Appendix F
Geotechnical Factual Data Report
(Tulloch - July 2019)

TULLOCH ENGINEERING

GEOTECHNICAL INVESTIGATION REPORT

Kingston 3rd Crossing Bridge Project

Factual Data Report – The Bridge



April 2019

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1. Introduction and Scope

TULLOCH Engineering Inc. (TULLOCH) was retained by Hatch Ltd on behalf of the City of Kingston (City) to conduct a multi-disciplinary subsurface investigation to support the validation phase of the proposed Third Crossing Bridge over the Cataraqui river located in Kingston, ON. Figure 1 shows a site plan of the proposed bridge. The proposed bridge is an approximately 1200 m long, 22-span structure connecting Gore Road to John Counter Boulevard. The main span is about 90 m wide over the Cataraqui River navigable channel.

This report provides the factual data from the geotechnical investigation and should be read in conjunction with other design memos that pertain to this project. The investigation consists of 11 (eleven) marine boreholes for the bridge river crossing and 5 (five) on-land boreholes for the west approach.

2. Previous Investigations

Three previous geotechnical investigations were carried out at the site in 1991, 2010, and 2016. The findings of the previous investigation were summarized in the following documents:

- Factual Data Report prepared by Golder Associates Ltd. for J.L. Richards, “Preliminary Geotechnical Report, Third Crossing of the Cataraqui River John Counter Boulevard to Gore Road” dated March, 2017 (Project Number E1541774/2000/0003.
- Technical Memorandum prepared by Golder Associates Ltd. for J.L. Richards, “Cataraqui River Crossing EA Study, Geotechnical and Geophysical Findings and Preliminary Guidelines” dated December 20, 2010 (Project Number 09-1121-0016).
- Preliminary Report prepared by Strata Engineering Corp. for Totten Sims Hubicki Associates Ltd., “Preliminary Geotechnical Report, Cataraqui River Crossing, City of Kingston & Township of Pittsburgh” dated April 30, 1991 (Project Number E-90-034).

3. Site Geology

Based on information obtained from the Canadian Geological Survey and other public sources, the geology of the Kingston area was initially mapped by M.B. Baker in 1916 who indicated that the bedrock of the area largely consisted of two distinct rock groups (Baker 1916). Specifically, for the area around the Cataraqui river, they consist of limestone from the Gull River Formation, overlying the Precambrian basement parent rock. The Precambrian basement rock is largely a metamorphic sequence that was formed during the Grenvillian Mountain Building Cycle. (Fisher, 1982). Above the parent rock in different areas of the Frontenac access limestone can be replaced with sandstones of the Potsdam group (Sandford, 2010), however the limestone was found to be the predominant cap rock on the site of the third crossing bridge.

Above the bedrock it is typical for a thick cover of lake deposited varved clays to be found throughout the area stretching along the banks of the St. Lawrence River east up to Gananoque, ON. Glacial deposits have been documented to be distributed sparsely and discontinuously found mostly on the leeward side of escarpments and flanks of hills along this section of southeastern Ontario (Henderson, 1964).

4. Site Investigations and Methodology

4.1 Marine Investigation

The marine geotechnical investigations were completed between October 22nd and December 7th, 2018. The investigation campaign consisted of advancing eleven (11) boreholes referenced as BH-18-101 to BH-18-111, including 9 (nine) deep boreholes advanced from the river bed into bedrock and three shallow probe holes BH-18-108 ,109 and 111 through the upper organic strata. The borehole locations were selected based on the proposed pier locations of the third crossing bridge at the time of the investigation. Since completing the work, the pier locations have been changed based on design optimizations and finalized on January 09, 2019. The boreholes were advanced through the overburden to bedrock and then cored to a minimum of 3 m at each drilling location. Figure 2 shows the borehole layout and stratigraphic profile.

Drilling was conducted from a segmented spud barge equipped with 1.5 m long silt curtains supplied by ODS Marine Construction (ODS). The barge was mobilized and

directed to the drilling locations utilizing a hand-held GPS with ±3 m accuracy. As-built coordinates were taken at each drilling location as presented in Figure 2 with usage of the same GPS.

Drilling depths were measured from the mudline of the river bed and then tied back to the water level elevation of the river from daily water level measurements taken from a surveyed rod either at the Kingston Marina or the east end of John Counter Blvd. A summary of Borehole locations, coordinates and river bed elevations can be seen below in Table 4-1.

Table 4-1: Borehole Location Summary

Borehole Number	Nearest Pier Location	Northing (m)	Easting (m)	River Bed Elevation (m)
BH-18-101	Pier 2/3	4901546	382018	72.75
BH-18-102	Pier 4	4901561	382089	72.90
BH-18-103	Pier 13	4901665	382513	73.00
BH-18-104	Pier 18 (West Main Span)	4901700	382782	73.48
BH-18-105	Pier 19 (East Main Span)	4901698	382876	73.28
BH-18-106	Pier 20	4901698	382952	73.46
BH-18-107	Pier 5	4901575	382157	73.36
BH-18-108	Pier 8	4901606	382281	73.42
BH-18-1089	Pier 9	4901625	382327	73.42
BH18-110	Pier 7	4901547	382245	72.98
BH-18-111	Pier 10	4901632	382374	73.40

Boreholes were advanced utilizing a Truck Mount CME 55 Rotary drill equipped with a 63.5 kg (140lb) Auto Hammer provided by Marathon Underground Constructors Corporation (Marathon) based in Greely, Ontario. Boreholes were advanced by wash-boring techniques using NW sized casing (88.9 mm Outside Diameter) equipped with a tri-cone casing advancer. A Mud-Tank was installed at the top of the drill string to

sequester and re-circulate drill cuttings and fluids to prevent spillage into the river. When refusal of the casing advancement was reached, boreholes were advanced into the bedrock using rotary diamond drilling techniques retrieving NQ2 sized rock core samples (48mm diameter core).

Soil sampling was directed by a TULLOCH geotechnical engineer, with Standard Penetration Tests (SPT) being conducted at regular intervals of depth. Disturbed samples of the encountered soils were recovered using a standard 51mm OD split spoon. SPT 'N' values were recorded for each split spoon sample. At each drilling location when cohesive soils were encountered, field shear vane tests were conducted throughout. In addition to the vane testing at each drilling location relatively undisturbed 75mm thin walled Shelby tube sample were collected. Environmental samples were also collected within the upper soil strata at boring locations across the bridge alignment based on direction provided by Hatch. Testing was conducted for metals, chemical contaminants such as VOCs and BTEX compounds as well as pH, resistivity and sulphate content for corrosivity purposes. Samples were taken in-situ from the split spoon sampler by TULLOCH personnel and sent to the ALS Environmental laboratory located in Waterloo, Ontario, for chemical analysis.

Upon casing refusal at the top of bedrock, the drill string was lifted approximately 0.9 m and slug testing was completed within the bottom soil deposit, consisting of a Glacial TILL layer and/or Silty Clay to Clay layer, above the bedrock through the drill casing. Data for the testing was collected via a Solinst level logger suspended down the drill string and confirmed by hand measurements taken using a water level dip tape at regular timed intervals.

NQ sized bedrock cores were retrieved in 5 ft runs and placed in wooden core boxes on the barge. The cores were then photographed on site and stored in a shipping container located at 630 John Counter Blvd for further examination. The rock cores were also examined by an expert geologist to describe the lithology and discontinuities of the bedrock, examine potential faults within the core and corroborate the information given from previous investigations. Rock core from the 2016 Golder investigation was also brought to the site to be re-examined.

After the target depth at each borehole had been achieved, the borehole was backfilled with bentonite-cement grout installed via a tremie pipe and backfilled to the surface of the river bed.

Cone Penetration Tests (CPT) were also conducted at BH 18-104, 105, 106 and 110 and flat-plate Dilatometer Tests (DMT) were carried out at BH 18-105 and 110. The CPT and DMT testing were conducted by ConeTec Investigations Ltd from Richmond Hill, ON. The testing was advanced using rods supplied by Conetec and pushed by the CME 55 drill rig.

In addition to the geotechnical investigations, an archeological monitoring program was also carried out during the field campaign at each drilling location excluding the shallow probe holes BH-18-108, 109 and 111. A Golder archeologist along with archeological monitoring personnel from the Huron Wendat and Mohawks of the Bay of Quinte First Nations were present on the barge and observed continuous split spoon samples to a depth of 7.0 m for cultural materials in the upper river bed sediment. Further details and findings of the archeological program can be seen the memorandum provided by Golder in Appendix I.

4.2 West Approach Investigation

After the conclusion of the marine investigation, a series of five (5) boreholes were drilled along the west approach of the proposed bridge site. The on-shore boreholes were advanced between December 10 – 12, 2018.

The purpose of these boreholes was to validate previous investigations for the bridge abutments as well as to support road upgrades and pavement design for John Counter Boulevard. The borehole layout can be seen in Figure 3. The field work consisted of drilling two boreholes BH-18-201 and 202 at the western abutment location of the bridge and advanced into bedrock to assess both soil and rock conditions. Similar sampling procedures were used for these two boreholes as in the marine investigation.

An additional three boreholes labelled BH-18-203 to 205 were shallow road boreholes drilled through John Counter Blvd. and terminated at auger refusal or 1.5 m depth, whichever was first. Asphalt thickness and granular subgrade thickness was measured at each location along with standard SPT, split spoon sampling and auger grab sampling.

Boreholes were advanced utilizing the same CME 55 rotary drill and auto hammer provided by Marathon.

4.3 Laboratory Testing

Soil and rock samples were collected by TULLOCH personnel and sealed and shipped to TULLOCH's CCIL certified laboratory located in Sue Sault Marie. Shelby tubes and rock core samples were shipped to Golder's Mississauga, Ontario, laboratory for additional testing of the undisturbed clay samples and for unconfined compression testing of the bedrock core samples. Additional rock core samples were sent to Golder's Burnaby, British Columbia, laboratory for abrasion testing at the request of Bauer, the foundation contractor. Table 3-1 below summarizes the lab testing program conducted for the geotechnical investigation. Detailed laboratory reports are attached in Appendix C along with grainsize and plasticity summary figures.

Table 4-2: Summary of Soil Laboratory Testing Programs

Test	Number of Tests	ASTM Standard
Oedometer Test	2	ASTM D2435
Direct Shear Test	2	ASTM D3080
Unconfined Rock Compression Test	15	ASTM D7012
Cerchar Abrasion Test	4	ASTM D7625

5. Subsurface Conditions

5.1 Marine Investigation Boreholes

The following sections summarize the subsurface conditions encountered during the marine geotechnical investigation. Each distinct material strata that was encountered will be discussed below. Detailed borehole logs and a stratigraphic summary can be viewed in Appendix A-1. Detailed Rock Core Discontinuity Logs are attached in Appendix A-2.

5.1.1 Cataraqui River Water Level

Water levels of the Cataraqui river were taken daily at surveyed rods at the east end of John Counter Blvd and at the boat launch located at the Kingston Marina. The river water depth was typically shallow ranging from 1.0 to 2.0 m along the bridge alignment and dropping to approximately 4.5 m through the navigable channel. Water levels remained relatively stable throughout the course of the investigation ranging from 74.1 to 74.6 masl.

5.1.2 PEAT (PT)

At all borehole locations a FIBROUS to SILTY PEAT (PT) was encountered at the river bed. The PEAT layer ranged in thickness from 0.5 to 3.6 m with an average thickness of 1.4 m.

Based on borehole data, the areas with the thick peat deposits included one near the western shore at BH 18-101 (Station 10+380), one from Station 10+630 to 10+750 (BH-18-108 and 109), and also one near BH 18+103 at Station 10+900. The PEAT varied from fibrous to amorphous with high organic contents ranging from 16% to 84%. Rootlets, larger pieces of wood fiber and shell fragments were often encountered within this layer. The material was dark brown and the fines were silty often with a low plasticity. The water content of the PEAT was high, ranging from 70% to 588%. The material was very loose with SPT 'N' values of 0 blows per 0.3 m. The consistency of the material was soft enough that advancing the sampling spoon 0.3 m could be achieved by the weight of the drilling rods only. The PEAT was found to be mixed with ORGANIC Layer at BH 18-103,105 and 106, which will be discussed in the next section.

CPT Testing showed a Tip Resistance (q_t) and Sleeve Friction (f_s) that were typically less than 400 kPa and 4 kPa respectively indicating a very weak soil.

DMT values for the peat also showed similar results to the CPT data again indicating a very weak soil with a Dilatometer Modulus (E_D) value at or below the detectable limit. For detailed results of CPT and DMT testing please see Appendix D and E respectively.

5.1.3 ORGANIC CLAYEY SILT and ORGANIC SILTY CLAY (OL-OH)

The ORGANIC CLAYEY SILT and ORGANIC SILTY CLAY was typically observed to be a transitional zone between the PEAT of the top river stratum and the lacustrine clay

deposit below. The material typically began with a higher organic content and then with depth the organic content began to reduce, and an increased plasticity was observed in general with the soil samples.

Based on borehole data, the organic soil deposit was encountered in eight (8) boreholes within the following four zones:

- Zone 1 near the western shore at BH 18-101, close to Pier 2
- Zone 2 at BH 18-108, 109 and 110, close to Piers 8 and 9
- Zone 3 at BH 18-103, close to Pier 13
- Zone 4 near the navigation channel at BH 18-104, 105 and 106, close to Piers 18, 19 and 20.

This organic layer included ORGANIC SILTY CLAY or ORGANIC CLAYEY SILT. In Zones 1, 3 and at BH 18-105 in Zone 4, the organic layer was ORGANIC SILTY CLAY with a low to high plasticity. As shown in Figure C2-1 in Appendix C, the liquid limits ranged from 30% to 59%. The water content varied from 39% to 579%, typically higher than the corresponding liquid limit. ORGANIC CLAYEY SILT was encountered at BH 18-108 to 110 in Zone 2 and at BH 18-104 and 106 in Zone 4. This material contained fine sand up to 35% and had a slight to low plasticity. During Atterberg limits testing, lab technicians had difficulties rolling the thread down to 3.2 mm diameter without the material breaking, partially due to the presence of organic matter in ORGANIC CLAYEY SILT.

This organic deposit extended to a depth from 2 m to 5.8 m at BH 18-109 with an average of 3.5 m. The thickness of this layer ranged from 0.2 to 3.8 m with an average thickness of 1.8 m. The organic content varies from 8.8 % to 19%. The compactness of this deposit was observed to be very loose with SPT ‘N’ values of 0 blows per 0.3 m with the consistency being soft enough to advance the sampling spoon 0.3 m from the weight of the auto hammer alone. The layer was observed to range from brown to grey, and contained trace to some sand, trace to some rootlets and shell fragments.

A Grain size summary can be viewed in Figure C1-1 for ORGANIC SILTY CLAY, as summarized below:

0% gravel;

1% sand;

49% silt; and

50% clay

Grain Size Distribution for ORGANIC CLAYEY SILT:

0% gravel;

22% to 35% sand;

34% to 45% silt; and

31% to 42% clay

CPT and DMT testing for the ORGANIC CLAYEY SILT TO SILTY CLAY was similar to the PEAT with very low values reporting at or below the detectable limits of the equipment. For detailed results of CPT and DMT testing please see Appendix D and E respectively.

5.1.4 SILTY CLAY to CLAY (CL-CH)

Below the ORGANIC layer, a thick clay deposit ranging from a SILTY CLAY to CLAY (CL-CH) was observed. The clay was typically found in two distinct regions, an upper, stiffer, SILTY CLAY crust overlying a weaker, finer grained SILTY CLAY to CLAY. This material made up the bulk of the soil stratum at the site and was found to be relatively consistent across the drilling locations on the river. The upper crust ranged in thickness from 0.3 to 16.2 m with an average thickness of 4.7 m. The thickest layer of the upper crust was encountered at BH-18-105. The lower SILTY CLAY region was found to range in thickness from 1.6 to 36.9 m.

The SILTY CLAY to CLAY (CL-CH) was observed to contain silt seams and trace organic matter in the upper crust. The material was grey in colour and cohesive generally ranging from medium to high plasticity. The material ranged from very stiff to firm. The upper crust material was typically observed to be much stiffer than the underlying material. SPT ‘N’ values within the material stratum ranged from 0 to 17 blows per 0.3 m. Occasionally, the material was observed to be varved with interlayered dark grey and light grey clay/silt seams.

Shear vane testing was conducted within the SILTY CLAY to CLAY stratum. The ultimate shear strength was found to range from 27 up to 174 kPa (vane refusal). Remoulded shear strength values ranged from 3 to 63 kPa.

Atterberg limits testing conducted on the SILTY CLAY to CLAY layer were found to have plasticity indices ranging from 12 to 36, averaging 24, plastic limits from 18 to 26, averaging 22, and liquid limits from 35 to 61, averaging 46. For more information, a plasticity summary chart is presented in Figure C2-2 in Appendix C. A Grain size summary can be viewed in Figure C1-2 for the SILTY CLAY to CLAY. Grain Size Distribution for this layer is summarized below:

0% gravel;

0% to 1% sand;

23% to 56% silt; and

44% to 77% clay

Two (2) Direct Shear test were also conducted on selected Shelby Tube samples (BH18-101 SA 10 and BH-18-107 SA 19) of the SILTY CLAY to CLAY. Detailed laboratory results can be seen in Appendix C. The effective peak friction angles were estimated to be approximately 25.4º and 30º with c' = 0 kPa respectively.

Oedometer consolidation testing was also completed on specimens collected from selected thin walled Shelby tube samples of the SILTY CLAY to CLAY soil deposit. Two tests were conducted on the selected samples from BH18-101 SA 10 and BH-18-107 SA 19. Detailed loading graphs and testing results can be seen in Appendix C. The test data from BH-18-107 SA 19 showed a very low compressibility, likely due to the presence of silt seams in the test sample or sample disturbance. The following summarized the parameters as per the test data from BH18-101 SA 10 only.

Pre-consolidation Pressure : P'_c=190 kPa

Virgin Compression Index: C_c= 0.52

Recompression Index: C_r=0.05

Coefficient of Consolidation: $1 \times 10^{-3}\ cm^2/s$, ranging from 7×10^{-3} to $0.2 \times 10^{-3}\ cm^2/s$

CPT testing for the marine clay material indicated two distinct strata, with an upper stiffer crust that gave way to a weaker clay stratum at depth. The only exception being at location BH- 18-105 where values similar to the crust were seen throughout the entire clay stratum. The CPT values for corrected Tip Resistance (q_t) ranged from approximately 2000 – 3000 kPa for the upper crust and from 1200 – 1600 kPa for the lower stratum. The Sleeve Friction (f_s) followed a similar pattern ranging from 40 – 80 kPa for the upper crust and then softened from a range of 8 – 20 kPa with depth. Once again, the values at BH-18-105 are indicative of a more uniform stiffer crust down to refusal.

The DMT data completed at BH-18-110 showed a distinct division between the upper clay crust and the lower weaker material with Dilatometer modulus (E_D) values reaching up to approximately 175 bar and then reducing back down to approximately 40 bar once the testing had broken through the upper crust. At BH 18-105, the Dilatometer modulus (E_D) values were generally uniform and ranged from 50 to 175 bar. For detailed results of CPT and DMT testing please see Appendix D and E respectively

5.1.5 Glacial TILL

At most drilling locations below the clay deposit, a CLAYEY SILT to SILTY SAND Glacial TILL was observed. The TILL was typically found in a relatively thin layer above the bedrock and was encountered at boring locations BH-18-101, 102, 105, 106 and 107. The TILL layer contained trace to some sub-angular gravel, with trace to some medium to fine grained sand. The presence of cobbles and boulders were also noted typically found immediately above the bedrock interface. The material ranged from non-cohesive to cohesive with a low plasticity. The TILL was found to be wet for the non-cohesive material and saturated for the cohesive material. Atterberg limits testing completed on the TILL layer were found to have plasticity indices ranging from 4 to 19, averaging 14. For more information a plasticity summary chart is presented in Figure C2-3 in Appendix C. The material was generally very dense/stiff except for BH-18-106 where the till was encountered close to the ground surface and was relatively loose. The SPT ‘N’ values ranged from 1 blows per 0.3m to refusal, averaging mainly greater than 50 blows per 0.3m indicating a very dense/hard material. Grain size testing was conducted on the TILL layer and the particle size distribution is summarized below:

0% to 12% gravel;

1% to 44% sand;

5% to 49% silt; and

12% to 53% clay

It should be noted that particles larger than 51mm in diameter cannot be sampled using the split spoon sampler. A grain size summary for the Glacial TILL can be seen in Figure C1-3 in Appendix C.

CPT and DMT data were not achievable through this stratum as the equipment hit refusal at the top of this layer.

5.1.6 Bedrock

The depth to bedrock varied significantly throughout the site with rock being encountered at shallow depths along the shores of the river and dropping significantly to about 40 m and 20 m deep in the western and eastern segments below the river bed respectively. The depth to bedrock ranged from 1.88 mbgs at BH-18-106 to approximately 42 mbgs at BH-18-102. A detailed bedrock surface profile can be seen in Figure 2 attached to this report. Table 5-1 summarizes the bedrock surface encountered for the marine investigation.

Table 5-1: Bedrock Surface Summary

Borehole No.	River Bed Elevation[1] (masl)	Bedrock Surface Depth[2] (m)	Bedrock Surface Elevation (masl)
BH-18-101	72.75	29.11	43.64
BH-18-102	72.9	42.21	30.69
BH-18-103	73.0	23.90	49.10
BH-18-104	73.48	21.26	52.22
BH-18-105	73.28	20.22	53.06
BH-18-106	73.46	1.88	71.58

Borehole No.	River Bed Elevation[1] (masl)	Bedrock Surface Depth[2] (m)	Bedrock Surface Elevation (masl)
BH-18-107	73.36	38.94	34.42
BH-18-110	72.98	40.84	32.14

NOTES: [1]Geodetic elevation of river at time at the time of drilling (Datum: CGVD28), [2] Depth below riverbed at the time of drilling (Datum: CGVD28)

The site lithology can be categorized into two distinct rock types which will be discussed below. Detailed mechanical properties as well as lab testing of rock specimens can be seen in the borehole logs in Appendix A-1 as well as in Appendix C. Detailed discontinuity logs of the bedrock cores can also be seen in Appendix A-2 Photographs of the cored bedrock samples and discontinuities can be seen in Appendix F.

5.1.6.1 Feldspathic Biotite Gneiss

Much of the bedrock encountered on site was a dark grey/green fine-grained gneiss typically intruded by a medium to coarse grained pink/red feldspathic granite. The gneiss was observed at drilling locations BH-18-101 to 105, 107 and 110. Thin hematite and calcite banding were also present throughout the bedrock samples which typically ran horizontal to the core axis but was also found to run in varying angles to the core axis throughout the samples. The minerology of the gneiss also had additions of chlorite within the parent rock which was also observed in the rock discontinuity logs. Contacts between the parent gneiss and intrusive granite were all observed to be sound. The rock was faintly weathered to fresh.

Brecciated faults were observed at BH-18-101 and 102. The fault zones encountered had been re-healed with sound contacts. There was evidence of secondary movement in some fault sections.

The Rock Quality Designation (RQD) for the core samples ranged from 35% to 100%, with the gneiss generally considered to be of good quality with an average RQD of 82%.

Cerchar abrasion testing was conducted on three gneiss specimens yielding a Cerchar index ranging from 1.46 to 1.67 and averaging 1.54, which is categorized as medium abrasiveness. The Cerchar index was lower than typically expected for Gneiss likely due to the presence of chlorite and possibly the calcite/hematite banding. Unconfined

compression (UC) tests were also conducted on eleven (11) Gneiss bedrock samples including one sample taken from a re-healed fault zone at BH-18-101. The strength of the samples ranged from 45.7 to 140.2 MPa, with an average strength of 92.4 MPa. Given the tested values, the Gneiss ranges from medium to very high strength rock. Lower values based on break patterns are likely associated with hematite and calcite banding. The fault sample yielded a strength of 70.7 MPa placing it in the high strength category indicating sound contacts that are well healed. Tables 5-2 summarizes the UC test data for Gneiss. Detailed results including pre and post compression photos of each specimen can be found in Appendix C. Core photos of the bedrock can be seen in Appendix F.

5.1.6.2 Limestone

Limestone was encountered at BH 18-106 located near the eastern shore of the Cataraqui River, it was also encountered in the west approach boreholes on John Counter Blvd, BH-18-201 ad 202. The limestone was found to be argillaceous in the upper portion with large silt/clay infillings in joints and frequent shale partings. The lower limestone was characterized by stylolites with shale partings. The limestone recovered on site was dark to light grey with horizontal bedding. Silt, clay and calcite infilling was observed within the joints. The rock was observed to be faintly weathered to fresh.

A fault gouge approximately 2 mm thick was observed at BH 18-201 at a depth of 6.50 mbgs.

The RQD for the limestone core ranged from 27% to 88%, with the limestone generally considered to be of fair quality with an average RQD of 61%.

Cerchar abrasion testing was conducted on one limestone specimen yielding a Cerchar index of 1.16, which is categorized as medium abrasiveness. Unconfined compression tests were also conducted on four (4) limestone samples, both the upper argillaceous and lower limestones were tested. The results of the sample breaks ranged from a strength of 65.5 to 89.2 MPa, with an average strength of 79.2 MPa. Based on the testing results the limestone is considered a high strength rock. Tables 5-3 summarizes the UC test data. Detailed results including pre and post compression photos of each tested specimen can be seen in Appendix C. Core photos of the bedrock can be seen in Appendix F.

Table 5-2: UC Test Data Summary - Gneiss

Borehole No.	Sample No.	Sample Depth (m)	UC Strength (MPa)
BH-18-101	*1*	*29.85-30.18*	*68.1*
	2	*30.68-30.90*	*124.5*
	3	*32.20-32.44*	*70.7*
BH-18-102	*1*	*42.88-43.13*	*90.4*
	2	45.24-45.42	140.2
BH-18-103	*1*	*26.13-26.39*	*103.1*
	2	*26.76-27.00*	*70.3*
BH-18-104	*1*	*21.92-22.20*	*45.7*
	2	*23.89-24.12*	*111.5*
BH-18-107	*1*	*39.29-39.55*	*114.5*
	3	*41.46-41.73*	*77.7*
Average Strength, MPa			92.4

Table 5-3: UC Test Data Summary - Limestone

Borehole No.	Sample No.	Sample Depth (m)	UC Strength (MPa)
BH-18-106	*1*	*2.60-2.74*	*84.3*
	2	*3.61-3.86*	*77.9*
BH-18-201	*1*	*4.95-5.11*	*65.4*
	3	*7.80-7.90*	*89.2*
Average Strength, MPa			79.2

5.2 West Approach Boreholes

Five (5) bore holes labeled BH-18-201 to 205 were advanced along the west approach of the bridge alignment and through John Counter Boulevard. BH-18-201 to 202 were drilled near the western shoreline of the Cataraqui River at the western abutment of the bridge and BH-18-203 – 205 were shallow road holes drilled through John Counter Boulevard to support road improvements and pavement design. The encountered soil strata will be discussed below. A borehole layout of the west approach boreholes can be seen in Figure 3. Detailed borehole logs for the west approach can be seen in Appendix A.

5.2.1 Asphalt

Asphalt was encountered at the road surface at drilling locations BH-18-202 to 205 and ranged in thickness from 75 to 100 mm thick. Significant road surface degradation was observed at drilling locations BH-18-201, 202 and 203.

5.2.2 Base Course

Beneath the asphalt road surface Granular A fill was observed at all drilling locations except BH 18-201 and 202. The fill ranged in thickness from 100 to 200 mm.

5.2.3 Subbase Course

A Subbase course FILL comprised of a SAND and GRAVEL (SW/GW) was also encountered at all boring locations along the west approach. The material ranged in thickness between 0.1 m and 1.3 m thick averaging a thickness of 0.7 m thick. The FILL was well graded and ranged in colour from grey to dark grey/black. The material was non-cohesive and exhibited signs of oxidation within the soil matrix. The FILL was also dry to moist and the material density ranged from loose to very dense with SPT 'N' Values ranging from 7 to 77 blows per 0.3 m averaging 34 blows per 0.3 m.

5.2.4 Fibrous SILTY PEAT (PT)

PEAT was encountered at BH-18-201, it was found to be high in organic content, with rootlets present in the sample. The peat was about 0.6 m thick and was wet. The material was considered very loose with an associated SPT 'N' value of 3 blows per 0.3 m.

5.2.5 SILTY CLAY (CL)

A SILTY CLAY (CL) was observed underlying the PEAT at BH-18-201. The material was 0.91 m thick and found to have a trace amount of organics and rootlets. The SILTY CLAY ranged in colour from brown to grey, was cohesive and had a water content approximately equal to plastic limit. The material was observed to be soft to firm with SPT 'N' values ranging from 3 to 4 blows per 0.3 m.

5.2.6 TILL

At drilling locations BH 18-201, 203 and 204 a layer of silty clay to clayey silt TILL was encountered prior to bedrock and/or auger refusal. The TILL was also observed to range from sandy to some fine-grained sand and to contain some to trace sub-angular gravel. This stratum was a mottled brownish grey to grey and dry to wet depending on the groundwater level. The compactness of the non-cohesive variant was very dense with an observed SPT 'N' value of 50 blows/4". The cohesive TILL ranged in consistency from firm to hard with SPT 'N' values ranging from 6 blows to refusal.

5.2.7 Bedrock

Bedrock was encountered at shallow depths along the west approach ranging from 0.21 to 4.16 mbgs. Visible bedrock outcrops can be found along the south road edge of John Counter Boulevard.

See section 5.1.6.2 for further details regarding bedrock conditions and lithology for the west approach. Detailed compression testing results taken from BH-18-201 can be seen in Appendix C and bedrock core photos can be seen in Appendix F.

6. Data

6.1 CPT and DMT Testing Data

ConeTec was retained by TULLOCH to perform CPT and DMT testing for borehole locations across the bridge alignment. The results of the testing for the CPT and DMT testing can be found in Appendix D and E respectively. For the interpretation of the testing it should be noted that all testing depths were taken from the reference of the river water level as noted in the figures in the appendices. Testing for BH-18-106 has been excluded due to the shallow depth and lack of usable data.

6.2 Hydraulic Conductivity Testing

Falling and rising head tests were conducted at each of the deep marine borehole drilling locations. The test procedure typically involved advancing the drill casing string to refusal on the assumed top of bedrock, raising the casing 0.9 m, and then conduct a rising or falling head test. The intent of the testing is to provide an estimate of the permeability value of the soil matrix right above the bedrock. Given that the testing was conducted down the drill casing and with a cut off time of 30 minutes, full recoveries were not realized, and results were extrapolated linearly using the Hvorslev Method (Fetter, 2000). Furthermore, due to drilling production time constraints, in some cases an initial static water level may not have been fully achieved prior to testing. Therefore, an approximate static water level was assumed for the purpose of estimating the conductivity for the overall test. Table 6-1 below summarizes the slug testing results from the investigation.

Table 6-1: Hydraulic Conductivity Test Summary

Borehole No.	Estimated Hydraulic Conductivity (cm/s)
BH-18-101	1×10^{-5}
BH-18-102	2×10^{-5}
BH-18-103	$< 1 \times 10^{-6}$
BH-18-104	2×10^{-5}
BH-18-105	2×10^{-5}
BH-18-107	2×10^{-6}
BH-18-110	$< 1 \times 10^{-6}$

Given the above assumptions, the hydraulic conductivity of the material immediately overlying the bedrock has a low permeability with the highest estimated hydraulic conductivity found to be 2×10^{-5} cm/s. The average permeability was found to be 1×10^{-5} cm/s. This indicates that the material is silty and well graded. Detailed conductivity test data can be seen in Appendix G.

6.3 Chemical Analysis Results

Table 6-2 shows a summary of the corrosivity testing. The concentration of sulphate indicates the degree of sulphate attack for concrete buried at the site. As shown in the table, the sulphate concentrations are less than 1000 mg/kg indicating a low degree of sulphate attack. Type GU Portland Cement should be suitable for use at this site.

The results of the chemical testing were compared in reference to ANSI/AWWA Corrosivity Rating System. A score greater than 10 indicates the soils are corrosive to buried metallic elements. The tested samples for boreholes 101, 102, 105 and 201 resulted in scores of 4, 2, 3, and 6 respectively.

In addition, chloride ions can lead to corrosion of steel. Typically, soils with chloride concentrations greater than 500 μg/g are considered corrosive. As noted in the table, chloride concentrations are less than 500 μg/g indicating non-corrosive nature of the soils.

Environmental/chemical testing was conducted at the selected borehole locations throughout both the marine and on-shore program. Results of this testing are included in Appendix H.

Table 6-2: Corrosivity Test Result Summary

Sample No.	BH-18-101/SS7	BH-18-102/SS1	BH-18-105/SS7	BH-18-201/SS5
Sample Depth (m)	4.9 – 5.5	0.0 – 0.6	4.9 – 5.5	3.0 – 3.7
Resistivity (Ω cm)	3580	4360	1920	4270
pH	7.88	6.53	8.31	7.83
Redox Potential (mV)	102	270	143	260
Sulfides (mg/kg)	3.7	N/D[1]	N/D[1]	N/A[2]
Moisture Content (%)	32	88.9	24.3	25.3
Sulphate (mg/kg)	N/D1	263	100	64
Chloride (ug/g)	30.9	174	144	51

Notes: [1] N/D: lower than the Detection Limit. [2] N/A: Test data not available and a maximum point of 3.5 was assigned accordingly in ANSI/AWWA Corrosivity Rating System.

6.4 Archeological Monitoring

During the marine investigation a team of Golder archaeologists was present for the drilling and sampling of the top 7.0 m of the soil along the bridge alignment to examine for cultural materials beneath the river bed. At the conclusion of the monitoring program no materials were encountered. The memo detailing the archeological monitoring program provided by Golder is provided in Appendix I.

7. Closure

TULLOCH has prepared this geotechnical report for the exclusive use of Hatch and the City and their authorized agents for the construction of the proposed Third Crossing Bridge.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practises in the field of geotechnical engineering, for the above noted location. Classification and identification of soils, and geologic units have been based upon commonly accepted methods employed in professional geotechnical practice. No warranty or other conditions, expressed or implied, should be understood. Please refer to the Report Limitations and Guidelines for Use, which pertains to this report and are shown below.

We trust that the information and factual data provided in this report will be sufficient to allow the City and their consultant to proceed towards detailed design of the Kingston Third Crossing Bridge. Should further elaboration be required for any portion of this project, we would be pleased to assist.

Erik Giles, P. Eng
Geotechnical Engineer

Greg Qu, Ph. D, P. Eng
Senior Geotechnical Engineer/Project Manager

NOTICE TO READER

This Report has been prepared by TULLOCH Engineering Ltd. ('TULLOCH') for the sole and exclusive use of Hatch Ltd. (the 'Client') to support foundation design for the proposed Third Crossing Bridge (the 'Development') in Kingston, Ontario (the 'Site'). The Report shall not be used for any other purpose, or provided to, relied upon or used by any third party without the express written consent of TULLOCH.

A limited number of boreholes were advanced at the Site; and as such, the information collected and presented herein applies to the borehole and test pit locations only. The subsurface conditions between boreholes and test pits can change and accordingly any use of the data contained in this Report should take into consideration the nature of the materials and potential variation between boreholes and test pits.

This Report contains opinions, conclusions and recommendations made by TULLOCH using professional judgment and reasonable care for the purpose of foundation design for the Development. Use of or reliance on this report by the Client is subject to the following conditions:

a) the report being read in the context of and subject to the terms of the Engineering Services Agreement for the Work, including any methodologies, procedures, techniques, assumptions and other relevant terms or conditions specified or agreed therein;
b) the report being read in its entirety. TULLOCH is not responsible for the use of portions of the report without reference to the entire report;
c) the conditions of the site may change over time or may have already changed due to natural forces or human intervention, and TULLOCH takes no responsibility for the impact that such changes may have on the accuracy or validity of the observations, conclusions and recommendations set out in this report;
d) the classification of soils and rocks in this report is based on commonly accepted methods. However, the classification of geologic materials and the boundaries between subsurface layers involves judgement. Boundaries between different soils layers may also be transitional rather than abrupt. TULLOCH does not warrant or guarantee the exactness of these descriptions and boundaries.
e) the subsurface conditions must be verified by a qualified geotechnical engineer during construction to ensure that the borehole data presented herein is representative of the actual site conditions so that the design recommendations contained herein remain valid; and
f) the report is based on information made available to TULLOCH by the Client or by certain third parties; and unless stated otherwise in the Agreement, Hatch has not verified the accuracy, completeness or validity of such information, makes no representation regarding its accuracy and hereby disclaims any liability in connection therewith.

This report has been prepared with the degree of care, skill and diligence normally provided by engineers in the performance of comparable services for projects of similar nature. The scope of this report includes foundation engineering design only and it specifically excludes investigation, detection, prevention and assessment of the presence of subsurface contaminants. No conclusions or inferences should be drawn regarding contamination at the site including but not limited to molds, fungi, spores, bacteria, viruses, soil gases such as Radon, PCBs, petroleum hydrocarbons, inorganic and volatile organic compounds, polycyclic aromatic hydrocarbons and or any by products thereof.

REFERENCES

Baker, M.B., (1916), Geology of Kingston and Vicinity, Ontario Bureau of Mines Reports, v.25

Fetter, C.W., (2000), Applied Hydrogeology (4th Edition). Pearson Education.

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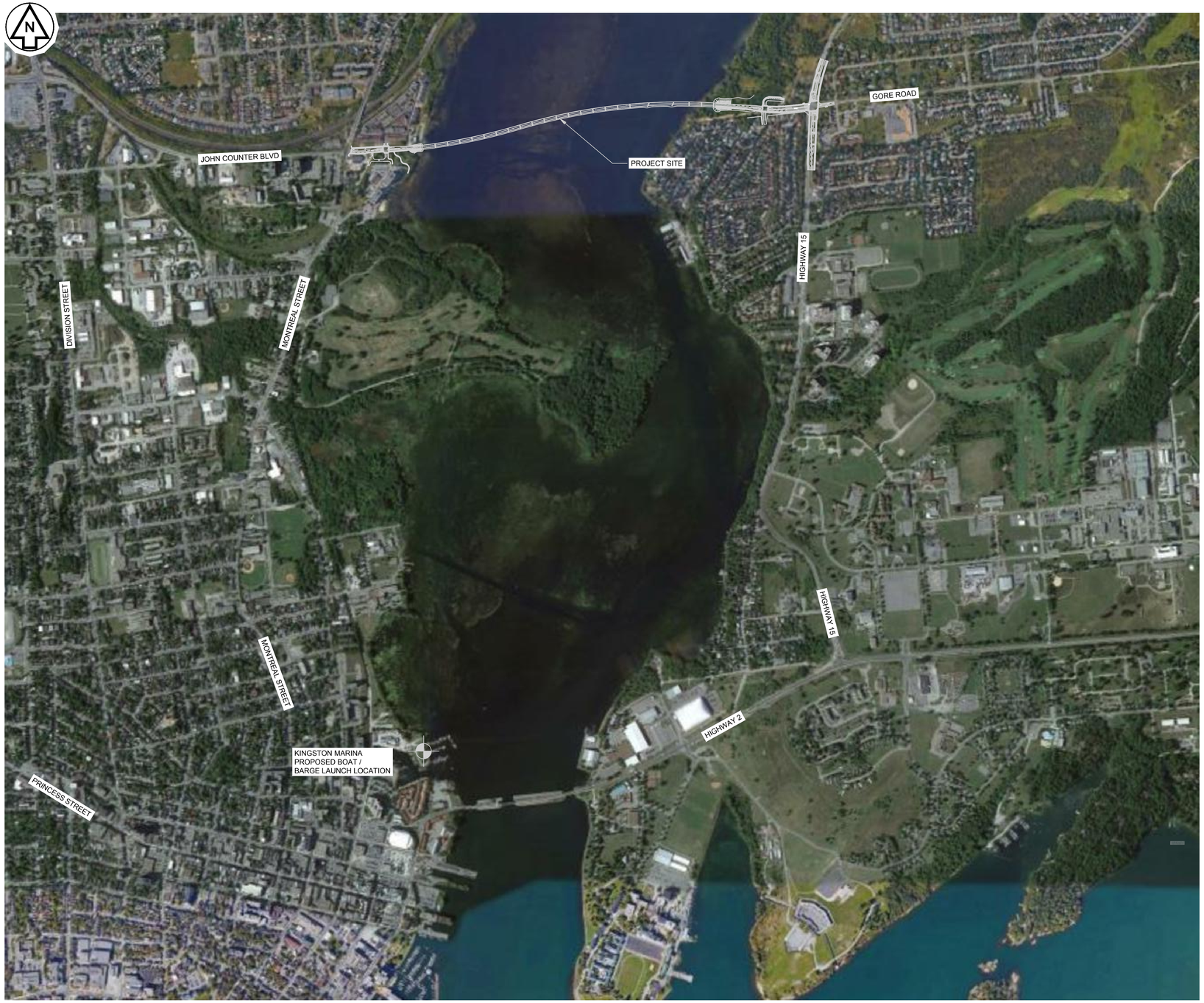
Henderson, E.P. (1964) Surficial Deposits in The Kingston-Gananoque (31 C SE ¼ Area of Eastern Ontario), Geological Survey of Canada

Sanford B.V., Arnott, R.W.C (2010): Stratigraphic and structural framework of the Potsdam Group in eastern Ontario, western Quebec and northern New York State

FIGURES



PLAN - KINGSTON
N.T.S.

NOTES:

1. PROJECTION OF THIS FIGURE HORIZONTAL DATUM IS NORTH AMERICAN DATUM 1983, UNIVERSAL TRANSVERSE MERCATOR (UTM) ZONE 18. VERTICAL DATUM IS CANADIAN GEODETIC VERTICAL DATUM 1928 (1978 ADJUSTMENT)
2. DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN.
3. PIER LOCATION UPDATED AS PER PLAN PROVIDED BY HATCH (H357883-03-260-WIP0-1000) 2019-01-09.
4. WATER LEVEL DATUM BELOW;

LOW WATER DATUM	EL. 74.16	CANADIAN HYDROGRAPHIC SERVICE (LAKE ONTARIO)
AVERAGE HIGH WATER	EL. 75.26	MINISTRY OF NATURAL RESOURCES (LAKE ONTARIO)
REGULATORY WATER LEVEL	EL. 76.30	CATARAQUI REGION CONSERVATION AUTHORITY "REGULATORY LIMIT WITHIN STUDY AREA"

DRAWING No.	DRAWING TITLE
-	-

REFERENCE DRAWINGS

No.	DATE	BY	DESCRIPTION
A	2019-01-18	GQ	ISSUED FOR GEOTECHNICAL REPORT

REVISIONS

ENGINEER'S SEAL

TULLOCH ENGINEERING

PROJECT: THIRD CROSSING OF THE CATARAQUI RIVER

CLIENT: CITY OF KINGSTON

DRAWING: Figure 1 Site Location Plan

DRAWN BY:	CHECKED BY:	PROJECT No. :	
K KORTEKAAS	G QU	18-4046	
DESIGNED BY:	APPROVED BY:	SCALE:	DATE:
G QU	S HINCHBERGER	AS NOTED	2018-09-07
DRAWING No.			REVISION No.
Figure 1 Site Location Plan			A

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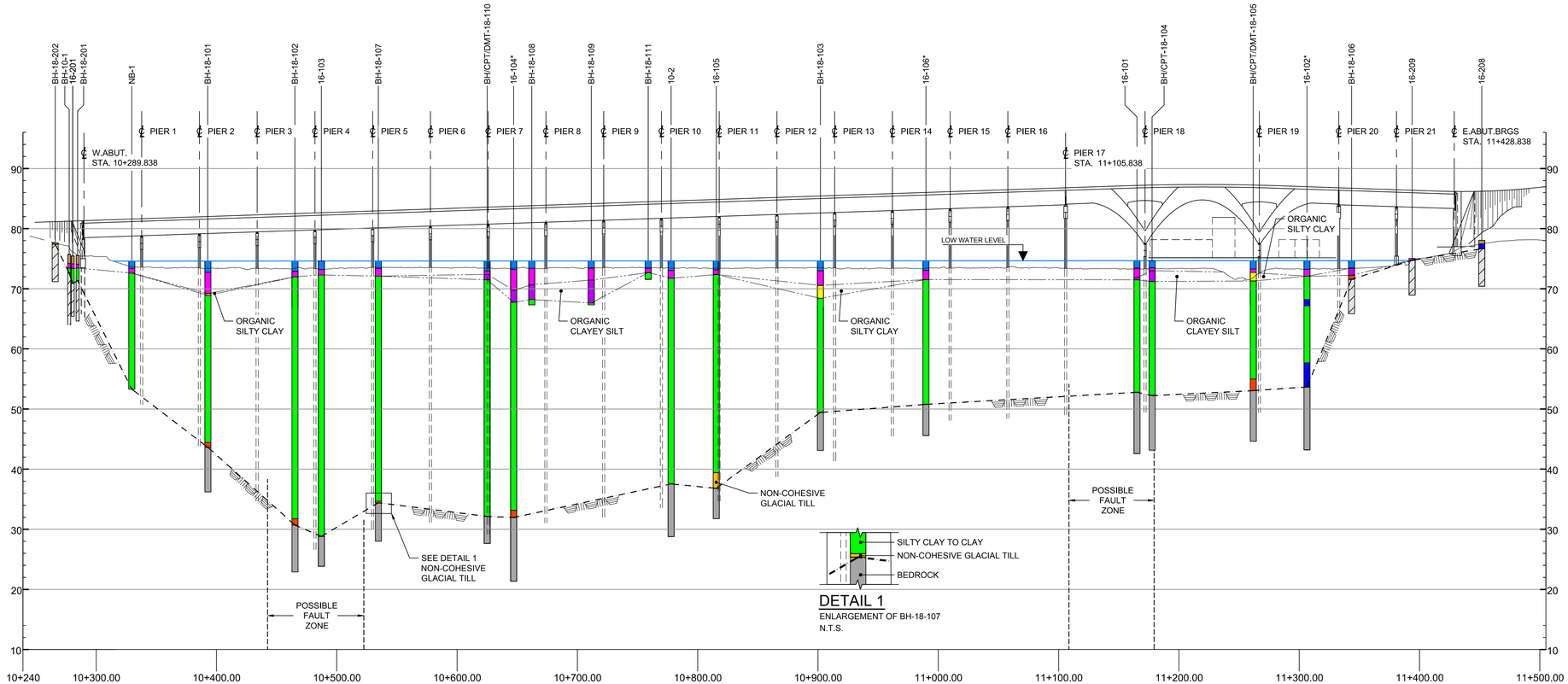
PLAN
SCALE: 1:2000



ELEVATION
HORIZONTAL SCALE 1:2000
VERTICAL SCALE: 1:400

DETAIL 1
ENLARGEMENT OF BH-18-107
N.T.S.

NOTES:

1. HORIZONTAL & VERTICAL CO-ORDINATES ARE UTM ZONE 18 (NAD83 CSRS).
2. BOREHOLE LOCATION SURVEYED USING HAND-HELD GPS WITH AN ACCURACY OF +/- 3m.
3. THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY FOR BOREHOLE LOCATIONS. THE SOIL STRATA BETWEEN BOREHOLE LOCATIONS IS ASSUMED.
4. THIS DRAWING IS TO BE READ WITH SUBJECT REPORT.
5. THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION ONLY.
6. PIER LOCATION UPDATED AS PER PLAN PROVIDED BY HATCH (H357883-03-260-WIP0-1000) 2019-01-09.
7. WATER LEVEL DATUM BELOW;

LOW WATER DATUM	EL. 74.16	CANADIAN HYDROGRAPHIC SERVICE (LAKE ONTARIO)
AVERAGE HIGH WATER	EL. 75.26	MINISTRY OF NATURAL RESOURCES (LAKE ONTARIO)
REGULATORY WATER LEVEL	EL. 76.30	CATARAQUI REGION CONSERVATION AUTHORITY "REGULATORY LIMIT WITHIN STUDY AREA"

LEGEND:

- BH-18-101 — 2018 BOREHOLE INVESTIGATIONS (TULLOCH)
- 10-2 — 2010 BOREHOLE INVESTIGATIONS (GOLDER, REPORT NO. 09-1121-0016)
- 16-201* — 2016 BOREHOE INVESTIGATIONS (GOLDER), * FOR SCPT AND BOREHOLES
- NB-1 — 1991 INVESTIGATIONS (STRATA, APPROXIMATE LOCATION)
- SUBMERGED HYDRO ONE UTILITY LINES (HYDRO ONE 2018-10-19)
- INFERRED BEDROCK PROFILE
- INFERRED INTERFACE BETWEEN PEAT / SILT AND CLAY
- WATER
- PEAT
- ORGANIC CLAYEY SILT
- ORGANIC SILTY CLAY
- SILTY CLAY TO CLAY
- SILT AND SAND
- COHESIVE GLACIAL TILL
- NON-COHESIVE GLACIAL TILL
- GRANITE / GNEISS
- LIMESTONE / DOLOSTONE
- FILL

BOREHOLE COORDINATES

WORK POINT	EASTING	NORTHING
BH-18-101	382 018	4 901 546
BH-18-102	382 089	4 901 561
BH-18-103	382 513	4 901 665
BH-18-104	382 782	4 901 700
BH-18-105	382 876	4 901 698
BH-18-106	382 952	4 901 698
BH-18-107	382 157	4 901 575
BH-18-108	382 281	4 901 606
BH-18-109	382 327	4 901 625
BH-18-110	382 245	4 901 597
BH-18-111	382 374	4 901 632
BH-18-201	381 911	4 901 529
BH-18-202	381 892	4 901 531

0 20 40 60 80 100 m
HORIZONTAL SCALE 1:2000

0 4 8 12 16 20 m
VERTICAL SCALE 1:400

DRAWING No.	DRAWING TITLE
-	-

REFERENCE DRAWINGS

No.	DATE	BY	DESCRIPTION
B	2019-03-29	GQ	ISSUED FOR GEOTECHNICAL REPORT
A	2019-01-18	GQ	ISSUED FOR GEOTECHNICAL REPORT

REVISIONS

ENGINEER'S SEAL

TULLOCH ENGINEERING

PROJECT: THIRD CROSSING OF THE CATARAQUI RIVER

CLIENT: CITY OF KINGSTON

DRAWING: Figure 2 Borehole Layout and Stratigarphic Profile Bridge Piers and Abutments

DRAWN BY:	CHECKED BY:	PROJECT No. :
K KORTEKAAS	G QU	18-4046
DESIGNED BY:	APPROVED BY:	SCALE: / DATE:
G QU	S HINCHBERGER	AS NOTED / 2018-09-07
DRAWING No.		REVISION No.
Figure 2 Borehole Layout and Profile - Bridge Piers and Abutments		B

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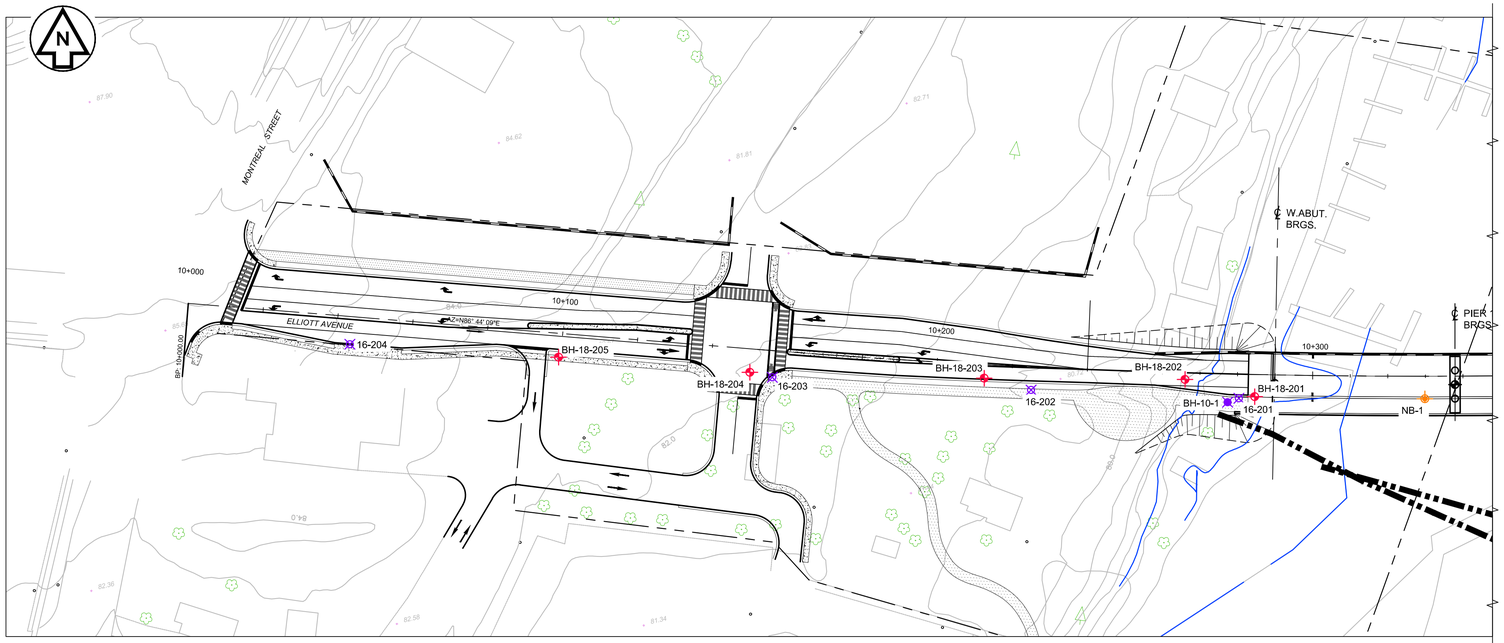
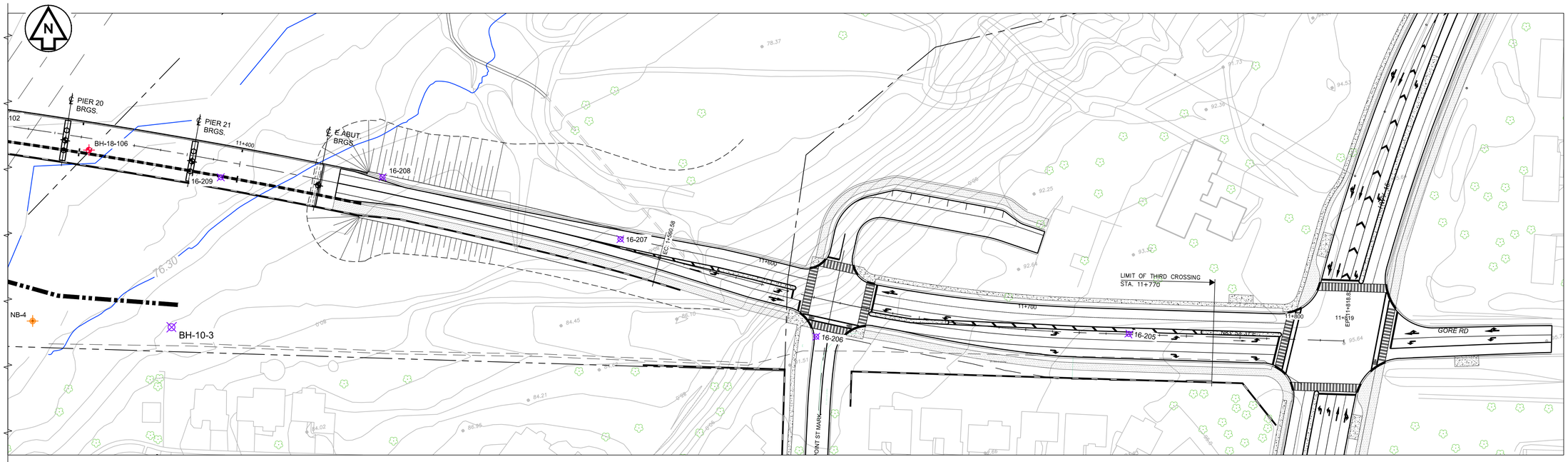


PLAN - WEST ABUTMENT
STA 10+000 TO 10+330
SCALE: 1:750



PLAN - EAST ABUTMENT
STA 11+250 TO 11+580
SCALE: 1:750

0 7.5 15 22.5 30 37.5
SCALE 1:750

NOTES:

1. PROJECTION OF THIS FIGURE HORIZONTAL DATUM IS NORTH AMERICAN DATUM 1983, UNIVERSAL TRANSVERSE MERCATOR (UTM) ZONE 18. VERTICAL DATUM IS CANADIAN GEODETIC VERTICAL DATUM 1928 (1978 ADJUSTMENT)
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- NB-1 — 1991 INVESTIGATIONS (STRATA, APPROXIMATE LOCATION)
- SUBMERGED HYDRO ONE UTILITY LINES (HYDRO ONE 2018-10-19)

BOREHOLE COORDINATES

WORK POINT	EASTING	NORTHING
BH-18-201	381 911	4 901 529
BH-18-202	381 892	4 901 531
BH-18-203	381 839	4 901 524
BH-18-204	381 777	4 901 517
BH-18-205	381 726	4 901 514

DRAWING No.	DRAWING TITLE
-	-

REFERENCE DRAWINGS

No.	DATE	BY	DESCRIPTION
A	2019-01-18	GQ	ISSUED FOR GEOTECHNICAL REPORT

REVISIONS

ENGINEER'S SEAL

TULLOCH ENGINEERING

PROJECT: THIRD CROSSING OF THE CATARAQUI RIVER

CLIENT: CITY OF KINGSTON

DRAWING: Figure 3 Borehole Layout Approach Embankments

DRAWN BY:	CHECKED BY:	PROJECT No.:	
K KORTEKAAS	G QU	18-4046	
DESIGNED BY:	APPROVED BY:	SCALE:	DATE:
G QU	S HINCHBERGER	AS NOTED	2018-09-07
DRAWING No.: Figure 3 Borehole Layout - Approach Embankments			REVISION No.: A

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APPENDIX A-1

BOREHOLE LOGS

ABBREVIATIONS, TERMINOLOGY AND PRINCIPAL SYMBOLS USED IN REPORT AND BOREHOLE LOGS

BOREHOLES AND TEST PIT LOGS

Soils

AA	Auger Sample	w	Water content
SS	Split Spoon	wP	Plastic Limit
TO	Tin-walled Tube	wL	Liquid Limit
TP	Thin-walled Piston	V(FV)	Field Vane
WS	Washed Sample	OR	Organic Content
SC	Soil Core	GR	Gravel
BS	Block Sample	SA	Sand
WH	Weight of rods & hammer	SI	Silt
WR	Weight of rods	CL	Clay

Bedrock

TCR	Total Core Recover	VN	Vein
SCR	Solid Core Recovery	CO	Contact
FI	Fracture frequency index	KV	Karstic void
HQ	Rock Core (63.5 mm dia.)	MB	Mechanical Break
NQ	Rock Core (47.6 mm dia.)	PL	Planar
BQ	Rock Core (36.5 mm dia.)	CU	Curved
JN	Joint	UN	Undulating
FLT	Fault	IR	Irregular
SH	Shear	SM	Smooth
K	Slikensided	SR	Slightly Rough
BD	Bedding	R	Rough
FO	Foliation	VR	Very rough

IN SITU SOIL TESTING

Standard Penetration Test (SPT) "N" value. The number of blows required to drive a 51 mm OD split barrel sampler into the soil a distance of 300 mm with a 63.5kg weight free falling a distance of 760mm after an initial penetration of 150mm has been achieved.

Dynamic Cone Penetration Test (DCPT) is the number of blows required to drive a cone with a 60 degree apex attached to "A" size drill rods continuously into the soil for each 300mm penetration with a 63.5 kg weight free falling a distance of 760mm.

Cone Penetration Test (CPT) is an electronic cone point with a 10 cm' base area with a 60 degree apex pushed through the soil at a penetration rate of 2cm/s.

Field Vane Test (FVT) consists of a vane blade, a set of rods and torque measuring apparatus used to determine the undrained shear strength of cohesive soils.

SOIL DESCRIPTIONS

The soil descriptions and classifications are based on an expanded Unified Soil Classification System (USCS). The USCS classifies soils on the basis of engineering properties. The system divides soils into three major categories; coarse grained and highly organrc soils. The soil is then subdivided based on either gradation or plasticity characteristics. The classification excludes particles larger than 75mm. To aid in quantifying materal amounts by eight within the respective grain size fractions the following terms have been included to expand the USCS:

Soil Classification		Terminology	Proportion
Clay	<0.002 mm	“trace”	1%to 10%
Silt	0.002 to 0.06 mm	"some"	10% to 20%
Sand	0.075 to 4.75 mm	Sandy, Gravelly, etc.	20% to 35%
Gravel	4.751o 75 mm	“and”	>35%
Cobbles	75 to 200 mm	Noun, SAND, SILT, etc.	>35%
Boulders	>200 mm		

Notes:

1. Soil properties, such as strength, gradation, plasticity, structure, etc. dictate the soils engineering behaviour over the grain size fractions;
2. With the exception of soil samples tested for grain size distribution or plasticity, all soil samples have been classified based on visual and tactile observations and is therefore an approximate description.

The following table outlines the qualitative terms used to describe the relative density condition of cohesionless soil:

Cohesionless Soils

Compactness	SPT “N” Value (blows/30cm)
Very Loose	0 to 4
Loose	5 to 10
Compact	11 to 30
Dense	31 to 50
Very Dense	>50

The following table outlines the qualitative terms used to describe the consistency of cohesive soils related to undrained shear strength and SPT, N-lndex:

Cohesive Soils

Consistency	Undrained Shear Strength (kPa)	SPT “N” Value (blows/30 cm)
Very Soft	<12.5	< 2
Soft	12.5 to 25	2 to 4
Firm	25 to 50	5 to 8
Stiff	50 to 100	9 to 15
Very Stiff	100 to 200	16 to 30
Hard	> 200	>30

Note: Utilizing the SPT, “N” value to correlate the consistency and undrained shear strength of cohesive soils is very approximate and needs to be used with caution.

Particle Sizes

Constituent	Description	Size (mm)	Size (in)
BOULDERS	Not Applicable	>300	>12
COBBLES	Not Applicable	75 to 300	3 to 12
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to0.425	(10) to (4) (40) to (10) (200) to (40)
SILT/CLAY	Classified by plasticity	< 0.075	< (200)

ROCK CORING

Rock Quality Designation (RQD) is an indirect measure of the number of fractures within a rock mass, Deere et al. (1967). It is the sum of sound pieces of rock core equal to or greater than 100 mm recovered from the core run, divided by the total length of the core run, expressed as a percentage. If the core section rs broken due to mechanical or handling, the pieces are fitted together and if 100 mm or greater included in the total sum.

Intact Rock Strength

Intact Strength (Mpa)	Description
< 1	Extremely low strength
1-5	Very low strength
5-25	Low strength
25-50	Medium strength
50-100	High strength
100-250	Very high strength
>250	Extremely high strength

Rock Mass Quality

RQD Classification	RQD Value (%)
Very poor quality	<25
Poor Quality	25 to 50
Fair Qualty	50 to 75
Good Quality	75 to 90
Excellent Quality	90 to 100

Rock Mass Weathering

Term	Description
Unweathered (Fresh)	No visible sign of material weathering to discoloration on major discontinuity surfaces.
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.
Moderatly Weathered	Less than half the rock material is decomposed and/or disintegrates to soil. Fresh or discolored rock is present either as a continuous frame work of as core stones.
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 frame work or as core stones.
Completely Weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is largely intact.
Residual Soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

Joint and Foliation Spacing

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

Bedding Thickness

Description	Spacing
Very thick	Greater than 2 m
Thick	0.6 m to 2 m
Medium	0.2 m to 0.6 m
Thin	60 mm to 0.2 m
Very thin	20 mm to 60 mm
Laminated	6 to 20 mm
Thinly laminated	Less than 6 mm

SYMBOLS

General

w_N Natural water content within the soil sample
γ Unit weight
γ' Effective unit weight
γ_D Dry unit weight
γ_{SAT} Saturated unit weight
ρ Density
ρ_s Density of solid particles
ρ_w Density of water
ρ_D Dry density
ρ_{SAT} Saturated density
e Void ratio
n Porosity
S Degree of saturation
E_{50} Fifty percent secant modulus

Consistency

w_L Liquid Limit
w_P Plastric Limit
I_P Plasticity Index
w_S Shrinkage limit
I_L Liquidity index
I_C Consistency index
e_{max} Void ratio in loosest state
e_{min} Void ratio in densest state
I_D Density index (formerly relative density)

Shear Strength

S_u Undrained shear strength parameter (total stress)
c' Effective cohesion intercept
ϕ' Effective friction angle
τ_R Peak shear strength
τ_R Residual shear strength
δ Angle of interface friction
μ Coefficient of friction = tan ϕ'

Consolidation

C_c Compression index (normally consolidated range)
C_r Recompression index (over consolidated range)
m_v Coefficient of volume change
c_v Coefficient of consolidation
T_v Time factor (vertical direction)
U Degree of consolidation
σ'_v Effictive overburden pressure
OCR Overconsolidation ratio

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-101

1 OF 4

METRIC

JOB NUMBER 19-1139 | LOCATION STATION 10+393 | ORIGINATED BY EG

CLIENT Hatch | DATUM CGVD28 | BOREHOLE TYPE Washboring/Coring | COMPILED BY EG

DRILLER MARATHON | DATE 2018.10.23 - 2018.10.23 | NORTHING 4901546 | EASTING 382018 | CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	RECOVERY RATIO	GROUND WATER CONDITIONS	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
72.7	RIVER BED							
0.0	(PT) FIBROUS PEAT TO FIBROUS SILTY PEAT with ORGANICS, rootlets, dark brown, wet, very loose		1	SS	WH	33%		OR: 84%
			2	SS	WH	33%		
			3	SS	WH	0%		
			4	SS	WH	0%		
			5a	SS	WH	100%		OR: 74%
69.2								
3.6	(OL) ORGANIC SILTY CLAY, some to trace decayed rootlets, dark grey, wet, very soft		5b	SS	WH	100%		
68.9								
3.8	(CI - CH) SILTY CLAY to CLAY, some to trace silt, silt seams, grey, cohesive, firm to very stiff		6	SS	2	50%		OR: 2.2%
			7	SS	5	100%		0 1 28 71
			8	SS	3	100%		
			9	SS	4	100%		
			10	TO		100%		

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH kPa (20 40 60 80 100)
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (20 40 60)

DEPTH (1 2 3 4 5 6 7 8 9)

119.8

+3 +5 +3 +3

Continued Next Page

200 + : Numbers refer to Field Vane Over Limit

+3, ×3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-101

METRIC

JOB NUMBER 19-1139 | LOCATION STATION 10+393 | ORIGINATED BY EG

CLIENT Hatch | DATUM CGVD28 | BOREHOLE TYPE Washboring/Coring | COMPILED BY EG

DRILLER MARATHON | DATE 2018.10.23 - 2018.10.23 | NORTHING 4901546 | EASTING 382018 | CHECKED BY GQ

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	RECOVERY RATIO					GR SA SI CL
	(CI - CH) SILTY CLAY to CLAY, some to trace silt, silt seams, grey, cohesive, firm to very stiff *(continued)*										
			11	SS	WH	100%		11			0 1 26 73
			12	SS	1	100%		12			
			13	SS	1	100%		13			
								14			
								15			
								16			
								17			
								18			
								19			

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

Continued Next Page

200 + : Numbers refer to Field Vane Over Limit

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-101

3 OF 4

METRIC

JOB NUMBER 19-1139 | LOCATION STATION 10+393 | ORIGINATED BY EG

CLIENT Hatch | DATUM CGVD28 | BOREHOLE TYPE Washboring/Coring | COMPILED BY EG

DRILLER MARATHON | DATE 2018.10.23 - 2018.10.23 | NORTHING 4901546 | EASTING 382018 | CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	(CI - CH) SILTY CLAY to CLAY, some to trace silt, silt seams, grey, cohesive, firm to very stiff *(continued)*										
			14	SS	WH	100%		21		○	
									+4		
									+3		
								22			
			15	SS	3	100%		23			
								24	+2		
								25			
								26			
			16	SS	3	100%				○	
								27	+4		
									+4		
								28			
44.5											
28.3	(SM) CLAYEY SILTY SAND (TILL), some gravel, angular, sand pockets, presence of cobbles & boulders, reddish grey, mottled		17	SS	52/ 10"	100%				⊢○	13 42 33 12
43.6								29			
29.1			Run 1	CORE							UCS = 68 MPa

Continued Next Page

200 + : Numbers refer to Field Vane Over Limit | $+^3$, $\times^3$: Numbers refer to Sensitivity | $\circ^{3\%}$ STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-101

4 OF 4

METRIC

JOB NUMBER 19-1139 | LOCATION STATION 10+393 | ORIGINATED BY EG

CLIENT Hatch | DATUM CGVD28 | BOREHOLE TYPE Washboring/Coring | COMPILED BY EG

DRILLER MARATHON | DATE 2018.10.23 - 2018.10.23 | NORTHING 4901546 | EASTING 382018 | CHECKED BY GQ

SOIL PROFILE			SAMPLES								
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	SILICEOUS GNEISS - light grey, fine to medium grained horizontal foliation, hematite/calcite banding 2 - 50 mm wide, very strong, fresh Run 1: TCR: 100% SCR: 100% RQD: 83% Fracture Index per 0.3m: 1.0 *(continued)*		Run 2	CORE				31			UCS = 125 MPa
41.5 31.2	Run 2: TCR: 100% SCR: 88% RQD: 98% Fracture Index per 0.3m: 1.0 *(continued)*		Run 3	CORE				32			UCS = 71 MPa
40.8 32.0	Run 3: TCR: 97% SCR: 76% RQD: 96% Fracture Index per 0.3m: 1.2		Run 4	CORE				33			
	Run 4: TCR: 100% SCR: 85% RQD: 90% Fracture Index per 0.3m: 1.5 - rehealed fault zones with quartz/feldspar, slightly weathered. secondary movement observed at 33.68 m, crystalline structure Run 5: TCR: 100% SCR: 59% RQD: 65% Fracture Index per 0.3m: 2.8		Run 5	CORE				34			
39.7 33.0								35			
38.0 34.8	DIORITE - green, fine to medium grained, crystalline, red hematite banding, very strong, faintly weathered Run 6: TCR: 77% SCR: 55% RQD: 64% Fracture index per 0.3m: 1.2		Run 6	CORE				36			
36.2 36.5	End of borehole										

$^{200}+$: Numbers refer to Field Vane Over Limit $+^{3}, \times^{3}$: Numbers refer to Sensitivity $\circ^{3\%}$ STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-102

1 OF 6

METRIC

JOB NUMBER 19-1139 | LOCATION STATION 10+465 | ORIGINATED BY EG

CLIENT Hatch | DATUM CGVD28 | BOREHOLE TYPE Washboring/Coring | COMPILED BY MA

DRILLER MARATHON | DATE 2018.10.29 - 2018.11.02 | NORTHING 4901561 | EASTING 382089 | CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
72.9	RIVER BED								
0.0	(PT) FIBROUS SILTY PEAT, with ORGANICS, rootlets, dark brown, wet, cohesive, very soft		1	SS	WR	67%			OR=16%
72.0			2a	SS	WH	100%			
0.9	(CI - CH) SILTY CLAY, some to trace organics, trace gravel, angular trace sand, fine to medium grained, silt seams, brownish grey to grey, cohesive, stiff to very stiff.		2b	SS	WH	100%		1	OR=5.2%
			3	SS	8	100%			0 1 42 57
								2	
			4	SS	17	100%			
								3	
			5	SS	15	100%			OR=2.2%
								4	
68.6									
4.3	(CI - CH) SILTY CLAY to CLAY, some silt, silt seams, grey, cohesive, firm to very stiff.		6	SS	4	100%			
								5	
	- Varved clay in sample		7	SS	5	100%			
								6	
			8	SS	2	100%			
								7	
			9	SS	WH	100%			
								8	
			10	SS	WH	100%			0 0 23 77

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH kPa (20 40 60 80 100)
- ○ UNCONFINED
- ● QUICK TRIAXIAL
- + FIELD VANE
- × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (20 40 60)

+4 +11 +5 +3 +3 +3 153 175.2

Continued Next Page

200 + : Numbers refer to Field Vane Over Limit

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-102

2 OF 6

METRIC

JOB NUMBER 19-1139 LOCATION STATION 10+465 ORIGINATED BY EG

CLIENT Hatch DATUM CGVD28 BOREHOLE TYPE Washboring/Coring COMPILED BY MA

DRILLER MARATHON DATE 2018.10.29 - 2018.11.02 NORTHING 4901561 EASTING 382089 CHECKED BY GQ

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	RECOVERY RATIO			20 40 60 80 100	w_P w w_L	GR SA SI CL
	(CI - CH) SILTY CLAY to CLAY, some silt, silt seams, grey, cohesive, firm to very stiff. *(continued)*								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	20 40 60	
								10	+5 +6		
			11	SS	WH	100%					
								11	+4 +5		
								12			
								13		○	
			12	SS	WH	100%					
								14	+7 +4		
								15			
								16			
			13	TO		100%					
								17	+8 +5		

Continued Next Page

200 + : Numbers refer to Field Vane Over Limit $+^3$, $\times^3$: Numbers refer to Sensitivity $\circ^{3\%}$ STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-102

3 OF 6

METRIC

JOB NUMBER 19-1139 | LOCATION STATION 10+465 | ORIGINATED BY EG

CLIENT Hatch | DATUM CGVD28 | BOREHOLE TYPE Washboring/Coring | COMPILED BY MA

DRILLER MARATHON | DATE 2018.10.29 - 2018.11.02 | NORTHING 4901561 | EASTING 382089 | CHECKED BY GQ

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	RECOVERY RATIO					GR SA SI CL
	(CI - CH) SILTY CLAY to CLAY, some silt, silt seams, grey, cohesive, firm to very stiff. *(continued)*							19			
			14	SS	2	100%					
								20	4, 6		
								21			
								22			
			15	SS	WR	100%					
								23	4, 5		
								24			
								25			
			16	SS	WR	100%					
								26	5, 5		

Continued Next Page

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

200 + : Numbers refer to Field Vane Over Limit

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-102

METRIC

JOB NUMBER 19-1139 | LOCATION STATION 10+465 | ORIGINATED BY EG

CLIENT Hatch | DATUM CGVD28 | BOREHOLE TYPE Washboring/Coring | COMPILED BY MA

DRILLER MARATHON | DATE 2018.10.29 - 2018.11.02 | NORTHING 4901561 | EASTING 382089 | CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	(CI - CH) SILTY CLAY to CLAY, some silt, silt seams, grey, cohesive, firm to very stiff. *(continued)*										
	- Varved clay in sample		17	SS	WR	100%		28			
								29	+4 +5		
								30			
			18	SS	2	100%		31		○	
								32	+3 +		
								33			
								34			
			19	SS	WR	100%		35	128 3 +	○	

Continued Next Page

200 + : Numbers refer to Field Vane Over Limit | $+^3$, $\times^3$: Numbers refer to Sensitivity | $\circ^{3\%}$ STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-102

5 OF 6

METRIC

JOB NUMBER 19-1139 | LOCATION STATION 10+465 | ORIGINATED BY EG

CLIENT Hatch | DATUM CGVD28 | BOREHOLE TYPE Washboring/Coring | COMPILED BY MA

DRILLER MARATHON | DATE 2018.10.29 - 2018.11.02 | NORTHING 4901561 | EASTING 382089 | CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	(CI - CH) SILTY CLAY to CLAY, some silt, silt seams, grey, cohesive, firm to very stiff. *(continued)*							37			
	- Possible non-cohesive interbedded layer at the depth of 37. 5 m, noting the low recovery from the split spoon.		20	SS	WH	0%		38			
	- Shear vane would not turn								4, 133		
			21	SS	2	100%		39			
									128, 4		
			22	SS	6	100%		40			
									1		
31.8								41			
41.2	(CL) SILTY CLAY (TILL), trace fine gravel, angular, trace sand, coarse to fine grained, silt and sand seams, presence of cobbles and boulders, grey, cohesive, very stiff to hard.		23	SS	20	100%					1 3 48 48
			24	SS	50/ 8"	33%		42			
30.7											
42.2	Feldspathic Biotite GNEISS - dark greenish grey, fine grained, intruded by pink coarse grained granite areas, sound granite contacts, horizontal hematite and calcite banding, strong to very strong, fresh		Run 1	CORE							
	Fault located between 43.66 m to 43.89 m, rehealed and brecciated with pink granite and dark intrusive rock.		Run 2	CORE				43			UCS = 90 MPa
	Run 1 - Short Run to set Coring bit parameters not reported Fault located between 43.66 to 43.89, rehealed and brecciated with pink granite and dark intrusive rock.										
29.0											
43.9	Run No.: 2 TCR%: 97% SCR%: 75% RQD: 78% Fracture index per 0.3m: 2.0		Run 3	CORE				44			

Continued Next Page

200 + : Numbers refer to Field Vane Over Limit | $+^3$, $\times^3$: Numbers refer to Sensitivity | $\circ^{3\%}$ STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-102 6 OF 6 METRIC

JOB NUMBER 19-1139 LOCATION STATION 10+465 ORIGINATED BY EG

CLIENT Hatch DATUM CGVD28 BOREHOLE TYPE Washboring/Coring COMPILED BY MA

DRILLER MARATHON DATE 2018.10.29 - 2018.11.02 NORTHING 4901561 EASTING 382089 CHECKED BY GQ

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	RECOVERY RATIO			20 40 60 80 100		GR SA SI CL
27.5	Feldspathic Biotite GNEISS - dark greenish grey, fine grained, intruded by pink coarse grained granite areas, sound granite contacts,										UCS = 140 MPa
45.4	horizontal hematite and calcite banding, strong to very strong, fresh Fault located between 43.66 m to 43.89 m, rehealed and brecciated with pink granite and dark intrusive rock. Run 1 - Short Run to set Coring bit parameters not reported *(continued)* Run No.: 3 TCR%: 95% SCR%: 35% RQD: 60% Fracture index per 0.3m: 3.2		Run 4	CORE				46			
26.0	*(continued)*										
46.9	Run No.: 4 TCR%: 100% SCR%: 93% RQD: 90% Fracture index per 0.3m: 0.6 Run No.: 5 TCR%: 98% SCR%: 68% RQD: 63% Fracture index per 0.3m: 2.0		Run 5	CORE				47 48			
24.4											
48.5	Fault located between 48.95 m to 49.07 m, rehealed with white calcite, brecciated pieces 10 to 30 mm Run No.: 6 TCR%: 87% SCR%: 32% RQD: 35% Fracture index per 0.3m: 4.6		Run 6	CORE				49			
22.9											
50.0	End of borehole							50			

200_{+} : Numbers refer to Field Vane Over Limit $+^{3}, \times^{3}$: Numbers refer to Sensitivity $\circ^{3\%}$ STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-103

1 OF 3

METRIC

JOB NUMBER 19-1139 LOCATION STATION 10+902 ORIGINATED BY EG

CLIENT Hatch DATUM CGVD28 BOREHOLE TYPE NQ Rotary/Coring COMPILED BY SK

DRILLER MARATHON DATE 2018.11.30 - 2018.12.03 NORTHING 4901665 EASTING 382513 CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH
73.0	RIVER BED							
0.0	(PT - OL) FIBROUS PEAT and ORGANIC SILT, trace to some decayed rootlets, dark brown, cohesive, very soft		1	SS	WR	30%		
			2	SS	WR	38%		1
			3	SS	WR	50%		
			4a	SS	WH	63%		2
70.6			4b	SS	WH	63%		
2.4	(OL - CL) ORGANIC SILTY CLAY, trace to some organics, trace sand, dark grey, wet, low to intermediate plasticity, very soft to firm		5	SS	WR	93%		3
			6	SS	WR	100%		4
68.4			7a	SS	WH	100%		
4.6	(CI - CH) SILTY CLAY, silt seams, grey, cohesive, stiff to very stiff		7b	SS	WH	100%		5
			8	SS	2	47%		6
			9	SS	7	100%		7
			10	SS	5	100%		8
63.9								9
9.1	(CI - CH) SILTY CLAY to CLAY, some silt, grey, cohesive, firm to stiff							

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH kPa (20 40 60 80 100)
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (20 40 60)

475 OR=50.50%

96

+10

+0

+2

146 2

133 6

+5

+3

REMARKS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
0	1	49	50
0	0	24	76

Continued Next Page

200 + : Numbers refer to Field Vane Over Limit

+3, ×3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-103

2 OF 3 **METRIC**

JOB NUMBER 19-1139 LOCATION STATION 10+902 ORIGINATED BY EG

CLIENT Hatch DATUM CGVD28 BOREHOLE TYPE NQ Rotary/Coring COMPILED BY SK

DRILLER MARATHON DATE 2018.11.30 - 2018.12.03 NORTHING 4901665 EASTING 382513 CHECKED BY GQ

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	RECOVERY RATIO			20 40 60 80 100	20 40 60	GR SA SI CL
	(CI - CH) SILTY CLAY to CLAY, some silt, grey, cohesive, firm to stiff *(continued)*		11	SS	6	100%		11	+5	○	
								12	+5		
			12	SS	1	100%		13		○	
								14	+5 +5		
			13	TO	WH	100%		16			
								17	+3 +4		
			14	SS	WH	100%		18		○	
								19			

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE

Continued Next Page

200 + : Numbers refer to Field Vane Over Limit +3, ×3: Numbers refer to Sensitivity ○3% STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-103

3 OF 3

METRIC

JOB NUMBER 19-1139 LOCATION STATION 10+902 ORIGINATED BY EG

CLIENT Hatch DATUM CGVD28 BOREHOLE TYPE NQ Rotary/Coring COMPILED BY SK

DRILLER MARATHON DATE 2018.11.30 - 2018.12.03 NORTHING 4901665 EASTING 382513 CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	SAMPLES: RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	(CI - CH) SILTY CLAY to CLAY, some silt, grey, cohesive, firm to stiff *(continued)*							21			
								22			
			15	SS	WH	100%		23	+4 +3		
49.1											
23.9	Feldspathic Biotite GNEISS - dark greenish grey, fine grained with medium to coarse grained pink granite intrusions, granite contacts are sound, presence of calcite and hematite banding horizontal to the core axis, strong to very strong rock, fresh Run No.: 1 TCR%: 100 SCR%: 76 RQD: 84 Fracture index per 0.3m: 1.8		Run 1	CORE				24			
47.5								25			
25.5	Run No.: 2 TCR%: 100 SCR%: 92 RQD: 98 Fracture index per 0.3m: 0.4		Run 2	CORE				26			UCS = 103 MPa UCS = 70 MPa
46.0								27			
27.0	Run No.: 3 TCR%: 100 SCR%: 90 RQD: 92 Fracture index per 0.3m: 0.8		Run 3	CORE				28			
44.5											
28.5	Run No.: 4 TCR%: 100 SCR%: 61 RQD: 76 Fracture index per 0.3m: 2.0		Run 4	CORE				29			
43.1											
29.9	End of borehole										

200 + : Numbers refer to Field Vane Over Limit

+ 3 , × 3 : Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-104

1 OF 3

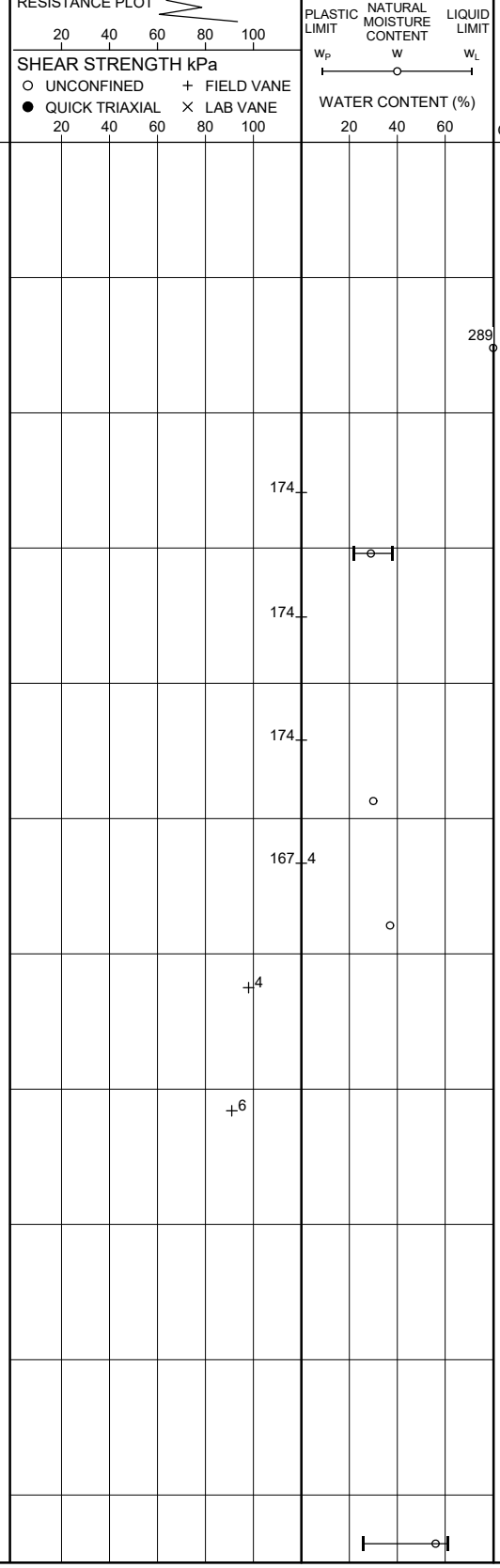
METRIC

JOB NUMBER 19-1139 | LOCATION STATION 11+173 | ORIGINATED BY EG

CLIENT Hatch | DATUM CGVD28 | BOREHOLE TYPE Washboring/Coring | COMPILED BY MA

DRILLER MARATHON | DATE 2018.11.09 - 2018.11.09 | NORTHING 4901700 | EASTING 382782 | CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
73.5	RIVER BED								
0.0	(PT) FIBROUS SILTY PEAT, with ORGANICS, rootlets, dark brown, cohesive, very soft		1	SS	WR	13%			
73.0									
0.5	(OL - PT) ORGANIC CLAYEY SILT, with decayed rootlets, with sand, dark brown, low plasticity, very soft		2	SS	WR	67%		1	
			3	SS	WR	100%			
			4	SS	4	100%		2	
71.2	- Shear vane would not turn								
2.3	(CI - CH) SILTY CLAY, trace organics, silt seams, grey, cohesive, very stiff		5	SS	11	100%		3	
70.0									
3.5	(CI - CH) SILTY CLAY, silt seams, grey to brownish grey, cohesive, very stiff - Shear vane would not turn		6	SS	12	79%		4	
	- Shear vane would not turn		7	SS	10	92%		5	0 0 32 68
68.1									
5.4	(CI - CH) SILTY CLAY to CLAY, some silt, grey, cohesive, stiff		8	SS	6	100%		6	
			9	SS	WH	62%		7	
			10	SS	3	100%			
			11	SS	WH	100%		8	
			12	TO				9	
			13	SS	2	100%		10	



Continued Next Page

200 + : Numbers refer to Field Vane Over Limit

+3, ×3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-104 2 OF 3 METRIC

JOB NUMBER 19-1139 LOCATION STATION 11+173 ORIGINATED BY EG

CLIENT Hatch DATUM CGVD28 BOREHOLE TYPE Washboring/Coring COMPILED BY MA

DRILLER MARATHON DATE 2018.11.09 - 2018.11.09 NORTHING 4901700 EASTING 382782 CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	(CI - CH) SILTY CLAY to CLAY, some silt, grey, cohesive, stiff *(continued)*							11	+3		
									+3		
								12			
								13			
			14	SS	3	100%				○	
								14	+4		
									+16		
								15			
								16			
			15	TO		100%					
								17	+5		
									+4		
			16	SS	WH	100%		18		○	0 0 44 56
									+5		
								19	+5		
			17	SS	1	100%				○	
								20	+7		
			18	SS	WH	0%					
	- possible non-cohesive layer, noting the low recovery from SS18.										
			19	SS	50/ 7"	75%					

Continued Next Page

200 + : Numbers refer to Field Vane Over Limit +3, ×3: Numbers refer to Sensitivity ○3% STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-104

3 OF 3 **METRIC**

JOB NUMBER 19-1139 LOCATION STATION 11+173 ORIGINATED BY EG

CLIENT Hatch DATUM CGVD28 BOREHOLE TYPE Washboring/Coring COMPILED BY MA

DRILLER MARATHON DATE 2018.11.09 - 2018.11.09 NORTHING 4901700 EASTING 382782 CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	SAMPLES: RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
52.2									
21.3	Feldspathic Biotite GNEISS - dark greenish grey, fine grained, intruded by pink granite, granite contacts are sound, presence of calcite and hematite banding, gneissic banding, strong to very strong, fresh Run No.: 1 TCR%: 100 SCR%: 81 RQD: 93 Fracture index per 0.3m: 1.47		Run 1	CORE				22	UCS = 46 MPa
50.8									
22.7	Run No.: 2 TCR%: 100 SCR%: 97 RQD: 100 Fracture index per 0.3m: 0.6		Run 2	CORE				23	
49.3								24	UCS = 112 MPa
24.2	Run No.: 3 TCR%: 100 SCR%: 97 RQD: 90 Fracture index per 0.3m: 0.6		Run 3	CORE				25	
47.7									
25.8	Run No.: 4 TCR%: 100 SCR%: 90 RQD: 85 Fracture index per 0.3m: 1.0		Run 4	CORE				26	
46.2								27	
27.3	Core lost from 28.24 - 28.32 m due to presence of calcite geode ground out during drilling Run No.: 5 TCR%: 95 SCR%: 92 RQD: 93 Fracture index per 0.3m: 0.80		Run 5	CORE				28	
44.7									
28.8	Run No.: 6 TCR%: 100 SCR%: 90 RQD: 92 Fracture index per 0.3m: 1.0		Run 6	CORE				29	
43.2								30	
30.3	End of borehole								

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH kPa (20 40 60 80 100)
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%) (20 40 60)

$^{200}+$: Numbers refer to Field Vane Over Limit

$+^{3}, \times^{3}$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-105

1 OF 3

METRIC

JOB NUMBER 19-1139 | LOCATION STATION 11+267 | ORIGINATED BY EG

CLIENT Hatch | DATUM CGVD28 | BOREHOLE TYPE NW Washboring/Coring | COMPILED BY MA

DRILLER MARATHON | DATE 2018.11.13 - 2018.11.13 | NORTHING 4901698 | EASTING 382876 | CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE; 20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
73.3	RIVER BED										
0.0 / 72.7	(PT - OL) FIBROUS PEAT and ORGANIC SILT, some clay, rootlets, dark brown, cohesive, very soft		1	SS	WR	33%				129	OR=11.5%
0.6 / 71.3	(OL-OH) ORGANIC SILTY CLAY, with interbeded peat layers, some sand, some decayed rootlets, brown to grey, cohesive, very soft		2	SS	WR	17%		1			
			3	SS	WR	100%					OR=8.8%
2.0	(CI - CH) SILTY CLAY, silt seams, grey to brownish grey, cohesive, stiff to very stiff							2	+3		
			4	SS	5	100%					
								3	+3		
			5	SS	8	100%					
									140 _3		
			6	SS	10	100%		4			0 0 32 68
									+4		
			7	SS	7	100%		5			
									+5		
			8	SS	7	100%		6			
									133 _8		
	- Fine grained sand pockets at 6.71 - 7.32 m		9	SS	7	100%		7			
									126 _4		
			10	TO		71%		8	+4		
									+4		
								9			
									+4		
									140 _3		

Continued Next Page

200 + : Numbers refer to Field Vane Over Limit | $+^3$, $\times^3$: Numbers refer to Sensitivity | $\circ^{3\%}$ STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-105 2 OF 3 METRIC

JOB NUMBER 19-1139 LOCATION STATION 11+267 ORIGINATED BY EG

CLIENT Hatch DATUM CGVD28 BOREHOLE TYPE NW Washboring/Coring COMPILED BY MA

DRILLER MARATHON DATE 2018.11.13 - 2018.11.13 NORTHING 4901698 EASTING 382876 CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	(CI - CH) SILTY CLAY, silt seams, grey to brownish grey, cohesive, stiff to very stiff *(continued)*		11	SS	6	100%		11			
			12	SS	6	100%		13			
			13	TO		100%		16			
55.0			14	SS	1	100%		18			
18.3	(CL) SILTY CLAY (TILL), trace gravel, sub-rounded to sub-angular, trace sand, fine grained, presence of cobbles and boulders, cohesive, stiff		15	SS	5	100%		19			0 1 46 53

Continued Next Page

200 + : Numbers refer to Field Vane Over Limit $+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-105

3 OF 3

METRIC

JOB NUMBER 19-1139 | LOCATION STATION 11+267 | ORIGINATED BY EG

CLIENT Hatch | DATUM CGVD28 | BOREHOLE TYPE NW Washboring/Coring | COMPILED BY MA

DRILLER MARATHON | DATE 2018.11.13 - 2018.11.13 | NORTHING 4901698 | EASTING 382876 | CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
53.1	- become more silty		16	SS	50/2"				
20.2	Feldspathic Biotite GNEISS - dark greenish grey, fine grained, intruded by pink granite, granite contacts are sound, presence of calcite and hematite banding, gneissic banding, strong to very strong, fresh Run No.: 1 TCR%: 100 SCR%: 34 RQD: 47 Fracture index per 0.3m: 3.0		Run 1	CORE					
52.3								21	
21.0	Run No.: 2 TCR%: 100 SCR%: 75 RQD: 98 Fracture index per 0.3m: 1.40		Run 2	CORE					
50.7								22	
22.6	Run No.: 3 TCR%: 100 SCR%: 73 RQD: 95 Fracture index per 0.3m: 1.80		Run 3	CORE					
49.2								23	
24.1	Run No.: 4 TCR%: 95 SCR%: 60 RQD: 78 Fracture index per 0.3m: 2.0		Run 4	CORE					
47.7								24	
25.6	Run No.: 5 TCR%: 100 SCR%:67 RQD: 80 Fracture index per 0.3m: 2.20		Run 5	CORE					
46.2								25	
27.1	Run No.: 6 TCR%: 100 SCR%: 65 RQD: 88 Fracture index per 0.3m: 3.0		Run 6	CORE					
44.6								26	
28.7	End of borehole							27	
								28	

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH kPa (20 40 60 80 100)
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (20 40 60)

$^{200}+$: Numbers refer to Field Vane Over Limit

$+^{3}, \times^{3}$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-106 1 OF 1 METRIC

JOB NUMBER 19-1139 LOCATION STATION 11+344 ORIGINATED BY EG

CLIENT Hatch DATUM CGVD28 BOREHOLE TYPE NW Washboring/Coring COMPILED BY SK

DRILLER MARATHON DATE 2018.11.27 - 2018.11.27 NORTHING 4901698 EASTING 382952 CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	SAMPLES: RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
73.5	RIVER BED										
0.0 / 73.2	(PT - OL) FIBROUS PEAT and ORGANIC CLAEY SILT, some decayed rootlets, dark brown, cohesive, very soft		1	SS	WR	22%					OR=19%
0.3 / 72.2	(OL - PT) ORGANIC CLAYEY SILT with PEAT, with decayed rootlets, trace to some sand, dark brown, cohesive, very soft		2	SS	WR	30%		1		295	
1.2 / 71.6	(CI) SILTY CLAY (TILL), trace sand, trace gravel, sub angular to sub rounded, grey, cohesive, firm		3	SS	2	75%				579	6 9 49 36
1.9 / 70.4	LIMESTONE - light grey, fine grained, horizontal bedding spaced at 2 - 100 mm characterized by stylolite, strong, fresh Run No.: 1 TCR%: 100 SCR%: 100 RQD: 88 Fracture index per 0.3m: 1.0		Run 1	CORE				2			UCS = 84 MPa
3.1 / 68.8	ARGILLACEOUS LIMESTONE - dark grey, fine grained, horizontal bedding, shale partings, closed jointing, medium strong, faintly weathered Run No.: 2 TCR%: 93 SCR%: 83 RQD: 68 Fracture index per 0.3m: 1.80		Run 2	CORE				3			UCS = 78 MPa
4.6 / 67.3	Run No.: 3 TCR%: 100 SCR%: 56 RQD: 48 Fracture index per 0.3m: 4.06		Run 3	CORE				4			
6.2 / 65.8	Run No.: 4 TCR%: 100 SCR%: 59 RQD: 46 Fracture index per 0.3m: 4.29		Run 4	CORE				5			
7.6	End of borehole							6			
								7			

$200+$: Numbers refer to Field Vane Over Limit $+^{3}, \times^{3}$: Numbers refer to Sensitivity $\circ^{3\%}$ STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-107

1 OF 5

METRIC

JOB NUMBER 19-1139 | LOCATION STATION 10+535 | ORIGINATED BY EG

CLIENT Hatch | DATUM CGVD28 | BOREHOLE TYPE NW Washboring/Coring | COMPILED BY MA

DRILLER MARATHON | DATE 2018.11.03 - 2018.11.03 | NORTHING 4901575 | EASTING 382157 | CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH
73.4	RIVER BED							
0.0	(PT) FIBROUS SILTY PEAT with ORGANICS, rootlets, dark brown, cohesive, very soft		1a	SS	WR	60%		
			1b	SS	WR	60%		
			2	SS	WR	68%		1
72.1								
1.2	(CI - CH) SILTY CLAY, trace sand, fine grained, trace organics, silt seams, dark grey to grey, cohesive, firm to very stiff.		3	SS	7	93%		
	- Shear vane would not turn		4	SS	5	100%		2
	- Shear vane would not turn		5	SS	9	100%		3
			6	SS	10	85%		4
			7	SS	6	100%		5
			8	SS	5	77%		6
66.8								
6.6	(CI - CH) SILTY CLAY to CLAY, some silt, grey, cohesive, stiff to very stiff		9	SS	3	100%		7
			10	SS	1	100%		8
								9

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH kPa (20 40 60 80 100)

○ UNCONFINED + FIELD VANE

● QUICK TRIAXIAL × LAB VANE

133 133 140 7 160 3 5 4 6 7 4.9 4 5

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (20 40 60)

REMARKS & GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

OR = 59%

0 1 21 78

Continued Next Page

200 + : Numbers refer to Field Vane Over Limit

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-107 2 OF 5 METRIC

JOB NUMBER 19-1139 LOCATION STATION 10+535 ORIGINATED BY EG

CLIENT Hatch DATUM CGVD28 BOREHOLE TYPE NW Washboring/Coring COMPILED BY MA

DRILLER MARATHON DATE 2018.11.03 - 2018.11.03 NORTHING 4901575 EASTING 382157 CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	(CI - CH) SILTY CLAY to CLAY, some silt, grey, cohesive, stiff to very stiff *(continued)*		11	SS	2	100%		11	+3	○	
								11	+3		
			12	SS	2	100%		13			
								14	+5		
								14	+4		
			13	SS	3	100%		16		○	
								17	+4		
								17	+4		
			14	SS	2	100%		19		○	

Continued Next Page

200 + : Numbers refer to Field Vane Over Limit +3, ×3: Numbers refer to Sensitivity ○3% STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-107

3 OF 5

METRIC

JOB NUMBER 19-1139 LOCATION STATION 10+535 ORIGINATED BY EG

CLIENT Hatch DATUM CGVD28 BOREHOLE TYPE NW Washboring/Coring COMPILED BY MA

DRILLER MARATHON DATE 2018.11.03 - 2018.11.03 NORTHING 4901575 EASTING 382157 CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	(CI - CH) SILTY CLAY to CLAY, some silt, grey, cohesive, stiff to very stiff *(continued)*										
								21			
								22			
			15	SS	1	100%					
								23			
								24			
								25			
			16	SS	3	100%					
								26			
								27			
								28			
	- Varved clay in sample		17	SS	1	100%					
								29			

Continued Next Page

200 + : Numbers refer to Field Vane Over Limit +3, ×3: Numbers refer to Sensitivity ○3% STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-107

4 OF 5

METRIC

JOB NUMBER 19-1139 LOCATION STATION 10+535 ORIGINATED BY EG

CLIENT Hatch DATUM CGVD28 BOREHOLE TYPE NW Washboring/Coring COMPILED BY MA

DRILLER MARATHON DATE 2018.11.03 - 2018.11.03 NORTHING 4901575 EASTING 382157 CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	(CI - CH) SILTY CLAY to CLAY, some silt, grey, cohesive, stiff to very stiff *(continued)*										
			18	TO		0%		31			
								32	+3, +4		
			19	TO		77%		33			
								34			
			20	SS	WR	100%		35	+3, +2		
	- Varved clay in sample							36			
			21	SS	WH	100%		37			
34.7								38	+3, 133		
38.7 / 34.4	(SM) SILTY SAND (TILL), some gravel, trace to some clay, presence of cobbles and boulders, brownish grey, non-cohesive, wet, very dense - Shear vane would not turn		22	SS	50/3"	13%					
38.9								39			UCS = 115 MPa
			Run 1	CORE							

Continued Next Page

200 + : Numbers refer to Field Vane Over Limit +3, ×3: Numbers refer to Sensitivity ○3% STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-107

5 OF 5

METRIC

JOB NUMBER 19-1139 LOCATION STATION 10+535 ORIGINATED BY EG

CLIENT Hatch DATUM CGVD28 BOREHOLE TYPE NW Washboring/Coring COMPILED BY MA

DRILLER MARATHON DATE 2018.11.03 - 2018.11.03 NORTHING 4901575 EASTING 382157 CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	SAMPLES: RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
32.6	Feldspathic biotite GNEISS - dark greenish grey, fine grained with pink medium to coarse grained granite intrusions, granite contacts are sound, presence of calcite and hematite banding, strong to very strong, fresh										
40.8	Run No.: 1 TCR%: 89 SCR%: 81 RQD: 74 Fracture index per 0.3m: 0.83 *(continued)*		Run 2	CORE				41			UCS = 78 MPa
31.1	Run No.: 2 TCR%: 100 SCR%: 80 RQD: 85 Fracture index per 0.3m: 1.4							42			
42.3	Run No.: 3 TCR%: 100 SCR%: 83 RQD: 83 Fracture index per 0.3m: 1.80		Run 3	CORE				43			
29.5											
43.8	Run No.: 4 TCR%: 98 SCR%: 83 RQD: 63 Fracture index per 0.3m: 1.80		Run 4	CORE				44			
28.0								45			
45.3	End of borehole										

200 + : Numbers refer to Field Vane Over Limit $+^3$, $\times^3$: Numbers refer to Sensitivity $\circ^{3\%}$ STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-108

1 OF 1

METRIC

JOB NUMBER 19-1139 | LOCATION STATION 10+662 | ORIGINATED BY EG

CLIENT Hatch | DATUM CGVD28 | BOREHOLE TYPE NW Washboring | COMPILED BY SK

DRILLER MARATHON | DATE 2018.12.04 - 2018.12.04 | NORTHING 4901606 | EASTING 382281 | CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
73.4	RIVER BED										
0.0	(PT) FIBROUS PEAT to FIBROUS SILTY PEAT, with ORGANICS, rootlets, dark brown, cohesive, very soft		1	SS	WR	0%					
			2	SS	WR	50%		1		560	
			3	SS	WR	63%				588	
			4	SS	WR	77%		2			
70.7			5a	SS	WR	100%					
2.7	(OL) ORGANIC CLAYEY SILT, some sand, some decayed rootlets and shell fragments, brown, cohesive, very soft		5b	SS	WR	100%		3			
			6	SS	WR	60%				256	0 35 34 31
	- Low plasticity		7	SS	WR	100%		4			
			8	SS	WR	100%				262	0 22 44 34
	- Low plasticity		9a	SS	WR	100%		5			
68.2											
5.2	(CI - CH) SILTY CLAY, silt seams, grey, cohesive, very soft		9b	SS	WR	100%					
			10	SS	WH	47%					
67.3								6			
6.1	End of borehole										

$200+$: Numbers refer to Field Vane Over Limit

$+^3, \times^3$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-109 1 OF 1 METRIC

JOB NUMBER 19-1139 LOCATION STATION 10+712 ORIGINATED BY EG

CLIENT Hatch DATUM CGVD28 BOREHOLE TYPE NW Washboring COMPILED BY SK

DRILLER MARATHON DATE 2018.12.04 - 2018.12.04 NORTHING 4901625 EASTING 382327 CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
73.4	RIVER BED										
0.0	(PT) FIBROUS PEAT with ORGANICS, rootlets, dark brown, cohesive, very soft		1	SS	WR	25%					
			2	SS	WR	68%		1			
71.4			3	SS	WR	55%		2			
2.0	(OL - ML) ORGANIC CLAYEY SILT, with sand, some decayed rootlets and shell fragments, brown, cohesive, very soft										
			4	SS	WH	93%				179.7	0 22 36 42
	- Low plasticity							3			
			5	SS	WH	93%					
			6	SS	WH	93%		4		159.3	0 23 44 33
	- Low plasticity										
			7a	SS	WH	100%		5			
			7b	SS	WH	100%					
67.6			8a	SS	WH	100%					
5.8	(CI - CH) SILTY CLAY, silt seams, grey, cohesive, very soft		8b	SS	WH	100%		6			
67.3											
6.1	End of borehole										

200 + : Numbers refer to Field Vane Over Limit $+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-110

1 OF 5

METRIC

JOB NUMBER 19-1139 LOCATION STATION 10+625 ORIGINATED BY EG

CLIENT Hatch DATUM CGVD28 BOREHOLE TYPE NW Washboring/Coring COMPILED BY SK

DRILLER MARATHON DATE 2018.11.28 - 2018.11.28 NORTHING 4901547 EASTING 382245 CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
73.0	RIVER BED										
0.0	(PT) FIBROUS PEAT, some silt, some organics, rootlets, dark brown, cohesive, very soft		1	SS	WR	0%					
72.4											OR=43.4%
0.6	(OL) ORGANIC CLAYEY SILT, some to trace decalyed rootlets, some to trace sand, brown to dark grey, cohesive, very soft		2	SS	WR	25%		1			
71.5			3	SS	1	5%					
1.5	(CI - CH) SILTY CLAY, trace organics,silt seams, varved, grey, cohesive, stiff to very stiff		4	SS	8	100%		2	174		
	- Varved clay in sample		5	SS	10	100%		3	174		
	- Shear vane would not turn		6	SS	11	100%		4	174		
	- Shear vane would not turn		7	SS	14	100%		5	174		0 0 36 64
	- Shear vane would not turn		8	SS	13	100%		6	140 4.4		
	- Fine grained sand pockets at 6.71 - 7.32 m		9	SS	5	100%		7	3 6		
64.9								8			
8.1	(CI - CH) SILTY CLAY to CLAY, some silt, varved, grey, cohesive, stiff to very stiff		10	TO	3	100%		9	5 5		

Continued Next Page

200 + : Numbers refer to Field Vane Over Limit +3, ×3: Numbers refer to Sensitivity ○3% STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-110

METRIC

JOB NUMBER 19-1139 | LOCATION STATION 10+625 | ORIGINATED BY EG

CLIENT Hatch | DATUM CGVD28 | BOREHOLE TYPE NW Washboring/Coring | COMPILED BY SK

DRILLER MARATHON | DATE 2018.11.28 - 2018.11.28 | NORTHING 4901547 | EASTING 382245 | CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	(CI - CH) SILTY CLAY to CLAY, some silt, varved, grey, cohesive, stiff to very stiff *(continued)*							11			
	- Varved clay in sample		11	SS	1	100%		12			
								13			
								14			
								15			
								16			
								17			
			12	SS	3	100%		18			
								19			

Continued Next Page

200 + : Numbers refer to Field Vane Over Limit | +3, ×3: Numbers refer to Sensitivity | ○3% STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-110

3 OF 5

METRIC

JOB NUMBER 19-1139 LOCATION STATION 10+625 ORIGINATED BY EG

CLIENT Hatch DATUM CGVD28 BOREHOLE TYPE NW Washboring/Coring COMPILED BY SK

DRILLER MARATHON DATE 2018.11.28 - 2018.11.28 NORTHING 4901547 EASTING 382245 CHECKED BY GQ

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	RECOVERY RATIO			20 40 60 80 100	w_P w w_L	GR SA SI CL
	(CI - CH) SILTY CLAY to CLAY, some silt, varved, grey, cohesive, stiff to very stiff *(continued)*							21			
								22			
								23			
	- Varved clay in sample		13	SS	3	100%		24			0 0 35 65
								25	+4 +5		
								26			
								27			
								28			
								29			

Continued Next Page

200 + : Numbers refer to Field Vane Over Limit +3, ×3: Numbers refer to Sensitivity ○3% STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-110

4 OF 5

METRIC

JOB NUMBER 19-1139 LOCATION STATION 10+625 ORIGINATED BY EG

CLIENT Hatch DATUM CGVD28 BOREHOLE TYPE NW Washboring/Coring COMPILED BY SK

DRILLER MARATHON DATE 2018.11.28 - 2018.11.28 NORTHING 4901547 EASTING 382245 CHECKED BY GQ

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	RECOVERY RATIO			20 40 60 80 100	20 40 60	GR SA SI CL
	(CI - CH) SILTY CLAY to CLAY, some silt, varved, grey, cohesive, stiff to very stiff *(continued)*		14	SS	3	100%					
								31	+4 +3		
								32			
								33			
								34			
								35			
	- Interlayered silt seams encountered		15	SS	WH	100%		36			
								37	146.4 0.1 +2		
								38			
								39			

Continued Next Page

200 + : Numbers refer to Field Vane Over Limit

+3, ×3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-110

5 OF 5 **METRIC**

JOB NUMBER 19-1139 LOCATION STATION 10+625 ORIGINATED BY EG

CLIENT Hatch DATUM CGVD28 BOREHOLE TYPE NW Washboring/Coring COMPILED BY SK

DRILLER MARATHON DATE 2018.11.28 - 2018.11.28 NORTHING 4901547 EASTING 382245 CHECKED BY GQ

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	RECOVERY RATIO			20 40 60 80 100; ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	w_P w w_L; WATER CONTENT (%) 20 40 60	GR SA SI CL
	(CI - CH) SILTY CLAY to CLAY, some silt, varved, grey, cohesive, stiff to very stiff *(continued)*										
32.1			16	SS	97	13%					
40.8	Feldspathic Biotite GNEISS - dark greenish grey, fine grained with medium to coarse grained pink granite intrusions, granite contacts are sound. presence of hematite and calcite banding, strong to very strong, fresh Run No.: 1 TCR%: 88 SCR%: 54 RQD: 58 Fracture index per 0.3m: 2.11		Run 1	CORE				41			
30.7								42			
42.3	Run No.: 2 TCR%: 100 SCR%: 92 RQD: 87 Fracture index per 0.3m: 1.20		Run 2	CORE				43			
29.2											
43.8	Run No.: 3 TCR%: 100 SCR%: 90 RQD: 92 Fracture index per 0.3m: 1.20		Run 3	CORE				44			
27.6								45			
45.3	End of borehole										

200 + : Numbers refer to Field Vane Over Limit +3, ×3: Numbers refer to Sensitivity ○3% STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-111

1 OF 1

METRIC

JOB NUMBER 19-1139 | LOCATION STATION 10+759 | ORIGINATED BY EG

CLIENT Hatch | DATUM CGVD28 | BOREHOLE TYPE NW Washboring | COMPILED BY SK

DRILLER MARATHON | DATE 2018.12.04 - 2018.12.04 | NORTHING 4901632 | EASTING 382374 | CHECKED BY GQ

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	RECOVERY RATIO					GR SA SI CL
73.4	RIVER BED										
0.0	(PT) FIBROUS SILTY PEAT with ORGANICS, rootlets, cohesive, very soft										
			1a	SS	WR	63%					
72.7											
0.7	(CI - CH) SILTY CLAY, trace to some organics, trace rootlets, silt seams, dark grey to grey, cohesive, very soft to stiff		1b	SS	WR	63%		1			
			2	SS	10	100%					
71.6											
1.8	End of borehole										

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

$200+$: Numbers refer to Field Vane Over Limit

$+^3, \times^3$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-201

1 OF 2

METRIC

JOB NUMBER 19-1139 | LOCATION STATION 10+285 | ORIGINATED BY EG

CLIENT Hatch | DATUM CGVD28 | BOREHOLE TYPE NW Washboring/Coring | COMPILED BY EG

DRILLER MARATHON | DATE 2018.12.11 - 2018.12.11 | NORTHING 4901529 | EASTING 381911 | CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
75.3	Ground Surface										
0.0 / 75.2	FILL - Gravel										
0.2 / 74.6	FILL - (SW/GW) SAND and GRAVEL, trace organics, rootlets, oxidation, grey to black, non-cohesive, frozen to moist, compact		1	SS	14	60%					
0.7 / 73.9	FILL - (GW) GRAVEL, angular, trace sand, light brown/grey, non-cohesive, moist, loose		2	SS	7	33%		1			
1.5 / 73.3	NATIVE - (PT) Fibrous, SILTY PEAT with ORGANICS, rootlets, dark brown, cohesive, soft		3A	SS	3	48%					
2.1 / 72.4	NATIVE - (CL) SILTY CLAY, trace organics, rootlets, silt seams, brown to grey, cohesive, soft to firm - pocket penetrometer test (SS4) : 75 kPa		3B 4	SS SS	3 4	48% 68%		2			
3.0 / 71.2	NATIVE - (CL/ML) SILTY CLAY to CLAYEY SILT (TILL), some to trace sand, fine grained, trace gravel , sub-angular, sand pockets, silt seams, brownish grey, cohesive, very stiff to firm - pocket penetrometer test (SS6): 110 kPa		5 6	SS SS	17 6	100% 60%		3 4			
4.2 / 70.7	ARGILLACEOUS LIMESTONE - dark grey, fine grained, thin faint bedding, vertical jointing, presence of shale partings and fault gouges, medium strong to strong, faintly weathered to fresh		Run 1	CORE							
4.6	Run No.: 1 TCR%: 44 SCR%: 44 RQD: 44 Fracture index per 0.3m: - 2.7 Fault gouging at 6.50 m, approximately 2mm thick Run No.: 2 TCR%: 100 SCR%: 43 RQD: 76 Fracture index per 0.3m: 2.80		Run 2	CORE				5			UCS = 65 MPa

Continued Next Page

200_{+} : Numbers refer to Field Vane Over Limit | $+^{3}, \times^{3}$: Numbers refer to Sensitivity | $\circ^{3\%}$ STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-201

2 OF 2 **METRIC**

JOB NUMBER 19-1139 LOCATION STATION 10+285 ORIGINATED BY EG

CLIENT Hatch DATUM CGVD28 BOREHOLE TYPE NW Washboring/Coring COMPILED BY EG

DRILLER MARATHON DATE 2018.12.11 - 2018.12.11 NORTHING 4901529 EASTING 381911 CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	SAMPLES: RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
69.2											
6.2	Run No.: 3 TCR%: 100 SCR%: 74 RQD: 76 Fracture index per 0.3m: 3.20		Run 3	CORE				7			
67.6											
7.7	LIMESTONE - light grey, fine grained, shale and stylolite partings, spaced ~ 10 - 100 mm , strong, fresh Note: Broken core caused by drill action at shale partings Run No.: 4 TCR%: 100 SCR%: 80 RQD: 82 Fracture index per 0.3m: 1.40		Run 4	CORE				8 9			UCS = 89 MPa
66.1											
9.3	Run No.: 5 TCR%: 100 SCR%: 92 RQD: 84 Fracture index per 0.3m: 1.40		Run 5	CORE				10			
64.4											
10.9	End of borehole										

200_{+} : Numbers refer to Field Vane Over Limit $+^{3}, \times^{3}$: Numbers refer to Sensitivity $\circ^{3\%}$ STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-202

1 OF 2

METRIC

JOB NUMBER 19-1139 | LOCATION STATION 10+266 | ORIGINATED BY EG

CLIENT Hatch | DATUM CGVD28 | BOREHOLE TYPE NW Washboring/Coring | COMPILED BY EG

DRILLER MARATHON | DATE 2018.12.11 - 2018.12.11 | NORTHING 4901531 | EASTING 381892 | CHECKED BY GQ

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	RECOVERY RATIO	GROUND WATER CONDITIONS	DEPTH
77.0	Ground Surface							
0.0 / 76.9	ASPHALT, about 75 mm thick							
0.1 / 76.8	FILL - (SW/GW) SAND and GRAVEL, grey, non-cohesive, frozen to wet, very dense		1	SS	50/ 3"	17%		
0.2	ARGILLACEOUS LIMESTONE - dark grey, fine grained, shale partings, horizontal thin bedding, joints ground through drilling action, medium strong to strong, faintly weathered to fresh Run No.: 1 TCR%: 89 SCR%: 36 RQD: 27 Fracture index per 0.3m: 6.25		Run 1	CORE				1
75.4 / 1.6	Run No.: 2 TCR%: 87 SCR%: 58 RQD: 57 Fracture index per 0.3m: 2.80		Run 2	CORE				2
73.7 / 3.3	LIMESTONE - light to dark grey, fine grained, horizontally thin bedding, shale and stylolite partings, strong, fresh Run No.: 3 TCR%: 100 SCR%: 61 RQD: 66 Fracture index per 0.3m: 2.40							3

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH kPa (20 40 60 80 100)
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (20 40 60)

REMARKS & GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

Continued Next Page

$200+$: Numbers refer to Field Vane Over Limit | $+^{3}, \times^{3}$: Numbers refer to Sensitivity | $\circ^{3\%}$ STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-202

2 OF 2 **METRIC**

JOB NUMBER 19-1139 LOCATION STATION 10+266 ORIGINATED BY EG

CLIENT Hatch DATUM CGVD28 BOREHOLE TYPE NW Washboring/Coring COMPILED BY EG

DRILLER MARATHON DATE 2018.12.11 - 2018.12.11 NORTHING 4901531 EASTING 381892 CHECKED BY GQ

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	RECOVERY RATIO					GR SA SI CL
	LIMESTONE - light to dark grey, fine grained, horizontally thin bedding, shale and stylolite partings, strong, fresh Run No.: 3 TCR%: 100 SCR%: 61 RQD: 66 Fracture index per 0.3m: 2.40 *(continued)*		Run 3	CORE							
72.1											
4.9	Run No.: 4 TCR%: 100 SCR%: 92 RQD: 84 Fracture index per 0.3m: 2.0		Run 4	CORE				5			
								6			
70.5											
6.5	End of borehole										

200 + : Numbers refer to Field Vane Over Limit +3, ×3: Numbers refer to Sensitivity ○3% STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-203 1 OF 1 METRIC

JOB NUMBER 19-1139 LOCATION STATION 10+213 ORIGINATED BY EG

CLIENT Hatch DATUM CGVD28 BOREHOLE TYPE NW Washboring COMPILED BY EG

DRILLER MARATHON DATE 2018.12.12 - 2018.12.12 NORTHING 4901524 EASTING 381839 CHECKED BY GQ

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	RECOVERY RATIO			20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	w_P w w_L 20 40 60	GR SA SI CL
81.2 Ground Surface											
0.0 81.1	ASPHALT, about 75 mm thick										
0.1 80.9	FILL - Granular A, about 200 mm thick.										
0.3 80.6	FILL - (SW/GW) SAND and GRAVEL, black to grey, non-cohesive, dry, dense		1	SS	35	50%					
0.6 80.3	NATIVE - (SM) Clayey, SILTY SAND (TILL), trace gravel, oxidation, brown/grey mottled, non-cohesive, dry, very dense		2	SS	50/ 4"	17%					
0.9	End of borehole - Auger refusal at 0.86m										

200 + : Numbers refer to Field Vane Over Limit +3, ×3: Numbers refer to Sensitivity ○3% STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-204 1 OF 1 METRIC

JOB NUMBER 19-1139 LOCATION STATION 10+150 ORIGINATED BY EG

CLIENT Hatch DATUM CGVD28 BOREHOLE TYPE NW Washboring COMPILED BY EG

DRILLER MARATHON DATE 2018.12.12 - 2018.12.12 NORTHING 4901517 EASTING 381777 CHECKED BY GQ

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	RECOVERY RATIO					GR SA SI CL
82.0	Ground Surface										
0.0 81.9	ASPHALT, about 75 mm thick										
0.1 81.7	FILL - Granular A, about 175 mm thick										
0.3 81.6	FILL - (SW/GW) SAND and GRAVEL, grey, non-cohesive, dry, compact		1	SS	13	55%					
0.3 81.3	NATIVE - (CH -SM) Sandy, SILTY CLAY (TILL), trace gravel, brown/grey, mottled, cohesive, stiff		2	SS	50/ 2"	13%					
0.7	End of borehole - Auger refusal at 0.69m										

200 + : Numbers refer to Field Vane Over Limit $+^3$, $\times^3$: Numbers refer to Sensitivity $\circ^{3\%}$ STRAIN AT FAILURE

TULLOCH ENGINEERING

RECORD OF BOREHOLE No BH-18-205 1 OF 1 METRIC

JOB NUMBER 19-1139 LOCATION STATION 10+099 ORIGINATED BY EG

CLIENT Hatch DATUM CGVD28 BOREHOLE TYPE NW Washboring COMPILED BY EG

DRILLER MARATHON DATE 2018.12.12 - 2018.12.12 NORTHING 4901514 EASTING 381726 CHECKED BY GQ

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	RECOVERY RATIO			20 40 60 80 100		GR SA SI CL
82.7	Ground Surface										
0.0 / 82.6	ASPHALT, about 100 mm thick										
0.1 / 82.4	FILL - Granular A, about 200 mm thick										
0.3	FILL - (SW/GW) SAND and GRAVEL, oxidation, grey/dark brown, mottled, non-cohesive, dry to moist, very dense		1	SS	77	77%					
			2	SS	55	50%		1			
81.2											
1.5	End of borehole - Auger refusal at 1.52m										

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE

WATER CONTENT (%): w_P w w_L

$200+$: Numbers refer to Field Vane Over Limit $+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

APPENDIX A-2

BEDROCK DISCONTINUITY LOGS

TULLOCH

Discontinuity Log

Project No. 18-4046

Project: Kingston Third Crossing Bridge

Borehole BH18-101

Sheet 1 **of** 2

Inspector SdB/SK/DB

Site: 630 John Counter Blvd.

Date 12-19-18

Depth* ☒ (m) ☐ (ft)	Discontinuity Details: Joint, Bedding plane joint, Solution cavity, Extremely closely spaced zone, Very closely spaced zone, Fragmented zone, Broken zone, Etc	Angle with Core Axis (°)	Plane	Curved	Irregular	Smooth	Rough	Slick	Slickensided	Staining[1]	Coating/Filling[2]	Aperture[3]	Healed[4]	Weathering[5]
28.80	Start of Run 1													
28.80 to 28.98	Broken rock													
28.98	Joint	85	X				X				Cal			F
28.98 tot 29.13	Joint	15	X				X				Cal			F
29.17	Joint	90	X				X				None			F
29.50	Ground	90					X				Cal			F
29.72	End of Run 1/ Start of Run 2	90	X											
29.85	Mechanical break	90	X											
30.24	Mechanical break	90	X											
30.90	Mechanical break	85	X											
31.00	Joint	85	X								Hem			F
31.24	End of Run 2/ Start of Run 3													
31.53	Joint	80	X				X				Hem, Cal			F
31.70	Joint	80	X				X				Hem, Cal			F
31.98	End of Run 3/ Start of Run 4													
32.50	Joint	85	X				X				Hem			F
32.69	Joint, ground	85					X				Hem			F
32.77	Joint	50	X				X				Hem			F
32.99	Broken core, red clay present													
33.02	End of Run 4/ Start or Run 5													
33.02 to 33.15	Broken rock													
33.33	Ground						X				Hem			F
33.39	Joint, ground, clay/ soil present						X				Hem			F
33.46	Joint	90	X				X				Ch, Hem			
33.50	Joint, red clay/ soil present	85	X				X				Hem			SW
33.57	Joint, clay/ soil present	90	X				X				Hem			FW
33.66	Joint, clay/ soil present										Hem			SW
33.71	Joint, clay present	90	X								Hem			SW

1 = Fe - Iron, Mn - Manganese
2 = C - Carbonate, G - Gypsum, SC - Silt/Clay
Py - Pyrite, St - Serpentine, Ch – Chlorite, Ch – Chlorite, Cal – Calcite, Hem - Hematite
3 = T – Tight
4 = P - Partially
5 = F - Faintly, S - Slightly

} Use other Symbols - If Required, Identify in Legend

*Measured to nearest 0.01 m/0.1 ft

Discontinuity Log

Project No. 18-4046

Borehole BH18-101

Project: Kingston Third Crossing Bridge **Sheet** 2 **of** 2

Inspector SdB/SK/DB

Site: 630 John Counter Blvd. **Date** 12-19-18

Depth* ☒ (m) ☐ (ft)	Discontinuity Details: Joint, Bedding plane joint, Solution cavity, Extremely closely spaced zone, Very closely spaced zone, Fragmented zone, Broken zone, Etc	Angle with Core Axis (°)	Plane	Curved	Irregular	Smooth	Rough	Slick	Slickensided	Staining[1]	Coating/Filling[2]	Aperture[3]	Healed[4]	Weathering[5]
33.81	Joint, red clay present	85	X								Hem			SW
33.87	Joint	90	X				X				Hem			SW
33.97 to 34.12	Broken rock, slight weathered rock section with clay/ soil seams													FW
34.12	Joint, ground						X				Hem			SW
34.32	Joint, ground						X				Hem			SW
34.50	Joint	90	X				X				Hem, Ch			F
34.57	Joint, clay/ soil present in seams	45	X				X							SW
34.65	Mechanical Break	85	X											
34.77	End of Run 5/ Start of Run 6													
35.01 to 35.09	Joint			x			X				Cal, Ch			F
35.10 to 35.13	Broken rock													
35.20	Ground, joint						X				Hem			F
35.26	Joint, ground, clay/ soil present										Hem			
35.62	Joint	90	x				X				Cal, Hem			F
35.85	Mechanical break	80	X											
36.04	Joint	85	X				X				Cal, Hem			F
36.53	End of Run 6													
	End of Drillhole													

1 = Fe - Iron, Mn - Manganese **4 = P - Partially**
2 = C - Carbonate, G - Gypsum, SC - Silt/Clay **5 = F - Faintly, S - Slightly**
Py - Pyrite, St - Serpentine, Ch – Chlorite, Cal – Calcite, Hem - Hematite
3 = T - Tight

} Use other Symbols - If Required, Identify in Legend

*Measured to nearest 0.01 m/0.1 ft

TULLOCH

Discontinuity Log

Project No. 18-4046

Project: Kingston Third Crossing Bridge

Borehole BH18-102

Sheet 1 **of** 3

Inspector EG/SdB

Site: 630 John Counter Blvd.

Date 12-18-18

Depth* ☒ (m) ☐ (ft)	Discontinuity Details: Joint, Bedding plane joint, Solution cavity, Extremely closely spaced zone, Very closely spaced zone, Fragmented zone, Broken zone, Etc	Angle with Core Axis (°)	Plane	Curved	Irregular	Smooth	Rough	Slick	Slickensided	Staining[1]	Coating/Filling[2]	Aperture[3]	Healed[4]	Weathering[5]
41.91 to 42.21	Boulder; ends are ground; top is capped with grey silt/clay; single piece													
42.21	Top of bedrock; capped with 2 mm grey silt/ clay													
42.37	Mechanical (ground)	90												
42.37 to 42.47	Broken rock; multiple core surfaces													
42.47	Mechanical (ground)	90												F
42.86	Mechanical break	90												F
43.13	Mechanical break	90												F
43.42	Joint (water)	90	X				X				Cal			F
43.66	Mechanical break	70												F
43.74	Mechanical Break	70												F
43.74 to 43.79	Brocken rock													
43.84	Mechanical break	80					X							F
43.89	End of Run 2/ Start of Run 4													
44.16 to 44.20	2 mechanical breaks	90												F
44.45 to 44.88	Joint parallel to axis	0	X		X		X				Cal, Hem			F
44.53	Mechanical break	90												F
44.59	Joint	90	X				X				Tr, Cal			F
44.91	Mechanical break	90	X											F
44.93	Mechanical (ground)	90												
45.14 to 45.21	Broken rock (hematite coating)	90												
45.42	End of Run 3													
45.42	Top of Run 4													
45.50	Joint (ground), hematite on surface	80												
45.82	Hematite seam (5mm thick)	90												
45.85	Mechanical break	80												F
45.90	Hematite seam (5mm), tight											T		
45.91	Hematite seam (5mm), tight											T		
45.96	Hematite seam (5mm), tight											T		

1 = Fe - Iron, Mn - Manganese
2 = C - Carbonate, G - Gypsum, SC - Silt/Clay
Py - Pyrite, St - Serpentine, Ch - Chlorite, Cal – Calcite, Hem - Hematite
3 = T – Tight
4 = P - Partially
5 = F - Faintly, S - Slightly

} Use other Symbols - If Required, Identify in Legend

*Measured to nearest 0.01 m/0.1 ft

TULLOCH

Discontinuity Log

Project No. 18-4046

Project: Kingston Third Crossing Bridge

Borehole BH18-102

Sheet 2 **of** 3

Inspector EG/SdB

Site: 630 John Counter Blvd.

Date 12-18-18

Depth* ☒ (m) ☐ (ft)	Discontinuity Details: Joint, Bedding plane joint, Solution cavity, Extremely closely spaced zone, Very closely spaced zone, Fragmented zone, Broken zone, Etc	Angle with Core Axis (°)	Plane	Curved	Irregular	Smooth	Rough	Slick	Slickensided	Staining[1]	Coating/Filling[2]	Aperture[3]	Healed[4]	Weathering[5]
46.08	Joint	90	X				X				Hem			F
46.23	Hematite seam (5mm)	70										T		
46.37	Hematite seam (5mm)	90										T		
46.39	Hematite/ Calcite seam (3mm)	90										T		
46.52	Joint	85	X				X				Hem, Cal			F
46.69	Joint	45	X				X				Cal			F
46.71	Joint (Cal 0.5mm, Hem Band 2.5mm) (3mm total)	60									Cal, Hem	T		
46.94	End of Run 4/ Start of Run 5													
46.96	Joint (ground/ Hem coated)	60	X				X				Hem			F
47.00	Joint (ground/ Hem coated)	70	X				X				Hem			F
47.04	Joint (ground/ Hem coated)	85	X				X				Hem			F
47.14	Joint	80	X				X				Hem, Cal			F
47.17	Mechanical break	90												F
47.55	Joint (Cal/ Hem coated)	70	X				X				Hem, Cal			F
47.70	Joint (Cal/ Hem coated)	90	X				X				Hem, Cal			F
47.73 to 47.80	Joint (Cal/ Hem coated)	45			X		X				Cal, Hem			F
47.86	Mechanical break (ground)	85												
47.91 to 47.93	Mechanical break (ground)	80												
48.11 to 48.13	Joint (Cal/ Hem coated)	90	X				X				Cal, Hem			F
48.46	End of Run 5 (Cal at end)/ Start of Run 6													
48.58	Joint	80	X				X				Cal, Hem			F
48.67	Mechanical break	80												F
48.77	Joint (ground)	80												F
48.80	Joint	85	X				X				Hem			F
48.81 to 48.95	Joint	15			X		X				Cal, Hem			F
48.95 to 49.07	Breccia-fault; rehealed with white calcite/ no porosity													
49.02	Joint	90	X				X				Hem			F
49.09	Joint	45	X				X				Ch, Cal, Hem			F
49.09 to 49.19	Joint	5			X		X				Hem, Cal			F
49.19	Joint	80			X		X				Hem, Cal			F

1 = Fe - Iron, Mn - Manganese **4 = P - Partially**
2 = C - Carbonate, G - Gypsum, SC - Silt/Clay **5 = F - Faintly, S - Slightly**
Py - Pyrite, St - Serpentine, Ch – Chlorite, Cal – Calcite, Hem - Hematite
3 = T – Tight

} Use other Symbols - If Required, Identify in Legend

*Measured to nearest 0.01 m/0.1 ft

Discontinuity Log

Project No. 18-4046

Project: Kingston Third Crossing Bridge

Borehole BH18-102

Sheet 3 **of** 3

Inspector EG/SdB

Site: 630 John Counter Blvd.

Date 12-18-18

Depth* ☒ (m) ☐ (ft)	Discontinuity Details: Joint, Bedding plane joint, Solution cavity, Extremely closely spaced zone, Very closely spaced zone, Fragmented zone, Broken zone, Etc	Angle with Core Axis (°)	Plane	Curved	Irregular	Smooth	Rough	Slick	Slickensided	Staining[1]	Coating/Filling[2]	Aperture[3]	Healed[4]	Weathering[5]
49.26	Joint	60	X				X				Hem. Cal			F
49.28 to 49.34	Joint (ground)	60												F
49.36 to 49.44	Joint	45			X		X				Hem, Cal			F
49.44	Joint	90	X				X				Hem			F
49.52	Joint (ground)	75												
49.64	Mechanical break	90												
49.78	Joint	60	X				X				Hem, Cal			F
49.78 to 49.81	Joint	0	X				X				Hem, Cal			F
49.99	End of Run 6													
	End of Drill hole													

1 = Fe - Iron, Mn - Manganese
2 = C - Carbonate, G - Gypsum, SC - Silt/Clay
Py - Pyrite, St - Serpentine, Ch – Chlorite, Cal – Calcite, Hem - Hematite
3 = T – Tight
4 = P - Partially
5 = F - Faintly, S - Slightly

} Use other Symbols - If Required, Identify in Legend

*Measured to nearest 0.01 m/0.1 ft

TULLOCH

Discontinuity Log

Project No. 18-4046

Project: Kingston Third Crossing Bridge

Borehole BH18-103

Sheet 1 **of** 1

Inspector SdB/EG

Site: 630 John Counter Blvd.

Date 12-19-18

Depth* ☒ (m) ☐ (ft)	Discontinuity Details: Joint, Bedding plane joint, Solution cavity, Extremely closely spaced zone, Very closely spaced zone, Fragmented zone, Broken zone, Etc	Angle with Core Axis (°)	Plane	Curved	Irregular	Smooth	Rough	Slick	Slickensided	Staining[1]	Coating/Filling[2]	Aperture[3]	Healed[4]	Weathering[5]
23.90	Start of Run 1													
23.96	Mechanical (ground)													
23.96 to 24.07	Mechanical break	0	X											F
24.07	Joint (drilling silt present)	70	X				X							F
24.07 to 24.13	Mechanical Break	0	X											F
24.13	Joint	85	X				X				Hem, Cal			F
24.2	Joint	90	X				X				Hem, Cal			F
24.41 to 24.66	Abrasion test (core taken)													
25.48	End of Run 1/ Start of Run 2													
26.44 to 26.56	Joint	45	X				X				Cal, Hem			F
26.76	Joint	85	X				X				Cal, Hem			F
27	End of Run 2/ Start of Run 3													
27.15	Joint	70	X				X				Cal, Hem			F
27.25	Joint	70	X				X				Hem, Cal			F
27.77	Joint	80	X				X				Hem, Cal			F
28.28	Mechanical break	90	X											
28.47	Joint	85	X				X				Ch, Hem, Cal			F
28.52	End of Run 3/ Start of Run 4													
28.52 to 28.65	Joint	45			X		X				Cal, Hem			F
28.75	Joint	70	X				X				Hem, Cal			F
28.96 to 29.27	Joint	80		X			X				Cal, Hem			F
29.08	Joint	90		X			X				Hem, Cal			F
29.54	Mechanical break	60		X										F
29.87	End of Run 4													
	End of Drillhole													

1 = Fe - Iron, Mn - Manganese **4 = P - Partially**
2 = C - Carbonate, G - Gypsum, SC - Silt/Clay **5 = F - Faintly, S - Slightly**
Py - Pyrite, St - Serpentine, Ch – Chlorite, Cal – Calcite, Hem - Hematite
3 = T – Tight

} Use other Symbols - If Required, Identify in Legend

*Measured to nearest 0.01 m/0.1 ft

TULLOCH

Discontinuity Log

Project No. 18-4046

Project: Kingston Third Crossing Bridge

Borehole BH18-104

Sheet 1 **of** 2

Inspector SdB/EG

Site: 630 John Counter Blvd.

Date 12-19-18

Depth* ☒ (m) ☐ (ft)	Discontinuity Details: Joint, Bedding plane joint, Solution cavity, Extremely closely spaced zone, Very closely spaced zone, Fragmented zone, Broken zone, Etc	Angle with Axis Core (°)	Plane	Curved	Irregular	Smooth	Rough	Slick	Slickensided	Staining[1]	Coating/Filling[2]	Aperture[3]	Healed[4]	Weathering[5]
21.26 to 21.31	Mechanical break	5	X											F
21.32	Joint, slightly ground	90	X				X				Cal, Hem			
21.43	Joint	90	X				X				Cal, Hem			F
21.67	Joint	90	X				X				Cal, Hem			F
21.92	Mechanical break	85	X											F
22.19	Joint	50	X				X				Cal, Hem, Ch			F
22.54	Mechanical break	45												F
22.71	End of Run 1/ Start of Run 2													
22.77	K Feldspar vein (20mm)													
23.53	Joint	85	X				X				Hem			F
23.70	Mechanical break	90	X								Hem			F
23.90	Joint	90	X				X				Cal, Hem			F
24.13	Mechanical break	90	X											F
24.23	End of Run 2/ Start of Run 3													
24.80	Joint (K Feldspar Vein, 50mm)	45	X				X				Cal, Hem			F
25.12	Joint	85	X				X				Cal, Hem			F
25.59	Joint	90	X				X				Hem			F
25.67	Mechanical break	85	X											F
25.67 to 25.71	Mechanical break	0	X											F
25.76	End of Run 3/ Start of Run 4													
2585	Joint	85	X				X				Ch, Cal, Hem			F
26.23 to 26.40	Joint	30			X		X				Ch, Hem			F
26.49 to 26.56	K Feldspar vein (70 mm)													
26.99	Mechanical break	80	X											F
27.04	Mechanical break	85	X											F
27.17	Joint	90	X				X				Hem			F
27.28	End of Run 4/ Start of Run 5													
27.36	K Feldspar intrusion													
27.56	K Feldspar intrusion													

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2 = C - Carbonate, G - Gypsum, SC - Silt/Clay **5 = F - Faintly, S - Slightly**
Py - Pyrite, St - Serpentine, Ch – Chlorite, Cal – Calcite, Hem - Hematite
3 = T – Tight

} Use other Symbols - If Required, Identify in Legend

*Measured to nearest 0.01 m/0.1 ft

TULLOCH

Discontinuity Log

Project No. 18-4046

Project: Kingston Third Crossing Bridge

Borehole BH18-104

Sheet 2 **of** 2

Inspector SdB/EG

Site: 630 John Counter Blvd.

Date 12-19-18

Depth* ☒ (m) ☐ (ft)	Discontinuity Details: Joint, Bedding plane joint, Solution cavity, Extremely closely spaced zone, Very closely spaced zone, Fragmented zone, Broken zone, Etc	Angle with Core Axis (°)	Plane	Curved	Irregular	Smooth	Rough	Slick	Slickensided	Staining[1]	Coating/Filling[2]	Aperture[3]	Healed[4]	Weathering[5]
27.85	K Feldspar intrusion													
28.09	Mechanical break	80	X											F
28.25 to 28.32	Core lost													
28.80	End of Run5/ Start of Run 6													
29.00	Mechanical break	80	X											F
29.20 to 29.36	Joint	20			X		X				Hem, Ch			F
29.87	Mechanical break	90	X											F
30.20	Mechanical break	90	X											F
30.20 to 30.25	Mechanical break	0	X											F
30.33	End of Run 6													
	End of Drillhole													

1 = Fe - Iron, Mn - Manganese **4 = P - Partially**
2 = C - Carbonate, G - Gypsum, SC - Silt/Clay **5 = F - Faintly, S - Slightly**
Py - Pyrite, St - Serpentine, Ch – Chlorite, Cal – Calcite, Hem - Hematite
3 = T – Tight

} Use other Symbols - If Required, Identify in Legend

*Measured to nearest 0.01 m/0.1 ft

TULLOCH

Discontinuity Log

Project No. 18-4046

Project: Kingston Third Crossing Bridge

Borehole BH18-106

Sheet 1 **of** 2

Inspector SK/DB

Site: 630 John Counter Blvd.

Date 12-19-18

Depth* ☒ (m) ☐ (ft)	Discontinuity Details: Joint, Bedding plane joint, Solution cavity, Extremely closely spaced zone, Very closely spaced zone, Fragmented zone, Broken zone, Etc	Angle with Core Axis (°)	Plane	Curved	Irregular	Smooth	Rough	Slick	Slickensided	Staining[1]	Coating/Filling[2]	Aperture[3]	Healed[4]	Weathering[5]
2.31	Bedding	90	X				X			Fe				
2.93	Shale parting	90	X				X							F
3.07	End of Run 1/ Start of Run 2													
3.10	Ground break	90												
3.12	Ground break	90												
2.38	Shale parting, broken	90												F
3.40	Shale parting, ground break	90												
3.42	Shale parting, ground	90												
3.49	Shale parting, ground	90												
3.59	Shale parting, slightly ground	90	X			X								F
3.86	Shale parting, ground	90												
4.32	Bugs (1 cm diameter)													
4.34	Ground break	90												
4.62	End of Run 2/ start of Run 3													
4.62 to 4.88	Closely jointed rock, four joints @ 25° to c/axis, causing broken core, silt on joints at top	45	X			X					Silt			FW
4.98	Bedding/ parting	90	X								Cal			F
5.13	Joint	85	X			X					None			F
5.21	Joint	45	X			X					None			F
5.33	Shale parting	90	X				X				None			F
5.56	Shale parting	85	X				X				None			F
5.61 to 5.72	Broken core due to vertical joint													F
5.61 to 5.82	Joint (vertical)	90	X			X					None			F
5.92	Shale parting	90	X			X					Silt			FW
5.96	Shale parting	90	X			X					Silt			FW
6.20	End of Run 2/ Start of Run 3													
6.31	Joint	60	X				X							F
6.34	Joint	20	X				X				Cal			FW
6.49 to 6.63	Broken core													
6.63	Joint	45	X				X				Cal			F

1 = Fe - Iron, Mn - Manganese
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Py - Pyrite, St - Serpentine, Ch – Chlorite, Cal – Calcite, Hem - Hematite
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4 = P - Partially
5 = F - Faintly, S - Slightly

} Use other Symbols - If Required, Identify in Legend

*Measured to nearest 0.01 m/0.1 ft

Discontinuity Log

Project No. 18-4046

Project: Kingston Third Crossing Bridge

Borehole BH18-106

Sheet 2 **of** 2

Site: 630 John Counter Blvd.

Inspector SK/DB

Date 12-19-18

Depth* ☒ (m) ☐ (ft)	Discontinuity Details: Joint, Bedding plane joint, Solution cavity, Extremely closely spaced zone, Very closely spaced zone, Fragmented zone, Broken zone, Etc	Angle with Core Axis (°)	Plane	Curved	Irregular	Smooth	Rough	Slick	Slickensided	Staining[1]	Coating/Filling[2]	Aperture[3]	Healed[4]	Weathering[5]
6.68	Shale parting, broken plates	90												F
6.71 to 6.99	Joint, core broken in places because of joint	5	X			X					Fe			FW
6.99	Mechanical break on styolite	90												F
7.05	Shale parting	90	X			X								F
7.20	Shale parting	90	X			X					None			F
7.24	Shale parting	90	X				X				None			F
7.40	Bedding	90	X				X				None			F
7.44	Bedding	90	X				X				None			F
7.57	Mechanical break	90												
7.62	End of Run 3													
	End of Drillhole													

1 = Fe - Iron, Mn - Manganese **4 = P - Partially**
2 = C - Carbonate, G - Gypsum, SC - Silt/Clay **5 = F - Faintly, S - Slightly**
Py - Pyrite, St - Serpentine, Ch - Chlorite, Cal – Calcite, Hem - Hematite
3 = T – Tight

} Use other Symbols - If Required, Identify in Legend

*Measured to nearest 0.01 m/0.1 ft

Discontinuity Log

Project No. 18-4046

Project: Kingston Third Crossing Bridge

Borehole BH18-107

Sheet 1 **of** 2

Inspector SdB/EG

Site: 630 John Counter Blvd.

Date 12-18-18

Depth* ☒ (m) ☐ (ft)	Discontinuity Details: Joint, Bedding plane joint, Solution cavity, Extremely closely spaced zone, Very closely spaced zone, Fragmented zone, Broken zone, Etc	Angle with Core Axis (°)	Plane	Curved	Irregular	Smooth	Rough	Slick	Slickensided	Staining[1]	Coating/Filling[2]	Aperture[3]	Healed[4]	Weathering[5]
38.71	Start of Core													
38.71 to 38.80	1 inch of grey plastic silt/clay; disturbed sub-rounded gravel, clay coated, ranging from 10 mm to 50 mm core pieces have been worn by coring													
38.80 to 38.86	Ground silt coated ends; pink granite gravel													
38.86 to 38.94	Ground silt coated ends; pink granite gravel													
39.14	Mechanical break	45	X				X							F
39.40	Joint	80	X				X				Cal, Hem			FW
39.50	Joint	85	X				X				Cal, Hem			
39.62	Mechanical break	90	X				X							
40.25	Ground break (hematite/ calcite band)	90												
40.28	Ground break (hematite/ calcite band)	90												
40-77	End of Run 1/ Start of Run 2													
40.88	Joint	90	X				X				Cal, Hem			F
40.92	Joint	20	X				X				Cal			F
40.95 to 41.35	Calcium Hematite joint	5			X						Cal, Hem	T		
41.48	Mechanical break (ground, calcium hematite)	90												
41.49	Mechanical break (ground, calcium hematite)	90												
41.49 to 41.76	Tight calcium hematite joint	5			X						Cal, hem	T		
41.76 to 41.88	Sample taken previously for abrasion test													
42.08	Mechanical break	90												
42.13	Mechanical break	90												
42.17	Mechanical break	90												
42.09 to 42.22	Joint			X			X				Ch			FW
42.29	End of Run 2/ Start of Run 3													
42.42	Joint	85	X				X				Cal, Hem	T		F
42.90	Joint	90	X				X				Cal, Hem	T		F
43.22	Joint	90	X				X				Cal, Hem			F
43.23	Joint	90	X				X				Cal, Hem			F
43.24	Joint	90	X				X				Cal, Hem			F
43.26	Joint	90	X				X				Cal, Hem			F

1 = Fe - Iron, Mn - Manganese
2 = C - Carbonate, G - Gypsum, SC - Silt/Clay
Py - Pyrite, St - Serpentine, Ch – Chlorite, Cal – Calcite, Hem - Hematite
3 = T – Tight
4 = P - Partially
5 = F - Faintly, S - Slightly

} Use other Symbols - If Required, Identify in Legend

*Measured to nearest 0.01 m/0.1 ft

TULLOCH

Discontinuity Log

Project No. 18-4046

Project: Kingston Third Crossing Bridge

Borehole BH18-107

Sheet 2 **of** 2

Inspector SdB/EG

Site: 630 John Counter Blvd.

Date 12-18-18

Depth* ☒ (m) ☐ (ft)	Discontinuity Details: Joint, Bedding plane joint, Solution cavity, Extremely closely spaced zone, Very closely spaced zone, Fragmented zone, Broken zone, Etc	Angle with Core Axis (°)	Plane	Curved	Irregular	Smooth	Rough	Slick	Slickensided	Staining[1]	Coating/Filling[2]	Aperture[3]	Healed[4]	Weathering[5]
43.28	Joint	90	X				X				Cal. Hem			F
43.32	Joint	90	X				X				Cal, Hem			F
43.36	Joint	90										T		
43.39	Joint	90	X				X				Cal, Hem			F
43.42	Joint	90	X								Cal, Hem	T		
43.55	Joint	90	X				X				Cal, hem			F
43.64	Joint	85	X								Cal, Hem	T		F
43.69	Joint	90	X				X				Cal, Hem			F
43.82	End of Run 3/ Start of Run 4													
43.87	Mechanical break	90												F
43.91	Joint	90									Cal, Hem	T		
44.01	Joint	85	X				X				Cal, Hem			F
44.10	Joint	90	X				X				Cal, Hem			F
44.35	Joint	90									Cal, Hem	T		
44.41	Mechanical break	90												F
44.46	Joint	90									Cal, Hem	T		
44.48	Joint	90	X				X				Cal, Hem			F
44.59	Joint	90	X				X				Cal, Hem, Ch			F
44.93	Joint	90			X						Cal, Hem	T		
45.03	Joint	90	X								Cal, Hem			F
45.10	Joint	90	X				X				Cal, Hem			F
45.28	Joint	80	X				X				Cal, Hem, Ch			F
45.34	End of Run 4													
	End of Drillhole													

1 = Fe - Iron, Mn - Manganese **4 = P - Partially**
2 = C - Carbonate, G - Gypsum, SC - Silt/Clay **5 = F - Faintly, S - Slightly**
Py - Pyrite, St - Serpentine, Ch - Chlorite, Cal – Calcite, Hem - Hematite
3 = T – Tight

} Use other Symbols - If Required, Identify in Legend

*Measured to nearest 0.01 m/0.1 ft

Discontinuity Log

Project No. 18-4046

Project: Kingston Third Crossing Bridge

Borehole BH18-201

Sheet 1 **of** 2

Inspector SK/DB

Site: 630 John Counter Blvd.

Date 12-19-2018

Depth* ☒ (m) ☐ (ft)	Discontinuity Details: Joint, Bedding plane joint, Solution cavity, Extremely closely spaced zone, Very closely spaced zone, Fragmented zone, Broken zone, Etc	Angle with Core Axis (°)	Plane	Curved	Irregular	Smooth	Rough	Slick	Slickensided	Staining[1]	Coating/Filling[2]	Aperture[3]	Healed[4]	Weathering[5]
4.24	Ground break	90												
4.62	End of Run 1/ Start of Run 2													
5.12 to 5.42	Broken core due to vertical joint													
5.42 to 5.69	Vertical joint, trace silt	0	X				X			Fe	S			FW
5.69 to 5.72	Broken core, vertical core conditions													
5.77	Broken core ¼ inch, silt, possibly ground	90												
5.77	Joint	90	X				X				None			
5.93	Joint	90								Fe				FW
6.12	End of run 2/ Start of Run 3													
6.48 to 6.50	Broken core													
6.50	Joint, gray clay, 2mm thick Fault Gouge	75									Cy			F
7.06 to 7.09	Broken core, argillaceous, shale parting	90	X							Fe				FW
7.59 to 7.62	Broken core, shale partings													
7.06	Joint	90	X			X								F
7.21	Shale parting, broken core	90												F
7.16 to 7.43	Shale parting, slightly ground	90												F
7.57	Shale parting	90												F
7.72 to 7.82	Joint, part of core missing due to joint	0	X			X								F
7.82	Bedding	90	X			X								F
8.56	Shale parting	85									None			F
8.62	Shale parting	85	X				X							F
8.76 to 8.79	Broken core, shale parting	90									Cy			F
9.17	Bedding	90	X			X					Cal			F
9.20	Bedding	90	X			X					Cal			F
9.20 to 9.23	Joint	0	X			X					None			F
9.27	End of Run 3/ Start of Run 4													
9.35	Bedding	90	X			X					None			F
9.77	Bedding, shale parting	90	X			X								F
9.80 to 9.82	Broken core, shale parting	90												

1 = Fe - Iron, Mn - Manganese
2 = C - Carbonate, G - Gypsum, SC - Silt/Clay
Py - Pyrite, St - Serpentine, Ch – Chlorite, S = Silt, Cy = Clay, Cal – Calcite, Hem - Hematite
3 = T – Tight
4 = P - Partially
5 = F - Faintly, S - Slightly

} Use other Symbols - If Required, Identify in Legend

*Measured to nearest 0.01 m/0.1 ft

TULLOCH

Discontinuity Log

Project No. 18-4046

Borehole BH18-201

Project: Kingston Third Crossing Bridge

Sheet 2 **of** 2

Inspector SK/DB

Site: 630 John Counter Blvd.

Date 12-19-2018

Depth* ☒ (m) ☐ (ft)	Discontinuity Details: Joint, Bedding plane joint, Solution cavity, Extremely closely spaced zone, Very closely spaced zone, Fragmented zone, Broken zone, Etc	Angle with Core Axis (°)	Plane	Curved	Irregular	Smooth	Rough	Slick	Slickensided	Staining[1]	Coating/Filling[2]	Aperture[3]	Healed[4]	Weathering[5]
10.02	Shale parting, soft	90	X											F
10.05	Shale parting	90	X			X								F
10.19	Shale parting, broken, soft	90	X											F
10.54	Mechanical break	90	X				X							F
10.69	Bedding	90	X				X				Silt			F
10.71	Mechanical break	90									None			F
11.46	End of Run 4													
	End of Drillhole													

1 = Fe - Iron, Mn - Manganese **4 = P - Partially**
2 = C - Carbonate, G - Gypsum, SC - Silt/Clay **5 = F - Faintly, S - Slightly**
Py - Pyrite, St - Serpentine, Ch – Chlorite, Cal – Calcite, Hem - Hematite
3 = T – Tight

} Use other Symbols - If Required, Identify in Legend

*Measured to nearest 0.01 m/0.1 ft

APPENDIX B

RECORD OF BOREHOLE LOGS – PREVIOUS INVESTIGATION

PROJECT: 1541774

RECORD OF BOREHOLE: 16-101

SHEET 1 OF 5

LOCATION: See Site Plan

BORING DATE: September 1,2 & 6, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		WATER LEVEL		74.68							
0	Wash-Boring	WATER		0.00							
1	HW Casing			73.46							
		(OL) ORGANIC SILT; black; wet, very loose		1.22	1	SS	WH				
2					2	SS	WR		452.3		
					3	SS	WR		191.3	OC = 16.5%	
3				71.48							
		(CI/CH) SILTY CLAY to CLAY; grey and grey brown; cohesive, w>PL, very stiff		3.20	4	SS	5				
4					5	SS	14				
					6	SS	26				
5					7	SS	14				
					8	SS	15			MH	
6					9	SS	9				
					10	SS	8				
7					11	SS	4				
				66.68							
8		(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, stiff		8.00	12	SS	WH				
								⊕	+		
9									+		
					13	SS	3				
10		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-101

SHEET 2 OF 5

LOCATION: See Site Plan

BORING DATE: September 1,2 & 6, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	Wash-Boring / HW Casing	(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, stiff			13	SS	3				
11					14	SS	2				
12											
13					15	SS	3				
14											
15					16	SS	3				
16											
17					17	SS	2				
18					18	SS	1			MH	
19											
20		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-101

SHEET 3 OF 5

LOCATION: See Site Plan

BORING DATE: September 1,2 & 6, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl; 20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
20	Wash-Boring / HW Casing	(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, stiff			19	SS	WH	⊕ + +			
21				52.78							
22		BOREHOLE CONTINUED ON RECORD OF DRILLHOLE 16-101		21.9							
23											
24											
25											
26											
27											
28											
29											
30											

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF DRILLHOLE: 16-101

SHEET 4 OF 5

LOCATION: See Site Plan

DRILLING DATE: September 1,2 & 6, 2016

DATUM: CGVD28

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME-55

DRILLING CONTRACTOR: Downing Drilling

JN - Joint, FLT - Fault, SHR- Shear, VN - Vein, CJ - Conjugate
BD- Bedding, FO- Foliation, CO- Contact, OR- Orthogonal, CL - Cleavage
PL - Planar, CU- Curved, UN- Undulating, ST - Stepped, IR - Irregular
PO- Polished, K - Slickensided, SM- Smooth, Ro - Rough, MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	COLOUR / % RETURN / FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	HYDRAULIC CONDUCTIVITY K, cm/sec	
		GROUND SURFACE		52.78								
22	Rotary Drill / HW Casing	Slightly weathered to fresh, medium to thickley bedded, green grey, fine grained, medium strong crystalline quartz feldspar GNEISS		21.90	1							
23					2							
24				50.54								
		Fresh, pink, coarse grained, medium strong GRANITE		24.14								
				49.80								
25		Fresh, fine grained, medium to thickly bedded, green grey, fine grained, very strong crystalline quartz feldspar GNEISS, with granite interbeds		24.88	3							
26					4							UCS = 220.2 MPa
27	Rotary Drill / NQ Core				5							
28					6							
29					7							
30					8							
31												
		CONTINUED NEXT PAGE										

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-RCK 004B 1541774.GPJ GAL-MISS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF DRILLHOLE: 16-101

SHEET 5 OF 5

LOCATION: See Site Plan

DRILLING DATE: September 1,2 & 6, 2016

DATUM: CGVD28

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME-55

DRILLING CONTRACTOR: Downing Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate

BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage

PL - Planar; CU- Curved; UN- Undulating; ST - Stepped; IR - Irregular

PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break

BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	COLOUR / % RETURN / FLUSH	RECOVERY: TOTAL CORE % (80 60 40 20)	RECOVERY: SOLID CORE % (80 60 40 20)	R.Q.D. % (80 60 40 20)	FRACT. INDEX PER 0.25 m (5 10 15 20)	HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-6} 10^{-5} 10^{-4} 10^{-3})
		--- CONTINUED FROM PREVIOUS PAGE ---									
32				42.58	8						
		End of Drillhole		32.10							
33											
34											
35											
36											
37											
38											
39											
40											
41											

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-RCK 004B 1541774.GPJ GAL-MISS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-102

SHEET 1 OF 5

LOCATION: See Site Plan

BORING DATE: September 7-9, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		WATER LEVEL		74.67							
0	Wash-Boring / HW Casing	WATER		0.00							
				73.22							
1		(PT) SILTY PEAT; black; wet, very loose		1.45	1	SS	WR				
				72.27							
2		(PT) SILTY PEAT; black; wet, very loose		2.40	2	SS	WR			OC = 50.4%	
				72.07					532.6		
		(CI/CH) SILTY CLAY to CLAY; grey, contains organic matter; cohesive, w>PL, firm		2.60							
3					3	SS	PM				
				71.07							
		(CI/CH) SILTY CLAY to CLAY; grey to grey brown, with black mottling, contains silty sand layers; cohesive, w>PL, very stiff		3.60							
4					4	SS	6				
					5	SS	6				
5					6	SS	6				
					7	SS	5				
6											
				68.22							
		(ML, CL, SM) layered SILT, CLAYEY SILT, SILTY SAND and fine SILTY SAND; grey; non-cohesive, wet, loose to compact		6.45	8	SS	11				
7	Wash-Boring / NW Casing				9	SS	9			MH	
				67.17							
		(CI/CH) SILTY CLAY to CLAY; grey to red grey, contains silty sand seams; cohesive, w>PL very stiff		7.50							
8					10	SS	9				
					11	SS	6				
9					12	SS	5				
								>96 +			
10		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-102

SHEET 2 OF 5

LOCATION: See Site Plan

BORING DATE: September 7-9, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m; SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s; WATER CONTENT PERCENT (Wp, W, Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10		*--- CONTINUED FROM PREVIOUS PAGE ---*									
	Wash-Boring / NW Casing	(CI/CH) SILTY CLAY to CLAY; grey to red grey, contains silty sand seams; cohesive, w>PL very stiff						>96 +			
					13	SS	5			MH	
11					14	SS	7				
12					15	SS	5				
13								>96 + >96 +			
				60.87							
		(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, stiff		13.80	16	SS	2				
14								⊕			
15								+			
					17	SS	WH				
16								+			
								+			
17				57.67							
		(ML, CL, SM) layered SILT, CLAYEY SILT, SILTY CLAY and fine SILTY SAND, trace gravel; grey; non-cohesive, wet, loose		17.00	18	SS	4				
18											
				56.37							
		(ML/SM) SILT and SAND, trace gravel; grey; non-cohesive, wet, compact to very dense		18.30							
19					19	SS	13			MH	
20		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-102

SHEET 3 OF 5

LOCATION: See Site Plan

BORING DATE: September 7-9, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
20	Wash-Boring NW Casing	(ML/SM) SILT and SAND, trace gravel; grey; non-cohesive, wet, compact to very dense			20	SS	52				
21				53.66	21	NQ RC	DD				
		BOREHOLE CONTINUED ON RECORD OF DRILLHOLE 16-102		21.01							
22											
23											
24											
25											
26											
27											
28											
29											
30											

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF DRILLHOLE: 16-102

SHEET 4 OF 5

LOCATION: See Site Plan

DRILLING DATE: September 7-9, 2016

DATUM: CGVD28

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME-55

DRILLING CONTRACTOR: Downing Drilling

JN - Joint, FLT - Fault, SHR- Shear, VN - Vein, CJ - Conjugate
BD- Bedding, FO- Foliation, CO- Contact, OR- Orthogonal, CL - Cleavage
PL - Planar, CU- Curved, UN- Undulating, ST - Stepped, IR - Irregular
PO- Polished, K - Slickensided, SM- Smooth, Ro - Rough, MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	COLOUR / % RETURN / FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	HYDRAULIC CONDUCTIVITY K, cm/sec	
		GROUND SURFACE		53.66								
	RD / NW	Slightly weathered to fresh, thinly to thickly bedded, grey and pink, fine to medium grained, very strong crystalline quartz feldspar GNEISS, with granite bedding		21.01	1		80 60 20	80 60 40 20	80 60 20	5 10 15 20		
22					2							
23					3							
24												UCS = 127.8 MPa
25					4							
26	Rotary Drill / NQ Core				5							
27												
28					6							
29												
30					7							
31					8							
		CONTINUED NEXT PAGE										

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-RCK 004B 1541774.GPJ GAL-MISS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF DRILLHOLE: 16-102

LOCATION: See Site Plan

DRILLING DATE: September 7-9, 2016

DATUM: CGVD28

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME-55

DRILLING CONTRACTOR: Downing Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU- Curved; UN- Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	COLOUR / % RETURN / FLUSH	RECOVERY: TOTAL CORE % (80 60 40 20)	RECOVERY: SOLID CORE % (80 60 40 20)	R.Q.D. % (80 60 40 20)	FRACT. INDEX PER 0.25 m (5 10 15 20)	HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-6} 10^{-5} 10^{-4} 10^{-3})
		--- CONTINUED FROM PREVIOUS PAGE ---									
	Rotary Drill / NQ Core				8						
				43.21							
		End of Drillhole		31.46							
32											
33											
34											
35											
36											
37											
38											
39											
40											
41											

DEPTH SCALE
1 : 50

LOGGED: PAH
CHECKED: MJK

Golder Associates

MIS-RCK 004B 1541774.GPJ GAL-MISS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-103

SHEET 1 OF 6

LOCATION: See Site Plan

BORING DATE: September 12-15, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		WATER LEVEL		74.70							
0	Wash-Boring / HW Casing	WATER		0.00							
				73.20							
1		(PT) SILTY PEAT; black; wet, very loose		1.50	1	SS	WR				
2				72.30	2	SS	PM		626.6 / 223.6		
		(OH/CL) SILTY CLAY; grey, contains organic matter; cohesive, w>PL		2.40							
				72.00							
3		(CI/CH) SILTY CLAY to CLAY; grey to grey brown; cohesive, w>PL, very stiff		2.70	3	SS	11				
					4	SS	21				
4											
					5	SS	26				
5					6	SS	12				
6	Wash-Boring / NW Casing				7	SS	12				
					8	SS	11				
7											
					9	SS	7				
8					10	SS	4				
				66.20							
		(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, stiff		8.50							
9					11	SS	3				
								⊕ +			
10		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PAH

CHECKED: MJK

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-103

SHEET 2 OF 6

LOCATION: See Site Plan

BORING DATE: September 12-15, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	Wash-Boring / NW Casing	(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, stiff									
					12	SS	WH				
11								⊕ +			
					13	SS	1	+			
12								+			
					14	SS	1	+			
13								+			
					15	SS	WH		Wp W Wl	MH	
14								⊕ +			
					16	TO	PH	+			
15								+			
					17	TO	PH				
16								+			
17											
18											
19											
20		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-103

SHEET 3 OF 6

LOCATION: See Site Plan

BORING DATE: September 12-15, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
20	Wash-Boring / NW Casing	(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, stiff			18	SS	PH	⊕ at 60			
21								+ at 60			
22								+ at 60			
23					19	SS	WR	+ at 60			
24								+ at 60			
25								+ at 60			
26					20	SS	1	+ at 60	○ at W		
27								+ at 60			
28								+ at 60			
29					21	SS	1	+ at 60			
30		*CONTINUED NEXT PAGE*						+ at 60			

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-103

SHEET 4 OF 6

LOCATION: See Site Plan

BORING DATE: September 12-15, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m; SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s; WATER CONTENT PERCENT (Wp, W, Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
30	Wash-Boring NW Casing	(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, stiff									
31											
32					22	SS	4				
33											
34											
35					23	SS	2				
36											
				38.10							
		(CL/CI-ML) layered SILTY CLAY and CLAYEY SILT; grey; cohesive, w>PL, stiff to very stiff		36.60							
37											
38					24	SS	1	>96 +			
39								>96 +			
				35.10							
		(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, stiff		39.60							
40		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-103

SHEET 5 OF 6

LOCATION: See Site Plan

BORING DATE: September 12-15, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
40	Wash-Boring / NW Casing	(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, stiff									
41					25	SS	4				
42								+	+		
43											
44					26	SS	4			MH	
45									+		
									+		
				28.82							
46		BOREHOLE CONTINUED ON RECORD OF DRILLHOLE 16-103		45.88							
47											
48											
49											
50											

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF DRILLHOLE: 16-103

SHEET 6 OF 6

LOCATION: See Site Plan

DRILLING DATE: September 12-15, 2016

DATUM: CGVD28

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME-55

DRILLING CONTRACTOR: Downing Drilling

JN - Joint, FLT - Fault, SHR- Shear, VN - Vein, CJ - Conjugate | BD- Bedding, FO- Foliation, CO- Contact, OR- Orthogonal, CL - Cleavage | PL - Planar, CU- Curved, UN- Undulating, ST - Stepped, IR - Irregular | PO- Polished, K - Slickensided, SM- Smooth, Ro - Rough, MB- Mechanical Break | BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	COLOUR / % RETURN / FLUSH	RECOVERY: TOTAL CORE % (80 60 40 20)	RECOVERY: SOLID CORE % (80 60 40 20)	R.Q.D. % (80 60 40 20)	FRACT. INDEX PER 0.25 m (5 10 15 20)	HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-6} 10^{-5} 10^{-4} 10^{-3})
		GROUND SURFACE		28.82							
46	Rotary Drill, NQ Core	Slightly weathered to fresh, thinly bedded, red to dark grey, fine grained, very strong crystalline quartz feldspar GNEISS, with granite beds		45.88	1						
47					2						
48					3						
49					4						
50					5						
				23.83							
51		End of Drillhole		50.87							
52											
53											
54											
55											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PAH

CHECKED: MJK

MIS-RCK 004B 1541774.GPJ GAL-MISS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-104

SHEET 1 OF 7

LOCATION: See Site Plan

BORING DATE: September 23, 26 & 27, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		WATER LEVEL		74.55							
0		WATER		0.00							
				73.20							
1	Wash-Boring / HW Casing	(PT) SILTY PEAT, some fibrous peat; brown; wet, very loose		1.35	1	CS	-		278.1		
2					2	SS	WR				
3					3	SS	PM		974.7		
4					4	SS	PM		548.2	OC = 48.2%	
					5	SS	PM		355.6		
				69.75							
5		(OH) ORGANIC SILT; grey brown, contains organic clay seams/layers and shells and wood fibres; wet, very loose		4.80	6	SS	PM		216.3	OC = 11.6%	
					7	SS	PM				
6					8	SS	WR		111.8		
				67.75							
7	Wash-Boring / NW Casing	(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, very stiff		6.80	9	SS	1				
					10	SS	5				
8					11	SS	7				
9					12	SS	7			MH	
					13	SS	6				
10		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-104

SHEET 2 OF 7

LOCATION: See Site Plan

BORING DATE: September 23, 26 & 27, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	Wash-Boring / NW Casing	(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, very stiff			14	SS	5				
11								>96 +			
								>96 +			
12				62.55 / 12.00							
		(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, stiff			15	SS	2				
13								⊕			
								+			
14					16	SS	WR		○		
								+			
15								+			
16											
17					17	SS	1				
								⊕			
								+			
18								+			
19											
20					18	SS	WR				
		CONTINUED NEXT PAGE									

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PAH

CHECKED: MJK

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-104

SHEET 3 OF 7

LOCATION: See Site Plan

BORING DATE: September 23, 26 & 27, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
20	Wash-Boring NW Casing	(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, stiff			18	SS	WR				
21					19	TO	PH				
22											
23											
24											
25					20	SS	WR			MH	
26											
27											
28					21	SS	WH				
29											
30				44.55							
		CONTINUED NEXT PAGE									

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: PAH
CHECKED: MJK

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-104

SHEET 4 OF 7

LOCATION: See Site Plan

BORING DATE: September 23, 26 & 27, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
30	Wash-Boring NW Casing	(CI/CH) SILTY CLAY to CLAY; grey, contains clayey silt layers; cohesive, w>PL, stiff		30.00							
					22	SS	WR				
31								+			
								+			
32											
33											
					23	SS	WR				
34								+			
								+			
35											
36											
					24	SS	WR		○		
37								+			
								+			
38											
39											
					25	SS	WR				
40		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-104

SHEET 5 OF 7

LOCATION: See Site Plan

BORING DATE: September 23, 26 & 27, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m; SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s; WATER CONTENT PERCENT (Wp, W, Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
40	Wash-Boring NW Casing	(CI/CH) SILTY CLAY to CLAY; grey, contains clayey silt layers; cohesive, w>PL, stiff									
41				33.15							
		Inferred layered CLAY, SILT, and fine SAND, some gravel		41.40							
42				31.96	26	NQ RC	DD				
		BOREHOLE CONTINUED ON RECORD OF DRILLHOLE 16-104		42.59							
43											
44											
45											
46											
47											
48											
49											
50											

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF DRILLHOLE: 16-104

SHEET 6 OF 7

LOCATION: See Site Plan

DRILLING DATE: September 23, 26 & 27, 2016

DATUM: CGVD28

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME-55

DRILLING CONTRACTOR: Downing Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU- Curved; UN- Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	COLOUR % RETURN / FLUSH	RECOVERY: TOTAL CORE % (80 60 40 20)	RECOVERY: SOLID CORE % (80 60 40 20)	R.Q.D. % (80 60 40 20)	FRACT. INDEX PER 0.25 m (5 10 15 20)	HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-6} 10^{-5} 10^{-4} 10^{-3})	
		GROUND SURFACE		31.96								
	Rotary Drill / NQ Core	Slightly weathered to fresh, thinly to medium bedded, green grey and pink, medium to coarse grained, very strong crystalline quartz feldspar GNEISS		42.59	1							
43					2							UCS = 103.8 MPa
44					3							
45					4							
46					5							
47					6							
48					7							
49					8							
50												
51												
52												
		CONTINUED NEXT PAGE										

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-RCK 004B 1541774.GPJ GAL-MISS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF DRILLHOLE: 16-104

SHEET 7 OF 7

LOCATION: See Site Plan

DRILLING DATE: September 23, 26 & 27, 2016

DATUM: CGVD28

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME-55

DRILLING CONTRACTOR: Downing Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU- Curved; UN- Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	COLOUR % RETURN / FLUSH	RECOVERY: TOTAL CORE % (80 60 40 20)	RECOVERY: SOLID CORE % (80 60 40 20)	R.Q.D. % (80 60 40 20)	FRACT. INDEX PER 0.25 m (5 10 15 20)	HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-6} 10^{-5} 10^{-4} 10^{-3})
		--- CONTINUED FROM PREVIOUS PAGE ---									
53	Rotary Drill / NQ Core	Slightly weathered to fresh, thinly to medium bedded, green grey and pink, medium to coarse grained, very strong crystalline quartz feldspar GNEISS		21.37	8						
		End of Drillhole		53.18							
54											
55											
56											
57											
58											
59											
60											
61											
62											

DEPTH SCALE
1 : 50

LOGGED: PAH
CHECKED: MJK

Golder Associates

MIS-RCK 004B 1541774.GPJ GAL-MISS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-105

SHEET 1 OF 5

LOCATION: See Site Plan

BORING DATE: September 28 & 29 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		WATER LEVEL		74.46							
0	Wash-Boring / HW Casing	WATER		0.00							
				73.16							
1		(PT) SILTY PEAT; brown; very loose		1.30	1	SS	WR				
				72.36							
2		(Cl) SILTY CLAY; grey; cohesive, w>PL, stiff		2.10	2	SS	WR				
				71.86							
		(Cl) SILTY CLAY; grey brown; cohesive, w~PL, very stiff		2.60	3	SS	PH				
3					4	SS	17				
					5	SS	30				
4					6	SS	17			MH	
					7	SS	25				
5					8	SS	22				
				68.46							
6	Wash-Boring / NW Casing	(Cl/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, very stiff		6.00	9	SS	9				
					10	SS	6				
7											
					11	SS	4				
8					12	SS	4				
				65.76							
		(Cl/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, stiff		8.70							
9					13	SS	2				
								⊕	+		
10		*CONTINUED NEXT PAGE*									

536.4

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-105

SHEET 2 OF 5

LOCATION: See Site Plan

BORING DATE: September 28 & 29 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	Wash-Boring / NW Casing	(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, stiff									
					14	SS	WH				
11											
					15	TO	PH				
12											
13											
					16	SS	WH				
14											
15											
16											
					17	SS	PM				
17											
18											
19											
					18	SS	WH				
20		*CONTINUED NEXT PAGE*									

DEPTH SCALE
1 : 50

LOGGED: PAH
CHECKED: MJK

Golder Associates

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-105

SHEET 3 OF 5

LOCATION: See Site Plan

BORING DATE: September 28 & 29 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
20	Wash-Boring / NW Casing	(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, stiff			18	SS	WH	+			
21								+			
22											
23					19	SS	WH				
24								+			
25								+			
26					20	SS	WR				
27								+			
28								+			
29					21	SS	WR				
30		*CONTINUED NEXT PAGE*						+			

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-105

SHEET 4 OF 5

LOCATION: See Site Plan

BORING DATE: September 28 & 29 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m; SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s; WATER CONTENT PERCENT (Wp, W, Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
30	Wash-Boring / NW Casing	(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, stiff									
31											
32					22	SS	WR				
33											
34											
35				39.41							
		(SM) SILTY SAND, some gravel; red grey, contains cobbles and boulders (GLACIAL TILL); non-cohesive, wet, compact to dense		35.05	23	SS	13			MH	
36											
37	Rotary Drill / NQ Core				24	NQ RC	DD				
				36.81							
		BOREHOLE CONTINUED ON RECORD OF DRILLHOLE 16-105		37.65							
38											
39											
40											

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PAH

CHECKED: MJK

PROJECT: 1541774

RECORD OF DRILLHOLE: 16-105

SHEET 5 OF 5

LOCATION: See Site Plan

DRILLING DATE: September 28 & 29 2016

DATUM: CGVD28

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME-55

DRILLING CONTRACTOR: Downing Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate

BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage

PL - Planar; CU- Curved; UN- Undulating; ST - Stepped; IR - Irregular

PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break

BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	COLOUR % RETURN / FLUSH	RECOVERY: TOTAL CORE % (80 60 40 20)	RECOVERY: SOLID CORE % (80 60 40 20)	R.Q.D. % (80 60 40 20)	FRACT. INDEX PER 0.25 m (5 10 15 20)	HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-6} 10^{-5} 10^{-4} 10^{-3})	
		GROUND SURFACE		36.81								
38	Rotary Drill / NQ Core	Slightly weathered to fresh, thinly to thickly bedded, grey pink, fine to medium grained, very strong crystalline quartz feldspar GNEISS, with granite bedding		37.65	1							
39					2							UCS = 148.5 MPa
40					3							
41												
42					4							
				31.76								
43		End of Drillhole		42.70								
44												
45												
46												
47												

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-RCK 004B 1541774.GPJ GAL-MISS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-106

SHEET 1 OF 4

LOCATION: See Site Plan

BORING DATE: September 15-16, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		WATER LEVEL		74.63							
0	Wash-Boring / HW Casing	WATER		0.00							
				73.06							
2		(PT) SILTY PEAT; brown to black; wet, very loose		1.57	1	SS	WR				
					2	SS	WR				
3				71.53	3	SS	WR				
		(CL, ML) SILTY CLAY and CLAYEY SILT; grey to grey brown, thinly to thickly laminated; cohesive, w>PL, very stiff		3.10	4	SS	11				
4					5	SS	20				
5	Wash-Boring / NW Casing				6	SS	26				
					7	SS	19				
6				68.33							
		(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, very stiff		6.30	8	SS	24				
7					9	SS	11				
8					10	SS	9				
					11	SS	8			MH	
9					12	SS	2				
10		*CONTINUED NEXT PAGE*									

Wash-Boring: 473.1; 440.1 OC = 34.4%

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-106

SHEET 2 OF 4

LOCATION: See Site Plan

BORING DATE: September 15-16, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m; SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s; WATER CONTENT PERCENT (Wp, W, Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, very stiff						>96 + >96 +			
				63.83							
		(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, very stiff		10.80							
11					13	SS	2				
								>96 +			
12								>96 +			
					14	SS	2				
13								+			
								>96 +			
14					15	SS	1		○		
	Wash-Boring NW Casing			59.63				+			
15		(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, stiff		15.00							
					16	SS	1				
16								+			
								+			
17					17	SS	3				
								+			
18								+			
					18	TO	PH				
19								⊕			
								+			
								+			
20				54.63							
		CONTINUED NEXT PAGE									

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PAH

CHECKED: MJK

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-106

SHEET 3 OF 4

LOCATION: See Site Plan

BORING DATE: September 15-16, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
20	Wash-Boring / NW Casing	(CI/CH) SILTY CLAY to CLAY; grey, contains clayey silt seams/layers; cohesive, w>PL, stiff		20.00	19	SS	WH			MH	
21								+			
22								+			
23					20	SS	3				
				50.77							
24		BOREHOLE CONTINUED ON RECORD OF DRILLHOLE 16-106		23.86							
25											
26											
27											
28											
29											
30											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PAH

CHECKED: MJK

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF DRILLHOLE: 16-106

SHEET 4 OF 4

LOCATION: See Site Plan

DRILLING DATE: September 15-16, 2016

DATUM: CGVD28

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME-55

DRILLING CONTRACTOR: Downing Drilling

JN - Joint, FLT - Fault, SHR- Shear, VN - Vein, CJ - Conjugate
BD- Bedding, FO- Foliation, CO- Contact, OR- Orthogonal, CL - Cleavage
PL - Planar, CU- Curved, UN- Undulating, ST - Stepped, IR - Irregular
PO- Polished, K - Slickensided, SM- Smooth, Ro - Rough, MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	HYDRAULIC CONDUCTIVITY K, cm/sec	
		GROUND SURFACE		50.77									
24	Rotary Drill / NQ Core	Slightly weathered to fresh, thickly bedded, red grey, fine to medium grained, strong crystalline quartz feldspar GNEISS		23.86	1								
25					2								
26													UCS = 82.9 MPa
27					3								
28					4								
29				45.59									
		End of Drillhole		29.04									
30													
31													
32													
33													

DEPTH SCALE
1 : 50

LOGGED: PAH
CHECKED: MJK

Golder Associates

MIS-RCK 004B 1541774.GPJ GAL-MISS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-201

SHEET 1 OF 2

LOCATION: See Site Plan

BORING DATE: October 3 & 6, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] ⊕ (ND = Not Detected) 20 40 60 80 / HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [%LEL] □ (ND = Not Detected) 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} / WATER CONTENT PERCENT Wp W Wl 20 40 60 80	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		75.45						
0	Power Auger 200 mm Diam. (Hollow Stem)	FILL - (ML) sandy SILT, trace gravel; brown to black; non-cohesive, moist		0.00	1	GRAB	-			Flush Mount Casing
				74.69						
1	Power Auger 200 mm Diam. (Hollow Stem)	FILL - (SP/GP) SAND and GRAVEL, some non-plastic fines; brown; non-cohesive, wet, loose		0.76	2	SS	7			
	Power Auger 200 mm Diam. (Hollow Stem)			74.14						
	Power Auger 200 mm Diam. (Hollow Stem)	(PT) fibrous PEAT; dark brown to black; very loose		1.31	3	SS	2			
2	Power Auger 200 mm Diam. (Hollow Stem)			73.38						
	Wash-Boring HW Casing	(CH) CLAY; grey; cohesive, w>PL, stiff		2.07	4	SS	4 ⊕			63.5 mm VSP Casing
3	Wash-Boring HW Casing				5	SS	11 ⊕			
	Wash-Boring HW Casing			71.79						
	Wash-Boring HW Casing	(ML) sandy CLAYEY SILT; grey; non-cohesive, wet, very loose		3.66	6	SS	2			
4	Wash-Boring HW Casing			70.88						
	Wash-Boring HW Casing	Inferred BEDROCK		4.6	7	SS	>50			
		BOREHOLE CONTINUED ON RECORD OF DRILLHOLE 16-201								
5										
6										
7										
8										
9										
10										

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PAH

CHECKED: MJK

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF DRILLHOLE: 16-201

SHEET 2 OF 2

LOCATION: See Site Plan

DRILLING DATE: October 3 & 6, 2016

DATUM: CGVD28

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME-55

DRILLING CONTRACTOR: Downing Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU- Curved; UN- Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	COLOUR / % RETURN / FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	HYDRAULIC CONDUCTIVITY K, cm/sec	
		GROUND SURFACE		70.85								
5	Rotary Drill / HQ Core	Fresh, thinly to medium bedded, fine grained, porous, very strong DOLOSTONE		4.60	1							UCS = 108.9 MPa
6					2							
7					3							63.5 mm VSP Casing
8					4							
9												
10				65.43	5							
		End of Drillhole		10.02								
11												
12												
13												
14												

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-RCK 004B 1541774.GPJ GAL-MISS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-201B

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: October 6, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		75.45							
0	Power Auger 200 mm Diam. (Hollow Stem)	For stratigraphy refer to RECORD OF BOREHOLE 16-201		0.00							Flush Mount Casing
1											
											Bentonite Seal
2											
3											Silica Sand
4				70.88							51 mm Diam. PVC #10 Slot Screen
		End of Borehole		4.57							
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-202

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: October 3, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m; SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s; WATER CONTENT PERCENT (Wp, W, Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		80.87							
0	Power Auger 200 mm Diam. (Hollow Stem)	FILL - (SP) gravelly SAND; black; non-cohesive, moist		0.00	1	GRAB	-		○		
				80.34							
		(ML) sandy SILT; light brown; non-cohesive, moist, very dense		0.53							
1					2	SS	>50		○		
				79.42							
		End of Borehole Auger Refusal		1.45							
2											
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: PAH
CHECKED: MJK

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-203

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: October 3, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.30m	HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] ⊕ *ND = Not Detected* (20 40 60 80) / HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [%LEL] □ *ND = Not Detected* (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp — W — Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		81.73							
0	Power Auger 200 mm Diam.	FILL - (SP) gravelly SAND; dark brown; non-cohesive, moist		0.00	1	GRAB	-		○		
				80.92	2	SS	>50 ⊕	***ND***			
1		End of Borehole Auger Refusal		0.81							
2											
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PAH

CHECKED: MJK

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-204

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: October 3, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.30m	HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] ⊕ *ND = Not Detected* (20 40 60 80) / HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [%LEL] □ *ND = Not Detected* (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp — W — Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		84.58							
0	Power Auger 200 mm Diam. (Hollow Stem)	FILL - (SP) gravelly SAND, angular; grey; non-cohesive, moist		0.00 / 84.35							
		FILL - (SP) sandy GRAVEL, angular; grey; non-cohesive, moist		0.23 / 83.92	1	GRAB	-	⊕ ND	○		
		End of Borehole Auger Refusal		0.66							
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-205

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: October 5, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		94.65							
0	Power Auger 200 mm Diam. (Hollow Stem)	ASPHALTIC CONCRETE		0.00							
		FILL - (SP) gravelly SAND, angular; grey; non-cohesive, moist		0.10	1	GRAB	-				
		FILL - (GP) sandy GRAVEL, angular; grey; non-cohesive, moist		0.25	2	GRAB	-				
		FILL - (GM) sandy SILTY GRAVEL; grey; non-cohesive, moist, dense		0.41							
1					3	SS	52				
2					4	SS	33		○	M	
				92.21							
		(SM/GM) SILTY SAND and GRAVEL; grey and brown; non-cohesive, moist, dense to very dense		2.44	5	SS	39				
3					6	SS	53				
				90.86							
		End of Borehole Auger Refusal		3.79							
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-206

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: October 5, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		91.50							
0	Power Auger 200 mm Diam. (Hollow Stem)	ASPHALTIC CONCRETE		0.00							
		FILL - (GP) sandy GRAVEL, angular; grey; non-cohesive, moist		0.10 91.09	1	GRAB	-				
		FILL - (GP) sandy GRAVEL; grey, contains shale fragments; non-cohesive, moist, very dense		0.41							
1					2	SS	>50		○		
				89.98							
		(SM) SILTY SAND, some gravel; grey brown; non-cohesive, moist, very dense		1.52 89.62	3	SS	>50				
2		End of Borehole Auger Refusal		1.88							
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: PAH
CHECKED: MJK

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-207

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: October 5, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		79.09							
0	Power Auger 200 mm Diam. (Hollow Stem)	FILL - (CL) SILTY CLAY; dark grey, contains organic matter; cohesive, w>PL		0.00	1	GRAB	-		W ○		
				78.48							
1		(ML) sandy SILT; light brown; non-cohesive, moist, very dense		0.61	2	SS	>50		○		
				77.95							
		End of Borehole Auger Refusal		1.14							
2											
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-208

SHEET 1 OF 2

LOCATION: See Site Plan

BORING DATE: October 4, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		78.06							
0	Power Auger 200 mm Diam. (Hollow Stem)	(CL/CI) SILTY CLAY; dark brown, contains organic matter; cohesive, w>PL		0.00							
				77.45							
1		(ML) sandy SILT; grey, contains shale fragments; non-cohesive, moist, very dense		0.61	1	SS	>50		○		
				76.66							
		BOREHOLE CONTINUED ON RECORD OF DRILLHOLE 16-208		1.4							
2											
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF DRILLHOLE: 16-208

SHEET 2 OF 2

LOCATION: See Site Plan

DRILLING DATE: October 4, 2016

DATUM: CGVD28

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME-55

DRILLING CONTRACTOR: Downing Drilling

JN - Joint, FLT - Fault, SHR- Shear, VN - Vein, CJ - Conjugate
BD- Bedding, FO- Foliation, CO- Contact, OR- Orthogonal, CL - Cleavage
PL - Planar, CU- Curved, UN- Undulating, ST - Stepped, IR - Irregular
PO- Polished, K - Slickensided, SM- Smooth, Ro - Rough, MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	COLOUR % RETURN / FLUSH	RECOVERY TOTAL CORE % (80 60 40 20)	RECOVERY SOLID CORE % (80 60 40 20)	R.Q.D. % (80 60 40 20)	FRACT. INDEX PER 0.25 m (5 10 15 20)	HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-6} 10^{-5} 10^{-4} 10^{-3})	
		GROUND SURFACE		76.66								
1	Rotary Drill / NQ Core	Slightly weathered to fresh, thinly to medium bedded, grey, fine grained, strong LIMESTONE		1.40	1							
2					2							
3												UCS = 92.4 MPa
4					3							
5					4							
6												
7					5							
				70.42								
		End of Drillhole		7.64								
8												
9												
10												
11												

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PAH

CHECKED: MJK

MIS-RCK 004B 1541774.GPJ GAL-MISS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF BOREHOLE: 16-209

SHEET 1 OF 2

LOCATION: See Site Plan

BORING DATE: October 4, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		75.04							
0	RD NQ	(PT) amorphous PEAT; dark brown to black; moist		0.00							
		BOREHOLE CONTINUED ON RECORD OF DRILLHOLE 16-209		74.72							
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

LOGGED: PAH
CHECKED: MJK

MIS-BHS 001 1541774.GPJ GAL-MIS.GDT 03/08/17 JEM

PROJECT: 1541774

RECORD OF DRILLHOLE: 16-209

SHEET 2 OF 2

LOCATION: See Site Plan

DRILLING DATE: October 4, 2016

DATUM: CGVD28

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME-55

DRILLING CONTRACTOR: Downing Drilling

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU- Curved; UN- Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	COLOUR / % RETURN / FLUSH	RECOVERY: TOTAL CORE % (80 60 40 20)	RECOVERY: SOLID CORE % (80 60 40 20)	R.Q.D. % (80 60 40 20)	FRACT. INDEX PER 0.25 m (5 10 15 20)	HYDRAULIC CONDUCTIVITY K, cm/sec (10^{-6} 10^{-5} 10^{-4} 10^{-3})
		GROUND SURFACE		74.72							
1	Rotary Drill / NQ Core	Slightly weathered to fresh, thinly to medium bedded, grey, fine grained, strong LIMESTONE		0.32	1						
2					2						
3											
4					3						
5					4						
6				68.94							
		End of Drillhole		6.10							
7											
8											
9											
10											

DEPTH SCALE

1 : 50

LOGGED: PAH

CHECKED: MJK

Golder Associates

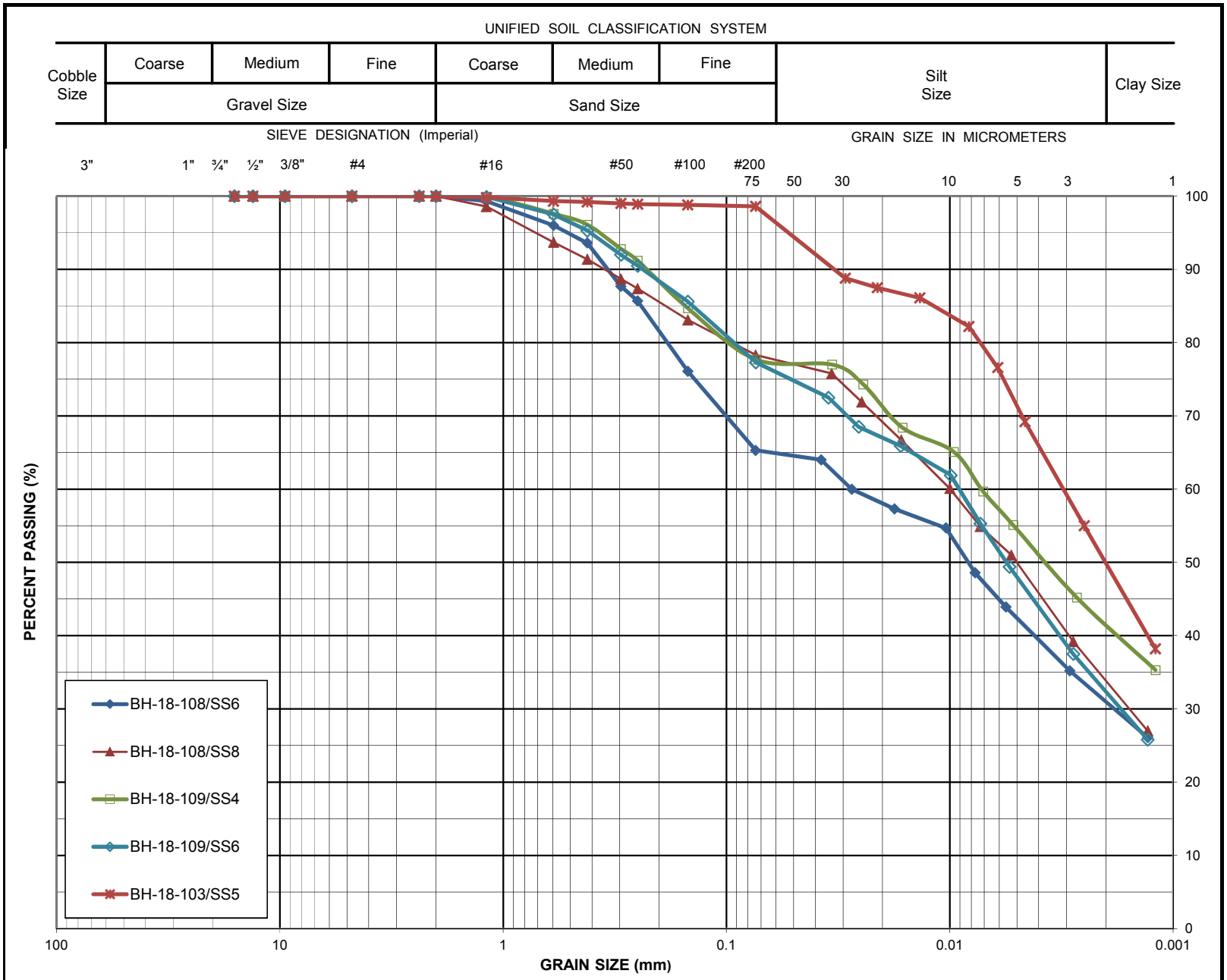
MIS-RCK 004B 1541774.GPJ GAL-MISS.GDT 03/08/17 JEM

APPENDIX C

LABORATORY RESULTS SUMMARY

APPENDIX C-1

GRAIN SIZE TESTS



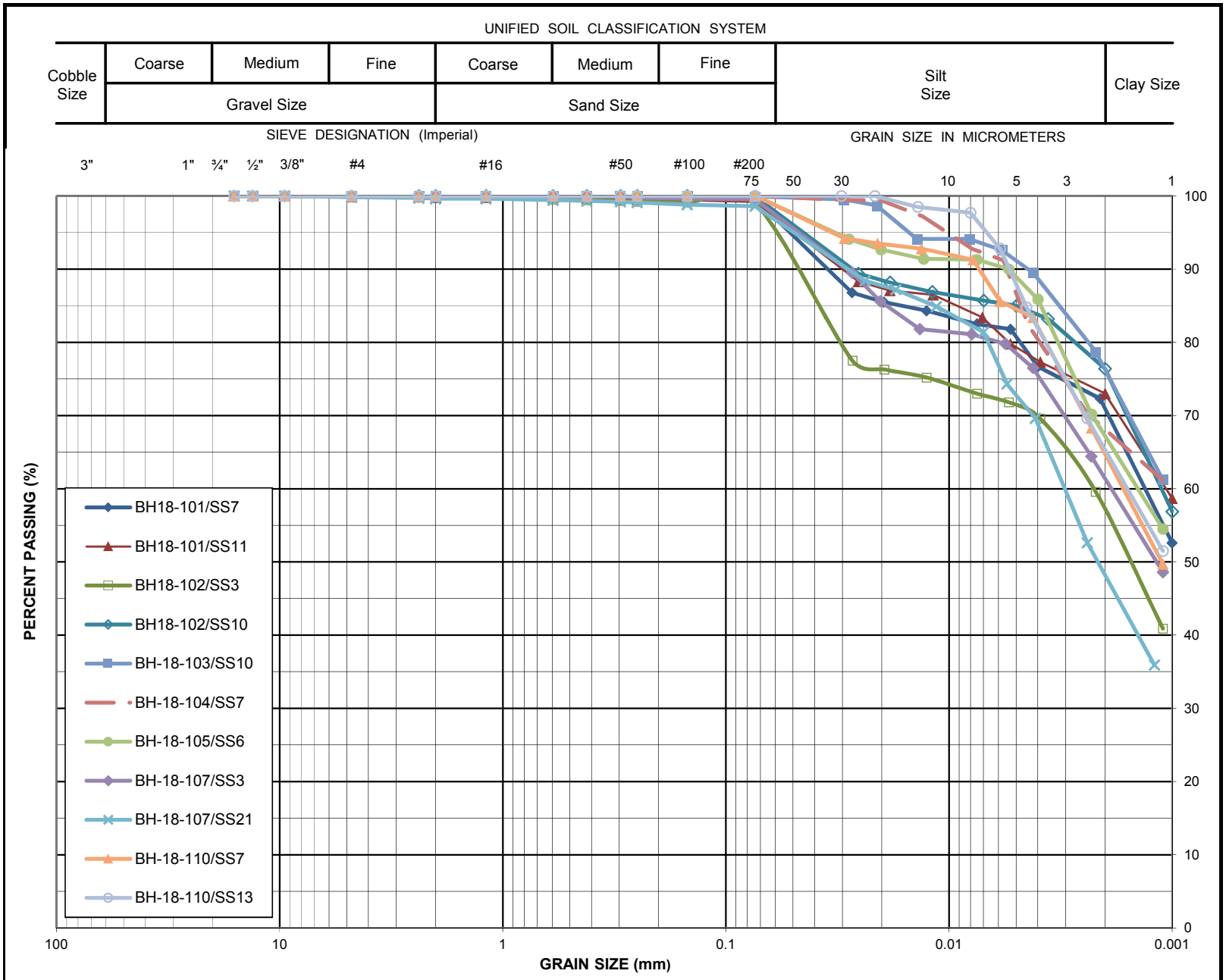
TULLOCH ENGINEERING

GRAIN SIZE SUMMARY - ORGANIC SILTY CLAY TO CLAYEY SILT

PROJECT NO: 18-4046		DATE:	Apr-19
BY:	EG	CHECK:	GQ

CITY OF KINGSTON - THIRD CROSSING BRIDGE

Figure C1-1

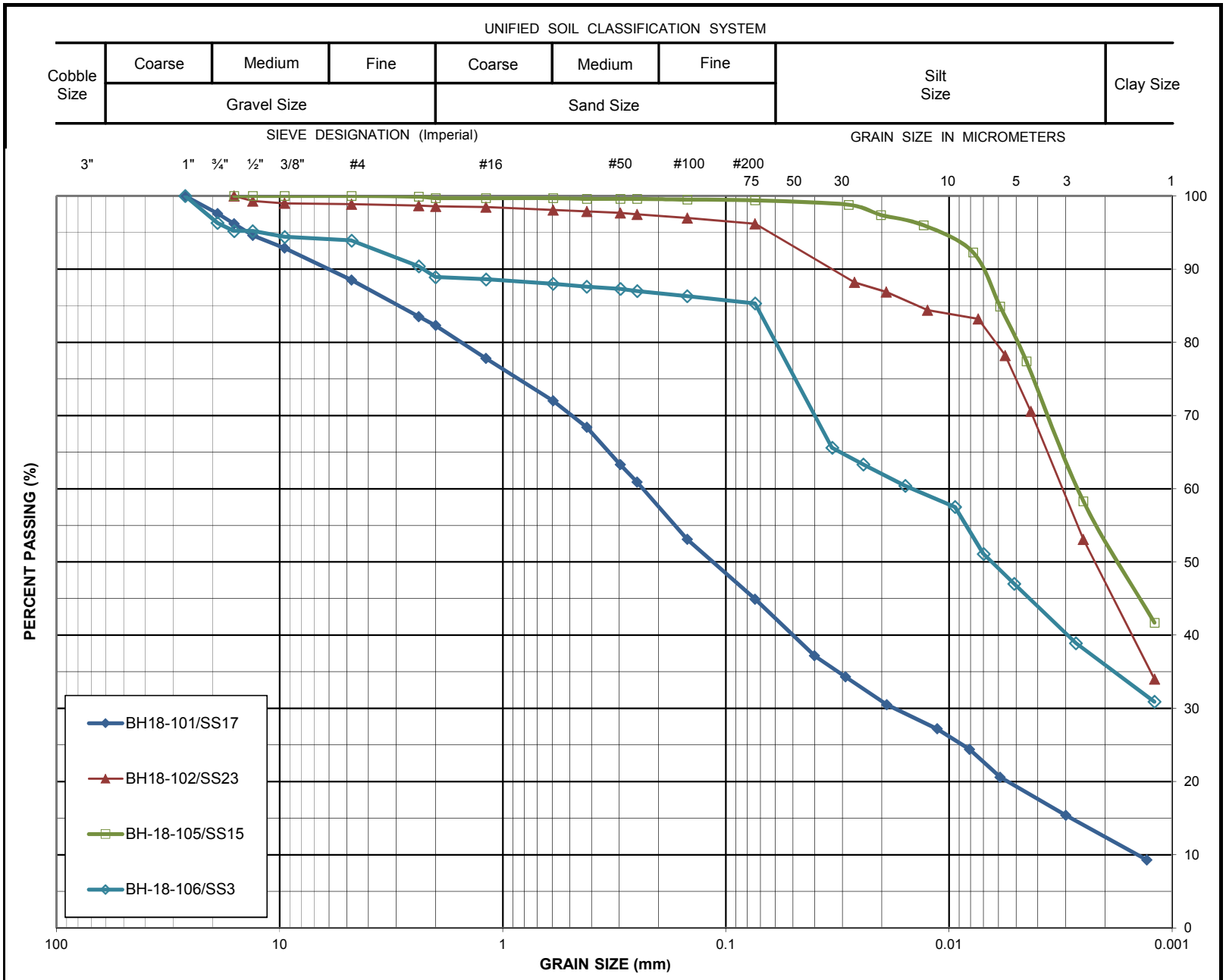


TULLOCH ENGINEERING

GRAIN SIZE SUMMARY - SILTY CLAY TO CLAY

PROJECT NO: 18-4046		DATE:	Apr-19
BY:	EG	CHECK:	GQ

CITY OF KINGSTON - THIRD CROSSING BRIDGE | **Figure C1-2**



TULLOCH ENGINEERING

GRAIN SIZE SUMMARY - TILL

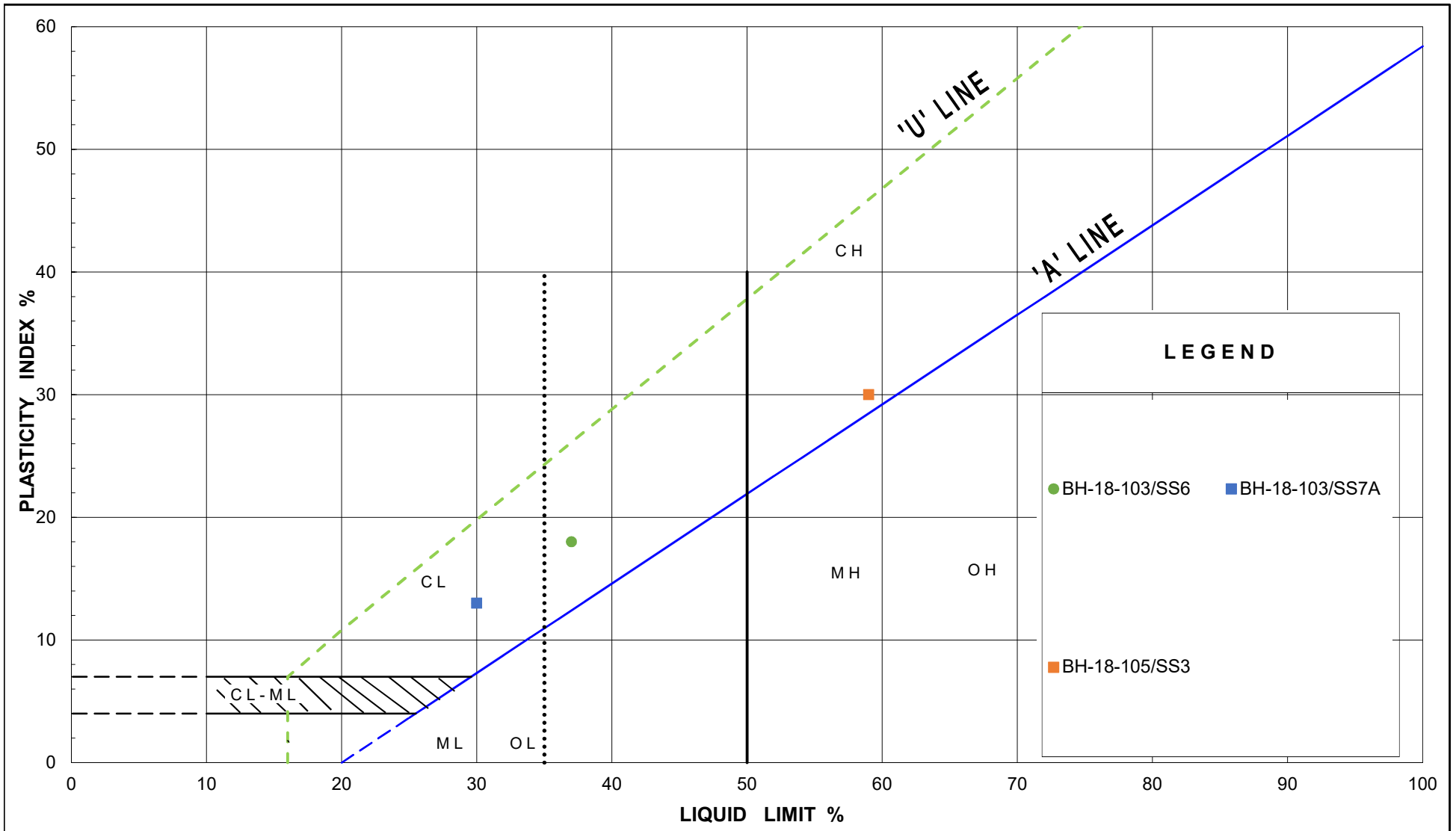
PROJECT NO: 18-4046		DATE:	Apr-19
BY:	EG	CHECK:	GQ

CITY OF KINGSTON - THIRD CROSSING BRIDGE

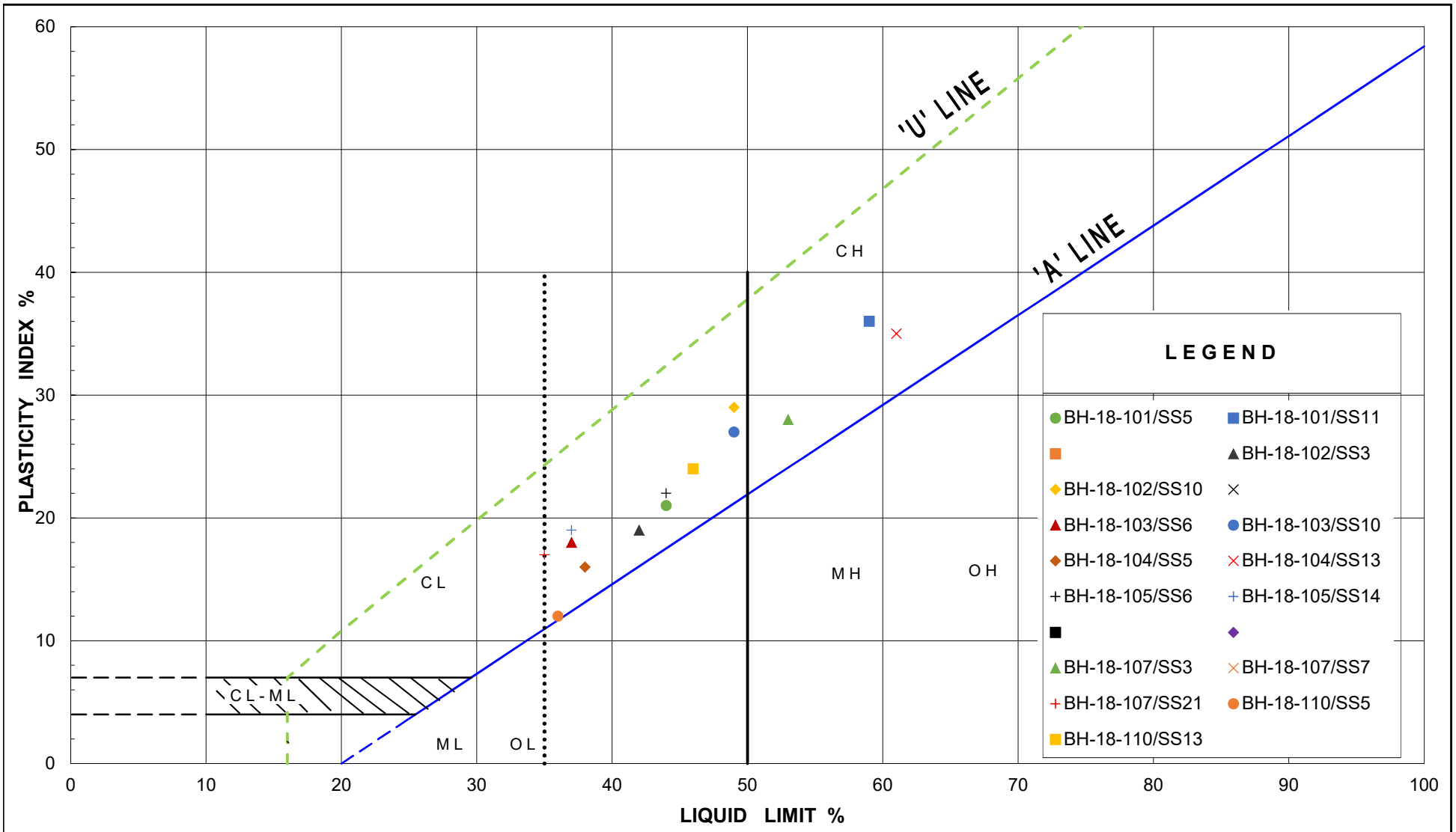
Figure C1-3

APPENDIX C-2

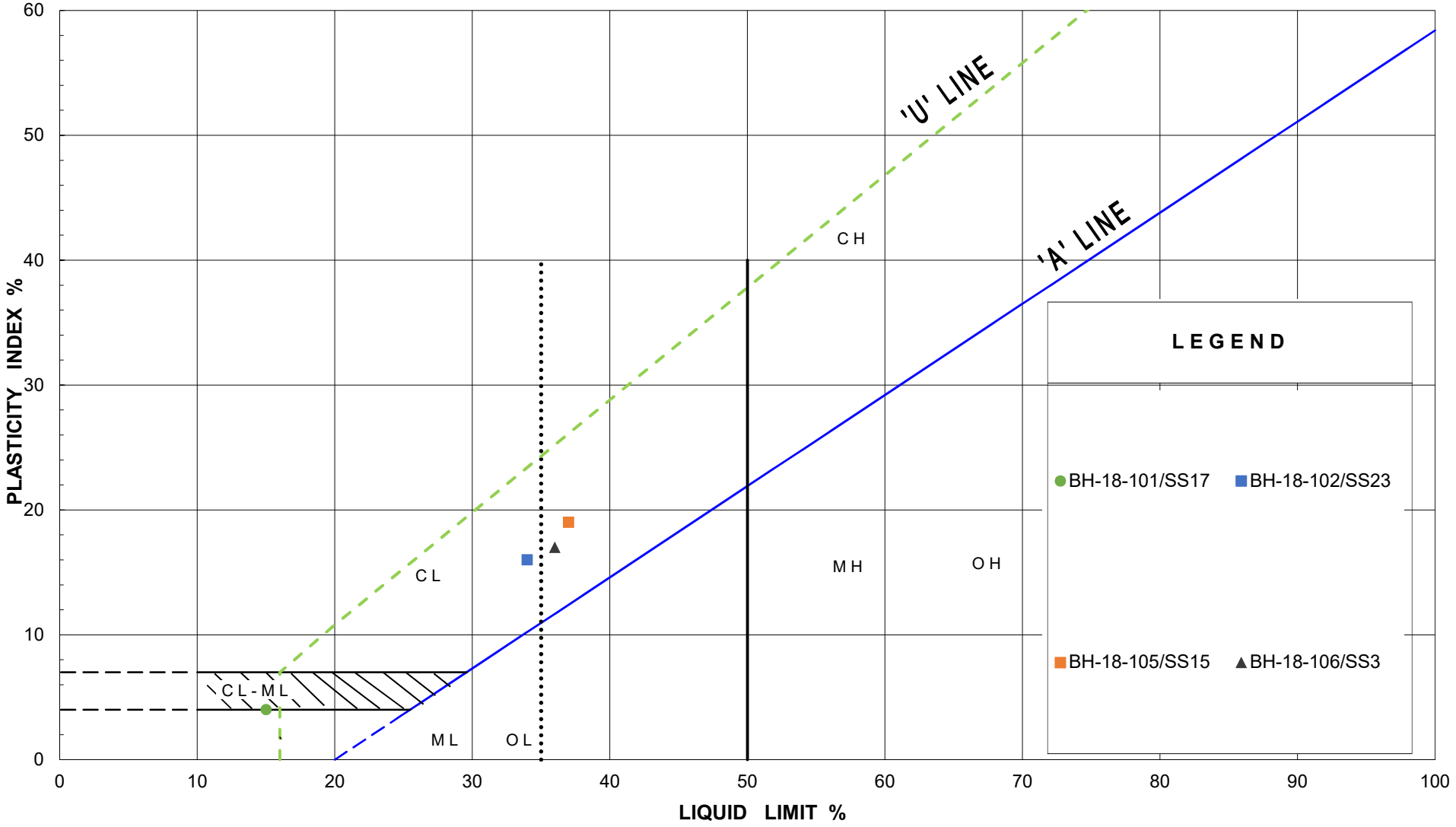
ATTERBERG LIMIT TESTS



TULLOCH ENGINEERING	PLASTICITY SUMMARY CHART **ORGANIC SILTY CLAY (OL-OH)**	Project No. 18-4046 Figure. No. Figure C2-1 Date 2019-03-28



TULLOCH ENGINEERING	PLASTICITY SUMMARY CHART **SILTY CLAY TO CLAY (CL-CH)**	Project No. 18-4046 Figure. No. Figure C2-2 Date 2019-03-28



TULLOCH ENGINEERING	PLASTICITY SUMMARY CHART **TILL**	Project No. 18-4046 Figure. No. Figure C2-3 Date 2019-03-28

APPENDIX C-3

DIRECT SHEAR TESTS

CONSOLIDATED DRAINED DIRECT SHEAR TEST ASTM D3080 SHEET 1 OF 3		FIGURE	
TEST STAGE	A	B	C
BOREHOLE NUMBER		BH-18-101	
SAMPLE		10	
SAMPLE DEPTH, (m)		-	
SAMPLE HEIGHT, (mm)	25.91	26.18	25.98
SAMPLE LENGTH, (mm)	60.00	60.00	60.00
WATER CONTENT, BEFORE TEST, (%)	43.9	43.9	43.9
NORMAL (CONSOLIDATION) STRESS, (kPa)	50	95	200
WATER CONTENT, AFTER TEST, (%)	51.9	46.6	37.8
DISPLACEMENT RATE, mm/min	0.0048	0.0048	0.0048
TIME TO FAILURE, hours	6	21	19
PEAK SHEAR STRESS[1], (kPa)	31.1	54.3	94.3
HORIZONTAL DISPLACEMENT AT PEAK, (mm)	1.7	6.0	5.5
RESIDUAL SHEAR STRESS, (kPa)	27.7	52.1	92.1
HORIZONTAL DISPLACEMENT AT RESIDUAL, (mm)	8.4	9.4	11.5
DRY DENSITY, initial, Mg/m^3	1.169	1.141	1.185
WET DENSITY, initial, Mg/m^3	1.682	1.642	1.704

TEST NOTES:

[1] In the absence of a peak, the shear stress reported is at 10 percent relative horizontal displacement (ASTM D3080).

[2] Normal stresses asigned by the client

[3] Direct Shear Tests carried out submerged, per clients instruction.

Date: 1/16/2019

Project No. 18105808(6000)

Golder Associates

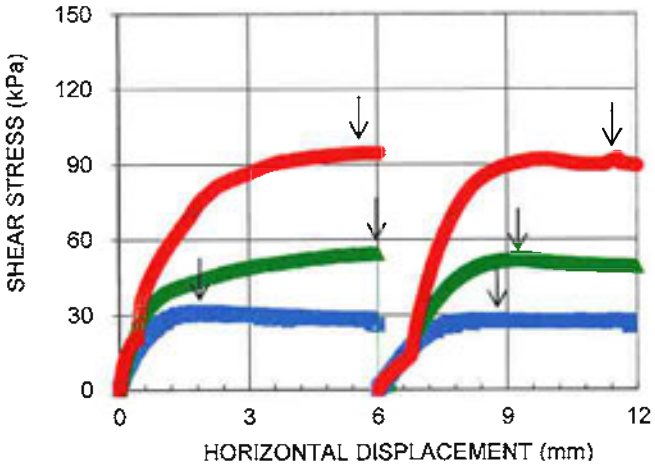
Prepared By: LH

Checked By:

CONSOLIDATED DRAINED DIRECT SHEAR TEST ASTM D3080 SHEET 2 OF 3	FIGURE

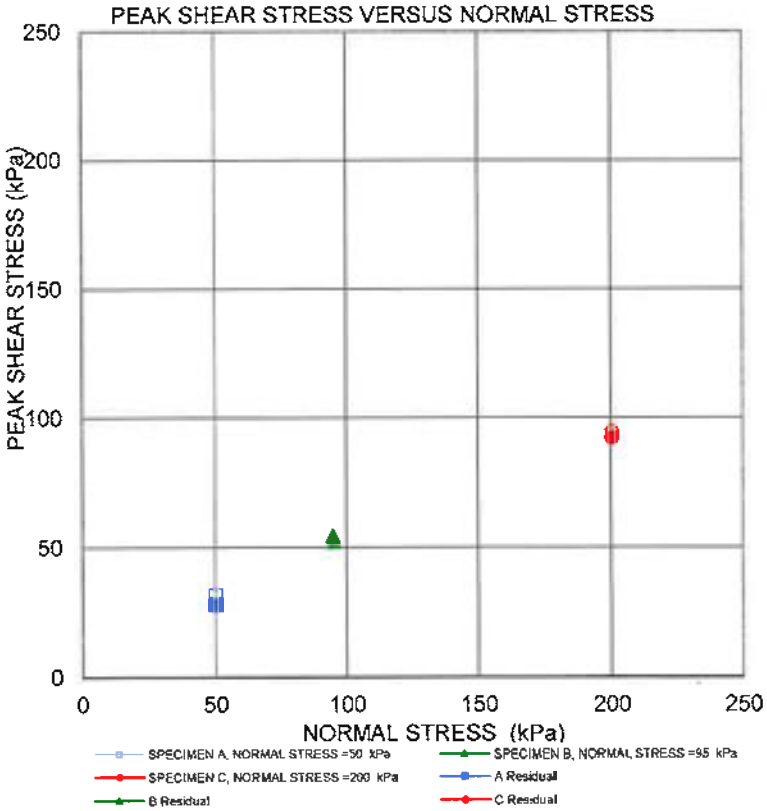
BH 18-101 SA 10

SHEAR STRESS VERSUS HORIZONTAL DISPLACEMENT



BH 18-101 SA 10

PEAK SHEAR STRESS VERSUS NORMAL STRESS



Date: 1/16/2019

Project No. 18105808(6000)

Golder Associates

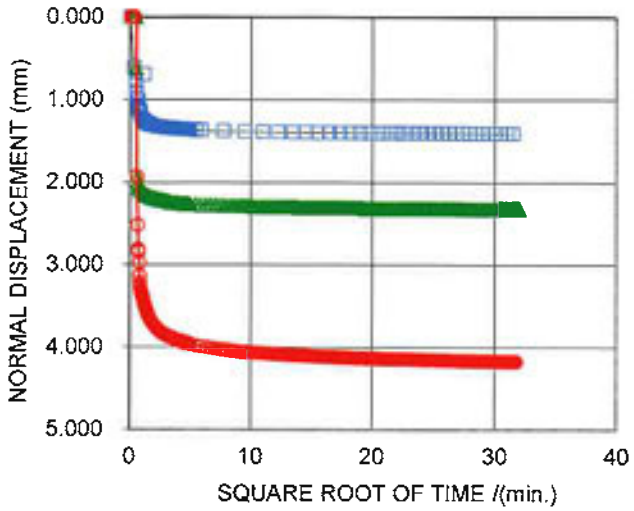
Prepared By LH

Checked By

CONSOLIDATED DRAINED DIRECT SHEAR TEST ASTM D3080 SHEET 3 OF 3	FIGURE

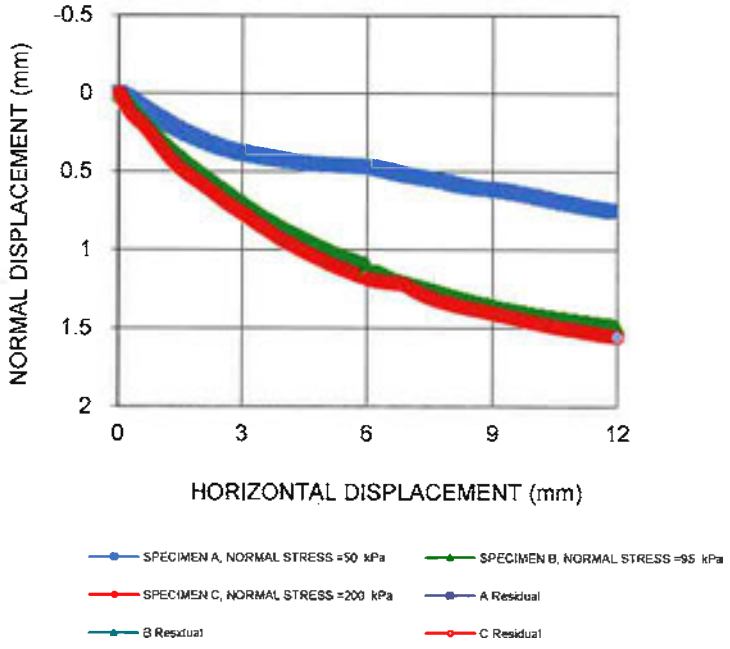
BH 18-101 SA 10

NORMAL DISPLACEMENT VERSUS SQUARE ROOT OF TIME



BH 18-101 SA 10

NORMAL DISPLACEMENT VERSUS HORIZONTAL DISPLACEMENT



Date: 1/16/2019

Project No. 18105808(6000)

Golder Associates

Prepared By LH

Checked By

CONSOLIDATED DRAINED DIRECT SHEAR TEST ASTM D3080 SHEET 1 OF 3	FIGURE		
TEST STAGE	A	B	C
BOREHOLE NUMBER		BH-18-107	
SAMPLE		19	
SAMPLE DEPTH, (m)		-	
SAMPLE HEIGHT, (mm)	25.26	25.78	25.53
SAMPLE LENGTH, (mm)	60.00	60.00	60.00
WATER CONTENT, BEFORE TEST, (%)	25.5	25.5	25.5
NORMAL (CONSOLIDATION) STRESS, (kPa)	150	330	660
WATER CONTENT, AFTER TEST, (%)	22.6	22.8	18.5
DISPLACEMENT RATE, mm/min	0.0048	0.0048	0.0048
TIME TO FAILURE, hours	16	21	21
PEAK SHEAR STRESS[1], (kPa)	105.6	217.1	375.7
HORIZONTAL DISPLACEMENT AT PEAK, (mm)	4.5	6.0	6.0
RESIDUAL SHEAR STRESS, (kPa)	98.7	190.2	362.6
HORIZONTAL DISPLACEMENT AT RESIDUAL, (mm)	11.1	11.5	12.0
DRY DENSITY, initial, Mg/m^3	1.566	1.539	1.596
WET DENSITY, initial, Mg/m^3	1.966	1.932	2.003

TEST NOTES:

[1] In the absence of a peak, the shear stress reported is at 10 percent relative horizontal displacement (ASTM D3080).

[2] Normal stresses asigned by the client

[3] Direct Shear Tests carried out submerged, per clients instruction.

Date: 1/17/2019

Project No. 18105808(6000)

Golder Associates

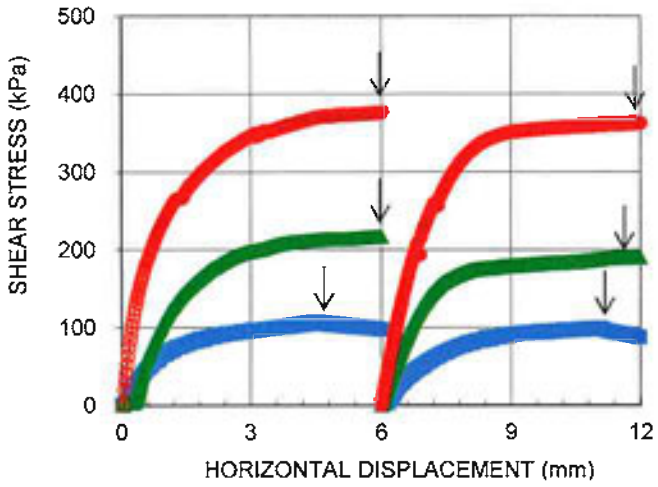
Prepared By: LH

Checked By:

CONSOLIDATED DRAINED DIRECT SHEAR TEST ASTM D3080 SHEET 2 OF 3	FIGURE

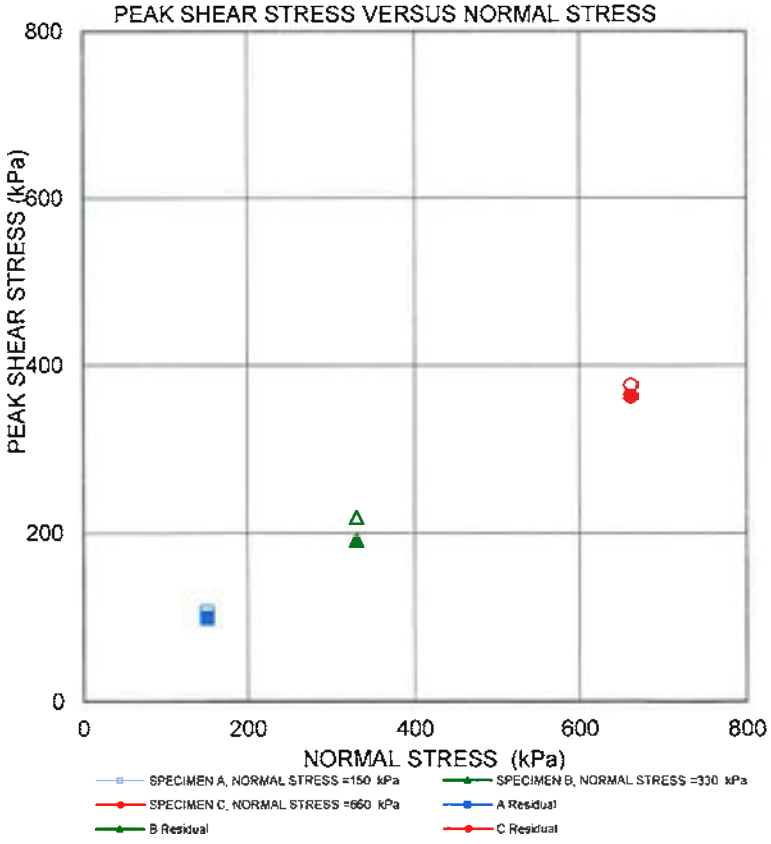
BH 18-107 SA 19

SHEAR STRESS VERSUS HORIZONTAL DISPLACEMENT



BH 18-107 SA 19

PEAK SHEAR STRESS VERSUS NORMAL STRESS



Date: 1/17/2019

Project No. 18105808(6000)

Golder Associates

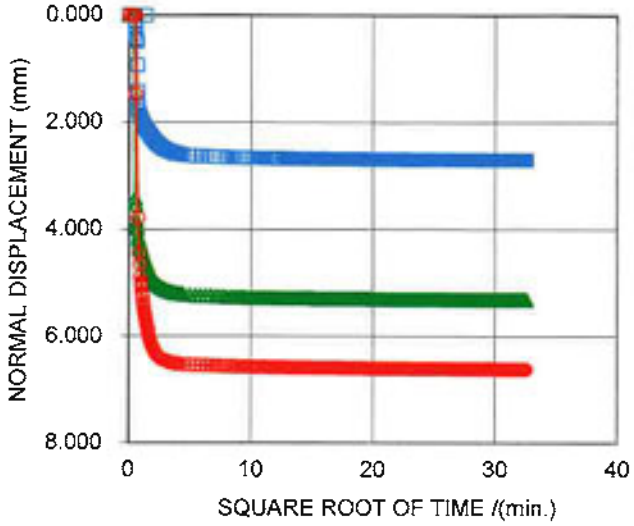
Prepared By LH

Checked By:

CONSOLIDATED DRAINED DIRECT SHEAR TEST ASTM D3080 SHEET 3 OF 3	FIGURE

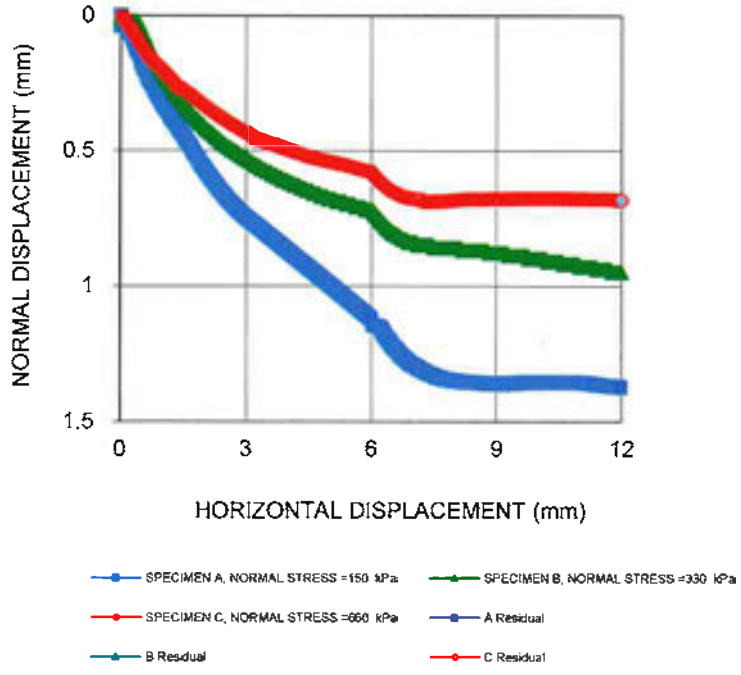
BH 18-107 SA 19

NORMAL DISPLACEMENT VERSUS SQUARE ROOT OF TIME



BH 18-107 SA 19

NORMAL DISPLACEMENT VERSUS HORIZONTAL DISPLACEMENT



Date: 1/17/2019

Project No. 18105808(6000)

Golder Associates

Prepared By LH

Checked By:

APPENDIX C-4

OEDOMETER TESTS

CONSOLIDATION TEST SUMMARY

ASTM D2435/D2435M

FIGURE

SAMPLE IDENTIFICATION

Project Number	18105808(6000)	Sample Number	10
Borehole Number	18-101	Sample Depth, m	9.5

TEST CONDITIONS

Test Type	Laboratory Standard	Load Duration, hr	24
Oedometer Number	1		
Date Started	01/09/2019		
Date Completed	01/22/2019		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	2.56	Unit Weight, kN/m^3	16.83
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m^3	11.18
Area, cm^2	31.67	Specific Gravity, measured	2.75
Volume, cm^3	80.91	Solids Height, cm	1.059
Water Content, %	50.56	Volume of Solids, cm^3	33.55
Wet Mass, g	138.89	Volume of Voids, cm^3	47.37
Dry Mass, g	92.25	Degree of Saturation, %	98.5

TEST COMPUTATIONS

Stress kPa	Corr. Height cm	Void Ratio	Average Height cm	t_{90} sec	cv cm^2/s	mv m^2/kN	k cm/s
0.00	2.555	1.412	2.555				
10.63	2.554	1.411	2.554				
39.86	2.528	1.386	2.541	290	4.72E-03	3.49E-04	1.62E-07
78.56	2.498	1.358	2.513	489	2.74E-03	3.02E-04	8.11E-08
155.86	2.438	1.302	2.468	694	1.86E-03	3.02E-04	5.51E-08
310.32	2.312	1.183	2.375	1127	1.06E-03	3.19E-04	3.32E-08
468.35	2.206	1.082	2.259	2653	4.08E-04	2.64E-04	1.05E-08
623.04	2.138	1.018	2.172	3197	3.13E-04	1.72E-04	5.26E-09
1241.36	1.988	0.877	2.063	866	1.04E-03	9.48E-05	9.68E-09
1920.00	1.908	0.802	1.948	576	1.40E-03	4.60E-05	6.29E-09
2560.00	1.860	0.756	1.884	1009	7.46E-04	2.97E-05	2.17E-09
623.04	1.891	0.785	1.875				
155.86	1.945	0.836	1.918				
40.05	1.997	0.885	1.971				
10.72	2.037	0.923	2.017				

Note:
Consolidation loading and unloading schedule assigned by the client.
cv and k are approximate only based on t_{90} estimated from Square Root of Time Method (ASTMD2435/2435M)
Specimen taken 0-6cm from bottom of the tube.
Specimen swelled under 10.63kPa.

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	2.04	Unit Weight, kN/m^3	18.71
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m^3	14.02
Area, cm^2	31.67	Specific Gravity, measured	2.75
Volume, cm^3	64.52	Solids Height, cm	1.059
Water Content, %	33.47	Volume of Solids, cm^3	33.55
Wet Mass, g	123.13	Volume of Voids, cm^3	30.98
Dry Mass, g	92.25		

Prepared By: LH

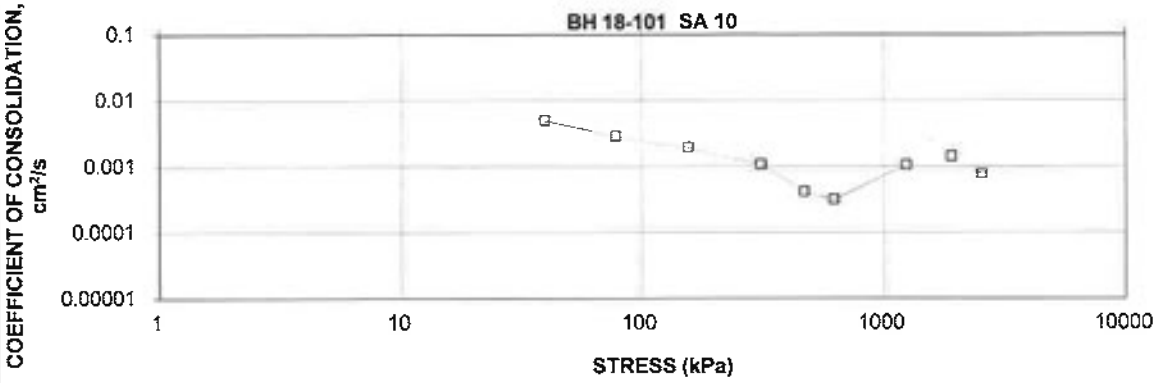
Golder Associates

Checked By:

CONSOLIDATION TEST SUMMARY	FIGURE

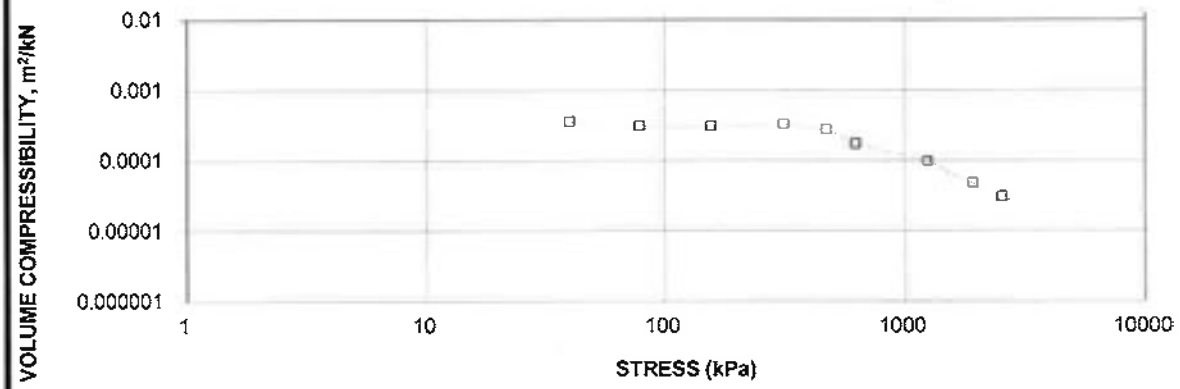
CONSOLIDATION TEST
CV cm^2/s VS STRESS (kPa)

BH 18-101 SA 10



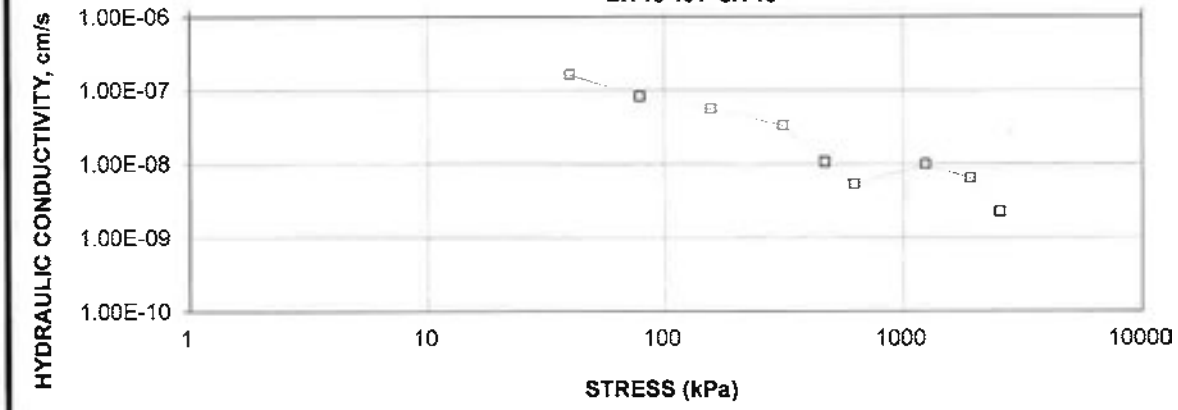
CONSOLIDATION TEST
MV m^2/kN vs STRESS (kPa)

BH 18-101 SA 10



CONSOLIDATION TEST
HYDRAULIC CONDUCTIVITY vs STRESS

BH 18-101 SA 10

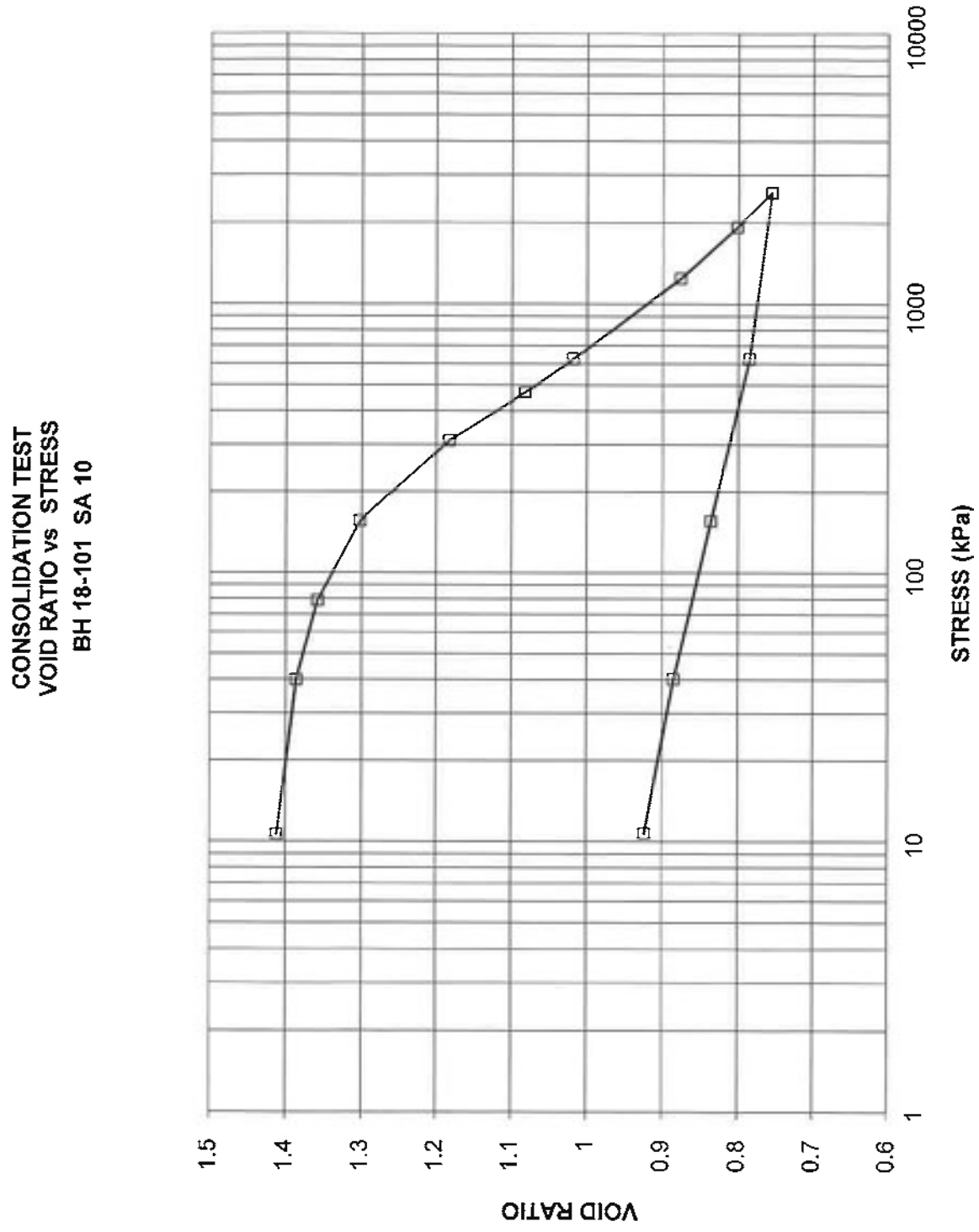


Project No. 18105808(6000)
Prepared By: LH

Golder Associates

Checked By:

CONSOLIDATION TEST VOID RATIO VS LOG STRESS	FIGURE



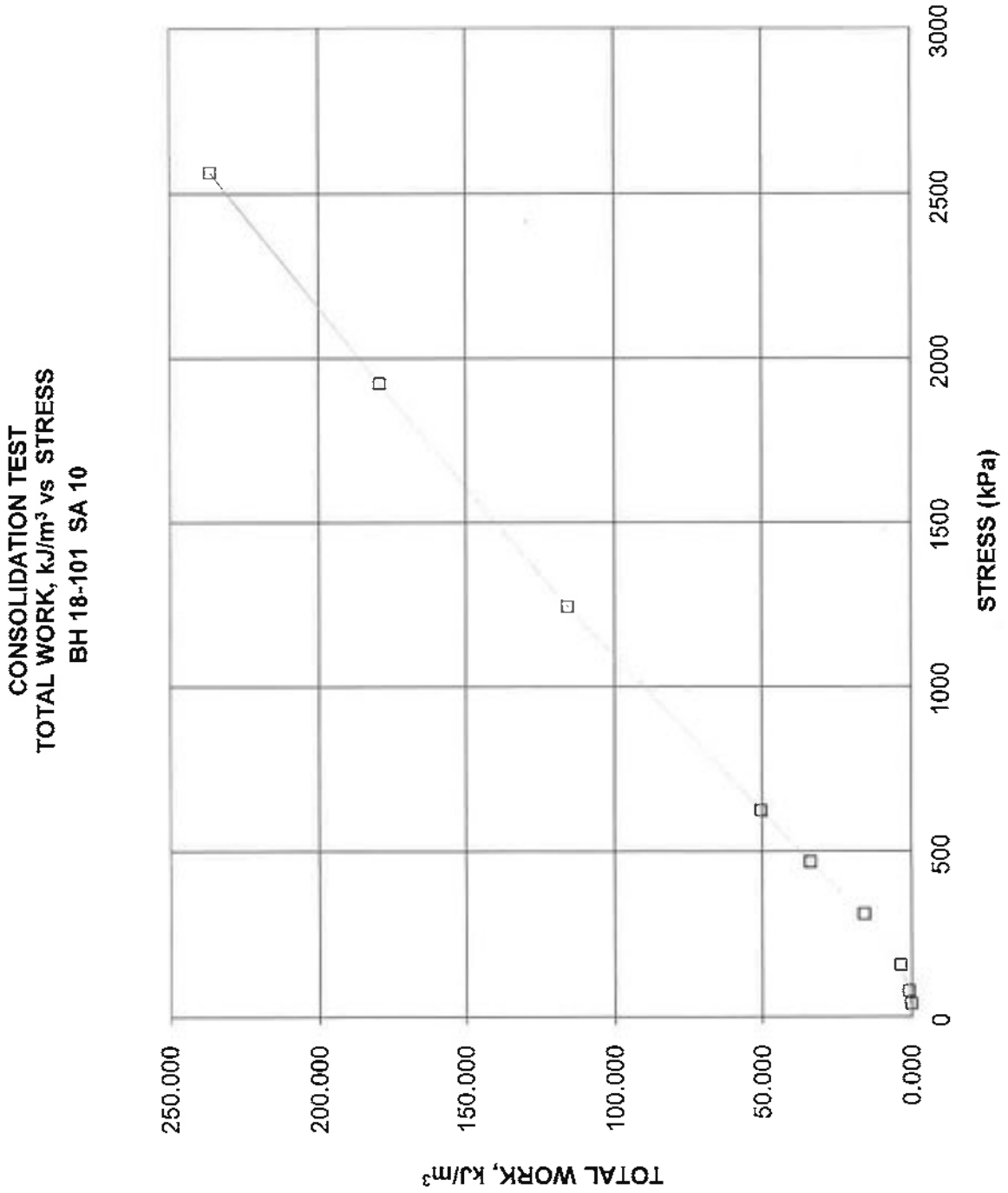
Project No. 18105808(6000)

Prepared By: LH

Golder Associates

Checked By:

CONSOLIDATION TEST TOTAL WORK VS STRESS	FIGURE



Project No. 18105808(6000)

Golder Associates

Prepared By: LH

Checked By:

CONSOLIDATION TEST SUMMARY

ASTM D2435/D2435M

FIGURE

SAMPLE IDENTIFICATION

Project Number	18105808(1000)	Sample Number	19
Borehole Number	18-107	Sample Depth, m	33.3

TEST CONDITIONS

Test Type	Laboratory Standard	Load Duration, hr	24
Oedometer Number	2		
Date Started	01/09/2019		
Date Completed	01/22/2019		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	2.54	Unit Weight, kN/m^3	18.90
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m^3	14.28
Area, cm^2	31.65	Specific Gravity, measured	2.76
Volume, cm^3	80.29	Solids Height, cm	1.338
Water Content, %	32.43	Volume of Solids, cm^3	42.35
Wet Mass, g	154.78	Volume of Voids, cm^3	37.95
Dry Mass, g	116.88	Degree of Saturation, %	99.9

TEST COMPUTATIONS

Stress kPa	Corr. Height cm	Void Ratio	Average Height cm	t_{90} sec	cv cm^2/s	mv m^2/kN	k cm/s
0.00	2.537	0.896	2.537				
10.69	2.494	0.864	2.515	3557	3.77E-04	1.60E-03	5.91E-08
39.89	2.432	0.818	2.463	2241	5.74E-04	8.29E-04	4.66E-08
78.61	2.387	0.784	2.409	2160	5.70E-04	4.63E-04	2.59E-08
155.96	2.329	0.740	2.358	1852	6.36E-04	2.97E-04	1.85E-08
310.55	2.263	0.691	2.296	984	1.14E-03	1.67E-04	1.86E-08
480.38	2.221	0.660	2.242	1188	8.97E-04	9.70E-05	8.53E-09
620.28	2.199	0.643	2.210	2217	4.67E-04	6.28E-05	2.88E-09
1239.07	2.114	0.580	2.157	470	2.10E-03	5.40E-05	1.11E-08
1920.00	2.068	0.546	2.091	540	1.72E-03	2.67E-05	4.50E-09
2560.00	2.039	0.524	2.054	591	1.51E-03	1.80E-05	2.67E-09
620.28	2.044	0.528	2.042				
156.03	2.074	0.550	2.059				
39.89	2.098	0.568	2.086				
10.73	2.124	0.588	2.111				

Note:
Consolidation loading and unloading schedule assigned by the client.
cv and k are approximate only based on t_{90} estimated from Square Root of Time Method (ASTMD2435/2435M)
Specimen taken 0-6cm from bottom of the tube.

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	2.12	Unit Weight, kN/m^3	20.85
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m^3	17.05
Area, cm^2	31.65	Specific Gravity, measured	2.76
Volume, cm^3	67.23	Solids Height, cm	1.338
Water Content, %	22.32	Volume of Solids, cm^3	42.35
Wet Mass, g	142.97	Volume of Voids, cm^3	24.88
Dry Mass, g	116.88		

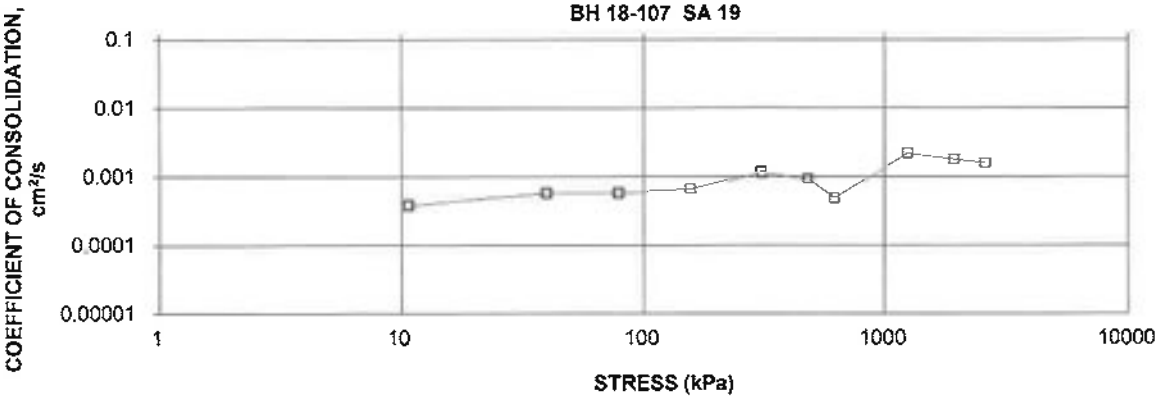
Prepared By: LH

Golder Associates

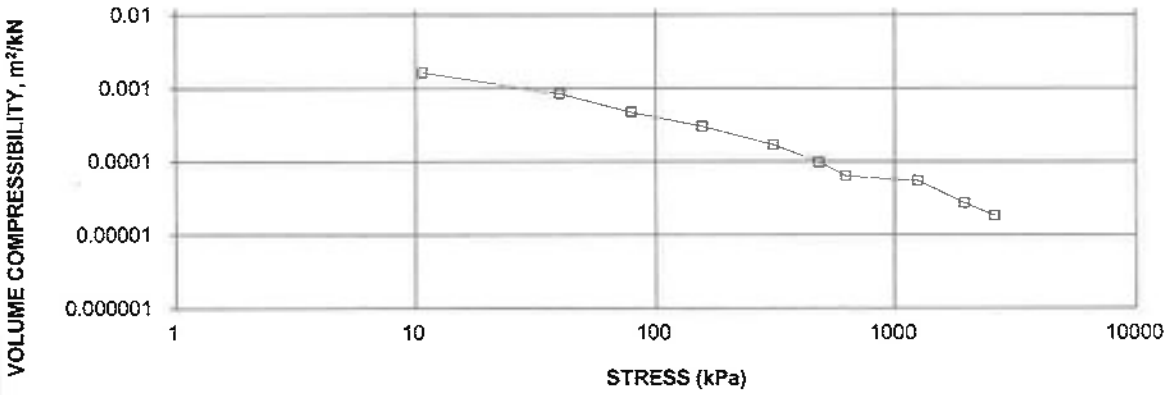
Checked By:

CONSOLIDATION TEST SUMMARY	FIGURE

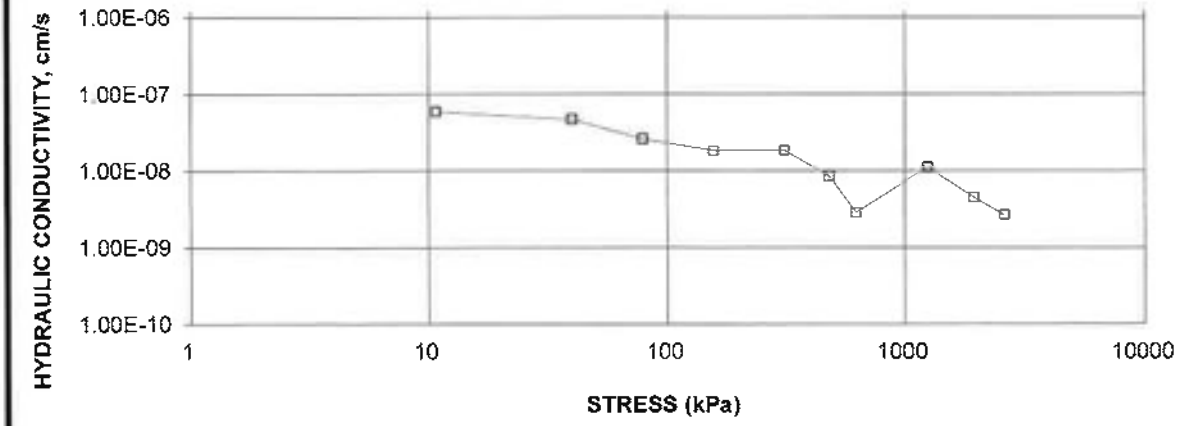
CONSOLIDATION TEST
CV cm^2/s VS STRESS (kPa)
BH 18-107 SA 19



CONSOLIDATION TEST
MV m^2/kN vs STRESS (kPa)
BH 18-107 SA 19



CONSOLIDATION TEST
HYDRAULIC CONDUCTIVITY vs STRESS
BH 18-107 SA 19



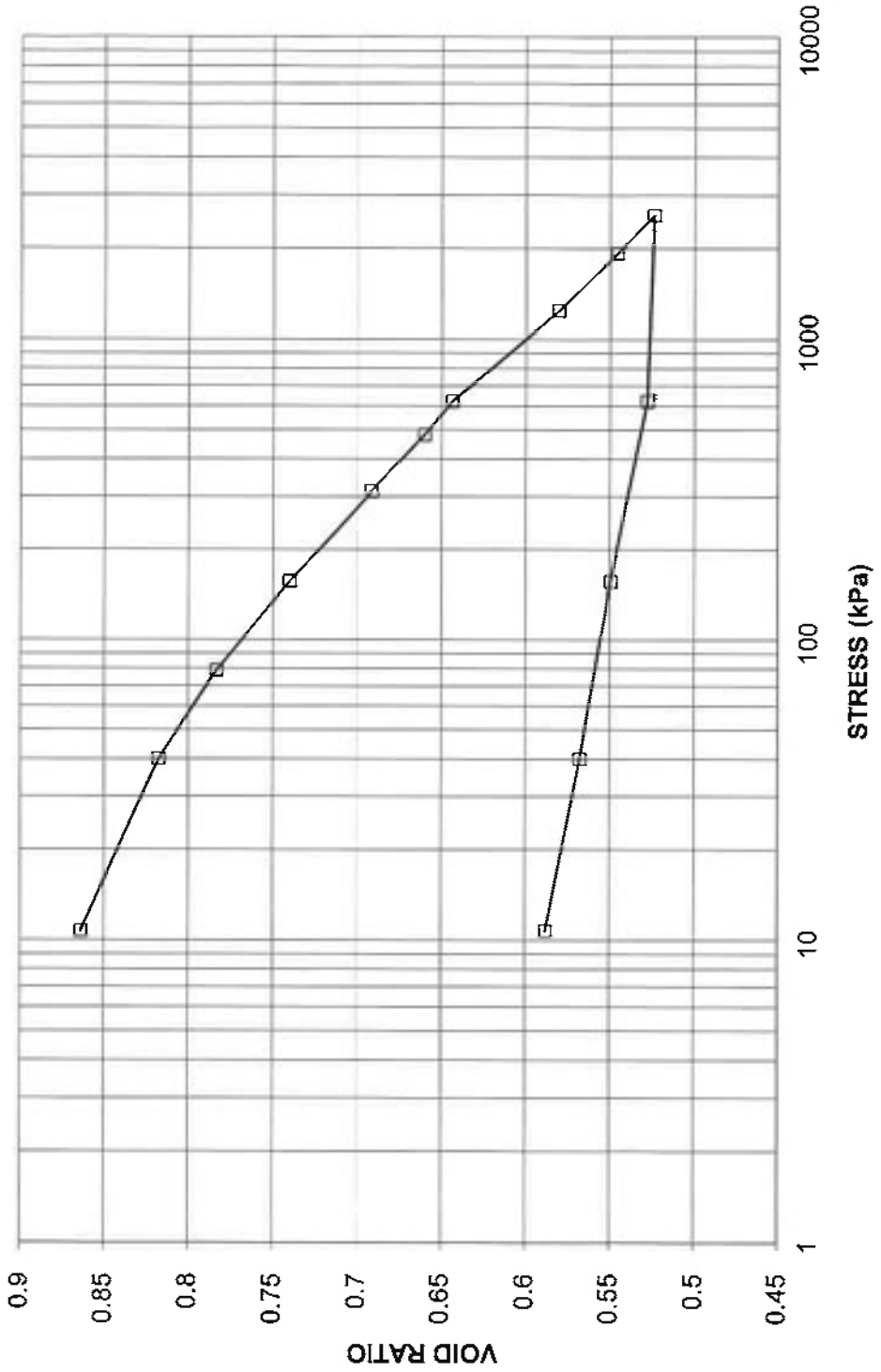
Project No. 18105808(6000)
Prepared By: LH

Golder Associates

Checked By:

CONSOLIDATION TEST VOID RATIO VS LOG STRESS	FIGURE

CONSOLIDATION TEST
VOID RATIO vs STRESS
BH 18-107 SA 19



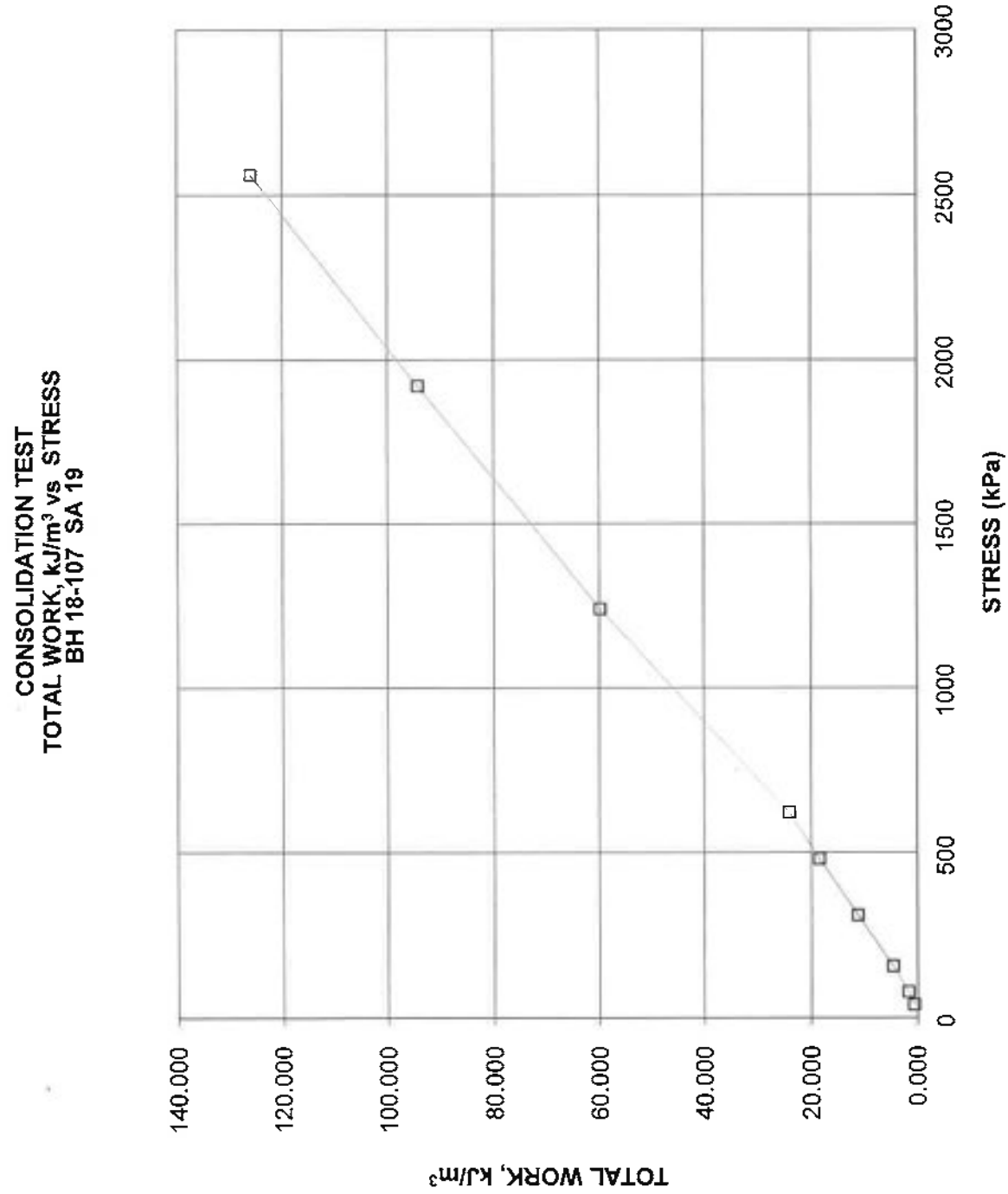
Project No. 18105808(6000)

Prepared By: LH

Golder Associates

Checked By: MM

CONSOLIDATION TEST TOTAL WORK VS STRESS	FIGURE



Project No. 18105808(6000)

Golder Associates

Prepared By: LH

Checked By:

APPENDIX C-5

UC ROCK TESTS

GOLDER

UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS

ASTM D7012

SAMPLE IDENTIFICATION

PROJECT NUMBER	18105808 (6000)	SAMPLE NUMBER	1
PROJECT NAME	WSP/Lab Testing/Miss	SAMPLE DEPTH, m	29.85-30.18
BOREHOLE NUMBER	18-101	DATE:	2019-01-09

TEST CONDITIONS

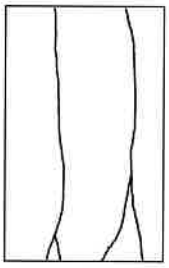
MACHINE SPEED, mm/min	N/A	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST,min	>2 <15	L/D	2.31

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	10.30	WATER CONTENT, (specimen) %	0.00
SAMPLE DIAMETER, cm	4.47	UNIT WEIGHT, kN/m^3	22.48
SAMPLE AREA, cm^2	15.68	DRY UNIT WT., kN/m^3	22.48
SAMPLE VOLUME, cm^3	161.51	SPECIFIC GRAVITY	-
WET WEIGHT, g	370.30	VOID RATIO	-
DRY WEIGHT, g	370.30		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	N/A	COMPRESSIVE STRENGTH, MPa	68.1

REMARKS:

Checked By:

Golder Associates

UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS
ASTM D7012

FIGURE

BEFORE COMPRESSION

AFTER COMPRESSION

Date Jan. 15, 2019
Project 18105808/6000

Golder Associates

Drawn Frank
Chkd. MM

FORM PRODUCED JUNE 1986

Form GA-D-4 (imperial)

GOLDER

UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS

ASTM D7012

SAMPLE IDENTIFICATION

PROJECT NUMBER	18105808 (6000)	SAMPLE NUMBER	2
PROJECT NAME	WSP/Lab Testing/Miss	SAMPLE DEPTH, m	30.68-30.90
BOREHOLE NUMBER	18-101	DATE:	2019-01-09

TEST CONDITIONS

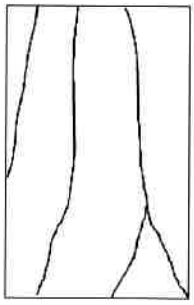
MACHINE SPEED, mm/min	N/A	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST,min	>2 <15	L/D	2.33

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	10.40	WATER CONTENT, (specimen) %	0.00
SAMPLE DIAMETER, cm	4.47	UNIT WEIGHT, kN/m^3	23.05
SAMPLE AREA, cm^2	15.72	DRY UNIT WT., kN/m^3	23.05
SAMPLE VOLUME, cm^3	163.56	SPECIFIC GRAVITY	-
WET WEIGHT, g	384.62	VOID RATIO	-
DRY WEIGHT, g	384.62		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	N/A	COMPRESSIVE STRENGTH, MPa	124.5

REMARKS:

Checked By:

Golder Associates

UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS
ASTM D7012

FIGURE

BEFORE COMPRESSION

AFTER COMPRESSION

Date Jan. 15, 2019
Project 18105808/6000

Golder Associates

Drawn Frank
Chkd. MM

FORM PRODUCED JUNE 1986

Form GA-D-4 (imperial)

GOLDER

UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS

ASTM D7012

SAMPLE IDENTIFICATION

PROJECT NUMBER	18105808 (6000)	SAMPLE NUMBER	3
PROJECT NAME	WSP/Lab Testing/Miss	SAMPLE DEPTH, m	32.20-32.44
BOREHOLE NUMBER	18-101	DATE:	2019-01-09

TEST CONDITIONS

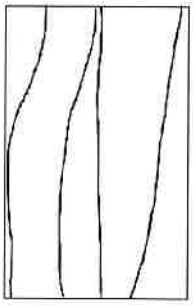
MACHINE SPEED, mm/min	N/A	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST,min	>2 <15	L/D	2.35

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	10.51	WATER CONTENT, (specimen) %	0.50
SAMPLE DIAMETER, cm	4.48	UNIT WEIGHT, kN/m^3	26.38
SAMPLE AREA, cm^2	15.74	DRY UNIT WT., kN/m^3	26.25
SAMPLE VOLUME, cm^3	165.33	SPECIFIC GRAVITY	-
WET WEIGHT, g	444.87	VOID RATIO	-
DRY WEIGHT, g	442.66		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	N/A	COMPRESSIVE STRENGTH, MPa	70.7

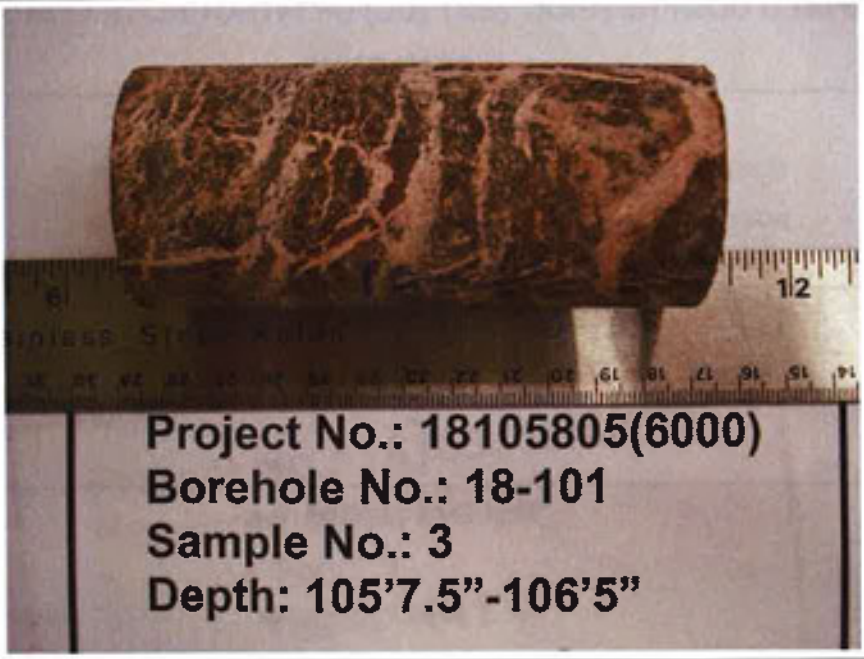
REMARKS:

Checked By:

Golder Associates

UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS
ASTM D7012

FIGURE



BEFORE COMPRESSION

AFTER COMPRESSION

Date Jan. 15, 2019
Project 18105808/6000

Golder Associates

Drawn Frank
Chkd

FORM PRODUCED JUNE 1986

Form GA-D-4 (Imperial)

GOLDER

UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS

ASTM D7012

SAMPLE IDENTIFICATION

PROJECT NUMBER	18105808 (6000)	SAMPLE NUMBER	1
PROJECT NAME	WSP/Lab Testing/Miss	SAMPLE DEPTH, m	42.88-43.13
BOREHOLE NUMBER	18-102	DATE:	2019-01-09

TEST CONDITIONS

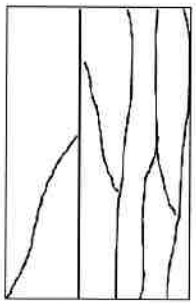
MACHINE SPEED, mm/min	N/A	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST,min	>2 <15	L/D	2.14

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	10.11	WATER CONTENT, (specimen) %	0.10
SAMPLE DIAMETER, cm	4.72	UNIT WEIGHT, kN/m^3	26.12
SAMPLE AREA, cm^2	17.48	DRY UNIT WT., kN/m^3	26.09
SAMPLE VOLUME, cm^3	176.74	SPECIFIC GRAVITY	-
WET WEIGHT, g	470.94	VOID RATIO	-
DRY WEIGHT, g	470.47		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	N/A	COMPRESSIVE STRENGTH, MPa	90.4

REMARKS:

Checked By:

Golder Associates

UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS
ASTM D7012

FIGURE

BEFORE COMPRESSION

AFTER COMPRESSION

Date Jan. 15, 2019
Project 18105808/6000

Golder Associates

Drawn Frank
Chkd. MH

FORM PRODUCED JUNE 1986

Form GA-D-4 (Imperial)

GOLDER

UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS

ASTM D7012

SAMPLE IDENTIFICATION

PROJECT NUMBER	18105808 (6000)	SAMPLE NUMBER	2
PROJECT NAME	WSP/Lab Testing/Miss	SAMPLE DEPTH, m	45.24-45.42
BOREHOLE NUMBER	18-102	DATE:	2019-01-09

TEST CONDITIONS

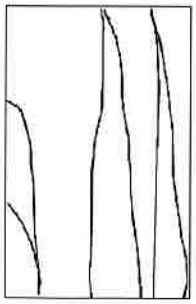
MACHINE SPEED, mm/min	N/A	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST,min	>2 <15	L/D	2.19

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	10.34	WATER CONTENT, (specimen) %	0.20
SAMPLE DIAMETER, cm	4.71	UNIT WEIGHT, kN/m^3	27.60
SAMPLE AREA, cm^2	17.45	DRY UNIT WT., kN/m^3	27.55
SAMPLE VOLUME, cm^3	180.41	SPECIFIC GRAVITY	-
WET WEIGHT, g	507.98	VOID RATIO	-
DRY WEIGHT, g	506.97		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	N/A	COMPRESSIVE STRENGTH, MPa	140.2

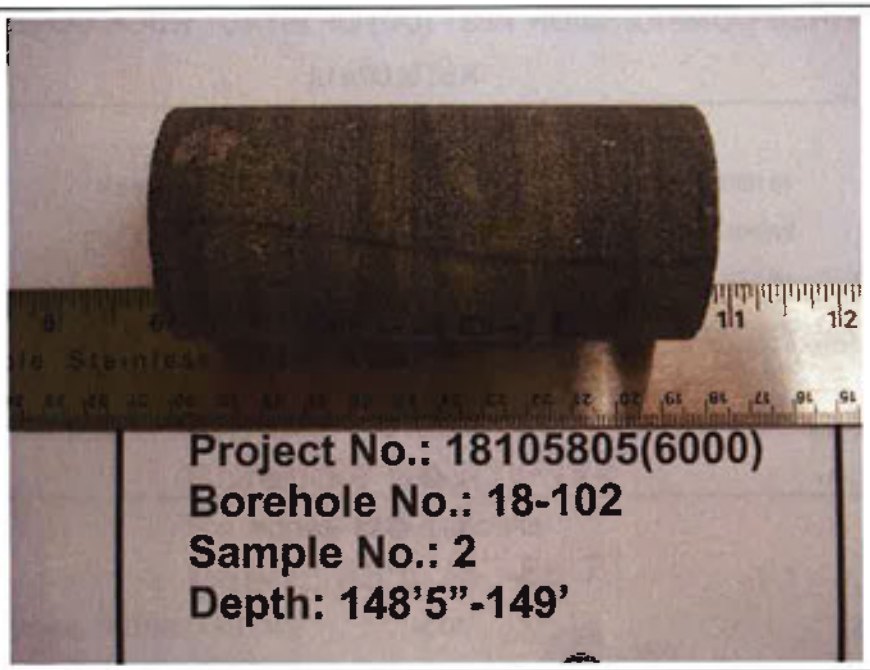
REMARKS:

Checked By:

Golder Associates

UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS
ASTM D7012

FIGURE



BEFORE COMPRESSION

AFTER COMPRESSION

Date Jan. 15, 2019
Project 18105808/6000

Golder Associates

Drawn Frank
Chkd. LM

FORM PRODUCED JUNE 1986

Form GA-D-4 (Imperial)

GOLDER

UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS

ASTM D7012

SAMPLE IDENTIFICATION

PROJECT NUMBER	18105808 (6000)	SAMPLE NUMBER	1
PROJECT NAME	WSP/Lab Testing/Miss	SAMPLE DEPTH, m	26.13-26.39
BOREHOLE NUMBER	18-103	DATE:	2019-01-09

TEST CONDITIONS

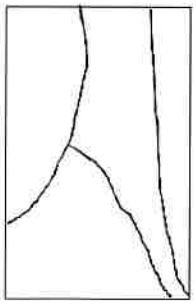
MACHINE SPEED, mm/min	N/A	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST,min	>2 <15	L/D	2.21

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	10.47	WATER CONTENT, (specimen) %	0.20
SAMPLE DIAMETER, cm	4.75	UNIT WEIGHT, kN/m^3	26.93
SAMPLE AREA, cm^2	17.69	DRY UNIT WT., kN/m^3	26.87
SAMPLE VOLUME, cm^3	185.19	SPECIFIC GRAVITY	-
WET WEIGHT, g	508.64	VOID RATIO	-
DRY WEIGHT, g	507.62		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	N/A	COMPRESSIVE STRENGTH, MPa	103.1

REMARKS:

Checked By:

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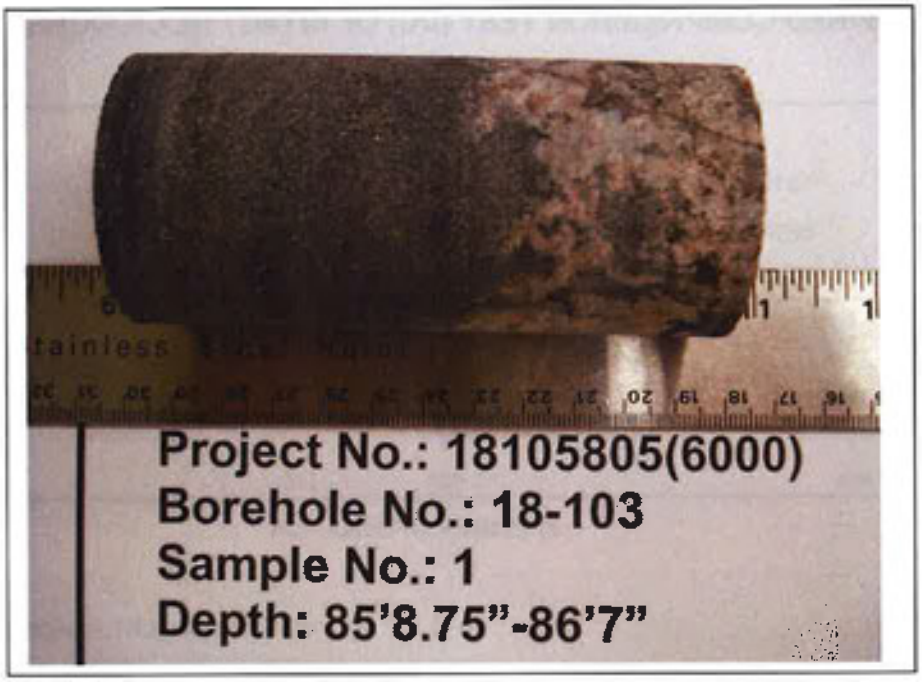
UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS
ASTM D7012

FIGURE



BEFORE COMPRESSION

AFTER COMPRESSION

Date Jan. 15, 2019
Project 18105808/6000

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UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS

ASTM D7012

SAMPLE IDENTIFICATION

PROJECT NUMBER	18105808 (6000)	SAMPLE NUMBER	2
PROJECT NAME	WSP/Lab Testing/Miss	SAMPLE DEPTH, m	26.76-27.00
BOREHOLE NUMBER	18-103	DATE:	2019-01-09

TEST CONDITIONS

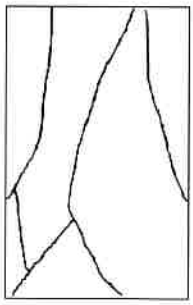
MACHINE SPEED, mm/min	N/A	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST,min	>2 <15	L/D	2.22

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	10.53	WATER CONTENT, (specimen) %	0.20
SAMPLE DIAMETER, cm	4.75	UNIT WEIGHT, kN/m^3	28.13
SAMPLE AREA, cm^2	17.71	DRY UNIT WT., kN/m^3	28.08
SAMPLE VOLUME, cm^3	186.51	SPECIFIC GRAVITY	-
WET WEIGHT, g	535.25	VOID RATIO	-
DRY WEIGHT, g	534.18		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	N/A	COMPRESSIVE STRENGTH, MPa	70.3

REMARKS:

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UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS ASTM D7012	FIGURE

BEFORE COMPRESSION

AFTER COMPRESSION

Date Jan. 15, 2019
Project 18105808/6000

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UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS

ASTM D7012

SAMPLE IDENTIFICATION

PROJECT NUMBER	18105808 (6000)	SAMPLE NUMBER	1
PROJECT NAME	WSP/Lab Testing/Miss	SAMPLE DEPTH, m	21.92-22.20
BOREHOLE NUMBER	18-104	DATE:	2019-01-09

TEST CONDITIONS

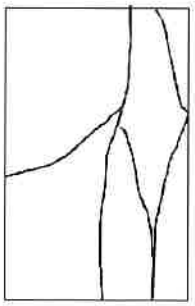
MACHINE SPEED, mm/min	N/A	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST,min	>2 <15	L/D	2.22

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	10.51	WATER CONTENT, (specimen) %	0.10
SAMPLE DIAMETER, cm	4.72	UNIT WEIGHT, kN/m^3	29.09
SAMPLE AREA, cm^2	17.51	DRY UNIT WT., kN/m^3	29.06
SAMPLE VOLUME, cm^3	183.98	SPECIFIC GRAVITY	-
WET WEIGHT, g	545.92	VOID RATIO	-
DRY WEIGHT, g	545.37		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	N/A	COMPRESSIVE STRENGTH, MPa	45.7

REMARKS:

Checked By: LM

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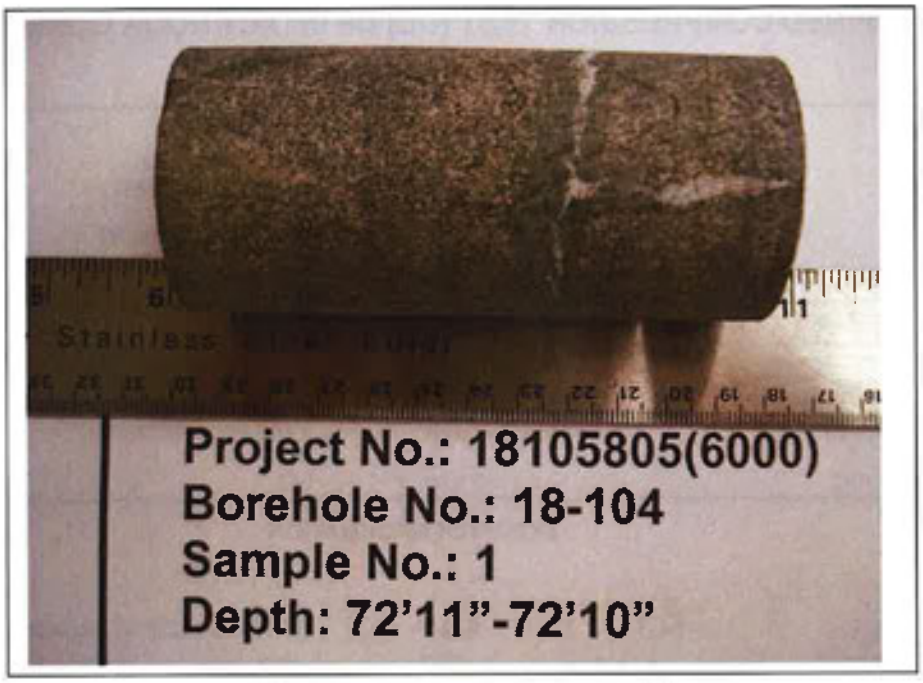
UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS
ASTM D7012

FIGURE



BEFORE COMPRESSION

AFTER COMPRESSION

Date Jan. 15, 2019
Project 18105808/6000

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GOLDER

UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS

ASTM D7012

SAMPLE IDENTIFICATION

PROJECT NUMBER	18105808 (6000)	SAMPLE NUMBER	2
PROJECT NAME	WSP/Lab Testing/Miss	SAMPLE DEPTH, m	23.89-24.12
BOREHOLE NUMBER	18-104	DATE:	2019-01-09

TEST CONDITIONS

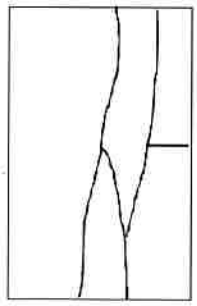
MACHINE SPEED, mm/min	N/A	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST,min	>2 <15	L/D	2.20

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	10.41	WATER CONTENT, (specimen) %	0.10
SAMPLE DIAMETER, cm	4.73	UNIT WEIGHT, kN/m^3	28.24
SAMPLE AREA, cm^2	17.55	DRY UNIT WT., kN/m^3	28.22
SAMPLE VOLUME, cm^3	182.74	SPECIFIC GRAVITY	-
WET WEIGHT, g	526.52	VOID RATIO	-
DRY WEIGHT, g	525.99		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	N/A	COMPRESSIVE STRENGTH, MPa	111.5

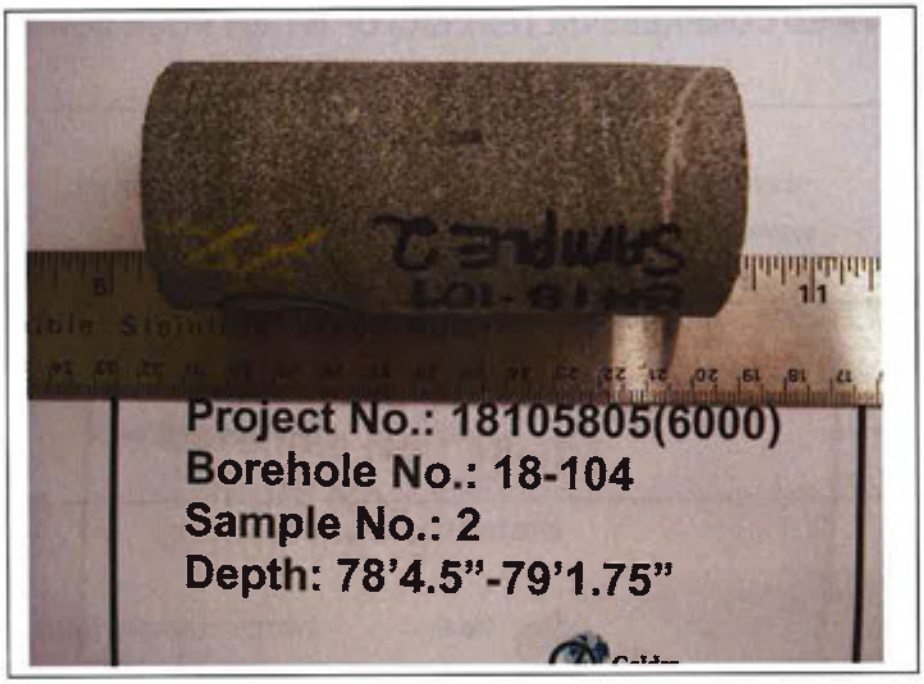
REMARKS:

Checked By:

Golder Associates

UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS
ASTM D7012

FIGURE



BEFORE COMPRESSION

AFTER COMPRESSION

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Project 18105808/6000

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UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS

ASTM D7012

SAMPLE IDENTIFICATION

PROJECT NUMBER	18105808 (6000)	SAMPLE NUMBER	1
PROJECT NAME	WSP/Lab Testing/Miss	SAMPLE DEPTH, m	2.60-2.74
BOREHOLE NUMBER	18-106	DATE:	2019-01-09

TEST CONDITIONS

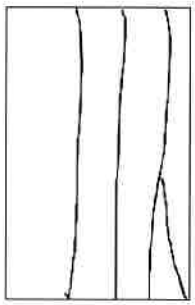
MACHINE SPEED, mm/min	N/A	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST,min	>2 <15	L/D	2.21

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	10.48	WATER CONTENT, (specimen) %	0.10
SAMPLE DIAMETER, cm	4.75	UNIT WEIGHT, kN/m^3	26.99
SAMPLE AREA, cm^2	17.68	DRY UNIT WT., kN/m^3	26.96
SAMPLE VOLUME, cm^3	185.25	SPECIFIC GRAVITY	-
WET WEIGHT, g	509.98	VOID RATIO	-
DRY WEIGHT, g	509.47		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	N/A	COMPRESSIVE STRENGTH, MPa	84.3

REMARKS:

Checked By:

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UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS ASTM D7012	FIGURE

BEFORE COMPRESSION

AFTER COMPRESSION

Date Jan. 15, 2019
Project 18105808/6000

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UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS

ASTM D7012

SAMPLE IDENTIFICATION

PROJECT NUMBER	18105808 (6000)	SAMPLE NUMBER	2
PROJECT NAME	WSP/Lab Testing/Miss	SAMPLE DEPTH, m	3.61-3.86
BOREHOLE NUMBER	18-106	DATE:	2019-01-09

TEST CONDITIONS

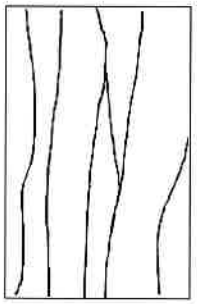
MACHINE SPEED, mm/min	N/A	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST,min	>2 <15	L/D	2.20

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	10.46	WATER CONTENT, (specimen) %	0.20
SAMPLE DIAMETER, cm	4.75	UNIT WEIGHT, kN/m^3	26.62
SAMPLE AREA, cm^2	17.70	DRY UNIT WT., kN/m^3	26.56
SAMPLE VOLUME, cm^3	185.14	SPECIFIC GRAVITY	-
WET WEIGHT, g	502.71	VOID RATIO	-
DRY WEIGHT, g	501.71		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	N/A	COMPRESSIVE STRENGTH, MPa	77.9

REMARKS:

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UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS
ASTM D7012

FIGURE

BEFORE COMPRESSION

AFTER COMPRESSION

Date Jan. 15, 2019
Project 18105808/6000

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UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS

ASTM D7012

SAMPLE IDENTIFICATION

PROJECT NUMBER	18105808 (6000)	SAMPLE NUMBER	1
PROJECT NAME	WSP/Lab Testing/Miss	SAMPLE DEPTH, m	39.29-39.55
BOREHOLE NUMBER	18-107	DATE:	2019-01-09

TEST CONDITIONS

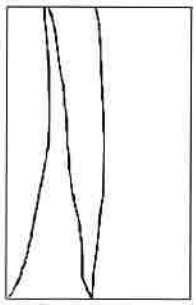
MACHINE SPEED, mm/min	N/A	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST,min	>2 <15	L/D	2.21

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	10.44	WATER CONTENT, (specimen) %	0.10
SAMPLE DIAMETER, cm	4.72	UNIT WEIGHT, kN/m^3	27.76
SAMPLE AREA, cm^2	17.48	DRY UNIT WT., kN/m^3	27.73
SAMPLE VOLUME, cm^3	182.57	SPECIFIC GRAVITY	-
WET WEIGHT, g	516.96	VOID RATIO	-
DRY WEIGHT, g	516.44		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	N/A	COMPRESSIVE STRENGTH, MPa	114.5

REMARKS:

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UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS ASTM D7012	FIGURE

BEFORE COMPRESSION

AFTER COMPRESSION

Date Jan. 15, 2019
Project 18105808/6000

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UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS

ASTM D7012

SAMPLE IDENTIFICATION

PROJECT NUMBER	18105808 (6000)	SAMPLE NUMBER	3
PROJECT NAME	WSP/Lab Testing/Miss	SAMPLE DEPTH, m	41.46-41.73
BOREHOLE NUMBER	18-107	DATE:	2019-01-09

TEST CONDITIONS

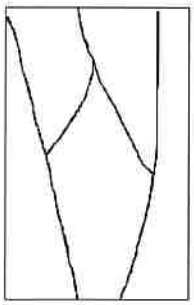
MACHINE SPEED, mm/min	N/A	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST,min	>2 <15	L/D	2.17

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	10.24	WATER CONTENT, (specimen) %	0.30
SAMPLE DIAMETER, cm	4.72	UNIT WEIGHT, kN/m^3	27.49
SAMPLE AREA, cm^2	17.47	DRY UNIT WT., kN/m^3	27.41
SAMPLE VOLUME, cm^3	178.80	SPECIFIC GRAVITY	-
WET WEIGHT, g	501.43	VOID RATIO	-
DRY WEIGHT, g	499.93		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	N/A	COMPRESSIVE STRENGTH, MPa	77.7

REMARKS:

Checked By:

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UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS ASTM D7012	FIGURE

BEFORE COMPRESSION

AFTER COMPRESSION

Date Jan. 15, 2019
Project 18105808/6000

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UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS

ASTM D7012

SAMPLE IDENTIFICATION

PROJECT NUMBER	18105808 (6000)	SAMPLE NUMBER	1
PROJECT NAME	WSP/Lab Testing/Miss	SAMPLE DEPTH, m	4.95-5.11
BOREHOLE NUMBER	18-201	DATE:	2019-01-09

TEST CONDITIONS

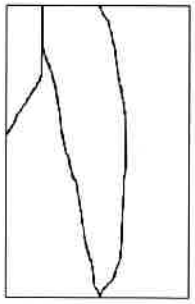
MACHINE SPEED, mm/min	N/A	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST,min	>2 <15	L/D	2.18

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	10.34	WATER CONTENT, (specimen) %	0.50
SAMPLE DIAMETER, cm	4.75	UNIT WEIGHT, kN/m^3	25.24
SAMPLE AREA, cm^2	17.68	DRY UNIT WT., kN/m^3	25.12
SAMPLE VOLUME, cm^3	182.77	SPECIFIC GRAVITY	-
WET WEIGHT, g	470.68	VOID RATIO	-
DRY WEIGHT, g	468.34		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	N/A	COMPRESSIVE STRENGTH, MPa	65.4

REMARKS:

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UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS
ASTM D7012

FIGURE

BEFORE COMPRESSION

AFTER COMPRESSION

Date Jan. 15, 2019
Project 18105808/6000

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UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS

ASTM D7012

SAMPLE IDENTIFICATION

PROJECT NUMBER	18105808 (6000)	SAMPLE NUMBER	3
PROJECT NAME	WSP/Lab Testing/Miss	SAMPLE DEPTH, m	7.80-7.90
BOREHOLE NUMBER	18-201	DATE:	2019-01-09

TEST CONDITIONS

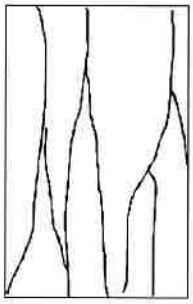
MACHINE SPEED, mm/min	N/A	TYPE OF SPECIMEN	Rock Core
DURATION OF TEST,min	>2 <15	L/D	2.15

SPECIMEN INFORMATION

SAMPLE HEIGHT, cm	10.21	WATER CONTENT, (specimen) %	0.00
SAMPLE DIAMETER, cm	4.75	UNIT WEIGHT, kN/m^3	26.53
SAMPLE AREA, cm^2	17.71	DRY UNIT WT., kN/m^3	26.53
SAMPLE VOLUME, cm^3	180.70	SPECIFIC GRAVITY	-
WET WEIGHT, g	489.08	VOID RATIO	-
DRY WEIGHT, g	489.08		

VISUAL INSPECTION

FAILURE SKETCH



TEST RESULTS

STRAIN AT FAILURE, %	N/A	COMPRESSIVE STRENGTH, MPa	89.2

REMARKS:

Checked By: LM

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UNCONFINED COMPRESSION TEST (UC) OF INTACT ROCK CORE SPECIMENS ASTM D7012	FIGURE

BEFORE COMPRESSION

AFTER COMPRESSION

Date Jan. 15, 2019
Project 18105808/6000

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APPENDIX C-6

CERCHAR TESTS

Table C6-1
Geotechnical Laboratory Results Summary
Kingston Third Crossing Bridge

Parameter	Unit	Limestone			Feldspathic Biotite GNEISS		
		Min.	Mean	Max.	Min.	Mean	Max.
Description	-	Argillaceous LIMETSTONE to LIMESTONE - grey to dark grey, fine grained, medium strong to strong, stylolites, shale parting, fine bedding, vertical and horizontal jointing, fresh			Feldspathic Biotite GNEISS - dark greenish grey, fine grained with pink to red feldspar instrusions ranging from medium to coarse grained, calcite and hemitite banding, strong to very strong rock, fresh		
Cerchar Abraison Testing							
Moisture Content	%	0.4			0.08	0.13	0.17
CAI_S		0.68			0.99	1.10	1.20
CAI		1.16			1.46	1.57	1.67
Unconfined Compression test	MPa	65.5	79.2	89.2	45.7	92.4	140.2

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Laboratory Determination of Abrasiveness of Rock Using the CERCHAR Method

Summary of Test Results

ASTM D7625

Project No.:	18105808/6000	**Apparatus Type:**	West Cerchar
Project:	Kingston 3rd Crossing Bridge	**Model:**	GCTS RAA-100
Location:	Kingston, Ontario	**Stylus Hardness:**	Rockwell Hardness HRC55
Client:	Tullock Engineering	**Stylus Diameter:**	9.53mm
Lab ID No:	438		

Borehole	Sample	Depth (m)	Lithology	Moisture (%)	Test Surface	Cerchar (CAI_a)	Cerchar (CAI)	Abrasiveness Classification	Photo Reference	Comments
BH18-103	R1	23.19 - 22.89 [76'1" - 76'11"]	Not Provided	0.08	Saw Cut	0.99	1.46	Medium abrasiveness	1 & 2	
BH18-105	R2	22.38 - 22.56 [73'5" - 74']	Not Provided	0.17	Saw Cut	1.20	1.67	Medium abrasiveness	3 & 4	
BH18-106	R1	2.39 - 2.57 [7'10" - 8'5"]	Not Provided	0.40	Saw Cut	0.68	1.16	Medium abrasiveness	5 & 6	
BH18-107	R2	42.34 - 42.42 [138'11" - 139'2"]	Not Provided	0.19	Saw Cut	1.01	1.48	Medium abrasiveness	7 & 8	

The test data given herein pertain to the sample provided only. This report constitutes a testing service only.

G. Patton	December 19, 2018	L.Perrey	December 20,2018
TESTED BY	DATE	CHECKED BY	DATE

Golder Associates Ltd.
300, 3811 North Fraser Way, Burnaby, British Columbia, Canada V5J 5J2
Tel: 604-412-6899 Fax: 604-412-6816 www.golder.com

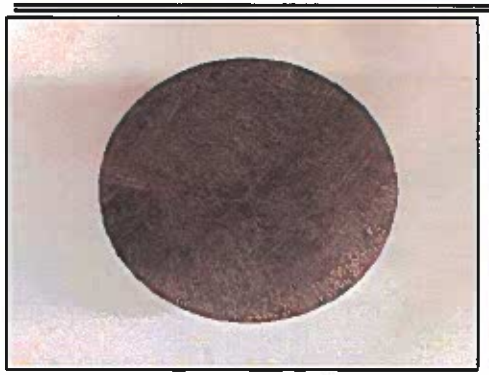
GOLDER

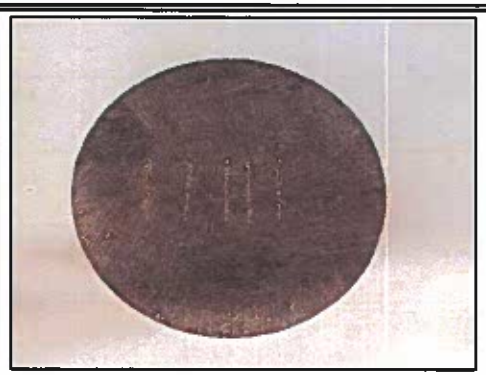
Laboratory Determination of Abrasiveness of Rock Using the CERCHAR Method

Summary of Test Results

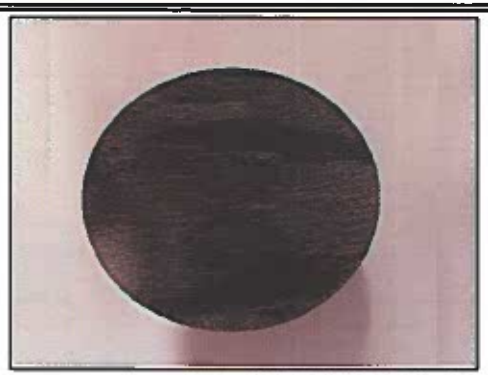
ASTM D7625

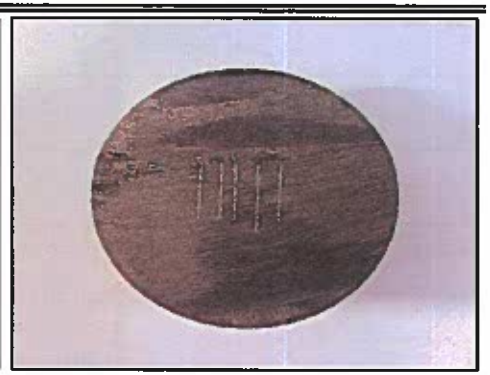
Project No.:	18105808/6000	**Apparatus Type:**	West Cerchar
Project:	Kingston 3rd Crossing Bridge	**Model:**	GCTS RAA-100
Location:	Kingston, Ontario	**Stylus Hardness:**	Rockwell Hardness HRC55
Client:	Tullock Engineering	**Stylus Diameter:**	9.53mm
Lab ID No:	438		



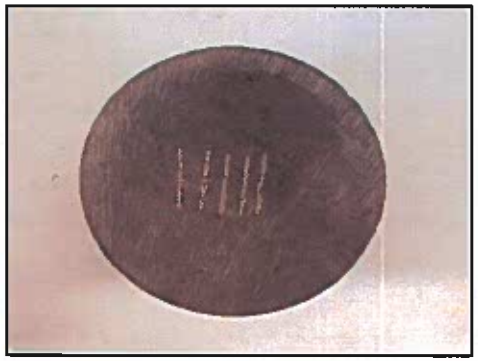


Photos 1 & 2: BH18-103 Sa R1 Cerchar before and after testing





Photos 3 & 4: BH18-105 Sa R2 Cerchar before and after testing



Photos 5 & 6: BH18-106 Sa R1 Cerchar before and after testing

Photos 7 & 8: BH18-107 Sa R2 Cerchar before and after testing

The test data given herein pertain to the sample provided only. This report constitutes a testing service only.

G. Patton	December 19, 2018	L.Perrey	December 20,2018
TESTED BY	DATE	CHECKED BY	DATE

Golder Associates Ltd.
300, 3811 North Fraser Way, Burnaby, British Columbia, Canada V5J 5J2
Tel: 604-412-6899 Fax 604-412-6816 www.golder.com

APPENDIX D

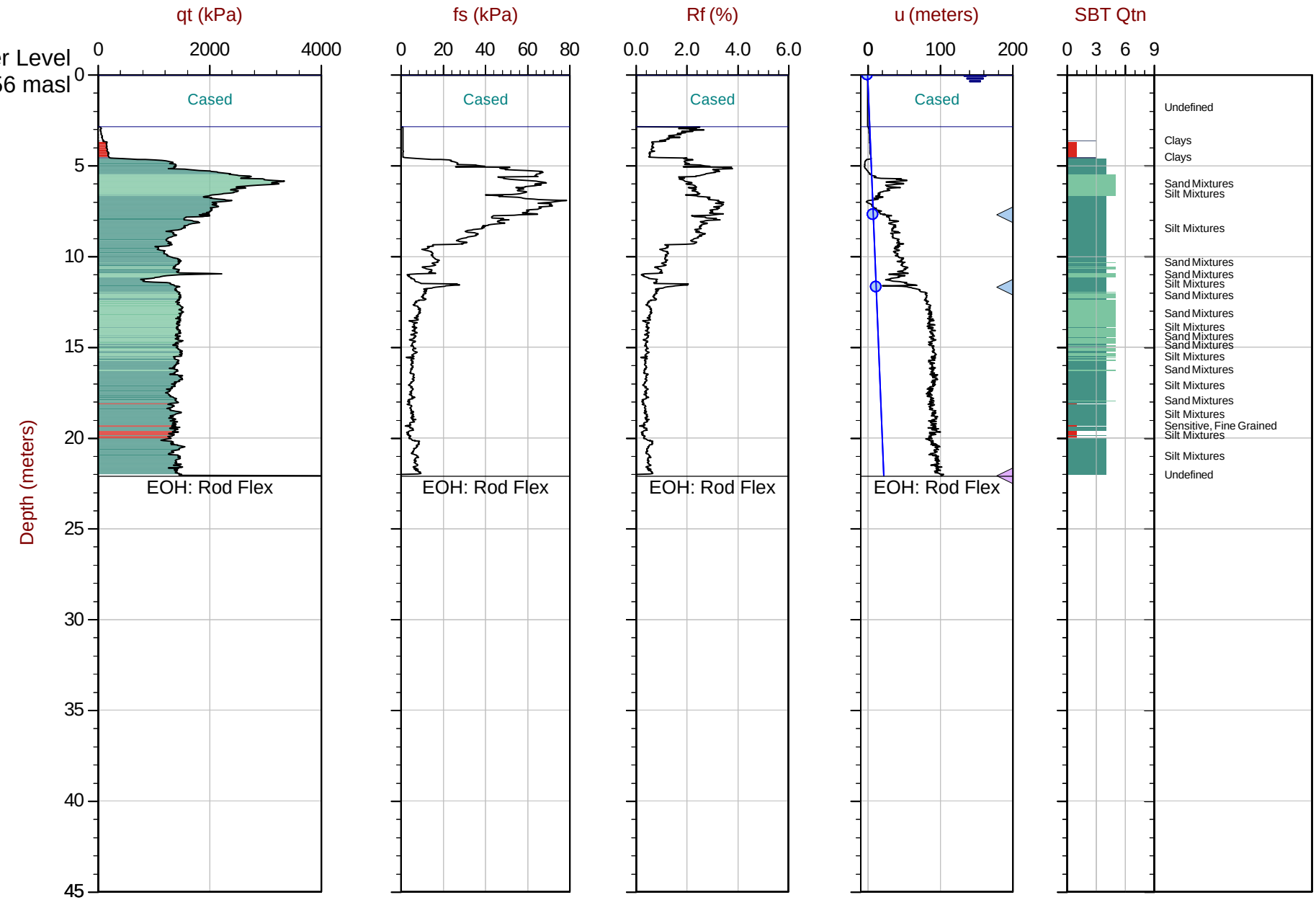
STATIC CONE PENETRATION TEST (CPT) RESULTS

CONETEC

TULLOCH Engineering

Job No: 18-05077
Date: 2018-11-20 15:23
Site: Kingston ON

Sounding: CPT18-104
Cone: 531:T1500F15U500



Max Depth: 22.100 m / 72.51 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 18-05077_CP18-104.COR
Unit Wt: SBTQtn (PKR2009), User Defined Layers

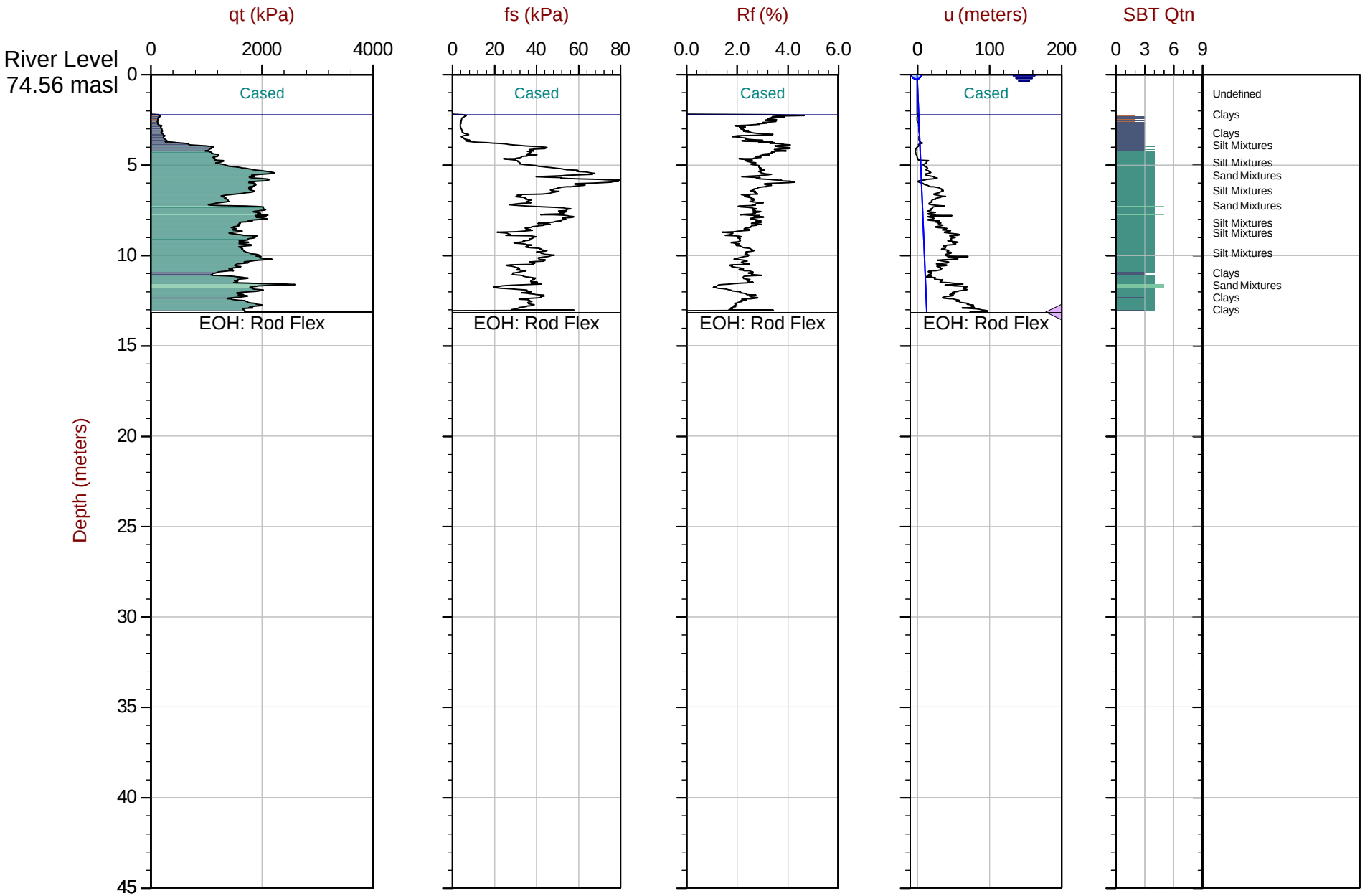
SBT: Robertson, 2009 and 2010
Coords: UTM 18N N: 4901699m E: 382782m
Sheet No: 1 of 1

Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Hydrostatic Line

TULLOCH Engineering

Job No: 18-05077
Date: 2018-11-20 10:39
Site: Kingston ON

Sounding: CPT18-105
Cone: 531:T1500F15U500



Max Depth: 13.150 m / 43.14 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 18-05077_CP18-105.COR
Unit Wt: SBTQtn (PKR2009), User Defined Layers

SBT: Robertson, 2009 and 2010
Coords: UTM 18N N: 4901700m E: 382877m
Sheet No: 1 of 1

Overplot Item: Ueq, Assumed Ueq, Dissipation, Ueq achieved, Dissipation, Ueq not achieved, Hydrostatic Line

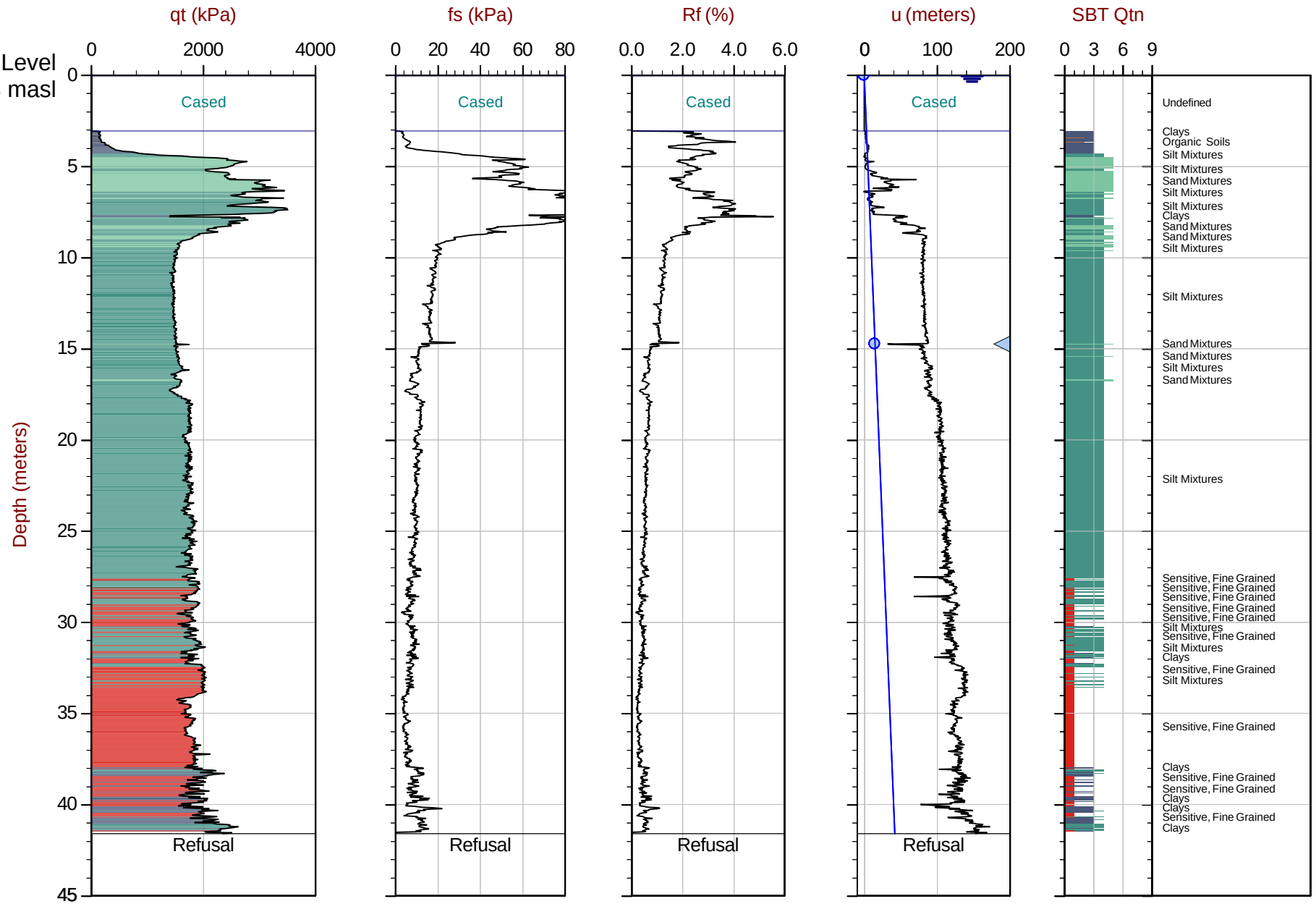
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

TULLOCH Engineering

Job No: 18-05077
Date: 2018-11-21 12:34
Site: Kingston ON

Sounding: CPT18-110
Cone: 531:T1500F15U500



Max Depth: 41.600 m / 136.48 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 18-05077_CP18-110.COR
Unit Wt: SBTQtn (PKR2009), User Defined Layers

SBT: Robertson, 2009 and 2010
Coords: UTM 18N N: 4901597 m E: 382239m
Sheet No: 1 of 1

Overplot Item: Ueq | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

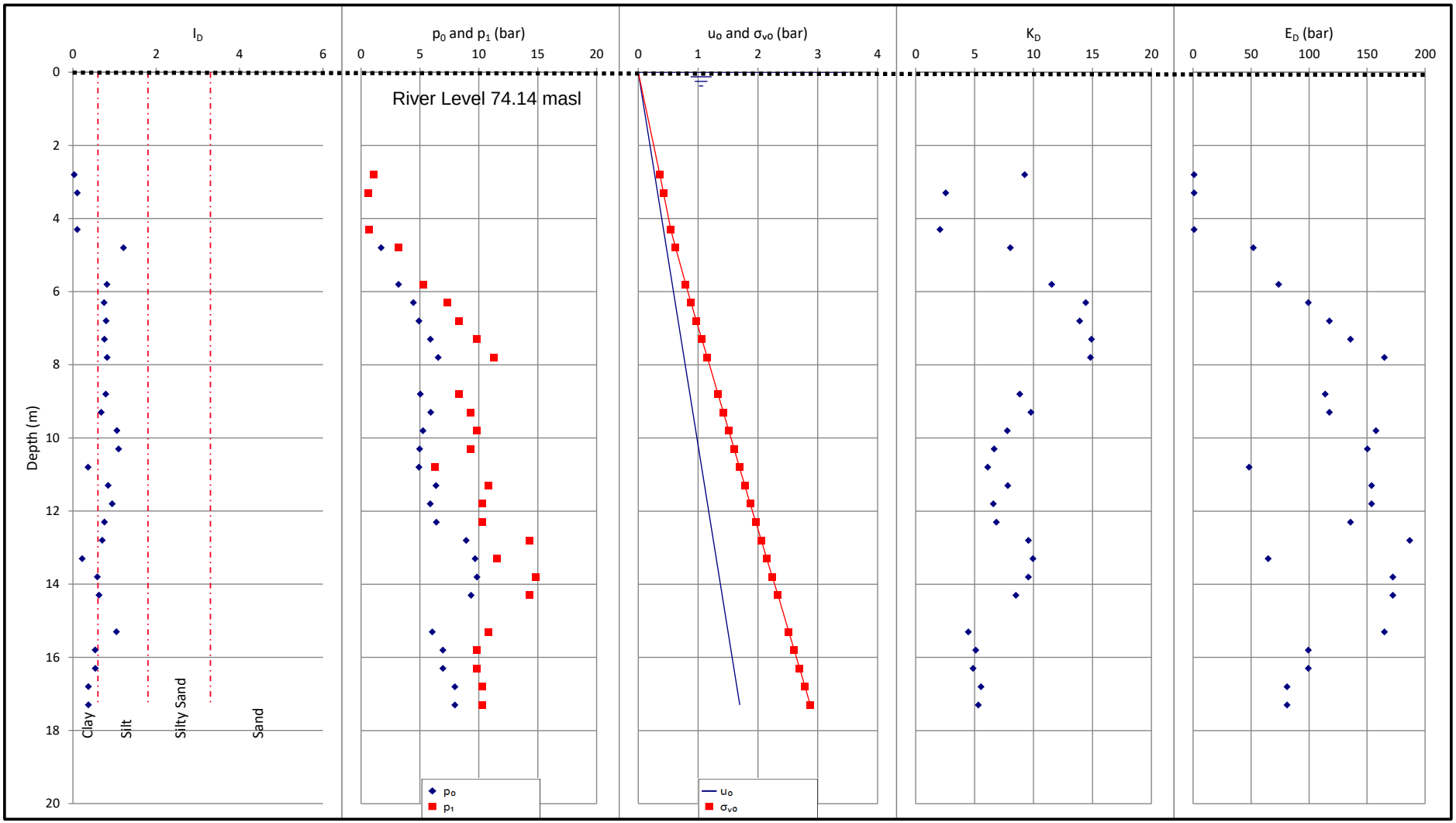
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

APPENDIX E

DILATOMETER TEST (DMT) RESULTS

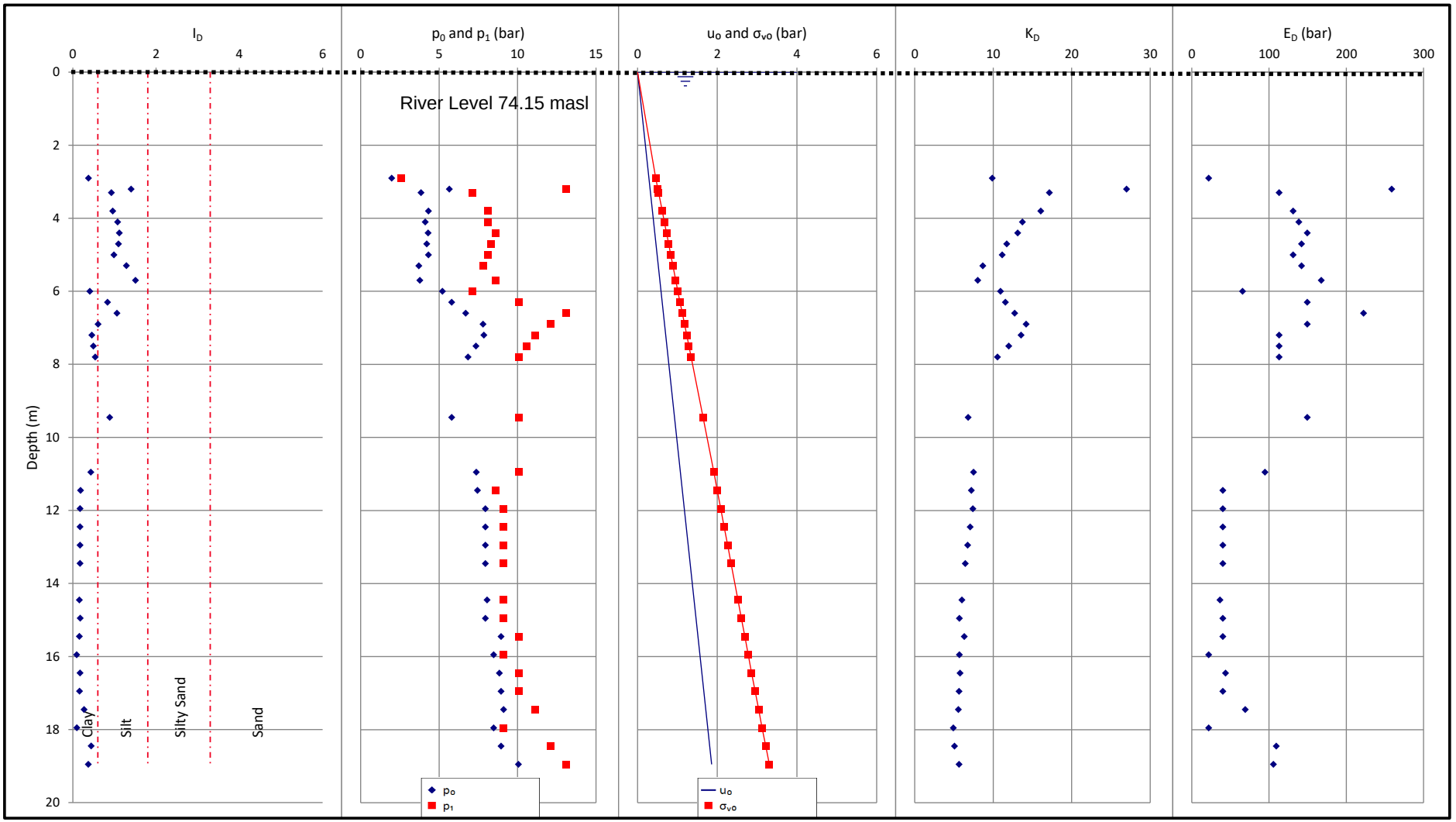
Job No:	18-05077	Coordinate System:	WGS 84 / UTM zone 18N
Project:	K3C	Northing (m):	4901696
Client:	TULLOCH Engineering Inc.	Easting (m):	382880
Sounding ID:	DMT18-105	Elevation (m):	
Date:	26-Nov-2018	Ground Water Depth (m):	0.0
Job Location:	Kingston ON	Gauge Zero Offset (bar):	0.1

FLAT PLATE DILATOMETER TEST RESULTS



Job No:	18-05077	Coordinate System:	WGS 84 / UTM zone 18N
Project:	K3C	Northing (m):	4901597
Client:	TULLOCH Engineering Inc.	Easting (m):	382880
Sounding ID:	DMT18-110	Elevation (m):	
Date:	22-Nov-2018	Ground Water Depth (m):	0.0
Job Location:	Kingston ON	Gauge Zero Offset (bar):	0.1

FLAT PLATE DILATOMETER TEST RESULTS



APPENDIX F

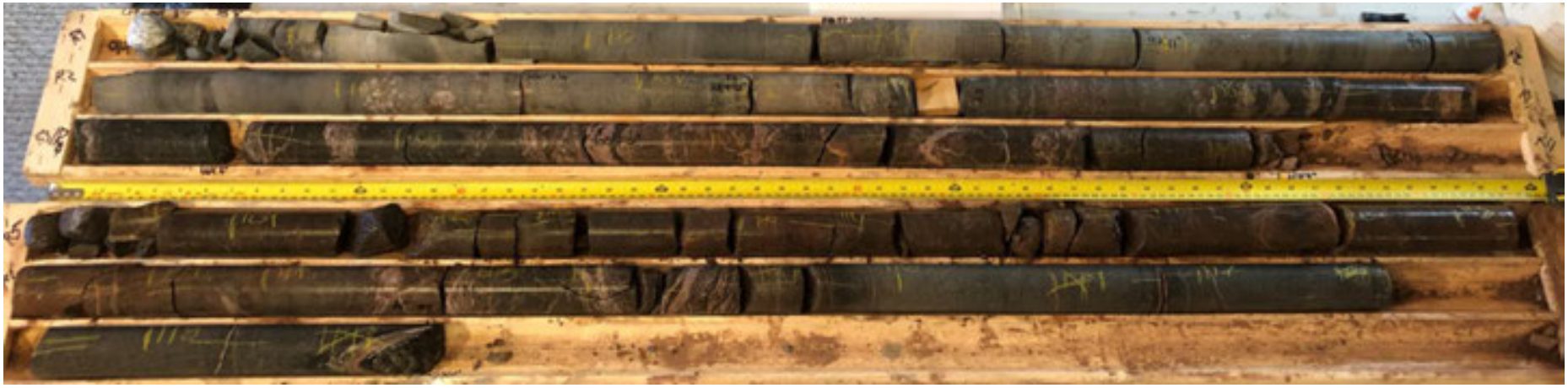
ROCK CORE PHOTOGRAPHS

Kingston Third Crossing Bridge Core Photos

Plate F1

BH-18-101 Boxes #1 and #2 – 29.11 m to 36.52 m

Top of Bedrock



Bottom of Bedrock

Date: Feb 2019

Project: 18-4046

TULLOCH ENGINEERING

Drawn: EKG

Chkd: GQ

Kingston Third Crossing Bridge Core Photos

Plate F2

BH-18-102 Boxes #1 to #3 - 42.21 m to 50.00 m

Top of Bedrock

Bottom of Bedrock

Date: Feb 2019

Project: 18-4046

TULLOCH ENGINEERING

Drawn: EKG

Chkd: GQ

Kingston Third Crossing Bridge Core Photos

Plate F3

BH-18-103 Boxes #1 and #2 – 23.90 – 29.89 m

Top of Bedrock

Bottom of Bedrock

Date: Feb 2019

Project: 18-4046

TULLOCH ENGINEERING

Drawn: EKG

Chkd: GQ

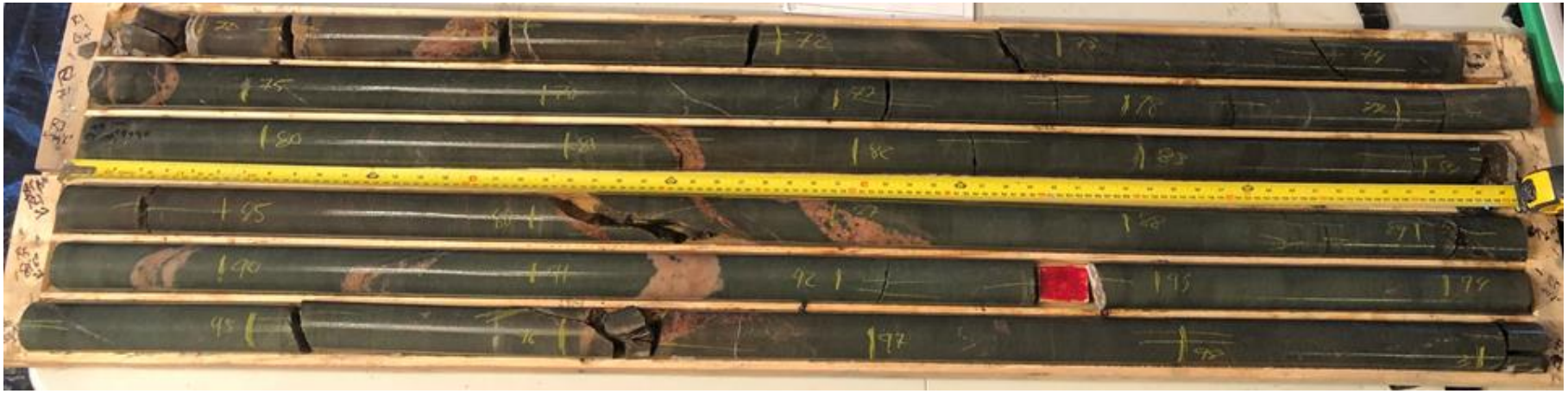
H357883-04-240-0001, Rev 1

Kingston Third Crossing Bridge Core Photos

Plate F4

BH-18-104 Boxes #1 and #2 – 21.26 m to 30.33 m

Top of Bedrock



Bottom of Bedrock

Date: Feb 2019

Project: 18-4046

TULLOCH ENGINEERING

Drawn: EKG

Chkd: GQ

Kingston Third Crossing Bridge Core Photos

Plate F5

BH-18-105 Boxes #1 to #3 – 20.22 m to 28.65 m

Top of Bedrock

Bottom of Bedrock

Date: Feb 2019

Project: 18-4046

TULLOCH ENGINEERING

Drawn: EKG

Chkd: GQ

H357883-04-240-0001, Rev 1

Kingston Third Crossing Bridge Core Photos

Plate F6

BH-18-106 Boxes #1 and #2 – 1.88 m to 7.62 m

Top of Bedrock

Bottom of Bedrock

Date: Feb 2019

Project: 18-4046

TULLOCH ENGINEERING

Drawn: EKG

Chkd: GQ

Kingston Third Crossing Bridge Core Photos

Plate F7

BH-18-107 Boxes #1 and #2 – 38.94 m to 45.34 m

Top of Bedrock

Bottom of Bedrock

Date: Feb 2019

Project: 18-4046

TULLOCH ENGINEERING

Drawn: EKG

Chkd: GQ

H357883-04-240-0001, Rev 1

Kingston Third Crossing Bridge Core Photos

Plate F8

BH-18-110 Box #1 – 40.84 m to 45.34 m

Top of Bedrock

Bottom of Bedrock

Date: Feb 2019

Project: 18-4046

TULLOCH ENGINEERING

Drawn: EKG

Chkd: GQ

Kingston Third Crossing Bridge Core Photos

Plate F9

BH-18-201 Boxes #1 and #2 – 4.17 m to 10.90 m

Top of Bedrock

Bottom of Bedrock

Date: Feb 2019

Project: 18-4046

TULLOCH ENGINEERING

Drawn: EKG

Chkd: GQ

Kingston Third Crossing Bridge Core Photos

Plate F10

BH-18-202 Boxes #1 and #2 – 0.21 m to 6.45 m

Top of Bedrock

Bottom of Bedrock

Date: Feb 2019

Project: 18-4046

TULLOCH ENGINEERING

Drawn: EKG

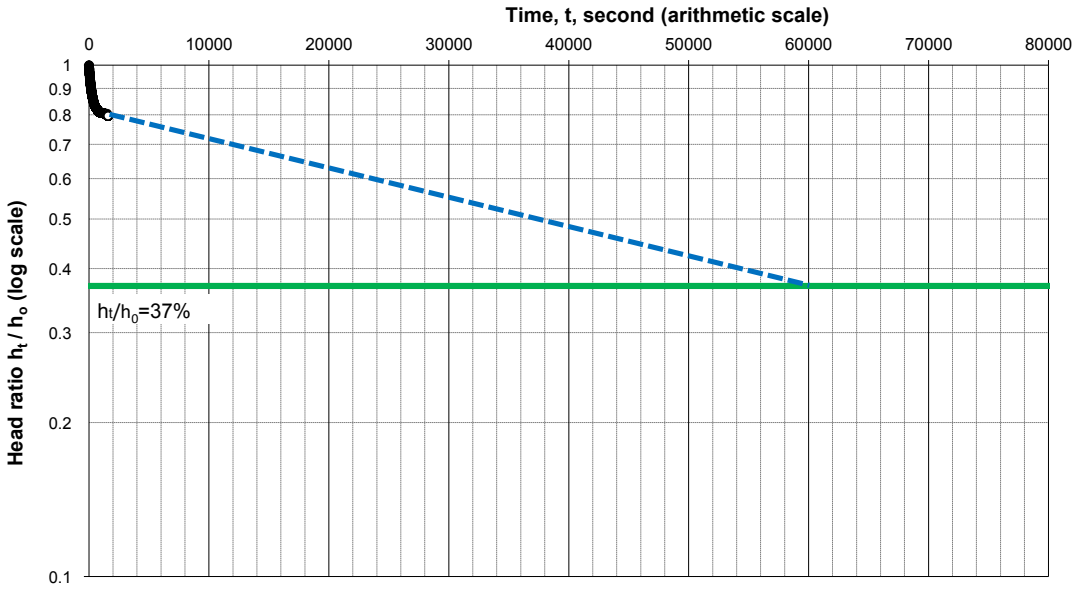
Chkd: GQ

APPENDIX G

SLUG TEST RESULTS

Water Pressure Testing Report - Variable Head Tests

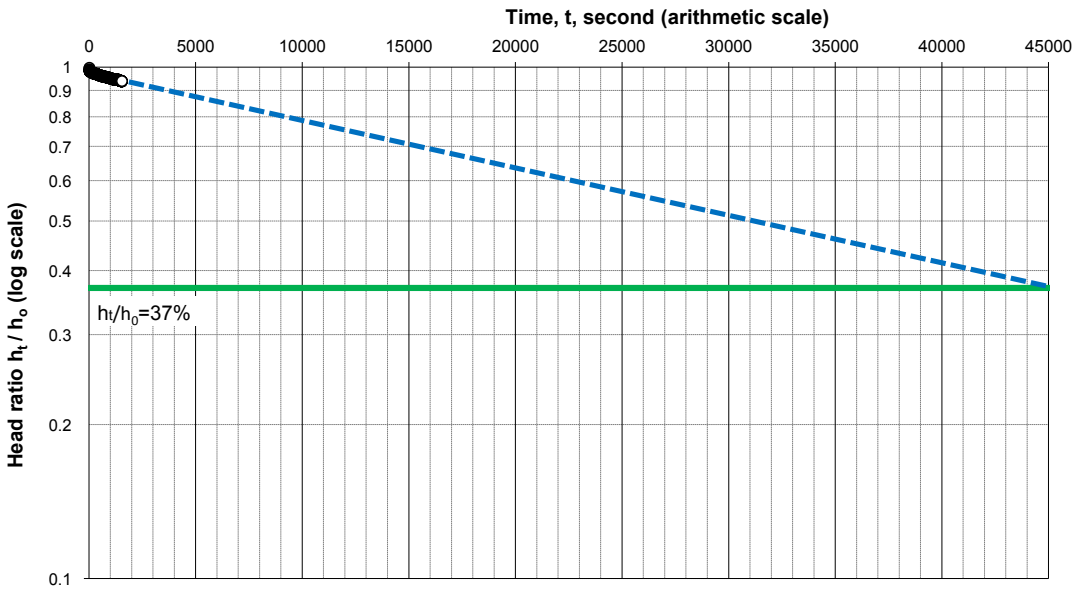
Client:	Hatch	Project:	K3C Bridge
Location:	See Site Plan	Borehole:	**BH-18-101**
Test Date:	23-Oct-18	Test by:	EG
Casing Diameter, mm*	114.3	Logged by:	GQ
Piezometer/Casing Diameter, mm*	114.3	Length of Screen / Gravel Pack Zone, m	0.91
Time to 37% of initial water level change, second :			60000
Estimated Permeability, cm/second:			**1E-05**



Interpretation method: Hvorslev Method, see "Applied Hydrogeology" By C.W.Fetter;Edition Three;Page 249

Notes:
- Casing driven to refusal (expected bedrock) and then lifted 0.90 m.
- Variable head test was performed through the casing.

TULLOCH ENGINEERING	Water Pressure Testing Report - Variable Head Tests		
Client:	Hatch	Project:	K3C Bridge
Location:	See Site Plan	Borehole:	**BH-18-102**
Test Date:	2-Nov-18	Test by:	EG
Casing Diameter, mm*	114.3	Logged by:	GQ
Piezometer/Casing Diameter, mm*	114.3	Length of Screen / Gravel Pack Zone, m	0.91
Time to 37% of initial water level change, second :			45000
Estimated Permeability, cm/second:			**1.9E-05**



Interpretation method: Hvorslev Method, see "Applied Hydrogeology" By C.W.Fetter;Edition Three;Page 249

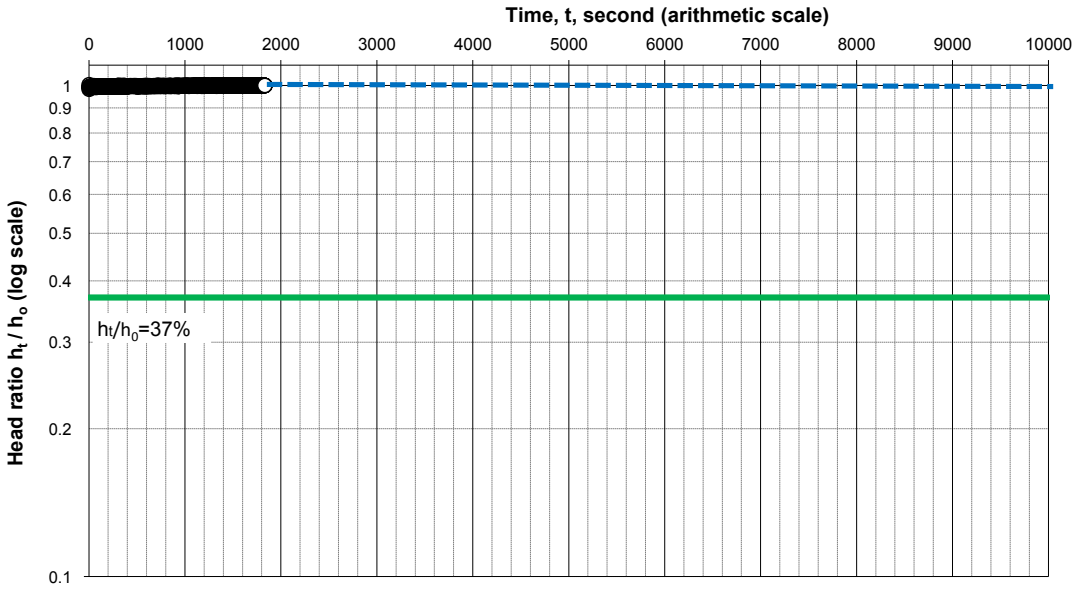
Notes:

Back pressure from native soil causing rising water level, initial water level taken to be initial waterlevel at initial logger readings

- Casing driven to refusal (expected bedrock) and then lifted 0.90 m.
- Variable head test was performed through the casing.

Water Pressure Testing Report - Variable Head Tests

Client:	Hatch	Project:	K3C Bridge
Location:	See Site Plan	Borehole:	**BH-18-103**
Test Date:	3-Dec-18	Test by:	EG
Casing Diameter, mm*	114.3	Logged by:	GQ
Piezometer/Casing Diameter, mm*	114.3	Length of Screen / Gravel Pack Zone, m	0.91
Time to 37% of initial water level change, second :			N/A
Estimated Permeability, cm/second:			**Low Permeability < 1E-6 cm/s**



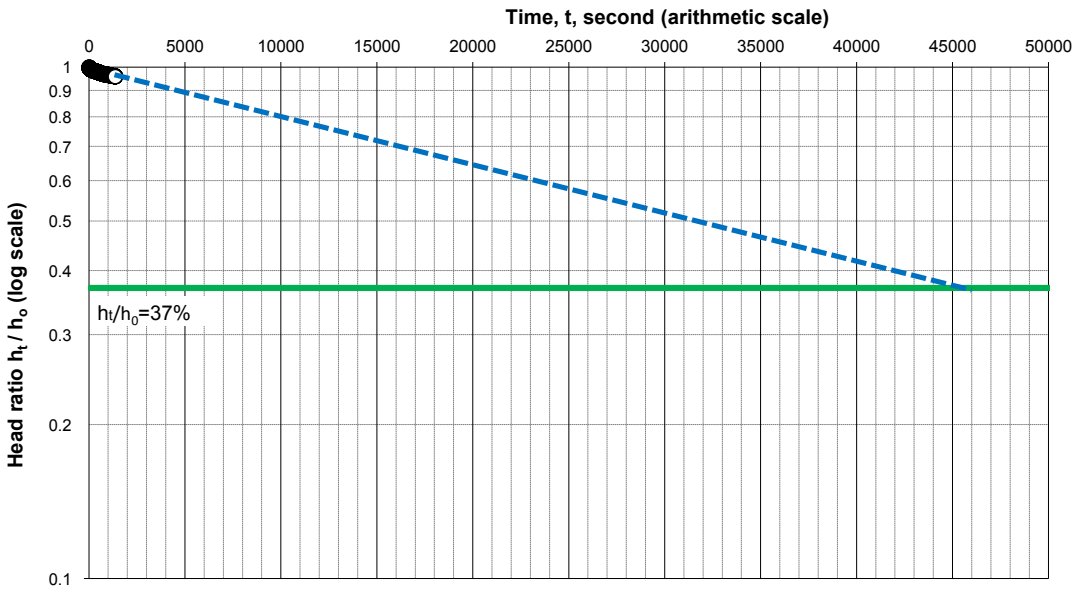
Interpretation method: Hvorslev Method, see "Applied Hydrogeology" By C.W.Fetter;Edition Three;Page 249

Notes:

Back pressure from native soil causing rising water level, initial water level taken to be initial waterlevel at initial logger readings

- Casing driven to refusal (expected bedrock) and then lifted 0.90 m.
- Variable head test was performed through the casing.

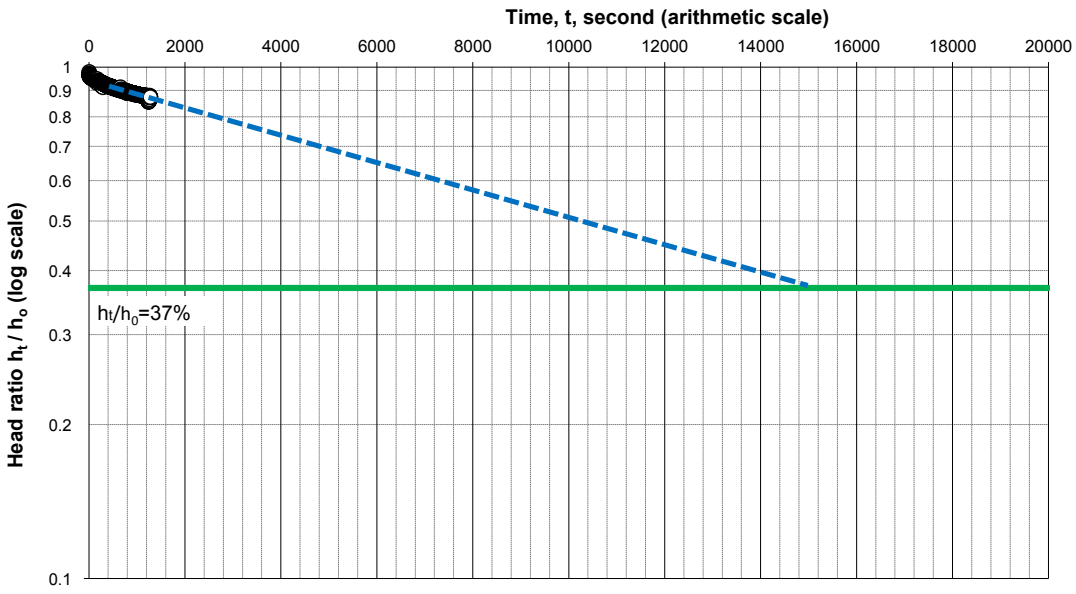
TULLOCH ENGINEERING	**Water Pressure Testing Report - Variable Head Tests**		
Client:	Hatch	Project:	K3C Bridge
Location:	See Site Plan	Borehole:	**BH-18-104**
Test Date:	9-Nov-18	Test by:	EG
Casing Diameter, mm*	114.3	Logged by:	GQ
Piezometer/Casing Diameter, mm*	114.3	Length of Screen / Gravel Pack Zone, m	0.91
Time to 37% of initial water level change, second :			45000
Estimated Permeability, cm/second:			**2E-05**



Interpretation method: Hvorslev Method, see "Applied Hydrogeology" By C.W.Fetter;Edition Three;Page 249

Notes:
- Casing driven to refusal (expected bedrock) and then lifted 0.90 m.
- Variable head test was performed through the casing.

TULLOCH ENGINEERING	**Water Pressure Testing Report - Variable Head Tests**		
Client:	Hatch	Project:	K3C Bridge
Location:	See Site Plan	Borehole:	**BH-18-105**
Test Date:	13-Nov-18	Test by:	EG
Drill Rod Diameter, mm*	41.3	Logged by:	GQ
Piezometer Diameter, mm*	41.3	Length of Screen / Gravel Pack Zone, m	0.91
Time to 37% of initial water level change, second :			15000
Estimated Permeability, cm/second:			**2E-05**

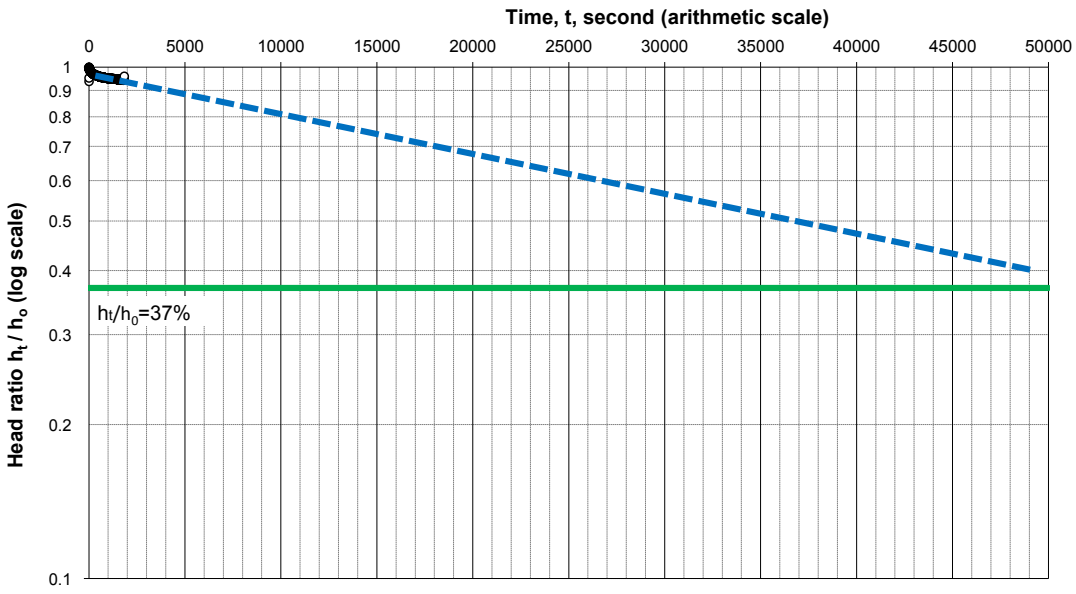


Interpretation method: Hvorslev Method, see "Applied Hydrogeology" By C.W.Fetter;Edition Three;Page 249

Notes:
- Casing driven to refusal (expected bedrock) and then lifted 0.90 m.
- Slug test performed in drilling rods which were advanced through casing due to soil heave from back pressure

Water Pressure Testing Report - Variable Head Tests

Client:	Hatch	Project:	K3C Bridge
Location:	See Site Plan	Borehole:	**BH-18-107**
Test Date:	3-Nov-18	Test by:	EG
Drill Rod Diameter, mm*	41.3	Logged by:	GQ
Piezometer/Casing Diameter, mm*	114.3	Length of Screen / Gravel Pack Zone, m	0.91
Time to 37% of initial water level change, second :			50000
Estimated Permeability, cm/second:			**2E-06**

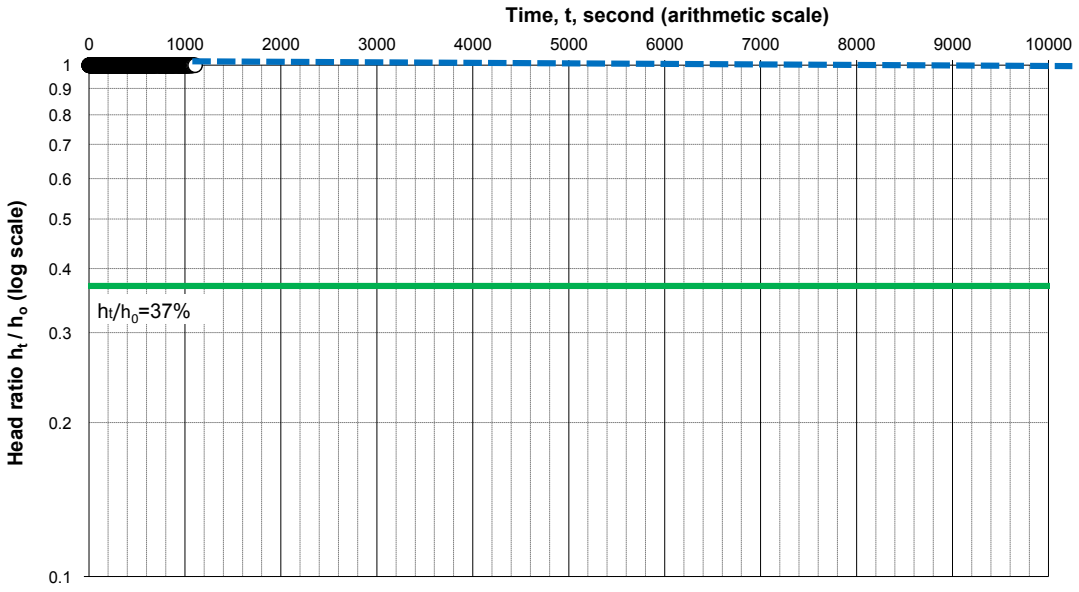


Interpretation method: Hvorslev Method, see "Applied Hydrogeology" By C.W.Fetter;Edition Three;Page 249

Notes:
- Casing driven to refusal (expected bedrock) and then lifted 0.90 m.
- Slug test performed in drilling rods which were advanced through casing due to soil heave from back pressure

Water Pressure Testing Report - Variable Head Tests

Client:	Hatch	Project:	K3C Bridge
Location:	See Site Plan	Borehole:	**BH-18-110**
Test Date:	28-Nov-18	Test by:	EG
Drill Rod Diameter, mm*	41.3	Logged by:	GQ
Piezometer/Casing Diameter, mm*	114.3	Length of Screen / Gravel Pack Zone, m	0.91
Time to 37% of initial water level change, second :			N/A
Estimated Permeability, cm/second:			**Low Permeability < 1E-6 cm/s**



Interpretation method: Hvorslev Method, see "Applied Hydrogeology" By C.W.Fetter;Edition Three;Page 249

Notes:
- Casing driven to refusal (expected bedrock) and then lifted 0.90 m.
- Variable head test was performed through the casing.

APPENDIX H

ENVIRONMENTAL TEST RESULTS

TULLOCH ENGINEERING INC
ATTN: ERIK GILES
80 Main Street West
Huntsville ON P1H 1W9

Date Received: 29-OCT-18
Report Date: 02-NOV-18 14:50 (MT)
Version: FINAL

Client Phone: 705-789-7851

Certificate of Analysis

Lab Work Order #: L2188452

Project P.O. #: NOT SUBMITTED
Job Reference: 18-4046
C of C Numbers: 17-728122
Legal Site Desc:

Emily Hansen
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2188452-1 BH18-101 SS2 Sampled By: CLIENT on 23-OCT-18 @ 12:00 Matrix: SOIL							
Physical Tests							
% Moisture	86.7		0.10	%	29-OCT-18	30-OCT-18	R4305866
Volatile Organic Compounds							
Acetone	<3.8	DLHM	3.8	ug/g	30-OCT-18	31-OCT-18	R4309149
Benzene	<0.051	DLHM	0.051	ug/g	30-OCT-18	31-OCT-18	R4309149
Bromodichloromethane	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
Bromoform	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
Bromomethane	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
Carbon tetrachloride	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
Chlorobenzene	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
Dibromochloromethane	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
Chloroform	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
1,2-Dibromoethane	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
1,2-Dichlorobenzene	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
1,3-Dichlorobenzene	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
1,4-Dichlorobenzene	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
Dichlorodifluoromethane	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
1,1-Dichloroethane	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
1,2-Dichloroethane	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
1,1-Dichloroethylene	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
cis-1,2-Dichloroethylene	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
trans-1,2-Dichloroethylene	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
Methylene Chloride	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
1,2-Dichloropropane	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
cis-1,3-Dichloropropene	<0.23	DLHM	0.23	ug/g	30-OCT-18	31-OCT-18	R4309149
trans-1,3-Dichloropropene	<0.23	DLHM	0.23	ug/g	30-OCT-18	31-OCT-18	R4309149
1,3-Dichloropropene (cis & trans)	<0.32		0.32	ug/g		01-NOV-18	
Ethylbenzene	<0.14	DLHM	0.14	ug/g	30-OCT-18	31-OCT-18	R4309149
n-Hexane	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
Methyl Ethyl Ketone	<3.8	DLHM	3.8	ug/g	30-OCT-18	31-OCT-18	R4309149
Methyl Isobutyl Ketone	<3.8	DLHM	3.8	ug/g	30-OCT-18	31-OCT-18	R4309149
MTBE	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
Styrene	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
1,1,1,2-Tetrachloroethane	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
1,1,2,2-Tetrachloroethane	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
Tetrachloroethylene	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
Toluene	<0.60	DLHM	0.60	ug/g	30-OCT-18	31-OCT-18	R4309149
1,1,1-Trichloroethane	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
1,1,2-Trichloroethane	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
Trichloroethylene	<0.075	DLHM	0.075	ug/g	30-OCT-18	31-OCT-18	R4309149
Trichlorofluoromethane	<0.38	DLHM	0.38	ug/g	30-OCT-18	31-OCT-18	R4309149
Vinyl chloride	<0.15	DLHM	0.15	ug/g	30-OCT-18	31-OCT-18	R4309149

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2188452-1 BH18-101 SS2 Sampled By: CLIENT on 23-OCT-18 @ 12:00 Matrix: SOIL							
Volatile Organic Compounds							
o-Xylene	<0.15	DLHM	0.15	ug/g	30-OCT-18	31-OCT-18	R4309149
m+p-Xylenes	<0.23	DLHM	0.23	ug/g	30-OCT-18	31-OCT-18	R4309149
Xylenes (Total)	<0.27		0.27	ug/g		01-NOV-18	
Surrogate: 4-Bromofluorobenzene	71.2		50-140	%	30-OCT-18	31-OCT-18	R4309149
Surrogate: 1,4-Difluorobenzene	81.0		50-140	%	30-OCT-18	31-OCT-18	R4309149
Hydrocarbons							
F1 (C6-C10)	<38	DLHM	38	ug/g	30-OCT-18	31-OCT-18	R4309149
F1-BTEX	<38		38	ug/g		01-NOV-18	
F2 (C10-C16)	<75	DLHM	75	ug/g	29-OCT-18	30-OCT-18	R4308189
F3 (C16-C34)	<380	DLHM	380	ug/g	29-OCT-18	30-OCT-18	R4308189
F4 (C34-C50)	<380	DLHM	380	ug/g	29-OCT-18	30-OCT-18	R4308189
Total Hydrocarbons (C6-C50)	<540		540	ug/g		01-NOV-18	
Chrom. to baseline at nC50	YES				29-OCT-18	30-OCT-18	R4308189
Surrogate: 2-Bromobenzotrifluoride	94.0		60-140	%	29-OCT-18	30-OCT-18	R4308189
Surrogate: 3,4-Dichlorotoluene	53.8	SURR-ND	60-140	%	30-OCT-18	31-OCT-18	R4309149
L2188452-2 BH18-101 SS7 Sampled By: CLIENT on 23-OCT-18 @ 14:20 Matrix: SOIL							
Physical Tests							
Conductivity	0.279		0.0040	mS/cm		01-NOV-18	R4309768
% Moisture	32.0		0.10	%	29-OCT-18	30-OCT-18	R4305866
pH	7.88		0.10	pH units		01-NOV-18	R4310147
Redox Potential	102		-1000	mV		31-OCT-18	R4308747
Resistivity	3580		1.0	ohm*cm		01-NOV-18	
Leachable Anions & Nutrients							
Chloride	30.9		5.0	ug/g	31-OCT-18	01-NOV-18	R4314229
Anions and Nutrients							
Sulphate	<20		20	mg/kg	30-OCT-18	01-NOV-18	R4314229
Inorganic Parameters							
Acid Volatile Sulphides	3.7	DLHC	2.0	mg/kg	31-OCT-18	31-OCT-18	R4308609
Volatile Organic Compounds							
Acetone	<0.50		0.50	ug/g	30-OCT-18	01-NOV-18	R4309149
Benzene	<0.0068		0.0068	ug/g	30-OCT-18	01-NOV-18	R4309149
Bromodichloromethane	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
Bromoform	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
Bromomethane	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
Carbon tetrachloride	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
Chlorobenzene	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
Dibromochloromethane	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
Chloroform	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
1,2-Dibromoethane	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
1,2-Dichlorobenzene	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2188452-2 BH18-101 SS7 Sampled By: CLIENT on 23-OCT-18 @ 14:20 Matrix: SOIL							
Volatile Organic Compounds							
1,3-Dichlorobenzene	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
1,4-Dichlorobenzene	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
Dichlorodifluoromethane	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
1,1-Dichloroethane	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
1,2-Dichloroethane	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
1,1-Dichloroethylene	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
cis-1,2-Dichloroethylene	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
trans-1,2-Dichloroethylene	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
Methylene Chloride	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
1,2-Dichloropropane	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
cis-1,3-Dichloropropene	<0.030		0.030	ug/g	30-OCT-18	01-NOV-18	R4309149
trans-1,3-Dichloropropene	<0.030		0.030	ug/g	30-OCT-18	01-NOV-18	R4309149
1,3-Dichloropropene (cis & trans)	<0.042		0.042	ug/g		01-NOV-18	
Ethylbenzene	<0.018		0.018	ug/g	30-OCT-18	01-NOV-18	R4309149
n-Hexane	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
Methyl Ethyl Ketone	<0.50		0.50	ug/g	30-OCT-18	01-NOV-18	R4309149
Methyl Isobutyl Ketone	<0.50		0.50	ug/g	30-OCT-18	01-NOV-18	R4309149
MTBE	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
Styrene	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
1,1,1,2-Tetrachloroethane	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
1,1,2,2-Tetrachloroethane	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
Tetrachloroethylene	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
Toluene	<0.080		0.080	ug/g	30-OCT-18	01-NOV-18	R4309149
1,1,1-Trichloroethane	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
1,1,2-Trichloroethane	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
Trichloroethylene	<0.010		0.010	ug/g	30-OCT-18	01-NOV-18	R4309149
Trichlorofluoromethane	<0.050		0.050	ug/g	30-OCT-18	01-NOV-18	R4309149
Vinyl chloride	<0.020		0.020	ug/g	30-OCT-18	01-NOV-18	R4309149
o-Xylene	<0.020		0.020	ug/g	30-OCT-18	01-NOV-18	R4309149
m+p-Xylenes	<0.030		0.030	ug/g	30-OCT-18	01-NOV-18	R4309149
Xylenes (Total)	<0.050		0.050	ug/g		01-NOV-18	
Surrogate: 4-Bromofluorobenzene	105.8		50-140	%	30-OCT-18	01-NOV-18	R4309149
Surrogate: 1,4-Difluorobenzene	112.6		50-140	%	30-OCT-18	01-NOV-18	R4309149
Hydrocarbons							
F1 (C6-C10)	<5.0		5.0	ug/g	30-OCT-18	01-NOV-18	R4309149
F1-BTEX	<5.0		5.0	ug/g		01-NOV-18	
F2 (C10-C16)	<10		10	ug/g	29-OCT-18	30-OCT-18	R4308189
F3 (C16-C34)	<50		50	ug/g	29-OCT-18	30-OCT-18	R4308189
F4 (C34-C50)	<50		50	ug/g	29-OCT-18	30-OCT-18	R4308189
Total Hydrocarbons (C6-C50)	<72		72	ug/g		01-NOV-18	
Chrom. to baseline at nC50	YES				29-OCT-18	30-OCT-18	R4308189

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2188452-2 BH18-101 SS7 Sampled By: CLIENT on 23-OCT-18 @ 14:20 Matrix: SOIL							
Hydrocarbons							
Surrogate: 2-Bromobenzotrifluoride	91.1		60-140	%	29-OCT-18	30-OCT-18	R4308189
Surrogate: 3,4-Dichlorotoluene	93.0		60-140	%	30-OCT-18	01-NOV-18	R4309149

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Sample Parameter Qualifier key listed:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
DLHM	Detection Limit Adjusted: Sample has High Moisture Content
SURR-ND	Surrogate recovery marginally exceeded ALS DQO. Reported non-detect results for associated samples were deemed to be unaffected.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CL-R511-WT	Soil	Chloride-O.Reg 153/04 (July 2011)	EPA 300.0

5 grams of dried soil is mixed with 10 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

EC-WT	Soil	Conductivity (EC)	MOEE E3138

A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

F1-F4-511-CALC-WT	Soil	F1-F4 Hydrocarbon Calculated Parameters	CCME CWS-PHC, Pub #1310, Dec 2001-S

Analytical methods used for analysis of CCME Petroleum Hydrocarbons have been validated and comply with the Reference Method for the CWS PHC.

Hydrocarbon results are expressed on a dry weight basis.

In cases where results for both F4 and F4G are reported, the greater of the two results must be used in any application of the CWS PHC guidelines and the gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.
In samples where BTEX and F1 were analyzed , F1-BTEX represents a value where the sum of Benzene, Toluene, Ethylbenzene and total Xylenes has been subtracted from F1.

In samples where PAHs, F2 and F3 were analyzed, F2-Naphth represents the result where Naphthalene has been subtracted from F2. F3-PAH represents a result where the sum of Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzo(a,h)anthracene, Fluoranthene, Indeno(1,2,3-cd)pyrene, Phenanthrene, and Pyrene has been subtracted from F3.

Unless otherwise qualified, the following quality control criteria have been met for the F1 hydrocarbon range:
1. All extraction and analysis holding times were met.
2. Instrument performance showing response factors for C6 and C10 within 30% of the response factor for toluene.
3. Linearity of gasoline response within 15% throughout the calibration range.

Unless otherwise qualified, the following quality control criteria have been met for the F2-F4 hydrocarbon ranges:
1. All extraction and analysis holding times were met.
2. Instrument performance showing C10, C16 and C34 response factors within 10% of their average.
3. Instrument performance showing the C50 response factor within 30% of the average of the C10, C16 and C34 response factors.
4. Linearity of diesel or motor oil response within 15% throughout the calibration range.

F1-HS-511-WT	Soil	F1-O.Reg 153/04 (July 2011)	E3398/CCME TIER 1-HS

Fraction F1 is determined by extracting a soil or sediment sample as received with methanol, then analyzing by headspace-GC/FID.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

F2-F4-511-WT	Soil	F2-F4-O.Reg 153/04 (July 2011)	CCME Tier 1

Petroleum Hydrocarbons (F2-F4 fractions) are extracted from soil with 1:1 hexane:acetone using a rotary extractor. Extracts are treated with silica gel to remove polar organic interferences. F2, F3, & F4 are analyzed by GC-FID. F4G-sg is analyzed gravimetrically.

Notes:
1. F2 (C10-C16): Sum of all hydrocarbons that elute between nC10 and nC16.
2. F3 (C16-C34): Sum of all hydrocarbons that elute between nC16 and nC34.
3. F4 (C34-C50): Sum of all hydrocarbons that elute between nC34 and nC50.
4. F4G: Gravimetric Heavy Hydrocarbons
5. F4G-sg: Gravimetric Heavy Hydrocarbons (F4G) after silica gel treatment.
6. Where both F4 (C34-C50) and F4G-sg are reported for a sample, the larger of the two values is used for comparison against the relevant CCME guideline for F4.
7. F4G-sg cannot be added to the C6 to C50 hydrocarbon results to obtain an estimate of total extractable hydrocarbons.
8. This method is validated for use.
9. Data from analysis of validation and quality control samples is available upon request.
10. Reported results are expressed as milligrams per dry kilogram, unless otherwise indicated.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG

Reference Information

must be reported).

MOISTURE-WT	Soil	% Moisture	Gravimetric: Oven Dried
PH-WT	Soil	pH	MOEE E3137A

A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

REDOX-POTENTIAL-WT	Soil	Redox Potential	APHA 2580

This analysis is carried out in accordance with the procedure described in the "APHA" method 2580 "Oxidation-Reduction Potential" 2012. Samples are extracted at a fixed ratio with DI water. Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.

RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	APHA 2510 B

Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.

RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	MOECC E3138

Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.

SO4-WT	Soil	Sulphate	EPA 300.0

5 grams of soil is mixed with 50 mL of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.

SULPHIDE-WT	Soil	Sulphide, Acid Volatile	APHA 4500S2J

This analysis is carried out in accordance with the method described in APHA 4500 S2-J. Hydrochloric acid is added to sediment samples within a purge and trap system. The evolved hydrogen sulphide (H2S) is carried into a basic solution by inert gas. The acid volatile sulfide is then determined colourimetrically.

VOC-1,3-DCP-CALC-WT	Soil	Regulation 153 VOCs	SW8260B/SW8270C
VOC-511-HS-WT	Soil	VOC-O.Reg 153/04 (July 2011)	SW846 8260 (511)

Soil and sediment samples are extracted in methanol and analyzed by headspace-GC/MS.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

XYLENES-SUM-CALC-WT	Soil	Sum of Xylene Isomer Concentrations	CALCULATION

Total xylenes represents the sum of o-xylene and m&p-xylene.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

17-728122

Reference Information

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L2188452 Report Date: 02-NOV-18

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: ERIK GILES

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-R511-WT	**Soil**							
Batch R4314229								
WG2919831-3 CRM		**AN-CRM-WT**						
Chloride			97.9		%		70-130	01-NOV-18
WG2919831-4 DUP		**L2189303-1**						
Chloride		<5.0	<5.0	RPD-NA	ug/g	N/A	30	01-NOV-18
WG2919831-2 LCS								
Chloride			104.0		%		80-120	01-NOV-18
WG2919831-1 MB								
Chloride			<5.0		ug/g		5	01-NOV-18
EC-WT	**Soil**							
Batch R4309768								
WG2919555-4 DUP		**WG2919555-3**						
Conductivity		0.746	0.737		mS/cm	1.2	20	01-NOV-18
WG2919555-2 IRM		**WT SAR2**						
Conductivity			91.2		%		70-130	01-NOV-18
WG2919947-1 LCS								
Conductivity			100.0		%		90-110	01-NOV-18
WG2919555-1 MB								
Conductivity			<0.0040		mS/cm		0.004	01-NOV-18
F1-HS-511-WT	**Soil**							
Batch R4309149								
WG2917688-4 DUP		**WG2917688-3**						
F1 (C6-C10)		<5.0	<5.0	RPD-NA	ug/g	N/A	30	31-OCT-18
WG2917688-2 LCS								
F1 (C6-C10)			109.6		%		80-120	31-OCT-18
WG2917688-1 MB								
F1 (C6-C10)			<5.0		ug/g		5	31-OCT-18
Surrogate: 3,4-Dichlorotoluene			97.3		%		60-140	31-OCT-18
WG2917688-6 MS		**L2188452-1**						
F1 (C6-C10)			81.0		%		60-140	01-NOV-18
F2-F4-511-WT	**Soil**							
Batch R4308189								
WG2917457-3 DUP		**WG2917457-5**						
F2 (C10-C16)		<10	<10	RPD-NA	ug/g	N/A	30	31-OCT-18
F3 (C16-C34)		<50	<50	RPD-NA	ug/g	N/A	30	31-OCT-18
F4 (C34-C50)		<50	<50	RPD-NA	ug/g	N/A	30	31-OCT-18
WG2917457-2 LCS								
F2 (C10-C16)			103.0		%		80-120	30-OCT-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: ERIK GILES

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
F2-F4-511-WT	**Soil**							
Batch R4308189								
WG2917457-2 LCS								
F3 (C16-C34)			101.8		%		80-120	30-OCT-18
F4 (C34-C50)			106.5		%		80-120	30-OCT-18
WG2917457-1 MB								
F2 (C10-C16)			<10		ug/g		10	30-OCT-18
F3 (C16-C34)			<50		ug/g		50	30-OCT-18
F4 (C34-C50)			<50		ug/g		50	30-OCT-18
Surrogate: 2-Bromobenzotrifluoride			92.1		%		60-140	30-OCT-18
WG2917457-4 MS		**WG2917457-5**						
F2 (C10-C16)			99.6		%		60-140	30-OCT-18
F3 (C16-C34)			97.6		%		60-140	30-OCT-18
F4 (C34-C50)			101.1		%		60-140	30-OCT-18
MOISTURE-WT	**Soil**							
Batch R4305866								
WG2917206-3 DUP		**L2181949-4**						
% Moisture		27.5	26.8		%	2.4	20	30-OCT-18
WG2917206-2 LCS								
% Moisture			100.2		%		90-110	30-OCT-18
WG2917206-1 MB								
% Moisture			<0.10		%		0.1	30-OCT-18
PH-WT	**Soil**							
Batch R4310147								
WG2917481-1 DUP		**L2188574-7**						
pH		7.75	7.62	J	pH units	0.13	0.3	01-NOV-18
WG2919950-1 LCS								
pH			7.04		pH units		6.9-7.1	01-NOV-18
REDOX-POTENTIAL-WT	**Soil**							
Batch R4308747								
WG2917558-1 DUP		**L2188686-1**						
Redox Potential		145	133		mV	8.6	25	31-OCT-18
SO4-WT	**Soil**							
Batch R4314229								
WG2917669-4 CRM		**AN-CRM-WT**						
Sulphate			101.9		%		60-140	01-NOV-18
WG2917669-3 DUP		**WG2917669-5**						
Sulphate		<20	<20					

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: ERIK GILES

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SO4-WT	**Soil**							
Batch R4314229								
WG2917669-3 DUP		**WG2917669-5**						
Sulphate		<20	<20	RPD-NA	mg/kg	N/A	30	01-NOV-18
WG2917669-2 LCS								
Sulphate			103.2		%		80-120	01-NOV-18
WG2917669-1 MB								
Sulphate			<20		mg/kg		20	01-NOV-18
SULPHIDE-WT	**Soil**							
Batch R4308609								
WG2919213-3 DUP		**L2187538-1**						
Acid Volatile Sulphides		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	31-OCT-18
WG2919213-2 LCS								
Acid Volatile Sulphides			99.5		%		70-130	31-OCT-18
WG2919213-1 MB								
Acid Volatile Sulphides			<0.20		mg/kg		0.2	31-OCT-18
VOC-511-HS-WT	**Soil**							
Batch R4309149								
WG2917688-4 DUP		**WG2917688-3**						
1,1,1,2-Tetrachloroethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
1,1,2,2-Tetrachloroethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
1,1,1-Trichloroethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
1,1,2-Trichloroethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
1,1-Dichloroethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
1,1-Dichloroethylene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
1,2-Dibromoethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
1,2-Dichlorobenzene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
1,2-Dichloroethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
1,2-Dichloropropane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
1,3-Dichlorobenzene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
1,4-Dichlorobenzene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
Acetone		<0.50	<0.50	RPD-NA	ug/g	N/A	40	31-OCT-18
Benzene		<0.0068	<0.0068	RPD-NA	ug/g	N/A	40	31-OCT-18
Bromodichloromethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
Bromoform		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
Bromomethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
Carbon tetrachloride		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: ERIK GILES

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-511-HS-WT	**Soil**							
Batch R4309149								
WG2917688-4 DUP		**WG2917688-3**						
Chlorobenzene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
Chloroform		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
cis-1,2-Dichloroethylene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
cis-1,3-Dichloropropene		<0.030	<0.030	RPD-NA	ug/g	N/A	40	31-OCT-18
Dibromochloromethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
Dichlorodifluoromethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
Ethylbenzene		<0.018	<0.018	RPD-NA	ug/g	N/A	40	31-OCT-18
n-Hexane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
Methylene Chloride		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
MTBE		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
m+p-Xylenes		<0.030	<0.030	RPD-NA	ug/g	N/A	40	31-OCT-18
Methyl Ethyl Ketone		<0.50	<0.50	RPD-NA	ug/g	N/A	40	31-OCT-18
Methyl Isobutyl Ketone		<0.50	<0.50	RPD-NA	ug/g	N/A	40	31-OCT-18
o-Xylene		<0.020	<0.020	RPD-NA	ug/g	N/A	40	31-OCT-18
Styrene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
Tetrachloroethylene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
Toluene		<0.080	<0.080	RPD-NA	ug/g	N/A	40	31-OCT-18
trans-1,2-Dichloroethylene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
trans-1,3-Dichloropropene		<0.030	<0.030	RPD-NA	ug/g	N/A	40	31-OCT-18
Trichloroethylene		<0.010	<0.010	RPD-NA	ug/g	N/A	40	31-OCT-18
Trichlorofluoromethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	31-OCT-18
Vinyl chloride		<0.020	<0.020	RPD-NA	ug/g	N/A	40	31-OCT-18
WG2917688-2 LCS								
1,1,1,2-Tetrachloroethane			116.2		%		60-130	31-OCT-18
1,1,2,2-Tetrachloroethane			103.3		%		60-130	31-OCT-18
1,1,1-Trichloroethane			110.8		%		60-130	31-OCT-18
1,1,2-Trichloroethane			105.6		%		60-130	31-OCT-18
1,1-Dichloroethane			111.4		%		60-130	31-OCT-18
1,1-Dichloroethylene			102.3		%		60-130	31-OCT-18
1,2-Dibromoethane			104.6		%		70-130	31-OCT-18
1,2-Dichlorobenzene			113.3		%		70-130	31-OCT-18
1,2-Dichloroethane			110.5		%		60-130	31-OCT-18
1,2-Dichloropropane			107.9		%		70-130	31-OCT-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: ERIK GILES

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-511-HS-WT	**Soil**							
Batch R4309149								
WG2917688-2 LCS								
1,3-Dichlorobenzene			114.9		%		70-130	31-OCT-18
1,4-Dichlorobenzene			117.4		%		70-130	31-OCT-18
Acetone			114.0		%		60-140	31-OCT-18
Benzene			111.0		%		70-130	31-OCT-18
Bromodichloromethane			109.4		%		50-140	31-OCT-18
Bromoform			103.3		%		70-130	31-OCT-18
Bromomethane			106.3		%		50-140	31-OCT-18
Carbon tetrachloride			110.9		%		70-130	31-OCT-18
Chlorobenzene			110.1		%		70-130	31-OCT-18
Chloroform			110.1		%		70-130	31-OCT-18
cis-1,2-Dichloroethylene			108.7		%		70-130	31-OCT-18
cis-1,3-Dichloropropene			113.1		%		70-130	31-OCT-18
Dibromochloromethane			106.4		%		60-130	31-OCT-18
Dichlorodifluoromethane			81.3		%		50-140	31-OCT-18
Ethylbenzene			116.8		%		70-130	31-OCT-18
n-Hexane			92.3		%		70-130	31-OCT-18
Methylene Chloride			111.5		%		70-130	31-OCT-18
MTBE			114.9		%		70-130	31-OCT-18
m+p-Xylenes			116.9		%		70-130	31-OCT-18
Methyl Ethyl Ketone			108.2		%		60-140	31-OCT-18
Methyl Isobutyl Ketone			99.6		%		60-140	31-OCT-18
o-Xylene			113.7		%		70-130	31-OCT-18
Styrene			115.3		%		70-130	31-OCT-18
Tetrachloroethylene			111.9		%		60-130	31-OCT-18
Toluene			105.5		%		70-130	31-OCT-18
trans-1,2-Dichloroethylene			111.2		%		60-130	31-OCT-18
trans-1,3-Dichloropropene			112.8		%		70-130	31-OCT-18
Trichloroethylene			114.5		%		60-130	31-OCT-18
Trichlorofluoromethane			111.0		%		50-140	31-OCT-18
Vinyl chloride			104.8		%		60-140	31-OCT-18
WG2917688-1 MB								
1,1,1,2-Tetrachloroethane			<0.050		ug/g		0.05	31-OCT-18
1,1,2,2-Tetrachloroethane			<0.050		ug/g		0.05	31-OCT-18
1,1,1-Trichloroethane			<0.050		ug/g		0.05	31-OCT-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: ERIK GILES

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-511-HS-WT	**Soil**							
Batch R4309149								
WG2917688-1 MB								
1,1,2-Trichloroethane			<0.050		ug/g		0.05	31-OCT-18
1,1-Dichloroethane			<0.050		ug/g		0.05	31-OCT-18
1,1-Dichloroethylene			<0.050		ug/g		0.05	31-OCT-18
1,2-Dibromoethane			<0.050		ug/g		0.05	31-OCT-18
1,2-Dichlorobenzene			<0.050		ug/g		0.05	31-OCT-18
1,2-Dichloroethane			<0.050		ug/g		0.05	31-OCT-18
1,2-Dichloropropane			<0.050		ug/g		0.05	31-OCT-18
1,3-Dichlorobenzene			<0.050		ug/g		0.05	31-OCT-18
1,4-Dichlorobenzene			<0.050		ug/g		0.05	31-OCT-18
Acetone			<0.50		ug/g		0.5	31-OCT-18
Benzene			<0.0068		ug/g		0.0068	31-OCT-18
Bromodichloromethane			<0.050		ug/g		0.05	31-OCT-18
Bromoform			<0.050		ug/g		0.05	31-OCT-18
Bromomethane			<0.050		ug/g		0.05	31-OCT-18
Carbon tetrachloride			<0.050		ug/g		0.05	31-OCT-18
Chlorobenzene			<0.050		ug/g		0.05	31-OCT-18
Chloroform			<0.050		ug/g		0.05	31-OCT-18
cis-1,2-Dichloroethylene			<0.050		ug/g		0.05	31-OCT-18
cis-1,3-Dichloropropene			<0.030		ug/g		0.03	31-OCT-18
Dibromochloromethane			<0.050		ug/g		0.05	31-OCT-18
Dichlorodifluoromethane			<0.050		ug/g		0.05	31-OCT-18
Ethylbenzene			<0.018		ug/g		0.018	31-OCT-18
n-Hexane			<0.050		ug/g		0.05	31-OCT-18
Methylene Chloride			<0.050		ug/g		0.05	31-OCT-18
MTBE			<0.050		ug/g		0.05	31-OCT-18
m+p-Xylenes			<0.030		ug/g		0.03	31-OCT-18
Methyl Ethyl Ketone			<0.50		ug/g		0.5	31-OCT-18
Methyl Isobutyl Ketone			<0.50		ug/g		0.5	31-OCT-18
o-Xylene			<0.020		ug/g		0.02	31-OCT-18
Styrene			<0.050		ug/g		0.05	31-OCT-18
Tetrachloroethylene			<0.050		ug/g		0.05	31-OCT-18
Toluene			<0.080		ug/g		0.08	31-OCT-18
trans-1,2-Dichloroethylene			<0.050		ug/g		0.05	31-OCT-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: ERIK GILES

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-511-HS-WT	**Soil**							
Batch R4309149								
WG2917688-1 MB								
trans-1,3-Dichloropropene			<0.030		ug/g		0.03	31-OCT-18
Trichloroethylene			<0.010		ug/g		0.01	31-OCT-18
Trichlorofluoromethane			<0.050		ug/g		0.05	31-OCT-18
Vinyl chloride			<0.020		ug/g		0.02	31-OCT-18
Surrogate: 1,4-Difluorobenzene			118.2		%		50-140	31-OCT-18
Surrogate: 4-Bromofluorobenzene			111.3		%		50-140	31-OCT-18
WG2917688-5 MS		**L2188176-1**						
1,1,1,2-Tetrachloroethane			129.1		%		50-140	31-OCT-18
1,1,2,2-Tetrachloroethane			114.4		%		50-140	31-OCT-18
1,1,1-Trichloroethane			122.1		%		50-140	31-OCT-18
1,1,2-Trichloroethane			116.1		%		50-140	31-OCT-18
1,1-Dichloroethane			122.3		%		50-140	31-OCT-18
1,1-Dichloroethylene			112.3		%		50-140	31-OCT-18
1,2-Dibromoethane			114.4		%		50-140	31-OCT-18
1,2-Dichlorobenzene			124.2		%		50-140	31-OCT-18
1,2-Dichloroethane			119.8		%		50-140	31-OCT-18
1,2-Dichloropropane			117.7		%		50-140	31-OCT-18
1,3-Dichlorobenzene			125.1		%		50-140	31-OCT-18
1,4-Dichlorobenzene			127.4		%		50-140	31-OCT-18
Acetone			117.0		%		50-140	31-OCT-18
Benzene			121.8		%		50-140	31-OCT-18
Bromodichloromethane			120.0		%		50-140	31-OCT-18
Bromoform			114.1		%		50-140	31-OCT-18
Bromomethane			116.0		%		50-140	31-OCT-18
Carbon tetrachloride			122.4		%		50-140	31-OCT-18
Chlorobenzene			121.3		%		50-140	31-OCT-18
Chloroform			121.3		%		50-140	31-OCT-18
cis-1,2-Dichloroethylene			119.3		%		50-140	31-OCT-18
cis-1,3-Dichloropropene			120.6		%		50-140	31-OCT-18
Dibromochloromethane			117.4		%		50-140	31-OCT-18
Dichlorodifluoromethane			90.0		%		50-140	31-OCT-18
Ethylbenzene			128.6		%		50-140	31-OCT-18
n-Hexane			100.7		%		50-140	31-OCT-18
Methylene Chloride			121.4		%		50-140	31-OCT-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: ERIK GILES

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-511-HS-WT	**Soil**							
Batch R4309149								
WG2917688-5 MS		**L2188176-1**						
MTBE			126.1		%		50-140	31-OCT-18
m+p-Xylenes			128.3		%		50-140	31-OCT-18
Methyl Ethyl Ketone			107.0		%		50-140	31-OCT-18
Methyl Isobutyl Ketone			107.9		%		50-140	31-OCT-18
o-Xylene			124.6		%		50-140	31-OCT-18
Styrene			126.0		%		50-140	31-OCT-18
Tetrachloroethylene			123.4		%		50-140	31-OCT-18
Toluene			116.6		%		50-140	31-OCT-18
trans-1,2-Dichloroethylene			120.5		%		50-140	31-OCT-18
trans-1,3-Dichloropropene			121.1		%		50-140	31-OCT-18
Trichloroethylene			125.2		%		50-140	31-OCT-18
Trichlorofluoromethane			123.7		%		50-140	31-OCT-18
Vinyl chloride			115.7		%		50-140	31-OCT-18

Quality Control Report

Workorder: L2188452 Report Date: 02-NOV-18

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: ERIK GILES

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

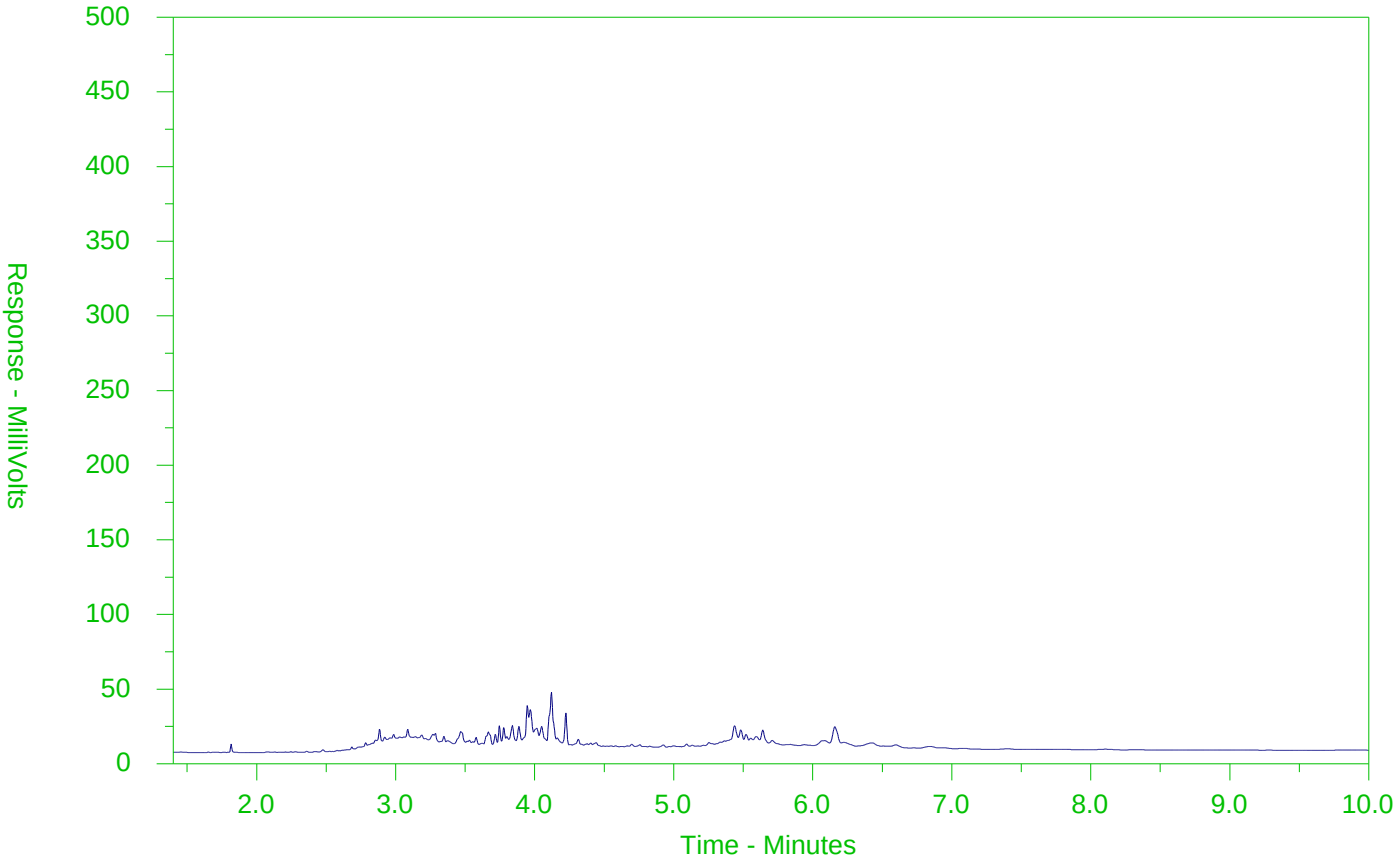
ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2188452-1
Client Sample ID: BH18-101 SS2



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →		← Motor Oils/Lube Oils/Grease →	
← Diesel/Jet Fuels →			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

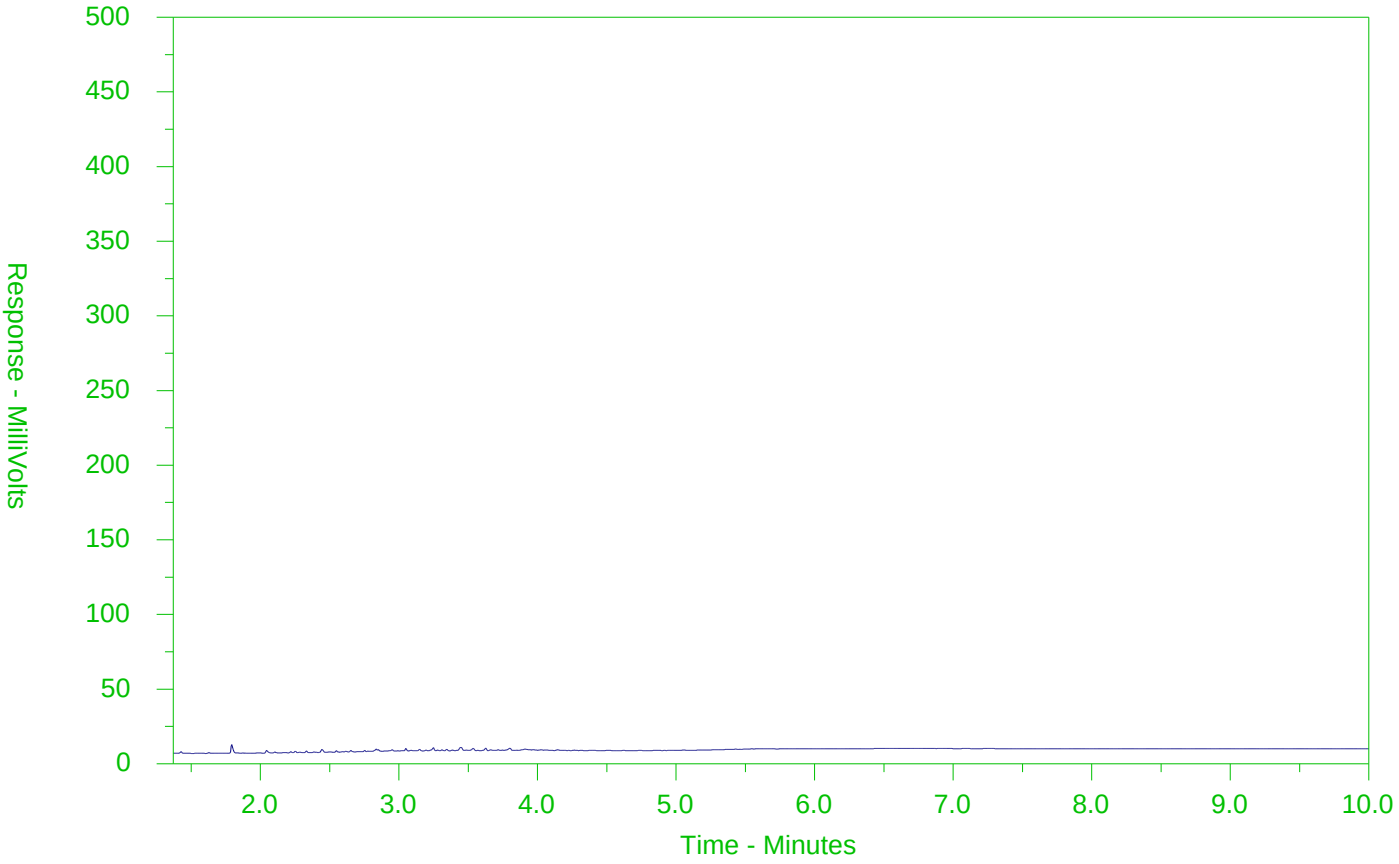
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2188452-2
Client Sample ID: BH18-101 SS7



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →	← Motor Oils/Lube Oils/Grease →		
← Diesel/Jet Fuels →			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2188452-COFC

COC Number 17 - 728122

Page 1 of 1

Report To	Contact and company name below will appear on the final report	Report Format / Distribution		Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)	
Company:	TULLOCH ENGINEERING	Select Report Format:	PDF [X] EXCEL [ ] EDD (DIGITAL) [ ]	Regular [R] [X]	Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	ERIK GILES	Quality Control (QC) Report with Report	YES [X] NO [ ]	PRIORITY (Business Days) 4 day [P4-20%] [ ]	EMERGENCY 1 Business day [E-100%] [ ]
Phone:	647-468-4844	Compare Results to Criteria on Report - provide details below if box checked	[ ]	3 day [P3-25%] [ ]	Same Day, Weekend or Statutory holiday [E2-200% (Laboratory opening fees may apply)] [ ]
	Company address below will appear on the final report	Select Distribution:	EMAIL [X] MAIL [ ] FAX [ ]	2 day [P2-50%] [ ]	
Street:	1100 ~~STREET~~ SOUTH SERVICE RD. SUITE 2	Email 1 or Fax	erik.giles@tulloch.ca	Date and Time Required for all E&P TATs:	dd-mmm-yy hh:mm
City/Province:	STONEY CREEK / ON	Email 2	greg.gu@tulloch.ca	For tests that can not be performed according to the service level selected, you will be contacted.	
Postal Code:	L8E 0C5	Email 3			
Invoice To	Same as Report To ~~YES~~ [X] NO [ ]	Invoice Distribution		Analysis Request	
	Copy of Invoice with Report [X] YES [ ] NO	Select Invoice Distribution:	EMAIL [X] MAIL [ ] FAX [ ]	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below	
Company:	TULLOCH ENGINEERING	Email 1 or Fax	Nancy.Seabrook@tulloch.ca		
Contact:	NANCY SEABROOK	Email 2			

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:	23923	AFE/Cost Center:	PO#
Job #:	16-4046	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):	L2188452	ALS Contact: M. TRAN	Sampler: E. GILES

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm yy)	Time (hh:mm)	Sample Type	TCLP: VOC/STARCH/FE	F2 - F5	TCLP: METALS/Hg/CrVI	REGN 153 VOC/F1-F4/BTEX	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
	BH 18-101 SS2	23/10/18	12:00	~~SOIL~~ JAR	X						2
	BH 18-101 SS2	23/10/18	12:00	JAR		X					1
	BH 18-101 SS2	23/10/18	12:30	JAR			X				1
	BH 18-101 SS7	23/10/18	14:00	JAR	X						2
	BH 18-101 SS7	23/10/18	14:00	JAR		X					1
	BH 18-101 SS7	23/10/18	14:00	JAR			X				1
	BH 18-101 SS7	23/10/18	14:20	JAR				X			1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? YES [ ] NO [X]	
Are samples for human consumption/ use? YES [ ] NO [X]	

SAMPLE CONDITION AS RECEIVED (lab use only)					
Frozen	[ ]	SIF Observations	Yes [ ]	No	[ ]
Ice Packs	[X]	Ice Cubes [ ]	Custody seal intact	Yes [ ]	No [ ]
Cooling Initiated	[ ]				

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
			6.3		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: E. GILES	Date: OCT 26/2018	Time: 15:45	Received by:	Date:	Time:	Received by:	Date: Oct 29/18	Time: 10:45

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

TULLOCH ENGINEERING INC
ATTN: ERIK GILES
80 Main Street West
Huntsville ON P1H 1W9

Date Received: 29-OCT-18
Report Date: 05-NOV-18 12:53 (MT)
Version: FINAL

Client Phone: 705-789-7851

Certificate of Analysis

Lab Work Order #: L2188538

Project P.O. #: NOT SUBMITTED
Job Reference: 18-4046
C of C Numbers:
Legal Site Desc:

Emily Hansen
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2188538-1 BH18-101 SS2 Sampled By: CLIENT on 23-OCT-18 @ 12:00 Matrix: SOIL							
Sample Preparation							
Initial pH	7.30		0.10	pH units		31-OCT-18	R4308571
Final pH	4.98		0.10	pH units		31-OCT-18	R4308571
TCLP Extractables							
Acenaphthene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Acenaphthylene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Anthracene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Benzo(a)anthracene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Benzo(a)pyrene	<0.0010		0.0010	mg/L	01-NOV-18	02-NOV-18	R4313967
Benzo(b)fluoranthene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Benzo(g,h,i)perylene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Cyanide, Weak Acid Diss	<0.10		0.10	mg/L		01-NOV-18	R4313749
Fluoride (F)	<10		10	mg/L		31-OCT-18	R4309528
Nitrate and Nitrite as N	<4.0		4.0	mg/L		31-OCT-18	R4309528
Nitrate-N	<2.0		2.0	mg/L		31-OCT-18	R4309528
Nitrite-N	<2.0		2.0	mg/L		31-OCT-18	R4309528
TCLP Metals							
Arsenic (As)	<0.050		0.050	mg/L		31-OCT-18	R4308989
Barium (Ba)	<0.50		0.50	mg/L		31-OCT-18	R4308989
Boron (B)	<2.5		2.5	mg/L		31-OCT-18	R4308989
Cadmium (Cd)	<0.0050		0.0050	mg/L		31-OCT-18	R4308989
Chromium (Cr)	<0.050		0.050	mg/L		31-OCT-18	R4308989
Lead (Pb)	<0.050		0.050	mg/L		31-OCT-18	R4308989
Mercury (Hg)	<0.00010		0.00010	mg/L		31-OCT-18	R4308467
Selenium (Se)	<0.025		0.025	mg/L		31-OCT-18	R4308989
Silver (Ag)	<0.0050		0.0050	mg/L		31-OCT-18	R4308989
Uranium (U)	<0.25		0.25	mg/L		31-OCT-18	R4308989
TCLP VOCs							
1,1-Dichloroethylene	<0.025	VOCHS	0.025	mg/L		01-NOV-18	R4310528
1,2-Dichlorobenzene	<0.025	VOCHS	0.025	mg/L		01-NOV-18	R4310528
1,2-Dichloroethane	<0.025	VOCHS	0.025	mg/L		01-NOV-18	R4310528
1,4-Dichlorobenzene	<0.025	VOCHS	0.025	mg/L		01-NOV-18	R4310528
Benzene	<0.025	VOCHS	0.025	mg/L		01-NOV-18	R4310528
Carbon tetrachloride	<0.025	VOCHS	0.025	mg/L		01-NOV-18	R4310528
Chlorobenzene	<0.025	VOCHS	0.025	mg/L		01-NOV-18	R4310528
Chloroform	<0.10	VOCHS	0.10	mg/L		01-NOV-18	R4310528
Dichloromethane	<0.50	VOCHS	0.50	mg/L		01-NOV-18	R4310528
Methyl Ethyl Ketone	<1.0	VOCHS	1.0	mg/L		01-NOV-18	R4310528
Tetrachloroethylene	<0.025	VOCHS	0.025	mg/L		01-NOV-18	R4310528
Trichloroethylene	<0.025	VOCHS	0.025	mg/L		01-NOV-18	R4310528
Vinyl chloride	<0.050	VOCHS	0.050	mg/L		01-NOV-18	R4310528
Surrogate: 4-Bromofluorobenzene	86.4		70-130	%		01-NOV-18	R4310528
Volatile Organic Compounds							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2188538-1 BH18-101 SS2 Sampled By: CLIENT on 23-OCT-18 @ 12:00 Matrix: SOIL							
Volatile Organic Compounds							
Surrogate: 1,4-Difluorobenzene	95.7		70-130	%		01-NOV-18	R4310528
Polycyclic Aromatic Hydrocarbons							
Benzo(k)fluoranthene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Chrysene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Dibenzo(ah)anthracene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Fluoranthene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Fluorene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Indeno(1,2,3-cd)pyrene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Naphthalene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Phenanthrene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Pyrene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Quinoline	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Surrogate: d10-Acenaphthene	94.3		50-150	%	01-NOV-18	02-NOV-18	R4313967
Surrogate: d12-Chrysene	97.9		50-150	%	01-NOV-18	02-NOV-18	R4313967
Surrogate: d8-Naphthalene	99.4		50-150	%	01-NOV-18	02-NOV-18	R4313967
Surrogate: d10-Phenanthrene	96.8		50-150	%	01-NOV-18	02-NOV-18	R4313967
L2188538-2 BH18-101 SS7 Sampled By: CLIENT on 23-OCT-18 @ 14:00 Matrix: SOIL							
Sample Preparation							
Initial pH	9.47		0.10	pH units		31-OCT-18	R4308571
Final pH	5.09		0.10	pH units		31-OCT-18	R4308571
TCLP Extractables							
Acenaphthene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Acenaphthylene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Anthracene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Benzo(a)anthracene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Benzo(a)pyrene	<0.0010		0.0010	mg/L	01-NOV-18	02-NOV-18	R4313967
Benzo(b)fluoranthene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Benzo(g,h,i)perylene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Cyanide, Weak Acid Diss	<0.10		0.10	mg/L		01-NOV-18	R4313749
Fluoride (F)	<10		10	mg/L		31-OCT-18	R4309528
Nitrate and Nitrite as N	<4.0		4.0	mg/L		31-OCT-18	R4309528
Nitrate-N	<2.0		2.0	mg/L		31-OCT-18	R4309528
Nitrite-N	<2.0		2.0	mg/L		31-OCT-18	R4309528
TCLP Metals							
Arsenic (As)	<0.050		0.050	mg/L		31-OCT-18	R4308989
Barium (Ba)	2.69		0.50	mg/L		31-OCT-18	R4308989
Boron (B)	<2.5		2.5	mg/L		31-OCT-18	R4308989
Cadmium (Cd)	<0.0050		0.0050	mg/L		31-OCT-18	R4308989
Chromium (Cr)	<0.050		0.050	mg/L		31-OCT-18	R4308989
Lead (Pb)	<0.050		0.050	mg/L		31-OCT-18	R4308989

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2188538-2 BH18-101 SS7 Sampled By: CLIENT on 23-OCT-18 @ 14:00 Matrix: SOIL							
TCLP Metals							
Mercury (Hg)	<0.00010		0.00010	mg/L		31-OCT-18	R4308467
Selenium (Se)	<0.025		0.025	mg/L		31-OCT-18	R4308989
Silver (Ag)	<0.0050		0.0050	mg/L		31-OCT-18	R4308989
Uranium (U)	<0.25		0.25	mg/L		31-OCT-18	R4308989
TCLP VOCs							
1,1-Dichloroethylene	<0.025	VOCHS	0.025	mg/L		01-NOV-18	R4310528
1,2-Dichlorobenzene	<0.025	VOCHS	0.025	mg/L		01-NOV-18	R4310528
1,2-Dichloroethane	<0.025	VOCHS	0.025	mg/L		01-NOV-18	R4310528
1,4-Dichlorobenzene	<0.025	VOCHS	0.025	mg/L		01-NOV-18	R4310528
Benzene	<0.025	VOCHS	0.025	mg/L		01-NOV-18	R4310528
Carbon tetrachloride	<0.025	VOCHS	0.025	mg/L		01-NOV-18	R4310528
Chlorobenzene	<0.025	VOCHS	0.025	mg/L		01-NOV-18	R4310528
Chloroform	<0.10	VOCHS	0.10	mg/L		01-NOV-18	R4310528
Dichloromethane	<0.50	VOCHS	0.50	mg/L		01-NOV-18	R4310528
Methyl Ethyl Ketone	<1.0	VOCHS	1.0	mg/L		01-NOV-18	R4310528
Tetrachloroethylene	<0.025	VOCHS	0.025	mg/L		01-NOV-18	R4310528
Trichloroethylene	<0.025	VOCHS	0.025	mg/L		01-NOV-18	R4310528
Vinyl chloride	<0.050	VOCHS	0.050	mg/L		01-NOV-18	R4310528
Surrogate: 4-Bromofluorobenzene	87.6		70-130	%		01-NOV-18	R4310528
Volatile Organic Compounds							
Surrogate: 1,4-Difluorobenzene	95.7		70-130	%		01-NOV-18	R4310528
Polycyclic Aromatic Hydrocarbons							
Benzo(k)fluoranthene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Chrysene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Dibenzo(ah)anthracene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Fluoranthene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Fluorene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Indeno(1,2,3-cd)pyrene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Naphthalene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Phenanthrene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Pyrene	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Quinoline	<0.0050		0.0050	mg/L	01-NOV-18	02-NOV-18	R4313967
Surrogate: d10-Acenaphthene	98.7		50-150	%	01-NOV-18	02-NOV-18	R4313967
Surrogate: d12-Chrysene	102.9		50-150	%	01-NOV-18	02-NOV-18	R4313967
Surrogate: d8-Naphthalene	103.2		50-150	%	01-NOV-18	02-NOV-18	R4313967
Surrogate: d10-Phenanthrene	102.2		50-150	%	01-NOV-18	02-NOV-18	R4313967

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Sample Parameter Qualifier key listed:

Qualifier	Description
VOCHS	VOC analysis was conducted for a water sample that contained > 5% headspace. Results may be biased low.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CN-TCLP-WT	Waste	Cyanide for O. Reg 347	APHA 4500CN I
F-TCLP-WT	Waste	Fluoride (F) for O. Reg 347	APHA 4110 B-Ion Chromatography
HG-TCLP-WT	Waste	Mercury (CVAA) for O.Reg 347	SW846 7470A
LEACH-TCLP-WT	Waste	Leachate Procedure for Reg 347	EPA 1311
		Inorganic and Semi-Volatile Organic contaminants are leached from waste samples in strict accordance with US EPA Method 1311, "Toxicity Characteristic Leaching Procedure" (TCLP). Test results are reported in leachate concentration units (normally mg/L).	
MET-TCLP-WT	Waste	O.Reg 347 TCLP Leachable Metals	EPA 200.8
N2N3-TCLP-WT	Waste	Nitrate/Nitrite-N for O. Reg 347	APHA 4110 B-Ion Chromatography
PAH-TCLP-WT	Waste	PAH for O. Reg 347	SW846 8270 (PAH)
		Samples are leached according to TCLP protocol and then the aqueous leachate is extracted and the resulting extracts are analyzed on GC/MSD. Depending on the analytical GC/MS column used benzo(j)fluoranthene may chromatographically co-elute with benzo(b)fluoranthene or benzo(k)fluoranthene.	
VOC-TCLP-WT	Waste	VOC for O. Reg 347	SW846 8260
		A sample of waste is leached in a zero headspace extractor at 30–2 rpm for 18–2.0 hours with the appropriate leaching solution. After tumbling the leachate is analyzed directly by headspace technology, followed by GC/MS using internal standard quantitation.	

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L2188538 Report Date: 05-NOV-18

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9

Contact: ERIK GILES

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CN-TCLP-WT	**Waste**							
Batch R4313749								
WG2919366-3 DUP		**L2188521-1**						
Cyanide, Weak Acid Diss		<0.10	<0.10	RPD-NA	mg/L	N/A	50	01-NOV-18
WG2919366-2 LCS								
Cyanide, Weak Acid Diss			104.2		%		70-130	01-NOV-18
WG2919366-1 MB								
Cyanide, Weak Acid Diss			<0.10		mg/L		0.1	01-NOV-18
WG2919366-4 MS		**L2188521-1**						
Cyanide, Weak Acid Diss			100.3		%		50-140	01-NOV-18
F-TCLP-WT	**Waste**							
Batch R4309528								
WG2919535-3 DUP		**L2188521-1**						
Fluoride (F)		<10	<10	RPD-NA	mg/L	N/A	30	31-OCT-18
WG2919535-2 LCS								
Fluoride (F)			99.6		%		70-130	31-OCT-18
WG2919535-1 MB								
Fluoride (F)			<10		mg/L		10	31-OCT-18
WG2919535-4 MS		**L2188521-1**						
Fluoride (F)			95.8		%		50-150	31-OCT-18
HG-TCLP-WT	**Waste**							
Batch R4308467								
WG2918910-3 DUP		**L2188521-1**						
Mercury (Hg)		<0.00010	<0.00010	RPD-NA	mg/L	N/A	50	31-OCT-18
WG2918910-2 LCS								
Mercury (Hg)			102.0		%		70-130	31-OCT-18
WG2918910-1 MB								
Mercury (Hg)			<0.00010		mg/L		0.0001	31-OCT-18
WG2918910-4 MS		**L2188521-1**						
Mercury (Hg)			98.0		%		50-140	31-OCT-18
MET-TCLP-WT	**Waste**							
Batch R4308989								
WG2918938-4 DUP		**WG2918938-3**						
Silver (Ag)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	40	31-OCT-18
Arsenic (As)		<0.050	<0.050	RPD-NA	mg/L	N/A	40	31-OCT-18
Boron (B)		<2.5	<2.5	RPD-NA	mg/L	N/A	40	31-OCT-18
Barium (Ba)		<0.50	<0.50	RPD-NA	mg/L	N/A	40	31-OCT-18
Cadmium (Cd)		0.0144	0.0142		mg/L	1.3	40	31-OCT-18
Chromium (Cr)		<0.050	<0.050	RPD-NA	mg/L	N/A	40	31-OCT-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: ERIK GILES

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TCLP-WT	**Waste**							
Batch R4308989								
WG2918938-4 DUP		**WG2918938-3**						
Lead (Pb)		0.070	0.073		mg/L	4.0	40	31-OCT-18
Selenium (Se)		<0.025	<0.025	RPD-NA	mg/L	N/A	40	31-OCT-18
Uranium (U)		<0.25	<0.25	RPD-NA	mg/L	N/A	40	31-OCT-18
WG2918938-2 LCS								
Silver (Ag)			110.4		%		70-130	31-OCT-18
Arsenic (As)			107.7		%		70-130	31-OCT-18
Boron (B)			103.8		%		70-130	31-OCT-18
Barium (Ba)			117.5		%		70-130	31-OCT-18
Cadmium (Cd)			107.9		%		70-130	31-OCT-18
Chromium (Cr)			106.9		%		70-130	31-OCT-18
Lead (Pb)			109.9		%		70-130	31-OCT-18
Selenium (Se)			104.0		%		70-130	31-OCT-18
Uranium (U)			105.4		%		70-130	31-OCT-18
WG2918938-1 MB								
Silver (Ag)			<0.0050		mg/L		0.005	31-OCT-18
Arsenic (As)			<0.050		mg/L		0.05	31-OCT-18
Boron (B)			<2.5		mg/L		2.5	31-OCT-18
Barium (Ba)			<0.50		mg/L		0.5	31-OCT-18
Cadmium (Cd)			<0.0050		mg/L		0.005	31-OCT-18
Chromium (Cr)			<0.050		mg/L		0.05	31-OCT-18
Lead (Pb)			<0.050		mg/L		0.05	31-OCT-18
Selenium (Se)			<0.025		mg/L		0.025	31-OCT-18
Uranium (U)			<0.25		mg/L		0.25	31-OCT-18
WG2918938-5 MS		**WG2918938-3**						
Silver (Ag)			122.1		%		50-150	31-OCT-18
Arsenic (As)			103.1		%		50-150	31-OCT-18
Boron (B)			92.5		%		50-150	31-OCT-18
Barium (Ba)			113.6		%		50-150	31-OCT-18
Cadmium (Cd)			99.0		%		50-150	31-OCT-18
Chromium (Cr)			99.0		%		50-150	31-OCT-18
Lead (Pb)			95.2		%		50-150	31-OCT-18
Selenium (Se)			100.1		%		50-150	31-OCT-18
Uranium (U)			95.2		%		50-150	31-OCT-18
N2N3-TCLP-WT	**Waste**							

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: ERIK GILES

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
N2N3-TCLP-WT	**Waste**							
Batch R4309528								
WG2919535-3 DUP		**L2188521-1**						
Nitrate-N		<2.0	<2.0	RPD-NA	mg/L	N/A	30	31-OCT-18
Nitrite-N		<2.0	<2.0	RPD-NA	mg/L	N/A	30	31-OCT-18
WG2919535-2 LCS								
Nitrate-N			100.9		%		70-130	31-OCT-18
Nitrite-N			98.3		%		70-130	31-OCT-18
WG2919535-1 MB								
Nitrate-N			<2.0		mg/L		2	31-OCT-18
Nitrite-N			<2.0		mg/L		2	31-OCT-18
WG2919535-4 MS		**L2188521-1**						
Nitrate-N			94.8		%		50-150	31-OCT-18
Nitrite-N			93.6		%		50-150	31-OCT-18
PAH-TCLP-WT	**Waste**							
Batch R4313967								
WG2919949-5 DUP		**WG2919949-6**						
Acenaphthene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	02-NOV-18
Acenaphthylene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	02-NOV-18
Anthracene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	02-NOV-18
Benzo(a)anthracene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	02-NOV-18
Benzo(a)pyrene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	50	02-NOV-18
Benzo(b)fluoranthene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	02-NOV-18
Benzo(g,h,i)perylene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	02-NOV-18
Benzo(k)fluoranthene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	02-NOV-18
Chrysene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	02-NOV-18
Dibenzo(ah)anthracene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	02-NOV-18
Fluoranthene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	02-NOV-18
Fluorene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	02-NOV-18
Indeno(1,2,3-cd)pyrene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	02-NOV-18
Naphthalene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	02-NOV-18
Phenanthrene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	02-NOV-18
Pyrene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	02-NOV-18
Quinoline		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	02-NOV-18
WG2919949-2 LCS								
Acenaphthene			93.4		%		50-130	02-NOV-18
Acenaphthylene			95.4		%		50-130	02-NOV-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: ERIK GILES

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TCLP-WT	**Waste**							
Batch R4313967								
WG2919949-2 LCS								
Anthracene			99.0		%		50-130	02-NOV-18
Benzo(a)anthracene			104.2		%		50-140	02-NOV-18
Benzo(a)pyrene			89.4		%		60-140	02-NOV-18
Benzo(b)fluoranthene			85.7		%		50-140	02-NOV-18
Benzo(g,h,i)perylene			95.9		%		50-140	02-NOV-18
Benzo(k)fluoranthene			90.1		%		50-150	02-NOV-18
Chrysene			104.7		%		50-140	02-NOV-18
Dibenzo(ah)anthracene			100.1		%		50-140	02-NOV-18
Fluoranthene			99.0		%		50-150	02-NOV-18
Fluorene			98.2		%		50-150	02-NOV-18
Indeno(1,2,3-cd)pyrene			109.8		%		50-140	02-NOV-18
Naphthalene			95.8		%		50-130	02-NOV-18
Phenanthrene			98.6		%		50-130	02-NOV-18
Pyrene			98.1		%		50-140	02-NOV-18
Quinoline			112.1		%		50-150	02-NOV-18
WG2919949-1 MB								
Acenaphthene			<0.0050		mg/L		0.005	02-NOV-18
Acenaphthylene			<0.0050		mg/L		0.005	02-NOV-18
Anthracene			<0.0050		mg/L		0.005	02-NOV-18
Benzo(a)anthracene			<0.0050		mg/L		0.005	02-NOV-18
Benzo(a)pyrene			<0.0010		mg/L		0.001	02-NOV-18
Benzo(b)fluoranthene			<0.0050		mg/L		0.005	02-NOV-18
Benzo(g,h,i)perylene			<0.0050		mg/L		0.005	02-NOV-18
Benzo(k)fluoranthene			<0.0050		mg/L		0.005	02-NOV-18
Chrysene			<0.0050		mg/L		0.005	02-NOV-18
Dibenzo(ah)anthracene			<0.0050		mg/L		0.005	02-NOV-18
Fluoranthene			<0.0050		mg/L		0.005	02-NOV-18
Fluorene			<0.0050		mg/L		0.005	02-NOV-18
Indeno(1,2,3-cd)pyrene			<0.0050		mg/L		0.005	02-NOV-18
Naphthalene			<0.0050		mg/L		0.005	02-NOV-18
Phenanthrene			<0.0050		mg/L		0.005	02-NOV-18
Pyrene			<0.0050		mg/L		0.005	02-NOV-18
Quinoline			<0.0050		mg/L		0.005	02-NOV-18
Surrogate: d8-Naphthalene			102.8		%		50-150	02-NOV-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: ERIK GILES

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TCLP-WT	**Waste**							
Batch R4313967								
WG2919949-1 MB								
Surrogate: d10-Phenanthrene			101.4		%		50-150	02-NOV-18
Surrogate: d12-Chrysene			102.4		%		50-150	02-NOV-18
Surrogate: d10-Acenaphthene			98.2		%		50-150	02-NOV-18
WG2919949-3 MB								
Acenaphthene			<0.0050		mg/L		0.005	02-NOV-18
Acenaphthylene			<0.0050		mg/L		0.005	02-NOV-18
Anthracene			<0.0050		mg/L		0.005	02-NOV-18
Benzo(a)anthracene			<0.0050		mg/L		0.005	02-NOV-18
Benzo(a)pyrene			<0.0010		mg/L		0.001	02-NOV-18
Benzo(b)fluoranthene			<0.0050		mg/L		0.005	02-NOV-18
Benzo(g,h,i)perylene			<0.0050		mg/L		0.005	02-NOV-18
Benzo(k)fluoranthene			<0.0050		mg/L		0.005	02-NOV-18
Chrysene			<0.0050		mg/L		0.005	02-NOV-18
Dibenzo(ah)anthracene			<0.0050		mg/L		0.005	02-NOV-18
Fluoranthene			<0.0050		mg/L		0.005	02-NOV-18
Fluorene			<0.0050		mg/L		0.005	02-NOV-18
Indeno(1,2,3-cd)pyrene			<0.0050		mg/L		0.005	02-NOV-18
Naphthalene			<0.0050		mg/L		0.005	02-NOV-18
Phenanthrene			<0.0050		mg/L		0.005	02-NOV-18
Pyrene			<0.0050		mg/L		0.005	02-NOV-18
Quinoline			<0.0050		mg/L		0.005	02-NOV-18
Surrogate: d8-Naphthalene			108.4		%		50-150	02-NOV-18
Surrogate: d10-Phenanthrene			104.8		%		50-150	02-NOV-18
Surrogate: d12-Chrysene			106.3		%		50-150	02-NOV-18
Surrogate: d10-Acenaphthene			101.8		%		50-150	02-NOV-18
WG2919949-4 MS		**WG2919949-6**						
Acenaphthene			96.4		%		50-150	02-NOV-18
Acenaphthylene			96.9		%		50-150	02-NOV-18
Anthracene			95.4		%		50-150	02-NOV-18
Benzo(a)anthracene			104.8		%		50-150	02-NOV-18
Benzo(a)pyrene			90.2		%		50-150	02-NOV-18
Benzo(b)fluoranthene			87.0		%		50-150	02-NOV-18
Benzo(g,h,i)perylene			94.9		%		50-150	02-NOV-18
Benzo(k)fluoranthene			93.8		%		50-150	02-NOV-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: ERIK GILES

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TCLP-WT	**Waste**							
Batch R4313967								
WG2919949-4 MS		**WG2919949-6**						
Chrysene			106.6		%		50-150	02-NOV-18
Dibenzo(ah)anthracene			99.4		%		50-150	02-NOV-18
Fluoranthene			99.4		%		50-150	02-NOV-18
Fluorene			99.6		%		50-150	02-NOV-18
Indeno(1,2,3-cd)pyrene			107.7		%		50-150	02-NOV-18
Naphthalene			103.2		%		50-150	02-NOV-18
Phenanthrene			99.7		%		50-150	02-NOV-18
Pyrene			98.6		%		50-150	02-NOV-18
Quinoline			107.9		%		50-150	02-NOV-18
VOC-TCLP-WT	**Waste**							
Batch R4310528								
WG2910609-1 LCS								
1,1-Dichloroethylene			115.0		%		70-130	01-NOV-18
1,2-Dichlorobenzene			111.0		%		70-130	01-NOV-18
1,2-Dichloroethane			107.8		%		70-130	01-NOV-18
1,4-Dichlorobenzene			113.9		%		70-130	01-NOV-18
Benzene			115.9		%		70-130	01-NOV-18
Carbon tetrachloride			113.6		%		60-140	01-NOV-18
Chlorobenzene			108.5		%		70-130	01-NOV-18
Chloroform			114.3		%		70-130	01-NOV-18
Dichloromethane			111.6		%		70-130	01-NOV-18
Methyl Ethyl Ketone			90.0		%		50-150	01-NOV-18
Tetrachloroethylene			112.2		%		70-130	01-NOV-18
Trichloroethylene			116.4		%		70-130	01-NOV-18
Vinyl chloride			113.9		%		60-130	01-NOV-18
WG2910609-2 MB								
1,1-Dichloroethylene			<0.025		mg/L		0.025	01-NOV-18
1,2-Dichlorobenzene			<0.025		mg/L		0.025	01-NOV-18
1,2-Dichloroethane			<0.025		mg/L		0.025	01-NOV-18
1,4-Dichlorobenzene			<0.025		mg/L		0.025	01-NOV-18
Benzene			<0.025		mg/L		0.025	01-NOV-18
Carbon tetrachloride			<0.025		mg/L		0.025	01-NOV-18
Chlorobenzene			<0.025		mg/L		0.025	01-NOV-18
Chloroform			<0.10		mg/L		0.1	01-NOV-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: ERIK GILES

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-TCLP-WT	**Waste**							
Batch R4310528								
WG2910609-2 MB								
Dichloromethane			<0.50		mg/L		0.5	01-NOV-18
Methyl Ethyl Ketone			<1.0		mg/L		1	01-NOV-18
Tetrachloroethylene			<0.025		mg/L		0.025	01-NOV-18
Trichloroethylene			<0.025		mg/L		0.025	01-NOV-18
Vinyl chloride			<0.050		mg/L		0.05	01-NOV-18
Surrogate: 1,4-Difluorobenzene			95.8		%		70-130	01-NOV-18
Surrogate: 4-Bromofluorobenzene			88.1		%		70-130	01-NOV-18
WG2910609-3 MS		**L2188693-1**						
1,1-Dichloroethylene			115.5		%		50-140	01-NOV-18
1,2-Dichlorobenzene			109.8		%		50-140	01-NOV-18
1,2-Dichloroethane			109.4		%		50-140	01-NOV-18
1,4-Dichlorobenzene			109.8		%		50-140	01-NOV-18
Benzene			117.2		%		50-140	01-NOV-18
Carbon tetrachloride			115.5		%		50-140	01-NOV-18
Chlorobenzene			108.4		%		50-140	01-NOV-18
Chloroform			116.8		%		50-140	01-NOV-18
Dichloromethane			112.5		%		50-140	01-NOV-18
Methyl Ethyl Ketone			90.7		%		50-140	01-NOV-18
Tetrachloroethylene			109.2		%		50-140	01-NOV-18
Trichloroethylene			114.3		%		50-140	01-NOV-18
Vinyl chloride			112.6		%		50-140	01-NOV-18

Quality Control Report

Workorder: L2188538 Report Date: 05-NOV-18

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: ERIK GILES

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2188538-COFC

COC Number: 17 - 728122

Page 1 of 1

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	
Company:	TULLOCH ENGINEERING	Select Report Format:	PDF X EXCEL EDD (DIGITAL)
Contact:	ERIK GILES	Quality Control (QC) Report with Report	YES NO
Phone:	647-968-4844	Compare Results to Criteria on Report - provide details below if box checked	
	Company address below will appear on the final report	Select Distribution:	EMAIL MAIL FAX
Street:	1100 ~~STEELES~~ SOUTH SERVICE RD. SUITE 2	Email 1 or Fax	erik.giles@tulloch.ca
City/Province:	STONEY CREEK/ON	Email 2	greg.gu@tulloch.ca
Postal Code:	L8E 0C5	Email 3	
Invoice To	Same as Report To ~~YES~~ NO	Invoice Distribution	
	Copy of Invoice with Report YES NO	Select Invoice Distribution:	EMAIL MAIL FAX
Company:	TULLOCH ENGINEERING	Email 1 or Fax	Darcy.Seabrook@tulloch.ca
Contact:	DARCY SEABROOK	Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:	Z3923	AFE/Cost Center:	PO#:
Job #:	16-4046	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):	L2188538	ALS Contact: M. TRAN	Sampler: E. GILES

- Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] X Standard TAT if received by 3 pm - business days - no surcharges apply

Priority (Business Days): 4 day [P4-20%] ☐ | 3 day [P3-25%] ☐ | 2 day [P2-50%] ☐

Emergency: 1 Business day [E-100%] ☐ | Same Day, Weekend or Statutory holiday [E2-200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	TCLP: VOA/STARS/F1	F2-F5	TCLP: METALS/Hg/CrVI	Metals/Resistivity/SO4/Cl/F	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
	BH 18-101 SS2	23/10/18	12:00	~~VOC/STARS/F1~~	X						2
	BH 18-101 SS2	23/10/18	12:00	JAR		X					1
	BH 18-101 SS2	23/10/18	12:30	JAR			X				1
	BH 18-101 SS7	23/10/18	14:00	JAR	X						2
	BH 18-101 SS7	23/10/18	14:00	JAR		X					1
	BH 18-101 SS7	23/10/18	14:00	JAR			X				1
	BH 18-101 SS7	23/10/18	14:20	JAR				X			1

Drinking Water (DW) Samples' (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☒ NO	
Are samples for human consumption/ use? ☐ YES ☒ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations: Yes ☐ No ☐

Ice Packs ☑ | Ice Cubes ☐ | Custody seal intact: Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				6.3			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: E. GILES	Date: OCT 26/2018	Time: 15:45	Received by:	Date:	Time:	Received by:	Date: 10/29/18	Time: 10:45

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

JULY 2017 FRONT

TULLOCH ENGINEERING INC
ATTN: Erik Giles
80 Main Street West
Huntsville ON P1H 1W9

Date Received: 05-NOV-18
Report Date: 12-NOV-18 15:16 (MT)
Version: FINAL

Client Phone: 705-789-7851

Certificate of Analysis

Lab Work Order #: L2191800

Project P.O. #: NOT SUBMITTED
Job Reference: 18-4046
C of C Numbers: 17-728512
Legal Site Desc:

Emily Hansen
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2191800-1 18-102-SS1 Sampled By: E.GILES on 29-OCT-18 @ 09:10 Matrix: SOIL							
Physical Tests							
Conductivity	0.228		0.0040	mS/cm		08-NOV-18	R4325930
% Moisture	88.9		0.10	%	05-NOV-18	06-NOV-18	R4320768
pH	6.53		0.10	pH units		06-NOV-18	R4322307
Redox Potential	270		-1000	mV		05-NOV-18	R4320328
Resistivity	4390		1.0	ohm*cm		08-NOV-18	
Leachable Anions & Nutrients							
Chloride	174		5.0	ug/g	08-NOV-18	08-NOV-18	R4328243
Anions and Nutrients							
Sulphate	263		20	mg/kg	05-NOV-18	07-NOV-18	R4326048
Inorganic Parameters							
Acid Volatile Sulphides	<1.0	DLHM	1.0	mg/kg	08-NOV-18	08-NOV-18	R4328126
L2191800-2 18-102-SS3 Sampled By: E.GILES on 29-OCT-18 @ 10:10 Matrix: SOIL							
Physical Tests							
% Moisture	25.5		0.10	%	05-NOV-18	06-NOV-18	R4320768
Volatile Organic Compounds							
Acetone	<0.50		0.50	ug/g	05-NOV-18	06-NOV-18	R4320953
Benzene	<0.0068		0.0068	ug/g	05-NOV-18	06-NOV-18	R4320953
Bromodichloromethane	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
Bromoform	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
Bromomethane	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
Carbon tetrachloride	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
Chlorobenzene	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
Dibromochloromethane	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
Chloroform	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
1,2-Dibromoethane	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
1,2-Dichlorobenzene	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
1,3-Dichlorobenzene	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
1,4-Dichlorobenzene	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
Dichlorodifluoromethane	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
1,1-Dichloroethane	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
1,2-Dichloroethane	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
1,1-Dichloroethylene	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
cis-1,2-Dichloroethylene	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
trans-1,2-Dichloroethylene	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
Methylene Chloride	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
1,2-Dichloropropane	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
cis-1,3-Dichloropropene	<0.030		0.030	ug/g	05-NOV-18	06-NOV-18	R4320953
trans-1,3-Dichloropropene	<0.030		0.030	ug/g	05-NOV-18	06-NOV-18	R4320953
1,3-Dichloropropene (cis & trans)	<0.042		0.042	ug/g		06-NOV-18	
Ethylbenzene	<0.018		0.018	ug/g	05-NOV-18	06-NOV-18	R4320953

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2191800-2 18-102-SS3 Sampled By: E.GILES on 29-OCT-18 @ 10:10 Matrix: SOIL							
Volatile Organic Compounds							
n-Hexane	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
Methyl Ethyl Ketone	<0.50		0.50	ug/g	05-NOV-18	06-NOV-18	R4320953
Methyl Isobutyl Ketone	<0.50		0.50	ug/g	05-NOV-18	06-NOV-18	R4320953
MTBE	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
Styrene	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
1,1,1,2-Tetrachloroethane	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
1,1,2,2-Tetrachloroethane	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
Tetrachloroethylene	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
Toluene	<0.080		0.080	ug/g	05-NOV-18	06-NOV-18	R4320953
1,1,1-Trichloroethane	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
1,1,2-Trichloroethane	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
Trichloroethylene	<0.010		0.010	ug/g	05-NOV-18	06-NOV-18	R4320953
Trichlorofluoromethane	<0.050		0.050	ug/g	05-NOV-18	06-NOV-18	R4320953
Vinyl chloride	<0.020		0.020	ug/g	05-NOV-18	06-NOV-18	R4320953
o-Xylene	<0.020		0.020	ug/g	05-NOV-18	06-NOV-18	R4320953
m+p-Xylenes	<0.030		0.030	ug/g	05-NOV-18	06-NOV-18	R4320953
Xylenes (Total)	<0.050		0.050	ug/g		06-NOV-18	
Surrogate: 4-Bromofluorobenzene	98.7		50-140	%	05-NOV-18	06-NOV-18	R4320953
Surrogate: 1,4-Difluorobenzene	111.2		50-140	%	05-NOV-18	06-NOV-18	R4320953
Hydrocarbons							
F1 (C6-C10)	<5.0		5.0	ug/g	05-NOV-18	06-NOV-18	R4320953
F1-BTEX	<5.0		5.0	ug/g		07-NOV-18	
F2 (C10-C16)	<10		10	ug/g	05-NOV-18	06-NOV-18	R4322715
F3 (C16-C34)	<50		50	ug/g	05-NOV-18	06-NOV-18	R4322715
F4 (C34-C50)	<50		50	ug/g	05-NOV-18	06-NOV-18	R4322715
Total Hydrocarbons (C6-C50)	<72		72	ug/g		07-NOV-18	
Chrom. to baseline at nC50	YES				05-NOV-18	06-NOV-18	R4322715
Surrogate: 2-Bromobenzotrifluoride	68.8		60-140	%	05-NOV-18	06-NOV-18	R4322715
Surrogate: 3,4-Dichlorotoluene	83.9		60-140	%	05-NOV-18	06-NOV-18	R4320953

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Sample Parameter Qualifier key listed:

Qualifier	Description
DLHM	Detection Limit Adjusted: Sample has High Moisture Content

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CL-R511-WT	Soil	Chloride-O.Reg 153/04 (July 2011)	EPA 300.0

5 grams of dried soil is mixed with 10 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

EC-WT	Soil	Conductivity (EC)	MOEE E3138

A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

F1-F4-511-CALC-WT	Soil	F1-F4 Hydrocarbon Calculated Parameters	CCME CWS-PHC, Pub #1310, Dec 2001-S

Analytical methods used for analysis of CCME Petroleum Hydrocarbons have been validated and comply with the Reference Method for the CWS PHC.

Hydrocarbon results are expressed on a dry weight basis.

In cases where results for both F4 and F4G are reported, the greater of the two results must be used in any application of the CWS PHC guidelines and the gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.
In samples where BTEX and F1 were analyzed , F1-BTEX represents a value where the sum of Benzene, Toluene, Ethylbenzene and total Xylenes has been subtracted from F1.

In samples where PAHs, F2 and F3 were analyzed, F2-Naphth represents the result where Naphthalene has been subtracted from F2. F3-PAH represents a result where the sum of Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzo(a,h)anthracene, Fluoranthene, Indeno(1,2,3-cd)pyrene, Phenanthrene, and Pyrene has been subtracted from F3.

Unless otherwise qualified, the following quality control criteria have been met for the F1 hydrocarbon range:
1. All extraction and analysis holding times were met.
2. Instrument performance showing response factors for C6 and C10 within 30% of the response factor for toluene.
3. Linearity of gasoline response within 15% throughout the calibration range.

Unless otherwise qualified, the following quality control criteria have been met for the F2-F4 hydrocarbon ranges:
1. All extraction and analysis holding times were met.
2. Instrument performance showing C10, C16 and C34 response factors within 10% of their average.
3. Instrument performance showing the C50 response factor within 30% of the average of the C10, C16 and C34 response factors.
4. Linearity of diesel or motor oil response within 15% throughout the calibration range.

F1-HS-511-WT	Soil	F1-O.Reg 153/04 (July 2011)	E3398/CCME TIER 1-HS

Fraction F1 is determined by extracting a soil or sediment sample as received with methanol, then analyzing by headspace-GC/FID.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

F2-F4-511-WT	Soil	F2-F4-O.Reg 153/04 (July 2011)	CCME Tier 1

Petroleum Hydrocarbons (F2-F4 fractions) are extracted from soil with 1:1 hexane:acetone using a rotary extractor. Extracts are treated with silica gel to remove polar organic interferences. F2, F3, & F4 are analyzed by GC-FID. F4G-sg is analyzed gravimetrically.

Notes:
1. F2 (C10-C16): Sum of all hydrocarbons that elute between nC10 and nC16.
2. F3 (C16-C34): Sum of all hydrocarbons that elute between nC16 and nC34.
3. F4 (C34-C50): Sum of all hydrocarbons that elute between nC34 and nC50.
4. F4G: Gravimetric Heavy Hydrocarbons
5. F4G-sg: Gravimetric Heavy Hydrocarbons (F4G) after silica gel treatment.
6. Where both F4 (C34-C50) and F4G-sg are reported for a sample, the larger of the two values is used for comparison against the relevant CCME guideline for F4.
7. F4G-sg cannot be added to the C6 to C50 hydrocarbon results to obtain an estimate of total extractable hydrocarbons.
8. This method is validated for use.
9. Data from analysis of validation and quality control samples is available upon request.
10. Reported results are expressed as milligrams per dry kilogram, unless otherwise indicated.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

MOISTURE-WT	Soil	% Moisture	Gravimetric: Oven Dried

Reference Information

PH-WT	Soil	pH	MOEE E3137A

A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

REDOX-POTENTIAL-WT	Soil	Redox Potential	APHA 2580

This analysis is carried out in accordance with the procedure described in the "APHA" method 2580 "Oxidation-Reduction Potential" 2012. Samples are extracted at a fixed ratio with DI water. Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.

RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	APHA 2510 B

Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.

RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	MOECC E3138

Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.

SO4-WT	Soil	Sulphate	EPA 300.0

5 grams of soil is mixed with 50 mL of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.

SULPHIDE-WT	Soil	Sulphide, Acid Volatile	APHA 4500S2J

This analysis is carried out in accordance with the method described in APHA 4500 S2-J. Hydrochloric acid is added to sediment samples within a purge and trap system. The evolved hydrogen sulphide (H2S) is carried into a basic solution by inert gas. The acid volatile sulfide is then determined colourimetrically.

VOC-1,3-DCP-CALC-WT	Soil	Regulation 153 VOCs	SW8260B/SW8270C
VOC-511-HS-WT	Soil	VOC-O.Reg 153/04 (July 2011)	SW846 8260 (511)

Soil and sediment samples are extracted in methanol and analyzed by headspace-GC/MS.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

XYLENES-SUM-CALC-WT	Soil	Sum of Xylene Isomer Concentrations	CALCULATION

Total xylenes represents the sum of o-xylene and m&p-xylene.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

17-728512

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L2191800 Report Date: 12-NOV-18

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-R511-WT	**Soil**							
Batch R4328243								
WG2925814-3 CRM		**AN-CRM-WT**						
Chloride			99.8		%		70-130	08-NOV-18
WG2925814-4 DUP		**L2193016-22**						
Chloride		59.0	59.0		ug/g	0.0	30	08-NOV-18
WG2925814-2 LCS								
Chloride			103.1		%		80-120	08-NOV-18
WG2925814-1 MB								
Chloride			<5.0		ug/g		5	08-NOV-18
EC-WT	**Soil**							
Batch R4325930								
WG2925495-4 DUP		**WG2925495-3**						
Conductivity		0.0961	0.0944		mS/cm	1.8	20	08-NOV-18
WG2925495-2 IRM		**WT SAR2**						
Conductivity			88.6		%		70-130	08-NOV-18
WG2925898-1 LCS								
Conductivity			99.4		%		90-110	08-NOV-18
WG2925495-1 MB								
Conductivity			<0.0040		mS/cm		0.004	08-NOV-18
F1-HS-511-WT	**Soil**							
Batch R4320953								
WG2923173-4 DUP		**WG2923173-3**						
F1 (C6-C10)		<5.0	<5.0	RPD-NA	ug/g	N/A	30	06-NOV-18
WG2923173-2 LCS								
F1 (C6-C10)			95.9		%		80-120	06-NOV-18
WG2923173-1 MB								
F1 (C6-C10)			<5.0		ug/g		5	06-NOV-18
Surrogate: 3,4-Dichlorotoluene			79.7		%		60-140	06-NOV-18
WG2923173-6 MS		**L2191800-2**						
F1 (C6-C10)			98.3		%		60-140	06-NOV-18
F2-F4-511-WT	**Soil**							
Batch R4322715								
WG2922808-3 DUP		**WG2922808-5**						
F2 (C10-C16)		<10	14	RPD-NA	ug/g	N/A	30	06-NOV-18
F3 (C16-C34)		<50	<50	RPD-NA	ug/g	N/A	30	06-NOV-18
F4 (C34-C50)		<50	<50	RPD-NA	ug/g	N/A	30	06-NOV-18
WG2922808-2 LCS								
F2 (C10-C16)			105.2		%		80-120	06-NOV-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
F2-F4-511-WT	**Soil**							
Batch R4322715								
WG2922808-2 LCS								
F3 (C16-C34)			105.4		%		80-120	06-NOV-18
F4 (C34-C50)			109.2		%		80-120	06-NOV-18
WG2922808-1 MB								
F2 (C10-C16)			<10		ug/g		10	06-NOV-18
F3 (C16-C34)			<50		ug/g		50	06-NOV-18
F4 (C34-C50)			<50		ug/g		50	06-NOV-18
Surrogate: 2-Bromobenzotrifluoride			77.3		%		60-140	06-NOV-18
WG2922808-4 MS		**WG2922808-5**						
F2 (C10-C16)			107.5		%		60-140	06-NOV-18
F3 (C16-C34)			112.6		%		60-140	06-NOV-18
F4 (C34-C50)			115.4		%		60-140	06-NOV-18
MOISTURE-WT	**Soil**							
Batch R4320768								
WG2922980-3 DUP		**L2191457-8**						
% Moisture		16.5	15.7		%	4.5	20	06-NOV-18
WG2922980-2 LCS								
% Moisture			100.1		%		90-110	06-NOV-18
WG2922980-1 MB								
% Moisture			<0.10		%		0.1	06-NOV-18
PH-WT	**Soil**							
Batch R4322307								
WG2922947-1 DUP		**L2191800-1**						
pH		6.53	6.46	J	pH units	0.07	0.3	06-NOV-18
WG2923639-1 LCS								
pH			7.05		pH units		6.9-7.1	06-NOV-18
REDOX-POTENTIAL-WT	**Soil**							
Batch R4320328								
WG2922950-1 DUP		**L2191800-1**						
Redox Potential		270	240		mV	12	25	05-NOV-18
SO4-WT	**Soil**							
Batch R4326048								
WG2922917-6 CRM		**AN-CRM-WT**						
Sulphate			108.4		%		60-140	07-NOV-18
WG2922917-3 DUP		**WG2922917-5**						
Sulphate		<20	<20					

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SO4-WT	**Soil**							
Batch R4326048								
WG2922917-3 DUP		**WG2922917-5**						
Sulphate		<20	<20	RPD-NA	mg/kg	N/A	30	07-NOV-18
WG2922917-2 LCS								
Sulphate			103.8		%		80-120	07-NOV-18
WG2922917-1 MB								
Sulphate			<20		mg/kg		20	07-NOV-18
SULPHIDE-WT	**Soil**							
Batch R4328126								
WG2926259-3 DUP		**L2192382-1**						
Acid Volatile Sulphides		<0.20	<0.20	RPD-NA	mg/kg	N/A	30	08-NOV-18
WG2926259-2 LCS								
Acid Volatile Sulphides			90.2		%		70-130	08-NOV-18
WG2926259-1 MB								
Acid Volatile Sulphides			<0.20		mg/kg		0.2	08-NOV-18
VOC-511-HS-WT	**Soil**							
Batch R4320953								
WG2923173-4 DUP		**WG2923173-3**						
1,1,1,2-Tetrachloroethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
1,1,2,2-Tetrachloroethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
1,1,1-Trichloroethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
1,1,2-Trichloroethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
1,1-Dichloroethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
1,1-Dichloroethylene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
1,2-Dibromoethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
1,2-Dichlorobenzene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
1,2-Dichloroethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
1,2-Dichloropropane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
1,3-Dichlorobenzene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
1,4-Dichlorobenzene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
Acetone		<0.50	<0.50	RPD-NA	ug/g	N/A	40	06-NOV-18
Benzene		<0.0068	<0.0068	RPD-NA	ug/g	N/A	40	06-NOV-18
Bromodichloromethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
Bromoform		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
Bromomethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
Carbon tetrachloride		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-511-HS-WT	**Soil**							
Batch R4320953								
WG2923173-4 DUP		**WG2923173-3**						
Chlorobenzene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
Chloroform		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
cis-1,2-Dichloroethylene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
cis-1,3-Dichloropropene		<0.030	<0.030	RPD-NA	ug/g	N/A	40	06-NOV-18
Dibromochloromethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
Dichlorodifluoromethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
Ethylbenzene		<0.018	<0.018	RPD-NA	ug/g	N/A	40	06-NOV-18
n-Hexane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
Methylene Chloride		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
MTBE		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
m+p-Xylenes		<0.030	<0.030	RPD-NA	ug/g	N/A	40	06-NOV-18
Methyl Ethyl Ketone		<0.50	<0.50	RPD-NA	ug/g	N/A	40	06-NOV-18
Methyl Isobutyl Ketone		<0.50	<0.50	RPD-NA	ug/g	N/A	40	06-NOV-18
o-Xylene		<0.020	<0.020	RPD-NA	ug/g	N/A	40	06-NOV-18
Styrene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
Tetrachloroethylene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
Toluene		<0.080	<0.080	RPD-NA	ug/g	N/A	40	06-NOV-18
trans-1,2-Dichloroethylene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
trans-1,3-Dichloropropene		<0.030	<0.030	RPD-NA	ug/g	N/A	40	06-NOV-18
Trichloroethylene		0.425	0.435		ug/g	2.3	40	06-NOV-18
Trichlorofluoromethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	06-NOV-18
Vinyl chloride		<0.020	<0.020	RPD-NA	ug/g	N/A	40	06-NOV-18
WG2923173-2 LCS								
1,1,1,2-Tetrachloroethane			106.4		%		60-130	06-NOV-18
1,1,2,2-Tetrachloroethane			110.2		%		60-130	06-NOV-18
1,1,1-Trichloroethane			119.9		%		60-130	06-NOV-18
1,1,2-Trichloroethane			108.8		%		60-130	06-NOV-18
1,1-Dichloroethane			120.5		%		60-130	06-NOV-18
1,1-Dichloroethylene			121.3		%		60-130	06-NOV-18
1,2-Dibromoethane			106.9		%		70-130	06-NOV-18
1,2-Dichlorobenzene			116.6		%		70-130	06-NOV-18
1,2-Dichloroethane			118.9		%		60-130	06-NOV-18
1,2-Dichloropropane			117.7		%		70-130	06-NOV-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-511-HS-WT	**Soil**							
Batch R4320953								
WG2923173-2 LCS								
1,3-Dichlorobenzene			115.7		%		70-130	06-NOV-18
1,4-Dichlorobenzene			119.3		%		70-130	06-NOV-18
Acetone			109.0		%		60-140	06-NOV-18
Benzene			123.8		%		70-130	06-NOV-18
Bromodichloromethane			119.0		%		50-140	06-NOV-18
Bromoform			100.4		%		70-130	06-NOV-18
Bromomethane			135.1		%		50-140	06-NOV-18
Carbon tetrachloride			119.6		%		70-130	06-NOV-18
Chlorobenzene			113.5		%		70-130	06-NOV-18
Chloroform			123.3		%		70-130	06-NOV-18
cis-1,2-Dichloroethylene			122.8		%		70-130	06-NOV-18
cis-1,3-Dichloropropene			118.7		%		70-130	06-NOV-18
Dibromochloromethane			105.0		%		60-130	06-NOV-18
Dichlorodifluoromethane			134.7		%		50-140	06-NOV-18
Ethylbenzene			106.6		%		70-130	06-NOV-18
n-Hexane			100.6		%		70-130	06-NOV-18
Methylene Chloride			125.0		%		70-130	06-NOV-18
MTBE			119.6		%		70-130	06-NOV-18
m+p-Xylenes			110.5		%		70-130	06-NOV-18
Methyl Ethyl Ketone			109.2		%		60-140	06-NOV-18
Methyl Isobutyl Ketone			97.4		%		60-140	06-NOV-18
o-Xylene			102.3		%		70-130	06-NOV-18
Styrene			103.6		%		70-130	06-NOV-18
Tetrachloroethylene			114.2		%		60-130	06-NOV-18
Toluene			108.8		%		70-130	06-NOV-18
trans-1,2-Dichloroethylene			127.2		%		60-130	06-NOV-18
trans-1,3-Dichloropropene			106.1		%		70-130	06-NOV-18
Trichloroethylene			124.2		%		60-130	06-NOV-18
Trichlorofluoromethane			132.0		%		50-140	06-NOV-18
Vinyl chloride			136.1		%		60-140	06-NOV-18
WG2923173-1 MB								
1,1,1,2-Tetrachloroethane			<0.050		ug/g		0.05	06-NOV-18
1,1,2,2-Tetrachloroethane			<0.050		ug/g		0.05	06-NOV-18
1,1,1-Trichloroethane			<0.050		ug/g		0.05	06-NOV-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-511-HS-WT	**Soil**							
Batch R4320953								
WG2923173-1 MB								
1,1,2-Trichloroethane			<0.050		ug/g		0.05	06-NOV-18
1,1-Dichloroethane			<0.050		ug/g		0.05	06-NOV-18
1,1-Dichloroethylene			<0.050		ug/g		0.05	06-NOV-18
1,2-Dibromoethane			<0.050		ug/g		0.05	06-NOV-18
1,2-Dichlorobenzene			<0.050		ug/g		0.05	06-NOV-18
1,2-Dichloroethane			<0.050		ug/g		0.05	06-NOV-18
1,2-Dichloropropane			<0.050		ug/g		0.05	06-NOV-18
1,3-Dichlorobenzene			<0.050		ug/g		0.05	06-NOV-18
1,4-Dichlorobenzene			<0.050		ug/g		0.05	06-NOV-18
Acetone			<0.50		ug/g		0.5	06-NOV-18
Benzene			<0.0068		ug/g		0.0068	06-NOV-18
Bromodichloromethane			<0.050		ug/g		0.05	06-NOV-18
Bromoform			<0.050		ug/g		0.05	06-NOV-18
Bromomethane			<0.050		ug/g		0.05	06-NOV-18
Carbon tetrachloride			<0.050		ug/g		0.05	06-NOV-18
Chlorobenzene			<0.050		ug/g		0.05	06-NOV-18
Chloroform			<0.050		ug/g		0.05	06-NOV-18
cis-1,2-Dichloroethylene			<0.050		ug/g		0.05	06-NOV-18
cis-1,3-Dichloropropene			<0.030		ug/g		0.03	06-NOV-18
Dibromochloromethane			<0.050		ug/g		0.05	06-NOV-18
Dichlorodifluoromethane			<0.050		ug/g		0.05	06-NOV-18
Ethylbenzene			<0.018		ug/g		0.018	06-NOV-18
n-Hexane			<0.050		ug/g		0.05	06-NOV-18
Methylene Chloride			<0.050		ug/g		0.05	06-NOV-18
MTBE			<0.050		ug/g		0.05	06-NOV-18
m+p-Xylenes			<0.030		ug/g		0.03	06-NOV-18
Methyl Ethyl Ketone			<0.50		ug/g		0.5	06-NOV-18
Methyl Isobutyl Ketone			<0.50		ug/g		0.5	06-NOV-18
o-Xylene			<0.020		ug/g		0.02	06-NOV-18
Styrene			<0.050		ug/g		0.05	06-NOV-18
Tetrachloroethylene			<0.050		ug/g		0.05	06-NOV-18
Toluene			<0.080		ug/g		0.08	06-NOV-18
trans-1,2-Dichloroethylene			<0.050		ug/g		0.05	06-NOV-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-511-HS-WT	**Soil**							
Batch R4320953								
WG2923173-1 MB								
trans-1,3-Dichloropropene			<0.030		ug/g		0.03	06-NOV-18
Trichloroethylene			<0.010		ug/g		0.01	06-NOV-18
Trichlorofluoromethane			<0.050		ug/g		0.05	06-NOV-18
Vinyl chloride			<0.020		ug/g		0.02	06-NOV-18
Surrogate: 1,4-Difluorobenzene			114.2		%		50-140	06-NOV-18
Surrogate: 4-Bromofluorobenzene			100.9		%		50-140	06-NOV-18
WG2923173-5 MS		**L2184465-27**						
1,1,1,2-Tetrachloroethane			104.6		%		50-140	06-NOV-18
1,1,2,2-Tetrachloroethane			103.3		%		50-140	06-NOV-18
1,1,1-Trichloroethane			117.1		%		50-140	06-NOV-18
1,1,2-Trichloroethane			104.2		%		50-140	06-NOV-18
1,1-Dichloroethane			117.1		%		50-140	06-NOV-18
1,1-Dichloroethylene			118.7		%		50-140	06-NOV-18
1,2-Dibromoethane			100.9		%		50-140	06-NOV-18
1,2-Dichlorobenzene			113.0		%		50-140	06-NOV-18
1,2-Dichloroethane			111.2		%		50-140	06-NOV-18
1,2-Dichloropropane			113.2		%		50-140	06-NOV-18
1,3-Dichlorobenzene			112.6		%		50-140	06-NOV-18
1,4-Dichlorobenzene			115.4		%		50-140	06-NOV-18
Acetone			99.7		%		50-140	06-NOV-18
Benzene			120.2		%		50-140	06-NOV-18
Bromodichloromethane			113.0		%		50-140	06-NOV-18
Bromoform			95.1		%		50-140	06-NOV-18
Bromomethane			127.9		%		50-140	06-NOV-18
Carbon tetrachloride			117.5		%		50-140	06-NOV-18
Chlorobenzene			110.3		%		50-140	06-NOV-18
Chloroform			118.7		%		50-140	06-NOV-18
cis-1,2-Dichloroethylene			117.6		%		50-140	06-NOV-18
cis-1,3-Dichloropropene			108.6		%		50-140	06-NOV-18
Dibromochloromethane			101.2		%		50-140	06-NOV-18
Dichlorodifluoromethane			130.8		%		50-140	06-NOV-18
Ethylbenzene			105.8		%		50-140	06-NOV-18
n-Hexane			99.3		%		50-140	06-NOV-18
Methylene Chloride			118.5		%		50-140	06-NOV-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-511-HS-WT	**Soil**							
Batch R4320953								
WG2923173-5 MS		**L2184465-27**						
MTBE			117.5		%		50-140	06-NOV-18
m+p-Xylenes			109.4		%		50-140	06-NOV-18
Methyl Ethyl Ketone			99.6		%		50-140	06-NOV-18
Methyl Isobutyl Ketone			89.6		%		50-140	06-NOV-18
o-Xylene			101.4		%		50-140	06-NOV-18
Styrene			100.7		%		50-140	06-NOV-18
Tetrachloroethylene			112.7		%		50-140	06-NOV-18
Toluene			109.3		%		50-140	06-NOV-18
trans-1,2-Dichloroethylene			122.6		%		50-140	06-NOV-18
trans-1,3-Dichloropropene			97.8		%		50-140	06-NOV-18
Trichloroethylene			133.2		%		50-140	06-NOV-18
Trichlorofluoromethane			129.8		%		50-140	06-NOV-18
Vinyl chloride			132.1		%		50-140	06-NOV-18

Quality Control Report

Workorder: L2191800 Report Date: 12-NOV-18

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

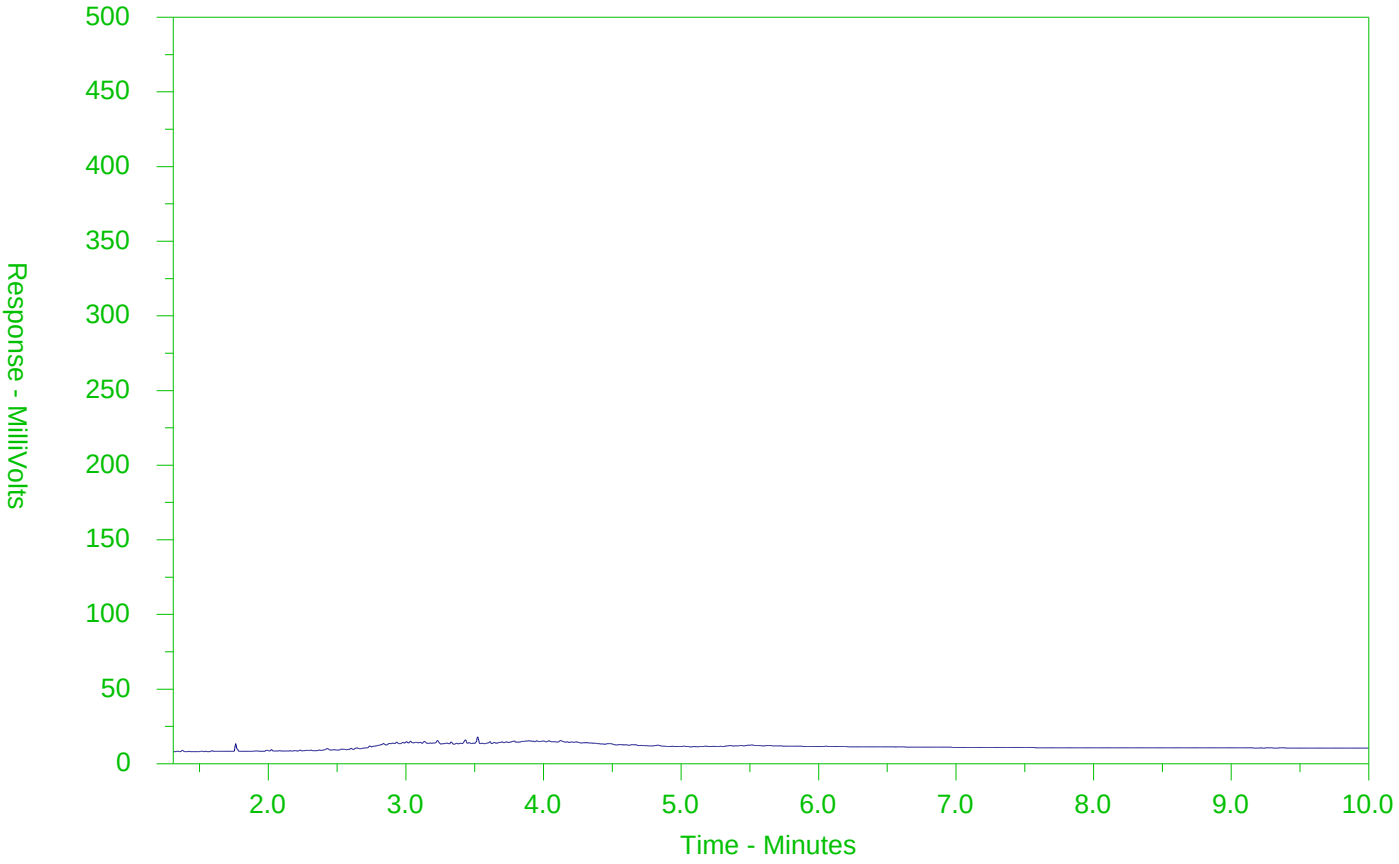
ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2191800-2
Client Sample ID: 18-102-SS3



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →	← Motor Oils/Lube Oils/Grease →		
← Diesel/Jet Fuels →			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2191800-COFC

COC Number: 17 - 728512

Page 1 of 1

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	TULLOCH ENGINEERING	Select Report Format: [X] PDF [X] EXCEL [ ] EDD (DIGITAL)	Regular [R] [X] Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	ERIK GILES	Quality Control (QC) Report with Report [X] YES [ ] NO	PRIORITY (Business Days): 4 day [P4-20%] [ ]; 3 day [P3-25%] [ ]; 2 day [P2-50%] [ ]
Phone:	647-968-4844	[ ] Compare Results to Criteria on Report - provide details below if box checked	EMERGENCY: 1 Business day [E-100%] [ ]; Same Day, Weekend or Statutory holiday [E2-200% (Laboratory opening fees may apply)] [ ]
	Company address below will appear on the final report	Select Distribution: [X] EMAIL [ ] MAIL [ ] FAX	
Street:	1100 SOUTH SERVICE RD.	Email 1 or Fax: erik.giles@tulloch.ca	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm
City/Province:	STONEY CREEK, ON	Email 2: greg.gu@tulloch.ca	For tests that can not be performed according to the service level selected, you will be contacted.
Postal Code:	L8E 0C5	Email 3:	
Invoice To	Same as Report To [ ] YES [ ] NO	Invoice Distribution	Analysis Request
	Copy of Invoice with Report [X] YES [ ] NO	Select Invoice Distribution: [X] EMAIL [ ] MAIL [ ] FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	TULLOCH ENGINEERING	Email 1 or Fax: Nancy-Seabrook@tulloch.ca	
Contact:	NANCY SEABROOK	Email 2: erik.giles@tulloch.ca	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:	Q3923	AFE/Cost Center:	PO#
Job #:	18-40046	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):	L2191800	ALS Contact: MELISSA TRAN	Sampler: E. GILES

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	RESISTIVITY/REDOX/SO4/Cl/pH	TOT. UC/BTX/F1	F2-F4	TOT. METALS (Cu)/(Zn)	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
	18-102 SS1	24/10/18	09:10	JAR	X						1
	18-102 SS3	24/10/18	10:10	JAR (P)		X					2
	18-102 SS3	24/10/18	10:10	JAR			X				1
	18-102 SS3	24/10/18	10:10	JAR				X			1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? [ ] YES [X] NO	
Are samples for human consumption/ use? [ ] YES [X] NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	[ ]	SIF Observations	Yes [ ]	No	[ ]
Ice Packs	[X]	Ice Cubes [ ]	Custody seal intact	Yes [ ]	No [ ]
Cooling Initiated	[ ]				

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				18.3			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
E. GILES	02/11/18	17:00					5-NOV-18	8:45

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1 If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

TULLOCH ENGINEERING INC
ATTN: Erik Giles
80 Main Street West
Huntsville ON P1H 1W9

Date Received: 05-NOV-18
Report Date: 08-NOV-18 14:44 (MT)
Version: FINAL

Client Phone: 705-789-7851

Certificate of Analysis

Lab Work Order #: L2191805

Project P.O. #: NOT SUBMITTED
Job Reference: 18-4046
C of C Numbers: 17-728512
Legal Site Desc:

Emily Hansen
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2191805-1 18-102 SS3 Sampled By: E.GILES on 29-OCT-18 @ 10:10 Matrix: SOIL							
Sample Preparation							
Initial pH	9.23		0.10	pH units		07-NOV-18	R4323380
Final pH	4.41		0.10	pH units		07-NOV-18	R4323380
TCLP Extractables							
Acenaphthene	<0.0050		0.0050	mg/L	07-NOV-18	08-NOV-18	R4326107
Acenaphthylene	<0.0050		0.0050	mg/L	07-NOV-18	08-NOV-18	R4326107
Anthracene	<0.0050		0.0050	mg/L	07-NOV-18	08-NOV-18	R4326107
Benzo(a)anthracene	<0.0050		0.0050	mg/L	07-NOV-18	08-NOV-18	R4326107
Benzo(a)pyrene	<0.0010		0.0010	mg/L	07-NOV-18	08-NOV-18	R4326107
Benzo(b)fluoranthene	<0.0050		0.0050	mg/L	07-NOV-18	08-NOV-18	R4326107
Benzo(g,h,i)perylene	<0.0050		0.0050	mg/L	07-NOV-18	08-NOV-18	R4326107
Cyanide, Weak Acid Diss	<0.10		0.10	mg/L		07-NOV-18	R4324974
Fluoride (F)	<10		10	mg/L		07-NOV-18	R4324542
Nitrate and Nitrite as N	<4.0		4.0	mg/L		07-NOV-18	R4324542
Nitrate-N	<2.0		2.0	mg/L		07-NOV-18	R4324542
Nitrite-N	<2.0		2.0	mg/L		07-NOV-18	R4324542
TCLP Metals							
Arsenic (As)	<0.050		0.050	mg/L		07-NOV-18	R4324688
Barium (Ba)	1.95		0.50	mg/L		07-NOV-18	R4324688
Boron (B)	<2.5		2.5	mg/L		07-NOV-18	R4324688
Cadmium (Cd)	<0.0050		0.0050	mg/L		07-NOV-18	R4324688
Chromium (Cr)	<0.050		0.050	mg/L		07-NOV-18	R4324688
Lead (Pb)	<0.050		0.050	mg/L		07-NOV-18	R4324688
Mercury (Hg)	<0.00010		0.00010	mg/L		07-NOV-18	R4324369
Selenium (Se)	<0.025		0.025	mg/L		07-NOV-18	R4324688
Silver (Ag)	<0.0050		0.0050	mg/L		07-NOV-18	R4324688
Uranium (U)	<0.25		0.25	mg/L		07-NOV-18	R4324688
TCLP VOCs							
1,1-Dichloroethylene	<0.025	VOCHS	0.025	mg/L		07-NOV-18	R4323331
1,2-Dichlorobenzene	<0.025	VOCHS	0.025	mg/L		07-NOV-18	R4323331
1,2-Dichloroethane	<0.025	VOCHS	0.025	mg/L		07-NOV-18	R4323331
1,4-Dichlorobenzene	<0.025	VOCHS	0.025	mg/L		07-NOV-18	R4323331
Benzene	<0.025	VOCHS	0.025	mg/L		07-NOV-18	R4323331
Carbon tetrachloride	<0.025	VOCHS	0.025	mg/L		07-NOV-18	R4323331
Chlorobenzene	<0.025	VOCHS	0.025	mg/L		07-NOV-18	R4323331
Chloroform	<0.10	VOCHS	0.10	mg/L		07-NOV-18	R4323331
Dichloromethane	<0.50	VOCHS	0.50	mg/L		07-NOV-18	R4323331
Methyl Ethyl Ketone	<1.0	VOCHS	1.0	mg/L		07-NOV-18	R4323331
Tetrachloroethylene	<0.025	VOCHS	0.025	mg/L		07-NOV-18	R4323331
Trichloroethylene	<0.025	VOCHS	0.025	mg/L		07-NOV-18	R4323331
Vinyl chloride	<0.050	VOCHS	0.050	mg/L		07-NOV-18	R4323331
Surrogate: 4-Bromofluorobenzene	84.6		70-130	%		07-NOV-18	R4323331
Volatile Organic Compounds							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2191805-1 18-102 SS3 Sampled By: E.GILES on 29-OCT-18 @ 10:10 Matrix: SOIL							
Volatile Organic Compounds							
Surrogate: 1,4-Difluorobenzene	94.9		70-130	%		07-NOV-18	R4323331
Polycyclic Aromatic Hydrocarbons							
Benzo(k)fluoranthene	<0.0050		0.0050	mg/L	07-NOV-18	08-NOV-18	R4326107
Chrysene	<0.0050		0.0050	mg/L	07-NOV-18	08-NOV-18	R4326107
Dibenzo(ah)anthracene	<0.0050		0.0050	mg/L	07-NOV-18	08-NOV-18	R4326107
Fluoranthene	<0.0050		0.0050	mg/L	07-NOV-18	08-NOV-18	R4326107
Fluorene	<0.0050		0.0050	mg/L	07-NOV-18	08-NOV-18	R4326107
Indeno(1,2,3-cd)pyrene	<0.0050		0.0050	mg/L	07-NOV-18	08-NOV-18	R4326107
Naphthalene	<0.0050		0.0050	mg/L	07-NOV-18	08-NOV-18	R4326107
Phenanthrene	<0.0050		0.0050	mg/L	07-NOV-18	08-NOV-18	R4326107
Pyrene	<0.0050		0.0050	mg/L	07-NOV-18	08-NOV-18	R4326107
Quinoline	<0.0050		0.0050	mg/L	07-NOV-18	08-NOV-18	R4326107
Surrogate: d10-Acenaphthene	94.4		50-150	%	07-NOV-18	08-NOV-18	R4326107
Surrogate: d12-Chrysene	71.6		50-150	%	07-NOV-18	08-NOV-18	R4326107
Surrogate: d8-Naphthalene	103.8		50-150	%	07-NOV-18	08-NOV-18	R4326107
Surrogate: d10-Phenanthrene	91.3		50-150	%	07-NOV-18	08-NOV-18	R4326107

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Sample Parameter Qualifier key listed:

Qualifier	Description
VOCHS	VOC analysis was conducted for a water sample that contained > 5% headspace. Results may be biased low.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CN-TCLP-WT	Waste	Cyanide for O. Reg 347	APHA 4500CN I
F-TCLP-WT	Waste	Fluoride (F) for O. Reg 347	APHA 4110 B-Ion Chromatography
HG-TCLP-WT	Waste	Mercury (CVAA) for O.Reg 347	SW846 7470A
LEACH-TCLP-WT	Waste	Leachate Procedure for Reg 347	EPA 1311
		Inorganic and Semi-Volatile Organic contaminants are leached from waste samples in strict accordance with US EPA Method 1311, "Toxicity Characteristic Leaching Procedure" (TCLP). Test results are reported in leachate concentration units (normally mg/L).	
MET-TCLP-WT	Waste	O.Reg 347 TCLP Leachable Metals	EPA 200.8
N2N3-TCLP-WT	Waste	Nitrate/Nitrite-N for O. Reg 347	APHA 4110 B-Ion Chromatography
PAH-TCLP-WT	Waste	PAH for O. Reg 347	SW846 8270 (PAH)
		Samples are leached according to TCLP protocol and then the aqueous leachate is extracted and the resulting extracts are analyzed on GC/MSD. Depending on the analytical GC/MS column used benzo(j)fluoranthene may chromatographically co-elute with benzo(b)fluoranthene or benzo(k)fluoranthene.	
VOC-TCLP-WT	Waste	VOC for O. Reg 347	SW846 8260
		A sample of waste is leached in a zero headspace extractor at 30–2 rpm for 18–2.0 hours with the appropriate leaching solution. After tumbling the leachate is analyzed directly by headspace technology, followed by GC/MS using internal standard quantitation.	

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

17-728512

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L2191805 Report Date: 08-NOV-18

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9

Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CN-TCLP-WT	**Waste**							
Batch R4324974								
WG2924924-3 DUP		**L2191657-1**						
Cyanide, Weak Acid Diss		<0.1	<0.1	RPD-NA	mg/L	N/A	50	07-NOV-18
WG2924924-2 LCS								
Cyanide, Weak Acid Diss			96.1		%		70-130	07-NOV-18
WG2924924-1 MB								
Cyanide, Weak Acid Diss			<0.1		mg/L		5	07-NOV-18
WG2924924-4 MS		**L2191657-1**						
Cyanide, Weak Acid Diss			93.3		%		50-140	07-NOV-18
F-TCLP-WT	**Waste**							
Batch R4324542								
WG2925182-3 DUP		**L2191350-1**						
Fluoride (F)		<10	<10	RPD-NA	mg/L	N/A	30	07-NOV-18
WG2925182-2 LCS								
Fluoride (F)			90.7		%		70-130	07-NOV-18
WG2925182-1 MB								
Fluoride (F)			<10		mg/L		10	07-NOV-18
WG2925182-4 MS		**L2191350-1**						
Fluoride (F)			91.0		%		50-150	07-NOV-18
HG-TCLP-WT	**Waste**							
Batch R4324369								
WG2924885-3 DUP		**L2191350-1**						
Mercury (Hg)		<0.00010	<0.00010	RPD-NA	mg/L	N/A	50	07-NOV-18
WG2924885-2 LCS								
Mercury (Hg)			106.0		%		70-130	07-NOV-18
WG2924885-1 MB								
Mercury (Hg)			<0.00010		mg/L		0.0001	07-NOV-18
WG2924885-4 MS		**L2191350-1**						
Mercury (Hg)			98.3		%		50-140	07-NOV-18
MET-TCLP-WT	**Waste**							
Batch R4324688								
WG2924896-4 DUP		**WG2924896-3**						
Silver (Ag)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	40	07-NOV-18
Arsenic (As)		<0.050	<0.050	RPD-NA	mg/L	N/A	40	07-NOV-18
Boron (B)		<2.5	<2.5	RPD-NA	mg/L	N/A	40	07-NOV-18
Barium (Ba)		<0.50	<0.50	RPD-NA	mg/L	N/A	40	07-NOV-18
Cadmium (Cd)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	40	07-NOV-18
Chromium (Cr)		<0.050	<0.050	RPD-NA	mg/L	N/A	40	07-NOV-18

Quality Control Report

Workorder: L2191805 Report Date: 08-NOV-18

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TCLP-WT	**Waste**							
Batch R4324688								
WG2924896-4 DUP		**WG2924896-3**						
Lead (Pb)		<0.050	<0.050	RPD-NA	mg/L	N/A	40	07-NOV-18
Selenium (Se)		<0.025	<0.025	RPD-NA	mg/L	N/A	40	07-NOV-18
Uranium (U)		<0.25	<0.25	RPD-NA	mg/L	N/A	40	07-NOV-18
WG2924896-2 LCS								
Silver (Ag)			108.8		%		70-130	07-NOV-18
Arsenic (As)			104.8		%		70-130	07-NOV-18
Boron (B)			108.5		%		70-130	07-NOV-18
Barium (Ba)			114.7		%		70-130	07-NOV-18
Cadmium (Cd)			101.4		%		70-130	07-NOV-18
Chromium (Cr)			99.4		%		70-130	07-NOV-18
Lead (Pb)			103.9		%		70-130	07-NOV-18
Selenium (Se)			100.2		%		70-130	07-NOV-18
Uranium (U)			107.5		%		70-130	07-NOV-18
WG2924896-1 MB								
Silver (Ag)			<0.0050		mg/L		0.005	07-NOV-18
Arsenic (As)			<0.050		mg/L		0.05	07-NOV-18
Boron (B)			<2.5		mg/L		2.5	07-NOV-18
Barium (Ba)			<0.50		mg/L		0.5	07-NOV-18
Cadmium (Cd)			<0.0050		mg/L		0.005	07-NOV-18
Chromium (Cr)			<0.050		mg/L		0.05	07-NOV-18
Lead (Pb)			<0.050		mg/L		0.05	07-NOV-18
Selenium (Se)			<0.025		mg/L		0.025	07-NOV-18
Uranium (U)			<0.25		mg/L		0.25	07-NOV-18
WG2924896-5 MS		**WG2924896-3**						
Silver (Ag)			146.3		%		50-150	07-NOV-18
Arsenic (As)			121.8		%		50-150	07-NOV-18
Boron (B)			122.8		%		50-150	07-NOV-18
Barium (Ba)			137.6		%		50-150	07-NOV-18
Cadmium (Cd)			114.0		%		50-150	07-NOV-18
Chromium (Cr)			115.8		%		50-150	07-NOV-18
Lead (Pb)			109.8		%		50-150	07-NOV-18
Selenium (Se)			116.7		%		50-150	07-NOV-18
Uranium (U)			116.3		%		50-150	07-NOV-18
N2N3-TCLP-WT	**Waste**							

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
N2N3-TCLP-WT	**Waste**							
Batch R4324542								
WG2925182-3 DUP		**L2191350-1**						
Nitrate-N		<2.0	<2.0	RPD-NA	mg/L	N/A	30	07-NOV-18
Nitrite-N		<2.0	<2.0	RPD-NA	mg/L	N/A	30	07-NOV-18
WG2925182-2 LCS								
Nitrate-N			102.4		%		70-130	07-NOV-18
Nitrite-N			102.9		%		70-130	07-NOV-18
WG2925182-1 MB								
Nitrate-N			<2.0		mg/L		2	07-NOV-18
Nitrite-N			<2.0		mg/L		2	07-NOV-18
WG2925182-4 MS		**L2191350-1**						
Nitrate-N			101.3		%		50-150	07-NOV-18
Nitrite-N			101.1		%		50-150	07-NOV-18
PAH-TCLP-WT	**Waste**							
Batch R4326107								
WG2925222-4 DUP		**WG2925222-6**						
Acenaphthene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	08-NOV-18
Acenaphthylene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	08-NOV-18
Anthracene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	08-NOV-18
Benzo(a)anthracene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	08-NOV-18
Benzo(a)pyrene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	50	08-NOV-18
Benzo(b)fluoranthene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	08-NOV-18
Benzo(g,h,i)perylene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	08-NOV-18
Benzo(k)fluoranthene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	08-NOV-18
Chrysene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	08-NOV-18
Dibenzo(ah)anthracene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	08-NOV-18
Fluoranthene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	08-NOV-18
Fluorene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	08-NOV-18
Indeno(1,2,3-cd)pyrene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	08-NOV-18
Naphthalene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	08-NOV-18
Phenanthrene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	08-NOV-18
Pyrene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	08-NOV-18
Quinoline		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	08-NOV-18
WG2925222-2 LCS								
Acenaphthene			99.8		%		50-130	08-NOV-18
Acenaphthylene			95.4		%		50-130	08-NOV-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TCLP-WT	**Waste**							
Batch R4326107								
WG2925222-2 LCS								
Anthracene			94.5		%		50-130	08-NOV-18
Benzo(a)anthracene			105.3		%		50-140	08-NOV-18
Benzo(a)pyrene			93.3		%		60-140	08-NOV-18
Benzo(b)fluoranthene			105.6		%		50-140	08-NOV-18
Benzo(g,h,i)perylene			102.1		%		50-140	08-NOV-18
Benzo(k)fluoranthene			106.0		%		50-150	08-NOV-18
Chrysene			111.1		%		50-140	08-NOV-18
Dibenzo(ah)anthracene			101.4		%		50-140	08-NOV-18
Fluoranthene			102.8		%		50-150	08-NOV-18
Fluorene			98.3		%		50-150	08-NOV-18
Indeno(1,2,3-cd)pyrene			108.2		%		50-140	08-NOV-18
Naphthalene			97.9		%		50-130	08-NOV-18
Phenanthrene			104.7		%		50-130	08-NOV-18
Pyrene			104.2		%		50-140	08-NOV-18
Quinoline			110.5		%		50-150	08-NOV-18
WG2925222-1 MB								
Acenaphthene			<0.0050		mg/L		0.005	08-NOV-18
Acenaphthylene			<0.0050		mg/L		0.005	08-NOV-18
Anthracene			<0.0050		mg/L		0.005	08-NOV-18
Benzo(a)anthracene			<0.0050		mg/L		0.005	08-NOV-18
Benzo(a)pyrene			<0.0010		mg/L		0.001	08-NOV-18
Benzo(b)fluoranthene			<0.0050		mg/L		0.005	08-NOV-18
Benzo(g,h,i)perylene			<0.0050		mg/L		0.005	08-NOV-18
Benzo(k)fluoranthene			<0.0050		mg/L		0.005	08-NOV-18
Chrysene			<0.0050		mg/L		0.005	08-NOV-18
Dibenzo(ah)anthracene			<0.0050		mg/L		0.005	08-NOV-18
Fluoranthene			<0.0050		mg/L		0.005	08-NOV-18
Fluorene			<0.0050		mg/L		0.005	08-NOV-18
Indeno(1,2,3-cd)pyrene			<0.0050		mg/L		0.005	08-NOV-18
Naphthalene			<0.0050		mg/L		0.005	08-NOV-18
Phenanthrene			<0.0050		mg/L		0.005	08-NOV-18
Pyrene			<0.0050		mg/L		0.005	08-NOV-18
Quinoline			<0.0050		mg/L		0.005	08-NOV-18
Surrogate: d8-Naphthalene			101.4		%		50-150	08-NOV-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TCLP-WT	**Waste**							
Batch R4326107								
WG2925222-1 MB								
Surrogate: d10-Phenanthrene			100.8		%		50-150	08-NOV-18
Surrogate: d12-Chrysene			94.9		%		50-150	08-NOV-18
Surrogate: d10-Acenaphthene			99.0		%		50-150	08-NOV-18
WG2925222-3 MB								
Acenaphthene			<0.0050		mg/L		0.005	08-NOV-18
Acenaphthylene			<0.0050		mg/L		0.005	08-NOV-18
Anthracene			<0.0050		mg/L		0.005	08-NOV-18
Benzo(a)anthracene			<0.0050		mg/L		0.005	08-NOV-18
Benzo(a)pyrene			<0.0010		mg/L		0.001	08-NOV-18
Benzo(b)fluoranthene			<0.0050		mg/L		0.005	08-NOV-18
Benzo(g,h,i)perylene			<0.0050		mg/L		0.005	08-NOV-18
Benzo(k)fluoranthene			<0.0050		mg/L		0.005	08-NOV-18
Chrysene			<0.0050		mg/L		0.005	08-NOV-18
Dibenzo(ah)anthracene			<0.0050		mg/L		0.005	08-NOV-18
Fluoranthene			<0.0050		mg/L		0.005	08-NOV-18
Fluorene			<0.0050		mg/L		0.005	08-NOV-18
Indeno(1,2,3-cd)pyrene			<0.0050		mg/L		0.005	08-NOV-18
Naphthalene			<0.0050		mg/L		0.005	08-NOV-18
Phenanthrene			<0.0050		mg/L		0.005	08-NOV-18
Pyrene			<0.0050		mg/L		0.005	08-NOV-18
Quinoline			<0.0050		mg/L		0.005	08-NOV-18
Surrogate: d8-Naphthalene			105.3		%		50-150	08-NOV-18
Surrogate: d10-Phenanthrene			96.1		%		50-150	08-NOV-18
Surrogate: d12-Chrysene			93.7		%		50-150	08-NOV-18
Surrogate: d10-Acenaphthene			98.2		%		50-150	08-NOV-18
WG2925222-5 MS		**WG2925222-6**						
Acenaphthene			101.9		%		50-150	08-NOV-18
Acenaphthylene			98.2		%		50-150	08-NOV-18
Anthracene			97.3		%		50-150	08-NOV-18
Benzo(a)anthracene			111.6		%		50-150	08-NOV-18
Benzo(a)pyrene			92.7		%		50-150	08-NOV-18
Benzo(b)fluoranthene			104.1		%		50-150	08-NOV-18
Benzo(g,h,i)perylene			103.0		%		50-150	08-NOV-18
Benzo(k)fluoranthene			105.9		%		50-150	08-NOV-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TCLP-WT	**Waste**							
Batch R4326107								
WG2925222-5 MS		**WG2925222-6**						
Chrysene			117.0		%		50-150	08-NOV-18
Dibenzo(ah)anthracene			101.4		%		50-150	08-NOV-18
Fluoranthene			106.1		%		50-150	08-NOV-18
Fluorene			101.0		%		50-150	08-NOV-18
Indeno(1,2,3-cd)pyrene			109.0		%		50-150	08-NOV-18
Naphthalene			107.9		%		50-150	08-NOV-18
Phenanthrene			106.7		%		50-150	08-NOV-18
Pyrene			110.0		%		50-150	08-NOV-18
Quinoline			111.3		%		50-150	08-NOV-18
VOC-TCLP-WT	**Waste**							
Batch R4323331								
WG2923678-1 LCS								
1,1-Dichloroethylene			118.3		%		70-130	07-NOV-18
1,2-Dichlorobenzene			110.0		%		70-130	07-NOV-18
1,2-Dichloroethane			100.9		%		70-130	07-NOV-18
1,4-Dichlorobenzene			115.5		%		70-130	07-NOV-18
Benzene			114.8		%		70-130	07-NOV-18
Carbon tetrachloride			117.2		%		60-140	07-NOV-18
Chlorobenzene			108.9		%		70-130	07-NOV-18
Chloroform			112.7		%		70-130	07-NOV-18
Dichloromethane			110.0		%		70-130	07-NOV-18
Methyl Ethyl Ketone			90.0		%		50-150	07-NOV-18
Tetrachloroethylene			118.3		%		70-130	07-NOV-18
Trichloroethylene			119.5		%		70-130	07-NOV-18
Vinyl chloride			124.4		%		60-130	07-NOV-18
WG2923678-2 MB								
1,1-Dichloroethylene			<0.025		mg/L		0.025	07-NOV-18
1,2-Dichlorobenzene			<0.025		mg/L		0.025	07-NOV-18
1,2-Dichloroethane			<0.025		mg/L		0.025	07-NOV-18
1,4-Dichlorobenzene			<0.025		mg/L		0.025	07-NOV-18
Benzene			<0.025		mg/L		0.025	07-NOV-18
Carbon tetrachloride			<0.025		mg/L		0.025	07-NOV-18
Chlorobenzene			<0.025		mg/L		0.025	07-NOV-18
Chloroform			<0.10		mg/L		0.1	07-NOV-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-TCLP-WT	**Waste**							
Batch R4323331								
WG2923678-2 MB								
Dichloromethane			<0.50		mg/L		0.5	07-NOV-18
Methyl Ethyl Ketone			<1.0		mg/L		1	07-NOV-18
Tetrachloroethylene			<0.025		mg/L		0.025	07-NOV-18
Trichloroethylene			<0.025		mg/L		0.025	07-NOV-18
Vinyl chloride			<0.050		mg/L		0.05	07-NOV-18
Surrogate: 1,4-Difluorobenzene			95.6		%		70-130	07-NOV-18
Surrogate: 4-Bromofluorobenzene			87.1		%		70-130	07-NOV-18
WG2923678-3 MS		**L2191514-1**						
1,1-Dichloroethylene			111.5		%		50-140	07-NOV-18
1,2-Dichlorobenzene			110.7		%		50-140	07-NOV-18
1,2-Dichloroethane			107.9		%		50-140	07-NOV-18
1,4-Dichlorobenzene			113.6		%		50-140	07-NOV-18
Benzene			117.6		%		50-140	07-NOV-18
Carbon tetrachloride			117.4		%		50-140	07-NOV-18
Chlorobenzene			107.9		%		50-140	07-NOV-18
Chloroform			118.1		%		50-140	07-NOV-18
Dichloromethane			112.7		%		50-140	07-NOV-18
Methyl Ethyl Ketone			86.1		%		50-140	07-NOV-18
Tetrachloroethylene			110.4		%		50-140	07-NOV-18
Trichloroethylene			119.5		%		50-140	07-NOV-18
Vinyl chloride			107.7		%		50-140	07-NOV-18

Quality Control Report

Workorder: L2191805 Report Date: 08-NOV-18

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2191805-COFC

OC Number: 17 - 728512

Page 1 of 1

Report To	Contact and company name below will appear on the final report	Report Format / Distr.	Select Service Level below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	TULLOCH ENGINEERING	Select Report Format: ☒ PDF ☒ EXCEL | | EDD (DIGITAL)	Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	ERIK GILES	Quality Control (QC) Report with Report ☒ YES ☐ NO	PRIORITY (Business Days): 4 day [P4-20%] ☐ / 3 day [P3-25%] ☐ / 2 day [P2-50%] ☐ — EMERGENCY: 1 Business day [E-100%] ☐ / Same Day, Weekend or Statutory holiday [E2-200% (Laboratory opening fees may apply)] ☐
Phone:	647-968-4644	☐ Compare Results to Criteria on Report - provide details below if box checked	Date and Time Required for all E&P TATs:
	Company address below will appear on the final report	Select Distribution: ☒ EMAIL | | MAIL ☐ FAX	For tests that can not be performed according to the service level selected, you will be contacted.
Street:	1100 SOUTH SERVICE RD	Email 1 or Fax: erik.giles@tulloch.ca	
City/Province:	STONEY CREEK, ON	Email 2: greg.ga@tulloch.ca	
Postal Code:	L8E 0C5	Email 3:	
Invoice To	Same as Report To ☐ YES ☐ NO	Invoice Distribution	
	Copy of Invoice with Report ☒ YES ☐ NO	Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX	
Company:	TULLOCH ENGINEERING	Email 1 or Fax: Nancy.Seabrook@tulloch.ca	
Contact:	NANCY SEABROOK	Email 2: erik.giles@tulloch.ca	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:	23923	AFE/Cost Center:	PO#
Job #:	18-4044	Major/Minor Code	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):	L2191805	ALS Contact: MELISSA TRAW	Sampler: E. GILES

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	RESISTIVITY/PH/EC/SALINITY	TCLP: VOC/BTEX/F1	F2-F4	TCLP METALS/Cr6/PAH	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
	18-102 SS1	29/10/18	09:10	JAR	X						1
	18-102 SS3	29/10/18	10:10	JAR (P)		X					2
	18-102 SS3	29/10/18	10:10	JAR			X				1
	18-102 SS3	29/10/18	10:10	JAR				X			1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☒ NO	
Are samples for human consumption/ use? ☐ YES ☒ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No ☐	N/A ☐
Ice Packs	☒	Ice Cubes	☐	Custody seal intact	Yes ☐ No ☐ N/A ☐
Cooling Initiated	☐				

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				18.2			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
E. GILES	02/11/18	17:00					5-NOV-18	8:45

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

[1] If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

TULLOCH ENGINEERING INC
ATTN: Erik Giles
80 Main Street West
Huntsville ON P1H 1W9

Date Received: 12-NOV-18
Report Date: 19-NOV-18 14:51 (MT)
Version: FINAL

Client Phone: 705-789-7851

Certificate of Analysis

Lab Work Order #: L2195281

Project P.O. #: NOT SUBMITTED
Job Reference: 18-4046
C of C Numbers: 17-728511
Legal Site Desc:

Emily Hansen
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2195281-1 BH18-104 SS2 Sampled By: CLIENT on 09-NOV-18 @ 08:50 Matrix: SOIL							
Physical Tests							
% Moisture	81.8		0.10	%	12-NOV-18	13-NOV-18	R4329406
pH	6.92		0.10	pH units		13-NOV-18	R4329648
Metals							
Antimony (Sb)	<1.0		1.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Arsenic (As)	2.3		1.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Barium (Ba)	264		1.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Beryllium (Be)	0.83		0.50	ug/g	14-NOV-18	14-NOV-18	R4333958
Boron (B)	9.6		5.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Cadmium (Cd)	0.54		0.50	ug/g	14-NOV-18	14-NOV-18	R4333958
Chromium (Cr)	41.2		1.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Cobalt (Co)	14.3		1.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Copper (Cu)	35.7		1.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Lead (Pb)	7.9		1.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Molybdenum (Mo)	1.1		1.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Nickel (Ni)	29.7		1.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Selenium (Se)	<1.0		1.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Silver (Ag)	<0.20		0.20	ug/g	14-NOV-18	14-NOV-18	R4333958
Thallium (Tl)	<0.50		0.50	ug/g	14-NOV-18	14-NOV-18	R4333958
Uranium (U)	1.3		1.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Vanadium (V)	47.0		1.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Zinc (Zn)	93.3		5.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Volatile Organic Compounds							
Acetone	<2.0	DLHM	2.0	ug/g	13-NOV-18	14-NOV-18	R4331947
Benzene	<0.027	DLHM	0.027	ug/g	13-NOV-18	14-NOV-18	R4331947
Bromodichloromethane	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
Bromoform	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
Bromomethane	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
Carbon tetrachloride	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
Chlorobenzene	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
Dibromochloromethane	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
Chloroform	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
1,2-Dibromoethane	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
1,2-Dichlorobenzene	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
1,3-Dichlorobenzene	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
1,4-Dichlorobenzene	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
Dichlorodifluoromethane	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
1,1-Dichloroethane	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
1,2-Dichloroethane	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
1,1-Dichloroethylene	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
cis-1,2-Dichloroethylene	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
trans-1,2-Dichloroethylene	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2195281-1 BH18-104 SS2 Sampled By: CLIENT on 09-NOV-18 @ 08:50 Matrix: SOIL							
Volatile Organic Compounds							
Methylene Chloride	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
1,2-Dichloropropane	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
cis-1,3-Dichloropropene	<0.12	DLHM	0.12	ug/g	13-NOV-18	14-NOV-18	R4331947
trans-1,3-Dichloropropene	<0.12	DLHM	0.12	ug/g	13-NOV-18	14-NOV-18	R4331947
1,3-Dichloropropene (cis & trans)	<0.17		0.17	ug/g		16-NOV-18	
Ethylbenzene	<0.070	DLHM	0.070	ug/g	13-NOV-18	14-NOV-18	R4331947
n-Hexane	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
Methyl Ethyl Ketone	<2.0	DLHM	2.0	ug/g	13-NOV-18	14-NOV-18	R4331947
Methyl Isobutyl Ketone	<2.0	DLHM	2.0	ug/g	13-NOV-18	14-NOV-18	R4331947
MTBE	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
Styrene	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
1,1,1,2-Tetrachloroethane	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
1,1,2,2-Tetrachloroethane	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
Tetrachloroethylene	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
Toluene	<0.31	DLHM	0.31	ug/g	13-NOV-18	14-NOV-18	R4331947
1,1,1-Trichloroethane	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
1,1,2-Trichloroethane	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
Trichloroethylene	<0.039	DLHM	0.039	ug/g	13-NOV-18	14-NOV-18	R4331947
Trichlorofluoromethane	<0.20	DLHM	0.20	ug/g	13-NOV-18	14-NOV-18	R4331947
Vinyl chloride	<0.078	DLHM	0.078	ug/g	13-NOV-18	14-NOV-18	R4331947
o-Xylene	<0.078	DLHM	0.078	ug/g	13-NOV-18	14-NOV-18	R4331947
m+p-Xylenes	<0.12	DLHM	0.12	ug/g	13-NOV-18	14-NOV-18	R4331947
Xylenes (Total)	<0.14		0.14	ug/g		16-NOV-18	
Surrogate: 4-Bromofluorobenzene	70.4		50-140	%	13-NOV-18	14-NOV-18	R4331947
Surrogate: 1,4-Difluorobenzene	84.6		50-140	%	13-NOV-18	14-NOV-18	R4331947
Hydrocarbons							
F1 (C6-C10)	<20	DLHM	20	ug/g	13-NOV-18	14-NOV-18	R4331947
F1-BTEX	<20		20	ug/g		16-NOV-18	
F2 (C10-C16)	<50	DLHM	50	ug/g	12-NOV-18	12-NOV-18	R4329908
F2-Naphth	<50		50	ug/g		16-NOV-18	
F3 (C16-C34)	<250	DLHM	250	ug/g	12-NOV-18	12-NOV-18	R4329908
F3-PAH	<250		250	ug/g		16-NOV-18	
F4 (C34-C50)	<250	DLHM	250	ug/g	12-NOV-18	12-NOV-18	R4329908
Total Hydrocarbons (C6-C50)	<360		360	ug/g		16-NOV-18	
Chrom. to baseline at nC50	YES				12-NOV-18	12-NOV-18	R4329908
Surrogate: 2-Bromobenzotrifluoride	89.9		60-140	%	12-NOV-18	12-NOV-18	R4329908
Surrogate: 3,4-Dichlorotoluene	57.8	SURR-ND	60-140	%	13-NOV-18	14-NOV-18	R4331947
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	<0.25	DLHM	0.25	ug/g	13-NOV-18	14-NOV-18	R4332130
Acenaphthylene	<0.25	DLHM	0.25	ug/g	13-NOV-18	14-NOV-18	R4332130
Anthracene	<0.25	DLHM	0.25	ug/g	13-NOV-18	14-NOV-18	R4332130

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2195281-1 BH18-104 SS2 Sampled By: CLIENT on 09-NOV-18 @ 08:50 Matrix: SOIL							
Polycyclic Aromatic Hydrocarbons							
Benzo(a)anthracene	<0.25	DLHM	0.25	ug/g	13-NOV-18	14-NOV-18	R4332130
Benzo(a)pyrene	<0.25	DLHM	0.25	ug/g	13-NOV-18	14-NOV-18	R4332130
Benzo(b)fluoranthene	<0.25	DLHM	0.25	ug/g	13-NOV-18	14-NOV-18	R4332130
Benzo(g,h,i)perylene	<0.25	DLHM	0.25	ug/g	13-NOV-18	14-NOV-18	R4332130
Benzo(k)fluoranthene	<0.25	DLHM	0.25	ug/g	13-NOV-18	14-NOV-18	R4332130
Chrysene	<0.25	DLHM	0.25	ug/g	13-NOV-18	14-NOV-18	R4332130
Dibenzo(ah)anthracene	<0.25	DLHM	0.25	ug/g	13-NOV-18	14-NOV-18	R4332130
Fluoranthene	<0.25	DLHM	0.25	ug/g	13-NOV-18	14-NOV-18	R4332130
Fluorene	<0.25	DLHM	0.25	ug/g	13-NOV-18	14-NOV-18	R4332130
Indeno(1,2,3-cd)pyrene	<0.25	DLHM	0.25	ug/g	13-NOV-18	14-NOV-18	R4332130
1+2-Methylnaphthalenes	<0.21		0.21	ug/g		15-NOV-18	
1-Methylnaphthalene	<0.15	DLHM	0.15	ug/g	13-NOV-18	14-NOV-18	R4332130
2-Methylnaphthalene	<0.15	DLHM	0.15	ug/g	13-NOV-18	14-NOV-18	R4332130
Naphthalene	<0.065	DLHM	0.065	ug/g	13-NOV-18	14-NOV-18	R4332130
Phenanthrene	<0.23	DLHM	0.23	ug/g	13-NOV-18	14-NOV-18	R4332130
Pyrene	<0.25	DLHM	0.25	ug/g	13-NOV-18	14-NOV-18	R4332130
Surrogate: 2-Fluorobiphenyl	77.5		50-140	%	13-NOV-18	14-NOV-18	R4332130
Surrogate: p-Terphenyl d14	74.8		50-140	%	13-NOV-18	14-NOV-18	R4332130
L2195281-2 BH18-104 SS6 Sampled By: CLIENT on 09-NOV-18 @ 10:30 Matrix: SOIL							
Physical Tests							
% Moisture	23.4		0.10	%	12-NOV-18	13-NOV-18	R4329406
pH	7.75		0.10	pH units		13-NOV-18	R4329648
Metals							
Antimony (Sb)	<1.0		1.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Arsenic (As)	3.3		1.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Barium (Ba)	346		1.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Beryllium (Be)	1.03		0.50	ug/g	14-NOV-18	14-NOV-18	R4333958
Boron (B)	11.8		5.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Cadmium (Cd)	<0.50		0.50	ug/g	14-NOV-18	14-NOV-18	R4333958
Chromium (Cr)	54.6		1.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Cobalt (Co)	17.1		1.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Copper (Cu)	32.8		1.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Lead (Pb)	8.7		1.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Molybdenum (Mo)	<1.0		1.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Nickel (Ni)	35.8		1.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Selenium (Se)	<1.0		1.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Silver (Ag)	<0.20		0.20	ug/g	14-NOV-18	14-NOV-18	R4333958
Thallium (Tl)	<0.50		0.50	ug/g	14-NOV-18	14-NOV-18	R4333958
Uranium (U)	<1.0		1.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Vanadium (V)	77.4		1.0	ug/g	14-NOV-18	14-NOV-18	R4333958

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2195281-2 BH18-104 SS6 Sampled By: CLIENT on 09-NOV-18 @ 10:30 Matrix: SOIL							
Metals							
Zinc (Zn)	96.2		5.0	ug/g	14-NOV-18	14-NOV-18	R4333958
Volatile Organic Compounds							
Acetone	<0.50		0.50	ug/g	13-NOV-18	14-NOV-18	R4331947
Benzene	<0.0068		0.0068	ug/g	13-NOV-18	14-NOV-18	R4331947
Bromodichloromethane	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
Bromoform	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
Bromomethane	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
Carbon tetrachloride	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
Chlorobenzene	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
Dibromochloromethane	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
Chloroform	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
1,2-Dibromoethane	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
1,2-Dichlorobenzene	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
1,3-Dichlorobenzene	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
1,4-Dichlorobenzene	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
Dichlorodifluoromethane	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
1,1-Dichloroethane	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
1,2-Dichloroethane	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
1,1-Dichloroethylene	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
cis-1,2-Dichloroethylene	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
trans-1,2-Dichloroethylene	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
Methylene Chloride	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
1,2-Dichloropropane	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
cis-1,3-Dichloropropene	<0.030		0.030	ug/g	13-NOV-18	14-NOV-18	R4331947
trans-1,3-Dichloropropene	<0.030		0.030	ug/g	13-NOV-18	14-NOV-18	R4331947
1,3-Dichloropropene (cis & trans)	<0.042		0.042	ug/g		16-NOV-18	
Ethylbenzene	<0.018		0.018	ug/g	13-NOV-18	14-NOV-18	R4331947
n-Hexane	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
Methyl Ethyl Ketone	<0.50		0.50	ug/g	13-NOV-18	14-NOV-18	R4331947
Methyl Isobutyl Ketone	<0.50		0.50	ug/g	13-NOV-18	14-NOV-18	R4331947
MTBE	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
Styrene	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
1,1,1,2-Tetrachloroethane	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
1,1,2,2-Tetrachloroethane	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
Tetrachloroethylene	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
Toluene	<0.080		0.080	ug/g	13-NOV-18	14-NOV-18	R4331947
1,1,1-Trichloroethane	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
1,1,2-Trichloroethane	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
Trichloroethylene	<0.010		0.010	ug/g	13-NOV-18	14-NOV-18	R4331947
Trichlorofluoromethane	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4331947
Vinyl chloride	<0.020		0.020	ug/g	13-NOV-18	14-NOV-18	R4331947

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2195281-2 BH18-104 SS6 Sampled By: CLIENT on 09-NOV-18 @ 10:30 Matrix: SOIL							
Volatile Organic Compounds							
o-Xylene	<0.020		0.020	ug/g	13-NOV-18	14-NOV-18	R4331947
m+p-Xylenes	<0.030		0.030	ug/g	13-NOV-18	14-NOV-18	R4331947
Xylenes (Total)	<0.050		0.050	ug/g		16-NOV-18	
Surrogate: 4-Bromofluorobenzene	98.2		50-140	%	13-NOV-18	14-NOV-18	R4331947
Surrogate: 1,4-Difluorobenzene	115.6		50-140	%	13-NOV-18	14-NOV-18	R4331947
Hydrocarbons							
F1 (C6-C10)	<5.0		5.0	ug/g	13-NOV-18	14-NOV-18	R4331947
F1-BTEX	<5.0		5.0	ug/g		16-NOV-18	
F2 (C10-C16)	<10		10	ug/g	12-NOV-18	12-NOV-18	R4329908
F2-Naphth	<10		10	ug/g		16-NOV-18	
F3 (C16-C34)	<50		50	ug/g	12-NOV-18	12-NOV-18	R4329908
F3-PAH	<50		50	ug/g		16-NOV-18	
F4 (C34-C50)	<50		50	ug/g	12-NOV-18	12-NOV-18	R4329908
Total Hydrocarbons (C6-C50)	<72		72	ug/g		16-NOV-18	
Chrom. to baseline at nC50	YES				12-NOV-18	12-NOV-18	R4329908
Surrogate: 2-Bromobenzotrifluoride	91.4		60-140	%	12-NOV-18	12-NOV-18	R4329908
Surrogate: 3,4-Dichlorotoluene	81.7		60-140	%	13-NOV-18	14-NOV-18	R4331947
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4332130
Acenaphthylene	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4332130
Anthracene	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4332130
Benzo(a)anthracene	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4332130
Benzo(a)pyrene	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4332130
Benzo(b)fluoranthene	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4332130
Benzo(g,h,i)perylene	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4332130
Benzo(k)fluoranthene	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4332130
Chrysene	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4332130
Dibenzo(ah)anthracene	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4332130
Fluoranthene	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4332130
Fluorene	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4332130
Indeno(1,2,3-cd)pyrene	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4332130
1+2-Methylnaphthalenes	<0.042		0.042	ug/g		14-NOV-18	
1-Methylnaphthalene	<0.030		0.030	ug/g	13-NOV-18	14-NOV-18	R4332130
2-Methylnaphthalene	<0.030		0.030	ug/g	13-NOV-18	14-NOV-18	R4332130
Naphthalene	<0.013		0.013	ug/g	13-NOV-18	14-NOV-18	R4332130
Phenanthrene	<0.046		0.046	ug/g	13-NOV-18	14-NOV-18	R4332130
Pyrene	<0.050		0.050	ug/g	13-NOV-18	14-NOV-18	R4332130
Surrogate: 2-Fluorobiphenyl	80.1		50-140	%	13-NOV-18	14-NOV-18	R4332130
Surrogate: p-Terphenyl d14	79.6		50-140	%	13-NOV-18	14-NOV-18	R4332130

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Sample Parameter Qualifier key listed:

Qualifier	Description
DLHM	Detection Limit Adjusted: Sample has High Moisture Content
SURR-ND	Surrogate recovery marginally exceeded ALS DQO. Reported non-detect results for associated samples were deemed to be unaffected.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
F1-F4-511-CALC-WT	Soil	F1-F4 Hydrocarbon Calculated Parameters	CCME CWS-PHC, Pub #1310, Dec 2001-S

Analytical methods used for analysis of CCME Petroleum Hydrocarbons have been validated and comply with the Reference Method for the CWS PHC.

Hydrocarbon results are expressed on a dry weight basis.

In cases where results for both F4 and F4G are reported, the greater of the two results must be used in any application of the CWS PHC guidelines and the gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.
In samples where BTEX and F1 were analyzed , F1-BTEX represents a value where the sum of Benzene, Toluene, Ethylbenzene and total Xylenes has been subtracted from F1.

In samples where PAHs, F2 and F3 were analyzed, F2-Naphth represents the result where Naphthalene has been subtracted from F2. F3-PAH represents a result where the sum of Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzo(a,h)anthracene, Fluoranthene, Indeno(1,2,3-cd)pyrene, Phenanthrene, and Pyrene has been subtracted from F3.

Unless otherwise qualified, the following quality control criteria have been met for the F1 hydrocarbon range:
1. All extraction and analysis holding times were met.
2. Instrument performance showing response factors for C6 and C10 within 30% of the response factor for toluene.
3. Linearity of gasoline response within 15% throughout the calibration range.

Unless otherwise qualified, the following quality control criteria have been met for the F2-F4 hydrocarbon ranges:
1. All extraction and analysis holding times were met.
2. Instrument performance showing C10, C16 and C34 response factors within 10% of their average.
3. Instrument performance showing the C50 response factor within 30% of the average of the C10, C16 and C34 response factors.
4. Linearity of diesel or motor oil response within 15% throughout the calibration range.

F1-HS-511-WT Soil F1-O.Reg 153/04 (July 2011) E3398/CCME TIER 1-HS

Fraction F1 is determined by extracting a soil or sediment sample as received with methanol, then analyzing by headspace-GC/FID.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

F2-F4-511-WT Soil F2-F4-O.Reg 153/04 (July 2011) CCME Tier 1

Petroleum Hydrocarbons (F2-F4 fractions) are extracted from soil with 1:1 hexane:acetone using a rotary extractor. Extracts are treated with silica gel to remove polar organic interferences. F2, F3, & F4 are analyzed by GC-FID. F4G-sg is analyzed gravimetrically.

Notes:
1. F2 (C10-C16): Sum of all hydrocarbons that elute between nC10 and nC16.
2. F3 (C16-C34): Sum of all hydrocarbons that elute between nC16 and nC34.
3. F4 (C34-C50): Sum of all hydrocarbons that elute between nC34 and nC50.
4. F4G: Gravimetric Heavy Hydrocarbons
5. F4G-sg: Gravimetric Heavy Hydrocarbons (F4G) after silica gel treatment.
6. Where both F4 (C34-C50) and F4G-sg are reported for a sample, the larger of the two values is used for comparison against the relevant CCME guideline for F4.
7. F4G-sg cannot be added to the C6 to C50 hydrocarbon results to obtain an estimate of total extractable hydrocarbons.
8. This method is validated for use.
9. Data from analysis of validation and quality control samples is available upon request.
10. Reported results are expressed as milligrams per dry kilogram, unless otherwise indicated.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

MET-200.2-CCMS-WT Soil Metals in Soil by CRC ICPMS EPA 200.2/6020A (mod)

Soil/sediment is dried, disaggregated, and sieved (2 mm). For tests intended to support Ontario regulations, the <2mm fraction is ground to pass through a 0.355 mm sieve. Strong Acid Leachable Metals in the <2mm fraction are solubilized by heated digestion with nitric and hydrochloric acids. Instrumental analysis is by Collision / Reaction Cell ICPMS.

Limitations: This method is intended to liberate environmentally available metals. Silicate minerals are not solubilized. Some metals may be only partially recovered (matrix dependent), including Al, Ba, Be, Cr, S, Sr, Ti, Tl, V, W, and Zr. Elemental Sulfur may be poorly recovered by this method. Volatile forms of sulfur (e.g. sulfide, H2S) may be excluded if lost during sampling, storage, or digestion.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

Reference Information

METHYLNAPS-CALC-WT	Soil	ABN-Calculated Parameters	SW846 8270
MOISTURE-WT	Soil	% Moisture	Gravimetric: Oven Dried
PAH-511-WT	Soil	PAH-O.Reg 153/04 (July 2011)	SW846 3510/8270

A representative sub-sample of soil is fortified with deuterium-labelled surrogates and a mechanical shaking techniqueis used to extract the sample with a mixture of methanol and toluene. The extracts are concentrated and analyzed by GC/MS. Results for benzo(b) fluoranthene may include contributions from benzo(j)fluoranthene, if also present in the sample.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

PH-WT	Soil	pH	MOEE E3137A

A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

VOC-1,3-DCP-CALC-WT	Soil	Regulation 153 VOCs	SW8260B/SW8270C
VOC-511-HS-WT	Soil	VOC-O.Reg 153/04 (July 2011)	SW846 8260 (511)

Soil and sediment samples are extracted in methanol and analyzed by headspace-GC/MS.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

XYLENES-SUM-CALC-WT	Soil	Sum of Xylene Isomer Concentrations	CALCULATION

Total xylenes represents the sum of o-xylene and m&p-xylene.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

17-728511

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L2195281 Report Date: 19-NOV-18

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
F1-HS-511-WT	**Soil**							
Batch R4331947								
WG2928919-4 DUP		**WG2928919-3**						
F1 (C6-C10)		<5.0	<5.0	RPD-NA	ug/g	N/A	30	14-NOV-18
WG2928919-2 LCS								
F1 (C6-C10)			96.2		%		80-120	14-NOV-18
WG2928919-1 MB								
F1 (C6-C10)			<5.0		ug/g		5	14-NOV-18
Surrogate: 3,4-Dichlorotoluene			103.4		%		60-140	14-NOV-18
WG2928919-6 MS		**L2195310-3**						
F1 (C6-C10)			76.5		%		60-140	14-NOV-18
F2-F4-511-WT	**Soil**							
Batch R4329908								
WG2928576-3 DUP		**WG2928576-5**						
F2 (C10-C16)		<10	<10	RPD-NA	ug/g	N/A	30	12-NOV-18
F3 (C16-C34)		<50	<50	RPD-NA	ug/g	N/A	30	12-NOV-18
F4 (C34-C50)		<50	<50	RPD-NA	ug/g	N/A	30	12-NOV-18
WG2928576-2 LCS								
F2 (C10-C16)			102.6		%		80-120	12-NOV-18
F3 (C16-C34)			104.8		%		80-120	12-NOV-18
F4 (C34-C50)			108.7		%		80-120	12-NOV-18
WG2928576-1 MB								
F2 (C10-C16)			<10		ug/g		10	12-NOV-18
F3 (C16-C34)			<50		ug/g		50	12-NOV-18
F4 (C34-C50)			<50		ug/g		50	12-NOV-18
Surrogate: 2-Bromobenzotrifluoride			82.0		%		60-140	12-NOV-18
WG2928576-4 MS		**WG2928576-5**						
F2 (C10-C16)			94.4		%		60-140	12-NOV-18
F3 (C16-C34)			100.1		%		60-140	12-NOV-18
F4 (C34-C50)			106.4		%		60-140	12-NOV-18
MET-200.2-CCMS-WT	**Soil**							
Batch R4333958								
WG2929782-2 CRM		**WT-CANMET-TILL1**						
Antimony (Sb)			106.9		%		70-130	14-NOV-18
Arsenic (As)			108.7		%		70-130	14-NOV-18
Barium (Ba)			109.1		%		70-130	14-NOV-18
Beryllium (Be)			110.1		%		70-130	14-NOV-18
Boron (B)			3.1		mg/kg		0-8.2	14-NOV-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-WT	**Soil**							
Batch R4333958								
WG2929782-2 CRM		**WT-CANMET-TILL1**						
Cadmium (Cd)			109.3		%		70-130	14-NOV-18
Chromium (Cr)			105.6		%		70-130	14-NOV-18
Cobalt (Co)			107.9		%		70-130	14-NOV-18
Copper (Cu)			110.8		%		70-130	14-NOV-18
Lead (Pb)			109.0		%		70-130	14-NOV-18
Molybdenum (Mo)			105.8		%		70-130	14-NOV-18
Nickel (Ni)			108.6		%		70-130	14-NOV-18
Selenium (Se)			0.31		mg/kg		0.11-0.51	14-NOV-18
Silver (Ag)			0.26		mg/kg		0.13-0.33	14-NOV-18
Thallium (Tl)			0.139		mg/kg		0.077-0.18	14-NOV-18
Uranium (U)			106.0		%		70-130	14-NOV-18
Vanadium (V)			106.2		%		70-130	14-NOV-18
Zinc (Zn)			104.6		%		70-130	14-NOV-18
WG2929782-6 DUP		**WG2929782-5**						
Antimony (Sb)		0.16	0.16		ug/g	0.2	30	14-NOV-18
Arsenic (As)		6.52	6.04		ug/g	7.6	30	14-NOV-18
Barium (Ba)		177	169		ug/g	4.7	40	14-NOV-18
Beryllium (Be)		0.64	0.57		ug/g	11	30	14-NOV-18
Boron (B)		12.7	10.7		ug/g	17	30	14-NOV-18
Cadmium (Cd)		0.111	0.111		ug/g	0.1	30	14-NOV-18
Chromium (Cr)		22.8	21.2		ug/g	7.4	30	14-NOV-18
Cobalt (Co)		13.9	13.0		ug/g	7.1	30	14-NOV-18
Copper (Cu)		40.8	38.6		ug/g	5.3	30	14-NOV-18
Lead (Pb)		12.8	12.9		ug/g	0.4	40	14-NOV-18
Molybdenum (Mo)		0.48	0.43		ug/g	9.2	40	14-NOV-18
Nickel (Ni)		28.7	27.1		ug/g	5.7	30	14-NOV-18
Selenium (Se)		<0.20	<0.20	RPD-NA	ug/g	N/A	30	14-NOV-18
Silver (Ag)		<0.10	<0.10	RPD-NA	ug/g	N/A	40	14-NOV-18
Thallium (Tl)		0.127	0.129		ug/g	1.4	30	14-NOV-18
Uranium (U)		0.586	0.565		ug/g	3.5	30	14-NOV-18
Vanadium (V)		32.5	30.2		ug/g	7.3	30	14-NOV-18
Zinc (Zn)		68.5	64.9		ug/g	5.5	30	14-NOV-18
WG2929782-4 LCS								

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-WT	**Soil**							
Batch R4333958								
WG2929782-4 LCS								
Antimony (Sb)			103.3		%		80-120	14-NOV-18
Arsenic (As)			112.0		%		80-120	14-NOV-18
Barium (Ba)			111.1		%		80-120	14-NOV-18
Beryllium (Be)			114.7		%		80-120	14-NOV-18
Boron (B)			110.4		%		80-120	14-NOV-18
Cadmium (Cd)			109.6		%		80-120	14-NOV-18
Chromium (Cr)			109.6		%		80-120	14-NOV-18
Cobalt (Co)			107.8		%		80-120	14-NOV-18
Copper (Cu)			106.9		%		80-120	14-NOV-18
Lead (Pb)			102.4		%		80-120	14-NOV-18
Molybdenum (Mo)			103.9		%		80-120	14-NOV-18
Nickel (Ni)			106.9		%		80-120	14-NOV-18
Selenium (Se)			103.2		%		80-120	14-NOV-18
Silver (Ag)			107.5		%		80-120	14-NOV-18
Thallium (Tl)			100.8		%		80-120	14-NOV-18
Uranium (U)			97.8		%		80-120	14-NOV-18
Vanadium (V)			112.8		%		80-120	14-NOV-18
Zinc (Zn)			102.5		%		80-120	14-NOV-18
WG2929782-1 MB								
Antimony (Sb)			<0.10		mg/kg		0.1	14-NOV-18
Arsenic (As)			<0.10		mg/kg		0.1	14-NOV-18
Barium (Ba)			<0.50		mg/kg		0.5	14-NOV-18
Beryllium (Be)			<0.10		mg/kg		0.1	14-NOV-18
Boron (B)			<5.0		mg/kg		5	14-NOV-18
Cadmium (Cd)			<0.020		mg/kg		0.02	14-NOV-18
Chromium (Cr)			<0.50		mg/kg		0.5	14-NOV-18
Cobalt (Co)			<0.10		mg/kg		0.1	14-NOV-18
Copper (Cu)			<0.50		mg/kg		0.5	14-NOV-18
Lead (Pb)			<0.50		mg/kg		0.5	14-NOV-18
Molybdenum (Mo)			<0.10		mg/kg		0.1	14-NOV-18
Nickel (Ni)			<0.50		mg/kg		0.5	14-NOV-18
Selenium (Se)			<0.20		mg/kg		0.2	14-NOV-18
Silver (Ag)			<0.10		mg/kg		0.1	14-NOV-18
Thallium (Tl)			<0.050		mg/kg		0.05	14-NOV-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-WT	**Soil**							
Batch R4333958								
WG2929782-1 MB								
Uranium (U)			<0.050		mg/kg		0.05	14-NOV-18
Vanadium (V)			<0.20		mg/kg		0.2	14-NOV-18
Zinc (Zn)			<2.0		mg/kg		2	14-NOV-18
MOISTURE-WT	**Soil**							
Batch R4329406								
WG2928734-3 DUP		**L2195281-1**						
% Moisture		81.8	83.2		%	1.8	20	13-NOV-18
WG2928734-2 LCS								
% Moisture			100.5		%		90-110	13-NOV-18
WG2928734-1 MB								
% Moisture			<0.10		%		0.1	13-NOV-18
PAH-511-WT	**Soil**							
Batch R4332130								
WG2928871-3 DUP		**WG2928871-5**						
1-Methylnaphthalene		<0.030	<0.030	RPD-NA	ug/g	N/A	40	14-NOV-18
2-Methylnaphthalene		<0.030	<0.030	RPD-NA	ug/g	N/A	40	14-NOV-18
Acenaphthene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
Acenaphthylene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
Anthracene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
Benzo(a)anthracene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
Benzo(a)pyrene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
Benzo(b)fluoranthene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
Benzo(g,h,i)perylene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
Benzo(k)fluoranthene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
Chrysene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
Dibenzo(ah)anthracene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
Fluoranthene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
Fluorene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
Indeno(1,2,3-cd)pyrene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
Naphthalene		<0.013	<0.013	RPD-NA	ug/g	N/A	40	14-NOV-18
Phenanthrene		<0.046	<0.046	RPD-NA	ug/g	N/A	40	14-NOV-18
Pyrene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
WG2928871-2 LCS								
1-Methylnaphthalene			98.3		%		50-140	14-NOV-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-511-WT	**Soil**							
Batch R4332130								
WG2928871-2 LCS								
2-Methylnaphthalene			98.4		%		50-140	14-NOV-18
Acenaphthene			99.2		%		50-140	14-NOV-18
Acenaphthylene			95.6		%		50-140	14-NOV-18
Anthracene			94.2		%		50-140	14-NOV-18
Benzo(a)anthracene			95.4		%		50-140	14-NOV-18
Benzo(a)pyrene			93.0		%		50-140	14-NOV-18
Benzo(b)fluoranthene			92.6		%		50-140	14-NOV-18
Benzo(g,h,i)perylene			85.3		%		50-140	14-NOV-18
Benzo(k)fluoranthene			94.4		%		50-140	14-NOV-18
Chrysene			102.9		%		50-140	14-NOV-18
Dibenzo(ah)anthracene			85.9		%		50-140	14-NOV-18
Fluoranthene			94.1		%		50-140	14-NOV-18
Fluorene			95.2		%		50-140	14-NOV-18
Indeno(1,2,3-cd)pyrene			85.5		%		50-140	14-NOV-18
Naphthalene			95.7		%		50-140	14-NOV-18
Phenanthrene			94.1		%		50-140	14-NOV-18
Pyrene			95.1		%		50-140	14-NOV-18
WG2928871-1 MB								
1-Methylnaphthalene			<0.030		ug/g		0.03	14-NOV-18
2-Methylnaphthalene			<0.030		ug/g		0.03	14-NOV-18
Acenaphthene			<0.050		ug/g		0.05	14-NOV-18
Acenaphthylene			<0.050		ug/g		0.05	14-NOV-18
Anthracene			<0.050		ug/g		0.05	14-NOV-18
Benzo(a)anthracene			<0.050		ug/g		0.05	14-NOV-18
Benzo(a)pyrene			<0.050		ug/g		0.05	14-NOV-18
Benzo(b)fluoranthene			<0.050		ug/g		0.05	14-NOV-18
Benzo(g,h,i)perylene			<0.050		ug/g		0.05	14-NOV-18
Benzo(k)fluoranthene			<0.050		ug/g		0.05	14-NOV-18
Chrysene			<0.050		ug/g		0.05	14-NOV-18
Dibenzo(ah)anthracene			<0.050		ug/g		0.05	14-NOV-18
Fluoranthene			<0.050		ug/g		0.05	14-NOV-18
Fluorene			<0.050		ug/g		0.05	14-NOV-18
Indeno(1,2,3-cd)pyrene			<0.050		ug/g		0.05	14-NOV-18
Naphthalene			<0.013		ug/g		0.013	14-NOV-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-511-WT	**Soil**							
Batch R4332130								
WG2928871-1 MB								
Phenanthrene			<0.046		ug/g		0.046	14-NOV-18
Pyrene			<0.050		ug/g		0.05	14-NOV-18
Surrogate: 2-Fluorobiphenyl			75.4		%		50-140	14-NOV-18
Surrogate: p-Terphenyl d14			70.1		%		50-140	14-NOV-18
WG2928871-4 MS		**WG2928871-5**						
1-Methylnaphthalene			95.1		%		50-140	14-NOV-18
2-Methylnaphthalene			95.1		%		50-140	14-NOV-18
Acenaphthene			96.0		%		50-140	14-NOV-18
Acenaphthylene			91.5		%		50-140	14-NOV-18
Anthracene			90.2		%		50-140	14-NOV-18
Benzo(a)anthracene			91.3		%		50-140	14-NOV-18
Benzo(a)pyrene			87.9		%		50-140	14-NOV-18
Benzo(b)fluoranthene			91.2		%		50-140	14-NOV-18
Benzo(g,h,i)perylene			79.6		%		50-140	14-NOV-18
Benzo(k)fluoranthene			89.9		%		50-140	14-NOV-18
Chrysene			99.2		%		50-140	14-NOV-18
Dibenzo(ah)anthracene			81.4		%		50-140	14-NOV-18
Fluoranthene			90.4		%		50-140	14-NOV-18
Fluorene			92.4		%		50-140	14-NOV-18
Indeno(1,2,3-cd)pyrene			80.5		%		50-140	14-NOV-18
Naphthalene			92.5		%		50-140	14-NOV-18
Phenanthrene			90.7		%		50-140	14-NOV-18
Pyrene			91.2		%		50-140	14-NOV-18
PH-WT	**Soil**							
Batch R4329648								
WG2928572-1 DUP		**L2195243-1**						
pH		7.57	7.63	J	pH units	0.06	0.3	13-NOV-18
WG2928948-1 LCS								
pH			6.99		pH units		6.9-7.1	13-NOV-18
VOC-511-HS-WT	**Soil**							
Batch R4331947								
WG2928919-4 DUP		**WG2928919-3**						
1,1,1,2-Tetrachloroethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
1,1,2,2-Tetrachloroethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-511-HS-WT	**Soil**							
Batch R4331947								
WG2928919-4 DUP		**WG2928919-3**						
1,1,1-Trichloroethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
1,1,2-Trichloroethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
1,1-Dichloroethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
1,1-Dichloroethylene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
1,2-Dibromoethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
1,2-Dichlorobenzene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
1,2-Dichloroethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
1,2-Dichloropropane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
1,3-Dichlorobenzene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
1,4-Dichlorobenzene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
Acetone		<0.50	<0.50	RPD-NA	ug/g	N/A	40	14-NOV-18
Benzene		<0.0068	<0.0068	RPD-NA	ug/g	N/A	40	14-NOV-18
Bromodichloromethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
Bromoform		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
Bromomethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
Carbon tetrachloride		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
Chlorobenzene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
Chloroform		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
cis-1,2-Dichloroethylene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
cis-1,3-Dichloropropene		<0.030	<0.030	RPD-NA	ug/g	N/A	40	14-NOV-18
Dibromochloromethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
Dichlorodifluoromethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
Ethylbenzene		<0.018	<0.018	RPD-NA	ug/g	N/A	40	14-NOV-18
n-Hexane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
Methylene Chloride		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
MTBE		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
m+p-Xylenes		<0.030	<0.030	RPD-NA	ug/g	N/A	40	14-NOV-18
Methyl Ethyl Ketone		<0.50	<0.50	RPD-NA	ug/g	N/A	40	14-NOV-18
Methyl Isobutyl Ketone		<0.50	<0.50	RPD-NA	ug/g	N/A	40	14-NOV-18
o-Xylene		<0.020	<0.020	RPD-NA	ug/g	N/A	40	14-NOV-18
Styrene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
Tetrachloroethylene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
Toluene		<0.080	<0.080		ug/g			14-NOV-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-511-HS-WT	**Soil**							
Batch R4331947								
WG2928919-4 DUP		**WG2928919-3**						
Toluene		<0.080	<0.080	RPD-NA	ug/g	N/A	40	14-NOV-18
trans-1,2-Dichloroethylene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
trans-1,3-Dichloropropene		<0.030	<0.030	RPD-NA	ug/g	N/A	40	14-NOV-18
Trichloroethylene		<0.010	<0.010	RPD-NA	ug/g	N/A	40	14-NOV-18
Trichlorofluoromethane		<0.050	<0.050	RPD-NA	ug/g	N/A	40	14-NOV-18
Vinyl chloride		<0.020	<0.020	RPD-NA	ug/g	N/A	40	14-NOV-18
WG2928919-2 LCS								
1,1,1,2-Tetrachloroethane			111.1		%		60-130	14-NOV-18
1,1,2,2-Tetrachloroethane			122.2		%		60-130	14-NOV-18
1,1,1-Trichloroethane			119.6		%		60-130	14-NOV-18
1,1,2-Trichloroethane			114.1		%		60-130	14-NOV-18
1,1-Dichloroethane			122.7		%		60-130	14-NOV-18
1,1-Dichloroethylene			114.7		%		60-130	14-NOV-18
1,2-Dibromoethane			123.1		%		70-130	14-NOV-18
1,2-Dichlorobenzene			120.6		%		70-130	14-NOV-18
1,2-Dichloroethane			125.8		%		60-130	14-NOV-18
1,2-Dichloropropane			119.2		%		70-130	14-NOV-18
1,3-Dichlorobenzene			120.3		%		70-130	14-NOV-18
1,4-Dichlorobenzene			123.6		%		70-130	14-NOV-18
Acetone			119.4		%		60-140	14-NOV-18
Benzene			120.1		%		70-130	14-NOV-18
Bromodichloromethane			121.7		%		50-140	14-NOV-18
Bromoform			120.9		%		70-130	14-NOV-18
Bromomethane			116.0		%		50-140	14-NOV-18
Carbon tetrachloride			117.1		%		70-130	14-NOV-18
Chlorobenzene			116.4		%		70-130	14-NOV-18
Chloroform			121.6		%		70-130	14-NOV-18
cis-1,2-Dichloroethylene			116.6		%		70-130	14-NOV-18
cis-1,3-Dichloropropene			125.0		%		70-130	14-NOV-18
Dibromochloromethane			122.6		%		60-130	14-NOV-18
Dichlorodifluoromethane			87.7		%		50-140	14-NOV-18
Ethylbenzene			109.1		%		70-130	14-NOV-18
n-Hexane			102.5		%		70-130	14-NOV-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-511-HS-WT	**Soil**							
Batch R4331947								
WG2928919-2 LCS								
Methylene Chloride			120.4		%		70-130	14-NOV-18
MTBE			129.9		%		70-130	14-NOV-18
m+p-Xylenes			115.4		%		70-130	14-NOV-18
Methyl Ethyl Ketone			121.4		%		60-140	14-NOV-18
Methyl Isobutyl Ketone			107.4		%		60-140	14-NOV-18
o-Xylene			106.3		%		70-130	14-NOV-18
Styrene			115.9		%		70-130	14-NOV-18
Tetrachloroethylene			113.5		%		60-130	14-NOV-18
Toluene			110.2		%		70-130	14-NOV-18
trans-1,2-Dichloroethylene			123.0		%		60-130	14-NOV-18
trans-1,3-Dichloropropene			130.0		%		70-130	14-NOV-18
Trichloroethylene			118.8		%		60-130	14-NOV-18
Trichlorofluoromethane			121.5		%		50-140	14-NOV-18
Vinyl chloride			114.7		%		60-140	14-NOV-18
WG2928919-1 MB								
1,1,1,2-Tetrachloroethane			<0.050		ug/g		0.05	14-NOV-18
1,1,2,2-Tetrachloroethane			<0.050		ug/g		0.05	14-NOV-18
1,1,1-Trichloroethane			<0.050		ug/g		0.05	14-NOV-18
1,1,2-Trichloroethane			<0.050		ug/g		0.05	14-NOV-18
1,1-Dichloroethane			<0.050		ug/g		0.05	14-NOV-18
1,1-Dichloroethylene			<0.050		ug/g		0.05	14-NOV-18
1,2-Dibromoethane			<0.050		ug/g		0.05	14-NOV-18
1,2-Dichlorobenzene			<0.050		ug/g		0.05	14-NOV-18
1,2-Dichloroethane			<0.050		ug/g		0.05	14-NOV-18
1,2-Dichloropropane			<0.050		ug/g		0.05	14-NOV-18
1,3-Dichlorobenzene			<0.050		ug/g		0.05	14-NOV-18
1,4-Dichlorobenzene			<0.050		ug/g		0.05	14-NOV-18
Acetone			<0.50		ug/g		0.5	14-NOV-18
Benzene			<0.0068		ug/g		0.0068	14-NOV-18
Bromodichloromethane			<0.050		ug/g		0.05	14-NOV-18
Bromoform			<0.050		ug/g		0.05	14-NOV-18
Bromomethane			<0.050		ug/g		0.05	14-NOV-18
Carbon tetrachloride			<0.050		ug/g		0.05	14-NOV-18
Chlorobenzene			<0.050		ug/g		0.05	14-NOV-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-511-HS-WT	**Soil**							
Batch R4331947								
WG2928919-1 MB								
Chloroform			<0.050		ug/g		0.05	14-NOV-18
cis-1,2-Dichloroethylene			<0.050		ug/g		0.05	14-NOV-18
cis-1,3-Dichloropropene			<0.030		ug/g		0.03	14-NOV-18
Dibromochloromethane			<0.050		ug/g		0.05	14-NOV-18
Dichlorodifluoromethane			<0.050		ug/g		0.05	14-NOV-18
Ethylbenzene			<0.018		ug/g		0.018	14-NOV-18
n-Hexane			<0.050		ug/g		0.05	14-NOV-18
Methylene Chloride			<0.050		ug/g		0.05	14-NOV-18
MTBE			<0.050		ug/g		0.05	14-NOV-18
m+p-Xylenes			<0.030		ug/g		0.03	14-NOV-18
Methyl Ethyl Ketone			<0.50		ug/g		0.5	14-NOV-18
Methyl Isobutyl Ketone			<0.50		ug/g		0.5	14-NOV-18
o-Xylene			<0.020		ug/g		0.02	14-NOV-18
Styrene			<0.050		ug/g		0.05	14-NOV-18
Tetrachloroethylene			<0.050		ug/g		0.05	14-NOV-18
Toluene			<0.080		ug/g		0.08	14-NOV-18
trans-1,2-Dichloroethylene			<0.050		ug/g		0.05	14-NOV-18
trans-1,3-Dichloropropene			<0.030		ug/g		0.03	14-NOV-18
Trichloroethylene			<0.010		ug/g		0.01	14-NOV-18
Trichlorofluoromethane			<0.050		ug/g		0.05	14-NOV-18
Vinyl chloride			<0.020		ug/g		0.02	14-NOV-18
Surrogate: 1,4-Difluorobenzene			142.9	RRQC	%		50-140	14-NOV-18
Surrogate: 4-Bromofluorobenzene			117.8		%		50-140	14-NOV-18
COMMENTS: Surrogate recovery marginally exceeded ALS DQO. Reported non-detect results for associated samples were deemed to be unaffected.								
WG2928919-5 MS		**L2195273-4**						
1,1,1,2-Tetrachloroethane			116.2		%		50-140	14-NOV-18
1,1,2,2-Tetrachloroethane			129.0		%		50-140	14-NOV-18
1,1,1-Trichloroethane			121.8		%		50-140	14-NOV-18
1,1,2-Trichloroethane			121.5		%		50-140	14-NOV-18
1,1-Dichloroethane			125.5		%		50-140	14-NOV-18
1,1-Dichloroethylene			115.1		%		50-140	14-NOV-18
1,2-Dibromoethane			132.2		%		50-140	14-NOV-18
1,2-Dichlorobenzene			126.9		%		50-140	14-NOV-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-511-HS-WT	**Soil**							
Batch R4331947								
WG2928919-5 MS		**L2195273-4**						
1,2-Dichloroethane			131.4		%		50-140	14-NOV-18
1,2-Dichloropropane			124.1		%		50-140	14-NOV-18
1,3-Dichlorobenzene			126.3		%		50-140	14-NOV-18
1,4-Dichlorobenzene			129.0		%		50-140	14-NOV-18
Acetone			133.6		%		50-140	14-NOV-18
Benzene			123.8		%		50-140	14-NOV-18
Bromodichloromethane			126.8		%		50-140	14-NOV-18
Bromoform			129.9		%		50-140	14-NOV-18
Bromomethane			115.1		%		50-140	14-NOV-18
Carbon tetrachloride			119.2		%		50-140	14-NOV-18
Chlorobenzene			121.9		%		50-140	14-NOV-18
Chloroform			125.5		%		50-140	14-NOV-18
cis-1,2-Dichloroethylene			121.1		%		50-140	14-NOV-18
cis-1,3-Dichloropropene			125.2		%		50-140	14-NOV-18
Dibromochloromethane			131.1		%		50-140	14-NOV-18
Dichlorodifluoromethane			80.9		%		50-140	14-NOV-18
Ethylbenzene			113.0		%		50-140	14-NOV-18
n-Hexane			102.1		%		50-140	14-NOV-18
Methylene Chloride			124.6		%		50-140	14-NOV-18
MTBE			134.9		%		50-140	14-NOV-18
m+p-Xylenes			119.4		%		50-140	14-NOV-18
Methyl Ethyl Ketone			128.4		%		50-140	14-NOV-18
Methyl Isobutyl Ketone			114.2		%		50-140	14-NOV-18
o-Xylene			110.5		%		50-140	14-NOV-18
Styrene			121.3		%		50-140	14-NOV-18
Tetrachloroethylene			117.8		%		50-140	14-NOV-18
Toluene			115.2		%		50-140	14-NOV-18
trans-1,2-Dichloroethylene			124.6		%		50-140	14-NOV-18
trans-1,3-Dichloropropene			132.2		%		50-140	14-NOV-18
Trichloroethylene			122.7		%		50-140	14-NOV-18
Trichlorofluoromethane			121.1		%		50-140	14-NOV-18
Vinyl chloride			112.8		%		50-140	14-NOV-18

Quality Control Report

Workorder: L2195281 Report Date: 19-NOV-18

Client: TULLOCH ENGINEERING INC
80 Main Street West
Huntsville ON P1H 1W9
Contact: Erik Giles

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.
RRQC	Refer to report remarks for information regarding this QC result.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

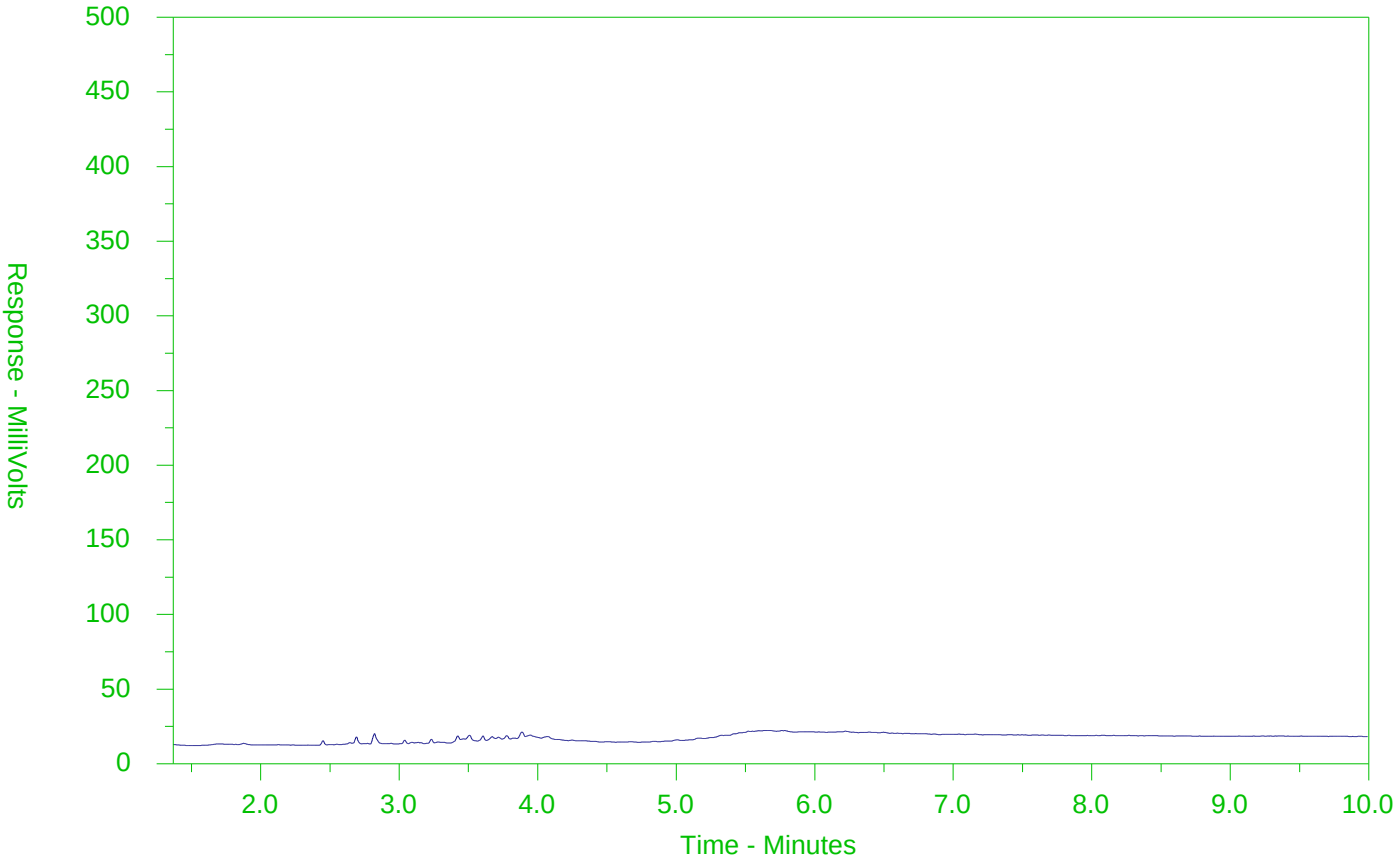
ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2195281-1
Client Sample ID: BH18-104 SS2



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →	← Motor Oils/Lube Oils/Grease →		
← Diesel/Jet Fuels →			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

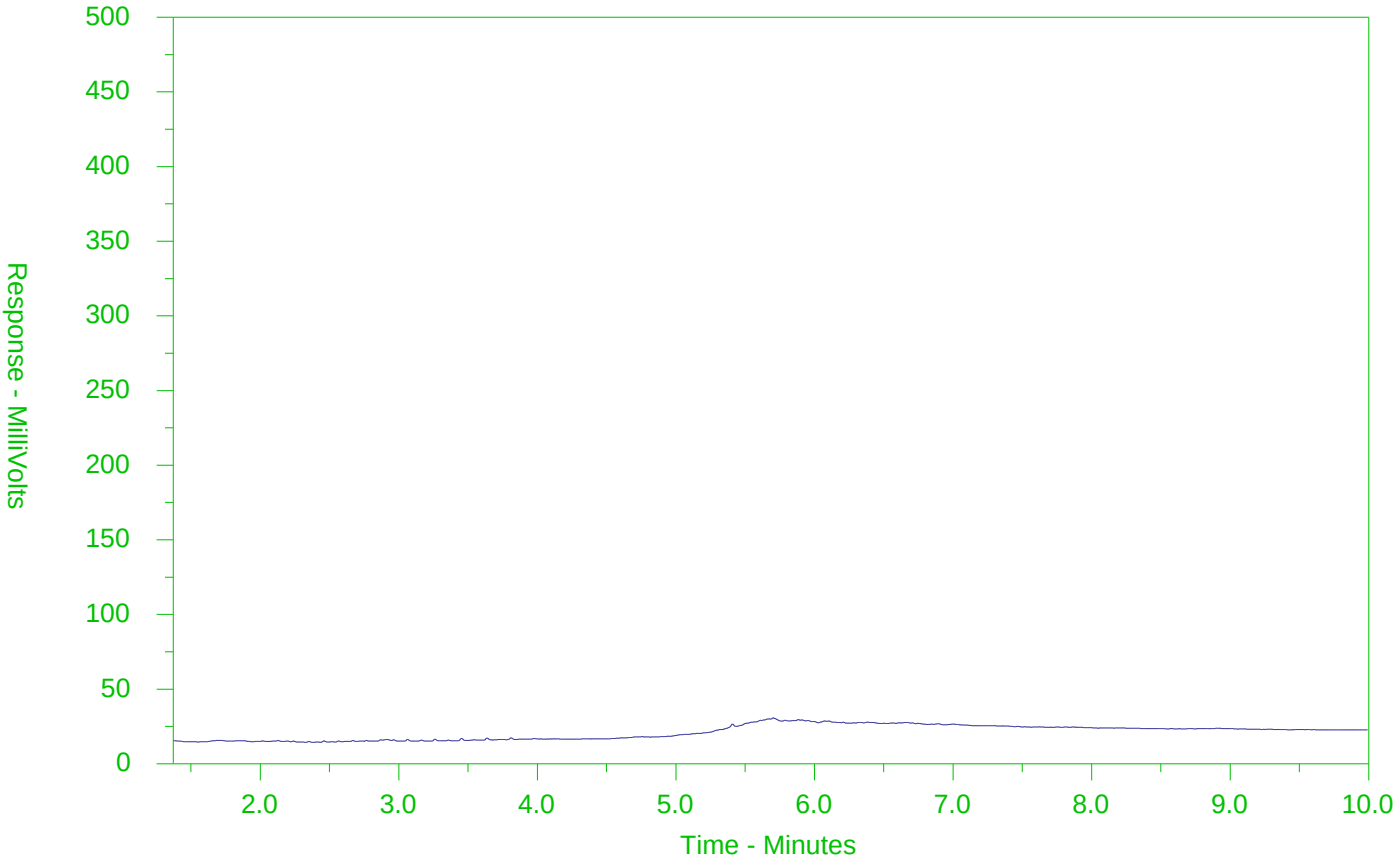
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2195281-2
Client Sample ID: BH18-104 SS6



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →	← Motor Oils/Lube Oils/Grease →		
← Diesel/Jet Fuels →			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2195281-COFC

COC Number: 17 - 728511

Page of

Report To	Contact and company name below will appear on the final report
Company:	TULLOCH ENGINEERING
Contact:	ERIK GILES
Phone:	647-968-0888
	Company address below will appear on the final report
Street:	1100 SOUTH SERVICE RD
City/Province:	STONEY CREEK, ON
Postal Code:	L8E 0C5
Invoice To	Same as Report To: YES [X] NO
	Copy of Invoice with Report: [X] YES NO
Company:	TULLOCH ENGINEERING
Contact:	NANCY SEABROOK

Project Information

ALS Account # / Quote #:	23923
Job #:	18-4046
PO / AFE:	
LSD:	8
ALS Lab Work Order # (lab use only):	L2195276

Report Format / D

Select Report Format: [X] PDF [X] EXCEL | EDD (DIGITAL)
Quality Control (QC) Report with Report: [X] YES [ ] NO
[ ] Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: [X] EMAIL | MAIL [ ] FAX
Email 1 or Fax: erik.giles@tulloch.ca
Email 2: greg.gu@tulloch.ca
Email 3:

Invoice Distribution

Select Invoice Distribution: [X] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax: nancy.seabrook@tulloch.ca
Email 2: erik.giles@tulloch.ca

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact:	Sampler:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] [ ] Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] [ ] | 3 day [P3-25%] [ ] | 2 day [P2-50%] [ ]

EMERGENCY: 1 Business day [E-100%] [ ] | Same Day, Weekend or Statutory holiday [E2-200% (Laboratory opening fees may apply)] [ ]

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	VOC/BTEX/F1	F2-F4	METALS/PHC/PAH	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
	BH18-101 SS7	09/11/18	8:50	SOIL (P)	X					2
	BH18-104 SS2	09/11/18	8:50	SOIL		X				1
	BH18-101 SS7	09/11/18	8:50	SOIL			X			1
	BH18-101 SS6	09/11/18	10:30	SOIL (P)	X					2
	BH18-104 SS6	09/11/18	10:30	SOIL		X				1
	BH18-101 SS6	09/11/18	10:30	SOIL			X			1

Drinking Water (DW) Samples' (client use)

Are samples taken from a Regulated DW System? [ ] YES [X] NO

Are samples for human consumption/ use? [ ] YES [X] NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen [ ] | SIF Observations: Yes [ ] No [ ]
Ice Packs [X] | Ice Cubes [ ] | Custody seal intact: Yes [ ] No [ ]
Cooling Initiated [ ]

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				14.6			

SHIPMENT RELEASE (client use)

Released by:	Date:	Time:
ERIK GILES	09/11/18	16:00

INITIAL SHIPMENT RECEPTION (lab use only)

Received by:	Date:	Time:

FINAL SHIPMENT RECEPTION (lab use only)

Received by:	Date:	Time:
[signature]	12-NOV-18	1030

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

TULLOCH ENGINEERING INC
ATTN: ERICK GILES
1100 SOUTH SERVICE ROAD
STONEY CREEK ON L8E G05

Date Received: 26-NOV-18
Report Date: 30-NOV-18 07:53 (MT)
Version: FINAL

Client Phone: 647-968-9894

Certificate of Analysis

Lab Work Order #: L2201528

Project P.O. #: NOT SUBMITTED
Job Reference: 18-4046
C of C Numbers: 17-728123
Legal Site Desc:

Emily Hansen
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2201528-1 BH 18-105 SS7 Sampled By: E. GILES on 13-NOV-18 @ 10:50 Matrix: SOIL							
Physical Tests							
Conductivity	0.520		0.0040	mS/cm		29-NOV-18	R4365788
% Moisture	24.3		0.10	%	26-NOV-18	27-NOV-18	R4360568
pH	8.31		0.10	pH units		27-NOV-18	R4363667
Redox Potential	143		-1000	mV		29-NOV-18	R4365991
Resistivity	1920		1.0	ohm*cm		29-NOV-18	
Leachable Anions & Nutrients							
Chloride	144		5.0	ug/g	28-NOV-18	28-NOV-18	R4365847
Anions and Nutrients							
Sulphate	100		20	mg/kg	26-NOV-18	27-NOV-18	R4364807
Inorganic Parameters							
Acid Volatile Sulphides	<0.20		0.20	mg/kg	26-NOV-18	26-NOV-18	R4359387

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CL-R511-WT	Soil	Chloride-O.Reg 153/04 (July 2011)	EPA 300.0

5 grams of dried soil is mixed with 10 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

EC-WT	Soil	Conductivity (EC)	MOEE E3138

A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
PH-WT	Soil	pH	MOEE E3137A

A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

REDOX-POTENTIAL-WT	Soil	Redox Potential	APHA 2580

This analysis is carried out in accordance with the procedure described in the "APHA" method 2580 "Oxidation-Reduction Potential" 2012. Samples are extracted at a fixed ratio with DI water. Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.

RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	APHA 2510 B

Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.

RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	MOECC E3138

Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.

SO4-WT	Soil	Sulphate	EPA 300.0

5 grams of soil is mixed with 50 mL of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.

SULPHIDE-WT	Soil	Sulphide, Acid Volatile	APHA 4500S2J

This analysis is carried out in accordance with the method described in APHA 4500 S2-J. Hydrochloric acid is added to sediment samples within a purge and trap system. The evolved hydrogen sulphide (H2S) is carried into a basic solution by inert gas. The acid volatile sulfide is then determined colourimetrically.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

17-728123

Reference Information

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L2201528 Report Date: 30-NOV-18

Client: TULLOCH ENGINEERING INC
1100 SOUTH SERVICE ROAD
STONEY CREEK ON L8E G05

Contact: ERICK GILES

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-R511-WT	**Soil**							
Batch R4365847								
WG2941035-3 CRM		**AN-CRM-WT**						
Chloride			84.7		%		70-130	28-NOV-18
WG2941035-4 DUP		**L2201193-2**						
Chloride		94.7	90.2		ug/g	4.9	30	28-NOV-18
WG2941035-2 LCS								
Chloride			103.8		%		80-120	28-NOV-18
WG2941035-1 MB								
Chloride			<5.0		ug/g		5	28-NOV-18
EC-WT	**Soil**							
Batch R4365788								
WG2942092-4 DUP		**WG2942092-3**						
Conductivity		1.00	1.02		mS/cm	2.1	20	29-NOV-18
WG2942092-2 IRM		**WT SAR2**						
Conductivity			96.2		%		70-130	29-NOV-18
WG2942396-1 LCS								
Conductivity			103.2		%		90-110	29-NOV-18
WG2942092-1 MB								
Conductivity			<0.0040		mS/cm		0.004	29-NOV-18
MOISTURE-WT	**Soil**							
Batch R4360568								
WG2939509-3 DUP		**L2201298-1**						
% Moisture		11.0	11.1		%	0.4	20	27-NOV-18
WG2939509-2 LCS								
% Moisture			99.99		%		90-110	27-NOV-18
WG2939509-1 MB								
% Moisture			<0.10		%		0.1	27-NOV-18
PH-WT	**Soil**							
Batch R4363667								
WG2940029-1 DUP		**L2201711-3**						
pH		8.02	8.06	J	pH units	0.04	0.3	27-NOV-18
WG2940201-1 LCS								
pH			6.97		pH units		6.9-7.1	27-NOV-18
REDOX-POTENTIAL-WT	**Soil**							
Batch R4365991								
WG2940120-1 DUP		**L2201711-2**						
Redox Potential		214	208		mV	2.8	25	29-NOV-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
1100 SOUTH SERVICE ROAD
STONEY CREEK ON L8E G05

Contact: ERICK GILES

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SO4-WT	**Soil**							
Batch R4364807								
WG2939561-4 CRM		**AN-CRM-WT**						
Sulphate			117.7		%		60-140	27-NOV-18
WG2939561-3 DUP		**L2201193-2**						
Sulphate		<20	<20	RPD-NA	mg/kg	N/A	30	27-NOV-18
WG2939561-2 LCS								
Sulphate			104.7		%		80-120	27-NOV-18
WG2939561-1 MB								
Sulphate			<20		mg/kg		20	27-NOV-18
SULPHIDE-WT	**Soil**							
Batch R4359387								
WG2939414-3 DUP		**L2201193-2**						
Acid Volatile Sulphides		<0.20	0.20	RPD-NA	mg/kg	N/A	30	26-NOV-18
WG2939414-2 LCS								
Acid Volatile Sulphides			88.6		%		70-130	26-NOV-18
WG2939414-1 MB								
Acid Volatile Sulphides			<0.20		mg/kg		0.2	26-NOV-18

Quality Control Report

Workorder: L2201528 Report Date: 30-NOV-18

Client: TULLOCH ENGINEERING INC
1100 SOUTH SERVICE ROAD
STONEY CREEK ON L8E G05
Contact: ERICK GILES

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2201528-COFC

COC Number: 17 - 728123

Page 1 of 1

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Turn Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	TULLOCH ENGINEERING	Select Report Format: ☒ PDF ☒ EXCEL ☐ EDD (DIGITAL)	Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	ERIK GILES	Quality Control (QC) Report with Report ☒ YES ☐ NO	PRIORITY (Business Days): ☐ 4 day [P4-20%] ☐ 3 day [P3-25%] ☐ 2 day [P2-50%]
Phone:	647-968-9844	☐ Compare Results to Criteria on Report - provide details below if box checked	EMERGENCY: ☐ 1 Business day [E-100%] ☐ Same Day, Weekend or Statutory holiday [E2-200% (Laboratory opening fees may apply)]
	Company address below will appear on the final report	Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX	
Street:	1100 SOUTH SERVICE RD	Email 1 or Fax erik.giles@tulloch.ca	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm
City/Province:	STONEY CREEK, ON	Email 2 greg.gu@tulloch.ca	For tests that can not be performed according to the service level selected, you will be contacted.
Postal Code:	L8E 6C6	Email 3	

Invoice To		Invoice Distribution	
	Same as Report To ☐ YES ☐ NO		
	Copy of Invoice with Report ☒ YES ☐ NO	Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX	
Company:	TULLOCH ENGINEERING	Email 1 or Fax nancy.seabrook@tulloch.ca	
Contact:	NANCY SEABROOK	Email 2 erik.giles@tulloch.ca	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:	Z3973	AFE/Cost Center:	PO#
Job #:	14-404L	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):	L2201528	ALS Contact: EA MELISSA TRAIN	Sampler: E. GILES

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	REGISTRATION / READY / SOIL / LIQ	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
	BH KB-105 SS7	13-11-18	10:50	JAR	X			1

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No	☐
Ice Packs	☐ Ice Cubes ☐	Custody seal intact	Yes ☐	No	☐
Cooling Initiated	☐				

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
			6.8		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: E. GILES	Date: NOV 21/18	Time: 17:30	Received by:	Date:	Time:	Received by:	Date: 26-11-18	Time: 12:15

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

TULLOCH ENGINEERING INC
ATTN: Erik Giles
1100 South Service Rd
Stoney Creek ON L8E 6C5

Date Received: 06-DEC-18
Report Date: 12-DEC-18 14:09 (MT)
Version: FINAL

Client Phone: 905-528-8761

Certificate of Analysis

Lab Work Order #: L2206843

Project P.O. #: NOT SUBMITTED
Job Reference: 18-4046
C of C Numbers: 17-728513
Legal Site Desc:

Comments: ADDITIONAL 07-DEC-18 14:03

Amanda Fazekas
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2206843-1 BH18-103 SS1 Sampled By: E. GILES on 04-DEC-18 @ 09:40 Matrix: SOIL							
Physical Tests							
% Moisture	89.4		0.10	%	09-DEC-18	10-DEC-18	R4384888
pH	6.33		0.10	pH units		10-DEC-18	R4386550
Hydrocarbons							
F2 (C10-C16)	<75	DLHM	75	ug/g	10-DEC-18	10-DEC-18	R4387587
F3 (C16-C34)	<380	DLHM	380	ug/g	10-DEC-18	10-DEC-18	R4387587
F4 (C34-C50)	<380	DLHM	380	ug/g	10-DEC-18	10-DEC-18	R4387587
Chrom. to baseline at nC50	YES				10-DEC-18	10-DEC-18	R4387587
Surrogate: 2-Bromobenzotrifluoride	96.9		60-140	%	10-DEC-18	10-DEC-18	R4387587

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)

Sample Parameter Qualifier key listed:

Qualifier	Description
DLHM	Detection Limit Adjusted: Sample has High Moisture Content

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
F1-F4-511-CALC-WT	Soil	F1-F4 Hydrocarbon Calculated Parameters	CCME CWS-PHC, Pub #1310, Dec 2001-S

Analytical methods used for analysis of CCME Petroleum Hydrocarbons have been validated and comply with the Reference Method for the CWS PHC.

Hydrocarbon results are expressed on a dry weight basis.

In cases where results for both F4 and F4G are reported, the greater of the two results must be used in any application of the CWS PHC guidelines and the gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.
In samples where BTEX and F1 were analyzed , F1-BTEX represents a value where the sum of Benzene, Toluene, Ethylbenzene and total Xylenes has been subtracted from F1.

In samples where PAHs, F2 and F3 were analyzed, F2-Naphth represents the result where Naphthalene has been subtracted from F2. F3-PAH represents a result where the sum of Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzo(a,h)anthracene, Fluoranthene, Indeno(1,2,3-cd)pyrene, Phenanthrene, and Pyrene has been subtracted from F3.

Unless otherwise qualified, the following quality control criteria have been met for the F1 hydrocarbon range:
1. All extraction and analysis holding times were met.
2. Instrument performance showing response factors for C6 and C10 within 30% of the response factor for toluene.
3. Linearity of gasoline response within 15% throughout the calibration range.

Unless otherwise qualified, the following quality control criteria have been met for the F2-F4 hydrocarbon ranges:
1. All extraction and analysis holding times were met.
2. Instrument performance showing C10, C16 and C34 response factors within 10% of their average.
3. Instrument performance showing the C50 response factor within 30% of the average of the C10, C16 and C34 response factors.
4. Linearity of diesel or motor oil response within 15% throughout the calibration range.

F2-F4-511-WT Soil F2-F4-O.Reg 153/04 (July 2011) CCME Tier 1

Petroleum Hydrocarbons (F2-F4 fractions) are extracted from soil with 1:1 hexane:acetone using a rotary extractor. Extracts are treated with silica gel to remove polar organic interferences. F2, F3, & F4 are analyzed by GC-FID. F4G-sg is analyzed gravimetrically.

Notes:
1. F2 (C10-C16): Sum of all hydrocarbons that elute between nC10 and nC16.
2. F3 (C16-C34): Sum of all hydrocarbons that elute between nC16 and nC34.
3. F4 (C34-C50): Sum of all hydrocarbons that elute between nC34 and nC50.
4. F4G: Gravimetric Heavy Hydrocarbons
5. F4G-sg: Gravimetric Heavy Hydrocarbons (F4G) after silica gel treatment.
6. Where both F4 (C34-C50) and F4G-sg are reported for a sample, the larger of the two values is used for comparison against the relevant CCME guideline for F4.
7. F4G-sg cannot be added to the C6 to C50 hydrocarbon results to obtain an estimate of total extractable hydrocarbons.
8. This method is validated for use.
9. Data from analysis of validation and quality control samples is available upon request.
10. Reported results are expressed as milligrams per dry kilogram, unless otherwise indicated.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

MOISTURE-WT Soil % Moisture CCME PHC in Soil - Tier 1 (mod)

PH-WT Soil pH MOEE E3137A

A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA	H357883-04-240-0001, Rev 1

Reference Information

Chain of Custody Numbers:

17-728513

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L2206843 Report Date: 12-DEC-18

Client: TULLOCH ENGINEERING INC
1100 South Service Rd
Stoney Creek ON L8E 6C5
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
F2-F4-511-WT	**Soil**							
Batch R4387587								
WG2950137-3 DUP		**WG2950137-5**						
F2 (C10-C16)		<75	<75	RPD-NA	ug/g	N/A	30	10-DEC-18
F3 (C16-C34)		<380	<380	RPD-NA	ug/g	N/A	30	10-DEC-18
F4 (C34-C50)		<380	<380	RPD-NA	ug/g	N/A	30	10-DEC-18
WG2950137-2 LCS								
F2 (C10-C16)			111.1		%		80-120	10-DEC-18
F3 (C16-C34)			115.5		%		80-120	10-DEC-18
F4 (C34-C50)			117.8		%		80-120	10-DEC-18
WG2950137-1 MB								
F2 (C10-C16)			<10		ug/g		10	10-DEC-18
F3 (C16-C34)			<50		ug/g		50	10-DEC-18
F4 (C34-C50)			<50		ug/g		50	10-DEC-18
Surrogate: 2-Bromobenzotrifluoride			97.3		%		60-140	10-DEC-18
WG2950137-4 MS		**WG2950137-5**						
F2 (C10-C16)			111.1		%		60-140	10-DEC-18
F3 (C16-C34)			115.2		%		60-140	10-DEC-18
F4 (C34-C50)			119.9		%		60-140	10-DEC-18
MOISTURE-WT	**Soil**							
Batch R4384888								
WG2949956-3 DUP		**L2207860-2**						
% Moisture		16.6	16.1		%	3.0	20	10-DEC-18
WG2949956-2 LCS								
% Moisture			99.3		%		90-110	10-DEC-18
WG2949956-1 MB								
% Moisture			<0.10		%		0.1	10-DEC-18
PH-WT	**Soil**							
Batch R4386550								
WG2949638-1 DUP		**L2207622-3**						
pH		8.06	8.01	J	pH units	0.05	0.3	10-DEC-18
WG2950114-1 LCS								
pH			6.94		pH units		6.9-7.1	10-DEC-18

Quality Control Report

Workorder: L2206843 Report Date: 12-DEC-18

Client: TULLOCH ENGINEERING INC
1100 South Service Rd
Stoney Creek ON L8E 6C5
Contact: Erik Giles

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
DLHM	Detection Limit Adjusted: Sample has High Moisture Content
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

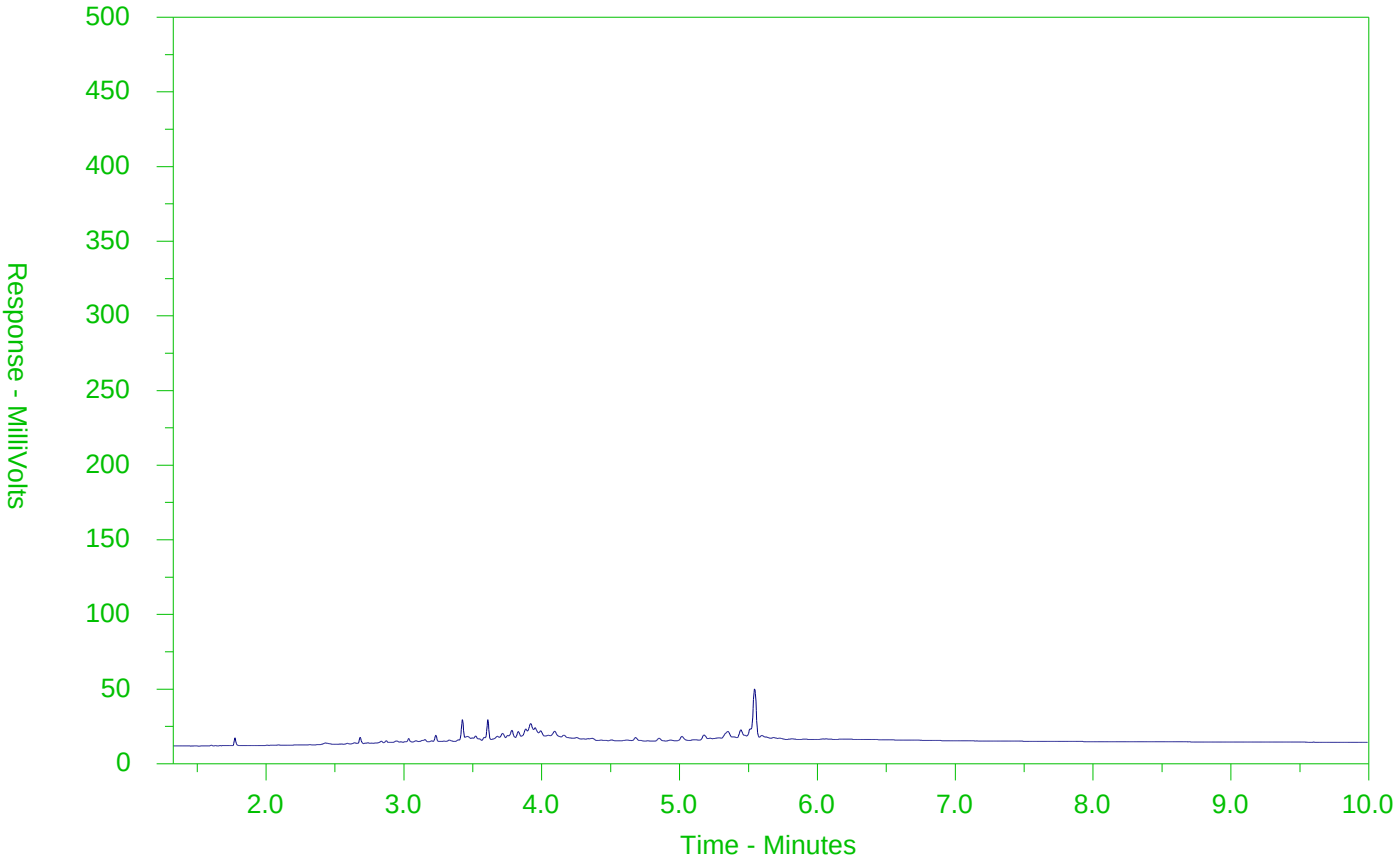
ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2206843-1
Client Sample ID: BH18-103 SS1



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →		← Motor Oils/Lube Oils/Grease →	
←Diesel/Jet Fuels→			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2206843-COFC

COC Number: 17 - 728513

Page of

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	TILLOCH ENGINEERING	Select Report Format: [X] PDF [X] EXCEL [ ] EDD (DIGITAL)	Regular [R] [X] Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	ERIK GILES	Quality Control (QC) Report with Report [X] YES [ ] NO	PRIORITY (Business Days): 4 day [P4-20%] [ ]; 3 day [P3-25%] [ ]; 2 day [P2-50%] [ ]
Phone:	647-484-9844	[ ] Compare Results to Criteria on Report - provide details below if box checked	EMERGENCY: 1 Business day [E-100%] [ ]; Same Day, Weekend or Statutory holiday [E2-200% (Laboratory opening fees may apply)] [ ]
	Company address below will appear on the final report	Select Distribution: [X] EMAIL [ ] MAIL [ ] FAX	
Street:	1118 SOUTH SERVICE	Email 1 or Fax erik.giles@tillochca	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm
City/Province:	STONEY CREEK ON	Email 2 gary.gwan@tillochca	For tests that can not be performed according to the service level selected, you will be contacted.
Postal Code:	L8E 6E5	Email 3 GJ	
Invoice To	Same as Report To [ ] YES [ ] NO	Invoice Distribution	Analysis Request
	Copy of Invoice with Report [X] YES [ ] NO	Select Invoice Distribution: [X] EMAIL [ ] MAIL [ ] FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	TILLOCH ENGINEERING	Email 1 or Fax nancy.seabrook@tillochca	
Contact:	NANCY SEABROOK	Email 2 erik.giles@tillochca	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:	23923	AFE/Cost Center:	PO#
Job #:	18-4046	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	

ALS Lab Work Order # (lab use only): L2206843

ALS Contact: MELISSA

Sampler: E. GILES

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	TCLW: MERHG/P4 / P4HG	F2-F4	BTEX/TCLW: VOC/TRH/F1	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
	BH18-103 SS1	04/12/18	9:40	TAW	X					1
	BH18-103 SS1	04/12/18	9:40	TAR		X				1
	BH18-103 SS1	04/12/18	9:40	TAW			X			2

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? [ ] YES [ ] NO	
Are samples for human consumption/ use? [ ] YES [ ] NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	[ ]	SIF Observations	Yes [ ]	No	[ ]
Ice Packs [ ]	Ice Cubes [X]	Custody seal intact	Yes [ ]	No	[ ]
Cooling Initiated	[ ]				

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				6.3			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: E. GILES	Date: DEC/18	Time: 17:20	Received by:	Date:	Time:	Received by:	Date: Dec 6/2018	Time: 9:00

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

H357883-04-240-0001, Rev 1

TULLOCH ENGINEERING INC
ATTN: Erik Giles
1100 South Service
Stoney Creek ON L2E 6C5

Date Received: 06-DEC-18
Report Date: 17-DEC-18 12:24 (MT)
Version: FINAL

Client Phone: 647-968-9844

Certificate of Analysis

Lab Work Order #: L2207713

Project P.O. #: NOT SUBMITTED
Job Reference: 18-4046
C of C Numbers:
Legal Site Desc:

Amanda Fazekas
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2207713-1 BH18-103 SS1 Sampled By: E. GILES on 04-DEC-18 @ 09:40 Matrix: SOIL							
Sample Preparation							
Initial pH	5.09		0.10	pH units		11-DEC-18	R4387650
Final pH	4.99		0.10	pH units		11-DEC-18	R4387650
TCLP Extractables							
Acenaphthene	<0.0050		0.0050	mg/L	11-DEC-18	17-DEC-18	R4396791
Acenaphthylene	<0.0050		0.0050	mg/L	11-DEC-18	17-DEC-18	R4396791
Anthracene	<0.0050		0.0050	mg/L	11-DEC-18	17-DEC-18	R4396791
Benzo(a)anthracene	<0.0050		0.0050	mg/L	11-DEC-18	17-DEC-18	R4396791
Benzo(a)pyrene	<0.0010		0.0010	mg/L	11-DEC-18	17-DEC-18	R4396791
Benzo(b)fluoranthene	<0.0050		0.0050	mg/L	11-DEC-18	17-DEC-18	R4396791
Benzo(g,h,i)perylene	<0.0050		0.0050	mg/L	11-DEC-18	17-DEC-18	R4396791
F1 (C6-C10)	<5.0		5.0	mg/L		12-DEC-18	R4390807
TCLP Metals							
Arsenic (As)	<0.050		0.050	mg/L		11-DEC-18	R4388467
Barium (Ba)	<0.50		0.50	mg/L		11-DEC-18	R4388467
Boron (B)	<2.5		2.5	mg/L		11-DEC-18	R4388467
Cadmium (Cd)	<0.0050		0.0050	mg/L		11-DEC-18	R4388467
Chromium (Cr)	<0.050		0.050	mg/L		11-DEC-18	R4388467
Lead (Pb)	<0.050		0.050	mg/L		11-DEC-18	R4388467
Mercury (Hg)	<0.00010		0.00010	mg/L		11-DEC-18	R4388090
Selenium (Se)	<0.025		0.025	mg/L		11-DEC-18	R4388467
Silver (Ag)	<0.0050		0.0050	mg/L		11-DEC-18	R4388467
Uranium (U)	<0.25		0.25	mg/L		11-DEC-18	R4388467
TCLP VOCs							
1,1-Dichloroethylene	<0.025		0.025	mg/L		12-DEC-18	R4390807
1,2-Dichlorobenzene	<0.025		0.025	mg/L		12-DEC-18	R4390807
1,2-Dichloroethane	<0.025		0.025	mg/L		12-DEC-18	R4390807
1,4-Dichlorobenzene	<0.025		0.025	mg/L		12-DEC-18	R4390807
Benzene	<0.025		0.025	mg/L		12-DEC-18	R4390807
Carbon tetrachloride	<0.025		0.025	mg/L		12-DEC-18	R4390807
Chlorobenzene	<0.025		0.025	mg/L		12-DEC-18	R4390807
Chloroform	<0.10		0.10	mg/L		12-DEC-18	R4390807
Dichloromethane	<0.50		0.50	mg/L		12-DEC-18	R4390807
Methyl Ethyl Ketone	<1.0		1.0	mg/L		12-DEC-18	R4390807
Tetrachloroethylene	<0.025		0.025	mg/L		12-DEC-18	R4390807
Trichloroethylene	<0.025		0.025	mg/L		12-DEC-18	R4390807
Vinyl chloride	<0.050		0.050	mg/L		12-DEC-18	R4390807
Surrogate: 4-Bromofluorobenzene	100.1		70-130	%		12-DEC-18	R4390807
Volatile Organic Compounds							
Surrogate: 1,4-Difluorobenzene	100.1		70-130	%		12-DEC-18	R4390807
Polycyclic Aromatic Hydrocarbons							
Benzo(k)fluoranthene	<0.0050		0.0050	mg/L	11-DEC-18	17-DEC-18	R4396791
Chrysene	<0.0050		0.0050	mg/L	11-DEC-18	17-DEC-18	R4396791

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2207713-1 BH18-103 SS1 Sampled By: E. GILES on 04-DEC-18 @ 09:40 Matrix: SOIL							
Polycyclic Aromatic Hydrocarbons							
Dibenzo(ah)anthracene	<0.0050		0.0050	mg/L	11-DEC-18	17-DEC-18	R4396791
Fluoranthene	<0.0050		0.0050	mg/L	11-DEC-18	17-DEC-18	R4396791
Fluorene	<0.0050		0.0050	mg/L	11-DEC-18	17-DEC-18	R4396791
Indeno(1,2,3-cd)pyrene	<0.0050		0.0050	mg/L	11-DEC-18	17-DEC-18	R4396791
Naphthalene	<0.0050		0.0050	mg/L	11-DEC-18	17-DEC-18	R4396791
Phenanthrene	<0.0050		0.0050	mg/L	11-DEC-18	17-DEC-18	R4396791
Pyrene	<0.0050		0.0050	mg/L	11-DEC-18	17-DEC-18	R4396791
Quinoline	<0.0050		0.0050	mg/L	11-DEC-18	17-DEC-18	R4396791
Surrogate: d10-Acenaphthene	94.0		50-150	%	11-DEC-18	17-DEC-18	R4396791
Surrogate: d12-Chrysene	96.0		50-150	%	11-DEC-18	17-DEC-18	R4396791
Surrogate: d8-Naphthalene	91.5		50-150	%	11-DEC-18	17-DEC-18	R4396791
Surrogate: d10-Phenanthrene	96.5		50-150	%	11-DEC-18	17-DEC-18	R4396791

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
F1-TCLP-WT	Waste	O. Reg 347 TCLP leachable F1	SW846 8260
HG-TCLP-WT	Waste	Mercury (CVAA) for O.Reg 347	SW846 7470A
LEACH-TCLP-WT	Waste	Leachate Procedure for Reg 347	EPA 1311
		Inorganic and Semi-Volatile Organic contaminants are leached from waste samples in strict accordance with US EPA Method 1311, "Toxicity Characteristic Leaching Procedure" (TCLP). Test results are reported in leachate concentration units (normally mg/L).	
MET-TCLP-WT	Waste	O.Reg 347 TCLP Leachable Metals	EPA 200.8
PAH-TCLP-WT	Waste	PAH for O. Reg 347	SW846 8270 (PAH)
		Samples are leached according to TCLP protocol and then the aqueous leachate is extracted and the resulting extracts are analyzed on GC/MSD. Depending on the analytical GC/MS column used benzo(j)fluoranthene may chromatographically co-elute with benzo(b)fluoranthene or benzo(k)fluoranthene.	
VOC-TCLP-WT	Waste	VOC for O. Reg 347	SW846 8260
		A sample of waste is leached in a zero headspace extractor at 30–2 rpm for 18–2.0 hours with the appropriate leaching solution. After tumbling the leachate is analyzed directly by headspace technology, followed by GC/MS using internal standard quantitation.	

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L2207713 Report Date: 17-DEC-18

Client: TULLOCH ENGINEERING INC
1100 South Service
Stoney Creek ON L2E 6C5
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
F1-TCLP-WT	**Waste**							
Batch R4390807								
WG2949705-1 LCS								
F1 (C6-C10)			96.3		%		70-130	12-DEC-18
WG2949705-2 MB								
F1 (C6-C10)			<5.0		mg/L		5	12-DEC-18
WG2949705-4 MS		**WG2949705-3**						
F1 (C6-C10)			102.1		%		50-150	12-DEC-18
HG-TCLP-WT	**Waste**							
Batch R4388090								
WG2951056-3 DUP		**L2207388-1**						
Mercury (Hg)		<0.00010	<0.00010	RPD-NA	mg/L	N/A	50	11-DEC-18
WG2951056-2 LCS								
Mercury (Hg)			100.0		%		70-130	11-DEC-18
WG2951056-1 MB								
Mercury (Hg)			<0.00010		mg/L		0.0001	11-DEC-18
WG2951056-4 MS		**L2207388-1**						
Mercury (Hg)			97.3		%		50-140	11-DEC-18
MET-TCLP-WT	**Waste**							
Batch R4388467								
WG2950968-4 DUP		**WG2950968-3**						
Silver (Ag)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	40	11-DEC-18
Arsenic (As)		<0.050	<0.050	RPD-NA	mg/L	N/A	40	11-DEC-18
Boron (B)		<2.5	<2.5	RPD-NA	mg/L	N/A	40	11-DEC-18
Barium (Ba)		1.30	1.31		mg/L	0.6	40	11-DEC-18
Cadmium (Cd)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	40	11-DEC-18
Chromium (Cr)		<0.050	<0.050	RPD-NA	mg/L	N/A	40	11-DEC-18
Lead (Pb)		<0.050	<0.050	RPD-NA	mg/L	N/A	40	11-DEC-18
Selenium (Se)		<0.025	<0.025	RPD-NA	mg/L	N/A	40	11-DEC-18
Uranium (U)		<0.25	<0.25	RPD-NA	mg/L	N/A	40	11-DEC-18
WG2950968-2 LCS								
Silver (Ag)			103.2		%		70-130	11-DEC-18
Arsenic (As)			102.9		%		70-130	11-DEC-18
Boron (B)			102.3		%		70-130	11-DEC-18
Barium (Ba)			100.9		%		70-130	11-DEC-18
Cadmium (Cd)			98.9		%		70-130	11-DEC-18
Chromium (Cr)			97.4		%		70-130	11-DEC-18
Lead (Pb)			106.2		%		70-130	11-DEC-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
1100 South Service
Stoney Creek ON L2E 6C5
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TCLP-WT	**Waste**							
Batch R4388467								
WG2950968-2 LCS								
Selenium (Se)			104.7		%		70-130	11-DEC-18
Uranium (U)			103.4		%		70-130	11-DEC-18
WG2950968-1 MB								
Silver (Ag)			<0.0050		mg/L		0.005	11-DEC-18
Arsenic (As)			<0.050		mg/L		0.05	11-DEC-18
Boron (B)			<2.5		mg/L		2.5	11-DEC-18
Barium (Ba)			<0.50		mg/L		0.5	11-DEC-18
Cadmium (Cd)			<0.0050		mg/L		0.005	11-DEC-18
Chromium (Cr)			<0.050		mg/L		0.05	11-DEC-18
Lead (Pb)			<0.050		mg/L		0.05	11-DEC-18
Selenium (Se)			<0.025		mg/L		0.025	11-DEC-18
Uranium (U)			<0.25		mg/L		0.25	11-DEC-18
WG2950968-5 MS		**WG2950968-3**						
Silver (Ag)			129.6		%		50-150	11-DEC-18
Arsenic (As)			107.5		%		50-150	11-DEC-18
Boron (B)			100.8		%		50-150	11-DEC-18
Barium (Ba)			107.8		%		50-150	11-DEC-18
Cadmium (Cd)			102.0		%		50-150	11-DEC-18
Chromium (Cr)			101.6		%		50-150	11-DEC-18
Lead (Pb)			102.7		%		50-150	11-DEC-18
Selenium (Se)			107.9		%		50-150	11-DEC-18
Uranium (U)			102.8		%		50-150	11-DEC-18
PAH-TCLP-WT	**Waste**							
Batch R4396791								
WG2951423-3 DUP		**WG2951423-5**						
Acenaphthene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	17-DEC-18
Acenaphthylene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	17-DEC-18
Anthracene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	17-DEC-18
Benzo(a)anthracene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	17-DEC-18
Benzo(a)pyrene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	50	17-DEC-18
Benzo(b)fluoranthene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	17-DEC-18
Benzo(g,h,i)perylene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	17-DEC-18
Benzo(k)fluoranthene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	17-DEC-18
Chrysene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	17-DEC-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
1100 South Service
Stoney Creek ON L2E 6C5
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TCLP-WT	**Waste**							
Batch R4396791								
WG2951423-3 DUP		**WG2951423-5**						
Dibenzo(ah)anthracene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	17-DEC-18
Fluoranthene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	17-DEC-18
Fluorene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	17-DEC-18
Indeno(1,2,3-cd)pyrene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	17-DEC-18
Naphthalene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	17-DEC-18
Phenanthrene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	17-DEC-18
Pyrene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	17-DEC-18
Quinoline		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	17-DEC-18
WG2951423-2 LCS								
Acenaphthene			95.9		%		50-130	17-DEC-18
Acenaphthylene			99.2		%		50-130	17-DEC-18
Anthracene			109.4		%		50-130	17-DEC-18
Benzo(a)anthracene			122.1		%		50-140	17-DEC-18
Benzo(a)pyrene			103.8		%		60-140	17-DEC-18
Benzo(b)fluoranthene			94.2		%		50-140	17-DEC-18
Benzo(g,h,i)perylene			108.1		%		50-140	17-DEC-18
Benzo(k)fluoranthene			103.2		%		50-150	17-DEC-18
Chrysene			113.9		%		50-140	17-DEC-18
Dibenzo(ah)anthracene			107.6		%		50-140	17-DEC-18
Fluoranthene			113.2		%		50-150	17-DEC-18
Fluorene			105.6		%		50-150	17-DEC-18
Indeno(1,2,3-cd)pyrene			119.1		%		50-140	17-DEC-18
Naphthalene			86.1		%		50-130	17-DEC-18
Phenanthrene			110.8		%		50-130	17-DEC-18
Pyrene			114.6		%		50-140	17-DEC-18
Quinoline			126.7		%		50-150	17-DEC-18
WG2951423-1 MB								
Acenaphthene			<0.0050		mg/L		0.005	17-DEC-18
Acenaphthylene			<0.0050		mg/L		0.005	17-DEC-18
Anthracene			<0.0050		mg/L		0.005	17-DEC-18
Benzo(a)anthracene			<0.0050		mg/L		0.005	17-DEC-18
Benzo(a)pyrene			<0.0010		mg/L		0.001	17-DEC-18
Benzo(b)fluoranthene			<0.0050		mg/L		0.005	17-DEC-18
Benzo(g,h,i)perylene			<0.0050		mg/L		0.005	17-DEC-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
1100 South Service
Stoney Creek ON L2E 6C5
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TCLP-WT	**Waste**							
Batch R4396791								
WG2951423-1 MB								
Benzo(k)fluoranthene			<0.0050		mg/L		0.005	17-DEC-18
Chrysene			<0.0050		mg/L		0.005	17-DEC-18
Dibenzo(ah)anthracene			<0.0050		mg/L		0.005	17-DEC-18
Fluoranthene			<0.0050		mg/L		0.005	17-DEC-18
Fluorene			<0.0050		mg/L		0.005	17-DEC-18
Indeno(1,2,3-cd)pyrene			<0.0050		mg/L		0.005	17-DEC-18
Naphthalene			<0.0050		mg/L		0.005	17-DEC-18
Phenanthrene			<0.0050		mg/L		0.005	17-DEC-18
Pyrene			<0.0050		mg/L		0.005	17-DEC-18
Quinoline			<0.0050		mg/L		0.005	17-DEC-18
Surrogate: d8-Naphthalene			90.0		%		50-150	17-DEC-18
Surrogate: d10-Phenanthrene			96.5		%		50-150	17-DEC-18
Surrogate: d12-Chrysene			95.9		%		50-150	17-DEC-18
Surrogate: d10-Acenaphthene			94.2		%		50-150	17-DEC-18
WG2951423-4 MS		**WG2951423-5**						
Acenaphthene			94.8		%		50-150	17-DEC-18
Acenaphthylene			97.0		%		50-150	17-DEC-18
Anthracene			102.2		%		50-150	17-DEC-18
Benzo(a)anthracene			111.2		%		50-150	17-DEC-18
Benzo(a)pyrene			90.9		%		50-150	17-DEC-18
Benzo(b)fluoranthene			84.1		%		50-150	17-DEC-18
Benzo(g,h,i)perylene			90.3		%		50-150	17-DEC-18
Benzo(k)fluoranthene			89.1		%		50-150	17-DEC-18
Chrysene			104.9		%		50-150	17-DEC-18
Dibenzo(ah)anthracene			88.9		%		50-150	17-DEC-18
Fluoranthene			105.0		%		50-150	17-DEC-18
Fluorene			100.2		%		50-150	17-DEC-18
Indeno(1,2,3-cd)pyrene			99.1		%		50-150	17-DEC-18
Naphthalene			93.5		%		50-150	17-DEC-18
Phenanthrene			103.5		%		50-150	17-DEC-18
Pyrene			105.9		%		50-150	17-DEC-18
Quinoline			119.0		%		50-150	17-DEC-18
VOC-TCLP-WT	**Waste**							

Quality Control Report

Client: TULLOCH ENGINEERING INC
1100 South Service
Stoney Creek ON L2E 6C5
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-TCLP-WT	**Waste**							
Batch R4390807								
WG2949705-1 LCS								
1,1-Dichloroethylene			101.7		%		70-130	12-DEC-18
1,2-Dichlorobenzene			108.7		%		70-130	12-DEC-18
1,2-Dichloroethane			121.1		%		70-130	12-DEC-18
1,4-Dichlorobenzene			106.5		%		70-130	12-DEC-18
Benzene			112.8		%		70-130	12-DEC-18
Carbon tetrachloride			103.0		%		60-140	12-DEC-18
Chlorobenzene			108.4		%		70-130	12-DEC-18
Chloroform			111.6		%		70-130	12-DEC-18
Dichloromethane			117.5		%		70-130	12-DEC-18
Methyl Ethyl Ketone			122.2		%		50-150	12-DEC-18
Tetrachloroethylene			102.1		%		70-130	12-DEC-18
Trichloroethylene			108.8		%		70-130	12-DEC-18
Vinyl chloride			82.4		%		60-130	12-DEC-18
WG2949705-2 MB								
1,1-Dichloroethylene			<0.025		mg/L		0.025	12-DEC-18
1,2-Dichlorobenzene			<0.025		mg/L		0.025	12-DEC-18
1,2-Dichloroethane			<0.025		mg/L		0.025	12-DEC-18
1,4-Dichlorobenzene			<0.025		mg/L		0.025	12-DEC-18
Benzene			<0.025		mg/L		0.025	12-DEC-18
Carbon tetrachloride			<0.025		mg/L		0.025	12-DEC-18
Chlorobenzene			<0.025		mg/L		0.025	12-DEC-18
Chloroform			<0.10		mg/L		0.1	12-DEC-18
Dichloromethane			<0.50		mg/L		0.5	12-DEC-18
Methyl Ethyl Ketone			<1.0		mg/L		1	12-DEC-18
Tetrachloroethylene			<0.025		mg/L		0.025	12-DEC-18
Trichloroethylene			<0.025		mg/L		0.025	12-DEC-18
Vinyl chloride			<0.050		mg/L		0.05	12-DEC-18
Surrogate: 1,4-Difluorobenzene			99.5		%		70-130	12-DEC-18
Surrogate: 4-Bromofluorobenzene			101.6		%		70-130	12-DEC-18
WG2949705-4 MS		**WG2949705-3**						
1,1-Dichloroethylene			100.9		%		50-140	12-DEC-18
1,2-Dichlorobenzene			109.5		%		50-140	12-DEC-18
1,2-Dichloroethane			119.2		%		50-140	12-DEC-18
1,4-Dichlorobenzene			109.9		%		50-140	12-DEC-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
1100 South Service
Stoney Creek ON L2E 6C5
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-TCLP-WT	**Waste**							
Batch R4390807								
WG2949705-4 MS		**WG2949705-3**						
Benzene			113.4		%		50-140	12-DEC-18
Carbon tetrachloride			104.7		%		50-140	12-DEC-18
Chlorobenzene			108.4		%		50-140	12-DEC-18
Chloroform			112.9		%		50-140	12-DEC-18
Dichloromethane			116.5		%		50-140	12-DEC-18
Methyl Ethyl Ketone			107.3		%		50-140	12-DEC-18
Tetrachloroethylene			102.3		%		50-140	12-DEC-18
Trichloroethylene			110.1		%		50-140	12-DEC-18
Vinyl chloride			78.8		%		50-140	12-DEC-18

Quality Control Report

Workorder: L2207713 Report Date: 17-DEC-18

Client: TULLOCH ENGINEERING INC
1100 South Service
Stoney Creek ON L2E 6C5
Contact: Erik Giles

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com
Canada Toll Free: 1 800 668 9878

L2207713-COFC

COC Number: 17 - 728513
Page of

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	TULLOCH ENGINEERING	Select Report Format: PDF EXCEL EDD (DIGITAL)	Regular [R] Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	ERIK GILES	Quality Control (QC) Report with Report YES NO	PRIORITY (Business Days): 4 day [P4-20%] 3 day [P3-25%] 2 day [P2-50%]
Phone:	647-436-8894	Compare Results to Criteria on Report - provide details below if box checked	DATE FOR TAT: 1 Business day [E-100%] Same Day, Weekend or Statutory holiday [E2-200% (Laboratory opening fees may apply)]
	Company address below will appear on the final report	Select Distribution: EMAIL MAIL FAX	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm
Street:	1122 SOUTH SERVICE	Email 1 or Fax erik.giles@tullochca	For tests that can not be performed according to the service level selected, you will be contacted.
City/Province:	STONEY CREEK, ON	Email 2 gary.gunn@tullochca	
Postal Code:	L8E 6G5	Email 3	
Invoice To	Same as Report To YES NO	Invoice Distribution	
	Copy of Invoice with Report YES NO	Select Invoice Distribution: EMAIL MAIL FAX	
Company:	TULLOCH ENGINEERING	Email 1 or Fax nancy.seabrook@tullochca	
Contact:	NANCY SEABROOK	Email 2 erik.giles@tullochca	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:	23923	AFE/Cost Center:	PO#
Job #:	18-40046	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:	L2207713	Location:	
ALS Lab Work Order # (lab use only):	~~L2206843~~	ALS Contact: TANUSHA	Sampler: E. GILES

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	TCLW: MEHGS/pH / PAH	F2-F4	VOC/TCLP: VOC/MAX/F1	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
	BH16-103 SS1	04/12/18	9:40	SOIL	X					1
	BH16-103 SS1	04/12/18	9:40	SOIL		X				1
	BH16-103 SS1	04/12/18	9:40	SOIL			X			2

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? YES NO	
Are samples for human consumption/ use? YES NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen		SIF Observations	Yes		No
Ice Packs	Ice Cubes	Custody seal intact	Yes		No
Cooling Initiated					

INITIAL COOLER TEMPERATURES °C	FINAL COOLER TEMPERATURES °C
	6.3

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: E GILES	Date: DEC/18	Time: 17:00	Received by:	Date:	Time:	Received by:	Date: Dec 6/2018	Time: 9:00

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

TULLOCH ENGINEERING INC
ATTN: Erik Giles
80 Main Street W.
Huntsville ON P1H 1W9

Date Received: 17-DEC-18
Report Date: 28-DEC-18 13:56 (MT)
Version: FINAL

Client Phone: 705-789-7851

Certificate of Analysis

Lab Work Order #: L2211214

Project P.O. #: NOT SUBMITTED
Job Reference: 18-4046
C of C Numbers:
Legal Site Desc:

Amanda Fazekas
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2211214-1 B418-201 AS-1 Sampled By: CLIENT on 12-DEC-18 @ 09:45 Matrix: SOIL							
Sample Preparation							
Initial pH	8.03		0.10	pH units		19-DEC-18	R4403607
Final pH	4.22		0.10	pH units		19-DEC-18	R4403607
Physical Tests							
pH	6.83		0.10	pH units		18-DEC-18	R4400440
TCLP Extractables							
Acenaphthene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Acenaphthylene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Anthracene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Benzo(a)anthracene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Benzo(a)pyrene	<0.0010		0.0010	mg/L	27-DEC-18	28-DEC-18	R4417569
Benzo(b)fluoranthene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Benzo(g,h,i)perylene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
TCLP Metals							
Arsenic (As)	<0.050		0.050	mg/L		19-DEC-18	R4404614
Barium (Ba)	1.07		0.50	mg/L		19-DEC-18	R4404614
Boron (B)	<2.5		2.5	mg/L		19-DEC-18	R4404614
Cadmium (Cd)	<0.0050		0.0050	mg/L		19-DEC-18	R4404614
Chromium (Cr)	<0.050		0.050	mg/L		19-DEC-18	R4404614
Lead (Pb)	<0.050		0.050	mg/L		19-DEC-18	R4404614
Mercury (Hg)	<0.00010		0.00010	mg/L		19-DEC-18	R4403011
Selenium (Se)	<0.025		0.025	mg/L		19-DEC-18	R4404614
Silver (Ag)	<0.0050		0.0050	mg/L		19-DEC-18	R4404614
Uranium (U)	<0.25		0.25	mg/L		19-DEC-18	R4404614
TCLP VOCs							
1,1-Dichloroethylene	<0.025		0.025	mg/L		20-DEC-18	R4405349
1,2-Dichlorobenzene	<0.025		0.025	mg/L		20-DEC-18	R4405349
1,2-Dichloroethane	<0.025		0.025	mg/L		20-DEC-18	R4405349
1,4-Dichlorobenzene	<0.025		0.025	mg/L		20-DEC-18	R4405349
Benzene	<0.025		0.025	mg/L		20-DEC-18	R4405349
Carbon tetrachloride	<0.025		0.025	mg/L		20-DEC-18	R4405349
Chlorobenzene	<0.025		0.025	mg/L		20-DEC-18	R4405349
Chloroform	<0.10		0.10	mg/L		20-DEC-18	R4405349
Dichloromethane	<0.50		0.50	mg/L		20-DEC-18	R4405349
Methyl Ethyl Ketone	<1.0		1.0	mg/L		20-DEC-18	R4405349
Tetrachloroethylene	<0.025		0.025	mg/L		20-DEC-18	R4405349
Trichloroethylene	<0.025		0.025	mg/L		20-DEC-18	R4405349
Vinyl chloride	<0.050		0.050	mg/L		20-DEC-18	R4405349
Surrogate: 4-Bromofluorobenzene	97.2		70-130	%		20-DEC-18	R4405349
Volatile Organic Compounds							
Surrogate: 1,4-Difluorobenzene	100.3		70-130	%		20-DEC-18	R4405349
Polycyclic Aromatic Hydrocarbons							
Benzo(k)fluoranthene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2211214-1 B418-201 AS-1 Sampled By: CLIENT on 12-DEC-18 @ 09:45 Matrix: SOIL							
Polycyclic Aromatic Hydrocarbons							
Chrysene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Dibenzo(ah)anthracene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Fluoranthene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Fluorene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Indeno(1,2,3-cd)pyrene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Naphthalene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Phenanthrene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Pyrene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Quinoline	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Surrogate: d10-Acenaphthene	100.9		50-150	%	27-DEC-18	28-DEC-18	R4417569
Surrogate: d12-Chrysene	89.7		50-150	%	27-DEC-18	28-DEC-18	R4417569
Surrogate: d8-Naphthalene	98.0		50-150	%	27-DEC-18	28-DEC-18	R4417569
Surrogate: d10-Phenanthrene	97.6		50-150	%	27-DEC-18	28-DEC-18	R4417569
L2211214-2 B418-201 SS5 Sampled By: CLIENT on 11-DEC-18 @ 11:20 Matrix: SOIL							
Physical Tests							
Conductivity	0.234		0.0040	mS/cm		24-DEC-18	R4413287
% Moisture	25.3		0.10	%	17-DEC-18	18-DEC-18	R4399013
Redox Potential	260		-1000	mV		19-DEC-18	R4403251
Resistivity	4270		1.0	ohm*cm		17-DEC-18	
Leachable Anions & Nutrients							
Chloride	50.7		5.0	ug/g	19-DEC-18	19-DEC-18	R4406811
Anions and Nutrients							
Sulphate	64		20	mg/kg	17-DEC-18	19-DEC-18	R4406811
L2211214-3 B418-201 SS6 Sampled By: CLIENT on 11-DEC-18 @ 11:30 Matrix: SOIL							
Sample Preparation							
Initial pH	9.38		0.10	pH units		19-DEC-18	R4403607
Final pH	6.19		0.10	pH units		19-DEC-18	R4403607
Physical Tests							
pH	7.83		0.10	pH units		18-DEC-18	R4400440
TCLP Extractables							
Acenaphthene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Acenaphthylene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Anthracene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Benzo(a)anthracene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Benzo(a)pyrene	<0.0010		0.0010	mg/L	27-DEC-18	28-DEC-18	R4417569
Benzo(b)fluoranthene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Benzo(g,h,i)perylene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
TCLP Metals							
Arsenic (As)	<0.050		0.050	mg/L		19-DEC-18	R4404614

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2211214-3 B418-201 SS6 Sampled By: CLIENT on 11-DEC-18 @ 11:30 Matrix: SOIL							
TCLP Metals							
Barium (Ba)	2.38		0.50	mg/L		19-DEC-18	R4404614
Boron (B)	<2.5		2.5	mg/L		19-DEC-18	R4404614
Cadmium (Cd)	<0.0050		0.0050	mg/L		19-DEC-18	R4404614
Chromium (Cr)	<0.050		0.050	mg/L		19-DEC-18	R4404614
Lead (Pb)	<0.050		0.050	mg/L		19-DEC-18	R4404614
Mercury (Hg)	<0.00010		0.00010	mg/L		19-DEC-18	R4403011
Selenium (Se)	<0.025		0.025	mg/L		19-DEC-18	R4404614
Silver (Ag)	<0.0050		0.0050	mg/L		19-DEC-18	R4404614
Uranium (U)	<0.25		0.25	mg/L		19-DEC-18	R4404614
TCLP VOCs							
1,1-Dichloroethylene	<0.025		0.025	mg/L		20-DEC-18	R4405349
1,2-Dichlorobenzene	<0.025		0.025	mg/L		20-DEC-18	R4405349
1,2-Dichloroethane	<0.025		0.025	mg/L		20-DEC-18	R4405349
1,4-Dichlorobenzene	<0.025		0.025	mg/L		20-DEC-18	R4405349
Benzene	<0.025		0.025	mg/L		20-DEC-18	R4405349
Carbon tetrachloride	<0.025		0.025	mg/L		20-DEC-18	R4405349
Chlorobenzene	<0.025		0.025	mg/L		20-DEC-18	R4405349
Chloroform	<0.10		0.10	mg/L		20-DEC-18	R4405349
Dichloromethane	<0.50		0.50	mg/L		20-DEC-18	R4405349
Methyl Ethyl Ketone	<1.0		1.0	mg/L		20-DEC-18	R4405349
Tetrachloroethylene	<0.025		0.025	mg/L		20-DEC-18	R4405349
Trichloroethylene	<0.025		0.025	mg/L		20-DEC-18	R4405349
Vinyl chloride	<0.050		0.050	mg/L		20-DEC-18	R4405349
Surrogate: 4-Bromofluorobenzene	96.6		70-130	%		20-DEC-18	R4405349
Volatile Organic Compounds							
Surrogate: 1,4-Difluorobenzene	100.0		70-130	%		20-DEC-18	R4405349
Polycyclic Aromatic Hydrocarbons							
Benzo(k)fluoranthene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Chrysene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Dibenzo(ah)anthracene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Fluoranthene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Fluorene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Indeno(1,2,3-cd)pyrene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Naphthalene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Phenanthrene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Pyrene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Quinoline	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Surrogate: d10-Acenaphthene	99.8		50-150	%	27-DEC-18	28-DEC-18	R4417569
Surrogate: d12-Chrysene	95.1		50-150	%	27-DEC-18	28-DEC-18	R4417569
Surrogate: d8-Naphthalene	98.4		50-150	%	27-DEC-18	28-DEC-18	R4417569
Surrogate: d10-Phenanthrene	99.5		50-150	%	27-DEC-18	28-DEC-18	R4417569
B418-203 AS-1							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2211214-4 B418-203 AS-1 Sampled By: CLIENT on 12-DEC-18 @ 11:45 Matrix: SOIL							
Sample Preparation							
Initial pH	9.68		0.10	pH units		19-DEC-18	R4403607
Final pH	6.11		0.10	pH units		19-DEC-18	R4403607
Physical Tests							
pH	7.73		0.10	pH units		18-DEC-18	R4400440
TCLP Extractables							
Acenaphthene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Acenaphthylene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Anthracene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Benzo(a)anthracene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Benzo(a)pyrene	<0.0010		0.0010	mg/L	27-DEC-18	28-DEC-18	R4417569
Benzo(b)fluoranthene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Benzo(g,h,i)perylene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
TCLP Metals							
Arsenic (As)	<0.050		0.050	mg/L		19-DEC-18	R4404614
Barium (Ba)	1.04		0.50	mg/L		19-DEC-18	R4404614
Boron (B)	<2.5		2.5	mg/L		19-DEC-18	R4404614
Cadmium (Cd)	<0.0050		0.0050	mg/L		19-DEC-18	R4404614
Chromium (Cr)	<0.050		0.050	mg/L		19-DEC-18	R4404614
Lead (Pb)	<0.050		0.050	mg/L		19-DEC-18	R4404614
Mercury (Hg)	<0.00010		0.00010	mg/L		19-DEC-18	R4403011
Selenium (Se)	<0.025		0.025	mg/L		19-DEC-18	R4404614
Silver (Ag)	<0.0050		0.0050	mg/L		19-DEC-18	R4404614
Uranium (U)	<0.25		0.25	mg/L		19-DEC-18	R4404614
TCLP VOCs							
1,1-Dichloroethylene	<0.025		0.025	mg/L		20-DEC-18	R4405349
1,2-Dichlorobenzene	<0.025		0.025	mg/L		20-DEC-18	R4405349
1,2-Dichloroethane	<0.025		0.025	mg/L		20-DEC-18	R4405349
1,4-Dichlorobenzene	<0.025		0.025	mg/L		20-DEC-18	R4405349
Benzene	<0.025		0.025	mg/L		20-DEC-18	R4405349
Carbon tetrachloride	<0.025		0.025	mg/L		20-DEC-18	R4405349
Chlorobenzene	<0.025		0.025	mg/L		20-DEC-18	R4405349
Chloroform	<0.10		0.10	mg/L		20-DEC-18	R4405349
Dichloromethane	<0.50		0.50	mg/L		20-DEC-18	R4405349
Methyl Ethyl Ketone	<1.0		1.0	mg/L		20-DEC-18	R4405349
Tetrachloroethylene	<0.025		0.025	mg/L		20-DEC-18	R4405349
Trichloroethylene	<0.025		0.025	mg/L		20-DEC-18	R4405349
Vinyl chloride	<0.050		0.050	mg/L		20-DEC-18	R4405349
Surrogate: 4-Bromofluorobenzene	98.0		70-130	%		20-DEC-18	R4405349
Volatile Organic Compounds							
Surrogate: 1,4-Difluorobenzene	99.8		70-130	%		20-DEC-18	R4405349
Polycyclic Aromatic Hydrocarbons							
Benzo(k)fluoranthene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2211214-4 B418-203 AS-1 Sampled By: CLIENT on 12-DEC-18 @ 11:45 Matrix: SOIL							
Polycyclic Aromatic Hydrocarbons							
Chrysene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Dibenzo(ah)anthracene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Fluoranthene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Fluorene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Indeno(1,2,3-cd)pyrene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Naphthalene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Phenanthrene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Pyrene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Quinoline	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Surrogate: d10-Acenaphthene	95.3		50-150	%	27-DEC-18	28-DEC-18	R4417569
Surrogate: d12-Chrysene	91.4		50-150	%	27-DEC-18	28-DEC-18	R4417569
Surrogate: d8-Naphthalene	92.6		50-150	%	27-DEC-18	28-DEC-18	R4417569
Surrogate: d10-Phenanthrene	95.1		50-150	%	27-DEC-18	28-DEC-18	R4417569
L2211214-5 B418-204 AS-1 Sampled By: CLIENT on 12-DEC-18 @ 00:45 Matrix: SOIL							
Sample Preparation							
Initial pH	9.32		0.10	pH units		19-DEC-18	R4403607
Final pH	4.57		0.10	pH units		19-DEC-18	R4403607
Physical Tests							
pH	7.53		0.10	pH units		18-DEC-18	R4400440
TCLP Extractables							
Acenaphthene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Acenaphthylene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Anthracene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Benzo(a)anthracene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Benzo(a)pyrene	<0.0010		0.0010	mg/L	27-DEC-18	28-DEC-18	R4417569
Benzo(b)fluoranthene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Benzo(g,h,i)perylene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
TCLP Metals							
Arsenic (As)	<0.050		0.050	mg/L		19-DEC-18	R4404614
Barium (Ba)	0.97		0.50	mg/L		19-DEC-18	R4404614
Boron (B)	<2.5		2.5	mg/L		19-DEC-18	R4404614
Cadmium (Cd)	<0.0050		0.0050	mg/L		19-DEC-18	R4404614
Chromium (Cr)	<0.050		0.050	mg/L		19-DEC-18	R4404614
Lead (Pb)	<0.050		0.050	mg/L		19-DEC-18	R4404614
Mercury (Hg)	<0.00010		0.00010	mg/L		19-DEC-18	R4403011
Selenium (Se)	<0.025		0.025	mg/L		19-DEC-18	R4404614
Silver (Ag)	<0.0050		0.0050	mg/L		19-DEC-18	R4404614
Uranium (U)	<0.25		0.25	mg/L		19-DEC-18	R4404614
TCLP VOCs							
1,1-Dichloroethylene	<0.025		0.025	mg/L		20-DEC-18	R4405349

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2211214-5 B418-204 AS-1 Sampled By: CLIENT on 12-DEC-18 @ 00:45 Matrix: SOIL							
TCLP VOCs							
1,2-Dichlorobenzene	<0.025		0.025	mg/L		20-DEC-18	R4405349
1,2-Dichloroethane	<0.025		0.025	mg/L		20-DEC-18	R4405349
1,4-Dichlorobenzene	<0.025		0.025	mg/L		20-DEC-18	R4405349
Benzene	<0.025		0.025	mg/L		20-DEC-18	R4405349
Carbon tetrachloride	<0.025		0.025	mg/L		20-DEC-18	R4405349
Chlorobenzene	<0.025		0.025	mg/L		20-DEC-18	R4405349
Chloroform	<0.10		0.10	mg/L		20-DEC-18	R4405349
Dichloromethane	<0.50		0.50	mg/L		20-DEC-18	R4405349
Methyl Ethyl Ketone	<1.0		1.0	mg/L		20-DEC-18	R4405349
Tetrachloroethylene	<0.025		0.025	mg/L		20-DEC-18	R4405349
Trichloroethylene	<0.025		0.025	mg/L		20-DEC-18	R4405349
Vinyl chloride	<0.050		0.050	mg/L		20-DEC-18	R4405349
Surrogate: 4-Bromofluorobenzene	97.9		70-130	%		20-DEC-18	R4405349
Volatile Organic Compounds							
Surrogate: 1,4-Difluorobenzene	99.6		70-130	%		20-DEC-18	R4405349
Polycyclic Aromatic Hydrocarbons							
Benzo(k)fluoranthene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Chrysene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Dibenzo(ah)anthracene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Fluoranthene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Fluorene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Indeno(1,2,3-cd)pyrene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Naphthalene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Phenanthrene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Pyrene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Quinoline	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Surrogate: d10-Acenaphthene	99.6		50-150	%	27-DEC-18	28-DEC-18	R4417569
Surrogate: d12-Chrysene	94.4		50-150	%	27-DEC-18	28-DEC-18	R4417569
Surrogate: d8-Naphthalene	96.4		50-150	%	27-DEC-18	28-DEC-18	R4417569
Surrogate: d10-Phenanthrene	98.3		50-150	%	27-DEC-18	28-DEC-18	R4417569
L2211214-6 B418-205 AS-1 Sampled By: CLIENT on 12-DEC-18 @ 13:30 Matrix: SOIL							
Sample Preparation							
Initial pH	9.19		0.10	pH units		19-DEC-18	R4403607
Final pH	5.96		0.10	pH units		19-DEC-18	R4403607
Physical Tests							
pH	7.63		0.10	pH units		18-DEC-18	R4400440
TCLP Extractables							
Acenaphthene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Acenaphthylene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Anthracene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2211214-6 B418-205 AS-1 Sampled By: CLIENT on 12-DEC-18 @ 13:30 Matrix: SOIL							
TCLP Extractables							
Benzo(a)anthracene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Benzo(a)pyrene	<0.0010		0.0010	mg/L	27-DEC-18	28-DEC-18	R4417569
Benzo(b)fluoranthene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Benzo(g,h,i)perylene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
TCLP Metals							
Arsenic (As)	<0.050		0.050	mg/L		19-DEC-18	R4404614
Barium (Ba)	0.95		0.50	mg/L		19-DEC-18	R4404614
Boron (B)	<2.5		2.5	mg/L		19-DEC-18	R4404614
Cadmium (Cd)	<0.0050		0.0050	mg/L		19-DEC-18	R4404614
Chromium (Cr)	<0.050		0.050	mg/L		19-DEC-18	R4404614
Lead (Pb)	<0.050		0.050	mg/L		19-DEC-18	R4404614
Mercury (Hg)	<0.00010		0.00010	mg/L		19-DEC-18	R4403011
Selenium (Se)	<0.025		0.025	mg/L		19-DEC-18	R4404614
Silver (Ag)	<0.0050		0.0050	mg/L		19-DEC-18	R4404614
Uranium (U)	<0.25		0.25	mg/L		19-DEC-18	R4404614
TCLP VOCs							
1,1-Dichloroethylene	<0.025		0.025	mg/L		20-DEC-18	R4405349
1,2-Dichlorobenzene	<0.025		0.025	mg/L		20-DEC-18	R4405349
1,2-Dichloroethane	<0.025		0.025	mg/L		20-DEC-18	R4405349
1,4-Dichlorobenzene	<0.025		0.025	mg/L		20-DEC-18	R4405349
Benzene	<0.025		0.025	mg/L		20-DEC-18	R4405349
Carbon tetrachloride	<0.025		0.025	mg/L		20-DEC-18	R4405349
Chlorobenzene	<0.025		0.025	mg/L		20-DEC-18	R4405349
Chloroform	<0.10		0.10	mg/L		20-DEC-18	R4405349
Dichloromethane	<0.50		0.50	mg/L		20-DEC-18	R4405349
Methyl Ethyl Ketone	<1.0		1.0	mg/L		20-DEC-18	R4405349
Tetrachloroethylene	<0.025		0.025	mg/L		20-DEC-18	R4405349
Trichloroethylene	<0.025		0.025	mg/L		20-DEC-18	R4405349
Vinyl chloride	<0.050		0.050	mg/L		20-DEC-18	R4405349
Surrogate: 4-Bromofluorobenzene	96.2		70-130	%		20-DEC-18	R4405349
Volatile Organic Compounds							
Surrogate: 1,4-Difluorobenzene	99.1		70-130	%		20-DEC-18	R4405349
Polycyclic Aromatic Hydrocarbons							
Benzo(k)fluoranthene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Chrysene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Dibenzo(ah)anthracene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Fluoranthene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Fluorene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Indeno(1,2,3-cd)pyrene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Naphthalene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Phenanthrene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Pyrene	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2211214-6 B418-205 AS-1 Sampled By: CLIENT on 12-DEC-18 @ 13:30 Matrix: SOIL							
Polycyclic Aromatic Hydrocarbons							
Quinoline	<0.0050		0.0050	mg/L	27-DEC-18	28-DEC-18	R4417569
Surrogate: d10-Acenaphthene	95.7		50-150	%	27-DEC-18	28-DEC-18	R4417569
Surrogate: d12-Chrysene	91.2		50-150	%	27-DEC-18	28-DEC-18	R4417569
Surrogate: d8-Naphthalene	94.1		50-150	%	27-DEC-18	28-DEC-18	R4417569
Surrogate: d10-Phenanthrene	94.4		50-150	%	27-DEC-18	28-DEC-18	R4417569

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CL-R511-WT	Soil	Chloride-O.Reg 153/04 (July 2011)	EPA 300.0
5 grams of dried soil is mixed with 10 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.			
Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).			
EC-WT	Soil	Conductivity (EC)	MOEE E3138
A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.			
Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).			
HG-TCLP-WT	Waste	Mercury (CVAA) for O.Reg 347	SW846 7470A
LEACH-TCLP-WT	Waste	Leachate Procedure for Reg 347	EPA 1311
Inorganic and Semi-Volatile Organic contaminants are leached from waste samples in strict accordance with US EPA Method 1311, "Toxicity Characteristic Leaching Procedure" (TCLP). Test results are reported in leachate concentration units (normally mg/L).			
MET-TCLP-WT	Waste	O.Reg 347 TCLP Leachable Metals	EPA 200.8
MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
PAH-TCLP-WT	Waste	PAH for O. Reg 347	SW846 8270 (PAH)
Samples are leached according to TCLP protocol and then the aqueous leachate is extracted and the resulting extracts are analyzed on GC/MSD. Depending on the analytical GC/MS column used benzo(j)fluoranthene may chromatographically co-elute with benzo(b)fluoranthene or benzo(k)fluoranthene.			
PH-WT	Soil	pH	MOEE E3137A
A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.			
Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).			
REDOX-POTENTIAL-WT	Soil	Redox Potential	APHA 2580
This analysis is carried out in accordance with the procedure described in the "APHA" method 2580 "Oxidation-Reduction Potential" 2012. Samples are extracted at a fixed ratio with DI water. Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.			
RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	APHA 2510 B
Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.			
RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	MOECC E3138
Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.			
SO4-WT	Soil	Sulphate	EPA 300.0
5 grams of soil is mixed with 50 mL of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.			
VOC-TCLP-WT	Waste	VOC for O. Reg 347	SW846 8260
A sample of waste is leached in a zero headspace extractor at 30–2 rpm for 18–2.0 hours with the appropriate leaching solution. After tumbling the leachate is analyzed directly by headspace technology, followed by GC/MS using internal standard quantitation.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L2211214 Report Date: 28-DEC-18

Client: TULLOCH ENGINEERING INC
80 Main Street W.
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-R511-WT	**Soil**							
Batch R4406811								
WG2956916-3 CRM		**AN-CRM-WT**						
Chloride			98.2		%		70-130	19-DEC-18
WG2956916-4 DUP		**L2211214-2**						
Chloride		50.7	49.8		ug/g	1.8	30	19-DEC-18
WG2956916-2 LCS								
Chloride			103.7		%		80-120	19-DEC-18
WG2956916-1 MB								
Chloride			<5.0		ug/g		5	19-DEC-18
EC-WT	**Soil**							
Batch R4413287								
WG2959451-4 DUP		**WG2959451-3**						
Conductivity		0.364	0.360		mS/cm	1.1	20	24-DEC-18
WG2959451-2 IRM		**WT SAR2**						
Conductivity			95.1		%		70-130	24-DEC-18
WG2960181-1 LCS								
Conductivity			102.2		%		90-110	24-DEC-18
WG2959451-1 MB								
Conductivity			<0.0040		mS/cm		0.004	24-DEC-18
MOISTURE-WT	**Soil**							
Batch R4399013								
WG2955465-3 DUP		**L2210016-1**						
% Moisture		16.0	17.1		%	6.6	20	18-DEC-18
WG2955465-2 LCS								
% Moisture			99.97		%		90-110	18-DEC-18
WG2955465-1 MB								
% Moisture			<0.10		%		0.1	18-DEC-18
PH-WT	**Soil**							
Batch R4400440								
WG2955450-1 DUP		**L2210016-3**						
pH		7.60	7.58	J	pH units	0.02	0.3	18-DEC-18
WG2956118-1 LCS								
pH			6.93		pH units		6.9-7.1	18-DEC-18
REDOX-POTENTIAL-WT	**Soil**							
Batch R4403251								
WG2955587-1 DUP		**L2211214-2**						
Redox Potential		260	252		mV	3.1	25	19-DEC-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street W.
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SO4-WT	**Soil**							
Batch R4406811								
WG2955503-4 CRM		**AN-CRM-WT**						
Sulphate			126.2		%		60-140	19-DEC-18
WG2955503-3 DUP		**L2211214-2**						
Sulphate		64	62		mg/kg	3.0	30	19-DEC-18
WG2955503-2 LCS								
Sulphate			104.0		%		80-120	19-DEC-18
WG2955503-1 MB								
Sulphate			<20		mg/kg		20	19-DEC-18
HG-TCLP-WT	**Waste**							
Batch R4403011								
WG2957329-3 DUP		**L2211214-1**						
Mercury (Hg)		<0.00010	<0.00010	RPD-NA	mg/L	N/A	50	19-DEC-18
WG2957329-2 LCS								
Mercury (Hg)			103.0		%		70-130	19-DEC-18
WG2957329-1 MB								
Mercury (Hg)			<0.00010		mg/L		0.0001	19-DEC-18
WG2957329-4 MS		**L2211214-1**						
Mercury (Hg)			97.7		%		50-140	19-DEC-18
MET-TCLP-WT	**Waste**							
Batch R4404614								
WG2957353-4 DUP		**WG2957353-3**						
Silver (Ag)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	19-DEC-18
Arsenic (As)		<0.050	<0.050	RPD-NA	mg/L	N/A	50	19-DEC-18
Boron (B)		<2.5	<2.5	RPD-NA	mg/L	N/A	50	19-DEC-18
Barium (Ba)		1.07	1.09		mg/L	1.6	50	19-DEC-18
Cadmium (Cd)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	19-DEC-18
Chromium (Cr)		<0.050	<0.050	RPD-NA	mg/L	N/A	50	19-DEC-18
Lead (Pb)		<0.050	<0.050	RPD-NA	mg/L	N/A	50	19-DEC-18
Selenium (Se)		<0.025	<0.025	RPD-NA	mg/L	N/A	50	19-DEC-18
Uranium (U)		<0.25	<0.25	RPD-NA	mg/L	N/A	50	19-DEC-18
WG2957353-2 LCS								
Silver (Ag)			103.3		%		70-130	19-DEC-18
Arsenic (As)			100.1		%		70-130	19-DEC-18
Boron (B)			100.8		%		70-130	19-DEC-18
Barium (Ba)			104.0		%		70-130	19-DEC-18
Cadmium (Cd)			99.8		%		70-130	19-DEC-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street W.
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TCLP-WT	**Waste**							
Batch R4404614								
WG2957353-2 LCS								
Chromium (Cr)			98.5		%		70-130	19-DEC-18
Lead (Pb)			103.8		%		70-130	19-DEC-18
Selenium (Se)			98.9		%		70-130	19-DEC-18
Uranium (U)			102.8		%		70-130	19-DEC-18
WG2957353-1 MB								
Silver (Ag)			<0.0050		mg/L		0.005	19-DEC-18
Arsenic (As)			<0.050		mg/L		0.05	19-DEC-18
Boron (B)			<2.5		mg/L		2.5	19-DEC-18
Barium (Ba)			<0.50		mg/L		0.5	19-DEC-18
Cadmium (Cd)			<0.0050		mg/L		0.005	19-DEC-18
Chromium (Cr)			<0.050		mg/L		0.05	19-DEC-18
Lead (Pb)			<0.050		mg/L		0.05	19-DEC-18
Selenium (Se)			<0.025		mg/L		0.025	19-DEC-18
Uranium (U)			<0.25		mg/L		0.25	19-DEC-18
WG2957353-5 MS		**WG2957353-3**						
Silver (Ag)			122.6		%		50-140	19-DEC-18
Arsenic (As)			103.2		%		50-140	19-DEC-18
Boron (B)			103.5		%		50-140	19-DEC-18
Barium (Ba)			103.6		%		50-140	19-DEC-18
Cadmium (Cd)			101.4		%		50-140	19-DEC-18
Chromium (Cr)			98.3		%		50-140	19-DEC-18
Lead (Pb)			101.2		%		50-140	19-DEC-18
Selenium (Se)			102.1		%		50-140	19-DEC-18
Uranium (U)			104.7		%		50-140	19-DEC-18
PAH-TCLP-WT	**Waste**							
Batch R4417569								
WG2960667-9 DUP		**WG2960667-7**						
Acenaphthene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	28-DEC-18
Acenaphthylene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	28-DEC-18
Anthracene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	28-DEC-18
Benzo(a)anthracene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	28-DEC-18
Benzo(a)pyrene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	50	28-DEC-18
Benzo(b)fluoranthene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	28-DEC-18
Benzo(g,h,i)perylene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	28-DEC-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street W.
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TCLP-WT	**Waste**							
Batch R4417569								
WG2960667-9 DUP		**WG2960667-7**						
Benzo(k)fluoranthene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	28-DEC-18
Chrysene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	28-DEC-18
Dibenzo(ah)anthracene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	28-DEC-18
Fluoranthene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	28-DEC-18
Fluorene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	28-DEC-18
Indeno(1,2,3-cd)pyrene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	28-DEC-18
Naphthalene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	28-DEC-18
Phenanthrene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	28-DEC-18
Pyrene		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	28-DEC-18
Quinoline		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	28-DEC-18
WG2960667-6 LCS								
Acenaphthene			99.8		%		50-130	28-DEC-18
Acenaphthylene			101.0		%		50-130	28-DEC-18
Anthracene			103.0		%		50-130	28-DEC-18
Benzo(a)anthracene			108.3		%		50-140	28-DEC-18
Benzo(a)pyrene			96.8		%		60-140	28-DEC-18
Benzo(b)fluoranthene			98.6		%		50-140	28-DEC-18
Benzo(g,h,i)perylene			91.8		%		50-140	28-DEC-18
Benzo(k)fluoranthene			90.1		%		50-150	28-DEC-18
Chrysene			101.3		%		50-140	28-DEC-18
Dibenzo(ah)anthracene			98.8		%		50-140	28-DEC-18
Fluoranthene			104.6		%		50-150	28-DEC-18
Fluorene			100.6		%		50-150	28-DEC-18
Indeno(1,2,3-cd)pyrene			107.1		%		50-140	28-DEC-18
Naphthalene			96.3		%		50-130	28-DEC-18
Phenanthrene			104.8		%		50-130	28-DEC-18
Pyrene			100.6		%		50-140	28-DEC-18
Quinoline			106.6		%		50-150	28-DEC-18
WG2960667-10 MB								
Acenaphthene			<0.0050		mg/L		0.005	28-DEC-18
Acenaphthylene			<0.0050		mg/L		0.005	28-DEC-18
Anthracene			<0.0050		mg/L		0.005	28-DEC-18
Benzo(a)anthracene			<0.0050		mg/L		0.005	28-DEC-18
Benzo(a)pyrene			<0.0010		mg/L		0.001	28-DEC-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street W.
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TCLP-WT	**Waste**							
Batch R4417569								
WG2960667-10 MB								
Benzo(b)fluoranthene			<0.0050		mg/L		0.005	28-DEC-18
Benzo(g,h,i)perylene			<0.0050		mg/L		0.005	28-DEC-18
Benzo(k)fluoranthene			<0.0050		mg/L		0.005	28-DEC-18
Chrysene			<0.0050		mg/L		0.005	28-DEC-18
Dibenzo(ah)anthracene			<0.0050		mg/L		0.005	28-DEC-18
Fluoranthene			<0.0050		mg/L		0.005	28-DEC-18
Fluorene			<0.0050		mg/L		0.005	28-DEC-18
Indeno(1,2,3-cd)pyrene			<0.0050		mg/L		0.005	28-DEC-18
Naphthalene			<0.0050		mg/L		0.005	28-DEC-18
Phenanthrene			<0.0050		mg/L		0.005	28-DEC-18
Pyrene			<0.0050		mg/L		0.005	28-DEC-18
Quinoline			<0.0050		mg/L		0.005	28-DEC-18
Surrogate: d8-Naphthalene			101.2		%		50-150	28-DEC-18
Surrogate: d10-Phenanthrene			102.9		%		50-150	28-DEC-18
Surrogate: d12-Chrysene			100.6		%		50-150	28-DEC-18
Surrogate: d10-Acenaphthene			103.3		%		50-150	28-DEC-18
WG2960667-5 MB								
Acenaphthene			<0.0050		mg/L		0.005	28-DEC-18
Acenaphthylene			<0.0050		mg/L		0.005	28-DEC-18
Anthracene			<0.0050		mg/L		0.005	28-DEC-18
Benzo(a)anthracene			<0.0050		mg/L		0.005	28-DEC-18
Benzo(a)pyrene			<0.0010		mg/L		0.001	28-DEC-18
Benzo(b)fluoranthene			<0.0050		mg/L		0.005	28-DEC-18
Benzo(g,h,i)perylene			<0.0050		mg/L		0.005	28-DEC-18
Benzo(k)fluoranthene			<0.0050		mg/L		0.005	28-DEC-18
Chrysene			<0.0050		mg/L		0.005	28-DEC-18
Dibenzo(ah)anthracene			<0.0050		mg/L		0.005	28-DEC-18
Fluoranthene			<0.0050		mg/L		0.005	28-DEC-18
Fluorene			<0.0050		mg/L		0.005	28-DEC-18
Indeno(1,2,3-cd)pyrene			<0.0050		mg/L		0.005	28-DEC-18
Naphthalene			<0.0050		mg/L		0.005	28-DEC-18
Phenanthrene			<0.0050		mg/L		0.005	28-DEC-18
Pyrene			<0.0050		mg/L		0.005	28-DEC-18
Quinoline			<0.0050		mg/L		0.005	28-DEC-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street W.
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-TCLP-WT	**Waste**							
Batch R4417569								
WG2960667-5 MB								
Surrogate: d8-Naphthalene			101.0		%		50-150	28-DEC-18
Surrogate: d10-Phenanthrene			103.3		%		50-150	28-DEC-18
Surrogate: d12-Chrysene			102.9		%		50-150	28-DEC-18
Surrogate: d10-Acenaphthene			99.6		%		50-150	28-DEC-18
WG2960667-8 MS		**WG2960667-7**						
Acenaphthene			100.7		%		50-150	28-DEC-18
Acenaphthylene			100.0		%		50-150	28-DEC-18
Anthracene			102.1		%		50-150	28-DEC-18
Benzo(a)anthracene			106.3		%		50-150	28-DEC-18
Benzo(a)pyrene			92.2		%		50-150	28-DEC-18
Benzo(b)fluoranthene			97.2		%		50-150	28-DEC-18
Benzo(g,h,i)perylene			95.6		%		50-150	28-DEC-18
Benzo(k)fluoranthene			100.3		%		50-150	28-DEC-18
Chrysene			103.1		%		50-150	28-DEC-18
Dibenzo(ah)anthracene			97.3		%		50-150	28-DEC-18
Fluoranthene			102.1		%		50-150	28-DEC-18
Fluorene			99.8		%		50-150	28-DEC-18
Indeno(1,2,3-cd)pyrene			100.7		%		50-150	28-DEC-18
Naphthalene			94.9		%		50-150	28-DEC-18
Phenanthrene			103.0		%		50-150	28-DEC-18
Pyrene			102.4		%		50-150	28-DEC-18
Quinoline			112.8		%		50-150	28-DEC-18
VOC-TCLP-WT	**Waste**							
Batch R4405349								
WG2923107-1 LCS								
1,1-Dichloroethylene			109.6		%		70-130	19-DEC-18
1,2-Dichlorobenzene			110.0		%		70-130	19-DEC-18
1,2-Dichloroethane			106.3		%		70-130	19-DEC-18
1,4-Dichlorobenzene			115.3		%		70-130	19-DEC-18
Benzene			111.1		%		70-130	19-DEC-18
Carbon tetrachloride			109.0		%		60-140	19-DEC-18
Chlorobenzene			107.9		%		70-130	19-DEC-18
Chloroform			107.9		%		70-130	19-DEC-18
Dichloromethane			109.2		%		70-130	19-DEC-18

Quality Control Report

Client: TULLOCH ENGINEERING INC
80 Main Street W.
Huntsville ON P1H 1W9
Contact: Erik Giles

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-TCLP-WT	**Waste**							
Batch R4405349								
WG2923107-1 LCS								
Methyl Ethyl Ketone			96.9		%		50-150	19-DEC-18
Tetrachloroethylene			112.3		%		70-130	19-DEC-18
Trichloroethylene			113.2		%		70-130	19-DEC-18
Vinyl chloride			90.5		%		60-130	19-DEC-18
WG2923107-2 MB								
1,1-Dichloroethylene			<0.025		mg/L		0.025	20-DEC-18
1,2-Dichlorobenzene			<0.025		mg/L		0.025	20-DEC-18
1,2-Dichloroethane			<0.025		mg/L		0.025	20-DEC-18
1,4-Dichlorobenzene			<0.025		mg/L		0.025	20-DEC-18
Benzene			<0.025		mg/L		0.025	20-DEC-18
Carbon tetrachloride			<0.025		mg/L		0.025	20-DEC-18
Chlorobenzene			<0.025		mg/L		0.025	20-DEC-18
Chloroform			<0.10		mg/L		0.1	20-DEC-18
Dichloromethane			<0.50		mg/L		0.5	20-DEC-18
Methyl Ethyl Ketone			<1.0		mg/L		1	20-DEC-18
Tetrachloroethylene			<0.025		mg/L		0.025	20-DEC-18
Trichloroethylene			<0.025		mg/L		0.025	20-DEC-18
Vinyl chloride			<0.050		mg/L		0.05	20-DEC-18
Surrogate: 1,4-Difluorobenzene			100.2		%		70-130	20-DEC-18
Surrogate: 4-Bromofluorobenzene			97.8		%		70-130	20-DEC-18
WG2923107-4 MS		**WG2923107-3**						
1,1-Dichloroethylene			105.2		%		50-140	20-DEC-18
1,2-Dichlorobenzene			114.7		%		50-140	20-DEC-18
1,2-Dichloroethane			113.3		%		50-140	20-DEC-18
1,4-Dichlorobenzene			113.0		%		50-140	20-DEC-18
Benzene			112.3		%		50-140	20-DEC-18
Carbon tetrachloride			105.4		%		50-140	20-DEC-18
Chlorobenzene			106.9		%		50-140	20-DEC-18
Chloroform			109.6		%		50-140	20-DEC-18
Dichloromethane			112.2		%		50-140	20-DEC-18
Methyl Ethyl Ketone			105.2		%		50-140	20-DEC-18
Tetrachloroethylene			103.4		%		50-140	20-DEC-18
Trichloroethylene			108.9		%		50-140	20-DEC-18
Vinyl chloride			86.8		%		50-140	20-DEC-18

Quality Control Report

Workorder: L2211214 Report Date: 28-DEC-18

Client: TULLOCH ENGINEERING INC
80 Main Street W.
Huntsville ON P1H 1W9
Contact: Erik Giles

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2211214-COFC

COC Number: 17 -

Page 1 of 1

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	TULLOCH ENGINEERING	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	Regular [R] ☐ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	ERIK GILES	Quality Control (QC) Report with Report ☑ YES ☐ NO	Priority (Business Days): 4 day [P4-20%] ☐ / 3 day [P3-25%] ☐ / 2 day [P2-50%] ☐
Phone:	705 789 7851 X438	☐ Compare Results to Criteria on Report - provide details below if box checked	Emergency: 1 Business day [E1 - 100%] ☐ / Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	
Street:	80 MAIN ST. W	Email 1 erik.giles@tulloch.ca	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm
City/Province:	HUNTSVILLE / ON	Email 2 greg.au@tulloch.ca	For tests that can not be performed according to the service level selected, you will be contacted.
Postal Code:	P1H 1W9	Email 3	
Invoice To	Same as Report To ☑ YES ☐ NO	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☑ YES ☐ NO	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	Tulloch Engineering	Email 1 or Fax Erik.Giles@tulloch.ca	
Contact:	Nancy Sea Bannon	Email 2 Nancy.SeaBannon@tulloch.ca	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:	23923 / Q69287	AFE/Cost Center:	PO#:
Job #:	18-4046	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):	L2211214	ALS Contact: EHANSEN	Sampler:

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	TCLP: METALS	TCLP: VOC	TCLP: PAH	PH		RESISTIVITY	SULFATE	CHLORIDE	REDOX						SAMPLES ON HOLD	Sample is hazardous (please provide further detail)	NUMBER OF CONTAINERS
	BH18-201 AS-1	12/12/18	9:45	SOIL	X	X	X	X													2
	BH18-201 SS5	11/12/18	11:20	SOIL						X	X	X	X								1
	BH18-701 SS6	11/12/18	11:30	SOIL	X	X	X	X													2
	BH18-203 AS-1	12/12/18	11:45	SOIL	X	X	X	X													2
	BH18-204 AS-1	12/12/18	12:45	SOIL	X	X	X	X													2
	BH18-205 AS-1	12/12/18	13:30	SOIL	X	X	X	X													2

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☒

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C			
	7.1		9.5			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: E. Giles	Date: DEC 14/18	Time:	Received by:	Date:	Time:	Received by:	Date: DEC 17/18	Time: 1 pm

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

SEPT 2017 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

APPENDIX I

ARCHEOLOGICAL MONITORING RESULTS

GOLDER

TECHNICAL MEMORANDUM

DATE March 18, 2019

Project No. 1665951

TO Dan Franco, P. Eng., Project Manager
City of Kingston

CC Berend Jan Velderman, Golder Associates Ltd
Hugh Daechsel, Golder Associates Ltd.

FROM Benjamin Holthof, M.P., M.M.A. CAHP

EMAIL Benjamin_Holthof@golder.com

SUMMARY OF ARCHAEOLOGICAL MONITORING OF IN WATER GEOTECHNICAL BOREHOLES IN THE CATARAQUI RIVER, KINGSTON ONTARIO FOR THE FINAL DESIGN PHASE OF THE THIRD CROSSING PROJECT

Introduction

Geotechnical Borehole testing of the riverbed in the Cataraqui River was undertaken between October 23, 2018 and December 5, 2018 for the final design phase of the Third Crossing project. Tulloch Engineering managed the geotechnical investigations, Marathon Drilling conducted the drilling operation and O.D.S. Marine Construction provided the barge, workboat and two personnel. A Golder Associates Ltd. (Golder) marine archaeologist and two First Nations monitors –one each from the Huron Wendat First Nation and the Mohawks of the Bay of Quinte were on the barge observing for cultural materials within the first 7.0 metres of riverbed sediment at each marine borehole.

The archaeological monitoring program followed the process adopted during marine geotechnical borehole drilling in the Cataraqui River in 2016, also conducted by a Golder archaeologist with First Nations monitors. At the outset of the marine geotechnical borehole drilling operation in 2018 the Golder archaeologist and First Nations monitors agreed on the process. Tulloch Engineering personnel managing the geotechnical program informed the archaeologist and First Nations monitors before each new borehole was started and were accommodated to ensure their ability to be on site. Golder and the First Nations monitors had a very good working relationship over the course of this project.

Eight geotechnical boreholes were drilled, each one at or near a proposed bridge pier location (Figure 1). Additional boreholes will be drilled on land, however Stage 1 and Stage 2 terrestrial archaeological investigations have been completed around the proposed location of terrestrial boreholes and no archaeological monitoring of the terrestrial boreholes is expected to be required.

Golder Associates Ltd.
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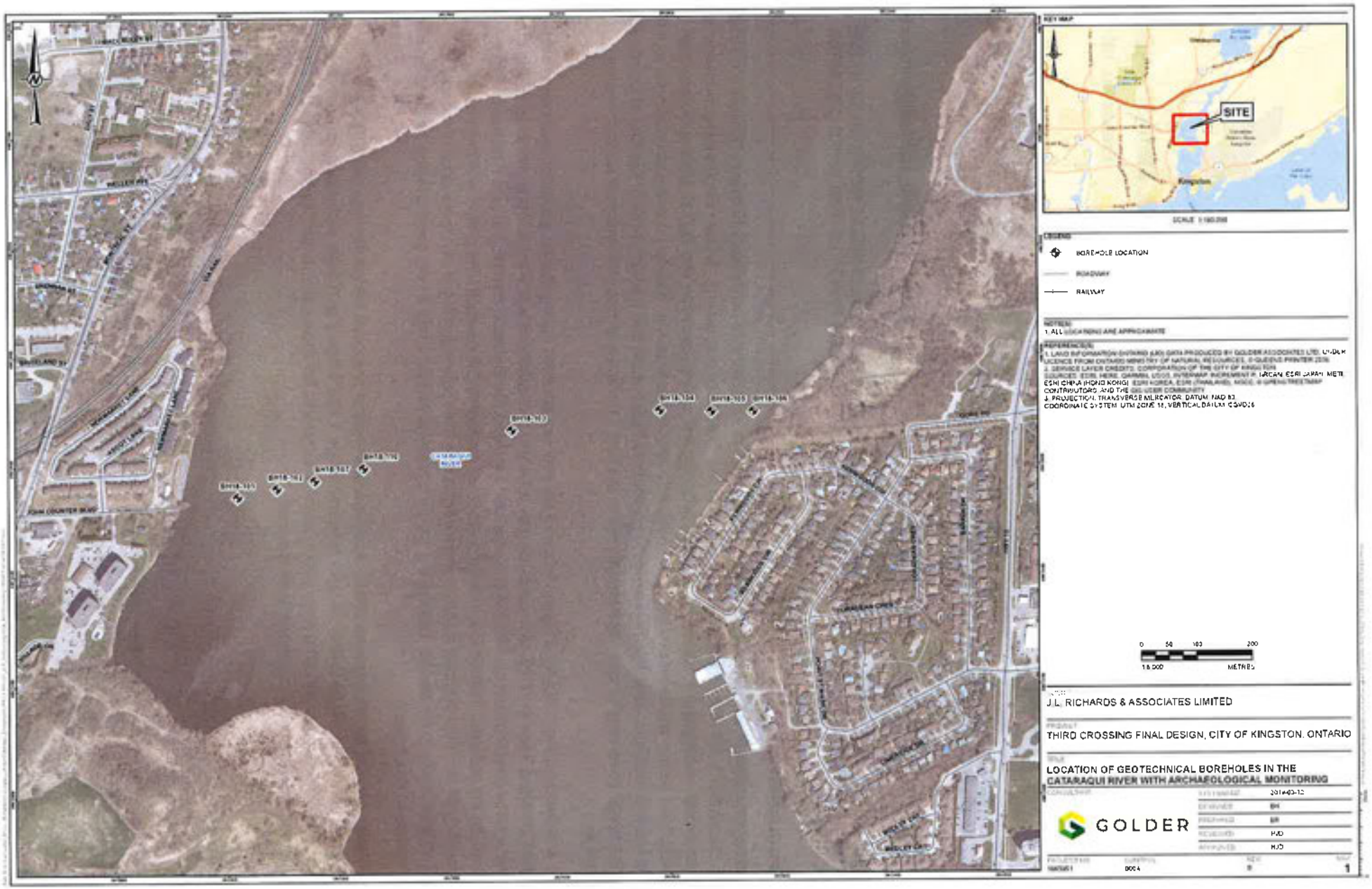

H357883-04-240-0001, Rev 1

Personnel on the Barge during archaeological monitoring of the boreholes included:

- Erik Giles — Tulloch Engineering
- Denis Rondeau — O.D.S. Marine Construction
- Duncan Ker — O.D.S. Marine Construction
- Ben Holthof — Golder Associates Ltd.
- Lindsay Dales — Golder Associates Ltd.
- Xavier Daigle — Huron Wendat First Nation
- Samuel Jefferies — Mohawks of the Bay of Quinte First Nation
- Shane Casselman — Marathon Underground
- Will Parker — Marathon Underground
- Larry Foster — Marathon Underground

Archaeological monitoring took place on:

- October 23, 2018 at Borehole 18-101;
- October 29, 2018 at Borehole 18-102;
- November 5, 2018 at Borehole 18-107;
- November 9, 2018 at Borehole 18-104;
- November 13, 2018 at Borehole 18-105;
- November 27, 2018 at Borehole 18-106;
- November 28, 2018 at Borehole 18-110; and,
- November 30, 2018 at Borehole 18-103.

Previous Underwater Archaeological Studies and Reports

Previously completed underwater archaeology studies and reports include:

- *Stage 1 –Background Research Underwater Archaeological Assessment for the City of Kingston Environmental Assessment Third Crossing of the Cataraqui River* by Scarlett Janusas Archaeological and Heritage Consulting and Education in 2009;
- *Stage 2 Marine Archaeological Assessment Cataraqui River 3rd Crossing City of Kingston, Frontenac County* by Scarlett Janusas Archaeological and Heritage Consulting and Education in 2011; and,
- *Summary of Archaeological Monitoring of In Water, Geotechnical Boreholes in the Cataraqui River, Kingston, Ontario* by Golder in 2016.

The 2009 and 2011 marine archaeological reports identified that the Cataraqui River area where the Third Crossing bridge is proposed has been a river and marsh environment for thousands of years. However cyclic variations in water depth in Lake Ontario over the past 4,000 years may have lowered water levels at times resulting in land which has been subsequently inundated by modern environmental processes. This was evidenced by the recovery of submerged wood near the contemporary west shore of the river that was radiocarbon dated to approximately 4430 to 4250 years BP (Janusas 2011:61). The Stage 1 assessment of the corridor identified archaeological potential for the waterway (Janusas 2009). The subsequent Stage 2 assessment did not, however, result in the location of any submerged archaeological sites (Janusas 2011). Archaeological monitoring of boreholes for the preliminary design phase of the project in 2016 did not find any cultural materials within the sediment observed during each borehole advancement.

The nature of potential cultural materials that may be found in the Cataraqui River includes debris from historic use of the area such as metal, ceramics or glass that may have fallen from boats on the river. Prehistoric materials could include stone artifacts or waterlogged materials such as components of vessels, wood used in constructing fish weirs, or artifacts deposited from canoe accidents. There remains the potential for the recovery of material from the river that would reflect Indigenous use of the area over the past 5,000 years.

Method

The workboat would take the Tulloch engineer with a handheld GPS unit to the location of a borehole and a small buoy dropped at the location. The barge with the drill rig would then be moved into position over the buoy and the drill rig set up. Samples were collected in 0.6 metre segments (Figure 2). Samples were split in half and Golder's archaeologist and the First Nations monitors would then photograph each sample. Samples were then visually and where necessary manually checked for cultural materials. Once samples from the first 7.0 meters of bottom sediments had been collected, drilling would continue without further inspection by the archaeologist or First Nations monitors.

Figure 2: Marathon Underground Drillers and Drill Rig on the Barge.

Results

The first 1.5 to 2.0 metres of each borehole consisted of a dark brown, silty bottom sediment and peat (Figure 3). These were full of organic fibrous material and had the occasional twig or root. Below the peat layer, samples changed to blue grey or brown grey marine clay (Figure 4). This clay was smooth with very few inclusions. Occasionally a small root, layer of silt or small piece of gravel would be found in the clay. The marine clay was usually very dense. No cultural materials were found in any samples during the course of monitoring these eight geotechnical boreholes.

Figure 3: Sample #3 from Borehole 18-103, silt and peat.

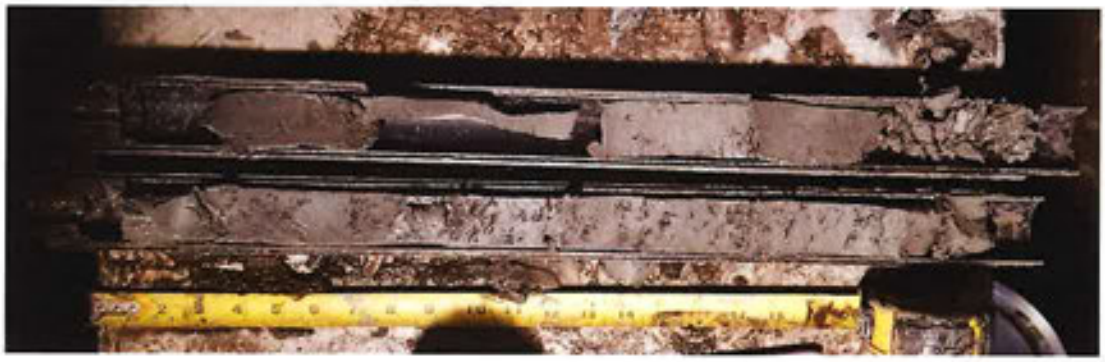

Figure 4: Sample #9 from Borehole 18-103, grey marine clay.

Limitations

The eight geotechnical boreholes sampled and subject to archaeological monitoring represent a very small sample size from a large riverbed area. Further disturbance of the river bed will require additional archaeological monitoring.

Recommendations

Although no cultural heritage resources were observed during the current borehole monitoring program, the known potential for archaeological resources within the Cataraqui River documented in previous reports indicates that should future impacts to the riverbed occur during this project, these activities should be monitored by an archaeologist to ensure all cultural heritage resources are sufficiently documented.

Closure

We trust that this report meets your current needs. If you have any questions or concerns, please contact the undersigned at Benjamin_Holthof@golder.com, or 1 (613) 328-5598.

Benjamin Holthof, M.Pl., M.,M.A., CAHP
Cultural Heritage Specialist, Marine Archaeologist

Hugh Daechsel, M.A.
Principal, Senior Archaeologist

BH/HJD/mvrd/ca
https://golderassociates.sharepoint.com/sites/25696g/deliverables/archaeology/phase 4000 - archaeology monitoring in cataraqui river/third crossing final design marine archaeology_18march2019.docx

Appendix P
DRAFT Report on Indigenous Consultation (City of Kingston - August 2019)