

# Subsurface Investigation Report

Enbridge Line 5 Reroute  
MP 34 HDD Crossing – Tyler Forks Alignment  
Location 70-C, North of Casey Sag Road, South side of Tyler Forks  
Location 71-C, North of Casey Sag Road, South side of Tyler Forks  
Location 72-C-1, West of Vogues Road, North side of Tyler Forks  
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.



Joseph C. Butler, PE  
Business Unit Manager / Senior Engineer  
License Number: E-43286-6  
September 28, 2020



September 28, 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 34 HDD Crossing – Tyler Forks Alignment  
Location 70-C, North of Casey Sag Road, South side of Tyler Forks  
Location 71-C, North of Casey Sag Road, South side of Tyler Forks  
Location 72-C-1, West of Vogues Road, North side of Tyler Forks  
Town of Gurney, Iron County, Wisconsin

Dear Mr. Erickson:

We are pleased to present this Subsurface Investigation Report for the Line 5 Reroute Project at the MP 34 HDD Crossing under Tyler Forks in Town of Ashland, 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@brauninterte.com](mailto:kwarmuth@brauninterte.com)) or David Morrison ([dmorrison@braunintertec.com](mailto: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 70-C, 71-C, and 72-C-1

HDD Alignment Profile

Descriptive Terminology of Soil

Descriptive Terminology off Rock

Geotechnical Testing Report: 331864

Sieve Analysis Reports: 319395, 319397, 319399, 319400, 331865, 327709, 331867

Moisture Content Report: 319395, 319397, 319399, 319400, 327709

Compressive Strength of Cores: 70-C, 71-C, 72-C-1

## **A. Introduction**

### **A.1. Project Description**

Enbridge Energy plans to relocate 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 70-C, 71-C, and 72-C-1 for the updated HDD crossing under Tyler Forks which is located at MP 34 in the proposed pipeline alignment in Town of Gurney, 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 three (3) standard penetration test (SPT) borings, denoted as 70-C, 71-C, and 72-C-1 to nominal depths ranging from 114 to 125 feet below grade.
- 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 two (2) borings consisted (proceeding down from the ground surface) of 4 feet of silty sand fill in boring 72-C-1, underlain by glacial deposits. The soils contained in the layers consisted of silty sands, poorly graded sands with silt, clayey sand, silty clayey sand, and poorly graded gravel 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 1124 to 1133 1/2 feet to the termination depth of the boring. The bedrock generally consisted of reddish gray with white basalt, gabbro, and rhyolite associated with the Kallander Creek Volcanics.

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

The Gabbro was generally classified as “highly fractured”. The rock was deemed as “moderately hard” in terms of the rock hardness scale and was “moderately weathered”.

The Rhyolite was generally classified as “moderately fractured” to “highly fractured”. The rock was deemed as “moderately hard” in terms of the rock hardness scale and ranged from “slightly weathered” to “moderately 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 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 (1170 1/2 to 1129)	Clayey Sand (SC)	16 - 17	104 - 105	118 - 120	31	20	1.25	1.4 – 1.9	64 - 73
	Silty Sand (SM)	2 - 70	91 - 118	110 - 130	27 - 37	5 - 25	0.5 - 2.5	0.1 - 4.1+	12 - 490
	Silty Clayey Sand (SC-SM)	6 - 85 blows for 11 inches of penetration	115 - 130	115 - 130	28 - 37	10 - 25	0.75 – 2.5	0.4 – 4.1+	24 - 367
	Poorly Graded Sand with Silt (SP-SM)	17 - 30	100 - 106	117 - 122	33 - 38	33 - 35	0	0	119 - 216
	Poorly Graded Gravel (GP)	50 blows for 5 inches of penetration - 50 blows for 1 inches of penetration	120 - 130	130 - 135	42 - 45	36	0	0	806 - 840
Lower Rock (1131 to 1145 1/2)	Basalt	N/A	169 - 206	169 - 206	35 - 38	31 - 36	0	0	446,400 – 597,600
	Gabbro	N/A	178 - 195	178 - 195	35 - 38	31 - 36	0	0	446,400 – 597,600
	Rhyolite	N/A	161-167	161-167	35 - 38	31 - 36	0	0	327,080 – 513,000

\*Sustained Young's Modulus values



## **B.4. Groundwater**

We encountered groundwater at depths ranging from 4 1/2 to 7 feet below the ground surface while advancing the borings.

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, Atterberg limits, and compressive strength of cores that was requested. The Appendix contains the results of these tests.

# **C. Procedures**

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

We drilled the penetration test borings with a floatation 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. Exploration Logs**

### **C.2.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.

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.2.b. 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. 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.2.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.3. Material Classification and Testing**

### **C.3.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.3.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.4. Groundwater Measurements**

The drillers checked for groundwater while advancing the penetration test borings, and again after auger withdrawal. We then filled the boreholes or allowed them to remain open for an extended period of observation, 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**

<b>Project Number B2001991</b> <b>Geotechnical Evaluation</b> <b>Enbridge Line 5 Re-Route</b> <b>Various Locations</b> <b>Ashland and Iron Counties, Wisconsin</b>					BORING: <b>70-C</b>		
					LOCATION: See attached sketch		
					LATITUDE: 46.42155	LONGITUDE: -90.51730	
DRILLER: EPC		LOGGED BY: A. Hillerud		START DATE: 06/19/20	END DATE: 06/24/20		
SURFACE ELEVATION: 1162.8 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 <sub>p</sub> tsf	MC %	Tests or Remarks
1158.3 4.5	X	SILTY SAND (SM), fine to medium-grained, trace Gravel, trace roots, brown, moist, very loose to loose (GLACIAL TILL)		1-1-1-2 (2) 16"		15	Test results are in the attached lab report.
			2-1-4-4 (5) 18"				
			1-4-3-5 (7) 3"				
			5-9-7-6 (16) 12"				
			3-9-9-8 (18) 24"				
1152.8 10.0		SILTY SAND (SM), fine to medium-grained, with Gravel, brown, wet, loose to dense (GLACIAL TILL) <i>Cobbles and Boulders from 4 1/2 to 10 feet</i>	5	4-5-5-5 (10) 18"			Drilling method switched to mud rotary at 14 feet.
			10	5-5-6-7 (11) 18"			
			15				
			20	14-21-19-20 (40) 24"			
			25	13-24-21 (45) 18"			
1134.8 28.0		POORLY GRADED SAND with SILT (SP-SM), fine to medium-grained, with Gravel, brown, wet, dense (GLACIAL OUTWASH)	30	8-14-16 (30) 18"		17	Test results are in the attached lab report.

Continued on next page

<b>Project Number B2001991</b> <b>Geotechnical Evaluation</b> <b>Enbridge Line 5 Re-Route</b> <b>Various Locations</b> <b>Ashland and Iron Counties, Wisconsin</b>					BORING: <b>70-C</b>						
					LOCATION: See attached sketch						
					LATITUDE: 46.42155	LONGITUDE: -90.51730					
DRILLER: EPC		LOGGED BY: A. Hillerud		START DATE: 06/19/20		END DATE: 06/24/20					
SURFACE ELEVATION: 1162.8 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 <sub>p</sub> tsf	MC %	Tests or Remarks		
1128.8		POORLY GRADED SAND with SILT (SP-SM), fine to medium-grained, with Gravel, brown, wet, dense (GLACIAL OUTWASH)							Hard drilling 34 to 38 feet, suspected bedrock at 34 feet.		
34.0		POORLY GRADED GRAVEL (GP), brown, wet, (WEATHERED BEDROCK)			35	50/1" (REF) 1"				Tri-cone speed of advancement and cuttings indicated apparent bedrock, switched to coring at 38 feet.	
1124.8		KALLANDER CREEK VOLCANICS, RHYOLITE, reddish gray with white, slightly weathered, moderately hard, fine-grained to medium-grained, massive, moderately fractured <i>Test results are in the attached lab report</i>			40	50/0" (REF) 0"			Run 1 MOH's 5		
38.0						100	90				
					45	70	90		Run 2 MOH's 5		
		<i>Test results are in the attached lab report</i>			50	100	100		Run 3 MOH's 5		
					55	100	100		Run 4 MOH's 5		
		<i>Test results are in the attached lab report</i>			60	90	100		Run 5 MOH's 5		
									Run 6 MOH's 5		
Continued on next page					RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Water Return %	Remarks

<b>Project Number B2001991</b> <b>Geotechnical Evaluation</b> <b>Enbridge Line 5 Re-Route</b> <b>Various Locations</b> <b>Ashland and Iron Counties, Wisconsin</b>						BORING: <b>70-C</b>					
						LOCATION: See attached sketch					
						LATITUDE: 46.42155			LONGITUDE: -90.51730		
DRILLER: EPC		LOGGED BY: A. Hillerud		START DATE: 06/19/20		END DATE: 06/24/20					
SURFACE ELEVATION: 1162.8 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	
1074.8		KALLANDER CREEK VOLCANICS, RHYOLITE, reddish gray with white, slightly weathered, moderately hard, fine-grained to medium-grained, massive, moderately fractured	65	85	100					Run 7 MOH's 5	
				95	100					Run 8 MOH's 5	
			70	95	100					Run 9 MOH's 5	
										Run 10 MOH's 5	
			75	95	100					Run 11 MOH's 5	
										Run 12 MOH's 5	
			80	80	100					Run 13 MOH's 5	
				95	100					Run 14 MOH's 5	
			85	85	100						
88.0		KALLANDER CREEK VOLCANICS, RHYOLITE, reddish gray with white, moderately weathered, moderately hard, fine-grained to medium-grained, massive, highly fractured	90	65	100					Run 7 MOH's 5	
										Run 8 MOH's 5	
			95	80	100					Run 9 MOH's 5	
Continued on next page											



<b>Project Number B2001991</b> <b>Geotechnical Evaluation</b> <b>Enbridge Line 5 Re-Route</b> <b>Various Locations</b> <b>Ashland and Iron Counties, Wisconsin</b>						BORING: <b>70-C</b>					
						LOCATION: See attached sketch					
						LATITUDE: 46.42155			LONGITUDE: -90.51730		
DRILLER: EPC		LOGGED BY: A. Hillerud		START DATE: 06/19/20		END DATE: 06/24/20					
SURFACE ELEVATION: 1162.8 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	
1059.8		KALLANDER CREEK VOLCANICS, RHYOLITE, reddish gray with white, moderately weathered, moderately hard, fine-grained to medium-grained, massive, highly fractured	100	4	100					Run 15 MOH's 5 Run 16 MOH's 5	
103.0		<i>Test results are in the attached lab report</i>									
		KALLANDER CREEK VOLCANICS, RHYOLITE, reddish gray with white, slightly weathered, moderately hard, fine-grained to medium-grained, massive, highly fractured	105	90	100					Run 17 MOH's 5	
		<i>Test results are in the attached lab report</i>									
			110	55	100					Run 18 MOH's 5	
		<i>Test results are in the attached lab report</i>									
			115	65	100					Run 19 MOH's 5	
1044.8											
118.0		END OF CORING								Water observed at 4.5 feet while drilling.	
		Boring then backfilled with cement/bentonite grout	120								
			125								

<b>Project Number B2001991</b> <b>Geotechnical Evaluation</b> <b>Enbridge Line 5 Re-Route</b> <b>Various Locations</b> <b>Ashland and Iron Counties, Wisconsin</b>					BORING: <b>71-C</b>		
					LOCATION: See attached sketch		
					LATITUDE: 46.42271	LONGITUDE: -90.51679	
DRILLER: EPC		LOGGED BY: A. Hillerud		START DATE: 06/18/20		END DATE: 06/18/20	
SURFACE ELEVATION: 1161.4 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 <sub>p</sub> tsf	MC %	Tests or Remarks
1157.4	X	SILTY SAND (SM), fine-grained, trace roots, brown, moist, very loose (GLACIAL TILL)		1-1-1-2 (2) 6"		15	Test results are in the attached lab report.
4.0			1-1-1-9 (2) 24"				
		5	7-8-9-9 (17) 4"				
			7-8-11-16 (19) 18"				
1151.4		10	11-12-17-16 (29) 18"				
10.0		SILTY SAND (SM), fine to medium-grained, with Gravel, brown, wet, medium dense to very dense (GLACIAL TILL)		3-8-11-14 (19) 24"		Drilling method switched to mud rotary at 14 feet	
	15	6-20-23-24 (43) 24"					
	20	20-32-38 (70) 18"					
1136.4		POORLY GRADED GRAVEL (GP), brown, wet, (WEATHERED BEDROCK) <i>Auger advanced without sampling to 37.5 feet</i>	25	50/5" (REF) 2"	10	Test results are in the attached lab report.	Tri-cone speed of advancement and cuttings indicated apparent bedrock, switched to coring at 37.5 feet.
25.0			30				

Continued on next page

<b>Project Number B2001991</b> <b>Geotechnical Evaluation</b> <b>Enbridge Line 5 Re-Route</b> <b>Various Locations</b> <b>Ashland and Iron Counties, Wisconsin</b>						BORING: <b>71-C</b>				
						LOCATION: See attached sketch				
						LATITUDE: 46.42271		LONGITUDE: -90.51679		
DRILLER: EPC		LOGGED BY: A. Hillerud		START DATE: 06/18/20		END DATE: 06/18/20				
SURFACE ELEVATION: 1161.4 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 <sub>p</sub> tsf	MC %	Tests or Remarks			
		POORLY GRADED GRAVEL (GP), brown, wet, (WEATHERED BEDROCK)								
1123.9 37.5		KALLANDER CREEK VOLCANICS, GABBRO, reddish gray with white, moderately weathered, moderately hard, fine-grained to medium- grained, massive, highly fractured		0    80 0    100					Run 1 MOH's 4 Run 2 MOH's 4 Run 3 MOH's 4	
1118.4 43.0		<i>Test results are in the attached lab report</i>		30    95						
		KALLANDER CREEK VOLCANICS, BASALT, reddish gray with white, moderately weathered, moderately hard, fine-grained to medium- grained, massive, highly fractured		45    100					Run 4 MOH's 4	
		<i>Test results are in the attached lab report</i>		75    100					Run 5 MOH's 4	
		<i>Test results are in the attached lab report</i>		30    100					Run 6 MOH's 4	
		<i>Test results are in the attached lab report</i>		55    100					Run 7 MOH's 4	
		<i>Test results are in the attached lab report</i>		80    100					Run 8 MOH's 4	
Continued on next page				RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Water Return %	Remarks

<b>Project Number B2001991</b> <b>Geotechnical Evaluation</b> <b>Enbridge Line 5 Re-Route</b> <b>Various Locations</b> <b>Ashland and Iron Counties, Wisconsin</b>					BORING: <b>71-C</b>					
					LOCATION: See attached sketch					
					LATITUDE: 46.42271		LONGITUDE: -90.51679			
DRILLER: EPC		LOGGED BY: A. Hillerud			START DATE: 06/18/20		END DATE: 06/18/20			
SURFACE ELEVATION: 1161.4 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
1095.9 65.5		KALLANDER CREEK VOLCANICS, BASALT, reddish gray with white, moderately weathered, moderately hard, fine-grained to medium-grained, massive, highly fractured	65	90	95					Run 9 MOH's 4
		KALLANDER CREEK VOLCANICS, BASALT, reddish brown with white, moderately weathered, moderately hard, fine-grained to medium-grained, medium bedded, highly fractured	70	80	100					Run 10 MOH's 4
1087.4 74.0		<i>Test results are in the attached lab report</i>								
		KALLANDER CREEK VOLCANICS, BASALT, reddish gray with white, slightly weathered, moderately hard, fine-grained to medium-grained, massive, highly fractured	75	70	100					Run 11 MOH's 4
		<i>Test results are in the attached lab report</i>	80	75	100					Run 12 MOH's 4
		<i>Test results are in the attached lab report</i>	85	65	100					Run 13 MOH's 4
		<i>Test results are in the attached lab report</i>	90	50	100					Run 14 MOH's 4
		<i>Test results are in the attached lab report</i>	95							Run 15 MOH's 4
Continued on next page										

<b>Project Number B2001991</b> <b>Geotechnical Evaluation</b> <b>Enbridge Line 5 Re-Route</b> <b>Various Locations</b> <b>Ashland and Iron Counties, Wisconsin</b>					BORING: <b>71-C</b>					
					LOCATION: See attached sketch					
					LATITUDE: 46.42271	LONGITUDE: -90.51679				
DRILLER: EPC		LOGGED BY: A. Hillerud		START DATE: 06/18/20		END DATE: 06/18/20				
SURFACE ELEVATION: 1161.4 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
1047.4		KALLANDER CREEK VOLCANICS, BASALT, reddish gray with white, slightly weathered, moderately hard, fine-grained to medium- grained, massive, highly fractured		70	100					Run 16 MOH's 4
			100	90	100					
			105	70	100					
			110	85	100					
114.0		END OF CORING								Water observed at 6.5 feet while drilling.
	Boring then backfilled with cement/bentonite grout									

<b>Project Number B2001991</b> <b>Geotechnical Evaluation</b> <b>Enbridge Line 5 Re-Route</b> <b>Various Locations</b> <b>Ashland and Iron Counties, Wisconsin</b>					BORING: <b>72-C-1</b>		
					LOCATION: See attached sketch		
					LATITUDE: 46.42484	LONGITUDE: -90.51302	
DRILLER: EPC		LOGGED BY: P. Moe		START DATE: 07/07/20	END DATE: 07/08/20		
SURFACE ELEVATION: 1170.3 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 <sub>p</sub> tsf	MC %	Tests or Remarks
1166.3	X	FILL: SILTY SAND (SM), fine to medium-grained, trace Gravel, brown, moist		2-6-7-10 (13) 24"		14	Test results are in the attached lab report
4.0		CLAYEY SAND (SC), fine to medium-grained, trace Gravel, brown, moist, medium dense (GLACIAL TILL)	5	3-8-9-10 (17) 24"			
1161.3				3-7-10-14 (17) 24"			
9.0		SILTY, CLAYEY SAND (SC-SM), fine to medium-grained, brown, moist, loose (GLACIAL TILL)	10	5-9-7-10 (16) 12"			
1159.3				2-2-4-4 (6) 24"			
11.0		SILTY SAND (SM), fine to medium-grained, brown, moist, loose to medium dense (GLACIAL TILL)		7-8-8-10 (16) 24"	21	Test results are in the attached lab report	
			15	3-3-4-5 (7) 24"			
1152.3							
18.0		SILTY, CLAYEY SAND (SC-SM), fine to medium-grained, trace Gravel, rock fragments, brown, moist, medium dense to very dense (GLACIAL TILL)	20	9-4-12-28 (16) 12"			
			25	25-35-50/5" (REF) 10"			
1138.3			30	23-29-31-31 (60) 24"			
32.0							

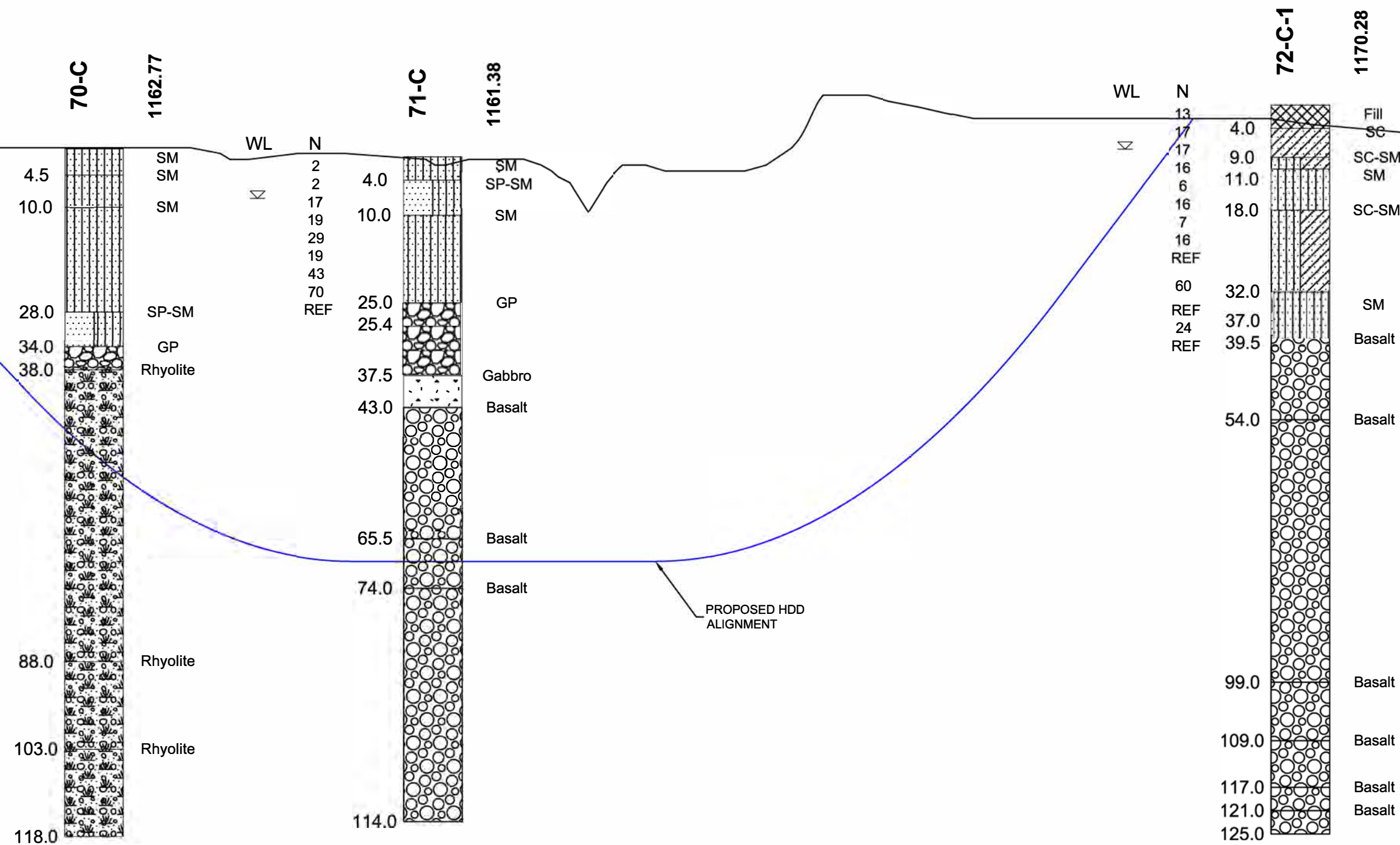
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<b>Project Number B2001991</b> <b>Geotechnical Evaluation</b> <b>Enbridge Line 5 Re-Route</b> <b>Various Locations</b> <b>Ashland and Iron Counties, Wisconsin</b>					BORING: <b>72-C-1</b>					
					LOCATION: See attached sketch					
					LATITUDE: 46.42484	LONGITUDE: -90.51302				
DRILLER: EPC		LOGGED BY: P. Moe		START DATE: 07/07/20		END DATE: 07/08/20				
SURFACE ELEVATION: 1170.3 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 <sub>p</sub> tsf	MC %	Tests or Remarks			
		SILTY SAND (SM), fine to medium-grained, with rock fragments, brown, moist, medium dense (GLACIAL TILL)	35	50/4" (REF) 0"			No recovery			
				48-14-10-13 (24) 8"		12	Tri-cone speed of advancement and cuttings indicated apparent bedrock, switched to coring at 39.5 feet.			
				50/1" (REF) 1"			Test results are in the attached lab report			
1130.8 39.5		KALLANDER CREEK VOLCANICS, BASALT, reddish gray with white, moderately weathered, moderately hard, fine-grained to medium-grained, massive, intensely fractured	40	0	89		Run 1 MOHs 2.5			
			45	7	100		Run 2 MOHs 2.5			
			50	17	100		Run 3 MOHs 2.5			
1116.3 54.0		<i>Test results are in the attached lab report</i>								
		KALLANDER CREEK VOLCANICS, BASALT, reddish gray with white, moderately weathered, moderately hard, fine-grained to medium-grained, massive, highly fractured	55	20	100		Run 4 MOHs 3			
			60	11	60		Run 5 MOHs 3			
Continued on next page				RQD %	Recovery %	Drilling Rate (min/ft)	Bit Pressure (psi)	Water Pressure (psi)	Water Return %	Remarks

<b>Project Number B2001991</b> <b>Geotechnical Evaluation</b> <b>Enbridge Line 5 Re-Route</b> <b>Various Locations</b> <b>Ashland and Iron Counties, Wisconsin</b>					BORING: <b>72-C-1</b>					
					LOCATION: See attached sketch					
					LATITUDE: 46.42484		LONGITUDE: -90.51302			
DRILLER: EPC		LOGGED BY: P. Moe			START DATE: 07/07/20		END DATE: 07/08/20			
SURFACE ELEVATION: 1170.3 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
		KALLANDER CREEK VOLCANICS, BASALT, reddish gray with white, moderately weathered, moderately hard, fine-grained to medium- grained, massive, highly fractured	65	14	100					Run 6 MOHs 3.5
		<i>Test results are in the attached lab report</i>	70	32	100					Run 7 MOHs 3.5
			75	43	100					Run 8 MOHs 3.5
			80	17	100					Run 9 MOHs 3.5
				11	100					Run 10 MOHs 3.5
			85	32	100					Run 11 MOHs 3.5
		<i>Test results are in the attached lab report</i>	90	38	100					Run 12 MOHs 3.5
				22	100					Run 13 MOHs 3.5
			95							Run 14 MOHs 3.5
Continued on next page										



<b>Project Number B2001991</b> <b>Geotechnical Evaluation</b> <b>Enbridge Line 5 Re-Route</b> <b>Various Locations</b> <b>Ashland and Iron Counties, Wisconsin</b>					BORING: <b>72-C-1</b>					
					LOCATION: See attached sketch					
					LATITUDE: 46.42484		LONGITUDE: -90.51302			
DRILLER: EPC		LOGGED BY: P. Moe		START DATE: 07/07/20		END DATE: 07/08/20				
SURFACE ELEVATION: 1170.3 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
1071.3		KALLANDER CREEK VOLCANICS, BASALT, reddish gray with white, moderately weathered, moderately hard, fine-grained to medium-grained, massive, highly fractured		33	40					
99.0		KALLANDER CREEK VOLCANICS, BASALT, reddish gray with white, moderately weathered, moderately hard, fine-grained to medium-grained, massive, intensely fractured		0	100					Run 15 MOHs 3.5
				0	100					Run 16 MOHs 3.5
		Test results are in the attached lab report		15	100					Run 17 MOHs 3.5
1061.3		KALLANDER CREEK VOLCANICS, BASALT, reddish gray with white, moderately weathered, moderately hard, fine-grained to medium-grained, massive, highly fractured		40	100					Run 18 MOHs 3.5
109.0				25	100					Run 19 MOHs 3.5
1053.3		KALLANDER CREEK VOLCANICS, BASALT, reddish gray with white, moderately weathered, moderately hard, fine-grained to medium-grained, massive, intensely fractured		0	50					Run 20 MOHs 3.5
117.0				17	100					Run 21 MOHs 3.5
1049.3		KALLANDER CREEK VOLCANICS, BASALT, reddish gray with white, moderately weathered, moderately hard, fine-grained to medium-grained, massive, highly fractured								
121.0										
1045.3		END OF CORING								Water observed at 7.0 feet while drilling.
125.0		Boring then backfilled with cement/bentonite grout								



Drawing Information

Project No:  
B2001991

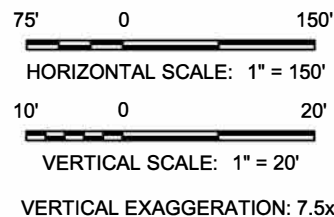
Drawing No:  
B2001991\_MP34\_TYLER-FORKS

Drawn By: BJB  
Date Drawn: 7/22/20  
Checked By: DM  
Last Modified: 9/17/20

Project Information

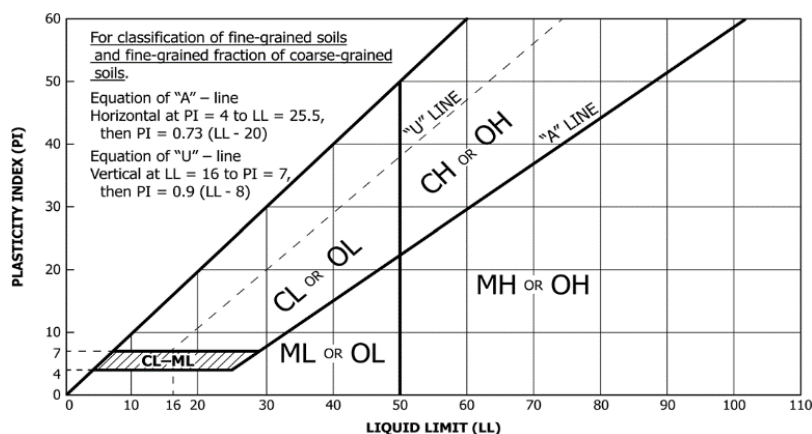
Enbridge Line 5 Re-route

**MP 34 - Tyler  
Forks**



Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests <sup>A</sup>				Group Symbol	Soil Classification Group Name <sup>B</sup>
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 <sup>C</sup> )	$C_u \geq 4$ and $1 \leq C_c \leq 3^D$	GW	Well-graded gravel <sup>E</sup>
			$C_u < 4$ and/or ( $C_c < 1$ or $C_c > 3$ ) <sup>D</sup>	GP	Poorly graded gravel <sup>E</sup>
		Gravels with Fines (More than 12% fines <sup>C</sup> )	Fines classify as ML or MH	GM	Silty gravel <sup>EFG</sup>
			Fines Classify as CL or CH	GC	Clayey gravel <sup>EFG</sup>
	Sands (50% or more coarse fraction passes No. 4 sieve)	Clean Sands (Less than 5% fines <sup>H</sup> )	$C_u \geq 6$ and $1 \leq C_c \leq 3^D$	SW	Well-graded sand <sup>I</sup>
			$C_u < 6$ and/or ( $C_c < 1$ or $C_c > 3$ ) <sup>D</sup>	SP	Poorly graded sand <sup>I</sup>
		Sands with Fines (More than 12% fines <sup>H</sup> )	Fines classify as ML or MH	SM	Silty sand <sup>FGI</sup>
			Fines classify as CL or CH	SC	Clayey sand <sup>FGI</sup>
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 <sup>J</sup>	CL	Lean clay <sup>KLM</sup>
			PI < 4 or plots below "A" line <sup>J</sup>	ML	Silt <sup>KLM</sup>
		Organic	Liquid Limit – oven dried Liquid Limit – not dried <0.75	OL	Organic clay <sup>KLMN</sup> Organic silt <sup>KLMQ</sup>
	Silts and Clays (Liquid limit 50 or more)	Inorganic	PI plots on or above "A" line	CH	Fat clay <sup>KLM</sup>
			PI plots below "A" line	MH	Elastic silt <sup>KLM</sup>
		Organic	Liquid Limit – oven dried Liquid Limit – not dried <0.75	OH	Organic clay <sup>KLMP</sup> Organic silt <sup>KLMQ</sup>
Highly Organic Soils		Primarily organic matter, dark in color, and organic odor		PT	Peat

- 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
- $C_u = D_{60} / D_{10}$        $C_c = (D_{30})^2 / (D_{10} \times D_{60})$
- If soil contains  $\geq 15\%$  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  
SP-SC poorly graded sand with clay
- If soil contains  $\geq 15\%$  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 predominant.
- If soil contains  $\geq 30\%$  plus No. 200, predominantly sand, add "sandy" to group name.
- If soil contains  $\geq 30\%$  plus No. 200 predominantly gravel, add "gravelly" to group name.
- PI  $\geq 4$  and plots on or above "A" line.
- PI plots on or above "A" line.
- PI plots below "A" line.



**DD** Dry density, pcf  
**WD** Wet density, pcf  
**P200** % Passing #200 sieve

**Laboratory Tests**  
**OC** Organic content, %  
**q<sub>p</sub>** Pocket penetrometer strength, tsf  
**MC** Moisture content, %  
**q<sub>u</sub>** Unconfined compression test, tsf

**LL** Liquid limit  
**PL** Plastic limit  
**PI** Plasticity index

## Particle Size Identification

Boulders..... over 12"  
Cobbles..... 3" to 12"  
Gravel  
Coarse..... 3/4" to 3" (19.00 mm to 75.00 mm)  
Fine..... No. 4 to 3/4" (4.75 mm to 19.00 mm)  
Sand  
Coarse..... No. 10 to No. 4 (2.00 mm to 4.75 mm)  
Medium..... No. 40 to No. 10 (0.425 mm to 2.00 mm)  
Fine..... No. 200 to No. 40 (0.075 mm to 0.425 mm)  
Silt..... No. 200 (0.075 mm) to .005 mm  
Clay..... < .005 mm

## Relative Proportions<sup>L, M</sup>

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

## 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.

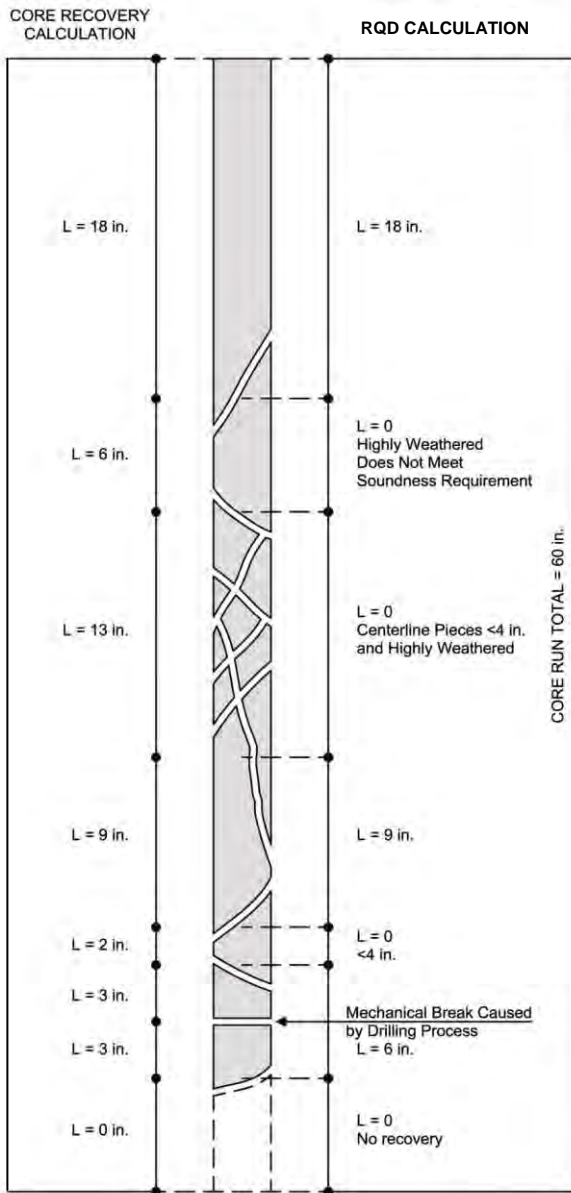
**Partial Penetration:** If the sampler could not be driven through a full 6-inch interval, the number of blows for that partial penetration is shown as #/x" (i.e. 50/2"). The N-value is reported as "REF" indicating refusal.

**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 (  ), or at some time after drilling (  ).



### Example Calculations

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

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

CR = 90%

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

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

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

RQD = 55%

### Weathering

*Unweathered:* No evidence of chemical or mechanical alteration.

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

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

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

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

### Hardness

<i>Very soft:</i>	Can be deformed by hand
<i>Soft:</i>	Can be scratched with a fingernail
<i>Moderately hard:</i>	Can be scratched easily with a knife
<i>Hard:</i>	Can be scratched with difficulty with a knife
<i>Very hard:</i>	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

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

### Degree of Fracturing (Jointing)

<i>Unfractured:</i>	Fracture spacing 6 ft. or more
<i>Slightly fractured:</i>	Fracture spacing 2 to 6 ft.
<i>Moderately fractured:</i>	Fracture spacing 8 in. to 2 ft.
<i>Highly fractured:</i>	Fracture spacing 2 in. to 8 in.
<i>Intensely fractured:</i>	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:** 331864 **Sampled By:** Drill Crew  
**Sample Date:** 08/06/2020  
**Received Date:** 08/25/2020 **Lab:** 11001 Hampshire Ave S, Bloomington, MN  
**Completed Date:** 08/25/2020 **Tested By:** Tschida, Simone T.

**Laboratory Results Summary**

Boring	Sample	Depth (ft)	MC (%)	Wash Loss (%)	LL	PL	PI	Organic Content %	Dry Density (pcf)	Resistivity (ohm-cm)	Q <sub>u</sub> (tsf)	Specific Gravity
72-C-1	4	7.0	13.6		16	13	3					
72-C-1	12	37.0	12.1				NP					

**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**

<b>Sample Number:</b>	319395	<b>Alternate ID:</b>	70-C 4 7.5'
<b>Sampling Method:</b>	Aggregate ASTM D75/AASHTO T2	<b>Depth (ft):</b>	7.5
<b>Boring Number:</b>	70-C	<b>Sampled By:</b>	Drill Crew
<b>Location:</b>	In-place		
<b>Location Details:</b>	Boring 70-C Sample 4 7.5'		
<b>Sample Date:</b>	06/17/2020		
<b>Received Date:</b>	07/01/2020	<b>Lab:</b>	4511 West First Street, Suite 4, Duluth, MN
<b>Tested Date:</b>	07/07/2020	<b>Tested By:</b>	Nelson, Brennan

**Laboratory Data**

Sieve Size	Passing (%)	Specification
9.5 mm (3/8 inch)	100.0	
4.75 mm (No. 4)	86.9	
2 mm (No. 10)	77.8	
850 µm (No. 20)	68.2	
425 µm (No. 40)	55.1	
150 µm (No. 100)	28.3	
75 µm (No. 200)	19.0	

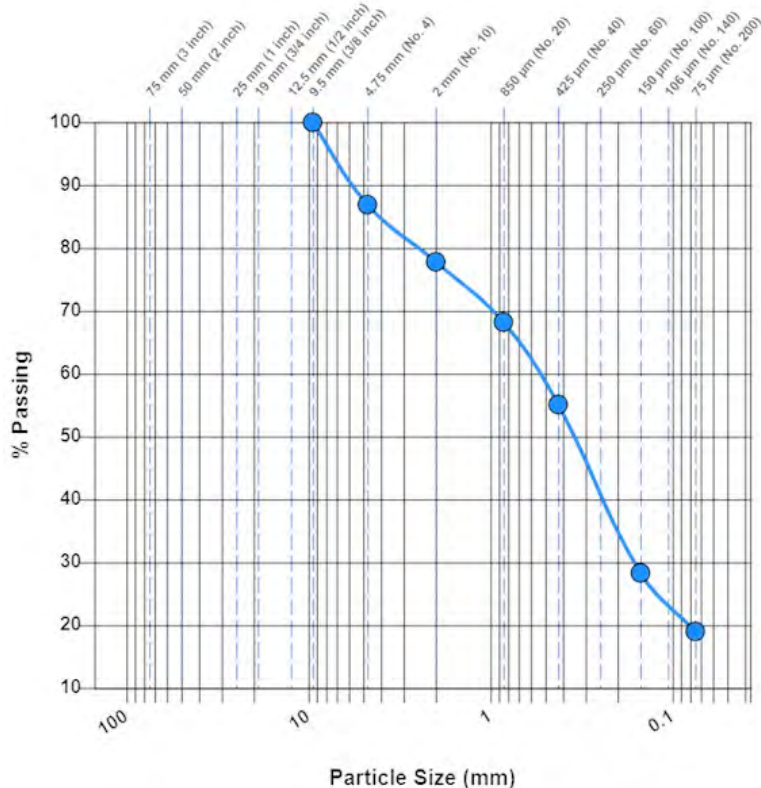
**Gravel (%)**  
13.1

**Sand (%)**  
67.9

**Silt & Clay (%)**  
19.0

**D30**  
0.156

**D60**  
0.584



**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 245.4 grams.

*[Signature]*

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**

<b>Sample Number:</b>	319397	<b>Alternate ID:</b>	70-C 10 30'
<b>Sampling Method:</b>	Aggregate ASTM D75/AASHTO T2	<b>Depth (ft):</b>	30
<b>Boring Number:</b>	70-C	<b>Sampled By:</b>	Drill Crew
<b>Location:</b>	In-place		
<b>Location Details:</b>	Boring 70-C Sample 10 30'		
<b>Sample Date:</b>	06/17/2020		
<b>Received Date:</b>	07/01/2020	<b>Lab:</b>	4511 West First Street, Suite 4, Duluth, MN
<b>Tested Date:</b>	07/07/2020	<b>Tested By:</b>	Nelson, Brennan

**Laboratory Data**

Sieve Size	Passing (%)	Specification
19 mm (3/4 inch)	100.0	
12.5 mm (1/2 inch)	94.5	
9.5 mm (3/8 inch)	88.6	
4.75 mm (No. 4)	83.1	
2 mm (No. 10)	79.0	
850 µm (No. 20)	75.9	
425 µm (No. 40)	69.4	
150 µm (No. 100)	35.5	
75 µm (No. 200)	10.4	

**Gravel (%)**

16.9

**Sand (%)**

72.7

**Silt & Clay (%)**

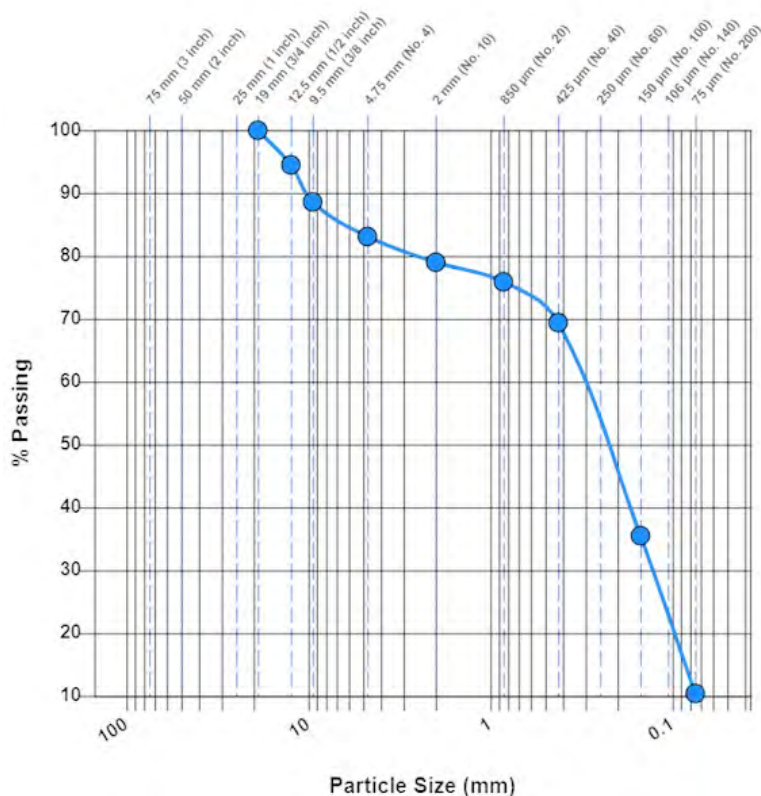
10.4

**D30**

0.099

**D60**

0.222



**Classification:** SP-SM Poorly graded sand with silt and 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 207.5 grams.

*[Signature]*

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**

<b>Sample Number:</b>	319399	<b>Alternate ID:</b>	71-C 4 7.5'
<b>Sampling Method:</b>	Aggregate ASTM D75/AASHTO T2	<b>Depth (ft):</b>	7.5
<b>Boring Number:</b>	71-C	<b>Sampled By:</b>	Drill Crew
<b>Location:</b>	In-place		
<b>Location Details:</b>	Boring 71-C Sample 4 7.5'		
<b>Sample Date:</b>	06/18/2020		
<b>Received Date:</b>	07/01/2020	<b>Lab:</b>	4511 West First Street, Suite 4, Duluth, MN
<b>Tested Date:</b>	07/07/2020	<b>Tested By:</b>	Nelson, Brennan

**Laboratory Data**

Sieve Size	Passing (%)	Specification
19 mm (3/4 inch)	100.0	
12.5 mm (1/2 inch)	84.6	
9.5 mm (3/8 inch)	80.9	
4.75 mm (No. 4)	69.1	
2 mm (No. 10)	59.6	
850 µm (No. 20)	51.9	
425 µm (No. 40)	38.4	
150 µm (No. 100)	12.4	
75 µm (No. 200)	7.4	

**Gravel (%)**

30.9

**Sand (%)**

61.7

**Silt & Clay (%)**

7.4

**D10**

0.091

**D30**

0.218

**D60**

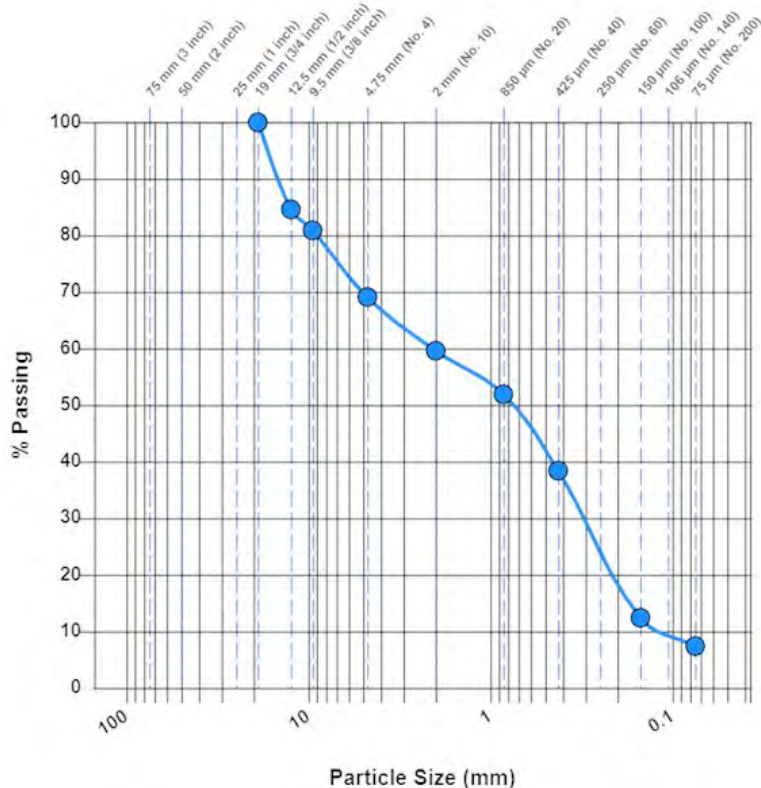
2.116

**C<sub>u</sub>**

23.25

**C<sub>c</sub>**

0.25



**Classification:** SP-SM Poorly graded sand with silt and 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 222.9 grams.

*[Signature]*



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

**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**

<b>Sample Number:</b>	319400	<b>Alternate ID:</b>	71-C 8 20'
<b>Sampling Method:</b>	Aggregate ASTM D75/AASHTO T2	<b>Depth (ft):</b>	20
<b>Boring Number:</b>	71-C	<b>Sampled By:</b>	Drill Crew
<b>Location:</b>	In-place		
<b>Location Details:</b>	Boring 71-C Sample 8 20'		
<b>Sample Date:</b>	06/17/2020		
<b>Received Date:</b>	07/01/2020	<b>Lab:</b>	4511 West First Street, Suite 4, Duluth, MN
<b>Tested Date:</b>	07/07/2020	<b>Tested By:</b>	Nelson, Brennan

**Laboratory Data**

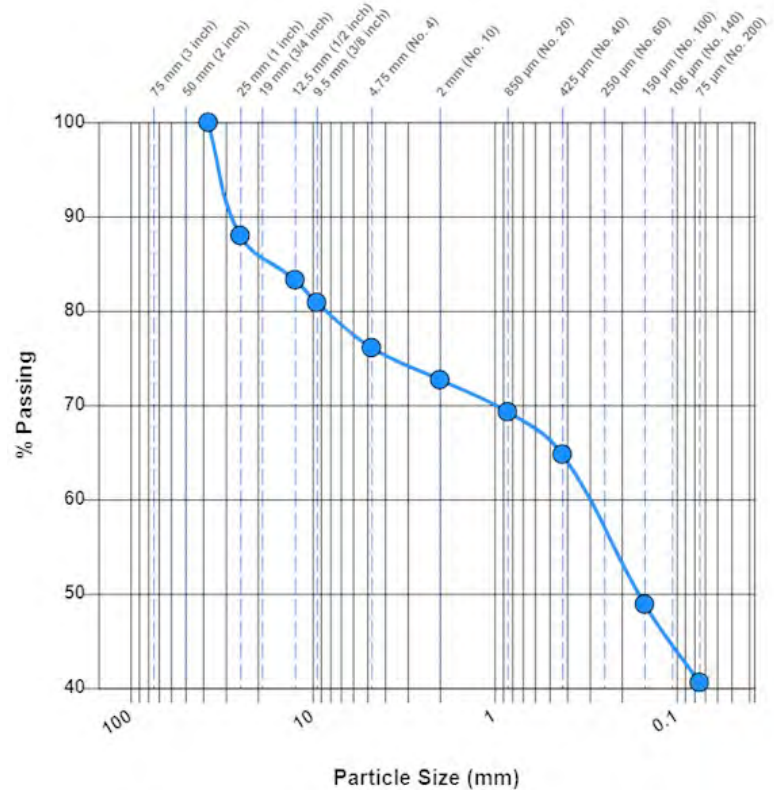
Sieve Size	Passing (%)	Specification
37.5 mm (1.5 inch)	100.0	
25 mm (1 inch)	88.0	
12.5 mm (1/2 inch)	83.3	
9.5 mm (3/8 inch)	80.9	
4.75 mm (No. 4)	76.1	
2 mm (No. 10)	72.7	
850 µm (No. 20)	69.3	
425 µm (No. 40)	64.8	
150 µm (No. 100)	48.9	
75 µm (No. 200)	40.6	

**Gravel (%)**  
23.9

**Sand (%)**  
35.5

**Silt & Clay (%)**  
40.6

**D60**  
0.220



**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 341.7 grams.

*[Signature]*

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**

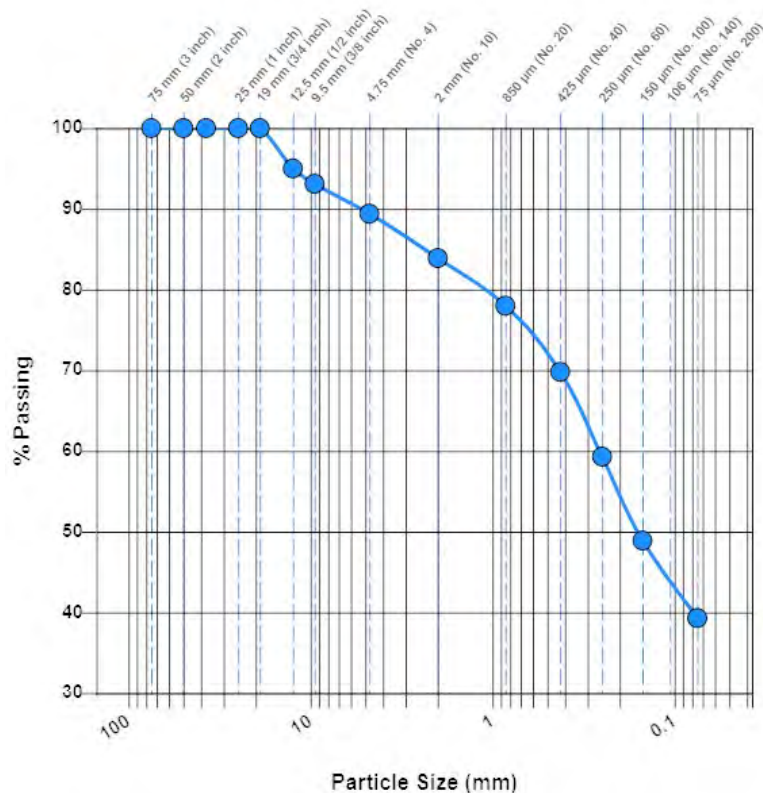
<b>Sample Number:</b>	331865	<b>Depth (ft):</b>	7
<b>Boring Number:</b>	72-C-1	<b>Sampled By:</b>	Drill Crew
<b>Sample Date:</b>	08/06/2020		
<b>Received Date:</b>	08/25/2020	<b>Lab:</b>	11001 Hampshire Ave S, Bloomington, MN
<b>Tested Date:</b>	08/26/2020	<b>Tested By:</b>	Tschida, Simone T.

**Laboratory Data**

Sieve Size	Passing (%)	Specification
19 mm (3/4 inch)	100.0	
12.5 mm (1/2 inch)	95.0	
9.5 mm (3/8 inch)	93.1	
4.75 mm (No. 4)	89.4	
2 mm (No. 10)	83.9	
850 µm (No. 20)	78.0	
425 µm (No. 40)	69.8	
250 µm (No. 60)	59.3	
150 µm (No. 100)	48.9	
75 µm (No. 200)	39.3	

<b>Gravel (%)</b>	<b>Sand (%)</b>	<b>Silt &amp; Clay (%)</b>
10.6	50.1	39.3

**D60**  
0.262



**Classification:** SC Clayey sand

**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 Payable 5400 Westheimer Ct  
Houston, TX 77056

**Project:**

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

**Sample Information**

<b>Sample Number:</b>	327709	<b>Alternate ID:</b>	72-C-1 7 14.5'-16.5'
<b>Sampling Method:</b>	Auger Boring ASTM D1452	<b>Depth (ft):</b>	14.5-16.5
<b>Boring Number:</b>	72-C-1	<b>Sampled By:</b>	Drill Crew
<b>Location:</b>	In-place		
<b>Location Details:</b>	Boring 72-C-1 Sample 7 14.5'-16.5'		
<b>Sample Date:</b>	07/13/2020		
<b>Received Date:</b>	08/06/2020	<b>Lab:</b>	4511 West First Street, Suite 4, Duluth, MN
<b>Tested Date:</b>	08/11/2020	<b>Tested By:</b>	Nelson, Brennan

**Laboratory Data**

Sieve Size	Passing (%)	Specification
9.5 mm (3/8 inch)	100.0	
4.75 mm (No. 4)	99.9	
2 mm (No. 10)	99.9	
850 µm (No. 20)	98.1	
425 µm (No. 40)	80.7	
150 µm (No. 100)	20.3	
75 µm (No. 200)	7.9	

**Gravel (%)**

0.1

**D10**

0.080

**C<sub>U</sub>**

2.70

**Sand (%)**

92.0

**D30**

0.166

**C<sub>C</sub>**

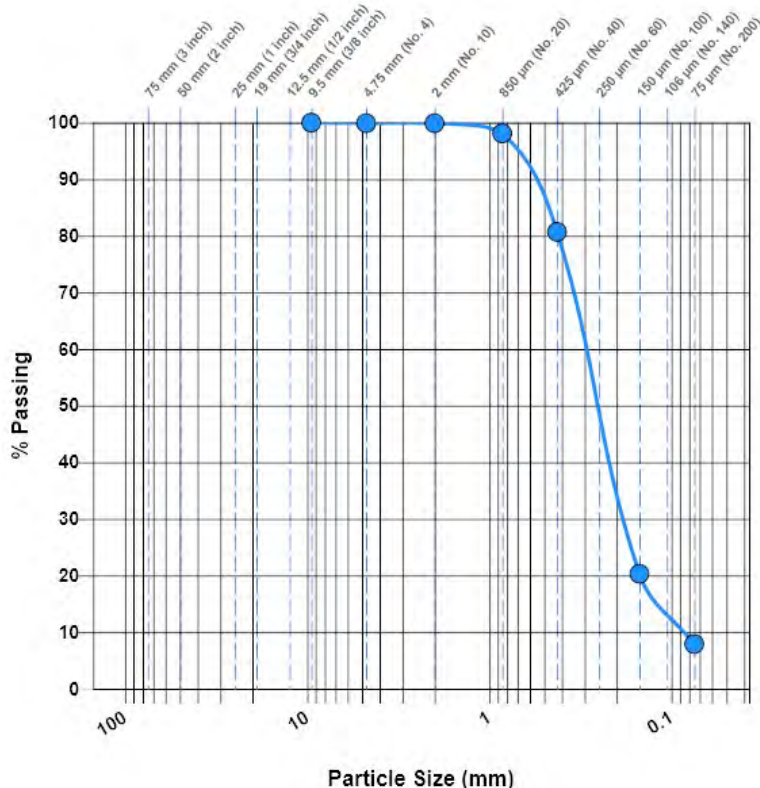
1.59

**Silt & Clay (%)**

7.9

**D60**

0.216



**Classification:** SP-SM Poorly graded sand with silt

**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 276.7 grams.

*[Signature]*

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**

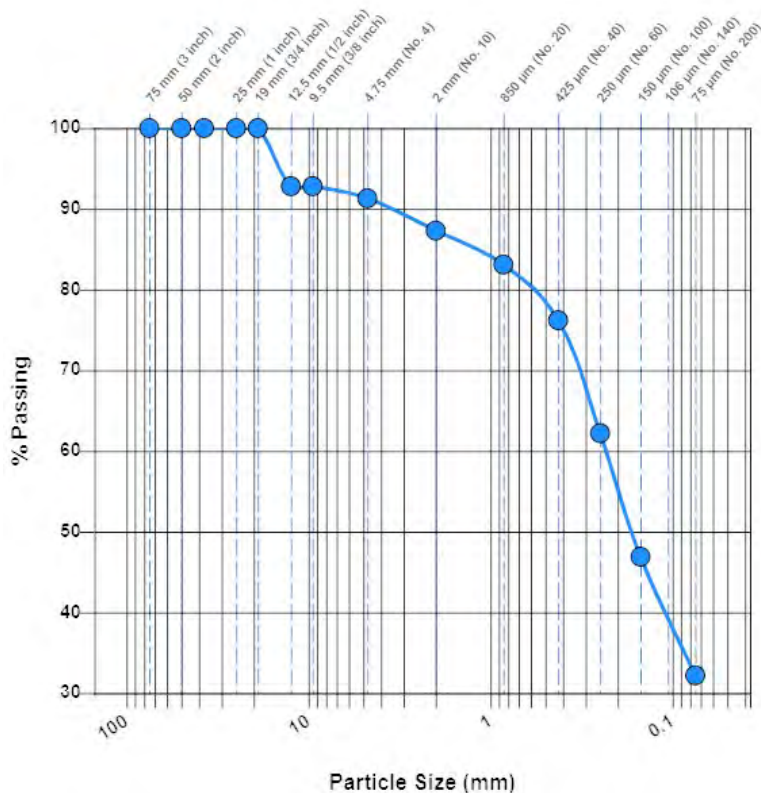
<b>Sample Number:</b>	331867	<b>Depth (ft):</b>	37
<b>Boring Number:</b>	72-C-1	<b>Sampled By:</b>	Drill Crew
<b>Sample Date:</b>	08/06/2020		
<b>Received Date:</b>	08/25/2020	<b>Lab:</b>	11001 Hampshire Ave S, Bloomington, MN
<b>Tested Date:</b>	08/26/2020	<b>Tested By:</b>	Tschida, Simone T.

**Laboratory Data**

Sieve Size	Passing (%)	Specification
19 mm (3/4 inch)	100.0	
12.5 mm (1/2 inch)	92.8	
9.5 mm (3/8 inch)	92.8	
4.75 mm (No. 4)	91.3	
2 mm (No. 10)	87.3	
850 µm (No. 20)	83.1	
425 µm (No. 40)	76.2	
250 µm (No. 60)	62.2	
150 µm (No. 100)	46.9	
75 µm (No. 200)	32.2	

<b>Gravel (%)</b>	<b>Sand (%)</b>	<b>Silt &amp; Clay (%)</b>
8.7	59.1	32.2

**D60**  
0.236



**Classification:** SM Silty sand

**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:** 319395 **Alternate ID:** 70-C 4 7.5'  
**Sampling Method:** Aggregate ASTM D75/AASHTO T2 **Sampled By:** Drill Crew  
**Location:** In-place  
**Location Details:** Boring 70-C Sample 4 7.5'  
**Sample Date:** 06/17/2020  
**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**

Boring #	Sample #	Depth (ft)	Moisture Content (%)
70-C	4	8.0	15.1

**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:** 319397 **Alternate ID:** 70-C 10 30'  
**Sampling Method:** Aggregate ASTM D75/AASHTO T2 **Sampled By:** Drill Crew  
**Location:** In-place  
**Location Details:** Boring 70-C Sample 10 30'  
**Sample Date:** 06/17/2020  
**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**

Boring #	Sample #	Depth (ft)	Moisture Content (%)
70-C	10	30.0	16.6

**General**

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



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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:** 319399 **Alternate ID:** 71-C 4 7.5'  
**Sampling Method:** Aggregate ASTM D75/AASHTO T2 **Sampled By:** Drill Crew  
**Location:** In-place  
**Location Details:** Boring 71-C Sample 4 7.5'  
**Sample Date:** 06/18/2020  
**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**

Boring #	Sample #	Depth (ft)	Moisture Content (%)
71-C	4	7.5	15.1

**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:** 319400 **Alternate ID:** 71-C 8 20'  
**Sampling Method:** Aggregate ASTM D75/AASHTO T2 **Sampled By:** Drill Crew  
**Location:** In-place  
**Location Details:** Boring 71-C Sample 8 20'  
**Sample Date:** 06/17/2020  
**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**

Boring #	Sample #	Depth (ft)	Moisture Content (%)
71-C	8	20.0	9.9

**General**

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





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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:** 327709 **Alternate ID:** 72-C-1 7 14.5'-16.5'  
**Sampling Method:** Auger Boring ASTM D1452 **Sampled By:** Drill Crew  
**Location:** In-place  
**Location Details:** Boring 72-C-1 Sample 7 14.5'-16.5'  
**Sample Date:** 07/13/2020  
**Received Date:** 08/06/2020 **Lab:** 4511 West First Street, Suite 4, Duluth, MN  
**Tested Date:** 08/11/2020 **Tested By:** Nelson, Brennan

**Laboratory Data**

Boring #	Sample #	Depth (ft)	Moisture Content (%)
72-C-1	7	15.0	21.2

**General**

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





Braun Intertec Corporation  
4511 West First Street, Suite 4  
Duluth, MN 55807

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  
**Project Number:** B2001991  
**Client:** Accounts Payable  
Enbridge Energy, Limited Partnership  
5400 Westheimer Ct  
Houston, TX 77056  
**Project Description:**  
Enbridge Line 5 Re-route

**Sample Data**

Date Sampled: Not Given  
Samples Obtained By: Braun  
Date Received: 7/10/2020  
Sample Preparation: Trim and Polished

**Laboratory Data**

ASTM D4543 Limits

Sample Number:	38-39	50-51	61-62	74-75	
Date Tested:	7/16/2020	7/16/2020	7/16/2020	7/16/2020	
Rock Type:	Rhyolite	Rhyolite	Rhyolite	Rhyolite	
Moisture Condition During Testing:	Dry	Dry	Dry	Dry	
Diameter (in.):	1.97	1.98	1.97	1.97	
Length (in.):	4.48	4.42	4.46	4.44	
Length-to-Diameter Ratio (L/D):	2.3	2.2	2.3	2.3	$2.0 \leq L/D \leq 2.5$
Side Tolerance, Maximum (in.)	$\leq 0.020$	$\leq 0.020$	$\leq 0.020$	$\leq 0.020$	$\leq 0.020$ in.
End Tolerance, Maximum (in.)	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in.
Perpendicularity Deviation (°)	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.250^\circ$
Parallelism Deviation (°)	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.25^\circ$
Maximum Load (lbs):	25,235	31,306	22,466	28,670	
Area (in <sup>2</sup> ):	3.05	3.08	3.05	3.05	
Compressive Strength (psi):	8,270	10,160	7,370	9,400	
Compressive Strength (MPa):	56	69	50	64	

**Remarks:**

Location 70-C

Reviewed By:  
David Morrison

Project Manager



Braun Intertec Corporation  
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Duluth, MN 55807

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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  
**Client:** Accounts Payable  
Enbridge Energy, Limited Partnership  
5400 Westheimer Ct  
Houston, TX 77056  
**Project Number:** B2001991  
**Project Description:**  
Enbridge Line 5 Re-route

**Sample Data**

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:	86-87	102-103	113-114	
Date Tested:	7/16/2020	7/16/2020	7/16/2020	
Rock Type:	Rhyolite	Rhyolite	Rhyolite	
Moisture Condition During Testing:	Dry	Dry	Dry	
Diameter (in.):	1.98	1.97	1.97	
Length (in.):	4.37	4.43	4.46	
Length-to-Diameter Ratio (L/D):	2.2	2.2	2.3	$2.0 \leq L/D \leq 2.5$
Side Tolerance, Maximum (in.)	$\leq 0.020$	$\leq 0.020$	$\leq 0.020$	$\leq 0.020$ in.
End Tolerance, Maximum (in.)	$\leq 0.001$ in.	$\leq 0.001$ in.	$\leq 0.001$ in.	$\leq 0.001$ in.
Perpendicularity Deviation (°)	$\leq 0.001$ in.	$\leq 0.001$ in.	$\leq 0.001$ in.	$\leq 0.250^\circ$
Parallelism Deviation (°)	$\leq 0.001$ in.	$\leq 0.001$ in.	$\leq 0.001$ in.	$\leq 0.25^\circ$
Maximum Load (lbs):	33,322	28,892	63,132	
Area (in <sup>2</sup> ):	3.08	3.05	3.05	
Compressive Strength (psi):	10,820	9,470	20,700	
Compressive Strength (MPa):	73	64	141	

**Remarks:**

Location 70-C

Reviewed By:  
David Morrison

Project Manager



Braun Intertec Corporation  
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Duluth, MN 55807

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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  
**Project Number:** B2001991  
**Client:** Accounts Payable  
Enbridge Energy, Limited Partnership  
5400 Westheimer Ct  
Houston, TX 77056  
**Project Description:**  
Enbridge Line 5 Re-route

**Sample Data**

Date Sampled: Not Given  
Samples Obtained By: Braun  
Date Received: 7/10/2020  
Sample Preparation: Trim and Polished

**Laboratory Data**

ASTM D4543 Limits

Sample Number:	42-43	53-54	63-64	73-74	
Date Tested:	7/16/2020	7/16/2020	7/16/2020	7/16/2020	
Rock Type:	Gabbro	Basalt	Basalt	Basalt	
Moisture Condition During Testing:	Dry	Dry	Dry	Dry	
Diameter (in.):	1.90	1.98	1.98	1.97	
Length (in.):	4.07	4.50	4.43	4.45	
Length-to-Diameter Ratio (L/D):	2.1	2.3	2.2	2.3	$2.0 \leq L/D \leq 2.5$
Side Tolerance, Maximum (in.)	$\leq 0.020$	$\leq 0.020$	$\leq 0.020$	$\leq 0.020$	$\leq 0.020$ in.
End Tolerance, Maximum (in.)	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in.
Perpendicularity Deviation (°)	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.250^\circ$
Parallelism Deviation (°)	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.25^\circ$
Maximum Load (lbs):	26,309	25,436	29,564	13,987	
Area (in <sup>2</sup> ):	2.84	3.08	3.08	3.05	
Compressive Strength (psi):	9,260	8,260	9,600	4,590	
Compressive Strength (MPa):	63	56	65	31	

**Remarks:**

Location 71-C

Reviewed By:  
David Morrison

Project Manager



Braun Intertec Corporation  
4511 West First Street, Suite 4  
Duluth, MN 55807

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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  
**Project Number:** B2001991  
**Client:** Accounts Payable  
Enbridge Energy, Limited Partnership  
5400 Westheimer Ct  
Houston, TX 77056  
**Project Description:**  
Enbridge Line 5 Re-route

**Sample Data**

Date Sampled: Not Given  
Samples Obtained By: Braun  
Date Received: 7/10/2020  
Sample Preparation: Trim and Polished

**Laboratory Data**

ASTM D4543 Limits

Sample Number:	83-84	95-96	103-104	112-113	
Date Tested:	7/16/2020	7/16/2020	7/16/2020	7/16/2020	
Rock Type:	Basalt	Basalt	Basalt	Basalt	
Moisture Condition During Testing:	Dry	Dry	Dry	Dry	
Diameter (in.):	1.97	1.98	1.97	1.98	
Length (in.):	4.38	4.42	4.51	3.75	
Length-to-Diameter Ratio (L/D):	2.2	2.2	2.3	1.9	$2.0 \leq L/D \leq 2.5$
Side Tolerance, Maximum (in.)	$\leq 0.020$	$\leq 0.020$	$\leq 0.020$	$\leq 0.020$	$\leq 0.020$ in.
End Tolerance, Maximum (in.)	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in.
Perpendicularity Deviation (°)	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.250^\circ$
Parallelism Deviation (°)	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.25^\circ$
Maximum Load (lbs):	14,462	16,951	22,699	16,205	
Area (in <sup>2</sup> ):	3.05	3.08	3.05	3.08	
Compressive Strength (psi):	4,740	5,500	7,440	5,260	
Compressive Strength (MPa):	32	37	51	36	

**Remarks:**

Location 71-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:** September 9, 2020

**Project Number:** B2001991

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

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

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**Sample Data**

Date Sampled: Not Given  
Samples Obtained By: Braun  
Date Received: 8/10/2020  
Sample Preparation: Trim and Polished

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**Laboratory Data**

ASTM D4543 Limits

Sample Number:	53-54	71-72	91-92	105-106	
Date Tested:	7/16/2020	7/16/2020	7/16/2020	7/16/2020	
Rock Type:	Basalt	Basalt	Basalt	Basalt	
Moisture Condition During Testing:	Dry	Dry	Dry	Dry	
Diameter (in.):	1.94	1.93	1.96	1.94	
Length (in.):	3.90	4.26	3.68	4.03	
Length-to-Diameter Ratio (L/D):	2.0	2.2	1.9	2.1	$2.0 \leq L/D \leq 2.5$
Side Tolerance, Maximum (in.)	$\leq 0.020$	$\leq 0.020$	$\leq 0.020$	$\leq 0.020$	$\leq 0.020$ in.
End Tolerance, Maximum (in.)	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in.
Perpendicularity Deviation (°)	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.250^\circ$
Parallelism Deviation (°)	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.001$ in	$\leq 0.25^\circ$
Maximum Load (lbs):	55,914	6,972	14,835	12,186	
Area (in <sup>2</sup> ):	2.96	2.93	3.02	2.96	
Compressive Strength (psi):	18,890	2,380	4,910	4,120	
Compressive Strength (MPa):	128	16	33	28	

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**Remarks:**

Location: 72-C-1

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Reviewed By:  
David Morrison

Project Manager