



**THURBER** ENGINEERING LTD.

**PRELIMINARY FOUNDATION INVESTIGATION REPORT  
CPR OVERHEAD AT TERRACE BAY STRUCTURE REPLACEMENT  
HIGHWAY 17, DISTRICT OF THUNDER BAY,  
TOWNSHIP OF STREY, ONTARIO  
LATITUDE: 48.788510°, LONGITUDE: -87.092973°  
G.W.P. 6113-17-00 SITE No. 48E-0018/B0**

**GEOCRES Number: 42D-61**

**Report**

to

**McIntosh Perry**

Date: September 30, 2021  
File: 29475



## TABLE OF CONTENTS

1.	INTRODUCTION .....	1
2.	SITE DESCRIPTION .....	1
3.	INVESTIGATION PROCEDURES .....	2
4.	LABORATORY TESTING .....	4
5.	SUBSURFACE CONDITIONS .....	4
5.1	Asphalt .....	5
5.2	Sand Fill .....	5
5.3	Sand .....	5
5.4	Silt .....	6
5.5	Silty Sand .....	7
5.6	Groundwater Conditions .....	7
6.	CORROSIVITY AND SULPHATE TEST RESULTS .....	8
7.	MISCELLANEOUS .....	8

## APPENDICES

Appendix A	Record of Borehole Sheets
Appendix B	Geotechnical and Analytical Laboratory Test Results
Appendix C	Site Photographs
Appendix D	Borehole Locations and Soil Strata Drawings
Appendix E	1947 Archival Drawing No. D2942



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## **1. INTRODUCTION**

This report presents the factual data obtained from a preliminary foundation investigation carried out by Thurber Engineering Ltd. (Thurber) for the proposed structure replacement of the CPR (Canadian Pacific Railway) Overhead bridge. The CPR Overhead bridge is located on Highway 17, on the easterly limits of the Town of Terrace Bay, Ontario.

The purpose of this investigation was to explore the subsurface conditions at the existing CPR Overhead bridge site and based on the data obtained, to provide a borehole location plan, stratigraphic profiles, records of boreholes, laboratory test results, and a written description of the subsurface conditions.

Thurber was retained by McIntosh Perry to carry out this foundation investigation under the Ministry of Transportation (MTO) Northwest Region Agreement Number 6020-E-0001.

## **2. SITE DESCRIPTION**

The site is located on Highway 17, on the easterly limit of the Town of Terrace Bay, in Strey Township, Thunder Bay District, Ontario. The existing overhead allows the CPR line to operate under Highway 17 in an east-west direction. Highway 17 runs in a general northeast-southwest direction at the bridge site. For the purposes of this report and drawings, Highway 17 is considered to run approximately east-west, and the existing bridge foundations are referred to as the west abutment, west pier, east pier, and east abutment.

The Ontario Structure Inspection Manual (OSIM) report prepared by MTO on October 24, 2019 indicates that the existing structure is a three-span, steel beam/girder bridge with a cast-in-place



concrete deck, built in 1948 with a major rehabilitation in 2000. The inspection report indicates that the bridge deck is approximately 52.4 m long and 14.5 m wide. Based on existing survey data for the site, the ground surface elevation of Highway 17 at the existing bridge is approximately Elevation 280.2 m. The existing bridge is supported on cast-in-place concrete footings at the abutments and piers.

The grade of Highway 17 at the CPR overhead is generally raised from the surrounding lands. The lands surrounding the overhead bridge include access roads, dense treed areas and CPR switches to the north side of the bridge. Photographs of the bridge and surrounding area are presented in Appendix C. No obvious indications of road settlement were observed, and the existing Highway 17 embankment slopes appeared to be performing satisfactorily.

Based on published geological information, the bridge lies within an area consisting of glaciomarine deposits of sand and gravelly sand. Based on local geological maps, the bedrock in the area is identified as massive to foliated granodiorite to granite.

An existing General Plan Drawing from 1947, DWG No. D2942 that pertains to the original bridge, indicates that the subsurface stratigraphy consists of coarse to fine sand, underlain by sandy silt to sand and silt. The stratigraphy is reproduced and presented on the soil strata drawings included in Appendix D.

### **3. INVESTIGATION PROCEDURES**

The field investigation for the replacement overhead bridge was carried out between December 7 and 19, 2020 and consisted of drilling and sampling four (4) foundation boreholes, labeled 20-01 to 20-04, and two (2) dynamic cone penetration tests (DCPTs), labeled 20-01A DCPT and 20-04A DCPT. Boreholes 20-02 and 20-03 were drilled adjacent to the existing east pier to depths ranging from approximately 27.4 to 32.3 m (Elevation 249.2 to 238.8 m). Part of these depths were DCPTs driven below the sampled depth. Access to the west pier was not allowed by CPR with the track-mounted drill rig due to sloping terrain and close proximity to the active CPR track. Boreholes 20-01 and 20-04, as well as DCPTs 20-01A DCPT and 20-04A DCPT, were advanced near the locations of the existing bridge abutments, and extended to depths ranging from approximately 20.3 to 29.2 m (Elevation 259.8 to 250.9 m).

The borehole logs from the foundation investigation are included in Appendix A. The approximate locations of the boreholes are shown on the Borehole Locations and Soil Strata drawing included in Appendix D. The boreholes from the archival drawing from 1947, DWG No. D2942, are also shown on the stratigraphic profile, and labeled as BH 47-1 to BH 47-3. The archival drawing is



included in Appendix E. The boreholes are not identified on the drawing, and therefore the assigned labels of BH 47-1 to BH 47-3 have been added to the drawing.

Utility clearances were obtained prior to the start of drilling. The ground surface elevations for the boreholes were estimated from field measurements and the topographic drawings provided to Thurber by McIntosh Perry. The coordinate system MTM NAD 83, Zone 14 was used for the boreholes. CPR flagging protection was arranged for drilling Boreholes 20-02 and 20-03.

A rubber tracked CME 55 drill rig was used to advance all of the boreholes using hollow stem augers and NW casing. Soil samples were obtained in the boreholes at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). A Dynamic Cone Penetration Test (DCPT) was also conducted at the base of Boreholes 20-02 and 20-03 as well as from the existing ground surface at DCPTs 20-01A DCPT and 20-04A DCPT to provide additional information for the investigation.

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

A standpipe piezometer was installed in Borehole 20-02 to permit measurement of the groundwater level. The piezometer was decommissioned at the end of the field investigation in general accordance with Ontario Regulation 903 as amended.

Completion details of the boreholes are summarized in Table 3.1.

**Table 3.1 – Borehole Completion Details**

<b>Borehole Number</b>	<b>Borehole Depth / Base Elevation (m)</b>	<b>Piezometer Tip Depth / Elevation (m)</b>	<b>Completion Details</b>
20-01	29.2 / 250.9	-	Backfilled with grout from 29.2 to 3.0 m, bentonite from 3.0 to 0.3 m, sand to 0.2 m, then asphalt to surface.
20-01A DCPT	20.3 / 259.8	-	Backfilled with grout from 20.3 to 0.2 m, then asphalt to surface
20-02	32.3 / 238.8	30.5 / 240.5	Filter sand from 30.5 to 27.1 m, then bentonite to surface.
20-03	27.4 / 243.8	-	Backfilled with bentonite from 27.4 m to surface.



Borehole Number	Borehole Depth / Base Elevation (m)	Piezometer Tip Depth / Elevation (m)	Completion Details
20-04	27.7 / 252.5	-	Backfilled with grout from 27.7 to 3.0 m, bentonite from 3.0 to 0.3 m, sand to 0.2 m, then asphalt to surface.
20-04A DCPT	20.8 / 259.3	-	Backfilled with bentonite from 20.5 to 0.2 m, then asphalt to surface

#### 4. LABORATORY TESTING

All recovered soil samples were subjected to visual identification (VI) and to natural moisture content determination. Selected samples were also subjected to grain size distribution analyses (sieve and/or hydrometer), where appropriate. The results of this laboratory testing program are shown on the Record of Borehole sheets included in Appendix A and on the figures included in Appendix B.

In order to assess the potential for sulphate attack on concrete foundations, as well as the potential for corrosion associated with the structure, samples of the fill and native soil from the boreholes near the existing abutments and piers were collected. The samples were submitted to SGS, a CALA accredited analytical laboratory in Mississauga, Ontario, for analytical testing of corrosivity parameters and sulphate content. The results of the analytical testing are summarized in Section 6 and are presented in Appendix B.

#### 5. SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets included in Appendix A. Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets and on the Borehole Locations and Soil Strata Drawings included in Appendix D. A general description of the stratigraphy, based on the conditions encountered in the boreholes, is given in the following paragraphs. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description and must be used for interpretation of the site conditions. It must be recognized and expected that soil conditions may vary between and beyond the borehole locations.

In general, the subsurface conditions encountered at the boreholes consisted of asphalt and granular fill, underlain by native deposits of sand and silt. Descriptions of the individual strata are presented below.



## 5.1 Asphalt

A 140 to 150 mm thick layer of asphalt was encountered at the ground surface in Boreholes 20-01 and 20-04, which were located on the shoulders of Highway 17.

## 5.2 Sand Fill

Sand fill was encountered below the asphalt or at the ground surface in all boreholes. The fill typically consisted of fine to coarse sand with traces of gravel and silt.

The sand fill extended to depths ranging from 9.7 to 10.2 m (Elev. 270.4 to 270.0 m) for the bridge abutment Boreholes 20-01 and 20-04. In Boreholes 20-02 and 20-03 near the track level, the sand fill extended to depths ranging from 0.8 to 1.2 m (Elev. 270.3 to 269.9 m). The upper 1.3 m of the fill in Borehole 20-04 consisted of silty sand with trace gravel. Trace organics were also encountered within the sand fill in Borehole 20-03.

The relative density of the sand fill generally ranged between loose and compact, with SPT 'N' values ranging from 4 to 27 blows for 0.3 m of penetration. The measured moisture content in the granular fill ranged from 4 to 18%, with a moisture content of 34% in Borehole 20-03, where trace organics were present. However, most samples had moisture contents between 4 and 6%.

The results of grain size analyses conducted on selected samples of the sand fill are illustrated on Figure B1 of Appendix B. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	1 to 3
Sand	90 to 95
Silt and Clay	4 to 8

## 5.3 Sand

A deposit of native sand containing trace to some gravel and trace to some silt was encountered below the granular fill in all boreholes. The thickness of the sand deposit ranged from 9.5 to 10.7 m and extended to depths of 10.7 to 20.9 m (Elev. 260.7 to 259.4). The 20-04A DCPT encountered refusal of 100 blows per 0.3 m of penetration at a depth of 20.8 m (Elev. 259.3 m), near the base of the native sand deposit.



A 1.5 m thick layer of very dense sandy silt was encountered within the sand deposit at a depth of 14.8 m (Elev. 265.3 m) in Borehole 20-01. An SPT 'N' value of 86 blows per 0.3 m of penetration was recorded in this layer.

SPT 'N' values measured in the native sand deposit ranged from 9 to 33 blows per 0.3 m of penetration, indicating that the deposit ranges from loose to dense. The measured moisture contents in the sand ranged from 4 to 28%.

The results of grain size analyses conducted on samples of the sand are illustrated on Figure B2 of Appendix B. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0 to 4
Sand	70 to 90
Silt and Clay	6
Silt	10 to 28
Clay	1 to 2

## 5.4 Silt

A native deposit of silt, containing trace to some sand and trace clay was encountered below the native sand in all boreholes. In the archival boreholes 47-1 to 47-3, the silt deposit is described as sandy silt to sand and silt. Boreholes 20-01, 20-02 and 20-04 were terminated within the silty sand at depths from 27.7 to 31.1 m (Elev. 252.5 to 240.0 m). Where fully penetrated in Borehole 20-03, the thickness of the native silt deposit was 10.1 m, with a base depth of 20.8 m (Elev. 250.4 m). The 20-01A DCPT encountered refusal of 100 blows per 0.3 m of penetration at a depth of 20.3 m (Elev. 259.8 m), within the native silt deposit.

A 1.6 m thick layer of dense sand with some silt was encountered within the silt deposit at a depth of 21.6 m (Elev. 258.5 m) in Borehole 20-01. A 1.5 m thick zone of intermittent layers of very dense sand and silt was encountered within the silt deposit at a depth of 16.3 m (Elev. 254.7 m) in Borehole 20-02.

SPT 'N' values measured in the silt deposit ranged from 23 to greater than 100 blows for 0.3 m of penetration, indicating that the deposit is compact to very dense. The measured moisture contents in the silt ranged from 10 to 21%.



The results of grain size analyses conducted on samples of the silt are illustrated on Figure B3 of Appendix B. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0
Sand	3 to 18
Silt	79 to 93
Clay	2 to 4

## 5.5 Silty Sand

Borehole 20-03 was terminated within a deposit of silty sand with trace clay below the native silt deposit. The borehole was sampled until a depth of 21.9 m (Elev. 249.2 m) and extended by DCPT until refusal was encountered at a depth of 27.4 m (Elev. 243.8 m).

The silty sand was compact, with an SPT 'N' value of 28 blows per 0.3 m of penetration. The measured moisture content of the silty sand was 18%.

The results of a grain size analysis conducted on a sample of the silty sand are illustrated on Figure B4 of Appendix B. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0
Sand	67
Silt	32
Clay	1

## 5.6 Groundwater Conditions

Groundwater conditions were observed during drilling operations and groundwater levels were measured in the open boreholes and the piezometer installed in Boreholes 20-02. A summary of the water level measurements is provided in Table 5.1 below:

**Table 5.1 - Groundwater Measurements**

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
20-01	December 15, 2020	11.1	269.0	Open borehole
	December 19, 2020	11.1		

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
20-02	December 8, 2020	1.2	269.8	Piezometer
	December 9, 2020	2.1	268.9	
	December 10, 2020	2.1	268.9	
20-04	December 14, 2020	7.3	272.9	Open borehole
	December 15, 2020	11.3	268.9	
	December 19, 2020	11.3	268.9	

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

## 6. CORROSIVITY AND SULPHATE TEST RESULTS

Two (2) samples of the fill and native soil were submitted for analytical testing of corrosivity parameters and sulphate. The results of the analytical tests are shown in Table 6.1. The laboratory certificates of analysis are presented in Appendix B.

**Table 6.1 - Analytical Test Results**

Parameter	Units (soil)	Test Results	
		BH20-02 SS3, 2.3 to 2.9 m	BH20-04 SS4, 3.0 to 3.7 m
		Native Sand	Fill Sand
Sulphide	%	<0.04	<0.04
Chloride	µg/g	26	660
Sulphate	µg/g	4.1	21
pH	no unit	8.92	9.06
Conductivity	uS/cm	131	1350
Resistivity (calculated)	ohms.cm	7,630	740
Redox Potential	mV	280	310

## 7. MISCELLANEOUS

Thurber obtained subsurface utility clearances prior to drilling. The northing and easting



coordinates and ground surface elevations were estimated based on field measurements relative to the topographic plans provided by MTO.

RPM Drilling of Thunder Bay, Ontario supplied and operated the drilling, sampling and in-situ testing equipment for the field investigation. CPR provided railway flagging protection. The field investigation was supervised on a full-time basis by Ms. Madisan Chiarotto, EIT of Thurber. The overall supervision of the field program was conducted by Mr. Joshua Alexander, EIT. and Mr. Mark Farrant, P.Eng. of Thurber. Geotechnical laboratory testing was carried out in Thurber's geotechnical laboratory.

Interpretation of the field data and preparation of this report was carried out by Mr. Joshua Alexander, EIT 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.

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



## **Appendix A**

### **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 <sup>(1)</sup> 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

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



### 4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

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

### 5. LEGEND FOR RECORDS OF BOREHOLES

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

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

 Water Level  
 Shear Strength Determination by Pocket Penetrometer

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

# UNIFIED SOILS CLASSIFICATION


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

# RECORD OF BOREHOLE No BH20-01

1 OF 4

METRIC

W.P. 6113-17-01 LOCATION CPR Overhead, Terrace Bay N 5 405 601.5 E 297 983.7 ORIGINATED BY MC  
DIST Thunder Bay HWY 17 BOREHOLE TYPE Hollow Stem Augers/Washboring COMPILED BY BH  
DATUM Geodetic DATE 2020.12.15 - 2020.12.19 LATITUDE 48.788777 LONGITUDE -87.092772 CHECKED BY JA

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 <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)							
								20   40   60   80   100				W <sub>p</sub> W                      W <sub>L</sub>							
280.1	GROUND SURFACE							○ UNCONFINED      + FIELD VANE											
0.0	ASPHALT(150mm)							● QUICK TRIAXIAL      × LAB VANE											
0.2	SAND, trace silt, trace gravel Compact to Loose Brown Damp (FILL)		1	GS			280							○				1   93   6 (SI+CL)	
			1	SS	16		279							○					
			2	SS	17		278							○					
			3	SS	9									○					
			4	SS	19		277								○				

Continued Next Page

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

# RECORD OF BOREHOLE No BH20-01

2 OF 4

METRIC

W.P. 6113-17-01 LOCATION CPR Overhead, Terrace Bay N 5 405 601.5 E 297 983.7 ORIGINATED BY MC  
DIST Thunder Bay HWY 17 BOREHOLE TYPE Hollow Stem Augers/Washboring COMPILED BY BH  
DATUM Geodetic DATE 2020.12.15 - 2020.12.19 LATITUDE 48.788777 LONGITUDE -87.092772 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						WATER CONTENT (%)				
								20 40 60 80 100						20 40 60				
Continued From Previous Page																		
	<b>SAND</b> , trace silt to silty, trace clay Compact Grey to Brown Wet						270											
			9	SS	25													
								269										
								268										
			10	SS	33													
	Loose						267											
		11	SS	9														
							266											
265.3																		
14.8	Layer of Very Dense Sandy Silt Grey Wet						265											
		12	SS	86														
							264											
263.8																		
16.3	Dense to Compact Grey Wet					263												
						262												
		14	SS	20														
						261												
260.7																		
19.4	<b>SILT</b> , some sand, trace clay Dense Grey Wet																	

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+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

ONTMT4S2 MTO-29475.GPJ 2017TEMPLATE(MTO).GDT 9/29/21

RECORD OF BOREHOLE No BH20-01

3 OF 4

METRIC

W.P. 6113-17-01 LOCATION CPR Overhead, Terrace Bay N 5 405 601.5 E 297 983.7 ORIGINATED BY MC  
DIST Thunder Bay HWY 17 BOREHOLE TYPE Hollow Stem Augers/Washboring COMPILED BY BH  
DATUM Geodetic DATE 2020.12.15 - 2020.12.19 LATITUDE 48.788777 LONGITUDE -87.092772 CHECKED BY JA

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

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

ONTMT4S2 MTO-29475.GPJ 2017TEMPLATE(MTO).GDT 9/29/21

# RECORD OF BOREHOLE No BH20-01

4 OF 4

METRIC

W.P. 6113-17-01 LOCATION CPR Overhead, Terrace Bay N 5 405 601.5 E 297 983.7 ORIGINATED BY MC  
 DIST Thunder Bay HWY 17 BOREHOLE TYPE Hollow Stem Augers/Washboring COMPILED BY BH  
 DATUM Geodetic DATE 2020.12.15 - 2020.12.19 LATITUDE 48.788777 LONGITUDE -87.092772 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
Continued From Previous Page																	
WATER LEVEL READINGS DATE          DEPTH(m)    ELEV.(m) 2020.12.15      11.1        269.0 2020.12.19      11.1        269.0																	

RECORD OF BOREHOLE No BH20-01A DCPT 1 OF 3

METRIC

W.P. 6113-17-01 LOCATION CPR Overhead, Terrace Bay N 5 405 602.4 E 297 984.3 ORIGINATED BY MC  
DIST Thunder Bay HWY 17 BOREHOLE TYPE DCPT COMPILED BY BH  
DATUM Geodetic DATE 2020.12.19 - 2020.12.19 LATITUDE 48.788784 LONGITUDE -87.092764 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100 PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W <sub>p</sub> W W <sub>L</sub> WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES					
280.1 0.0	GROUND SURFACE DCPT Begins						280			
							279			
							278			
							277			
							276			
							275			
							274			
							273			
							272			
							271			

Continued Next Page

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

RECORD OF BOREHOLE No BH20-01A DCPT 2 OF 3

METRIC

W.P. 6113-17-01 LOCATION CPR Overhead, Terrace Bay N 5 405 602.4 E 297 984.3 ORIGINATED BY MC  
DIST Thunder Bay HWY 17 BOREHOLE TYPE DCPT COMPILED BY BH  
DATUM Geodetic DATE 2020.12.19 - 2020.12.19 LATITUDE 48.788784 LONGITUDE -87.092764 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100 PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W <sub>p</sub> W W <sub>L</sub> WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	Continued From Previous Page						270				
							269				
							268				
							267				
							266				
							265				
							264				
							263				
							262				
							261				

Continued Next Page

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

RECORD OF BOREHOLE No BH20-01A DCPT 3 OF 3

METRIC

W.P. 6113-17-01 LOCATION CPR Overhead, Terrace Bay N 5 405 602.4 E 297 984.3 ORIGINATED BY MC  
DIST Thunder Bay HWY 17 BOREHOLE TYPE DCPT COMPILED BY BH  
DATUM Geodetic DATE 2020.12.19 - 2020.12.19 LATITUDE 48.788784 LONGITUDE -87.092764 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80					
	Continued From Previous Page						260									
259.8																
20.3	END OF DCPT UPON REFUSAL. BACKFILLED WITH GROUT FROM 20.3 TO 0.2 m, THEN ASPHALT TO SURFACE.															



ONTMT4S2 MTO-29475.GPJ 2017TEMPLATE(MTO).GDT 9/29/21

# RECORD OF BOREHOLE No BH20-02

1 OF 4

METRIC

W.P. 6113-17-01 LOCATION CPR Overhead, Terrace Bay N 5 405 579.1 E 297 987.5 ORIGINATED BY MC  
DIST Thunder Bay HWY 17 BOREHOLE TYPE Hollow Stem Augers/Washboring/DCPT COMPILED BY BH  
DATUM Geodetic DATE 2020.12.07 - 2020.12.08 LATITUDE 48.788575 LONGITUDE -87.092720 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  γ  kN/m <sup>3</sup>	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 <sub>P</sub> W      W <sub>L</sub>			
271.0	GROUND SURFACE						271	20	40	60	80	100						
0.0	<b>SAND</b> , trace silt, trace gravel Brown Moist (FILL)		1	GS										○				
270.3																		
0.8	<b>SAND</b> , trace silt to silty, trace gravel, trace clay Compact Light Brown to Brown Moist to Wet		1	SS	16		270							○				4 90 6 (SI+CL)
			2	SS	13		269							○				
			3	SS	12		268							○				
			4	SS	13		267							○				0 76 22 2
							266											
			5	SS	26		265							○				
							264											
			6	SS	15		263							○				
							262							○				
			7	SS	18													

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BH20-02

2 OF 4

METRIC

W.P. 6113-17-01 LOCATION CPR Overhead, Terrace Bay N 5 405 579.1 E 297 987.5 ORIGINATED BY MC  
DIST Thunder Bay HWY 17 BOREHOLE TYPE Hollow Stem Augers/Washboring/DCPT COMPILED BY BH  
DATUM Geodetic DATE 2020.12.07 - 2020.12.08 LATITUDE 48.788575 LONGITUDE -87.092720 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
	Continued From Previous Page											
260.1			8	SS	30		261					
11.0	SILT, some to trace sand, trace clay Dense to Very Dense Grey Wet						260					
			9	SS	57		259					0 11 87 2
							258					
			10	SS	30		257					
							256					
			11	SS	60		255					
254.7							254					0 91 9 (SI+CL)
16.3	Intermittent layers of sand and silt		12	SS	56		253					
							252					
253.2			13	SS	100/ 0.250							
17.8												

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

ONTMT4S2 MTO-29475.GPJ 2017TEMPLATE(MTO).GDT 9/29/21

RECORD OF BOREHOLE No BH20-02

3 OF 4

METRIC

W.P. 6113-17-01 LOCATION CPR Overhead, Terrace Bay N 5 405 579.1 E 297 987.5 ORIGINATED BY MC  
DIST Thunder Bay HWY 17 BOREHOLE TYPE Hollow Stem Augers/Washboring/DCPT COMPILED BY BH  
DATUM Geodetic DATE 2020.12.07 - 2020.12.08 LATITUDE 48.788575 LONGITUDE -87.092720 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80					
Continued From Previous Page							251									
			14	SS	68											
							250									
							249									
			15	SS	49		248									0 3 93 4
							247									
							246									
			16	SS	54		245									
							244									
							243									
			17	SS	57		242									0 6 90 4

Continued Next Page

+<sup>3</sup> ×<sup>3</sup>: Numbers refer to  
Sensitivity 20  
15 10 5  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BH20-02

4 OF 4

METRIC

W.P. 6113-17-01 LOCATION CPR Overhead, Terrace Bay N 5 405 579.1 E 297 987.5 ORIGINATED BY MC  
DIST Thunder Bay HWY 17 BOREHOLE TYPE Hollow Stem Augers/Washboring/DCPT COMPILED BY BH  
DATUM Geodetic DATE 2020.12.07 - 2020.12.08 LATITUDE 48.788575 LONGITUDE -87.092720 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL										
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60						80	100	20	40	60					
	Continued From Previous Page																								
240.0	Compact		18	SS	23																				
31.1	End of sampling and start DCPT.																								
238.8																									
32.3	<p>END OF BOREHOLE AT 32.3m UPON DCPT REFUSAL. Monitoring Well installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. BACKFILLED WITH GROUT FROM 32.3 TO 10.7 m, BENTONITE TO SURFACE.</p> <p>WATER LEVEL READINGS</p> <table border="1"> <thead> <tr> <th>DATE</th> <th>DEPTH(m)</th> <th>ELEV.(m)</th> </tr> </thead> <tbody> <tr> <td>2020.12.08</td> <td>1.2</td> <td>269.8</td> </tr> <tr> <td>2020.12.09</td> <td>2.1</td> <td>268.9</td> </tr> <tr> <td>2020.12.10</td> <td>2.1</td> <td>268.9</td> </tr> </tbody> </table>	DATE	DEPTH(m)	ELEV.(m)	2020.12.08	1.2	269.8	2020.12.09	2.1	268.9	2020.12.10	2.1	268.9												
DATE	DEPTH(m)	ELEV.(m)																							
2020.12.08	1.2	269.8																							
2020.12.09	2.1	268.9																							
2020.12.10	2.1	268.9																							

# RECORD OF BOREHOLE No BH20-03

1 OF 3

METRIC

W.P. 6113-17-01 LOCATION CPR Overhead, Terrace Bay N 5 405 581.9 E 297 969.3 ORIGINATED BY MC  
DIST Thunder Bay HWY 17 BOREHOLE TYPE Hollow Stem Augers/Washboring/DCPT COMPILED BY BH  
DATUM Geodetic DATE 2020.12.09 - 2020.12.10 LATITUDE 48.788600 LONGITUDE -87.092968 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  γ  kN/m <sup>3</sup>	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		
271.2	GROUND SURFACE												
0.8	TOPSOIL (25mm)												
	SAND, some gravel, trace organics Compact Brown Moist to Wet (FILL)		1	SS	11								
269.9			2	SS	14								
1.2	SAND, trace silt to silty, trace clay Compact Brown Wet												
			3	SS	18								0 71 28 1
			4	SS	15								
			5	SS	16								
			6	SS	19								0 89 10 1
			7	SS	17								
			8	SS	20								
			9	SS	16								

Continued Next Page

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

# RECORD OF BOREHOLE No BH20-03

2 OF 3

METRIC

W.P. 6113-17-01 LOCATION CPR Overhead, Terrace Bay N 5 405 581.9 E 297 969.3 ORIGINATED BY MC  
DIST Thunder Bay HWY 17 BOREHOLE TYPE Hollow Stem Augers/Washboring/DCPT COMPILED BY BH  
DATUM Geodetic DATE 2020.12.09 - 2020.12.10 LATITUDE 48.788600 LONGITUDE -87.092968 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	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								
260.5	Continued From Previous Page						261									
10.7	SILT, some sand, trace clay Compact to Very Dense Grey Wet		10	SS	26		260									0 18 79 3
							259									
			11	SS	56		258									
							257									
			12	SS	37		256									
							255									
			13	SS	93		254									0 12 86 2
							253									
			14	SS	65		252									
			15	SS	103											

Continued Next Page

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

# RECORD OF BOREHOLE No BH20-03

3 OF 3

METRIC

W.P. 6113-17-01 LOCATION CPR Overhead, Terrace Bay N 5 405 581.9 E 297 969.3 ORIGINATED BY MC  
DIST Thunder Bay HWY 17 BOREHOLE TYPE Hollow Stem Augers/Washboring/DCPT COMPILED BY BH  
DATUM Geodetic DATE 2020.12.09 - 2020.12.10 LATITUDE 48.788600 LONGITUDE -87.092968 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
	Continued From Previous Page		16	SS	113/ 0.250		251							
250.4 20.8	Silty <b>SAND</b> , trace clay Compact Brown Wet						250							
249.2 21.9	Compact		17	SS	28								0 67 32 1	
	End of sampling and start DCPT.						249							
							248							
							247							
							246							
							245							
							244							
243.8 27.4	END OF BOREHOLE AT 27.4m UPON DCPT REFUSAL. BACKFILLED WITH BENTONITE FROM 27.4 m TO SURFACE.													

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BH20-04

1 OF 3

METRIC

W.P. 6113-17-01 LOCATION CPR Overhead, Terrace Bay N 5 405 542.1 E 297 961.5 ORIGINATED BY MC  
DIST Thunder Bay HWY 17 BOREHOLE TYPE Solid Stem Augers/Washboring COMPILED BY BH  
DATUM Geodetic DATE 2020.12.12 - 2020.12.18 LATITUDE 48.788242 LONGITUDE -87.093073 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								20 40 60 80 100					
280.2	GROUND SURFACE												
0.0	ASPHALT(140mm)												
0.1	Silty SAND, trace gravel Compact Brown Dry (FILL)		1	GS			280						
			1	SS	18		279						
278.8													
1.4	SAND, trace gravel, trace silt Loose to Compact Brown to Grey Damp to Wet (FILL)		2	SS	8		278						2 93 5 (SI+CL)
			3	SS	9								
			4	SS	6		277						
							276						
			5	SS	10		275						3 92 5 (SI+CL)
			6	SS	13		274						
							273						
			7	SS	27		272						
			8	SS	9		271						1 95 4 (SI+CL)

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BH20-04

2 OF 3

METRIC

W.P. 6113-17-01 LOCATION CPR Overhead, Terrace Bay N 5 405 542.1 E 297 961.5 ORIGINATED BY MC  
DIST Thunder Bay HWY 17 BOREHOLE TYPE Solid Stem Augers/Washboring COMPILED BY BH  
DATUM Geodetic DATE 2020.12.12 - 2020.12.18 LATITUDE 48.788242 LONGITUDE -87.093073 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
270.0	Continued From Previous Page						270						
10.2	SAND, trace silt to silty, trace clay Compact to Dense Brown Wet		9	SS	32		269						
			10	SS	29		268						
			11	SS	27		267						
			12	SS	24		266						
			13	SS	31		265						
			14	SS	30		264						
							263						
							262						
							261						

Continued Next Page

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

RECORD OF BOREHOLE No BH20-04

3 OF 3

METRIC

W.P. 6113-17-01 LOCATION CPR Overhead, Terrace Bay N 5 405 542.1 E 297 961.5 ORIGINATED BY MC  
DIST Thunder Bay HWY 17 BOREHOLE TYPE Solid Stem Augers/Washboring COMPILED BY BH  
DATUM Geodetic DATE 2020.12.12 - 2020.12.18 LATITUDE 48.788242 LONGITUDE -87.093073 CHECKED BY JA

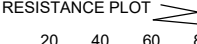
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
	Continued From Previous Page													
259.4			15	SS	27		260							0 72 26 2
20.9	SILT, some sand, trace clay Dense to Very Dense Grey Wet						259							
			16	SS	32		258							
							257							
							256							
			17	SS	100/ 0.225		255							
							254							0 22 75 3
			18	SS	102/ 0.200		253							
252.5			19	SS	100/ 0.275									
27.7	END OF BOREHOLE AT 28.0m. BOREHOLE OPEN TO 14.3m AND WATER LEVEL AT 7.3m UPON COMPLETION. BACKFILLED WITH GROUT FROM 27.7 TO 3.0 m, BENTONITE FROM 3.0 TO 0.3 m, SAND TO 0.2 m, THEN ASPHALT TO SURFACE.  WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2020.12.15 11.4 268.9 2020.12.15 11.3 268.9													

ONTMT4S2 MTO-29475.GPJ 2017TEMPLATE(MTO).GDT 9/29/21

# RECORD OF BOREHOLE No BH20-04A DCPT 1 OF 3

METRIC

W.P. 6113-17-01 LOCATION CPR Overhead, Terrace Bay N 5 405 540.6 E 297 960.7 ORIGINATED BY MC  
DIST Thunder Bay HWY 17 BOREHOLE TYPE DCPT COMPILED BY BH  
DATUM Geodetic DATE 2020.12.18 - 2020.12.18 LATITUDE 48.788229 LONGITUDE -87.093084 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT  SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
280.1 0.0	GROUND SURFACE DCPT Begins						280				
							279				
							278				
							277				
							276				
							275				
							274				
							273				
							272				
							271				

Continued Next Page

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

RECORD OF BOREHOLE No BH20-04A DCPT 2 OF 3

METRIC

W.P. 6113-17-01 LOCATION CPR Overhead, Terrace Bay N 5 405 540.6 E 297 960.7 ORIGINATED BY MC  
DIST Thunder Bay HWY 17 BOREHOLE TYPE DCPT COMPILED BY BH  
DATUM Geodetic DATE 2020.12.18 - 2020.12.18 LATITUDE 48.788229 LONGITUDE -87.093084 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100 PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W <sub>p</sub> W W <sub>L</sub> WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES					
	Continued From Previous Page						270			
							269			
							268			
							267			
							266			
							265			
							264			
							263			
							262			
							261			

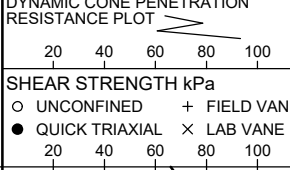
Continued Next Page

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

# RECORD OF BOREHOLE No BH20-04A DCPT 3 OF 3

**METRIC**

W.P. 6113-17-01 LOCATION CPR Overhead, Terrace Bay N 5 405 540.6 E 297 960.7 ORIGINATED BY MC  
 DIST Thunder Bay HWY 17 BOREHOLE TYPE DCPT COMPILED BY BH  
 DATUM Geodetic DATE 2020.12.18 - 2020.12.18 LATITUDE 48.788229 LONGITUDE -87.093084 CHECKED BY JA

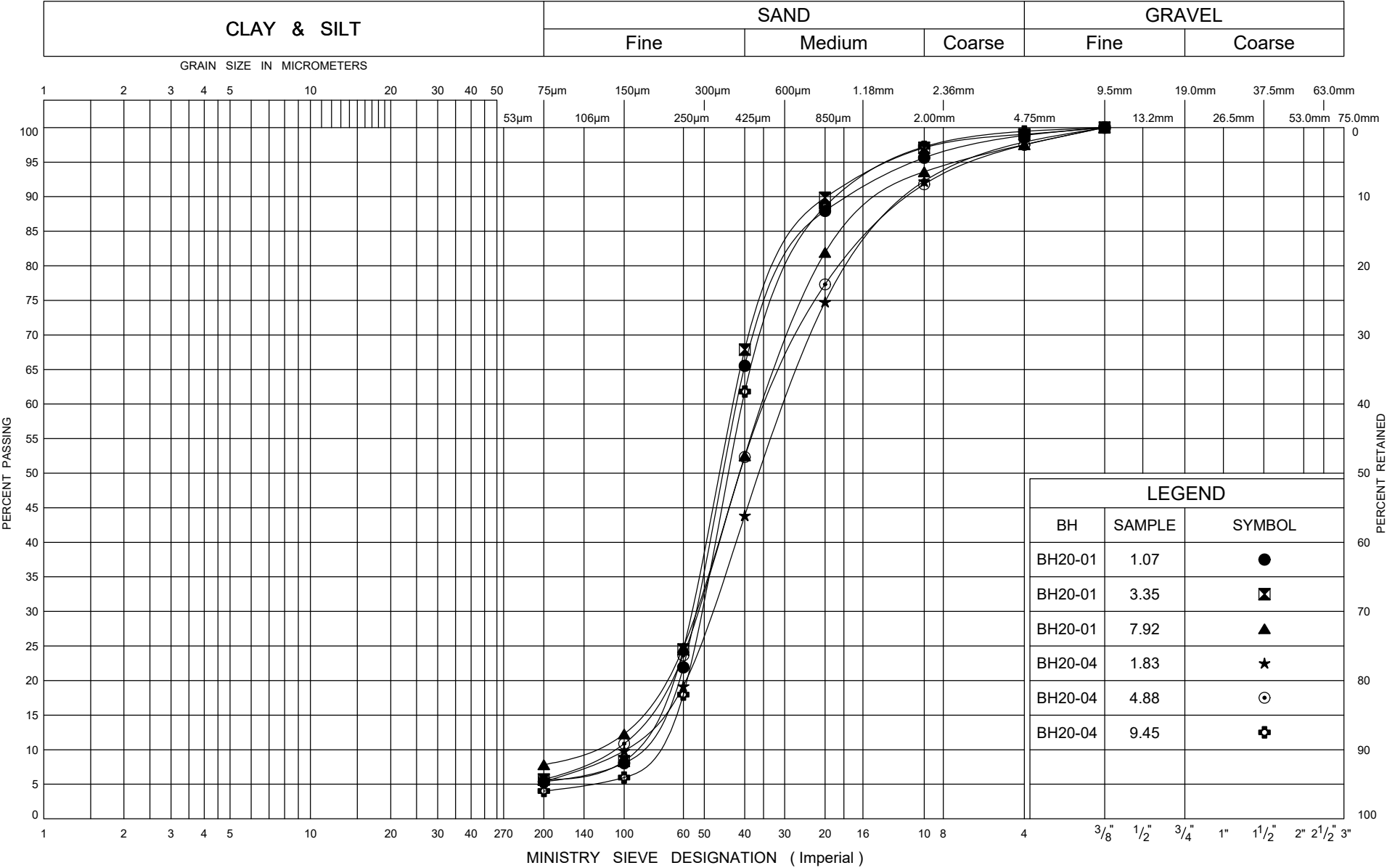
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W <sub>p</sub> — W — W <sub>L</sub> WATER CONTENT (%)	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	Continued From Previous Page						260				
259.3											
20.8	END OF DCPT UPON REFUSAL.										

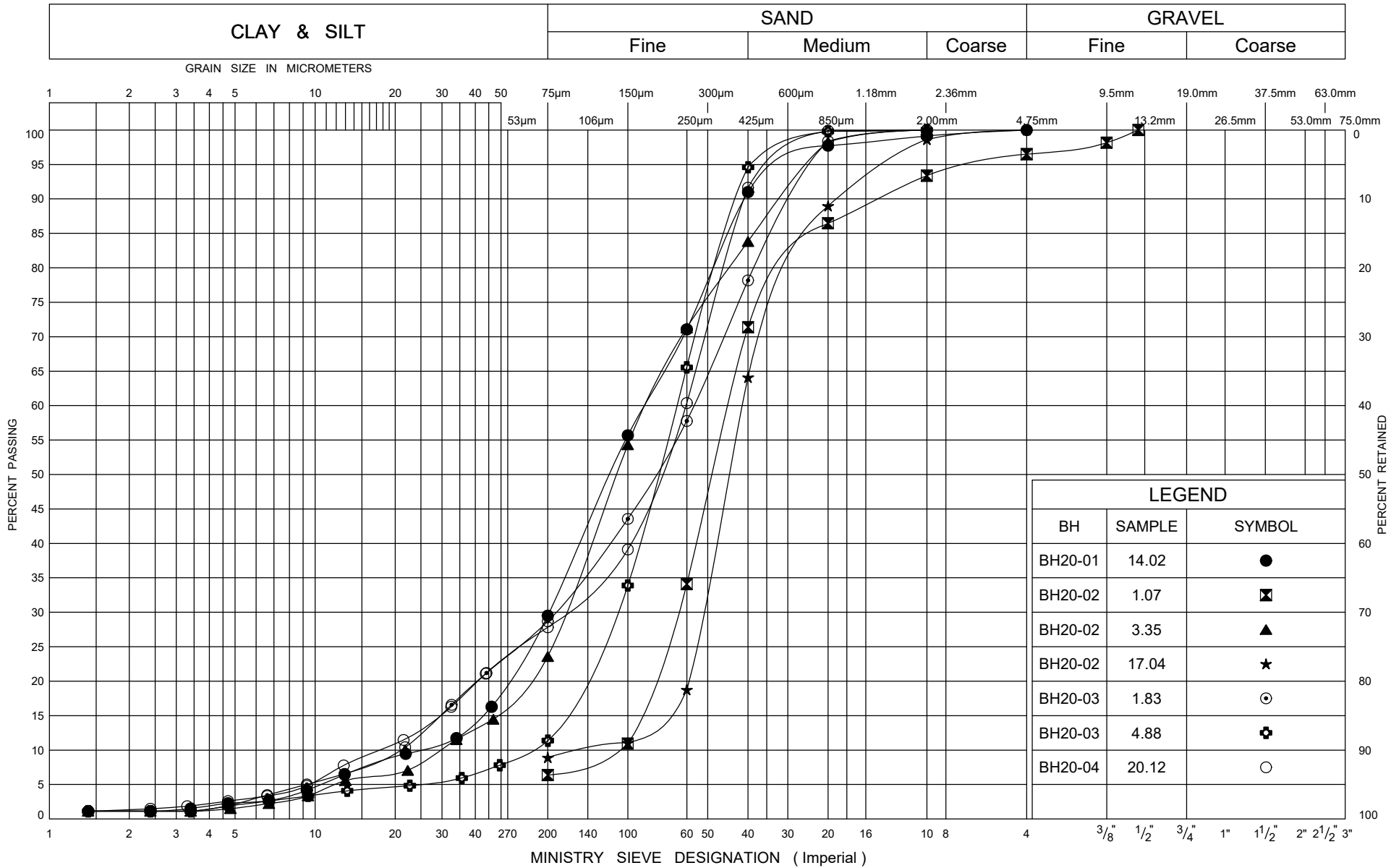
ONTMT4S2 MTO-29475.GPJ 2017TEMPLATE(MTO).GDT 9/29/21

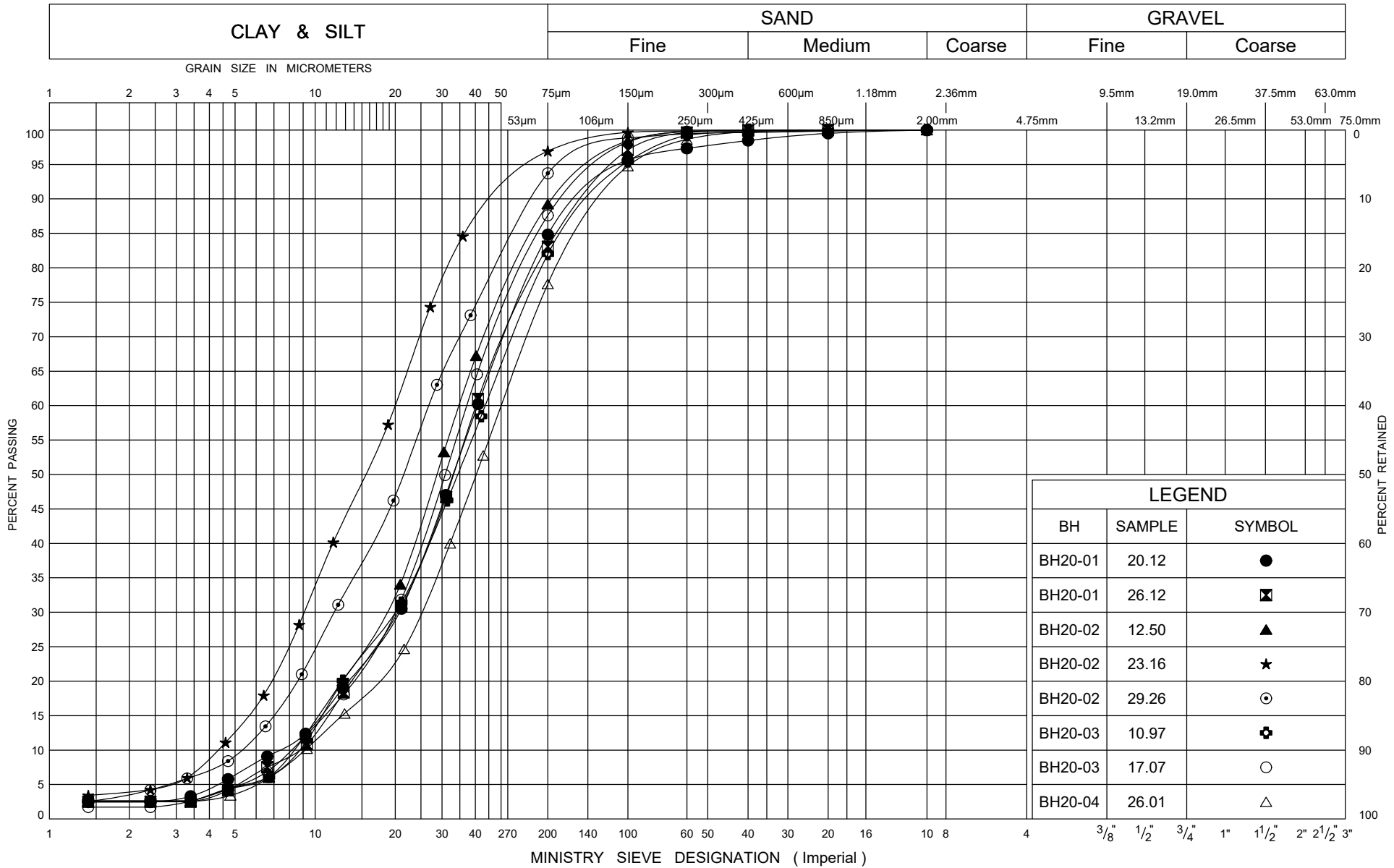


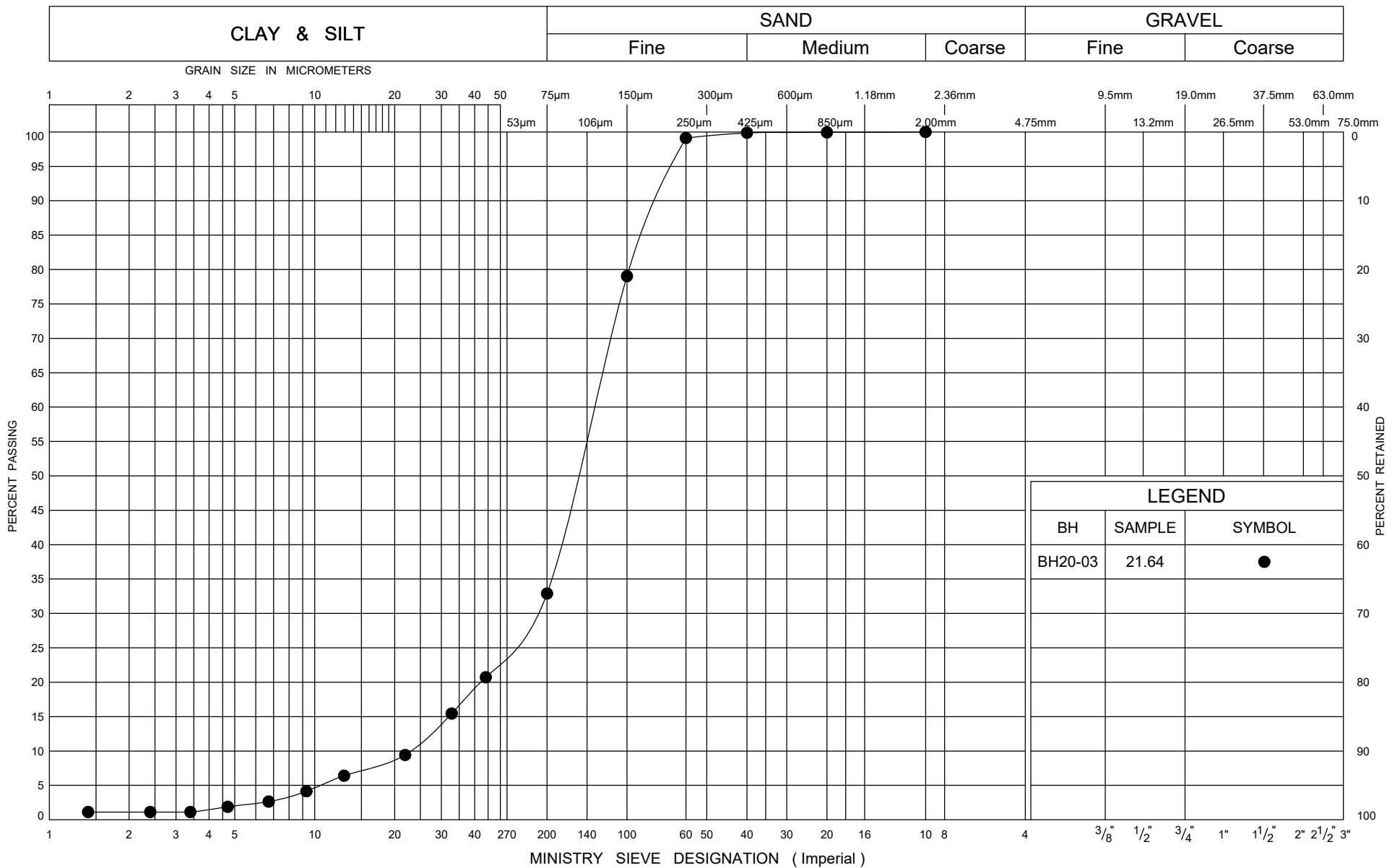
## **Appendix B**

### **Geotechnical Laboratory Test Results**











## FINAL REPORT

CA14102-JAN21 R1

29475, Hwy 17, CPR Bridge Terrace Bay

Prepared for

**Thurber Engineering Ltd.**

## First Page

### CLIENT DETAILS

Client Thurber Engineering Ltd.

Address 103, 2010 Winston Park Drive  
Oakville, ON  
L6H 5R7, Canada

Contact Joshua Alexander

Telephone 613-606-7303

Facsimile

Email jalexander@thurber.ca

Project 29475, Hwy 17, CPR Bridge Terrace Bay

Order Number

Samples Soil (2)

### LABORATORY DETAILS

Project Specialist Brad Moore Hon. B.Sc

Laboratory SGS Canada Inc.

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

Telephone 705-652-2143

Facsimile 705-652-6365

Email brad.moore@sgs.com

SGS Reference CA14102-JAN21

Received 01/07/2021

Approved 01/14/2021

Report Number CA14102-JAN21 R1

Date Reported 01/14/2021

### COMMENTS

Temperature of Sample upon Receipt: 6 degrees C

Cooling Agent Present: Yes

Custody Seal Present: Yes

Chain of Custody Number: 013627

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

Brad Moore Hon. B.Sc

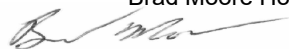




TABLE OF CONTENTS

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First Page..... 1

Index..... 2

Results..... 3-4

QC Summary..... 5-6

Legend..... 7

Annexes..... 8



# FINAL REPORT

CA14102-JAN21 R1

**Client:** Thurber Engineering Ltd.

**Project:** 29475, Hwy 17, CPR Bridge Terrace Bay

**Project Manager:** Joshua Alexander

**Samplers:** Madison Chiarotto

## PACKAGE: - Corrosivity Index (SOIL)

<b>Sample Number</b>	5	6
<b>Sample Name</b>	BH20-04 SS4	BH20-02 SS3
<b>Sample Matrix</b>	Soil	Soil
<b>Sample Date</b>	12/12/2020	07/12/2020

Parameter	Units	RL		Result	Result
<b>Corrosivity Index</b>					
Corrosivity Index	none	1		13	4
Soil Redox Potential	mV	-		310	280
Sulphide (Na <sub>2</sub> CO <sub>3</sub> )	%	0.04		< 0.04	< 0.04
pH	pH Units	0.05		9.06	8.92
Resistivity (calculated)	ohms.cm	-9999		740	7630

## PACKAGE: - General Chemistry (SOIL)

<b>Sample Number</b>	5	6
<b>Sample Name</b>	BH20-04 SS4	BH20-02 SS3
<b>Sample Matrix</b>	Soil	Soil
<b>Sample Date</b>	12/12/2020	07/12/2020

Parameter	Units	RL		Result	Result
<b>General Chemistry</b>					
Conductivity	uS/cm	2		1350	131

## PACKAGE: - Metals and Inorganics (SOIL)

<b>Sample Number</b>	5	6
<b>Sample Name</b>	BH20-04 SS4	BH20-02 SS3
<b>Sample Matrix</b>	Soil	Soil
<b>Sample Date</b>	12/12/2020	07/12/2020

Parameter	Units	RL		Result	Result
<b>Metals and Inorganics</b>					
Moisture Content	%	0.1		4.5	17.8
Sulphate	µg/g	0.4		21	4.1



FINAL REPORT

CA14102-JAN21 R1

Client: Thurber Engineering Ltd.

Project: 29475, Hwy 17, CPR Bridge Terrace Bay

Project Manager: Joshua Alexander

Samplers: Madison Chiarotto

PACKAGE: - Other (ORP) (SOIL)

Sample Number	5	6
Sample Name	BH20-04 SS4	BH20-02 SS3
Sample Matrix	Soil	Soil
Sample Date	12/12/2020	07/12/2020

Parameter	Units	RL		Result	Result
Other (ORP)					
Chloride	µg/g	0.4		660	26



FINAL REPORT

CA14102-JAN21 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	DIO0098-JAN21	µg/g	0.4	<0.4	0	20	95	80	120	105	75	125
Sulphate	DIO0098-JAN21	µg/g	0.4	<0.4	4	20	95	80	120	87	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)	ECS0012-JAN21	%	0.04	< 0.04	13	20	80	80	120			

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0079-JAN21	uS/cm	2	< 2	0	20	98	90	110	NA		



QC SUMMARY

pH  
Method: SM 4500 | Internal ref.: ME-CA-1ENVIEWL-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	EWL0079-JAN21	pH Units	0.05	NA	0		100			NA		

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

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

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

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

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

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

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

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

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

## LEGEND

### FOOTNOTES

**NSS** Insufficient sample for analysis.

**RL** Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

**NA** The sample was not analysed for this analyte

**ND** Non Detect

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

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

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

This report must not be reproduced, except in full. This report supersedes all previous versions.

-- End of Analytical Report --

## Request for Laboratory Services and CHAIN OF CUSTODY

No: 013627  
 Page 1 of 2

Received By: Clay Moore  
 Received Date: 10/7/20 (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): 6.6 Type: ice

LAB LMS # CA14102-  
Jan 21

## REPORT INFORMATION

## INVOICE INFORMATION

Company: Thurber  
 Contact: Joshua Alexander  
 Address: 2910 Winston Park Dr.  
Unit 103 Oakville, ON, L6H  
 Phone: 613-606-7303 SR5

☐ (same as Report Information)  
 Company: \_\_\_\_\_  
 Contact: \_\_\_\_\_  
 Address: \_\_\_\_\_

Fax: \_\_\_\_\_

Phone: \_\_\_\_\_

Email: jalexander@thurber.ca

Email: accounting@thurber.ca

## REGULATIONS

## REGULATIONS

## Regulation 153/04:

☐ Table 1 ☐ Res/Park ☐ Soil Texture: \_\_\_\_\_  
☐ Table 2 ☐ Ind/Com ☐ Coarse ☐ PWOC ☐ MMER  
☐ Table 3 ☐ Agr/Other ☐ Medium ☐ CCME ☐ Other: \_\_\_\_\_  
☐ Table \_\_\_\_\_ ☐ Fine ☐ MSA \_\_\_\_\_

## Other Regulations:

☐ Reg 347/558 (3 Day min TAT)  
☐ PWOC ☐ MMER  
☐ CCME ☐ Other: \_\_\_\_\_  
☐ MSA \_\_\_\_\_

## RECORD OF SITE CONDITION (RSC)

☐ YES ☐ NO

## SAMPLE IDENTIFICATION

## DATE SAMPLED

## TIME SAMPLED

## # OF BOTTLES

## MATRIX

## Field Filtered (Y/N)

## Metals &amp; Inorganics

incl CrVI, CN, Hg, pH, B(HWS), EC, SAR-soil (Cl, Na-water)

## 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 ☐ Aroclor ☐

## 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 ☐ Extended ☐

☐ TCCLP ☐ Specificity ☐ Tests ☐ MSA ☐ VOC ☐ PCB ☐ Bi/a/p ☐ AEN ☐ Ignit.

## COMMENTS:

## ANALYSIS REQUESTED

Specify Due Date: \_\_\_\_\_

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

Quotation #:

Project #: 29475

P.O. #:

Site Location/ID: Key 17, CPR Bridge, Tenac Bay

## TURNAROUND TIME (TAT) REQUIRED

☒ 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

## Observations/Comments/Special Instructions

Sampled By (NAME): Madison Chiavotto

Signature: [Signature]

Date: 01/07/21 (mm/dd/yy)

Pink Copy - Client

Relinquished By (NAME): Josh Alexander

Signature: [Signature]

Date: 01/07/21 (mm/dd/yy)

Yellow & White Copy - SGS

Revision # 1.2

Note: Submission of samples to SGS is acknowledgment that you have been provided directly on sample collection, handling and transportation of samples. (2) Submission of samples to SGS is considered authorization for completion of work. Signatures may appear on this form or be retained on file in the contract, or in an alternative format (e.g. shipping documents). (3) Results may be sent by email to an unlimited number of addresses for no additional cost. Fax is available upon request. This document is issued by the Company under its General Conditions of Service accessible at [http://www.sgs.com/terms\\_and\\_conditions.htm](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.



## **Appendix C**

### **Site Photographs**



**Photo C1: North approach to existing bridge looking South along Highway 17.**

**(Date taken: December 7, 2020)**



**Photo C2: East side of bridge looking west. (Date taken: December 7, 2020)**



**Photo C3: West side of bridge looking east. (Date taken: December 7, 2020)**



**Photo C4: North pier looking south. (Date taken: December 7, 2020)**



**Photo C5: Underside of bridge deck looking south from north pier. (Date taken: December 7, 2020)**



**Photo C6: North abutment looking north. (Date taken: December 7, 2020)**



**Photo C7: South abutment looking south. (Date taken: December 7, 2020)**



**Photo C8: CPR tracks looking east from south pier. (Date taken: December 11, 2020)**

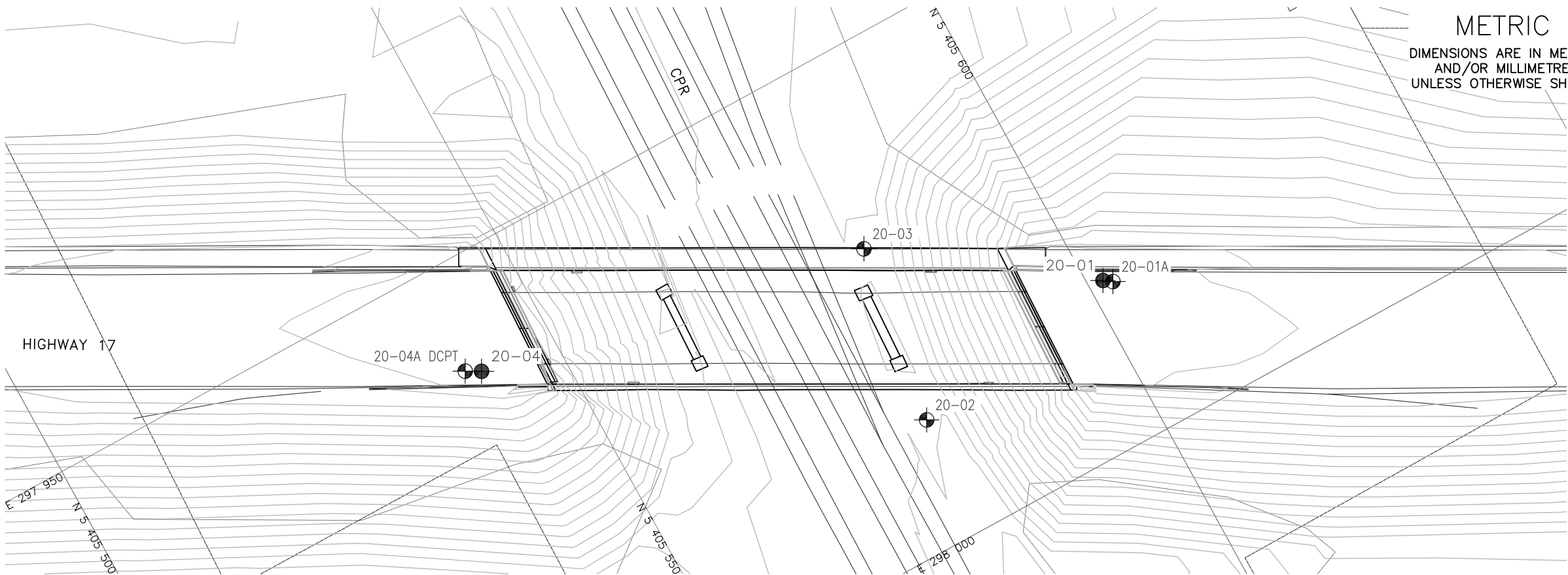


**Photo C9: CPR tracks looking west from south pier. (Date taken: December 11, 2020)**



## **Appendix D**

### **Borehole Locations and Soil Strata Drawings**



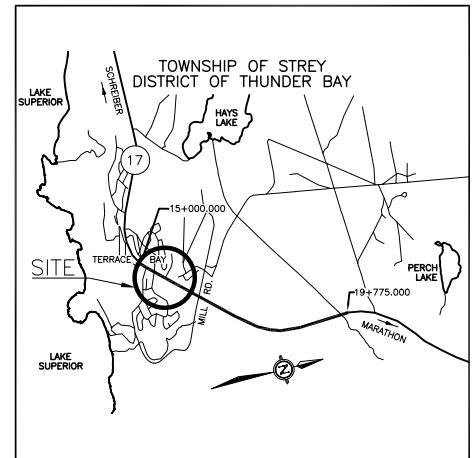
METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
WP No 6113-17-01

HIGHWAY 17  
REPLACEMENT OF CPR  
OVERHEAD AT TERRACE BAY  
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET



KEYPLAN

LEGEND

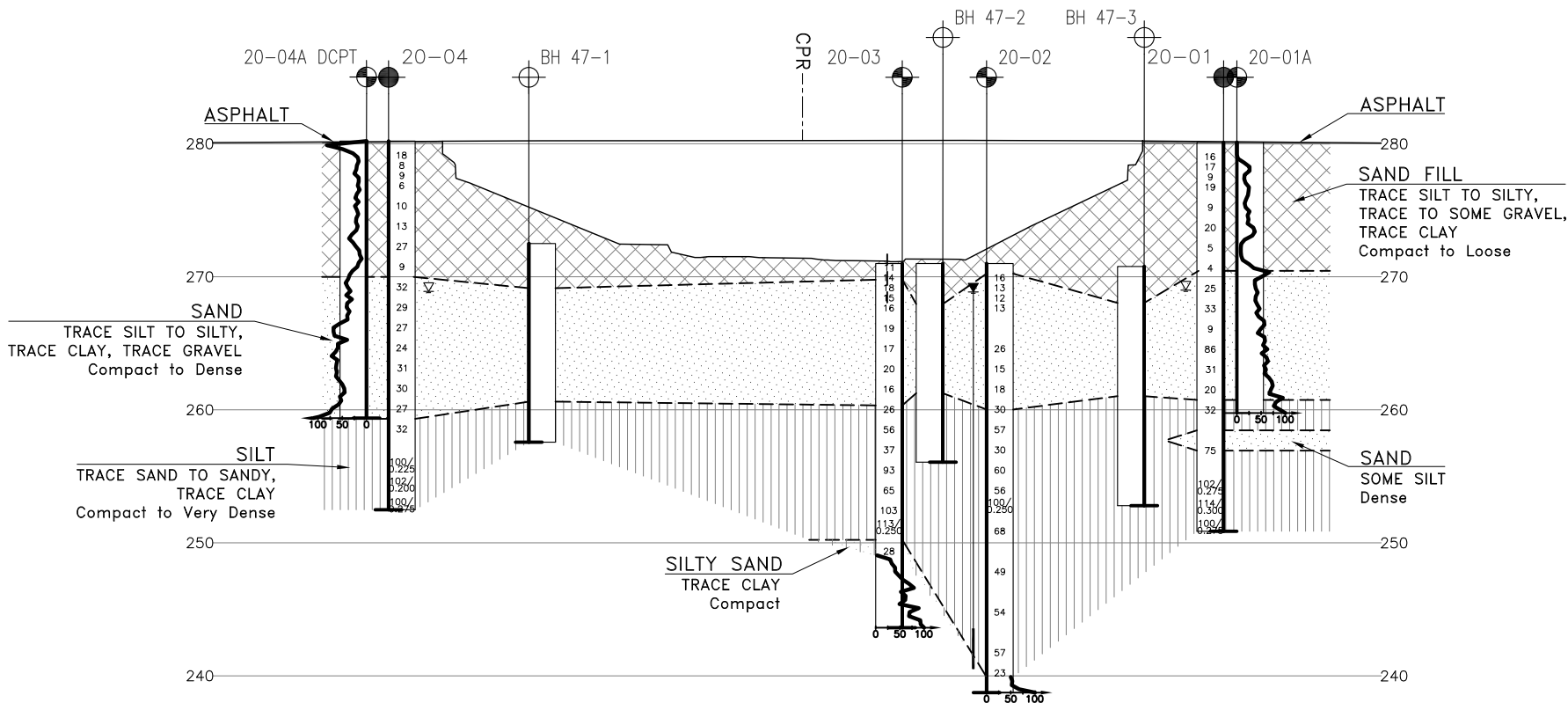
- Borehole
- Borehole and Cone
- Archival Borehole - circa 1947
- N
- Blows /0.3m (Std Pen Test, 475J/blow)
- CONE
- Blows /0.3m (60' Cone, 475J/blow)
- PH
- Pressure, Hydraulic
- Water Level During Drilling
- Water Level In Piezometer
- 90%
- Rock Quality Designation (RQD)
- A/R
- Auger Refusal

NO	ELEVATION	NORTHING	EASTING
20-01	280.1	5 405 601.5	297 983.7
20-01A	280.1	5 405 602.4	297 984.3
20-02	271.0	5 405 579.1	297 987.5
20-03	271.2	5 405 581.9	297 969.3
20-04	280.2	5 405 542.1	297 961.6
20-04A DCPT	280.1	5 405 540.6	297 960.7

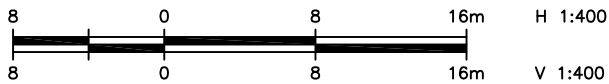
-NOTES-

- 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. 42D-61



PROFILE ALONG HWY 17

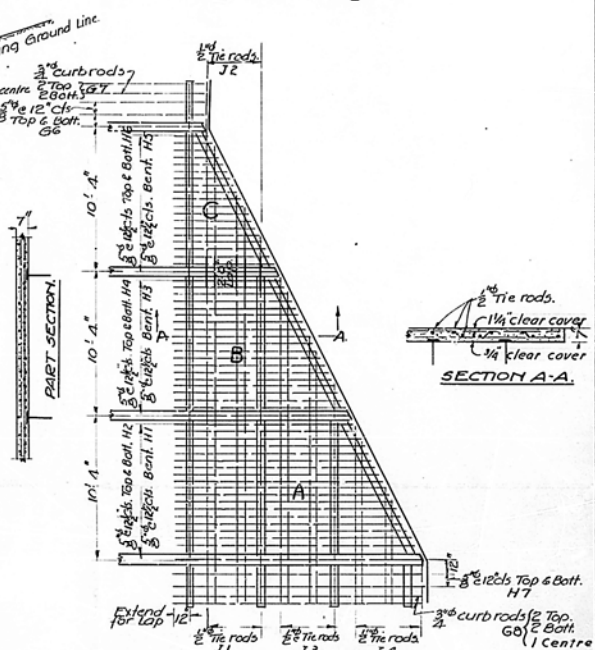
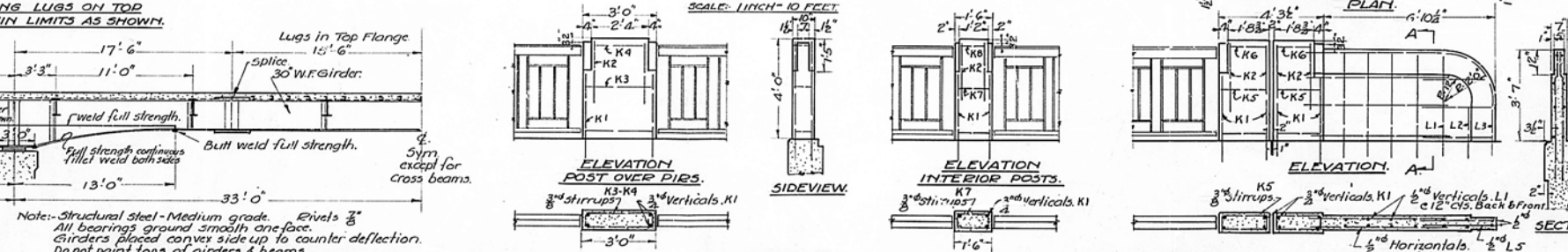
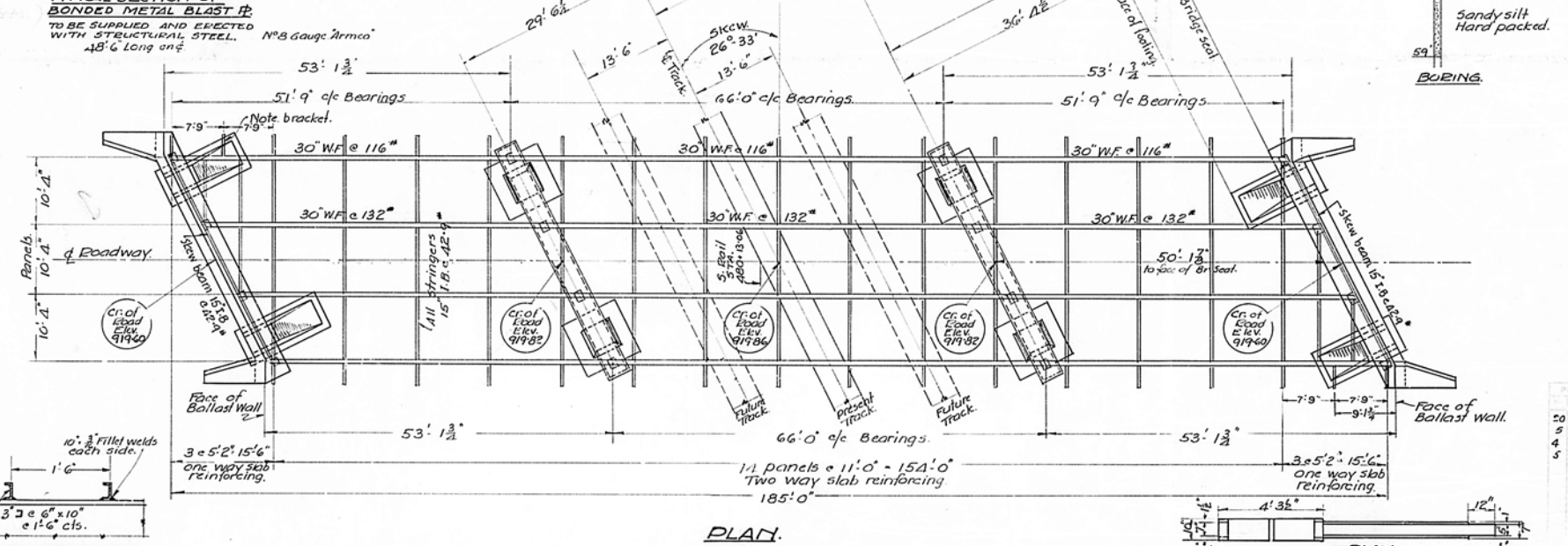
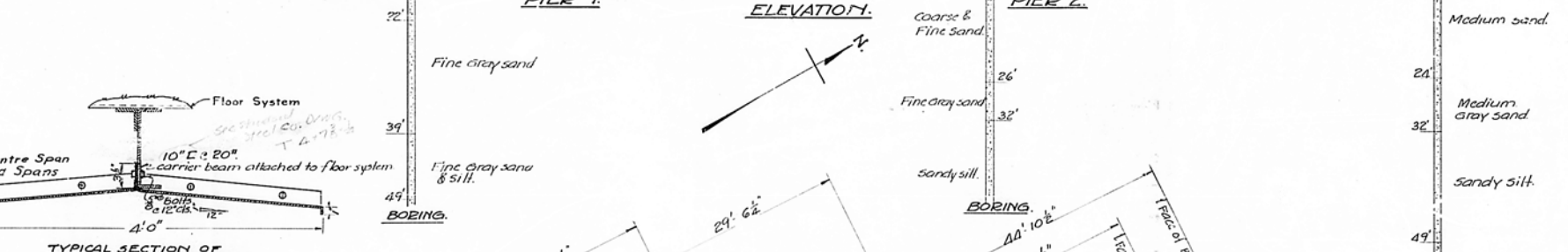
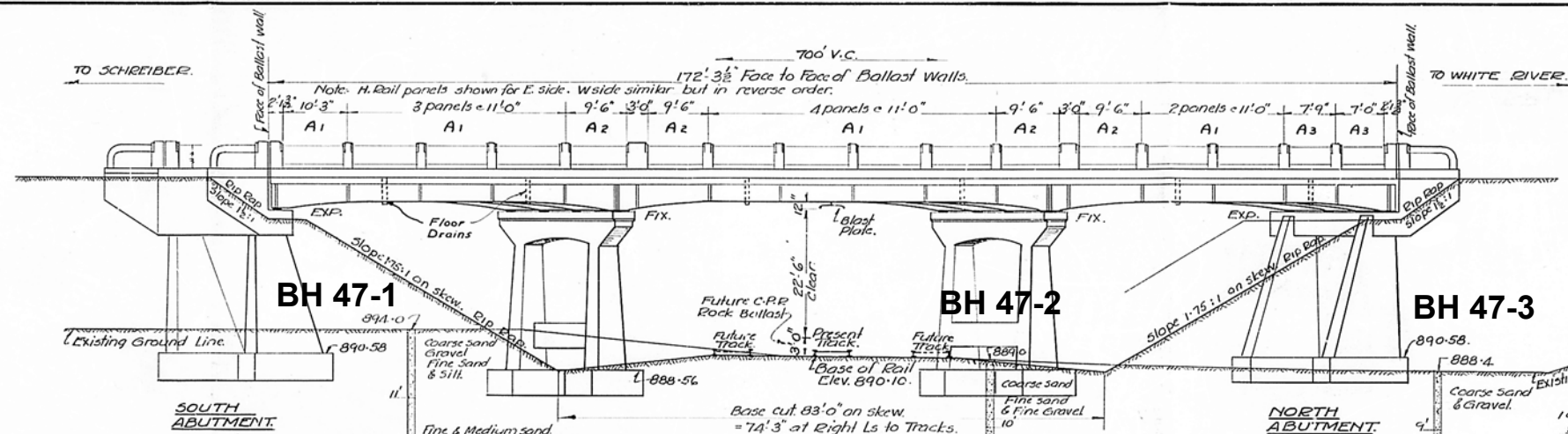


REVISIONS	DATE	BY	DESCRIPTION
DESIGN	JA	CHK MF	CODE
DRAWN	BH	CHK PKC	SITE 48E-0018/B0
LOAD	DATE	SEP 2021	DWG 1



## **Appendix E**

**1947 Archival Drawing No. D2942**



**NOTE FOR CONTRACTOR.**  
Structure to be built in accordance with D.H.O. General Specifications for Highway Bridges 1935 Form No. 9, and the "Special Specifications" as given in the "Information to Bidders" sheet, additional copies of which may be obtained from the Division engineer.

1/47 CONCRETE MIX. Footings 1: 2: 4  
All other concrete 1: 1 3/4: 3 1/2  
with 1 lb of Pozzolite per bag of cement.

NOV/17/21	WV	1/4 EXTRA COVER UNDERSIDE OF DECK, CENTRE SPAN
NOV/17/21	WV	COLLISION STRUT ON PIPE3
DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS, ONTARIO.  
BRIDGE OFFICE.

OVERHEAD GRADE SEPARATION  
BETWEEN THE  
CANADIAN PACIFIC RAILWAY  
AND  
REVISION OF THE KING'S HIGHWAY #17.  
AT TERRACE BAY TOWNSITE  
SCHREIBER TO WHITE RIVER DIV. NO 19.  
TWR. NO 83. DISTRICT OF THUNDER BAY.

GENERAL PLAN.

APPROVED.  
*Arthur J. French*  
Chief Bridge Engineer.

-----  
Chief Engineer.

Design	check	Loading	CONTRACTS
		H20.	CONCR. WORK 47-95
			STRUCT. STEEL 47-102
		TORONTO.	DWG NO
		06/14-21-1957	06/14-21-1957
			D2942
			SHEET
			1-