Subsurface Investigation Report

Enbridge Line 5 Reroute
MP 38 HDD Crossing – Potato River
Location 75-C, East of WI-169, South of Potato River
Location 77-C, East of WI-169, South of Potato River
Location 79-C-1, East of WI-169, South of Potato River
Location 81-C, South West of Curry Road, North of Potato River
Town of Gurney, Iron 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.

Jøseph C. Butler, PE

Business Unit Manager / Senior Engineer

License Number: E-43286-6

September 17, 2020

Project B2001991

Braun Intertec Corporation





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September 17, 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 38 HDD Crossing – Potato River

Location 75-C, East of WI-169, South of Potato River Location 77-C, East of WI-169, South of Potato River Location 79-C-1, East of WI-169, South of Potato River

Location 81-C, South West of Curry Road, North of Potato River

Gurney Town, Iron County, Wisconsin

Dear Mr. Erickson:

We are pleased to present this Subsurface Investigation Report for the Line 5 Reroute Project at the MP 38 HDD Crossing under Potato River in Gurney Town, Iron 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@brauninterte.com) or David Morrison (kmarmuth@brauninterte.com) 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 75-C, 77-C, 79-C-1, and 81-C HDD Alignment Profile Descriptive Terminology of Soil Descriptive Terminology of Rock

Sieve Analysis Reports: 326707, 326710, 326712, 318772, 319401, 319405, 315520, 315521, 324771 Moisture Content Reports: 326707, 326710, 326712, 318772, 319401, 319405, 315520, 315521, 324771

Hydrometer and Sieve Analysis Reports: 328877

Compressive Strength of Cores Report: 75-C-1, 77-C (Set 7 & 7B), 79-C-1



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 services as part of this effort.

This report provides a factual data obtained at Borehole Locations 75-C, 77-C, 79-C-1, and 81-C for the HDD crossing under Potato River which is located at MP 38 in the proposed pipeline alignment in Gurney Town, Iron 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 75-C, 77-C, 79-C-1, and 81-C to nominal depths ranging from 144 to 219 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 Encountered

The general geologic profile of the soils encountered between the four (4) borings consisted (proceeding down from the ground surface) of 1 foot of topsoil over 6 feet of fill in boring 79-C-1 and 4 feet of peat encountered in boring 75-C, the fill, topsoil, and peat are underlain by alternating layers of lacustrine (lake deposited) and glacial deposits. The soils contained in the layers consisted of peat, silty sands, poorly graded sands, fat clay, lean clay with sand, silty clay, silty clayey sand, poorly graded gravel with silt, and silt to the termination depth of each boring or refusal on bedrock, 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 Encountered

Below the glacial deposits, the boring encountered bedrock extending from an approximate elevation ranging between of 1074 to 1047 feet to the termination depth of the boring.

The bedrock generally consisted of grayish pink with white rhyolite associated with the Kallander Creek Volcanics and gray with white basalt, and gray with whitish red andesite associated with the Portage Lake Volcanics.

The rhyolite was generally classified as "moderately fractured" to "intensely fractured". The rock was deemed as "hard" in terms of the rock hardness scale and ranged from "slightly weathered" to "moderately weathered"

The basalt was generally classified as "moderately fractured" to "highly fractured". The rock was deemed as "moderately hard" to "hard" in terms of the rock hardness scale and was deemed "slightly weathered" to "moderately weathered".

The andesite was generally classified as "highly fractured". The rock was deemed as "moderately hard" to "hard" in terms of the rock hardness scale and was deemed "slightly weathered" to "moderately weathered".

B.2.c. Altered Bedrock

In boring 81-C, we encountered poorly consolidated conglomerate from a depth of 123 feet to the termination of the boring. The drill crew made several failed attempts to collect a sample using coring methods to a depth of 157 feet. These attempts were not successful due to the bedrock behaving more



like a soil than bedrock. At 157 feet they changed to a smaller tri-cone bit to drill through the material and attempt to collect samples using split spoon but could not penetrate through the material using standard split spoon sampling and the core barrel was too large to continue coring. Due to the difficulty of sampling using standard methods of coring and split-spoon the driller collected samples from the auger cuttings.

B.3. Estimated Soil Properties

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

Table 1: Estimated Soil Properties

		eu son Prope			Drained				Modulus
Soil Strata and Elevations (ft)	Soil Type	Blow Count per foot Range (BPF)	Dry Unit Weight Range (pcf)	Undrained Unit Weight Range (pcf)	Friction Angle Range (degrees)	Undrained Friction Angle (degrees)	Undrained Cohesion Range (ksf)	Drained Cohesion Range (ksf)	of Elasticity Range* (tsf)
	Silty Sand (SM)	5 - 27	110 - 120	115 - 125	28 - 34	10 - 25	0.75 – 2.0	0.4 – 4.0	29- 189
Upper Soils (1163 to 1110)	Silty Clayey Sand (SC-SM)	14 - 20	105 - 115	118 - 122	30 - 31	15 - 20	1.0 – 1.25	0.9 – 1.9	56- 86
	Sandy Lean Clay (CL)	19	100 - 125	125 - 130	29 - 30	10	2.5 – 4.5	1.6 – 3.0	76 - 109
	Silty Sand (SM)	1 – 50 blows per 1 inch of penetration	92 - 116	110 - 130	27 - 37	5 - 25	0.5 – 2.5	0.1 – 4.1+	6 - 490
Middle Soils (1110	Silt (ML)	9 - 67	99 - 112	112 - 127	30 - 36	30 - 35	0	0	36 - 289
to 1046)	Fat Clay (CH)	12	90 - 110	112 - 117	22 - 25	0	1.0 – 3.6	0.6 – 2.1	48 - 69
	Peat (PT)	11	80	80	15	0	0.15	0.1	32 - 44



Soil Strata and Elevations (ft)	Soil 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)	5 - 80	91 - 114	105 - 127	30 - 40	30 - 36	0	0	35 - 576
	Silty Clay (CL-ML)	9	100 - 120	122 - 125	27 - 28	5	1.5 – 2.5	0.9 – 1.5	36 - 39
	Poorly Graded Gravel with Silt (GP-GM)	19 - 22	119 - 121	125 - 127	37 - 38	34	0	0	219 - 264
	Lean Clay (CL)	15 - 66	100 - 125	125 - 135	29 - 35	10	2.5 – 10.0	1.6 – 6.0+	60 - 380
	Poorly Graded Gravel with Silt (GP-GM)	50 blows per 1 inch of penetration - 60 blows per 0 inches of penetration	120 - 130	130 - 135	42 - 45	36	0	0	806 - 840
Lower Soils (1110 to 944)	Silty Sand (SM)	50 blows per 1 inch of penetration- 50 blows per 0 inches of penetration	120 - 125	125 - 130	35 - 37	25	2.5	4.1+	403 - 490
	Lean Clay (CL)	50 blows per 1 inch of penetration - 50 blows per 0 inches of penetration	100 - 125	133 - 135	33 - 35	10	10.0	6.1+	280 - 403



Soil Strata and Elevations (ft)	Soil 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)
	Rhyolite	N/A	161-167	161-167	35 - 38	31 - 36	0	0	327,080 – 513,000
Bedrock (1074 to 943 1/2)	Basalt	N/A	169 - 206	169 - 206	35 - 38	31 - 36	0	0	446,400 – 597,600
	Andesite	N/A	157 - 175	157 - 175	35 - 38	31 - 36	0	0	381,600 – 388,800

^{*}Sustained Young's Modulus values

B.4. Groundwater

We encountered groundwater at a depths ranging between 6 1/2 to 11 feet below the ground surface in borings 77-C and 79-C-1 while advancing the borings.

We did not observe groundwater while advancing borings 75-C and 81-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 sieve analysis, moisture testing, hydrometer with sieve analysis, and 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

The Appendix includes Log of Boring sheets for our penetration test borings. The logs identify and describe the penetrated geologic materials, and present the results of penetration resistance and other in-situ tests performed. The logs also present the results of laboratory tests performed on penetration test samples, and groundwater measurements. The Appendix also includes a Fence Diagram intended to provide a summarized cross-sectional view of the soil profile across the site.

We inferred strata boundaries from changes in the penetration test samples and the auger cuttings. Because we did not perform continuous sampling, the strata boundary depths are only approximate. The boundary depths likely vary away from the boring locations, and the boundaries themselves may occur as gradual rather than abrupt transitions.



C.3.b. Logs of Coring

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.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.







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DRILLER:		. Gorma			GED BY:					ART DAT		06/09/20	END D		06/17/20
SURFACE ELEVATION:				3502	OLD D1.	METHOD:	4 1/4" HS	٠,٨		RFACIN		00/00/20	WEATH		
ELEVATION:	1093.	OIL F			ion of Ma		4 1/4 17		30						sunny
Elev./ Depth ft	Water Level	(Soil-A		D2488 (Rock-USACE E	ΕM	Sample	RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Water Return %	Remarks
	9 0 7 0 7 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	RHYO weathe graine	LITE, q ered, h d, mas	grayish ard, fin sive, hi	e-graine ghly frac	n white, slightly d to medium-	- - 100 - - - -		75	90	3	5120	120	90	
- - - - - - - - - - - - - - -							105 - - - - - 110 - -		55	95	3	6040	120	90	Run 15 MOHs 7
 - - - - -							- 115 - - -								Run 16 MOHs 7
- - - - -							120 - -		30	90	3	6040	100	90	
 - - -	0 4 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2						-		65	90	3	6040	100	90	Run 17 MOHs 7
 - - - -	0 4 4 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2						125 - - -								Run 18 MOHs 7
	0.31/2.0		<u> </u>	ontinue	ed on ne	ext page									



The Science Y	ou Build On					See D	escriptiv	e Termino	logy shee	t for exp	lanation	of abbreviations
		er B2001					RING:			75	-C	
		Evaluation				LO	CATION	See atta	ched sket	ch		
Enbridg Various		5 Re-Ro	oute									
			nties, Wis	consin		LA	TITUDE:	46	.46354	LONG	TUDE:	-90.48130
DRILLER:		C. Gorman	LOGGE				ART DAT		06/09/20			06/17/20
SURFACE ELEVATION:	1093			1	1/4" HSA		RFACIN			WEATI		sunny
				of Materials					Φ			
Elev./ Depth ft	Water Level		1110-1	2487; Rock-USACE EN -2908)	Sample	RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressur (psi)	Water Return %	Remarks
		RHYOLIT weathered grained, n		k with white, slightly rained to medium-	 130 — 	55	100	2	5580	150	90	
		· o			135 — — — — — — — — — — — — — — — — — — —	60	95	2	5580	100	90	Run 19 MOHs 7
- 946.6 - 147.0 - 943.6		KALLANE RHYOLIT weathered grained, n	d, hard, fine-g nassive, highl	k with white, moderate rained to medium- y fractured	145 — — — — — — — — — — — — — — — — — — —	35	80	3	5580		80	Run 20 MOHs 7
_ 150.0 			en backfilled	CORING I with cement/bentor	_							



Cocation	The Science Y		D0004	004					Termino	ology sheet	t for explanation o	of abbreviations
Enbridge Line 5 Re-Route Various Locations Ashland and Iron Counties, Wisconsin PRILLER: EPC LOGGED BY: A. Hillerud START DATE: 05/28/20 END DATE: 05/27/20 DRILLER: 1099 2 ft RIG: Subcontractor METHOD: 4 1/4" HSA Elev_Homo. Elev_Homo. (Soll-ASTM D2486 or 2487; Rock-USACE EM 110-1-29/08) Elev_Homo. SILTY SAND (SM), fine to medium-grained, with 110-1-29/08) SILTY SAND (SM), fine to medium-grained, with 5 - V (15) - V	Enbridge Line 5 Re-Route							BORING:	0 "		77-C	
DRILLER: EPC LOGGED BY: A. Hillerud START DATE: 05/26/20 END DATE: 05/27/20	Enbrido Various	ge Line Locat	5 Re-Ro ions	ute				LOCATION:	See atta	iched sket	cn	
SILTY SAND (SM), fine-grained, brown, moist, very loose (GLACIAL TILL) SILTY CLAY (CL-ML), with Sand lenses, brown, 10772 12.0 POORLY GRADED SAND with SILT (SP-SM), fine to medium-dense (GLACIAL TILL) SILTY SAND (SM), fin	Ashlan	d and I	ron Cour	nties, Wiscon	sin			LATITUDE:	46	6.46545	LONGITUDE:	-90.48187
Elev/ Depth of Materials Description of Materials Soil-ASTM D2489 or 2487; Rock-USACE EM 1110-1-2908) SiltTY SAND (SM), fine to medium-grained, with Gravel, brown, wet, loose to medium-grained, with Gravel, brown, moist, hard (GLACIAL TILL) LEAN CLAY with SAND (CL), with Gravel, brown, moist, hard (GLACIAL TILL) 25 13-29-37 (66) 18" Auger met refusal at 31.3 feet. Drilling method side to mind refusal at 31.3 feet. Drilling method gravel, brown, wet, very dense (GLACIAL TILL) 30 745-40-50/4" 45-40-50/4	DRILLER:		EPC	LOGGED BY:	,	A. Hillerud		START DAT	E:	05/26/20	END DATE:	05/27/20
Comparison of the part of th	SURFACE ELEVATION:	1089	0.2 ft RIG:	Subcontractor	METHOD:	4 1/4" H	SA	SURFACING	3:		WEATHER:	
Very loose (GLACIAL TILL)	Depth	Water Level	(Soil-AST	M D2488 or 2487;	Rock-USAC	E EM	Sample	(N-Value)			Tests or F	Remarks
1-5-10-12 (15) 8" LEAN CLAY with SAND (CL), with Gravel, brown, moist, hard (GLACIAL TILL) 13-29-37 (66) 18" 18" SILTY SAND (SM), fine to medium-grained, with Gravel, brown, wet, very dense (GLACIAL TILL) Auger met refusal at 31.3 feet. Drilling method	4.5 		SILTY SAI Gravel, wi dense (GL SILTY CLA moist, stiff POORLY (fine to med wet, loose	(GLACIAL TILL) ND (SM), fine to meth Boulders, brown ACIAL TILL) AY (CL-ML), with Standard (GLACIAL TILL) GRADED SAND with to medium dense	edium-graine, moist, med and lenses, th SILT (SP Gravel, brov	ed, with 5 lium 10 brown, 10 -SM), wn,		(1) 18" 1-1-2-3 (3) 24" 7-7-8-14 (15) 2" 4-10-10-10 (20) 6" 2-3-6-9 (9) 10" 2-2-3-4 (5) 12" 6-5-6-6			Test results are attached lab re	e in the port in the port
-1057.9 18" 33 feet.	23.0 		brown, mo	vist, hard (GLAČIAĹ ND (SM), fine to me own, wet, very den	. TILL) edium-graine se (GLACIA	I, 25 ed, with L TILL)		(15) 8" 13-29-37 (66) 18" 45-40-50/4" (REF)			feet. Drilling m switched to roo	ethod



The Science	You Build On						See De	escriptive	Termino	logy sheet		on of abbreviation
	Numbe						BOI	RING:			77-C	
Enbrid	hnical E ge Line s Locati	5 Re					LO	CATION:	See atta	ched sketo	ch	
Ashlan	d and Ir	on C	Counties, Wiscon	sin			LAT	TTUDE:	46	.46545	LONGITUDE	-90.48187
DRILLER:		EPC	LOGGED BY:	A. Hil	lerud		STA	ART DAT	E:	05/26/20	END DATE:	05/27/20
SURFACE ELEVATION:	1089.	2 ft	RIG: Subcontractor	METHOD: 4	1/4" HS/	Ą	SUI	SURFACING:		WEATHER:		
Elev./ Depth ft	Water	(Soil-	Description of Ma -ASTM D2488 or 2487; 1110-1-290	Rock-USACE EN	M	Sample	(N-V	ows ⁄alue) overy	q _p tsf	MC %	Tests	or Remarks
_	.0.000	POR.	TAGE LAKE VOLCANIO	CS ANDESITE			75	400				Run 1
_	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	gray	with red, slightly weathe	ered, moderately	_	H	75	100				MOH's 4
- - - - - - -		highly	fine-grained to medium y fractured results are in the attack		'e, 35— — — —		45	75				Run 2 MOH's 4
 -	0 4 9 0				_		40	100				Run 3
 - - - - -				40 —		70	90				MOH's 4 Run 4 MOH's 4	
- - - - -					45 — —		40	100				Run 5 MOH's 4
 1040.2		Test	results are in the attac	hed lab report	_		60	100				Run 6 MOH's 4
49.0 - - - - - - -	Ye S N S S S S S S S S	gray mode	TAGE LAKE VOLCANION with red, moderately we rately hard, fine-graine ed, massive, highly frac	eathered, d to medium-	50 —		10	100				Run 7 MOH's 4
- - -					55 — —		10	100				Run 8 MOH's 4
- - - - -		Test results are in the attache	hed lab report	60 —		35	95				Run 9 MOH's 4	
- - 					_		35	90				Run 10 MOH's 4
_			Continued on ne	ext page			RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Water Ro Pressure (psi) %	Remarks



Project Nu	ւլանը Jimber B2001991				RING:		-9,	77-C	on of abbreviations
-	ical Evaluation			LOC	CATION:	See attac	hed sketo		
_	Line 5 Re-Route								
Various Lo									
Ashland a	nd Iron Counties, Wiscon	sin		LAT	TTUDE:	46.	46545	LONGITUDE	-90.48187
DRILLER:	EPC LOGGED BY:	A. Hillerud		STA	RT DAT	E:	05/26/20	END DATE:	05/27/20
SURFACE ELEVATION:	1089.2 ft RIG: Subcontractor	METHOD: 4 1/4" HS	Α	SUF	RFACING	3:		WEATHER:	
Elev./ Depth ft	Description of Ma (Soil-ASTM D2488 or 2487; 1110-1-2908	Rock-USACE EM	Sample	RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi) Water Return	% Remarks
- - - - - - - - - - - - - - - - - - -	PORTAGE LAKE VOLCANIC gray with red, moderately we moderately hard, fine-grained grained, massive, highly fractive are in the attack.	eathered, 65 - d to medium- tured -	_	45	100				Run 11 MOH's 4
_ 69.0 _ - - - - -	portage Lake Volcanic gray with red, slightly weather hard, fine-grained to medium highly fractured	ered, moderately 70-		75	100				Run 12 MOH's 4
1015.2 74.0 - - - - - - - - - - - - - 1010.2	PORTAGE LAKE VOLCANIO gray with red, moderately we moderately hard, fine-graine grained, thick bedded, highly	eathered, 75 – d to medium-		65	100				Run 13 MOH's 4
79.0	PORTAGE LAKE VOLCANION gray with red, moderately we moderately hard, fine-grained grained, thick bedded, highly Test results are in the attack	eathered, 80 - d to medium- r fractured		40	100				Run 14 MOH's 4
-	** o **	- 85 - - - -		60	100				Run 15 MOH's 4
- 1000.2 - 89.0 	PORTAGE LAKE VOLCANIO gray with red, moderately we moderately hard, fine-graine grained, massive, highly frac	eathered, 90 - d to medium-		10	100				Run 16 MOH's 4
93.0 - 995.2 - 94.0	PORTAGE LAKE VOLCANIO gray with red, slightly weather grained to medium-grained, fractured	ered, hard, fine-		30	100				Run 17 MOH's 4 Run 18 MOH's 4
	Continued on ne	ext page							



The Science Y										e Termino	logy shee			of abbreviations
Project								ORING:			77	-C		
Geotec								LC	CATION:	See attac	ched sketo	ch		
Enbridg				ıte										
Various				tica Wiccon	oin							I		
Ashian	u and			ties, Wiscon	Sin			LA	TITUDE:	46	.46545	LONGI	TUDE:	-90.48187
DRILLER:		EF	C	LOGGED BY:	A. I	Hillerud		ST	ART DAT	E:	05/26/20	END D	ATE:	05/27/20
SURFACE ELEVATION:	108	39.2 ft	RIG:	Subcontractor	METHOD:	4 1/4" H	ISA	SU	JRFACIN	G:		WEATH	HER:	
Elev./				Description of Ma	terials		<u>e</u>		ary	g (t	<u>re</u>	_ e	- c	
Depth	<i>N</i> ater Level	(S	oil-AS I M	1 D2488 or 2487; 1110-1-2908		ΕM	Sample	RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Vate etur %	Remarks
ft	> _			1110 1 2000	·)		လိ	_	Re	ا ت ت	g.	> ਦੂ	> &	
_	0.0			LAKE VOLCANIO										
-	0.0			d, moderately we nedium-grained, r				70	100					
 - 990.2	0.0	ື fra	ctured			•								
_ 99.0	0.0		est result RTAGE	s are in the attach LAKE VOLCANIO	ied lab report S ANDESITE	:	Ħ							Run 19
_	0.0	ૈઃ. gra	ay with re	d, slightly weathe	red, hard, fine	_ 100	1							MOH's 4
_	0 0		ained to n ctured	nedium-grained, i	massive, highly	/	-	55	100					
_	0.00	* 0 Ha	cturcu				-	55	100					
_	0 0	0 0					-							
985.2 104.0	0.0	کا DC	DTAGE	LAKE VOLCANIO	'S ANDESITE		-							Run 20
_ 10 4 .0	0.0			d, moderately we			4							MOH's 4
<u>-</u>	0.0			nedium-grained, ı	massive, highly	/	_							
_	0.0	∷: tra	ctured					40	70					
_	0.0	0												
980.2	0.0	. 0 . 0												
_ 109.0				LAKE VOLCANIO			П							Run 21
- -	\rangle \cdot			n white, moderate hard, fine-grained		110								MOH's 3
-				ck bedded, highly			1	40	100					
_		. Ö 7	est result	s are in the attach	ned lab report		-							
		. Ö					-							
975.2 114.0) % PC	RTAGE	LAKE VOLCANIO	S. BASALT, a	rav	╌┠╂							Run 22
_	٥٥	့် wit	h white,	slightly weathered	l, hard, fine-gra		$-\mathbf{H}$							MOH's 4
-	٥٥		medium- ctured	grained, massive,	moderately		-							
-			clureu				_[[85	100					
<u>-</u>		.0					_							
970.2	0,	0 0					_∐							
_ 119.0	0,0			LAKE VOLCANION hitish red, slightly										Run 23 MOH's 4
_	0.0			l to medium-grain										INIOTTS 4
-	0.0	fra	ctured	•				75	100					
-	0.00	0												
 -	0.0	6 0 6 0												
_	0.0	. o					╂			-				Run 24
L	0 0	,	est result	s are in the attach	ned lab renort	125	-[[MOH's 4
_	0.0	0		and and of			$-\ $	35	100					
_	0	. o												
	0.4	0.0		2	- 4		_							
			(Continued on ne	xt page									



The Science You Ruild On				e Terminolo	ogy sheet			of abbreviations
Project Number B2001991			RING:			77-C	<u> </u>	
Geotechnical Evaluation		LOC	CATION:	See attac	hed sketo	ch		
Enbridge Line 5 Re-Route Various Locations								
Ashland and Iron Counties, Wisconsin		LAT	ITUDE:	46.4	46545	LONGITU	JDE:	-90.48187
DRILLER: EPC LOGGED BY: A. Hillert	ud	STA	RT DAT	E: (05/26/20	END DAT	 ΓΕ:	05/27/20
SURFACE ELEVATION: 1089.2 ft RIG: Subcontractor METHOD: 4 1/4	4" HSA	SUF	RFACING	 3:		WEATHE	R:	
Description of Materials	Φ		<u>></u>		<u>φ</u>	φ	_	
Elev./ Depth ft (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Return %	Remarks
960.2 PORTAGE LAKE VOLCANICS, ANDESITE, gray with whitish red, slightly weathered, hard,								D 05
Fine-grained to medium-grained, massive, highly	130 —							Run 25 MOH's 4
	[」]							
gray with whitish red, slightly weathered, hard, fine-grained to medium-grained, massive,		90	100					
moderately fractured	-							
								Run 26
	135 —							MOH's 4
-		45	100					
- 950.2								
L 139.0 PORTAGE LAKE VOLCANICS, ANDESITE, gray with whitish red, slightly weathered, hard,	140							Run 27 MOH's 4
fine-grained to medium-grained, thick bedded,	140 —							MOI134
highly fractured		40	100					
	_[
-								Run 28
145.0 END OF CORING	145	100	100					MOH's 4
END OF CORING	-							Water observed at
Boring then backfilled with cement/bentonite	9							6.5 feet while drilling.
- grout	-							urilling.
_	-							
- -	150							
F								
E								
	155							
<u> </u>								
<u> </u>								



Project	Number B2001991		BORING:	Termino	logy sheet	for explanation o	i appreviations
	hnical Evaluation		LOCATION:	See atta	ched sketo		
Enbride	ge Line 5 Re-Route						
Various	Locations						
Ashlan	d and Iron Counties, Wiscor	sin	LATITUDE:	46	6.46723	LONGITUDE:	-90.48094
DRILLER:	EPC LOGGED BY:	A. Hillerud	START DAT	E:	06/05/20	END DATE:	06/18/20
SURFACE ELEVATION:	1087.9 ft RIG: Subcontractor	METHOD: 4 1/4" HSA	SURFACING	S :		WEATHER:	
Elev./	Description of M টু ভু (Soil-ASTM D2488 or 2487;	aterials o	Blows		МС		
Depth ft	(Soil-ASTM D2488 or 2487;		(N-Value) Recovery	q _p tsf	%	Tests or R	temarks
1086.9	SILTY SAND (SM), fine to m		0-1-1-1 (2) WOH/6"				
_ 1.0	FILL: SILTY SAND (SM), fine	e to medium-	6"				
-	grained, brown, moist		2-2-2-3 (4)				
F			20"				
_			2-3-4-14				
1081.9		5—	(7) 18"				
_ 6.0	POORLY GRADED GRAVE						
-	GM), fine to medium-grained medium dense (GLACIAL TI		8-10-12-12 (22)		5	Test results are	
_		,	`18" [′]			attached lab re	port
_			8-10-9-5				
 1076.9		10	(19) 16"				
_ 11.0	SILTY SAND (SM), fine to m						
1075.9 12.0	trace Gravel, brown, wet, loc SANDY SILT (ML), fine to m		5-5-4-2 (9)				
- ' <u>-</u>	trace Gravel, brown, moist, s		(9) 2"				
- -	GLACIAL TILL)	_/_/	1-5-8-7				
_		15—	(13)				
-			4"				
-			9-7-7-8 (14)				
_		$\exists X$	12"				
_		_/_\					
_		20 —					
_		\exists					
_			12-11-7-7 (18)		13	Test results are	in the
_		$- \chi $	16"			attached lab re	
		/\					
1062.9 25.0	SILTY SAND (SM), fine to m	edium-grained,					
 -	trace Gravel, rock fragments dense (GLACIAL TILL)	, brown, moist, very					
 	delise (SEAGIAE TIEE)		31-34-42-38				
 -		$- \chi $	(76) 24"				
<u></u>		_					
_		30 —					
_		+					
<u> </u>	Continued on no	ext page					
P2001001						l.	



The Science Y									Termino	ology sheet		of abbreviations
		r B2001						RING:			79-C-1	
	ge Line	Evaluatio 5 Re-Ro ons					LO	CATION:	See atta	iched sketo	ch	
Ashlan	d and Ir	on Cour	nties, Wiscon	sin			LA	ΓΙΤUDE:	46	6.46723	LONGITUDE:	-90.48094
DRILLER:		EPC	LOGGED BY:	F	A. Hillerud		STA	ART DAT	E:	06/05/20	END DATE:	06/18/20
SURFACE ELEVATION:	1087.9	9 ft RIG:	Subcontractor	METHOD:	4 1/4"	HSA	SU	RFACING	3:		WEATHER:	
Elev./ Depth ft	Water Level	(Soil-ASTI	Description of Ma M D2488 or 2487; 1110-1-2908	Rock-USAC	E EM	Sample	Bl (N-\ Rec	ows /alue) overy	q _p tsf	MC %	Tests or	Remarks
		trace Grav	ND (SM), fine to me rel, rock fragments, ACIAL TILL)		st, very	35 —	(R 32-40	0/5" EF) 5" -40-50/ 5" 30) 6"			Auger met ref feet. Drilling n switched to ro 41 feet.	nethod
_ 1046.9 — 41.0 - —		dark gray moderately	E LAKE VOLCANIC with white, modera y hard, fine-grained nassive, highly fract	tely weather I to medium	ed,			0/0" EF) 0" 40				Run 1 MOHs 3 Run 2 MOHs 3
 - - - - -		Test resu	lts are in the attach	ed lab repoi	rt '	45 — 1 — 1	27	100				WOTIS 3
- - - - - - - - -						50 —	29	100				Run 3 MOHs 3
— - - - - -		Test resu	lts are in the attach	ed lab repoi	rt [!]	55—	23	100				Run 4 MOHs 3
- - - - -	0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -				(60 —	22	100				Run 5 MOHs 3
_ - -	9 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		Continued on ne	xt page		-	RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Water Return Pressure (psi) %	Run 6 MOHs 3 Remarks



The Science V						See De	escriptive	e Terminol	ogy sheet			of abbreviations
		r B2001					RING:			79-C	:-1	
Enbrid		Evaluation 5 Re-Ro ons				LOC	CATION:	: See attac	ched sketo	ch		
Ashlan	d and Ir	on Cou	nties, Wiscon	sin		LAT	TTUDE:	46.	46723	LONGIT	UDE:	-90.48094
DRILLER:		EPC	LOGGED BY:	A. Hille	rud	STA	RT DAT	E:	06/05/20	END DA	TE:	06/18/20
SURFACE ELEVATION:	1087.	9 ft RIG:	Subcontractor	METHOD: 4	1/4" HSA	SUF	RFACIN	G:		WEATH	ER:	
Elev./ Depth ft	Water Level	(Soil-AST	Description of Ma M D2488 or 2487; 1110-1-2908	Rock-USACE EM	Sample	RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Water Return %	Remarks
- - - - - - - -		dark gray moderatel	E LAKE VOLCANIC with white, modera y hard, fine-grained nassive, highly fract	tely weathered, I to medium-	65 — —	10	100					
- - - - - - - - -					70 —	7	100					Run 7 MOHs 3
- - - - - - - - - - - -		PORTAGE gray with v	E LAKE VOLCANIC white, moderately v y hard, fine-grained	eathered,	75— ———————————————————————————————————	0	20					Run 8 MOHs 3
 - - - -		grained, n Test resu	nassive, highly fract	ured	80—	0	100					Run 9 MOHs 3
 - 					-	0	100	-				Run 10 MOHs 3
					85—	13	100					Run 11 MOHs 3
- - - - - - - -					90-	15	100					Run 12 MOHs 3
- - - - -		Test resu	ılts are in the attach	·	95—	7	100					Run 13 MOHs 3
			Continued on ne	xt page								



The Science V									e Terminol	ogy sheet			of abbreviations
Project							ВО	RING:			79-0	C-1	
Geotec							LO	CATION:	See attac	ched sketo	ch		
Enbrido Various			coute										
			unties, Wiscon	sin			LAT	TITUDE:	46	.46723	LONGI	TUDE:	-90.48094
DRILLER:		EPC	LOGGED BY:		A. Hilleru	ıd	STA	ART DAT	<u></u>	06/05/20	END D	ATE:	06/18/20
SURFACE ELEVATION:	1087	.9 ft RIG	G: Subcontractor	METHOD:	4 1/4	4" HSA	SU	RFACING	 Э:		WEATH	HER:	
			Description of Ma	ıterials		υ		2	D 0	ō	. Ф		
Depth ft	Water Level	`	TM D2488 or 2487; 1110-1-2908	3)		Sample	RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Water Returr %	Remarks
- -		gray with	GE LAKE VOLCANION white, moderately well hard, fine-grained	veathered,									
-			massive, highly frac										Run 14 MOHs 3
- - - - - -		Test res	sults are in the attacl	ned lab repo		100 — —	8	100					inorio c
- -				·									Run 15
 - - - -						— 105 — —	18	100					MOHs 3
 - -													Run 16 MOHs 3
						110 —	10	100					INOT IS 3
- 974.9 _ 113.0 		PORTAC dark gra moderat grained,	GE LAKE VOLCANIO y with white, modera ely hard, fine-grained massive, highly frac sults are in the attach	tely weather d to medium tured	red, -	115 — —	15	100					Run 17 MOHs 3
						120 — —	20	100					Run 18 MOHs 3
_ _		•											Run 19 MOHs 3
 - -						125 — 1 — 1 — 1	33	100					
-	0.4 . 0	?,	Continued on ne	yt nage									
	1 1		Continued On the	nt paye					l	1			



The Science Yo									e Terminol	ogy sheet			of abbreviations
Project								RING:			79-0	C-1	
Geotech Enbridg Various	je Line	5 Re-Ro					LOC	CATION:	: See attac	ched sketo	ch		
Ashland	d and Ir	on Cour	nties, Wiscon	sin			LAT	ITUDE:	46.	46723	LONGI	TUDE:	-90.48094
DRILLER:		EPC	LOGGED BY:	A. Hil	lerud		STA	RT DAT	E:	06/05/20	END D	ATE:	06/18/20
SURFACE ELEVATION:	1087.9	oft RIG:	Subcontractor	METHOD: 4	1/4" HSA		SUF	RFACIN	G:		WEATH	IER:	
Elev./ Depth ft	Water Level	(Soil-AST	Description of Ma M D2488 or 2487; 1110-1-2908	Rock-USACE EN	И	Sample	RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Water Return %	Remarks
- - - - - - - - - - 954.9		dark gray moderately grained, m	E LAKE VOLCANIC with white, modera y hard, fine-grained nassive, highly fract lits are in the attach	tely weathered, I to medium- ured	130 —		47	100					Run 20 MOHs 3
133.0		dark gravi	E LAKE VOLCANIC with white, slightly ed to medium-grain	vootbored bard	, — hly 135 — —		75	100					Run 21 MOHs 3.5
- - - - -		Test resu	ults are in the attach	ed lab report	 140 		89	100					Run 22 MOHs 3.5
	0 4 0 0 0 4 0 0 0 0				_		100	100					Run 23
943.9 144.0		Boring the	END OF COF en backfilled with grout		145 — nite — — — — — 150 — — — — — — — — — — — — — — — — — — —			100					MOHs 3.5 Water observed at 11.0 feet while drilling



Project		er B200	199	 1				BORING:	Termino	logy sneet	for explanation of 81-C	of appreviations
		Evaluat		ı				LOCATION:	See atta	ached sket		
		5 Re-R		9				2007.11014.	200 am			
Various	Locat	tions										
Ashlan	d and	Iron Co	untie	es, Wiscor	sin			LATITUDE:	46	6.47087	LONGITUDE:	-90.48258
DRILLER:		EPC		LOGGED BY:		S. Sulliv	/an	START DAT	E:	04/09/20	END DATE:	04/09/20
SURFACE ELEVATION:	1162	2.9 ft RIG	S: Sı	bcontractor	METHOD:	3 1	/4" HSA	SURFACING	3:		WEATHER:	
Elev./ Depth ft	Water Level	(Soil-AS		scription of Ma 2488 or 2487; 1110-1-2908	Rock-USA	ACE EM	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or F	Remarks
		SILTY S. Sand, widense (C	AND (ith Gra	SM), fine to mavel, brown, mAL TILL)	edium-gra oist, mediu	ined um	10-	3-2-3-6 (5) 12" 7-6-6-10 (12) 18" 3-6-9-7 (15) 24" 4-4-6-7 (10) 12" 3-4-6-6 (10) 18" 3-5-11-12 (16) 24" 4-7-8-9 (15) 24" 4-11-15-13 (26) 24" 15-11-9-11 (20) 24" 7-12-15 (27) 18"		4	Test results are attached lab re	
_ 33.0 —	<u> </u> //	SANDY		CLAY with GF		_),	_					
D0004004			Co	ntinued on ne	xt page							



Project N		er B200	199)1				BORING:		- 3)	81-C	
Geotechi	nical E	Evalua	tion					LOCATION:	See atta	ched sket		
Enbridge Various L	Line	5 Re-F	Rout	e								
			unti	es, Wiscon	sin			LATITUDE:	46	.47087	LONGITUDE:	-90.48258
DRILLER:		EPC		LOGGED BY:		S. Sulliva	an	START DAT	E:	04/09/20	END DATE:	04/09/20
SURFACE ELEVATION:	1162.	9 ft RIG	G: S	ubcontractor	METHOD:	3 1/-	4" HSA	SURFACING	G:		WEATHER:	
Elev./ ja Depth ta ft	Level	(Soil-AS		escription of Ma 02488 or 2487; 1110-1-2908	Rock-USA	CE EM	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or F	Remarks
- - - - - - - - - - - - - - - - - - -	111111	brown, r	noist	N CLAY with GF, very stiff (GLA	CIAL TILL)		35	6-9-10 (19) 18"				
	//	medium	-grair	ned, reddish bro ACIAL TILL)			40	4-8-9 (17) 18"				
- - - - -	//						45	4-6-8 (14) 18"				
- - - - - - 11109.9	//						50	5-9-11 (20) 18"				
53.0		SILTY S Sand, b (GLACI	rown,	(SM), fine to m moist, dense to LL)	edium-grai o very dens	ned se	55 —	11-18-24 (42) 12"				
- - - - - -							60	18-20-22 (42) 18"				
- - - - - -							65	10-18-39 (57) 18"				
-			Co	ontinued on ne	ext nace							
2001001							Corporation				91.0	nage 2 of



The Science S		or B200400					BORING:	Termino	logy sheet	for explanation of 81-C	t abbreviations
		er B200199 Evaluation					LOCATION:	See atta	ached sket		
		5 Re-Rout					LOCATION.	Jee all	aoneu skel	OI I	
Various			-								
Ashlan	d and l	ron Counti	es, Wiscor	ısin			LATITUDE:	46	6.47087	LONGITUDE:	-90.48258
DRILLER:		EPC	LOGGED BY:		S. Sulliva	an	START DAT	E:	04/09/20	END DATE:	04/09/20
SURFACE ELEVATION:	1162.	.9 ft RIG: S	ubcontractor	METHOD:	3 1/4	4" HSA	SURFACING	G:		WEATHER:	
Elev./ Depth ft	Water		escription of Ma 2488 or 2487; 1110-1-2908	Rock-USA	CE EM	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or F	Remarks
-			(SM), fine to m moist, dense to L)			70 —	15-21-24 (45) 18"		12	Test results are attached lab re	
		SANDY SILT dense (GLAC	(ML), brown, m	oist, dense	e to very	75	20-16-24 (40) 18"			Drilling method	
						80 —	19-26-41 (67) 18"			mud rotary at 7	77 feet
1079.9 - 83.0 		fine to mediur	ADED SAND w m-grained, brov GLACIAL OUTV	vn, moist, d		85 —	20-31-43 (74) 18"				
- - - - - - - - -						90	15-20-30 (50) 18"				
-						95	17-23-24 (47) 18"		15	Test results are attached lab re	
- - - - - - -						100	30-40-40 (80)				
	1 - 1 - 1	Co	ntinued on ne	ext page							



Project		er B20019	191				BORING:	Terrinio	logy sileet	for explanation o	i appreviations
		Evaluatio					LOCATION:	See atta	ached sket		
		5 Re-Roι					2007111011	200 a.ii			
Various											
Ashlan	d and l	ron Coun	ties, Wiscon	sin			LATITUDE:	46	6.47087	LONGITUDE:	-90.48258
DRILLER:		EPC	LOGGED BY:		S. Sulliva	n	START DAT	E:	04/09/20	END DATE:	04/09/20
SURFACE ELEVATION:	1162.	9 ft RIG:	Subcontractor	METHOD:	3 1/4	" HSA	SURFACING	3 :		WEATHER:	
Elev./ Depth ft	Water		Description of Ma D2488 or 2487; 1110-1-2908	Rock-USA	CE EM	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or F	Remarks
- 1045.9 - 1041.9 - 123.0 - 123.0 - 1027.9	\(\partial \partial \par	Rock fragm (BOULDER Boulders, gi POORLY G GM), fine-gi dense, (ALT Samples to split spoon	ray, (BOULDER) RADED GRAVEL rained, with Sand ERED BEDROC aken from auger of	ack, very d	ense, (GP- et, very 1	110	12-20-18 (38) 18" 50/2" (REF) 2" 5" 5" 60/0" (REF) 0" 50/1" (REF) 1"		11	Probable Bedrifeet Test results are attached lab re	e in the
_ 135.0 		1	D (SM), fine to m	-	ned,	_					
D0004004			Continued on ne	ext page							



Project	Number B200	1991			BORING:	Termino	logy sneet	for explanation o	abbreviations
	hnical Evaluat				LOCATION:	See atta	ched sket		
	ge Line 5 Re-R								
Various	Locations								
Ashlan	d and Iron Coเ	ınties, Wiscoı	nsin		LATITUDE:	46	3.47087	LONGITUDE:	-90.48258
DRILLER:	EPC	LOGGED BY:	S. Sulliv	/an	START DAT	E:	04/09/20	END DATE:	04/09/20
SURFACE ELEVATION:	1162.9 ft RIG	: Subcontractor	METHOD: 3 1	/4" HSA	SURFACING	3:		WEATHER:	
	Mater (Soil-AS	Description of M TM D2488 or 2487; 1110-1-290	Rock-USACE EM	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or F	Remarks
ft	SILTY SA with Grav (ALTERE Sample split spo	AND (SM), fine to movel, brown, moist, vol. BEDROCK) is taken from auger on a staken from auger and, (ALTERED BED) is taken from auger as taken from auger	d, reddish brown,	140 —	50/0" (REF) 0" 50/0"			No recovery No recovery No recovery	
 					50/0" (REF) 0"			No recovery	
<u>-</u>		Continued on n	ext page						



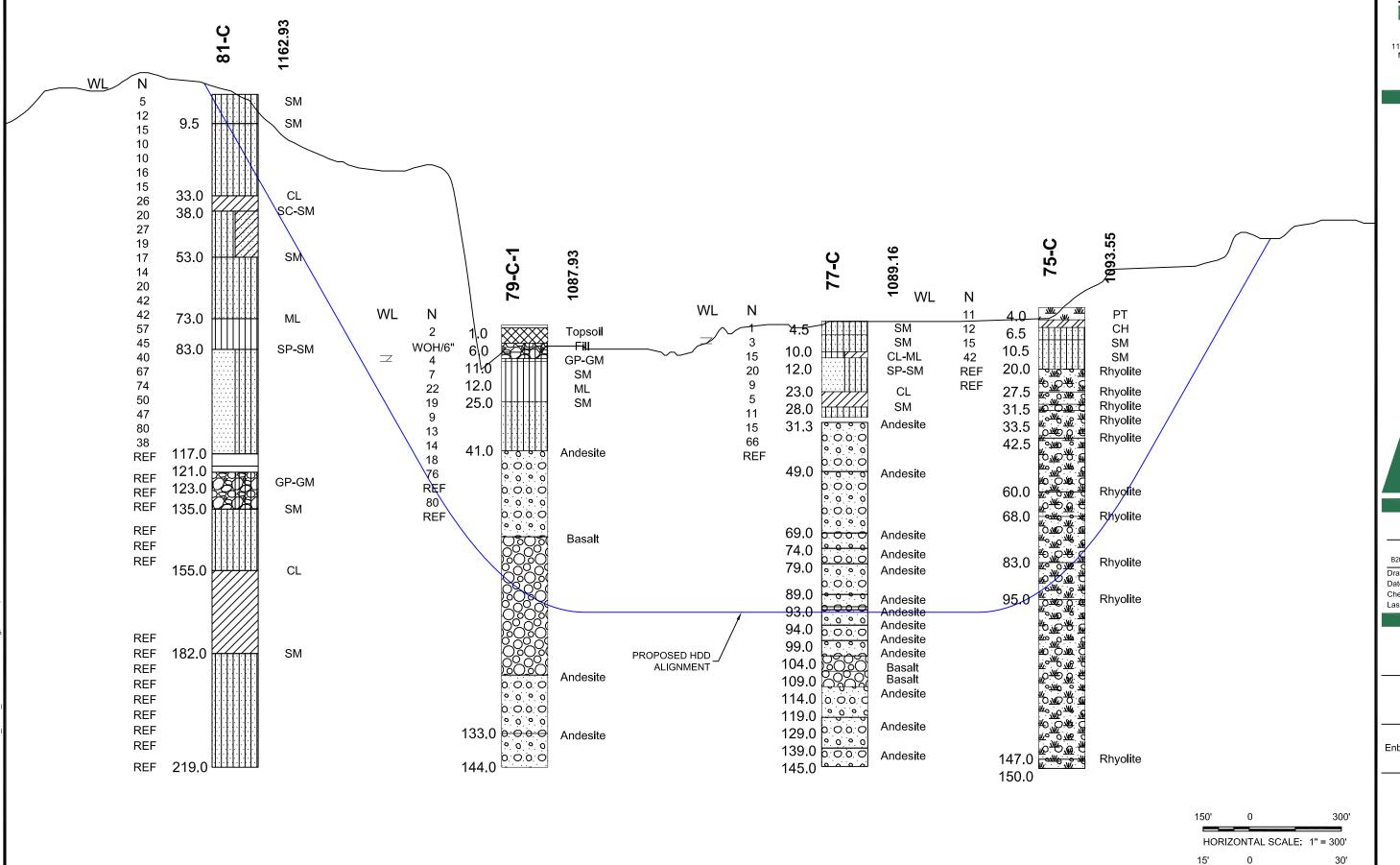
Project Number B2001991 Geotechnical Evaluation					BORING: BOCATION: See attached sketch					
										Enbridge Line 5 Re-Route Various Locations
Ashland a	shland and Iron Counties, Wisconsin						LATITUDE: 46.47087		-90.48258	
DRILLER:	EPC	LOGGED BY:	S. Sull	ivan	START DAT	E:	04/09/20	END DATE:	04/09/20	
SURFACE ELEVATION:	1162.9 ft RIG: Su	bcontractor	METHOD: 3	DD: 3 1/4" HSA		SURFACING:			WEATHER:	
Elev./ Depth to def	De (Soil-ASTM D2	Sample	Blows (N-Value) Recovery	q _p tsf	MC %	Tests or F	Remarks			
-	LEAN CLAY (C moist, hard, (A		d, reddish brown, ROCK)	175—	50/0" (REF) 0"			No recovery		
- - - - - -				180 —	50/1" (REF) 1"			No recovery		
- - 980.9 - 182.0 -	SILTY SAND (with Gravel, br (ALTERED BE	own, wet, very	edium-grained, ⁄ dense,	-	50/1" (REF) 1"			No recovery		
	Samples take split spoon	en from auger (cuttings, not from	185 —	50/0" (REF) 0"			No recovery		
- - - - - - -				195	50/0" (REF) 0"			No recovery		
- - - - - - -				- - -	50/0" (REF) 0"			No recovery		
- - - - - - -		ntinued on ne	ovt nage	200 —	50/0" (REF) 0"			No recovery		



LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations **Project Number B2001991** 81-C **Geotechnical Evaluation** LOCATION: See attached sketch **Enbridge Line 5 Re-Route Various Locations** Ashland and Iron Counties, Wisconsin LATITUDE: LONGITUDE: 46.47087 -90.48258 EPC LOGGED BY: DRILLER: START DATE: 04/09/20 END DATE: 04/09/20 S. Sullivan SURFACE ELEVATION: 1162.9 ft RIG: Subcontractor METHOD: 3 1/4" HSA SURFACING: WEATHER: **Description of Materials** Elev./ Blows Water Level (Soil-ASTM D2488 or 2487; Rock-USACE EM MC q_p tsf (N-Value) Depth Tests or Remarks 1110-1-2908) % ft Recovery SILTY SAND (SM), fine to medium-grained, 205with Gravel, brown, wet, very dense, (ALTERED BEDROCK) 50/0" No recovery (REF) 0" 210 50/0" No recovery (REF) 215 943.9 50/0" No recovery 219.0 **END OF BORING** Water not observed while (REF) 220 -0" drilling. Boring then backfilled with cement/bentonite grout 225 230

235



Minneapolis, MN 55438 952.995.2000 braunintertec.com

Project No.

B2001991 Drawing No: B2001991_MP38_POTATO-RIVER

Drawn By: Date Drawn: Checked By: Last Modified: 8/24/20

Enbridge Line 5 Re-route

MP 38 - Potato

River Crossing

VERTICAL SCALE: 1" = 30' VERTICAL EXAGGERATION: 10x



Descriptive Terminology of Soil

Particle Size Identification

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



Criteria for Assigning Group Symbols and						Soil Classification	
	Group Names Using Laboratory Tests ^A					Group Name ^B	
uo	Gravels Clean Gravels		avels	$C_u \ge 4$ and $1 \le C_c \le 3^D$	GW	Well-graded gravel ^E	
ls ed o	(More than 50% of coarse fraction	(Less than 5% fines ^c)		$C_u < 4$ and/or $(C_c < 1 \text{ or } C_c > 3)^D$	GP	Poorly graded gravel ^E	
ned Soi 6 retain sieve)	retained on No. 4	Gravels with Fines		Fines classify as ML or MH	GM	Silty gravel ^{E F G}	
aine 3% re 3 sie	sieve)	(More than 1	2% fines ^c)	Fines Classify as CL or CH	GC	Clayey gravel ^{EFG}	
Coarse-grained Soils (more than 50% retained No. 200 sieve)	Sands	Clean Sa	ands	$C_u \ge 6$ and $1 \le C_c \le 3^D$	SW	Well-graded sand	
oarse e thar No.	(50% or more coarse	(Less than 5% fines ^H)		$C_u < 6 \text{ and/or} (C_c < 1 \text{ or } C_c > 3)^D$	SP	Poorly graded sand	
nor.	fraction passes No. 4	(* * .) * * * * * * H)		Fines classify as ML or MH	SM	Silty sand ^{FGI}	
	sieve)			Fines classify as CL or CH	SC	Clayey sand ^{F G I}	
	(Liquid limit less than	Inorganic	PI > 7 and	plots on or above "A" line	CL	Lean clay ^{KLM}	
s the			PI < 4 or p	olots below "A" line ^J	ML	Silt ^{KLM}	
Fine-grained Soils 50% or more passes the No. 200 sieve)		Organic	nic Liquid Limit – oven dried Liquid Limit – not dried <0.75		OL	Organic clay KLMN Organic silt KLMO	
grain more				n or above "A" line	СН	Fat clay ^{KLM}	
ine-	(Liquid limit 50 or more)	morganic	PI plots below "A" line		МН	Elastic silt ^{KLM}	
(50			nit – oven dried nit – not dried <0.75	ОН	Organic clay KLMP Organic silt KLMQ		
Highly Organic Soils Primarily orga			anic matte	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.
- If fines are organic, add "with organic fines" to group name.
- Sands with 5 to 12% fines require dual symbols:

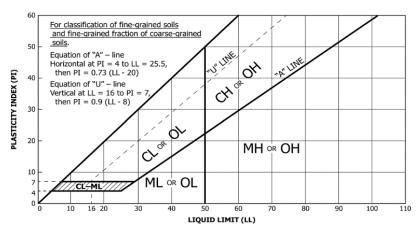
SW-SM well-graded sand with silt

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 OC Organic content. % Pocket penetrometer strength, tsf MC Moisture content, % \mathbf{q}_{υ} Unconfined compression test, tsf

ш Liquid limit PL Plastic limit

Plasticity index

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≥ 15%
Inclusion Thicknesses
lens 0 to 1/8"
seam1/8" to 1"
layer over 1"
Apparent Relative Density of Cohesionless Soils

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.

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

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

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

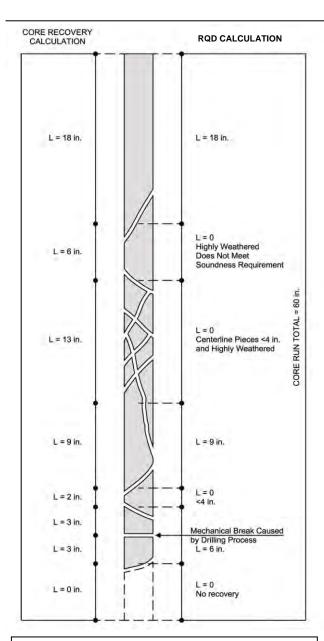
hammer and rods alone; driving not required.

Water Level: Indicates the water level measured by the drillers either while drilling (\bigcirc), at the end of drilling (\bigcirc), 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)

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 Size
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

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



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 near Mellen, WI

Enbridge Line 5 Re-route

B2001991

Sample Information

Sample Number: 326707 Alternate ID: 81-C 6 12'-14'

Sampling Method: Auger Boring ASTM D1452 Depth (ft): 12-14 **Boring Number:** 81-C Sampled By: **Drill Crew**

Location: In-place

Location Details: Boring 81-C Sample 6 12'-14'

Sample Date: 04/09/2020

Received Date: 08/03/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

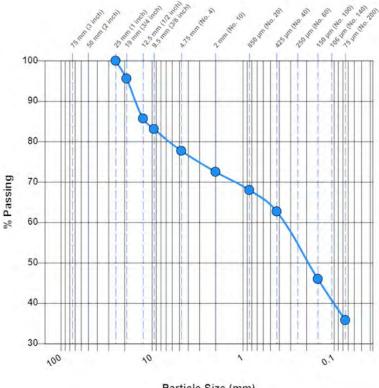
Tested Date: 08/04/2020 Tested By: Nelson, Brennan

Laboratory Data

Sieve Size	Passing (%)	Specification
19 mm (3/4 inch)	95.6	
12.5 mm (1/2 inch)	85.7	
9.5 mm (3/8 inch)	83.1	
4.75 mm (No. 4)	77.7	
2 mm (No. 10)	72.5	
850 µm (No. 20)	68.0	
425 μm (No. 40)	62.7	
150 µm (No. 100)	46.0	
75 μm (No. 200)	35.8	

Silt & Clay (%) Gravel (%) Sand (%) 22.3 41.9 35.8

D60 0.234



Particle Size (mm)

Classification: SM Silty sand with gravel

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 is 244.1 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

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

Sample Information

Sample Number: 326710 **Alternate ID:** 81-C 18 69.5'-71'

Sampling Method:Auger Boring ASTM D1452Depth (ft):69.5-71Boring Number:81-CSampled By:Drill Crew

Location: In-place

Location Details: Boring 81-C Sample 18 69.5'-71'

Sample Date: 04/10/2020

Received Date: 08/03/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

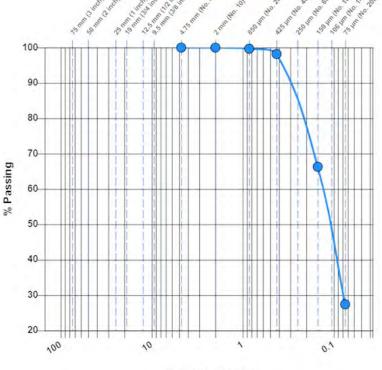
Tested Date: 08/04/2020 Tested By: Nelson, Brennan

Laboratory Data

Sieve Size	Passing (%)	Specification
4.75 mm (No. 4)	100.0	
2 mm (No. 10)	100.0	
850 μm (No. 20)	99.7	
425 μm (No. 40)	98.2	
150 µm (No. 100)	66.3	
75 μm (No. 200)	27.4	

Sand (%) Silt & Clay (%) 72.6 27.4

D30 D60 0.077 0.101



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 is 195.7 grams.

Silm



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

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

Sample Information

Sample Number: 326712 Alternate ID: 81-C 23 94.5'-96'

Sampling Method:Auger Boring ASTM D1452Depth (ft):94.5-96Boring Number:81-CSampled By:Drill Crew

Location: In-place

Location Details: Boring 81-C Sample 23 94.5'-96'

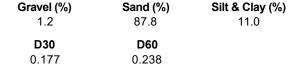
Sample Date: 04/10/2020

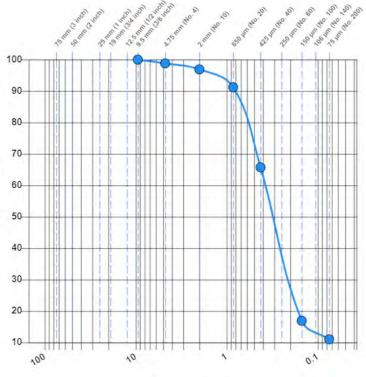
Received Date: 08/03/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

Tested Date: 08/04/2020 Tested By: Nelson, Brennan

Laboratory Data

Sieve Size	Passing (%)	Specification
9.5 mm (3/8 inch)	100.0	
4.75 mm (No. 4)	98.8	
2 mm (No. 10)	96.9	
850 µm (No. 20)	91.2	
425 μm (No. 40)	65.7	
150 µm (No. 100)	16.9	
75 μm (No. 200)	11.0	





Particle Size (mm)

Classification: SP-SM Poorly graded sand with silt

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

% Passing

Dispersion Apparatus: Shaking

General

Results: The test is for informational purposes. **Remarks:** Total dry weight of sample is 223.6 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: 318772 Alternate ID: 81-C 25 112'

Sampling Method: Auger Boring ASTM D1452 Depth (ft): 112

Boring Number: 81-C Location: In-place

Location Details: Boring 81-C Sample 25 112'

Sample Date: 04/14/2020

Received Date: 06/29/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

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

Laboratory Data

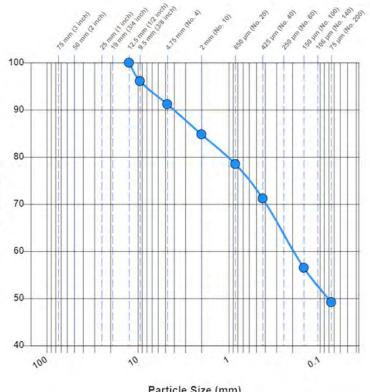
Sieve Size	Passing (%)	Specification
12.5 mm (1/2 inch)	100.0	
9.5 mm (3/8 inch)	96.1	
4.75 mm (No. 4)	91.2	
2 mm (No. 10)	84.8	
850 µm (No. 20)	78.5	
425 µm (No. 40)	71.2	
150 µm (No. 100)	56.5	
75 μm (No. 200)	49.2	

Gravel (%) 8.8

Sand (%) 42.0

Silt & Clay (%) 49.2

D60 0.174



Particle Size (mm)

Classification: SM Silty sand

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

% Passing

Dispersion Apparatus: Shaking

General

Results: The test is for informational purposes. Remarks: Total dry weight of sample 241.5 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: 319401 Alternate ID: 79-C-1 4 7'

Sampling Method: Aggregate ASTM D75/AASHTO T2 Depth (ft):

Boring Number: 79-C-1 Sampled By: **Drill Crew**

Location: In-place

Location Details: Boring 79-C-1 Sample 4 7'

Sample Date: 06/05/2020

Received Date: 07/01/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

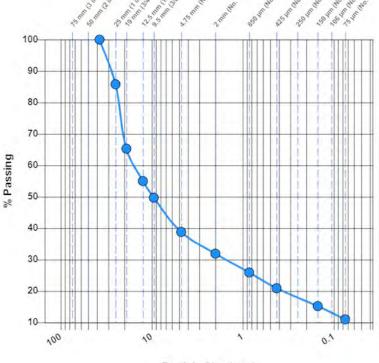
Tested Date: 07/07/2020 Tested By: Nelson, Brennan

Laboratory Data

Sieve Size	Passing (%)	Specification
37.5 mm (1.5 inch)	100.0	
25 mm (1 inch)	85.8	
19 mm (3/4 inch)	65.3	
12.5 mm (1/2 inch)	55.0	
9.5 mm (3/8 inch)	49.7	
4.75 mm (No. 4)	38.8	
2 mm (No. 10)	31.9	
850 µm (No. 20)	25.9	
425 μm (No. 40)	20.9	
150 μm (No. 100)	15.2	
75 μm (No. 200)	11.0	



Silt & Clay (%) 11.0



Particle Size (mm)

Classification: GP-GM Poorly graded gravel with silt and 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 is 275.6 grams.



ASTM D6913

4511 West First Street Suite 4

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

Sampled By:

Test Method:

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: 319405 Alternate ID: 79-C-1 8 20'

Sampling Method: Aggregate ASTM D75/AASHTO T2 Depth (ft): 20

Boring Number: 79-C-1 Location: In-place

Boring 79-C-1 Sample 8 20' **Location Details:**

Sample Date: 06/08/2020

Received Date: 07/01/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

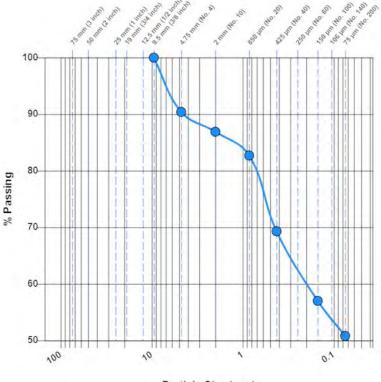
Tested Date: 07/07/2020 Tested By: Nelson, Brennan

Laboratory Data

Sieve Size	Passing (%)	Specification
9.5 mm (3/8 inch)	100.0	
4.75 mm (No. 4)	90.4	
2 mm (No. 10)	86.9	
850 µm (No. 20)	82.7	
425 µm (No. 40)	69.3	
150 µm (No. 100)	57.0	
75 µm (No. 200)	50.8	

Gravel (%) Sand (%) Silt & Clay (%) 9.6 39.6 50.8

D60 0.174



Particle Size (mm)

Method A (Composite Sieving)

Classification: ML Sandy silt

Dispersion Apparatus:

Specimen Obtained: Oven Dry Shaking

General

Results: The test is for informational purposes. Remarks: Total dry weight of sample is 267.9 grams.



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: 315520 Alternate ID: 77-C Sample 4 7'-9'

Sampling Method: Auger Boring ASTM D1452 Depth (ft): 7'

Boring Number: 77-C Location: In-place

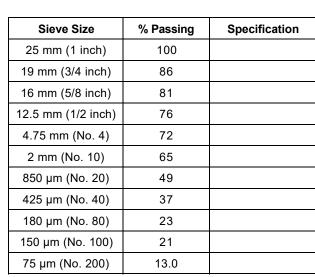
Location Details: Boring 77-C Sample 4 7'-9'

Sample Date: 05/26/2020

4511 West First Street, Suite 4, Duluth, MN Received Date: 06/15/2020 Lab:

Tested Date: 06/17/2020

Laboratory Data



Test Method: Method A (Composite Sieving)

Dispersion Apparatus: Shaking **Specimen Obtained:**

10 100 Oven Dry 10

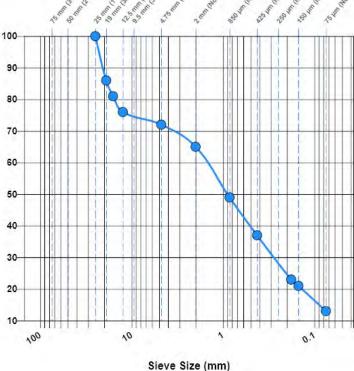
Passing

%

Classification: SM Silty sand with gravel

General

Results: The test is for informational purposes. Remarks: Total dry weight of sample 111.9 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

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

Sample Information

Sample Number: 315521 **Alternate ID:** 77-C 6 & 7 12'-16.5'

Sampling Method: Auger Boring ASTM D1452 Depth (ft): 12

Boring Number: 77-C Sampled By: Drill Crew

Location: In-place

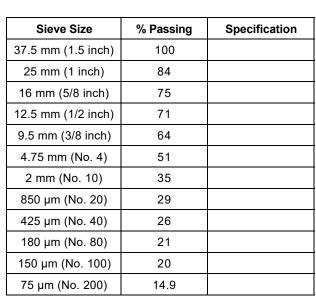
Location Details: Boring 77-C Sample 6 & 7 12'-16.5'

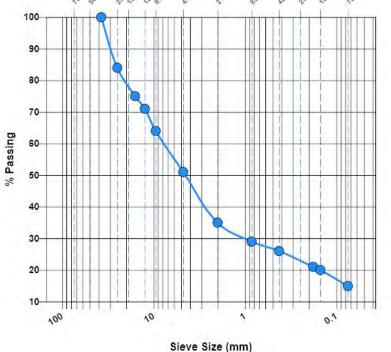
Sample Date: 05/26/2020

Received Date: 06/15/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

Tested Date: 06/17/2020

Laboratory Data





Test Method: Method A (Composite Sieving)

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

Classification: SP-SM Poorly graded sand with silt and gravel

General

Results: The test is for informational purposes. **Remarks:** Total weight of dry sample 355.8 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

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

Sample Information

Sample Number: 324771 Alternate ID: 75-C Sample 303 7.5'

Sampling Method: Auger Boring ASTM D1452 Depth (ft): 7.5 **Boring Number:** 75-C Sampled By: **Drill Crew**

Location: In-place

Boring 75-C Sample 303 7.5' **Location Details:**

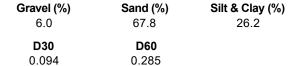
Sample Date: 07/27/2020

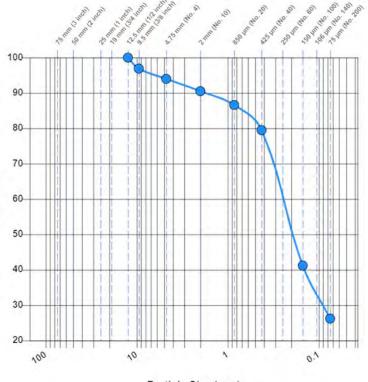
Received Date: 07/27/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

Tested Date: 07/27/2020 Tested By: Patterson, Gregg

Laboratory Data

Sieve Size	Passing (%)	Specification
12.5 mm (1/2 inch)	100.0	
9.5 mm (3/8 inch)	96.9	
4.75 mm (No. 4)	94.0	
2 mm (No. 10)	90.5	
850 µm (No. 20)	86.6	
425 μm (No. 40)	79.5	
150 µm (No. 100)	41.2	
75 μm (No. 200)	26.2	





Particle Size (mm)

Classification: SM Silty sand

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

% Passing

Dispersion Apparatus: Shaking

General

Results: The test is for informational purposes. Remarks: Total dry weight of sample 319.0 grams

David Morrison



ASTM D2216

4511 West First Street Suite 4 Duluth MN 55807

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: 326707 **Alternate ID:** 81-C 6 12'-14'

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

Location: In-place

Location Details: Boring 81-C Sample 6 12'-14'

Sample Date: 04/09/2020

Received Date: 08/03/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

Tested Date: 08/04/2020 **Tested By:** Nelson, Brennan

Laboratory Data					
Boring # Sample # Depth (ft) Moisture Content (%)					
81-C	6	13.0	3.6		

General

Results: The test is for informational purposes.



ASTM D2216

4511 West First Street Suite 4 Duluth MN 55807

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: 326710 **Alternate ID:** 81-C 18 69.5'-71'

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

Location: In-place

Location Details: Boring 81-C Sample 18 69.5'-71'

Sample Date: 04/10/2020

Received Date: 08/03/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

Tested Date: 08/04/2020 **Tested By:** Nelson, Brennan

	Laborat	ory Data	
Boring #	Sample #	Depth (ft)	Moisture Content (%)
81-C	18	70.0	11.7

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 Enbridge Lin

Enbridge Line 5 near Mellen, WI

Enbridge Line 5 Re-route

B2001991

Sample Information

Sample Number: 326712 **Alternate ID:** 81-C 23 94.5'-96'

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

Location: In-place

Location Details: Boring 81-C Sample 23 94.5'-96'

Sample Date: 04/10/2020

Received Date: 08/03/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

Tested Date: 08/04/2020 **Tested By:** Nelson, Brennan

	Laborat	ory Data	
Boring #	Sample #	Depth (ft)	Moisture Content (%)
81-C	23	95.0	14.7

General

Results: The test is for informational purposes.



ASTM D2216

4511 West First Street Suite 4 Duluth, MN 55807

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: 318772 **Alternate ID:** 81-C 25 112'

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

Location: In-place

Location Details: Boring 81-C Sample 25 112'

Sample Date: 04/14/2020

Received Date: 06/29/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

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

	Laborat	ory Data	
Boring #	Sample #	Depth (ft)	Moisture Content (%)
81-C	25	112.0	11.1

General

Results: The test is for informational purposes.



ASTM D2216

4511 West First Street Suite 4 Duluth MN 55807

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:319401Alternate ID:79-C 4 7'Sampling Method:Aggregate ASTM D75/AASHTO T2Sampled By:Drill Crew

Location: In-place

Location Details: Boring 79-C Sample 4 7'

Sample Date: 06/05/2020

Received Date: 07/01/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

Tested Date: 07/07/2020 Tested By: Nelson, Brennan

	Laborat	ory Data	
Boring #	Sample #	Depth (ft)	Moisture Content (%)
79-C-1	4	7.0	5.0

General

The test is for informational purposes.



ASTM D2216

4511 West First Street Suite 4 Duluth MN 55807

Duluth, MN 55807 Phone: 218-624-4967

Location:

Results:

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: 319405 **Alternate ID:** 79-C-1 8 20'

Sampling Method: Aggregate ASTM D75/AASHTO T2

In-place

Location Details: Boring 79-C-1 Sample 8 20'

Sample Date: 06/08/2020

Received Date: 07/01/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

Tested Date: 07/07/2020 Tested By: Nelson, Brennan

	Laborat	ory Data	
Boring #	Sample #	Depth (ft)	Moisture Content (%)
79-C-1	8	20.0	12.5

General

The test is for informational purposes.



ASTM D2216

4511 West First Street Suite 4 Duluth MN 55807

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: 315520 Alternate ID: 77-C Sample 4 7'-9'

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

Location: In-place

Location Details: Boring 77-C Sample 4 7'-9'

Sample Date: 05/26/2020

Received Date: 06/15/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

Tested Date: 06/17/2020 **Tested By:** Nelson, Brennan

	Laborat	ory Data	
Boring #	Sample #	Depth (ft)	Moisture Content (%)
77-C	4	8.0	18.6

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: 315521 **Alternate ID:** 77-C 6 & 7 12'-16.5'

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

Location: In-place

Location Details: Boring 77-C Sample 6 & 7 12'-16.5'

Sample Date: 05/26/2020

Received Date: 06/15/2020 Lab: 4511 West First Street, Suite 4, Duluth, MN

Tested Date: 06/17/2020 **Tested By:** Nelson, Brennan

	Laborat	ory Data	
Boring #	Sample #	Depth (ft)	Moisture Content (%)
77-C	6 and 7	14.5	12.1

General

Results: The test is for informational purposes.



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: 328877 Depth (ft): 35 **Boring Number:** 81-C

Sampled By: **Drill Crew**

Sample Date: 08/05/2020

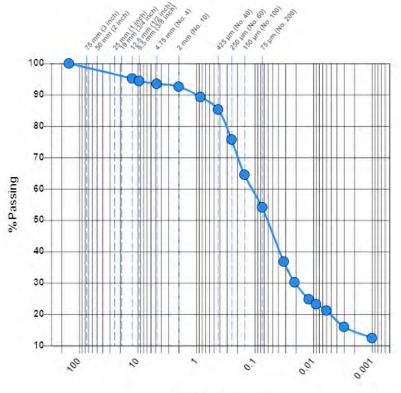
Received Date: 11001 Hampshire Ave S, Bloomington, MN 08/12/2020 Lab:

Tested Date: 08/12/2020 Tested By: Streier, Jim

Laboratory Data

Sieve-Hydrometer Analysis

Particle Size	% Passing	Specification
19 mm (3/4 inch)	100.0	oposinounon
		_
12.5 mm (1/2 inch)	95.2	-
9.5 mm (3/8 inch)	94.4	-
4.75 mm (No. 4)	93.5	-
2 mm (No. 10)	92.6	-
850 µm (No. 20)	89.3	-
425 µm (No. 40)	85.3	-
250 µm (No. 60)	75.7	-
150 µm (No. 100)	64.5	-
75 μm (No. 200)	54.1	-
32.0 (µm)	36.8	-
20.7 (μm)	30.2	-
12.2 (µm)	24.8	-
8.7 (µm)	23.2	
6.2 (µm)	21.2	-
3.1 (µm)	16.0	-
1.4 (µm)	12.4	-



Particle Size (mm)

Soil Classification: CL Sandy lean clay

Gravel (%): Sand (%): Silt (%): 34.6 Clay (%): 19.5 6.5 39.4

20.7 D₆₀ (µm): 117.5 D₃₀ (µm):

General



Phone: 218.624.4967 Fax: 218.624.0196 Web: braunintertec.com

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 29, 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: 7/10/2020
Sample Preparation: Trim and Polished

Laboratory Data ASTM D4543 Limits

Sample Number: Date Tested: Rock Type: Moisture Condition During Testing: Diameter (in.): Length (in.): Length-to-Diameter Ratio (L/D): Side Tolerance, Maximum (in.) End Tolerance, Maximum (in.) Perpendicularity Deviation (°) Parallelism Deviation (°) Maximum Load (lbs): Area (in²):	$\begin{array}{c} 23\text{-}24 \\ 7/16/2020 \\ \text{Felsite} \\ \text{Dry} \\ 1.76 \\ 4.11 \\ 2.3 \\ \underline{< 0.020} \\ \underline{< 0.001 \text{ in}} \\ \underline{< 0.001 \text{ in}} \\ \underline{< 0.001 \text{ in}} \\ \underline{< 0.43} \\ 2.43 \end{array}$	$\begin{array}{c} 33\text{-}34 \\ 7/16/2020 \\ \text{Felsite} \\ \text{Dry} \\ 1.76 \\ 3.75 \\ 2.1 \\ \underline{< 0.020} \\ \underline{< 0.001 \text{ in}} \\ \underline{< 0.438} \\ 2.43 \end{array}$	$\begin{array}{c} 43\text{-}44\\ 7/16/2020\\ \text{Felsite}\\ \text{Dry}\\ 1.76\\ 3.22\\ 1.8\\ \underline{<0.020}\\ \underline{<0.001\text{ in}}\\ \underline{<0.001\text{ in}}\\ \underline{<0.001\text{ in}}\\ \underline{<2.43} \end{array}$	$54-55$ $7/16/2020$ Felsite Dry 1.77 4.41 2.5 ≤ 0.020 ≤ 0.001 in ≤ 0.001 in ≤ 0.001 in ≤ 0.001 derivative ≤ 0.001 in	$2.0 \le L/D \le $ $\le 0.020 \text{ ir}$ $\le 0.001 \text{ ir}$ $\le 0.250^{\circ}$ $\le 0.25^{\circ}$
Area (in ²):	2.43	2.43	2.43	2.46	
Compressive Strength (psi): Compressive Strength (MPa):	9,040 61	19,520 133	14,120 96	16,900 115	

Remarks:

Location 75-C-1

Reviewed By: David Morrison

The



Phone: 218.624.4967 Fax: 218.624.0196 Web: braunintertec.com

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: August 3, 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: 7/10/2020
Sample Preparation: Trim and Polished

Laboratory Data ASTM D4543 Limits

Sample Number: Date Tested: Rock Type: Moisture Condition During Testing: Diameter (in.): Length (in.): Length-to-Diameter Ratio (L/D): Side Tolerance, Maximum (in.) End Tolerance, Maximum (in.) Perpendicularity Deviation (°) Parallelism Deviation (°) Maximum Load (lbs):	$64-65$ $7/16/2020$ Felsite Dry 1.76 ≤ 0.020 $\leq 0.001 \text{ in}$ $\leq 0.001 \text{ in}$ $\leq 0.001 \text{ in}$ $21,868$	74-75 $7/16/2020$ Felsite Dry 1.76 4.47 2.5 < 0.020 $< 0.001 in$ $< 0.001 in$ $52,176$	$\begin{array}{c} 86\text{-}87 \\ 7/16/2020 \\ \text{Felsite} \\ \text{Dry} \\ 1.76 \\ 3.99 \\ 2.3 \\ \underline{< 0.020} \\ \underline{< 0.001 \text{ in}} \\ \underline{< 0.001 \text{ in}} \\ \underline{< 0.001 \text{ in}} \\ \underline{< 8.583} \\ \end{array}$	$\begin{array}{c} 96\text{-}97 \\ 7/16/2020 \\ \text{Felsite} \\ \text{Dry} \\ 1.76 \\ 3.60 \\ 2.0 \\ \underline{< 0.020} \\ \underline{< 0.001 \text{ in}} \\ 58,347 \end{array}$	$ 2.0 \le L/D \le \le 0.020 i \le 0.001 i \le 0.250 \le 0.25^{\circ} $
Parallelism Deviation (°)	< 0.001 in	< 0.001 in	< 0.001 in	< 0.001 in	
Area (in²): Compressive Strength (psi): Compressive Strength (MPa):	2.43 9,000 61	2.43 21,470 146	2.43 15,880 108	2.43 24,010 163	

Remarks:

Location 75-C-1

Reviewed By: David Morrison

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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: August 3, 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: 7/10/2020
Sample Preparation: Trim and Polished

Laboratory Data ASTM D4543 Limits

Sample Number: Date Tested: Rock Type: Moisture Condition During Testing: Diameter (in.): Length (in.): Length-to-Diameter Ratio (L/D): Side Tolerance, Maximum (in.) End Tolerance, Maximum (in.) Perpendicularity Deviation (°) Parallelism Deviation (°) Maximum Load (lbs): Area (in²):	$\begin{array}{c} 117\text{-}118 \\ 7/16/2020 \\ \text{Rhyolite} \\ \text{Dry} \\ 1.76 \\ 4.20 \\ 2.4 \\ < 0.020 \\ < 0.001 \text{ in} \\ < 0.001 \text{ in} \\ 40.891 \\ 2.43 \end{array}$	129-130 7/16/2020 Rhyolite Dry 1.76 4.02 2.3 <0.0020 <0.001 in <0.001 in 39,150 2.43	$\begin{array}{c} 139\text{-}140 \\ 7/16/2020 \\ \text{Rhyolite} \\ \text{Dry} \\ 1.76 \\ 4.11 \\ 2.3 \\ \underline{< 0.020} \\ \underline{< 0.001 \text{ in}} \\ \underline{< 0.001 \text{ in}} \\ \underline{< 0.001 \text{ in}} \\ 45,924 \\ 2.43 \\ \end{array}$	149-150 7/16/2020 Rhyolite Dry 1.76 4.35 2.5 <0.020 <0.001 in <0.001 in 53,005 2.43	$2.0 \le L/D \le 0.020 i \le 0.021 i \le 0.001 i \le 0.250 \le 0.25^{\circ}$
Area (in²): Compressive Strength (psi): Compressive Strength (MPa):	2.43 16,830 114	2.43 16,110 109	2.43 18,900 128	2.43 21,810 148	

Remarks:

Location 75-C-1

Reviewed By: David Morrison

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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

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: 6/17/2020
Sample Preparation: Trim and Polished

Laboratory Data ASTM D4543 Limits

Sample Number: Date Tested:	35-36	47-48	58-59	67-68
Rock Type:	Gabbro	Gabbro	Basalt	Basalt
Moisture Condition During Testing:	Dry	Dry	Dry	Dry
Diameter (in.):	1.98	1.99	1.98	1.98
Length (in.):	4.58	3.99	4.42	4.39
Length-to-Diameter Ratio (L/D):	2.3	2.0	2.2	2.2
Side Tolerance, Maximum (in.)	< 0.020	< 0.020	< 0.020	< 0.020
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	< 0.001 in
Parallelism Deviation (°)	< 0.001 in	< 0.001 in	< 0.001 in	< 0.001 in
Maximum Load (lbs):	43,284	42,743	28,297	30,697
Area (in ²):	3.08	3.11	3.08	3.08
Compressive Strength (psi):	14,050	13,740	9,190	9,970
Compressive Strength (MPa):	95	93	62	68

Remarks:

Location 77-C

Reviewed By: David Morrison

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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

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: 6/17/2020
Sample Preparation: Trim and Polished

Laboratory Data ASTM D4543 Limits

Sample Number:	81-82	95-96	112-113	125-126	
Date Tested:					
Rock Type:	Basalt	Gabbro	Basalt	Andesite	
Moisture Condition During Testing:	Dry	Dry	Dry	Dry	
Diameter (in.):	1.97	1.99	1.98	1.98	
Length (in.):	3.26	4.37	3.25	4.11	
Length-to-Diameter Ratio (L/D):	1.7	2.2	1.6	2.1	$2.0 \le L/D \le 2.5$
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):	16,938	39,704	15,844	11,941	
Area (in ²):	3.05	3.11	3.08	3.08	
Compressive Strength (psi):	5,550	12,770	5,140	3,880	
Compressive Strength (MPa):	38	87	35	26	

Remarks:

Location 77-C

Sample 112-113 was sulfur capped for testing purposes

Reviewed By: David Morrison

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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 16, 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: 7/10/2020
Sample Preparation: Trim and Polished

Laboratory Data ASTM D4543 Limits

Sample Number:	45-46	55-56	78-79	92-93	
Date Tested: Rock Type:	Andesite	Andesite	Basalt	Basalt	
Moisture Condition During Testing:	Dry	Dry	Dry	Dry	
Diameter (in.):	1.86	1.86	1.87	1.86	
ength (in.):	3.60	3.79	3.00	3.76	
ength-to-Diameter Ratio (L/D):	1.9	2.0	1.6	2.0	
de Tolerance, Maximum (in.)	< 0.020	< 0.020	< 0.020	< 0.020	
d Tolerance, Maximum (in.)	< 0.001 in	< 0.001 in	< 0.001 in	< 0.001 in	
pendicularity Deviation (°)	< 0.001 in	< 0.001 in	< 0.001 in	< 0.001 in	
llelism Deviation (°)	< 0.001 in	< 0.001 in	< 0.001 in	< 0.001 in	
kimum Load (lbs):	42,156	47,618	5,224	12,079	
ea (in²):	2.72	2.72	2.75	2.72	
mpressive Strength (psi):	15,500	17,510	1,900	4,440	
mpressive Strength (MPa):	105	119	13	30	

Remarks:

Location 79-C-1

Reviewed By: David Morrison

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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 29, 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: 7/10/2020
Sample Preparation: Trim and Polished

Laboratory Data ASTM D4543 Limits

Remarks:

Location 79-C-1

Reviewed By: David Morrison

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