## **Subsurface Investigation Report**

Enbridge Line 5 Reroute
MP 14 HDD Crossing – Brunsweiler River
Location 21-C, East of Van De Bruggen Rd., South of County Rd. C
Location 22-C, East of Van De Bruggen Rd., South of County Rd. C
Location 23-C-3, West of Hanninen Rd., South of County Rd. C
Location 25-C, West of Hanninen Rd., South of County Rd. C
Town of Marengo, Ashland County, Wisconsin

Prepared for

## **Enbridge Energy**

### **Professional Certification:**

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly licensed Professional Engineer under the laws of the State of Wisconsin.

Joseph C. Butler, PE

Business Unit Manager / Senior Engineer

License Number: E-43286-6

August 21, 2020

Project B2001991

**Braun Intertec Corporation** 





**Braun Intertec Corporation** 4511 West First Street, Suite 4 Duluth, MN 55807 Phone: 218.624.4967 Fax: 218.624.0196 Web: braunintertec.com

August 21, 2020

Project B2001991

David E. Morrison

**Project Consultant** 

Mr. Adam Erickson Enbridge Energy, Limited Partnership Manulife Place, 10180-101 Street Edmonton, AB T5J 3S4

Re: Subsurface Investigation

Enbridge Line 5 Reroute

MP 14 HDD Crossing – Brunsweiler River

Location 21-C, East of Van De Bruggen Rd., South of County Rd. C Location 22-C, East of Van De Bruggen Rd., South of County Rd. C Location 23-C-3, West of Hanninen Rd., South of County Rd. C Location 25-C, West of Hanninen Rd., South of County Rd. C

Town of Marengo, Ashland County, Wisconsin

Dear Mr. Erickson:

We are pleased to present this Subsurface Investigation Report for the Line 5 Reroute Project at the MP 14 HDD Crossing under Brunsweiler River in Town of Marengo, Ashland County, Wisconsin.

Thank you for making Braun Intertec your geotechnical consultant for this project. If you have questions about this report, or if there are other services that we can provide in support of our work to date, please contact Kyle Warmuth (<a href="mailto:kwarmuth@braunintertec.com">kwarmuth@braunintertec.com</a>) or David Morrison (<a href="mailto:kmarmuth@braunintertec.com">kmarmuth@braunintertec.com</a>) at 218.624.4967.

Sincerely,

BRAUN INTERTEC CORPORATION

Kyle P. Warmuth Staff Consultant

Joseph C. Butler, PE

Business Unit Manager / Senior Engineer

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### **Appendix**

Log of Boring Sheets 21-C, 22-C, 23-C-3, 25-C

**HDD Alignment Profile** 

Descriptive Terminology of Soil
Descriptive Terminology of Rock
Geotechnical Testing Reports: 320970

Moisture Content Test Reports: 312751 through 312754, 314651, 318222, 318227, and 318228

Sieve Analysis Reports: 312751 through 312754, 314651, 318222, 318227, and 318228

Hydrometer & Sieve Analysis Reports: 320990, 320991

Compressive Strength of Cores: 6A & 6B 21-C, 22-C, Set 7A & 7B 23-C-3, 25-C

### A. Introduction

## A.1. Project Description

Enbridge Energy plans to relocated Line 5 around the Bad River Indian Reservation, as part of that project, a geotechnical investigation and evaluation is being completed. We are providing subsurface investigation surfaces as part of this effort.

This report provides a factual data obtained at Borehole Locations 21-C, 22-C, 23-C-3, and 25-C for the HDD crossing under Brunsweiler River which is located at MP 14 in the proposed pipeline alignment in Town of Marengo, Ashland County, Wisconsin.

### A.2. Purpose

The purpose of our subsurface investigation is to characterize subsurface geologic conditions at the selected exploration location.

## A.3. Background Information and Reference Documents

We reviewed the following information:

- Wisconsin Geologic Map, "Soils of Wisconsin", prepared by F. D. Hole, M.T Beatty, C.J.
   Milfred, G.B. Lee, and A.J Klingelhoets, dated 1968.
- "Bedrock Geologic Map of Wisconsin", prepared by M.G. Mudrey, Jr., B.A. Brown, and J.K. Greenberg, dated 1982.
- "Rock Mechanics Properties of Typical Foundation Rock Types", prepared by J.R. Brandon, dated July 1974.
- Aerial photos from Google Earth Pro©.

## A.4. Scope of Services

We performed our scope of services for the project in accordance with our Quote to Mr. Jonathan Underland of Enbridge Energy, under the terms of the Work Order (132013839) provided by Enbridge Energy. The following list describes the geotechnical tasks completed in accordance with our authorized scope of services.

- Reviewing the background information and reference documents previously cited.
- Lake Superior Consulting selected and staked the boring location and we cleared the
  exploration location of underground utilities. The Soil Boring Location Sketch included in the
  Appendix shows the approximate location of the boring.
- Performing four (4) standard penetration test (SPT) borings with coring, denoted as 21-C, 22-C, 23-C-3, and 25-C to nominal depths ranging from 107 to 178 feet below grade across the site.
- Performing laboratory testing on select samples as selected by Lake Superior Consulting.
- Preparing this report containing a boring location sketch, an exploration log, laboratory tests, a summary of the geologic materials encountered.

Our scope of services did not include environmental services or testing and our geotechnical personnel performing this evaluation are not trained to provide environmental services or testing. We can provide environmental services or testing at your request.

### B. Results

### **B.1.** Geologic Overview

We based the geologic origins used in this report on the soil types, in-situ and laboratory testing, and available common knowledge of the geological history of the site. Because of the complex depositional history, geologic origins can be difficult to ascertain. We did not perform a detailed investigation of the geologic history for the site.



## **B.2.** Geologic Materials

#### B.2.a. Soil and Bedrock Encountered

The general geologic profile of the soils encountered between the four (4) borings consisted (proceeding down from the ground surface) of 1 1/2 to 4 feet of silty sand in borings 22-C and 25-C, underlain by layers of lacustrine (lake deposited) and glacial deposits. The soils contained in the layers consisted of silty sands, poorly graded sands with silt, fat clay, lean clay, silty clayey sand, silty clay with sand, and silts to the termination depth of each boring, the encountered soils contained variable amounts of gravel. Table 1 in section B.3 contains more information on each material encountered.

#### B.2.b. Bedrock

Below the glacial deposits, the boring encountered bedrock extending from an approximate elevation ranging between of 773 to 729 feet to the termination depth of the boring. The bedrock generally consisted of gray with red conglomerate associated with the Freda Sandstone formation. The conglomerate was generally classified as "moderately fractured" to "highly fractured". The rock was deemed as "very soft" to "hard" in terms of the rock hardness scale and ranged from "decomposed" to "slightly weathered".

## **B.3.** Estimated Soil Properties

Estimated soil properties for each significant strata change are presented below in Table 1.

**Table 1: Estimated Soil Properties** 

Soil Strata and Elevations (ft)	Soil and Rock Type	Blow Count per foot Range (BPF)	Dry Unit Weight Range (pcf)	Undrained Unit Weight Range (pcf)	Drained Friction Angle Range (degrees)	Undrained Friction Angle (degrees)	Undrained Cohesion Range (ksf)	Drained Cohesion Range (ksf)	Modulus of Elasticity Range* (tsf)
	Silty Sand (SM)	3 - 13	107 - 115	110 - 118	27 - 30	5 - 15	0.5 – 1.0	0.1 – 1.35	17 - 91
Upper Soils	Sandy Silt (ML)	9 - 21	93 - 101	112 - 122	26 - 31	29 - 31	0	0	36 - 91
(844 to 773)	Sandy Lean Clay (CL)	3	100 - 115	115 - 120	25	0	0.25 – 0.5	0.2 - 0.4	12 - 17
	Silty Clay with Sand (CL-ML)	14 - 15	100 - 115	115 - 117	25	0	2.0 – 3.6	1.1 – 2.1	56 - 86



Soil Strata and Elevations (ft)	Soil and Rock Type	Blow Count per foot Range (BPF)	Dry Unit Weight Range (pcf)	Undrained Unit Weight Range (pcf)	Drained Friction Angle Range (degrees)	Undrained Friction Angle (degrees)	Undrained Cohesion Range (ksf)	Drained Cohesion Range (ksf)	Modulus of Elasticity Range* (tsf)
	Poorly Graded Sand with Silt (SP-SM)	11 - 44	92 - 104	112 - 127	32 - 40	32 - 36	0	0	77 – 317
	Silty Clayey Sand (SC- SM)	13 - 57	105 - 115	117 - 130	30 - 37	15 – 25	1.0 – 2.5	0.9 – 4.1+	52 - 246
	Silty Fat Clay (CH)	1 - 11	66 - 74	100 - 112	15 - 22	0	0.1 - 1.8	0.15 – 1.0	4 - 63
	Silt with Sand (ML)	16 - 66	100 - 108	118 - 127	30 - 36	30 - 35	0	0	64 - 285
	Lean Clay with Sand (CL)	5 - 50 blows per 4 inches of penetration	95 - 107	120 - 135	26 - 35	0 - 10	0.75 - 10	0.5 – 6.1+	20 - 288
	Silty Sand (SM)	23 - 50 blows per 3 inches of penetration	104 - 113	120 - 130	32 - 37	25	1.5 – 2.5	2.0 – 4.1+	132 - 350
	Silty Sand (SM)	14 - 50 blows per 1 inches of penetration	115 - 120	118 - 130	31 - 37	20 - 25	1.25 – 2.5	1.4 – 4.1+	81 - 350
Middle Soils (780	Silt (ML)	21 - 29	100 - 120	120 - 125	31 - 33	31 - 33	0	0	84 - 125
to 729 1/2)	Poorly Graded Sand with Silt (SP-SM)	4	100 - 105	105 - 110	30 - 31	30	0	0	28 – 29



Soil Strata and Elevations (ft)	Soil and Rock Type	Blow Count per foot Range (BPF)	Dry Unit Weight Range (pcf)	Undrained Unit Weight Range (pcf)	Drained Friction Angle Range (degrees)	Undrained Friction Angle (degrees)	Undrained Cohesion Range (ksf)	Drained Cohesion Range (ksf)	Modulus of Elasticity Range* (tsf)
	Silty Clayey Sand (SC- SM)	13 - 40	105 - 115	117 - 130	30 - 37	15 - 25	1.0 – 2.5	0.9 – 4.1+	52 - 173
	Poorly Graded Gravel with Sand (GP)	16 - 21	110 - 114	122 - 127	35 - 38	33 - 34	0	0	184 - 252
	Lean Clay with Sand (CL)	63 blows per 10 inches of penetration	100 - 125	133 - 135	33 - 35	10	10	6.1+	252 - 363
Bedrock (773 to 666)	Cong. **	N/A	120 - 130	130 - 135	42 - 45	43	0	0	93,600 - 100,800

<sup>\*</sup>Sustained Young's Modulus values

### **B.4.** Groundwater

We encountered groundwater at depths ranging from 7 to 11 below the ground surface in borings 21-C, 23-C-3, and 25-C while advancing the borings.

We did not observe groundwater while advancing borings 22-C. Groundwater may take days or longer to reach equilibrium in the boreholes and we immediately backfilled the boreholes, in accordance with our scope of work.

Project planning should anticipate seasonal and annual fluctuations of groundwater. Mud-rotary drilling techniques were used to advance the borings, hindering the ability to observe groundwater.



<sup>\*\*</sup>Conglomerate

## **B.5.** Laboratory Test Results

The boring logs show the results of the hydrometer with sieve analysis, moisture testing, soil density testing, Atterberg limits, unconfined compressive strength of soil, compressive strength of cores that were requested. The Appendix contains the results of these tests.

### C. Procedures

## **C.1.** Penetration Test Borings

We drilled the penetration test borings with a float tire-mounted core and auger drill equipped with hollow-stem auger. We performed the borings in general accordance with ASTM D6151 taking penetration test samples at 2 1/2- or 5-foot intervals in general accordance to ASTM D1586. We collected thin-walled tube samples in general accordance with ASTM D1587 at selected depths. The boring logs show the actual sample intervals and corresponding depths. We also collected bulk samples of auger cuttings at selected locations for laboratory testing.

### C.2. Rock Cores

We performed rock cores with an NQ-3 core barrel. First, we lowered the bit and casing to the bottom of the previously advanced borehole. Then we lowered the core barrel into the casing with a wire line, and locked into place. We advanced the bit and barrel by rotating the assembly while applying crowd pressure. We used bentonite-drilling mud to cool the bit and wash cuttings to the surface. Our drillers noted bit pressure, rate of advance, fluid pressure and fluid return as coring progressed. They also noted intervals with a rapid rate of advance, a sudden loss of fluid pressure or return and intervals with a loss of bit pressure.

After completing each 5-foot core run, the drillers unlocked the core barrel from the bit and brought the barrel to the surface. They then extruded the split inner tube from the barrel and opened the tube to reveal the core sample. After field classification and logging, the drillers packed the core into a cardboard storage box, arranged into 2-foot long sections.



## C.3. Exploration Logs

### C.3.a. Log of Boring Sheets

Log of Coring sheets follow the logs of the penetration test borings through which we performed rock coring. The logs identify and describe rock lithology, weathering, hardness, bedding and fracture characteristics, and other features. The logs also report the bit pressure, rate of advance, and water pressure and return (if applicable) recorded during the coring process. The percent recovery and rock quality designation (RQD) for each 5-foot core run is also shown.

We inferred strata boundaries from changes in lithology along the length of the core sample. Due to natural and mechanical fractures, destruction of the rock fabric during coring, and limited recovery, it is difficult to place the core sample in the geologic profile; the strata boundary depths in the rock are also approximate, and likely vary from the core locations.

### C.3.b. Logs of Coring

We performed rock cores with an NQ-3 core barrel. First, we lowered the bit and casing to the bottom of the previously advanced borehole. Then we lowered the core barrel into the casing with a wire line, and locked into place. We advanced the bit and barrel by rotating the assembly while applying crowd pressure. We used bentonite-drilling mud to cool the bit and wash cuttings to the surface. They noted intervals with a rapid rate of advance.

After completing each 5 to 10-foot core run, the drillers unlocked the core barrel from the bit and brought the barrel to the surface. They then extruded the split inner tube from the barrel and opened the tube to reveal the core sample. After field classification and logging, the drillers packed the core into a cardboard storage box, arranged into 2-foot long sections.

### C.3.c. Geologic Origins

We assigned geologic origins to the materials shown on the logs and referenced within this report, based on: (1) a review of the background information and reference documents cited above, (2) visual classification of the various geologic material samples retrieved during the course of our subsurface exploration, (3) penetration resistance and other in-situ testing performed for the project, (4) laboratory test results, and (5) available common knowledge of the geologic processes and environments that have impacted the site and surrounding area in the past.



## C.4. Material Classification and Testing

#### C.4.a. Visual and Manual Classification

We visually and manually classified the geologic materials encountered based on ASTM D2488. When we performed laboratory classification tests, we used the results to classify the geologic materials in accordance with ASTM D2487. The Appendix includes a chart explaining the classification system we used.

### C.4.b. Laboratory Testing

The exploration logs in the Appendix note most of the results of the laboratory tests performed on geologic material samples. The remaining laboratory test results follow the exploration logs. We performed the tests in general accordance with ASTM or AASHTO procedures.

### C.5. Groundwater Measurements

The drillers checked for groundwater while advancing the penetration test borings, and again after auger withdrawal. We then filled the boreholes, as noted on the boring logs.

## D. Qualifications

### **D.1.** Variations in Subsurface Conditions

### D.1.a. Material Strata

We developed our evaluation, analyses and recommendations from a limited amount of site and subsurface information. It is not standard engineering practice to retrieve material samples from exploration locations continuously with depth. Therefore, we must infer strata boundaries and thicknesses to some extent. Strata boundaries may also be gradual transitions, and project planning should expect the strata to vary in depth, elevation and thickness, away from the exploration locations.

Variations in subsurface conditions present between exploration locations may not be revealed until performing additional exploration work, or starting construction. If future activity for this project reveals any such variations, you should notify us so that we may reevaluate our recommendations. Such variations could increase construction costs, and we recommend including a contingency to accommodate them.



#### D.1.b. Groundwater Levels

We made groundwater measurements under the conditions reported herein and shown on the exploration logs, and interpreted in the text of this report. Note that the observation periods were relatively short, and project planning can expect groundwater levels to fluctuate in response to rainfall, flooding, irrigation, seasonal freezing and thawing, surface drainage modifications and other seasonal and annual factors.

### D.2. Continuity of Professional Responsibility

### D.2.a. Plan Review

We based this report on a limited amount of information, and we made a number of assumptions to help us develop our recommendations. We should be retained to review the geotechnical aspects of the designs and specifications. This review will allow us to evaluate whether we anticipated the design correctly, if any design changes affect the validity of our recommendations, and if the design and specifications correctly interpret and implement our recommendations.

### D.2.b. Construction Observations and Testing

We recommend retaining us to perform the required observations and testing during construction as part of the ongoing geotechnical evaluation. This will allow us to correlate the subsurface conditions exposed during construction with those encountered by the borings and provide professional continuity from the design phase to the construction phase. If we do not perform observations and testing during construction, it becomes the responsibility of others to validate the assumption made during the preparation of this report and to accept the construction-related geotechnical engineer-of-record responsibilities.

### D.3. Use of Report

This report is for the exclusive use of the addressed parties. Without written approval, we assume no responsibility to other parties regarding this report. Our evaluation, analyses and recommendations may not be appropriate for other parties or projects.



## D.4. Standard of Care

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.







The Science You Build On	See Descriptive Terminology sheet for explanation of abbreviations BORING: 21-C					
Project Number B2001991 Geotechnical Evaluation	LOCATION: See attached sketch					
Enbridge Line 5 Re-Route	ECOATION. See allaoned skelon					
Various Locations						
Ashland and Iron Counties, Wisconsin	LATITUDE: 46.40544 LONGITUDE: -90.81643					
DRILLER: EPC LOGGED BY: A. Hillerud	START DATE: 05/14/20 END DATE: 05/14/20					
SURFACE ELEVATION: 844.0 ft RIG: Subcontractor METHOD: 4 1/4" HSA	SURFACING: WEATHER:					
Elev./ Depth ft Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Blows (N-Value) q <sub>p</sub> MC (N-Value) tsf % Tests or Remarks					
SILTY SAND (SM), fine-grained, brown, moist (GLACIAL TILL)  839.5  4.5  SANDY SILT (ML), fine-grained, trace Gravel, brown, moist to wet, loose to medium dense (GLACIAL TILL)  10  830.0  POORLY GRADED SAND with SILT (SP-SM), fine-grained, trace Gravel, brown, moist to wet, medium dense (GLACIAL TILL)	1-1-2-4 (3) 24" 4-7-6-9 (13) 16" 3-9-9-11 (18) 18"  4-10-11-14 (21) 24"  3-7-8-12 (15) 24"  2-4-5-7 (9) 24"  2-5-6-7 (11) 24"  Drilling method switched to mud rotary at 15 feet					
medium dense to dense (GLACIAL TILL)  20  25  Continued on next page	7-14-16 (30) 18"  16-21-23 (44) 18"  22 Test results are in the attached lab report					



Project Nu		S	See Descriptive Terminology sheet for explanation of abbreviations BORING: 21-C						
	mber B2001991 cal Evaluation			o attached akate					
	ine 5 Re-Route		LUCATION: Se	ee attached sketo	Л				
Various Lo									
	nd Iron Counties, Wiscon	sin	LATITUDE:	46.40544	LONGITUDE: -90.81643				
DRILLER:	EPC LOGGED BY:	A. Hillerud	START DATE:	05/14/20	END DATE: 05/14/20				
SURFACE ELEVATION:	844.0 ft RIG: Subcontractor	METHOD: 4 1/4" HSA	SURFACING:	WEATHER:					
Elev./ Depth Reverse ft	Description of Ma (Soil-ASTM D2488 or 2487; 1110-1-2908	Rock-USACE EM   호	Blows (N-Value) Recovery	q <sub>p</sub> MC tsf %	Tests or Remarks				
- - - - - - - - - - - - - - - - - - -	POORLY GRADED SAND w fine-grained, trace Gravel, bi medium dense to dense (GL	rown, moist to wet,	9-18-23 (41) 18"						
38.0	SILT with SAND (ML), brown dense to very dense (GLACI		5-10-12 (22) 18"						
- - - - - - - -		45	7-11-24 (35) 18"						
- - - - - - - -		50	27-31-35 (66) 18"	21	Test results are in the attached lab report				
- - - - - - -		55 —	10-8-8 (16) 18"						
786.0 - 58.0 	SILTY CLAY (CH), with Sand (GLACIAL TILL)	I, brown, wet, stiff	3-5-6 (11) 18"						
781.0 63.0	/// SILTY SAND (SM), fine to m	edium-grained,							
	Continued on ne	ext page							



Project		er B20019	991		See Descriptive Terminology sheet for explanation of abbreviations  BORING:  21-C							
_		Evaluatio					LOCATION: See attached sketch					
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Various			41 1821									
Ashland	and I	ron Coun	ties, Wiscon	sin		LA	LATITUDE: 46.40544 LONGITUDE: -9				-90.81643	
DRILLER:		EPC	LOGGED BY:	<b>A</b> . H	lillerud	S	START DATE: 05/14/20 END DATE:				05/14/20	
SURFACE ELEVATION:	844.	0 ft RIG:	Subcontractor	4 1/4" HSA	SI	JRFACIN	G:	I	WEATH	HER:		
Elev./ Depth ft	Water Level	(Soil-ASTN	Description of Ma I D2488 or 2487; 1110-1-2908	(N-	Blows (N-Value) q <sub>P</sub> MC Kecovery tsf MC Tests			ests or	Remarks			
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		5,	ts are in the attach	ned lab report		0	100					Run 2 MOH's 3
77.5 - 		FREDA SA with red, sli	NDSTONE, CONG ghtly weathered, r d to medium-grain	GLOMERATE, of moderately hard	d,	70	100					Run 3 MOH's 3
		moderately	fractured		80 —	90	100					Run 4 MOH's 3
80.5 - 761.5		with red, m hard, fine-g	NDSTONE, CONG oderately weather prained to medium	ed, moderately		20	100					Run 5 MOH's 3
82.5 -  - 		FREDA SA with red, sli fine-grained	ghly fractured NDSTONE, CONG ghtly weathered, r d to coarse-graine	moderately hard	d,	25	60					Run 6 MOH's 3
_ _ _ _ _ 755.9		highly fract	ureu			55	100					Run 7 MOH's 3
755.9 _ 88.1 _ _		with red, sli fine-grained	NDSTONE, CONG ghtly weathered, r d to coarse-graine	noderately hard	ď.	80	100					Run 8 MOH's 3
- - - - - - - -		highly fract	ured ts are in the attach	ned lab report	95 —	40	100					Run 9 MOH's 3
748.5 95.5		3			95				200			
P2001001		(	Continued on ne	xt page		RQD 9	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Water Return %	Remarks



										See Descriptive Terminology sheet for explanation of abbreviations						
Project Number B2001991 Geotechnical Evaluation									BORING: 21-C							
							LO	CATION	See attac	ched sketo	ch					
	ge Line 5 l Location		ute													
		_	ties, Wiscon	sin			LAT	ITUDE:	46	40544	LONGI	TUDE:	-90.81643			
DRILLER:		PC	LOGGED BY:	A. Hill	orud			ART DAT								
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ELEVATION:	844.0 ft	RIG:	Subcontractor		1/4" HSA	١	SUI	RFACIN	G:		WEATH	IER:				
Elev./ Depth ft	Water Level	Soil-ASTN	Description of Ma I D2488 or 2487; 1110-1-2908	Rock-USACE EM	И	Sample	RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Water Return %	Remarks			
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- - - - -	FI O o fir	th red, sli e-grained ghly fract	NDSTONE, CONghtly weathered, and to coarse-graine	moderately hard, d, thick bedded,			70	100					MOH's 3			
733.5 110.5 		th red, sli	NDSTONE, CON ghtly weathered, i d to coarse-graine	moderately hard,	ay _		65	100	-				Run 15 MOH's 4			
- - - -		ghly fract		-,			50	100					Run 16 MOH's 3			
					115 — —								Run 17 MOH's 3			
- - - - -					120 —		50	100								
723.5 120.5 - -	wi ເລື່ອ fir	th red, sli e-graine	NDSTONE, CONdightly weathered, id to coarse-graine	moderately hard,	ay _				_				Run 18 MOH's 3			
 - 		•	fractured ts are in the attach	ned lab report	-		70	100								
718.5 125.5 - _		th red, sli	NDSTONE, CONoghtly weathered, indicate to coarse-graine	moderately hard,	-				_				Run 19 MOH's 3			
<u> </u>	٥٠٠٠٥		Continued on ne		· ———											
			Continued on the	nt page				ļ								



	The science for sino Oil										See Descriptive Terminology sheet for explanation of abbreviations						
Project Number B2001991 Geotechnical Evaluation										BORING: 21-C							
								LO	CATION:	See attac	ched sket	ch					
Enbridg				te													
Various					-:												
Ashland	and	Iron	Count	ies, Wiscon	sın			LAT	TTUDE:	46	.40544	LONGI	TUDE:	-90.81643			
DRILLER:		EPC		LOGGED BY:	Α	. Hillerud		STA	ART DAT	E:	05/14/20	END D	ATE:	05/14/20			
SURFACE ELEVATION:	84	4.0 ft	RIG:	Subcontractor	METHOD:	4 1/4" H	SA	SUI	RFACING	<b>3</b> :		WEATH	HER:				
Elev./				Description of Ma			Ф		چ	D 0	ē	. <u>e</u>					
Depth	Water Level	(So	il-ASTM	D2488 or 2487; 1110-1-2908		EEM	Sample	RQD %	Recovery %	Drilling Rate (min/ft)	Bit sssu psi)	Water Pressure (psi)	/ater	Remarks			
ft	≶ ⊐			1110-1-2900	·)		Sa	"	Rec	֓֞֞֜֞֜֞֜֞֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓	Bit Pressure (psi)	P. P.	'> œ				
_	Ö.			IDSTONE, CON													
-	jo j	ig with	red, slig -arained	htly weathered, i to coarse-graine	moderately had medium be	ard, edded		30	100								
-		high	ly fractu	red	a, mediam b	130								D 00			
_		Ö.				-								Run 20 MOH's 3			
_						-		30	90								
F																	
F						-	$-\Pi$	40	00					Run 21 MOH's 3			
_						135	_	40	90					MOnss			
_							_	0	100					Run 22			
_						-		U	100					MOH's 3			
_		Ö				_								Run 23 MOH's 3			
-	j.,	ن						45	100								
F		Ö				440											
703.5 140.5	0.0	ੂੰ ਨੂੰ	DA SAN	IDSTONE, CON		140 -	-							Run 24			
140.5 -				ihtly weathered, i										MOH's 3			
-				to coarse-graine	d, thick bedd	ed,		55	100								
700.5				fractured are in the attach	ned lab repon	t								D 05			
143.5 _		FRE	DA SAN	IDSTONE, CON	GLOMERATE	E, gray		15	100					Run 25 MOH's 3			
<sup></sup> 698.5		with ine-	red, slig -arained	htly weathered, i to coarse-graine	moderately had medium be	ard, 145- edded —		10	100								
145.5		ö∖high	ıly fractu	red		-								Run 26 MOH's 3			
F	Ď.			IDSTONE, CONderately weather			_	0	100					WOTTS			
_		ু harc	d, fine-gr	ained to medium			-							Run 27			
_		ূ bed	ded, high	nly fractured		-	_	50	100					MOH's 3			
_						150	_	30	100								
_														Run 28			
_	20													MOH's 3			
-								30	100								
-																	
689.5		°°°		IDSTONE CON	OLOMEDATE									Run 29			
154.5 -		ু: with	red, slig	IDSTONE, CONG htly weathered, i	moderately h	ard,								I VIII Z J			
-		္ပြံ fine	-grained	to coarse-graine	d, thick bedd	ed,		35	100								
<u> </u>	0.3	nigh	ıly fractu	red		-											
		Ö Te	st results	are in the attach	ned lab repor	t ·	$\dashv$ H							Run 30			
F		્રી /ડે	, Journa	. L. o tilo attaol			-[ [	50	100								
		Ö.		Namatina and a second			_[ii										
			C	continued on ne	ext page												



Project Nu		BORING: 21-C												
Geotechni			•				ŀ	LOCATION: See attached sketch						
Enbridge L			<b>)</b>											
Various Lo														
Ashland a	nd Iron C	Countie	s, Wiscon	sin				LATITUDE: 46.40544				LONGITUDE: -90.81643		
DRILLER:	EPC		LOGGED BY:		A. Hillerud			START DATE: 05/14/20 END DATE:				05/14/20		
SURFACE ELEVATION:	844.0 ft	RIG: Su	bcontractor	METHOD:	4 1/4"	HSA		SURFACING: WEATHER:						
		Description of Materials												
Elev./ Mater H		I-ASTM D	2488 or 2487;   1110-1-2908	Rock-USA 3)		Sample	RQD	%	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Water Return %	Remarks
683.5 160.5  681.7	ຶ່ວ ວິລິ with ເ ວິລິ fine-ເ	red, slight	STONE, CONG ly weathered, r coarse-graine	moderately	hard,			0	100					Run 31 MOH's 3
162.3   	FREI with I medi	DA SAND red, highly ium-graine ured	STONE, CONO weathered, so ed, medium be	oft, fine-gra	ained to ly	——————————————————————————————————————	7	75	100					Run 32 MOH's 4
- - - - - - -	່ວ່າ ວ່າ with ເ ວິ່ງ fine-ເ	red, slight	STONE, CONG ly weathered, r coarse-graine d	moderately	hard,		7	70	100					Run 33 MOH's 3
- - - - - - -	Victorial Test	t results a	re in the attach	ned lab rep		70-	4	15	100					Run 34 MOH's 3
- 669.5 - 174.5 - 668.2 - 175.8	<u>ືວ∷ ື</u> with ເ ∫fine-g	red, slight grained to erately fra	STONE, CONO ly weathered, r medium-grain ctured END OF COF	moderately ed, thick be	hard,	75 —	g	95	100					Run 35 MOH's 3 Water observed at 11.0 feet while drilling.
- - - - -	Borir	ng then b	ackfilled with grout	cement/b		30 —								3
_ _ _ _														
- - -					18	35 — —								
- - - -					19	90 —								



Project Number B2001991		See Descriptive Terminology sheet for explanation of abbreviations BORING:  22-C					
Geotechnical Evaluation		LOCATION: See attached sketch					
Enbridge Line 5 Re-Route							
Various Locations							
Ashland and Iron Counties, Wiscon	sin	LATITUDE:	46.4052	7 LONG	GITUDE: -90.81324		
DRILLER: EPC LOGGED BY:	P. Moe	START DATE	: 05/06	6/20 END	DATE: 05/13/20		
SURFACE ELEVATION: 844.1 ft RIG: Subcontractor	METHOD: 4 1/4" HSA	SURFACING	:	WEAT	THER: sunny, windy		
Elev./ Depth ft  Description of Ma (Soil-ASTM D2488 or 2487; 1110-1-2908	Rock-USACE EM 출	Blows (N-Value) Recovery		C 6	Tests or Remarks		
FILL: SILTY SAND (SM), fine grained, trace organic, roots,  840.1  4.0  838.1  6.0  836.1  8.0  834.1  10.0  SANDY SILT (ML), fine to me brown, moist, stiff (LACUSTR ME) (LACUSTRINE)  POORLY GRADED SAND wiftine to medium-grained, brown, moist, stiff (LACUSTRINE)  FAT CLAY (CH), reddish brown to medium (LACUSTRINE)  FAT CLAY (CH), reddish brown to medium (LACUSTRINE)	edium-grained, RINE) 5—  ML), fine to st, medium  th SILT (SP-SM), rn, moist, medium	1-1-2-1 (3) 12" 2-3-3-3 (6) 14" 2-7-7-8 (14) 16" 3-8-7-8 (15) 14" 1-0-1-0 (1) WOH/12" 24"  TW 24" 0-0-1-1 (1) WOH/12" 24"  TW 24"	5		results are in the hed lab report		
	25 —	0-1-1-3 (2) WOH/6" 24"					
Continued on ne	30 —	TW 24"			ng method switched to rotary at 30 feet vall		



Project N	Number B20019	001	;	See Descriptive Terminology sheet for explanation of abbreviations BORING: 22-C							
	nical Evaluatio					LOCATION: See attached sketch					
	Line 5 Re-Ro				LOOKHON.	Joe alla	SHOU SKELL	<i></i>			
Various I	Locations										
Ashland	and Iron Coun	ities, Wiscon	sin		LATITUDE:	46	.40527	LONGITUDE:	-90.81324		
DRILLER:	EPC	LOGGED BY:	P. Mo	ре	START DATI	E:	05/06/20	END DATE:	05/13/20		
SURFACE ELEVATION:	844.1 ft RIG:	Subcontractor	METHOD: 4	1/4" HSA	SURFACING	SURFACING: WEATHER:					
Elev./ ja Depth fr ft	(Soil-ASTM	Description of Ma ID D2488 or 2487; 1110-1-2908	Rock-USACE EM	Sample	Blows (N-Value) Recovery	q <sub>p</sub> tsf	MC %	Tests or l	Remarks		
- - - - - - - - - - - - - - - - - - -	LEAN CLA	(CH), reddish brov (LACUSTRINE) Y with SAND (CL) own, moist, hard (	, fine to medium-	35 — 35 — 40 — 45 — 45 — 45	0-1-3-2 (4) WOH/6" 24" TW 24" 0-2-3-3 (5) WOH/6" 18"		26	Thinwall  Test results ar attached lab re			
- 791.1 - 53.0 	SILT with S	ID (SM), fine to mist, very dense (Gl	ACIAL TILL)	60	TW 24"  20-20-24-31 (44) 18"  16-28-43-49 (71) 20"			Thinwall			
		Continued on ne	ext page	$\dashv$							
B2001991		Commission of the	Braun Interte					22-	C nage 2 of 6		



The Science Y									Termino	ology sheet			of abbreviations
		r B20019					RING:			22-C	<del></del>		
	ge Line	Evaluatio 5 Re-Roi ons					LO	CATION:	See atta	iched sketo	ch		
Ashlan	d and Ir	on Coun	ties, Wiscon	sin			LA	TITUDE:	46	6.40527	LONGITU	IDE:	-90.81324
DRILLER:		EPC	LOGGED BY:	Р	P. Moe		ST	ART DAT	E:	05/06/20	END DAT	E:	05/13/20
SURFACE ELEVATION:	844.1	ft RIG:	Subcontractor	METHOD:	4 1/4"	HSA	SU	RFACING	3:		WEATHE	R:	sunny, windy
Elev./ Depth ft	Water Level	(Soil-ASTN	Description of Ma 1 D2488 or 2487; 1110-1-2908	Rock-USACE	EM	Sample	BI (N-\ Rec	ows /alue) overy	q <sub>p</sub> tsf	MC %	Tes	ts or F	Remarks
- - - - - - 776.1			AND (ML), fine to st, hard (GLACIAL			5 —	(	)-27-36 57) 20"		18	Test resu attached		
68.0     773.1  71.0			Y with SAND (CL) brown, moist, hare		,	0 —	(R	0/4" !EF) 4"			Auger me feet. Set		usal at 71 ng at 73 feet.
- - - - - -		with red, m hard, fine-g	NDSTONE, CONG oderately weather grained to medium ghly fractured	ed, moderatel	y ium	5—	0 20	40					Run 1 MOH's 4 Run 2 MOH's 4
766.6 77.5 - - - -		with red, hi	NDSTONE, CONG ghly weathered, rr d to coarse-graine ured	oderately hard	d, dded,	0-	20	90					Run 3 MOH's 4
					8	5—	40	60					Run 4 MOH's 4
					9		10	70					Run 5 MOH's 4
91.0		with red, m hard, fine-g bedded, hig	NDSTONE, CONG oderately weather grained to coarse-gally fractured	ed, moderatel grained, mediu	y um	5—	70	100				I	Run 6 MOH's 4
			Continued on ne	xt page			RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Water Pressure (psi)	ter Return	Remarks



The Science You Build On	Se	e Des	criptive	Terminol	ogy sheet			of abbreviations
Project Number B2001991		BOR	ING:			22-	·C	
Geotechnical Evaluation		LOC	ATION:	See attac	ched sketo	ch		
Enbridge Line 5 Re-Route								
Various Locations	-							
Ashland and Iron Counties, Wisconsin			TUDE:		.40527	LONGI		-90.81324
DRILLER: EPC LOGGED BY: P. Moe		STAF	RT DAT	E:	05/06/20	END D	ATE:	05/13/20
SURFACE ELEVATION: 844.1 ft RIG: Subcontractor METHOD: 4 1/4" HSA		SUR	FACING			WEATH	IER:	sunny, windy
Elev./ Depth ft  Description of Materials  (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	RØD	%	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Water Return %	Remarks
FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured	7	<b>'</b> 5	100					Run 7 MOH's 4
Total	9	95	100					Run 8 MOH's 4
FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, thick bedded, highly fractured  Test results are in the attached lab report	7	70	100					Run 9 MOH's 4
-	9	90	100					Run 10
116.0	5	55	100					Run 11 MOH's 4
	2	20	100					Run 12 MOH's 4
- 123.0  - 123.0  - 123.0  - 123.0  - 123.0  - 123.0  - 123.0  - 125.0  - 1	3	35	100					Run 13 MOH's 4
128.0 Continued on next page		$\neg$						



The Science Y		S	ee De	scriptive	e Terminol	ogy sheet			of abbreviations
	Number B2001991		BOF	RING:			22-0		
Enbridg	hnical Evaluation ge Line 5 Re-Route		LOC	:ATION:	See attac	hed sketo	ch		
	Locations d and Iron Counties, Wisconsin		LATI	ITUDE:	46.	40527	LONGIT	UDE:	-90.81324
DRILLER:	EPC LOGGED BY: P. Moe		STA	RT DAT	.E. (	05/06/20	END DA	TF·	05/13/20
SURFACE	844.1 ft RIG: Subcontractor METHOD: 4 1/4" HSA			RFACIN		30/00/20	WEATH		sunny, windy
ELEVATION:	D : (: CM ( : )		100.			4)			curry, windy
Elev./ Depth ft	Description of Materials  (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)		KQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	water Return %	Remarks
- - - - - - - - - - - - - - - - - - -	FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, — fine-grained to coarse-grained, thick bedded, highly fractured		70	100					Run 14 MOH's 4
133.0 - - - - - - - - - - 707.1	with red, fine-grained to coarse-grained, medium bedded, highly fractured		15	80					Run 15 MOH's 4
_ 137.0	FREDA SANDSTONE, CONGLOMERATE, gray		40	85					Run 16
- 706.1 - 138.0 	with red, moderately weathered, very soft, fine-grained, medium bedded, highly fractured FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, moderately hard, fine-grained to coarse-grained, thick bedded, highly fractured  Test results are in the attached lab report		75	100					MOH's 2 Run 17 MOH's 4
- - - - - - - - - - - - - - - - - - -	145—		35	75					Run 18 MOH's 4
	FREDA SANDSTONE, CONGLOMERATE, gray with red, highly weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured		15	100					Run 19 MOH's 4
	with red, slightly weathered, moderately hard, — fine-grained to coarse-grained, thick bedded, highly fractured  Test results are in the attached lab report  —		60	100					Run 20
_ 158.0  -	with red, moderately weathered, moderately hard, fine-grained to coarse-grained, thick  Continued on next page								Run 21 MOH's 4



Droioct		er B2001	001					Descriptiv	e remino	ogy snee	22.		of abbreviations
		Evaluatio							: See attac	shed sket		-0	
1		5 Re-Ro				'	.OUATION	. See alial	JIEU SKEL	JI I			
Various													
			nties, Wiscon	sin			L	.ATITUDE:	46	.40527	LONGI	TUDE:	-90.81324
DRILLER:		EPC	LOGGED BY:		P. Moe		5	START DA	 ГЕ:	05/06/20	END D	ATE:	05/13/20
SURFACE	844.1		Subcontractor	METHOD:	4 1/4"	HSA		SURFACIN			WEATI		sunny, windy
ELEVATION:		r it ir	Description of Ma		, .		$\top$		T	0		T	
Elev./ Depth ft	Water Level	(Soil-AST	M D2488 or 2487; 1110-1-2908	Rock-USAC	E EM	Sample	RQD	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Water Return %	Remarks
- - - - - 681.1		with red, n hard, fine-	ANDSTONE, CONG noderately weather grained to coarse-outlined ighly fractured	ed, modera	tely		40	100					
_ 163.0 		with red, s fine-graine moderatel	ANDSTONE, CONG lightly weathered, red to coarse-graine y fractured	moderately l d, massive,	hard, 16	65 —	70	100					Run 22 MOH's 4
676.1			Its are in the attach	<u> </u>	_				_				Run 23
168.0 		with red, s	ANDSTONE, CONG lightly weathered, red to coarse-graine	moderately l	hard,	70 — —	65	5 100					MOH's 4
173.0 - 173.0 		with red, s fine-graine moderatel	ANDSTONE, CONG lightly weathered, red to coarse-graine y fractured	moderately l d, massive,	hard, 17		70	100					Run 24 MOH's 4
_ 178.0			END OF COF	RING					1				Water not observed
		Boring the	en backfilled with grout	cement/be	18								while drilling.
D2001001					_							22	



Project N	umber B2001991		BORING:	Terminology sheet	23-C-3	abbleviations
	ical Evaluation		LOCATION:	See attached sketo		
	Line 5 Re-Route					
Various L	ocations and Iron Counties, Wiscons	sin	LATITUDE	40.40007	LONGITUDE	00.04440
	•		LATITUDE:	46.40667	LONGITUDE:	-90.81112
DRILLER:	EPC LOGGED BY:	A. Hillerud	START DATE			06/04/20
SURFACE ELEVATION:		METHOD: 4 1/4" HSA	SURFACING	i:	WEATHER:	
Elev./ Depth to ft	Description of Mat  (Soil-ASTM D2488 or 2487; F  1110-1-2908)	Rock-USACE EM   플	Blows (N-Value) Recovery	q <sub>p</sub> MC tsf %	Tests or R	emarks
- - - - - - - - 771.6	SILTY SAND (SM), fine to me Gravel, brown, moist, medium OUTWASH)		1-8-10-16 (18) 14" 9-7-7-6 (14) 4"			
_ 4.0 _ - - - 768.6	POORLY GRADED SAND wit fine to medium-grained, trace moist, loose (GLACIAL OUTW	Gravel, brown, 5—\/	2-2-2-4 (4) 12"			
7.0 - 7.0	fine to coarse-grained, brown, dense (GLACIAL OUTWASH)	, wet, medium $\stackrel{\frown}{} -      $	4-5-11-14 (16) 8"	11	Test results are attached lab re	
	\$\o^\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\	10 —	13-14-7-6 (21) 10"		Drilling method mud rotary at 1	
_ 12.0  761.6	SILT with SAND (ML), trace G moist, medium dense (LACUS	STRINE)	8-11-14-17 (25) 18"		Auger met refu	sal at 15.8
_ 14.0  - 759.8 15.8 	LEAN CLAY with SAND (CL), brown, moist, hard (LACUSTF		10-13-50/4" (REF) 12"		feet. Drilling me switched to roc 18 feet.	
- - - - - -	FREDA SANDSTONE, CONG with red, moderately weathered grained to medium-grained, mighly fractured	ed, hard, fine-	0 50			Run 1 I/OH's 4
752.6 23.0 - - - - - - - - - 748.0	FREDA SANDSTONE, CONG with red, moderately weathered hard, fine-grained to coarse-g bedded, highly fractured  Test results are in the attached	ed, moderately — rained, thick 25—	30 100			Run 2 MOH's 4
27.5	FREDA SANDSTONE, CONG with red, moderately weathered hard, fine-grained to coarse-g bedded, highly fractured	ed, moderately —	65 90		r F	Run 3 - No ecovery Run 4 MOH's 3
_	Continued on nex	xt page	RQD % Recovery %	Drilling Rate Bit Pressure (min/ft) (psi)	Water Water Return	Remarks



The Science You Bui						See D	escriptive	e Termino	logy sheet			of abbreviations
Project Nu						ВО	RING:			23-0	C-3	
Geotechni						LO	CATION:	See attac	ched sket	ch		
Enbridge L			e									
Various Lo			\\/:	- i						l		
Ashiand ai	na iron	Counti	es, Wiscon	SIN		LA	TITUDE:	46	.40667	LONGI	TUDE:	-90.81112
DRILLER:	EP	2	LOGGED BY:	A. Hilleru	d	ST	ART DAT	E:	06/01/20	END D	ATE:	06/04/20
SURFACE ELEVATION:	775.6 ft	RIG: S	Subcontractor	METHOD: 4 1/4	I" HSA	SU	RFACING	G:		WEATH	HER:	
Elev./			escription of Ma		Ф	'	ry	D	ē	. <u>e</u>		
Elev./   Ele	(So	il-ASTM I	D2488 or 2487; 1110-1-2908	Rock-USACE EM	Sample	RQD %	Recovery %	Drilling Rate (min/ft)	Bit sssu psi)	Water Pressure (psi)	/ate/ eturi %	Remarks
ft 5			1110-1-2900	')	Sa	IL.	Rec	ן בֿ " בֿ	Bit Pressure (psi)	Pre	'≤ œ	
743.0				GLOMERATE, gray		100	100					Run 5
<del>- 32.5</del> - 742.6			lerately weather ined to coarse-				100					MOH's 5
33.0	Ded bed	ded, high	ly fractured			40	80					Run 6
740.6 - 35.0				GLOMERATE, red hard, fine-grained	35							MOH's 4 Run 7
_ 33.0				ded, moderately		65	100					MOH's 4
_		tured	DOTONE CON	OLOMEDATE		03	100					
<u> </u>			lerately weather	GLOMERATE, gray ed. moderately								Run 8
_	္ကြင့္လို့ hard	d, fine-gra	ined to coarse-o									MOH's 3
			ly fractured	GLOMERATE, gray	40 —							
_	ి: ి with	red, mod	lerately weather	ed, moderately		65	100					
_			ined to coarse-o									
732.6			are in the attach									
_ 43.0	project FRE	EDA SAN	DSTONE, CON	GLOMERATE, gray								Run 9
_				oderately hard, d, thick bedded,								MOH's 3
_		nly fractur		a, trilok bedaed,	45—	45	100					
						. •						
_					-							Run 10
_					-11							MOH's 3
_					50 —							
_						20	30					
_												
722.6												
_ 53.0				GLOMERATE, gray								Run 11 MOH's 4
-			lerately weather ined to coarse-									IVIOTTS 4
-	🐎 ္ပါ bed	ded, high	ly fractured		55—	40	80					
-	)::0: <i>le</i>	st results	are in the attach	ed lab report	_							
- 747.0												
717.6 58.0	D.O. TRE	EDA SAN	DSTONE. CON	GLOMERATE, gray	┈╂							Run 12
-	្តីខ្លុំ with	red, mod	lerately weather	ed, moderately	-							MOH's 4
F			iined to coarse-( ly fractured	grained, medium	60	45	80					
<u> </u>		aoa, mgn	., naoiaroa									
713.6			DOTONE CO:	OLONED:==			1					Dum 40
_ 62.0 <del>712.6</del>			DSTONE, CON lly weathered, m	GLOMERATE, gray		0	60					Run 13 MOH's 4
- 63.0		-grained t	o medium-grain	ed, medium								Run 14
		C	ontinued on ne	xt page								MOH's 4



The Science V							e Terminol	ogy sheet	•	on of abbrevia	ations
	Number B					RING:			23-C-3		
	hnical Eval ge Line 5 R				LO	CATION:	See attac	hed sketo	ch		
	Locations										
		Counties, Wiscon	sin		LA	ΓITUDE:	46.	40667	LONGITUD	E: -90.81	112
DRILLER:	EP	C LOGGED BY:	A. Hillerud		STA	ART DAT	E: (	06/01/20	END DATE:	06/0	)4/20
SURFACE ELEVATION:	775.6 ft	RIG: Subcontractor	METHOD: 4 1/4"	HSA	SU	RFACIN	 Э:		WEATHER:		
		Description of Ma	ıterials	0		>		Φ	Φ		
Elev./ Depth ft	Water Level	oil-ASTM D2488 or 2487; 1110-1-290		Sample	RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi) Water Return	% Remar	rks
- - - - - - 707.6	with fine bed	EDA SANDSTONE, CON red, highly weathered, re- grained to medium-grain lded, highly fractured EDA SANDSTONE, CON red, moderately weathe	noderately hard, led, medium  GLOMERATE, gray	65 — — — — — — — — — — — — — — — — — — —	35	90					
68.0 	nard	d, fine-grained to coarse- lded, highly fractured EDA SANDSTONE, CON n red, highly weathered, n e-grained to coarse-graine	grained, medium  GLOMERATE, gray noderately hard,  7	_ '0 —	0	80				Run 15 MOH's 4	
_ 71.0 _	္ႏုံ္ \high မ္းႏုိ FRE	hly fractured EDA SANDSTONE, CON red, moderately weathe	40 75					Run 16 MOH's 4			
	l in	d, fine-grained to coarse- lded, highly fractured st results are in the attac	grained, medium	/5 —     	15	100				Run 17 MOH's 3	
- - - - - - - - - - - - - 692.6			8		40	100				Run 18 MOH's 3	
83.0 - - - - - - -	່ວີວິດ ໄດ້ການ ການ ທ່ານ ການ ການ Mard Deck Mard Deck Mard Deck Mard Deck Mard Deck Mard Mard Mard Mard Mard Mard Mard Mard	EDA SANDSTONE, CON n red, moderately weathe d, fine-grained to coarsedded, highly fractured est results are in the attack	red, moderately grained, thick	35 — — — — — — — — — — — — — — — — — — —	45	100				Run 19 MOH's 3	
 - - - - - - - - - - - - - - - - - -			ę	00 —	35	100				Run 20 MOH's 3	
93.0	່ວີວ່າ with ໃດວິດ fine	EDA SANDSTONE, CON n red, highly weathered, r e-grained to coarse-graine hly fractured	noderately hard, ed, medium bedded, g	— — 95 —	35	100				Run 21 MOH's 3	
		Continued on ne	ext page								



Project			ır R	20019	91				36		SCRIPTIVE	; reminoi	ogy sneet	23-(		of abbreviations
Geotec												See attac	ched sketo		J-J	
Enbridg											1014.	Joo and	onoll			
Various																
Ashlan	d aı	nd Ir	on	Count	ies, Wiscon	sin				LAT	ITUDE:	46.	.40667	LONGI	TUDE:	-90.81112
DRILLER:			EP	С	LOGGED BY:		A. Hiller	ud		STA	RT DAT	E:	06/01/20	END D	ATE:	06/04/20
SURFACE ELEVATION:		775.6	6 ft	RIG:	Subcontractor	METHOD:	4 1	/4" HSA		SUF	RFACING	3:		WEATH	HER:	
,					Description of Ma				ש		iry	m :	ē	. <u>e</u>		
Depth ft	Water Level				D2488 or 2487; 1110-1-290	3)			ROD	%	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Water Return %	Remarks
- - - 677.6			with	n red, hig	NDSTONE, CON hly weathered, r to coarse-grains	noderately	hard,	_								
_ 98.0	1		higl	hly fractu	red	had lah rai	nort.									Run 22 MOH's 3
- - - -			FRI with har	EDA SAN n red, mo d, fine-gr	NDSTONE, CON derately weathe rained to coarse- hly fractured	GLOMER/ red, mode	ATE, gray rately	100 — ——————————————————————————————————	2	40	100					Werra a
									╂							Run 23
																MOH's 3
								105 —	4	45	100					
 - 668.6			Те	est results	s are in the attac	hed lab rep	oort	-								
107.0		<u> </u>	•		END OF CO	RING										Water observed at
-			Bor	ing then	backfilled with	cement/l	hentonit	_								7.0 feet while
-			DOI	ing then	grout	Contony	ociitoiiit									drilling.
F								110								
-																
_																
_																
E								115								
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P2001001								Corporati							22.0	



Project		er B200199	 1			BORING:	Termino	logy sneet	for explanation of <b>25-C</b>	i appreviations
		Evaluation	•			LOCATION:	See atta	ched sketo		
Enbridg	e Line	5 Re-Route	е							
Various										
Ashland	and I	Iron Countie	es, Wiscon	sin		LATITUDE:	46	.40430	LONGITUDE:	-90.80661
DRILLER:		EPC	LOGGED BY:	S.	Sullivan	START DATE	≣:	04/24/20	END DATE:	05/04/20
SURFACE ELEVATION:	839.	.3 ft RIG: Si	ubcontractor	METHOD:	3 1/4" HSA	SURFACING	):		WEATHER:	
Elev./ Depth ft	Water Level		escription of Ma 2488 or 2487; 1110-1-2908	Rock-USACE	Sample	Blows (N-Value) Recovery	q <sub>p</sub> tsf	MC %	Tests or F	Remarks
837.8			AND (SM), fine organic, brown			1-1-2-2 (3)				
1.5		SANDY LEAN	I CLAY (CL), fir	ne to medium-		13"				
- 837.3 2.0		grained, trace medium (GLA	roots, reddish	brown, moist,		1-6-8-9 (14)				
_ 2.0		SILTY, CLAYE	Y SAND (SC-S		//	21"				
L I		medium-grain hard (GLACIA	ed, reddish bro	wn, moist, stif	f to	2-5-8-9				
_		I Hard (GLACIA	NE TIEE)			(13) 18"				
						7-28-29-29				
_						(57)				
-		A				22"				
829.8 9.5	abla	SILTY SAND	(SM), fine to m	edium-grained	I, 10—\/	5-13-17-25				
L I	_	brown, wet, m	edium dense to			(30) 22"			Drilling method	
L l		(GLACIAL TIL	.L)			18-32-31-23			mud rotary at 1	2 feet
_						(63) 20"		3	Test results are attached lab re	
-									attaonou las ro	port
823.8					15 — [	18-19-17-30 (36)				
15.5			I CLAY (CL), fir			20"				
-		grained, reddi TILL)	sh brown, mois	t, nard (GLAC	JAL —					
F										
F I										
F					20 —	14-22-21-27				
F I					- X	(43) 24"				
F I					_					
-										
F					_					
813.8					25 —	18-23-33-33				
25.5			(SM), fine to m			(56) 20"				
F		(GLACIAL TIL	medium dense L)	to very derise	<u> </u>					
F					4					
F					4					
F					30 —	10-17-19-20				
F					$- \chi $	(36) 18"				
F		<u></u>	entinued on ne	avt nace	_	.0				
P2001001			munueu on ne	ixi page					L	



Project Nu	umber B2001991	S	BORING:	erminology sheet	t for explanation of <b>25-C</b>	appreviations
	ical Evaluation			ee attached sketo		
	Line 5 Re-Route		LOCATION. SE	se allauneu SKEIC	JII	
Various Lo						
Ashland a	and Iron Counties, Wiscon	sin	LATITUDE:	46.40430	LONGITUDE:	-90.80661
DRILLER:	EPC LOGGED BY:	S. Sullivan	START DATE:	04/24/20	END DATE:	05/04/20
SURFACE ELEVATION:	839.3 ft RIG: Subcontractor	METHOD: 3 1/4" HSA	SURFACING:		WEATHER:	
Elev./ Depth text of the second secon	Description of Ma (Soil-ASTM D2488 or 2487; 1110-1-2908	Rock-USACE EM   힐	Blows (N-Value) Recovery	q <sub>p</sub> MC tsf %	Tests or R	emarks
-	SILTY SAND (SM), fine to m brown, moist, medium dense (GLACIAL TILL)	edium-grained, e to very dense				
- - - - - -		35	9-12-13-19 (25) 18"			
- - - - - -		40	9-11-14-17 (25) 18"			
- - - - - - - -		45	7-11-12-11 (23) 14"			
- - - - - - - - - -		50 — 1	0-13-13-20 (26) 22"			
- - - - - - - -		55	7-11-17-19 (28) 16"			
779.8 59.5	SILT with SAND (ML), fine to brown, moist, medium dense	medium-grained, 60 (GLACIAL TILL)	9-13-16-20 (29) 14"	21	Test results are attached lab re	
-	Continued on ne	ext page				
B2001991	Contained on the	Braun Intertec Corporation			25-C	nage 2 of 6



Project Nu	mber B2001991		BORING:	Terminology sheet	25-C	i annievialions
	cal Evaluation			See attached sket		
	ine 5 Re-Route					
Various Lo	ocations nd Iron Counties, Wiscon	ein	LATITUDE	40.40400	LONOITURE	00.00001
			LATITUDE:	46.40430	LONGITUDE:	-90.80661
DRILLER:	EPC LOGGED BY:	S. Sullivan	START DATE			05/04/20
SURFACE ELEVATION:	839.3 ft RIG: Subcontractor	METHOD: 3 1/4" HSA	SURFACING	i:	WEATHER:	
Elev./ Depth te so	Description of Ma (Soil-ASTM D2488 or 2487; I 1110-1-2908	Rock-USACE EM 출	Blows (N-Value) Recovery	q <sub>p</sub> MC tsf %	Tests or F	Remarks
- - - - -	SILT with SAND (ML), fine to brown, moist, medium dense		7-13-12-12 (25) 16"			
- - - - - - - -		70	9-10-11-19 (21) 14"			
- 765.3 - 74.0 	SILTY, CLAYEY SAND (SC-S medium-grained, reddish brown hard (GLACIAL TILL)		10-13-11-11 (24) 18"			
		80	4-5-8-8 (13) 20"			
- - - - - - - - -		85 —	7-14-18-21 (32) 18"			
750.8 88.5 - - - -	SILTY, CLAYEY SAND (SC-S medium-grained, with Gravel hard (GLACIAL TILL)		14-19-21-46 (40) 16"			
745.3 94.0	SILTY SAND (SM), fine to me rock fragments, gray, moist, v (GLACIAL TILL)  Continued on ne	very dense 95—=	50/2" (REF) 2"		250	nage 3 of 6



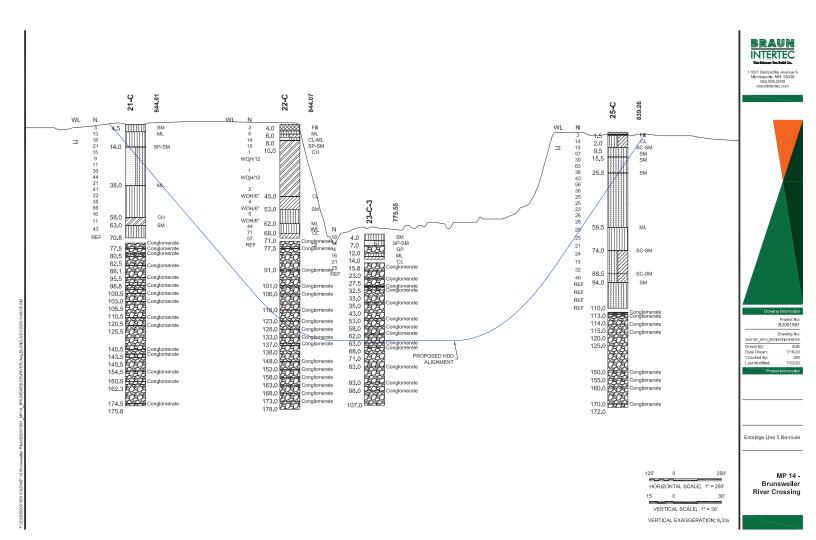
The Science		- D20040	204					RING:	, iciiiiiioi	ogy sneet			or appreviations
		er B20019 Evaluatio							0 "		25-	<u>.</u>	
		5 Re-Ro			LOC	CATION:	See attac	ched sketo	n				
	ge Line s Locati		ule										
			ties, Wiscon	sin			I AT	ITUDE:	46	40430	LONGI	TUDF:	-90.80661
DRILLER:		EPC	LOGGED BY:		S. Sullivan			RT DAT		04/24/20	END D		05/04/20
SURFACE	839.3		Subcontractor	METHOD:	3 1/4" HS	Δ		RFACINO			WEATH		00,01,20
ELEVATION:		1410.	Description of Ma		0 1/1 110						***		
Elev./ Depth ft	Water Level		M D2488 or 2487; 1110-1-2908	Rock-USA ()		Sample		ows alue) overy	q <sub>p</sub> tsf	MC %	Te	ests or	Remarks
- - - - - - - - - - - - - - - - - - -			ID (SM), fine to me ents, gray, moist, v TILL)				50 (RE 1	EF) " /1" EF) "					
726.3 - 113.0 - 725.3		with red, sl medium-gr	NDSTONE, CONG	soft, fine-g d, highly fi	rained to / ractured /		25 0 0	65 75 100					Run 1 MOH's = 2 Run 2
114.0 - 724.3 - 115.0 - - - - - - - - - - - - -		with red, de grained to highly fract FREDA SA with red, sl fine-grained bedded, high	NDSTONE, CONG ecomposed, mode coarse-grained, mured NDSTONE, CONG ightly weathered, r d to medium-grainghly fractured NDSTONE, CONG	rately hard edium bed GLOMERA moderately ed, mediui	d, fine- lded, — ATE, gray / hard, — m —		70	100					MOH's = 3 Run 3 MOH's = 3 Run 4 MOH's = 3
120.0 		with red, m hard, fine-g bedded, hig Test resul FREDA SA with red, sl fine-grained highly fract FREDA SA with red, de	oderately weather grained to coarse-ç ghly fractured ts are in the attach NDSTONE, CONG ightly weathered, r d to medium-grain	ed, moder grained, th ned lab rep GLOMERA moderately ed, thick b GLOMERA rately hard	ately ick — oort — ATE, gray — hard, — hedded, 125— ATE, gray — d, fine-		60 85	100					Run 5 MOH's = 3 Run 6 MOH's = 3
	1 2000		Continued on ne	xt nage			RQD %	Recovery %	Drilling Rate	Bit Pressure	Water	Water Return	Remarks

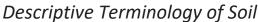


The science for kind On									ee Descriptive Terminology sheet for explanation of abbreviations							
Project					В	BORING: 25-C										
Geotecl					LC	LOCATION: See attached sketch										
Enbridg				ıte												
Various				tios Wisson				40.405	1.63:-		00.00==:					
	a an			ties, Wiscon			TITUDE:		.40430	LONGITUDE: -90.80661						
DRILLER:		EP	C	LOGGED BY:	S. Sulliv	ST	TART DAT	E:	04/24/20	END DATE: 05/04/20						
SURFACE ELEVATION:		839.3 ft	RIG:	Subcontractor	SI	JRFACING	G:		WEATHER:							
Elev./	ter /el	(S		Description of Ma D2488 or 2487;	iterials Rock-USACE EM	Sample	۵.۵	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Water Return %	Domarka			
Depth ft	Water Level			1110-1-2908	3)	San	RQD %	%   %					Remarks			
		i∷ö FR	EDA SAI	NDSTONE, CON	GLOMERATE, gra	v III		_								
_	,00	:0°81 wit	h rad da	composed mode	rately hard fine											
	٥	- ∩°⊵° IIai	clureu		ick bedded, highly	130 —							Run 7			
F	ڕٛ	્રે <b>ંૄે <i>T</i>લ્</b>	est result	s are in the attach	ned lab report								MOH's = 3			
<u> </u>	()					-	50	100								
E	9						50	100								
_	9					-										
F	,00					135—							Run 8			
_	ڕٛ	0.00				-11							MOH's = 3			
_	٥					-11										
_	١					_##	70	100								
_	Š					_##										
_	,					140 —							D 0			
_	9					_##							Run 9 MOH's = 3			
_	٥					_##										
_	ي ا						80	100								
L	٥															
F	ر ا					145										
F	٥	Ç∷ Te	est result	s are in the attach	ned lab report	145—							Run 10 MOH's = 3			
F	8												IVIOTTS – 3			
-	6						75	100								
_	,					-11										
─ - 689.3																
_ 150.0		FR	EDA SAI	NDSTONE, CON	GLOMERATE, gra	<del>150 y</del>							Run 11			
<u> </u>	(	5≝ő Wit	h red, ma	oderately weather nedium-grained, r	ed, soft, fine-								MOH's = 3			
			hly fractu		nculum pedded,	-	35	100								
_						-										
													Dun 40			
684.3 155.0		7:00 7:00 FR	FDA SAI	NDSTONE CON	GLOMERATE, gra	155 V	55	100					Run 12 MOH's = 3			
		়্ ্রী wit	h red, mo	oderately weather	ed, soft, fine-								Run 13			
<u> </u>			iined to n ctured	nedium-grained, t	hick bedded, highl	у _	•	100					MOH's = 3			
_			o.ui ou			-11	60	100								
L	(					_										
679.3	3					IJ										
160.0				Continued on ne	ext page											



Project Number B2001991										BORING: 25-C								
Geotechnical Evaluation											LOCATION: See attached sketch							
Enbridge Line 5 Re-Route											LOCATION. See attached sketch							
Various Locations																		
	Ashland and Iron Counties, Wisconsin											TTUDE:	46.	40430	LONGITUDE: -90.80661			
DRILLER:			EPO		I	LOGGED BY:		S. Sulliv	van		STA	RT DAT	E:	04/24/20	END DATE: 05/04/20			
SURFACE ELEVATION:		839.3 ft RIG: Subcontractor METHOD: 3 1/4" HSA								SUI	SURFACING: WEATHER:							
,		D ::: (M : : )																
Elev./ Depth ft	Water Level	(Soil-ASTM D2488 or 2487; Rock-USACE EM									RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Water Return %	Remarks	
- - - - - - - -			with fine high	red, slig -grained nly fractu	to c red	TONE, CONG weathered, r coarse-grained e in the attach	noderatel d, thick be	ly hard, edded,	y — — — — 165 —		90	100					Run 14 MOH's = 3 Run 15	
- - - - - - - - - - - - - - - - - - -											85	100					MOH's = 3	
_ 170.0  - 667.3			hard	ı rea, mo d, fine-gr	aine	TONE, CONC ately weather ed to medium	ea, moae	rately	y —		0	50					Run 16 MOH's = 3 Water	
_ 172.0 _ - -					Ε	ractured ND OF COF		l 4 14	_/ _								observed at 10.0 feet while drilling.	
<u>-</u> -			Boring then backfilled with cement/bentonite grout 175—															
- - -																		
_									_									
E			180—															
_									_									
_									_									
_									_									
<u> </u>									_									
<u> </u>									185 —									
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<u> -</u>			190 —															
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-										$\vdash$								
P2001001									Corpore							25	C page 6 of 6	





Based on Standards ASTM D2487/2488 (Unified Soil Classification System)



	Criteria fo	or Assigning G	roup Symb	ols and		Soil Classification
	Group N	Group Symbol	Group Name <sup>B</sup>			
o	Gravels	Clean Gr	Clean Gravels $C_u \ge 4$ and $1 \le C_c \le 3^D$		GW	Well-graded gravel <sup>E</sup>
ed o	(More than 50% of coarse fraction	(Less than 5	% fines <sup>c</sup> )	$C_u < 4 \text{ and/or } (C_c < 1 \text{ or } C_c > 3)^D$	GP	Poorly graded gravel <sup>E</sup>
ned Soi % retain sieve)	retained on No. 4	Gravels wit	th Fines	Fines classify as ML or MH	GM	Silty gravel <sup>E F G</sup>
aine )% re ) sie	sieve)	(More than 1	2% fines <sup>c</sup> )	Fines Classify as CL or CH	GC	Clayey gravel <sup>E F G</sup>
Coarse-grained Soils (more than 50% retained No. 200 sieve)	Sands	Clean S	ands	$C_u \ge 6$ and $1 \le C_c \le 3^D$	SW	Well-graded sand
<b>parse</b> e than	(50% or more coarse	(Less than 5	% fines <sup>H</sup> )	$C_u < 6 \text{ and/or } (C_c < 1 \text{ or } C_c > 3)^D$	SP	Poorly graded sand
no r	fraction passes No. 4	Sands wit	h Fines	Fines classify as ML or MH	SM	Silty sand <sup>FGI</sup>
	sieve)	(More than 12% fines <sup>H</sup> )		Fines classify as CL or CH	SC	Clayey sand <sup>FGI</sup>
		Inorganic	PI > 7 and	l plots on or above "A" line I	CL	Lean clay <sup>KLM</sup>
the	Silts and Clays (Liquid limit less than	morganic	PI < 4 or p	olots below "A" line	ML	Silt <sup>KLM</sup>
Fine-grained Soils 50% or more passes the No. 200 sieve)	50)	Organic	Liquid Limit – oven dried Liquid Limit – not dried <0.75		OL	Organic clay KLMN Organic silt KLMO
grain more		Inorganic	PI plots o	n or above "A" line	СН	Fat clay <sup>KLM</sup>
Fine-g % or n No.	Silts and Clays (Liquid limit 50 or	morganic	PI plots b	elow "A" line	MH	Elastic silt <sup>KLM</sup>
(50	more)	Organic	Liquid Limit – oven dried Liquid Limit – not dried <0.75		ОН	Organic clay KLMP Organic silt KLMQ
Hig	hly Organic Soils	Primarily org	anic matter	r, dark in color, and organic odor	PT	Peat

- A. Based on the material passing the 3-inch (75-mm) sieve.
- If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
- Gravels with 5 to 12% fines require dual symbols:

GW-GM well-graded gravel with silt

GW-GC well-graded gravel with clay

GP-GM poorly graded gravel with silt

GP-GC poorly graded gravel with clay

- $C_c = (D_{30})^2 / (D_{10} \times D_{60})$ D.  $C_u = D_{60} / D_{10}$
- If soil contains ≥ 15% sand, add "with sand" to group name.
- If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.
- G. If fines are organic, add "with organic fines" to group name.
- Sands with 5 to 12% fines require dual symbols:

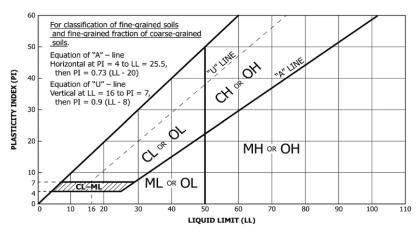
SW-SM well-graded sand with silt

SW-SC well-graded sand with clay

SP-SM poorly graded sand with silt

poorly graded sand with clay

- I. If soil contains ≥ 15% gravel, add "with gravel" to group name.
- If Atterberg limits plot in hatched area, soil is CL-ML, silty clay.
- If soil contains 15 to < 30% plus No. 200, add "with sand" or "with gravel", whichever is
- If soil contains ≥ 30% plus No. 200, predominantly sand, add "sandy" to group name.
- M. If soil contains ≥ 30% plus No. 200 predominantly gravel, add "gravelly" to group name.
- N. PI ≥ 4 and plots on or above "A" line.
- O. PI < 4 or plots below "A" line.
- PI plots on or above "A" line.
- PI plots below "A" line.



#### **Laboratory Tests**

DD Dry density, pcf WD Wet density, pcf P200 % Passing #200 sieve  $\mathbf{q}_{\upsilon}$ 

OC Organic content. % Pocket penetrometer strength, tsf MC Moisture content, % Unconfined compression test, tsf

ш Liquid limit PL Plastic limit Plasticity index

Particle Size Identification
Boulders over 12"
Cobbles 3" to 12"
Gravel
Coarse 3/4" to 3" (19.00 mm to 75.00 mm)
Fine No. 4 to 3/4" (4.75 mm to 19.00 mm)
Sand
Coarse No. 10 to No. 4 (2.00 mm to 4.75 mm)
Medium No. 40 to No. 10 (0.425 mm to 2.00 mm)
Fine No. 200 to No. 40 (0.075 mm to 0.425 mm)
Silt No. 200 (0.075 mm) to .005 mm
Clay< .005 mm
Relative Proportions <sup>L, M</sup>
trace 0 to 5%
little 6 to 14%
with≥ 15%
Inclusion Thicknesses
lens 0 to 1/8"
seam1/8" to 1"

#### **Apparent Relative Density of Cohesionless Soils**

Very loose	0 to 4 BPF
Loose	5 to 10 BPF
Medium dense	11 to 30 BPF
Dense	31 to 50 BPF
Very dense	over 50 BPF

Consistency of	Blows	Approximate Unconfined
Cohesive Soils	Per Foot	Compressive Strength
Very soft	. 0 to 1 BPF	< 0.25 tsf
Soft	. 2 to 4 BPF	0.25 to 0.5 tsf
Medium	. 5 to 8 BPF	0.5 to 1 tsf
Stiff	. 9 to 15 BPF	1 to 2 tsf
Very Stiff	. 16 to 30 BPF	2 to 4 tsf
Hard	. over 30 BPF.	> 4 tsf

#### **Moisture Content:**

Dry: Absence of moisture, dusty, dry to the touch.

Moist: Damp but no visible water.

Wet: Visible free water, usually soil is below water table.

#### **Drilling Notes:**

Blows/N-value: Blows indicate the driving resistance recorded for each 6-inch interval. The reported N-value is the blows per foot recorded by summing the second and third interval in accordance with the Standard Penetration Test, ASTM D1586.

Partial Penetration: If the sampler could not be driven through a full 6-inch interval, the number of blows for that partial penetration is shown as #/x" (i.e. 50/2"). The N-value is reported as "REF" indicating refusal.

**Recovery:** Indicates the inches of sample recovered from the sampled interval. For a standard penetration test, full recovery is 18", and is 24" for a thinwall/shelby tube sample.

WOH: Indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

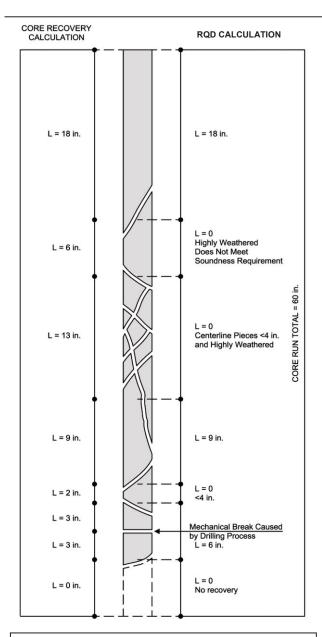
WOR: Indicates the sampler penetrated soil under weight of rods alone; hammer weight and driving not required.

Water Level: Indicates the water level measured by the drillers either while drilling (  $\searrow$  ), at the end of drilling (  $\checkmark$  ), or at some time after drilling ( ).



## Descriptive Terminology of Rock

Based on U.S. Army Corps of Engineers EM 1110-1-2908



#### **Example Calculations**

Core Recovery, CR = <u>Total length of rock recovered</u>
Total core run length

Example: CR = (18 + 6 + 13 + 9 + 2 + 3 + 3)(60)

CR = 90%

RQD = <u>Sum of sound pieces 4 inches or larger</u> Total core run length

RQD Percent	Rock Quality
< 25	very poor
25 < 50	poor
50 < 75	fair
75 < 90	good
90 < 100	excellent

Example: RQD = (18 + 9 + 6) (60)

RQD = 55%

#### Weathering

Unweathered: No evidence of chemical or mechanical alteration.

*Slightly weathered:* Slight discoloration on surface, slight alteration along discontinuities, less than 10% of rock volume altered.

Moderately Weathered: Discoloration evident, surface pitted and altered with alteration penetrating well below rock surfaces, weathering halos evident, 10% to 50% of the rock altered.

Highly Weathered: Entire mass discolored, alteration pervading nearly all of the rock, with some pockets of slightly weathered rock noticeable, some mineral leached away.

*Decomposed:* Rock reduced to a soil consistency with relict rock texture, generally molded and crumbled by hand.

#### **Hardness**

Very soft: Can be deformed by hand

Soft: Can be scratched with a fingernail Moderately hard: Can be scratched easily with a knife

Hard: Can be scratched with difficulty with a knife

Very hard: Cannot be scratched with a knife

#### **Texture**

Sedimentary Rocks:Grain SizeCoarse grained2 - 5 mmMedium grained0.4 - 2 mmFine grained0.1 - 0.4 mmVery fine grained< 0.1 mm</td>

#### Igneous and Metamorphic Rocks:

Coarse grained 5 mm

Medium grained 1 – 5 mm

Fine grained 0.1 – 1 mm

Aphanitic < 0.1 mm

#### Thickness of Bedding

Massive: 3 ft. thick or greater Thick bedded: 1 to 3 ft. thick Medium bedded: 4 in. to 1 ft. thick Thin bedded: 4 in. thick or less

#### **Degree of Fracturing (Jointing)**

Unfractured: Fracture spacing 6 ft. of more Slightly fractured: Fracture spacing 2 to 6 ft.

Moderately fractured: Fracture spacing 8 in. to 2 ft.

Highly fractured: Fracture spacing 2 in. to 8 in.

Intensely fractured: Fracture spacing 2 in. or less



## **Geotechnical Testing**

Various ASTM

11001 Hampshire Avenue S Minneapolis, MN 55438 Phone: 952-995-2000

Client: Project:

Enbridge Energy, Limited Partnership Attn: Accounts Payable5400 Westheimer Ct Houston, TX 77056

Enbridge Line 5 Re-route Enbridge Line 5 near Mellen, WI

B2001991

#### **Sample Information**

Metafield ID: 320970 Sampled By: Drill Crew

**Sample Date:** 06/23/2020

Received Date: 07/09/2020 Lab: 11001 Hampshire Ave S, Bloomington, MN

Completed Date: 07/10/2020 Tested By: Streier, Jim

#### **Laboratory Results Summary**

Boring	Sample	Depth (ft)	MC (%)	Wash Loss (%)	LL	PL	PI	Organic Content %	Dry Density (pcf)	Resistivity (ohm-cm)	Q <sub>u</sub> (tsf)	Specific Gravity
45-2-C		75.0	8.8		19	14	5					
45-2-C		95.0	12.2		24	14	10					
2-C-2		20.0	21.6		23	19	4		106.1			
2-C-2		40.0	26.4		42	16	26		99.3			
13-C-2		12.5	22.7		55	18	37					
13-C-2		30.0	29.9		50	18	32		93.8			
13-C-2		40.0	32.5		52	17	35		91.0			
20-C-1		30.0	21.6		29	16	13					
84-C-2		15.0	19.0		37	14	23					
84-C-2		35.0	20.2		30	15	15					
28-WB- 1		15.0	40.8		74	21	53		81.3			
28-WB- 1		35.0	54.4		65	21	44		69.6			
22-C		12.5	50.7		56	18	38		71.0			
22-C		45.0	26.1		34	14	20					
43-1-C- 1		55.0	12.2		21	16	5		126.7			
17-C		15.0	42.8						78.9			
19-C		12.5	40.6						81.2			

#### **General**

It m



**ASTM D2216** 

4511 West First Street Suite 4

Duluth, MN 55807 Phone: 218-624-4967

Results:

Client: Project:

Enbridge Energy, Limited Partnership Attn: Accounts Payable5400 Westheimer Ct

Houston, TX 77056

B2001991 Enbridge Line 5 Re-route Enbridge Line 5 near Mellen, WI

#### **Sample Information**

**Sample Number:** 312751 **Alternate ID:** 21-C 5 9.5'-11'

Sampling Method: Auger Boring ASTM D1452 Sampled By: Drill Crew

Location: In-place

**Location Details:** Boring 21-C Sample 5 9.5'-11'

**Sample Date:** 06/03/2020

Received Date: 06/03/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

**Tested Date:** 06/05/2020 **Tested By:** Patterson, Gregg

Laboratory Data							
Boring # Sample # Depth (ft) Moisture Content (%)							
21-C	5	10.0	20.5				

#### General

The test is for informational purposes.



**ASTM D2216** 

4511 West First Street Suite 4

Duluth, MN 55807 Phone: 218-624-4967

Results:

Client: Project:

Enbridge Energy, Limited Partnership Attn: Accounts Payable5400 Westheimer Ct

Houston, TX 77056

B2001991 Enbridge Line 5 Re-route Enbridge Line 5 near Mellen, WI

#### **Sample Information**

**Sample Number:** 312752 **Alternate ID:** 21-C 10 30'-31.5'

Sampling Method: Auger Boring ASTM D1452 Sampled By: Drill Crew

Location: In-place

Location Details: Boring 21-C Sample 10 30'-31.5'

**Sample Date:** 05/14/2020

Received Date: 06/03/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

**Tested Date:** 06/05/2020 **Tested By:** Patterson, Gregg

Laboratory Data							
Boring # Sample # Depth (ft) Moisture Content (%)							
21-C	10	31.0	21.6				

#### General

The test is for informational purposes.



**ASTM D2216** 

4511 West First Street Suite 4

Duluth, MN 55807 Phone: 218-624-4967 Client: Project:

Enbridge Energy, Limited Partnership Attn: Accounts Payable5400 Westheimer Ct

Houston, TX 77056

B2001991 Enbridge Line 5 Re-route Enbridge Line 5 near Mellen, WI

#### **Sample Information**

**Sample Number:** 312753 **Alternate ID:** 21-C 14 50'-51.5'

Sampling Method: Auger Boring ASTM D1452 Sampled By: Drill Crew

Location: In-place

Location Details: Boring 21-C Sample 14 50'-51.5'

**Sample Date:** 05/14/2020

Received Date: 06/03/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

**Tested Date:** 06/05/2020 **Tested By:** Patterson, Gregg

Laboratory Data							
Boring # Depth (ft) Moisture Content (%)							
21-C	14	50.0	20.7				

#### General

**Results:** The test is for informational purposes.



**ASTM D2216** 

4511 West First Street Suite 4

Duluth, MN 55807 Phone: 218-624-4967

Results:

Client: Project:

Enbridge Energy, Limited Partnership Attn: Accounts Payable5400 Westheimer Ct

Houston, TX 77056 Enbridge

Enbridge Line 5 Re-route Enbridge Line 5 near Mellen, WI

B2001991

#### **Sample Information**

Sample Number: 312754 Alternate ID: 21-C 17 65'
Sampling Method: Auger Boring ASTM D1452 Sampled By: Drill Crew

Location: In-place

Location Details: Boring 21-C Sample 17 65'

**Sample Date:** 05/14/2020

Received Date: 06/03/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

**Tested Date:** 06/05/2020 **Tested By:** Patterson, Gregg

Laboratory Data							
Boring # Sample # Depth (ft) Moisture Content (%)							
21-C	17	65.0	14.8				

#### General

The test is for informational purposes.

Mm



**ASTM D2216** 

4511 West First Street Suite 4

Duluth, MN 55807 Phone: 218-624-4967 Client: Project:

Enbridge Energy, Limited Partnership Attn: Accounts Payable5400 Westheimer Ct

Houston, TX 77056

Enbridge Line 5 Re-route Enbridge Line 5 near Mellen, WI

B2001991

#### **Sample Information**

Sample Number: 314651 Alternate ID: 23-C-3 Sample 4 7-9'

Sampling Method: Auger Boring ASTM D1452 Sampled By: Drill Crew

Location: In-place

Location Details: 23-C-3 Sample 4 7-9'

**Sample Date:** 06/01/2020

Received Date: 06/11/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

**Tested Date:** 06/11/2020 **Tested By:** Nelson, Brennan

Laboratory Data							
Boring # Sample # Depth (ft) Moisture Content (%)							
23-C-3	4	79.0	10.9				

#### General

**Results:** The test is for informational purposes.

Ilm



**ASTM D2216** 

4511 West First Street Suite 4

Duluth, MN 55807 Phone: 218-624-4967 Client: Project:

Enbridge Energy, Limited Partnership Attn: Accounts Payable5400 Westheimer Ct

Houston, TX 77056

Enbridge Line 5 Re-route Enbridge Line 5 near Mellen, WI

B2001991

#### **Sample Information**

Sample Number: 318222 Alternate ID: 22-C Sample 18 65'

Sampling Method: Auger Boring ASTM D1452 Sampled By: Drill Crew

Location: In-place

Location Details: Boring 22-C 18 65'

**Sample Date:** 05/16/2020

Received Date: 06/25/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

Tested Date: 06/25/2020 Tested By: Nelson, Brennan

Laboratory Data							
Boring # Sample # Depth (ft) Moisture Content (%)							
22-C	18	65.0	17.6				

#### General

**Results:** The test is for informational purposes.



**ASTM D2216** 

4511 West First Street Suite 4

Duluth, MN 55807 Phone: 218-624-4967 Client: Project:

Enbridge Energy, Limited Partnership Attn: Accounts Payable5400 Westheimer Ct

Houston, TX 77056

B2001991 Enbridge Line 5 Re-route Enbridge Line 5 near Mellen, WI

#### **Sample Information**

Sample Number: 318227 Alternate ID: 25-C Sample 7 12'

Sampling Method: Auger Boring ASTM D1452 Sampled By: Drill Crew

Location: In-place

Location Details: Boring 25-C 7 12'

**Sample Date:** 04/24/2020

Received Date: 06/25/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

**Tested Date:** 06/29/2020 **Tested By:** Nelson, Brennan

Laboratory Data						
Boring # Sample # Depth (ft) Moisture Content (%)						
25-C	7	13.0	3.1			

#### General

**Results:** The test is for informational purposes.



**ASTM D2216** 

4511 West First Street Suite 4

Duluth, MN 55807 Phone: 218-624-4967 Client: Project:

Enbridge Energy, Limited Partnership Attn: Accounts Payable5400 Westheimer Ct

Houston, TX 77056

B2001991 Enbridge Line 5 Re-route Enbridge Line 5 near Mellen, WI

#### **Sample Information**

Sample Number: 318228 Alternate ID: 25-C Sample 20 60'

Sampling Method: Auger Boring ASTM D1452 Sampled By: Drill Crew

Location: In-place

Location Details: Boring 25-C 20 60'

**Sample Date:** 04/24/2020

Received Date: 06/25/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

Tested Date: 06/29/2020 Tested By: Nelson, Brennan

Laboratory Data					
Boring # Sample # Depth (ft) Moisture Content (%)					
25-C	20	61.0	20.6		

#### General

**Results:** The test is for informational purposes.



**ASTM D6913** 

4511 West First Street Suite 4

Duluth, MN 55807 Phone: 218-624-4967 Client: Project:

Enbridge Energy, Limited Partnership Attn: Accounts Payable5400 Westheimer Ct

Houston, TX 77056 Enbridg

Enbridge Line 5 near Mellen, WI

Enbridge Line 5 Re-route

B2001991

#### **Sample Information**

**Sample Number:** 312751 **Alternate ID:** 21-C 5 9.5'-11'

Sampling Method:Auger Boring ASTM D1452Depth (ft):9.5-11Boring Number:21-CSampled By:Drill Crew

Location: In-place

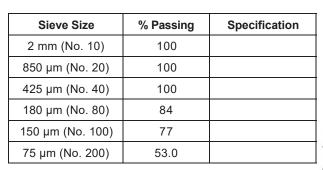
**Location Details:** Boring 21-C Sample 5 9.5'-11'

**Sample Date:** 06/03/2020

Received Date: 06/03/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

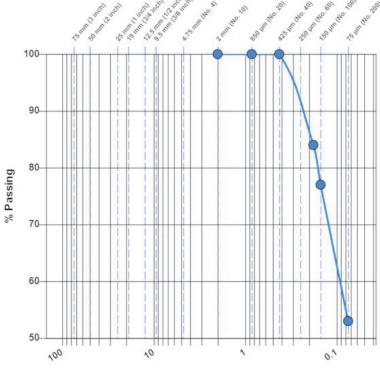
**Tested Date:** 06/05/2020

#### **Laboratory Data**



Test Method: Method A (Composite Sieving)

Dispersion Apparatus: Shaking Specimen Obtained: Oven Dry



Sieve Size (mm)

Classification: ML Sandy silt

General

**Results:** The test is for informational purposes. **Remarks:** Total dry weight of sample 229.17 grams

Ilm



4511 West First Street Suite 4

Duluth, MN 55807 Phone: 218-624-4967 Client: Project:

Enbridge Energy, Limited Partnership Attn: Accounts Payable5400 Westheimer Ct

Houston, TX 77056

B2001991 Enbridge Line 5 Re-route Enbridge Line 5 near Mellen, WI

#### **Sample Information**

Sample Number: 312752 Alternate ID: 21-C 10 30'-31.5'

Sampling Method: Auger Boring ASTM D1452 Depth (ft): 30-31.5 **Boring Number:** 21-C Sampled By: **Drill Crew** 

Location: In-place

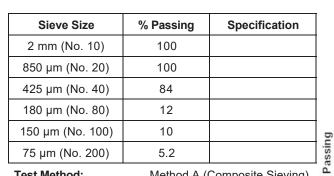
**Location Details:** Boring 21-C Sample 10 30'-31.5'

Sample Date: 05/14/2020

**Received Date:** 06/03/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

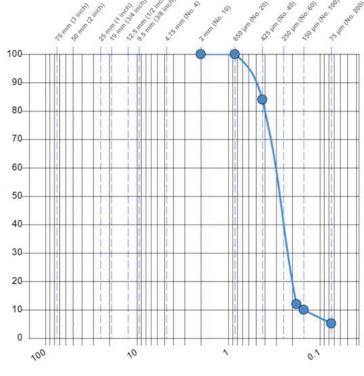
**Tested Date:** 06/08/2020

#### **Laboratory Data**



Method A (Composite Sieving) **Test Method:** 

**Dispersion Apparatus:** Shaking Specimen Obtained: Oven Dry



Sieve Size (mm)

Classification: SP-SM Poorly graded sand with silt

#### **General**

Results: The test is for informational purposes. Remarks: Total weight of dry sample 265.75 grams.

**ASTM D6913** 

Client: Project:

4511 West First Street Suite 4 Duluth, MN 55807 Phone: 218-624-4967

Enbridge Energy, Limited Partnership Attn: Accounts Payable5400 Westheimer Ct Houston, TX 77056

B2001991 Enbridge Line 5 Re-route Enbridge Line 5 near Mellen, WI

#### Sample Information

Sample Number: 312753 Alternate ID: 21-C 14 50'-51.5'

Sampling Method: Auger Boring ASTM D1452 Depth (ft): 50-51.5 **Boring Number:** 21-C Sampled By: **Drill Crew** 

Location: In-place

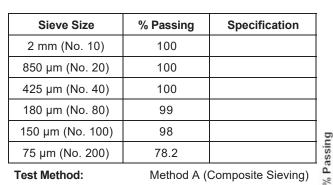
**Location Details:** Boring 21-C Sample 14 50'-51.5'

Sample Date: 05/14/2020

**Received Date:** 06/03/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

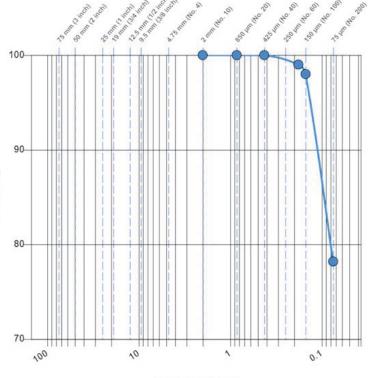
**Tested Date:** 06/05/2020

#### **Laboratory Data**



Method A (Composite Sieving) **Test Method:** 

**Dispersion Apparatus:** Shaking Specimen Obtained: Oven Dry



Sieve Size (mm)

Classification: ML Sandy silt

#### **General**

Results: The test is for informational purposes. Remarks: Total weight of dry sample 230.09 grams.



**ASTM D6913** 

4511 West First Street Suite 4

Duluth, MN 55807 Phone: 218-624-4967 Client: Project:

Sampled By:

**Drill Crew** 

Enbridge Energy, Limited Partnership Attn: Accounts Payable5400 Westheimer Ct

Houston, TX 77056

B2001991 Enbridge Line 5 Re-route Enbridge Line 5 near Mellen, WI

#### **Sample Information**

**Sample Number:** 312754 **Alternate ID:** 21-C 17 65'

Sampling Method: Auger Boring ASTM D1452 Depth (ft): 65

Boring Number: 21-C

Location: In-place

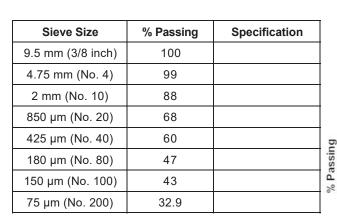
Location Details: Boring 21-C Sample 17 65'

**Sample Date:** 05/14/2020

Received Date: 06/03/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

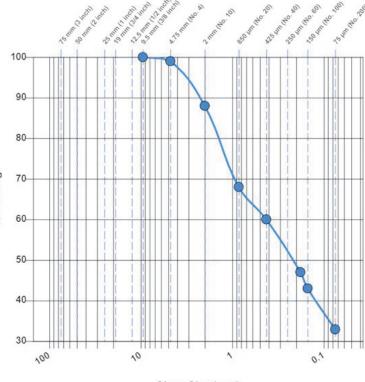
**Tested Date:** 06/05/2020

#### **Laboratory Data**



**Test Method:** Method A (Composite Sieving)

**Dispersion Apparatus:** Shaking **Specimen Obtained:** Oven Dry



Sieve Size (mm)

Classification: SM Silty sand

General

**Results:** The test is for informational purposes. **Remarks:** Total dry weight of sample 175.17 grams

Ilm

**ASTM D6913** 

Client:

Duluth, MN 55807 Phone: 218-624-4967

4511 West First Street

Suite 4

Enbridge Energy, Limited Partnership Attn: Accounts Payable5400 Westheimer Ct Houston, TX 77056

B2001991 Enbridge Line 5 Re-route Enbridge Line 5 near Mellen, WI

4511 West First Street, Suite 4, Duluth, MN

Project:

#### Sample Information

Sample Number: 314651

Auger Boring ASTM D1452

Location:

Sampling Method:

In-place

23-C-3 Sample 4 7-9' **Location Details:** 

Sample Date:

06/01/2020

**Received Date:** 

06/11/2020

**Tested Date:** 

06/11/2020

Alternate ID: 23-C-3 Sample 4 7-9'

Sampled By: Drill Crew

**Laboratory Data** 

Lab:





Method A (Composite Sieving) **Test Method:** 

**Dispersion Apparatus:** Shaking **Specimen Obtained:** Oven Dry

Classification: GP Poorly graded gravel with sand

100-90-80-70-60-50-40-30-20-10-0 100 10

Sieve Size (mm)

General

Results: The test is for informational purposes. Remarks: Total weight of dry sample 309.8 grams



**ASTM D6913** 

4511 West First Street Suite 4

Duluth, MN 55807 Phone: 218-624-4967 Client: Project:

Sampled By:

Enbridge Energy, Limited Partnership Attn: Accounts Payable5400 Westheimer Ct Houston, TX 77056

Enbridge Line 5 near Mellen, WI

Enbridge Line 5 Re-route

B2001991

**Drill Crew** 

**Sample Information** 

Sample Number: 318222 Alternate ID: 22-C Sample 18 65'

Sampling Method: Auger Boring ASTM D1452 Depth (ft): 65

**Boring Number:** 22-C Location: In-place

**Location Details:** Boring 22-C 18 65'

Sample Date: 05/16/2020

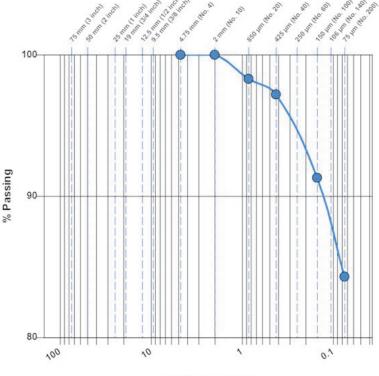
**Received Date:** 06/25/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

**Tested Date:** 06/25/2020 Tested By: Nelson, Brennan

#### **Laboratory Data**

Sieve Size	Passing (%)	Specification
4.75 mm (No. 4)	100.0	
2 mm (No. 10)	100.0	
850 µm (No. 20)	98.3	
425 μm (No. 40)	97.2	
150 µm (No. 100)	91.3	
75 μm (No. 200)	84.3	

**Sand (%)** Silt & Clay (%) 15.7 84.3



Particle Size (mm)

Classification: ML Silt with sand

Specimen Obtained: Oven Dry **Test Method:** Method A (Composite Sieving)

**Dispersion Apparatus:** Shaking

General

Results: The test is for informational purposes. Total dry weight of sample 224.8 grams Remarks:



**ASTM D6913** 

4511 West First Street Suite 4

Duluth, MN 55807 Phone: 218-624-4967

Sampling Method:

Client: Project:

Alternate ID:

Sampled By:

Depth (ft):

Enbridge Energy, Limited Partnership Attn: Accounts Payable5400 Westheimer Ct Houston, TX 77056

Enbridge Line 5

12

Drill Crew

near Mellen, WI

Enbridge Line 5 Re-route

B2001991

25-C Sample 7 12'

#### **Sample Information**

Sample Number: 318227

Auger Boring ASTM D1452

**Boring Number:** 25-C

Location: In-place

**Location Details:** Boring 25-C 7 12'

Sample Date: 04/24/2020

**Received Date:** 06/25/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

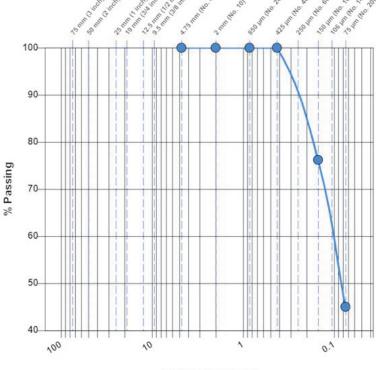
**Tested Date:** 06/29/2020 Tested By: Nelson, Brennan

#### **Laboratory Data**

Sieve Size	Passing (%)	Specification
4.75 mm (No. 4)	100.0	
2 mm (No. 10)	100.0	
850 µm (No. 20)	100.0	
425 μm (No. 40)	100.0	
150 µm (No. 100)	76.2	
75 μm (No. 200)	45.0	

**Sand (%)** Silt & Clay (%) 55.0 45.0

**D60** 0.111



Particle Size (mm)

Classification: SM Silty sand

Specimen Obtained: Oven Dry **Test Method:** Method A (Composite Sieving)

**Dispersion Apparatus:** Shaking

General

Results: The test is for informational purposes. Remarks: Total dry weight of sample 199.4 grams



**ASTM D6913** 

4511 West First Street Suite 4

Duluth, MN 55807 Phone: 218-624-4967 Client: Project:

Enbridge Energy, Limited Partnership Attn: Accounts Payable5400 Westheimer Ct

Houston, TX 77056

Enbridge Line 5 Re-route Enbridge Line 5 near Mellen, WI

B2001991

**Sample Information** 

Sample Number: 318228 Alternate ID: 25-C Sample 20 60'

Sampling Method: Auger Boring ASTM D1452 Depth (ft): 60

**Boring Number:** 25-C Sampled By: **Drill Crew** 

Location: In-place

**Location Details:** Boring 25-C 20 60'

Sample Date: 04/24/2020

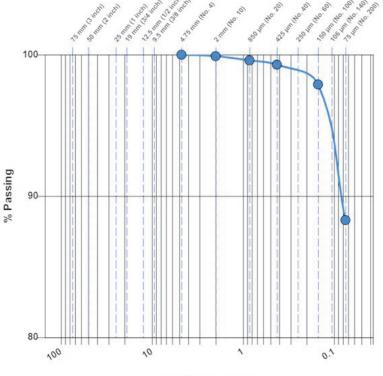
**Received Date:** 06/25/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

**Tested Date:** 06/29/2020 Tested By: Nelson, Brennan

#### **Laboratory Data**

Sieve Size	Passing (%)	Specification
4.75 mm (No. 4)	100.0	
2 mm (No. 10)	99.9	
850 µm (No. 20)	99.6	
425 µm (No. 40)	99.3	
150 µm (No. 100)	97.9	
75 μm (No. 200)	88.3	

**Sand (%)** Silt & Clay (%) 11.7 88.3



Particle Size (mm)

Classification: ML Silt with sand

Specimen Obtained: Oven Dry **Test Method:** Method A (Composite Sieving)

**Dispersion Apparatus:** Shaking

General

Results: The test is for informational purposes. Remarks: Total dry weight of sample 214.0 grams.



# Hydrometer And Sieve Analysis

11001 Hampshire Avenue S Minneapolis, MN 55438

Phone: 952-995-2000

Client: Project:

Enbridge Energy, Limited Partnership Attn: Accounts Payable5400 Westheimer Ct Houston, TX 77056

Enbridge Line 5 Re-route Enbridge Line 5 near Mellen, WI

B2001991

**Sample Information** 

Sample Number:320990Depth (ft):12.5Boring Number:22-CSampled By:Drill Crew

**Sample Date:** 06/23/2020

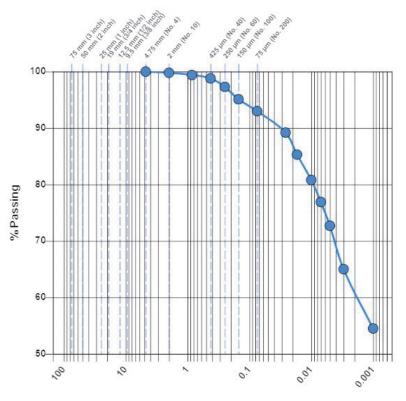
Received Date: 07/09/2020 Lab: 11001 Hampshire Ave S, Bloomington, MN

Tested Date: 07/10/2020 Tested By: Streier, Jim

#### **Laboratory Data**

**Sieve-Hydrometer Analysis** 

	<u> </u>						
Particle Size	% Passing	Specification					
4.75 mm (No. 4)	100.0	ı					
2 mm (No. 10)	99.8	-					
850 µm (No. 20)	99.4	-					
425 μm (No. 40)	98.8	-					
250 μm (No. 60)	97.3	-					
150 μm (No. 100)	95.1	-					
75 μm (No. 200)	93.0	-					
26.3 (µm)	89.2	-					
16.9 (µm)	85.3	-					
10.0 (µm)	80.8	-					
7.2 (µm)	76.9	-					
5.2 (µm)	72.7	-					
2.6 (µm)	65.0	-					
1.2 (µm)	54.5	-					



Particle Size (mm)

Soil Classification: CH Fat clay

Gravel (%): 0.0 Sand (%): 7.0 Silt (%): 20.3 Clay (%): 72.7

**D**<sub>60</sub> (μm): 2.0

#### General



# **Hydrometer And Sieve Analysis**

11001 Hampshire Avenue S Minneapolis, MN 55438 Phone: 952-995-2000

Client: Project:

Enbridge Energy, Limited Partnership Attn: Accounts Payable5400 Westheimer Ct Houston, TX 77056

Enbridge Line 5 Re-route Enbridge Line 5 near Mellen, WI

B2001991

**Sample Information** 

Sample Number: 320991 Depth (ft): 45

**Boring Number:** 22-C Sampled By: **Drill Crew** 

Sample Date: 06/23/2020

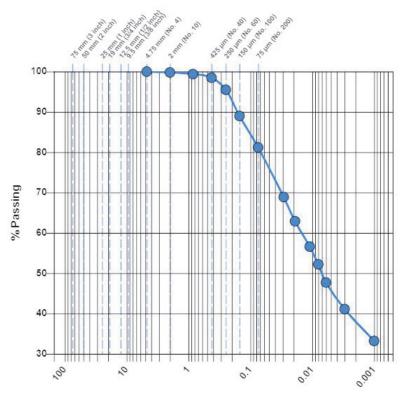
**Received Date:** 07/09/2020 Lab: 11001 Hampshire Ave S, Bloomington, MN

**Tested Date:** 07/10/2020 Tested By: Streier, Jim

#### **Laboratory Data**

Sieve-Hydrometer Analysis

	<u> </u>						
Particle Size	% Passing	Specification					
4.75 mm (No. 4)	100.0	1					
2 mm (No. 10)	99.8	-					
850 µm (No. 20)	99.4	-					
425 μm (No. 40)	98.5	-					
250 µm (No. 60)	95.5	-					
150 µm (No. 100)	89.0	-					
75 μm (No. 200)	81.2	-					
28.7 (µm)	68.9	-					
18.6 (µm)	62.9	-					
11.0 (µm)	56.6	-					
7.9 (µm)	52.2	-					
5.7 (µm)	47.7	-					
2.8 (µm)	41.1						
1.3 (µm)	33.2	-					



Particle Size (mm)

Soil Classification: CL Lean clay with sand

Gravel (%): Sand (%): Silt (%): 35.7 45.5 0.0 18.8 Clay (%):

D<sub>60</sub> (µm): 15.3

#### General



Phone: 218.624.4967 Fax: 218.624.0196 Web: braunintertec.com

B2001991

Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures (Method C) ASTM D 7012

Date: June 12, 2020 Project Number:

Client: Accounts Payable Enbridge Energy, Limited Partnership

5400 Westheimer Ct Houston, TX 77056 **Project Description:** Enbridge Line 5 Re-route

Sample Data

Date Sampled: Not Given Samples Obtained By: Braun Date Received: 6/3/2020

Sample Preparation: Trim and Polished

Laboratory Data ASTM D4543 Limits

Sample Number:	77-78	91-92	106-107	124-125	142-143	
Date Tested:	6/12/2020	6/12/2020	6/12/2020	6/12/2020	6/12/2020	
Rock Type:	Conglomerate	Conglomerate	Conglomerate	Conglomerate	Conglomerate	
Moisture Condition During Testing:	Dry	Dry	Dry	Dry	Dry	
Diameter (in.):	1.95	1.86	1.98	1.98		
Length (in.):	4.09	4.60	3.97	3.66	Untestable	
Length-to-Diameter Ratio (L/D):	2.1	2.5	2.0	1.8		$2.0 \le L/D \le 2.5$
Side Tolerance, Maximum (in.)	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	$\leq$ 0.020 in.
End Tolerance, Maximum (in.)	< 0.001 in	$\leq$ 0.001 in.				
Perpendicularity Deviation (°)	< 0.001 in	≤ 0.250°				
Parallelism Deviation (°)	< 0.001 in	≤ 0.25°				
Maximum Load (lbs):	14,070	33,294	20,692	5,286	Untestable	
Area (in <sup>2</sup> ):	2.99	2.72	3.08	3.08		
Compressive Strength (psi):	4,710	12,240	6,720	1,720		
Compressive Strength (MPa):	32	83	46	12		

Remarks:

Location 21-C

Reviewed By: David Morrison

D/M\_



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Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures (Method C) ASTM D 7012

**Date:** June 12, 2020

Project Number:

B2001991

Client: Accounts Payable

Enbridge Energy, Limited Partnership

5400 Westheimer Ct Houston, TX 77056 **Project Description:** Enbridge Line 5 Re-route

Sample Data

Date Sampled: Not Given Samples Obtained By: Braun Date Received: 6/3/2020

Sample Preparation: Trim and Polished

Laboratory Data ASTM D4543 Limits

Sample Number:	142-143	158-159	173-174	
Date Tested:	6/11/2020	6/11/2020	6/11/2020	
Rock Type:	Conglomerate	Conglomerate	Conglomerate	
Moisture Condition During Testing:	Dry	Dry	Dry	
Diameter (in.):	1.98	1.98	1.98	
Length (in.):	4.50	4.31	4.55	
Length-to-Diameter Ratio (L/D):	2.3	2.2	2.3	$2.0 \leq L/D \leq 2$
Side Tolerance, Maximum (in.)	< 0.020	< 0.020	< 0.020	$\leq$ 0.020 in.
End Tolerance, Maximum (in.)	< 0.001 in	< 0.001 in	< 0.001 in	$\leq$ 0.001 in.
Perpendicularity Deviation (°)	< 0.001 in	< 0.001 in	< 0.001 in	≤ 0.250°
Parallelism Deviation (°)	< 0.001 in	< 0.001 in	< 0.001 in	≤ 0.25°
Maximum Load (lbs):	85,541	3,142	25,231	
Area (in <sup>2</sup> ):	3.08	3.08	3.08	
Compressive Strength (psi):	27,770	1,020	8,190	
Compressive Strength (MPa):	189	7	56	

Remarks:

Location 21-C

Reviewed By: David Morrison

D/M\_



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# Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures (Method C) ASTM D 7012

**Date:** July 10, 2020

Accounts Payable

Enbridge Energy, Limited Partnership

5400 Westheimer Ct Houston, TX 77056 Project Number: B2001991

**Project Description:** Enbridge Line 5 Re-route

Sample Data

**Client:** 

Date Sampled: Not Given
Samples Obtained By: Braun
Date Received: 6/25/2020
Sample Preparation: Trim and Polished

Laboratory Data ASTM D4543 Limits

Sample Number:	94.5-95.5	110-111	124-125	142-143	
Date Tested:					
Rock Type:	Conglomerate	Conglomerate	Conglomerate	Conglomerate	
Moisture Condition During Testing:	Dry	Dry	Dry	Dry	
Diameter (in.):	1.98	1.97	1.97	1.97	
Length (in.):	3.86		2.77		
Length-to-Diameter Ratio (L/D):	1.9		1.4		$2.0 \le L/D \le 2.5$
Side Tolerance, Maximum (in.)	< 0.020	< 0.020	< 0.020	< 0.020	$\leq$ 0.020 in.
End Tolerance, Maximum (in.)	< 0.001 in	< 0.001 in	< 0.001 in	< 0.001 in	$\leq$ 0.001 in.
Perpendicularity Deviation (°)	< 0.001 in	< 0.001 in	< 0.001 in	< 0.001 in	≤ 0.250°
Parallelism Deviation (°)	< 0.001 in	< 0.001 in	< 0.001 in	< 0.001 in	≤ 0.25°
Maximum Load (lbs):	20,925		2,851		
Area (in <sup>2</sup> ):	3.08	3.05	3.05	3.05	
Compressive Strength (psi):	6,790	Untestable	930	Untestable	
Compressive Strength (MPa):	46		6		

Remarks:

Location 22-C

Reviewed By: David Morrison

II M



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# Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures (Method C) ASTM D 7012

**Date:** July 10, 2020

**Project Number:** 

B2001991

Client: Accounts Payable

Enbridge Energy, Limited Partnership

5400 Westheimer Ct Houston, TX 77056 **Project Description:** Enbridge Line 5 Re-route

Sample Data

Date Sampled: Not Given
Samples Obtained By: Braun
Date Received: 6/25/2020
Sample Preparation: Trim and Polished

Laboratory Data ASTM D4543 Limits

Sample Number:	155-156	167-168	177-178	
Date Tested:				
Rock Type:	Conglomerate	Conglomerate	Conglomerate	
Moisture Condition During Testing:	Dry	Dry	Dry	
Diameter (in.):	1.97	1.97	1.97	
Length (in.):	3.29	2.83		
Length-to-Diameter Ratio (L/D):	1.7	1.4		$2.0 \le L/D \le 2.5$
Side Tolerance, Maximum (in.)	< 0.020	< 0.020	< 0.020	$\leq$ 0.020 in.
End Tolerance, Maximum (in.)	< 0.001 in	< 0.001 in	< 0.001 in	$\leq$ 0.001 in.
Perpendicularity Deviation (°)	< 0.001 in	< 0.001 in	< 0.001 in	≤ 0.250°
Parallelism Deviation (°)	< 0.001 in	< 0.001 in	< 0.001 in	≤ 0.25°
Maximum Load (lbs):	5,697	4,105	Untestable	
Area (in <sup>2</sup> ):	3.05	3.05	3.05	
Compressive Strength (psi):	1,870	1,350	Untestable	
Compressive Strength (MPa):	13	9		

#### Remarks:

Location 22-C

Samples 155-156 and 167-168 were capped with sulfur

Reviewed By: David Morrison

91/M\_\_\_\_



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# Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures (Method C) ASTM D 7012

**Date:** June 26, 2020

Project Number:

B2001991

Client: Accounts Payable

Enbridge Energy, Limited Partnership

5400 Westheimer Ct Houston, TX 77056 **Project Description:** Enbridge Line 5 Re-route

#### Sample Data

Date Sampled:Not GivenSamples Obtained By:BraunDate Received:6/17/2020Sample Preparation:Trim and Polished

Laboratory Data ASTM D4543 Limits

Sample Number:	24-25	38-39	54-55	71-72	84-85	
Date Tested:	6/25/2020		6/25/2020	6/25/2020	6/25/2020	
Rock Type:	conglomerate		conglomerate	conglomerate	conglomerate	
Moisture Condition During Testing:	Dry		Dry	Dry	Dry	
Diameter (in.):	1.96		1.84	1.84	1.55	
Length (in.):	4.28		3.72	4.07	3.84	
Length-to-Diameter Ratio (L/D):	2.2		2.0	2.2	2.5	$2.0 \le L/D \le 2.5$
Side Tolerance, Maximum (in.)	< 0.020		< 0.020	< 0.020	< 0.020	$\leq$ 0.020 in.
End Tolerance, Maximum (in.)	< 0.001 in		< 0.001 in	< 0.001 in	< 0.001 in	$\leq$ 0.001 in.
Perpendicularity Deviation °)	< 0.001 in		< 0.001 in	< 0.001 in	< 0.001 in	≤ 0.250°
Parallelism Deviation °)	< 0.001 in		< 0.001 in	< 0.001 in	< 0.001 in	≤ 0.25°
Maximum Load (lbs):	17,939		2,916	5,788	3,025	
Area (in <sup>2</sup> ):	3.02		2.66	2.66	1.89	
Compressive Strength (psi):	5,940	UNTESTABLE	1,100	2,180	1,600	
Compressive Strength (MPa):	40		7	15	11	

#### Remarks:

Location (23-C-3)

Sample 71-72 was sulfur capped for testing purposes

Reviewed By: David Morrison

Im



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Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures (Method C) ASTM D 7012

**Date:** June 26, 2020

**Project Number:** 

B2001991

Client: Accounts Payable

Enbridge Energy, Limited Partnership

5400 Westheimer Ct Houston, TX 77056 **Project Description:** Enbridge Line 5 Re-route

Sample Data

Date Sampled: Not Given
Samples Obtained By: Braun
Date Received: 6/17/2020
Sample Preparation: Trim and Polished

Laboratory Data ASTM D4543 Limits

Sample Number:	97-98	106-107	
Date Tested:			
Rock Type:	conglomerate	conglomerate	
Moisture Condition During Testing:	Dry	Dry	
Diameter (in.):	1.88	1.86	
Length (in.):	4.37	3.79	
Length-to-Diameter Ratio (L/D):	2.3	2.0	
Side Tolerance, Maximum (in.)	< 0.020	< 0.020	
End Tolerance, Maximum (in.)	< 0.001 in	< 0.001 in	
Perpendicularity Deviation (°)	< 0.001 in	< 0.001 in	
Parallelism Deviation (°)	< 0.001 in	< 0.001 in	
Maximum Load (lbs):	12,433	2,745	
Area (in <sup>2</sup> ):	2.78	2.72	
Compressive Strength (psi):	4,470	1,010	
Compressive Strength (MPa):	30	7	

Remarks:

Location (23-C-3)

Reviewed By: David Morrison

The



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# Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures (Method C) ASTM D 7012

**Date:** July 10, 2020

Accounts Payable

Enbridge Energy, Limited Partnership

5400 Westheimer Ct Houston, TX 77056 Project Number: B2001991

**Project Description:** Enbridge Line 5 Re-route

Sample Data

**Client:** 

Date Sampled: Not Given
Samples Obtained By: Braun
Date Received: 6/25/2020
Sample Preparation: Trim and Polished

Laboratory Data ASTM D4543 Limits

Sample Number:	115.5-116.5	129-130	145-146	163-164	
Date Tested:					
Rock Type:	Conglomerate	Conglomerate	Conglomerate	Conglomerate	
Moisture Condition During Testing:	Dry	Dry	Dry	Dry	
Diameter (in.):	1.85	1.84	1.86	1.86	
Length (in.):	3.82		3.45	3.05	
Length-to-Diameter Ratio (L/D):	2.1		1.9	1.6	$2.0 \leq L/D \leq 1$
Side Tolerance, Maximum (in.)	< 0.020	< 0.020	< 0.020	< 0.020	≤ 0.020 in
End Tolerance, Maximum (in.)	< 0.001 in	< 0.001 in	< 0.001 in	< 0.001 in	≤ 0.001 in
Perpendicularity Deviation (°)	< 0.001 in	< 0.001 in	< 0.001 in	< 0.001 in	≤ 0.250°
Parallelism Deviation (°)	< 0.001 in	< 0.001 in	< 0.001 in	< 0.001 in	≤ 0.25°
Maximum Load (lbs):	36,723	Untestable	3,366	3,835	
Area (in <sup>2</sup> ):	2.69	2.66	2.72	2.72	
Compressive Strength (psi):	13,650		1,240	1,410	
Compressive Strength (MPa):	93		8	10	

Remarks:

Location 25-C

Sample 163-164 was capped with sulfur

Reviewed By: David Morrison

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