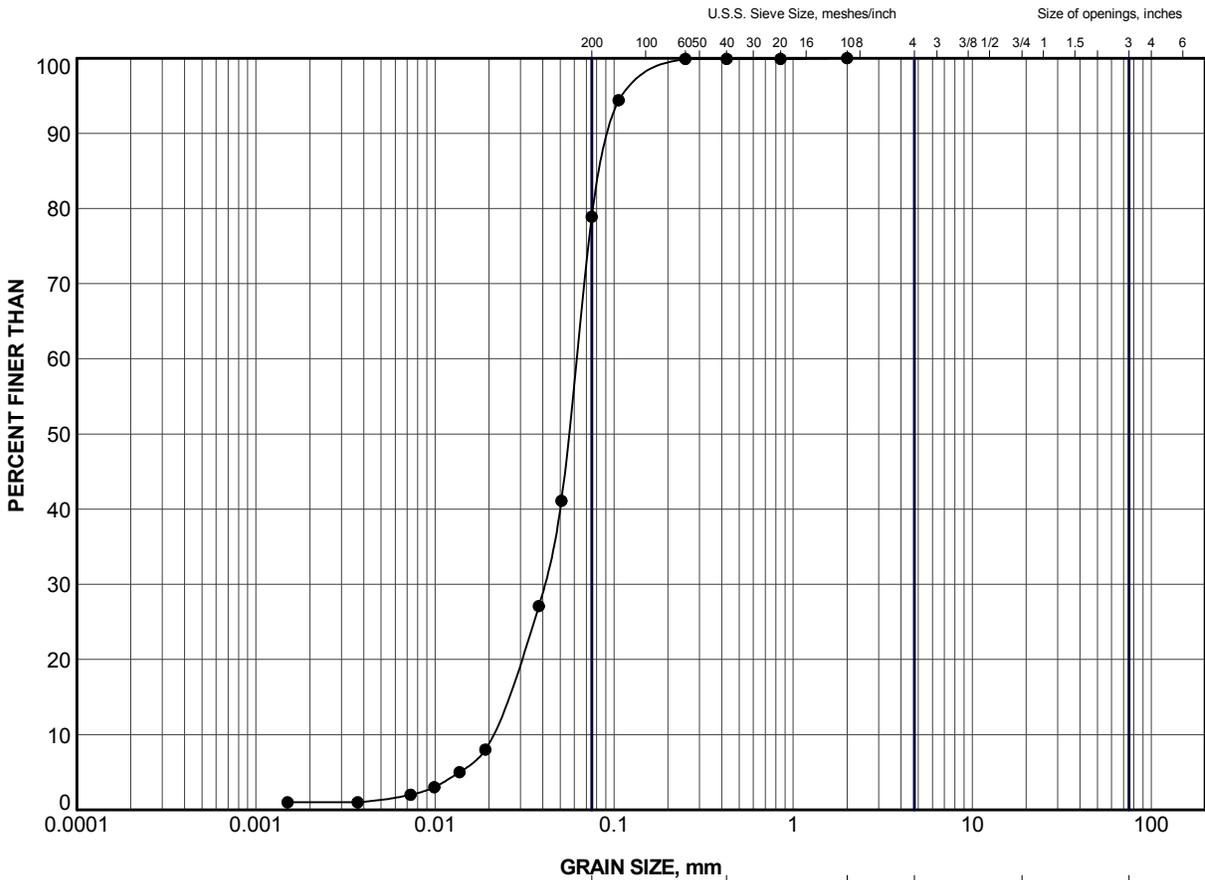
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C12-01	5	311.0
■	C12-01	8	308.7
▲	C12-02	11	310.9
+	C12-03	6	311.5
◆	C12-05	5	310.5

PROJECT					HIGHWAY 11 RESURFACING HIGHWAY 11 (SBL AND NBL) CULVERT 17+255				
TITLE					GRAIN SIZE DISTRIBUTION SAND				
PROJECT No.		14-1111-0007			FILE No.		14-1111-0007.GPJ		
DRAWN	TB	Oct 2014			SCALE	N/A	REV.		
CHECK	MCK	Oct 2014			FIGURE A2				
APPR	CN	Oct 2014							



SUD-MTO GSD (NEW) GLDR_LDN.GDT



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

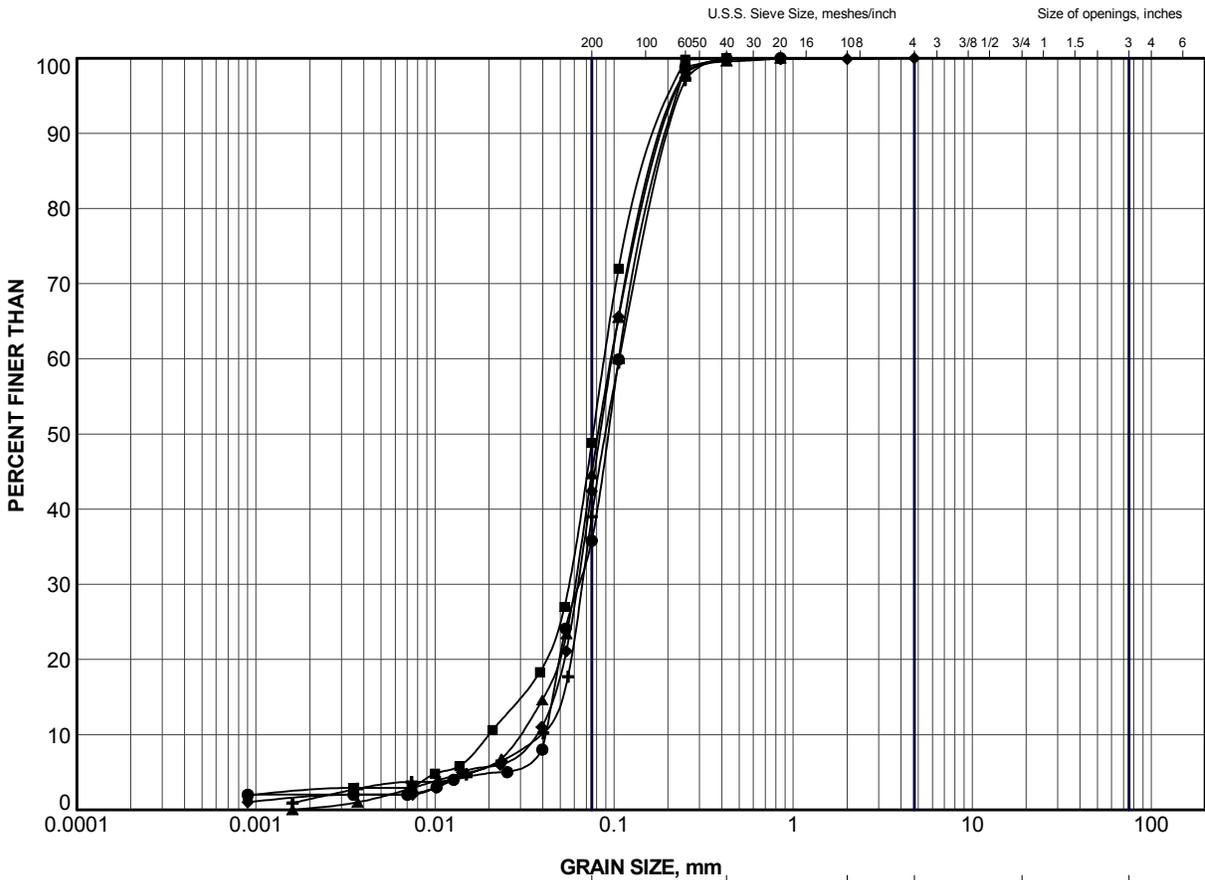
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C12-02	14	306.3

PROJECT					HIGHWAY 11 RESURFACING HIGHWAY 11 (SBL AND NBL) CULVERT 17+255				
TITLE					GRAIN SIZE DISTRIBUTION SANDY SILT				
PROJECT No.		14-1111-0007			FILE No.		14-1111-0007.GPJ		
DRAWN	TB	Oct 2014			SCALE	N/A		REV.	
CHECK	MCK	Oct 2014			FIGURE A3				
APPR	CN	Oct 2014							



SUD-MTO GSD (NEW) GLDR_LDN.GDT



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C12-03	9	307.7
■	C12-03	12	303.1
▲	C12-04	10	310.5
+	C12-04	12	307.4
◆	C12-05	8	307.4

PROJECT HIGHWAY 11 RESURFACING HIGHWAY 11 (SBL AND NBL) CULVERT 17+255				
TITLE GRAIN SIZE DISTRIBUTION SILT and SAND				
PROJECT No. 14-1111-0007		FILE No. 14-1111-0007.GPJ		
DRAWN	TB	Oct 2014	SCALE	N/A
CHECK	MCK	Oct 2014	FIGURE A4	
APPR	CN	Oct 2014		
 Golder Associates SUDBURY, ONTARIO				



APPENDIX B

Culvert at STA 17+285 – Highway 11 – Township of Stephenson

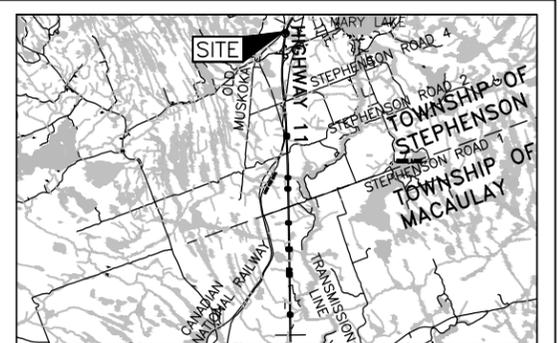
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No. GWP No. 5195-10-00

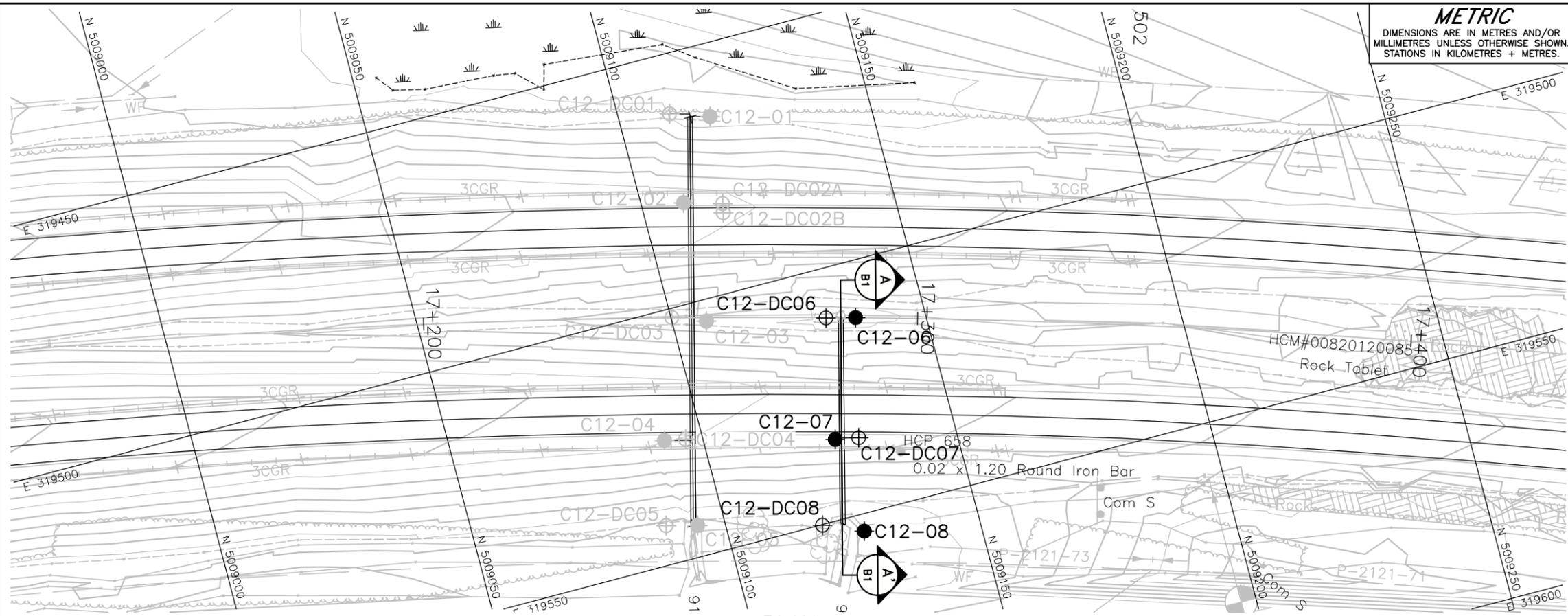


HIGHWAY 11
CULVERT STA. 17+285 (NBL)
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



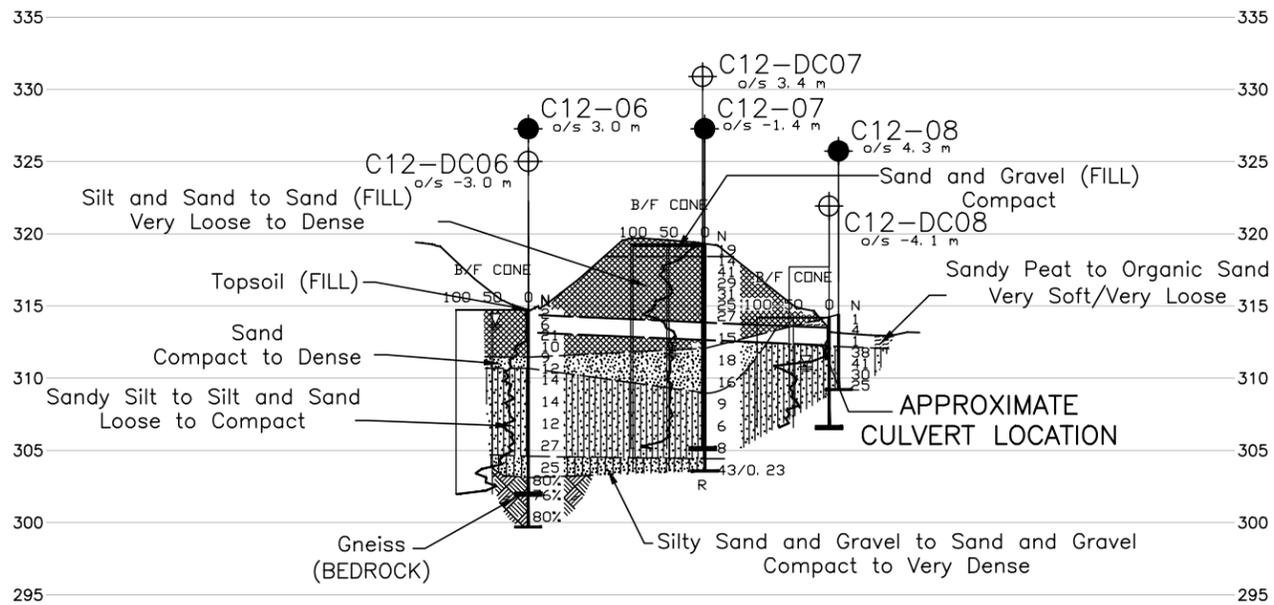
KEY PLAN
SCALE 3 0 3 6 km



PLAN
SCALE 10 0 10 20 m

LEGEND

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



A-A'
B1
CULVERT C12
STA. 17+285



BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
C12-06	314.8	5009136.2	319511.3
C12-07	319.2	5009125.9	319534.0
C12-08	314.4	5009126.9	319553.5
C12-DC06	314.7	5009130.3	319509.9
C12-DC07	319.3	5009130.6	319534.9
C12-DC08	314.2	5009119.0	319550.1

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-343

HWY. 11	PROJECT NO. 14-1111-0007	DIST. .
SUBM'D. MCK	CHKD. CN	DATE: 11/7/2014
DRAWN: MR/JFC	CHKD. CN	APPD. JMAC
		DWG. B1

PROJECT 14-1111-0007 **RECORD OF BOREHOLE No C12-07** **SHEET 1 OF 2** **METRIC**
G.W.P. 5195-10-00 **LOCATION** N 5009125.9;E 319534.0 **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 17, 2014 **CHECKED BY** CN

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)						
						20	40	60	80	100	20	40	60	80	100	10	20	30	GR	SA	SI	CL	
319.2	GROUND SURFACE																						
0.0	Sand and gravel (FILL) Compact Brown Moist		1	SS	19																		
318.4			2	SS	14																		
0.8	Sand, trace to some silt, trace clay (FILL) Compact to dense Brown Moist to wet		3	SS	41																		
			4	SS	29																		0 82 16 2
			5	SS	31																		
			6	SS	25																		
			7	SS	27																		
			8	SS	15																		0 88 11 1
312.0																							
7.2	SAND, trace to some silt Compact Brown Wet		9	SS	18																		
			10	SS	16																		
309.0																							
10.2	Sandy SILT Loose Grey to brown Wet		11	SS	9																		
			12	SS	6																		0 22 76 2
			13	SS	8																		
304.4																							
14.8																							

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

PROJECT <u>14-1111-0007</u>	RECORD OF BOREHOLE No C12-07	SHEET 2 OF 2	METRIC
G.W.P. <u>5195-10-00</u>	LOCATION <u>N 5009125.9; E 319534.0</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 17, 2014</u>	CHECKED BY <u>CN</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
	-- CONTINUED FROM PREVIOUS PAGE --															
303.6 15.6	SAND and GRAVEL Very dense Grey Wet		14	SS	43/0.23								o			
	END OF BOREHOLE SPOON REFUSAL AND REFUSAL TO FURTHER CASING ADVANCEMENT (HAMMER BOUNCING) NOTE: 1. Water level in open borehole at a depth of 7.5 m below ground surface (Elev. 311.7 m) upon completion of drilling.															

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PROJECT 14-1111-0007 **RECORD OF DCPT No C12-DC07** SHEET 1 OF 2 **METRIC**
 G.W.P. 5195-10-00 LOCATION N 5009130.6; E 319534.9 ORIGINATED BY ID
 DIST HWY 11 BOREHOLE TYPE CME 55, Dynamic Cone Penetration Test COMPILED BY MT
 DATUM Geodetic DATE June 18, 2014 CHECKED BY CN

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
319.3	GROUND SURFACE												
0.0	Dynamic Cone Penetration Test (DCPT)												
						319							
						318							
						317							
						316							
						315							
						314							
						313							
						312							
						311							
						310							
						309							
						308							
						307							
						306							
305.1	END OF DCPT REFUSAL TO FURTHER PENETRATION												
14.2													

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

PROJECT <u>14-1111-0007</u>	RECORD OF DCPT No C12-DC07	SHEET 2 OF 2	METRIC
G.W.P. <u>5195-10-00</u>	LOCATION <u>N 5009130.6 ; E 319534.9</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>June 18, 2014</u>	CHECKED BY <u>CN</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
	-- CONTINUED FROM PREVIOUS PAGE --															
	(70 Blows / 0.15 m) (HAMMER BOUNCING)															

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PROJECT 14-1111-0007 **RECORD OF DCPT No C12-DC08** SHEET 1 OF 1 **METRIC**
 G.W.P. 5195-10-00 LOCATION N 5009119.0; E 319550.1 ORIGINATED BY MT
 DIST HWY 11 BOREHOLE TYPE Portable Equipment, Dynamic Cone Penetration Test COMPILED BY MT
 DATUM Geodetic DATE June 17, 2014 CHECKED BY CN

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40	60
314.2	GROUND SURFACE																		
0.0	Dynamic Cone Penetration Test (DCPT)					314													
						313													
						312													
						311													
						310													
						309													
						308													
						307													
306.6	END OF DCPT																		
7.6																			

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

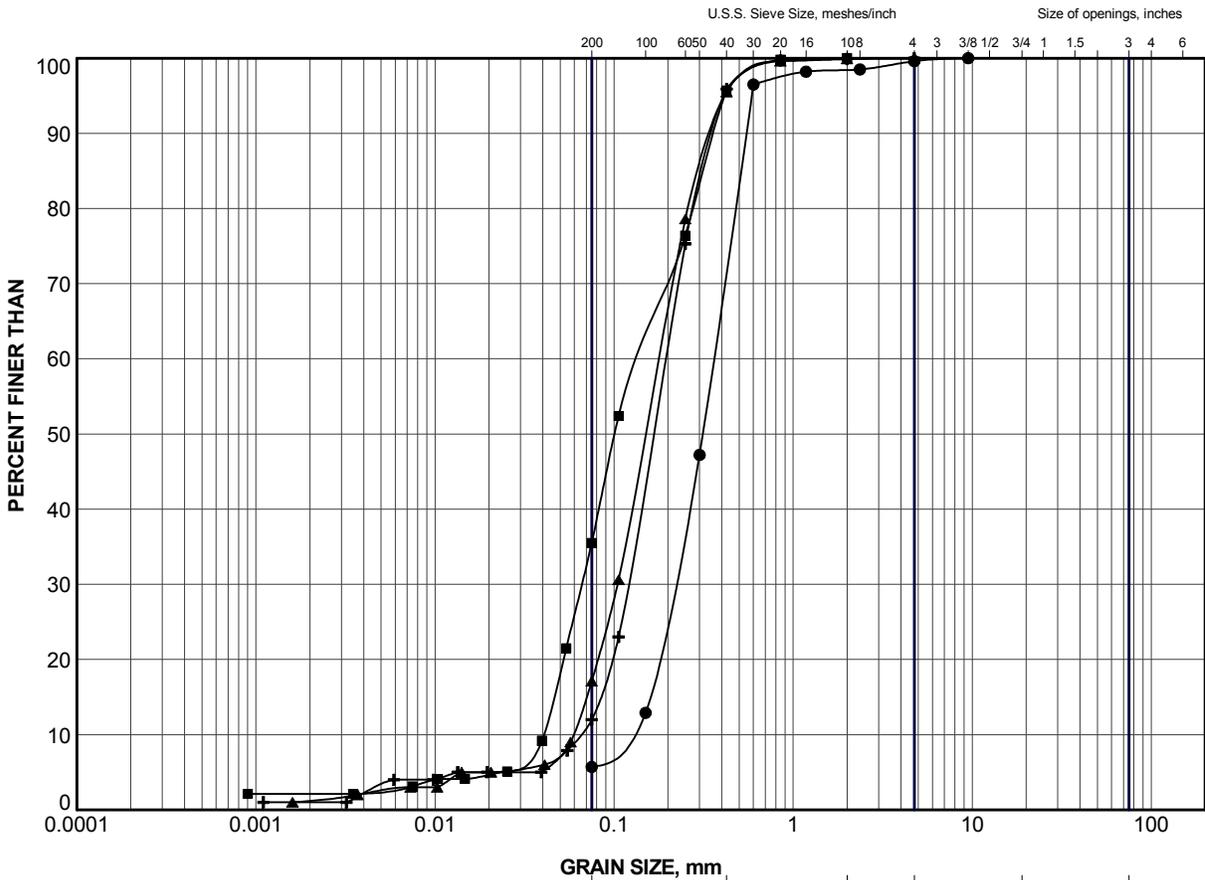


Table B1: Summary of Analytical Testing of Surface Water

Culvert Location Highway 11 (Township)	Parameter (Units, Detection Limit)				
	Chloride (mg/L)	Sulfate (mg/L)	Conductivity (μ S/cm)	Resistivity (Ω -cm)	pH
STA 17+285 (Stephenson)	710 / 7	19 / 1	2400 / 1	410	6.59

Notes: 1. Samples obtained July 18, 2014
2. Analytical testing carried out by Maxxam

Prepared by: MCK
Checked by: CN
Reviewed by: JMAC



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

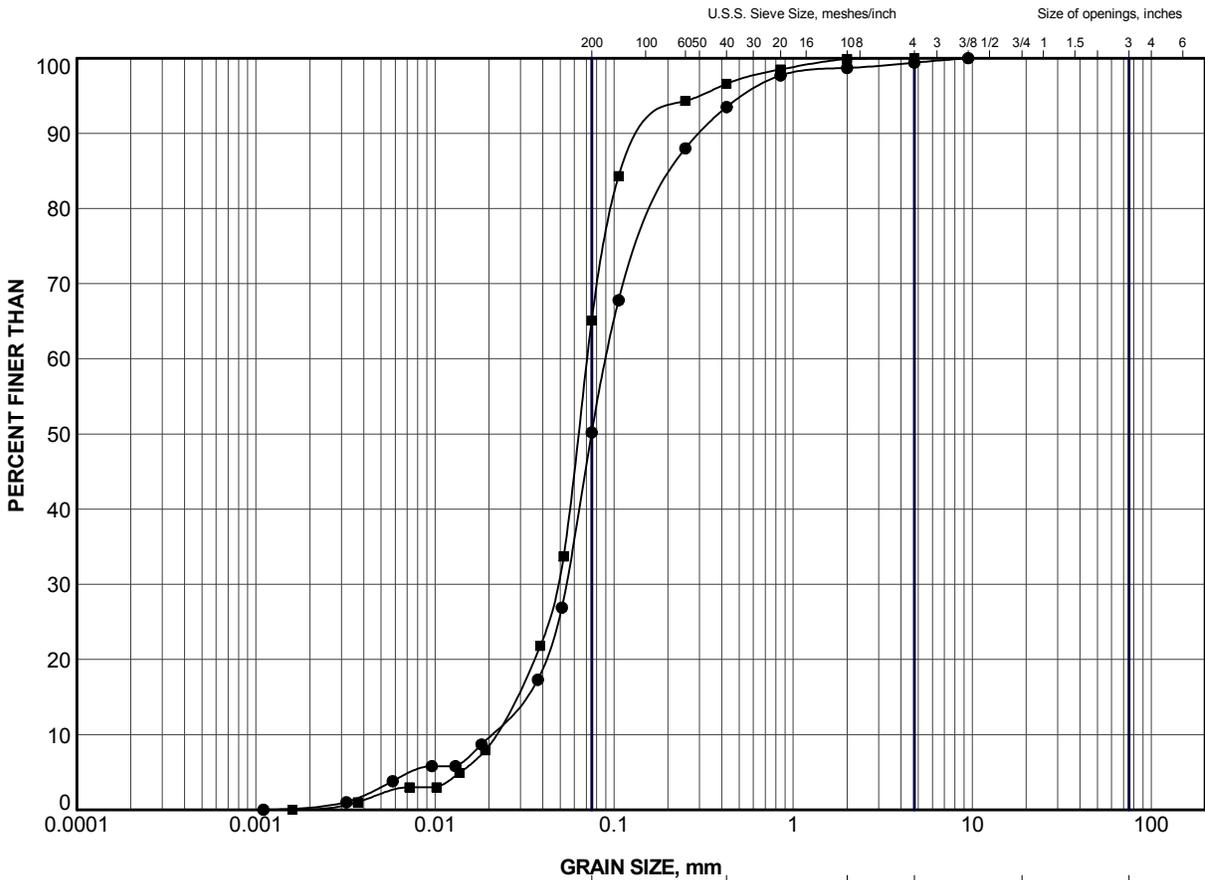
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C12-06	3	313.0
■	C12-06	5A	311.6
▲	C12-07	4	316.6
+	C12-07	8	312.8

PROJECT					HIGHWAY 11 RESURFACING HIGHWAY 11 (NBL) CULVERT 17+285				
TITLE					GRAIN SIZE DISTRIBUTION SILT to SAND (FILL)				
PROJECT No.		14-1111-0007		FILE No.		14-1111-0007.GPJ			
DRAWN	TB	Oct 2014		SCALE	N/A	REV.			
CHECK	MCK	Oct 2014		FIGURE B1					
APPR	CN	Oct 2014							



SUD-MTO GSD (NEW) GLDR_LDN.GDT



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

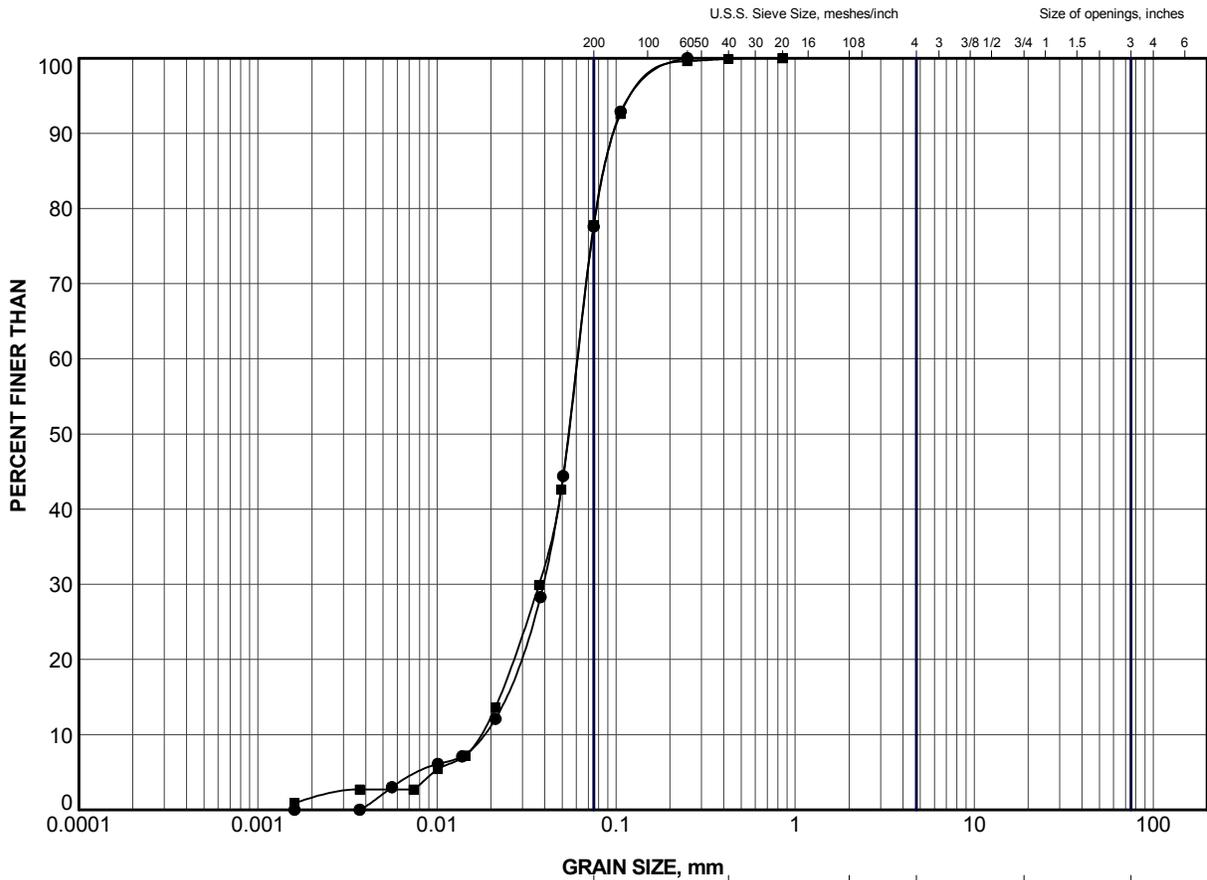
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C12-08	5	311.1
■	C12-08	7	309.5

PROJECT					HIGHWAY 11 RESURFACING HIGHWAY 11 (NBL) CULVERT 17+285				
TITLE					GRAIN SIZE DISTRIBUTION SILT and SAND				
PROJECT No.		14-1111-0007			FILE No.		14-1111-0007.GPJ		
DRAWN	TB	Nov 2014			SCALE	N/A		REV.	
CHECK	MCK	Nov 2014			FIGURE B3				
APPR	CN	Nov 2014							



SUD-MTO GSD (NEW) GLDR_LDN.GDT



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

LEGEND			
SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C12-06	9	306.9
■	C12-07	12	306.7

PROJECT					HIGHWAY 11 RESURFACING HIGHWAY 11 (NBL) CULVERT 17+285				
TITLE					GRAIN SIZE DISTRIBUTION SANDY SILT				
PROJECT No.		14-1111-0007			FILE No.		14-1111-0007.GPJ		
DRAWN	TB	Oct 2014			SCALE	N/A		REV.	
CHECK	MCK	Oct 2014			FIGURE B4				
APPR	CN	Oct 2014							
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