

Subsurface Investigation Report

Enbridge Line 5 Reroute

MP 14 HDD Crossing – Brunswweiler 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.

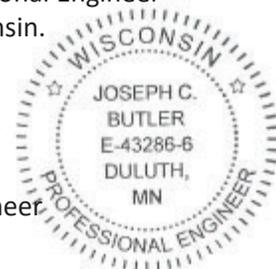


Joseph C. Butler, PE

Business Unit Manager / Senior Engineer

License Number: E-43286-6

August 21, 2020



Project B2001991

Braun Intertec Corporation

August 21, 2020

Project B2001991

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 – Brunswelier 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 Brunswelier 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 (kwarmuth@braunintertec.com) or David Morrison (dmorrison@braunintertec.com) at 218.624.4967.

Sincerely,

BRAUN INTERTEC CORPORATION



Kyle P. Warmuth
Staff Consultant



David E. Morrison
Project 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 Brunsweler 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)
Upper Soils (844 to 773)	Silty Sand (SM)	3 - 13	107 - 115	110 - 118	27 - 30	5 - 15	0.5 – 1.0	0.1 – 1.35	17 - 91
	Sandy Silt (ML)	9 - 21	93 - 101	112 - 122	26 - 31	29 - 31	0	0	36 - 91
	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
Middle Soils (780 to 729 1/2)	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
	Silt (ML)	21 - 29	100 - 120	120 - 125	31 - 33	31 - 33	0	0	84 - 125
	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

*Sustained Young's Modulus values

**Conglomerate

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.

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.

Appendix

Project Number B2001991 Geotechnical Evaluation Enbridge Line 5 Re-Route Various Locations Ashland and Iron Counties, Wisconsin					BORING: 21-C			
					LOCATION: See attached sketch			
					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	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks	
839.5	∞	SILTY SAND (SM), fine-grained, brown, moist (GLACIAL TILL)	5	1-1-2-4 (3) 24"	21	21	Test results are in the attached lab report	
4.5				4-7-6-9 (13) 16"				
830.0		14.0	POORLY GRADED SAND with SILT (SP-SM), fine-grained, trace Gravel, brown, moist to wet, medium dense to dense (GLACIAL TILL)	15				3-9-9-11 (18) 18"
								4-10-11-14 (21) 24"
				10				3-7-8-12 (15) 24"
				20				2-4-5-7 (9) 24"
			25	2-5-6-7 (11) 24"				
			30	7-14-16 (30) 18"				
			30	16-21-23 (44) 18"				
			30	9-10-11 (21) 18"				
Continued on next page								

Project Number B2001991				BORING: 21-C	
Geotechnical Evaluation				LOCATION: See attached sketch	
Enbridge Line 5 Re-Route				LATITUDE: 46.40544 LONGITUDE: -90.81643	
Various Locations				START DATE: 05/14/20 END DATE: 05/14/20	
Ashland and Iron Counties, Wisconsin				SURFACING: WEATHER:	
DRILLER: EPC		LOGGED BY: A. Hillerud			
SURFACE ELEVATION: 844.0 ft	RIG: Subcontractor	METHOD: 4 1/4" HSA			

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
806.0		POORLY GRADED SAND with SILT (SP-SM), fine-grained, trace Gravel, brown, moist to wet, medium dense to dense (GLACIAL TILL)	35	9-18-23 (41) 18"			
38.0		SILT with SAND (ML), brown, wet, medium dense to very dense (GLACIAL TILL)	40	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		SILTY CLAY (CH), with Sand, brown, wet, stiff (GLACIAL TILL)	60	3-5-6 (11) 18"			
58.0							
781.0		SILTY SAND (SM), fine to medium-grained,					
63.0							

Continued on next page

Project Number B2001991 Geotechnical Evaluation Enbridge Line 5 Re-Route Various Locations Ashland and Iron Counties, Wisconsin	BORING: 21-C	
	LOCATION: See attached sketch	
	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	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks		
773.2 70.8		SILTY SAND (SM), fine to medium-grained, trace Gravel, brown, wet, dense to very dense (GLACIAL TILL)	65	9-19-24 (43) 18"		15	Test results are in the attached lab report		
			70	19-50/3" (REF) 9"			Auger met refusal at 70.8 feet		
							Drilling method switched to rock coring at 74 feet		
766.5		FREDA SANDSTONE, CONGLOMERATE, gray with red, decomposed, moderately hard, fine-grained to medium-grained, medium bedded, highly fractured	75	0 70			Run 1 MOH's 3		
77.5		<i>Test results are in the attached lab report</i>		0 100			Run 2 MOH's 3		
763.5		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to medium-grained, thick bedded, moderately fractured	80	70 100			Run 3 MOH's 3		
80.5		FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, moderately hard, fine-grained to medium-grained, medium bedded, highly fractured		90 100			Run 4 MOH's 3		
761.5		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, thick bedded, highly fractured		20 100			Run 5 MOH's 3		
82.5		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, thick bedded, highly fractured	85	25 60			Run 6 MOH's 3		
755.9				55 100			Run 7 MOH's 3		
88.1		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured	90	80 100			Run 8 MOH's 3		
		<i>Test results are in the attached lab report</i>		40 100			Run 9 MOH's 3		
748.5			95						
95.5									

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RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Water Return %	Remarks
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Project Number B2001991 Geotechnical Evaluation Enbridge Line 5 Re-Route Various Locations Ashland and Iron Counties, Wisconsin					BORING: 21-C							
					LOCATION: See attached sketch							
					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	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Water Return %	Remarks		
745.2		FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, moderately hard, fine-grained to medium-grained, medium bedded, highly fractured		25	75					Run 10 MOH's 3		
98.8		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured	100	45	100					Run 11 MOH's 4		
743.5		FREDA SANDSTONE, CONGLOMERATE, gray with red, highly weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured		0	100					Run 12 MOH's 3		
100.5		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured		55	100					Run 13 MOH's 3		
741.0		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 3		
103.0		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured	105	65	100					Run 15 MOH's 4		
738.5		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured		50	100					Run 16 MOH's 3		
105.5		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured		50	100					Run 17 MOH's 3		
733.5		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured	110	70	100					Run 18 MOH's 3		
110.5		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured		70	100					Run 19 MOH's 3		
723.5		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured	115	70	100							
120.5		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured		70	100							
718.5		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured	120	70	100							
125.5		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured		70	100							
		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured	125	70	100							
Continued on next page												

Project Number B2001991 Geotechnical Evaluation Enbridge Line 5 Re-Route Various Locations Ashland and Iron Counties, Wisconsin	BORING: 21-C	
	LOCATION: See attached sketch	
	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	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	RQD %	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, medium bedded, highly fractured	130	30	100					Run 20 MOH's 3
				30	90					Run 21 MOH's 3
			135	40	90					Run 22 MOH's 3
				0	100					Run 23 MOH's 3
				45	100					Run 24 MOH's 3
703.5			140							Run 24 MOH's 3
140.5		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, thick bedded, moderately fractured		55	100					Run 25 MOH's 3
700.5		<i>Test results are in the attached lab report</i>								Run 25 MOH's 3
143.5		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured	145	15	100					Run 26 MOH's 3
698.5		FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, moderately hard, fine-grained to medium-grained, medium bedded, highly fractured		0	100					Run 27 MOH's 3
145.5				50	100					Run 28 MOH's 3
			150	30	100					Run 29
689.5		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, thick bedded, highly fractured	155	35	100					Run 30
154.5		<i>Test results are in the attached lab report</i>		50	100					

Continued on next page

Project Number B2001991 Geotechnical Evaluation Enbridge Line 5 Re-Route Various Locations Ashland and Iron Counties, Wisconsin					BORING: 22-C		
					LOCATION: See attached sketch		
					LATITUDE: 46.40527	LONGITUDE: -90.81324	
DRILLER: EPC	LOGGED BY: P. Moe	START DATE: 05/06/20	END DATE: 05/13/20				
SURFACE ELEVATION: 844.1 ft	RIG: Subcontractor	METHOD: 4 1/4" HSA	SURFACING:	WEATHER: sunny, windy			
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
840.1		FILL: SILTY SAND (SM), fine to medium-grained, trace organic, roots, brown, moist		1-1-2-1 (3) 12"			
4.0				2-3-3-3 (6) 14"			
838.1		SANDY SILT (ML), fine to medium-grained, brown, moist, stiff (LACUSTRINE)	5	2-7-7-8 (14) 16"			
6.0		SILTY CLAY with SAND (CL-ML), fine to medium-grained, brown, moist, medium (LACUSTRINE)		3-8-7-8 (15) 14"			
836.1				1-0-1-0 (1) WOH/12" 24"			
8.0		POORLY GRADED SAND with SILT (SP-SM), fine to medium-grained, brown, moist, medium dense (GLACIAL TILL)					
834.1		FAT CLAY (CH), reddish brown, moist, very soft to medium (LACUSTRINE)	10				
10.0				TW 24"		51	Thinwall Test results are in the attached lab report
				0-0-1-1 (1) WOH/12" 24"			
			15				
				TW 24"			Thinwall
			20				
				0-1-1-3 (2) WOH/6" 24"			
			25				
				TW 24"			Drilling method switched to mud rotary at 30 feet Thinwall
			30				

Continued on next page

Project Number B2001991				BORING: 22-C	
Geotechnical Evaluation				LOCATION: See attached sketch	
Enbridge Line 5 Re-Route				LATITUDE: 46.40527	LONGITUDE: -90.81324
Various Locations				START DATE: 05/06/20	END DATE: 05/13/20
DRILLER: EPC		LOGGED BY: P. Moe		SURFACING:	
SURFACE ELEVATION: 844.1 ft		RIG: Subcontractor	METHOD: 4 1/4" HSA	WEATHER: sunny, windy	

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
		FAT CLAY (CH), reddish brown, moist, very soft to medium (LACUSTRINE)					
			35	0-1-3-2 (4) WOH/6" 24"			
			40	TW 24"			Thinwall
799.1 45.0		LEAN CLAY with SAND (CL), fine to medium-grained, brown, moist, hard (LACUSTRINE)				26	Test results are in the attached lab report
			45	0-2-3-3 (5) WOH/6" 18"			
			50	TW 24"			Thinwall
791.1 53.0		SILTY SAND (SM), fine to medium-grained, brown, moist, very dense (GLACIAL TILL)					
			55	20-20-24-31 (44) 18"			
			60	16-28-43-49 (71) 20"			
782.1 62.0		SILT with SAND (ML), fine to medium-grained, brown, moist, hard (GLACIAL TILL)					

Continued on next page

Project Number B2001991 Geotechnical Evaluation Enbridge Line 5 Re-Route Various Locations Ashland and Iron Counties, Wisconsin					BORING: 22-C					
					LOCATION: See attached sketch					
DRILLER: EPC			LOGGED BY: P. Moe		LATITUDE: 46.40527	LONGITUDE: -90.81324				
SURFACE ELEVATION: 844.1 ft			RIG: Subcontractor	METHOD: 4 1/4" HSA	START DATE: 05/06/20	END DATE: 05/13/20				
					SURFACING:		WEATHER: sunny, windy			
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks			
776.1		SILT with SAND (ML), fine to medium-grained, brown, moist, hard (GLACIAL TILL)	65	14-30-27-36 (57) 20"		18	Test results are in the attached lab report Auger met refusal at 71 feet. Set casing at 73 feet.			
68.0		LEAN CLAY with SAND (CL), with rock fragments, brown, moist, hard (GLACIAL TILL)	70	50/4" (REF) 4"						
773.1		FREDIA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, moderately hard, fine-grained to medium-grained, medium bedded, highly fractured	75	0 40			Run 1 MOH's 4			
766.6			75	20 100			Run 2 MOH's 4			
77.5			80	20 90			Run 3 MOH's 4			
			85	40 60			Run 4 MOH's 4			
			90	10 70			Run 5 MOH's 4			
753.1			95	70 100			Run 6 MOH's 4			
91.0		FREDIA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured <i>Test results are in the attached lab report</i>								
Continued on next page				RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Water Return %	Remarks

Project Number B2001991 Geotechnical Evaluation Enbridge Line 5 Re-Route Various Locations Ashland and Iron Counties, Wisconsin					BORING: 22-C					
					LOCATION: See attached sketch					
					LATITUDE: 46.40527	LONGITUDE: -90.81324				
DRILLER: EPC	LOGGED BY: P. Moe		START DATE: 05/06/20	END DATE: 05/13/20						
SURFACE ELEVATION: 844.1 ft	RIG: Subcontractor	METHOD: 4 1/4" HSA	SURFACING:		WEATHER: sunny, windy					
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Water Return %	Remarks
743.1		FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured	100	75	100					Run 7 MOH's 4
101.0		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, thick bedded, moderately fractured	105	95	100					Run 8 MOH's 4
738.1		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, thick bedded, highly fractured	110	70	100					Run 9 MOH's 4
106.0		<i>Test results are in the attached lab report</i>	115	90	100					Run 10
728.1		FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured	120	55	100					Run 11 MOH's 4
116.0			125	20	100					Run 12 MOH's 4
721.1		FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, moderately hard, fine-grained to coarse-grained, thick bedded, highly fractured	125	35	100					Run 13 MOH's 4
123.0		<i>Test results are in the attached lab report</i>								
716.1		Continued on next page								
128.0										

Project Number B2001991 Geotechnical Evaluation Enbridge Line 5 Re-Route Various Locations Ashland and Iron Counties, Wisconsin					BORING: 22-C					
					LOCATION: See attached sketch					
					LATITUDE: 46.40527	LONGITUDE: -90.81324				
DRILLER: EPC	LOGGED BY: P. Moe	START DATE: 05/06/20	END DATE: 05/13/20							
SURFACE ELEVATION: 844.1 ft	RIG: Subcontractor	METHOD: 4 1/4" HSA	SURFACING:	WEATHER: sunny, windy						
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Water Return %	Remarks
711.1		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, thick bedded, highly fractured	130	70	100					Run 14 MOH's 4
133.0		FREDA SANDSTONE, CONGLOMERATE, gray with red, fine-grained to coarse-grained, medium bedded, highly fractured	135	15	80					Run 15 MOH's 4
707.1		FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, very soft, fine-grained, medium bedded, highly fractured		40	85					Run 16 MOH's 2
137.0		FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, moderately hard, fine-grained to coarse-grained, thick bedded, highly fractured	140	75	100					Run 17 MOH's 4
706.1		<i>Test results are in the attached lab report</i>								
138.0			145	35	75					Run 18 MOH's 4
696.1		FREDA SANDSTONE, CONGLOMERATE, gray with red, highly weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured	150	15	100					Run 19 MOH's 4
148.0		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, thick bedded, highly fractured	155	60	100					Run 20
691.1		<i>Test results are in the attached lab report</i>								
153.0										
686.1		FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, moderately hard, fine-grained to coarse-grained, thick								Run 21 MOH's 4
158.0										

Continued on next page

Project Number B2001991 Geotechnical Evaluation Enbridge Line 5 Re-Route Various Locations Ashland and Iron Counties, Wisconsin					BORING: 22-C							
					LOCATION: See attached sketch							
					LATITUDE: 46.40527		LONGITUDE: -90.81324					
DRILLER: EPC		LOGGED BY: P. Moe		START DATE: 05/06/20		END DATE: 05/13/20						
SURFACE ELEVATION: 844.1 ft		RIG: Subcontractor		METHOD: 4 1/4" HSA		SURFACING:		WEATHER: sunny, windy				
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Water Return %	Remarks		
681.1		FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, moderately hard, fine-grained to coarse-grained, thick bedded, highly fractured		40	100							
163.0		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, massive, moderately fractured	165	70	100					Run 22 MOH's 4		
676.1		<i>Test results are in the attached lab report</i>										
168.0		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, massive, highly fractured	170	65	100					Run 23 MOH's 4		
671.1		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to coarse-grained, massive, moderately fractured	175	70	100					Run 24 MOH's 4		
173.0		<i>Test results are in the attached lab report</i>										
666.1		END OF CORING										
178.0		Boring then backfilled with cement/bentonite grout	180							Water not observed while drilling.		
			185									
			190									

Project Number B2001991 Geotechnical Evaluation Enbridge Line 5 Re-Route Various Locations Ashland and Iron Counties, Wisconsin	BORING: 23-C-3	
	LOCATION: See attached sketch	
	LATITUDE: 46.40667	LONGITUDE: -90.81112

DRILLER: EPC	LOGGED BY: A. Hillerud	START DATE: 06/01/20	END DATE: 06/04/20
SURFACE ELEVATION: 775.6 ft	RIG: Subcontractor	METHOD: 4 1/4" HSA	SURFACING: WEATHER:

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks			
771.6 4.0	K	SILTY SAND (SM), fine to medium-grained, with Gravel, brown, moist, medium dense (GLACIAL OUTWASH)		1-8-10-16 (18) 14" 9-7-7-6 (14) 4"						
768.6 7.0		POORLY GRADED SAND with SILT (SP-SM), fine to medium-grained, trace Gravel, brown, moist, loose (GLACIAL OUTWASH)	5	2-2-2-4 (4) 12"						
763.6 12.0		POORLY GRADED GRAVEL with SAND (GP), fine to coarse-grained, brown, wet, medium dense (GLACIAL OUTWASH)	10	4-5-11-14 (16) 8" 13-14-7-6 (21) 10"		11		Test results are in the attached lab report	Drilling method switched to mud rotary at 10 feet	
761.6 14.0		SILT with SAND (ML), trace Gravel, brown, moist, medium dense (LACUSTRINE)		8-11-14-17 (25) 18"						
759.8 15.8		LEAN CLAY with SAND (CL), with Gravel, brown, moist, hard (LACUSTRINE)	15	10-13-50/4" (REF) 12"					Auger met refusal at 15.8 feet. Drilling method switched to rock coring at 18 feet.	
752.6 23.0			FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, hard, fine-grained to medium-grained, medium bedded, highly fractured	20	0 50				Run 1 MOH's 4	
748.0 27.5		FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, moderately hard, fine-grained to coarse-grained, thick bedded, highly fractured <i>Test results are in the attached lab report</i>	25	30 100				Run 2 MOH's 4		
		FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, moderately hard, fine-grained to coarse-grained, thick bedded, highly fractured	30	65 90				Run 3 - No recovery Run 4 MOH's 3		
Continued on next page				RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Water Return %	Remarks

Project Number B2001991 Geotechnical Evaluation Enbridge Line 5 Re-Route Various Locations Ashland and Iron Counties, Wisconsin					BORING: 23-C-3					
					LOCATION: See attached sketch					
					LATITUDE: 46.40667	LONGITUDE: -90.81112				
DRILLER: EPC	LOGGED BY: A. Hillerud		START DATE: 06/01/20	END DATE: 06/04/20						
SURFACE ELEVATION: 775.6 ft	RIG: Subcontractor	METHOD: 4 1/4" HSA	SURFACING:		WEATHER:					
Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Water Return %	Remarks
743.0		FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, moderately hard, fine-grained to coarse-grained, thick bedded, highly fractured		100	100					Run 5 MOH's 5
32.5				40	80					Run 6 MOH's 4
742.6										Run 7 MOH's 4
33.0										
740.6		FREDA SANDSTONE, CONGLOMERATE, red with gray, slightly weathered, hard, fine-grained to medium-grained, thick bedded, moderately fractured	35	65	100					
35.0										Run 8 MOH's 3
		FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, moderately hard, fine-grained to coarse-grained, thick bedded, highly fractured								
		FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, moderately hard, fine-grained to coarse-grained, thick bedded, moderately fractured	40	65	100					
732.6		<i>Test results are in the attached lab report</i>								Run 9 MOH's 3
43.0		FREDA SANDSTONE, CONGLOMERATE, gray with red, highly weathered, moderately hard, fine-grained to coarse-grained, thick bedded, highly fractured	45	45	100					
										Run 10 MOH's 3
			50	20	30					
722.6										Run 11 MOH's 4
53.0		FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, moderately hard, fine-grained to coarse-grained, thick bedded, highly fractured	55	40	80					
		<i>Test results are in the attached lab report</i>								Run 12 MOH's 4
717.6		FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured	60	45	80					
58.0										Run 13 MOH's 4
713.6										Run 14 MOH's 4
62.0		FREDA SANDSTONE, CONGLOMERATE, gray with red, highly weathered, moderately hard, fine-grained to medium-grained, medium		0	60					
712.6										
63.0										

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Project Number B2001991 Geotechnical Evaluation Enbridge Line 5 Re-Route Various Locations Ashland and Iron Counties, Wisconsin	BORING: 23-C-3	
	LOCATION: See attached sketch	
	LATITUDE: 46.40667	LONGITUDE: -90.81112

DRILLER: EPC	LOGGED BY: A. Hillerud	START DATE: 06/01/20	END DATE: 06/04/20
SURFACE ELEVATION: 775.6 ft	RIG: Subcontractor	METHOD: 4 1/4" HSA	SURFACING:
		WEATHER:	

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Water Return %	Remarks
707.6		FREDA SANDSTONE, CONGLOMERATE, gray with red, highly weathered, moderately hard, fine-grained to medium-grained, medium bedded, highly fractured	65	35	90					
68.0		FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured		0	80					Run 15 MOH's 4
704.6		FREDA SANDSTONE, CONGLOMERATE, gray with red, highly weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured	70	40	75					Run 16 MOH's 4
71.0		FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured <i>Test results are in the attached lab report</i>		75	15	100				Run 17 MOH's 3
				80	40	100				Run 18 MOH's 3
692.6		FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, moderately hard, fine-grained to coarse-grained, thick bedded, highly fractured <i>Test results are in the attached lab report</i>		85	45	100				Run 19 MOH's 3
83.0				90	35	100				Run 20 MOH's 3
682.6		FREDA SANDSTONE, CONGLOMERATE, gray with red, highly weathered, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured		95	35	100				Run 21 MOH's 3
93.0										

Continued on next page

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2001991				BORING: 25-C	
Geotechnical Evaluation				LOCATION: See attached sketch	
Enbridge Line 5 Re-Route				LATITUDE: 46.40430	LONGITUDE: -90.80661
Various Locations				START DATE: 04/24/20	END DATE: 05/04/20
DRILLER: EPC		LOGGED BY: S. Sullivan		SURFACING:	
SURFACE ELEVATION: 839.3 ft		RIG: Subcontractor	METHOD: 3 1/4" HSA	WEATHER:	

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
		SILTY SAND (SM), fine to medium-grained, brown, moist, medium dense to very dense (GLACIAL TILL)					
			35	9-12-13-19 (25) 18"			
			40	9-11-14-17 (25) 18"			
			45	7-11-12-11 (23) 14"			
			50	10-13-13-20 (26) 22"			
			55	7-11-17-19 (28) 16"			
779.8							
59.5		SILT with SAND (ML), fine to medium-grained, brown, moist, medium dense (GLACIAL TILL)	60	9-13-16-20 (29) 14"		21	Test results are in the attached lab report

Continued on next page

Project Number B2001991				BORING: 25-C	
Geotechnical Evaluation				LOCATION: See attached sketch	
Enbridge Line 5 Re-Route				LATITUDE: 46.40430	
Various Locations				LONGITUDE: -90.80661	
Ashland and Iron Counties, Wisconsin				START DATE: 04/24/20	
DRILLER: EPC		LOGGED BY: S. Sullivan		END DATE: 05/04/20	
SURFACE ELEVATION: 839.3 ft		RIG: Subcontractor		SURFACING:	
		METHOD: 3 1/4" HSA		WEATHER:	

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks
		SILT with SAND (ML), fine to medium-grained, brown, moist, medium dense (GLACIAL TILL)	65	7-13-12-12 (25) 16"			
			70	9-10-11-19 (21) 14"			
765.3							
74.0		SILTY, CLAYEY SAND (SC-SM), fine to medium-grained, reddish brown, moist, stiff to hard (GLACIAL TILL)	75	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-SM), fine to medium-grained, with Gravel, brown, moist, hard (GLACIAL TILL)	90	14-19-21-46 (40) 16"			
			95	50/2" (REF) 2"			
745.3		SILTY SAND (SM), fine to medium-grained, with rock fragments, gray, moist, very dense (GLACIAL TILL)					
94.0							

Continued on next page

Project Number B2001991				BORING: 25-C	
Geotechnical Evaluation				LOCATION: See attached sketch	
Enbridge Line 5 Re-Route				LATITUDE: 46.40430	
Various Locations				LONGITUDE: -90.80661	
Ashland and Iron Counties, Wisconsin				START DATE: 04/24/20	
DRILLER: EPC		LOGGED BY: S. Sullivan		END DATE: 05/04/20	
SURFACE ELEVATION: 839.3 ft		RIG: Subcontractor		SURFACING:	
		METHOD: 3 1/4" HSA		WEATHER:	

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or Remarks	
729.3 110.0		SILTY SAND (SM), fine to medium-grained, with rock fragments, gray, moist, very dense (GLACIAL TILL)		50/2" (REF) 2" 50/1" (REF) 1" 50/1" (REF) 1"				
726.3 113.0		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, soft, fine-grained to medium-grained, thick bedded, highly fractured		25 65 0 75			Run 1 MOH's = 2	
725.3 114.0		FREDA SANDSTONE, CONGLOMERATE, gray with red, decomposed, moderately hard, fine-grained to coarse-grained, medium bedded, highly fractured		0 100			Run 2 MOH's = 3	
724.3 115.0		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to medium-grained, medium bedded, highly fractured		70 100			Run 3 MOH's = 3	
719.3 120.0		FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, moderately hard, fine-grained to coarse-grained, thick bedded, highly fractured <i>Test results are in the attached lab report</i>		60 100			Run 4 MOH's = 3	
714.3 125.0		FREDA SANDSTONE, CONGLOMERATE, gray with red, slightly weathered, moderately hard, fine-grained to medium-grained, thick bedded, highly fractured		85 100			Run 5 MOH's = 3	
		FREDA SANDSTONE, CONGLOMERATE, gray with red, decomposed, moderately hard, fine-grained to coarse-grained, thick bedded, highly fractured					Run 6 MOH's = 3	

Continued on next page

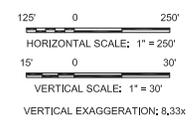
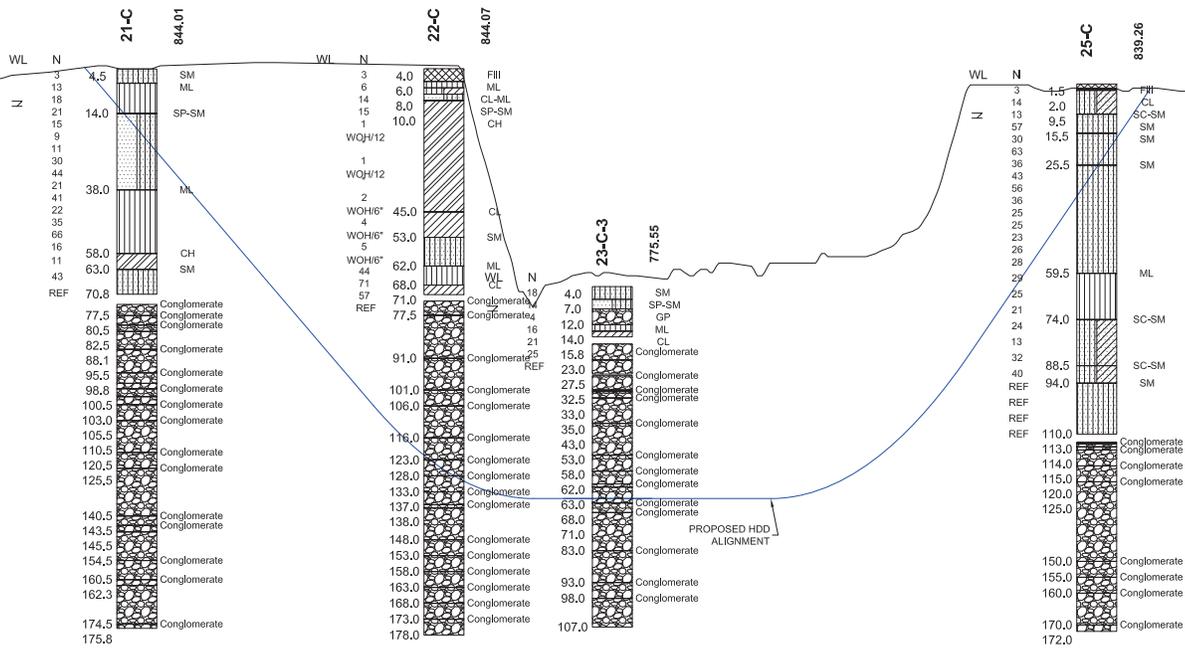
RQD % Recovery % Drilling Rate (min/ft) Bit Pressure (psi) Water Pressure (psi) Water Return % Remarks

Project Number B2001991 Geotechnical Evaluation Enbridge Line 5 Re-Route Various Locations Ashland and Iron Counties, Wisconsin					BORING: 25-C					
					LOCATION: See attached sketch					
					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 ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Water Return %	Remarks
		FREDA SANDSTONE, CONGLOMERATE, gray with red, decomposed, moderately hard, fine-grained to coarse-grained, thick bedded, highly fractured <i>Test results are in the attached lab report</i>	130	50	100					Run 7 MOH's = 3
			135	70	100					Run 8 MOH's = 3
			140	80	100					Run 9 MOH's = 3
		<i>Test results are in the attached lab report</i>	145	75	100					Run 10 MOH's = 3
689.3 150.0		FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, soft, fine-grained to medium-grained, medium bedded, highly fractured	150	35	100					Run 11 MOH's = 3
684.3 155.0			155	55	100					Run 12 MOH's = 3
679.3 160.0		FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, soft, fine-grained to medium-grained, thick bedded, highly fractured		60	100					Run 13 MOH's = 3
Continued on next page										

Project Number B2001991				BORING: 25-C	
Geotechnical Evaluation				LOCATION: See attached sketch	
Enbridge Line 5 Re-Route				LATITUDE: 46.40430	
Various Locations				LONGITUDE: -90.80661	
Ashland and Iron Counties, Wisconsin				START DATE: 04/24/20	
DRILLER: EPC		LOGGED BY: S. Sullivan		END DATE: 05/04/20	
SURFACE ELEVATION: 839.3 ft		RIG: Subcontractor		SURFACING:	
		METHOD: 3 1/4" HSA		WEATHER:	

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	RQD %	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 <i>Test results are in the attached lab report</i>		90	100					Run 14 MOH's = 3
			165	85	100					Run 15 MOH's = 3
669.3		FREDA SANDSTONE, CONGLOMERATE, gray with red, moderately weathered, moderately hard, fine-grained to medium-grained, thin bedded, highly fractured	170	0	50					Run 16 MOH's = 3
170.0		END OF CORING								Water observed at 10.0 feet while drilling.
667.3		Boring then backfilled with cement/bentonite grout	175							
172.0			180							
			185							
			190							

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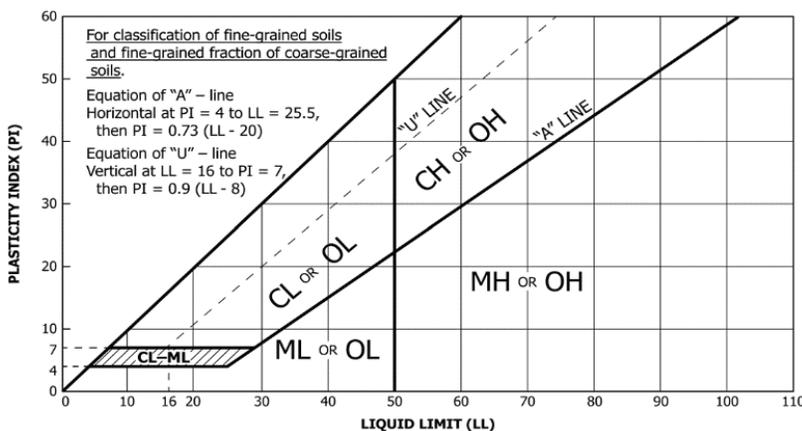
Drawing Information	
Project No:	B2001991
Drawing No:	800199_MP14_BrunswellerRiver
Drawn By:	BJS
Date Drawn:	7/16/20
Checked By:	DM
Last Modified:	7/22/20

Project Information	
Enbridge Line 5 Re-route	

MP 14 - Brunsweller River Crossing

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A			Soil Classification	
			Group Symbol	Group Name ^B
Coarse-grained Soils (more than 50% retained on No. 200 sieve)	Gravels (More than 50% of coarse fraction retained on No. 4 sieve)	Clean Gravels (Less than 5% fines ^C) $C_u \geq 4$ and $1 \leq C_c \leq 3^D$	GW	Well-graded gravel ^E
		Gravels with Fines (More than 12% fines ^C) Fines classify as ML or MH	GP	Poorly graded gravel ^E
	Sands (50% or more coarse fraction passes No. 4 sieve)	Clean Sands (Less than 5% fines ^H) $C_u \geq 6$ and $1 \leq C_c \leq 3^D$	SW	Well-graded sand ^I
		Sands with Fines (More than 12% fines ^H) $C_u < 6$ and/or ($C_c < 1$ or $C_c > 3$) ^D	SP	Poorly graded sand ^I
		Fines classify as ML or MH	SM	Silty sand ^{F,G,I}
			Fines classify as CL or CH	SC
Fine-grained Soils (50% or more passes the No. 200 sieve)	Silts and Clays (Liquid limit less than 50)	Inorganic PI > 7 and plots on or above "A" line ^J	CL	Lean clay ^{K,L,M}
		PI < 4 or plots below "A" line ^J	ML	Silt ^{K,L,M}
	Organic Liquid Limit - oven dried Liquid Limit - not dried < 0.75	OL	Organic clay ^{K,L,M,N} Organic silt ^{K,L,M,O}	
		Silts and Clays (Liquid limit 50 or more)	Inorganic PI plots on or above "A" line	CH
	PI plots below "A" line		MH	Elastic silt ^{K,L,M}
	Organic Liquid Limit - oven dried Liquid Limit - not dried < 0.75	OH	Organic clay ^{K,L,M,P} Organic silt ^{K,L,M,Q}	
		Highly Organic Soils	Primarily organic matter, dark in color, and organic odor	PT

- A. Based on the material passing the 3-inch (75-mm) sieve.
- B. If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
- C. 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
- D. $C_u = D_{60} / D_{10}$ $C_c = (D_{30})^2 / (D_{10} \times D_{60})$
- E. If soil contains $\geq 15\%$ sand, add "with sand" to group name.
- F. 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.
- H. 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
SP-SC poorly graded sand with clay
- I. If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.
- J. If Atterberg limits plot in hatched area, soil is CL-ML, silty clay.
- K. If soil contains 15 to < 30% plus No. 200, add "with sand" or "with gravel", whichever is predominant.
- L. If soil contains $\geq 30\%$ plus No. 200, predominantly sand, add "sandy" to group name.
- M. If soil contains $\geq 30\%$ plus No. 200 predominantly gravel, add "gravelly" to group name.
- N. $PI \geq 4$ and plots on or above "A" line.
- O. $PI < 4$ or plots below "A" line.
- P. PI plots on or above "A" line.
- Q. PI plots below "A" line.



Laboratory Tests					
DD	Dry density, pcf	OC	Organic content, %	LL	Liquid limit
WD	Wet density, pcf	q _p	Pocket penetrometer strength, tsf	PL	Plastic limit
P200	% Passing #200 sieve	MC	Moisture content, %	PI	Plasticity index
		q _u	Unconfined compression test, tsf		

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^{L,M}

trace..... 0 to 5%
little..... 6 to 14%
with..... $\geq 15\%$

Inclusion Thicknesses

lens..... 0 to 1/8"
seam..... 1/8" to 1"
layer..... over 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 Cohesive Soils Blows Per Foot Approximate Unconfined 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.

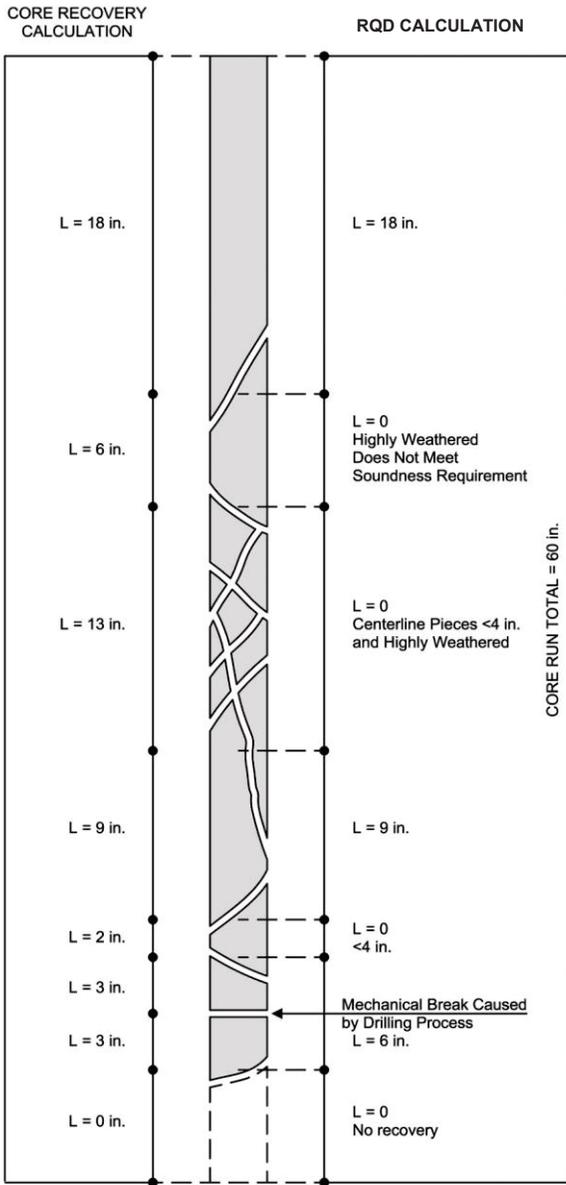
Partial Penetration: If the sampler could not be driven through a full 6-inch interval, the number of blows for that partial penetration is shown as #/x" (i.e. 50/2"). The N-value is reported as "REF" indicating refusal.

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 (∇), at the end of drilling (\blacktriangledown), or at some time after drilling (\blacktriangledown).



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

<i>Sedimentary Rocks:</i>	<u>Grain Size</u>
Coarse grained	2 – 5 mm
Medium grained	0.4 – 2 mm
Fine grained	0.1 – 0.4 mm
Very fine grained	< 0.1 mm

Igneous and Metamorphic Rocks:

Coarse grained	5 mm
Medium grained	1 – 5 mm
Fine grained	0.1 – 1 mm
Aphanitic	< 0.1 mm

Example Calculations

Core Recovery, CR = $\frac{\text{Total length of rock recovered}}{\text{Total core run length}}$

Example: $CR = \frac{(18 + 6 + 13 + 9 + 2 + 3 + 3)}{(60)}$

CR = 90%

RQD = $\frac{\text{Sum of sound pieces 4 inches or larger}}{\text{Total core run length}}$

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

Example: $RQD = \frac{(18 + 9 + 6)}{(60)}$

RQD = 55%

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

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

Client:

Enbridge Energy, Limited Partnership
Attn: Accounts Payable 5400 Westheimer Ct
Houston, TX 77056

Project:

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

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 _u (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

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

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

Project:
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

Results: The test is for informational purposes.



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

Project:
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

Results: The test is for informational purposes.



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Phone: 218-624-4967

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Attn: Accounts Payable5400 Westheimer Ct
Houston, TX 77056

Project:
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 #	Sample #	Depth (ft)	Moisture Content (%)
21-C	14	50.0	20.7

General

Results: The test is for informational purposes.



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Phone: 218-624-4967

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Houston, TX 77056

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

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.



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Duluth, MN 55807
Phone: 218-624-4967

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

Project:
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.



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

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

Project:
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.



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Duluth, MN 55807
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Attn: Accounts Payable 5400 Westheimer Ct
Houston, TX 77056

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

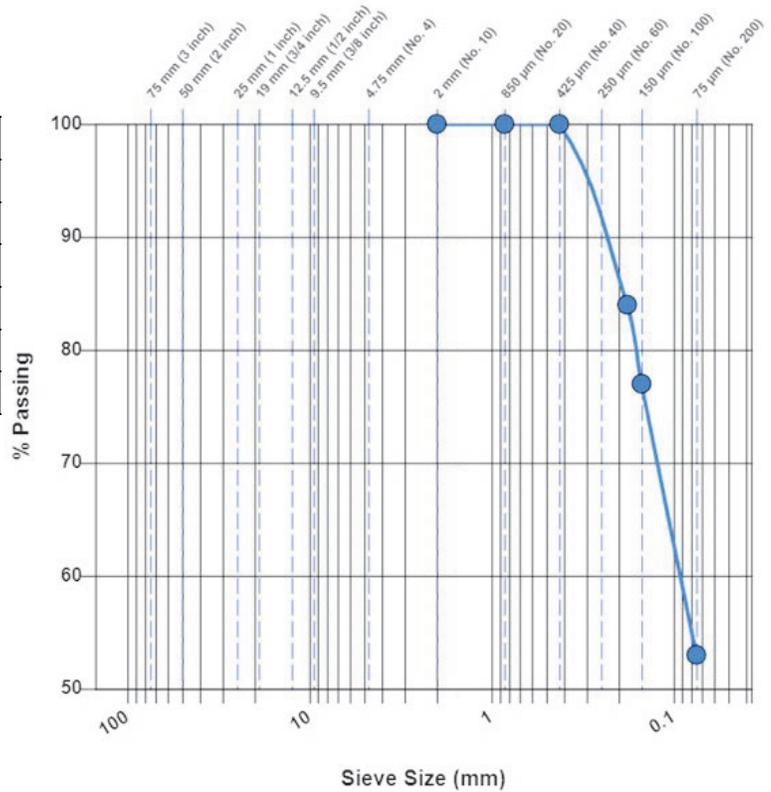
Sample Information

Sample Number: 312751 **Alternate ID:** 21-C 5 9.5'-11'
Sampling Method: Auger Boring ASTM D1452 **Depth (ft):** 9.5-11
Boring Number: 21-C **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

Laboratory Data

Sieve Size	% Passing	Specification
2 mm (No. 10)	100	
850 µm (No. 20)	100	
425 µm (No. 40)	100	
180 µm (No. 80)	84	
150 µm (No. 100)	77	
75 µm (No. 200)	53.0	

Test Method: Method A (Composite Sieving)
Dispersion Apparatus: Shaking
Specimen Obtained: Oven Dry



Classification: ML Sandy silt

General

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

4511 West First Street
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Duluth, MN 55807
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Client:
Enbridge Energy, Limited Partnership
Attn: Accounts Payable 5400 Westheimer Ct
Houston, TX 77056

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

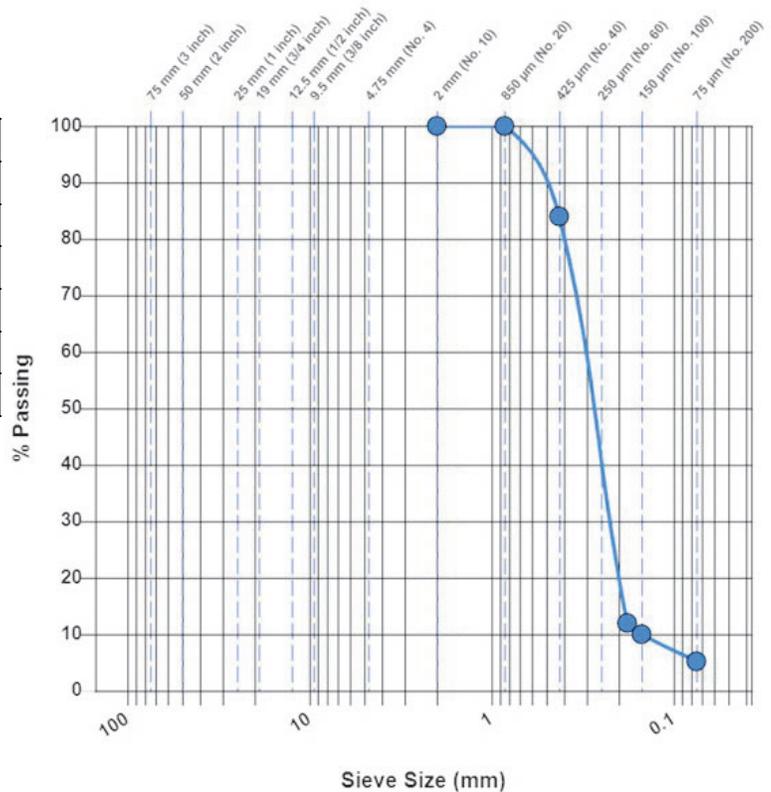
Sample Information

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

Sieve Size	% Passing	Specification
2 mm (No. 10)	100	
850 µm (No. 20)	100	
425 µm (No. 40)	84	
180 µm (No. 80)	12	
150 µm (No. 100)	10	
75 µm (No. 200)	5.2	

Test Method: Method A (Composite Sieving)
Dispersion Apparatus: Shaking
Specimen Obtained: Oven Dry



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.

Sieve Analysis Of Soil

6/8/2020

ASTM D6913

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

Client:

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

Project:

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

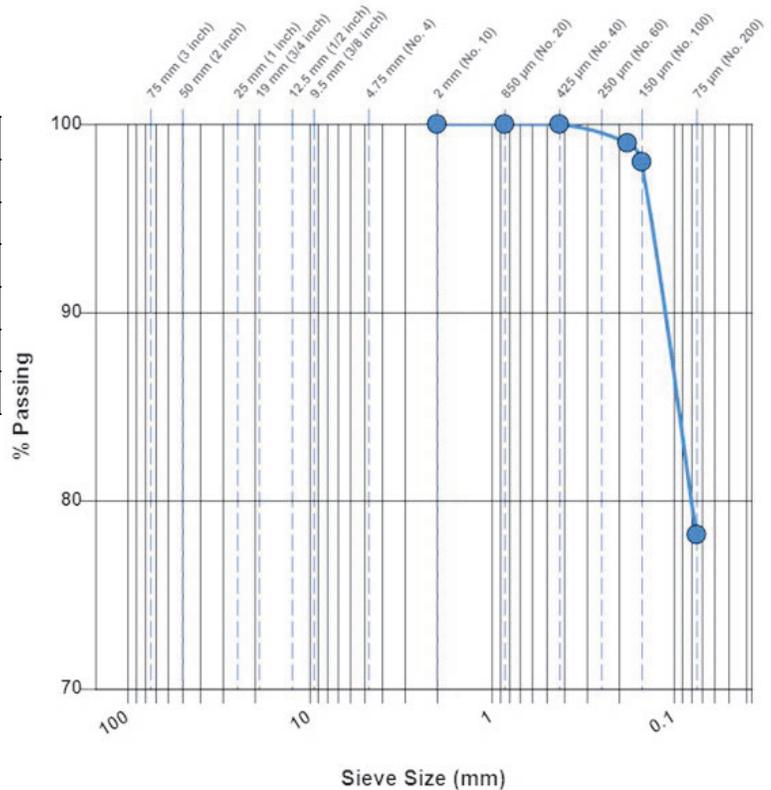
Received Date: 06/03/2020 **Lab:** 4511 West First Street, Suite 4, Duluth, MN

Tested Date: 06/05/2020

Laboratory Data

Sieve Size	% Passing	Specification
2 mm (No. 10)	100	
850 µm (No. 20)	100	
425 µm (No. 40)	100	
180 µm (No. 80)	99	
150 µm (No. 100)	98	
75 µm (No. 200)	78.2	

Test Method: Method A (Composite Sieving)
Dispersion Apparatus: Shaking
Specimen Obtained: Oven Dry



Classification: ML Sandy silt

General

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

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

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

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

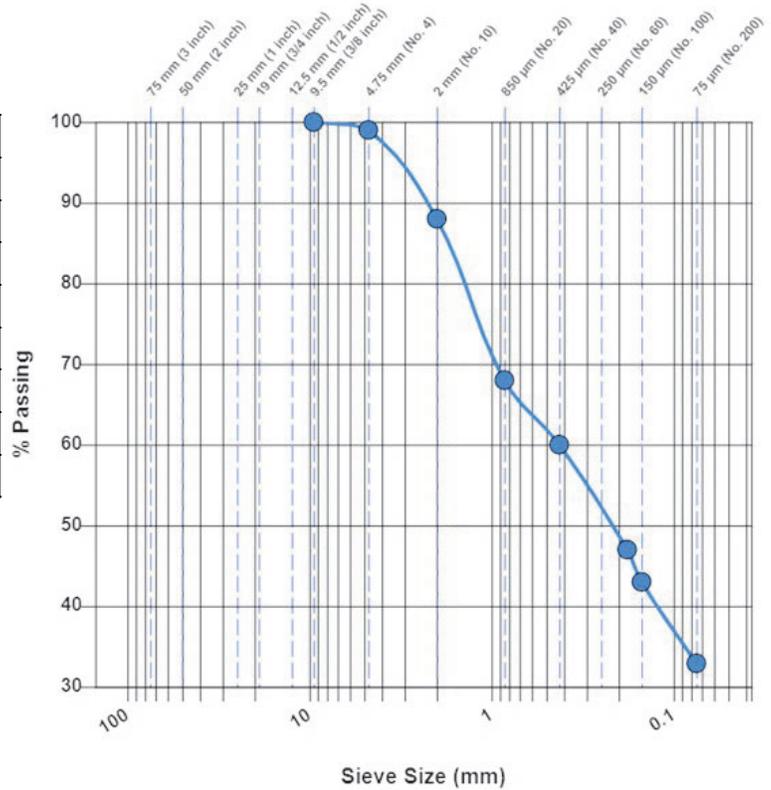
Sample Information

Sample Number: 312754 **Alternate ID:** 21-C 17 65'
Sampling Method: Auger Boring ASTM D1452 **Depth (ft):** 65
Boring Number: 21-C **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

Laboratory Data

Sieve Size	% Passing	Specification
9.5 mm (3/8 inch)	100	
4.75 mm (No. 4)	99	
2 mm (No. 10)	88	
850 µm (No. 20)	68	
425 µm (No. 40)	60	
180 µm (No. 80)	47	
150 µm (No. 100)	43	
75 µm (No. 200)	32.9	

Test Method: Method A (Composite Sieving)
Dispersion Apparatus: Shaking
Specimen Obtained: Oven Dry



Classification: SM Silty sand

General

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

Sieve Analysis Of Soil

6/11/2020

ASTM D6913

4511 West First Street
Suite 4
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Phone: 218-624-4967

Client:

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

Project:

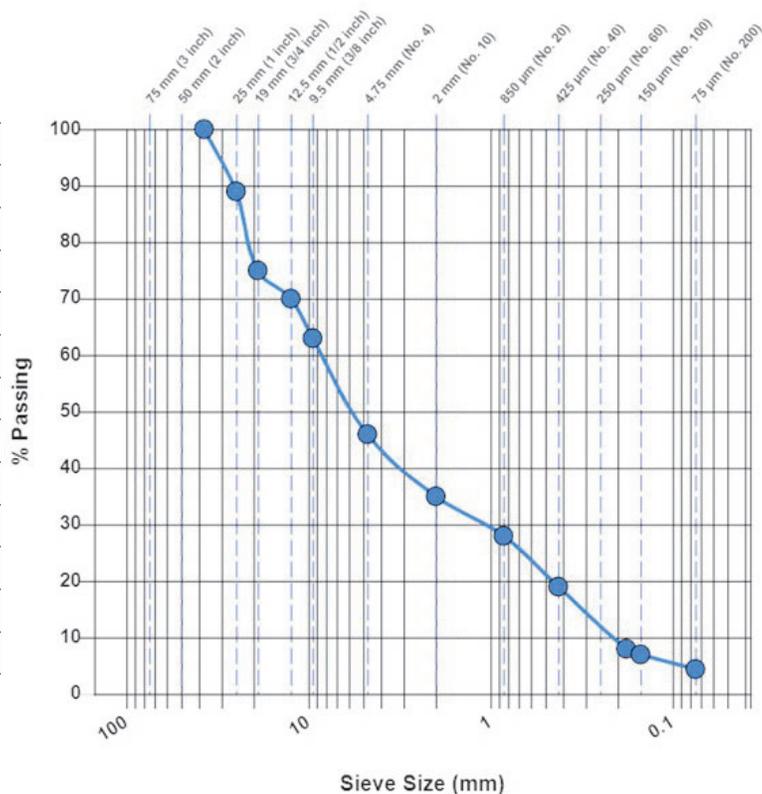
B2001991
Enbridge Line 5 Re-route
Enbridge Line 5
near Mellen, WI

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

Laboratory Data

Sieve Size	% Passing	Specification
37.5 mm (1.5 inch)	100	
25 mm (1 inch)	89	
19 mm (3/4 inch)	75	
12.5 mm (1/2 inch)	70	
9.5 mm (3/8 inch)	63	
4.75 mm (No. 4)	46	
2 mm (No. 10)	35	
850 µm (No. 20)	28	
425 µm (No. 40)	19	
180 µm (No. 80)	8	
150 µm (No. 100)	7	
75 µm (No. 200)	4.4	



Test Method: Method A (Composite Sieving)
Dispersion Apparatus: Shaking
Specimen Obtained: Oven Dry
Classification: GP Poorly graded gravel with sand

General

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

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Client:
Enbridge Energy, Limited Partnership
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Houston, TX 77056

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

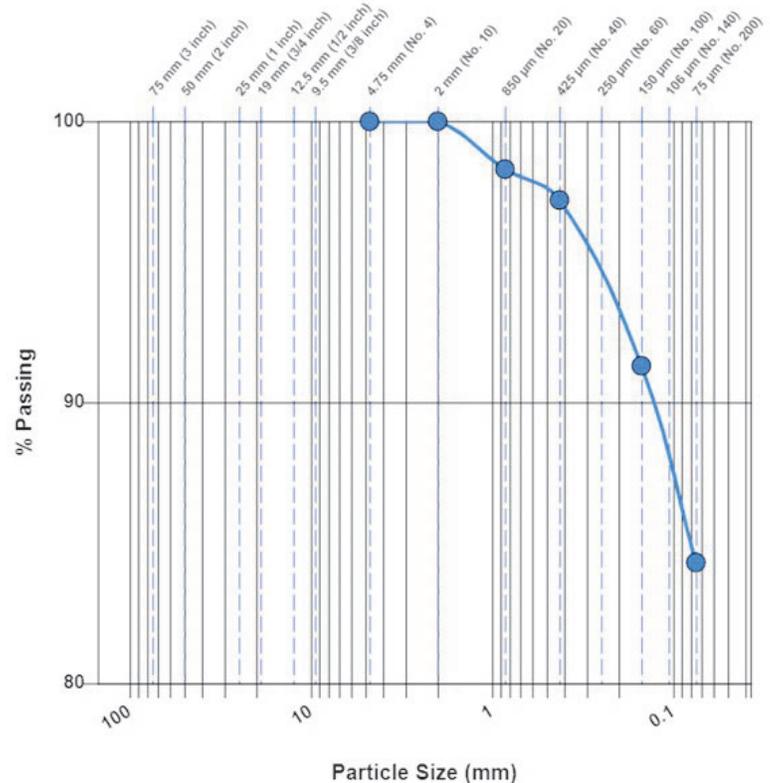
Sample Information

Sample Number: 318222 **Alternate ID:** 22-C Sample 18 65'
Sampling Method: Auger Boring ASTM D1452 **Depth (ft):** 65
Boring Number: 22-C **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

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



Classification: ML Silt with sand
Specimen Obtained: Oven Dry
Dispersion Apparatus: Shaking

Test Method: Method A (Composite Sieving)

General

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

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Phone: 218-624-4967

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

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

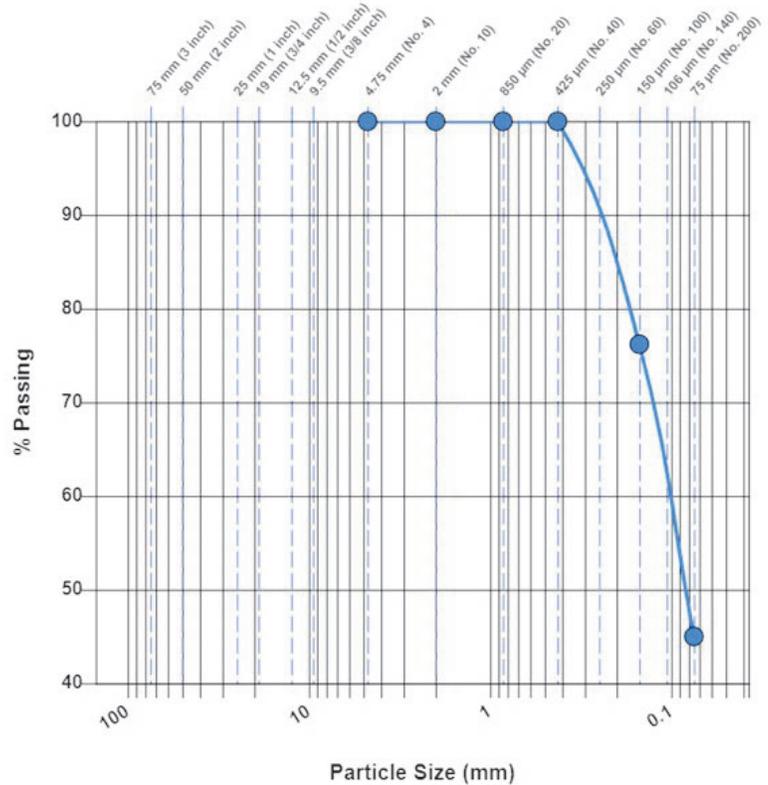
Sample Information

Sample Number: 318227 **Alternate ID:** 25-C Sample 7 12'
Sampling Method: Auger Boring ASTM D1452 **Depth (ft):** 12
Boring Number: 25-C **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

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



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

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Phone: 218-624-4967

Client:
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Houston, TX 77056

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

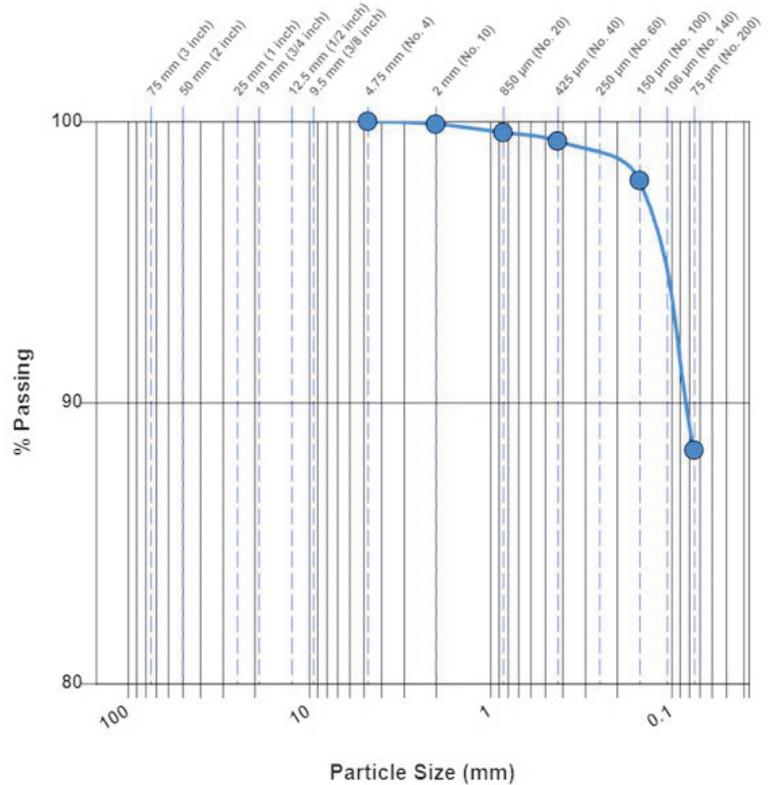
Sample Information

Sample Number: 318228 **Alternate ID:** 25-C Sample 20 60'
Sampling Method: Auger Boring ASTM D1452 **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



Classification: ML Silt with sand
Specimen Obtained: Oven Dry
Dispersion Apparatus: Shaking

Test Method: Method A (Composite Sieving)

General

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

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

Client:
Enbridge Energy, Limited Partnership
Attn: Accounts Payable 5400 Westheimer Ct
Houston, TX 77056

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

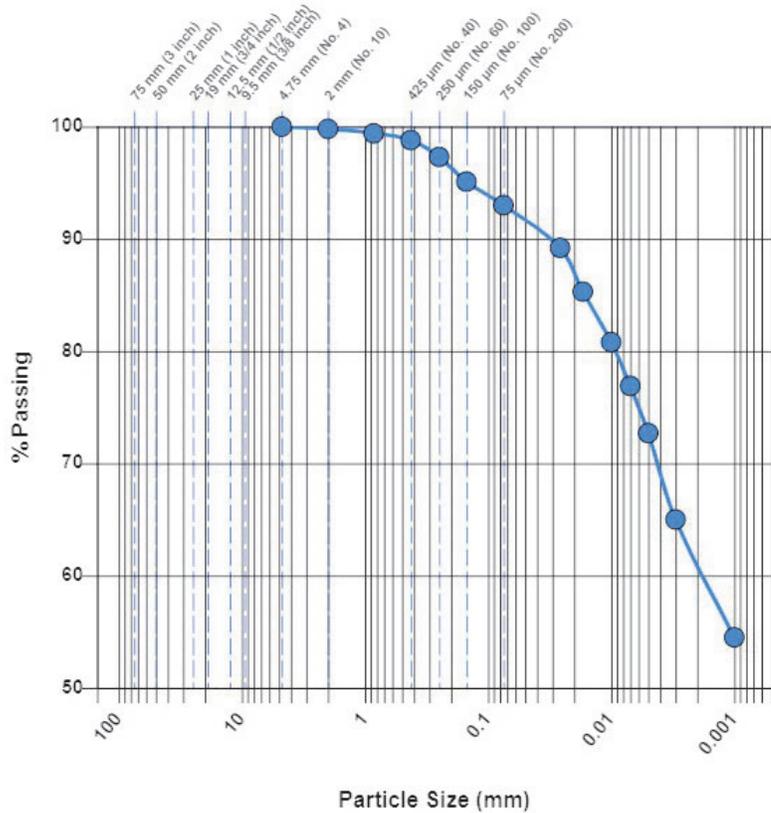
Sample Information

Sample Number: 320990	Depth (ft): 12.5
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

Particle Size	% Passing	Specification
4.75 mm (No. 4)	100.0	-
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	-



Soil Classification: CH Fat clay

Gravel (%): 0.0	Sand (%): 7.0	Silt (%): 20.3	Clay (%): 72.7
D₆₀ (µm): 2.0			

General

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

Client:
Enbridge Energy, Limited Partnership
Attn: Accounts Payable 5400 Westheimer Ct
Houston, TX 77056

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

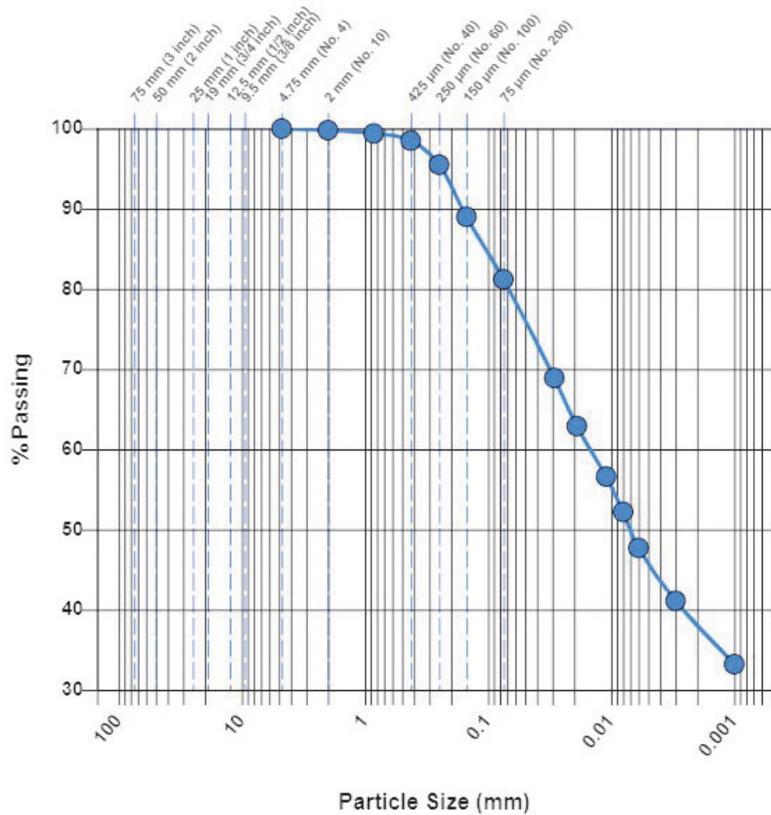
Sample Information

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

Particle Size	% Passing	Specification
4.75 mm (No. 4)	100.0	-
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	-



Soil Classification: CL Lean clay with sand

Gravel (%): 0.0 **Sand (%):** 18.8 **Silt (%):** 35.7 **Clay (%):** 45.5
D₆₀ (µm): 15.3

General



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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 **Project Description:**
 Enbridge Energy, Limited Partnership
 5400 Westheimer Ct
 Houston, TX 77056
 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 ≤ L/D ≤ 2.5
Side Tolerance, Maximum (in.)	≤ 0.020	≤ 0.020	≤ 0.020	≤ 0.020	≤ 0.020	≤ 0.020 in.
End Tolerance, Maximum (in.)	≤ 0.001 in	≤ 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 ²):	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

Project Manager



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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 **Project Description:**
 Enbridge Energy, Limited Partnership
 5400 Westheimer Ct
 Houston, TX 77056
 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 ≤ L/D ≤ 2.5
Side Tolerance, Maximum (in.)	≤ 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.
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 ²):	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

Project Manager

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

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:	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 ≤ L/D ≤ 2.5
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):	20,925		2,851		
Area (in ²):	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



Project Manager

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

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 ≤ L/D ≤ 2.5
Side Tolerance, Maximum (in.)	≤ 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.
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 ²):	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



Project Manager



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

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:	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 ≤ L/D ≤ 2.5
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):	17,939		2,916	5,788	3,025	
Area (in ²):	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

Project Manager



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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 **Project Description:**
Enbridge Energy, Limited Partnership
5400 Westheimer Ct
Houston, TX 77056
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	2.0 ≤ L/D ≤ 2.5
Side Tolerance, Maximum (in.)	≤ 0.020	≤ 0.020	≤ 0.020 in.
End Tolerance, Maximum (in.)	≤ 0.001 in	≤ 0.001 in	≤ 0.001 in.
Perpendicularity Deviation (°)	≤ 0.001 in	≤ 0.001 in	≤ 0.250°
Parallelism Deviation (°)	≤ 0.001 in	≤ 0.001 in	≤ 0.25°
Maximum Load (lbs):	12,433	2,745	
Area (in ²):	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

Project Manager

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

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:	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 ≤ L/D ≤ 2.5
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 ²):	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



Project Manager