REPORT

March 16, 2018

FOUNDATION INVESTIGATION AND DESIGN REPORT

STRUCTURAL BUNDLE - 11 STRUCTURES ON HIGHWAYS 129, 532 AND 556
HIGHWAY 129 - WENEBEGON RIVER TRIBUTARY CULVERT REHABILITATION, 37.8 KM NORTH OF HIGHWAY 556 (SITE NO. 46-331/C) - LAT. 47.126965 ; LONG. -83.142217
LANE TOWNSHIP, ALGOMA DISTRICT, ONTARIO
GWP 5272-14-00 ; WP 5272-14-01

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Golder Associates

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FOUNDATION INVESTIGATION REPORT
STRUCTURAL BUNDLE – 11 STRUCTURES ON HIGHWAYS 129, 532 AND 556
HIGHWAY 129 – WENEBEGON RIVER TRIBUTARY CULVERT REHABILITATION, 37.8 KM NORTH OF HIGHWAY 556 (SITE NO. 46S-331/C) – LAT. 47.126965 ; LONG. -83.142217
LANE TOWNSHIP, ALGOMA DISTRICT, ONTARIO
MINISTRY OF TRANSPORTATION, ONTARIO
GWP 5272-14-00 ; WP 5272-14-01

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Golder Associates

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by AECOM on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for the support of dewatering works for the rehabilitation of a culvert on Highway 129 (Site No. 46-331/C) in the Lane Township, Algoma District, Ontario.

The purpose of the field investigation is to establish the subsurface conditions near the inlet and outlet of the existing culvert by methods of borehole drilling, in-situ testing and laboratory testing on selected soil samples.

This report summarizes the factual results of the field and laboratory work (including field investigation procedures, borehole stratigraphy, and geotechnical and analytical laboratory test results) as well as a description of the interpreted soil and groundwater conditions at the Wenebegon River Tributary culvert site.

The Terms of Reference and Scope of Work for the foundation investigation are outlined in MTO's Request for Proposal dated May 2016 (Agreement No. 5016-E-0029). Golder's proposal for foundation engineering services is contained in Section 17.8 of AECOM's Technical Proposal for this assignment.

2.0 PROJECT AND SITE DESCRIPTION

2.1 Project Description

The existing culvert at the site conveys the Wenebegon River Tributary under Highway 129 in a northwest to southeast direction. The culvert was constructed in 1987 and there is no history of the culvert undergoing rehabilitation works. It is understood that a structural assessment of the existing culvert was carried out in 2015 at which time the culvert was identified as being in good structural condition with significant deterioration of the structural steel coatings. As such, the culvert is expected to be rehabilitated by lining the barrel.

2.2 Site Description

The site of the existing culvert is located about 37.8 km north of Highway 556 in the Lane Township, Algoma District, Ontario.

The existing culvert structure consists of a single cell Corrugated Steel Pipe (CSP) of approximately 3 m diameter and is about 40 m long. The invert of this culvert is at approximately Elevation 418.3 m. Concrete cut-off walls, approximately 5.6 m long by 2.2 m high, are located at the inlet and outlet of the culvert. The top of the wall is at approximately Elevation 419.2 m at the inlet and at approximately Elevation 419.0 m at the outlet.

Highway 129 at the location of the culvert is supported by an approximately 5 m to 5.5 m high embankment that carries one lane of traffic in each direction. The travelled portion of the highway consists of a paved surface with unpaved shoulders. The highway surface is at approximately Elevation 423.8 m in the vicinity of the culvert.

It is noted that overhead electrical transmission lines run along the highway on the west side of Highway 129 (i.e., immediately west of the inlet).

In general, the topography in the area of the culvert is relatively flat to rolling with relatively sparse tree/brush cover along the highway right-of-way.

3.0 INVESTIGATION PROCEDURES

The fieldwork at the culvert site was carried out on August 2 and 3 as well as on August 10 and 11, 2017 during which time two boreholes (designated as Boreholes WRC-01 and WRC-02) were advanced near the inlet and outlet of the culvert, respectively.

The subsurface soil conditions encountered in the boreholes are shown in detail on the Records of Boreholes in Appendix A. Lists of abbreviations and symbols are also provided in Appendix A to assist in the interpretation of the borehole records. The locations of the as-drilled boreholes are shown in plan on Drawing 1.

The boreholes were advanced using portable drilling equipment supplied and operated by Ohlmann Geotechnical Services (OGS) Drilling Inc. of Almonte, Ontario. Both boreholes were advanced using NW casing with wash boring techniques, and NQ coring, where required to penetrate through cobbles/boulders. The soil samples were generally obtained at intervals of depth of about 0.75 m and 1.5 m, using a 50 mm outer diameter split-spoon sampler driven by a manual hammer in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586).

The boreholes were advanced to depths of 10 m and 9 m below existing water surface and backfilled upon completion in accordance with Ontario Regulation 903 (Wells) (as amended).

Prior to commencement of field work, Golder arranged for the clearance of underground utilities/services. The field work was observed on a full-time basis by a member of Golder's engineering staff who monitored the drilling and sampling operations, and logged the boreholes in the field. The soil samples were transported to Golder's Mississauga geotechnical laboratory where the samples underwent further visual examination and geotechnical laboratory testing.

Geotechnical classification testing (i.e., water content and grain size distribution) was carried out on selected soil samples. The results of the geotechnical laboratory testing are summarized on the borehole records in Appendix A and the details of the geotechnical testing are provided in Appendix B. All of the laboratory tests were carried out in accordance with MTO Laboratory and/or ASTM Standards, as appropriate.

A soil sample was also collected from Borehole WRC-01 for corrosivity testing. The selected soil sample was submitted, under chain-of-custody procedures, to Maxxam Analytics of Mississauga, Ontario (a Standards Council of Canada accredited laboratory) for analysis of a suite of corrosivity parameters including pH, sulphate, sulphide, chloride and resistivity/conductivity

Temporary benchmarks were established and surveyed near the existing culvert by Callon Dietz Inc. prior to the drilling crew mobilizing to site. Upon completion of drilling, borehole offsets and corresponding ground surface elevation changes were recorded and tied-in to the surveyed benchmark locations to determine the as-drilled borehole locations and ground surface elevations. The borehole survey information, including northing and easting coordinates (presented in the MTM NAD83 Zone 13 and latitude / longitude coordinate systems) and the ground surface elevations referenced to Geodetic datum, are provided on the borehole records in Appendix A, presented on Drawing 1, and summarized below.

Borehole No.	Approximate Location	Coordinates (MTM NAD83 Zone 13)		Water Surface Elevation	Borehole Depth
		Northing (Latitude)	Easting (Longitude)		
WRC-01	Inlet – west toe of Highway 129 embankment [1]	5221208.5 (47.127072°)	369857.2 (-83.142491°)	418.6 m	10.0 m [2]
WRC-02	Outlet – east toe of Highway 129 embankment [1]	5221183.4 (47.126842°)	369898.4 (-83.141952°)	418.4 m	9.0 m [2]

Notes:
1. Boreholes WRC-01 and WRC-02 were advanced using portable drilling equipment set up on a drilling platform in the Wenebegon River Tributary near the highway embankment toes.
2. The termination depth at the locations of Boreholes WRC-01 and WRC-02 was measured from the water surface in the Wenebegon River Tributary. The water depth in the river at the inlet and outlet of the existing culvert was about 0.4 m and 1.0 m at the time of drilling.

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

Based on Northern Ontario Engineering Geology Terrain (NOEGTS)[1] mapping, the Wenebegon River Tributary culvert site is located within an outwash plain consisting primarily of sandy and gravelly soils, bordered by bedrock knobs. The area is generally described as undulating to rolling with areas of low relief where watercourses and lakes have formed.

Based on geological mapping developed by the Ontario Ministry of Northern Development and Mines (MNDM)[2], the site is underlain by strong bedrock consisting of massive granodiorite to granite.

4.2 Subsurface Conditions

The subsurface soil and groundwater conditions encountered in the boreholes advanced at this site, together with the results of the in-situ and geotechnical laboratory testing, are presented on the Records of Boreholes (provided in Appendix A) and the laboratory test figures/sheets (provided in Appendix B). The results of the analytical testing are included in Appendix C. The results of the in-situ field tests (i.e., SPT 'N'-values) as presented on the borehole records are uncorrected, and are based on sampling procedures carried out with a manual hammer at the locations of Boreholes WRC-01 and WRC-02.

The stratigraphic boundaries shown on the borehole records and on the soil strata profile (i.e., Drawing 1) are inferred from observations of drilling progress, non-continuous sampling, and in-situ testing and therefore, represent transitions between soil types rather than exact planes of geological change. Further, subsurface conditions will vary between and beyond the borehole locations.

In general, the subsurface conditions encountered at the Wenebegon River Tributary culvert site consist of water (associated with the Wenebegon River Tributary) underlain by a granular deposit comprised of sandy gravel and/or

[1] Ontario Ministry of Natural Resources and Forestry. Northern Ontario Engineering Geology Terrain Study. Ontario Geological Society Electronic Mapping. Map 41OSW, Study Number 86.

[2] Ministry of Northern Development of Mines. Bedrock Geology of Ontario – East Central Sheet, Ontario Geological Survey – Map 2543.

an extensive deposit of sandy silt to sand. Cobbles and boulders were noted at the surface of river bed near the inlet and outlet of the culvert.

Detailed descriptions of the subsurface conditions encountered in the boreholes at this site are provided in the following subsections.

4.2.1 Water

Approximately 0.4 m of water was encountered at the inlet in Borehole WRC-01. At the outlet, in Borehole WRC-02, approximately 1.0 m of water was encountered.

4.2.2 Cobbles and Boulders

An approximately 0.3 m thick layer of cobbles/boulders was encountered at the river bed at about Elevation 417.4 m in Borehole WRC-02. Cobbles/boulders were also observed on the river bed near the inlet and outlet of the culvert.

4.2.3 Sandy Gravel

An approximately 0.8 m thick deposit of sandy gravel, trace silt was encountered at the river bed at about Elevation 418.2 m in Borehole WRC-01. A zone of cobbles and boulders was noted between depths of about 0.7 m and 1.2 m below water surface in this borehole.

A single SPT 'N'-value measured within this deposit is 50 blows for 0.13 m of penetration, indicating a very dense state of compactness; however, the high 'N'-value may potentially be unrepresentative due to the presence of cobbles/boulders.

A water content measured on a sample of the sandy gravel deposit is about 14 per cent.

4.2.4 Sandy Silt to Sand

An extensive deposit of sandy silt to sand, trace to some gravel, trace silt and trace clay was encountered below the deposit of sandy gravel in Borehole WRC-01 and below the layer of cobbles/boulders in Borehole WRC-02. The upper portion of sandy silt deposit in Borehole WRC-02 (i.e., to a depth of about 2.0 m below water surface) contains trace organics. This deposit extends to depths of at least 10.0 m to 9.0 m, corresponding to Elevations 408.6 m and 409.4 m in Boreholes WRC-01 and WRC-02, respectively. In Borehole WRC-02, at the outlet, this deposit was primarily sandy silt in the upper portion of the deposit, transitioning to a sand at depth.

The SPT 'N'-values measured within this deposit range from 2 blows to 27 blows per 0.3 m of penetration, indicating a very loose to compact state of compactness. The SPT 'N'-values measured near the bottom of the deposit in both boreholes were not recorded on the borehole records. These 'N'-values are considered unrepresentative as a result of the split-spoon sampler becoming wedged inside the NW casing and the casing being "dragged" down with the split-spoon sampler during the sampling procedure.

The water contents measured on samples of this deposit range between about 17 per cent and 26 per cent.

The results of grain size distribution tests carried out on five samples of this deposit are shown on Figure B1 in Appendix B.

4.3 Groundwater Conditions

Given the presence of the Wenebegon River Tributary and the predominantly granular (i.e., non-cohesive) deposits encountered at the site, the groundwater level is anticipated to be coincident with the water level in the river.

The river water level, at the location of the existing culvert, was measured on August 3, 2017 at approximately Elevation 418.6 m (near the inlet) and on August 11, 2017 at approximately Elevation 418.4 m (near the outlet)

The water level in the creek and the degree of saturation of the embankment fill is subject to seasonal fluctuations and precipitation events, and are expected to be higher during wet seasons and sustained periods of precipitation.

4.4 Analytical Testing of Soil

One soil sample was selected from Borehole WRC-01 and submitted to Maxxam Analytics Ontario for corrosivity testing. The analytical laboratory test results are provided on the Certificates of Analysis presented in Appendix C, and summarized below.

Borehole Designation	Sample No.	Average Approx. Sample Depth [2] (m)	Average Approx. Sample Elevation (m)	Material Type	Resistivity (ohm·cm)	Conductivity (µohm/cm)	pH	Chloride (Cl) Content (ppm or µg/g)	Sulphate (SO_4) Content (ppm or µg/g)
WRC-01 [1]	SA 3	1.1	417.1	Sand	43,000	41	6.6	< 20 [3]	24

Notes:
1. It is noted that corrosivity test results associated with soil samples recovered from boreholes that were advanced at other sites associated with this project are also presented on the Certificates of Analysis.
2. Sample depth measured from the bottom of the river bed.
3. The chloride concentration is below the reportable detection limit of 20 µg/g.

It is noted that the sulphide concentration of the soil sample was also analyzed and is 0.57 µg/g.

5.0 CLOSURE

The field work for this investigation was supervised by Ms. Alysha Kobylinski, B.A.Sc., who also prepared this Foundation Investigation Report. The report was reviewed by Mr. Tomasz Zalucki, P.Eng., a geotechnical engineer at Golder. Mr. Paul Dittrich, Ph.D., P.Eng., a Principal and Designated MTO Foundations Contact for Golder, conducted an independent quality control review of the report.

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AK/TZ/JPD/ak,tz

https://golderassociates.sharepoint.com/sites/14262g/deliverables/04-final fidr/wenebegon river tributary culvert/1670846-05-rpt-rev0-wenebegon river tributary culvert fidr-20180316.docx

PART B

FOUNDATION DESIGN REPORT
STRUCTURAL BUNDLE – 11 STRUCTURES ON HIGHWAYS 129, 532 AND 556
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GWP 5272-14-00 ; WP 5272-14-01

March 16, 2018
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Golder Associates

6.0 DISCUSSION AND ENGINEERING RECOMMENDATIONS

This section of the report provides foundation design recommendations for the rehabilitation of the Wenebegon River culvert under Highway 129 (Site No. 46S-331/C). These recommendations are based on interpretation of the factual data obtained from the boreholes advanced during the field investigation. The discussion and recommendations presented are intended to provide the designers with sufficient information to assess feasible dewatering alternatives to support the culvert rehabilitation. The foundation investigation report, discussion and recommendations are intended for the use of MTO and its designers and shall not be used or relied upon for any other purpose or by any other parties, including the construction or design-build contractor.

Contractors must make their own interpretation based on the factual data presented in the Foundation Investigation Report (Part A of this report). Where comments are made on construction, they are provided to highlight those aspects that could affect the design of the project and for which special provisions may be required in the Contract Documents. Those requiring information on aspects of construction must make their own interpretation of the factual information provided as such interpretation may affect equipment selection, proposed construction methods, scheduling and the like.

6.1 General

It is understood that the existing 3.0 m diameter Corrugated Steel Pipe (CSP) culvert will be rehabilitated. The rehabilitation work is anticipated to entail lining of the barrel. Consequently, a temporary cofferdam system will be required at inlet and outlet of the culvert to ensure the rehabilitation work is carried out in the dry.

6.2 Cofferdams

Cofferdams at this site could consist of steel sheet piles driven to a suitable depth. It is noted that some form of sheet pile tip protection may be required to protect the sheet piles during driving through the cobbles/boulders. The cofferdams at the site should be designed and constructed in accordance with OPSS.PROV 539 (*Temporary Protection Systems)* to Performance Level 3 The design of the cofferdam system should include an evaluation of tolerable lateral movement, base stability and hydraulic uplift as defined in the Canadian Foundation Engineering Manual (CFEM, 2006). The contractor is responsible for the design and construction of the cofferdam system.

The cofferdam may be designed using the following parameters:

Fill / Soil Type	Bulk Unit Weight, γ (kN/m^3)	Internal Angle of Friction, ϕ' (degrees)	Undrained Shear Strength, s_u (kPa)	Lateral Earth Pressure Coefficients [1]		
				K_p (Passive)[2]	K_o (At-Rest)	K_a (Active)
Very Dense Sandy Gravel	22	34	--	3.84	0.44	0.26

Fill / Soil Type	Bulk Unit Weight, γ (kN/m^3)	Internal Angle of Friction, ϕ' (degrees)	Undrained Shear Strength, s_u (kPa)	Lateral Earth Pressure Coefficients (1)		
				K_p (Passive)^2	K_o (At-Rest)	K_a (Active)
Generally Very Loose to Compact Sandy Silt to Sand	19	28	--	2.77	0.53	0.36

Note:
1. The lateral earth pressure coefficients presented above are based on a horizontal surface adjacent to the excavation. If sloped surfaces are expected, the coefficients should be corrected accordingly.
2. The total passive resistance below the base of the river bed or excavation, if required, (i.e., within the sheet pile cofferdam) may be calculated based on the values of K_p indicated above but reduced by an appropriate factor that considers the allowable wall movement in accordance with Figure C6.16 of the Canadian Highway Bridge Design Code (CHBDC, 2014) to account for the fact that a large strain would be required for mobilization of the full passive resistance.

The installation of sheet piles may be impeded by the presence of cobbles and boulders at the river bed and within the upper portion of the granular deposit encountered immediately below the river bed. Given the presence of these obstructions, consideration should be given to protecting the tips of the sheet piles and/or the use of heavier sheet pile sections.

6.3 Obstructions

As described in Sections 4.2.2 and 4.2.3, cobbles/boulders were noted at the river bed and within the upper portion of the granular deposit encountered immediately below the river bed. Conventional construction equipment should be capable of excavating through such obstructions. It is recommended that a Non-Standard Special Provision be included in the contract documents to address these obstructions (refer to Appendix D).

6.4 Control of Groundwater and Surface Water

Given that the rehabilitation work will need to be carried out in the dry, control of groundwater / river flow will be required.

Temporary shoring for groundwater control could be in the form of a sheet pile cut-off wall advanced to an appropriate depth to control groundwater inflow from the river and to prevent base heave/piping of the founding subgrade. As noted in Section 6.2 obstruction to sheet piling may be encountered and should be addressed accordingly.

Depending on the river flow, surface water flow and groundwater levels at the time of construction, water flow could be diverted and/or pumped from behind a temporary cofferdam in accordance with MTO's Special Provision 517F01 (*Temporary Flow Passage System*). However, if construction water pumping volumes are anticipated to exceed 50 m^3/day, an Environmental Activity Section Registry (EASR) will be required as per the recently introduced changes to the Environmental Protection Act by the Ontario Ministry of Environment and Climate Change (MOECC).

Surface water should be directed away from the work area to prevent ponding of water that could interfere with the rehabilitation work.

6.5 Analytical Testing of Construction Materials

The results of analytical tests carried out on a sample of the sand deposit recovered from Borehole WRC-01 are presented in Section 4.4 and on the Certificates of Analysis in Appendix C.

The analytical test results of the soil sample were compared to Table 7.1 (Relative Effect of Resistivity on Corrosion Potential/Aggressiveness (from NCHRP 1978)), as presented in the Federal Highway Administration/National Highway Institute Publication No. FHWA-NHI-14-007 (Federal Highway Administration, 2015), to assess the relative level of corrosion potential on buried steel in contact with soil. The resistivity value measured on the soil sample is 43,000 ohm·cm. These results indicate "non-corrosive" soils (i.e., resistivity greater than 10,000 ohm·cm.

Although it is understood that the existing culvert will only be rehabilitated and concrete structures will not be constructed, the analytical test results were also compared to CSA A23.1 Table 3 (Additional requirements for concrete subjected to sulphate attack) to assess the potential severity of sulphate attack on concrete during its service life. The sulphate concentration measured on the soil sample is less than 0.002 per cent, which is below the moderate degree of exposure (i.e., below the class S-3 exposure limits). Therefore, based on the soil sample tested, when the designer is selecting the exposure class for concrete structures (if required), the effects of sulphates from within the granular deposit in contact with a concrete structure constructed below the ground surface may not need to be considered. However, given that the structure may be exposed to de-icing salt/chemicals, consideration should be given by the designer to designing concrete structures for a "C" type exposure class as defined by CSA A23.1 Table 1.

Ultimately, it is the designer's decision to determine the appropriate exposure class and to ensure that all aspects of CSA A23.1 Section 4.1.1 (*Durability Requirements*) are satisfied.

It is also noted that the measured pH level is about 6.6.

7.0 CLOSURE

This Foundation Design Report was prepared by Ms. Alysha Kobylinski, B.A.Sc. and reviewed by Mr. Tomasz Zalucki, P.Eng. Mr. Paul Dittrich, Ph.D., P.Eng., a Principal and Designated MTO Foundations Contact for Golder, conducted an independent quality control review of the report.

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https://golderassociates.sharepoint.com/sites/14262g/deliverables/04-final fidr/wenebegon river tributary culvert/1670846-05-rpt-rev0-wenebegon river tributary culvert fidr-20180316.docx

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Canadian Standards Association (CSA). 2014. Canadian Highway Bridge Design Code and Commentary on CAN/CSA S6-14. CSA Special Publication, S6.1-14.

Federal Highway Administration. February 2015. Geotechnical Engineering Circular No. 7, Soil Nail Walls - Reference Manual, Publication No. FHWA-NHI-14-007, FHWA GEC 2007. Distributed by the U.S. Department of Transportation, Federal Highway Administration/National Highway Institute. Prepared by Ryan R. Berg and Associates Inc.

Ontario Ministry of Natural Resources and Forestry. Northern Ontario Engineering Geology Terrain Study. Ontario Geological Society Electronic Mapping. Map 41OSW, Study Number 86.

Ontario Ministry of Northern Development of Mines. Bedrock Geology of Ontario – East Central Sheet, Ontario Geological Survey – Map 2543.

ASTM International:

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

Canadian Standards Association (CSA):

CAN/CSA A23.1-14 Concrete Materials and Methods of Concrete Construction

Ontario Occupational Health and Safety Act:

Ontario Regulation 213 Construction Projects (as amended)

Ontario Provincial Standard Specifications (OPSS):

OPSS.PROV 539 Construction Specification for Temporary Protection Systems

Ontario Regulations:

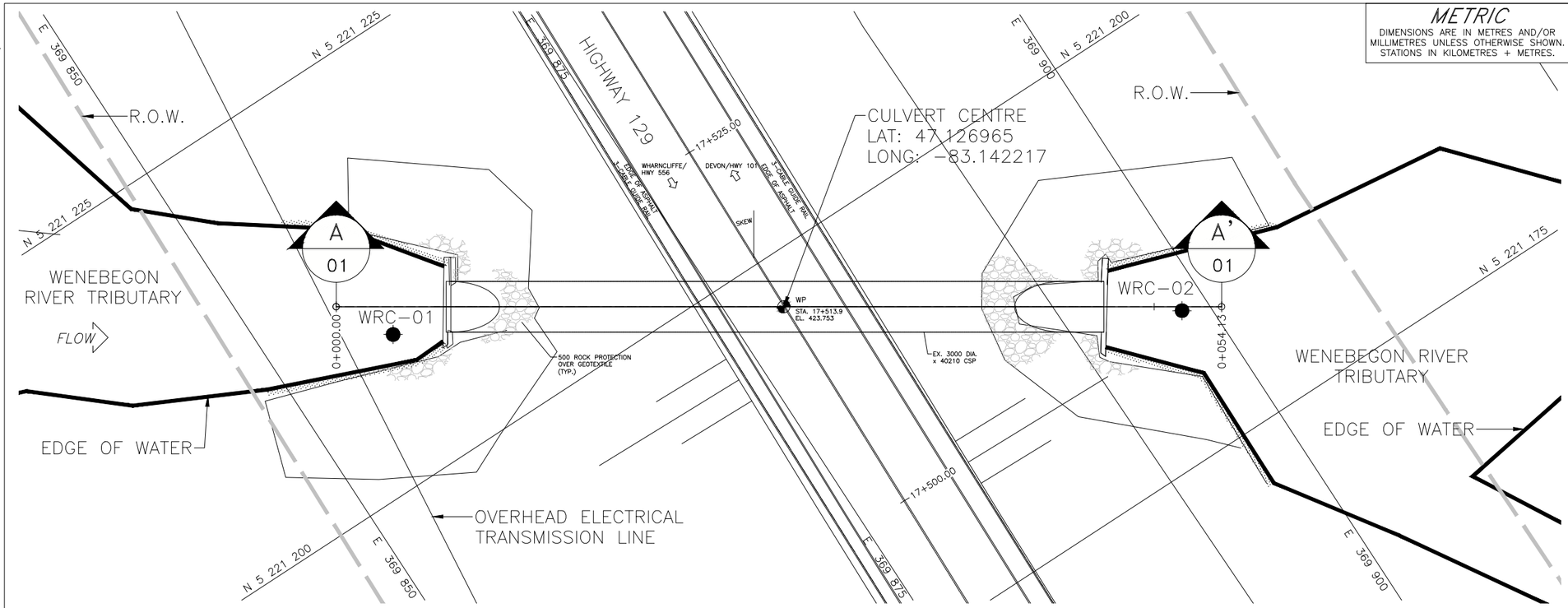
R.R.O 1990, Regulation 903 Wells, under Ontario Water Resources Act, R.S.O. 1990, c. O.40

Ontario Special Provisions (SP):

SP 517F01 Temporary Flow Passage System

DRAWINGS

MINISTRY OF TRANSPORTATION, ONTARIO



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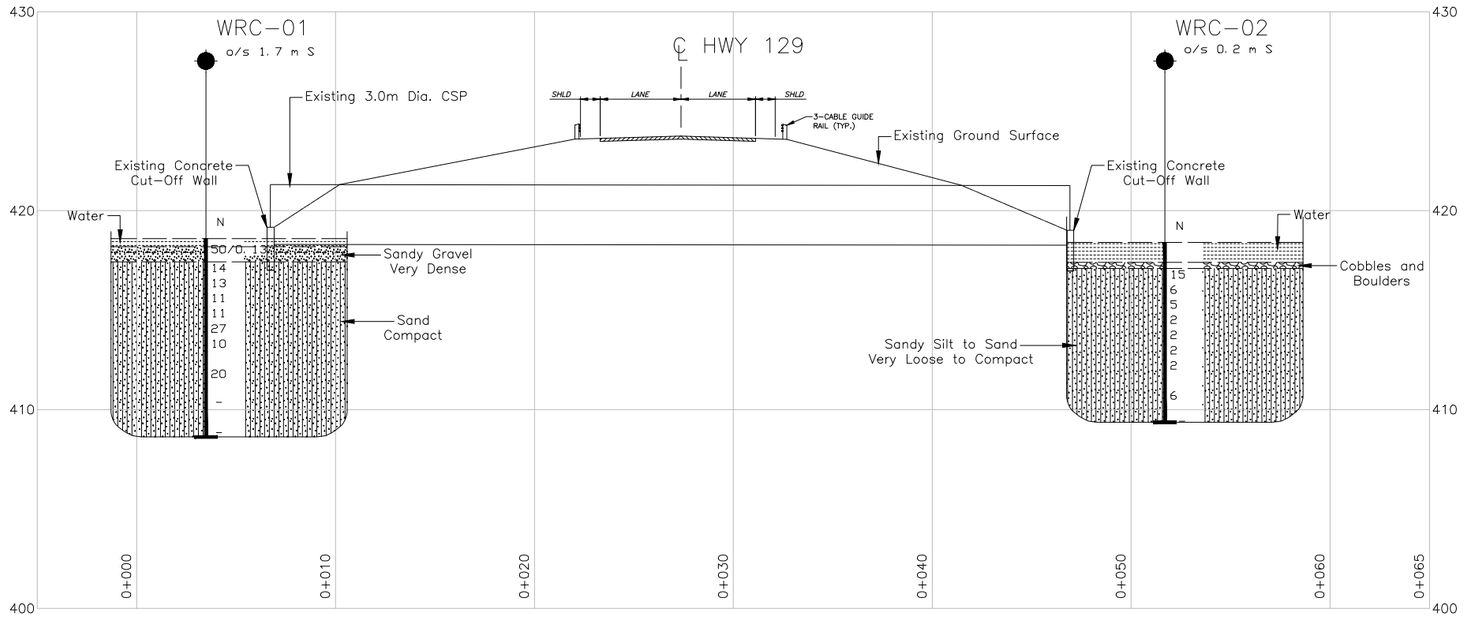


SCALE 1:150 m A-A' 01 CULVERT PROFILE

SCALE
3 0 3 6 m

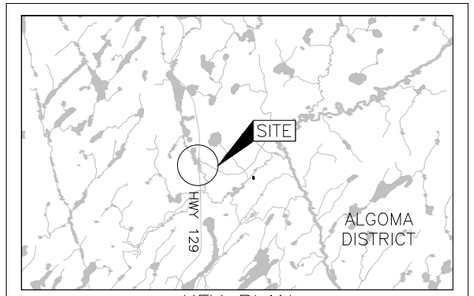
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No. 5016-E-0029
WP No. 5272-14-01

SHEET

HIGHWAY 129
WENEBEGON RIVER TRIBUTARY CULVERT
BOREHOLE LOCATION AND SOIL STRATA

Golder Associates



LEGEND

- Borehole – Current Investigation
- N — Standard Penetration Test Value
- 16 — Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
WRC-01	418.6	5221208.5	369857.2
WRC-02	418.4	5221183.4	369898.4

LICENSED PROFESSIONAL ENGINEER J.P. DITTRICH PROVINCE OF ONTARIO March 14, 2018

LICENSED PROFESSIONAL ENGINEER T.ZALUCKI 100128614 PROVINCE OF ONTARIO March 14, 2018

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.

REFERENCE

Base plans provided in digital format by client, drawing file "Overlay 46-331C.dwg", dated December 21, 2017, received December 21, 2017.

NO.	DATE	BY	REVISION
.	.	.	.

Geocres No. 410-36

HWY. 129	PROJECT NO. 1670846		DIST.
SUBM'D. AK	CHKD. TZ	DATE: 3/14/2018	SITE:46S-331/C
DRAWN: SMD	CHKD. JPD	APPD. JPD	DWG. 01

PLOT DATE: March 14, 2018
FILENAME: S:\Clients\MTO\Sault_Ste_Marie\09_PROJ\1670846_Hwy6_129_532_556\02_PROD\0003_Wenebegonriver\1670846-0003-BC-0001.dwg

APPENDIX A

Records of Borehole Sheets

LIST OF SYMBOLS

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

I. GENERAL

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

II. STRESS AND STRAIN

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

III. SOIL PROPERTIES

(a) Index Properties

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

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

(a) Index Properties (continued)

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

(b) Hydraulic Properties

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

(c) Consolidation (one-dimensional)

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

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = tan δ
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 $\tau = c' + \sigma' \tan \phi'$

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, 60º 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^2 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 (Cohesionless) Soils

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

IV. SOIL TESTS

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

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

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

RECORD OF BOREHOLE No WRC-01

SHEET 1 OF 1

METRIC

PROJECT 1670846

W.P. 5272-14-01

LOCATION N 5221208.5; E 369857.2 MTM NAD 83 ZONE 13 (LAT. 47.127072; LONG. -83.142491)

ORIGINATED BY AK

DIST ALGOMA HWY 556

BOREHOLE TYPE Wash Boring; NQ Coring

COMPILED BY AK

DATUM Geodetic

DATE August 2 and 3, 2017

CHECKED BY TZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR	SA	SI	CL
418.6	WATER SURFACE													
0.0 / 418.2	WATER													
0.4	Sandy GRAVEL, trace silt Very dense Brown Wet		1	SS	50/0.13		418							
			2	RC	-									
417.4 / 1.2	- Cobbles encountered between depths of about 0.7 m and 1.2 m SAND, trace to some gravel, trace silt, trace clay Compact Brown Wet		3	SS	14		417							
			4	SS	13						9	85	5	1
			5	SS	11		416							
			6	SS	11		415							
			7	SS	27		414				1	95	4	0
			8	SS	10		413							
			9	SS	20		412							
			10	SS	-		411				0	98	2	0
							410							
408.6			11	SS	-		409							
10.0	END OF BOREHOLE NOTE: 1. Open borehole caved to a depth of about 1.2 m below ground surface upon completion of drilling.													

+ ³, × ³: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

GOLDER

RECORD OF BOREHOLE No WRC-02

SHEET 1 OF 1 **METRIC**

PROJECT 1670846
W.P. 5272-14-01
DIST ALGOMA HWY 556
DATUM Geodetic
LOCATION N 5221183.4; E 369898.4 MTM NAD 83 ZONE 13 (LAT. 47.126842; LONG. -83.141952)
BOREHOLE TYPE Wash Boring; NQ Coring
DATE August 10 and 11, 2017
ORIGINATED BY AK
COMPILED BY AK
CHECKED BY TZ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
418.4	WATER SURFACE										
0.0	WATER						418				
417.4											
417.1	COBBLES and BOULDERS		1	RC	-						
1.3	Sandy SILT to SAND, trace gravel, trace silt, trace clay, trace organics between depths of about 1.3 m and 2.0 m Very loose to compact Brown Wet		2	SS	15		417				
			3	SS	6		416				
			4	SS	5				○		0 29 71 0
			5	SS	2		415				
			6	SS	2		414		○		
			7	SS	2		413				
			8	SS	2				○		0 97 3 0
							412				
			9	SS	6		411		○		
							410				
409.4			10	SS	-						
9.0	END OF BOREHOLE NOTE: 1. Open borehole caved to a depth of about 4.3 m below ground surface upon completion of drilling.										

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

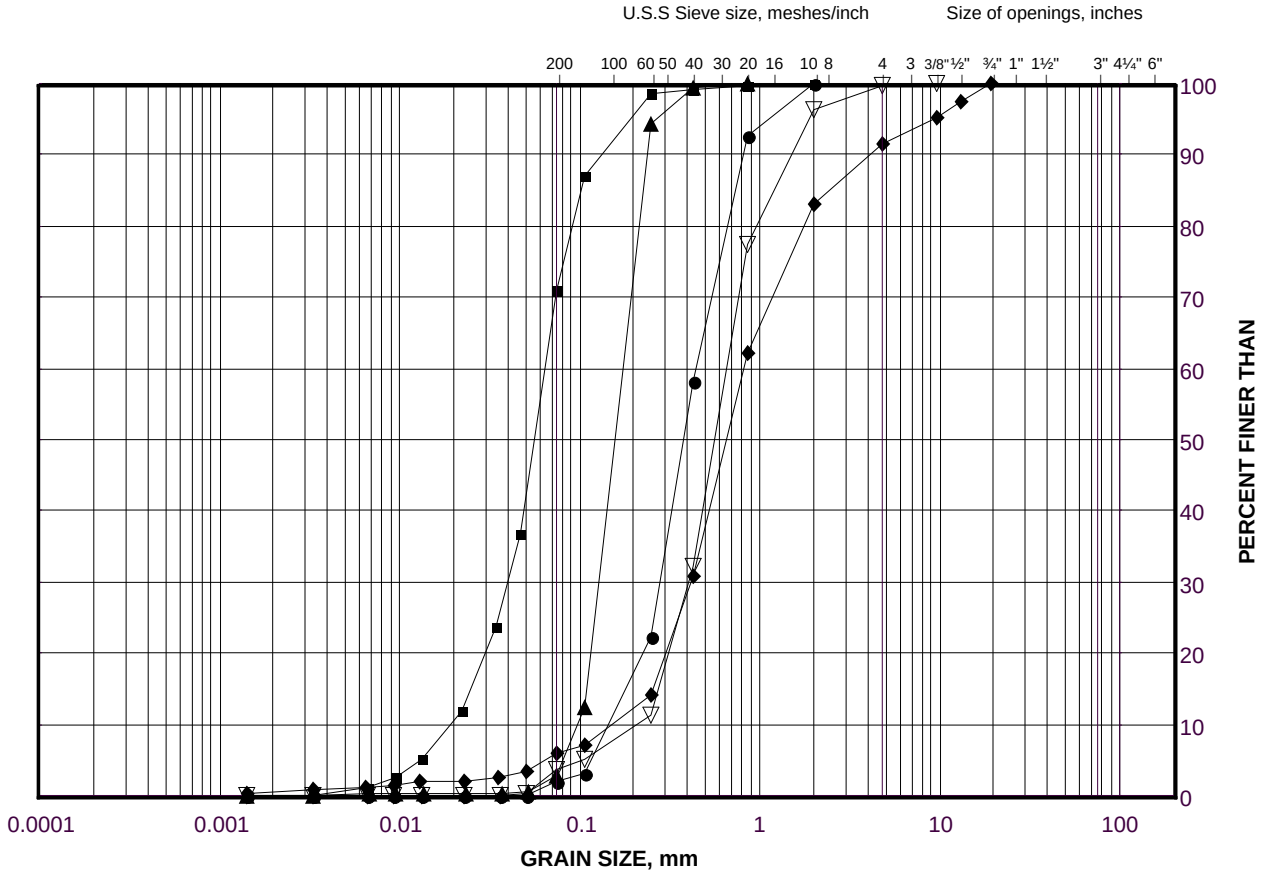
APPENDIX B

Geotechnical Laboratory Test Results

GRAIN SIZE DISTRIBUTION

Sandy Silt to Sand

FIGURE B1



LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	WRC-01	10	410.4
■	WRC-02	4	415.3
◆	WRC-01	4	416.4
▲	WRC-02	8	412.2
▽	WRC-01	7	414.1

Project Number: 1670846

Checked By: TZ

Golder Associates

Date: 21-Dec-17

APPENDIX C

Analytical Laboratory Test Results

Maxxam
A Bureau Veritas Group Company

Your Project #: 1670846
Your C.O.C. #: 628368-01-01

Attention:Darcy Hansen

Golder Associates Ltd
Mississauga - Standing Offer
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2017/09/20
Report #: R4722990
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7J9789
Received: 2017/09/13, 11:39

Sample Matrix: Soil
Samples Received: 8

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Chloride (20:1 extract)	8	N/A	2017/09/18	CAM SOP-00463	EPA 325.2 m
Conductivity	8	N/A	2017/09/18	CAM SOP-00414	OMOE E3530 v1 m
pH CaCl2 EXTRACT	8	2017/09/15	2017/09/15	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	8	2017/09/14	2017/09/18	CAM SOP-00414	SM 22 2510 m
Sulphate (20:1 Extract)	8	N/A	2017/09/18	CAM SOP-00464	EPA 375.4 m
Sulphide (from Campobello) (1)	8	N/A	N/A		

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This test was performed by Campo to Burnaby Subcontract

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Your Project #: 1670846
Your C.O.C. #: 628368-01-01

Attention:Darcy Hansen

Golder Associates Ltd
Mississauga - Standing Offer
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2017/09/20
Report #: R4722990
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7J9789
Received: 2017/09/13, 11:39

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: EGitej@maxxam.ca
Phone# (905)817-5829

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B7J9789
Report Date: 2017/09/20

Golder Associates Ltd
Client Project #: 1670846
Sampler Initials: DH

RESULTS OF ANALYSES OF SOIL

Maxxam ID		FCS510	FCS510	FCS511	FCS512	FCS513	FCS514		
Sampling Date		2017/08/23	2017/08/23	2017/09/07	2017/09/06	2017/07/16	2017/07/11		
COC Number		628368-01-01	628368-01-01	628368-01-01	628368-01-01	628368-01-01	628368-01-01		
	UNITS	ACB-03 SA4	ACB-03 SA4 Lab-Dup	ACC1-03 SA2	ACCS-03 SA2	MRB-04 SA3	MRB-03 SA5	RDL	QC Batch
Calculated Parameters									
Resistivity	ohm-cm	7300		15000	4100	5900	2400		5165355
Inorganics									
Soluble (20:1) Chloride (Cl)	ug/g	55	58	24	130	58	260	20	5167700
Conductivity	umho/cm	137	133	69	246	169	424	2	5167946
Available (CaCl2) pH	pH	6.48		6.20	5.13	5.62	5.77		5165977
Soluble (20:1) Sulphate (SO4)	ug/g	<20	<20	64	22	29	<20	20	5167702

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

Maxxam ID		FCS515	FCS516	FCS517		
Sampling Date		2017/08/23	2017/07/29	2017/08/02		
COC Number		628368-01-01	628368-01-01	628368-01-01		
	UNITS	DCC-01 SA2	MCC-03 SA1	WRC-01 SA3	RDL	QC Batch
Calculated Parameters						
Resistivity	ohm-cm	2200	24000	43000		5165355
Inorganics						
Soluble (20:1) Chloride (Cl)	ug/g	190	<20	<20	20	5167700
Conductivity	umho/cm	450	41	23	2	5167946
Available (CaCl2) pH	pH	8.18	6.90	6.62		5165977
Soluble (20:1) Sulphate (SO4)	ug/g	<20	<20	24	20	5167702

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B7J9789
Report Date: 2017/09/20

Golder Associates Ltd
Client Project #: 1670846
Sampler Initials: DH

TEST SUMMARY

Maxxam ID: FCS510
Sample ID: ACB-03 SA4
Matrix: Soil

Collected: 2017/08/23
Shipped:
Received: 2017/09/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5167700	N/A	2017/09/18	Deonarine Ramnarine
Conductivity	AT	5167946	N/A	2017/09/18	Neil Dassanayake
pH CaCl2 EXTRACT	AT	5165977	2017/09/15	2017/09/15	Tahir Ahmed
Resistivity of Soil		5165355	2017/09/18	2017/09/18	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5167702	N/A	2017/09/18	Deonarine Ramnarine
Sulphide (from Campobello)	SPEC	5170216	N/A	2017/09/19	Lims Auto Schedule Runner

Maxxam ID: FCS510 Dup
Sample ID: ACB-03 SA4
Matrix: Soil

Collected: 2017/08/23
Shipped:
Received: 2017/09/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5167700	N/A	2017/09/18	Deonarine Ramnarine
Conductivity	AT	5167946	N/A	2017/09/18	Neil Dassanayake
Sulphate (20:1 Extract)	KONE/EC	5167702	N/A	2017/09/18	Deonarine Ramnarine

Maxxam ID: FCS511
Sample ID: ACC1-03 SA2
Matrix: Soil

Collected: 2017/09/07
Shipped:
Received: 2017/09/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5167700	N/A	2017/09/18	Deonarine Ramnarine
Conductivity	AT	5167946	N/A	2017/09/18	Neil Dassanayake
pH CaCl2 EXTRACT	AT	5165977	2017/09/15	2017/09/15	Tahir Ahmed
Resistivity of Soil		5165355	2017/09/18	2017/09/18	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5167702	N/A	2017/09/18	Deonarine Ramnarine
Sulphide (from Campobello)	SPEC	5170216	N/A	2017/09/19	Lims Auto Schedule Runner

Maxxam ID: FCS512
Sample ID: ACCS-03 SA2
Matrix: Soil

Collected: 2017/09/06
Shipped:
Received: 2017/09/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5167700	N/A	2017/09/18	Deonarine Ramnarine
Conductivity	AT	5167946	N/A	2017/09/18	Neil Dassanayake
pH CaCl2 EXTRACT	AT	5165977	2017/09/15	2017/09/15	Tahir Ahmed
Resistivity of Soil		5165355	2017/09/18	2017/09/18	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5167702	N/A	2017/09/18	Deonarine Ramnarine
Sulphide (from Campobello)	SPEC	5170216	N/A	2017/09/19	Lims Auto Schedule Runner

Maxxam ID: FCS513
Sample ID: MRB-04 SA3
Matrix: Soil

Collected: 2017/07/16
Shipped:
Received: 2017/09/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5167700	N/A	2017/09/18	Deonarine Ramnarine

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Maxxam Job #: B7J9789
Report Date: 2017/09/20

Golder Associates Ltd
Client Project #: 1670846
Sampler Initials: DH

TEST SUMMARY

Maxxam ID: FCS513
Sample ID: MRB-04 SA3
Matrix: Soil

Collected: 2017/07/16
Shipped:
Received: 2017/09/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	5167946	N/A	2017/09/18	Neil Dassanayake
pH CaCl2 EXTRACT	AT	5165977	2017/09/15	2017/09/15	Tahir Ahmed
Resistivity of Soil		5165355	2017/09/18	2017/09/18	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5167702	N/A	2017/09/18	Deonarine Ramnarine
Sulphide (from Campobello)	SPEC	5170216	N/A	2017/09/19	Lims Auto Schedule Runner

Maxxam ID: FCS514
Sample ID: MRB-03 SA5
Matrix: Soil

Collected: 2017/07/11
Shipped:
Received: 2017/09/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5167700	N/A	2017/09/18	Deonarine Ramnarine
Conductivity	AT	5167946	N/A	2017/09/18	Neil Dassanayake
pH CaCl2 EXTRACT	AT	5165977	2017/09/15	2017/09/15	Tahir Ahmed
Resistivity of Soil		5165355	2017/09/18	2017/09/18	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5167702	N/A	2017/09/18	Deonarine Ramnarine
Sulphide (from Campobello)	SPEC	5170216	N/A	2017/09/19	Lims Auto Schedule Runner

Maxxam ID: FCS515
Sample ID: DCC-01 SA2
Matrix: Soil

Collected: 2017/08/23
Shipped:
Received: 2017/09/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5167700	N/A	2017/09/18	Deonarine Ramnarine
Conductivity	AT	5167946	N/A	2017/09/18	Neil Dassanayake
pH CaCl2 EXTRACT	AT	5165977	2017/09/15	2017/09/15	Tahir Ahmed
Resistivity of Soil		5165355	2017/09/18	2017/09/18	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5167702	N/A	2017/09/18	Deonarine Ramnarine
Sulphide (from Campobello)	SPEC	5170216	N/A	2017/09/19	Lims Auto Schedule Runner

Maxxam ID: FCS516
Sample ID: MCC-03 SA1
Matrix: Soil

Collected: 2017/07/29
Shipped:
Received: 2017/09/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5167700	N/A	2017/09/18	Deonarine Ramnarine
Conductivity	AT	5167946	N/A	2017/09/18	Neil Dassanayake
pH CaCl2 EXTRACT	AT	5165977	2017/09/15	2017/09/15	Tahir Ahmed
Resistivity of Soil		5165355	2017/09/18	2017/09/18	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5167702	N/A	2017/09/18	Deonarine Ramnarine
Sulphide (from Campobello)	SPEC	5170216	N/A	2017/09/19	Lims Auto Schedule Runner

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Maxxam Job #: B7J9789
Report Date: 2017/09/20

Golder Associates Ltd
Client Project #: 1670846
Sampler Initials: DH

TEST SUMMARY

Maxxam ID: FCS517
Sample ID: WRC-01 SA3
Matrix: Soil

Collected: 2017/08/02
Shipped:
Received: 2017/09/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	5167700	N/A	2017/09/18	Deonarine Ramnarine
Conductivity	AT	5167946	N/A	2017/09/18	Neil Dassanayake
pH CaCl2 EXTRACT	AT	5165977	2017/09/15	2017/09/15	Tahir Ahmed
Resistivity of Soil		5165355	2017/09/18	2017/09/18	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	5167702	N/A	2017/09/18	Deonarine Ramnarine
Sulphide (from Campobello)	SPEC	5170216	N/A	2017/09/19	Lims Auto Schedule Runner

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7J9789
Report Date: 2017/09/20

Golder Associates Ltd
Client Project #: 1670846
Sampler Initials: DH

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	5.7°C

Custody seal was present and intact.

Sample FCS513 [MRB-04 SA3] : Sample submitted and analyzed past the recommended hold time for pH, Chloride, Sulphate and Conductivity/Resistivity analysis.

Sample FCS514 [MRB-03 SA5] : Sample submitted and analyzed past the recommended hold time for pH, Chloride, Sulphate and Conductivity/Resistivity analysis.

Sample FCS517 [WRC-01 SA3] : Sample submitted and analyzed past the recommended hold time for pH, Chloride, Sulphate and Conductivity/Resistivity analysis.

Results relate only to the items tested.

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Maxxam Job #: B7J9789
Report Date: 2017/09/20

QUALITY ASSURANCE REPORT

Golder Associates Ltd
Client Project #: 1670846
Sampler Initials: DH

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5165977	Available (CaCl2) pH	2017/09/15			99	97 - 103			0.11	N/A
5167700	Soluble (20:1) Chloride (Cl)	2017/09/18	NC	70 - 130	104	70 - 130	<20	ug/g	5.5	35
5167702	Soluble (20:1) Sulphate (SO4)	2017/09/18	124	70 - 130	107	70 - 130	<20	ug/g	NC	35
5167946	Conductivity	2017/09/18			101	90 - 110	<2	umho/cm	3.2	10

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

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Maxxam Job #: B7J9789
Report Date: 2017/09/20

Golder Associates Ltd
Client Project #: 1670846
Sampler Initials: DH

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Cristina Carriere

Cristina Carriere, Scientific Service Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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13-Sep-17 11:39
Ema Gitej
B7J9789
KES ENV-689
C#628368-01-01

Page of
Bottle Order #: 628368
Project Manager: Ema Gitej

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:	
Company Name:	#1326 Golder Associates Ltd	Company Name:		Quotation #:	B70916
Attention:	Accounts Payable	Attention:	Darcy Hansen	P.O. #:	
Address:	6925 Century Ave Suite 100 Mississauga ON L5N 7K2	Address:		Project:	[redacted] 1670846
Tel:	(905) 567-4444 x Fax: (905) 567-6561 x	Tel:	(905) 567-4444 x2064 Fax:	Project Name:	
Email:	AP_CustomerService@golder.com	Email:	Darcy_Hansen@golder.com	Site #:	
				Sampled By:	

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)
☐ Table 1 ☐ Res/Park ☐ Medium/Fine
☐ Table 2 ☐ Ind/Comm ☐ Coarse
☐ Table 3 ☐ Agri/Other ☐ For RSC
☐ Table ___

Other Regulations
☐ CCME ☐ Sanitary Sewer Bylaw
☐ Reg 558 ☐ Storm Sewer Bylaw
☐ MISA Municipality ___
☐ PWQO
☐ Other ___

Special Instructions

Include Criteria on Certificate of Analysis (Y/N)? ___

Field Filtered (please circle): Metals / Hg / Cr VI

ANALYSIS REQUESTED (PLEASE BE SPECIFIC):

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

Regular (Standard) TAT:
(will be applied if Rush TAT is not specified)
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___
Rush Confirmation Number: ___ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Chloride & SO4 (20:1 extract)	Conductivity/Resistivity	pH CaCl2 EXTRACT	Sulphide (Maxxam BIC)	# of Bottles	Comments
1		ACB-03 SA4	Aug 23, 2017	-		1	1	1	1	2	
2		ACC1-03 SA2	sept 7, 2017	—		1	1	1	1	2	
3		ACC2-03 SA2	sept 6, 2017	—		1	1	1	1	2	
4		MRB-04 SA3	Jul 16, 2017	—		1	1	1	1	2	
5		MRB-03 SA5	Jul 11, 2017	—		1	1	1	1	2	
6		PCC-01 SA2	Aug 23, 2017	—		1	1	1	1	2	
7		MCC-03 SA1	Jul 29 2017	—		1	1	1	1	2	
8		WRC-01 SA3	Aug 2, 2017	—		1	1	1	1	2	
9											
10											

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Darcy Hansen	12/09/13	10am	[illegible] USA MUNSTER	2017/09/13	11:39	

Laboratory Use Only

Time Sensitive	Temperature (°C) on Recei	Custody Seal Present	Yes	No
	5 5 7	Intact	✓	

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO MAXXAM'S STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.MAXXAM.CA/TERMS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT HTTP://MAXXAM.CA/WP-CONTENT/UPLOADS/ONTARIO-COC.PDF.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

White: Maxxa Yellow: Client

Maxxam Analytics International Corporation o/a Maxxam Analytics

Maxxam
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Success Through Science®

Your Project #: MB7J9789
Site Location: 1670846
Your C.O.C. #: B7J9789-M058-01-01

Attention:EMA GITEJ

MAXXAM ANALYTICS
CAMPOBELLO
6740 CAMPOBELLO ROAD
MISSISSAUGA, ON
CANADA L5N 2L8

Report Date: 2017/09/18
Report #: R2445858
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B780085
Received: 2017/09/16, 12:10

Sample Matrix: Soil
Samples Received: 8

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Moisture	8	2017/09/18	2017/09/18	BBY8SOP-00017	BCMOE BCLM Dec2000 m
Sulphide in Soil	8	2017/09/18	2017/09/18	BBY6SOP-00006	SM 22 4500 S2- D m

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

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Your Project #: MB7J9789
Site Location: 1670846
Your C.O.C. #: B7J9789-M058-01-01

Attention:EMA GITEJ

MAXXAM ANALYTICS
CAMPOBELLO
6740 CAMPOBELLO ROAD
MISSISSAUGA, ON
CANADA L5N 2L8

Report Date: 2017/09/18
Report #: R2445858
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B780085
Received: 2017/09/16, 12:10

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Letitia Prefontaine, B.Sc., Senior Project Manager
Email: LPrefontaine@maxxam.ca
Phone# (604)639-2616
==========
This report has been generated and distributed using a secure automated process.
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Maxxam Job #: B780085
Report Date: 2017/09/18

MAXXAM ANALYTICS
Client Project #: MB7J9789
Site Location: 1670846
Sampler Initials: DH

RESULTS OF CHEMICAL ANALYSES OF SOIL

Maxxam ID		RZ2662	RZ2662	RZ2663		RZ2664		
Sampling Date		2017/08/23	2017/08/23	2017/09/07		2017/09/06		
COC Number		B7J9789-M058-01-01	B7J9789-M058-01-01	B7J9789-M058-01-01		B7J9789-M058-01-01		
	UNITS	ACB-03 SA4	ACB-03 SA4 Lab-Dup	ACC1-03 SA2	RDL	ACCS-03 SA2	RDL	QC Batch
MISCELLANEOUS								
Sulphide	ug/g	0.69 (1)	<0.50	0.52	0.50	1.06 (2)	0.55	8761700

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
(1) Matrix spike exceeds acceptance limits due to matrix interference. Re-analysis yields similar results.
(2) RDL raised due to high sample moisture content.

Maxxam ID		RZ2665	RZ2666		RZ2667		
Sampling Date		2017/07/16	2017/07/11		2017/08/23		
COC Number		B7J9789-M058-01-01	B7J9789-M058-01-01		B7J9789-M058-01-01		
	UNITS	MRB-04 SA3	MRB-03 SA5	RDL	DCC-01 SA2	RDL	QC Batch
MISCELLANEOUS							
Sulphide	ug/g	<0.50	0.52	0.50	0.68 (1)	0.55	8761700

RDL = Reportable Detection Limit
(1) RDL raised due to high sample moisture content.

Maxxam ID		RZ2668	RZ2669		
Sampling Date		2017/07/29	2017/08/02		
COC Number		B7J9789-M058-01-01	B7J9789-M058-01-01		
	UNITS	MCC-03 SA1	WRC-01 SA3	RDL	QC Batch
MISCELLANEOUS					
Sulphide	ug/g	0.78	0.57	0.50	8761700

RDL = Reportable Detection Limit

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Maxxam Job #: B780085
Report Date: 2017/09/18

MAXXAM ANALYTICS
Client Project #: MB7J9789
Site Location: 1670846
Sampler Initials: DH

PHYSICAL TESTING (SOIL)

Maxxam ID		RZ2662	RZ2663	RZ2664	RZ2665		
Sampling Date		2017/08/23	2017/09/07	2017/09/06	2017/07/16		
COC Number		B7J9789-M058-01-01	B7J9789-M058-01-01	B7J9789-M058-01-01	B7J9789-M058-01-01		
	UNITS	ACB-03 SA4	ACC1-03 SA2	ACCS-03 SA2	MRB-04 SA3	RDL	QC Batch
Physical Properties							
Moisture	%	24	22	28	8.2	0.30	8761682
RDL = Reportable Detection Limit							

Maxxam ID		RZ2666	RZ2667	RZ2668	RZ2669		
Sampling Date		2017/07/11	2017/08/23	2017/07/29	2017/08/02		
COC Number		B7J9789-M058-01-01	B7J9789-M058-01-01	B7J9789-M058-01-01	B7J9789-M058-01-01		
	UNITS	MRB-03 SA5	DCC-01 SA2	MCC-03 SA1	WRC-01 SA3	RDL	QC Batch
Physical Properties							
Moisture	%	13	32	14	17	0.30	8761682
RDL = Reportable Detection Limit							

Maxxam Job #: B780085
Report Date: 2017/09/18

MAXXAM ANALYTICS
Client Project #: MB7J9789
Site Location: 1670846
Sampler Initials: DH

TEST SUMMARY

Maxxam ID: RZ2662 **Collected:** 2017/08/23
Sample ID: ACB-03 SA4 **Shipped:**
Matrix: Soil **Received:** 2017/09/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL/BAL	8761682	2017/09/18	2017/09/18	Lolita Obusan
Sulphide in Soil	SPEC/COL	8761700	2017/09/18	2017/09/18	Prabhleen Sodhi

Maxxam ID: RZ2662 Dup **Collected:** 2017/08/23
Sample ID: ACB-03 SA4 **Shipped:**
Matrix: Soil **Received:** 2017/09/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sulphide in Soil	SPEC/COL	8761700	2017/09/18	2017/09/18	Prabhleen Sodhi

Maxxam ID: RZ2663 **Collected:** 2017/09/07
Sample ID: ACC1-03 SA2 **Shipped:**
Matrix: Soil **Received:** 2017/09/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL/BAL	8761682	2017/09/18	2017/09/18	Lolita Obusan
Sulphide in Soil	SPEC/COL	8761700	2017/09/18	2017/09/18	Prabhleen Sodhi

Maxxam ID: RZ2664 **Collected:** 2017/09/06
Sample ID: ACCS-03 SA2 **Shipped:**
Matrix: Soil **Received:** 2017/09/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL/BAL	8761682	2017/09/18	2017/09/18	Lolita Obusan
Sulphide in Soil	SPEC/COL	8761700	2017/09/18	2017/09/18	Prabhleen Sodhi

Maxxam ID: RZ2665 **Collected:** 2017/07/16
Sample ID: MRB-04 SA3 **Shipped:**
Matrix: Soil **Received:** 2017/09/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL/BAL	8761682	2017/09/18	2017/09/18	Lolita Obusan
Sulphide in Soil	SPEC/COL	8761700	2017/09/18	2017/09/18	Prabhleen Sodhi

Maxxam ID: RZ2666 **Collected:** 2017/07/11
Sample ID: MRB-03 SA5 **Shipped:**
Matrix: Soil **Received:** 2017/09/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL/BAL	8761682	2017/09/18	2017/09/18	Lolita Obusan
Sulphide in Soil	SPEC/COL	8761700	2017/09/18	2017/09/18	Prabhleen Sodhi

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Maxxam Job #: B780085
Report Date: 2017/09/18

MAXXAM ANALYTICS
Client Project #: MB7J9789
Site Location: 1670846
Sampler Initials: DH

TEST SUMMARY

Maxxam ID: RZ2667
Sample ID: DCC-01 SA2
Matrix: Soil

Collected: 2017/08/23
Shipped:
Received: 2017/09/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL/BAL	8761682	2017/09/18	2017/09/18	Lolita Obusan
Sulphide in Soil	SPEC/COL	8761700	2017/09/18	2017/09/18	Prabhleen Sodhi

Maxxam ID: RZ2668
Sample ID: MCC-03 SA1
Matrix: Soil

Collected: 2017/07/29
Shipped:
Received: 2017/09/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL/BAL	8761682	2017/09/18	2017/09/18	Lolita Obusan
Sulphide in Soil	SPEC/COL	8761700	2017/09/18	2017/09/18	Prabhleen Sodhi

Maxxam ID: RZ2669
Sample ID: WRC-01 SA3
Matrix: Soil

Collected: 2017/08/02
Shipped:
Received: 2017/09/16

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL/BAL	8761682	2017/09/18	2017/09/18	Lolita Obusan
Sulphide in Soil	SPEC/COL	8761700	2017/09/18	2017/09/18	Prabhleen Sodhi

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Maxxam Job #: B780085
Report Date: 2017/09/18

MAXXAM ANALYTICS
Client Project #: MB7J9789
Site Location: 1670846
Sampler Initials: DH

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	9.0°C
Package 2	6.0°C

Sample RZ2662 [ACB-03 SA4] : Sample was extracted past method specified hold time for Moisture. {Exceedance of hold time increases the uncertainty of test results but does not necessarily imply that results are compromised.} Sample received past method specified hold time for Moisture. Sample analyzed past method specified hold time for Sulphide in Soil. Sample received past method specified hold time for Sulphide in Soil.

Sample RZ2663 [ACC1-03 SA2] : Sample analyzed past method specified hold time for Sulphide in Soil. {Exceedance of hold time increases the uncertainty of test results but does not necessarily imply that results are compromised.} Sample received past method specified hold time for Sulphide in Soil.

Sample RZ2664 [ACCS-03 SA2] : Sample analyzed past method specified hold time for Sulphide in Soil. {Exceedance of hold time increases the uncertainty of test results but does not necessarily imply that results are compromised.} Sample received past method specified hold time for Sulphide in Soil.

Sample RZ2665 [MRB-04 SA3] : Sample was extracted past method specified hold time for Moisture. {Exceedance of hold time increases the uncertainty of test results but does not necessarily imply that results are compromised.} Sample received past method specified hold time for Moisture. Sample analyzed past method specified hold time for Sulphide in Soil. Sample received past method specified hold time for Sulphide in Soil.

Sample RZ2666 [MRB-03 SA5] : Sample was extracted past method specified hold time for Moisture. {Exceedance of hold time increases the uncertainty of test results but does not necessarily imply that results are compromised.} Sample received past method specified hold time for Moisture. Sample analyzed past method specified hold time for Sulphide in Soil. Sample received past method specified hold time for Sulphide in Soil.

Sample RZ2667 [DCC-01 SA2] : Sample was extracted past method specified hold time for Moisture. {Exceedance of hold time increases the uncertainty of test results but does not necessarily imply that results are compromised.} Sample received past method specified hold time for Moisture. Sample analyzed past method specified hold time for Sulphide in Soil. Sample received past method specified hold time for Sulphide in Soil.

Sample RZ2668 [MCC-03 SA1] : Sample was extracted past method specified hold time for Moisture. {Exceedance of hold time increases the uncertainty of test results but does not necessarily imply that results are compromised.} Sample received past method specified hold time for Moisture. Sample analyzed past method specified hold time for Sulphide in Soil. Sample received past method specified hold time for Sulphide in Soil

Results relate only to the items tested.

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Maxxam Job #: B780085
Report Date: 2017/09/18

QUALITY ASSURANCE REPORT

MAXXAM ANALYTICS
Client Project #: MB7J9789
Site Location: 1670846
Sampler Initials: DH

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8761682	Moisture	2017/09/18					<0.30	%	0 (1)	20
8761700	Sulphide	2017/09/18	39 (2,3)	75 - 125	84	75 - 125	<0.50	ug/g	NC (4)	30

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Duplicate Parent ID

(2) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

(3) Matrix Spike Parent ID [RZ2662-01]

(4) Duplicate Parent ID [RZ2662-01]

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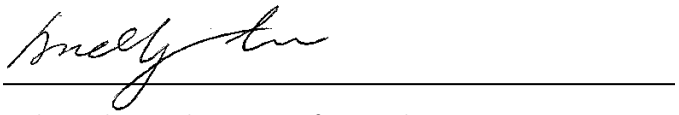
Maxxam Job #: B780085
Report Date: 2017/09/18

MAXXAM ANALYTICS
Client Project #: MB7J9789
Site Location: 1670846
Sampler Initials: DH

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Andy Lu, Ph.D., P.Chem., Scientific Specialist

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APPENDIX D

Non-Standard Special Provisions

EARTH EXCAVATION FOR CULVERT – Item No.

Non-Standard Special Provision

Amendment to OPSS.PROV 206, November 2014

Construction Specification for Grading

206.07.03.01 Earth Excavation - Grading

206.07.03.01.01 General

Section 206.07.03.01.01 of OPSS.PROV 206 shall be amended by the addition of the following:

The Contactor shall be alerted to the potential presence of cobbles at the creek bed, within the granular deposit encountered immediately below the creek bed, and within the granular deposits below the existing embankment fill. Considerations of the presence of these obstructions must be made in the selection of appropriate equipment and procedures for excavations.

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