

Final Foundation Investigation Report (FIR)

Highway 61 Culvert Replacement

Station 26+422, Township of Crooks

Gannett Fleming

Ontario Ministry of Transportation (MTO)

GWP 6176-15-00

GEOCRES No. 52A00-265

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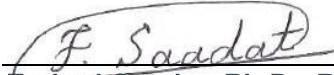
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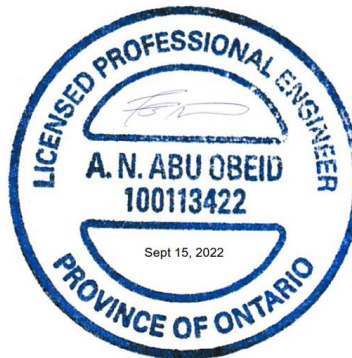


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1 Introduction

Englobe Corp. (Englobe) has been retained by Gannett Fleming (Client), on behalf of the Ministry of Transportation of Ontario (MTO, Owner), to carry out a foundation investigation and prepare Foundation Investigation (FIR) and Foundation Investigation and Design (FIDR) Reports for the proposed replacement of an existing culvert (C37) at approximate Station 26+422 on Highway No. 61 in the Township of Crooks, Ontario (Site) shown on Drawing No. 1, Appendix A. This assignment was performed at the request of the Client as per the project Terms of Reference outlined in MTO Request for Quotation (RFQ) Version 3.2 under Assignment Number 6020-E-0021 (GEOCREs No. 52A00-265).

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2 Site Description

The existing 41.73 m long culvert structure (C37) is a Corrugated Steel Pipe (CSP) culvert crossing Highway 61 at approximate Station 26+422, approximately 3.5 km south of Cloud Lake Road and Highway 61 intersection, in the Township of Crook. Highway 61 at this culvert crossing is a two-lane undivided highway with asphalt surface and partially paved shoulders on both sides running in an approximate north-south direction, as shown on Drawing No. 1 in Appendix A. Highway 61 is constructed on an embankment about 12.5 m wide (including shoulders) and up to approximately 6 m in height above the crown of the culvert, with the centreline of the roadway at an approximate elevation 281.2 m at the culvert location. The pavement surface is generally in good to fair condition with some transvers cracks across the asphalt surface. The topography of the surrounding area varies in the vicinity of the crossing. The sides of the roadway at the culvert crossing were observed to be heavily vegetated with bushes, shrubs, and mature trees. The embankment is scoured at the upstream as was noted in GF Culvert Inspection Report. An access to a private property at the west side of Highway 61 is located about 60 m to the north of the culvert crossing. On the east side of the Highway 61, low hanging hydro lines were observed.

The existing culvert structure is crossing Highway 61 at almost a perpendicular alignment from east (upstream) to west (downstream). The existing culvert structure is 800 mm wide and 620 mm high at the upstream and 800 mm wide and 650 mm high at the downstream, as shown on Drawing No. 2 in Appendix A and described in detail and shown on the sketches and Figures in GF Culvert Inspection Report in Appendix D. The culvert edges extend out beyond the embankment without wing walls. The CSP culvert barrel at the invert and springline is very severely corroded with total section loss below the springline. The channel dimensions were described by GF in general as 3 m wide channel upstream (US) with banks at 3H:1V and water depth of 80 mm; and 3 m wide dry channel downstream (DS) with banks at 3H:1V. The top of the culvert elevations at the inlet and outlet are El. 275.8 and El. 275.2 m, respectively with clearance of 620 mm and 650 mm (i.e. dry), respectively. Flow through the culvert is from east/right (Rt) to the west/left (Lt) as shown on Drawing No. 2 in Appendix A.

2.1 Site Physiography and Surficial Geology

Based on published Northern Ontario Geology Terrain Study (NOEGTS) of the general area by J. F. Gartner, J.D. Mollard, and M.A. Road (1981), the Site is located within the Glaciolacustrine Plain with native overburden/sediments within the immediate project area consisting mainly of clayey deposits.



3 Investigation Procedures

3.1 Site Investigation

The purpose of the geotechnical investigation was to explore and record the subsurface conditions at both ends of the existing culvert and in the roadway embankment at the culvert crossing. The fieldwork was carried out between October 27 and November 8, 2021 and consisted of two boreholes on the roadway extending to a maximum depth of 18.9 m below existing ground/road surface (mbgs) and two boreholes off the roadway at the culvert inlet and outlet extending to a maximum depth of 6.7 mbgs.

The fieldwork included locating the boreholes, clearing the borehole locations of underground services, in-situ sampling and testing operations, logging of the boreholes, labeling and preparation of samples for transportation to the Englobe North Bay laboratory, plus overall drill supervision.

Englobe's staff visited the Site before the planned site investigation to mark out the proposed borehole locations. Utility clearance was obtained from Ontario-1-Call. Public utility authorities were informed, and all utility clearance documents were obtained before the commencement of drilling work. A traffic control plan was prepared and implemented by Workforce Inc. of Sudbury, Ontario, according to Ontario Traffic Manual Book 7 during the fieldwork. The drilling rigs used for drilling were owned and operated by Maple Leaf Drilling Ltd. of Sunnyside, Manitoba. Boreholes were advanced using a CME 750 track mounted drill and a B20 portable drilling rig.

The fieldwork for this investigation included four (4) sampled boreholes (BH). BH Nos. 1 and 2 were advanced in the roadway shoulders through the embankment. BH Nos. 3 and 4 were advanced at the inlet (Rt) and outlet (Lt) ends of the culvert, respectively. The locations of the boreholes are shown on Drawing No. 2 in Appendix A and are provided in the Table below.

Table 1 Borehole Locations

Borehole No.	Borehole Location (MTM Nad 83)		Borehole Location (Geographic)	
1	N 5334784.2	E 345887.5	Lat: 48.15057°	Long: - 89.44775°
2	N 5334778.6	E 345876.4	Lat: 48.15052°	Long: - 89.44790°
3	N 5334794.6	E 345901.4	Lat: 48.15067°	Long: - 89.44756°
4	N 5334775.1	E 345859.3	Lat: 48.15049°	Long: - 89.44813°

BH Nos. 1 and 2 were advanced using a hallow stem auger aided by track-mounted CME 750 drilling rig equipped with wash boring equipment, N-size casing, rock coring equipment (NQ size core) and routine geotechnical sampling equipment. BH Nos. 3 and 4, which were drilled off the roadway near the inlet and outlet, were advanced using a B20 portable drilling rig equipped with a solid stem auger.

Soil samples were obtained at regular intervals of depth at the borehole locations using a standard 51 mm split spoon sampler advanced in accordance with the Standard Penetration Test (SPT) procedures (ASTM D1586). All soil samples taken during this investigation were stored in labeled airtight containers for transport to the Englobe North Bay laboratory for visual examination and select laboratory testing.

Groundwater conditions in the open boreholes were observed during the advancement of the individual boreholes. Two 19 mm diameter standpipes were installed in Borehole Nos. 3 and 4 prior to backfilling to allow for follow-up monitoring of the stabilized groundwater levels. The remaining boreholes were backfilled upon completion of drilling in accordance with requirements of Ontario Regulation 903.

The location of the individual boreholes was determined in the field using highway chainage established by the Ministry of Transportation and offsets relative to highway centreline. The MTO coordinates, northing and easting, were then established for the boring locations using coordinates from MTM Zone 15, NAD 83 CSRS. Elevations contained in this report are referenced to an on-site geodetic datum. The borehole elevations are based on the GPS RTK survey carried out by Englobe.

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4 Laboratory Investigation

All soil and rock samples obtained during the investigation were transported to Englobe Laboratory in Thunder Bay, Ontario. This laboratory is certified by the Ministry of Transportation Ontario (MTO) under RAQS program at Medium Complexity level for Soil and Rock Testing including Testing for Foundation Engineering. All retrieved samples were subjected to visual identification and tactile categorization to describe the soils. The laboratory tests to determine index properties were performed in accordance with the Ministry of Transportation Ontario (MTO) test procedures, which follow the American Society for Testing Materials (ASTM) test procedures. Laboratory testing included grain size distribution; sieve and hydrometer analysis according to ASTM D422 and LS-702, Atterberg's Limits ASTM D4318 and LS-703/704, water content ASTM D2216 and LS-701. The results of the laboratory testing are presented on the individual Record of Borehole Sheets (Appendix B), with a summary of results presented on the laboratory sheets in Appendix C (Figures Nos. L-1 to L-8).

Chemical tests on one representative soil and one water samples to determine the soil and water corrosivity characteristics (pH, chloride, resistivity, sulphate) were carried out by an accredited independent laboratory (Bureau Veritas in Mississauga) to assess soil condition for buried structural steel and concrete elements.

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5 Subsurface Conditions

The subsurface conditions revealed by the investigation program are summarized in Table 2 below and on the stratigraphic profile presented on Drawing No. 2 (Appendix A) and on the detailed Records of Borehole Logs (Appendix B). It should be noted that the stratigraphic delineation presented on the borehole logs and soil strata plot is interpreted from the results of non-continuous sampling, response to drilling progress, recorded SPT 'N'-values, plus field observations. Typically, such boundaries represent transitions from one zone to another and are not an exact demarcation of specific geological units. Additional consideration should be given to the fact that subsurface conditions may vary markedly between adjacent boreholes and beyond any specific boring location and are shown on the drawings for illustration purposes only.

Table 2 Summary of Generalized Stratigraphy in Boreholes with Depth and Elevation (m)

Deposit/Layer Description	Depths/Elevations (m)			
	Borehole No. 1	Borehole No. 2	Borehole No. 3	Borehole No. 4
Asphalt/Topsoil	0.04 (El. 281.2)	0.04 (El. 281.2)	0 - 0.1 (El. 275.8 - 275.7)	0 - 0.1 (El. 275.4 - 275.3)
Pavement Granular Base: Loose to Compact Sand and Gravel	0.04 - 2.3 (El. 281.2 - 278.9)	0.04 - 2.3 (El. 281.2 - 278.9)	--	--
Embankment Fill: Loose to Compact Silt, with some Clay and Sand.	2.3 - 4.6 (El. 278.9 - 276.6)	2.3 - 4.6 (El. 278.9 - 276.6)	--	--
Embankment Fill: Loose Sand with some Gravel and Clay, trace of Silt.	4.6 - 6.9 (El. 276.6 - 274.3)	--	--	--
Embankment Fill: Soft to Firm Silt and Clay, with trace of Sand and Gravel and presence of organics.	--	4.6 - 6.9 (El. 276.6 - 274.3)	--	--
Native: Firm to Stiff Clay, with some and Silt.	6.9 - 9.1 (El. 274.3 - 272.1)	--	--	--
Native: Compact to Dense Silt some Clay with interlayered of Sandy Silt and Clayey Silt.	9.1 - 18.9 (El. 272.1 - 262.3)	6.9 - 18.9 (El. 274.3 - 262.3)	0.1 - 5.3 (El. 275.7 - 270.5)	--
Native: Compact to Dense Sand/Silty Sand with trace of Gravel, and Clay.	--	--	5.3 - 6.7 (El. 270.5 - 269.1)	0.1 - 5.3 (El. 275.3 - 270.1)
Native: Very Stiff to Hard Clayey Silt, with trace of Sand and gravel.	--	--	--	5.3 - 6.7 (El. 270.1 - 268.7)

5.1 Asphalt and Pavement Structure

A thin layer of approximate 40 mm asphalt was encountered in both BH Nos. 1 and 2 which were drilled on the shoulders through the embankment. The asphalt was underlain by a sand fill layer

consisting mainly of brown sand and gravel with trace to some silt. The sand fill extended to approximate depth of 2.3 mbgs (El. 278.9 m) in both boreholes.

This sand fill layer was almost dry with approximate moisture content of 10% measured in the geotechnical laboratory. A representative sample from the subbase underwent grain size analysis and the results are summarized in Table 3 and provided in Figure No. L-1, Appendix C.

Table 3 Particle Size Distribution Results of the Subbase (Sand) Fill

Sample Tested	Sample Depth / Elev. (m)	Grain Size Analysis (%)				Soil Classification
		Gravel	Sand	Silt	Clay	
BH No. 2 / SS-3	1.7 (279.5)	14	49	37		SM

The sand fill layer was generally loose to dense, based on recorded SPT 'N' values ranging from 8 to 35 blows/300 mm.

5.2 Topsoil

A thin topsoil layer (organic silt) of approximately 0.1 m thickness was observed in BH Nos. 3 and 4, located beyond the paved shoulders.

5.3 Embankment Fill

The encountered embankment fill materials underlying the pavement structure in Borehole Nos. 1 and 2 extended down to 6.9 mbgs (El. 274.3 m). The embankment fill materials varied in composition with depth.

Below the roadway pavement structure in both boreholes, a 2.3 m thick loose to compact silt fill layer was encountered between El. 278.9 m and 276.6 m. This silt fill layer was observed to be brown and damp. Below this upper silt fill layer, a 2.3 m thick loose sand fill layer was encountered between El. 276.6 m and El. 274.3 m in BH No. 1, whereas a 2.3 m thick soft to firm silt and clay fill layer was encountered between El. 276.6 m and El. 274.3 m below this upper silt fill layer in BH No. 2.

The results for grain size analyses and Atterberg limits (Liquid Limit (LL), Plastic Limit (PL) and Plasticity Index (PI)) of a representative soil sample of the upper silt fill layer are summarized in Table 4 and presented on Figure Nos. L-2 and L-8 in Appendix C.

Table 4 Particle Size Distribution and Atterberg Limit Results of the Silt Fill

Sample Tested	Sample Depth / Elev. (m)	Grain Size Analysis (%)				Atterberg Limits (%)			Water Content (%)	Soil Classification
		Gravel	Sand	Silt	Clay	LL	PL	PI		
BH No. 1/SS-5	3.2 (278.0)	1	13	65	21	28	20	8	26	CL-ML

The upper silt fill layer was generally loose to compact, based on recorded SPT 'N' values ranging from 4 to 21 blows/300 mm. As indicated above, the upper silt layer in BH No. 1 was underlain by sand fill deposit approximately 2.3 m thick and extending to a maximum depth of 6.9 mbgs (EL. 274.3 m). The sand deposit included different portions of gravel, silt and clay and was observed to be brown and dry to damp with an approximate moisture content of 5 % measured in the geotechnical laboratory.

A representative soil sample from this layer was subjected to grain size analysis and the results are summarized in Table 5 and provided in Figure No. L-3, Appendix C.

Table 5 Particle Size Distribution Results of the Sand Fill

Sample Tested	Sample Depth / Elev. (m)	Grain Size Analysis (%)				Soil Classification
		Gravel	Sand	Silt	Clay	
BH No. 1/SS-8	5.4 (275.8)	31	61	8		SP - SM

The sand fill layer was generally loose, based on recorded SPT 'N' values ranging from 4 to 9 blows/300 mm.

As indicated above, the upper silt layer in BH No. 2 was underlain by silt and clay fill deposit approximately 2.3 m thick and extending to a maximum depth of 6.9 mbgs (EL. 274.3 m). The silt and clay layer included different portions of sand and gravel with occasional organic inclusions and possibly buried tree log remains. The silt and clay layer was observed to be grey and damp with an approximate moisture content of 30 % measured in the geotechnical laboratory.

A representative soil sample from this layer was subjected to grain size analysis and Atterberg limits and the results are summarized in Table 6 and provided in Figure No. L-4 and L-8, Appendix C.

Table 6 Particle Size Distribution and Atterberg Limit Results of the Silt and Clay Fill

Sample Tested	Sample Depth / Elev. (m)	Grain Size Analysis (%)				Atterberg Limits (%)			Water Content (%)	Soil Classification
		Gravel	Sand	Silt	Clay	LL	PL	PI		
BH No. 2/SS-8	5.6 (275.8)	1	8	53	37	39	22	17	30	CI

The silt and clay fill layer was generally firm, based on recorded SPT 'N' values ranging from 7 to 8 blows/300 mm. Higher SPT 'N' value (i.e. +50 blows/300 mm) was recorded at approximate depth of 6.2 mbgs (El. 275 m) possibly due to presence of buried tree log remains.

5.4 Native Clay (CL)

A native clay deposit was encountered underlying the embankment fill only in BH No. 1. The native clay in BH No. 1 was encountered at approximate depth of 6.9 mbgs (El. 274.3 m) and it extended down to an approximate depth of 9.1 mbgs (El. 252.8 m).

This deposit mainly consisted of low plasticity clay (CL) with different portions of sand, gravel and silt. The layer was observed to be brown to reddish brown in general. The consistency of this deposit generally varied from firm to stiff based on recorded SPT 'N' values ranging from 5 to 12 blows/300 mm.

5.5 Native Silt (ML to CL)

Underlying the native clay in BH No. 1, and the embankment fill in BH No. 2, and at ground surface in BH No. 3, a native deposit of silt was encountered with some clayey and sandy interbeds.

The native silt was encountered in BH No. 1 at an approximate depth of 9.1 mbgs (El. 272.1 m) and it extended to the maximum drilling depth in BH No. 1 (i.e. 18.9 mbgs, El. 262.3 m). The native silt was encountered in BH No. 2 immediately below the embankment fill at an approximate depth of 6.9 mbgs (El. 274.3 m) and it extended also to the maximum drilling depth in BH No. 1 (i.e. 18.9 mbgs, El. 262.3 m). The silt layer was encountered below the topsoil in BH No. 3 at an approximate elevation of 275.7 m and it extended down to 5.3 mbgs (El. 270.5 m). This deposit mainly consisted of silt with minor portions of gravel, sand and clay. This deposit was observed to be brown to reddish brown in general.

The natural moisture contents measured on samples recovered from the deposit ranged from 11 to 32% and was on average 23%. Nine gradation analyses and three Atterberg were carried out on

samples from this deposit, and the results are summarized in Table 7 and provided in Figure Nos. L-5, L-6 and L-8, Appendix C.

Table 7 Particle Size Distribution and Atterberg Limits Results of the Native Silt

Sample Tested	Sample Depth / Elev. (m)	Grain Size Analysis (%)				Atterberg Limits (%)			Water Content (%)	Soil Classification
		Gravel	Sand	Silt	Clay	LL	PL	PI		
BH No. 1/SS-13	9.3 (271.9)	23	17	40	21	38	19	19	26	CI
BH No. 1/SS-17	14.0 (267.2)	0	43	57		--	--	--	11	ML
BH No. 1/SS-20	18.6 (262.6)	0	15	63	22	--	--	--	22	ML
BH No. 2/SS-13	9.4 (271.8)	1	1	88	9	--	--	--	32	ML
BH No. 2/SS-16	12.5 (268.7)	1	12	62	24	28	15	13	20	CL
BH No. 2/SS-18	15.5 (265.7)	0	15	85		--	--	--	14	ML
BH No. 3/SS-2	1.0 (274.8)	0	13	87		--	--	--	25	ML
BH No. 3/SS-4	2.5 (273.3)	1	15	66	18	29	15	14	24	CL
BH No. 3/SS-5	3.3 (272.5)	17	11	57	14	--	--	--	32	ML

The compactness of this deposit generally varied from loose to dense based on recorded SPT 'N' values ranging from 8 to 42 blows/300 mm.

5.6 Native Sand/Silty Sand (SM to ML)

Below the native silt in BH No 3 and at shallow depth below the topsoil in BH No. 4, a sand/silty sand deposit was encountered. The sand/silty sand in BH No. 3 was encountered at an approximate depth of 5.3 mbgs (El. 270.5) and extended down to the maximum depth of drilling in BH No. 3 (i.e. 6.7 mbgs, El/ 269.1 m). In BH No. 4, the sand/silty sand deposit was encountered at shallow depth below the topsoil approximately at El. 275.3 m and extended down to an approximate depth of 5.3 mbgs (El. 270.1 m).

The layer consisted mainly of sand and silt with different portions of gravel and clay. The layer was observed to be brown to reddish brown in general and damp to wet with measured natural moisture content of 21%.

A representative sample from the deposit underwent gradation analyses, and the results are summarized in Table 8 and provided in Figure No. L-6, Appendix C.

Table 8 Particle Size Distribution and Atterberg Limits Results of the Native Sand/Silty Sand

Sample Tested	Sample Depth / Elev. (m)	Grain Size Analysis (%)				Soil Classification
		Gravel	Sand	Silt	Clay	
BH No. 4/SS-5	3.4 (272.0)	9	34	34	14	SM to ML

The sand/silty sand layer was observed to be loose to very dense based on SPT 'N' values ranging from 9 to 58 blows/300 mm.

5.7 Native Clayey Silt (CL)

Underlying the native sand/silty sand in BH No. 4, a native deposit of clayey silt was encountered at an approximated depth of 5.3 mbgs (El. 270.1 m) and extended to the maximum depth of drilling in BH No 4 (i.e. 6.7 mbgs, El. 268.7 m).

The layer consisted mainly of clayey silt with minor portions of sand and gravel. The layer was observed to be brown in general and wet with measured natural moisture content of 32%.

A representative sample from the deposit underwent gradation analyses and Atterberg limits, and the results are summarized in Table 9 and provided in Figure Nos. L-7 and L-8, Appendix C.

Table 9 Particle Size Distribution and Atterberg Limits Results of the Native Clayey Silt

Sample Tested	Sample Depth / Elev. (m)	Grain Size Analysis (%)				Atterberg Limits (%)			Water Content (%)	Soil Classification
		Gravel	Sand	Silt	Clay	LL	PL	PI		
BH No. 2/SS-8	5.6 (275.8)	2	9	59	30	36	23	13	32	CL

The consistency of this deposit generally varied from very stiff to hard based on recorded SPT 'N' values ranging from 17 to 37 blows/300 mm.

5.8 Groundwater Conditions

Groundwater and cave-in levels were measured in the open boreholes during the course of the fieldwork as summarized in Table 10. These levels are recorded on the individual Record of Borehole Log Sheets (Appendix B).

Table 10 Groundwater Levels

BH No.	Drilling Date	Ground Surface Elev. (m)	Borehole Bottom		Monitoring Date	GW in Well	
			Depth (m)	Elev. (m)		Depth (m)	Elev. (m)
BH No. 1	Oct. 27, 2021	281.2	18.9	262.3	--	--	--
BH No. 2	Oct. 28, 2021	281.2	18.9	262.3	--	--	--
BH No. 3	Nov. 8, 2021	275.8	6.7	269.1	Nov. 19, 2021 Dec. 21, 2021	Dry Dry	Dry Dry
BH No. 4	Nov. 8, 2021	275.4	6.7	268.7	Nov. 19, 2021 Dec. 21, 2021	1.0 0.8	274.4 274.6

The groundwater and surface water levels should be expected to fluctuate seasonally/yearly. The stabilized groundwater level is anticipated to correspond with the creek water level. The lowest creek level is anticipated to be above the average invert elevation of the culvert at elevation 274.8 m. The water level in the creek was measured in January 2022 and was at EL. 275.2 m at the upstream adjacent to BH No. 3 and EL. 274.9 m at the downstream adjacent to BH No. 4

5.9 Soil and Water Corrosivity Testing

A representative soil sample collected from BH No. 2 and water sample collected from BH No.3 were subjected to corrosivity chemical tests by Bureau Veritas Laboratories in Thunder Bay to determine its potential corrosivity by measuring resistivity, pH, sulphate and chloride content of the sample within the estimated infrastructure depths. The results are presented in Table 11.

Table 11 Soil and Water Corrosivity Chemical Analysis Results

BH No.	Sample	Depth (Elev.) (m)	pH	Sulphate (%)	Chloride (%)	Resistivity (Ohm-cm)
BH No. 2	SS-10	7.2 (274.0)	7.21	<0.0020	0.0270	2100
BH No. 4	Water	--	7.93	0.00323	0.0240	--

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6 General Comments

The field investigation was carried out using track mounted CME 750 drilling rigs and a portable B20 drilling rig owned and operated by Maple Leaf Drilling Ltd. Laboratory testing of select soil samples was undertaken at the Englobe Laboratory in North Bay. The fieldwork for this site investigation was under the full-time supervision of Englobe technical staff. The report was written by Mr. Farbod Sadaat, Ph.D., P.Eng., and peer reviewed by Mr. Ala Abu Obeid, M.Sc., P.Eng., PMP. The report was also reviewed by the MTO Designated Contact Mike Tanos, P.Eng., with independent review by Jake Berghamer, P.Eng.

7 STATEMENT OF LIMITATIONS

The design recommendations given in this geotechnical report are applicable only to the project described in the text and only if constructed substantially in accordance with details of alignment and elevations stated in the report. Since all details of the design may not be known, in our analysis certain assumptions had to be made. The actual conditions, however, may vary from those assumed, in which case changes and modifications may be required to our geotechnical recommendations.

The comments in this report are intended solely for the guidance of the design engineer and address the geotechnical conditions only. The number of boreholes required to determine the localized conditions between boreholes directly affecting construction costs, equipment, scheduling, etc. would in fact be greater than what has been carried out for design purposes. Therefore, contractors bidding on this project or undertaking this work should make their own interpretations of the factual borehole results and carry out further work as they deem necessary to assess the scope of the project.

Foundation Design of this report is intended solely for the use of the client and the design team for the detail design of this specific project on behalf of the Ministry of Transportation and is not intended to be included in the tender documents; and shall not be used for any other purposes or by any other parties including the construction Contractor.

Appendix A

Drawings

Drawing No. 1 - Site Location Plan & Key Map

Drawing No. 2 - Borehole Location Plan & Embankment Profile

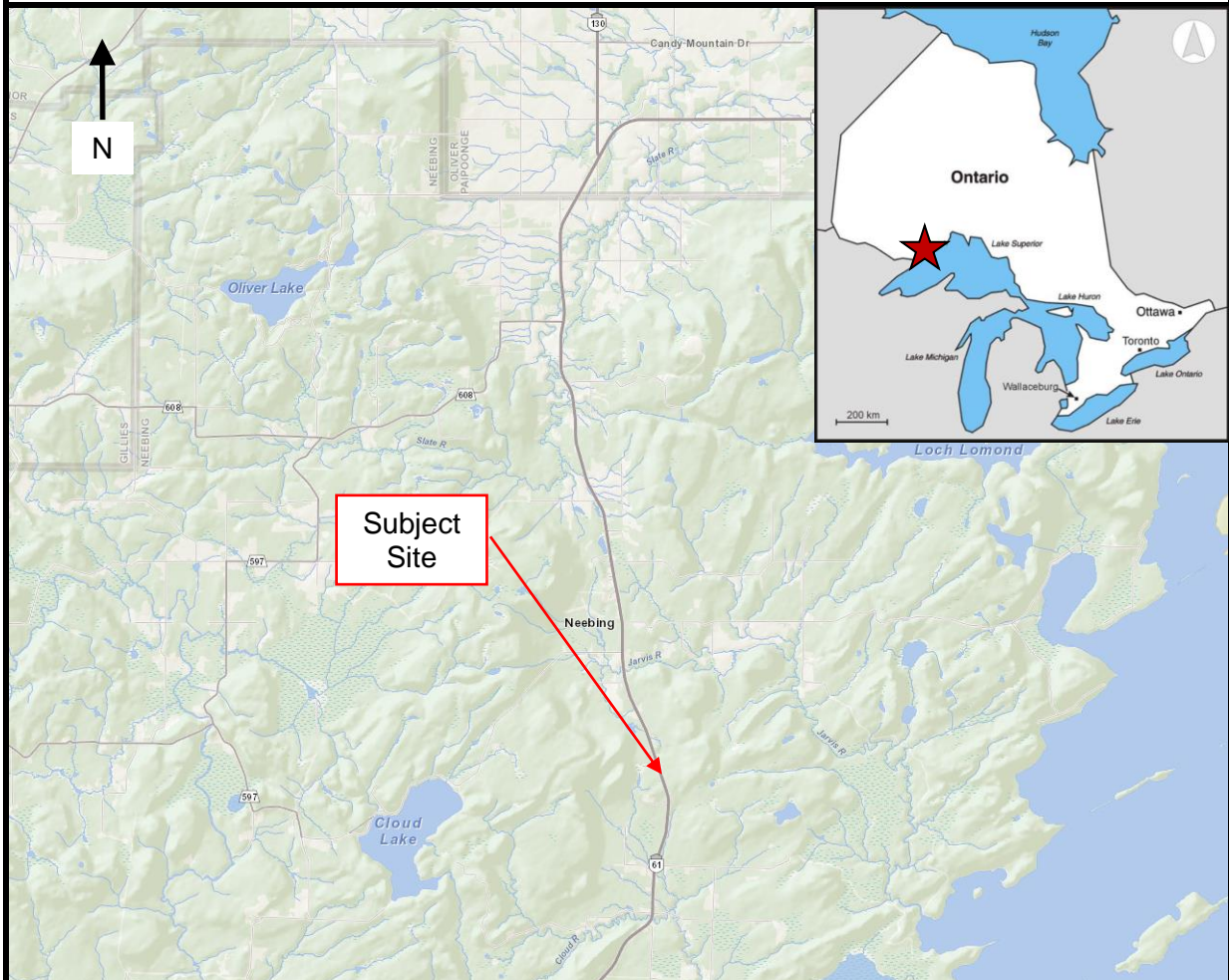


eNGLOBE

KEY PLAN

Drawing No. 1

NOT TO SCALE



DRAFT FOUNDATION INVESTIGATION REPORT

Station 26+422 Culvert
Culvert Replacement
Highway No. 61, Twp. of Crooks
Assignment Number 6020-E-0021
GWP 6176-15-00

Reference No: 02109931

December 2021

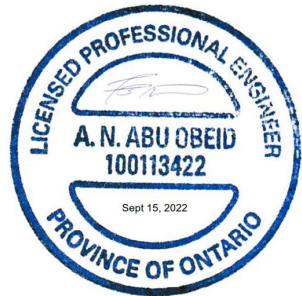


CAD FILE LOCATION AND NAME: I:\52\Projects For Other Offices\02109931 - FDN, HYD & DSS - Hwy 61, 6012-E-0021 (DIST)\Drawings\02109931 - 26+422, Crookes.dwg
MODIFIED: 5/25/2022 6:00:28 PM BY: MTCU
DATE PLOTTED: 9/6/2022 2:08:23 AM BY:

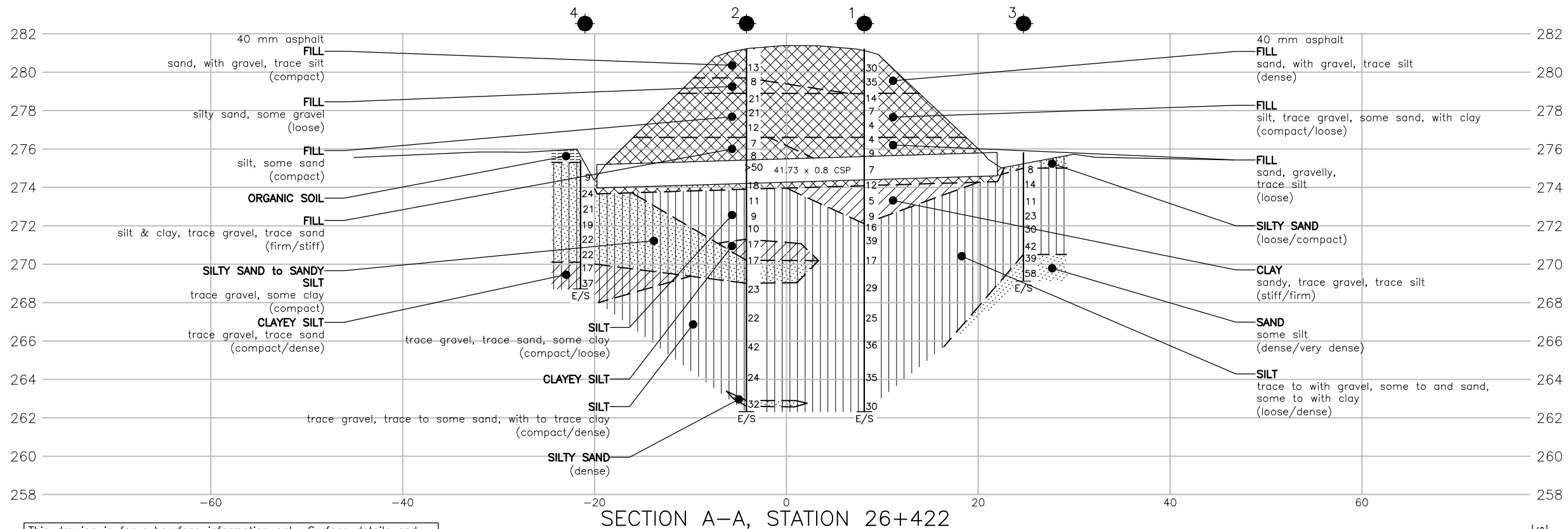
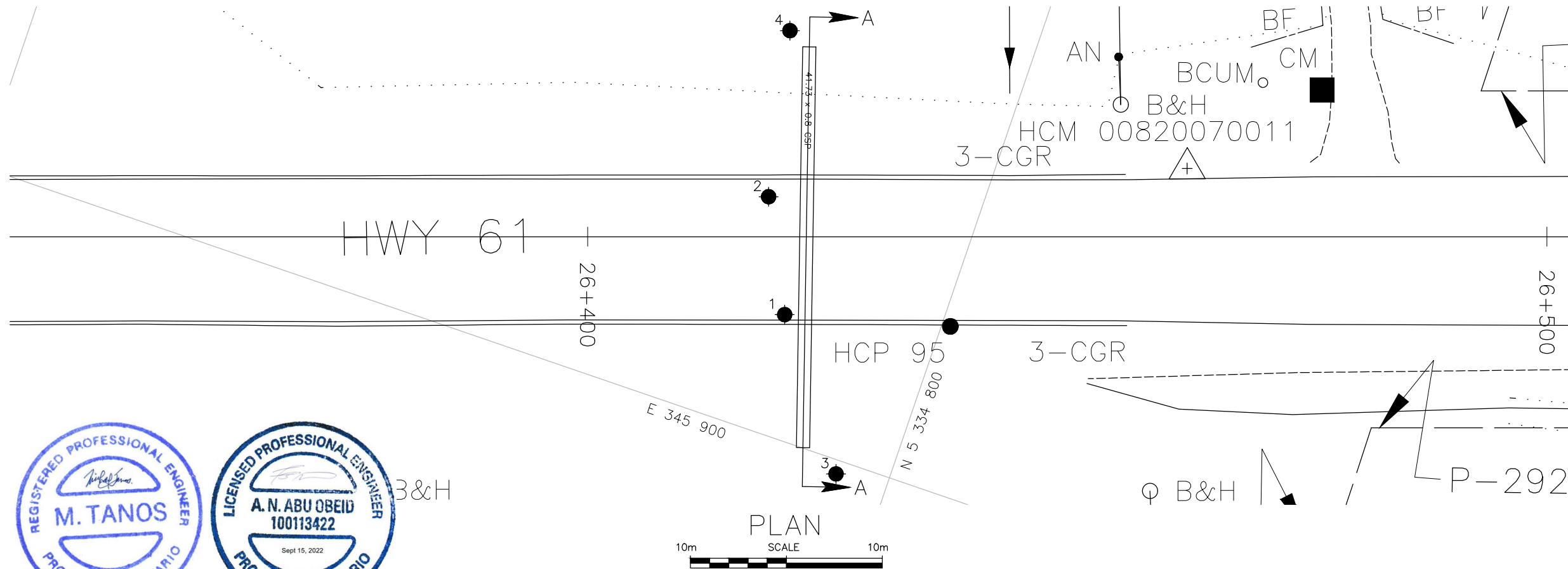
PR-D-707 BM-03
MINISTRY OF TRANSPORTATION, ONTARIO



2022-09-15



2022-09-15



This drawing is for subsurface information only. Surface details and features are for conceptual illustration. The proposed structure location is shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contract Documents.

DISTRICT
CONT. No.
GWP No. 6176-15-00

REHABILITATION OF HWY 61
CULVERT REPLACEMENT
STATION ±26+422

BOREHOLE LOCATIONS
AND SOIL STRATIGRAPHY

SHEET
2

ENGLOBE

KEY PLAN
N.T.S.

N

DCPT

Water Level at Time of Investigation

Auger Refusal at Elevation

E/S

Piezometer

Borehole

Blows/0.3 m (Std Pen Test, 475 J/blow)

Blows/0.3 m (60° Cone, 475 J/blow)

Water Level at Time of Investigation

Auger Refusal at Elevation

End of Sampling

Piezometer

BOREHOLE No.	ELEVATION	O/S	NORTHING	EASTING
1	281.2	8.1 m Rt	5334784.2	345887.5
2	281.2	4.2 m Lt	5334778.6	345876.4
3	275.8	24.7 m Rt	5334794.6	345901.4
4	275.4	21.5 m Lt	5334775.1	345859.3

NOTES:

The boundaries between soil strata have been established at the borehole locations only. The boundaries illustrated and stratigraphy between boreholes on this drawing are assumed based on borehole data and may vary. They are intended for design only.

Base plan and alignment provided in digital format by Aecom on July 27, 2021

Coordinates based on MTM Zone 15 NAD83 CSRS

GEOCRES No. 52A00-265

DEC/21

DM

DRAFT

MAY/22

DM

REVISED DRAFT

SEP/22

DM

FINAL

DESIGN	CHK	CODE	LOAD	DATE
DRAWN	DM	CHK	FS	SITE
STRUCT	SCHEME	DWG	2	

Appendix B

Subsurface Data

Enclosure No. 1 List of Abbreviations and Symbols
Enclosure Nos. 2 to 7 Record of Borehole Sheets



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LIST OF SYMBOLS AND DEFINITIONS FOR GEOTECHNICAL SAMPLING AND COMMON LITHOLOGIES

The following is a reference sheet for commonly used symbols and definitions within this report and in any figures or appendices, including borehole logs and test results. Symbols and definitions conform to the standard proposed by the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE) wherever possible. Discrepancies may exist when comparing to third-party results using the Unified Soil Classification System (USCS).

PART A – SOILS

Standard Penetration Test (SPT) 'N'

The number of blows required to drive a 50-mm (2 in) split barrel sampler 300 mm (12 in). The standard hammer has a mass of 63.5 kg (140 lbs) and is dropped vertically from a height of 760 mm (30 in). Additional information can be found in ASTM D1586-11 and in §4.5.2 of the CFEM 4th Ed.

For penetration less than 300 mm, 'N' is recorded with the penetration that was achieved.

Non-Cohesive Soils

The relative density of non-cohesive soils relates empirically to SPT 'N' as follows:

Relative Density	'N'
Very Loose	0 – 4
Loose	4 – 10
Compact	10 – 30
Dense	30 – 50
Very Dense	> 50

Cohesive Soils

The consistency and undrained shear strength of cohesive soils relates empirically to SPT 'N' as follows:

Consistency	Undrained Shear Strength (kPa)	'N'
Very Soft	< 12	0 – 2
Soft	12 – 25	2 – 4
Firm	25 – 50	4 – 8
Stiff	50 – 100	8 – 15
Very Stiff	100 – 200	15 – 30
Hard	> 200	> 30

PART B – ROCK

The following parameters are used to describe core recovery and to infer the quality of a rockmass.

Total Core Recovery, TCR (%)

The total length of solid drill core recovered, regardless of the quality or length of the pieces, taken as a percentage of the length of the core run.

Solid Core Recovery, SCR (%)

The total length of solid, full-diameter drill core recovered, taken as a percentage of the length of the core run.

Rock Quality Designation, RQD (%)

The sum of the lengths of solid drill core greater than 100 mm long, taken as a percentage of the length of the core run. RQD is commonly used to infer the quality of the rockmass, as follows:

Rockmass Quality	RQD (%)
Very Poor	< 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	> 90

Weathering

The terminology used to describe the degree of weathering for recovered rock core is defined as follows, as suggested by the *Geological Society of London*:

Completely weathered: All rock material is decomposed and/or disintegrated to soil. The original mass structure is largely intact.

Highly weathered: More than half the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as a discontinuous framework or as core stone.

Moderately weathered: Less than half the rock material is decomposed and/or disintegrates to soil. Fresh or discolored rock is present either as a continuous framework or as core stone.

Slightly weathered: Discoloration indicates weathering of rock material and discontinuity of surfaces. All the rock material may be discolored by weathering and may be somewhat weaker than its fresh condition.

Fresh: No visible signs of weathering.

PART C – SAMPLING SYMBOLS

Symbol	Description
SS	Split spoon sample
TW	Thin-walled (Shelby Tube) sample
PH	Sampler advanced by hydraulic pressure
WH	Sampler advanced by static weight
SC	Soil core

PART D – IN-SITU AND LAB TESTING

SOIL NAMING CONVENTIONS

Particle sizes are described as follows:

Particle Size Descriptor	Size (mm)
Boulder	> 300
Cobble	75 – 300
Gravel	Coarse Fine
	19 – 75 4.75 – 19
	Coarse
	2.0 – 4.75
Sand	Medium
	0.425 – 2.0
	Fine
	0.075 – 0.425
Silt	0.002 – 0.075
Clay	< 0.002

The principle constituent of a soil is written in uppercase. The minor constituents of a soil are written according to the following convention:

Descriptive Term	Proportion of Soil (%)
Trace	1 – 10
Some	10 – 20
(ey) or (y)	20 – 35
And	35 – 50

Eg.: A soil comprising 65% Silt, 21% Sand and 14% Clay would be described as a: Sandy SILT, Some Clay

RECORD OF BOREHOLE No. 1

1 OF 2

METRIC

W.P. GWP 6176-15-00 LOCATION 26+420, 7.8 m Rt, Crooks Twp. ORIGINATED BY RT
 DIST Thunder Bay HWY 61 BOREHOLE TYPE Hollow Stem Auger COMPILED BY DM
 DATUM Geodetic DATE 2021.10.27 - 2021.10.27 MTM Zone 15 345887.46 E 5334784.163 N
 LATITUDE 48.150573 LONGITUDE -89.447751 CHECKED BY FS

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100					
281.2 0.0	40 mm asphalt FILL - SAND - with gravel, trace silt, brown, dry, compact to dense		1	AS		281										Dry on Completion (October 27, 2021)
			2	SS	30	280										
			3	SS	35	279										
278.9 2.3	FILL - SILT - some sand, brown, dry, compact - with clay, some sand, trace gravel, brown, dry, firm, loose		4	SS	14	278										1 13 65 21
			5	SS	7	277										
			6	SS	4	276										
276.6 4.6	FILL - SAND - trace silt, brown, dry, very loose - gravelly, trace silt, loose - and clay, trace gravel		7	SS	4	275										31 61 (8)
			8	SS	9	274										
			9	SS	7	273										
274.3 6.9	CLAY - sandy, trace silt, gravel, brown, moist, stiff to firm - some silt, trace sand - and silt, trace sand, gravel, red, dry		10	SS	12	272										23 17 40 21
			11	SS	5	271										
			12	SS	9	270										
272.1 9.1	SILT - some gravel, sand, clay, red, dry, compact - some clay, trace gravel, brown, dry, dense - sandy, some clay - and sand		13	SS	16	269										0 43 (57)
			14	SS	39	268										
			15	SS	17	267										
			16	SS	29											
			17	SS	25											

Continued Next Page

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

ONTARIO MTO GWP 6176-15-00 - HIGHWAY 61 - CULVERT 26+422.GPJ ONTARIO MTO.GDT 22-4-6

RECORD OF BOREHOLE No. 1

2 OF 2

METRIC

W.P. GWP 6176-15-00 LOCATION 26+420, 7.8 m Rt, Crooks Twp. ORIGINATED BY RT
 DIST Thunder Bay HWY 61 BOREHOLE TYPE Hollow Stem Auger COMPILED BY DM
 DATUM Geodetic DATE 2021.10.27 - 2021.10.27 MTM Zone 15 345887.46 E 5334784.163 N
 LATITUDE 48.150573 LONGITUDE -89.447751 CHECKED BY FS

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																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											

RECORD OF BOREHOLE No. 2

1 OF 2

METRIC

W.P. GWP 6176-15-00 LOCATION 26+419, 4. m Lt, Crooks Twp. ORIGINATED BY RT
DIST Thunder Bay HWY 61 BOREHOLE TYPE Hollow Stem Auger COMPILED BY DM
DATUM Geodetic DATE 2021.10.28 - 2021.10.28 MTM Zone 15 345876.376 E 5334778.601 N
LATITUDE 48.150524 LONGITUDE -89.447901 CHECKED BY FS

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
281.2 0.0	40 mm asphalt FILL - SAND - with gravel, trace silt, brown, dry, compact		1	AS			281										Dry on Completion (October 28, 2021)
			2	SS	13		280										
279.7 1.5	FILL - SILTY SAND - some gravel, brown, dry, loose		3	SS	8		279						o				14 49 (37)
278.9 2.3	FILL - SILT - some sand, brown, dry, compact		4	SS	21		278										1 8 53 37
			5	SS	21		277										
	- with clay, trace sand		6	SS	12		276										
276.6 4.6	FILL - SILT & CLAY - trace sand, gravel, grey, firm to stiff		7	SS	7		275										Spoon Refusal (possible buried tree log)
	- trace organics, medium plasticity		8	SS	8		274										
	- and organics		9	SS	50+		273										
274.3 6.9	SILT - some clay, trace gravel, brown, dry, compact		10	SS	18		272										1 1 88 9
	- some clay		11	SS	11		271										
	- with clay, trace sand, moist		12	SS	9		270										
	- trace gravel, sand, clay		13	SS	10		269										1 12 62 24
271.3 9.9	CLAYEY SILT - brown/red, moist		14	SS	17		268										
270.2 11.0	SANDY SILT - brown, moist		15	SS	17		267										
269.0 12.2	SILT - with clay, some sand, trace gravel, grey/brown, dry, very stiff, compact		16	SS	23												
	- and clay, trace sand		17	SS	22												

Continued Next Page

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

ONTARIO MTO GWP 6176-15-00 - HIGHWAY 61 - CULVERT 26+422.GPJ ONTARIO MTO.GDT 22-4-6

RECORD OF BOREHOLE No. 2

2 OF 2

METRIC

W.P. GWP 6176-15-00 LOCATION 26+419, 4. m Lt, Crooks Twp. ORIGINATED BY RT
 DIST Thunder Bay HWY 61 BOREHOLE TYPE Hollow Stem Auger COMPILED BY DM
 DATUM Geodetic DATE 2021.10.28 - 2021.10.28 MTM Zone 15 345876.376 E 5334778.601 N
 LATITUDE 48.150524 LONGITUDE -89.447901 CHECKED BY FS

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			20	40	60	80	100		
266.0							266							
15.2	SILT - some sand, trace clay, brown, dry, dense		18	SS	42									0 15 (85)
							265							
	- with clay, trace sand, brown, dry, compact		19	SS	24		264							
262.9							263							
18.3	SILTY SAND - brown, dry, dense		20	SS	32									
262.8														
18.6	SILT - with clay, trace sand, red/grey, dry													
262.3														
18.9	End of Borehole at 18.9 m bgs													

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No. 3

1 OF 1

METRIC

W.P. GWP 6176-15-00 LOCATION 26+422, 24.0 m Rt, Crooks Twp. ORIGINATED BY MQ
 DIST Thunder Bay HWY 61 BOREHOLE TYPE Solid Stem Auger COMPILED BY DM
 DATUM Geodetic DATE 2021.11.08 - 2021.11.08 MTM Zone 15 345901.415 E 5334794.6 N
 LATITUDE 48.150666 LONGITUDE -89.447563 CHECKED BY FS

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE	WATER CONTENT (%)					
275.8							20	40	60	80	100						GR SA SI CL
0.0	100 mm organic soil		1	AS													Dry on Completion (November 8, 2021) 0 13 (87) 1 15 66 18 17 11 57 14
275.0	SILTY SAND - dark brown, dry, loose to compact																
0.8	SILT - some clay, sand, brown		2	SS	8								○				
	- damp		3	SS	14												
	- some clay (red/black), sand, trace gravel, moist, low plasticity		4	SS	11								○				
	- some gravel, clay, sand, damp		5	SS	23									○			
	- some fine sand, trace clay, brown, damp, dense		6	SS	30												
			7	SS	42												
270.5																	
5.3	SAND - some silt, brown, damp, dense to very dense		8	SS	39												
			9	SS	58												
269.1																	
6.7	End of Borehole at 6.7 m bgs																

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

RECORD OF BOREHOLE No. 4

1 OF 1

METRIC

W.P. GWP 6176-15-00 LOCATION 26+420, 22.0 m Lt, Crooks Twp. ORIGINATED BY MQ
 DIST Thunder Bay HWY 61 BOREHOLE TYPE Solid Stem Auger COMPILED BY DM
 DATUM Geodetic DATE 2021.11.08 - 2021.11.08 MTM Zone 15 345859.295 E 5334775.1 N
 LATITUDE 48.150494 LONGITUDE -89.448131 CHECKED BY FS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W _p	W	W _L			WATER CONTENT (%)	
275.4 0.0	100 mm organic soil SILTY SAND - brown, dry, loose to compact - trace clay, gravel, damp - some clay, trace gravel, brown/red, moist, compact - wet		1	AS			20	40	60	80	100					Groundwater Level at 0.8 m bgs (Elevation 274.6 m) Dec 21, 2021 Groundwater Level at 1.0 m bgs (Elevation 274.4 m) Nov 19, 2021
			2	SS	9											
			3	SS	24											
			4	SS	21											
			5	SS	19											
			6	SS	22											
			7	SS	22											
270.1 5.3	CLAYEY SILT - trace sand, gravel, brown, wet, compact to dense		8	SS	17										2 9 59 30	
			9	SS	37											
268.7 6.7	End of Borehole at 6.7 m bgs															

ONTARIO MTO GWP 6176-15-00 - HIGHWAY 61 - CULVERT 26+422.GPJ ONTARIO MTO.GDT 22-4-6

Appendix C

Borehole Plan and Laboratory Data

Figure No. L-1: Fill: Silt and Sand Grain Size Distribution Curve

Figure No. L-2: Fill: Silty Sand Grain Size Distribution Curve

Figure No. L-3: Fill: Silt and Clay Grain Size Distribution Curve

Figure No. L-4: Fill: Sand Grain Size Distribution Curve

Figure No. L-5: Silt Grain Size Distribution Curve

Figure No. L-6: Silt Grain Size Distribution Curve

Figure No. L-7: Sandy Silt Grain Size Distribution Curve

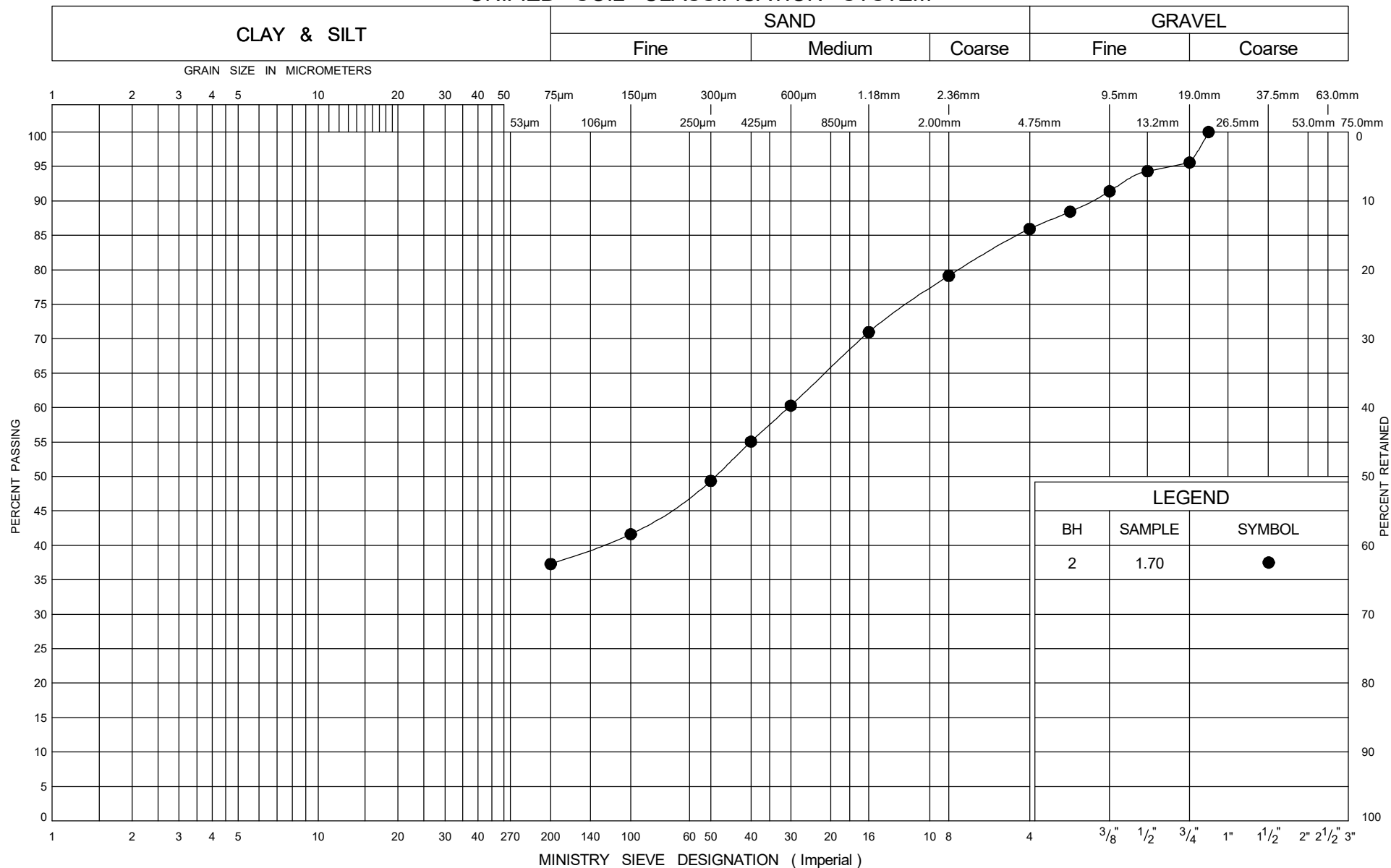
Figure No. L-8: Atterberg Limits Summary

Chemical Test Results

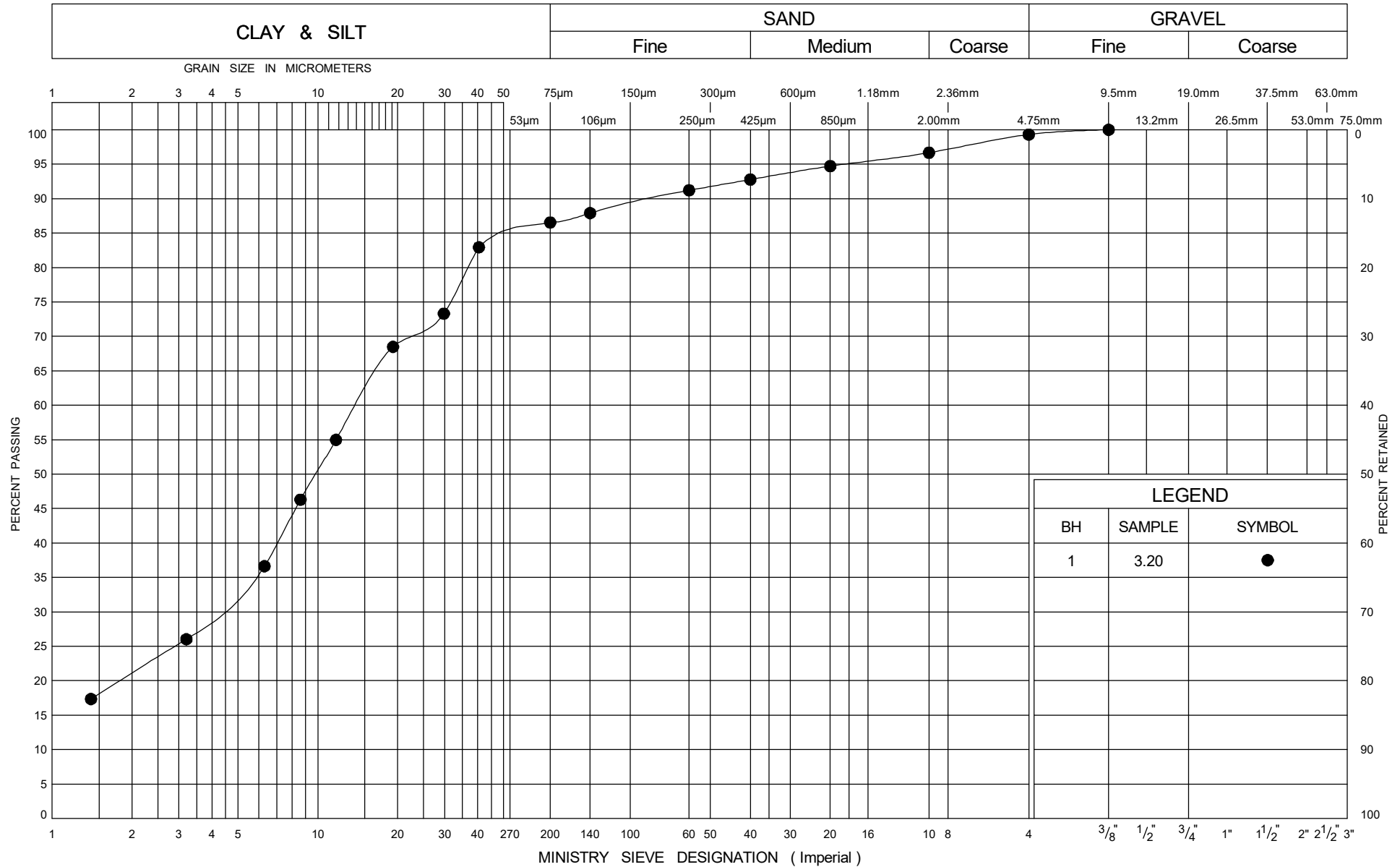


eNGLOBE

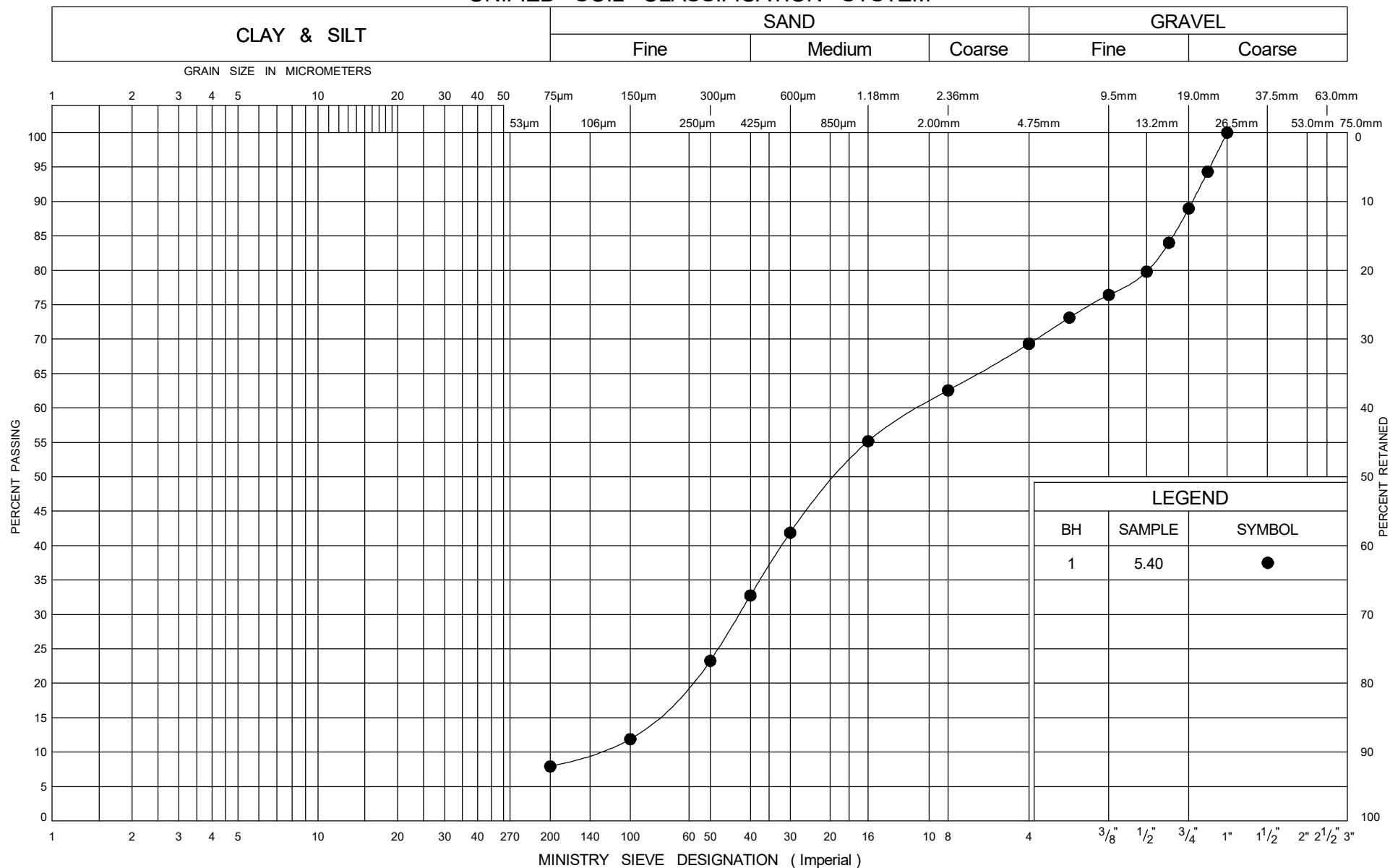
UNIFIED SOIL CLASSIFICATION SYSTEM



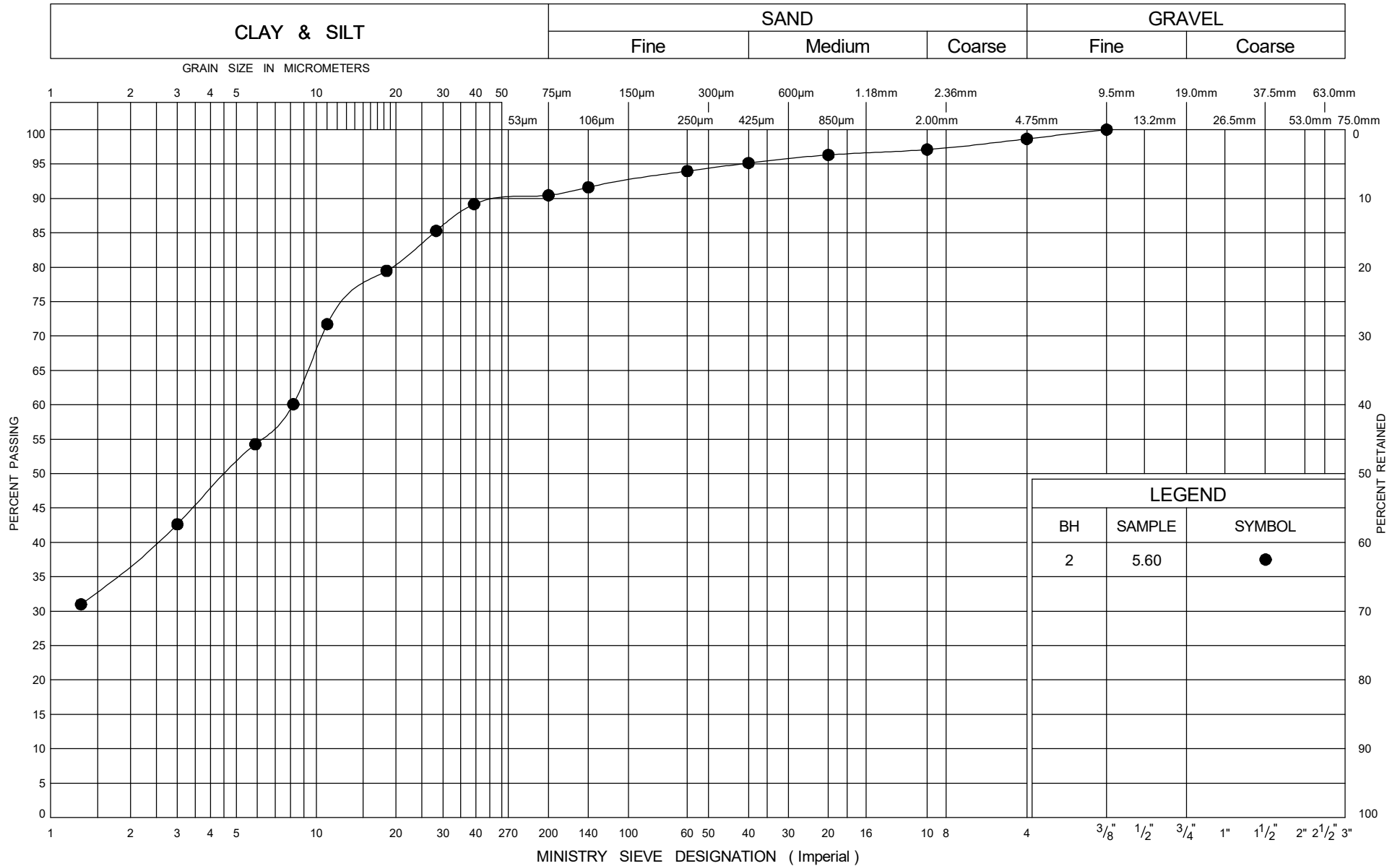
UNIFIED SOIL CLASSIFICATION SYSTEM



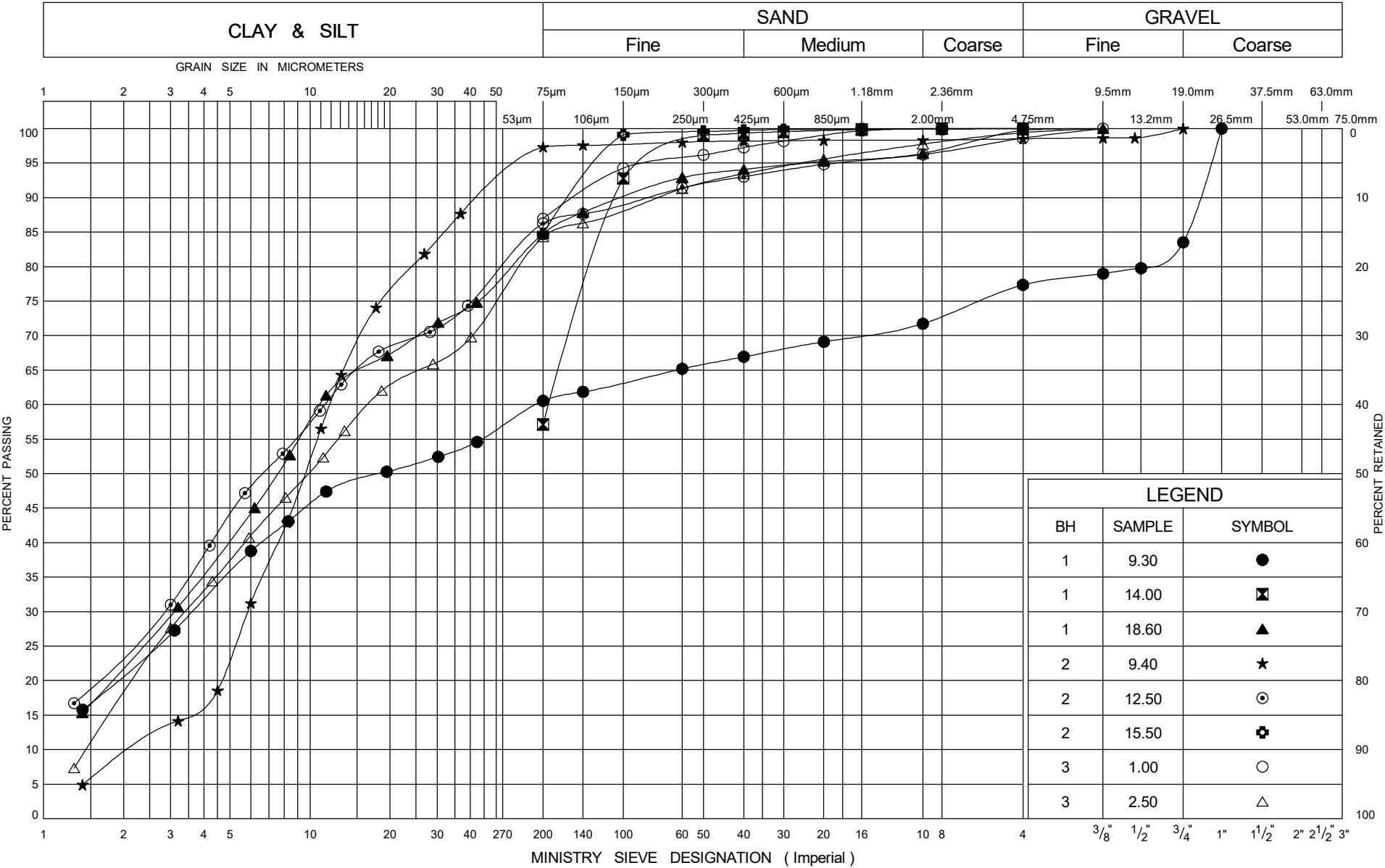
UNIFIED SOIL CLASSIFICATION SYSTEM



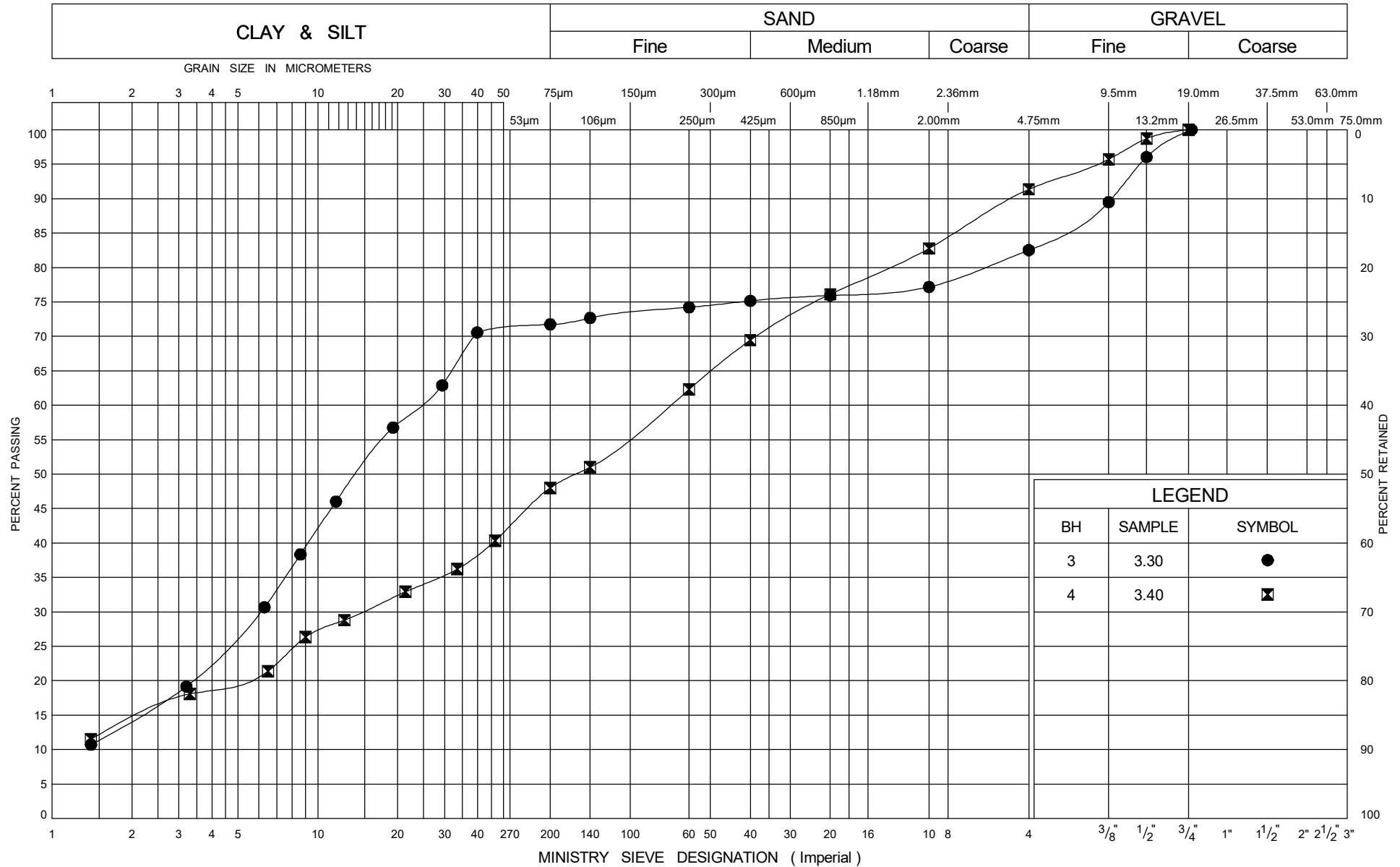
UNIFIED SOIL CLASSIFICATION SYSTEM



UNIFIED SOIL CLASSIFICATION SYSTEM



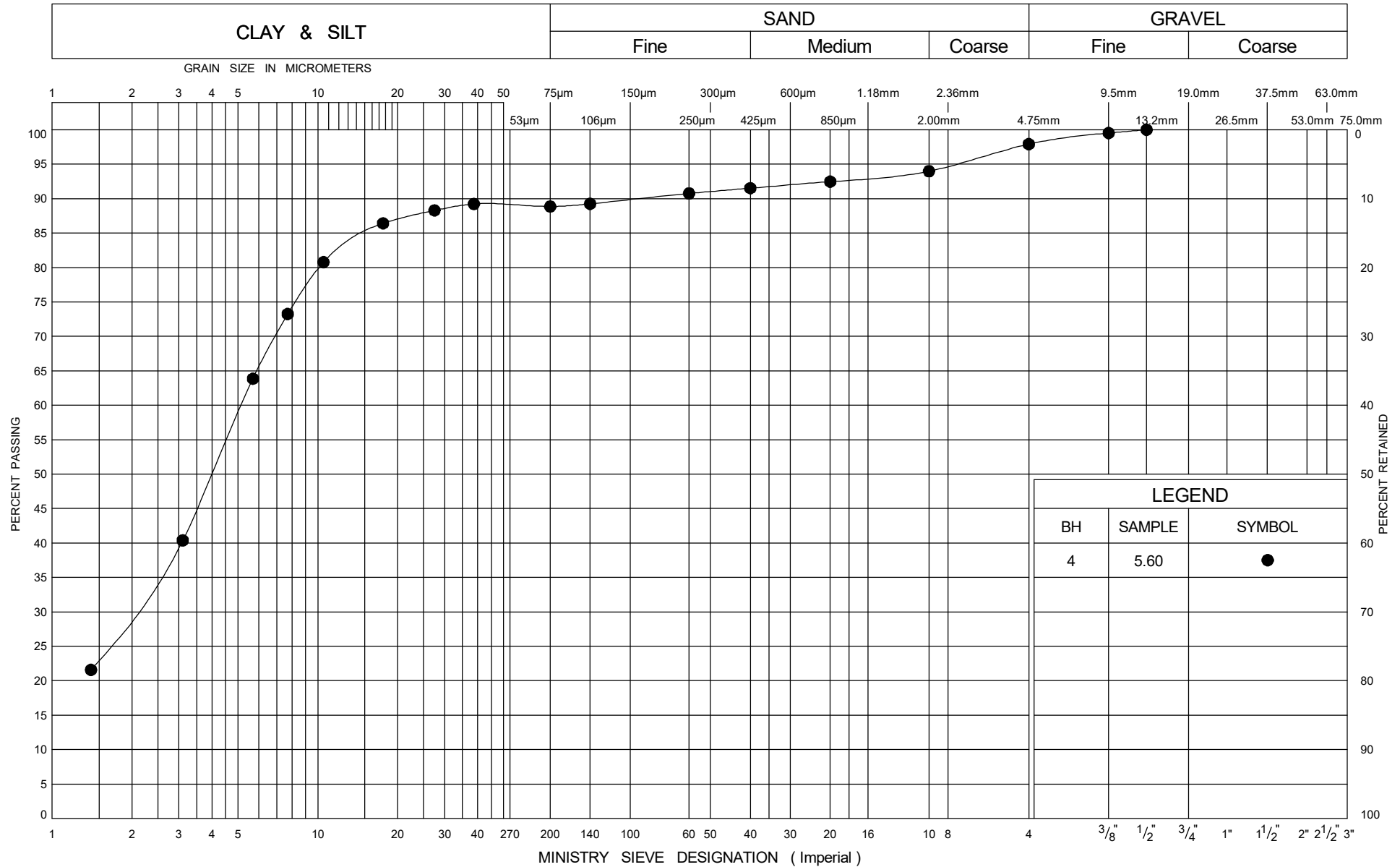
UNIFIED SOIL CLASSIFICATION SYSTEM

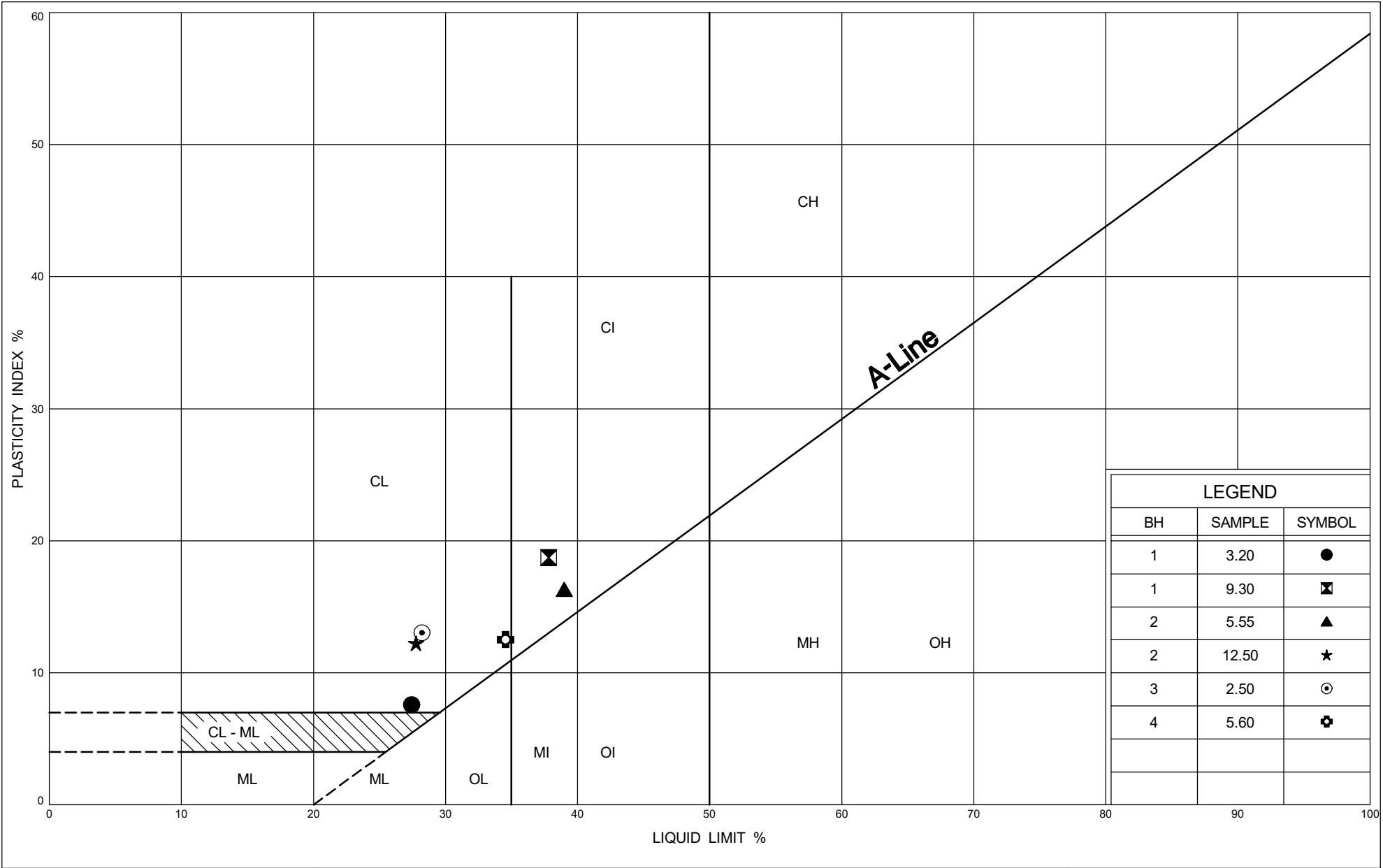


LEGEND

BH	SAMPLE	SYMBOL
3	3.30	●
4	3.40	⊠

UNIFIED SOIL CLASSIFICATION SYSTEM







Your Project #: 2109931
Site Location: HIGHWAY 61, NEEBING, ON
Your C.O.C. #: na

Attention: Diana McKay

DST Consulting Engineers Inc
Thunder Bay - Standing Offer
605 Hewitson Street
Thunder Bay, ON
CANADA P7B 5V5

Report Date: 2022/01/07
Report #: R6953568
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1Z7709

Received: 2021/11/29, 12:17

Sample Matrix: Soil
Samples Received: 4

Analyses	Quantity	Date	Date	Laboratory Method	Analytical Method
		Extracted	Analyzed		
Chloride (20:1 extract)	4	2021/12/06	2021/12/06	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity	4	2021/12/03	2021/12/03	CAM SOP-00414	OMOE E3530 v1 m
pH CaCl2 EXTRACT	4	2022/01/07	2021/12/02	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	4	2021/12/21	2022/01/07	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract)	4	2021/12/03	2022/01/06	CAM SOP-00464	EPA 375.4 m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

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

Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.



Your Project #: 2109931
Site Location: HIGHWAY 61, NEEBING , ON
Your C.O.C. #: na

Attention: Diana McKay

DST Consulting Engineers Inc
Thunder Bay - Standing Offer
605 Hewitson Street
Thunder Bay, ON
CANADA P7B 5V5

Report Date: 2022/01/07
Report #: R6953568
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1Z7709

Received: 2021/11/29, 12:17

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Deepthi Shaji, Project Manager

Email: Deepthi.Shaji@bureauveritas.com

Phone# (905)817-5700 Ext:7065843

=====

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Total Cover Pages : 2

Page 2 of 9



BUREAU
VERITAS

Bureau Veritas Job #: C1Z7709
Report Date: 2022/01/07

DST Consulting Engineers Inc
Client Project #: 2109931
Site Location: HIGHWAY 61, NEEBING, ON
Sampler Initials: RT

RESULTS OF ANALYSES OF SOIL

Bureau Veritas ID		RK0370			RK0370			RK0371		
Sampling Date		2021/10/15 14:00			2021/10/15 14:00			2021/10/23 09:30		
COC Number		na			na			na		
	UNITS	20+375 BH2, S#15	RDL	QC Batch	20+375 BH2, S#15 Lab-Dup	RDL	QC Batch	20+040 BH1, S#10	RDL	QC Batch

Calculated Parameters

Resistivity	ohm-cm	1500		7746098				780		7746098
-------------	--------	------	--	---------	--	--	--	-----	--	---------

Inorganics

Soluble (20:1) Chloride (Cl-)	ug/g	180	20	7764954	170	20	7764954	490	20	7764954
Conductivity	mS/cm	0.661	0.002	7770495				1.28	0.002	7770495
Available (CaCl2) pH	pH	7.17		7770243				7.63		7770243
Soluble (20:1) Sulphate (SO4)	ug/g	300	20	7760268	310	20	7760268	670	20	7760268

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

Lab-Dup = Laboratory Initiated Duplicate

Bureau Veritas ID		RK0372	RK0373		
Sampling Date		2021/10/25 11:50	2021/10/28 13:30		
COC Number		na	na		
	UNITS	14+588 BH1, S#15	26+418 BH2, S#10	RDL	QC Batch
Calculated Parameters					
Resistivity	ohm-cm	2300	2100		7746098
Inorganics					
Soluble (20:1) Chloride (Cl-)	ug/g	260	270	20	7764954
Conductivity	mS/cm	0.439	0.469	0.002	7770495
Available (CaCl2) pH	pH	5.13	7.21		7770243
Soluble (20:1) Sulphate (SO4)	ug/g	<20	<20	20	7760268
RDL = Reportable Detection Limit					
QC Batch = Quality Control Batch					



BUREAU
VERITAS

Bureau Veritas Job #: C1Z7709
Report Date: 2022/01/07

DST Consulting Engineers Inc
Client Project #: 2109931
Site Location: HIGHWAY 61, NEEBING , ON
Sampler Initials: RT

TEST SUMMARY

Bureau Veritas ID: RKO370
Sample ID: 20+375 BH2, S#15
Matrix: Soil

Collected: 2021/10/15
Shipped:
Received: 2021/11/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7764954	2021/12/06	2021/12/06	Alina Dobreanu
Conductivity	AT	7770495	2021/12/03	2021/12/03	Kien Tran
pH CaCl2 EXTRACT	AT	7770243	2021/12/02	2021/12/02	Taslina Aktar
Resistivity of Soil		7746098	2022/01/07	2022/01/07	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7760268	2021/12/03	2022/01/06	Avneet Kour Sudan

Bureau Veritas ID: RKO370 Dup
Sample ID: 20+375 BH2, S#15
Matrix: Soil

Collected: 2021/10/15
Shipped:
Received: 2021/11/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7764954	2021/12/06	2021/12/06	Alina Dobreanu
Sulphate (20:1 Extract)	KONE/EC	7760268	2021/12/30	2022/01/06	Avneet Kour Sudan

Bureau Veritas ID: RKO371
Sample ID: 20+040 BH1, S#10
Matrix: Soil

Collected: 2021/10/23
Shipped:
Received: 2021/11/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7764954	2021/12/06	2021/12/06	Alina Dobreanu
Conductivity	AT	7770495	2021/12/03	2021/12/03	Kien Tran
pH CaCl2 EXTRACT	AT	7770243	2021/12/02	2021/12/02	Taslina Aktar
Resistivity of Soil		7746098	2022/01/07	2022/01/07	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7760268	2021/12/03	2022/01/06	Avneet Kour Sudan

Bureau Veritas ID: RKO372
Sample ID: 14+588 BH1, S#15
Matrix: Soil

Collected: 2021/10/25
Shipped:
Received: 2021/11/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7764954	2021/12/06	2021/12/06	Alina Dobreanu
Conductivity	AT	7770495	2021/12/03	2021/12/03	Kien Tran
pH CaCl2 EXTRACT	AT	7770243	2021/12/02	2021/12/02	Taslina Aktar
Resistivity of Soil		7746098	2022/01/07	2022/01/07	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7760268	2021/12/03	2022/01/06	Avneet Kour Sudan

Bureau Veritas ID: RKO373
Sample ID: 26+418 BH2, S#10
Matrix: Soil

Collected: 2021/10/28
Shipped:
Received: 2021/11/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7764954	2021/12/06	2021/12/06	Alina Dobreanu
Conductivity	AT	7770495	2021/12/03	2021/12/03	Kien Tran
pH CaCl2 EXTRACT	AT	7770243	2021/12/02	2021/12/02	Taslina Aktar
Resistivity of Soil		7746098	2022/01/07	2022/01/07	Automated Statchk



BUREAU
VERITAS

Bureau Veritas Job #: C1Z7709
Report Date: 2022/01/07

DST Consulting Engineers Inc
Client Project #: 2109931
Site Location: HIGHWAY 61, NEEBING , ON
Sampler Initials: RT

TEST SUMMARY

Bureau Veritas ID: RKO373
Sample ID: 26+418 BH2, S#10
Matrix: Soil

Collected: 2021/10/28
Shipped:
Received: 2021/11/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sulphate (20:1 Extract)	KONE/EC	7760268	2021/12/03	2022/01/06	Avneet Kour Sudan



GENERAL COMMENTS

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

Package 1	16.7°C
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Results relate only to the items tested.



**BUREAU
VERITAS**

Bureau Veritas Job #: C1Z7709

Report Date: 2022/01/07

QUALITY ASSURANCE REPORT

DST Consulting Engineers Inc

Client Project #: 2109931

Site Location: HIGHWAY 61, NEEBING , ON

Sampler Initials: RT

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7760268	Soluble (20:1) Sulphate (SO ₄)	2022/01/06	112	70 - 130	99	70 - 130	<20	ug/g	1.9	35
7764954	Soluble (20:1) Chloride (Cl ⁻)	2021/12/06	93	80 - 120	107	80 - 120	<20	ug/g	6.0	35
7770243	Available (CaCl ₂) pH	2021/12/02			100	N/A				
7770495	Conductivity	2021/12/03			99	90 - 110	<0.002	mS/cm		

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

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

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

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



BUREAU
VERITAS

Bureau Veritas Job #: C1Z7709

Report Date: 2022/01/07

DST Consulting Engineers Inc

Client Project #: 2109931

Site Location: HIGHWAY 61, NEEBING , ON

Sampler Initials: RT

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Brad Newman, B.Sc., C.Chem., Scientific Service Specialist

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6740 Campobello Road, Mississauga, Ontario L5N 2L8
Phone: 905-817-5700 Fax: 905-817-5779 Toll Free: 800-563-6266
CAM FCD-01191/6



Your Project #: 2109931
 Site Location: HWY 61
 Your C.O.C. #: na

Attention: Mathew Quick

Englobe Corp.
 Thunder Bay - Standing Offer
 605 Hewitson Street
 Thunder Bay, ON
 CANADA P7B 5V5

Report Date: 2022/02/01
 Report #: R6985321
 Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BV LABS JOB #: C1AD315

Received: 2021/12/22, 11:50

Sample Matrix: Water
 # Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Chloride by Automated Colourimetry	1	N/A	2022/01/21	CAM SOP-00463	SM 23 4500-Cl E m
Chloride by Automated Colourimetry	2	N/A	2022/01/04	CAM SOP-00463	SM 23 4500-Cl E m
Chloride by Automated Colourimetry	1	N/A	2022/01/07	CAM SOP-00463	SM 23 4500-Cl E m
Total Cyanide	3	2022/01/04	2022/01/04	CAM SOP-00457	OMOE E3015 5 m
Total Cyanide	1	2022/01/07	2022/01/07	CAM SOP-00457	OMOE E3015 5 m
Fluoride	1	2022/01/20	2022/01/21	CAM SOP-00449	SM 23 4500-F C m
Fluoride	1	2022/01/06	2022/01/07	CAM SOP-00449	SM 23 4500-F C m
Fluoride	2	2021/12/24	2021/12/29	CAM SOP-00449	SM 23 4500-F C m
Mercury in Water by CVAA	1	2022/01/07	2022/01/07	CAM SOP-00453	EPA 7470A m
Mercury in Water by CVAA	3	2021/12/29	2021/12/30	CAM SOP-00453	EPA 7470A m
Dissolved Metals by ICPMS	1	N/A	2022/01/06	CAM SOP-00447	EPA 6020B m
Dissolved Metals by ICPMS	3	N/A	2021/12/30	CAM SOP-00447	EPA 6020B m
Animal and Vegetable Oil and Grease	1	N/A	2022/01/05	CAM SOP-00326	EPA1664B m,SM5520B m
Animal and Vegetable Oil and Grease	3	N/A	2021/12/30	CAM SOP-00326	EPA1664B m,SM5520B m
Total Oil and Grease	1	2022/01/05	2022/01/05	CAM SOP-00326	EPA1664B m,SM5520B m
Total Oil and Grease	3	2021/12/29	2021/12/29	CAM SOP-00326	EPA1664B m,SM5520B m
pH	1	2022/01/20	2022/01/21	CAM SOP-00413	SM 4500H+ B m
pH	1	2022/01/06	2022/01/07	CAM SOP-00413	SM 4500H+ B m
pH	2	2021/12/24	2021/12/29	CAM SOP-00413	SM 4500H+ B m
Phenols (4AAP)	1	N/A	2022/01/06	CAM SOP-00444	OMOE E3179 m
Phenols (4AAP)	3	N/A	2021/12/29	CAM SOP-00444	OMOE E3179 m
Sulphate by Automated Colourimetry	1	N/A	2022/01/21	CAM SOP-00464	EPA 375.4 m
Sulphate by Automated Colourimetry	1	N/A	2022/01/07	CAM SOP-00464	EPA 375.4 m
Sulphate by Automated Colourimetry	2	N/A	2021/12/29	CAM SOP-00464	EPA 375.4 m
Total Kjeldahl Nitrogen in Water	1	2022/01/06	2022/01/06	CAM SOP-00938	OMOE E3516 m
Total Kjeldahl Nitrogen in Water	1	2021/12/29	2022/01/04	CAM SOP-00938	OMOE E3516 m
Total Kjeldahl Nitrogen in Water	2	2021/12/29	2022/01/06	CAM SOP-00938	OMOE E3516 m
Total Phosphorus (Colourimetric)	1	2022/01/06	2022/01/07	CAM SOP-00407	SM 23 4500 P B H m
Total Phosphorus (Colourimetric)	3	2021/12/29	2022/01/04	CAM SOP-00407	SM 23 4500 P B H m
Mineral/Synthetic O & G (TPH Heavy Oil) (1)	1	2022/01/05	2022/01/05	CAM SOP-00326	EPA1664B m,SM5520F m



Your Project #: 2109931
Site Location: HWY 61
Your C.O.C. #: na

Attention: Mathew Quick

Englobe Corp.
Thunder Bay - Standing Offer
605 Hewitson Street
Thunder Bay, ON
CANADA P7B 5V5

Report Date: 2022/02/01
Report #: R6985321
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BV LABS JOB #: C1AD315

Received: 2021/12/22, 11:50

Sample Matrix: Water
Samples Received: 4

Analyses	Quantity	Date	Date	Laboratory Method	Analytical Method
		Extracted	Analyzed		
Mineral/Synthetic O & G (TPH Heavy Oil) (1)	3	2021/12/29	2021/12/29	CAM SOP-00326	EPA1664B m, SM5520F m
Total Suspended Solids	1	2022/01/07	2022/01/10	CAM SOP-00428	SM 23 2540D m
Total Suspended Solids	3	2021/12/29	2021/12/30	CAM SOP-00428	SM 23 2540D m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

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

Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

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Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

(1) Note: TPH (Heavy Oil) is equivalent to Mineral / Synthetic Oil & Grease



Your Project #: 2109931
Site Location: HWY 61
Your C.O.C. #: na

Attention: Mathew Quick

Englobe Corp.
Thunder Bay - Standing Offer
605 Hewitson Street
Thunder Bay, ON
CANADA P7B 5V5

Report Date: 2022/02/01
Report #: R6985321
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BV LABS JOB #: C1AD315
Received: 2021/12/22, 11:50

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Deepthi Shaji, Project Manager
Email: Deepthi.Shaji@bureauveritas.com
Phone# (905)817-5700 Ext:7065843

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BUREAU
VERITAS

Bureau Veritas Job #: C1AD315

Report Date: 2022/02/01

Englobe Corp.

Client Project #: 2109931

Site Location: HWY 61

OIL & GREASE - A/V/M/T (WATER)

Bureau Veritas ID				RLX569	RLX571	RLX572		
Sampling Date				2021/12/20 11:25	2021/12/20 15:55	2021/12/20 14:30		
COC Number				na	na	na		
	UNITS	Criteria	Criteria-2	BH4 26+420 LT	BH3 20+40 LT	BH3 20+370 RT	RDL	QC Batch
Calculated Parameters								
Total Animal/Vegetable Oil and Grease	mg/L	150	-	<0.50	<0.50	<0.50	0.50	7753651
Petroleum Hydrocarbons								
Total Oil & Grease	mg/L	-	-	<0.50	<0.50	<0.50	0.50	7758374
Total Oil & Grease Mineral/Synthetic	mg/L	15	0.5	<0.50	<0.50	<0.50	0.50	7758395
No Fill	No Exceedance							
Grey	Exceeds 1 criteria policy/level							
Black	Exceeds both criteria/levels							
RDL = Reportable Detection Limit								
QC Batch = Quality Control Batch								
Criteria: City of Thunder Bay By-Law Nr BL 27/2019								
Discharges to Sanitary and Combined Sewers - A, Storm Sewer B respectively								
Criteria-2: Ontario Provincial Water Quality Objectives								
Ref. to MOEE Water Management document dated Feb.1999								

Bureau Veritas ID				RLX574		
Sampling Date				2021/12/20		
COC Number				na		
	UNITS	Criteria	Criteria-2	DUP 1	RDL	QC Batch
Calculated Parameters						
Total Animal/Vegetable Oil and Grease	mg/L	150	-	<0.50	0.50	7765119
Petroleum Hydrocarbons						
Total Oil & Grease	mg/L	-	-	<0.50	0.50	7766387
Total Oil & Grease Mineral/Synthetic	mg/L	15	0.5	<0.50	0.50	7766400
No Fill	No Exceedance					
Grey	Exceeds 1 criteria policy/level					
Black	Exceeds both criteria/levels					
RDL = Reportable Detection Limit						
QC Batch = Quality Control Batch						
Criteria: City of Thunder Bay By-Law Nr BL 27/2019						
Discharges to Sanitary and Combined Sewers - A, Storm Sewer B respectively						
Criteria-2: Ontario Provincial Water Quality Objectives						
Ref. to MOEE Water Management document dated Feb.1999						



RESULTS OF ANALYSES OF WATER

Bureau Veritas ID					RLX569			RLX569		
Sampling Date					2021/12/20 11:25			2021/12/20 11:25		
COC Number					na			na		
	UNITS	Criteria	Criteria B	Criteria-2	BH4 26+420 LT	RDL	QC Batch	BH4 26+420 LT Lab-Dup	RDL	QC Batch
Inorganics										
Fluoride (F-)	mg/L	10	-	-	0.14	0.10	7792030			
Total Kjeldahl Nitrogen (TKN)	mg/L	100	-	-	<0.10	0.10	7757516			
pH	pH	5.5:10.5	6.0:10.0	6.5:8.5	7.93		7792055			
Phenols-4AAP	mg/L	1	-	0.001	<0.0010	0.0010	7756961			
Total Phosphorus	mg/L	10	-	0.01	0.12	0.040	7758252			
Total Suspended Solids	mg/L	350	15	-	300	10	7756985			
Dissolved Sulphate (SO4)	mg/L	1500	-	-	23	1.0	7792108	23	1.0	7792108
Total Cyanide (CN)	mg/L	2	-	-	<0.0050	0.0050	7763702			
Dissolved Chloride (Cl-)	mg/L	1500	-	-	240	3.0	7792105	240	3.0	7792105
No Fill	No Exceedance									
Grey	Exceeds 1 criteria policy/level									
Black	Exceeds both criteria/levels									
RDL = Reportable Detection Limit										
QC Batch = Quality Control Batch										
Lab-Dup = Laboratory Initiated Duplicate										
Criteria,Criteria B: City of Thunder Bay By-Law Nr BL 27/2019										
Discharges to Sanitary and Combined Sewers - A, Storm Sewer B respectively										
Criteria-2: Ontario Provincial Water Quality Objectives										
Ref. to MOEE Water Management document dated Feb.1999										



RESULTS OF ANALYSES OF WATER

Bureau Veritas ID					RLX571		RLX572											
Sampling Date					2021/12/20 15:55		2021/12/20 14:30											
COC Number					na		na											
	UNITS	Criteria	Criteria B	Criteria-2	BH3 20+40 LT	RDL	BH3 20+370 RT	RDL	QC Batch									
Inorganics																		
Fluoride (F-)	mg/L	10	-	-	<0.10	0.10	<0.10	0.10	7754486									
Total Kjeldahl Nitrogen (TKN)	mg/L	100	-	-	<0.10	0.10	0.18	0.10	7757516									
pH	pH	5.5:10.5	6.0:10.0	6.5:8.5	7.58		7.22		7754492									
Phenols-4AAP	mg/L	1	-	0.001	0.0011	0.0010	<0.0010	0.0010	7756961									
Total Phosphorus	mg/L	10	-	0.01	0.11	0.040	2.2	0.20	7758252									
Total Suspended Solids	mg/L	350	15	-	150	10	7600	100	7756985									
Dissolved Sulphate (SO4)	mg/L	1500	-	-	39	1.0	12	1.0	7754526									
Total Cyanide (CN)	mg/L	2	-	-	<0.0050	0.0050	<0.0050	0.0050	7763702									
Dissolved Chloride (Cl-)	mg/L	1500	-	-	17	1.0	68	1.0	7754537									
No Fill	No Exceedance																	
Grey										Exceeds 1 criteria policy/level								
Black																		
RDL = Reportable Detection Limit																		
QC Batch = Quality Control Batch																		
Criteria,Criteria B: City of Thunder Bay By-Law Nr BL 27/2019																		
Discharges to Sanitary and Combined Sewers - A, Storm Sewer B respectively																		
Criteria-2: Ontario Provincial Water Quality Objectives																		
Ref. to MOEE Water Management document dated Feb.1999																		



RESULTS OF ANALYSES OF WATER

Bureau Veritas ID					RLX574			RLX574		
Sampling Date					2021/12/20			2021/12/20		
COC Number					na			na		
	UNITS	Criteria	Criteria B	Criteria-2	DUP 1	RDL	QC Batch	DUP 1 Lab-Dup	RDL	QC Batch
Inorganics										
Fluoride (F-)	mg/L	10	-	-	0.16	0.10	7769228	0.13	0.10	7769228
Total Kjeldahl Nitrogen (TKN)	mg/L	100	-	-	<0.10	0.10	7767598			
pH	pH	5.5:10.5	6.0:10.0	6.5:8.5	7.59		7769240	7.51		7769240
Phenols-4AAP	mg/L	1	-	0.001	<0.0010	0.0010	7767296	<0.0010	0.0010	7767296
Total Phosphorus	mg/L	10	-	0.01	0.073	0.040	7767532			
Total Suspended Solids	mg/L	350	15	-	54	10	7770137			
Dissolved Sulphate (SO4)	mg/L	1500	-	-	23	1.0	7769137	23	1.0	7769137
Total Cyanide (CN)	mg/L	2	-	-	<0.0050	0.0050	7770379			
Dissolved Chloride (Cl-)	mg/L	1500	-	-	250	3.0	7769147	260	3.0	7769147
No Fill	No Exceedance									
Grey	Exceeds 1 criteria policy/level									
Black	Exceeds both criteria/levels									
RDL = Reportable Detection Limit										
QC Batch = Quality Control Batch										
Lab-Dup = Laboratory Initiated Duplicate										
Criteria,Criteria B: City of Thunder Bay By-Law Nr BL 27/2019										
Discharges to Sanitary and Combined Sewers - A, Storm Sewer B respectively										
Criteria-2: Ontario Provincial Water Quality Objectives										
Ref. to MOEE Water Management document dated Feb.1999										



BUREAU
VERITAS

Bureau Veritas Job #: C1AD315
Report Date: 2022/02/01

Englobe Corp.
Client Project #: 2109931
Site Location: HWY 61

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Bureau Veritas ID					RLX569	RLX571	RLX572		
Sampling Date					2021/12/20 11:25	2021/12/20 15:55	2021/12/20 14:30		
COC Number					na	na	na		
	UNITS	Criteria	Criteria B	Criteria-2	BH4 26+420 LT	BH3 20+40 LT	BH3 20+370 RT	RDL	QC Batch

Metals

Mercury (Hg)	mg/L	0.1	0.001	0.0002	<0.00010	0.00010	<0.00010	0.00010	7757969
Dissolved Aluminum (Al)	ug/L	50000	-	-	13	<4.9	280	4.9	7754368
Dissolved Antimony (Sb)	ug/L	5000	-	20	<0.50	<0.50	<0.50	0.50	7754368
Dissolved Arsenic (As)	ug/L	1000	-	100	<1.0	4.7	1.6	1.0	7754368
Dissolved Barium (Ba)	ug/L	-	-	-	130	74	39	2.0	7754368
Dissolved Beryllium (Be)	ug/L	-	-	11	<0.40	<0.40	<0.40	0.40	7754368
Dissolved Bismuth (Bi)	ug/L	5000	-	-	<1.0	<1.0	<1.0	1.0	7754368
Dissolved Boron (B)	ug/L	-	-	200	13	<10	12	10	7754368
Dissolved Cadmium (Cd)	ug/L	1000	1	0.2	0.16	<0.090	0.32	0.090	7754368
Dissolved Calcium (Ca)	ug/L	-	-	-	89000	99000	70000	200	7754368
Dissolved Chromium (Cr)	ug/L	5000	200	-	<5.0	<5.0	<5.0	5.0	7754368
Dissolved Cobalt (Co)	ug/L	5000	-	0.9	0.78	1.7	3.5	0.50	7754368
Dissolved Copper (Cu)	ug/L	3000	10	5	5.2	1.1	3.8	0.90	7754368
Dissolved Iron (Fe)	ug/L	50000	-	300	<100	400	580	100	7754368
Dissolved Lead (Pb)	ug/L	5000	50	5	<0.50	<0.50	0.69	0.50	7754368
Dissolved Lithium (Li)	ug/L	-	-	-	16	16	15	5.0	7754368
Dissolved Magnesium (Mg)	ug/L	-	-	-	41000	34000	24000	50	7754368
Dissolved Manganese (Mn)	ug/L	5000	-	-	150	480	700	2.0	7754368
Dissolved Molybdenum (Mo)	ug/L	5000	-	40	1.6	3.7	1.1	0.50	7754368
Dissolved Nickel (Ni)	ug/L	3000	50	25	3.6	3.1	6.1	1.0	7754368
Dissolved Phosphorus (P)	ug/L	10000	-	-	<100	<100	<100	100	7754368
Dissolved Potassium (K)	ug/L	-	-	-	730	1000	530	200	7754368
Dissolved Selenium (Se)	ug/L	5000	-	100	<2.0	<2.0	<2.0	2.0	7754368
Dissolved Silicon (Si)	ug/L	-	-	-	11000	10000	13000	50	7754368
Dissolved Silver (Ag)	ug/L	5000	-	0.1	<0.090	<0.090	<0.090	0.090	7754368
Dissolved Sodium (Na)	ug/L	-	-	-	190000	9700	25000	100	7754368

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Criteria, Criteria B: City of Thunder Bay By-Law Nr BL 27/2019 Discharges to Sanitary and Combined Sewers - A, Storm Sewer B respectively Criteria-2: Ontario Provincial Water Quality Objectives Ref. to MOEE Water Management document dated Feb.1999	



ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Bureau Veritas ID					RLX569	RLX571	RLX572		
Sampling Date					2021/12/20 11:25	2021/12/20 15:55	2021/12/20 14:30		
COC Number					na	na	na		
	UNITS	Criteria	Criteria B	Criteria-2	BH4 26+420 LT	BH3 20+40 LT	BH3 20+370 RT	RDL	QC Batch
Dissolved Strontium (Sr)	ug/L	-	-	-	230	81	100	1.0	7754368
Dissolved Tellurium (Te)	ug/L	-	-	-	<1.0	<1.0	<1.0	1.0	7754368
Dissolved Thallium (Tl)	ug/L	-	-	0.3	<0.050	<0.050	<0.050	0.050	7754368
Dissolved Tin (Sn)	ug/L	5000	-	-	<1.0	<1.0	<1.0	1.0	7754368
Dissolved Titanium (Ti)	ug/L	5000	-	-	<5.0	<5.0	11	5.0	7754368
Dissolved Tungsten (W)	ug/L	-	-	30	<1.0	<1.0	<1.0	1.0	7754368
Dissolved Uranium (U)	ug/L	-	-	5	4.4	3.2	1.2	0.10	7754368
Dissolved Vanadium (V)	ug/L	5000	-	6	1.1	<0.50	1.1	0.50	7754368
Dissolved Zinc (Zn)	ug/L	3000	50	30	<5.0	<5.0	11	5.0	7754368
Dissolved Zirconium (Zr)	ug/L	-	-	4	<1.0	<1.0	<1.0	1.0	7754368
No Fill	No Exceedance								
Grey	Exceeds 1 criteria policy/level								
Black	Exceeds both criteria/levels								
RDL = Reportable Detection Limit									
QC Batch = Quality Control Batch									
Criteria,Criteria B: City of Thunder Bay By-Law Nr BL 27/2019									
Discharges to Sanitary and Combined Sewers - A, Storm Sewer B respectively									
Criteria-2: Ontario Provincial Water Quality Objectives									
Ref. to MOEE Water Management document dated Feb.1999									



BUREAU
VERITAS

Bureau Veritas Job #: C1AD315
Report Date: 2022/02/01

Englobe Corp.
Client Project #: 2109931
Site Location: HWY 61

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Bureau Veritas ID					RLX574			RLX574		
Sampling Date					2021/12/20			2021/12/20		
COC Number					na			na		
	UNITS	Criteria	Criteria B	Criteria-2	DUP 1	RDL	QC Batch	DUP 1 Lab-Dup	RDL	QC Batch
Metals										
Mercury (Hg)	mg/L	0.1	0.001	0.0002	<0.00010	0.00010	7769670			
Dissolved Aluminum (Al)	ug/L	50000	-	-	<4.9	4.9	7767223	<4.9	4.9	7767223
Dissolved Antimony (Sb)	ug/L	5000	-	20	<0.50	0.50	7767223	<0.50	0.50	7767223
Dissolved Arsenic (As)	ug/L	1000	-	100	<1.0	1.0	7767223	<1.0	1.0	7767223
Dissolved Barium (Ba)	ug/L	-	-	-	130	2.0	7767223	130	2.0	7767223
Dissolved Beryllium (Be)	ug/L	-	-	11	<0.40	0.40	7767223	<0.40	0.40	7767223
Dissolved Bismuth (Bi)	ug/L	5000	-	-	<1.0	1.0	7767223	<1.0	1.0	7767223
Dissolved Boron (B)	ug/L	-	-	200	11	10	7767223	<10	10	7767223
Dissolved Cadmium (Cd)	ug/L	1000	1	0.2	0.26	0.090	7767223	0.26	0.090	7767223
Dissolved Calcium (Ca)	ug/L	-	-	-	89000	200	7767223	88000	200	7767223
Dissolved Chromium (Cr)	ug/L	5000	200	-	<5.0	5.0	7767223	<5.0	5.0	7767223
Dissolved Cobalt (Co)	ug/L	5000	-	0.9	0.69	0.50	7767223	0.66	0.50	7767223
Dissolved Copper (Cu)	ug/L	3000	10	5	1.6	0.90	7767223	1.5	0.90	7767223
Dissolved Iron (Fe)	ug/L	50000	-	300	<100	100	7767223	<100	100	7767223
Dissolved Lead (Pb)	ug/L	5000	50	5	<0.50	0.50	7767223	<0.50	0.50	7767223
Dissolved Lithium (Li)	ug/L	-	-	-	15	5.0	7767223	15	5.0	7767223
Dissolved Magnesium (Mg)	ug/L	-	-	-	39000	50	7767223	39000	50	7767223
Dissolved Manganese (Mn)	ug/L	5000	-	-	140	2.0	7767223	140	2.0	7767223
Dissolved Molybdenum (Mo)	ug/L	5000	-	40	1.8	0.50	7767223	1.6	0.50	7767223
Dissolved Nickel (Ni)	ug/L	3000	50	25	3.2	1.0	7767223	3.5	1.0	7767223
Dissolved Phosphorus (P)	ug/L	10000	-	-	<100	100	7767223	<100	100	7767223
Dissolved Potassium (K)	ug/L	-	-	-	660	200	7767223	640	200	7767223
Dissolved Selenium (Se)	ug/L	5000	-	100	<2.0	2.0	7767223	<2.0	2.0	7767223
Dissolved Silicon (Si)	ug/L	-	-	-	11000	50	7767223	11000	50	7767223
Dissolved Silver (Ag)	ug/L	5000	-	0.1	<0.090	0.090	7767223	<0.090	0.090	7767223
No Fill	No Exceedance									
Grey	Exceeds 1 criteria policy/level									
Black	Exceeds both criteria/levels									
RDL = Reportable Detection Limit										
QC Batch = Quality Control Batch										
Lab-Dup = Laboratory Initiated Duplicate										
Criteria,Criteria B: City of Thunder Bay By-Law Nr BL 27/2019										
Discharges to Sanitary and Combined Sewers - A, Storm Sewer B respectively										
Criteria-2: Ontario Provincial Water Quality Objectives										
Ref. to MOEE Water Management document dated Feb.1999										



BUREAU
VERITAS

Bureau Veritas Job #: C1AD315

Report Date: 2022/02/01

Englobe Corp.

Client Project #: 2109931

Site Location: HWY 61

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Bureau Veritas ID					RLX574			RLX574		
Sampling Date					2021/12/20			2021/12/20		
COC Number					na			na		
	UNITS	Criteria	Criteria B	Criteria-2	DUP 1	RDL	QC Batch	DUP 1 Lab-Dup	RDL	QC Batch
Dissolved Sodium (Na)	ug/L	-	-	-	180000	100	7767223	180000	100	7767223
Dissolved Strontium (Sr)	ug/L	-	-	-	230	1.0	7767223	230	1.0	7767223
Dissolved Tellurium (Te)	ug/L	-	-	-	<1.0	1.0	7767223	<1.0	1.0	7767223
Dissolved Thallium (Tl)	ug/L	-	-	0.3	<0.050	0.050	7767223	<0.050	0.050	7767223
Dissolved Tin (Sn)	ug/L	5000	-	-	<1.0	1.0	7767223	<1.0	1.0	7767223
Dissolved Titanium (Ti)	ug/L	5000	-	-	<5.0	5.0	7767223	<5.0	5.0	7767223
Dissolved Tungsten (W)	ug/L	-	-	30	<1.0	1.0	7767223	<1.0	1.0	7767223
Dissolved Uranium (U)	ug/L	-	-	5	4.7	0.10	7767223	4.7	0.10	7767223
Dissolved Vanadium (V)	ug/L	5000	-	6	0.92	0.50	7767223	1.0	0.50	7767223
Dissolved Zinc (Zn)	ug/L	3000	50	30	<5.0	5.0	7767223	<5.0	5.0	7767223
Dissolved Zirconium (Zr)	ug/L	-	-	4	<1.0	1.0	7767223	<1.0	1.0	7767223

No Fill

No Exceedance

Grey

Exceeds 1 criteria policy/level

Black

Exceeds both criteria/levels

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

Lab-Dup = Laboratory Initiated Duplicate

Criteria, Criteria B: City of Thunder Bay By-Law Nr BL 27/2019

Discharges to Sanitary and Combined Sewers - A, Storm Sewer B
respectively

Criteria-2: Ontario Provincial Water Quality Objectives

Ref. to MOEE Water Management document dated Feb.1999



**BUREAU
VERITAS**

Bureau Veritas Job #: C1AD315
Report Date: 2022/02/01

Englobe Corp.
Client Project #: 2109931
Site Location: HWY 61

TEST SUMMARY

Bureau Veritas ID: RLX569
Sample ID: BH4 26+420 LT
Matrix: Water

Collected: 2021/12/20
Shipped:
Received: 2021/12/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	KONE	7792105	N/A	2022/01/21	Alina Dobreanu
Total Cyanide	SKAL/CN	7763702	2022/01/04	2022/01/04	Aditiben Patel
Fluoride	ISE	7792030	2022/01/20	2022/01/21	Surinder Rai
Mercury in Water by CVAA	CV/AA	7757969	2021/12/29	2021/12/30	Gagandeep Rai
Dissolved Metals by ICPMS	ICP/MS	7754368	N/A	2021/12/30	Azita Fazaeli
Animal and Vegetable Oil and Grease	BAL	7753651	N/A	2021/12/30	Automated Statchk
Total Oil and Grease	BAL	7758374	2021/12/29	2021/12/29	Saumya Modh
pH	AT	7792055	2022/01/20	2022/01/21	Surinder Rai
Phenols (4AAP)	TECH/PHEN	7756961	N/A	2021/12/29	Louise Harding
Sulphate by Automated Colourimetry	KONE	7792108	N/A	2022/01/21	Avneet Kour Sudan
Total Kjeldahl Nitrogen in Water	SKAL	7757516	2021/12/29	2022/01/04	Rajni Tyagi
Total Phosphorus (Colourimetric)	LACH/P	7758252	2021/12/29	2022/01/04	Shivani Shivani
Mineral/Synthetic O & G (TPH Heavy Oil)	BAL	7758395	2021/12/29	2021/12/29	Saumya Modh
Total Suspended Solids	BAL	7756985	2021/12/29	2021/12/30	Shaneil Hall

Bureau Veritas ID: RLX569 Dup
Sample ID: BH4 26+420 LT
Matrix: Water

Collected: 2021/12/20
Shipped:
Received: 2021/12/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	KONE	7792105	N/A	2022/01/21	Alina Dobreanu
Sulphate by Automated Colourimetry	KONE	7792108	N/A	2022/01/21	Avneet Kour Sudan

Bureau Veritas ID: RLX571
Sample ID: BH3 20+40 LT
Matrix: Water

Collected: 2021/12/20
Shipped:
Received: 2021/12/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	KONE	7754537	N/A	2022/01/04	Alina Dobreanu
Total Cyanide	SKAL/CN	7763702	2022/01/04	2022/01/04	Aditiben Patel
Fluoride	ISE	7754486	2021/12/24	2021/12/29	Neil Dassanayake
Mercury in Water by CVAA	CV/AA	7757969	2021/12/29	2021/12/30	Gagandeep Rai
Dissolved Metals by ICPMS	ICP/MS	7754368	N/A	2021/12/30	Azita Fazaeli
Animal and Vegetable Oil and Grease	BAL	7753651	N/A	2021/12/30	Automated Statchk
Total Oil and Grease	BAL	7758374	2021/12/29	2021/12/29	Saumya Modh
pH	AT	7754492	2021/12/24	2021/12/29	Neil Dassanayake
Phenols (4AAP)	TECH/PHEN	7756961	N/A	2021/12/29	Louise Harding
Sulphate by Automated Colourimetry	KONE	7754526	N/A	2021/12/29	Avneet Kour Sudan
Total Kjeldahl Nitrogen in Water	SKAL	7757516	2021/12/29	2022/01/06	Rajni Tyagi
Total Phosphorus (Colourimetric)	LACH/P	7758252	2021/12/29	2022/01/04	Shivani Shivani
Mineral/Synthetic O & G (TPH Heavy Oil)	BAL	7758395	2021/12/29	2021/12/29	Saumya Modh
Total Suspended Solids	BAL	7756985	2021/12/29	2021/12/30	Shaneil Hall



BUREAU
VERITAS

Bureau Veritas Job #: C1AD315

Report Date: 2022/02/01

Englobe Corp.

Client Project #: 2109931

Site Location: HWY 61

TEST SUMMARY

Bureau Veritas ID: RLX572
Sample ID: BH3 20+370 RT
Matrix: Water

Collected: 2021/12/20
Shipped:
Received: 2021/12/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	KONE	7754537	N/A	2022/01/04	Alina Dobreanu
Total Cyanide	SKAL/CN	7763702	2022/01/04	2022/01/04	Aditiben Patel
Fluoride	ISE	7754486	2021/12/24	2021/12/29	Neil Dassanayake
Mercury in Water by CVAA	CV/AA	7757969	2021/12/29	2021/12/30	Gagandeep Rai
Dissolved Metals by ICPMS	ICP/MS	7754368	N/A	2021/12/30	Azita Fazaeli
Animal and Vegetable Oil and Grease	BAL	7753651	N/A	2021/12/30	Automated Statchk
Total Oil and Grease	BAL	7758374	2021/12/29	2021/12/29	Saumya Modh
pH	AT	7754492	2021/12/24	2021/12/29	Neil Dassanayake
Phenols (4AAP)	TECH/PHEN	7756961	N/A	2021/12/29	Louise Harding
Sulphate by Automated Colourimetry	KONE	7754526	N/A	2021/12/29	Avneet Kour Sudan
Total Kjeldahl Nitrogen in Water	SKAL	7757516	2021/12/29	2022/01/06	Rajni Tyagi
Total Phosphorus (Colourimetric)	LACH/P	7758252	2021/12/29	2022/01/04	Shivani Shivani
Mineral/Synthetic O & G (TPH Heavy Oil)	BAL	7758395	2021/12/29	2021/12/29	Saumya Modh
Total Suspended Solids	BAL	7756985	2021/12/29	2021/12/30	Shaneil Hall

Bureau Veritas ID: RLX574
Sample ID: DUP 1
Matrix: Water

Collected: 2021/12/20
Shipped:
Received: 2021/12/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	KONE	7769147	N/A	2022/01/07	Alina Dobreanu
Total Cyanide	SKAL/CN	7770379	2022/01/07	2022/01/07	Aditiben Patel
Fluoride	ISE	7769228	2022/01/06	2022/01/07	Neil Dassanayake
Mercury in Water by CVAA	CV/AA	7769670	2022/01/07	2022/01/07	Gagandeep Rai
Dissolved Metals by ICPMS	ICP/MS	7767223	N/A	2022/01/06	Azita Fazaeli
Animal and Vegetable Oil and Grease	BAL	7765119	N/A	2022/01/05	Automated Statchk
Total Oil and Grease	BAL	7766387	2022/01/05	2022/01/05	Saumya Modh
pH	AT	7769240	2022/01/06	2022/01/07	Neil Dassanayake
Phenols (4AAP)	TECH/PHEN	7767296	N/A	2022/01/06	Louise Harding
Sulphate by Automated Colourimetry	KONE	7769137	N/A	2022/01/07	Avneet Kour Sudan
Total Kjeldahl Nitrogen in Water	SKAL	7767598	2022/01/06	2022/01/06	Rajni Tyagi
Total Phosphorus (Colourimetric)	LACH/P	7767532	2022/01/06	2022/01/07	Shivani Shivani
Mineral/Synthetic O & G (TPH Heavy Oil)	BAL	7766400	2022/01/05	2022/01/05	Saumya Modh
Total Suspended Solids	BAL	7770137	2022/01/07	2022/01/10	Shaneil Hall

Bureau Veritas ID: RLX574 Dup
Sample ID: DUP 1
Matrix: Water

Collected: 2021/12/20
Shipped:
Received: 2021/12/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	KONE	7769147	N/A	2022/01/07	Alina Dobreanu
Fluoride	ISE	7769228	2022/01/06	2022/01/07	Neil Dassanayake
Dissolved Metals by ICPMS	ICP/MS	7767223	N/A	2022/01/06	Azita Fazaeli
pH	AT	7769240	2022/01/06	2022/01/07	Neil Dassanayake
Phenols (4AAP)	TECH/PHEN	7767296	N/A	2022/01/06	Louise Harding



BUREAU
VERITAS

Bureau Veritas Job #: C1AD315

Report Date: 2022/02/01

Englobe Corp.

Client Project #: 2109931

Site Location: HWY 61

TEST SUMMARY

Bureau Veritas ID: RLX574 Dup

Sample ID: DUP 1

Matrix: Water

Collected: 2021/12/20

Shipped:

Received: 2021/12/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sulphate by Automated Colourimetry	KONE	7769137	N/A	2022/01/07	Avneet Kour Sudan



GENERAL COMMENTS

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

Package 1	1.7°C
Package 2	0.3°C

Revised report[2022/02/01] - Criteria included in the report as per client request.

Results relate only to the items tested.

BUREAU
VERITAS

Bureau Veritas Job #: C1AD315

Report Date: 2022/02/01

QUALITY ASSURANCE REPORT

Englobe Corp.

Client Project #: 2109931

Site Location: HWY 61

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7754368	Dissolved Aluminum (Al)	2021/12/30	105	80 - 120	104	80 - 120	<4.9	ug/L				
7754368	Dissolved Antimony (Sb)	2021/12/30	105	80 - 120	100	80 - 120	<0.50	ug/L	NC	20		
7754368	Dissolved Arsenic (As)	2021/12/30	101	80 - 120	100	80 - 120	<1.0	ug/L	NC	20		
7754368	Dissolved Barium (Ba)	2021/12/30	103	80 - 120	99	80 - 120	<2.0	ug/L	NC	20		
7754368	Dissolved Beryllium (Be)	2021/12/30	100	80 - 120	96	80 - 120	<0.40	ug/L	NC	20		
7754368	Dissolved Bismuth (Bi)	2021/12/30	98	80 - 120	96	80 - 120	<1.0	ug/L				
7754368	Dissolved Boron (B)	2021/12/30	98	80 - 120	96	80 - 120	<10	ug/L	NC	20		
7754368	Dissolved Cadmium (Cd)	2021/12/30	103	80 - 120	98	80 - 120	<0.090	ug/L	NC	20		
7754368	Dissolved Calcium (Ca)	2021/12/30	102	80 - 120	99	80 - 120	<200	ug/L				
7754368	Dissolved Chromium (Cr)	2021/12/30	101	80 - 120	99	80 - 120	<5.0	ug/L	NC	20		
7754368	Dissolved Cobalt (Co)	2021/12/30	101	80 - 120	98	80 - 120	<0.50	ug/L	NC	20		
7754368	Dissolved Copper (Cu)	2021/12/30	102	80 - 120	97	80 - 120	<0.90	ug/L	NC	20		
7754368	Dissolved Iron (Fe)	2021/12/30	100	80 - 120	98	80 - 120	<100	ug/L				
7754368	Dissolved Lead (Pb)	2021/12/30	97	80 - 120	96	80 - 120	<0.50	ug/L	NC	20		
7754368	Dissolved Lithium (Li)	2021/12/30	101	80 - 120	98	80 - 120	<5.0	ug/L				
7754368	Dissolved Magnesium (Mg)	2021/12/30	102	80 - 120	100	80 - 120	<50	ug/L				
7754368	Dissolved Manganese (Mn)	2021/12/30	102	80 - 120	101	80 - 120	<2.0	ug/L				
7754368	Dissolved Molybdenum (Mo)	2021/12/30	105	80 - 120	101	80 - 120	<0.50	ug/L	NC	20		
7754368	Dissolved Nickel (Ni)	2021/12/30	99	80 - 120	97	80 - 120	<1.0	ug/L	NC	20		
7754368	Dissolved Phosphorus (P)	2021/12/30	110	80 - 120	114	80 - 120	<100	ug/L				
7754368	Dissolved Potassium (K)	2021/12/30	103	80 - 120	101	80 - 120	<200	ug/L				
7754368	Dissolved Selenium (Se)	2021/12/30	104	80 - 120	101	80 - 120	<2.0	ug/L	NC	20		
7754368	Dissolved Silicon (Si)	2021/12/30	104	80 - 120	101	80 - 120	<50	ug/L				
7754368	Dissolved Silver (Ag)	2021/12/30	100	80 - 120	97	80 - 120	<0.090	ug/L	NC	20		
7754368	Dissolved Sodium (Na)	2021/12/30	104	80 - 120	102	80 - 120	<100	ug/L	NC	20		
7754368	Dissolved Strontium (Sr)	2021/12/30	100	80 - 120	99	80 - 120	<1.0	ug/L				
7754368	Dissolved Tellurium (Te)	2021/12/30	105	80 - 120	100	80 - 120	<1.0	ug/L				
7754368	Dissolved Thallium (Tl)	2021/12/30	96	80 - 120	96	80 - 120	<0.050	ug/L	NC	20		
7754368	Dissolved Tin (Sn)	2021/12/30	105	80 - 120	98	80 - 120	<1.0	ug/L				
7754368	Dissolved Titanium (Ti)	2021/12/30	103	80 - 120	99	80 - 120	<5.0	ug/L				
7754368	Dissolved Tungsten (W)	2021/12/30	101	80 - 120	98	80 - 120	<1.0	ug/L				

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QUALITY ASSURANCE REPORT(CONT'D)

Englobe Corp.

Client Project #: 2109931

Site Location: HWY 61

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7754368	Dissolved Uranium (U)	2021/12/30	102	80 - 120	99	80 - 120	<0.10	ug/L	NC	20		
7754368	Dissolved Vanadium (V)	2021/12/30	101	80 - 120	99	80 - 120	<0.50	ug/L	NC	20		
7754368	Dissolved Zinc (Zn)	2021/12/30	103	80 - 120	99	80 - 120	<5.0	ug/L	NC	20		
7754368	Dissolved Zirconium (Zr)	2021/12/30	106	80 - 120	102	80 - 120	<1.0	ug/L				
7754486	Fluoride (F-)	2021/12/29	111	80 - 120	104	80 - 120	<0.10	mg/L	0.47	20		
7754492	pH	2021/12/29			102	98 - 103			0.52	N/A		
7754526	Dissolved Sulphate (SO4)	2021/12/29	NC	75 - 125	106	80 - 120	<1.0	mg/L	1.3	20		
7754537	Dissolved Chloride (Cl-)	2022/01/04	110	80 - 120	105	80 - 120	<1.0	mg/L	3.8	20		
7756961	Phenols-4AAP	2021/12/29	101	80 - 120	98	80 - 120	<0.0010	mg/L	NC	20		
7756985	Total Suspended Solids	2021/12/30					<10	mg/L	NC	25	99	85 - 115
7757516	Total Kjeldahl Nitrogen (TKN)	2022/01/04	102	80 - 120	102	80 - 120	<0.10	mg/L	18	20	103	80 - 120
7757969	Mercury (Hg)	2021/12/30	95	75 - 125	99	80 - 120	<0.00010	mg/L	NC	20		
7758252	Total Phosphorus	2022/01/04	89	80 - 120	96	80 - 120	<0.020	mg/L	0.22	20	94	80 - 120
7758374	Total Oil & Grease	2021/12/29			100	85 - 115	<0.50	mg/L	1.8	25		
7758395	Total Oil & Grease Mineral/Synthetic	2021/12/29			96	85 - 115	<0.50	mg/L	3.2	25		
7763702	Total Cyanide (CN)	2022/01/04	96	80 - 120	99	80 - 120	<0.0050	mg/L	2.9	20		
7766387	Total Oil & Grease	2022/01/05			100	85 - 115	<0.50	mg/L	4.3	25		
7766400	Total Oil & Grease Mineral/Synthetic	2022/01/05			96	85 - 115	<0.50	mg/L	4.8	25		
7767223	Dissolved Aluminum (Al)	2022/01/06	103	80 - 120	99	80 - 120	<4.9	ug/L	NC	20		
7767223	Dissolved Antimony (Sb)	2022/01/06	108	80 - 120	101	80 - 120	<0.50	ug/L	NC	20		
7767223	Dissolved Arsenic (As)	2022/01/06	103	80 - 120	99	80 - 120	<1.0	ug/L	NC	20		
7767223	Dissolved Barium (Ba)	2022/01/06	104	80 - 120	102	80 - 120	<2.0	ug/L	2.4	20		
7767223	Dissolved Beryllium (Be)	2022/01/06	101	80 - 120	97	80 - 120	<0.40	ug/L	NC	20		
7767223	Dissolved Bismuth (Bi)	2022/01/06	96	80 - 120	95	80 - 120	<1.0	ug/L	NC	20		
7767223	Dissolved Boron (B)	2022/01/06	99	80 - 120	94	80 - 120	<10	ug/L	5.7	20		
7767223	Dissolved Cadmium (Cd)	2022/01/06	104	80 - 120	99	80 - 120	<0.090	ug/L	1.2	20		
7767223	Dissolved Calcium (Ca)	2022/01/06	NC	80 - 120	101	80 - 120	<200	ug/L	0.76	20		
7767223	Dissolved Chromium (Cr)	2022/01/06	100	80 - 120	97	80 - 120	<5.0	ug/L	NC	20		
7767223	Dissolved Cobalt (Co)	2022/01/06	99	80 - 120	96	80 - 120	<0.50	ug/L	4.1	20		
7767223	Dissolved Copper (Cu)	2022/01/06	103	80 - 120	97	80 - 120	<0.90	ug/L	6.0	20		
7767223	Dissolved Iron (Fe)	2022/01/06	101	80 - 120	98	80 - 120	<100	ug/L	NC	20		

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QUALITY ASSURANCE REPORT(CONT'D)

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Client Project #: 2109931

Site Location: HWY 61

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7767223	Dissolved Lead (Pb)	2022/01/06	96	80 - 120	95	80 - 120	<0.50	ug/L	NC	20		
7767223	Dissolved Lithium (Li)	2022/01/06	105	80 - 120	100	80 - 120	<5.0	ug/L	2.9	20		
7767223	Dissolved Magnesium (Mg)	2022/01/06	NC	80 - 120	98	80 - 120	<50	ug/L	0.53	20		
7767223	Dissolved Manganese (Mn)	2022/01/06	101	80 - 120	99	80 - 120	<2.0	ug/L	0.90	20		
7767223	Dissolved Molybdenum (Mo)	2022/01/06	109	80 - 120	100	80 - 120	<0.50	ug/L	12	20		
7767223	Dissolved Nickel (Ni)	2022/01/06	97	80 - 120	96	80 - 120	<1.0	ug/L	8.6	20		
7767223	Dissolved Phosphorus (P)	2022/01/06	113	80 - 120	112	80 - 120	<100	ug/L	NC	20		
7767223	Dissolved Potassium (K)	2022/01/06	103	80 - 120	99	80 - 120	<200	ug/L	3.3	20		
7767223	Dissolved Selenium (Se)	2022/01/06	101	80 - 120	98	80 - 120	<2.0	ug/L	NC	20		
7767223	Dissolved Silicon (Si)	2022/01/06	104	80 - 120	100	80 - 120	<50	ug/L	1.5	20		
7767223	Dissolved Silver (Ag)	2022/01/06	99	80 - 120	100	80 - 120	<0.090	ug/L	NC	20		
7767223	Dissolved Sodium (Na)	2022/01/06	NC	80 - 120	99	80 - 120	<100	ug/L	0.37	20		
7767223	Dissolved Strontium (Sr)	2022/01/06	101	80 - 120	98	80 - 120	<1.0	ug/L	0.42	20		
7767223	Dissolved Tellurium (Te)	2022/01/06	103	80 - 120	100	80 - 120	<1.0	ug/L	NC	20		
7767223	Dissolved Thallium (Tl)	2022/01/06	96	80 - 120	95	80 - 120	<0.050	ug/L	NC	20		
7767223	Dissolved Tin (Sn)	2022/01/06	108	80 - 120	100	80 - 120	<1.0	ug/L	NC	20		
7767223	Dissolved Titanium (Ti)	2022/01/06	104	80 - 120	98	80 - 120	<5.0	ug/L	NC	20		
7767223	Dissolved Tungsten (W)	2022/01/06	101	80 - 120	99	80 - 120	<1.0	ug/L	NC	20		
7767223	Dissolved Uranium (U)	2022/01/06	107	80 - 120	104	80 - 120	<0.10	ug/L	0.64	20		
7767223	Dissolved Vanadium (V)	2022/01/06	102	80 - 120	98	80 - 120	<0.50	ug/L	10	20		
7767223	Dissolved Zinc (Zn)	2022/01/06	97	80 - 120	95	80 - 120	<5.0	ug/L	NC	20		
7767223	Dissolved Zirconium (Zr)	2022/01/06	112	80 - 120	101	80 - 120	<1.0	ug/L	NC	20		
7767296	Phenols-4AAP	2022/01/06	102	80 - 120	100	80 - 120	<0.0010	mg/L	NC	20		
7767532	Total Phosphorus	2022/01/07	96	80 - 120	98	80 - 120	<0.020	mg/L	0.12	20	98	80 - 120
7767598	Total Kjeldahl Nitrogen (TKN)	2022/01/06	NC	80 - 120	105	80 - 120	<0.10	mg/L	7.7	20	103	80 - 120
7769137	Dissolved Sulphate (SO4)	2022/01/07	NC	75 - 125	103	80 - 120	<1.0	mg/L	3.5	20		
7769147	Dissolved Chloride (Cl-)	2022/01/07	NC	80 - 120	103	80 - 120	<1.0	mg/L	2.7	20		
7769228	Fluoride (F-)	2022/01/07	110	80 - 120	101	80 - 120	<0.10	mg/L	20	20		
7769240	pH	2022/01/07			102	98 - 103			1.0	N/A		
7769670	Mercury (Hg)	2022/01/07	94	75 - 125	98	80 - 120	<0.00010	mg/L	NC	20		
7770137	Total Suspended Solids	2022/01/10					<10	mg/L	0	25	97	85 - 115



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QUALITY ASSURANCE REPORT(CONT'D)

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Site Location: HWY 61

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
7770379	Total Cyanide (CN)	2022/01/07	84	80 - 120	96	80 - 120	<0.0050	mg/L	NC	20		
7792030	Fluoride (F-)	2022/01/21	108	80 - 120	102	80 - 120	<0.10	mg/L	NC	20		
7792055	pH	2022/01/21			102	98 - 103			0.27	N/A		
7792105	Dissolved Chloride (Cl-)	2022/01/21	NC	80 - 120	105	80 - 120	<1.0	mg/L	0.64	20		
7792108	Dissolved Sulphate (SO4)	2022/01/21	NC	75 - 125	102	80 - 120	<1.0	mg/L	1.0	20		

N/A = Not Applicable

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

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

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

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

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

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

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference $\leq 2 \times \text{RDL}$).



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Client Project #: 2109931

Site Location: HWY 61

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Brad Newman, B.Sc., C.Chem., Scientific Service Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.



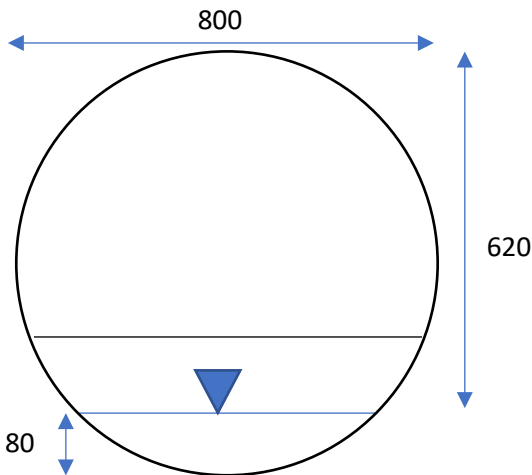
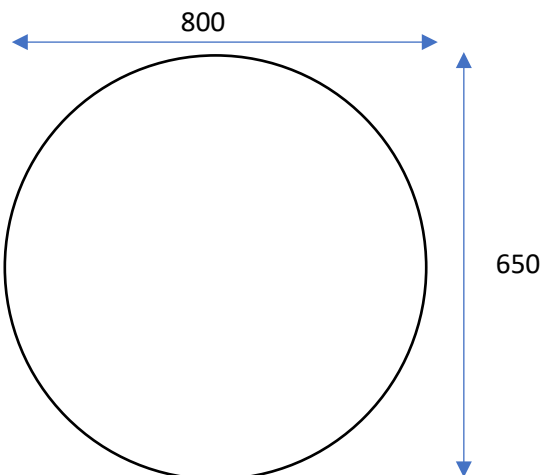
0/0/1°C, 0/0/1°C

Appendix D
Culvert Inspection Report
(as provided by Gannett Fleming)



eNGLOBE

FIELD INSPECTION FORM

A. GENERAL INFORMATION			
Project #	6176-15-00 - Highway 61	Project Description	From 0.5km north of Jarvis Bay Road to 0.4km South of Hwy 130
Date	October 4, 2021	Weather Conditions	Sunny
Inspector 1	David Jackson	Inspector 2 /Reviewer	-
B. CULVERT ID / LOCATION			
Culvert ID	C37	Chainage	26+422
UTM Easting	345874.8893	UTM Northing	5334781.3277
Description	South of the Cloud Lake Road & Highway 61 intersection		
C. STRUCTURE DETAILS			
Material – CSP			
Dimensions – 800 x 700 US / 800 X 650 DS			
Clearance (soffit to normal water level) – 620mm US / Dry DS			
High Water Mark (on structure) – 300mm from Bottom at US			
Structures (U/S / D/S of Crossing) – N/A			
Debris – N/A			
D. ENVIRONMENTAL CONDITIONS			
Watercourse Type and Creek Material – Creek with gravel and stones			
Bank Conditions (stability) – Scour at US end			
Channel Dimensions (width and depth) – 3m, 3:1, 80mm US / 3m, 3:1, Dry DS			
Observed Flow Conditions (ephemeral/permanent) – Permanent – standing water			
E. SITE CONDITIONS			
Road Condition (sag, settlement, etc.) – OK			
Physical Culvert Condition (rust, damage, etc.) – Rusted/damaged			
Culvert Appearance (general comments) – Replace			
Site Sketch – <div style="display: flex; justify-content: space-around; align-items: flex-end; text-align: center;"> <div style="position: relative; width: 300px; height: 300px;">  </div> <div style="position: relative; width: 300px; height: 300px;">  </div> </div>			

Corrugated Steel Pipe Culvert (Culvert #37) @ 26+422

C37 - #1 – Upstream Channel Conditions



C37 - #2 – Upstream Face of the Culvert



C37 - #3 – Downstream Channel Conditions



C37 - #4 – Downstream Face of the Culvert

