



Detailed Foundation Investigation Report Hewitson Creek Culvert Replacement

**Highway 17 Realignment, 9.3 to 13.3 km West of the Township of Schreiber
Northwestern Region, Ontario**

G.W.P. 6333-14-00, Site No. 48C-0026/C0

Latitude: 48.837787°, Longitude: -87.407203°

GEOCRES No. 42D14-002

Client Name: Hatch

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**DETAILED FOUNDATION INVESTIGATION REPORT
HEWITSON CREEK CULVERT REPLACEMENT
HIGHWAY 17 REALIGNMENT, 9.3 TO 13.3 KM WEST OF TOWNSHIP OF SCHREIBER
MTO NORTHWESTERN REGION, ONTARIO
G.W.P. 6333-14-00, Site No. 48C-0026/C0
LATITUDE: 48.837787°, LONGITUDE: -87.407203°

GEOCRES No. 42D14-002**

1. INTRODUCTION

This report presents the factual findings obtained from a foundation investigation carried out by Thurber Engineering Ltd. (Thurber) for the proposed Hewitson Creek Culvert replacement, as part of the Highway 17 Curve Realignment from 9.3 to 13.3 km west of the Township of Schreiber, Ontario.

The project includes an approximately 4 km long realignment of Highway 17, starting 9.3 km west of the Township of Schreiber. This report pertains to the construction of a new structural culvert where the realigned Highway 17 crosses Hewitson Creek. The project scope includes the detailed design of the Hewitson Creek Culvert and the associated high fill approach embankments.

A separate investigation was completed for construction of new high fill embankments and deep cut sections for the new alignment, as well as the installation of new non-structural culverts in two locations. The high fill and deep cut foundations report is discussed in a separate report entitled:

“Detailed Foundation Investigation and Design Report, High Fill Embankments, Deep Cuts, and Non-Structural Culverts, Highway 17 Realignment, 9.3 To 13.3 Km West of Township of Schreiber, MTO Northwestern Region, Ontario, G.W.P. 6333-14-00”, File: 37996, Dated October 22, 2024 (Reference 1).

The purpose of Thurber’s investigation was to explore the subsurface conditions at the proposed structural culvert and approach embankment locations, and based on the data obtained, to provide borehole location plans, record of borehole sheets, stratigraphic profiles, laboratory test results and a written description of the subsurface conditions.

Thurber carried out the assignment as a sub-consultant to Hatch Ltd. (Hatch), under the Ministry of Transportation Ontario (MTO) Assignment No. 6023-E-0007.

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

2. SITE DESCRIPTION

2.1 Existing and Proposed Highway 17

The existing Highway 17 within the project limits is a two-lane, undivided roadway with at-grade intersections and an eastbound truck-climbing lane. For the purposes of this report, the existing and new highway alignments are considered to operate in an east/west direction. Three at-grade intersections are present within the project limits; at an unnamed access road for Hydro One near the west limit, at the Rainbow Falls Whitesand Lake Campground entrance, and at Ch. Hunter Road near the east limit.

The existing highway corridor is surrounded predominately by heavily wooded areas. The highway crosses a Hydro One high voltage transmission corridor west of Hewitson Creek and east of Rainbow Falls Provincial Park. A CPKC rail corridor is located to the south of the highway, and an MTO gravel pit is located south of the highway near the east end of the proposed new alignment. The proposed new alignment is located south of the Hydro One corridor, north of the CPKC rail corridor, and crosses through Rainbow Falls Provincial Park. Steep hills and creek valleys were noted throughout the existing and proposed alignment. Bedrock was observed at the ground surface locally near the east and west ends of the proposed alignment near the existing highway.

The Hewitson Creek valley is steep and heavily forested. The creek bed elevation at the culvert site ranges from approximately 204 to 205 m, while the top of the creek valley slopes are at approximate Elev. 222 m on the west side (Sta. 10+930), and 230 m on the east side (Sta. 11+150), indicating that the valley slopes are approximately 17 to 25 m high. Hewitson Creek generally flows from north to south, and the surface water level in the creek is approximately Elev. 206 to 206.5 m.

Typical photographs of the Hewitson Creek Culvert site are included in Appendix F.

2.2 Existing Subsurface Information

A preliminary foundation investigation was previously completed by Thurber for the Hewitson Creek Culvert Replacement. The preliminary foundation investigation report for this site is available within the online Geocres Library.

- Geocres 42D-071
 - Preliminary Foundation Investigation Report, Highway 17 Realignment and Hewitson Creek Culvert, 9.3 to 13.3 Km West of Township of Schreiber, Northwestern Region, Ontario, G.W.P. 6333-14-00, Dated March 27, 2023

The historical borehole locations have been included in the borehole plan in Appendix A. The borehole program for the culvert structure and approach embankments included two boreholes

identified as HEW-01 and HEW-02. The boreholes were advanced to depths of 5.6 and 4.3 m (Elev. 201.0 m and 201.9 m) near the west edge of the proposed culvert location. The stratigraphy was described as topsoil overlying silty sand to sand and gravel with frequent cobbles and boulders. The historical borehole logs are included in Appendix B.

2.3 Regional Geology

Quaternary geological mapping¹ indicates that the proposed Hewitson Creek culvert primarily lies within glaciolacustrine nearshore beach deposits consisting of gravelly sand to sand and gravel. Near the east and west ends of the proposed highway alignment, Precambrian bedrock was mapped, indicating the presence of igneous or metamorphic rock at surface or below discontinuous and thin layers of drift.

Bedrock mapping² in this area indicates the bedrock is typically comprised of the massive granodiorite to granite of the Whitesand Lake Batholith. This batholith is typically comprised of medium to coarse grained granite and includes a grey phase ranging in composition from monzodiorite to quartz monzonite³.

3. SITE INVESTIGATION AND FIELD TESTING

The scope of the detailed foundation investigation at the Hewitson Creek site consisted of a field drilling program of advancing 11 boreholes at the locations of the proposed structural culvert and high fill approaches. The field investigation for these areas was carried out in two phases. One borehole (HF2A-01) was advanced during the track-mounted drilling from March 2 to 3, 2024. The remaining Hewitson Creek and high fill boreholes were drilled between March 23 to April 17, 2024. The previous phase of the investigation completed along the high fill and deep cut sections was conducted between March 1 and 18, 2024 and included 21 boreholes.

The boreholes completed for the Hewitson Creek investigation, along with the locations, assigned nomenclature and depths / base elevations are summarized in Table 3.1.

¹ Ontario Geological Survey, Ministry of Northern Development and Mines, and Northeast Science and Information Section, Ministry of Natural Resources 2005. *Digital Northern Ontario Engineering Geology Terrain Study (NOEGTS)*; Ontario Geological Survey, Miscellaneous Release--Data 160.

² Ontario Geological Survey 2011. *1:250 000 scale bedrock geology of Ontario*; Ontario Geological Survey, Miscellaneous Release--Data 126 - Revision 1.

³ Carter, M. W. 1988: *Geology of Schreiber-Terrace Bay area, District of Thunder Bay*; Ontario Geological Survey, Open File Report 5692

Table 3.1: Summary of Investigation Program

Location and Assigned Nomenclature	Approximate Station	Boreholes	Borehole Depth / Base Elevation (m)
West Approach Embankment / High Fill 2A (HF2A)	10+940 to 10+990	HF2A-01 to HF2A-02	9.5 to 19.0 / 202.3 to 198.0
Hewitson Creek Structural Culvert (HCC)	10+990 to 11+020	HCC-01 to HCC-06	11.6 to 19.5 / 195.2 to 185.5
East Approach Embankment / High Fill 2B (HF2B)	11+020 to 11+130	HF2B-01 to HF2B-03	13.2 to 21.6 / 205.6 to 183.1

The locations of the boreholes are shown on the Borehole Locations and Soil Strata Drawings included in Appendix A. Details of the subsurface conditions encountered during the foundation investigation are presented in the Record of Borehole sheets in Appendix B.

The centreline of the proposed new alignment was surveyed and staked on site by Hatch in advance of the drilling investigation. The borehole locations were established in the field based on measurements (stations and offset distances) from the staked centreline alignments. The horizontal coordinates and ground surface elevations at the borehole locations were established from the topographic data provided by Hatch. The coordinate system MTM NAD83, Zone 14 was used. Utility clearances were obtained prior to the start of drilling.

Access for a drill rig to the base of the >25 m valley was difficult without an appropriately designed access road. Hence, all boreholes, except for Borehole HF2A-01, were advanced using a Boart Longyear LF-70, Heli-portable drill rig. The drilling methodology used was wash boring with HWT casing and HQ coring methods. Borehole HF2A-01 was advanced using a track-mounted drill rig with solid and hollow stem augers, wash boring with NW casing, and NQ coring methods. All drilling equipment was supplied and operated by Eastern Ontario Diamond Drilling Ltd. of Hawkesbury, Ontario. Standard Penetration Testing (SPT) was carried out in accordance with ASTM D1586 at selected depth intervals.

The Heli-portable drill rig and all drilling equipment were transported across the site by a Bell 407 Helicopter (Aircraft Identification: C-GKTN, C-FKOP). The helicopters and all related equipment were provided by Wisk Air Helicopters of Thunder Bay, Ontario.

The field investigation was supervised on a full-time basis by members of Thurber's technical staff who directed the drilling, sampling and in-situ testing operations, logged the boreholes and processed the recovered soil and rock samples for transport to Thurber's laboratory for further examination and testing.

The rock cores were logged, and the Total Core Recovery (TCR), Solid Core Recovery (SCR), Rock Quality Designation (RQD) and the Fracture Indices (FI) were determined.

Groundwater conditions were observed in the open boreholes throughout the drilling operation. Monitoring wells were installed in Boreholes HCC-01 and HCC-05. Both wells consisted of 50 mm

Schedule 40 PVC pipe with a 3 m long slotted screen, enclosed in a column of filter sand to permit groundwater level monitoring. Monitoring well installation details, groundwater level observations and water level readings are shown on the Record of Borehole sheets. A sample of the groundwater was obtained from the well at Borehole HCC-01 and submitted to a specialist analytical laboratory under chain of custody procedures for testing for a suite of water quality parameters. Single well response tests (“slug”) tests were carried out in the wells installed in both Boreholes HCC-01 and HCC-05. The monitoring wells were decommissioned as per O. Reg. 903 at the completion of the well testing. All other boreholes were backfilled with bentonite upon completion of drilling in general accordance with O. Reg. 903.

4. LABORATORY TESTING

The recovered soil samples were subjected to visual identification (VI) and to natural moisture content determination. Selected samples were subjected to grain size distribution analyses (sieve and/or hydrometer), and Atterberg Limits testing. Rock core samples were subjected to Point Load Testing (PLT) and Unconfined Compressive Strength (UCS) Testing. The laboratory test results are summarized on the Record of Borehole sheets included in Appendix B, and presented on the figures included in Appendices C and D.

Selected soil and surface water samples for the proposed Hewitson Creek Culvert location were submitted for analytical testing to assess the potential for sulphate attack on concrete foundations, as well as the potential for corrosion associated with the structure. In order to assess the quality of the groundwater for disposal purposes, a water sample was collected from the well installed in Borehole HCC-01. The analyses were carried out by SGS Canada Inc. (SGS), an independent Canadian Association for Laboratory Accreditation (CALA) accredited laboratory. The results of the analytical testing are summarized in Sections 6 and 7 and the laboratory Certificates of Analysis are included in Appendix E.

5. DESCRIPTION OF SUBSURFACE CONDITIONS

Subsurface conditions encountered during the foundation investigation are shown on the Borehole Locations and Soil Strata Drawings in Appendix A. Detailed descriptions of individual soil stratum are presented on the Record of Borehole sheets included in Appendix B.

A general description of the soil stratigraphy is given below. However, the factual data presented on the Record of Borehole sheets takes precedence over these general descriptions and must be used for interpretation of the site conditions. It should be recognized and expected that soil, bedrock and groundwater conditions vary between and beyond borehole locations.

In general, the overburden soil across the site consists of topsoil or organic material overlying interbedded sand, silt and gravel deposits, frequently containing cobbles and boulders. Granite to granodiorite bedrock was encountered below the overburden soils.

5.1 Surficial Topsoil and Organics

Topsoil or surficial organics were encountered at the ground surface in all HCC and HF2 boreholes. Topsoil was encountered in HCC-05, HCC-06, and HF2B-01. Organic materials were observed at surface in boreholes HCC-01 to HCC-04, HF2A-01, HF2A-02, HF2B-02 and HF2B-03. The layer thickness ranged from 150 to 700 mm at the borehole locations (base Elev. from 221.1 to 204.5 m). Topsoil and surficial organics thickness may vary between and beyond the boreholes.

The surficial organics observed on site were described as loose, dark brown to black, and occasionally containing rootlets and wood fibres.

SPT 'N' values recorded in the organic materials ranged from 7 to 12 blows per 0.3 m penetration, indicating a loose to compact relative density. Natural moisture contents in the topsoil and organics ranged from 53 to 236%.

5.2 Sand and Gravel to Gravel

A 1.7 to 8.0 m thick deposit of sand and gravel to gravel was encountered in Boreholes HCC-01 to HCC-03, HCC-05, HCC-06, HF2A-01, HF2A-02, HF2B-02, and HF2B-03. The sand and gravel to gravel material was encountered below the surficial organics and topsoil, and occasionally interbedded with the silty sand to silt and sand layers. Occasional fine seams of silty sand were encountered throughout the deposit.

The sand and gravel to gravel layer frequently contained cobbles and boulders with diameters ranging from 75 mm to 350 mm. The cobble and boulder details are provided on the Record of Borehole sheets in Appendix B. Photographs of the cored cobbles and boreholes are provided in Appendix D.

The top of the sand and gravel layers were encountered at depths ranging from 0.2 m to 5.6 m (Elev. 215.7 to 200.3 m), and the base of the layers extended to depths of 2.5 to 13.2 m (Elev. 212.6 to 197.0 m).

Sand and gravel layers that were interbedded with sand and silt layers were encountered at depths from 4.4 m to 13.3 m (Elev. 202.4 m to 192.2 m) and extended to depths from 8.5 to 14.9 m (Elev. 198.3 to 190.6 m) in Boreholes HCC-01, HCC-02, and HCC-05.

SPT 'N' values recorded in this deposit ranged from 12 blows per 0.3 m penetration to greater than 50 blows per 0.075 m penetration, indicating a compact to very dense relative density. The natural moisture contents measured typically ranged from 1 to 27%, locally up to 49% in Borehole HCC-03 below the surficial organics.

The results of grain size analyses conducted on samples of the Sand and Gravel to Gravel are provided on the Record of Borehole sheets in Appendix B and illustrated on Figures C1 and C2 of Appendix C. The results are summarized as follows:

Soil Particle	Percentage (%)	
	Gravel	Sandy Gravel to Sand and Gravel
Gravel	63 to 80	39 to 57
Sand	19 to 31	30 to 50
Silt and Clay	1 to 6	4 to 17

5.3 Silty Sand to Sandy Silt

A layer of silty sand to sandy silt, containing trace gravel and clay was encountered throughout the site underlying topsoil, organics, or a sand and gravel to gravel layer. Silty sand to sandy silt was encountered in boreholes HCC-01, HCC-04, HCC-05, HCC-06, HF2A-01, HF2B-01, and HF2B-02 at depths ranging from 0.2 to 10.5 m (Elev. 221.1 to 194.5 m). The layers of silty sand, silt and sand, and sandy silt were typically interbedded. Individual layers of each ranged in thickness from 1.4 to 11.8 m and were occasionally interbedded with the sand and gravel to gravelly sand. Localized gravelly layers were occasionally encountered throughout the deposit. The base of the silty sand to sandy silt layer was encountered at depths ranging from 4.4 to 15.1 m (Elev. 208.1 to 189.8 m).

The silty sand to sandy silt deposit contained occasional cobbles and boulders throughout the site. The cobble and boulder diameters ranged from 75 mm to 280 mm. The cobble and boulder details are provided on the Record of Borehole sheets in Appendix B and photographs of the cored cobbles and boulders are provided in Appendix D.

SPT 'N' values recorded in the silty sand to sandy silt ranged from 13 blows per 0.3 m penetration to greater than 100 m for 0.1 m penetration, indicating a compact to very dense relative density. Natural moisture contents typically ranged from 7 to 30%.

The results of grain size analyses conducted on samples of the silty sand to sandy silt are provided on the Record of Borehole sheets in Appendix B and illustrated on Figures C3 and C4 of Appendix C. The results are summarized as follows:

Soil Particle	Percentage (%)	
	Silty Sand	Silt and Sand to Sandy Silt
Gravel	0 to 17	0 to 8
Sand	59 to 76	25 to 51
Silt	20 to 34	46 to 74
Clay	1 to 3	1 to 4

5.4 Sand

Localized deposits of sand, containing trace to some silt and trace to some gravel were encountered underlying the organic materials at depths ranging from 0.2 m to 0.7 m (Elev. 209.8 to 204.5 m) in Boreholes HF2A-02, HF2B-01, and HF2B-02. The sand deposit was also encountered interbedded within the sand and gravel to gravel deposit in HCC-02 and below the silt and sand to sandy silt deposit in HCC-04 at depths of 4.4 m and 12.0 m (Elev. 201.8 and 198.0 m), respectively. The sand deposit ranged in thickness from 1.8 to 5.7 m, and the base encountered at depths from 2.5 to 15.0 m (Elev. 205.0 to 195.0 m).

The sand deposit contained occasional cobbles throughout the site. The details regarding the thickness and location of the cobbles are provided on the Record of Borehole sheets in Appendix B. Photographs of the cored cobbles are provided in Appendix D.

SPT 'N' values recorded in the sand ranged from 10 blows per 0.3 m penetration to greater than 50 blows for 0.0 m of penetration, indicating a compact to very dense relative density (typically compact). Natural moisture contents in the sand ranged from 2 to 36%, locally up to 52% in HF2B-01 below the surficial topsoil.

The results of grain size analyses conducted on samples of the sand are provided on the Record of Borehole sheets in Appendix B and illustrated in Figure C5 of Appendix C. The results are summarized as follows:

Soil Particle	Percentage (%)	
Gravel	1 to 8	
Sand	79 to 91	
Silt	8	13
Clay	0	

5.5 Silt

Localized silt deposits containing trace to some clay, trace to some sand, and trace gravel were encountered underlying the silty sand to sandy silt deposit. Occasional cobbles from 100 to 175 mm in diameter were encountered within the silt in HF2B-03. The top of the silt ranged in depth from 1.8 m to 15.1 m (Elev. 219.5 to 189.8 m) in Boreholes HCC-06, HF2A-01 and HF2B-02. Silt was also encountered at 0.2 m depth (Elev. 218.6 m) below the surficial organic materials in Borehole HF2B-03.

The silt layers ranged in thickness from 1.4 to 5.0 m, with the base encountered at depths from 5.2 to 18.6 m (Elev. 215.7 to 186.1 m) upon the underlying bedrock, or locally in HF2B-03 upon the underlying sand and gravel.

SPT 'N' values recorded in the silt typically ranged from 6 blows per 0.3 m penetration to greater

than 100 blows per 0.025 m of penetration, indicating a loose to very dense relative density (typically compact to very dense). Natural moisture contents in the silt ranged from 17 to 28%.

The results of grain size analyses conducted on samples of the silt are provided on the Record of Borehole sheets in Appendix B and illustrated in Figure C6 of Appendix C. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0
Sand	6 to 18
Silt	76 to 86
Clay	5 to 15

The results of an Atterberg Limits test conducted on a sample of the silt are provided on the Record of Borehole sheets in Appendix B and illustrated on Figure C7 of Appendix C. The results are summarized as follows:

Index Property	Percentage (%)
Liquid Limit	22
Plasticity Index	3

The results of the Atterberg Limits test indicates that the material can be characterized as a non-plastic silt (ML).

5.6 Bedrock

Bedrock was encountered below the overburden materials in Boreholes HCC-01 to HCC-06, HF2A-01, HF2A-02, HF2B-01, and HF2A-02. The top of bedrock was encountered at depths between 6.5 m and 18.6 m (Elev. 205.7 to 186.1 m). The bedrock depths and elevations are shown on Table 5.1 below.

Table 5.1: Bedrock Depths

Borehole ID	Bedrock Depth (m)	Bedrock Elevation (m)
HCC-01	8.5	198.3
HCC-02	10.2	196.0
HCC-03	8.6	197.0
HCC-04	15.0	195.0
HCC-05	14.9	190.6

Borehole ID	Bedrock Depth (m)	Bedrock Elevation (m)
HCC-06	16.5	188.5
HF2A-01	15.6	205.7
HF2A-02	6.5	201.0
HF2B-01	13.0	197.0
HF2B-02	18.6	186.1

The bedrock was proven by coring 3 to 3.4 m below the rock surface. The bedrock was visually identified as granite in Boreholes HCC-01 to HCC-03, HCC-05, HCC-06, HF2A-02, and HF2B-02 and was described as red, typically slightly weathered to fresh, and medium to coarse grained. Granodiorite was visually identified in Boreholes HCC-04, HF2A-01, and HF2B-01 and was grey with occasional slightly red zones, slightly weathered to fresh, and medium to coarse grained.

Fracture index (FI), measured as the total number of fractures per 0.3 m of rock core length, were typically between 0 and 5, occasionally increasing to or exceeding 10 fractures in rubble zones. Total Core Recovery (TCR) values measured on recovered bedrock samples ranged from 94 to 100%. Solid Core Recovery (SCR) values ranged from 25 to 100% but typically exceeded 70%. Rock Quality Designation (RQD) values varied from 10 to 100% indicating a range from poor to excellent quality rock (average of 66%).

Unconfined compressive strength (UCS) tests were conducted on 5 samples. The testing results varied from 78 to 230 MPa. Estimated rock strength values were also interpreted from Point Load Tests conducted on the rock core. The average UCS values per core run from the point load tests ranged from 44 to 275 MPa. The results of the UCS and Point Load Tests indicate that the bedrock is typically very strong with localized zones ranging from medium strong to strong. The results of the rock tests and photographs of the rock core samples are presented in Appendix D.

5.7 Groundwater Conditions

The groundwater levels were observed throughout drilling and monitoring wells were installed in Boreholes HCC-01 and HCC-05 to monitor the groundwater table. The measured groundwater levels are summarized in Table 5.2 below.

Table 5.2: Hewitson Creek Culvert Groundwater Measurements

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
HCC-01	April 4, 2024	2.3	204.5	Monitoring Well
	April 8, 2024	2.3	204.5	
	April 11, 2024	2.4	204.4	

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
	April 13, 2024	2.4	204.4	
HCC-02	March 28, 2024	1.0	205.2	Open Borehole
HCC-03	March 26, 2024	1.6	204.0	Open Borehole
HCC-04	April 4, 2024	6.4	203.6	Open Borehole
HCC-05	April 11, 2024	6.1	199.4	Monitoring Well
	April 13, 2024	6.2	199.3	
	April 15, 2024	6.3	199.2	
HCC-06	April 12, 2024	2.7	202.3	Open Borehole
HF2A-02	April 1, 2024	2.9	204.6	Open Borehole
HF2B-01	April 6, 2024	6.5	203.5	Open Borehole
HF2B-02	April 15, 2024	2.4	202.3	Open Borehole
HF2B-03	April 16, 2024	9.4	209.4	Open Borehole

The groundwater levels above are short-term readings and seasonal fluctuations of the groundwater levels are to be expected. In particular, the groundwater levels may be at a higher elevation after periods of significant or prolonged precipitation.

6. CORROSIVITY AND SULPHATE TEST RESULTS

Two soil samples and one surface water sample were collected from near the proposed culvert location and submitted for analytical testing of corrosivity parameters and sulphate. The results of the analytical tests are summarized in Table 6.1 below and presented in Appendix E.

Table 6.1 Corrosivity Test Results

Parameter	Units (Soil)	Units (Water)	HCC-03 SS4 (8.5'-10.5')	HCC-04 SS5 (11'-13')	Hewitson Creek
			Sand and Gravel 2.6 to 3.2 m	Silt and Sand to Sandy Silt 3.3 to 4.0 m	Surface Water
Redox Potential	mV	mV	298	272	254
Resistivity*	ohms.cm	ohms.cm	12300*	19200*	27800*
Chloride	µg/g	mg/L	12	1.6	4.5
Sulphate	µg/g	mg/L	3.3	0.6	2.2
Sulphide	%	µg/L	< 0.01	< 0.01	< 6
Conductivity	mS/cm	uS/cm	81	52	36
pH	-	-	7.66	7.66	6.88

* Calculated based on conductivity result

7. WATER QUALITY

For screening of the general groundwater quality at the culvert site, a sample of the groundwater from the monitoring well at Borehole HCC-01 was collected on April 18, 2024. The water sample was analyzed for selected inorganic parameters included in the Ontario Provincial Water Quality Objectives (PWQO), as well as Total Suspended Solids. A filtered sample was also tested for dissolved metal parameters for comparison purposes. The analytical test results are presented in Appendix E.

The analytical results of the water testing were compared to limits for the PWQO for surface water discharge. The concentrations of all parameters tested that did not meet the criteria established in the PWQO are listed below in Table 7.1. The Total Suspended Solids concentration was 4 mg/L.

Table 7.1: Water Parameters Exceeding PWQO Criteria

Sample ID	Parameter	Criteria	Parameter Limit (µg/L)	Result
HCC-01	Total Cobalt	PWQO	0.9	1.28
	Total Copper	PWQO	5	6
	Total Iron	PWQO	300	6000
	Total Phosphorus	PWQO	10	23
	Total Silver	PWQO	0.1	0.9
HCC-01 Dissolved Solution (Filtered sample)	Dissolved Cobalt	PWQO	0.9	1.16
	Dissolved Iron	PWQO	300	5680
	Dissolved Phosphorus	PWQO	10	18

8. SINGLE WELL RESPONSE TEST RESULTS

8.1 Test Procedure

Single well response tests (SWRT) (“slug” tests) were carried out in the 50 mm diameter wells installed in Boreholes HCC-01 and HCC-05. The well installed in Borehole HCC-01 was screened across silty sand and sandy gravel to sand and gravel. The well installed in Borehole HCC-05 was screened across silt and sand, gravel, and granite bedrock. The tests were completed using the following method:

- The static water level was measured and recorded, and a datalogger was inserted into the well below the water level. The datalogger was set to record water levels every 0.5 to 0.5 seconds, based on the anticipated rate of recovery of the wells.

- A slug of groundwater was removed from the well with a dedicated bailer to induce a change in hydraulic head (rising head test).
- Manual and electronic measurements were recorded until the water level in the well recovered sufficiently.
- Manual measurements were compared to electronic measurements for quality control of the data.

8.2 Hydraulic Conductivity

The slug tests were completed and analyzed using the Hvorslev method. The plots of the slug test results are included in Appendix C. The hydraulic conductivity values calculated from the in-situ slug tests are summarized in Table 8.1:

Table 8.1: Hydraulic Conductivity

Monitoring Well	Hydraulic Conductivity (m/s)	Screened Formation
HCC-01	1.8×10^{-6}	silty sand; sandy gravel to sand and gravel
HCC-05	3.2×10^{-5}	silt and sand; gravel; granite bedrock

9. CLOSURE

The field investigation was supervised on a full-time basis by Mr. George Azzopardi and Mr. Matthew Macaskill, of Thurber. Overall supervision of the field program was provided by Ms. Rachel Bourassa, E.I.T.

Interpretation of the field data and report preparation was carried out by Ms. Rachel Bourassa, E.I.T., and Mr. Mark Farrant, P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a designated principal contact for MTO Foundations Projects.

Thurber Engineering Ltd.



Rachel Bourassa, E.I.T.
Geotechnical Engineering Intern



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



Date: December 12, 2024
File: 37996

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

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

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

2. COMPLETE REPORT

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

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3. BASIS OF REPORT

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

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5. INTERPRETATION OF THE REPORT

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

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

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

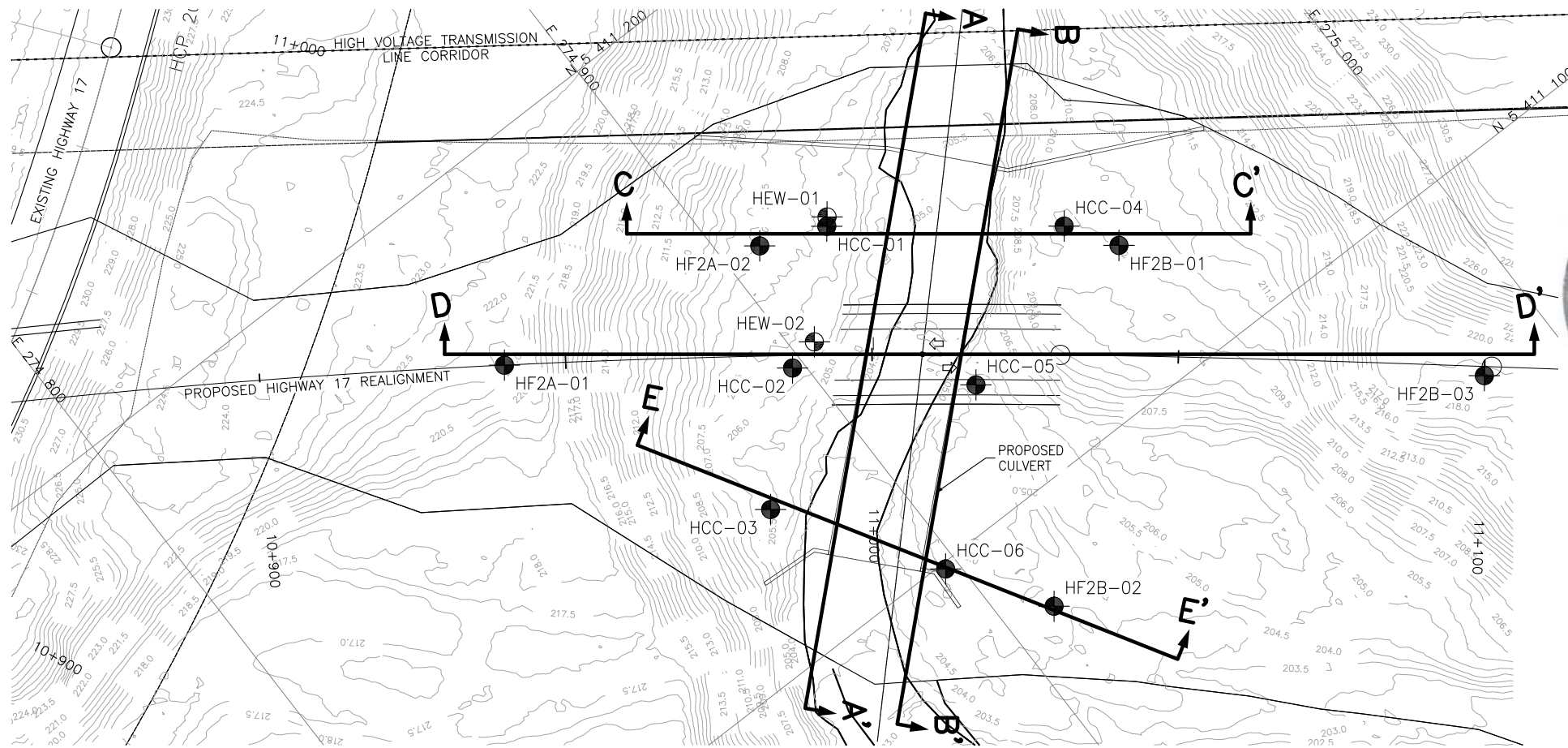
7. INDEPENDENT JUDGEMENTS OF CLIENT

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

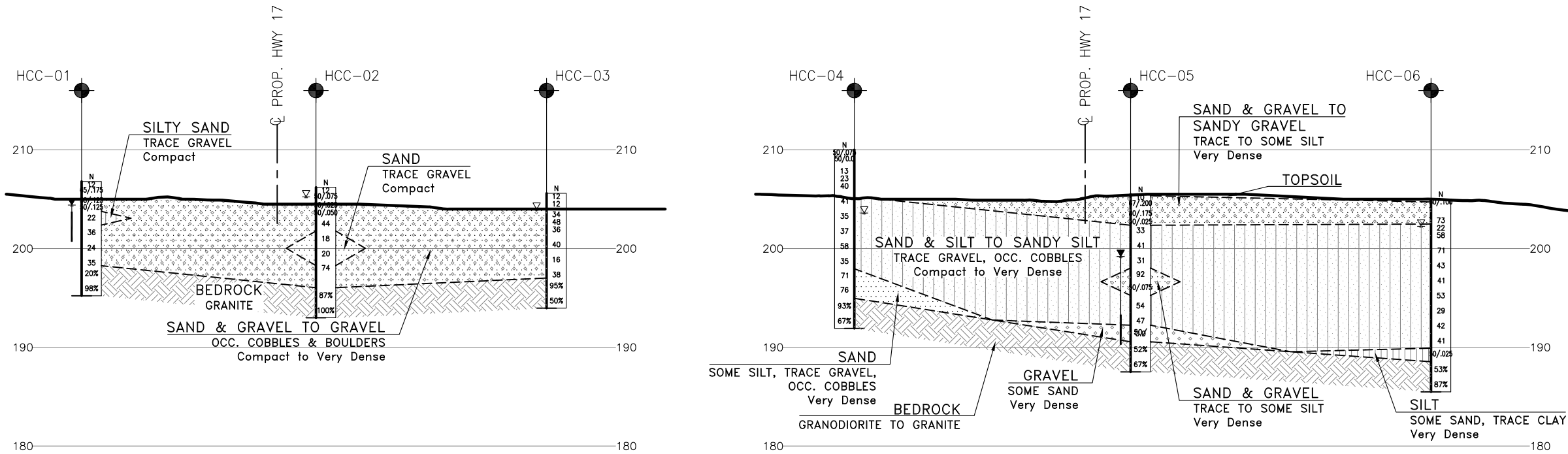
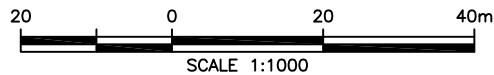


APPENDIX A

Stratigraphic Plan and Profile Drawings



PLAN



SECTION A-A'



SECTION B-B'



METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

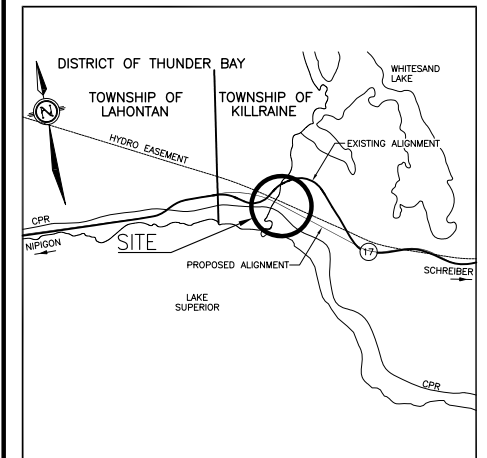


CONT No
WP No 6333-14-00

HIGHWAY 17
HEWITSON CREEK
CULVERT REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET



KEYPLAN

LEGEND

	Borehole (Current Investigation)
	Borehole (Previous Investigation)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
	Water Level Upon Completion of Drilling
	Water Level in Monitoring Well/Piezometer
	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
HCC-01	206.8	5 411 155.1	274 916.7
HCC-02	206.2	5 411 140.2	274 898.1
HCC-03	205.6	5 411 124.2	274 881.2
HCC-04	210.0	5 411 131.4	274 947.3
HCC-05	205.5	5 411 119.7	274 920.1
HCC-06	205.0	5 411 099.1	274 897.8
HEW-01	206.6	5 411 156.3	274 917.7
HEW-02	206.2	5 411 141.4	274 903.6
HF2A-01	221.3	5 411 169.4	274 861.3
HF2A-02	207.5	5 411 159.3	274 906.1
HF2B-01	210.0	5 411 123.4	274 952.5
HF2B-02	204.7	5 411 083.4	274 908.1
HF2B-03	218.8	5 411 070.1	274 986.6

-NOTES-

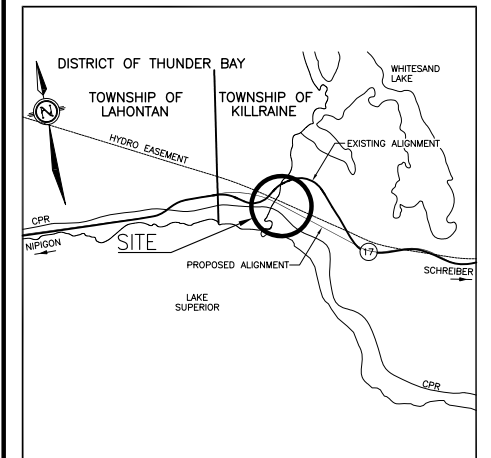
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Coordinate system is MTM NAD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

GEOCRES No. 42D14-002

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RB	CHK MEF	CODE
DRAWN	AN	CHK RB	SITE 48C-0028/CO/STRUCT
			LOAD
			DATE DEC 2024
			DWG 1








SHEET |



KEYPLAN

LEGEND

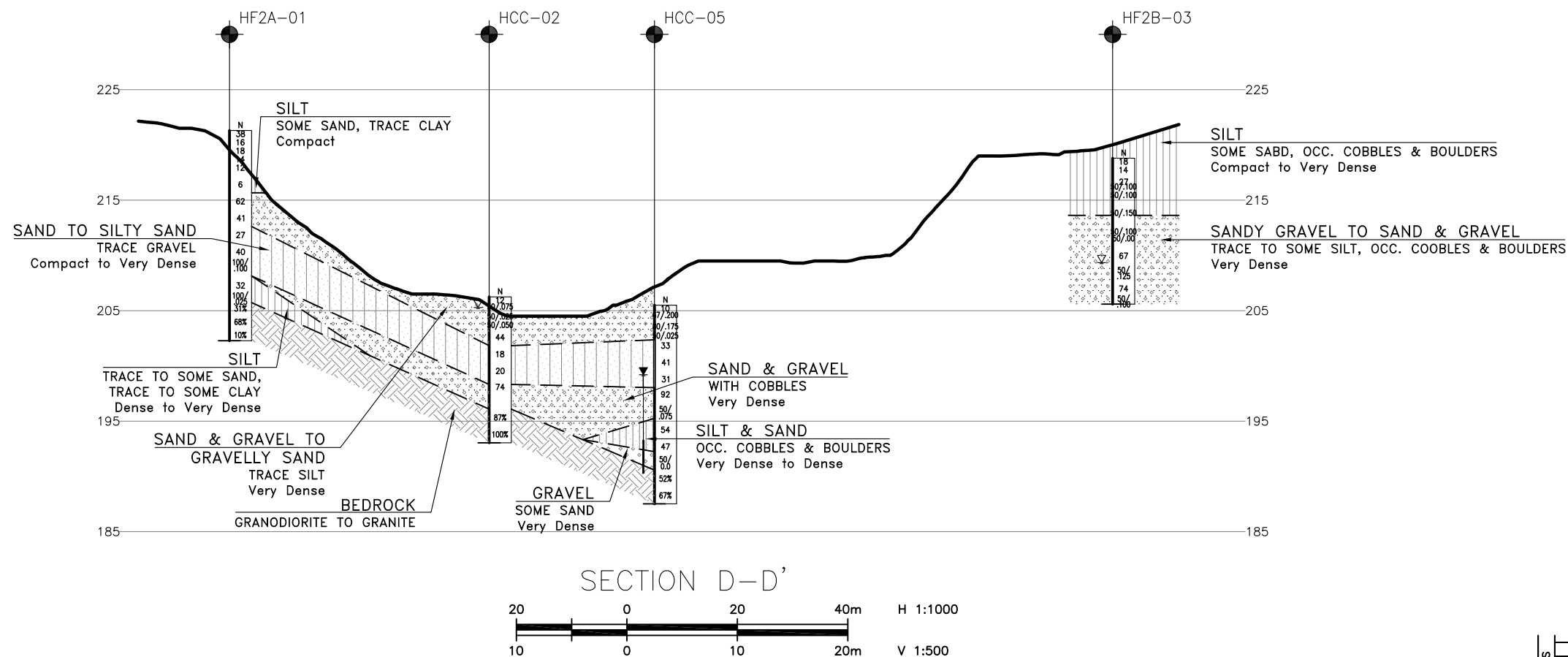
	Borehole (Current Investigation)
	Borehole (Previous Investigation)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60' Cone, 475J/blow)
	Water Level Upon Completion of Drilling
	Water Level in Monitoring Well/Piezometer
	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
HCC-01	206.8	5 411 155.1	274 916.7
HCC-02	206.2	5 411 140.2	274 898.1
HCC-03	205.6	5 411 124.2	274 881.2
HCC-04	210.0	5 411 131.4	274 947.3
HCC-05	205.5	5 411 119.7	274 920.1
HCC-06	205.0	5 411 099.1	274 897.8
HEW-01	206.6	5 411 156.3	274 917.7
HEW-02	206.2	5 411 141.4	274 903.6
HF2A-01	221.3	5 411 169.4	274 861.3
HF2A-02	207.5	5 411 159.3	274 906.1
HF2B-01	210.0	5 411 123.4	274 952.5
HF2B-02	204.7	5 411 083.4	274 908.1
HF2B-03	218.8	5 411 070.1	274 986.6

-NOTES-

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

GEOCRES No. 42D14-002



REVISIONS									
	DATE	BY				DESCRIPTION			
	DESIGN RB	CHK MEF		CODE		LOAD		DATE	DEC 2024
	DRAWN AN	CHK RB		SITE 48C-0026/co	STRUCT		DWG 2		

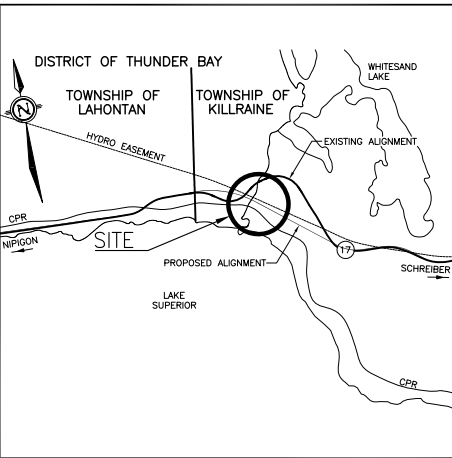
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN



CONT No
WP No 6333-14-00

HIGHWAY 17
HEWITSON CREEK
CULVERT REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



KEYPLAN

LEGEND

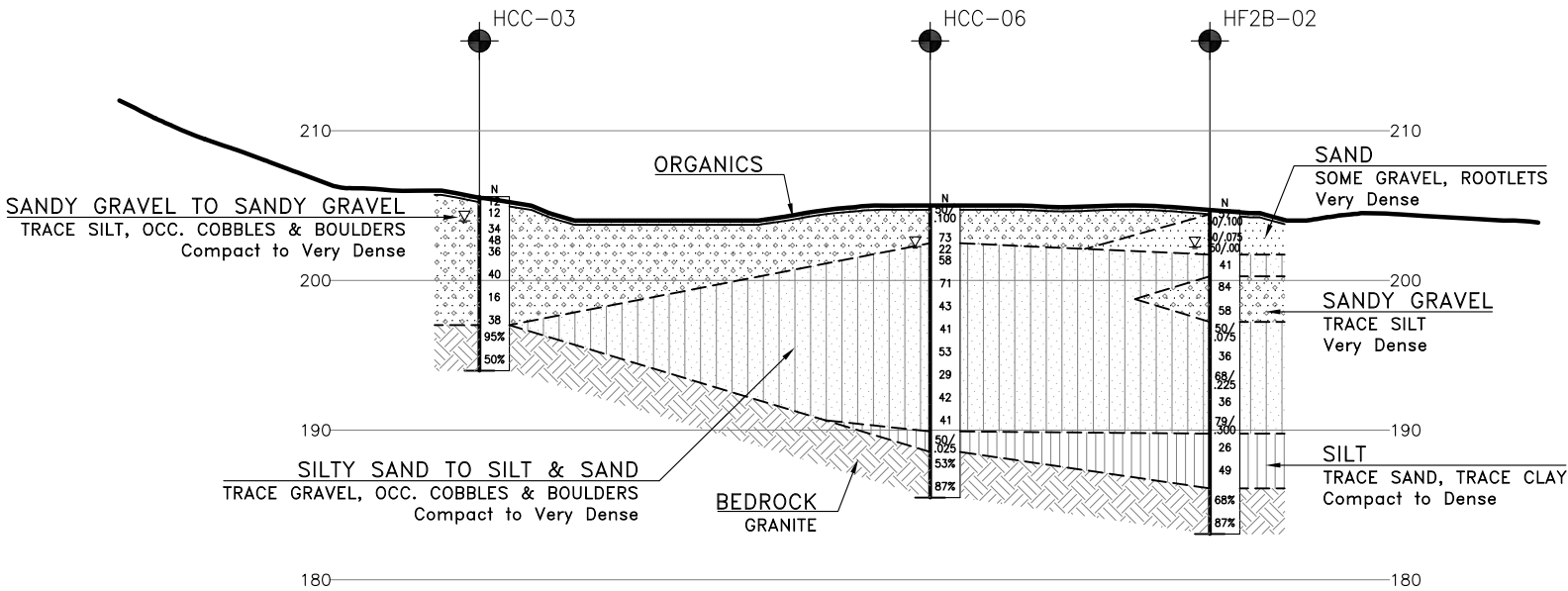
	Borehole (Current Investigation)
	Borehole (Previous Investigation)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
	Water Level Upon Completion of Drilling
	Water Level in Monitoring Well/Piezometer
	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
HCC-01	206.8	5 411 155.1	274 916.7
HCC-02	206.2	5 411 140.2	274 898.1
HCC-03	205.6	5 411 124.2	274 881.2
HCC-04	210.0	5 411 131.4	274 947.3
HCC-05	205.5	5 411 119.7	274 920.1
HCC-06	205.0	5 411 099.1	274 897.8
HEW-01	206.6	5 411 156.3	274 917.7
HEW-02	206.2	5 411 141.4	274 903.6
HF2A-01	221.3	5 411 169.4	274 861.3
HF2A-02	207.5	5 411 159.3	274 906.1
HF2B-01	210.0	5 411 123.4	274 952.5
HF2B-02	204.7	5 411 083.4	274 908.1
HF2B-03	218.8	5 411 070.1	274 986.6

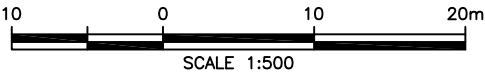
-NOTES-

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

GEOCRES No. 42D14-002



SECTION E-E'



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RB	CHK MEF	CODE
DRAWN	AN	CHK RB	SITE 48C-0028/CO
			STRUCT
			DWG 3
			DATE DEC 2024

APPENDIX B

Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

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

NOTE: Hierarchy of Soil Strength Prediction

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



4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

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

5. LEGEND FOR RECORDS OF BOREHOLES

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

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


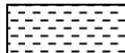



 Water Level
 Shear Strength Determination by Pocket Penetrometer

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

UNIFIED SOILS CLASSIFICATION

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

EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION		SYMBOLS	
Fresh (FR)	No visible signs of weathering.		
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.		CLAYSTONE
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SILTSTONE
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.		SANDSTONE
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.		COAL
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.		Bedrock (general)

DISCONTINUITY SPACING		STRENGTH CLASSIFICATION			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m				
Very thinly bedded	20 to 60mm	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Laminated	6 to 20mm				
Thinly Laminated	Less than 6mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
		Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
		Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
		Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

TERMS	
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.

RECORD OF BOREHOLE No HCC-01

1 OF 2

METRIC

GWP# 6333-14-00 LOCATION MTM NAD83-14: N 5 411 155.1 E 274 916.7 ORIGINATED BY GA
DIST Thunder Bay HWY 17 BOREHOLE TYPE HWT Casing/HQ Coring COMPILED BY AN
DATUM Geodetic DATE 2024.03.29 - 2024.03.31 LATITUDE 48.838040 LONGITUDE -87.407122 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
206.8	GROUND SURFACE							20	40	60	80	100				
0.0	ORGANICS: (150mm)							○ UNCONFINED	+ FIELD VANE							
0.2	Sandy GRAVEL to SAND and GRAVEL, some silt, frequent cobbles Very Dense Brown Wet Cobbles at 0.3m (150mm in dia.) Cobbles at 0.6m (90mm in dia.) Boulders at 1.1m (250mm in dia.) Cobbles at 2.1m (90mm in dia.) Boulders at 2.7m (215mm in dia.)		1	SS	12											
			2	SS	65/ 0.175											
			3	SS	50/ 0.125											
			4	SS	50/ 0.125											
203.8	Silty SAND, with trace gravel Compact Brown Wet Cobbles at 4.3m (75mm in dia.)		5	SS	22											
202.4	Sandy GRAVEL to SAND and GRAVEL, some silt, occasional cobbles Dense to Compact Grey Wet Cobbles at 5.6m (100mm in dia.) Cobbles at 6.1m (100mm in dia.)		6	SS	36											
			7	SS	24											
			8	SS	35											
198.3	BEDROCK: (Granite), slightly weathered to fresh, coarse grained, very strong, red Vertical fractures from 8.5m to 9.8m Occasional healed fractures from		1	RUN												

Continued Next Page

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

RECORD OF BOREHOLE No HCC-01 2 OF 2 METRIC

GWP# 6333-14-00 LOCATION MTM NAD83-14: N 5 411 155.1 E 274 916.7 ORIGINATED BY GA
DIST Thunder Bay HWY 17 BOREHOLE TYPE HWT Casing/HQ Coring COMPILED BY AN
DATUM Geodetic DATE 2024.03.29 - 2024.03.31 LATITUDE 48.838040 LONGITUDE -87.407122 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
	Continued From Previous Page							20	40	60	80	100					
	9.4m to 10.1m		2	RUN			196										2 1 0 0 0 RUN #2 TCR=100% SCR=100% RQD=98% UCS=130.0MPa UCS=171.9MPa (Point Load Ave.
195.2																	
11.6	END OF BOREHOLE AT 11.6m. BOREHOLE OPEN TO 11.6m. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2024.04.04 2.3 204.5 2024.04.08 2.3 204.5 2024.04.11 2.4 204.4 2024.04.13 2.4 204.4																

RECORD OF BOREHOLE No HCC-02

1 OF 2

METRIC

GWP# 6333-14-00 LOCATION MTM NAD83-14: N 5 411 140.2 E 274 898.1 ORIGINATED BY GA
DIST Thunder Bay HWY 17 BOREHOLE TYPE HWT Casing/HQ Coring COMPILED BY AN
DATUM Geodetic DATE 2024.03.28 - 2024.03.28 LATITUDE 48.837905 LONGITUDE -87.407374 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)					
206.2	GROUND SURFACE							20	40	60	80	100					
0.0	ORGANICS: (225mm)							○ UNCONFINED	+	FIELD VANE							
								● QUICK TRIAXIAL	×	LAB VANE							
0.2	SAND and GRAVEL, trace organics, occasional cobbles and boulders Compact to Very Dense Grey Wet		1	SS	12	▽	206										
			2	SS	50/ 0.075		205										
	Cobbles at 1.5m (100mm in dia.)																
	No recovery		3	SS	50/ 0.025		204										
			4	SS	50/ 0.050												
	No recovery																
	Cobbles at 2.5m (100mm in dia.)																
			5	SS	44		203										
201.8							202										
4.4	SAND, trace gravel, trace silt Compact Brown Wet																
	Cobbles at 4.7m (90mm in dia.)		6	SS	18		201									1 91 8 0	
			7	SS	20		200										
							199										
198.3																	
7.9	SAND and GRAVEL, frequent cobbles Very Dense Brown Wet		8	SS	74		198										
	Silty sand seam at 8.2m (300mm thick)																
	Cobbles at 8.4m (100mm in dia.)																
	Boulders at 8.7m (250mm in dia.)						197										


Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HCC-02 2 OF 2 METRIC

GWP# 6333-14-00 LOCATION MTM NAD83-14: N 5 411 140.2 E 274 898.1 ORIGINATED BY GA
DIST Thunder Bay HWY 17 BOREHOLE TYPE HWT Casing/HQ Coring COMPILED BY AN
DATUM Geodetic DATE 2024.03.28 - 2024.03.28 LATITUDE 48.837905 LONGITUDE -87.407374 CHECKED BY RB

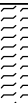


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)											
								○ UNCONFINED + FIELD VANE					w _p w w _L											
								● QUICK TRIAXIAL × LAB VANE																
196.0	Continued From Previous Page							20	40	60	80	100												
10.2	BEDROCK: (Granite), slightly weathered to fresh, coarse grained, very strong, red to grey		1	RUN			196												FI	RUN #1 TCR=100% SCR=100% RQD=87% UCS=78.1MPa UCS=189.0MPa (Point Load Ave.)				
							195																	
							194																	
				2	RUN																			
193.0																								
13.2	END OF BOREHOLE AT 13.2m. BOREHOLE OPEN TO 13.2m AND WATER LEVEL AT 1.0m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO GROUND SURFACE.																							

RECORD OF BOREHOLE No HCC-03

1 OF 2

METRIC

GWP# 6333-14-00 LOCATION MTM NAD83-14: N 5 411 124.2 E 274 881.2 ORIGINATED BY GA
DIST Thunder Bay HWY 17 BOREHOLE TYPE HWT Casing/HQ Coring COMPILED BY AN
DATUM Geodetic DATE 2024.03.23 - 2024.03.26 LATITUDE 48.837760 LONGITUDE -87.407604 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE									
								● QUICK TRIAXIAL	× LAB VANE									
205.6	GROUND SURFACE																	
0.0	ORGANICS: (700mm)		1	SS	12		205							167	39 50 11 (SI+CL)			
204.9																		
0.7	SAND and GRAVEL, trace silt, occasional cobbles and boulders Compact to Dense Grey Wet Boulders at 1.4m (225mm in dia.)		2	SS	12		204											
			3	SS	34													
			4	SS	48													
			5	SS	36													
		</																


Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HCC-03 2 OF 2 METRIC

GWP# 6333-14-00 LOCATION MTM NAD83-14: N 5 411 124.2 E 274 881.2 ORIGINATED BY GA
DIST Thunder Bay HWY 17 BOREHOLE TYPE HWT Casing/HQ Coring COMPILED BY AN
DATUM Geodetic DATE 2024.03.23 - 2024.03.26 LATITUDE 48.837760 LONGITUDE -87.407604 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE														
	Continued From Previous Page							20	40	60	80	100		20	40	60		GR SA SI CL				
	Sub-vertical fracture at 10.1m		2	RUN			195										3	RUN #2 TCR=100% SCR=80% RQD=45% UCS=141.5MPa UCS=121.5MPa (Point Load Ave.				
	Frequent healed fractures observed from 10.4m to 11.0m																					8
	Frequent calcite veins (<5mm wide) from 11.0m to 11.6m																					9
																						1
194.0																		5				
11.6	END OF BOREHOLE AT 11.6m. BOREHOLE OPEN TO 11.6m AND WATER LEVEL AT 1.6m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO GROUND SURFACE.																					

RECORD OF BOREHOLE No HCC-04

1 OF 2

METRIC

GWP# 6333-14-00 LOCATION MTM NAD83-14: N 5 411 131.4 E 274 947.3 ORIGINATED BY GA
DIST Thunder Bay HWY 17 BOREHOLE TYPE HWT Casing/HQ Coring COMPILED BY AN
DATUM Geodetic DATE 2024.04.02 - 2024.04.04 LATITUDE 48.837828 LONGITUDE -87.406703 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL		
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE													
210.0	GROUND SURFACE							20	40	60	80	100		20	40	60						
0.0	ORGANICS: (175mm) Black Wet		1	SS	50/ 0.075																	
0.2	SILT and SAND to Sandy SILT , trace gravel, occasional cobbles Compact to Very Dense Grey Wet		2	SS	50/ 0.00									○								
	Cobbles at 0.9m (90mm in dia.)																					
	Cobbles at 1.4m (100mm in dia.)		3	SS	13									○					3	37	59	1
			4	SS	23									○								
			5	SS	40									○								
			6	SS	41									○					8	30	60	2
			7	SS	35									○								
			8	SS	37									○								
			9	SS	58									○								
	Cobbles at 7.5m (125mm in dia.)																					

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HCC-04

2 OF 2

METRIC

GWP# 6333-14-00 LOCATION MTM NAD83-14: N 5 411 131.4 E 274 947.3 ORIGINATED BY GA
DIST Thunder Bay HWY 17 BOREHOLE TYPE HWT Casing/HQ Coring COMPILED BY AN
DATUM Geodetic DATE 2024.04.02 - 2024.04.04 LATITUDE 48.837828 LONGITUDE -87.406703 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20 40 60 80 100									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
Continued From Previous Page						20 40 60 80 100					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w _p w w _L WATER CONTENT (%)						
198.0	SILT and SAND to Sandy SILT , trace gravel, occasional cobbles Dense to Very Dense Grey Wet						199							0 25 74 1			
12.0			10	SS	35												
	SAND , some silt, trace gravel, occasional cobbles Very Dense Grey Wet								198								8 79 13 (SI+CL)
			11	SS	71												
	BEDROCK: (Granodiorite), slightly weathered to fresh, medium grained, very strong, grey, frequent healed sub-vertical fractures Horizontal joint at 15.4m Sub-vertical joint from 16.7 to 17.0m and 17.6m Horizontal joints at 17.1 and 17.7m						197									RUN #1 TCR=100% SCR=93% RQD=93% UCS=143.1MPa (Point Load Ave.)	
195.0			12	SS	76												
15.0			1	RUN					196								RUN #2 TCR=100% SCR=93% RQD=67% UCS=177.0MPa (Point Load Ave.)
			2	RUN			195									FI 0 1 0 0 1 2 1 3 0	
191.9									194								0
							193									0	
									192								0
18.1	END OF BOREHOLE AT 18.1m. BOREHOLE OPEN TO 18.1m AND WATER LEVEL AT 6.4m. BOREHOLE CAVED TO 2.7m, THEN BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.																

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

RECORD OF BOREHOLE No HCC-05

1 OF 2

METRIC

GWP# 6333-14-00 LOCATION MTM NAD83-14: N 5 411 119.7 E 274 920.1 ORIGINATED BY GA
DIST Thunder Bay HWY 17 BOREHOLE TYPE HWT Casing/HQ Casing/HQ Coring COMPILED BY AN
DATUM Geodetic DATE 2024.04.07 - 2024.04.10 LATITUDE 48.837722 LONGITUDE -87.407073 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
205.5	GROUND SURFACE							20 40 60 80 100							
0.0	TOPSOIL: (150mm)							20 40 60 80 100							
0.2	SAND and GRAVEL, trace silt, trace organics and rootlets to 0.7m Compact to Very Dense Brown Moist		1	SS	10		205								
			2	SS	67/ 0.200		204								
			3	SS	80/ 0.175		203								
			4	SS	50/ 0.025		202								
202.4	Cobbles at 2.2m (100mm in dia.)														
3.1	Silty SAND, trace gravel Dense Grey Wet		5	SS	33		201								
			6	SS	41		200								
			7	SS	31		199								
			8	SS	92		198								
198.0	Cobbles at 4.0m (125mm in dia.)														
7.5	SAND and GRAVEL, trace to some silt Very Dense Grey Wet		9	SS	50/ 0.075		197								
							196								
	No recovery														

Continued Next Page

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

RECORD OF BOREHOLE No HCC-05

2 OF 2

METRIC

GWP# 6333-14-00 LOCATION MTM NAD83-14: N 5 411 119.7 E 274 920.1 ORIGINATED BY GA
DIST Thunder Bay HWY 17 BOREHOLE TYPE HWT Casing/HQ Casing/HQ Coring COMPILED BY AN
DATUM Geodetic DATE 2024.04.07 - 2024.04.10 LATITUDE 48.837722 LONGITUDE -87.407073 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
								20 40 60 80 100				w _P w w _L				
								○ UNCONFINED + FIELD VANE								
								● QUICK TRIAXIAL × LAB VANE								
Continued From Previous Page								20 40 60 80 100				20 40 60				GR SA SI CL
195.2																
10.3	SILT and SAND , trace gravel, occasional cobbles and bluders Very Dense to Dense Grey Wet						195								1 51 46 2	
		10	SS	54			194									
		11	SS	47			193									
192.2	Boulders at 13.2m (330mm in dia.)															
13.3	GRAVEL , some sand Very Dense Grey Wet Cobbles at 13.6m (up to 100mm in dia.)						192									
		12	SS	50/ 0.0			191									
190.6																
14.9	BEDROCK: (Granite), fresh, coarse grained, very strong, red to grey						190								RUN #1 TCR=100% SCR=82% RQD=52% UCS=150.4MPa (Point Load Ave.)	
		1	RUN													
							189								RUN #2 TCR=100% SCR=83% RQD=67% UCS=161.2MPa (Point Load Ave.)	
	Sub-vertical joint at 17.6m						188									
187.5																
18.0	END OF BOREHOLE AT 18.0m. BOREHOLE OPEN TO 18.0m AND WATER LEVEL AT 2.1m. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2024.04.11 6.1 199.4 2024.04.13 6.2 199.3 2024.04.15 6.3 199.2															

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

METRIC

[illegible]




+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No HCC-06

2 OF 3

METRIC

GWP# 6333-14-00 LOCATION MTM NAD83-14: N 5 411 099.1 E 274 897.8 ORIGINATED BY GA
DIST Thunder Bay HWY 17 BOREHOLE TYPE HWT Casing/HQ Casing/HQ Coring COMPILED BY AN
DATUM Geodetic DATE 2024.04.10 - 2024.04.12 LATITUDE 48.837535 LONGITUDE -87.407375 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
								20 40 60 80 100										
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE										
	Continued From Previous Page							WATER CONTENT (%) 20 40 60										
194.5	SILT and SAND , occasional cobbles and boulders Compact to Dense Brown Wet						194								1 51 47 1			
10.5			10	SS	29													
			11	SS	42													
			12	SS	41													
189.9	SILT , some sand, trace clay Very Dense Brown Wet						190							0 13 79 8				
15.1			13	SS	50/ 0.025													
188.5	BEDROCK: (Granite), fresh, coarse grained, very strong, red Vertical fracture from 17.4m to 17.9m Frequent healed sub-vertical fractures Sub-vertical fracture from 18.6m to 17.8m Vertical fracture from 18.9m to 19.3m		1	RUN			188							FI 4 0 >10 >10 0 2 3 2 3 2	RUN #1 TCR=100% SCR=58% RQD=53% UCS=168.4MPa (Point Load Ave.) RUN #2 TCR=100% SCR=100% RQD=68% UCS=108.6MPa (Point Load Ave.)			
16.5																		
					2		RUN		187									
185.5							186											
19.5	END OF BOREHOLE AT 19.5m. BOREHOLE OPEN TO 19.5m AND WATER LEVEL AT 2.7m.																	

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

METRIC

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

[illegible]

ONTMT4S2 2020LIBRARY(MTO).GLB MTO-37996.GPJ 8/6/24

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No HF2A-01

1 OF 2

METRIC

GWP# 6333-14-00 LOCATION MTM NAD83-14: N 5 411 169.4 E 274 861.3 ORIGINATED BY MM
DIST Thunder Bay HWY 17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
DATUM Geodetic DATE 2024.03.02 - 2024.03.03 LATITUDE 48.838166 LONGITUDE -87.407878 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)							
								○ UNCONFINED + FIELD VANE					w _p w w _L							
								● QUICK TRIAXIAL × LAB VANE												
221.3	GROUND SURFACE						20	40	60	80	100									
0.0	ORGANICS: (200mm)						20	40	60	80	100									
0.2	Silty SAND , trace to some gravel Compact to Dense Brown Moist		1	SS	38															
			2	SS	16															
219.5			3	SS	18															
1.8	SILT , some sand, trace clay Compact Grey Moist																			
			4	SS	14															
			5	SS	12															
	Loose		6	SS	6															
215.7																				
5.6	Gravelly SAND , trace silt Very Dense Brown Moist		7	SS	62															
			8	SS	41															
212.6																				
8.7	Silty SAND , trace gravel Compact Brown Wet																			
			9	SS	27															

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

METRIC

ELEV DEPTH	SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 80 100					
								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
	Continued From Previous Page						20 40 60 80 100					kN/m³	GR SA SI CL

Continued from Previous Page					
	Silty SAND, trace gravel Dense to Very Dense Brown Wet				
		10	SS	40	
	Some gravel, occasional cobbles	11	SS	100/ 0-100	
208.1					
13.2	SILT , trace to some sand, trace to some clay Dense to Very Dense Grey Wet (ML)	12	SS	32	
205.7		13	SS	100/ 0-025	
15.6	BEDROCK: (Granodiorite), slightly weathered to fresh, medium grained, very strong, reddish grey to grey	1	RUN		
		2	RUN		
		3	RUN		
202.3					
19.0	END OF BOREHOLE AT 19.0m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.				

ONTMT4S2 2020LIBRARY(MTO).GLB MTO-37996.GPJ 8/6/24

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No HF2A-02

1 OF 2

METRIC

GWP# 6333-14-00 LOCATION MTM NAD83-14: N 5 411 159.3 E 274 906.1 ORIGINATED BY GA
DIST Thunder Bay HWY 17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
DATUM Geodetic DATE 2024.04.01 - 2024.04.01 LATITUDE 48.838077 LONGITUDE -87.407267 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
207.5	GROUND SURFACE							20	40	60	80	100			
0.0	ORGANICS rootlets, wood fibres Loose Dark Brown Wet (700mm)		1	SS	7		207							132	
206.8															
0.7	SAND , trace silt, trace gravel, some organics Compact Brown to Grey Wet 150mm thick wood layer at 1.8m		2	SS	10		206								
			3	SS	28										
205.0															
2.5	GRAVEL , some sand to sandy, occasional cobbles and boulders Dense to Very Dense Brown to Grey Wet Cobbles (100mm in dia.) at 2.7m		4	SS	72		205								
			5	SS	42		204								
							203								
			6	SS	50/ 0.075		202								
	Boulder (350mm) at 5.2m														
201.0			7	SS	50/ 0.00		201								
6.5	BEDROCK: (Granite), slightly weathered to fresh, medium grained, very strong, reddish grey to grey		1	RUN			200								
			2	RUN			199								
198.0															
9.5	END OF BOREHOLE AT 9.5m. BOREHOLE OPEN TO 9.5m AND WATER LEVEL AT 2.9m.														

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+³, ×³: Numbers refer to
Sensitivity

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(%) STRAIN AT FAILURE

METRIC

[illegible]

RECORD OF BOREHOLE No HF2B-01

1 OF 2

METRIC

GWP# 6333-14-00 LOCATION MTM NAD83-14: N 5 411 123.4 E 274 952.5 ORIGINATED BY GA
DIST Thunder Bay HWY 17 BOREHOLE TYPE HWT Casing/HQ Casing/HQ Coring COMPILED BY AN
DATUM Geodetic DATE 2024.04.05 - 2024.04.06 LATITUDE 48.837757 LONGITUDE -87.406632 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
210.0	GROUND SURFACE																
0.0	TOPSOIL: (150mm)																
0.2	SAND, trace to some silt, some gravel Compact to Very Dense Brown Moist to Wet Cobbles (150mm in dia.) at 0.8m Cobbles (100mm in dia.) at 1.4m		1	SS	18												
			2	SS	50/												
					0.075												
							209										
			3	SS	18												
			4	SS	15												
							207										
			5	SS	15												
							206										
			6	SS	14												
							205										
							204										
204.1	Sandy SILT, trace to some gravel, occasional cobbles and boulders Compact to Very Dense Brown Moist to Wet																
5.9			7	SS	15												
							203										
			8	SS	35												
							202										
							201										
			9	SS	45												

Continued Next Page

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

RECORD OF BOREHOLE No HF2B-01 2 OF 2 METRIC

GWP# 6333-14-00 LOCATION MTM NAD83-14: N 5 411 123.4 E 274 952.5 ORIGINATED BY GA
DIST Thunder Bay HWY 17 BOREHOLE TYPE HWT Casing/HQ Casing/HQ Coring COMPILED BY AN
DATUM Geodetic DATE 2024.04.05 - 2024.04.06 LATITUDE 48.837757 LONGITUDE -87.406632 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE										
	Continued From Previous Page							20	40	60	80	100		20	40	60		
199.5	Cobbles (125mm in dia.) at 10.4m																	
10.5	Silty SAND , some gravel Very Dense Brown to Grey Wet		10	SS	77		199							○				17 60 21 2
							198											
197.0			11	SS	92									○				
13.0	BEDROCK: (Granodiorite), slightly weathered to fresh, medium grained, strong, grey Sub-vertical joints at 13.1, 13.2, 13.3 and 13.4m		1	RUN			197										FI 4 2 >10	RUN #1 TCR=100% SCR=78% RQD=43% UCS=176.0MPa (Point Load Ave.)
							196										3 2	
	Sub-vertical joints at 14.8 and 14.9m		2	RUN			195										2 2 >10 >10 >10	RUN #2 TCR=100% SCR=25% RQD=20% UCS=193.6MPa (Point Load Ave.)
194.0																		
16.0	END OF BOREHOLE AT 16.0m. BOREHOLE OPEN TO 16.0m AND WATER LEVEL AT 6.5m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.						194											

RECORD OF BOREHOLE No HF2B-02

1 OF 3

METRIC

GWP# 6333-14-00 LOCATION MTM NAD83-14: N 5 411 083.4 E 274 908.1 ORIGINATED BY GA
DIST Thunder Bay HWY 17 BOREHOLE TYPE HWT Casing/HQ Casing/HQ Coring COMPILED BY AN
DATUM Geodetic DATE 2024.04.13 - 2024.04.15 LATITUDE 48.837395 LONGITUDE -87.407234 CHECKED BY RB

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

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE


METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

ONTMT4S2 2020LIBRARY(MTO).GLB MTO-37996.GPJ 8/6/24

METRIC

SOIL PROFILE								SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT						PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES																		
	Continued From Previous Page																		kN/m ³	GR SA SI CL			
183.1	Highly fractured from 20.2m to 20.3m																		>10	RUN #2			
																			>10	TCR=100%			
			2	RUN															5	SCR=97%			
	Occasional calcite veinlets from 21.2m to 21.3m																		3	RQD=87%			
																			2	UCS=122MPa			
21.6	END OF BOREHOLE AT 21.6m. BOREHOLE OPEN TO 21.6m AND WATER LEVEL AT 2.4m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.																		1	UCS=182.9MPa (Point Load Ave.)			

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No HF2B-03

1 OF 2

METRIC

GWP# 6333-14-00 LOCATION MTM NAD83-14: N 5 411 070.1 E 274 986.6 ORIGINATED BY GA
DIST Thunder Bay HWY 17 BOREHOLE TYPE HWT Casing/HQ Casing/HQ Coring COMPILED BY AN
DATUM Geodetic DATE 2024.04.16 - 2024.04.16 LATITUDE 48.837279 LONGITUDE -87.406163 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
218.8	GROUND SURFACE														
0.0	ORGANICS: (200mm)														
0.2	SILT , some sand, occasional wood fibres, occasional rootlets Compact to Very Dense Brown Moist		1	SS	18		218								0 18 76 6
			2	SS	14		217								
			3	SS	27		216								
			4	SS	50/ 0.100		215								
			5	SS	50/ 0.100		214								
			6	SS	50/ 0.150		213								
			7	SS	50/ 0.100		212								
			8	SS	50/ 0.00		211								
213.6	Sandy GRAVEL to SAND and GRAVEL , trace to some silt, occasional cobbles and boulders Very Dense Brown Moist Cobbles (75mm in dia.) at 5.4m					210									
5.2	Boulders (300mm in dia.) at 7.3m Boulders from 7.7m to 8.2m					209									

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HF2B-03 2 OF 2 METRIC

GWP# 6333-14-00 LOCATION MTM NAD83-14: N 5 411 070.1 E 274 986.6 ORIGINATED BY GA
DIST Thunder Bay HWY 17 BOREHOLE TYPE HWT Casing/HQ Casing/HQ Coring COMPILED BY AN
DATUM Geodetic DATE 2024.04.16 - 2024.04.16 LATITUDE 48.837279 LONGITUDE -87.406163 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE										
	Continued From Previous Page							20	40	60	80	100						
	Cobbles (100mm in dia.) at 10.0m		10	SS	50/ 0.125		208											
	Cobbles (125mm in dia.) at 11.0m							207										
			11	SS	74		206											
205.6																		
13.2	END OF BOREHOLE AT 13.2m. BOREHOLE OPEN TO 13.2m AND WATER LEVEL AT 9.4m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.		12	SS	50/ 0.100													

RECORD OF BOREHOLE No HEW-01

1 OF 2

METRIC

GWP# 6333-14-00 LOCATION MTM Zone 14: N 5 411 156.3 E 274 917.7 ORIGINATED BY GA
 DIST Thunder Bay HWY 17 BOREHOLE TYPE Portable Drilling, Wash Boring, BW Casing Advance, AW Coring COMPILED BY AN
 DATUM Geodetic DATE 2023.01.14 - 2023.01.19 LATITUDE 48.838051 LONGITUDE -93.407109 CHECKED BY CN

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
206.6	GROUND SURFACE							<div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × LAB VANE</div></div>						
0.0	TOPSOIL: (75 mm) Silty SAND , some gravel to SAND and GRAVEL , trace silt, frequent cobbles and boulders Compact to Very Dense Brown Wet AW coring intervals: 0.6 - 0.9 1.1 - 1.2 1.2 - 1.3 1.7 - 2.0 2.1 - 2.2 2.4 - 2.7		1	SS	17		206							
0.1			2	SS	35/0.150									
			3	SS	25		205							
			4	SS	35/0.100									
			5	SS	35/0.150									
			6	SS	35/0.150		204							
			7	SS	14		203							1 77 21 1
			8	SS	56		202							
			9	SS	35/0.150									0 53 44 3
201.0	AW coring from a depth of 4.9 to 5.3 m		10	SS	35/0.150		201							
206.8	End of borehole at 5.6 m and start of DCPT													
5.8	END OF DCPT AT 5.8 m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE. NOTES: 1. A third-weight hammer was used to advance the split spoon sampler. The "N" values presented above have been adjusted to provide an estimate of the "N" value that would have been obtained with a standard hammer. 2. Water level after drilling was 3.1 m. Due to the introduction of water through the drilling methods, it is not representative of a stabilized water level. 3. The cored depth intervals and particle sizes of recovered gravels, cobbles and boulders are summarized as follows: Depth (m) Recovered 0.6 - 0.9 1 x 190 mm, 1 x 70 mm 1.1 - 1.2 Gravels up to 75 mm 1.2 - 1.3 1 x 100 mm, and gravels up to 25 mm													

Continued Next Page

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

RECORD OF BOREHOLE No HEW-01

2 OF 2

METRIC

GWP# 6333-14-00 LOCATION MTM Zone 14: N 5 411 156.3 E 274 917.7 ORIGINATED BY GA
DIST Thunder Bay HWY 17 BOREHOLE TYPE Portable Drilling, Wash Boring, BW Casing Advance, AW Coring COMPILED BY AN
DATUM Geodetic DATE 2023.01.14 - 2023.01.19 LATITUDE 48.838051 LONGITUDE -93.407109 CHECKED BY CN

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page																
	1.7 - 2.0 1 x 230 mm, 1 x 100 mm																
	2.1 - 2.2 Gravels and cobbles up to 100 mm																
	2.4 - 2.7 1 x 220 mm, 1 x 100 mm, and gravels																
	4.9 - 5.3 Cobbles up to 120 mm																
	5.3 - 5.5 Gravels up to 20 mm																

RECORD OF BOREHOLE No HEW-02

1 OF 1

METRIC

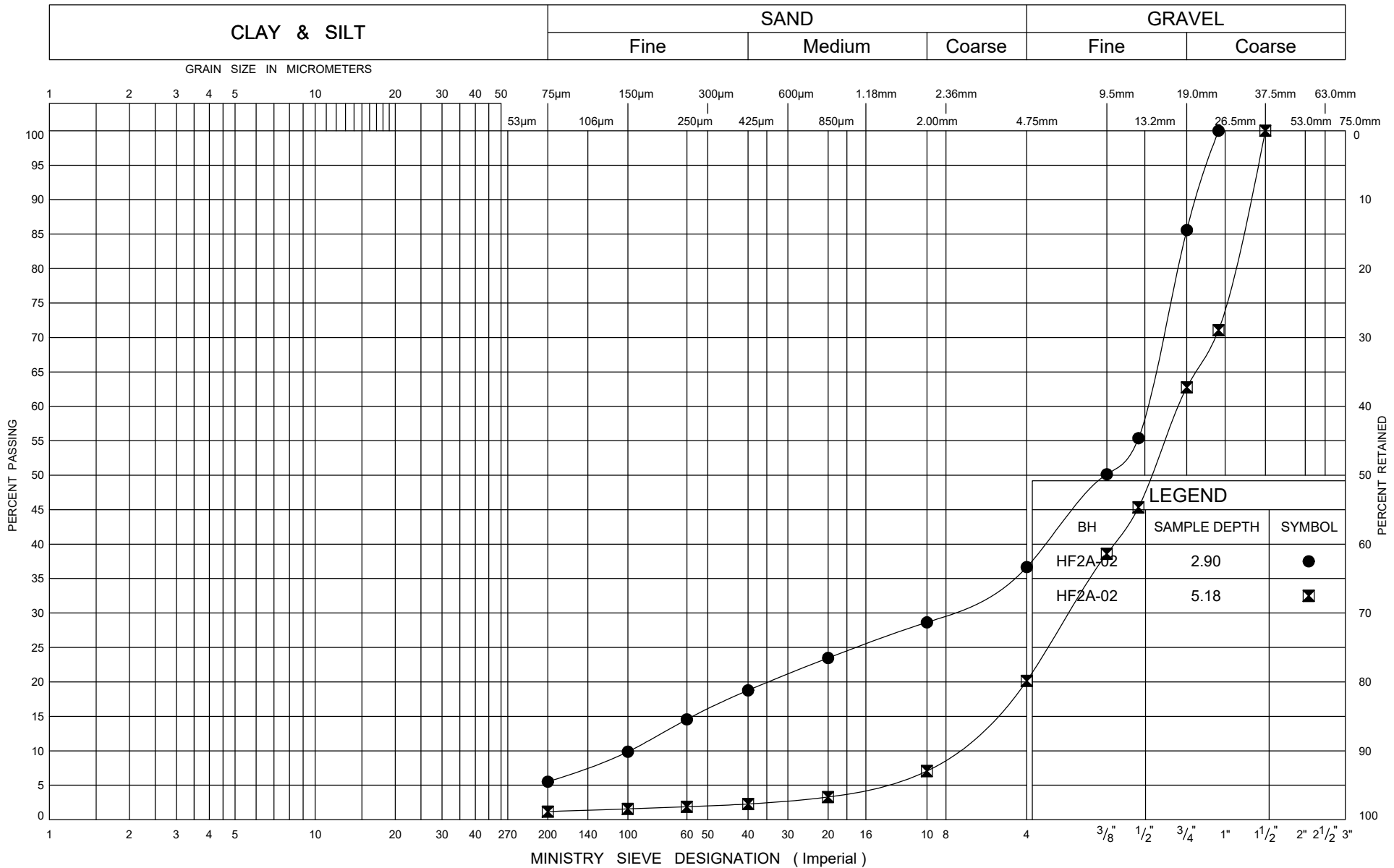
GWP# 6333-14-00 LOCATION MTM Zone 14: N 5 411 141.4 E 274 903.6 ORIGINATED BY GA
 DIST Thunder Bay HWY 17 BOREHOLE TYPE Portable Drilling, Wash Boring, BW Casing Advance, AW Coring COMPILED BY AN
 DATUM Geodetic DATE 2023.01.20 - 2023.01.24 LATITUDE 48.837916 LONGITUDE -93.407300 CHECKED BY CN

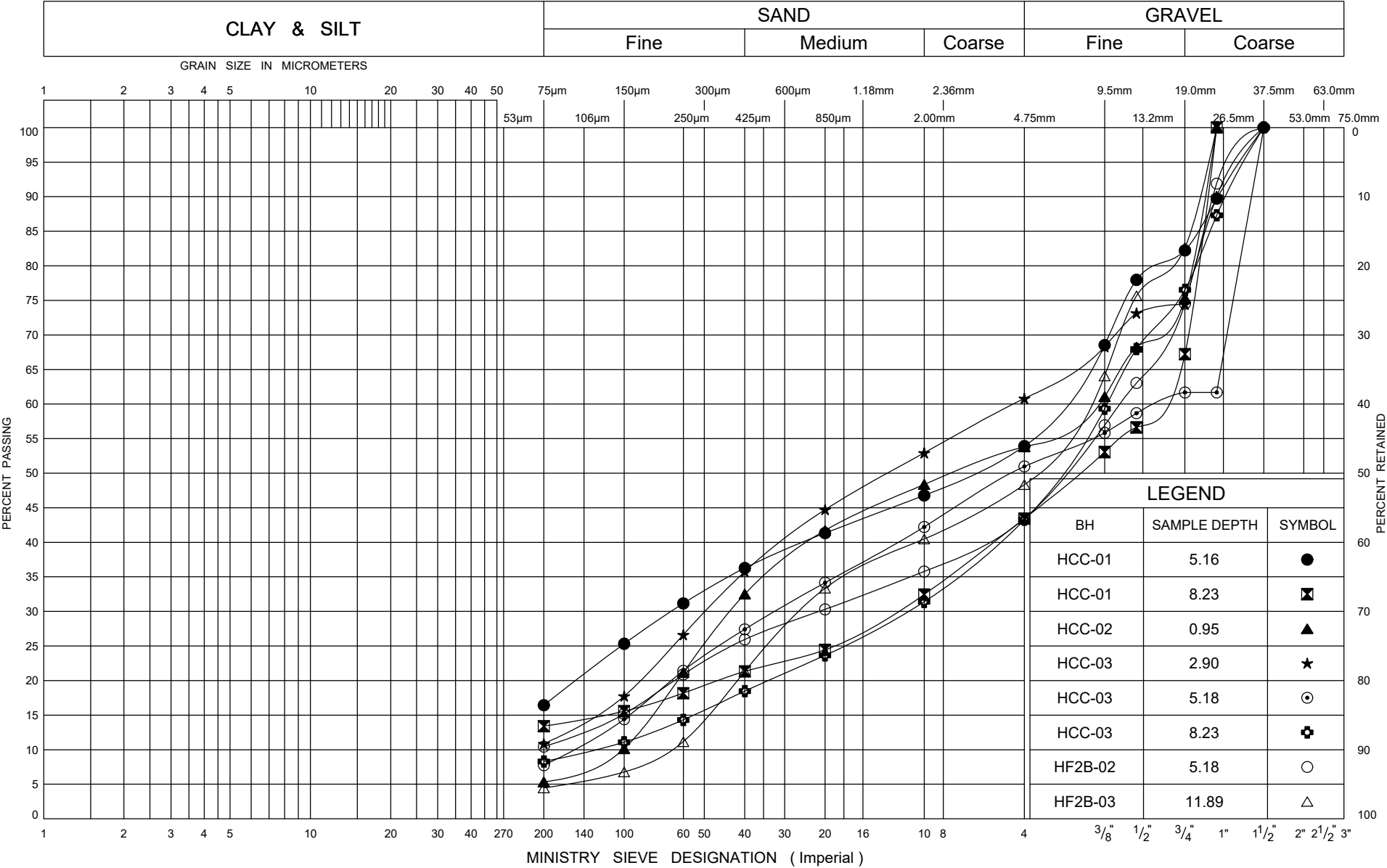
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE			WATER CONTENT (%) w _P w w _L					
206.2	GROUND SURFACE							20	40	60	80	100				
0.0	TOPSOIL: (150 mm)		1	SS	50/0.150		206									
0.2	Silty SAND , some gravel to SAND and GRAVEL , trace silt, frequent cobbles and boulders Dense to Very Dense Brown Wet AW coring intervals: 0.3 - 0.6 0.6 - 0.8 0.9 - 1.1 1.3 - 1.5 1.8 - 2.1 2.1 - 2.3 2.3 - 2.5 2.5 - 2.6		2	SS	50/0.0											
			3	SS	50/0.0											
			4	SS	50/0.50											
			5	SS	50/0.150											
			6	SS	50/0.0											
			7	SS	33											
			8	SS	49											
			9	SS	50/0.075											
			201.9						202							
4.3	END OF BOREHOLE AT 4.3 m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE. NOTES: 1. Water level after drilling was 1.9 m. Due to the introduction of water through the drilling methods, it is not representative of a stabilized water level. 2. The cored depth intervals and particle sizes of recovered gravels and cobbles are summarized as follows: Depth (m) Recovered 0.3 - 0.6 Gravels up to 75 mm 0.6 - 0.8 1 x 200 mm 0.9 - 1.1 Gravels up to 75 mm 1.3 - 1.5 1 x 140 mm, 1 x 100 mm, and 1 x 60 mm 1.8 - 2.1 Gravels up to 50 mm 2.1 - 2.3 1 x 130 mm, 1 x 80 mm 2.3 - 2.5 Gravels up to 75 mm 2.5 - 2.6 Gravels up to 30 mm 3.8 - 4.0 Gravels up to 40 mm 4.2 - 4.3 1 x 100 mm															

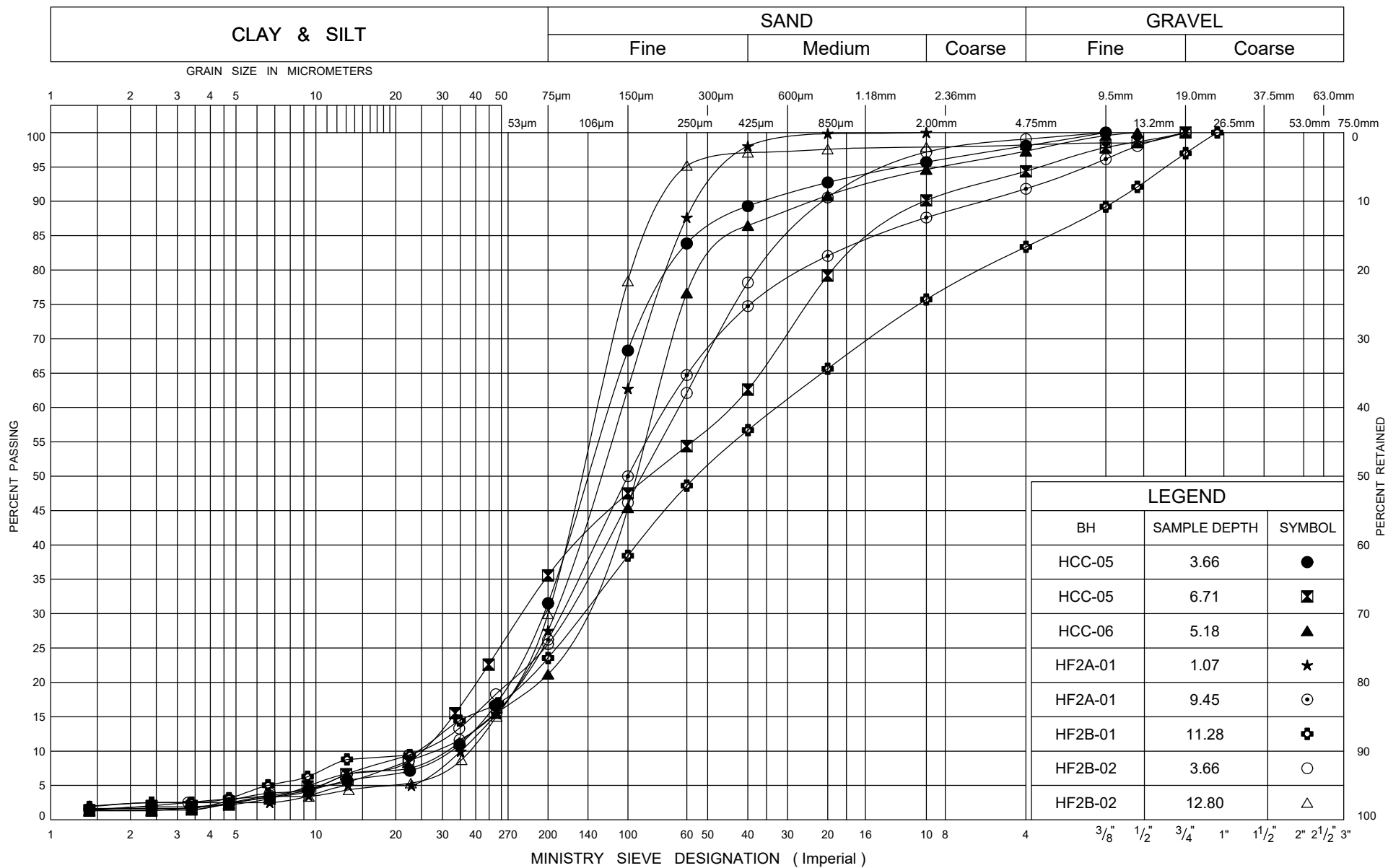
ONTMT452 2020LIBRARY(MTO) - COPY.GLB MTO-34844.GPJ 2/22/23

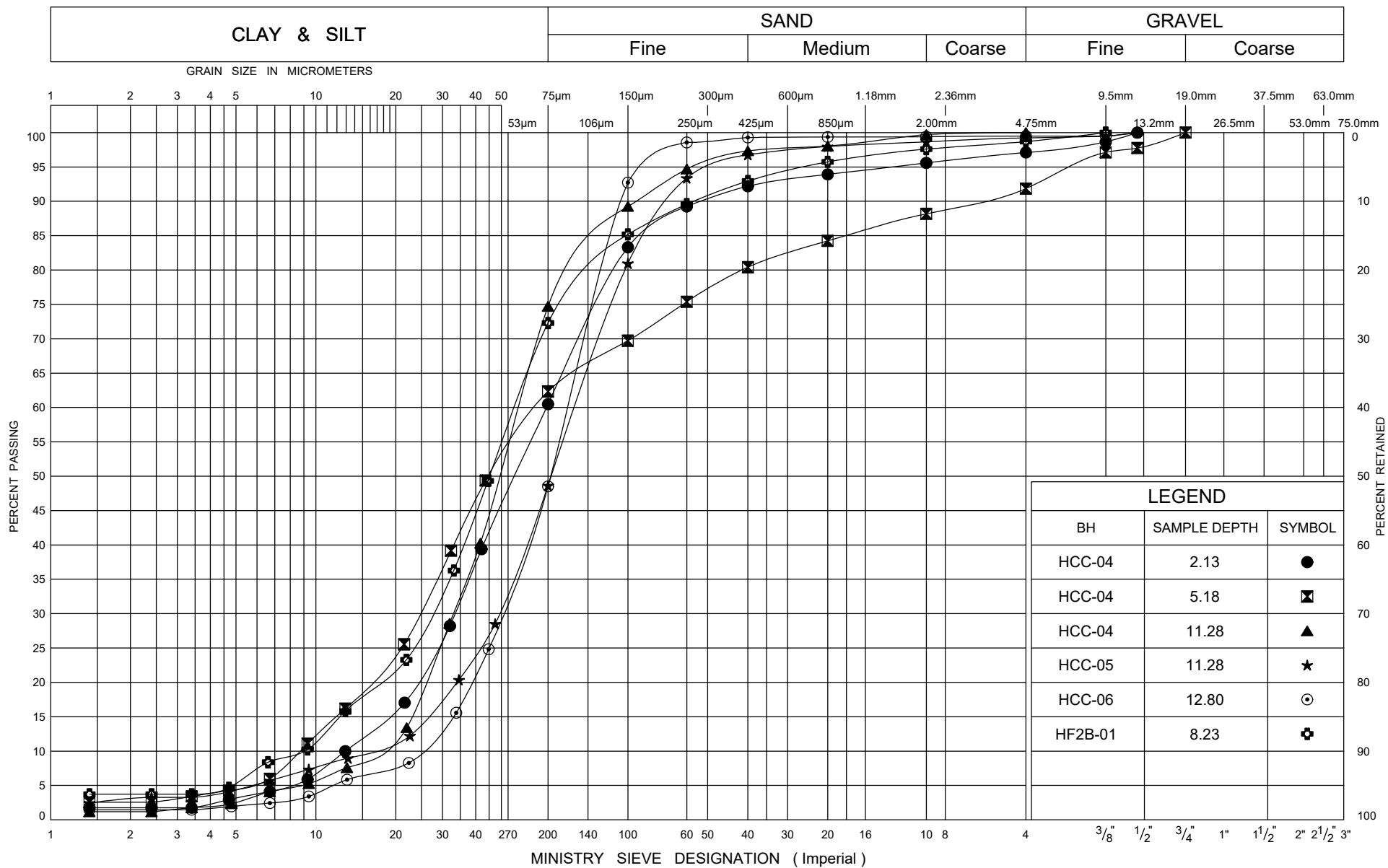
APPENDIX C

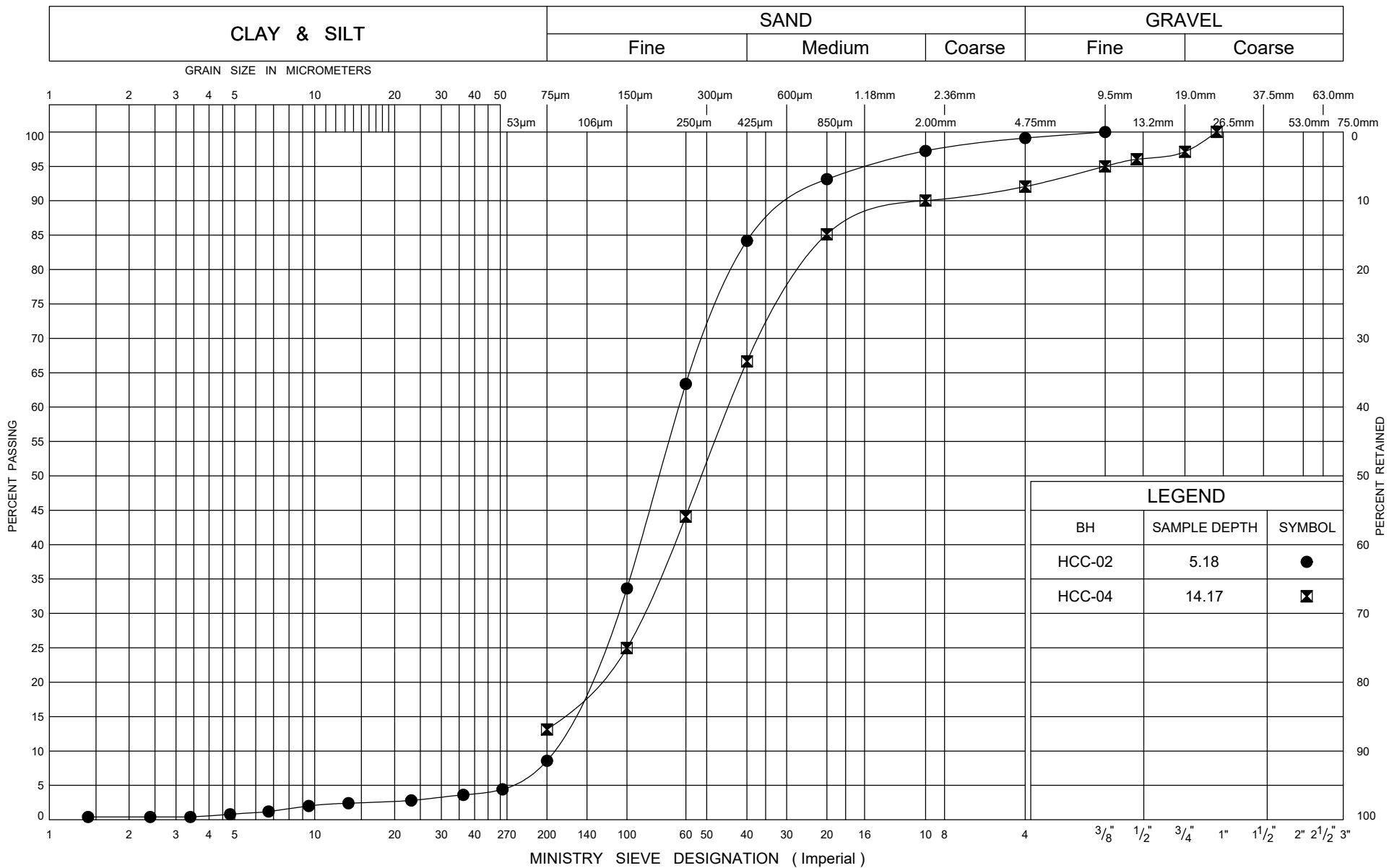
Soil Laboratory Figures and Well Test Results

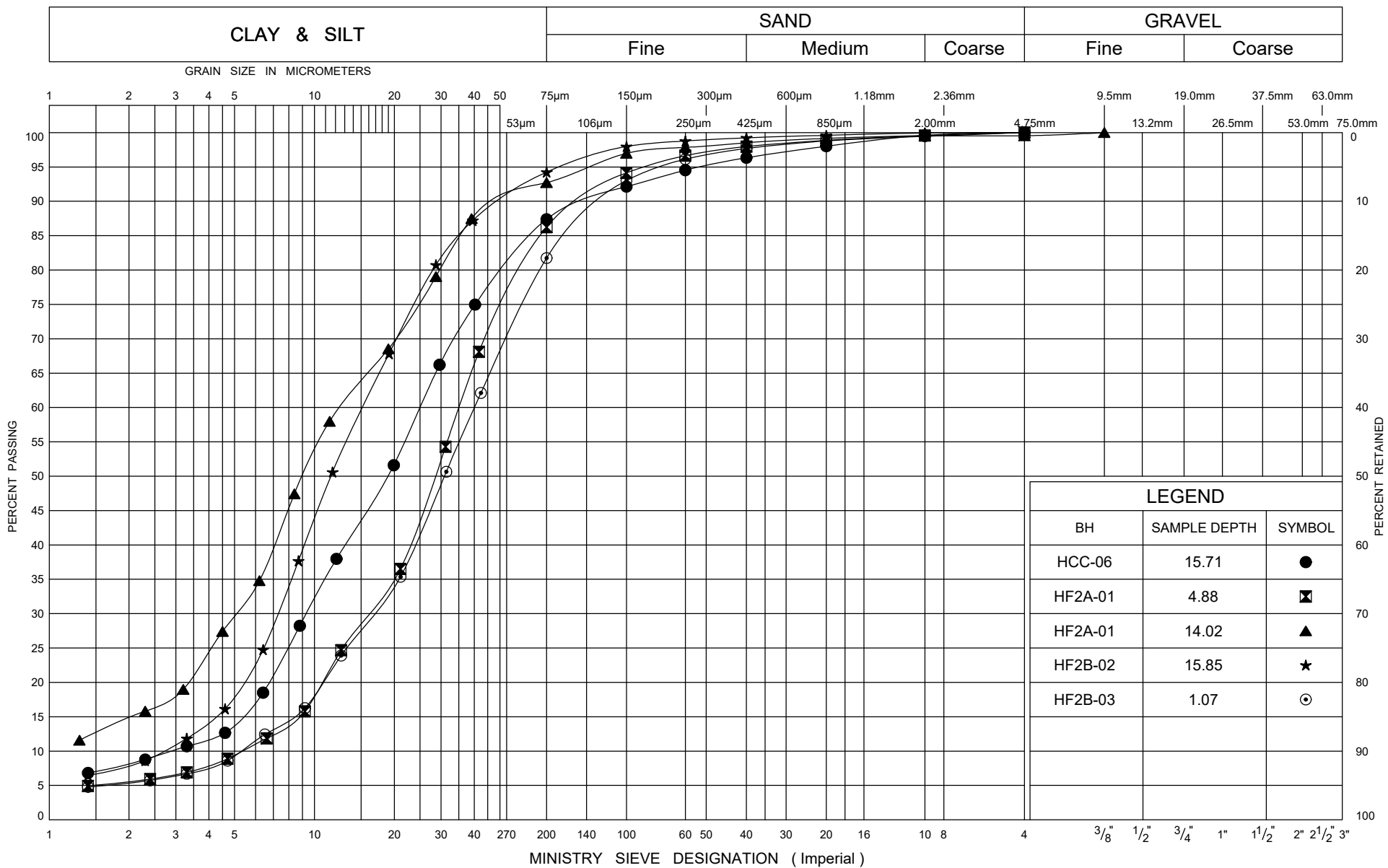


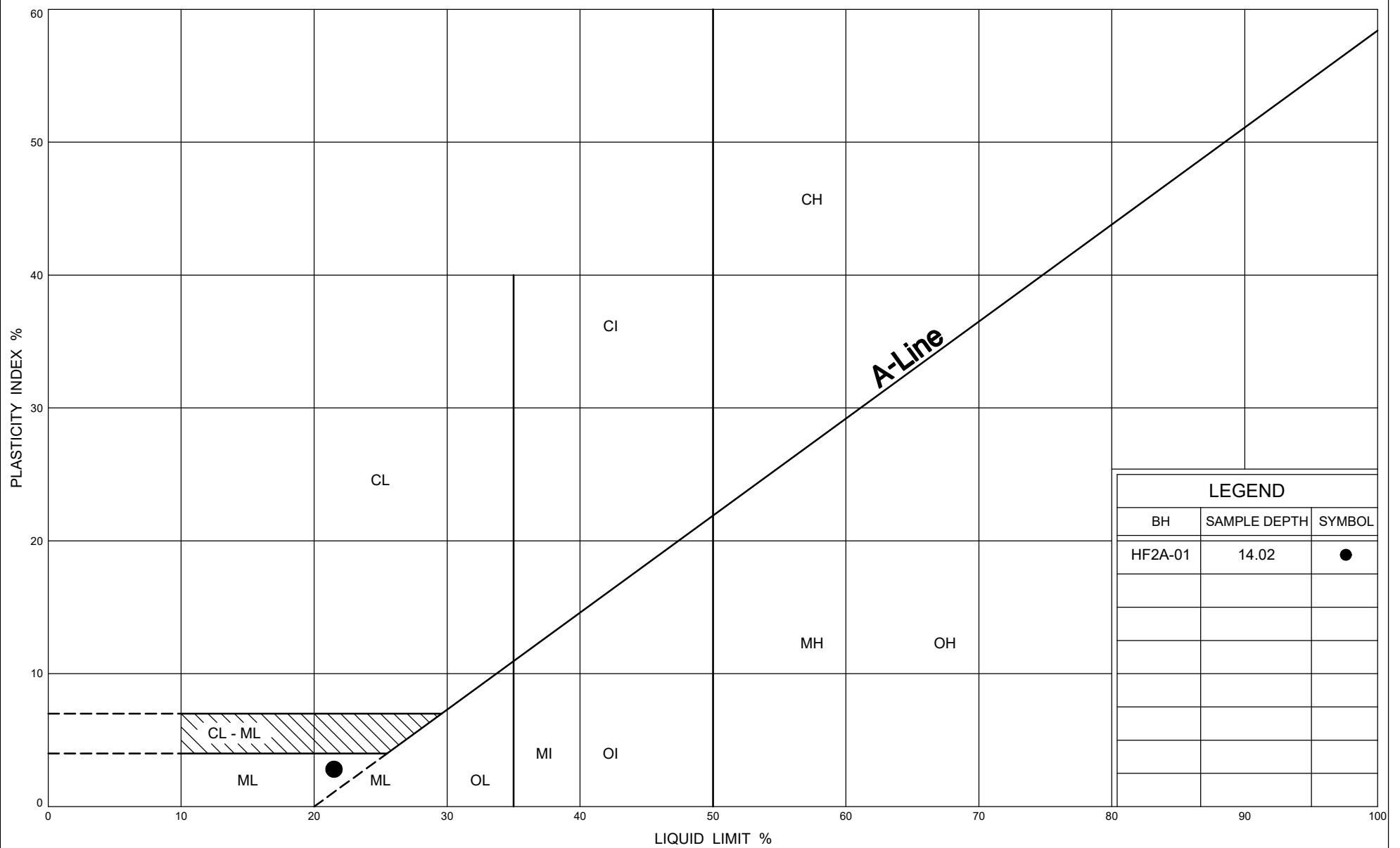












Ministry of
Transportation

PLASTICITY CHART SILT

FIG No C7

GWP# 6333-14-00



THURBER ENGINEERING LTD.

Slug Test Analysis Report

Project: Highway 17 - Hewiston Creek Culvert

Number: 37996

Client: Hatch

Location: Selim, Ontario

Slug Test: HCC-01

Test Well: HCC-01

Test Conducted by: GA

Test Date: 2024-04-19

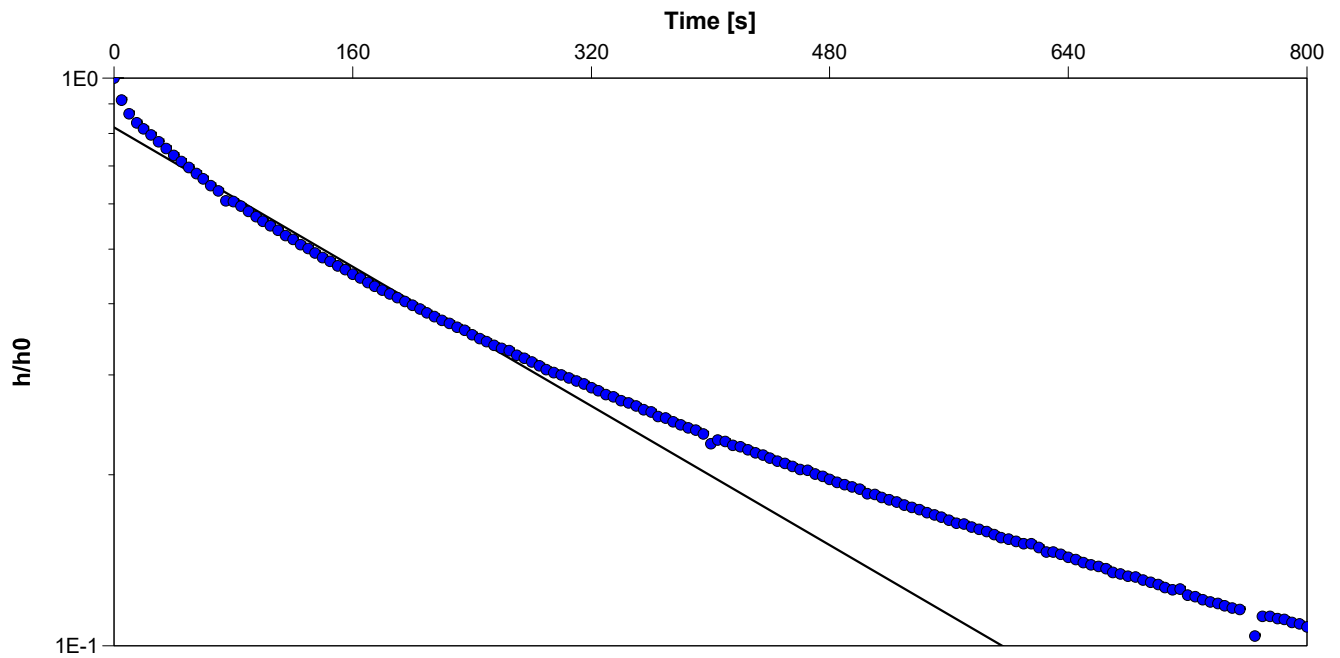
Analysis Performed by: ES

HCC-01 SWRT Analysis

Analysis Date: 2024-05-10

Aquifer Thickness:

Checked By:DH



Calculation using Hvorslev

Observation Well

Hydraulic Conductivity
[m/s]

HCC-01

1.8×10^{-6}



THURBER ENGINEERING LTD.

Slug Test Analysis Report

Project: Highway 17 - Hewiston Creek Culvert

Number: 37996

Client: Hatch

Location: Selim, Ontario

Slug Test: HCC-05

Test Well: HCC-05

Test Conducted by: GA

Test Date: 2024-04-19

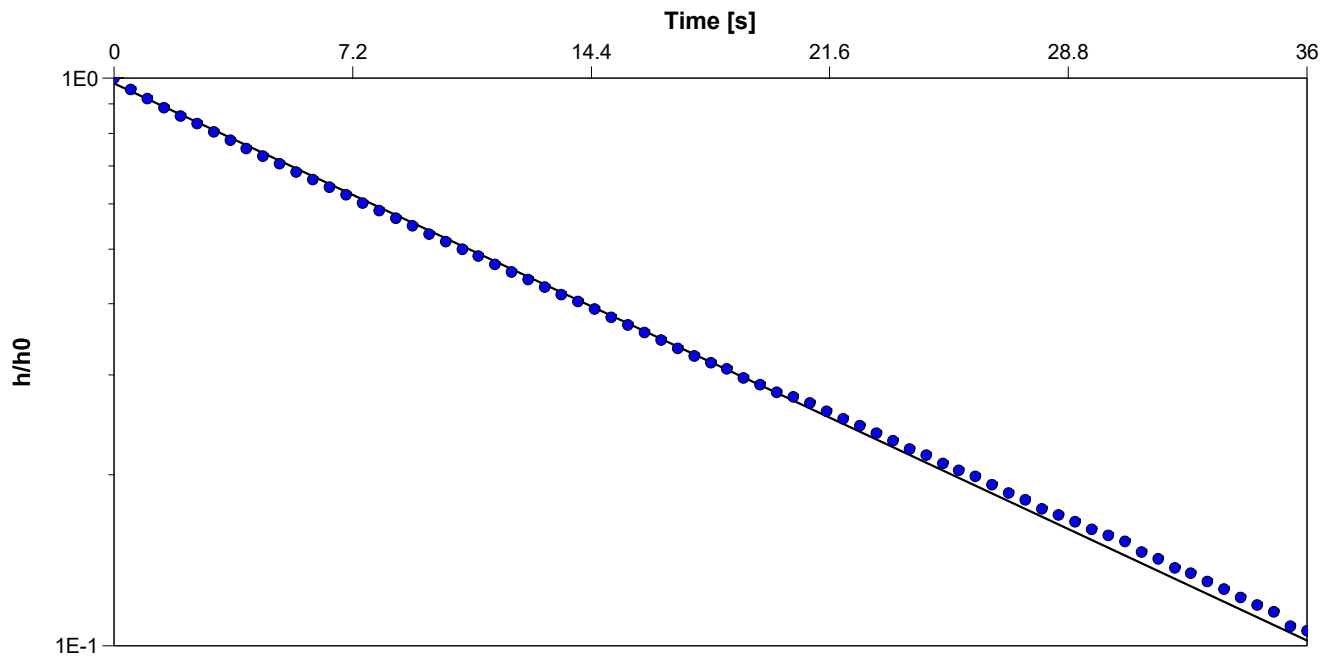
Analysis Performed by: ES

HCC-05 SWRT Analysis

Analysis Date: 2024-05-10

Aquifer Thickness:

Checked BY: DH



Calculation using Hvorslev

Observation Well

Hydraulic Conductivity
[m/s]

HCC-05

3.2×10^{-5}

APPENDIX D

Bedrock Laboratory Test Results and Rock Core Photographs

Gravel, Cobble, and Boulder Core Photos

Borehole HCC-01



Borehole HCC-02



Gravel, Cobble, and Boulder Core Photos

Borehole HCC-04



Borehole HCC-05



Gravel, Cobble, and Boulder Core Photos

Borehole HCC-06



Borehole HF2A-01



Gravel, Cobble, and Boulder Core Photos

Borehole HF2B-01



Borehole HF2B-02

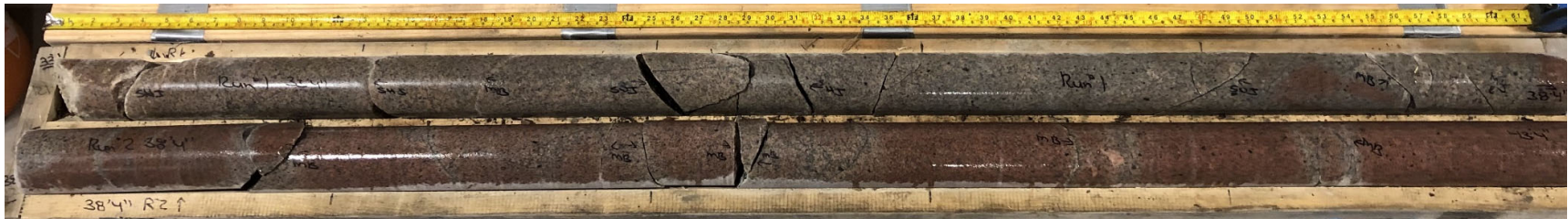


Bedrock Core Photos

Borehole HCC-01, Runs 1 and 2: 8.5 to 11.6 (Elev. 198.4 to 195.3 m)



Borehole HCC-02, Runs 1 and 2: 10.2 to 13.2 (Elev. 196.0 to 193.0 m)



Borehole HCC-03, Runs 1 and 2: 8.6 to 11.6 (Elev. 196.9 to 193.9 m)



Bedrock Core Photos

Borehole HCC-04, Runs 1 and 2: 15.0 to 18.1 (Elev. 195.0 to 191.9 m)



Borehole HCC-05, Runs 1 and 2: 14.9 to 18.0 (Elev. 189.6 to 186.5 m)



Borehole HCC-06, Runs 1 and 2: 16.5 to 19.5 (Elev. 188.5 to 185.5 m)



Bedrock Core Photos

Borehole HF2A-01, Runs 1, 2, and 3: 15.6 to 19.0 (Elev. 205.4 to 202.0 m)



Borehole HF2A-02, Runs 1 and 2: 6.5 to 9.5 (Elev. 201.0 to 198.0 m)



Borehole HF2B-01, Runs 1 and 2: 13.0 to 16.0 (Elev. 197.0 to 194.0 m)



Bedrock Core Photos

Borehole HF2B-02, Runs 1 and 2: 18.6 to 21.6 (Elev. 186.1 to 183.1 m)



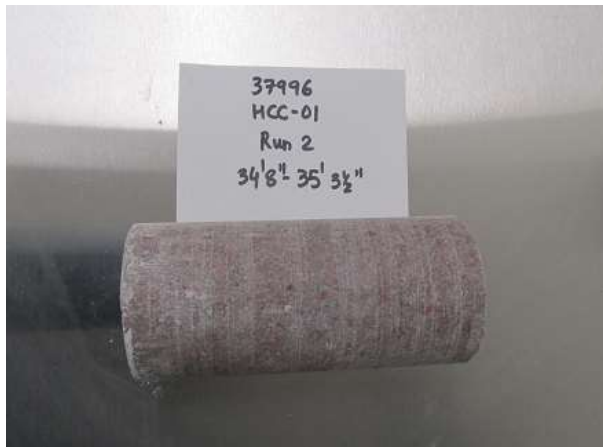
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

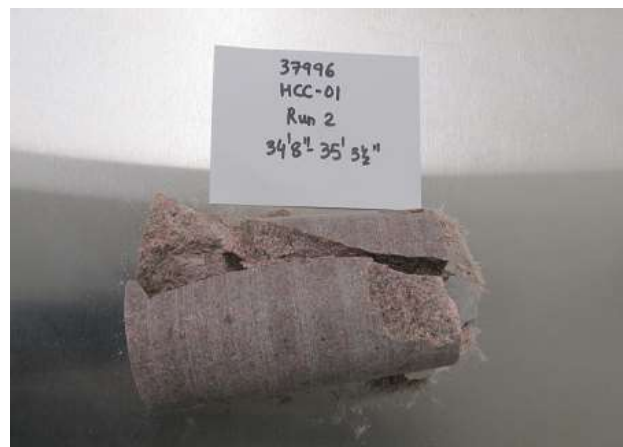
CLIENT:	MTO/Hatch	FILE NUMBER:	37996
PROJECT NAME:	Highway 17 Hewitson Creek	REPORT DATE:	11-Jul-24
BOREHOLE No.:	HCC-01	TEST DATE:	30-Apr-24
SAMPLE No.:	2		
SAMPLE DEPTH:	10.57 - 10.76 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	13.2	Weight (g):	1083.1
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,632
H. to Dia. Ratio**:	2.1:1	Dry Density (kg/m ³):	2,632
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	N/A
Sample Volume (cm ³):	411.48		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	0.250 MPa/s
MAXIMUM COMPRESSIVE LOAD:	405.3 kN
UNCONFINED COMPRESSIVE STRENGTH:	130.0 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: GF
 REVIEWED BY: WM

UCS - HCC-01 Run 2

UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

CLIENT:	MTO/Hatch	FILE NUMBER:	37996
PROJECT NAME:	Highway 17 Hewitson Creek	REPORT DATE:	11-Jul-24
BOREHOLE No.:	HCC-02	TEST DATE:	30-Apr-24
SAMPLE No.:	1		
SAMPLE DEPTH:	11.18 - 11.30 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	13.0	Weight (g):	1070.8
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,642
H. to Dia. Ratio**:	2.1:1	Dry Density (kg/m ³):	2,642
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	N/A
Sample Volume (cm ³):	405.24		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	0.250 MPa/s
MAXIMUM COMPRESSIVE LOAD:	243.4 kN
UNCONFINED COMPRESSIVE STRENGTH:	78.1 MPa

Note: * The moisture content was obtained before the test.
** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: GF
REVIEWED BY: WM

UCS - HCC-02 Run 1

UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

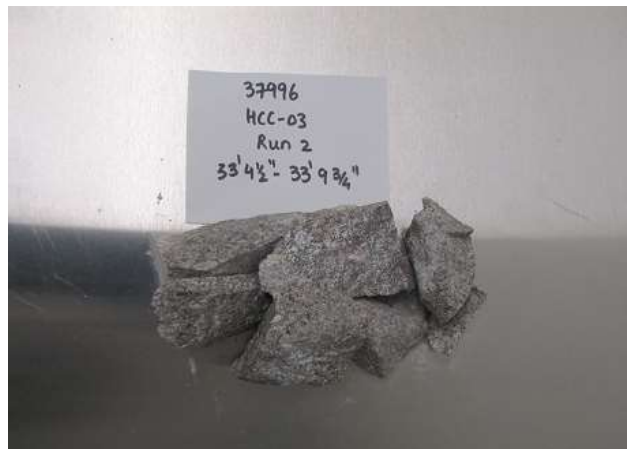
CLIENT:	MTO/Hatch	FILE NUMBER:	37996
PROJECT NAME:	Highway 17 Hewitson Creek	REPORT DATE:	11-Jul-24
BOREHOLE No.:	HCC-03	TEST DATE:	30-Apr-24
SAMPLE No.:	2		
SAMPLE DEPTH:	10.17 - 10.31 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	13.0	Weight (g):	1063.4
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,624
H. to Dia. Ratio**:	2.1:1	Dry Density (kg/m ³):	2,624
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	N/A
Sample Volume (cm ³):	405.24		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	0.250 MPa/s
MAXIMUM COMPRESSIVE LOAD:	441.2 kN
UNCONFINED COMPRESSIVE STRENGTH:	141.5 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: GF
 REVIEWED BY: WM

UCS - HCC-03 Run 2

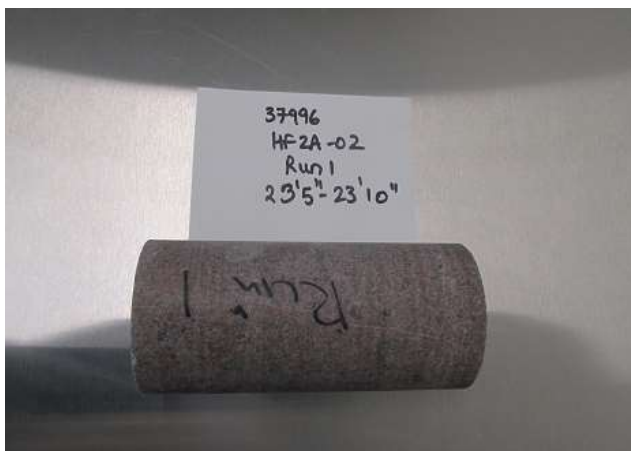
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

CLIENT:	MTO/Hatch	FILE NUMBER:	37996
PROJECT NAME:	Highway 17 Hewitson Creek	REPORT DATE:	11-Jul-24
BOREHOLE No.:	HF2A-02	TEST DATE:	30-Apr-24
SAMPLE No.:	1		
SAMPLE DEPTH:	7.14 - 7.26 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	13.0	Weight (g):	1078.3
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,661
H. to Dia. Ratio**:	2.1:1	Dry Density (kg/m ³):	2,661
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	N/A
Sample Volume (cm ³):	405.24		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	0.250 MPa/s
MAXIMUM COMPRESSIVE LOAD:	715.8 kN
UNCONFINED COMPRESSIVE STRENGTH:	229.6 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: GF
 REVIEWED BY: WM

UCS - HF2A-02 Run 1

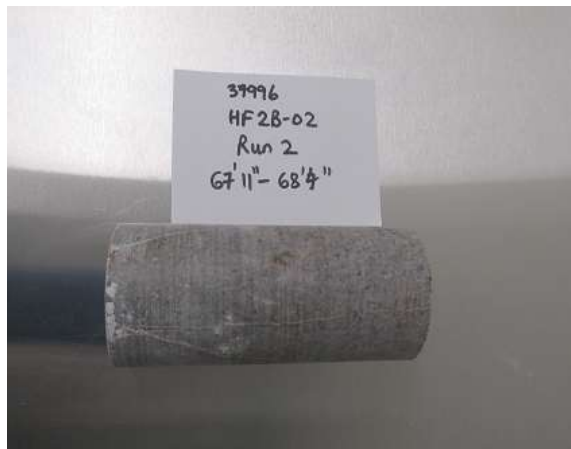
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

CLIENT:	MTO/Hatch	FILE NUMBER:	37996
PROJECT NAME:	Highway 17 Hewitson Creek	REPORT DATE:	11-Jul-24
BOREHOLE No.:	HF2B-02	TEST DATE:	30-Apr-24
SAMPLE No.:	2		
SAMPLE DEPTH:	20.70 - 20.83 m		
DESCRIPTION:	Granite		

Avg. Height (cm):	13.1	Weight (g):	1079.5
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,644
H. to Dia. Ratio**:	2.1:1	Dry Density (kg/m ³):	2,644
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	N/A
Sample Volume (cm ³):	408.36		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	0.250 MPa/s
MAXIMUM COMPRESSIVE LOAD:	380.2 kN
UNCONFINED COMPRESSIVE STRENGTH:	122.0 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: GF
 REVIEWED BY: WM

UCS - HF2B-02 Run 2



THURBER ENGINEERING LTD.

POINT LOAD TEST SHEET

ASTM D5731-08

Job No: 37996

Project Name: HWY 17 Hewitson Creek

Core Size: HQ BH No : HCC-01

Date Drilled: 08-Mar-24

Date Tested: 23-Apr-24

Tester: BS

Client: Hatch

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	$I_{s(50)}$ (MPa)	UCS (MPa)	Rock Type	Rock Strength (after Hoek & Brown, 1997)
1	1	9.9	D	14.4	63.1	111.4	3.8	91.1	Granite	Strong
2	1	10.0	A	22.5	63.1	59.4	5.2	124.3	Granite	Very Strong
3	2	10.2	D	30.0	62.9	203.4	8.0	191.1	Granite	Very Strong
4	2	10.5	A	30.0	63.0	61.4	6.7	161.6	Granite	Very Strong
5	2	11.0	A	30.0	63.0	60.0	6.8	164.4	Granite	Very Strong
6	2	11.2	D	30.0	63.0	114.7	7.9	190.7	Granite	Very Strong
7	2	11.5	A	30.0	63.0	66.6	6.3	151.6	Granite	Very Strong
8										
9										
10										
11						Run 1 Average:		107.7		Very Strong
12						Run 2 Average:		171.9		Very Strong
13										
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* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1

* Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

* Diametral Test should have $0.7 \times D$ on either side of test point.

* Correlation factor to obtain UCS values is 24.

* **Bolded text indicates the PLT Gauge reached the maximum of 30 Mpa, and the core did not break**



Job No: 37996
 Project Name: HWY 17 Hewitson Creek
 Core Size: HQ BH No : HCC-02

Date Drilled: 28-Mar-24
 Date Tested: 23-Apr-24
 Tester: BS
 Client: Hatch

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	$I_{s(50)}$ (MPa)	UCS (MPa)	Rock Type	Rock Strength (after Hoek & Brown, 1997)
1	1	10.4	D	30.0	62.7	130.4	8.0	192.2	Granite	Very Strong
2	1	10.5	A	29.9	62.8	61.5	6.7	161.4	Granite	Very Strong
3	1	10.9	D	12.9	32.6	98.1	9.5	228.1	Granite	Very Strong
4	1	11.3	D	30.0	62.6	126.4	8.0	192.7	Granite	Very Strong
5	1	11.6	A	30.0	62.8	57.4	7.1	170.5	Granite	Very Strong
6	2	11.9	D	30.0	62.5	120.9	8.1	193.4	Granite	Very Strong
7	2	12.2	A	23.6	62.8	64.2	5.1	123.1	Granite	Very Strong
8	2	12.4	D	19.4	62.7	165.6	5.2	124.4	Granite	Very Strong
9	2	12.9	A	30.0	62.6	60.8	6.8	163.4	Granite	Very Strong
10	2	14.7	D	30.0	62.8	117.9	8.0	191.8	Granite	Very Strong
11										
12						Run 1 Average:		189.0		Very Strong
13						Run 2 Average:		159.2		Very Strong
14										
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THURBER ENGINEERING LTD.

POINT LOAD TEST SHEET

ASTM D5731-08

Job No: 37996

Project Name: HWY 17 Hewitson Creek

Core Size: HQ BH No : HCC-03

Date Drilled: 06-Mar-24

Date Tested: 23-Apr-24

Tester: BS

Client: Hatch

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	$I_{s(50)}$ (MPa)	UCS (MPa)	Rock Type	Rock Strength (after Hoek & Brown, 1997)
1	1	8.7	D	30.0	62.8	100.9	8.0	191.8	Granite	Very Strong
2	1	9.1	A	8.4	62.7	63.8	1.8	44.1	Granite	Medium Strong
3	1	9.5	D	30.0	62.6	137.9	8.0	192.7	Granite	Very Strong
4	1	9.7	D	21.4	62.7	112.8	5.7	137.1	Granite	Very Strong
5	1	10.0	A	30.0	62.7	66.5	6.4	152.4	Granite	Very Strong
6	2	11.2	D	12.1	62.6	109.9	3.2	77.8	Granite	Strong
7	2	11.3	A	30.0	62.6	60.0	6.9	165.2	Granite	Very Strong
8										
9						Run 1 Average:		143.6		Very Strong
10						Run 2 Average:		121.5		Very Strong
11										
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* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1

* Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

* Diametral Test should have $0.7 \times D$ on either side of test point.

* Correlation factor to obtain UCS values is 24.

* **Bolded text indicates the PLT Gauge reached the maximum of 30 Mpa, and the core did not break**



THURBER ENGINEERING LTD.

POINT LOAD TEST SHEET
ASTM D5731-08

Job No: 37996
Project Name: HWY 17 Hewitson Creek
Core Size: HQ BH No : HCC-04

Date Drilled: 31-Mar-24
Date Tested: 23-Apr-24
Tester: BS
Client: Hatch

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	I _{s(50)} (MPa)	UCS (MPa)	Rock Type	Rock Strength (after Hoek & Brown, 1997)
1	1	15.9	D	19.9	62.3	105.1	5.4	129.1	Granite	Very Strong
2	1	16.0	A	30.0	62.4	64.2	6.5	157.1	Granite	Very Strong
3	2	17.1	A	30.0	62.3	65.0	6.5	155.8	Granite	Very Strong
4	2	17.4	D	30.0	62.4	119.1	8.1	193.6	Granite	Very Strong
5	2	17.6	A	30.0	62.4	60.1	6.9	165.3	Granite	Very Strong
6	2	17.7	D	30.0	62.5	106.2	8.0	193.2	Granite	Very Strong
7										
8										
9						Run 1 Average:		143.1		Very Strong
10						Run 2 Average:		177.0		Very Strong
11										
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* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1

Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

* Diametral Test should have $0.7 \times D$ on either side of test point.

* Correlation factor to obtain UCS values is 24.

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THURBER ENGINEERING LTD.

POINT LOAD TEST SHEET

ASTM D5731-08

Job No: 37996
 Project Name: HWY 17 Hewitson Creek
 Core Size: HQ BH No : HCC-05

Date Drilled: 10-Apr-24
 Date Tested: 23-Apr-24
 Tester: GA
 Client: Hatch

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	$I_s(50)$ (MPa)	UCS (MPa)	Rock Type	Rock Strength (after Hoek & Brown, 1997)
1	1	15.2	D	30.0	62.1	140.2	8.1	195.1	Granite	Very Strong
2	1	15.6	A	30.0	62.1	68.1	6.3	150.5	Granite	Very Strong
3	1	15.8	D	30.0	62.2	152.9	8.1	194.6	Granite	Very Strong
4	1	16.1	A	13.0	62.3	73.5	2.6	61.2	Granite	Strong
5	2	16.8	D	30.0	62.3	142.8	8.1	194.1	Granite	Very Strong
6	2	17.0	A	30.0	62.4	61.9	6.7	161.6	Granite	Very Strong
7	2	17.4	A	30.0	62.3	62.1	6.7	161.5	Granite	Very Strong
8	2	17.3	D	19.7	62.4	132.2	5.3	127.4	Granite	Very Strong
9										
10						Run 1 Average:		150.4		Very Strong
11						Run 2 Average:		161.2		Very Strong
12										
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* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1

* Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

* Diametral Test should have $0.7 \times D$ on either side of test point.

* Correlation factor to obtain UCS values is 24.

* **Bolded text indicates the PLT Gauge reached the maximum of 30 Mpa, and the core did not break**



THURBER ENGINEERING LTD.

POINT LOAD TEST SHEET

ASTM D5731-08

Job No: 37996
 Project Name: HWY 17 Hewitson Creek
 Core Size: HQ BH No : HCC-06

Date Drilled: 13-Apr-24
 Date Tested: 23-Apr-24
 Tester: BS
 Client: Hatch

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	I _{s(50)} (MPa)	UCS (MPa)	Rock Type	Rock Strength (after Hoek & Brown, 1997)
1	1	16.6	D	26.0	62.2	163.4	7.0	168.4	Granite	Very Strong
2	2	18.1	D	30.0	62.4	200.1	8.1	193.9	Granite	Very Strong
3	2	18.5	A	12.4	62.4	62.5	2.8	66.4	Granite	Strong
4	2	18.9	D	19.1	62.4	148.9	5.1	123.3	Granite	Very Strong
5	2	19.3	A	10.4	62.5	69.8	2.1	50.8	Granite	Strong
6										
7						Run 1 Average:		168.4		Very Strong
8						Run 2 Average:		108.6		Very Strong
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- * It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1
- * Long pieces of core can be tested diametrically to produce suitable lengths for axial testing
- * Diametral Test should have 0.7 x D on either side of test point.
- * Correlation factor to obtain UCS values is 24.
- * **Bolded text indicates the PLT Gauge reached the maximum of 30 Mpa, and the core did not break**



THURBER ENGINEERING LTD.

POINT LOAD TEST SHEET

ASTM D5731-08

Job No: 37996
 Project Name: HWY 17 Hewitson Creek
 Core Size: NQ BH No : HF2A-01

Date Drilled: 03-Mar-24
 Date Tested: 15-Apr-24
 Tester: BS
 Client: Hatch

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	$I_{s(50)}$ (MPa)	UCS (MPa)	Rock Type	Rock Strength (after Hoek & Brown, 1997)
1	1	15.7	D	13.6	47.3	80.1	5.6	135.3	Granite	Very Strong
2	1	16.1	D	20.2	47.3	70.5	8.3	200.4	Granite	Very Strong
3	1	16.4	D	27.8	47.3	75.0	11.5	275.7	Granite	Extremely Strong
4	2	16.8	D	25.2	47.3	72.8	10.4	249.9	Granite	Very Strong
5	2	17.0	D	27.2	47.3	67.1	11.2	269.8	Granite	Extremely Strong
6	2	17.3	D	21.5	47.3	75.0	8.9	213.2	Granite	Very Strong
7	2	17.6	D	27.3	47.3	71.7	11.3	270.8	Granite	Extremely Strong
8	3	18.2	D	22.5	47.4	71.7	9.3	222.4	Granite	Very Strong
9	3	18.6	D	24.1	47.3	65.3	10.0	239.0	Granite	Very Strong
10	3	18.8	D	24.3	47.4	71.0	10.0	240.2	Granite	Very Strong
11										
12					Run 1 Average:			203.8		Very Strong
13					Run 2 Average:			250.9		Extremely Strong
14					Run 3 Average:			233.9		Very Strong
15										
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* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1

* Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

* Diametral Test should have $0.7 \times D$ on either side of test point.

* Correlation factor to obtain UCS values is 24.

Last Modified: September 14, 2016



THURBER ENGINEERING LTD.

POINT LOAD TEST SHEET

ASTM D5731-08

Job No: 37996

Project Name: HWY 17 Hewitson Creek

Core Size: HQ BH No : HF2A-02

Date Drilled: 01-Apr-24

Date Tested: 23-Apr-24

Tester: GA

Client: Hatch

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	$I_s(50)$ (MPa)	UCS (MPa)	Rock Type	Rock Strength (after Hoek & Brown, 1997)
1	1	6.7	A	30.0	63.0	60.8	6.8	162.7	Granite	Very Strong
2	1	6.9	D	30.0	62.8	172.4	8.0	191.8	Granite	Very Strong
3	1	7.3	A	30.0	62.5	65.4	6.5	154.8	Granite	Very Strong
4	1	7.6	A	30.0	62.8	68.4	6.2	148.9	Granite	Very Strong
5	1	7.8	D	30.0	62.8	119.3	8.0	191.8	Granite	Very Strong
6	2	8.2	A	30.0	62.8	64.8	6.5	155.3	Granite	Very Strong
7	2	8.5	D	30.0	62.8	115.7	8.0	191.8	Granite	Very Strong
8	2	8.7	A	27.8	62.8	62.0	6.2	149.0	Granite	Very Strong
9	2	9.1	D	30.0	62.9	117.8	8.0	191.5	Granite	Very Strong
10	2	9.3	A	26.8	62.9	62.0	6.0	143.2	Granite	Very Strong
11										
12						Run 1 Average:		170.0		Very Strong
13						Run 2 Average:		166.2		Very Strong
14										
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* Correlation factor to obtain UCS values is 24.

* **Bolded text indicates the PLT Gauge reached the maximum of 30 Mpa, and the core did not break**



THURBER ENGINEERING LTD.

POINT LOAD TEST SHEET

ASTM D5731-08

Job No: 37996

Project Name: HWY 17 Hewitson Creek

Core Size: HQ BH No : HF2A-02

Date Drilled: 06-Apr-24

Date Tested: 23-Apr-24

Tester: GA

Client: Hatch

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	$I_{s(50)}$ (MPa)	UCS (MPa)	Rock Type	Rock Strength (after Hoek & Brown, 1997)
1	1	13.6	D	30.0	62.6	131.3	8.0	192.7	Granite	Very Strong
2	1	13.8	D	30.0	62.5	100.9	8.0	193.1	Granite	Very Strong
3	1	13.9	A	30.0	63.5	61.2	6.7	160.9	Granite	Very Strong
4	1	14.4	A	30.0	62.4	64.2	6.5	157.2	Granite	Very Strong
5	2	14.6	D	30.0	62.4	117.5	8.1	193.6	Granite	Very Strong
6										
7						Run 1 Average:		176.0		Very Strong
8						Run 2 Average:		193.6		Very Strong
9										
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THURBER ENGINEERING LTD.

POINT LOAD TEST SHEET

ASTM D5731-08

Job No: 37996

Project Name: HWY 17 Hewitson Creek

Core Size: HQ BH No : HF2B-02

Date Drilled: 15-Apr-24

Date Tested: 23-Apr-24

Tester: GA

Client: Hatch

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	I _{s(50)} (MPa)	UCS (MPa)	Rock Type	Rock Strength (after Hoek & Brown, 1997)
1	1	18.8	A	23.4	62.0	61.1	5.3	128.2	Granite	Very Strong
2	1	19.0	D	15.9	61.9	58.1	4.3	104.0	Granite	Very Strong
3	1	19.2	A	30.0	61.9	64.1	6.6	158.2	Granite	Very Strong
4	1	19.6	D	17.2	62.1	104.1	4.7	111.7	Granite	Very Strong
5	1	19.8	A	18.2	62.1	60.0	4.2	101.0	Granite	Very Strong
6	2	21.1	D	30.0	62.2	151.4	8.1	194.7	Granite	Very Strong
7	2	21.4	A	30.0	62.2	63.2	6.6	159.4	Granite	Very Strong
8	2	21.5	D	30.0	62.2	124.2	8.1	194.4	Granite	Very Strong
9										
10						Run 1 Average:		120.6		Very Strong
11						Run 2 Average:		182.9		Very Strong
12										
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* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1

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APPENDIX E

Analytical Laboratory Test Results



FINAL REPORT

CA14731-APR24 R1

Prepared for

Thurber Engineering Ltd.

First Page

CLIENT DETAILS

Client **Thurber Engineering Ltd.**

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Oakville, ON
L6H 0N1, Canada**

Contact **Rachel Bourassa**

Telephone **905-829-8666 x 263**

Facsimile

Email **rbourassa@thurber.ca**

Project

Order Number

Samples **Solution (2)**

LABORATORY DETAILS

Project Specialist **Maarit Wolfe, Hon.B.Sc**

Laboratory **SGS Canada Inc.**

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

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Email **Maarit.Wolfe@sgs.com**

SGS Reference **CA14731-APR24**

Received **04/19/2024**

Approved **04/26/2024**

Report Number **CA14731-APR24 R1**

Date Reported **04/26/2024**

COMMENTS

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

Temperature of Sample upon Receipt: 1 degrees C
Cooling Agent Present: YES
Custody Seal Present: YES

Chain of Custody Number:035940

SIGNATORIES

Maarit Wolfe, Hon.B.Sc





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CA14731-APR24 R1

Client: Thurber Engineering Ltd.

Project:

Project Manager: Rachel Bourassa

Samplers: Gazzopardi

MATRIX: WATER

Sample Number	7	8
Sample Name	HCC-01	HCC-01
		Dissolved
Sample Matrix	Solution	Solution
Sample Date	18/04/2024	18/04/2024

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

Parameter	Units	RL	L1	Result	Result
General Chemistry					
Total Suspended Solids	mg/L	2		4	---
Alkalinity	mg/L as CaCO3	2		82	---
Bicarbonate	mg/L as CaCO3	2		82	---
Carbonate	mg/L as CaCO3	2		< 2	---
OH	mg/L as CaCO3	2		< 2	---
Colour	TCU	3		111	---
Conductivity	uS/cm	2		590	---
Turbidity	NTU	0.10		9.8	---
Ammonia+Ammonium (N)	as N mg/L	0.04		0.23	---
Total Reactive Phosphorous (o-phosphate as P)	mg/L	0.03		< 0.03	---
Total Organic Carbon	mg/L	1		12	---
Metals and Inorganics					
Fluoride	mg/L	0.06		0.12	---
Bromide	mg/L	0.3		< 0.3	---
Nitrite (as N)	as N mg/L	0.03		< 0.03	---
Nitrate (as N)	as N mg/L	0.06		< 0.06	---
Sulphate	mg/L	2		< 2	---
Aluminum (0.2µm)	mg/L	0.001	0.075	0.074	---
Hardness	mg/L as CaCO3	0.05		95.7	92.0
Aluminum (total)	mg/L	0.001		0.290	0.072



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MATRIX: WATER

Sample Number	7	8
Sample Name	HCC-01	HCC-01 Dissolved
Sample Matrix	Solution	Solution
Sample Date	18/04/2024	18/04/2024

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

Parameter	Units	RL	L1	Result	Result
Metals and Inorganics (continued)					
Arsenic (total)	mg/L	0.0002	0.005	0.0003	0.0003
Boron (total)	mg/L	0.002	0.2	0.010	0.007
Barium (total)	mg/L	0.00008		0.0815	0.0771
Beryllium (total)	mg/L	0.000007	1.1	0.000029	0.000017
Cobalt (total)	mg/L	0.000004	0.0009	0.00128	0.00116
Calcium (total)	mg/L	0.01		29.2	28.2
Cadmium (total)	mg/L	0.000003	0.0001	0.000004	< 0.000003
Copper (total)	mg/L	0.001	0.005	0.006	< 0.001
Chromium (total)	mg/L	0.00008	0.1	0.00161	0.00086
Iron (total)	mg/L	0.007	0.3	6.00	5.68
Potassium (total)	mg/L	0.009		0.968	0.934
Magnesium (total)	mg/L	0.001		5.54	5.22
Manganese (total)	mg/L	0.00001		0.149	0.158
Molybdenum (total)	mg/L	0.0004	0.04	0.0017	0.0013
Nickel (total)	mg/L	0.0001	0.025	0.0033	0.0023
Sodium (total)	mg/L	0.01		86.3	84.4
Phosphorus (total)	mg/L	0.003	0.01	0.023	0.018
Lead (total)	mg/L	0.00009	0.005 0.025	0.00026	< 0.00009
Silicon (total)	mg/L	0.02		5.95	5.34
Silver (total)	mg/L	0.00005	0.0001	0.00090	< 0.00005



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Client: Thurber Engineering Ltd.

Project:

Project Manager: Rachel Bourassa

Samplers: Gazzopardi

MATRIX: WATER

Sample Number	7	8
Sample Name	HCC-01	HCC-01 Dissolved
Sample Matrix	Solution	Solution
Sample Date	18/04/2024	18/04/2024

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

Parameter	Units	RL	L1	Result	Result
Metals and Inorganics (continued)					
Strontium (total)	mg/L	0.00008		0.0524	0.0514
Thallium (total)	mg/L	0.000005	0.0003	< 0.000005	< 0.000005
Tin (total)	mg/L	0.00006		0.0022	0.00178
Titanium (total)	mg/L	0.0001		0.0128	0.0016
Antimony (total)	mg/L	0.0009	0.02	< 0.0009	< 0.0009
Selenium (total)	mg/L	0.00004	0.1	0.00014	0.00011
Uranium (total)	mg/L	0.000002	0.005	0.000186	0.000149
Vanadium (total)	mg/L	0.00001	0.006	0.00342	0.00255
Zinc (total)	mg/L	0.002	0.02	0.005	0.007
Cation sum	meq/L	-9999		6.07	---
Anion Sum	meq/L	-9999		5.59	---
Anion-Cation Balance	% difference	-9999		4.11	---
Ion Ratio	-	-9999		1.09	---
Total Dissolved Solids (calculated)	mg/L	-9999		311	---
Conductivity (calculated)	uS/cm	-9999		583	---
Langeliers Index 4° C	@ 4° C	-9999		-1.09	---
Saturation pH 4°C	pHs @ 4°C	-9999		8.58	---



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Client: Thurber Engineering Ltd.
Project:
Project Manager: Rachel Bourassa
Samplers: Gazzopardi

MATRIX: WATER

Sample Number	7	8
Sample Name	HCC-01	HCC-01
		Dissolved
Sample Matrix	Solution	Solution
Sample Date	18/04/2024	18/04/2024

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

Parameter	Units	RL	L1	Result	Result
Other (ORP)					
pH	No unit	0.05	8.6	7.49	---
Chloride	mg/L	1		140	---
Mercury (dissolved)	mg/L	0.00001	0.0002	---	< 0.00001
Mercury (total)	mg/L	0.00001	0.0002	< 0.00001	---



EXCEEDANCE SUMMARY

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

HCC-01

Cobalt	SM 3030/EPA 200.8	mg/L	0.00128	0.0009
Copper	SM 3030/EPA 200.8	mg/L	0.006	0.005
Iron	SM 3030/EPA 200.8	mg/L	6.00	0.3
Phosphorus	SM 3030/EPA 200.8	mg/L	0.023	0.01
Silver	SM 3030/EPA 200.8	mg/L	0.00090	0.0001

HCC-01 Dissolved

Cobalt	SM 3030/EPA 200.8	mg/L	0.00116	0.0009
Iron	SM 3030/EPA 200.8	mg/L	5.68	0.3
Phosphorus	SM 3030/EPA 200.8	mg/L	0.018	0.01



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QC SUMMARY

Alkalinity

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Alkalinity	EWL0530-APR24	mg/L as CaCO3	2	< 2	2	20	102	80	120	NA		

Ammonia by SFA

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Ammonia+Ammonium (N)	SKA0235-APR24	mg/L	0.04	<0.04	ND	10	104	90	110	105	75	125



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QC SUMMARY

Anions by discrete analyzer

Method: US EPA 325.2 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-026

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO8069-APR24	mg/L	1	<1	0	20	95	80	120	100	75	125
Sulphate	DIO8069-APR24	mg/L	2	<2	0	20	105	80	120	91	75	125

Anions by IC

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Bromide	DIO0518-APR24	mg/L	0.3	<0.3	ND	20	105	90	110	92	75	125
Nitrite (as N)	DIO0518-APR24	mg/L	0.03	<0.03	0	20	99	90	110	98	75	125
Nitrate (as N)	DIO0518-APR24	mg/L	0.06	<0.06	0	20	99	90	110	89	75	125



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QC SUMMARY

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Organic Carbon	SKA0226-APR24	mg/L	1	<1	ND	20	99	90	110	99	75	125

Carbonate/Bicarbonate
Method: SM 2320 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Carbonate	EWL0530-APR24	mg/L as CaCO3	2	< 2	ND	10	NA	90	110	NA		
Bicarbonate	EWL0530-APR24	mg/L as CaCO3	2	< 2	2	10	NA	90	110	NA		
OH	EWL0530-APR24	mg/L as CaCO3	2	< 2	ND	10	NA	90	110	NA		



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QC SUMMARY

Colour

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Colour	EWL0515-APR24	TCU	3	< 3	ND	10	105	80	120	NA		

Conductivity

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0530-APR24	uS/cm	2	< 2	0	20	100	90	110	NA		

Fluoride by Specific Ion Electrode

Method: SM 4500 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-014

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Fluoride	EWL0509-APR24	mg/L	0.06	<0.06	2	10	99	90	110	NV	75	125



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QC SUMMARY

Mercury by CVAAS
Method: EPA 7471A/SM 3112B | Internal ref.: ME-CA-IENVISPE-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Mercury (total)	EHG0043-APR24	mg/L	0.00001	< 0.00001	ND	20	101	80	120	74	70	130



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QC SUMMARY

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Silver (total)	EMS0239-APR24	mg/L	0.00005	<0.00005	ND	20	99	90	110	91	70	130
Aluminum (total)	EMS0239-APR24	mg/L	0.001	<0.001	19	20	100	90	110	121	70	130
Aluminum (0.2µm)	EMS0239-APR24	mg/L	0.001	<0.001	19	20	100	90	110	121	70	130
Arsenic (total)	EMS0239-APR24	mg/L	0.0002	<0.0002	7	20	104	90	110	115	70	130
Barium (total)	EMS0239-APR24	mg/L	0.00008	<0.00008	2	20	97	90	110	75	70	130
Beryllium (total)	EMS0239-APR24	mg/L	0.000007	<0.000007	ND	20	99	90	110	101	70	130
Boron (total)	EMS0239-APR24	mg/L	0.002	<0.002	0	20	101	90	110	103	70	130
Calcium (total)	EMS0239-APR24	mg/L	0.01	<0.01	1	20	102	90	110	106	70	130
Cadmium (total)	EMS0239-APR24	mg/L	0.000003	<0.000003	5	20	97	90	110	99	70	130
Cobalt (total)	EMS0239-APR24	mg/L	0.000004	<0.000004	9	20	104	90	110	113	70	130
Chromium (total)	EMS0239-APR24	mg/L	0.00008	<0.00008	16	20	104	90	110	99	70	130
Copper (total)	EMS0239-APR24	mg/L	0.001	<0.001	ND	20	104	90	110	115	70	130
Iron (total)	EMS0239-APR24	mg/L	0.007	<0.007	15	20	103	90	110	100	70	130
Potassium (total)	EMS0239-APR24	mg/L	0.009	<0.009	2	20	102	90	110	106	70	130
Magnesium (total)	EMS0239-APR24	mg/L	0.001	<0.001	1	20	99	90	110	96	70	130
Manganese (total)	EMS0239-APR24	mg/L	0.00001	<0.00001	0	20	101	90	110	114	70	130
Molybdenum (total)	EMS0239-APR24	mg/L	0.0004	<0.0004	2	20	107	90	110	115	70	130
Sodium (total)	EMS0239-APR24	mg/L	0.01	<0.01	3	20	98	90	110	102	70	130
Nickel (total)	EMS0239-APR24	mg/L	0.0001	<0.0001	5	20	104	90	110	107	70	130
Lead (total)	EMS0239-APR24	mg/L	0.00009	<0.00009	ND	20	97	90	110	97	70	130



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QC SUMMARY

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Phosphorus (total)	EMS0239-APR24	mg/L	0.003	<0.003	18	20	97	90	110	NV	70	130
Antimony (total)	EMS0239-APR24	mg/L	0.0009	<0.0009	ND	20	108	90	110	111	70	130
Selenium (total)	EMS0239-APR24	mg/L	0.00004	<0.00004	13	20	98	90	110	116	70	130
Silicon (total)	EMS0239-APR24	mg/L	0.02	<0.02	5	20	92	90	110	NV	70	130
Tin (total)	EMS0239-APR24	mg/L	0.00006	<0.00006	ND	20	101	90	110	NV	70	130
Strontium (total)	EMS0239-APR24	mg/L	0.00008	<0.00008	2	20	99	90	110	99	70	130
Titanium (total)	EMS0239-APR24	mg/L	0.0001	<0.0001	5	20	104	90	110	NV	70	130
Thallium (total)	EMS0239-APR24	mg/L	0.000005	<0.000005	4	20	100	90	110	91	70	130
Uranium (total)	EMS0239-APR24	mg/L	0.000002	<0.000002	2	20	99	90	110	97	70	130
Vanadium (total)	EMS0239-APR24	mg/L	0.00001	<0.00001	3	20	103	90	110	114	70	130
Zinc (total)	EMS0239-APR24	mg/L	0.002	<0.002	ND	20	103	90	110	91	70	130

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0530-APR24	No unit	0.05	NA	0		101			NA		



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QC SUMMARY

Reactive Phosphorus by SFA
Method: SM 4500-P F | Internal ref.: ME-CA-IENVISFA-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Reactive Phosphorous (o-phosphate as P)	SKA0218-APR24	mg/L	0.03	<0.03	ND	10	99	90	110	82	75	125

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Suspended Solids	EWL0507-APR24	mg/L	2	< 2	0	10	98	90	110	NA		

Turbidity
Method: SM 2130 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Turbidity	EWL0492-APR24	NTU	0.10	< 0.10	0	10	100	90	110	NA		



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QC SUMMARY

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

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

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

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

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

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

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

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

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

LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.

RL Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

NA The sample was not analysed for this analyte

ND Non Detect

Results relate only to the sample tested.

Data reported represent the sample as submitted to SGS. Solid samples expressed on a dry weight basis.

"Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

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

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This report supersedes all previous versions.

-- End of Analytical Report --



FINAL REPORT

CA15114-APR24 R

Prepared for

Thurber Engineering Ltd.



FINAL REPORT

CA15114-APR24 R

First Page

CLIENT DETAILS

Client Thurber Engineering Ltd.

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L6H 0N1, Canada

Contact Rachel Bourassa

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Facsimile

Email rbourassa@thurber.ca

Project

Order Number

Samples Solution (3)

LABORATORY DETAILS

Project Specialist Jill Campbell, B.Sc.,GISAS

Laboratory SGS Canada Inc.

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

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Facsimile 705-652-6365

Email jill.campbell@sgs.com

SGS Reference CA15114-APR24

Received 04/19/2024

Approved 04/25/2024

Report Number CA15114-APR24 R

Date Reported 04/25/2024

COMMENTS

Temperature of Sample upon Receipt: 1 degrees C

Cooling Agent Present: YES

Custody Seal Present: YES

Chain of Custody: 035940

SIGNATORIES

Jill Campbell, B.Sc.,GISAS



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FINAL REPORT

CA15114-APR24 R

Client: Thurber Engineering Ltd.
Project:
Project Manager: Rachel Bourassa
Samplers: G.Azzopardi

MATRIX: WATER

Sample Number	6	7	8
Sample Name	HF1	HF3	Hewiston Creek
Sample Matrix	Solution	Solution	Solution
Sample Date	18/04/2024	18/04/2024	18/04/2024

Parameter	Units	RL		Result	Result	Result
General Chemistry						
Conductivity	uS/cm	2		26	194	36
Redox Potential	mV	no		226	192	254
Sulphide	µg/L	6		< 6	< 6	< 6
Metals and Inorganics						
Sulphate	mg/L	0.04		1.6	4.0	2.2
Other (ORP)						
pH	No unit	0.05		6.80	7.78	6.88
Chloride	mg/L	0.04		0.37	38	4.5



FINAL REPORT

CA15114-APR24 R

QC SUMMARY

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0477-APR24	mg/L	0.04	<0.04	4	20	98	90	110	103	75	125
Sulphate	DIO0477-APR24	mg/L	0.04	<0.04	1	20	98	90	110	101	75	125
Chloride	DIO0537-APR24	mg/L	0.04	<0.04	3	20	99	90	110	86	75	125
Sulphate	DIO0537-APR24	mg/L	0.04	<0.04	0	20	99	90	110	93	75	125

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0529-APR24	uS/cm	2	< 2	0	20	100	90	110	NA		
Conductivity	EWL0530-APR24	uS/cm	2	< 2	0	20	100	90	110	NA		



FINAL REPORT

CA15114-APR24 R

QC SUMMARY

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0529-APR24	No unit	0.05	NA	0		101			NA		
pH	EWL0530-APR24	No unit	0.05	NA	0		101			NA		

Redox Potential
Method: SM 2580 |

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Redox Potential	EWL0490-APR24	mV	no	NA	0	20	104	80	120	NA		

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide	SKA0241-APR24	ug/L	6	<0.006	ND	20	99	80	120	NA	75	125



QC SUMMARY

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

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

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

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

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

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

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

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

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

LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.

RL Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

NA The sample was not analysed for this analyte

ND Non Detect

Results relate only to the sample tested.

Data reported represent the sample as submitted to SGS. Solid samples expressed on a dry weight basis.

"Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

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SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated.

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This report supersedes all previous versions.

-- End of Analytical Report --

Request for Laboratory Services and CHAIN OF CUSTODY

Laboratory Information Section - Lab use only

Received By: Kelly Medford
Received Date: APR 18 2024 (mm/dd/yy)
Received Time: 10:00 (hr: min)

Received By (signature): [Signature]
Custody Seal Present: Yes ☒ No ☐
Custody Seal Intact: Yes ☒ No ☐

Cooling Agent Present: Yes ☒ No ☐
Temperature Upon Receipt (°C): 1.1 Type: ICE

LAB LIMS # CA14731-APR24
P.O. #: CA15114-APR24
Site Location/ID: CA14731-APR24

REPORT INFORMATION

Company: Thompson Engineering
Contact: Rachael Benavides
Address: 252-1905 Ironoak
Phone: 905-829-8866
Fax: 905-829-8866

INVOICE INFORMATION

☒ (same as Report Information)
Company: Thompson Engineering
Contact: Rachael Benavides
Address: 252-1905 Ironoak
Phone: 905-829-8866
Fax: 905-829-8866

Email: Rachael.Benavides@thompsoneng.ca

REGULATIONS

☐ O.Reg 153/04 ☐ O.Reg 406/19
Table 1 ☐ Res/Park ☐ Soil Texture: ☐ Reg 347/538 (3 Day min TAT)
Table 2 ☐ Ind/Com ☐ Coarse ☒ PWQO ☐ MMER
Table 3 ☐ Agri/Other ☐ Medium/Fine ☐ CCME ☐ Other:
Table ☐ Appx. ☐ MSA
Soil Volume ☐ <350m3 ☐ >350m3 ☐ ODWS Not Reportable * See note

RECORD OF SITE CONDITION (RSC)

YES ☐ NO ☐

SAMPLE IDENTIFICATION

DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX
18/11/24	8:30	3	Liquid
18/11/24	9:45	3	Liquid
18/11/24	8:45	3	Liquid
18/11/24	8:55	11	Liquid

Field Filtered (Y/N)	M & I	SVOC	PCB	PHC	VOC	Pest	Other (please specify)	SPLP	TCLP
	Metals & Inorganics incl CrVI, CN, Hg, pH, B(HWS), EC, SAR, soil (Cl, Na-water)							Specify tests	Specify tests
	Full Metals Suite ICP metals plus B(HWS-soil only) Hg, CrVI								
	ICP Metals only Sb, As, Ba, Be, B, Cd, Cr, Co, Cu, Pb, Mo, Ni, Se, Ag, Ti, U, V, Zn								
	PAHs only								
	SVOCs all incl PAHs, ABNs, CPs								
	PCBs Total <input type="checkbox"/> Aroclor <input type="checkbox"/>								
	F1-F4 + BTEX								
	F1-F4 only no BTEX								
	VOCs all incl BTEX								
	BTEX only								
	Pesticides Organochlorine or specify other								
	Sewer Use: Specify pkg:								
	Water Characterization Pkg General <input type="checkbox"/> Extended <input type="checkbox"/>								

COMMENTS:

Regular TAT (5-7 days)
RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days
PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION
Specify Due Date:
*NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

TURNAROUND TIME (TAT) REQUIRED

TAT's are quoted in business days (exclude statutory holidays & weekends).
Samples received after 6pm or on weekends: TAT begins next business day

Observations/Comments/Special Instructions

Sampled By (NAME): G. Alvarez Signature: [Signature] Date: 04/18/24 (mm/dd/yy) Pink Copy - Client

Relinquished By (NAME): G. Alvarez Signature: [Signature] Date: 04/18/24 (mm/dd/yy) Yellow & White Copy - SGS

Note: Submission of samples to SGS is acknowledgment that you have been provided direction on sample collection, handling and transportation of samples. (2) Submission of samples to SGS is considered authorization for completion of work. Signatures may appear on this form or be retained on file in the contract, or in an alternative format (e.g., shipping documents). (3) Results may be sent by email to an unlimited number of addressees for no additional cost. Fax is available upon request. This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/terms_and_conditions.htm. (Printed copies are available upon request). Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.



FINAL REPORT

CA40086-MAY24 R1

37996, Hewitson Creek

Prepared for

Thurber Engineering Ltd.

First Page

CLIENT DETAILS

Client **Thurber Engineering Ltd.**

Address **1908 Ironoak Way, Suite 202
Oakville, ON
L6H 0N1, Canada**

Contact **Rachel Bourassa**

Telephone **905-829-8666 x 263**

Facsimile

Email **rbourassa@thurber.ca**

Project **37996, Hewitson Creek**

Order Number

Samples **Soil (6)**

LABORATORY DETAILS

Project Specialist **Maarit Wolfe, Hon.B.Sc**

Laboratory **SGS Canada Inc.**

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

Telephone **705-652-2000**

Facsimile **705-652-6365**

Email **Maarit.Wolfe@sgs.com**

SGS Reference **CA40086-MAY24**

Received **05/09/2024**

Approved **05/21/2024**

Report Number **CA40086-MAY24 R1**

Date Reported **05/21/2024**

COMMENTS

Temperature of Sample upon Receipt: 8 degrees C

Cooling Agent Present: YES

Custody Seal Present: YES

Chain of Custody Number: NA

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

SIGNATORIES

Maarit Wolfe, Hon.B.Sc





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FINAL REPORT

CA40086-MAY24 R1

Client: Thurber Engineering Ltd.
Project: 37996, Hewitson Creek
Project Manager: Rachel Bourassa
Samplers: Rachel Bourassa

MATRIX: SOIL

			Sample Number	5	6	7	8	9	10
			Sample Name	HCC-04 SS5 (11'-13')	HCC-03 SS4 (8.5'-10.5')	HF3-03 SS11 (40'-40'9")	HF1-01 SS3 (5'-7')	HF3-02 SS5 (10'-12')	HF1-04 SS4 (7'6"-9'6")
			Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil
			Sample Date	03/04/2024	24/03/2024	09/03/2024	16/03/2024	11/03/2024	16/03/2024
Parameter	Units	RL		Result	Result	Result	Result	Result	Result
Corrosivity Index									
Corrosivity Index	none	1		1	1	4	1	1	1
Soil Redox Potential	mV	no		272	298	304	295	284	278
Sulphide (Na2CO3)	%	0.01		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
pH	pH Units	0.05		7.66	7.66	8.78	6.05	7.13	6.32
Resistivity (calculated)	ohms.cm	-9999		19200	12300	5620	11400	20000	27800
General Chemistry									
Conductivity	uS/cm	2		52	81	178	88	50	36
Metals and Inorganics									
Moisture Content	%	0.1		11.6	8.4	12.8	7.3	11.3	8.4
Sulphate	µg/g	0.4		0.6	3.3	1.0	3.0	2.1	2.1
Other (ORP)									
Chloride	µg/g	0.4		1.6	12	11	27	10	6.1



FINAL REPORT

CA40086-MAY24 R1

QC SUMMARY

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0352-MAY24	µg/g	0.4	<0.4	11	35	105	80	120	103	75	125
Sulphate	DIO0352-MAY24	µg/g	0.4	<0.4	9	35	98	80	120	88	75	125

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide (Na2CO3)	ECS0045-MAY24	%	0.01	< 0.01								

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0387-MAY24	uS/cm	2	< 2	1	20	99	90	110	NA		



FINAL REPORT

CA40086-MAY24 R1

QC SUMMARY

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0364-MAY24	pH Units	0.05	NA	0		101			NA		

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AC: Acceptance criteria

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

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

LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.

RL Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

NA The sample was not analysed for this analyte

ND Non Detect

Results relate only to the sample tested.

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-- End of Analytical Report --

APPENDIX F

Site Photographs



THURBER ENGINEERING LTD.

SITE PHOTOS



Photo 1: Aerial view of Hewitson Creek Culvert site, looking southwest, photo taken March 4, 2024



Photo 2: Helicopter moving equipment at the Hewitson Creek Culvert site, near 25+255 CL, photo taken April 11, 2024



Photo 3: Helicopter moving equipment between borehole locations, photo taken March 26, 2024



Photo 4: Looking north at HCC-03 near Sta 10+982, west side of creek, photo taken April 10, 2024



Photo 5: Looking south at HCC-03, west side of creek, photo taken March 26, 2024



Photo 6: Looking East at Borehole HCC-02, west side of creek, photo taken March 26, 2024



Photo 7: Looking north along Hewitson Creek from the proposed culvert site near 11+017 CL, photo taken April 10, 2024



**Photo 8: Looking upstream along Hewitson Creek from the proposed culvert site near 11+017 CL,
photo taken April 10, 2024**



THURBER ENGINEERING LTD.

SITE PHOTOS



Photo 9: Looking northwest from Hewitson Creek from the proposed culvert site near 11+017 CL, photo taken April 10, 2024



Photo 10: Looking east towards drilling crew working at HCC-05, east side of creek, photo taken April 10, 2024