



DETAILED FOUNDATION INVESTIGATION REPORT

Omer Lake Culvert Replacement

Highway 11, District of Thunder Bay, Ontario

Agreement No.: 6021-E-0007, Work Order 3

G.W.P. 6911-12-00, Site No. 48C-0181/C0

Latitude: 49.377205°, Longitude: -88.133495°

GEOCRES No.: 52H08-004

Client Name: HATCH

Date: January 30, 2025

File: 47632

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**DETAILED FOUNDATION INVESTIGATION REPORT
OMER LAKE CULVERT REPLACEMENT
HIGHWAY 11, DISTRICT OF THUNDER BAY, ONTARIO
AGREEMENT NO.: 6021-E-0007, WORK ORDER 3
G.W.P. 6911-12-00, SITE NO. 48C-0181/C0
LATITUDE: 49.377205°, LONGITUDE: -88.133495°**

GEOCRES No.: 52H08-004

1. INTRODUCTION

This report presents the factual data obtained from a supplemental foundation investigation carried out by Thurber Engineering Ltd. (Thurber) for detailed design of the proposed Omer Lake Culvert replacement. The Omer Lake Culvert is located on Highway 11, south of Macdiarmid, in the Unsurveyed Territory, District of Thunder Bay, Ontario.

A preliminary foundation investigation was previously completed by Thurber for this culvert replacement. The preliminary foundation investigation report for this site is available within the online Geocres Library (Geocres No. 52H-051) and is entitled:

“Foundation Investigation and Design Report, Omer Lake Culvert Replacement, Highway 11, District of Thunder Bay, Ontario, Agreement 6019-E-0009, Work Order 16, G.W.P. 6911-12-00, Site No. 48C-0181/C0”, File: 31344, Dated: January 6, 2023.

The purpose of this supplemental investigation was to advance additional deeper boreholes along the proposed replacement culvert sheet pile foundation alignments and in embankment widening areas, and based on the data obtained, to provide a borehole location plan, stratigraphic profile, records of boreholes, laboratory test results and a written description of the subsurface conditions, incorporating the factual data obtained from both investigations.

Thurber carried out the investigation as a sub-consultant to Hatch Corporation (Hatch), under the Ministry of Transportation Ontario (MTO) Retainer Agreement Number 6021-E-0007, Work Order 3.

It is a condition of this report that Thurber’s performance of its professional services is subject to the attached Statement of Limitations and Conditions.

2. SITE DESCRIPTION

The site is located on Highway 11, approximately 32 km south of Highway 580, in the Unsurveyed Territory, District of Thunder Bay, Ontario. The existing culvert allows a tributary of Omer Lake to

flow in an east to west direction under Highway 11. Highway 11 generally runs in a north-south direction at the culvert site. The watercourse connects Omer Lake on the east side of Highway 11 to Lake Nipigon on the west site.

The available base plan drawing provided by Hatch indicates that the existing structure is an open bottom, concrete box culvert. The base plan indicates that the span of the structure is 3.1 m, the height is 1.5 m and the length is 32.8 m. The estimated culvert invert is at approximate Elevation 259.1 m at both the inlet (east) and the outlet (west). The existing road grade at the culvert location is at approximate Elev. 264.7 m, which indicates approximately 4.1 m of fill above the culvert. The local creek water level was reportedly measured at Elev. 259.9 m in November 2018. The site topography within the culvert area is generally sloped down from north to south, with low lying grassy/marshy land and treed areas surrounding the culvert site.

The highway embankment side slopes near the existing culvert appear to be performing satisfactorily and range in inclination from approximately 1.3H:1V to 2H:1V or flatter. No significant evidence of instability, settlement or erosion was observed. Trees were observed to be growing above the inlet of the existing culvert structure.

Photographs in Appendix E show the general nature of the site and the existing culvert.

Based on published geological mapping, the quaternary geology in the area of the culvert site consists of undifferentiated till with predominantly sand to silty sand matrix. The bedrock in the area is described as metasedimentary rocks with mafic dikes and related intrusive rocks.

3. INVESTIGATION PROCEDURE

Two site investigations were carried out in support of the Omer Lake Culvert design. The preliminary site investigation and field-testing program was carried out in two phases from April 20 to 25, 2021 and from May 6 to 8, 2021. The field program consisted of drilling and sampling nine (9) boreholes (21-01, 21-02, 21-03A, 21-03B, and 21-04 to 21-08) to depths from 2.7 to 17.4 m below the ground surface (Elevation 253.2 to 246.2 m). Dynamic Cone Penetration Tests (DCPTs) were advanced from the base of Boreholes 21-01, 21-03A, 21-03B, 21-07 and 21-08 to depths from 8.8 to 24.4 m below the ground surface (Elevation 251.0 to 239.5 m). Boreholes 21-01, 21-02 and 21-05 to 21-08 were drilled through the paved portion of Highway 11. Boreholes 21-03A, 21-03B and 21-04 were drilled off-road near the inlet and outlet of the existing culvert.

The supplemental detailed design investigation was carried out in two phases from June 17 to 20, 2024 and from August 8 to 13, 2024. The field program consisted of drilling and sampling six (6) boreholes (24-01 to 24-06) to depths from 4.4 to 23.5 m below ground surface (Elevation 241.0 to 255.9 m). DCPTs were advanced from the base of Boreholes 24-03, 24-04, and 24-05 to depths

of 6.6 to 11.7 m below ground surface (Elevation 248.3 to 253.3). DCPTs (24-03A, 24-04A and 24-05A) were also advanced from ground surface adjacent to Boreholes 24-03, 24-04, and 24-05 to depths of 4.7 to 9.9 m below ground surface (Elevation 250.5 to 255.3 m). The boreholes were drilled along the approximate locations of the proposed sheet pile foundations for the replacement culvert, with Boreholes 24-01 and 24-02 drilled through the paved portion of Highway 11 and Boreholes 24-03 to 24-06 drilled off-road near the inlet and outlet of the existing culvert.

The approximate locations of the boreholes are shown on the Borehole Locations and Soil Strata Drawings included in Appendix A. The Record of Borehole sheets for the preliminary and detailed investigations are included in Appendix B.

Utility clearances were obtained prior to the start of drilling. The ground surface elevations for the boreholes were estimated from field measurements and the topographic drawings provided to Thurber by Hatch. The coordinate system MTM NAD 83, Zone 14 was used for the boreholes.

The boreholes through the road surface were advanced using a rubber track-mounted CME55 drill rig, using solid stem auger and/or wash boring techniques, as well as Dynamic Cone Penetration Tests (DCPTs). The off-road boreholes were advanced using a portable Hilti drill and tripod equipment using wash boring techniques, as well as DCPTs. In all boreholes, soil samples were obtained at selected intervals with a 50 mm outside diameter split spoon sampler driven in conjunction with the Standard Penetration Test (SPT).

The drilling and sampling operations were supervised on a full-time basis by a member of Thurber's technical staff. The supervisor logged the boreholes and processed the recovered soil samples for transport to Thurber's laboratory for further examination and testing.

Monitoring wells were installed in Boreholes 21-01 and 21-02. Both wells consisted of 50 mm Schedule 40 PVC pipe with a 3.0 m long slotted screen, enclosed in a column of filter sand to permit groundwater level monitoring. Monitoring well installation details, groundwater level observations and water level readings are shown on the Record of Borehole sheets. A sample of the groundwater was obtained from the well at Borehole 21-01 and submitted to a specialist analytical laboratory under chain of custody procedures for testing for a suite of water quality parameters. Single well response tests ("slug") tests were carried out in the wells installed in both Boreholes 21-01 and 21-02. Upon collection of the final water level readings on April 25, 2021, the wells were decommissioned in accordance with MOECP O.Reg. 903.

Details of the drilling program, including drilling depths, monitoring well installation and completion details are summarized in Table 3.1 below.

Table 3.1: Borehole Completion Details

Borehole Number	Borehole Depth / Base Elevation (m)	Monitoring Well Tip Depth / Elevation (m)	Completion Details
21-01	17.4 / 247.1	13.7 / 250.8	Borehole caved to 13.7 m, filter sand from 13.7 m to 10.4 m, bentonite holeplug from 10.4 m to 0.6 m, concrete from 0.6 m to 0.2 m, and cold patch asphalt to ground surface.
21-02	17.4 / 247.6	10.7 / 254.3	Borehole caved to 10.7 m, filter sand from 10.7 m to 7.3 m, bentonite holeplug from 7.3 m to 0.6 m, concrete from 0.6 m to 0.2 m, and cold patch asphalt to ground surface.
21-03A	6.7 / 253.2	None installed	Borehole caved to 2.3 m and was backfilled with bentonite holeplug from 2.3 m to ground surface.
21-03B	2.7 / 257.1	None installed	Borehole backfilled with bentonite holeplug from 2.7 m to ground surface.
21-04	14.0 / 246.2	None installed	Borehole caved to 10.0 m and was backfilled with bentonite holeplug from 10.0 m to ground surface.
21-05	17.4 / 246.9	None installed	Borehole caved to 11.4 m and was backfilled with bentonite holeplug from 11.4 m to 0.6 m, concrete from 0.6 m to 0.2 m, and cold patch asphalt to ground surface.
21-06	17.4 / 247.8	None installed	Borehole caved to 5.3 m and was backfilled with bentonite holeplug from 5.3 m to 0.6 m, concrete from 0.6 m to 0.2 m, and cold patch asphalt to ground surface.
21-07	17.4 / 248.3	None installed	Borehole caved to 6.1 m and was backfilled with bentonite holeplug from 6.1 m to 0.6 m, concrete from 0.6 m to 0.2 m, and cold patch asphalt to ground surface.
21-08	17.4 / 246.5	None installed	Borehole caved to 5.9 m and was backfilled with bentonite holeplug from 5.9 m to 0.6 m, concrete from 0.6 m to 0.2 m, and cold patch asphalt to ground surface.

Borehole Number	Borehole Depth / Base Elevation (m)	Monitoring Well Tip Depth / Elevation (m)	Completion Details
24-01	23.5 / 241.0	None installed	Borehole caved to 7.7 m and was backfilled with bentonite holeplug to 0.6 m, gravel from 0.6 m to 0.1 m, and cold patch asphalt to ground surface.
24-02	23.5 / 241.4	None installed	Borehole caved to 18.0 m and was backfilled with bentonite holeplug to 0.6 m, gravel from 0.6 m to 0.1 m, and cold patch asphalt to ground surface.
24-03	8.2 / 252.2	None installed	Borehole caved to 2.3 m and was backfilled with bentonite holeplug to ground surface.
24-04	6.6 / 253.3	None installed	Borehole caved to 2.3 m and was backfilled with bentonite holeplug to ground surface.
24-05	9.1 / 250.9	None installed	Borehole caved to 2.4 m and was backfilled with bentonite holeplug to ground surface.
24-06	5.5 / 255.9	None installed	Borehole caved to 4.3 m and was backfilled with bentonite holeplug to ground surface.

4. LABORATORY TESTING

All recovered soil samples were subjected to visual identification and natural moisture content determination. Selected samples were subjected to grain size distribution analyses (sieve and hydrometer), and the results of this testing program are summarized on the Record of Borehole sheets in Appendix B and are shown on the figures included in Appendix C.

In order to assess the potential for sulphate attack on concrete foundations, as well as the potential for corrosion associated with the structure, two samples of the soil and a sample of the creek water were collected during the investigation and submitted to SGS Canada Inc., a CALA accredited analytical laboratory in Lakefield, Ontario, for analytical testing of soil corrosivity parameters. In order to assess the quality of the groundwater for disposal purposes, a water sample was collected from the well installed in Borehole 21-01. The results of the analytical testing are summarized in this report and presented in Appendix D.

In order to assess the organic content of the buried peat to sand and silt mixed with peat on site, six (6) soil samples collected in the detailed design investigation were submitted to ALS Canada Inc., a CALA accredited analytical laboratory in Waterloo, Ontario, for analytical testing (loss on

ignition at 440°C). The results of the analytical testing are summarized in this report and presented in Appendix D.

An environmental soil sampling program was completed concurrently with the foundation investigation to collect four soil samples for excess soil analysis, with the sample locations and depths selected by Hatch. The results of this sampling program were reported separately to Hatch by email on July 18, 2024.

5. DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets included in Appendix B. Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets and on the Borehole Locations and Soil Strata drawings in Appendix A. A general description of the stratigraphy, based on the conditions encountered in the boreholes from the preliminary and detailed investigations, is given in the following paragraphs. However, the factual data presented in the Record of Borehole sheets governs any interpretation of the site conditions. It must be recognized that soil conditions may vary between and beyond the borehole locations.

In general, the subsurface stratigraphy below the asphalt typically consists of sand to silty sand fill underlain by a layer of peat to sand and silt mixed with peat. Underlying the peat, the native soils consisted of sand to silt and sand, with lower deposits of silt. More detailed descriptions of individual strata are presented below.

5.1 Asphalt

Boreholes 21-01, 21-02, 21-05 to 21-08, 24-01 and 24-02 were drilled through the paved portion of Highway 11. The asphalt ranged in thickness from 50 to 225 mm at these locations. A 250 to 305 mm thick layer of granular fill was encountered below the asphalt in Boreholes 24-01 and 24-02.

A thin layer of asphalt (approximately 25 mm thick) was also encountered at a depth of 0.6 m in Boreholes 21-02 and 21-08 within the fill.

5.2 Silty Sand Fill

Silty sand fill ranging to granular fill was encountered below the asphalt and granular fill in Boreholes 21-01, 21-02, 21-05 to 21-08 and 24-01. The fill generally consisted of silty sand with some gravel, and ranged to sand, some gravel to gravelly with some silt in Boreholes 21-07 and 24-01.

The silty sand fill ranged in thickness from 0.4 m to 1.2 m, with an underside depth ranging from 0.8 m to 1.4 m below ground surface (Elevation 264.4 to 263.1 m).

SPT 'N' values in the silty sand fill generally ranged from 28 to 100 blows per 0.3 m penetration, indicating a compact to very dense relative density; typically very dense.

The measured moisture contents generally ranged from 2 to 7%.

The results of grain size analyses conducted on selected samples of silty sand to gravelly sand fill are provided on the Record of Borehole sheets in Appendix B and plotted on Figure C1 in Appendix C. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	12 to 27
Sand	60 to 73
Silt & Clay	13 to 23

5.3 Sand and Silt Fill

Sand and silt embankment fill was encountered below the silty sand fill in Boreholes 21-01, 21-02, 21-05 to 21-08, 24-01 and 24-02. The fill ranged in composition from sand with some silt to sand and silt and contained trace gravel and trace clay.

The sand and silt fill ranged in thickness from 3.3 m to 4.8 m, with an underside depth ranging from 4.1 m to 6.1 m below ground surface (Elevation 261.6 to 259.4 m).

SPT 'N' values in the fill ranged from 4 to 43 blows per 0.3 m penetration, indicating a very loose to dense relative density; typically compact.

The measured moisture contents generally ranged from 4 to 23%.

The results of grain size analyses conducted on selected samples of the sand and silt fill are provided on the Record of Borehole sheets in Appendix B and plotted on Figure C2 in Appendix C. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0 to 5
Sand	37 to 84
Silt	23 to 62
Clay	0 to 6
Silt & Clay	11

5.4 Peat to Sand and Silt mixed with Peat

A surficial layer of peat was encountered at the ground surface in Boreholes 21-03A, 21-04, 24-03, 24-04 and 24-05, and a buried layer of peat ranging to sand and silt mixed with peat was

encountered below the sand and silt fill in Boreholes 21-01, 21-02, 21-05 to 21-08, 24-01 and 24-02. The peat generally contained sand and silt, as well as wood fragments and some clay lenses. A thin layer of topsoil (75 mm) was encountered at the ground surface at Borehole 24-06.

In Boreholes 21-03A, 21-04, 24-03, 24-04, and 24-05, the depth and thickness of the surficial peat ranged from 150 mm to 1.8 m (Elevation 260.0 to 258.1 m). In Boreholes 21-01, 21-02, 21-05 to 21-08, 24-01 and 24-02, the thickness of the buried peat ranged from 1.1 m to 3.1 m, with an underside depth ranging from 5.6 m to 7.7 m below ground surface (Elevation 258.5 to 257.1 m).

SPT 'N' values in the peat to sand and silt mixed with peat ranged from 1 to 13 blows per 0.3 m penetration, indicating a very loose to compact density; typically loose. Borehole 24-01 encountered a single SPT 'N' Value of 50 blows per 125 mm, most likely due to the presence of the wood fragments encountered in the sample.

Measured moisture contents ranged from 24 to 186%.

The results of a grain size analysis conducted on samples of sand and silt mixed with peat are provided on the Record of Borehole sheets in Appendix B and plotted on Figure C3 in Appendix C. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0
Sand	38 to 73
Silt	26 to 59
Clay	0 to 5

Based on visual laboratory assessment of selected samples, the peat to sand and silt mixed with peat is considered to be non-plastic.

The organic content of selected peat samples was estimated to range from approximately 2 to 10%, based on the results of analytical testing for the percent loss on ignition at 440 degrees Celsius and the remaining ash content. The laboratory certificates of analysis are presented in Appendix D and summarized in Table 5.1 below:

Table 5.1: Organic Content Test Results

Sample ID	Depth Range (m)	Loss on Ignition at 440°C	Ash Content at 440°C
24-01 SS8	5.3 – 5.5	7.0%	93.0%
24-02 SS7	4.6 – 5.2	4.1%	95.9%
24-03 SS-1 (0'-2') & SS-3 (4'-6')	0 – 1.8	6.4%	93.6%
24-04 SS-1 (0'-2') & SS-4 (6'-8')	0 – 2.4	4.2%	95.8%
24-05 SS-2B (2'7"-4') & SS-3A (4'-5'1")	0.8 – 1.5	9.8%	90.2%
24-06 SS-1 (0'-2') & SS-2A (2'-3'5")	0 – 1.0	2.2%	97.8%

5.5 Sand to Silt and Sand

A deposit ranging in composition from sand with trace to some silt, to silty sand, to silt and sand was encountered below the peat or topsoil in all of the boreholes. The deposit also generally contained trace gravel and trace clay. A lower deposit of sand to silt and sand was also encountered below the silt layer in Boreholes 24-01 and 24-02.

Boreholes 21-02 and 21-06 were terminated in the upper sand to silt and sand deposit at a depth of 17.4 m (Elevation 247.8 to 247.6 m). Boreholes 24-01 and 24-02 were terminated in the lower sand to silt and sand deposit at a depth of 23.5 m below ground surface (Elevation 241.4 to 241.0 m). The thickness of the upper sand to silt and sand deposit, where fully penetrated in Boreholes 21-01, 21-04, 21-05, 21-07, 24-01 and 24-02, ranged from 5.4 to 9.1 m, with an underside depth ranging from 5.6 to 16.3 m (Elevation 254.6 to 248.2 m).

SPT 'N' values in the sand to silt and sand ranged from 2 blow to 54 blows, indicating a very loose to very dense relative density; typically compact.

Measured moisture contents generally ranged from 11 to 59%. The results of grain size analyses conducted on samples of the sand to silt and sand deposit are provided on the Record of Borehole sheets in Appendix B, and plotted on Figures C4 to C6 of Appendix C. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0 to 4
Sand	35 to 92
Silt	4 to 64
Clay	0 to 7

5.6 Silt

A silt deposit was encountered below the sand to silt and sand layer in Boreholes 21-01, 21-04, 21-05, 21-07, 24-01 and 24-02. The silt contained trace to some sand, trace to some clay, and trace gravel.

A 1.4 m thick upper layer of silt was also encountered in Borehole 21-04 within the sand to silt and sand deposit at a depth of 3.2 m (Elevation 257.0 m).

The thickness of the silt layer, where fully penetrated in Boreholes 24-01 and 24-02, ranged from 6.1 to 7.2 m with an underside depth of 22.0 to 22.4 m below ground surface (Elevation 242.9 to 242.1 m). Sampling was terminated in Boreholes 21-01, 21-04, 21-05 and 21-07 within the silt deposit at depths ranging from 14.0 to 17.4 m below ground surface (Elevation 248.3 to 246.2 m). Dynamic Cone Penetration Tests (DCPTs) were conducted at the base of the sampled portions of Boreholes 21-01, 21-03A, 21-03B, 21-07, 21-08, 24-03, 24-04, 24-05, and from the ground surface of Boreholes 24-03A, 24-04A and 24-05A. The DCPTs were terminated at depths ranging from 4.7 to 24.4 m below the ground surface (Elevation 255.3 to 239.5 m). The DCPTs at Boreholes 21-03B, 24-03, 24-03A, 24-04, 24-04A, 24-05, and 24-05A encountered refusal of 100 blows per 0.3 m penetration. The DCPT termination depths are estimated to mainly correspond to the silt deposit, with some DCPTs ended within the overlying or underlying sand to silt and sand deposits.

SPT 'N' values in the silt deposit ranged from 11 to 38 blows, indicating a compact to dense relative density.

Recorded moisture contents in the silt ranged from 12 to 23%. The results of grain size analyses conducted on samples of the silt deposit are provided on the Record of Borehole sheets in Appendix B and plotted on Figure C7 of Appendix C. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0
Sand	0 to 18
Silt	72 to 96
Clay	2 to 20

The results of the Atterberg Limits tests conducted on samples of the silt are provided on the Record of Borehole sheets in Appendix B and illustrated on Figure C8 of Appendix C. The results are summarized as follows:

Index Property	Percentage (%)
Liquid Limit	17 to 21
Plasticity Index	2 to 4

The results of the Atterberg Limits tests indicate that the silt has low plasticity (ML).

5.7 Groundwater Conditions

Groundwater conditions were observed during drilling operations and groundwater levels were measured in the open boreholes upon completion of drilling, and in the monitoring wells installed in Boreholes 21-01 and 21-02. The measured groundwater levels are summarized in Table 5.2 below. The monitoring wells were decommissioned on April 25, 2021 following final water level readings and slug testing.

Table 5.2: Groundwater Measurements

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
21-01	April 22, 2021	5.5	259.0	In monitoring well
	April 23, 2021	4.7	259.8	
	April 25, 2021	4.7	259.8	
21-02	April 23, 2021	5.2	259.8	In monitoring well
	April 25, 2021	5.2	259.8	
21-03A	May 8, 2021	0.1	259.3	Open Borehole
21-04	May 6, 2021	0.9	260.3	Open Borehole
21-05	April 22, 2021	*	-	Open Borehole
21-06	April 23, 2021	*	-	Open Borehole
21-07	April 23, 2021	*	-	Open Borehole
21-08	April 25, 2021	*	-	Open Borehole
24-01	June 18, 2024	4.9	259.6	Open Borehole
24-02	June 20, 2024	5.0	259.9	Open Borehole
24-03	August 11, 2024	*	-	Open Borehole
24-04	August 12, 2024	*	-	Open Borehole
24-05	August 13, 2024	*	-	Open Borehole
24-06	Augst 8, 2024	*	-	Open Borehole

*Water level not recorded due to residual drilling water in the borehole.

The groundwater level is likely to reflect the local creek water level. The local creek water level was measured at Elevation 259.9 m in November 2018.

It should also be noted that groundwater levels are short term observations and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after periods of significant and/or prolonged precipitation and spring snow melts.

6. CORROSIVITY AND SULPHATE TEST RESULTS

Samples of the sand and silt mixed with peat and the native sand from Boreholes 21-01 and 21-02 respectively, and a sample of surface water collected from the watercourse were submitted for analytical testing of corrosivity parameters and sulphate. The laboratory certificates of analysis are presented in Appendix D. The results of the analytical tests are summarized below in Table 6.1.

Table 6.1: Analytical Test Results

Parameter	Units (Soil)	Units (Water)	Test Results		
			21-01, SS6B (16'-17') (4.9 – 5.2 m)	21-02, SS8 (25" – 27') (7.6 – 8.2 m)	Omer Lake Watercourse
			(Native Sand and Silt mixed with Peat)	(Native Sand)	(Surface Water)
Redox Potential	mV	mV	210	199	243
Sulphide	%	µg/L	<0.04	<0.04	8
pH	-	-	7.52	8.74	7.65
Chloride	µg/g	mg/L	4700	190	39
Sulphate	µg/g	mg/L	51	5.2	2.1
Conductivity	µS/cm	µS/cm	4230	436	210
Resistivity	ohm-cm	ohm-cm	236	2290	4762*

* Calculated based on conductivity result

7. WATER QUALITY

For assessment of the general groundwater quality in the project area, a sample of the groundwater from the monitoring well at Borehole 21-01 was collected on April 25, 2021. The water sample was analyzed for selected inorganic parameters included in the Ontario Provincial Water Quality Objectives (PWQO). A filtered sub-sample was also tested for dissolved metal parameters for comparison purposes. The analytical test results are presented in Appendix D.

The analytical results of the water testing were compared to limits for the PWQO for surface water discharge. The concentrations of all parameters tested that did not meet the criteria established in the PWQO are listed below in Table 7.1.

Table 7.1: Water Parameters Exceeding PWQO Criteria

Sample ID	Parameter	Criteria	Parameter Limit (µg/L)	Result (µg/L)
BH21-01	Total Cobalt	PWQO	0.9	2.51
	Total Phosphorus	PWQO	10	121
	Total Copper	PWQO	1	12.2
	Total Aluminum	PWQO	15	1470
	Total Iron	PWQO	300	3120
	Total Phenols	PWQO	1	<2*
BH21-01 (Filtered sub-sample)	Dissolved Phosphorus	PWQO	10	16
	Dissolved Copper	PWQO	1	3.4
	Dissolved Aluminum	PWQO	15	31

*Note: The laboratory detection limit is higher than the PWQO criteria for this parameter and therefore this test result may not be indicative of an actual parameter exceeding the criteria.

8. SINGLE WELL RESPONSE TEST RESULTS

8.1 Test Procedure

Single well response tests (SWRT) (“slug” tests) were carried out on the 50 mm diameter wells installed in Boreholes 21-01 and 21-02. The well installed in Borehole 21-01 was screened across sand and silt to silty sand. The well installed in Borehole 21-02 was screened across sand, some silt. The tests were completed using the following method:

- The static water level was measured and recorded, and a datalogger was inserted into the well below the water level. The datalogger was set to record water levels every 0.125 to 0.5 seconds, based on the anticipated rate of recovery of the wells.
- A slug of groundwater was removed from the well with a dedicated bailer to induce a change in hydraulic head (rising head test).
- Manual and electronic measurements were recorded until the water level in the well recovered sufficiently.
- Manual measurements were compared to electronic measurements for quality control of the data.

8.2 Hydraulic Conductivity

The slug tests were completed and analyzed using the Hvorslev method. The plots of the slug test results are included in Appendix C. The hydraulic conductivity values calculated from the in-situ slug tests are summarized in the following table.

Table 8.1: Single Well Response Test Results

Monitoring Well	Hydraulic Conductivity (m/s)	Screened Formation
21-01	6.1×10^{-5}	Sand and silt to silty sand
21-02	4.7×10^{-5}	Sand, some silt

9. MISCELLANEOUS

Thurber obtained utility clearances for the borehole locations prior to drilling. Borehole locations were selected and established in the field by Thurber Engineering Ltd.

RPM Drilling of Thunder Bay, Ontario supplied a rubber track-mounted CME55 drill rig and Ohlmann Geotechnical Services (OGS) Inc. of Almonte, Ontario supplied a portable Hilti drill, to conduct the drilling, sampling and in-situ testing operations for the boreholes in both the preliminary and detailed design investigations. Traffic control services conforming to Ontario Traffic Manual (Book 7) were provided by Men at Worx Ltd. of Thunder Bay, Ontario.

Geotechnical laboratory testing was carried out in Thurber's geotechnical laboratory. Analytical testing was carried out by SGS Canada Inc. for the preliminary investigation and ALS Canada Ltd. for the detailed design investigation.

The preliminary field investigation was supervised on a full-time basis by Ms. Rachel Bourassa, and Mr. Greg Stanhope of Thurber. Overall supervision of the field program was provided by Mr. Joshua Alexander and Mr. Mark Farrant, P. Eng. of Thurber.

The detailed design field investigation was supervised on a full-time basis by Mr. Greg Stanhope and Mr. Jaimin Patel of Thurber. Overall supervision of the field program was provided by Ms. Madisan Chiarotto, P.Eng. and Mr. Mark Farrant, P.Eng. of Thurber.

The report was prepared by Ms. Madisan Chiarotto, P.Eng. and Mr. Mark Farrant, P.Eng., and reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

THURBER ENGINEERING LTD.

A handwritten signature in blue ink that reads 'Madisan Chiarotto'.

Madisan Chiarotto, P.Eng.
Geotechnical Engineer



P.K. Chatterji, P.Eng.
Principal, Designated MTO Contact



Mark Farrant, P.Eng.
Associate, Senior Geotechnical Engineer

Date: January 30, 2025
File: 47632

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

- a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.
- b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.
- c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.
- d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

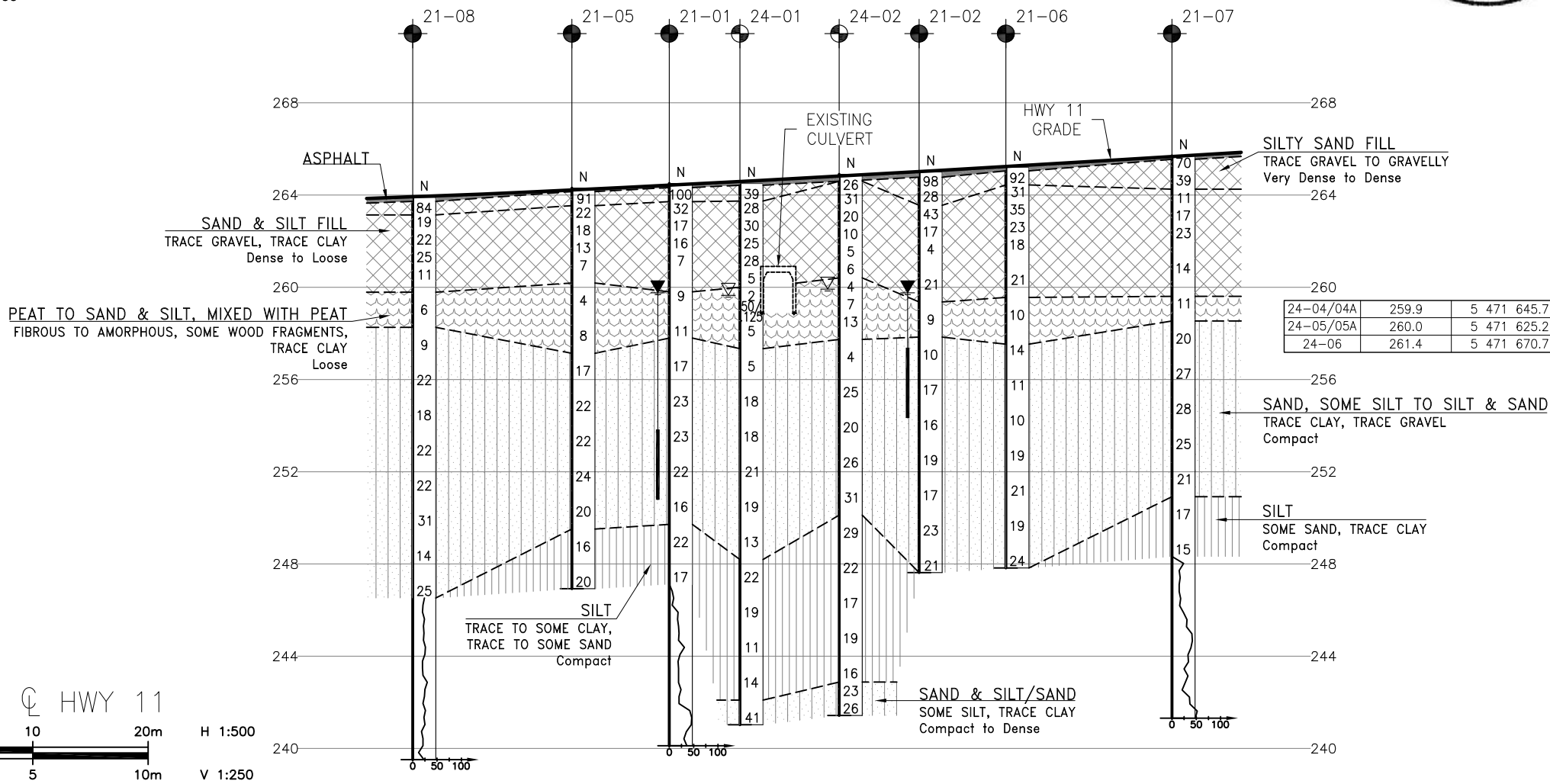
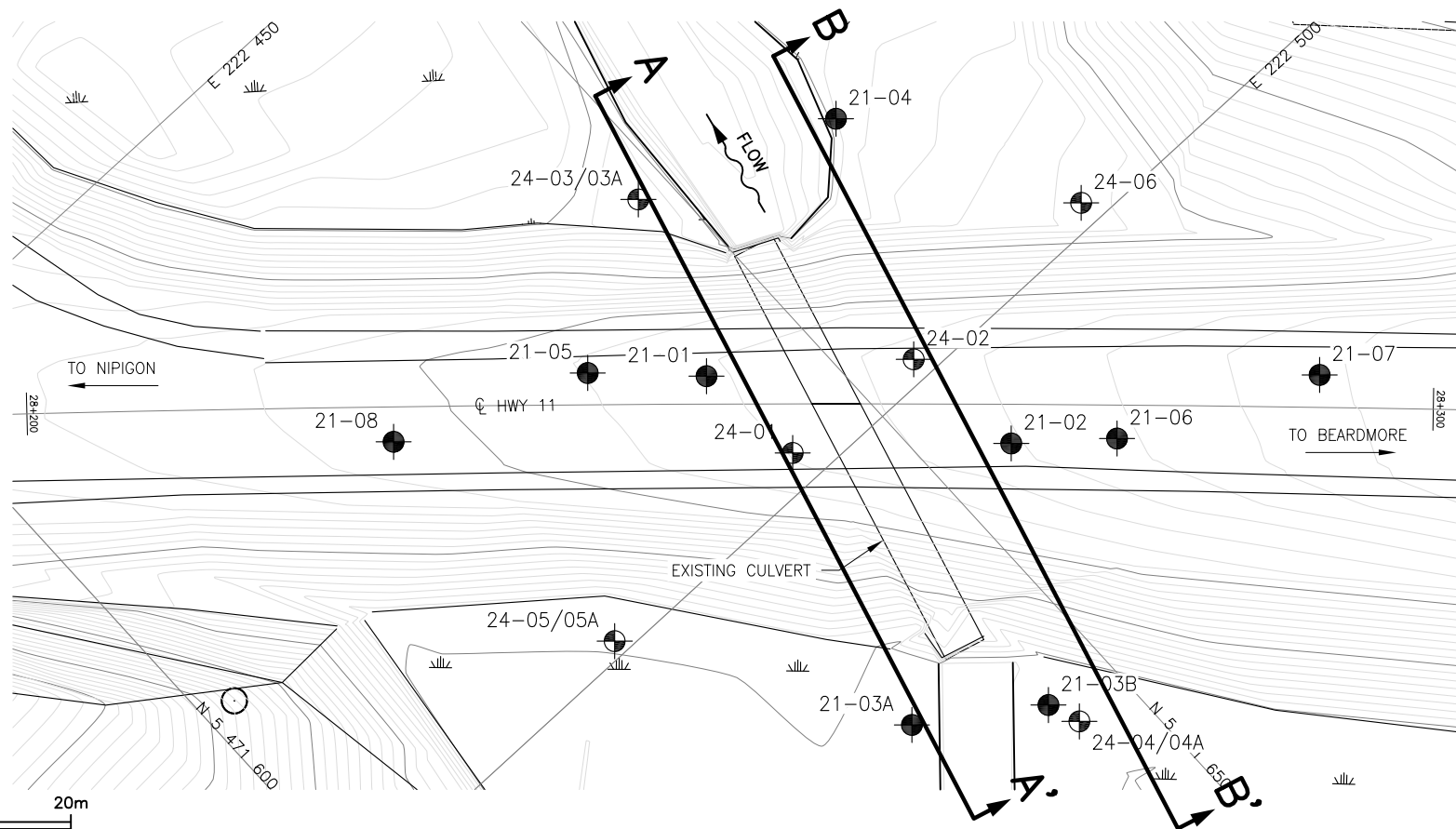
Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

APPENDIX A

Borehole Locations and Soil Strata Drawings



METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN



CONT No
GWP No 6911-12-00

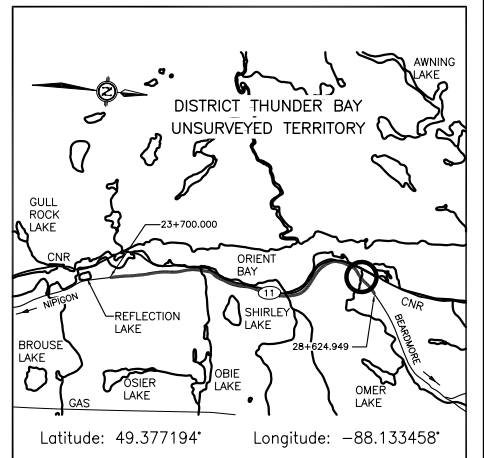
OMER LAKE CULVERT
ON HIGHWAY 11
REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET

HATCH

THURBER



KEYPLAN

LEGEND

●	Borehole
⊙	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
W	Water Level
HA	Head Artesian Water
P	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
21-01	264.5	5 471 642.7	222 489.4
21-02	265.0	5 471 655.5	222 507.6
21-03A	259.9	5 471 636.7	222 517.6
21-03B	259.8	5 471 644.9	222 523.1
21-04	260.2	5 471 661.8	222 482.1
21-05	264.3	5 471 636.6	222 483.6
21-06	265.2	5 471 661.2	222 512.4
21-07	265.7	5 471 674.9	222 518.8
21-08	263.9	5 471 623.1	222 477.9
24-01	264.5	5 471 643.5	222 497.6
24-02	264.9	5 471 654.4	222 498.5
24-03/03A	260.4	5 471 647.6	222 476.9

-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Coordinate system is MTM NAD 83 Zone 14.

GEOCRES No. 52H08-004

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	MC	CHK MEF	CODE
DRAWN	AN	CHK MC	SITE 48C-0181/CO
LOAD	DATE	JAN 2025	
STRUCT	DWG	1	

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

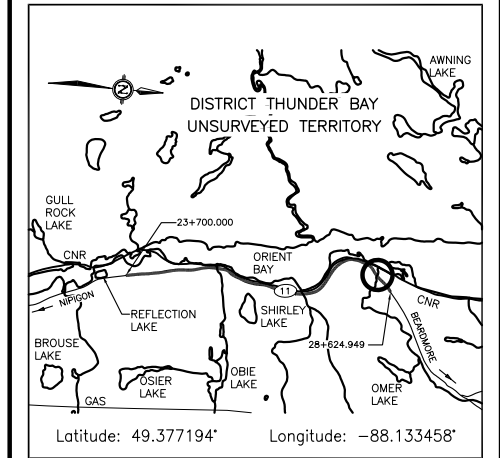
CONT No
GWP No 6911-12-00

OMER LAKE CULVERT
ON HIGHWAY 11
REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

HATCH

THURBER



KEYPLAN

LEGEND

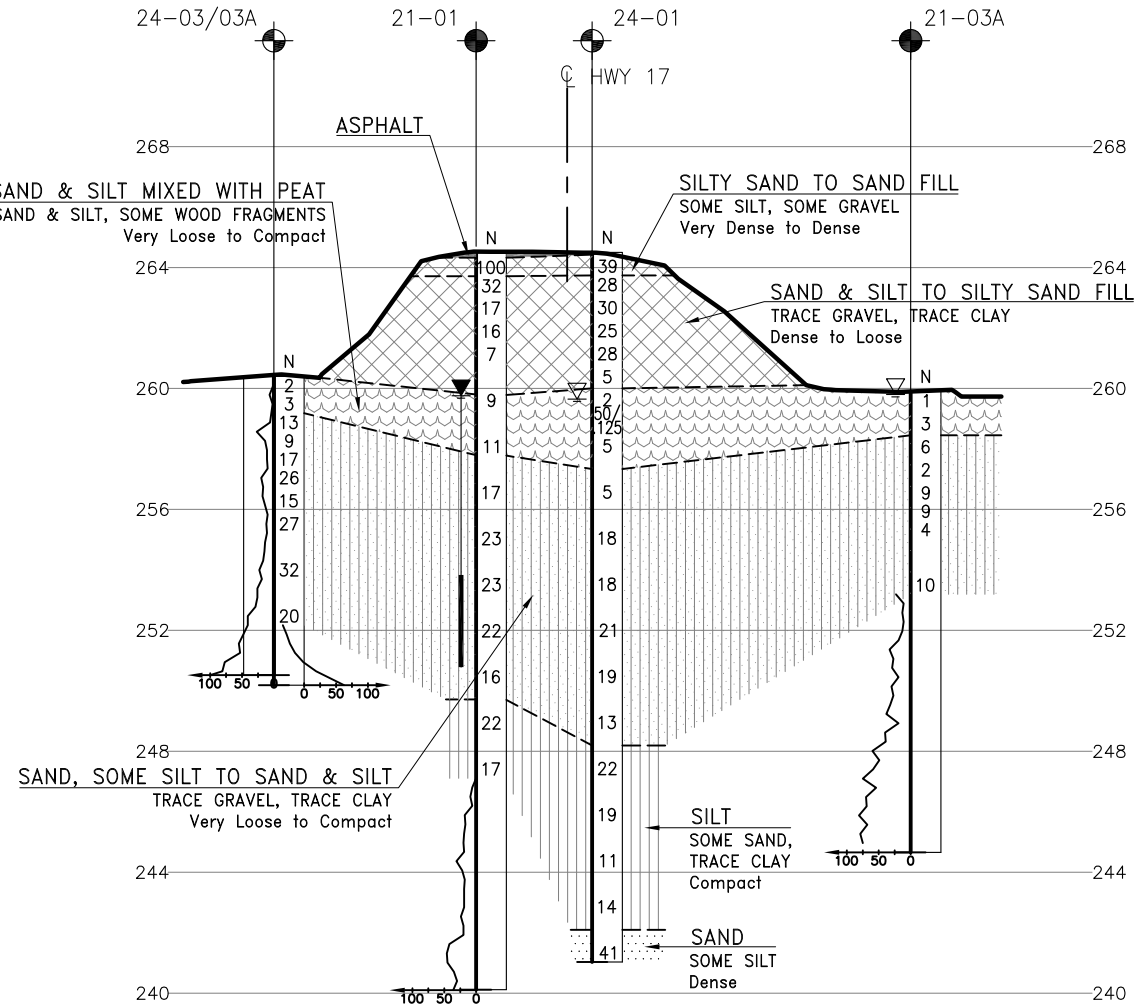
	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
21-01	264.5	5 471 642.7	222 489.4
21-02	265.0	5 471 655.5	222 507.6
21-03A	259.9	5 471 636.7	222 517.6
21-03B	259.8	5 471 644.9	222 523.1
21-04	260.2	5 471 661.8	222 482.1
21-05	264.3	5 471 636.6	222 483.6
21-06	265.2	5 471 661.2	222 512.4
21-07	265.7	5 471 674.9	222 518.8
21-08	263.9	5 471 623.1	222 477.9
24-01	264.5	5 471 643.5	222 497.6
24-02	264.9	5 471 654.4	222 498.5
24-03/03A	260.4	5 471 647.6	222 476.9

-NOTES-

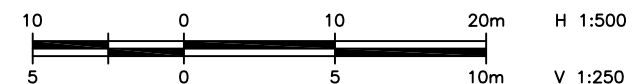
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Coordinate system is MTM NAD 83 Zone 14.

GEORES No. 52H08-004

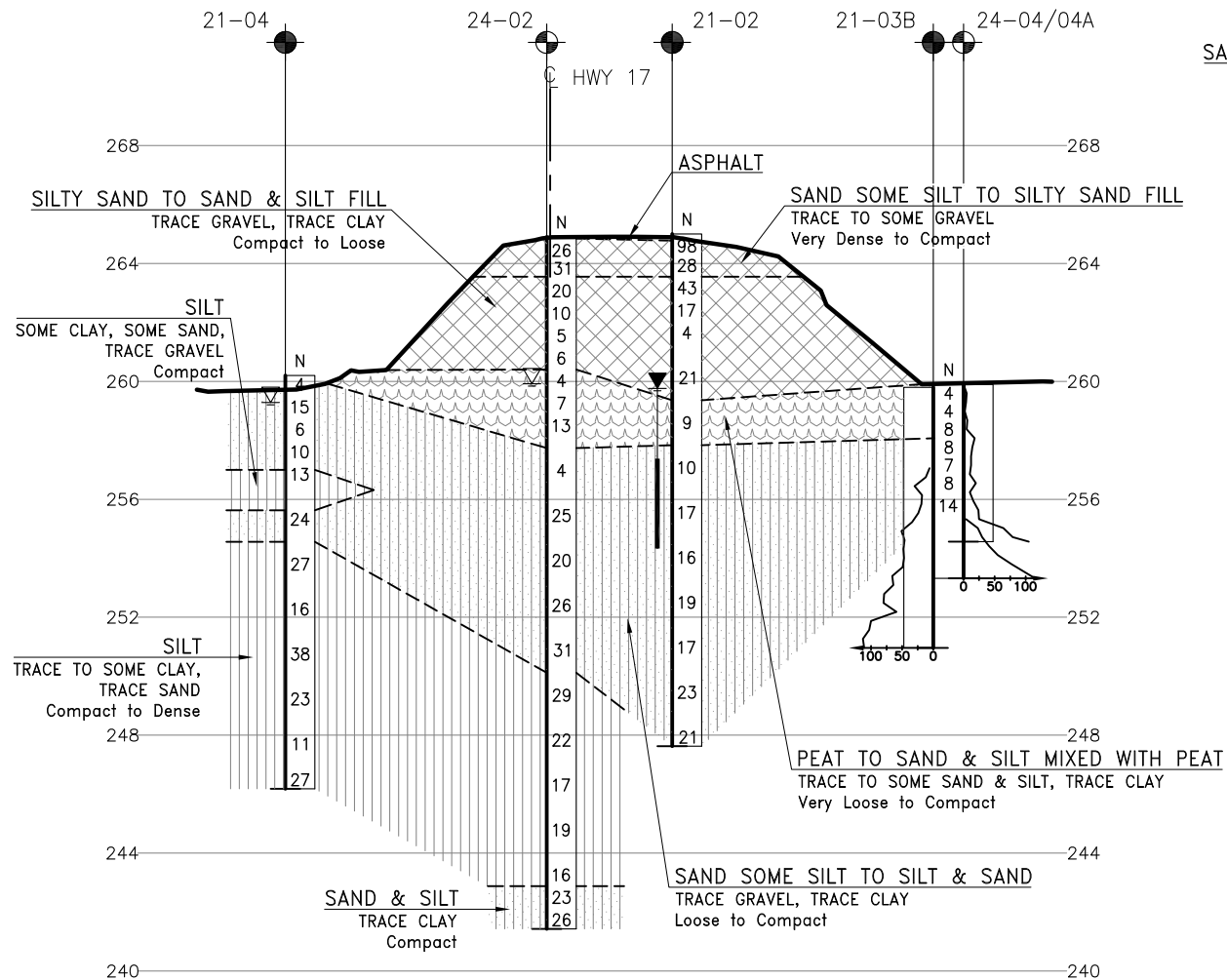


SECTION ALONG A-A'

24-04/04A	259.9	5 471 645.7	222 525.4
24-05/05A	260.0	5 471 625.2	222 498.9
24-06	261.4	5 471 670.7	222 498.3



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	MC	CHK MEF	CODE
DRAWN	AN	CHK MC	SITE 48C-0181/CO
			LOAD
			DATE JAN 2025
			DWG 2



SECTION ALONG B-B'

APPENDIX B

Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽¹⁾ 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer



4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$

 Water Level
 Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS $W_L < 50\%$	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. ($W_L < 30\%$).
		CI	Inorganic clays of medium plasticity, silty clays. ($30\% < W_L < 50\%$).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

RECORD OF BOREHOLE No 21-01

1 OF 3

METRIC

GWP# 6118-17-01 LOCATION Omer Lake Tributary Culvert; MTM NAD83-14 N 5 471 642.7 E 222 489.4 ORIGINATED BY RB
DIST Thunder Bay HWY 11 BOREHOLE TYPE Solid Stem Augers/DCPT COMPILED BY AN
DATUM Geodetic DATE 2021.04.20 - 2021.04.21 LATITUDE 49.377150 LONGITUDE -88.133602 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
264.5	GROUND SURFACE							20	40	60	80	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											

Continued Next Page

+³, ×³: Numbers refer to Sensitivity
20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 21-01

2 OF 3

METRIC

GWP# 6118-17-01 LOCATION Omer Lake Tributary Culvert; MTM NAD83-14 N 5 471 642.7 E 222 489.4 ORIGINATED BY RB
DIST Thunder Bay HWY 11 BOREHOLE TYPE Solid Stem Augers/DCPT COMPILED BY AN
DATUM Geodetic DATE 2021.04.20 - 2021.04.21 LATITUDE 49.377150 LONGITUDE -88.133602 CHECKED BY MEF

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	WATER CONTENT (%)					
	Continued From Previous Page													
252.8	SAND and SILT , trace clay Compact Grey Wet		10	SS	23									0 35 64 1
251.7	Silty SAND Compact Brown Wet		11	SS	22									
249.7			12	SS	16									
247.1	SILT , trace clay, trace sand Compact Grey Wet		13	SS	22									
247.1			14	SS	17									0 4 86 10
17.4	End of sampling at 17.4m and start DCPT													

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity 20
15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 21-01

3 OF 3

METRIC

GWP# 6118-17-01 LOCATION Omer Lake Tributary Culvert; MTM NAD83-14 N 5 471 642.7 E 222 489.4 ORIGINATED BY RB
DIST Thunder Bay HWY 11 BOREHOLE TYPE Solid Stem Augers/DCPT COMPILED BY AN
DATUM Geodetic DATE 2021.04.20 - 2021.04.21 LATITUDE 49.377150 LONGITUDE -88.133602 CHECKED BY MEF

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	WATER CONTENT (%)					
	Continued From Previous Page							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	20 40 60					
240.1							244							
							243							
							242							
							241							
240.1 24.4	END OF DCPT AT 24.4m. BOREHOLE CAVED TO 12.5m BEFORE MONITORING WELL INSTALLATION. Piezometer installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2021.04.22 5.5 259.0 2021.04.23 4.7 259.8 2021.04.25 4.7 259.8													

ONTMT452 2020LIBRARY(MTO).GLB OMER LAKE CULVERTS.GPJ 1/30/25

RECORD OF BOREHOLE No 21-02

1 OF 2

METRIC

GWP# 6118-17-01 LOCATION Omer Lake Tributary Culvert; MTM NAD83-14 N 5 471 655.5 E 222 507.6 ORIGINATED BY RB
DIST Thunder Bay HWY 11 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2021.04.22 - 2021.04.22 LATITUDE 49.377267 LONGITUDE -88.133355 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
265.0	GROUND SURFACE							<div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × LAB VANE</div></div>						
0.0	ASPHALT: (225mm)							<div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × LAB VANE</div></div>						
0.2	Silty SAND, some to trace gravel Very Dense to Compact Brown Moist (FILL)		1	SS	98		264							136423 (SI+CL)
	25mm thick layer of asphalt at 0.6m		2	SS	28									
263.6														
1.4	SAND and SILT, trace clay, trace gravel Dense to Loose Brown Moist (FILL)		3	SS	43		263							
			4	SS	17		262							
			5	SS	4									143551
	Trace organics, rootlets and wood fragments		6	SS	21		261							
							260							
259.4														
5.6	PEAT, fibrous, trace sand, trace silt Loose Brown to Black Wet		7	SS	9		259							
							258							
257.8														
7.2	SAND, some silt Compact Grey Wet		8	SS	10		257							088120
			9	SS	17		256							

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 21-02

2 OF 2

METRIC

GWP# 6118-17-01 LOCATION Omer Lake Tributary Culvert; MTM NAD83-14 N 5 471 655.5 E 222 507.6 ORIGINATED BY RB
DIST Thunder Bay HWY 11 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2021.04.22 - 2021.04.22 LATITUDE 49.377267 LONGITUDE -88.133355 CHECKED BY MEF

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
	Continued From Previous Page																
251.7	SAND , some silt Compact Grey Wet		10	SS	16		254										
							253										
			11	SS	19		252										
13.3	Silty SAND Compact Grey Wet		12	SS	17		251										
							250										
			13	SS	23		249									0 64 36 0	
							248										
247.6			14	SS	21												
17.4	END OF BOREHOLE AT 17.4m. Piezometer installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2021.04.23 5.2 259.8 2021.04.25 5.2 259.8																

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METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 21-03A

2 OF 2

METRIC

GWP# 6118-17-01 LOCATION Omer Lake Tributary Culvert; MTM NAD83-14 N 5 471 636.7 E 222 517.6 ORIGINATED BY GS
 DIST Thunder Bay HWY 11 BOREHOLE TYPE Casing/DCPT COMPILED BY AN
 DATUM Geodetic DATE 2021.05.08 - 2021.05.08 LATITUDE 49.377100 LONGITUDE -88.133213 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL LIMIT MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)				
	Continued From Previous Page							20 40 60 80 100	○ UNCONFINED + FIELD VANE	W _P W W _L					
								● QUICK TRIAXIAL × LAB VANE							
								</							

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METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 21-04

1 OF 2

METRIC

GWP# 6118-17-01 LOCATION Omer Lake Tributary Culvert; MTM NAD83-14 N 5 471 661.8 E 222 482.1 ORIGINATED BY GS
DIST Thunder Bay HWY 11 BOREHOLE TYPE Casing/Tripod COMPILED BY AN
DATUM Geodetic DATE 2021.05.06 - 2021.05.06 LATITUDE 49.377321 LONGITUDE -88.133706 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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								
260.2	GROUND SURFACE															
0.0	PEAT: (150mm)															
0.2	Sandy SILT , some roots, organics Loose to Compact Brown to Grey Moist		1	SS	4		260									
			2	SS	15		259									
258.8																
1.4	SILT and SAND , trace clay, trace gravel Loose to Compact Grey Wet		3	SS	6		258									
			4	SS	10											
257.0																
3.2	SILT , some clay, some sand, trace gravel Compact Grey Moist		5	SS	13		257									
255.6																
4.6	Silty SAND Compact Brown Moist		6	SS	24		255									
254.6																
5.6	SILT , some to trace clay, trace sand Compact to Dense Grey Moist		7	SS	27		254									
			8	SS	16		253									
							252									
			9	SS	38		251									

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+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 21-04

2 OF 2

METRIC

GWP# 6118-17-01 LOCATION Omer Lake Tributary Culvert; MTM NAD83-14 N 5 471 661.8 E 222 482.1 ORIGINATED BY GS
 DIST Thunder Bay HWY 11 BOREHOLE TYPE Casing/Tripod COMPILED BY AN
 DATUM Geodetic DATE 2021.05.06 - 2021.05.06 LATITUDE 49.377321 LONGITUDE -88.133706 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				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					
	Continued From Previous Page							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
								20 40 60 80 100					
								WATER CONTENT (%) W _P W W _L					
								20 40 60					

RECORD OF BOREHOLE No 21-05

1 OF 2

METRIC

GWP# 6118-17-01 LOCATION Omer Lake Tributary Culvert; MTM NAD83-14 N 5 471 636.6 E 222 483.6 ORIGINATED BY RB
DIST Thunder Bay HWY 11 BOREHOLE TYPE Wash Boring COMPILED BY AN
DATUM Geodetic DATE 2021.04.22 - 2021.04.22 LATITUDE 49.377095 LONGITUDE -88.133682 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%) w _P w w _L				GR	SA	SI	CL
264.3	GROUND SURFACE																		
0.0	ASPHALT: (150mm)																		
0.2	Silty SAND, some gravel Very Dense Brown		1	SS	91		264						○						
263.5	Moist (FILL)																		
0.8	SAND and SILT, trace gravel Compact to Loose Brown Moist (FILL)		2	SS	22		263						○						
			3	SS	18		262						○						
			4	SS	13		261						○						
			5	SS	7		260						○						
260.2																			
4.1	Silty SAND mixed with PEAT, some wood fragments Loose Brown to Black Wet (FILL)		6	SS	4		259												
			7	SS	8		258							○					
257.1																			
7.2	Silty SAND Compact Brown Wet		8	SS	17		257							○					
							256												
			9	SS	22		255							○					

Continued Next Page

+³, ×³: Numbers refer to Sensitivity
20
15
10
(%) STRAIN AT FAILURE

METRIC

ELEV. DEPTH	SOIL PROFILE		SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20 40 60 80 100			
	Continued From Previous Page						SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100		WATER CONTENT (%) 20 40 60	kN/m ³	GR SA SI CL

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+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 21-06

1 OF 2

METRIC

GWP# 6118-17-01 LOCATION Omer Lake Tributary Culvert; MTM NAD83-14 N 5 471 661.2 E 222 512.4 ORIGINATED BY RB
DIST Thunder Bay HWY 11 BOREHOLE TYPE Solid Stem Augers/Wash Boring COMPILED BY AN
DATUM Geodetic DATE 2021.04.23 - 2021.04.23 LATITUDE 49.377320 LONGITUDE -88.133290 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				GR	SA	SI	CL
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE	W _P	W	W _L					
265.2	GROUND SURFACE						20	40	60	80	100								
0.0	ASPHALT: (150mm)																		
0.2	Silty SAND, some gravel Very Dense Brown Moist (FILL)		1	SS	92														
264.4																			
0.8	SAND and SILT Dense to Compact Brown Moist (FILL)		2	SS	31														
			3	SS	35														
			4	SS	23														
			5	SS	18														
			6	SS	21														
	Trace organics																		
259.6																			
5.6	PEAT, fibrous, silty sand layers Compact Brown to Black Wet		7	SS	10														
257.5																			
7.7	SAND, some silt Compact Brown to Grey Wet		8	SS	14														
			9	SS	11														
				</															

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+³, ×³: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 21-06

2 OF 2

METRIC

GWP# 6118-17-01 LOCATION Omer Lake Tributary Culvert; MTM NAD83-14 N 5 471 661.2 E 222 512.4 ORIGINATED BY RB
DIST Thunder Bay HWY 11 BOREHOLE TYPE Solid Stem Augers/Wash Boring COMPILED BY AN
DATUM Geodetic DATE 2021.04.23 - 2021.04.23 LATITUDE 49.377320 LONGITUDE -88.133290 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%) w _P w w _L				GR	SA	SI	CL
	Continued From Previous Page							20	40	60	80	100							
	SAND , some silt Compact Grey Wet						255												
			10	SS	10		254							○					
							253												
			11	SS	19									○					
251.9							252												
13.3	Silty SAND Compact Grey Wet						251							○				0	71
			12	SS	21		250								○				29
							249												0
							248							○					
247.8			14	SS	24														
17.4	END OF BOREHOLE AT 17.4m. BOREHOLE CAVED TO 5.3m. NO WATER MEASUREMENT DUE TO RESIDUAL DRILLING WATER IN BOREHOLE. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.6m, DRY CONCRETE TO 0.2m, THEN ASPHALT TO SURFACE UPON COMPLETION.																		

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RECORD OF BOREHOLE No 21-07

1 OF 3

METRIC

GWP# 6118-17-01 LOCATION Omer Lake Tributary Culvert; MTM NAD83-14 N 5 471 674.9 E 222 518.8 ORIGINATED BY RB
DIST Thunder Bay HWY 11 BOREHOLE TYPE Solid Stem Augers/Wash Boring/DCPT COMPILED BY AN
DATUM Geodetic DATE 2021.04.23 - 2021.04.23 LATITUDE 49.377444 LONGITUDE -88.133205 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
265.7	GROUND SURFACE							20 40 60 80 100						GR SA SI CL
0.0	ASPHALT: (150mm)							20 40 60 80 100						
0.2	Gravelly SAND , some silt Very Dense to Dense Brown Moist (FILL)		1	SS	70		265							27 60 13 (SI+CL)
			2	SS	39									
264.3														
1.4	SAND and SILT , trace clay Compact Brown Moist (FILL)		3	SS	11		264							0 48 50 2
			4	SS	17		263							
			5	SS	23		262							
261.6														
4.1	Silty SAND , trace oxidation Compact Brown Moist (FILL)		6	SS	14		261							
							260							
259.6														
6.1	Low recovery due to wood fragments, Anticipated PEAT , mixed with silty sand		7	SS	11		259							
258.5														
7.2	SAND , some silt Compact Brown Moist		8	SS	20		258							
							257							
			9	SS	27		256							

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+³, ×³: Numbers refer to
Sensitivity 20
15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 21-07

2 OF 3

METRIC

GWP# 6118-17-01 LOCATION Omer Lake Tributary Culvert; MTM NAD83-14 N 5 471 674.9 E 222 518.8 ORIGINATED BY RB
DIST Thunder Bay HWY 11 BOREHOLE TYPE Solid Stem Augers/Wash Boring/DCPT COMPILED BY AN
DATUM Geodetic DATE 2021.04.23 - 2021.04.23 LATITUDE 49.377444 LONGITUDE -88.133205 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%) w _p w w _L				GR	SA	SI	CL	
	Continued From Previous Page							20	40	60	80	100								
250.9 14.8	SAND , some silt Compact Brown Moist						255													
			10	SS	28															
			11	SS	25															
			12	SS	21															
251																				
250	SILT , some sand, trace clay Compact Grey Wet		13	SS	17															
249																				
248.3 17.4	End of sampling at 17.4m and start DCPT																			

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+³, ×³: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

METRIC

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+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 21-08

1 OF 3

METRIC

GWP# 6118-17-01 LOCATION Omer Lake Tributary Culvert; MTM NAD83-14 N 5 471 623.1 E 222 477.9 ORIGINATED BY RB
DIST Thunder Bay HWY 11 BOREHOLE TYPE Solid Stem Augers/Wash Boring/DCPT COMPILED BY AN
DATUM Geodetic DATE 2021.04.25 - 2021.04.25 LATITUDE 49.376973 LONGITUDE -88.133757 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)					
								○ UNCONFINED + FIELD VANE		● QUICK TRIAXIAL × LAB VANE		w _p w w _L					
263.9	GROUND SURFACE						20	40	60	80	100						
0.0	ASPHALT: (175mm)						20	40	60	80	100						
0.2	Silty SAND , some gravel Very Dense Brown		1	SS	84												
263.1	Moist (FILL)																
0.8	Layer of asphalt at 0.6m		2	SS	19												
	SAND and SILT , trace gravel, trace clay Compact Brown																
	Moist (FILL)		3	SS	22												
	Trace oxidation		4	SS	25												
	Trace organics		5	SS	11												
259.8																	
4.1	PEAT , fibrous to amorphous, interbedded with sandy silt, trace clay Loose Brown to Black Wet		6	SS	6												
258.3																	
5.6	SAND , some silt, trace clay Loose to Compact Grey Wet																
	Trace wood fragments		7	SS	9												
			8	SS	22												
			9	SS	18												

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 21-08

2 OF 3

METRIC

GWP# 6118-17-01 LOCATION Omer Lake Tributary Culvert; MTM NAD83-14 N 5 471 623.1 E 222 477.9 ORIGINATED BY RB
DIST Thunder Bay HWY 11 BOREHOLE TYPE Solid Stem Augers/Wash Boring/DCPT COMPILED BY AN
DATUM Geodetic DATE 2021.04.25 - 2021.04.25 LATITUDE 49.376973 LONGITUDE -88.133757 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				GR	SA	SI	CL
								○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × LAB VANE										
	Continued From Previous Page																		
	SAND , some silt, trace clay Compact to Dense Grey Wet		10	SS	22														
			11	SS	22												0 85 14 1		
			12	SS	31														
249.0																			
14.9	Sandy SILT , trace clay Compact Grey Wet		13	SS	14												0 38 60 2		
			14	SS	25														
246.5																			
17.4	End of sampling at 17.4m and start DCPT																		

Continued Next Page


+³, ×³: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 21-08

3 OF 3

METRIC

GWP# 6118-17-01 LOCATION Omer Lake Tributary Culvert; MTM NAD83-14 N 5 471 623.1 E 222 477.9 ORIGINATED BY RB
 DIST Thunder Bay HWY 11 BOREHOLE TYPE Solid Stem Augers/Wash Boring/DCPT COMPILED BY AN
 DATUM Geodetic DATE 2021.04.25 - 2021.04.25 LATITUDE 49.376973 LONGITUDE -88.133757 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE				
	Continued From Previous Page							20 40 60 80 100		20 40 60		
												
239.5								243				
								242				
								241				
								240				
24.4	END OF DCPT AT 24.4m. BOREHOLE CAVED TO 5.9m. NO WATER MEASUREMENT DUE TO RESIDUAL DRILLING WATER IN BOREHOLE. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.6m, DRY CONCRETE TO 0.2m, THEN ASPHALT TO SURFACE UPON COMPLETION.											

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RECORD OF BOREHOLE No 24-01

1 OF 3

METRIC

GWP# 6911-12-00 LOCATION Omer Lake Culvert N 5 471 643.5 E 222 497.6 ORIGINATED BY GAS
DIST Thunder Bay HWY 11 BOREHOLE TYPE Solid Stem Augers/Wash Boring COMPILED BY MC
DATUM Geodetic DATE 2024.06.17 - 2024.06.18 LATITUDE 49.377159 LONGITUDE -88.133490 CHECKED BY MF

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									WATER CONTENT (%)
								20	40	60	80	100	20	40			60
264.5	GROUND SURFACE																
0.0	ASPHALT: (75mm)																
0.1																	
264.1	GRANULAR: (305mm)																
0.4	SAND, some gravel, some silt		1	SS	39											12 73 15	
263.7	Dense Brown Moist (FILL)		2	SS	28											(SI+CL)	
0.8	Silty SAND to SAND and SILT, trace gravel, trace clay Compact to Loose Brown Moist (FILL)																
			3	SS	30												
			4	SS	25												
			5	SS	28												
			6	SS	5												
260.0																	
4.5	Silty SAND, mixed with PEAT, some wood fragments Loose Grey to Dark Brown Wet		7	SS	2												
			8	SS	50/ 0.125												
			9	SS	5												
257.3																	
7.2	SAND, some silt, trace gravel Loose to Compact Brown Wet																
			10	SS	5												
			11	SS	18												

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+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

METRIC

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+³, ×³: Numbers refer to Sensitivity

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RECORD OF BOREHOLE No 24-01

3 OF 3

METRIC

GWP# 6911-12-00 LOCATION Omer Lake Culvert N 5 471 643.5 E 222 497.6 ORIGINATED BY GAS
DIST Thunder Bay HWY 11 BOREHOLE TYPE Solid Stem Augers/Wash Boring COMPILED BY MC
DATUM Geodetic DATE 2024.06.17 - 2024.06.18 LATITUDE 49.377159 LONGITUDE -88.133490 CHECKED BY MF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				w _P w w _L				
Continued From Previous Page						20	40	60	80	100	20	40	60			
242.1	SILT, some sand, trace clay Compact Grey Moist to Wet		18	SS	11		244							○		
			19	SS	14		243							○	0 18 77 5	
22.4	SAND, some silt Dense Grey Wet						242									
241.0			20	SS	41									○		
23.5	END OF BOREHOLE AT 23.5m. BOREHOLE OPEN AND CAVED INTO 7.7m AND WATER LEVEL AT 4.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO 0.6m, GRAVEL TO 0.1m, THEN ASPHALT TO SURFACE.															

RECORD OF BOREHOLE No 24-02

1 OF 3

METRIC

GWP# 6911-12-00 LOCATION Omer Lake Culvert N 5 471 654.4 E 222 498.5 ORIGINATED BY GAS
DIST Thunder Bay HWY 11 BOREHOLE TYPE Solid Stem Augers/Wash Boring COMPILED BY MC
DATUM Geodetic DATE 2024.06.19 - 2024.06.20 LATITUDE 49.377256 LONGITUDE -88.133480 CHECKED BY MF

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				
264.9	GROUND SURFACE															
0.0	ASPHALT: (50mm)															
0.1																
264.6	GRANULAR: (250mm)															
0.3	SAND, some silt to silty, trace gravel Compact to Loose Brown Moist (FILL)		1	SS	26											5 84 11 (SI+CL)
			2	SS	31											
			3	SS	20											
			4	SS	10											4 73 23 0
			5	SS	5											
			6	SS	6											
260.4																
4.5	SAND and SILT, mixed withPEAT Loose to Compact Brown to Black Wet		7	SS	4											
			8	SS	7											0 55 45 0
			9	SS	13											
257.7																
7.2	Silty SAND Loose to Compact Brown to Grey Wet															
			10	SS	4											
			11	SS	25											

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+³, ×³: Numbers refer to
Sensitivity 20
15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 24-02

2 OF 3

METRIC

GWP# 6911-12-00 LOCATION Omer Lake Culvert N 5 471 654.4 E 222 498.5 ORIGINATED BY GAS
DIST Thunder Bay HWY 11 BOREHOLE TYPE Solid Stem Augers/Wash Boring COMPILED BY MC
DATUM Geodetic DATE 2024.06.19 - 2024.06.20 LATITUDE 49.377256 LONGITUDE -88.133480 CHECKED BY MF

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%)					
	Continued From Previous Page													
	Silty SAND Loose to Compact Brown to Grey Wet		12	SS	20		254							
							253							
			13	SS	26		252							0 79 21 0
			14	SS	31		251							
250.1														
14.8	SILT , trace to some sand Compact Grey Wet (ML)		15	SS	29		250							
							249							
			16	SS	22		248							
							247							
			17	SS	17		246							0 5 90 5
							245							

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity 20
15 10 5 (%) STRAIN AT FAILURE

ONTMT452 2020LIBRARY(MTO)\GLB OMER LAKE CULVERTS.GPJ 1/30/25

RECORD OF BOREHOLE No 24-02

3 OF 3

METRIC

GWP# 6911-12-00 LOCATION Omer Lake Culvert N 5 471 654.4 E 222 498.5 ORIGINATED BY GAS
DIST Thunder Bay HWY 11 BOREHOLE TYPE Solid Stem Augers/Wash Boring COMPILED BY MC
DATUM Geodetic DATE 2024.06.19 - 2024.06.20 LATITUDE 49.377256 LONGITUDE -88.133480 CHECKED BY MF




SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					w _p w w _L					
								20	40	60	80	100	20	40	60			
	Continued From Previous Page		18	SS	19													
			19	SS	16													
242.9																		
22.0	SILT and SAND , trace clay Compact Grey Wet		20	SS	23													
			21	SS	26													
241.4																		
23.5	END OF BOREHOLE AT 23.5m. BOREHOLE OPEN AND CAVED INTO 18.0m AND WATER LEVEL AT 5.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO 0.6m, GRAVEL TO 0.1m, THEN ASPHALT TO SURFACE.																	

RECORD OF BOREHOLE No 24-03

1 OF 2

METRIC

GWP# 6911-12-00 LOCATION Omer Lake Culvert N 5 471 647.6 E 222 476.9 ORIGINATED BY JP
DIST Thunder Bay HWY 11 BOREHOLE TYPE Tripod/Casing/Dynamic Cone Penetration Test COMPILED BY AN
DATUM Geodetic DATE 2024.08.10 - 2024.08.11 LATITUDE 49.377193 LONGITUDE -88.133776 CHECKED BY MF

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								WATER CONTENT (%)
260.4	GROUND SURFACE							20	40	60	80	100				
0.0	PEAT , trace silt, some roots Very Loose Dark Brown to Black Wet		1	SS	2		260								186	
			2	SS	3										○	
259.2																
1.2	Sandy SILT , trace clay, trace peat Compact Dark Brown Moist to Wet		3	SS	13		259								○	
258.6																
1.8	SAND , trace to some silt, trace clay, trace gravel Loose to Compact Brown to Grey Moist to Wet		4	SS	9		258								○	1 78 18 3
			5	SS	17										○	
			6	SS	26		257								○	
			7	SS	15										○	
							256									
			8	SS	27										○	2 91 4 3
							255									
			9	SS	32		254								○	
							253									
			10	SS	20										○	0 90 8 2
252.2																
8.2	End of sampling and start of DCPT due to refusal (wet sand conditions) with advancing the casing further						252									
							251									

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 24-03

2 OF 2

METRIC

GWP# 6911-12-00 LOCATION Omer Lake Culvert N 5 471 647.6 E 222 476.9 ORIGINATED BY JP
DIST Thunder Bay HWY 11 BOREHOLE TYPE Tripod/Casing/Dynamic Cone Penetration Test COMPILED BY AN
DATUM Geodetic DATE 2024.08.10 - 2024.08.11 LATITUDE 49.377193 LONGITUDE -88.133776 CHECKED BY MF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			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					W _P W W _L					
	Continued From Previous Page							20	40	60	80	100		20	40	60		
250.2																		
10.2	END OF BOREHOLE AT 10.2m UPON DCPT REFUSAL. BOREHOLE OPEN AND CAVED TO 2.3m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.																	

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RECORD OF BOREHOLE No 24-03A

1 OF 2

METRIC

GWP# 6911-12-00 LOCATION Omer Lake Culvert N 5 471 647.6 E 222 476.9 ORIGINATED BY JP
DIST Thunder Bay HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
DATUM Geodetic DATE 2024.08.11 - 2024.08.11 LATITUDE 49.377193 LONGITUDE -88.133776 CHECKED BY MF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE WATER CONTENT (%) 20 40 60 PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _p W 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				
260.4 0.0	GROUND SURFACE Start of DCPT from surface								
260									
259									
258									
257									
256									
255									
254									
253									
252									
251									
250.5 9.9									

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+³, ×³: Numbers refer to Sensitivity
20
15
10
(%) STRAIN AT FAILURE

METRIC[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 24-04

1 OF 1

METRIC

GWP# 6911-12-00 LOCATION Omer Lake Culvert N 5 471 645.7 E 222 525.5 ORIGINATED BY JP
DIST Thunder Bay HWY 11 BOREHOLE TYPE Tripod/Casing/Dynamic Cone Penetration Test COMPILED BY MC
DATUM Geodetic DATE 2024.08.12 - 2024.08.12 LATITUDE 49.377182 LONGITUDE -88.133107 CHECKED BY MF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
259.9	GROUND SURFACE							20 40 60 80 100						
0.0	PEAT , some sand and silt, trace clay, some roots Loose Brown to Dark Brown Wet		1	SS	4		259							
			2	SS	4									
			3	SS	8									
258.1							258							0 58 38 4 Non-Plastic
1.8	SAND , some silt, trace clay, trace gravel Loose to Compact Brown to Grey Moist to Wet		4	SS	8									
			5	SS	7		257							4 78 16 2
			6	SS	8									
							256							
			7	SS	14									0 88 10 2
255.5														
4.4	End of sampling and start of DCPT due to refusal (wet sand conditions) with advancing the casing further						255							
							254							
253.3														
6.6	END OF BOREHOLE AT 6.6m UPON DCPT REFUSAL. BOREHOLE OPEN AND CAVED TO 2.3m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.													

+³, ×³: Numbers refer to
Sensitivity

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(%) STRAIN AT FAILURE

METRIC

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+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 24-05

1 OF 2

METRIC

GWP# 6911-12-00 LOCATION Omer Lake Culvert N 5 471 625.2 E 222 498.9 ORIGINATED BY JP
DIST Thunder Bay HWY 11 BOREHOLE TYPE Tripod/Casing/Dynamic Cone Penetration Test COMPILED BY MC
DATUM Geodetic DATE 2024.08.13 - 2024.08.13 LATITUDE 49.376994 LONGITUDE -88.133468 CHECKED BY MF

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 (%)				
260.0	GROUND SURFACE							20	40	60	80	100					GR SA SI CL					
0.0	PEAT , some silt and sand, trace clay, trace roots and wood fragments Very Loose to Loose Grey to Dark Brown Wet		1	SS	6		259										0 38 59 3 Non-Plastic					
			2	SS	3																	
258.5		3	SS	9														0 39 56 5				
1.5	Silty SAND Loose Brown Moist		4	SS	8				258													
257.6																						
2.4	SAND , trace to some silt, trace clay Compact Brown Moist		5	SS	24						257											
			6	SS	24																	
			7	SS	23																0 92 6 2	
			8	SS	19																	
						254																
9	SS	18																				
						253																
252.8																						
7.2	Silty SAND , trace clay Compact Grey Moist		10	SS	24		252										0 67 31 2					
250.9							251															
9.1	End of sampling and start of DCPT due to refusal (wet sand conditions) with advancing the casing further																					

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

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(%) STRAIN AT FAILURE

ONTMT452 2020LIBRARY(MTO)\GLB OMER LAKE CULVERTS.GPJ 1/30/25

RECORD OF BOREHOLE No 24-05

2 OF 2

METRIC

GWP# 6911-12-00 LOCATION Omer Lake Culvert N 5 471 625.2 E 222 498.9 ORIGINATED BY JP
DIST Thunder Bay HWY 11 BOREHOLE TYPE Tripod/Casing/Dynamic Cone Penetration Test COMPILED BY MC
DATUM Geodetic DATE 2024.08.13 - 2024.08.13 LATITUDE 49.376994 LONGITUDE -88.133468 CHECKED BY MF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
	Continued From Previous Page							<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><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ONTMT452 2020LIBRARY(MTO)\GLB OMER LAKE CULVERTS.GPJ 1/30/25

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 24-06

1 OF 1

METRIC

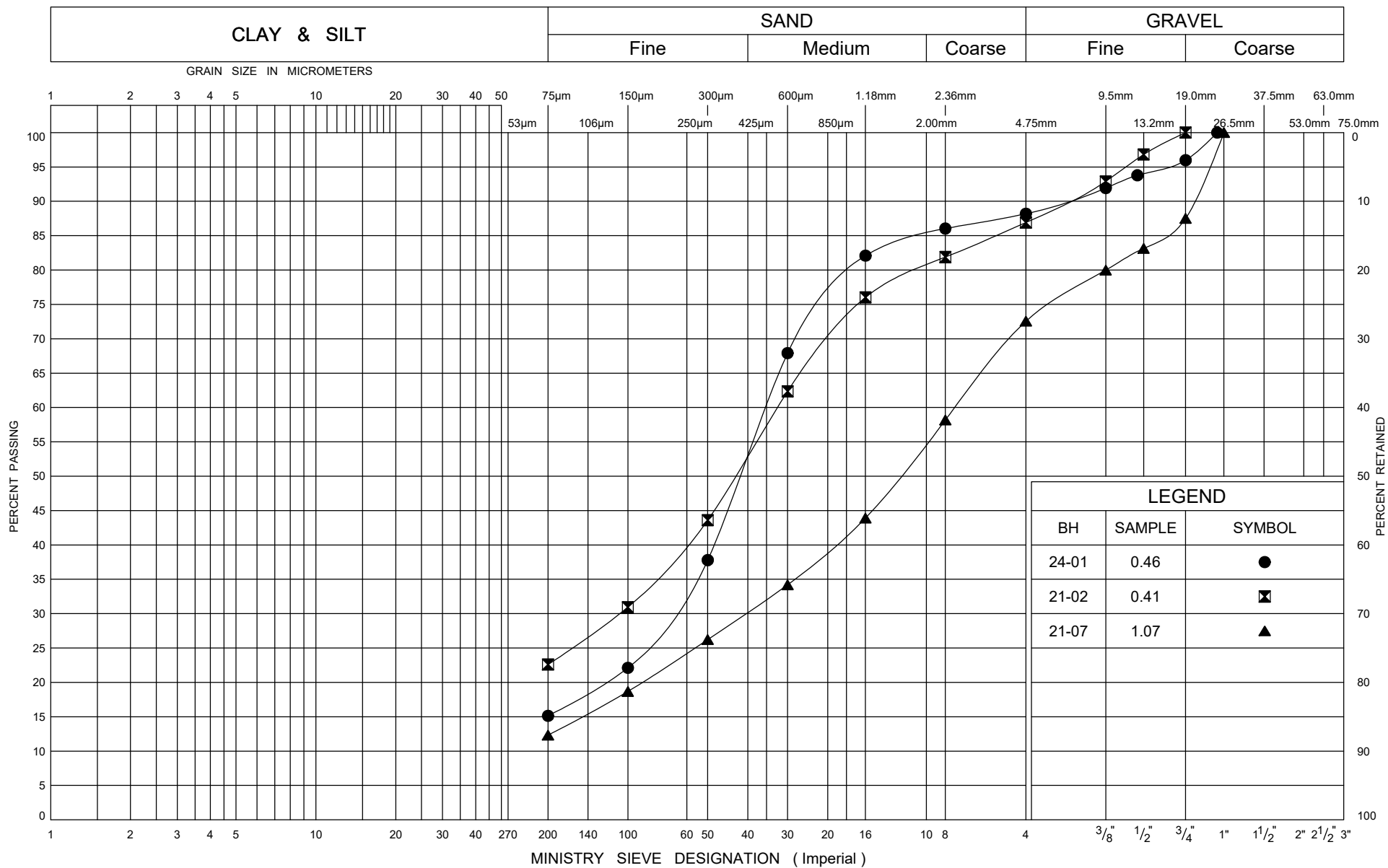
GWP# 6911-12-00 LOCATION Omer Lake Culvert N 5 471 670.7 E 222 498.3 ORIGINATED BY JP
DIST Thunder Bay HWY 11 BOREHOLE TYPE Tripod/Casing COMPILED BY AN
DATUM Geodetic DATE 2024.08.08 - 2024.08.08 LATITUDE 49.377403 LONGITUDE -88.133486 CHECKED BY MF

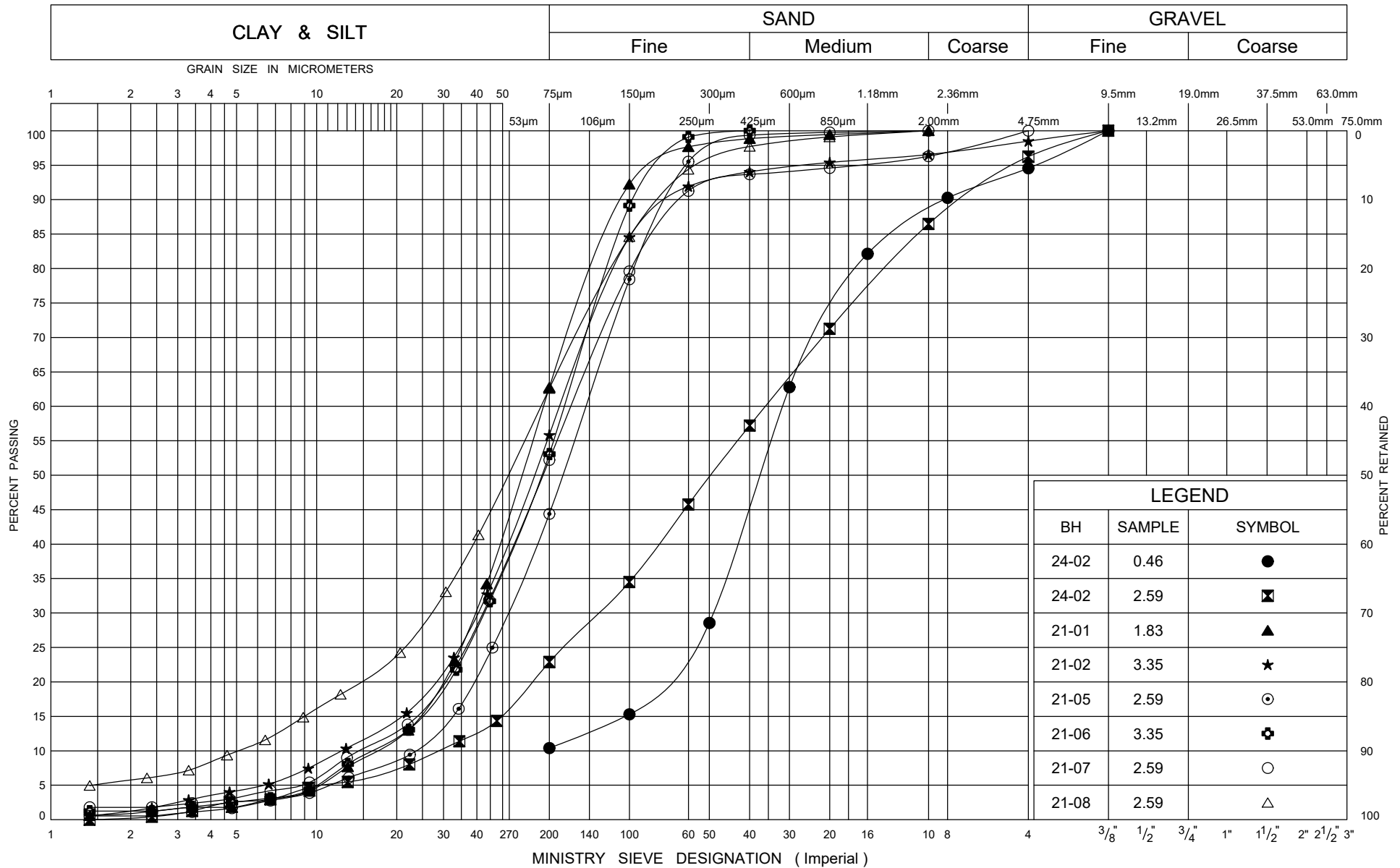
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							PLASTIC LIMIT w _P NATURAL MOISTURE CONTENT w LIQUID LIMIT w _L WATER CONTENT (%)			
261.4	GROUND SURFACE							20	40	60	80	100						
0.0 0.1	TOPSOIL: (75mm) SAND and SILT , some roots Very Loose Brown to Dark Brown Moist		1	SS	2		261								○			
			2	SS	4										○			
260.4	Silty SAND , trace clay Loose to Compact Brown Moist		3	SS	18		260								○			
			4	SS	11										○			
			5	SS	7		259								○			
			6	SS	21		258								○			
	Becoming dense		7	SS	49										○			
257.1	SAND and SILT , trace clay Dense to Very Dense Brown to Grey Moist		8	SS	54		257								○			
			9	SS	35										○			
255.9							256											
5.5	END OF BOREHOLE AT 5.5m. BOREHOLE CAVED-IN TO 4.3m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.																	

+³, ×³: Numbers refer to Sensitivity
20
15
10
(%) STRAIN AT FAILURE

APPENDIX C

Geotechnical Laboratory and Well Test Results





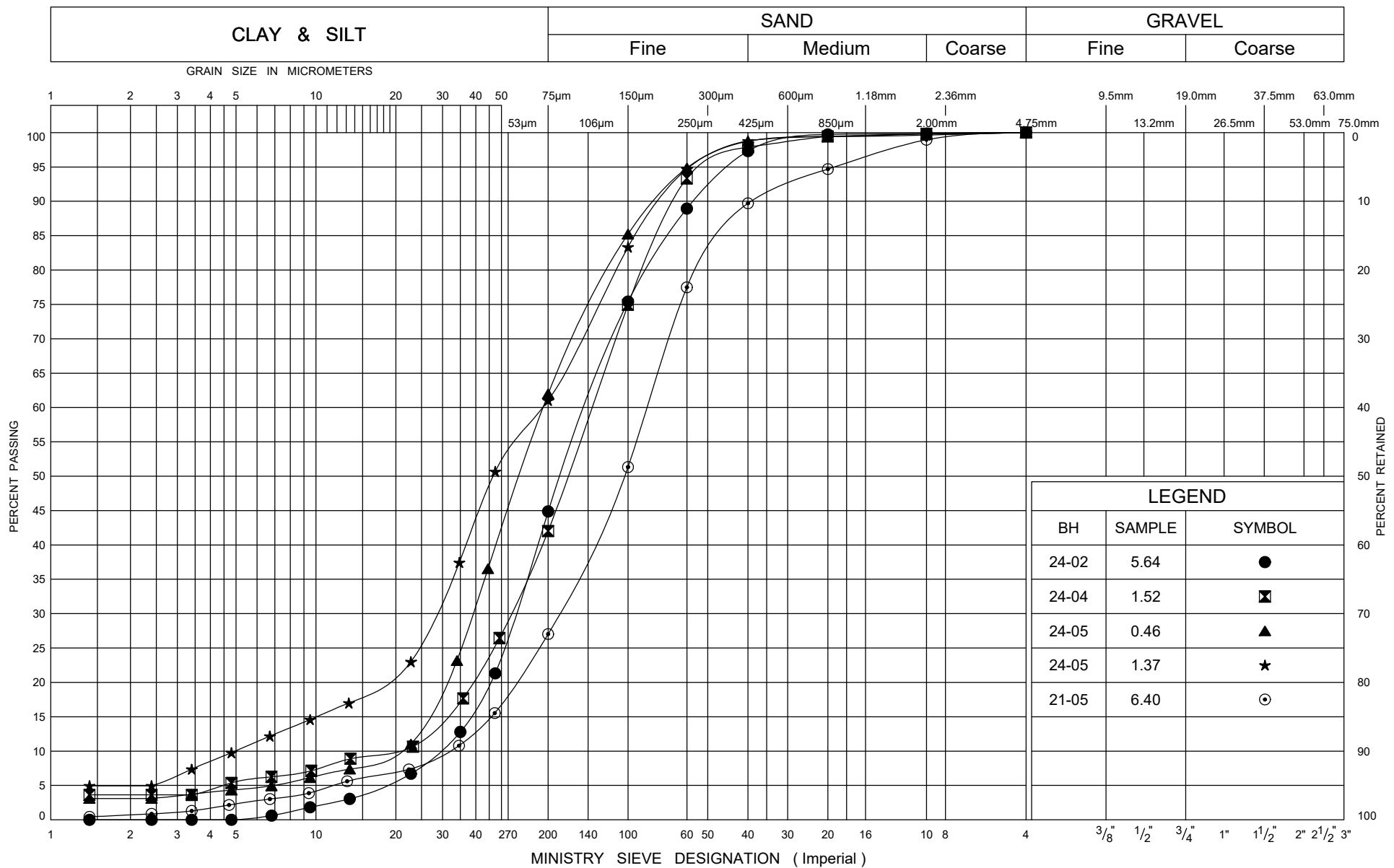
Ministry of
Transportation

GRAIN SIZE DISTRIBUTION SAND and SILT FILL

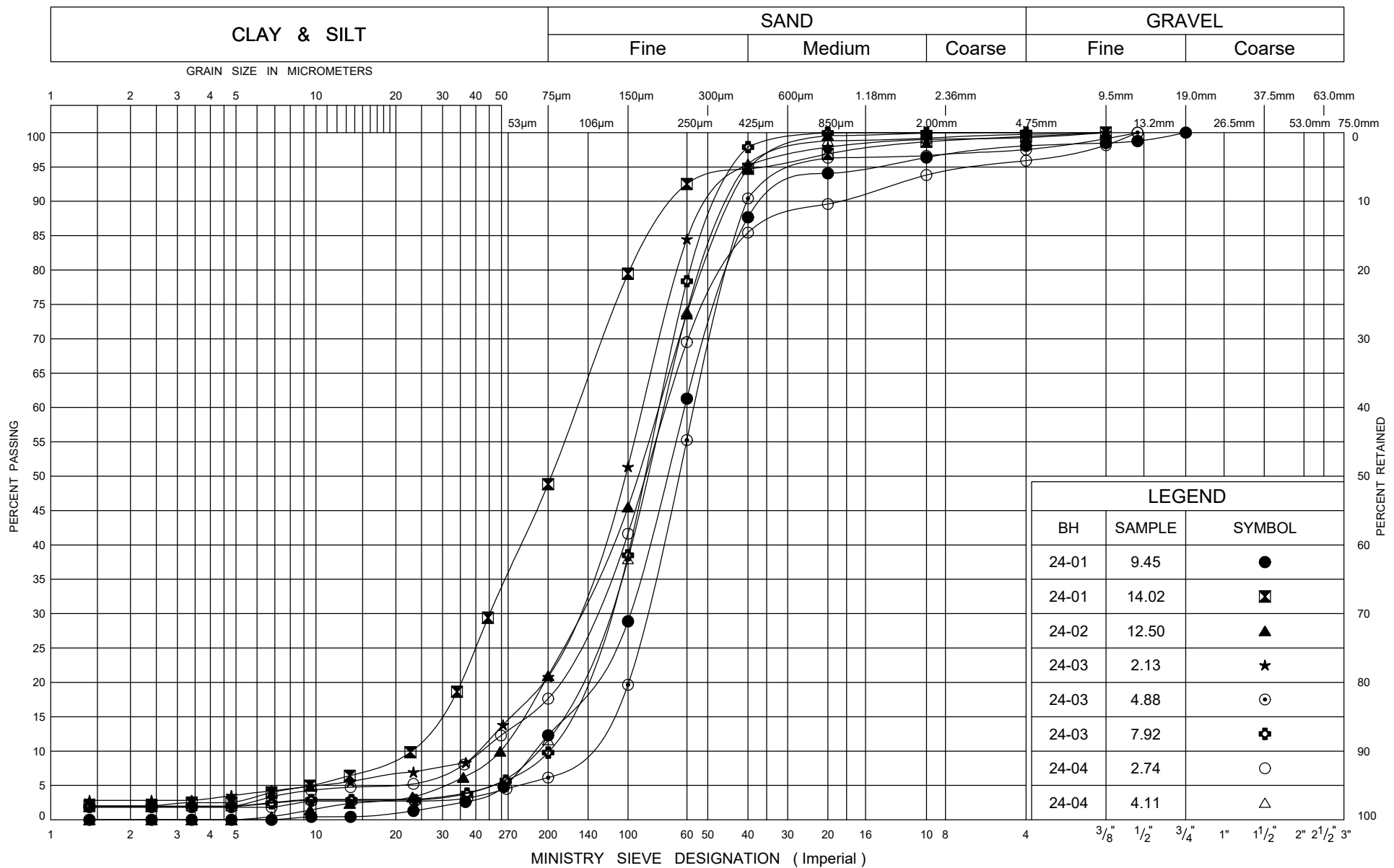
FIG No C2

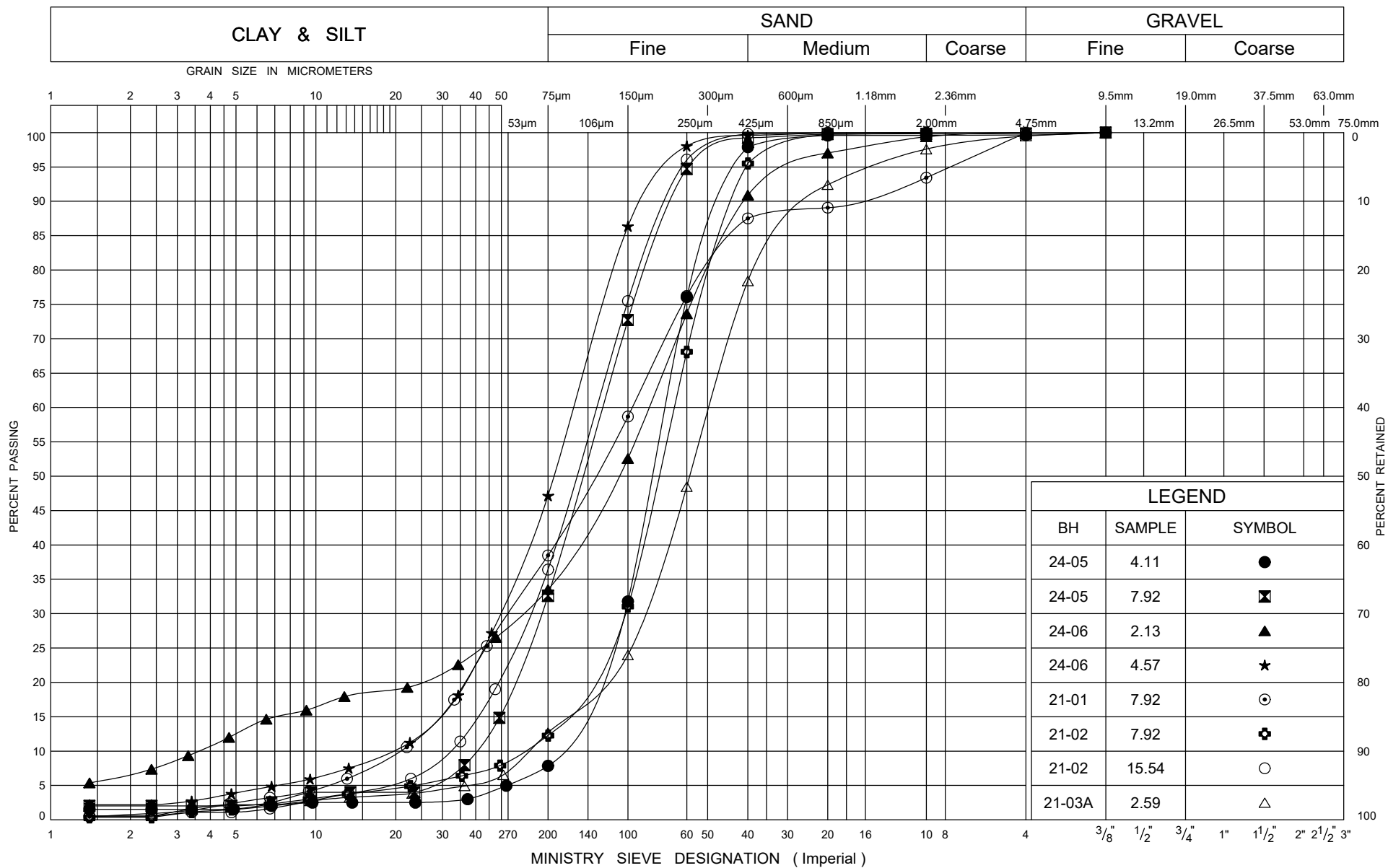
GWP# 6911-12-00

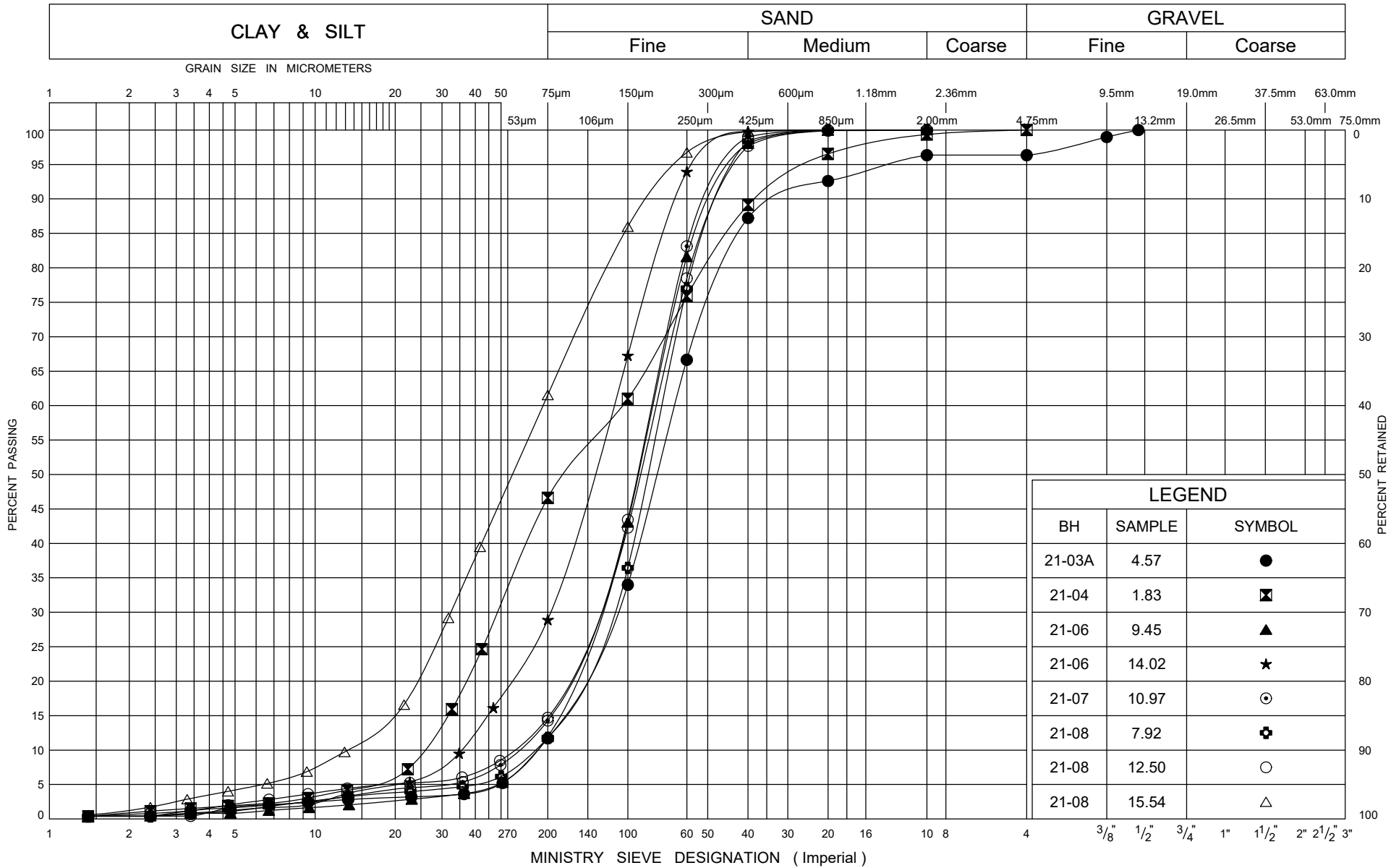
Omer Lake Culvert

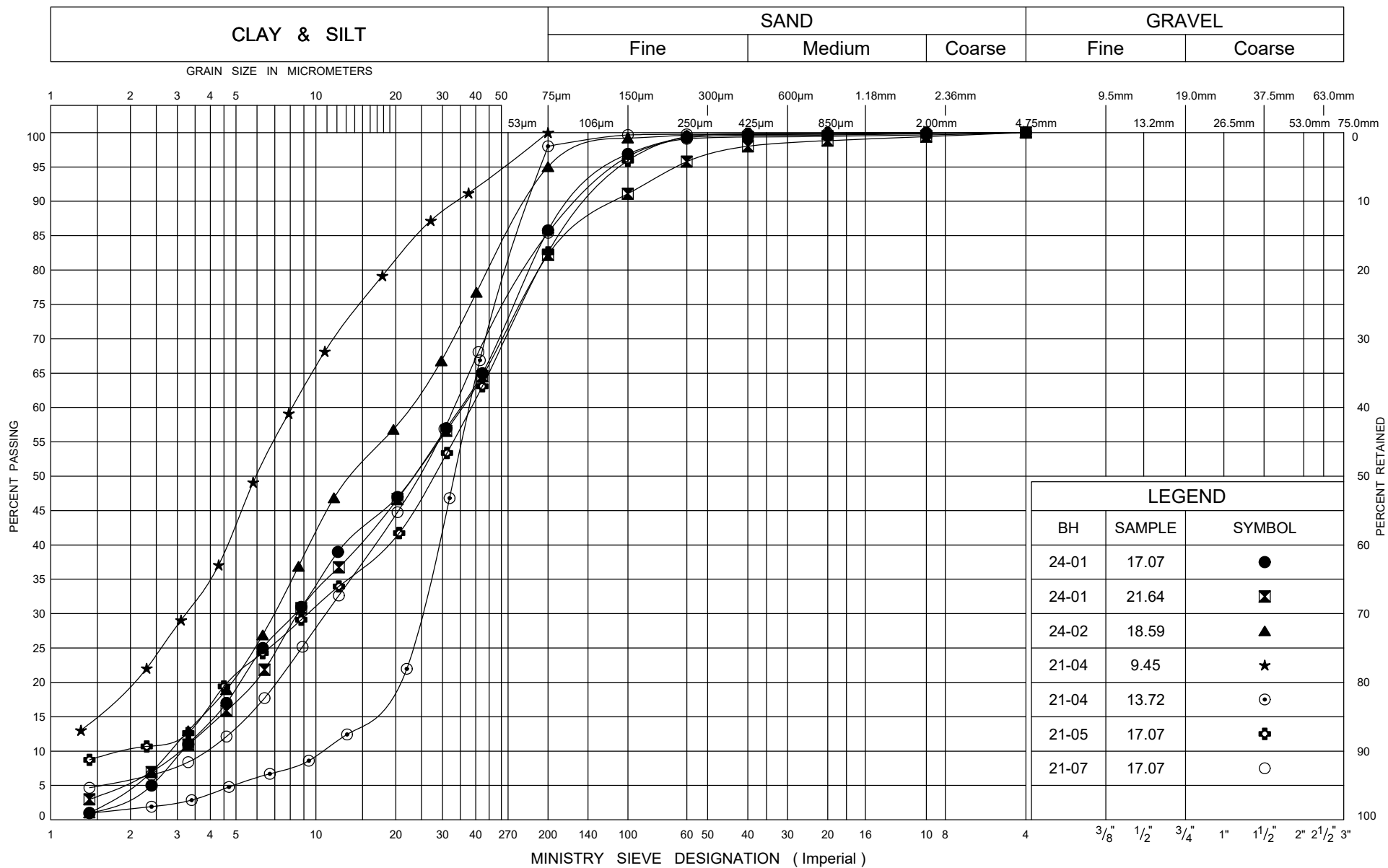


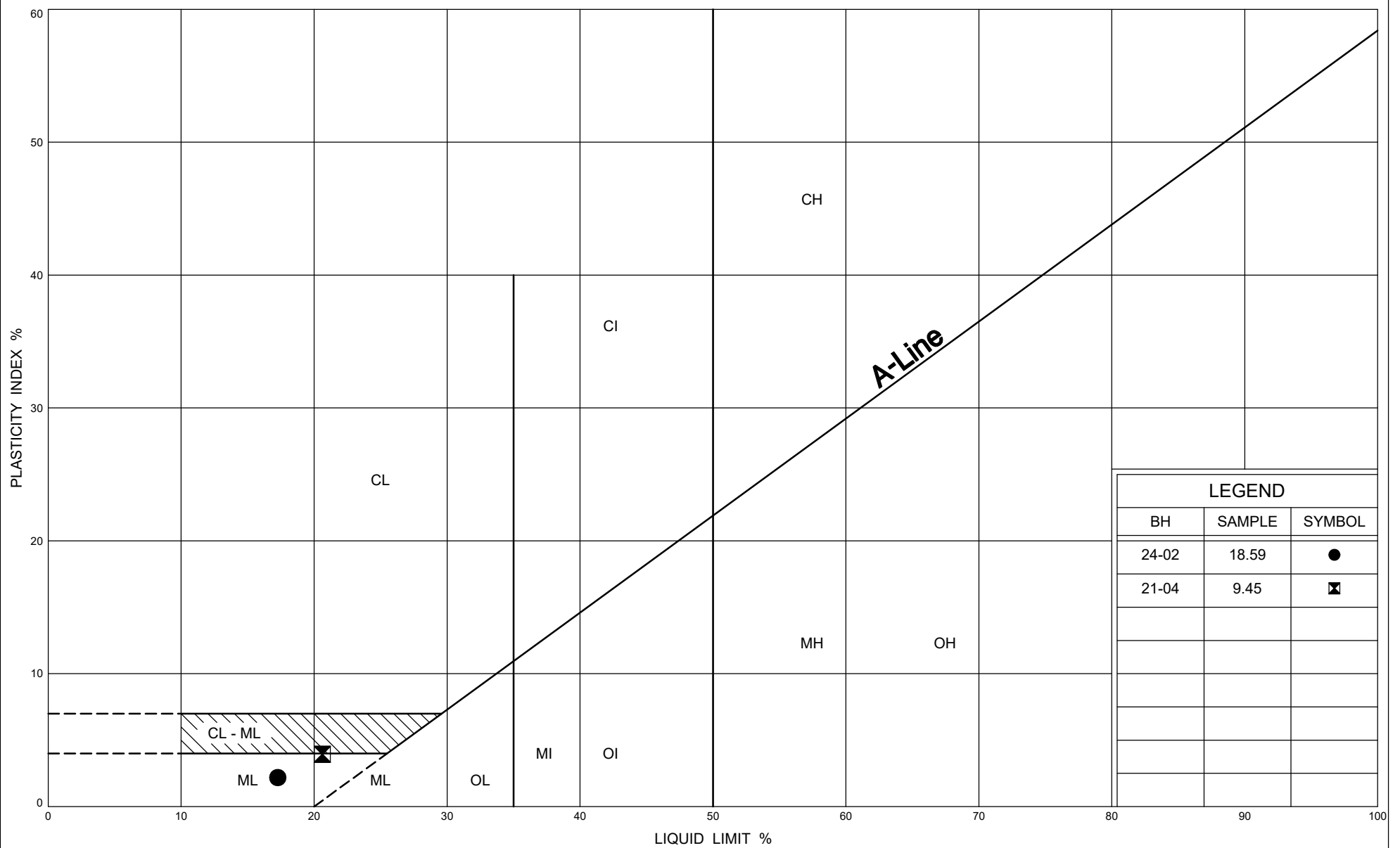
LEGEND		
BH	SAMPLE	SYMBOL
24-02	5.64	●
24-04	1.52	⊠
24-05	0.46	▲
24-05	1.37	★
21-05	6.40	⊙













THURBER ENGINEERING LTD.

Slug Test Analysis Report

Project: Omer Lake Tributary Culvert

Number: 31344

Client: Hatch

Location: District of Thunder Bay

Slug Test: 21-01

Test Well: 21-01

Test Conducted by: RB

Test Date: 2021-04-23

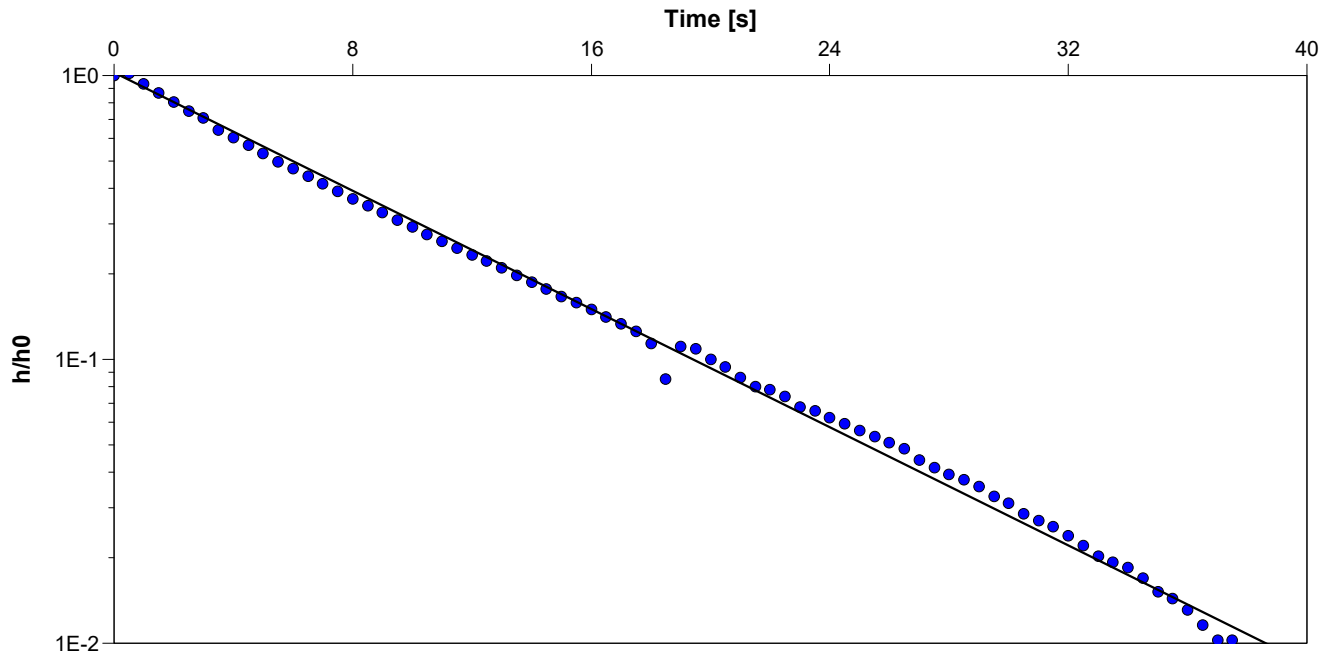
Analysis Performed by: PC

21-01 SWRT Analysis

Analysis Date: 2021-10-12

Aquifer Thickness:

Checked by: DH



Calculation using Hvorslev

Observation Well

Hydraulic
Conductivity
[m/s]

21-01

6.1×10^{-5}



THURBER ENGINEERING LTD.

Slug Test Analysis Report

Project: Omer Lake Tributary Culvert

Number: 31344

Client: Hatch

Location: District of Thunder Bay

Slug Test: 21-02

Test Well: 21-02

Test Conducted by: RB

Test Date: 2021-04-25

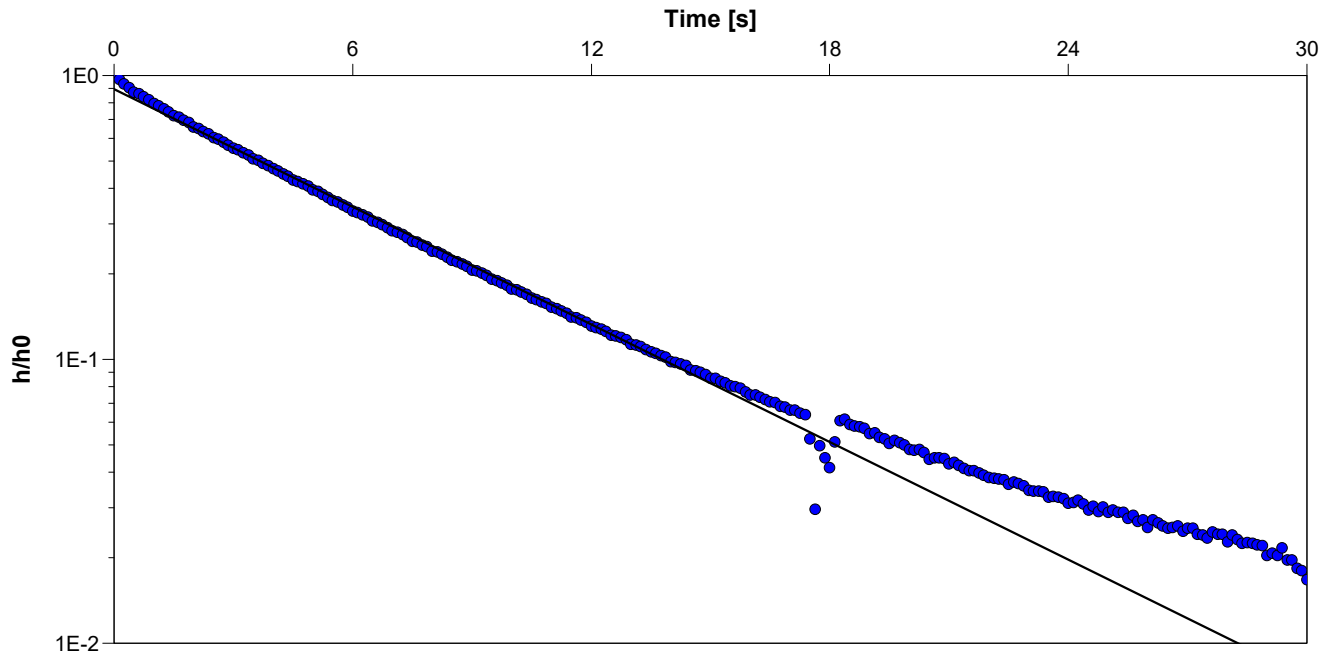
Analysis Performed by: PC

21-02 SWRT Analysis

Analysis Date: 2021-10-12

Aquifer Thickness:

Checked by: DH



Calculation using Hvorslev

Observation Well

Hydraulic
Conductivity
[m/s]

21-02

4.7×10^{-5}

APPENDIX D

Analytical Laboratory Test Results

CERTIFICATE OF ANALYSIS

Work Order	: WT2419203	Page	: 1 of 3
Client	: Thurber Engineering Ltd.	Laboratory	: ALS Environmental - Waterloo
Contact	: Madison Chiarotto	Account Manager	: Amanda Overholster
Address	: 1908 Ironoak Way Suite 202 Oakville ON Canada L6H 0N1	Address	: 60 Northland Road, Unit 1 Waterloo ON Canada N2V 2B8
Telephone	: ----	Telephone	: 1 416 817 2944
Project	: 47632 - Omer Lake Culvert	Date Samples Received	: 10-Jul-2024 18:00
PO	: ----	Date Analysis Commenced	: 12-Jul-2024
C-O-C number	: ----	Issue Date	: 16-Jul-2024 15:55
Sampler	: Client		
Site	: ----		
Quote number	: 2024 SOA		
No. of samples received	: 2		
No. of samples analysed	: 2		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	Position	Laboratory Department
Colby Bingham	Laboratory Supervisor	Sask Soils, Saskatoon, Saskatchewan



General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

Unit	Description
%	percent

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Workorder Comments

Sample(s) 1,2: Samples Received with temperature >10 °C



Analytical Results

Sub-Matrix: Soil/Solid (Matrix: Soil/Solid)					Client sample ID	24-01 SS8	24-02 SS7	----	----	----
					Client sampling date / time	12-Jun-2024 00:00	12-Jun-2024 00:00	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	WT2419203-001	WT2419203-002	-----	-----	-----	
					Result	Result	----	----	----	
Physical Tests										
Loss on ignition @ 440°C	----	E205E/SK	1.0	%	7.0	4.1	----	----	----	
Ash content @ 440°C	----	E205E/SK	1.0	%	93.0	95.9	----	----	----	

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: WT2419203	Page	: 1 of 5
Client	: Thurber Engineering Ltd.	Laboratory	: ALS Environmental - Waterloo
Contact	: Madison Chiarotto	Account Manager	: Amanda Overholster
Address	: 1908 Ironoak Way Suite 202 Oakville ON Canada L6H 0N1	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: 1 416 817 2944
Project	: 47632 - Omer Lake Culvert	Date Samples Received	: 10-Jul-2024 18:00
PO	: ----	Issue Date	: 16-Jul-2024 15:56
C-O-C number	: ----		
Sampler	: Client		
Site	: ----		
Quote number	: 2024 SOA		
No. of samples received	: 2		
No. of samples analysed	: 2		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO: Data Quality Objective.

LOR: Limit of Reporting (detection limit).

RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "----" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.



Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Soil/Solid**

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Physical Tests : Loss On Ignition (440°C)										
Glass soil jar/Teflon lined cap [ON MECP] 24-01 SS8	E205E	12-Jun-2024	----	----	----		13-Jul-2024	365 days	32 days	✓
Physical Tests : Loss On Ignition (440°C)										
Glass soil jar/Teflon lined cap [ON MECP] 24-02 SS7	E205E	12-Jun-2024	----	----	----		13-Jul-2024	365 days	32 days	✓

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).



Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Soil/Solid**

Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type	Method	QC Lot #	Count		Frequency (%)		
			QC	Regular	Actual	Expected	Evaluation
Analytical Methods							
Laboratory Duplicates (DUP)							
Loss On Ignition (440°C)	E205E	1543724	1	2	50.0	5.0	✓
Laboratory Control Samples (LCS)							
Loss On Ignition (440°C)	E205E	1543724	1	2	50.0	5.0	✓
Method Blanks (MB)							
Loss On Ignition (440°C)	E205E	1543724	1	2	50.0	5.0	✓



Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

<i>Analytical Methods</i>	<i>Method / Lab</i>	<i>Matrix</i>	<i>Method Reference</i>	<i>Method Descriptions</i>
Loss On Ignition (440°C)	E205E ALS Environmental - Saskatoon	Soil/Solid	ASTM D2974 Method A	Loss On Ignition (LOI) is determined by drying a portion of an air dried and ground sample at 105°C overnight, then igniting at 440°C for 16-20 hours. The weight loss after ignition is reported as % loss on ignition. LOI is reported on a dry weight basis. LOI at 440°C can be used as an estimation of Organic Matter (ASTM D2974 Method A).
<i>Preparation Methods</i>	<i>Method / Lab</i>	<i>Matrix</i>	<i>Method Reference</i>	<i>Method Descriptions</i>
Dry and Grind in Soil/Solid <60°C	EPP442 ALS Environmental - Saskatoon	Soil/Solid	Soil Sampling and Methods of Analysis, Carter 2008	After removal of any coarse fragments and reservation of wet subsamples a portion of homogenized sample is set in a tray and dried at less than 60°C until dry. The sample is then particle size reduced with an automated crusher or mortar and pestle, typically to <2 mm. Further size reduction may be needed for particular tests.

QUALITY CONTROL REPORT

Work Order	: WT2419203	Page	: 1 of 3
Client	: Thurber Engineering Ltd.	Laboratory	: ALS Environmental - Waterloo
Contact	: Madison Chiarotto	Account Manager	: Amanda Overholster
Address	: 1908 Ironoak Way Suite 202 Oakville ON Canada L6H 0N1	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: 1 416 817 2944
Project	: 47632 - Omer Lake Culvert	Date Samples Received	: 10-Jul-2024 18:00
PO	: ----	Date Analysis Commenced	: 12-Jul-2024
C-O-C number	: ----	Issue Date	: 16-Jul-2024 15:59
Sampler	: Client		
Site	: ----		
Quote number	: 2024 SOA		
No. of samples received	: 2		
No. of samples analysed	: 2		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Reference Material (RM) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	Position	Laboratory Department
Colby Bingham	Laboratory Supervisor	Saskatoon Sask Soils, Saskatoon, Saskatchewan



General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

- Key :
- Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
 - CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
 - DQO = Data Quality Objective.
 - LOR = Limit of Reporting (detection limit).
 - RPD = Relative Percent Difference
 - # = Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "----" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: Soil/Solid					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Physical Tests (QC Lot: 1543724)											
WT2419203-001	24-01 SS8	Loss on ignition @ 440°C	----	E205E	1.0	%	7.0	7.0	0.02	Diff <2x LOR	----



Reference Material (RM) Report

A Reference Material (RM) is a homogenous material with known and well-established analyte concentrations. RMs are processed in an identical manner to test samples, and are used to monitor and control the accuracy and precision of a test method for a typical sample matrix. RM results are expressed as percent recovery of the target analyte concentration. RM targets may be certified target concentrations provided by the RM supplier, or may be ALS long-term mean values (for empirical test methods).

Sub-Matrix:

Sub-Matrix:					Reference Material (RM) Report				
					RM Target Concentration	Recovery (%) RM	Recovery Limits (%)		Qualifier
Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method			Low	High	
Physical Tests (QCLot: 1543724)									
QC-1543724-002	RM	Loss on ignition @ 440°C	----	E205E	8.78 %	94.3	80.0	120	----



www.alsglobal.com

Report To		Contact and company name below will appear on the final report		Reports / Recipients		Turnaround Time (TAT) Requested	
Company:	Thurber Engineering Limited	Select Report Format:	<input type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input type="checkbox"/> EDD (DIGITAL)			<input type="checkbox"/> Routine (R) if received by 3pm M-F - no surcharges apply	
Contact:	Madison Charlotto	Merge QC/QCI Reports with COA	<input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> N/A			<input type="checkbox"/> 1 day (P1) if received by 3pm M-F - 20% rush surcharge minimum	
Phone:	647-548-8390	Compare Results to Criteria on Report - provide details below if box checked	<input type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX			<input type="checkbox"/> 3 day (P3) if received by 3pm M-F - 25% rush surcharge minimum	
Company address below will appear on the final report		Select Distribution:	<input type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX			<input type="checkbox"/> 2 day (P2) if received by 3pm M-F - 50% rush surcharge minimum	
Street:	202-1908 Ironoak Way	Email 1 or Fax	mcharlotto@thurber.ca			<input type="checkbox"/> 1 day (E) if received by 3pm M-F - 100% rush surcharge minimum	
City/Province:	Oakville/ON	Email 2	mfarant@thurber.ca			<input type="checkbox"/> Same day (E2) if received by 10am M-F - 200% rush surcharge - fees may apply to rush requests on weekends, statutory holidays, a routine tests	
Postal Code:	L6H 0N1	Email 3				Date and Time Required for all E&P TATs:	
Invoice To	Same as Report To	Invoice Recipients				For all tests with rush TATs requested, please	
Copy of Invoice with Report	<input type="checkbox"/> YES <input type="checkbox"/> NO	Select Invoice Distribution:	<input type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX			Indicate Filtered (F), Preserved (P) or Filtered:	
Company:	Thurber Engineering Limited	Email 1 or Fax	AccountingON@thurber.ca			Analysis R	
Contact:	Madison Charlotto	Email 2					
Project Information		Oil and Gas Required Fields (client use)					
ALS Account # / Quote #		AFC/Coast Center:					
Job #	47632 - Omer Lake Culvert	Major/Minor Code:					
PO / AFE		Requisitioner:					
LSD:		Location:					
ALS Lab Work Order # (ALS use only):		ALS Contact:					
Sample Identification and/or Coordinates (This description will appear on the report)		Date	Time	Sample Type			
ALS Sample # (ALS use only)	24-01 SS8	12-Jun-23		Soil			
	24-02 SS7	12-Jun-23		Soil			
Drinking Water (DW) Samples ¹ (client use)		Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)					
Are samples taken from a Regulated DW System?							
<input type="checkbox"/> YES <input type="checkbox"/> NO							
Are samples for human consumption/ use?							
<input type="checkbox"/> YES <input type="checkbox"/> NO							
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (ALS use only)					
Released by: Greg Stanhope	Date: 25 May 09 2024	Time:	Received by:	Date:	Time:	Received by:	Date:
REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION		WHITE - LABORATORY COPY		YELLOW - CLIENT COPY			
Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.		1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.					

CERTIFICATE OF ANALYSIS

Work Order	: WT2424358	Page	: 1 of 2
Client	: Thurber Engineering Ltd.	Laboratory	: ALS Environmental - Waterloo
Contact	: Madisan Chiarotto	Account Manager	: Amanda Overholster
Address	: 1908 Ironoak Way Suite 202 Oakville ON Canada L6H 0N1	Address	: 60 Northland Road, Unit 1 Waterloo ON Canada N2V 2B8
Telephone	: ----	Telephone	: 1 416 817 2944
Project	: 47632 - Omer Lake Culvert	Date Samples Received	: 21-Aug-2024 17:10
PO	: ----	Date Analysis Commenced	: 24-Aug-2024
C-O-C number	: ----	Issue Date	: 29-Aug-2024 22:27
Sampler	: CLIENT		
Site	: ----		
Quote number	: 2024 SOA		
No. of samples received	: 4		
No. of samples analysed	: 4		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	Position	Laboratory Department
Maria Painchaud	Laboratory Assistant	Sask Soils, Saskatoon, Saskatchewan



General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

Unit	Description
%	percent

<: less than.
>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical Results

Sub-Matrix: Soil/Solid
(Matrix: Soil/Solid)

Client sample ID					24-03 SS-1 (0'-2') & SS-3 (4'-6')	24-04 SS-1 (0'-2') & SS-4 (6'-8')	24-05 SS-2B (2'7"-4') & SS-3A (4'-5'1")	24-06 SS-1 (0'-2') & SS-2A (2'-3'5")	----
Client sampling date / time					11-Aug-2024 00:00	12-Aug-2024 00:00	13-Aug-2024 00:00	08-Aug-2024 00:00	----
Analyte	CAS Number	Method/Lab	LOR	Unit	WT2424358-001	WT2424358-002	WT2424358-003	WT2424358-004	-----
					Result	Result	Result	Result	----
Physical Tests									
Loss on ignition @ 440°C	----	E205E/SK	1.0	%	6.4	4.2	9.8	2.2	----
Ash content @ 440°C	----	E205E/SK	1.0	%	93.6	95.8	90.2	97.8	----

Please refer to the General Comments section for an explanation of any result qualifiers detected.
Please refer to the Accreditation section for an explanation of analyte accreditations.

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: WT2424358	Page	: 1 of 5
Client	: Thurber Engineering Ltd.	Laboratory	: ALS Environmental - Waterloo
Contact	: Madisan Chiarotto	Account Manager	: Amanda Overholster
Address	: 1908 Ironoak Way Suite 202 Oakville ON Canada L6H 0N1	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: 1 416 817 2944
Project	: 47632 - Omer Lake Culvert	Date Samples Received	: 21-Aug-2024 17:10
PO	: ----	Issue Date	: 29-Aug-2024 23:15
C-O-C number	: ----		
Sampler	: CLIENT		
Site	: ----		
Quote number	: 2024 SOA		
No. of samples received	: 4		
No. of samples analysed	: 4		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO: Data Quality Objective.

LOR: Limit of Reporting (detection limit).

RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "----" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.



Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Soil/Solid**

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Physical Tests : Loss On Ignition (440°C)										
Glass soil jar/Teflon lined cap [ON MECP] 24-05 SS-2B (2'7"-4') & SS-3A (4'-5'1")	E205E	13-Aug-2024	----	----	----		28-Aug-2024	365 days	16 days	✔
Physical Tests : Loss On Ignition (440°C)										
Glass soil jar/Teflon lined cap [ON MECP] 24-04 SS-1 (0'-2') & SS-4 (6'-8')	E205E	12-Aug-2024	----	----	----		28-Aug-2024	365 days	17 days	✔
Physical Tests : Loss On Ignition (440°C)										
Glass soil jar/Teflon lined cap [ON MECP] 24-03 SS-1 (0'-2') & SS-3 (4'-6')	E205E	11-Aug-2024	----	----	----		28-Aug-2024	365 days	18 days	✔
Physical Tests : Loss On Ignition (440°C)										
Glass soil jar/Teflon lined cap [ON MECP] 24-06 SS-1 (0'-2') & SS-2A (2'-3'5")	E205E	08-Aug-2024	----	----	----		28-Aug-2024	365 days	21 days	✔

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).



Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Soil/Solid**

Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type	Method	QC Lot #	Count		Frequency (%)		
			QC	Regular	Actual	Expected	Evaluation
Analytical Methods							
Laboratory Duplicates (DUP)							
Loss On Ignition (440°C)	E205E	1621023	1	4	25.0	5.0	✓
Laboratory Control Samples (LCS)							
Loss On Ignition (440°C)	E205E	1621023	1	4	25.0	5.0	✓
Method Blanks (MB)							
Loss On Ignition (440°C)	E205E	1621023	1	4	25.0	5.0	✓



Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

<i>Analytical Methods</i>	<i>Method / Lab</i>	<i>Matrix</i>	<i>Method Reference</i>	<i>Method Descriptions</i>
Loss On Ignition (440°C)	E205E ALS Environmental - Saskatoon	Soil/Solid	ASTM D2974 Method A	Loss On Ignition (LOI) is determined by drying a portion of an air dried and ground sample at 105°C overnight, then igniting at 440°C for 16-20 hours. The weight loss after ignition is reported as % loss on ignition. LOI is reported on a dry weight basis. LOI at 440°C can be used as an estimation of Organic Matter (ASTM D2974 Method A).
<i>Preparation Methods</i>	<i>Method / Lab</i>	<i>Matrix</i>	<i>Method Reference</i>	<i>Method Descriptions</i>
Dry and Grind in Soil/Solid <60°C	EPP442 ALS Environmental - Saskatoon	Soil/Solid	Soil Sampling and Methods of Analysis, Carter 2008	After removal of any coarse fragments and reservation of wet subsamples a portion of homogenized sample is set in a tray and dried at less than 60°C until dry. The sample is then particle size reduced with an automated crusher or mortar and pestle, typically to <2 mm. Further size reduction may be needed for particular tests.

QUALITY CONTROL REPORT

Work Order	: WT2424358	Page	: 1 of 3
Client	: Thurber Engineering Ltd.	Laboratory	: ALS Environmental - Waterloo
Contact	: Madisan Chiarotto	Account Manager	: Amanda Overholster
Address	: 1908 Ironoak Way Suite 202 Oakville ON Canada L6H 0N1	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: 1 416 817 2944
Project	: 47632 - Omer Lake Culvert	Date Samples Received	: 21-Aug-2024 17:10
PO	: ----	Date Analysis Commenced	: 24-Aug-2024
C-O-C number	: ----	Issue Date	: 29-Aug-2024 19:32
Sampler	: CLIENT		
Site	: ----		
Quote number	: 2024 SOA		
No. of samples received	: 4		
No. of samples analysed	: 4		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Reference Material (RM) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	Position	Laboratory Department
Maria Painchaud	Laboratory Assistant	Saskatoon Sask Soils, Saskatoon, Saskatchewan



General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

- Key :
- Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
 - CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
 - DQO = Data Quality Objective.
 - LOR = Limit of Reporting (detection limit).
 - RPD = Relative Percent Difference
 - # = Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "----" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: Soil/Solid					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Physical Tests (QC Lot: 1621023)											
WT2424358-001	24-03 SS-1 (0'-2') & SS-3 (4'-6')	Loss on ignition @ 440°C	----	E205E	1.0	%	6.4	6.9	0.5	Diff <2x LOR	----

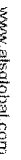


Reference Material (RM) Report

A Reference Material (RM) is a homogenous material with known and well-established analyte concentrations. RMs are processed in an identical manner to test samples, and are used to monitor and control the accuracy and precision of a test method for a typical sample matrix. RM results are expressed as percent recovery of the target analyte concentration. RM targets may be certified target concentrations provided by the RM supplier, or may be ALS long-term mean values (for empirical test methods).

Sub-Matrix:

Sub-Matrix:					Reference Material (RM) Report				
					RM Target Concentration	Recovery (%) RM	Recovery Limits (%)		Qualifier
Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method			Low	High	
Physical Tests (QCLot: 1621023)									
QC-1621023-002	RM	Loss on ignition @ 440°C	----	E205E	8.78 %	98.6	80.0	120	----



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

FOR NUMBER 20

Environmental Division
Waterloo

Work Order Reference
WT2424358

**E LABEL HERE
(only)**

AVG. 2020 FROST



FINAL REPORT

CA15887-APR21 R1

31344, Omer Lake Culvert

Prepared for

Thurber Engineering Ltd.



FINAL REPORT

CA15887-APR21 R1

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	Thurber Engineering Ltd.	Project Specialist	Brad Moore Hon. B.Sc
Address	103, 2010 Winston Park Drive	Laboratory	SGS Canada Inc.
	Oakville, ON	Address	185 Concession St., Lakefield ON, K0L 2H0
	L6H 5R7, Canada		
Contact	Joshua Alexander	Telephone	705-652-2143
Telephone	613-606-7303	Facsimile	705-652-6365
Facsimile		Email	brad.moore@sgs.com
Email	jalexander@thurber.ca	SGS Reference	CA15887-APR21
Project	31344, Omer Lake Culvert	Received	04/28/2021
Order Number		Approved	05/05/2021
Samples	Soil (2)	Report Number	CA15887-APR21 R1
		Date Reported	05/05/2021

COMMENTS
Temperature of Sample upon Receipt: 7 degrees C
Cooling Agent Present: yes
Custody Seal Present: yes
Chain of Custody Number: 019461
Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

SIGNATORIES
<div>Brad Moore Hon. B.Sc</div> <div></div>



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First Page..... 1

Index..... 2

Results..... 3-4

QC Summary..... 5-6

Legend..... 7

Annexes..... 8



FINAL REPORT

CA15887-APR21 R1

Client: Thurber Engineering Ltd.

Project: 31344, Omer Lake Culvert

Project Manager: Joshua Alexander

Samplers: NA

PACKAGE: - Corrosivity Index (SOIL)

Sample Number	5	6
Sample Name	BH21-01, SS6B	BH21-02, SS8
Sample Matrix	Soil	Soil
Sample Date	20/04/2021	22/04/2021

Parameter	Units	RL		Result	Result
Corrosivity Index					
Corrosivity Index	none	1		11	6
Soil Redox Potential	mV	-		210	199
Sulphide (Na ₂ CO ₃)	%	0.04		< 0.04	< 0.04
pH	pH Units	0.05		7.52	8.74
Resistivity (calculated)	ohms.cm	-9999		236	2290

PACKAGE: - General Chemistry (SOIL)

Sample Number	5	6
Sample Name	BH21-01, SS6B	BH21-02, SS8
Sample Matrix	Soil	Soil
Sample Date	20/04/2021	22/04/2021

Parameter	Units	RL		Result	Result
General Chemistry					
Conductivity	uS/cm	2		4230	436

PACKAGE: - Metals and Inorganics (SOIL)

Sample Number	5	6
Sample Name	BH21-01, SS6B	BH21-02, SS8
Sample Matrix	Soil	Soil
Sample Date	20/04/2021	22/04/2021

Parameter	Units	RL		Result	Result
Metals and Inorganics					
Moisture Content	%	0.1		29.2	18.9
Sulphate	µg/g	0.4		51	5.2



FINAL REPORT

CA15887-APR21 R1

Client: Thurber Engineering Ltd.

Project: 31344, Omer Lake Culvert

Project Manager: Joshua Alexander

Samplers: NA

PACKAGE: - Other (ORP) (SOIL)

Sample Number	5	6
Sample Name	BH21-01, SS6B	BH21-02, SS8
Sample Matrix	Soil	Soil
Sample Date	20/04/2021	22/04/2021

Parameter	Units	RL		Result	Result
Other (ORP)					
Chloride	µg/g	0.4		4700	190



FINAL REPORT

CA15887-APR21 R1

QC SUMMARY

Anions by IC
Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0520-APR21	µg/g	0.4	<0.4	3	20	99	80	120	113	75	125
Sulphate	DIO0520-APR21	µg/g	0.4	<0.4	6	20	97	80	120	85	75	125

Carbon/Sulphur
Method: ASTM E1915-07A | Internal ref.: ME-CA-IENVIARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide (Na2CO3)	ECS0001-MAY21	%	0.04	< 0.04	ND	20	105	80	120			

Conductivity
Method: SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0541-APR21	uS/cm	2	< 2	3	20	101	90	110	NA		



FINAL REPORT

CA15887-APR21 R1

QC SUMMARY

pH
Method: SM 4500 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0541-APR21	pH Units	0.05	NA	0		100			NA		

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

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

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.



LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.

RL Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

NA The sample was not analysed for this analyte

ND Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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-- End of Analytical Report --

Request for Laboratory Services and Chain of Custody

[illegible]



FINAL REPORT

CA15886-APR21 R

31344, Omer Lake Culvert

Prepared for

Thurber Engineering Ltd.



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FINAL REPORT

CA15886-APR21 R

Client: Thurber Engineering Ltd.

Project: 31344, Omer Lake Culvert

Project Manager: Joshua Alexander

Samplers: NA

PACKAGE: - **General Chemistry** (WATER)

Sample Number 6
Sample Name Omer Lake
Trit@Hwy 11
Sample Matrix Solution
Sample Date 25/04/2021

Parameter	Units	RL	Result
General Chemistry			
Conductivity	uS/cm	2	210
Redox Potential	mV	-	243
Sulphide	µg/L	6	8

PACKAGE: - **Metals and Inorganics** (WATER)

Sample Number 6
Sample Name Omer Lake
Trit@Hwy 11
Sample Matrix Solution
Sample Date 25/04/2021

Parameter	Units	RL	Result
Metals and Inorganics			
Sulphate	mg/L	0.04	2.1

PACKAGE: - **Other (ORP)** (WATER)

Sample Number 6
Sample Name Omer Lake
Trit@Hwy 11
Sample Matrix Solution
Sample Date 25/04/2021

Parameter	Units	RL	Result
Other (ORP)			
pH	No unit	0.05	7.65
Chloride	mg/L	0.04	39



FINAL REPORT

CA15886-APR21 R

QC SUMMARY

Anions by IC
Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphate	DIO0053-MAY21	mg/L	0.04	<0.04	ND	20	96	80	120	90	75	125
Chloride	DIO0524-APR21	mg/L	0.04	<0.04	0	20	101	80	120	101	75	125

Conductivity
Method: SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0547-APR21	uS/cm	2	< 2	1	20	97	90	110	NA		

pH
Method: SM 4500 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0547-APR21	No unit	0.05	NA	0		100			NA		



FINAL REPORT

CA15886-APR21 R

QC SUMMARY

Redox Potential
Method: SM 2580 I

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Redox Potential	EWL0502-APR21	mV	no	NA	1	20	104	80	120	NA		

Sulphide by SFA
Method: SM 4500 I Internal ref.: ME-CA-IENVISFA-LAK-AN-008

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide	SKA0022-MAY21	ug/L	6	<0.006	ND	20	102	80	120	NA	75	125



FINAL REPORT

CA15886-APR21 R

QC SUMMARY

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Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.



LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.

RL Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

NA The sample was not analysed for this analyte

ND Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

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-- End of Analytical Report --

Received By: <u>Colin Mazar</u> Received Date: <u>04/28/21</u> (mm/dd/yy) Received Time: <u>11:00</u> (hr:min)		Received By (signature): <u>[Signature]</u> Custody Seal Present: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Custody Seal Intact: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		Cooling Agent Present: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Temperature Upon Receipt (°C): <u>7.7</u> Type: <u>ice</u>		LAB LIMS #: <u>CA15805-</u> 87421			
Company: <u>Thurber</u> Contact: <u>Sash Alexander</u> Address: <u>2010-123 Winston</u> <u>Park Dr. Unit 103</u> Phone: <u>613 606-7303</u> Fax: _____ Email: <u>jalexander@thurber.com</u>		Invoice Information <input type="checkbox"/> (same as Report Information) Company: _____ Contact: _____ Address: _____ Phone: _____ Email: _____		Quotation #: <u>31344</u> Project #: <u>31344</u> P.O. #: _____ Site Location/ID: <u>Over Lake Culvert</u>		Turnaround Time (TAT) REQUIRED <input checked="" type="checkbox"/> Regular TAT (5-7 days) RUSH TAT (Additional Charges May Apply): <input type="checkbox"/> 1 Day <input type="checkbox"/> 2 Days <input type="checkbox"/> 3 Days <input type="checkbox"/> 4 Days PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION			
REPORT INFORMATION <input type="checkbox"/> O.Reg 153/04 <input type="checkbox"/> O.Reg 406/19 <input type="checkbox"/> Table 1 <input type="checkbox"/> Res/Park <input type="checkbox"/> Soil Texture: _____ <input type="checkbox"/> Table 2 <input type="checkbox"/> Ind/Com <input type="checkbox"/> Coarse _____ <input type="checkbox"/> Table 3 <input type="checkbox"/> Agri/Other <input type="checkbox"/> Medium/Fine _____ <input type="checkbox"/> Table _____ Soil Volume <input type="checkbox"/> <350m3 <input type="checkbox"/> >350m3		REGULATIONS Other Regulations: <input type="checkbox"/> Reg 347/558 (3 Day min TAT) <input checked="" type="checkbox"/> Reg 347/558 (3 Day min TAT) <input type="checkbox"/> CCME <input type="checkbox"/> MISA <input type="checkbox"/> ODWS Not Reportable *See note <input type="checkbox"/> YES <input type="checkbox"/> NO		Sewer By-Law: <input type="checkbox"/> Sanitary <input type="checkbox"/> Storm <input type="checkbox"/> Municipality: _____		ANALYSIS REQUESTED M & I <input type="checkbox"/> SVOC <input type="checkbox"/> PCB <input type="checkbox"/> PHC <input type="checkbox"/> VOC <input type="checkbox"/> Pest <input type="checkbox"/> TCLP <input type="checkbox"/> Other (please specify) _____ Field Filtered (Y/N) <input type="checkbox"/> Metals & Inorganics <input type="checkbox"/> Full Metals Suite <input type="checkbox"/> ICP Metals only <input type="checkbox"/> PAHs only <input type="checkbox"/> SVOCs <input type="checkbox"/> PCBs <input type="checkbox"/> F1-F4 + BTEX <input type="checkbox"/> F1-F4 only <input type="checkbox"/> VOCs <input type="checkbox"/> BTEX only <input type="checkbox"/> Pesticides <input type="checkbox"/> Organisms or specify other _____ Water Characterization Pkg <input type="checkbox"/> General <input type="checkbox"/> Extended <input checked="" type="checkbox"/> Sewer Use: _____ Screening Levels Table: _____ Appendix 2: 406/19 Leachate <input type="checkbox"/>		COMMENTS: TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 6pm or on weekends: TAT begins next business day *NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY	
RECORD OF SITE CONDITION (RSC) <input type="checkbox"/> YES <input type="checkbox"/> NO		DATE SAMPLED		TIME SAMPLED		# OF BOTTLES		MATRIX	
SAMPLE IDENTIFICATION		1 BH 21-01		04/25/21 13:00pm		13		water	
2 Over Lake Take Home		04/25/21 1:00pm		1		1		water	
3 BH 21-01, 55GB		04/25/21 2:00pm		1		1		Soil	
4 BH 21-01, 55B		04/25/21 4:00pm		1		1		Soil	
5		6		7		8		9	
10		11		12		13		14	
Observations/Comments/Special Instructions: <u>Please only test parameters within hold time</u>									
Sampled By (NAME): <u>Sash Alexander</u>		Signature: <u>[Signature]</u>		Date: <u>04/28/21</u> (mm/dd/yy)		Pink Copy - Client		Yellow & White Copy - SGS	
Note: Submission of samples to SGS is acknowledgement that you have been provided direction on sample collection, handling and transportation of samples. (2) Submission of samples to SGS is considered authorization for completion of work. Signatures may appear on this form or be retained on file in the contract, or in an alternative format (e.g. shipping documents). (3) Results may be sent by email to an unlimited number of addresses for no additional cost. Fax is available upon request. This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/terms_and_conditions.htm . (Printed copies are available upon request.) Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.									



FINAL REPORT

CA15885-APR21 R1

31344, Omer Lake Culvert

Prepared for

Thurber Engineering Ltd.



FINAL REPORT

CA15885-APR21 R1

First Page

CLIENT DETAILS

Client Thurber Engineering Ltd.

Address 103, 2010 Winston Park Drive, Oakville
Canada, L6H 5R7
Phone: 613-606-7303. Fax:

Contact Joshua Alexander

Telephone 613-606-7303

Facsimile

Email jalexander@thurber.ca

Project 31344, Omer Lake Culvert

Order Number

Samples Ground Water (1)

LABORATORY DETAILS

Project Specialist Jill Campbell, B.Sc.,GISAS

Laboratory SGS Canada Inc.

Address 185 Concession St., Lakefield ON, K0L 2H0

Telephone 2165

Facsimile 705-652-6365

Email jill.campbell@sgs.com

SGS Reference CA15885-APR21

Received 04/28/2021

Approved 05/04/2021

Report Number CA15885-APR21 R1

Date Reported 05/04/2021

COMMENTS

MAC - Maximum Acceptable Concentration
AO/OG - Aesthetic Objective / Operational Guideline
NR - Not reportable under applicable Provincial drinking water regulations as per client.

Temperature of Sample upon Receipt:7
Cooling Agent Present:Yes
Custody Seal Present:Yes

Chain of Custody Number:019461

SIGNATORIES

Jill Campbell, B.Sc.,GISAS



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FINAL REPORT

CA15885-APR21 R1

Client: Thurber Engineering Ltd.

Project: 31344, Omer Lake Culvert

Project Manager: Joshua Alexander

Samplers: NA

PACKAGE: **General Chemistry** (WATER)

Sample Number 7

Sample Name BH21-01

Sample Matrix Ground Water

Sample Date 25/04/2021

L1 = PWQQ_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Parameter	Units	RL	L1	Result
General Chemistry				
UV Transmittance	%T			72.9
Alkalinity	mg/L as CaCO ₃	2		116
Bicarbonate	mg/L as CaCO ₃	2		116
Carbonate	mg/L as CaCO ₃	2		< 2
OH	mg/L as CaCO ₃	2		< 2
Colour	TCU	3		11
Conductivity	uS/cm	2		638
Total Suspended Solids	mg/L	2		121
Organic Nitrogen	mg/L	0.05		0.43
Total Kjeldahl Nitrogen (N)	as N mg/L	0.05		1.58
Ammonia+Ammonium (N)	as N mg/L	0.04		1.15
Dissolved Organic Carbon	mg/L	1		7
Total Organic Carbon	mg/L	1		8
Sulphide	µg/L	6		< 6



FINAL REPORT

CA15885-APR21 R1

Client: Thurber Engineering Ltd.

Project: 31344, Omer Lake Culvert

Project Manager: Joshua Alexander

Samplers: NA

PACKAGE: **Metals and Inorganics (WATER)**

Sample Number 7

Sample Name BH21-01

Sample Matrix Ground Water

Sample Date 25/04/2021

L1 = PWQQ_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Parameter	Units	RL	L1	Result
Metals and Inorganics				
Fluoride	mg/L	0.06		0.12
Bromide	mg/L	0.05		0.05#<MDL
Nitrite (as N)	as N mg/L	0.003		0.003#<MDL
Nitrate (as N)	as N mg/L	0.006		0.102
Sulphate	mg/L	0.04		8.8
Mercury	µg/L	0.01	0.2	0.01
Hardness	mg/L as CaCO3	0.05		107
Aluminum	µg/L	1	15	1470
Arsenic	µg/L	0.2	5	3.1
Boron	µg/L	2	200	8
Barium	µg/L	0.02		20.4
Beryllium	µg/L	0.007	11	0.091
Bismuth	µg/L	0.01		0.01
Cobalt	µg/L	0.004	0.9	2.51
Calcium	mg/L	0.01		32.1
Cadmium	µg/L	0.003	0.1	0.044
Copper	µg/L	0.2	1	12.2
Chromium	µg/L	0.08	100	4.35
Iron	ug/L	7	300	3120
Potassium	mg/L	0.009		2.30
Magnesium	mg/L	0.001		6.46
Manganese	µg/L	0.01		95.5
Molybdenum	µg/L	0.04	40	3.61



FINAL REPORT

CA15885-APR21 R1

Client: Thurber Engineering Ltd.
Project: 31344, Omer Lake Culvert
Project Manager: Joshua Alexander
Samplers: NA

PACKAGE: Metals and Inorganics (WATER)

Sample Number 7
Sample Name BH21-01
Sample Matrix Ground Water
Sample Date 25/04/2021

L1 = PWQO_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Parameter	Units	RL	L1	Result
Metals and Inorganics (continued)				
Nickel	µg/L	0.1	25	6.2
Sodium	mg/L	0.01		93.8
Phosphorus	mg/L	0.003	0.01	0.121
Lead	µg/L	0.01	11	1.83
Silicon	ug/L	20		4400
Silver	µg/L	0.05	0.1	< 0.05
Strontium	µg/L	0.02		71.5
Thallium	µg/L	0.005	0.3	0.038
Tin	µg/L	0.06		1.54
Titanium	ug/L	0.05		44.7
Antimony	µg/L	0.9	20	1.6
Selenium	µg/L	0.04	100	0.21
Uranium	µg/L	0.002	5	4.94
Vanadium	µg/L	0.01	6	4.58
Zinc	µg/L	2	20	13



FINAL REPORT

CA15885-APR21 R1

Client: Thurber Engineering Ltd.
Project: 31344, Omer Lake Culvert
Project Manager: Joshua Alexander
Samplers: NA

PACKAGE: Other (ORP) (WATER)

Sample Number 7
Sample Name BH21-01
Sample Matrix Ground Water
Sample Date 25/04/2021

L1 = PWQQ_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Parameter	Units	RL	L1	Result
Other (ORP)				
pH	No unit	5	0.1	8.21
Chloride	mg/L	0.04		130
Chromium VI	µg/L	0.2	1	< 0.2
Phenols				
4AAP-Phenolics	mg/L	0.002	0.001	< 0.002



EXCEEDANCE SUMMARY

				PWQO_L / WATER
				/ - - Table 2 -
				General - July 1999
				PIBS 3303E
Parameter	Method	Units	Result	L1

BH21-01

Aluminum	SM 3030/EPA 200.8	µg/L	1470	15
Cobalt	SM 3030/EPA 200.8	µg/L	2.51	0.9
Copper	SM 3030/EPA 200.8	µg/L	12.2	1
Iron	SM 3030/EPA 200.8	ug/L	3120	300
Phosphorus	SM 3030/EPA 200.8	mg/L	0.121	0.01
pH	SM 4500	No unit	8.21	0.1
4AAP-Phenolics	SM 5530B-D	mg/L	< 0.002	0.001



FINAL REPORT

CA15885-APR21 R1

QC SUMMARY

Alkalinity

Method: SM 2320 | Internal ref.: ME-CA-1ENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Alkalinity	EWL0547-APR21	mg/L as CaCO3	2	< 2	0	20	100	80	120	NA		

Ammonia by SFA

Method: SM 4500 | Internal ref.: ME-CA-1ENVISFA-LAK-AN-007

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Ammonia+Ammonium (N)	SKA0276-APR21	mg/L	0.04	<0.04	4	10	101	90	110	101	75	125



FINAL REPORT

CA15885-APR21 R1

QC SUMMARY

Anions by IC
Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Bromide	DIO0523-APR21	mg/L	0.05	<0.05	1	20	99	80	120	99	75	125
Nitrite (as N)	DIO0523-APR21	mg/L	0.003	<0.003	ND	20	95	80	120	98	75	125
Nitrate (as N)	DIO0523-APR21	mg/L	0.006	<0.006	0	20	102	80	120	92	75	125
Chloride	DIO0525-APR21	mg/L	0.04	<0.04	NV	20	100	80	120	NV	75	125
Sulphate	DIO0525-APR21	mg/L	0.04	<0.04	0	20	96	80	120	90	75	125

Carbon by SFA
Method: SM 5310 | Internal ref.: ME-CA-IENVISFA-LAK-AN-009

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Dissolved Organic Carbon	SKA0010-MAY21	mg/L	1	<1	1	10	103	90	110	102	75	125
Total Organic Carbon	SKA0010-MAY21	mg/L	1	<1	1	10	103	90	110	102	75	125



FINAL REPORT

CA15885-APR21 R1

QC SUMMARY

Carbonate/Bicarbonate

Method: SM 2320 | Internal ref.: ME-CA-ENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Carbonate	EWL0547-APR21	mg/L as CaCO3	2	< 2	ND	10	NA	90	110	NA		
Bicarbonate	EWL0547-APR21	mg/L as CaCO3	2	< 2	0	10	NA	90	110	NA		
OH	EWL0547-APR21	mg/L as CaCO3	2	< 2	ND	10	NA	90	110	NA		

Colour

Method: SM 2120 | Internal ref.: ME-CA-ENVIEWL-LAK-AN-002

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Colour	EWL0518-APR21	TCU	3	< 3	ND	10	105	80	120	NA		



FINAL REPORT

CA15885-APR21 R1

QC SUMMARY

Conductivity
Method: SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0547-APR21	uS/cm	2	< 2	1	20	97	90	110	NA		

Fluoride by Specific Ion Electrode
Method: SM 4500 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-014

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Fluoride	EWL0520-APR21	mg/L	0.06	<0.06	ND	10	107	90	110	106	75	125

Hexavalent Chromium by SFA
Method: EPA218.6/EPA3060A | Internal ref.: ME-CA-IENVISKA-LAK-AN-012

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chromium VI	SKA0265-APR21	ug/L	0.2	<0.2	6	20	104	80	120	NV	75	125



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QC SUMMARY

Mercury by CVAAS
Method: SM3112/EPA 245 | Internal ref.: ME-CA-IENVISPE-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Mercury	EHG0027-APR21	ug/L	0.01	<0.01	ND	20	108	80	120	115	70	130



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CA15885-APR21 R1

QC SUMMARY

Metals in aqueous samples - ICP-MS
Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-ENVISPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Silver	EMS0161-APR21	ug/L	0.05	< 0.05	ND	20	99	90	110	105	70	130
Aluminum	EMS0161-APR21	ug/L	1	< 1	ND	20	106	90	110	130	70	130
Arsenic	EMS0161-APR21	ug/L	0.2	< 0.2	1	20	102	90	110	114	70	130
Barium	EMS0161-APR21	ug/L	0.02	< 0.02	3	20	99	90	110	101	70	130
Beryllium	EMS0161-APR21	ug/L	0.007	< 0.07	ND	20	110	90	110	111	70	130
Boron	EMS0161-APR21	ug/L	2	< 2	1	20	94	90	110	NV	70	130
Bismuth	EMS0161-APR21	ug/L	0.01	< 0.01	ND	20	93	90	110	97	70	130
Calcium	EMS0161-APR21	mg/L	0.01	< 0.02	4	20	95	90	110	91	70	130
Cadmium	EMS0161-APR21	ug/L	0.003	< 0.003	18	20	96	90	110	117	70	130
Cobalt	EMS0161-APR21	ug/L	0.004	< 0.004	18	20	101	90	110	109	70	130
Chromium	EMS0161-APR21	ug/L	0.08	< 0.08	ND	20	101	90	110	100	70	130
Copper	EMS0161-APR21	ug/L	0.2	< 0.2	2	20	99	90	110	95	70	130
Iron	EMS0161-APR21	ug/L	7	< 7	2	20	99	90	110	100	70	130
Potassium	EMS0161-APR21	mg/L	0.009	< 0.009	2	20	99	90	110	NV	70	130
Magnesium	EMS0161-APR21	mg/L	0.001	< 0.001	0	20	99	90	110	91	70	130
Manganese	EMS0161-APR21	ug/L	0.01	< 0.01	1	20	100	90	110	99	70	130
Molybdenum	EMS0161-APR21	ug/L	0.04	< 0.04	7	20	99	90	110	110	70	130
Sodium	EMS0161-APR21	mg/L	0.01	< 0.01	0	20	99	90	110	96	70	130
Nickel	EMS0161-APR21	ug/L	0.1	< 0.1	2	20	98	90	110	130	70	130
Lead	EMS0161-APR21	ug/L	0.01	< 0.01	ND	20	108	90	110	118	70	130



FINAL REPORT

CA15885-APR21 R1

QC SUMMARY

Metals in aqueous samples - ICP-MS (continued)
Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-1ENVISPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Phosphorus	EMS0161-APR21	mg/L	0.003	< 0.003	ND	20	98	90	110	NV	70	130
Antimony	EMS0161-APR21	ug/L	0.9	< 0.09	ND	20	100	90	110	125	70	130
Selenium	EMS0161-APR21	ug/L	0.04	< 0.04	ND	20	99	90	110	111	70	130
Silicon	EMS0161-APR21	ug/L	20	< 0.02	6	20	97	90	110	NV	70	130
Tin	EMS0161-APR21	ug/L	0.06	< 0.06	ND	20	95	90	110	NV	70	130
Strontium	EMS0161-APR21	ug/L	0.02	< 0.02	1	20	96	90	110	94	70	130
Titanium	EMS0161-APR21	ug/L	0.05	< 0.05	10	20	96	90	110	NV	70	130
Thallium	EMS0161-APR21	ug/L	0.005	< 0.005	ND	20	100	90	110	108	70	130
Uranium	EMS0161-APR21	ug/L	0.002	< 0.002	3	20	99	90	110	109	70	130
Vanadium	EMS0161-APR21	ug/L	0.01	< 0.01	ND	20	103	90	110	110	70	130
Zinc	EMS0161-APR21	ug/L	2	< 2	0	20	99	90	110	105	70	130

pH
Method: SM 4500 | Internal ref.: ME-CA-1ENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0547-APR21	No unit	5	NA	0		100			NA		



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QC SUMMARY

Phenols by SFA
Method: SM 5530B-D | Internal ref.: ME-CA-IENVISFA-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
4AAP-Phenolics	SKA0021-MAY21	mg/L	0.002	<0.002	ND	10	100	80	120	86	75	125

Sulphide by SFA
Method: SM 4500 | Internal ref.: ME-CA-IENVISFA-LAK-AN-008

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide	SKA0022-MAY21	ug/L	6	<0.006	ND	20	102	80	120	NA	75	125

Suspended Solids
Method: SM 2540D | Internal ref.: ME-CA-IENVIEWL-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Suspended Solids	EWL0558-APR21	mg/L	2	< 2	1	10	99	90	110	NA		



QC SUMMARY

Total Nitrogen

Method: SM 4500-N C/4500-NO3- F | Internal ref.: ME-CA-IENVISFA-LAK-AN-002

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Kjeldahl Nitrogen (N)	SKA0272-APR21	mg/L	0.05	<0.05	0	10	102	90	110	85	75	125

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

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

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.



LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.

RL Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

NA The sample was not analysed for this analyte

ND Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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-- End of Analytical Report --

REPORT INFORMATION						INVOICE INFORMATION						LABORATORY INFORMATION SECTION - Lab use only											
Received By: <u>Cathy Mazar</u>			Received Date: <u>04/28/21</u> (mm/dd/yy)			Custody Seal Present: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>			Cooling Agent Present: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>			Type: <u>ice</u>											
Received Time: <u>11:00</u> (hr.: min)						Custody Seal Intact: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>			Temperature Upon Receipt (°C) <u>7.77</u>			LAB LIMS #: <u>CA15805-874928</u>											
Company: <u>Thurber</u>						Quotation #: <u>31344</u>						P.O. #:											
Contact: <u>Sash Alexander</u>						Project #: <u>Over Lake Culvert</u>						Site Location/ID: <u>Over Lake Culvert</u>											
Address: <u>2010-133 Livingston Park Dr., unit 103</u>						TURNAROUND TIME (TAT) REQUIRED						TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 6pm or on weekends: TAT begins next business day.											
Phone: <u>613 606-7303</u>						<input checked="" type="checkbox"/> Regular TAT (5-7 days)						<input type="checkbox"/> 1 Day <input type="checkbox"/> 2 Days <input type="checkbox"/> 3 Days <input type="checkbox"/> 4 Days											
Fax: _____						RUSH TAT (Additional Charges May Apply):						PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION											
Email: <u>jalexander@thurber.ca</u>						Specify Due Date: _____						*NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY											
REGULATIONS												ANALYSIS REQUESTED											
Other Regulations: <input type="checkbox"/> Reg 347/558 (3 Day min TAT) <input checked="" type="checkbox"/> RWQO <input type="checkbox"/> CCME <input type="checkbox"/> MISA <input type="checkbox"/> ODWS Not Reportable *See note						Sewer By-Law: <input type="checkbox"/> Sanitary <input type="checkbox"/> Storm Municipality: _____						COMMENTS:											
RECORD OF SITE CONDITION (RSC) YES <input type="checkbox"/> NO <input type="checkbox"/>						DATE SAMPLED						TIME SAMPLED BOTTLES						MATRIX					
SAMPLE IDENTIFICATION						DATE SAMPLED						TIME SAMPLED BOTTLES						MATRIX					
1 BH 21-01						04/25/21 3:00PM						13						water					
2 Over Lake Take @ Hwy 11						11:00AM						1						water					
3 BH 21-01, SSGB						04/28/21 2:00PM						1						Soil					
4 BH 21-02, SSB						04/22/21 4:00PM						1						Soil					
5																							
6																							
7																							
8																							
9																							
10																							
11																							
12																							
Observations/Comments/Special Instructions: <u>Please only test parameters within hold time</u>																							
Sampled By (NAME): _____						Signature: <u>[Signature]</u>						Date: <u>04/28/21</u> (mm/dd/yy)						Pink Copy - Client					
Relinquished by (NAME): <u>Sash Alexander</u>						Signature: <u>[Signature]</u>						Date: <u>04/28/21</u> (mm/dd/yy)						Yellow & White Copy - SGS					
Note: Submission of samples to SGS is acknowledgement that you have been provided direction on sample collection/handling and transportation of samples. (2) Submission of samples to SGS is considered authorization for completion of work. Signatures may appear on this form or be retained on file in the contract, or in an alternative format (e.g. shipping documents). (3) Results may be sent by email to an unlimited number of addresses for no additional cost. Fax is available upon request. This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/terms_and_conditions.htm . (Printed copies are available upon request.) Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.																							



FINAL REPORT

CA15271-MAY21 R1

31344, Omer Lake Culvert

Prepared for

Thurber Engineering Ltd.



FINAL REPORT

CA15271-MAY21 R1

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	Thurber Engineering Ltd.	Project Specialist	Brad Moore Hon. B.Sc
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Email	jalexander@thurber.ca	SGS Reference	CA15271-MAY21
Project	31344, Omer Lake Culvert	Received	05/18/2021
Order Number		Approved	05/27/2021
Samples	Ground Water (1)	Report Number	CA15271-MAY21 R1
		Date Reported	05/27/2021

COMMENTS

SIGNATORIES

Brad Moore Hon. B.Sc

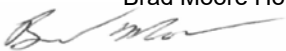




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FINAL REPORT

CA15271-MAY21 R1

Client: Thurber Engineering Ltd.

Project: 31344, Omer Lake Culvert

Project Manager: Joshua Alexander

Samplers: NA

PACKAGE: **Metals and Inorganics (WATER)**

Sample Number 7

Sample Name BH21-01

Sample Matrix Ground Water

Sample Date 25/04/2021

L1 = PWQO_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Parameter	Units	RL	L1	Result
Metals and Inorganics				
Hardness (dissolved)	mg/L as CaCO ₃	0.05		77.7
Aluminum (dissolved)	mg/L	0.001	0.015	0.031
Arsenic (dissolved)	mg/L	0.0002		0.0017
Boron (dissolved)	mg/L	0.002		0.009
Barium (dissolved)	mg/L	0.00002		0.00923
Beryllium (dissolved)	mg/L	0.00000 7		< 0.000007
Bismuth (dissolved)	mg/L	0.00001		< 0.00001
Cobalt (dissolved)	mg/L	0.00000 4		0.000091
Calcium (dissolved)	mg/L	0.01		23.4
Cadmium (dissolved)	mg/L	0.00000 3		0.000012
Copper (dissolved)	mg/L	0.0002		0.0034
Chromium (dissolved)	mg/L	0.00008		0.00026
Iron (dissolved)	mg/L	0.007		0.042
Potassium (dissolved)	mg/L	0.009		2.18
Magnesium (dissolved)	mg/L	0.001		4.66
Manganese (dissolved)	mg/L	0.00001		0.00049
Molybdenum (dissolved)	mg/L	0.00004		0.00453
Nickel (dissolved)	mg/L	0.0001		0.0010
Sodium (dissolved)	mg/L	0.01		94.7
Phosphorus (dissolved)	mg/L	0.003		0.016



FINAL REPORT

CA15271-MAY21 R1

Client: Thurber Engineering Ltd.
Project: 31344, Omer Lake Culvert
Project Manager: Joshua Alexander
Samplers: NA

PACKAGE: Metals and Inorganics (WATER)

Sample Number 7
Sample Name BH21-01
Sample Matrix Ground Water
Sample Date 25/04/2021

L1 = PWQQ_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Parameter	Units	RL	L1	Result
Metals and Inorganics (continued)				
Lead (dissolved)	mg/L	0.00009		< 0.00009
Silicon (dissolved)	mg/L	0.02		2.89
Silver (dissolved)	mg/L	0.00005		< 0.00005
Strontium (dissolved)	mg/L	0.00002		0.0596
Thallium (dissolved)	mg/L	0.00000 5		0.000013
Tin (dissolved)	mg/L	0.00006		0.00071
Titanium (dissolved)	mg/L	0.00005		0.00049
Antimony (dissolved)	mg/L	0.0009		0.0022
Selenium (dissolved)	mg/L	0.00004		0.00015
Uranium (dissolved)	mg/L	0.00000 2		0.00410
Vanadium (dissolved)	mg/L	0.00001		0.00090
Zinc (dissolved)	mg/L	0.002		< 0.002



EXCEEDANCE SUMMARY

				PWQO_L / WATER
				/ - - Table 2 -
				General - July 1999
				PIBS 3303E
Parameter	Method	Units	Result	L1

BH21-01

Aluminum (dissolved)	SM 3030/EPA 200.8	mg/L	0.031	0.015
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FINAL REPORT

CA15271-MAY21 R1

QC SUMMARY

Metals in aqueous samples - ICP-MS
Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-ENVISPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Silver (dissolved)	EMS0103-MAY21	mg/L	0.00005	<0.00005	ND	20	100	90	110	99	70	130
Aluminum (dissolved)	EMS0103-MAY21	mg/L	0.001	<0.001	1	20	94	90	110	106	70	130
Arsenic (dissolved)	EMS0103-MAY21	mg/L	0.0002	<0.0002	11	20	102	90	110	100	70	130
Barium (dissolved)	EMS0103-MAY21	mg/L	0.00002	<0.00002	1	20	100	90	110	100	70	130
Beryllium (dissolved)	EMS0103-MAY21	mg/L	0.000007	<0.00007	ND	20	93	90	110	88	70	130
Boron (dissolved)	EMS0103-MAY21	mg/L	0.002	<0.002	5	20	96	90	110	99	70	130
Bismuth (dissolved)	EMS0103-MAY21	mg/L	0.00001	<0.00001	5	20	90	90	110	81	70	130
Calcium (dissolved)	EMS0103-MAY21	mg/L	0.01	<0.01	2	20	102	90	110	102	70	130
Cadmium (dissolved)	EMS0103-MAY21	mg/L	0.000003	<0.000003	2	20	101	90	110	108	70	130
Cobalt (dissolved)	EMS0103-MAY21	mg/L	0.000004	<0.000004	1	20	99	90	110	98	70	130
Chromium (dissolved)	EMS0103-MAY21	mg/L	0.00008	<0.00008	5	20	100	90	110	101	70	130
Copper (dissolved)	EMS0103-MAY21	mg/L	0.0002	<0.0002	4	20	100	90	110	94	70	130
Iron (dissolved)	EMS0103-MAY21	mg/L	0.007	<0.007	0	20	102	90	110	100	70	130
Potassium (dissolved)	EMS0103-MAY21	mg/L	0.009	<0.009	1	20	104	90	110	100	70	130
Magnesium (dissolved)	EMS0103-MAY21	mg/L	0.001	<0.001	2	20	110	90	110	100	70	130
Manganese (dissolved)	EMS0103-MAY21	mg/L	0.00001	<0.00001	1	20	101	90	110	106	70	130
Molybdenum (dissolved)	EMS0103-MAY21	mg/L	0.00004	<0.00004	7	20	95	90	110	108	70	130
Sodium (dissolved)	EMS0103-MAY21	mg/L	0.01	<0.01	2	20	107	90	110	99	70	130
Nickel (dissolved)	EMS0103-MAY21	mg/L	0.0001	<0.0001	2	20	103	90	110	102	70	130
Lead (dissolved)	EMS0103-MAY21	mg/L	0.00009	<0.00001	3	20	109	90	110	104	70	130



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QC SUMMARY

Metals in aqueous samples - ICP-MS (continued)
Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-ENVISPE-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Phosphorus (dissolved)	EMS0103-MAY21	mg/L	0.003	<0.003	6	20	99	90	110	NV	70	130
Antimony (dissolved)	EMS0103-MAY21	mg/L	0.0009	<0.0009	2	20	100	90	110	120	70	130
Selenium (dissolved)	EMS0103-MAY21	mg/L	0.00004	<0.00004	12	20	101	90	110	105	70	130
Silicon (dissolved)	EMS0103-MAY21	mg/L	0.02	<0.02	4	20	109	90	110	NV	70	130
Tin (dissolved)	EMS0103-MAY21	mg/L	0.00006	<0.00006	2	20	98	90	110	NV	70	130
Strontium (dissolved)	EMS0103-MAY21	mg/L	0.00002	<0.00002	2	20	98	90	110	101	70	130
Titanium (dissolved)	EMS0103-MAY21	mg/L	0.00005	<0.00005	5	20	104	90	110	NV	70	130
Thallium (dissolved)	EMS0103-MAY21	mg/L	0.000005	<0.000005	ND	20	104	90	110	100	70	130
Uranium (dissolved)	EMS0103-MAY21	mg/L	0.000002	<0.000002	2	20	102	90	110	96	70	130
Vanadium (dissolved)	EMS0103-MAY21	mg/L	0.00001	<0.00001	0	20	99	90	110	102	70	130
Zinc (dissolved)	EMS0103-MAY21	mg/L	0.002	<0.002	3	20	99	90	110	108	70	130



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QC SUMMARY

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

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

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.



LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.

RL Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

NA The sample was not analysed for this analyte

ND Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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-- End of Analytical Report --



APPENDIX E

Site Photographs



Figure 1: Looking north at north approach on Highway 11 (June 2024)



Figure 2: Looking south at south approach on Highway 11 (June 2024)



Figure 3: Looking southwest at culvert inlet (August 2024)



Figure 4: Looking east towards marshy conditions near culvert inlet (August 2024)



Figure 5: Looking north towards culvert outlet (August 2024)



Figure 6: Looking southwest towards marshy conditions south of culvert outlet (August 2024)