Appendix I: Geotechnical Report

Appendices

Appendix A

Site Coordinates and Investigation Summary

Appendix A
Site Coordinates and Investigation Summary

Geotech ID	Turbine ID	Structure Type	UTM NAD83 Z14N [m]		Soil Boring	Electrical Resistivity	Thermal Resistivity	Piezometer	Geophysical Testing
			Northing	Easting					
GEO-001	2.3-1	Turbine	4546219.3	322614.9	X				
GEO-002	2.3-2	Turbine	4550155.9	328951.3	X				
GEO-003	2.3-3	Turbine	4540531.8	325135.2	X				X
GEO-004	2.3-4	Turbine	4555547.5	339126.9	X			X	
GEO-005	2.3-5	Turbine	4550876.8	330232.5	X	X	X	X	
GEO-006	2.3-6	Turbine	4551577.3	334368.0	X	X	X		
GEO-007	2.3-7	Turbine	4553214.6	334691.8	X			X	
GEO-008	2.3-8	Turbine	4547748.1	328866.6	X				
GEO-009	2.3-9	Turbine	4551544.0	338428.4	X				
GEO-010	2.3-10	Turbine	4548944.7	344822.5					
GEO-011	2.3-107	Turbine	4552418.4	336574.9					
GEO-012	2.3-12	Turbine	4549320.8	330222.6					
GEO-013	3.8-1	Turbine	4545288.4	319620.5	X				X
GEO-014	3.8-2	Turbine	4544715.0	319963.6	X				
GEO-015	3.8-3	Turbine	4546020.6	323462.6	X	X	X		
GEO-016	3.8-4	Turbine	4545670.1	323772.0	X				
GEO-017	--	Dropped	4542879.1	324854.2					
GEO-018	3.8-6	Turbine	4542650.4	325199.4	X			X	
GEO-019	3.8-7	Turbine	4541998.9	325124.8	X				
GEO-020	3.8-8	Turbine	4541256.1	324761.0	X				
GEO-021	3.8-9	Turbine	4541120.8	325225.7	X			X	
GEO-022	3.8-10	Turbine	4542520.9	326422.2	X				
GEO-023	--	Dropped	4547723.2	327081.5					
GEO-024	3.8-12	Turbine	4546802.8	326622.5	X				
GEO-025	3.8-13	Turbine	4546402.9	326953.6	X				
GEO-026	3.8-14	Turbine	4545875.5	327741.3	X				
GEO-027	--	Dropped	4546004.7	327761.1					
GEO-028	3.8-15	Turbine	4545425.5	327878.9	X				
GEO-029	--	Dropped	4547820.4	327610.2					
GEO-030	3.8-17	Turbine	4547428.1	327749.1	X				
GEO-031	3.8-18	Turbine	4545328.4	329526.3	X				
GEO-032	--	Dropped	4545165.1	329395.5					
GEO-033	3.8-19	Turbine	4551644.0	337479.1	X				X
GEO-034	3.8-20	Turbine	4551541.8	337992.8	X				
GEO-035	3.8-21	Turbine	4550629.4	338124.3	X			X	
GEO-036	3.8-22	Turbine	4550103.1	338202.1	X				
GEO-037	3.8-23	Turbine	4549927.6	338928.3	X				
GEO-038	3.8-24	Turbine	4549899.6	339979.5	X	X	X		
GEO-039	3.8-25	Turbine	4554829.0	339283.5	X				
GEO-040	3.8-26	Turbine	4551698.0	340823.8	X				
GEO-041	3.8-27	Turbine	4548942.9	341288.9	X				
GEO-042	3.8-28	Turbine	4548991.7	344231.2	X				
GEO-043	3.8-29	Turbine	4548203.7	343986.5	X				
GEO-044	3.8-29-2	Turbine	4548181.0	344107.0	X				
GEO-045	3.8-30	Turbine	4542927.6	326484.0	X				
GEO-046	--	Dropped	4543036.5	326466.9					
GEO-047	3.8-31	Turbine	4542157.5	324459.5	X				
GEO-048	3.8-31-2	Turbine	4542147.8	324163.3	X				
GEO-049	3.8-32	Turbine	4544539.9	326421.6	X				
GEO-050	3.8-33	Turbine	4544111.4	325884.5	X			X	
GEO-051	3.8-34	Turbine	4543626.0	325869.2	X				
GEO-052	3.8-35	Turbine	4548866.6	343529.1	X				
GEO-053	3.8-36	Turbine	4544801.8	319596.9	X				
GEO-054	--	Dropped	4545274.7	328724.8					
GEO-055	--	Dropped	4550584.0	338924.8					
GEO-056	3.8-39	Turbine	4550364.6	339674.3	X				
GEO-057	--	Dropped	4548099.8	345470.5					
GEO-058	3.8-41	Turbine	4547477.2	345610.7					
GEO-059	3.8-42	Turbine	4547019.2	345658.2	X				

Geotech ID	Turbine ID	Structure Type	UTM NAD83 Z14N [m]		Soil Boring	Electrical Resistivity	Thermal Resistivity	Piezometer	Geophysical Testing
			Northing	Easting					
GEO-060	3.8-43	Turbine	4543949.2	325266.8	X			X	
GEO-061	3.8-44	Turbine	4553223.6	336017.9	X				X
GEO-062	3.8-45	Turbine	4548686.1	328618.5	X				
GEO-063	3.8-46	Turbine	4552372.8	337543.9	X				
GEO-064	--	Dropped	4548400.0	343623.0					
GEO-065	--	Dropped	4548297.0	343623.0					
GEO-066	3.8-51	Turbine	4543617.4	324704.8	X				X
GEO-067	--	Dropped	4542169.5	325992.6					
GEO-068	3.8-53	Turbine	4544367.3	326870.1	X				
GEO-069	3.8-54	Turbine	4546020.7	329629.2	X				
GEO-070	3.8-55	Turbine	4547759.0	328810.0	X				
GEO-071	2.3-11/3.8-56	Turbine	4553213.4	336408.8	X				
GEO-072	3.8-57	Turbine	4553078.1	336837.0	X				
GEO-073	3.8-58	Turbine	4552429.3	336577.0					
GEO-074	3.8-59	Turbine	4552379.1	337006.9	X				
GEO-075	3.8-60	Turbine	4551391.1	338409.0	X				
GEO-076	3.8-61	Turbine	4548968.7	343381.3	X				
GEO-077	3.8-62	Turbine	4548935.4	344812.7	X				
GEO-078	3.8-63	Turbine	4545354.8	328297.0	X				
GEO-079	3.8-101	Turbine	4546147.4	325270.7	X				
GEO-080	3.8-101	Turbine	4550123.9	337534.8					
GEO-081	3.8-104	Turbine	4547664.2	326388.0	X				
GEO-082	3.8-105	Turbine	4546818.3	326235.2	X				
GEO-083	3.8-106	Turbine	4546775.0	326708.0	X				
GEO-084	3.8-5	Turbine	4542846.9	324876.3	X			X	
GEO-085	3.8-11	Turbine	4547740.3	327077.5	X				X
GEO-086	3.8-14-2	Turbine	4545922.4	327750.9	X				
GEO-087	3.8-16	Turbine	4547804.6	327652.3	X	X	X		
GEO-088	3.8-18-2	Turbine	4545185.4	329414.1	X				
GEO-089	3.8-37	Turbine	4545293.9	328728.7	X	X	X		
GEO-090	3.8-38	Turbine	4550571.2	339008.4	X				
GEO-091	3.8-40	Turbine	4548037.1	345589.1	X				
GEO-092	3.8-47	Turbine	4548374.3	343629.4	X			X	
GEO-093	3.8-47-2	Turbine	4548322.8	343634.7	X				
GEO-094	3.8-52	Turbine	4542142.6	325974.7	X				
GEO-095	3.8-48	Turbine	4543793.3	326847.9					
GEO-096	3.8-30-2	Turbine	4543010.5	326543.0	X				
Sub-Res	--	Previous Substation	4547035.0	327329.0		X	X		

Appendix B

Soil Boring Logs

Barr Engineering Company
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-001

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/ft	WATER CONTENT % PL LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	Physical Properties WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	0	TOPSOIL (CL): dark brown; moist; trace roots.	0.4			4									
		LEAN CLAY (CL): brown; moist; gray mottling.	2.5			15									
	5	LEAN CLAY (CL): brown to dark brown; moist; stiff to very stiff; gray mottling; little gravel; trace sand.				18									
						15									
	10					14									
						11	16 31								
	15	LEAN CLAY (CL): gray; moist; medium stiff to stiff; trace gravel; trace sand.	13.0			8									
									17.1	114.6		3.1			
	20					11									
		24.0 ft: harder drilling - encountered cobble.				11			17.3						
	25														
						12									
	30														
						12			16.7						
	35														
						9									
	40														
						20			16.1	117.5		4.8			
	45	POORLY GRADED GRAVEL WITH SAND AND SILT (GP): gray; wet; medium dense to very dense.	45.0												
						22									
	50														
						>> 50/0.5"									
	55	LIMESTONE; auger refusal.	55.0												
		Bottom of Boring at 56.5 feet	56.5												
	60														
	65														

Completion Depth:	56.5
Date Boring Started:	4/11/18
Date Boring Completed:	4/11/18
Logged By:	BAA
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4546219.3m, E:322614.9m
Datum:	NAD83

Remarks:

SAMPLE TYPES

SPLIT SPOON | 3-inch Shelby Tube

WATER LEVELS (ft)

End of Drilling 34.0

At Time of Drilling 45.0

LEGEND

MC Moisture Content
γ Dry Unit Weight
ϕ Friction Angle
Q_u Unconfined Compression
Q_p Hand Penetrometer UC
Gs Specific Gravity
RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

M:\GINT\PROJECTS\35741003.00_SENECA WIND PROJECT.GPJ BARRLIBRARY.GLB HORIZONTAL LOG REPORT BARR GEOTECH TEMPLATE.GDT

Barr Engineering Company
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-002

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/ft	WATER CONTENT % PL LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	Physical Properties WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
		Surface Elev.:													
	0	TOPSOIL (CL): brown; moist; trace roots.	1.0			3							2		
		LEAN CLAY (CL): brown; moist; stiff to very stiff; gray mottling; orange and black oxidation staining; few gravel; with sand.				11							4		
	5					21									
						27			16.3				4.5		
	10					24									
						15							4.5		
	15					10			16.2				4.5		
		LEAN CLAY (CL): gray to dark gray; moist; stiff to very stiff; with sand; few gravel.	20.0			13							2.5		
	20					11							2.75		
						10			16.6				2		
	25					15							4		
						16							3.5		
	30	SILTY SAND (SM): fine to medium grained; dark gray to gray; moist; medium dense; trace gravel.	42.0			21		13.6 84.9	4.6						
		LEAN CLAY (CL): dark gray to gray; moist; stiff to very stiff; with sand; few gravel.	49.0			11							2		
	35					17			12.8				4		
		Bottom of Boring at 61.5 feet	61.5			21							4.5		
	40														
	45														
	50														
	55														
	60														
	65														

Completion Depth:	61.5
Date Boring Started:	4/27/18
Date Boring Completed:	4/27/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4550155.9m, E:328951.3m
Datum:	NAD83

Remarks:

SAMPLE TYPES
- SPLIT SPOON

WATER LEVELS (ft)
- End of Drilling: Dry
- At Time of Drilling: Dry

LEGEND
- MC Moisture Content
- γ Dry Unit Weight
- ϕ Friction Angle
- Q_u Unconfined Compression
- Q_p Hand Penetrometer UC
- Gs Specific Gravity
- RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

M:\GINT\PROJECTS\35741003.00 SENECA WIND PROJECT.GPJ BARRLIBRARY.GLB HORIZONTAL LOG REPORT BARR GEOTECH TEMPLATE.GDT

Barr Engineering Company
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-003

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/ft	WATER CONTENT % PL LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
		Surface Elev.:													
	0	TOPSOIL (CL): dark brown; moist; roots.	0.5			6							3		
	5	LEAN CLAY (CL): brown with gray mottling; moist; medium stiff to very stiff; orange oxidation spots; trace to little sand; trace gravel.				8, 15, 21, 24, 22			14.4	120.4		6.6	4.5, 4.5		
	10														
	15					11	15, 27		12.3, 14.7	120.1		1.5			
	20	LIMESTONE; beige; highly weathered; vuggy; clay infilling in joints.	19.0			45									17
	25	LIMESTONE; tan to light gray; vuggy; clay infilling in joints; highly weathered to 28 feet.	22.0												0
	30														57
	35														87
	40														78
	45														65
	50														40
	55														44
	60	Bottom of Boring at 60.0 feet	60.0												38
	65														

Physical Properties

Completion Depth:	60.0
Date Boring Started:	3/26/18
Date Boring Completed:	3/28/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4540531.8m, E:325135.2m
Datum:	NAD83

Remarks: Borehole collapsed to 26.5 feet after coring.

SAMPLE TYPES

SPLIT SPOON | 3-inch Shelby Tube | ROCK CORE

WATER LEVELS (ft)

At Time of Drilling 10.2
before coring

LEGEND

MC Moisture Content
γ Dry Unit Weight
ϕ Friction Angle
Q_u Unconfined Compression
Q_p Hand Penetrometer UC
Gs Specific Gravity
RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

M:\GINT\PROJECTS\35741003.00 SENECA WIND PROJECT.GPJ BARRLIBRARY.GLB HORIZONTAL LOG REPORT BARR GEOTECH TEMPLATE.GDT

Barr Engineering Company
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-004

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

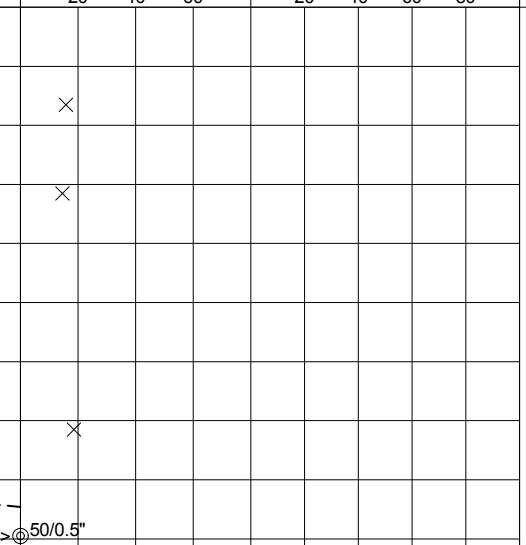
Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	
	0	Surface Elev.:	
	0	TOPSOIL (CL): brown; moist; trace roots.	0.5
	5	LEAN CLAY (CL): brown; moist; gray mottling; orange and black oxidation staining; with sand; few gravel.	
	10		
	15		
	20		
	20	LEAN CLAY (CL): gray to dark gray; moist to wet; with sand; few gravel.	20.0
	25	26.0 ft: thin wet sand seams.	
	30		
	35		
	40		
	40	LIMESTONE; gray; highly weathered.	42.0
	45	LIMESTONE; gray to light gray; moderately weathered; 0° fracture dipping.	44.5
	50		
	55		
	60	Bottom of Boring at 60.5 feet	60.5
	65		

Graphic Log | Sample Type & Rec.

STANDARD PENETRATION TEST DATA — N in blows/ft: 10 20 30 40

WATER CONTENT % — PL LL — 20 40 60

SIEVE ANALYSIS — GRAVEL SAND SILT CLAY FINES — 20 40 60 80



Physical Properties

WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
				2.5		
				4.5		
				4.5		
15.8				4.5		
				4.5		
				4.5		
14.6				4.5		
				3.5		
				1.5		
18.5						
				4.5		
						40
						63
						82
						71

Completion Depth:	60.5
Date Boring Started:	4/28/18
Date Boring Completed:	5/1/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4555547.5m, E:339126.9m
Datum:	NAD83

Remarks: Piezometer installed to a depth of 12 feet below grade.

SAMPLE TYPES: SPLIT SPOON; ROCK CORE

WATER LEVELS (ft): At Time of Drilling 26.0; 0.5 hrs After Drilling 20.0; 72 hrs After Drilling 15.5

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

M:\GINT\PROJECTS\35741003.00 SENECA WIND PROJECT.GPJ BARRLIBRARY.GLB HORIZONTAL LOG REPORT BARR GEOTECH TEMPLATE.GDT

Barr Engineering Company
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-005

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Elevation, feet
Surface Elev.:		
0	TOPSOIL (CL): brown; moist; trace roots.	
1.0	LEAN CLAY (CL): brown; moist; medium stiff; trace sand.	
5.5	LEAN CLAY (CL): brown to grayish brown; moist; stiff to very stiff; trace to few sand.	
46.0	LIMESTONE; light gray; horizontal fractures; medium hard.	
	55.5 ft: trace fossils.	
60.5	Bottom of Boring at 60.5 feet	

Graphic Log | Sample Type & Rec. | STANDARD PENETRATION TEST DATA (N in blows/ft) | WATER CONTENT % (PL – LL) | SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)

Depth, feet	N in blows/ft	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
0	4, 8					1.5		
5	22, 27					2		
10	16, 17					4.5		
15	16	15.9				4.5		
20	11	16.7				4		
25		16.8	115		2.5	2.5		
30	13					4.5		
35	14	16.4				2.5		
40	20					3		
45	>> 50/4"					4.5		17
50								11
55								25
60								0
65								67

Completion Depth:	60.5
Date Boring Started:	4/21/18
Date Boring Completed:	5/2/18
Logged By:	IGM / DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4550876.8m, E:330232.5m
Datum:	NAD83

Remarks: Cobbles at surface.

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube; ROCK CORE

WATER LEVELS (ft): End of Drilling Dry; At Time of Drilling Dry

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

M:\GINT\PROJECTS\35741003.00 SENECA WIND PROJECT.GPJ BARRLIBRARY.GLB HORIZONTAL LOG REPORT BARR GEOTECH TEMPLATE.GDT

Barr Engineering Company
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-006

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL – LL)	SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
		Surface Elev.:													
	0	LEAN CLAY (CL): brown; moist; trace roots.				4							1		
	5	LEAN CLAY (CL): brown; moist; stiff to very stiff; gray mottling; with sand; trace gravel.	2.5			15, 18, 21							2.75, 4.5, 4.5		
	10					19			16.7				4.25		
	15	LEAN CLAY (CL): gray; moist to wet; stiff; with sand; few gravel.	12.5			13, 11							2.75, 2.25		
	20								16.6	115.9		3.3			
	25					13							2.75		
	30	30.5 ft: thin seam of wet sand.				12			16.2				2.5		
	35					14							3		
	40					11			15.7				2.5		
	45								16.7	114.8		2.3	4		
	50					14							4.25		
	55					14, >>50/4"			16.9				3.5		
	60	LIMESTONE; light gray to brown; auger refusal.	57.5												
	65	Bottom of Boring at 58.5 feet	58.5												

Physical Properties

Completion Depth:	58.5
Date Boring Started:	4/22/18
Date Boring Completed:	4/22/18
Logged By:	IGM
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4551577.3m, E:334368.0m
Datum:	NAD83

Remarks:

SAMPLE TYPES

SPLIT SPOON; 3-inch Shelby Tube

WATER LEVELS (ft)

End of Drilling
Dry
At Time of Drilling 30.5

LEGEND

MC Moisture Content
γ Dry Unit Weight
ϕ Friction Angle
Q_u Unconfined Compression
Q_p Hand Penetrometer UC
Gs Specific Gravity
RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Barr Engineering Company
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-007

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL — LL)	SIEVE ANALYSIS (GRAVEL / SAND / SILT / CLAY / FINES)	Physical Properties WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	0	Surface Elev.:												
		TOPSOIL (CL): brown; moist; trace roots. 0.2			7, 4, 6							3		
	5	LEAN CLAY (CL): brown; moist; medium stiff to very stiff; gray mottling; orange and black oxidation staining; with sand; few gravel.			18, 16							1.5		
	10				9			16.6				4.5		
		LEAN CLAY (CL): gray; moist to wet; medium stiff to hard; with sand; few gravel. 11.0										4.5		
	15							15.3				3		
	20				13							2.5		
	25				6			15				1.75		
								12.8	124		2.8	1.5		
	30	30.0 ft: with wet sand seams.			31							3.5		
		LIMESTONE; light gray; clay-filled fractures; horizontal fractures; orange and black oxidation. 32.0			50/0.5"									21
	40													69
	45	44.5 ft: 1/4-inch thick clay seam.												96
	50													97
	55													100
		LIMESTONE; tan with light gray; clay-filled fractures; horizontal fractures; orange and black oxidation. 57.5 / 60.5												98
	60													
	65	Bottom of Boring at 60.5 feet												

Completion Depth:	60.5
Date Boring Started:	4/26/18
Date Boring Completed:	5/1/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4553214.6m, E:334691.8m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube; ROCK CORE

WATER LEVELS (ft): At Time of Drilling 30.0; After Drilling before coring 30.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-008

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Physical Properties WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
0	LEAN CLAY (CL): brown; moist.						2.75		
2.5	LEAN CLAY (CL): brown; moist; stiff to very stiff; with sand; trace gravel.						4.5		
5							4.5		
10			18.2				4.5		
15			17.5				4.25		
20.0	LEAN CLAY (CL): gray; moist; medium stiff to very stiff; with sand; trace gravel.		18.5	112.2		2.2	1.5		
25							1		
30			14.2				4.5		
35.0	SILTY SAND (SM): fine grained; gray; moist; very dense; trace gravel and cobbles.								
37.0	LEAN CLAY (CL): no sample.								
46.0	LIMESTONE; gray; medium strong; vuggy; clay-infilled fractures.								17
50									46
55									72
60									100
60.0	Bottom of Boring at 60.0 feet								
65									

STANDARD PENETRATION TEST DATA — N in blows/ft: 10 20 30 40

WATER CONTENT % — PL LL: 20 40 60

SIEVE ANALYSIS — GRAVEL SAND SILT CLAY FINES: 20 40 60 80

Completion Depth:	60.0
Date Boring Started:	4/21/18
Date Boring Completed:	4/30/18
Logged By:	IGM / DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4547748.1m, E:328866.6m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube; ROCK CORE

WATER LEVELS (ft): After Drilling before coring 29.0; At Time of Drilling Dry

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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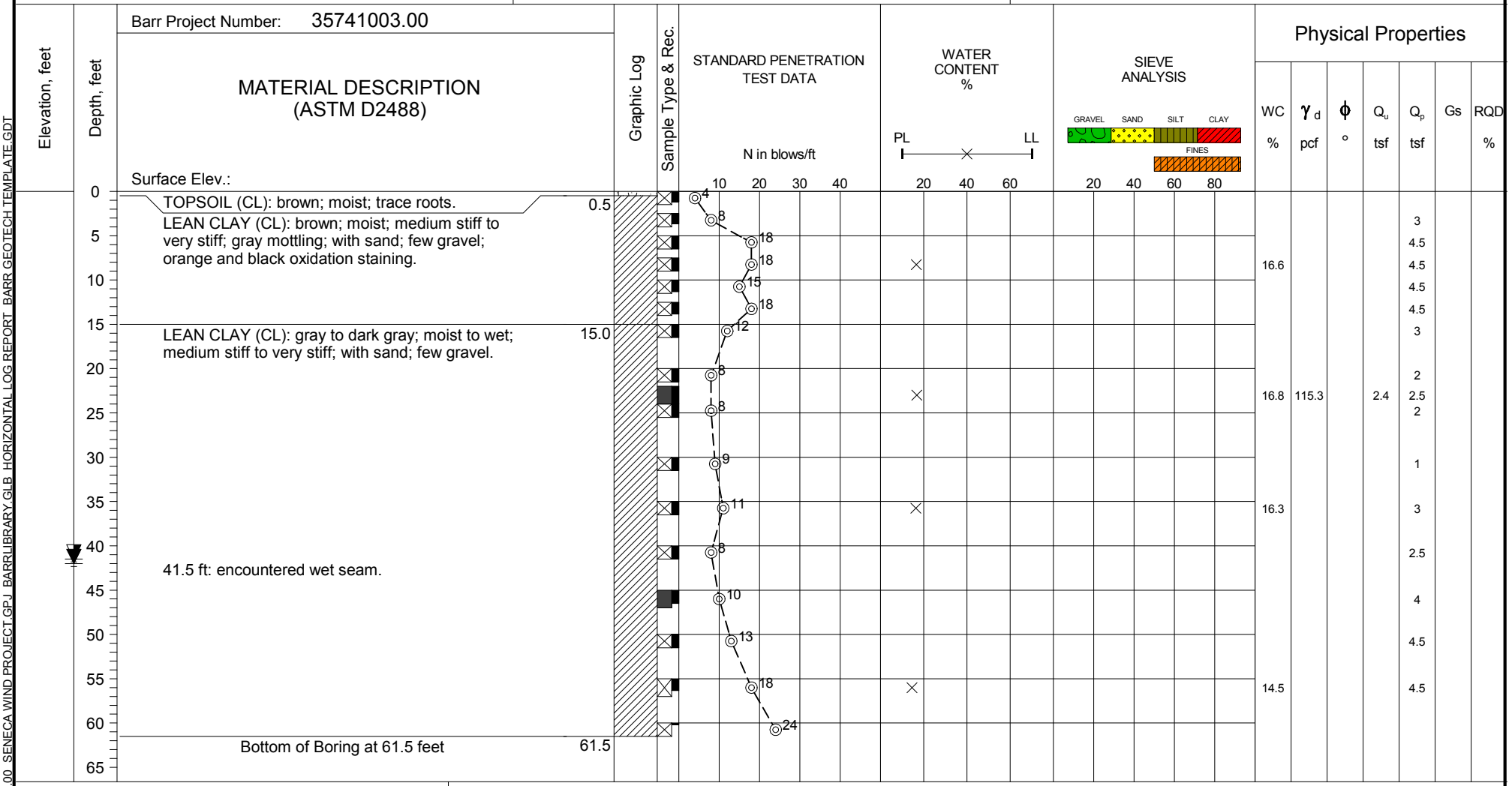
LOG OF BORING GEO-009

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00



Completion Depth:	61.5
Date Boring Started:	5/9/18
Date Boring Completed:	5/9/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4551544.0m, E:338428.4m
Datum:	NAD83

Remarks:

SAMPLE TYPES

SPLIT SPOON | 3-inch Shelby Tube

WATER LEVELS (ft)

End of Drilling 42.0

At Time of Drilling 41.5

LEGEND

MC Moisture Content
γ Dry Unit Weight
ϕ Friction Angle
Qu Unconfined Compression
Qp Hand Penetrometer UC
Gs Specific Gravity
RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING GEO-013

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
0	TOPSOIL (CL): brown; moist; trace roots.	0.5					1		
	LEAN CLAY (CL): brown; moist to wet; stiff to hard; with sand; trace gravel.						4.5		
5							4.5		
			15.8				4.5		
10							4.5		
							3.5		
15			16.9	115.2		4.9			
	20.0 - 20.8 ft: wet clayey sand seam.		14.5				4.5		
20									
25							4.5		
	POORLY GRADED SAND WITH SILT (SP-SM): coarse grained; brown; moist to wet; trace gravel.	26.5							
30	SILTY GRAVEL (GM): yellowish brown; moist to wet; dense; few sand.	30.0	11.3						
	LEAN CLAY (CL): gray to dark gray; moist to wet; stiff to very stiff; with sand; few gravel.	35.0					1.75		
35									
40			24.2						
	CLAYEY GRAVEL WITH SAND (GC): gray with brown; wet; very dense.	43.5							
45									
50			11.6						
	Auger refusal on bedrock.	56.5							
55	Bottom of Boring at 56.5 feet								
60									
65									

STANDARD PENETRATION TEST DATA — N in blows/ft: 5, 15, 22, 21, 19, 13, 38, 35, 42, 15, 17, >>54, >>54, >>50/0.5"

WATER CONTENT % — PL, LL

SIEVE ANALYSIS — GRAVEL, SAND, SILT, CLAY, FINES — 49.5, 89.3

Completion Depth:	56.5
Date Boring Started:	4/18/18
Date Boring Completed:	4/20/18
Logged By:	IGM
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA / Mud rotary
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4545288.4m, E:319620.5m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube

WATER LEVELS (ft): At Time of Drilling 20.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-014

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL – LL)	SIEVE ANALYSIS (GRAVEL / SAND / SILT / CLAY / FINES)	Physical Properties WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	0	TOPSOIL (CL): brown; moist; trace roots.	0.5			4, 20, 30									
	5	LEAN CLAY (CL): brown; moist; very stiff; trace gravel; trace sand; gray mottling.				21, 22, 19									
	10								16.6						
	15	LEAN CLAY (CL): gray; moist; stiff to very stiff; trace gravel; trace sand.	15.0			15, 20									
	20								14.9	120.5		6.3			
	25	POORLY GRADED GRAVEL WITH SAND (GP): gray; moist; medium dense to very dense; heaving sand in auger - controlled with drilling mud.	26.0			>> 76/11"									
	30					>> 50/5"									
	35					22			13.6						
▼	40					>> 81/10"									4.5
	45	LEAN CLAY (CL): gray; moist; hard; trace gravel; some sand.	40.5 41.5			>> 84/11.5"		0 – 82.1							
	50	SILTY SAND (SM): fine to coarse grained; gray; moist; very dense.				>> 50/6"									
	55	LIMESTONE; gray; massive.	51.5			>> 50/5.5"									
	60	Bottom of Boring at 56.5 feet	56.5												
	65														

Completion Depth:	56.5
Date Boring Started:	4/11/18
Date Boring Completed:	4/12/18
Logged By:	BAA / BWL
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA / Mud rotary
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4544715.0m, E:319963.6m
Datum:	NAD83

Remarks:

SAMPLE TYPES
- SPLIT SPOON

WATER LEVELS (ft)
- At Time of Drilling 41.0

LEGEND
- MC Moisture Content
- γ Dry Unit Weight
- ϕ Friction Angle
- Q_u Unconfined Compression
- Q_p Hand Penetrometer UC
- Gs Specific Gravity
- RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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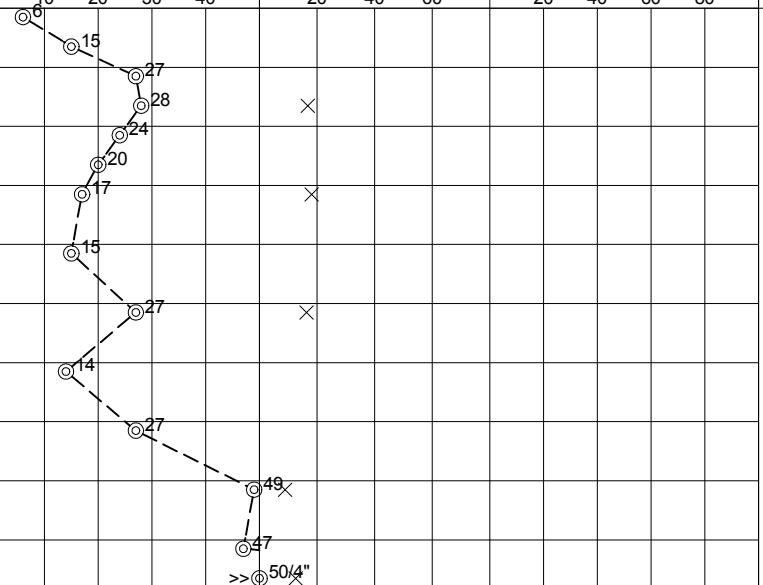
LOG OF BORING GEO-015

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	Surface Elev.:								
0	TOPSOIL (CL): brown; moist; trace roots.	0.2					1		
5	LEAN CLAY (CL): brown; moist; stiff to very stiff; gray mottling; with sand; trace to few gravel; orange and black oxidation staining.						4.5		
10			16.8				4.5		
15	LEAN CLAY (CL): gray to dark gray; moist; stiff to very stiff; with sand; few gravel; trace cobbles.	16.0	18.1				4		
20							3.5		
25			16.3						
30							2.5		
35									
40	CLAYEY SAND (SC): fine to medium grained; gray; wet; dense to very dense.	38.0	8.9						
45	45.0 ft: sand heaving up in augers - controlled with water.								
50	Auger refusal on bedrock.	48.5	12.6						
	Bottom of Boring at 48.5 feet								
55									
60									
65									

Graphic Log | Sample Type & Rec. | STANDARD PENETRATION TEST DATA (N in blows/ft: 10 20 30 40) | WATER CONTENT % (PL — LL; 20 40 60) | SIEVE ANALYSIS (GRAVEL SAND SILT CLAY; FINES; 20 40 60 80)



Physical Properties: WC % | γ_d pcf | ϕ ° | Q_u tsf | Q_p tsf | Gs | RQD %

Completion Depth:	48.5
Date Boring Started:	4/20/18
Date Boring Completed:	4/20/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4546020.6m, E:323462.6m
Datum:	NAD83

Remarks:

SAMPLE TYPES
- SPLIT SPOON

WATER LEVELS (ft)
- End of Drilling 36.5
- At Time of Drilling 38.0

LEGEND
- MC Moisture Content
- γ Dry Unit Weight
- ϕ Friction Angle
- Q_u Unconfined Compression
- Q_p Hand Penetrometer UC
- Gs Specific Gravity
- RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Barr Engineering Company
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-016

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
0	TOPSOIL (CL): brown; moist; trace roots.	0.2					1.5		
	LEAN CLAY (CL): brown; moist; stiff to very stiff; gray mottling; orange and black oxidation staining; with sand; trace to few gravel.						4.5		
5							4.5		
							4.5		
10			15				4.5		
							4.5		
15							4.5		
20			17.1						
	LEAN CLAY (CL): gray to dark gray; moist to wet; medium stiff to very stiff; with sand; few gravel.	23.0					2		
25									
			16.9	115.5		2.7	4		
30			18.3				3.5		
35							3		
40	40.0 ft: 2-inch seam of wet fine sand.						2		
45	45.0 ft: encountered obstruction which refused augers. Switched to rock coring methods, but limited recovery was obtained. It appears that the obstruction was likely a boulder within the clayey glacial till soils.		5.4						
50	Recovery in core barrel was limited to few clay pieces and sand and gravel remnants.								0
55									0
60	Bottom of Boring at 60.0 feet	60.0							
65									

STANDARD PENETRATION TEST DATA (N in blows/ft): 5, 22, 23, 23, 22, 16, 14, 16, 8, 19, 18, 12, >>50/5"

WATER CONTENT % (PL — LL)

SIEVE ANALYSIS: GRAVEL, SAND, SILT, CLAY, FINES

Completion Depth:	60.0
Date Boring Started:	4/20/18
Date Boring Completed:	4/30/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4545670.1m, E:323772.0m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube; ROCK CORE

WATER LEVELS (ft): At Time of Drilling 30.0; 100 hrs After Drilling 9.5 before coring

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-018

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL – LL)	SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)	Physical Properties WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
Surface Elev.:															
	0	TOPSOIL: brown; moist; roots.	0.5										2.75		
	5	LEAN CLAY (CL): brown with gray mottling; moist to wet; medium stiff to very stiff; orange oxidation spots and black mottling; trace to little sand.	8.5			5, 8, 16, 22, >>50/0.5"			17.3				3.5, 4		
	10	LIMESTONE; light brown with gray; fresh; massive; trace to no vugs; trace pyrite inclusions.													0
	15														0
	20														30
	25	LIMESTONE; light gray; trace pyrite inclusions; occasional vuggy zones.	26.0												8
	30														57
	35														335
	40														51
	45														59
	50														37
	55														57
	60	Bottom of Boring at 60.0 feet	60.0												100
	65														

Completion Depth:	60.0
Date Boring Started:	4/7/18
Date Boring Completed:	4/8/18
Logged By:	DJZ / BWL
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4542650.4m, E:325199.4m
Datum:	NAD83

Remarks:

SAMPLE TYPES

SPLIT SPOON | ROCK CORE

WATER LEVELS (ft)

At Time of Drilling	3.0
After Drilling	4.0
12 hrs After Drilling (sat overnight - measured in core barrel)	2.0

LEGEND

MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING GEO-019

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL – LL)	SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)	Physical Properties: WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	0	Surface Elev.:												
	0	TOPSOIL (CL): brown; moist; trace roots.										2.5		
	1.5	LEAN CLAY (CL): brown; moist to wet; medium stiff to very stiff; gray mottling; trace to few sand; occasional black oxidation staining.			4, 8, 14, 23			19.6				2 4.5		
	10	12.0 ft: encountered thin wet sand seam.			10, 20			14.5	119.8		2.5	4 4.5		
	15											4		
	17.5	LIMESTONE; tan with gray; fresh; trace to no vugs; trace pyrite.			>> 50/0.5"									0
	20													10
	25													48
	30													59
	35													52
	40													66
	42.5	MUDSTONE. Gray; soft.												79
	44.0	LIMESTONE; tan to light brown; massive; occasional small vugs.												94
	45													52
	50													
	55													
	60													
	62.5	Bottom of Boring at 62.5 feet												
	65													

Completion Depth:	62.5
Date Boring Started:	4/6/18
Date Boring Completed:	4/7/18
Logged By:	DJZ / BWL
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4541998.9m, E:325124.8m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube; ROCK CORE

WATER LEVELS (ft): At Time of Drilling 12.0; After Drilling before coring 17.5

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Telephone: 952-832-2600

LOG OF BORING GEO-020

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL – LL)	SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)	Physical Properties: WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	0	Surface Elev.:												
		TOPSOIL (CL): brown; moist; trace roots.										2.5		
	0.5													
		LEAN CLAY (CL): brown to light brown; moist; with orange and black oxidationstaining; trace sand.										2		
	2.0													
	5				5, 13, 21							4.5		
					24, 18			17.1						
	9.5													
	10	LEAN CLAY (CL): brown with gray mottling; moist; stiff to very stiff; with orange and black oxidation staining; with gravel and sand.			6, 11									
	14.0							15.3				4		
	15	CLAYEY SAND WITH GRAVEL (SC): fine to medium grained; dark brown and gray; wet; loose.						14.6	120.5		2.3			
		LEAN CLAY (CL): gray to dark gray; moist to wet; very stiff to hard; few thin sand seams.			24, >> 50/1"									
	20													
	23.0	LIMESTONE; weak; light to dark gray; vuggy; clay infilled joints.												10
	25													0
	30													30
	35													28
	40													32
	45	44.0 - 49.0 ft: few thin shale seams.												65
	50													36
	55													45
	60													40
	62.0	Bottom of Boring at 62.0 feet												
	65													

Completion Depth:	62.0
Date Boring Started:	3/28/18
Date Boring Completed:	3/29/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4541256.1m, E:324761.0m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube; ROCK CORE

WATER LEVELS (ft): At Time of Drilling 9.5; After Drilling 16.8

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-021

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	
	0	Surface Elev.:	
	0	TOPSOIL (CL): brown; moist; roots.	0.5
	2.5	LEAN CLAY (CL): brown; moist.	2.5
	5	LEAN CLAY (CL): brown with gray mottling; moist; stiff to very stiff; orange and black oxidation; few to little sand.	
	10		
	15		
	16.5	POORLY GRADED SAND (SP): fine grained; brown and gray; wet; very dense; highly weathered limestone; few gravel.	16.5
	17.5	LIMESTONE; light brown; fresh; very hard; clayey; many softer drilling zones.	17.5
	20		
	25		
	30	30.0 ft: lost water circulation to surface and never re-established; void from 30.0 to 31.5 ft observed.	
	33.0	LIMESTONE; light gray; very hard; occasional small vugs.	33.0
	35		
	40		
	44.0	SILTSTONE; light gray with dark gray; very hard.	44.0
	45		
	50		
	55		
	60	Bottom of Boring at 60.0 feet	60.0
	65		

Graphic Log | Sample Type & Rec.

STANDARD PENETRATION TEST DATA — N in blows/ft: 10 20 30 40

WATER CONTENT % — PL LL: 20 40 60

SIEVE ANALYSIS — GRAVEL SAND SILT CLAY FINES: 20 40 60 80

Physical Properties

WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
				2		
				3.5		
				4.5		
16.2				4.5		
				4.5		
13	125.2		4.3	4		
						0
						0
						0
						26
						33
						46
						37
						63
						75
						0

Completion Depth:	60.0
Date Boring Started:	4/3/18
Date Boring Completed:	4/4/18
Logged By:	DJZ / BWL
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4541120.8m, E:325225.7m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; ROCK CORE

WATER LEVELS (ft): At Time of Drilling 16.0; After Drilling before coring 8.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-022

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL – LL)	SIEVE ANALYSIS (GRAVEL / SAND / SILT / CLAY / FINES)	Physical Properties WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
		Surface Elev.:													
	0	TOPSOIL (CL): brown; moist; trace roots; trace sand.	0.4			4, 5, 8									
	5	LEAN CLAY (CL): brown; moist; medium stiff; gray mottling; trace gravel.	7.5			27			18.5	111		2.6			
	10	LEAN CLAY (CL): dark brown; moist; very stiff; trace to little gravel. 13.0 ft: with gray zones.				17, 19			12						
	15														
	20	LIMESTONE; light brown with gray; fresh; faint bedding; trace small to large vugs; hard with occasional soft zones. 25.0 ft: 1.5-foot void observed.	20.0			>> 50/6"			13						30
	25														78
	30	30.0 ft: 6-inch void observed.													81
	35	36.0 ft: very vuggy.													91
	40	40.0 ft: small void observed.													94
	45														72
	50														79
	55	53.0 ft: shell fragments within rock.													18
	60	Bottom of Boring at 60.0 feet	60.0												
	65														

Completion Depth:	60.0
Date Boring Started:	4/11/18
Date Boring Completed:	4/11/18
Logged By:	BAA / BWL
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4542520.9m, E:326422.2m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube; ROCK CORE

WATER LEVELS (ft): At Time of Drilling 9.0; 6 hrs After Drilling 6.3

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-024

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL – LL)	SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	0	Surface Elev.:												
	0	LEAN CLAY (CL): brown; moist; stiff to hard; some sand; little gravel.			5, 17, 22, 25, 25, 31, 18, 10, 11, 19, 11, 18, 14	PL 16 – 31 LL		18						
	40.0	SILTY SAND (SM): fine to medium grained; gray; moist; medium dense.						20.9				1.5		
	45.0	LEAN CLAY (CL): brown; moist; stiff; trace gravel; with sand.						13.9				2		
	47.5	Auger refusal on bedrock.						17.7				1.5		
		Bottom of Boring at 47.5 feet										1.5		

Completion Depth:	47.5
Date Boring Started:	4/17/18
Date Boring Completed:	4/17/18
Logged By:	IGM
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA / Mud rotary
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4546802.8m, E:326622.5m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON

WATER LEVELS (ft): At Time of Drilling before mud rotaryDry

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING GEO-025

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL–LL)	SIEVE ANALYSIS (GRAVEL / SAND / SILT / CLAY / FINES)	Physical Properties WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	0	Surface Elev.:													
	0	TOPSOIL (CL): brown; moist; trace roots.	0.2												
	5	LEAN CLAY (CL): brown; moist; stiff to very stiff; gray mottling; orange and black oxidation staining; with sand; few gravel.				7, 16, 22, 20, 18, 16, 15	16, 32		17.2						
	15								17.1						
	20	LEAN CLAY (CL): gray to dark gray; moist; stiff; with sand; trace gravel.	20.0			11									
	25	POORLY GRADED SAND (SP): fine grained; gray; moist.	26.0			17									
	30		28.0			14		0, 54.7	14.5						
	30	LEAN CLAY (CL): gray to dark gray; moist; very stiff; with sand.	31.0			>> 50/5"									
	35	SILTY SAND (SM): fine to medium grained; gray; wet; medium dense to very dense; weathered limestone.													0
	40	LIMESTONE; gray; vuggy; clay infilled fractures; hard; horizontal fractures.	40.0												18
	45														23
	50								3.2	154.3		867.5			34
	55														83
	60	57.0 ft: lost circulation and never re-established.							1.9	162.3		874.1			
	60	Bottom of Boring at 60.0 feet	60.0												
	65														

Completion Depth:	60.0
Date Boring Started:	4/16/18
Date Boring Completed:	4/16/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4546402.9m, E:326953.6m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube; ROCK CORE

WATER LEVELS (ft): After Drilling before coring 33.7; At Time of Drilling 29.5

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING GEO-026

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL — LL)	SIEVE ANALYSIS (GRAVEL / SAND / SILT / CLAY / FINES)	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
		Surface Elev.:													
	0	TOPSOIL (CL): dark brown; moist; trace roots.	0.4			10									
	5	LEAN CLAY (CL): brown; moist; stiff; gray mottling; trace gravel; with sand.				9, 13, 11									
	10					43			22.5	105.2		2.1			0
	15	LIMESTONE; light tan with gray and brown; slightly weathered; soft to hard; trace small to large vugs; faint bedding.	11.0												68
	20														85
	25	25.0 - 26.5 ft: very hard zone.													68
	30	28.5 ft: very hard zone.													60
	35														84
	40														96
	45	43.5 ft: trace shell fragments.													73
	50														96
	55														40
	60	Bottom of Boring at 60.0 feet	60.0												100
	65														

Completion Depth:	60.0
Date Boring Started:	4/12/18
Date Boring Completed:	4/13/18
Logged By:	BAA / BWL
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4545875.5m, E:327741.3m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; ROCK CORE

WATER LEVELS (ft): At Time of Drilling 11.0; 12 hrs After Drilling 12.0 before coring

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING GEO-028

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL — LL)	SIEVE ANALYSIS (GRAVEL / SAND / SILT / CLAY / FINES)	Physical Properties: WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	0	Surface Elev.:													
		TOPSOIL (CL): brown; moist; trace roots.	0.3			5, 6, >>50/5"									
	5	LEAN CLAY (CL): brown; moist; medium stiff; gray mottling; little gravel.	4.5												
		SILTY SAND (SM): fine grained; light gray; moist; very dense; weathered limestone.	7.0												
	10	LIMESTONE; brown to tan with gray; fresh; trace small vugs. 9.0 ft: lost water circulation and never re-established. 18.5 - 19.5 ft: hard layer. 19.5 ft: water is draining out of borehole into formation.													35
	15														48
	20														72
	25		23.5												85
		LIMESTONE; tan with gray; fresh; wavy bedding; some massive zones; trace small to medium vugs.													
	30														71
	35														66
	40														54
		LIMESTONE; brown with gray; fresh; hard with few soft zones; faint wavy bedding; trace small to medium vugs.	41.0												
	45														84
	50														68
	55														71
	60														56
		Bottom of Boring at 60.0 feet	60.0												
	65														

Completion Depth:	60.0
Date Boring Started:	4/12/18
Date Boring Completed:	4/13/18
Logged By:	BAA / BWL
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4545425.5m, E:327878.9m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; ROCK CORE

WATER LEVELS (ft): At Time of Drilling; before coringDry

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-030

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

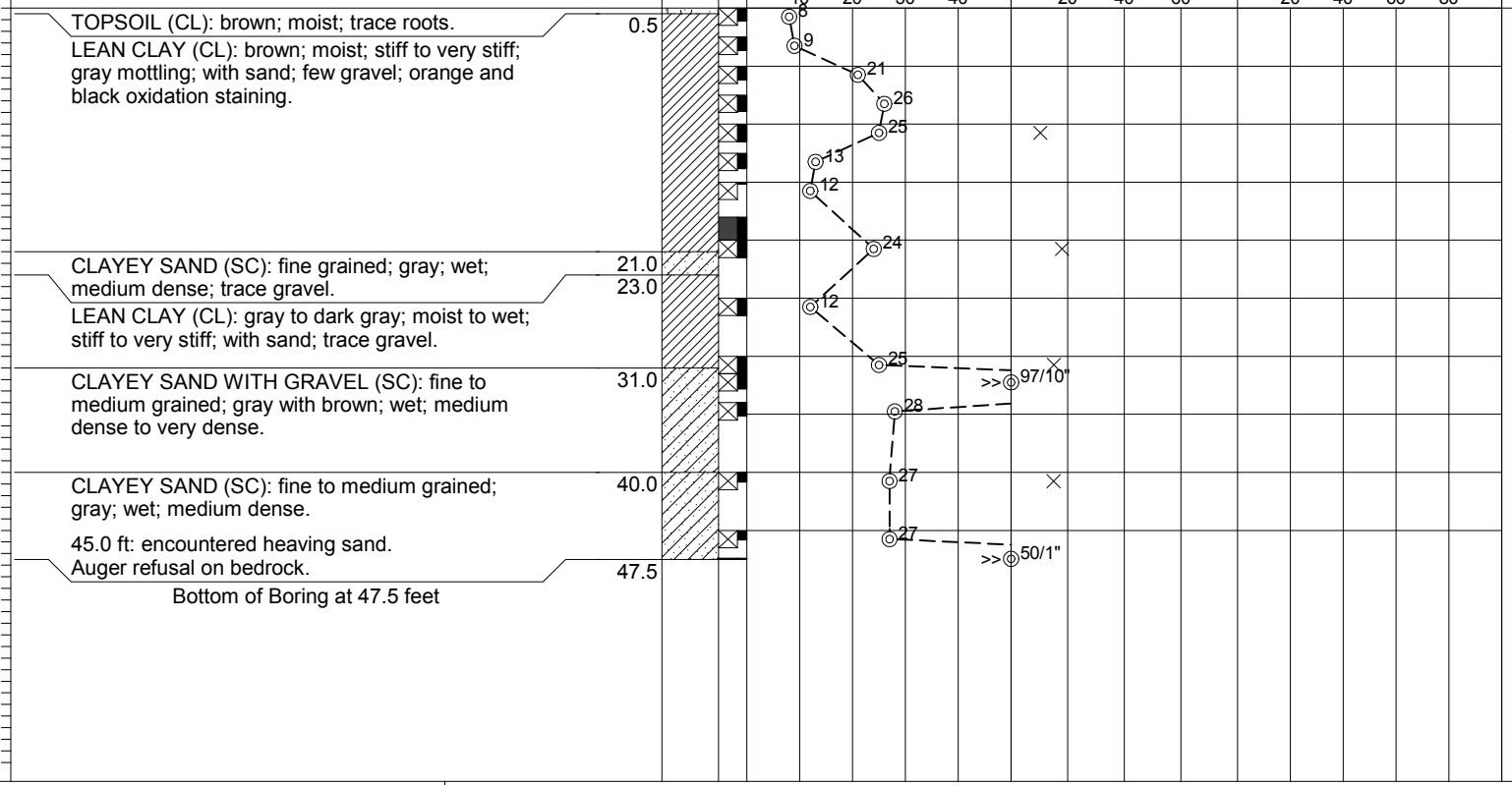
Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	
	0	TOPSOIL (CL): brown; moist; trace roots.	0.5
	5	LEAN CLAY (CL): brown; moist; stiff to very stiff; gray mottling; with sand; few gravel; orange and black oxidation staining.	
	10		
	15		
	20		
	25	CLAYEY SAND (SC): fine grained; gray; wet; medium dense; trace gravel.	21.0
		LEAN CLAY (CL): gray to dark gray; moist to wet; stiff to very stiff; with sand; trace gravel.	23.0
	30	CLAYEY SAND WITH GRAVEL (SC): fine to medium grained; gray with brown; wet; medium dense to very dense.	31.0
	35		
	40	CLAYEY SAND (SC): fine to medium grained; gray; wet; medium dense.	40.0
	45	45.0 ft: encountered heaving sand. Auger refusal on bedrock.	47.5
	50	Bottom of Boring at 47.5 feet	
	55		
	60		
	65		

Graphic Log | Sample Type & Rec.

STANDARD PENETRATION TEST DATA — N in blows/ft (10, 20, 30, 40)

WATER CONTENT % — PL, LL (20, 40, 60)

SIEVE ANALYSIS — GRAVEL, SAND, SILT, CLAY, FINES (20, 40, 60, 80)



Physical Properties

WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
10.3						
18						
15.1						
15		39.3				

Completion Depth:	47.5
Date Boring Started:	4/18/18
Date Boring Completed:	4/18/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4547428.1m, E:327749.1m
Datum:	NAD83

Remarks: Encountered heaving sand at 45 ft. Borehole offset 10 ft south and redrilled with a head of mud in augers.

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube

WATER LEVELS (ft): After Drilling 15.0; At Time of Drilling 21.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING GEO-031

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	Surface Elev.:								
0	TOPSOIL (CL): dark brown; moist; trace roots.	0.2							
5	LEAN CLAY (CL): brown; moist; stiff; little sand; little gravel.	5.0							
10	LEAN CLAY (CL): dark brown to brown; moist; stiff to very stiff; little sand; trace gravel.		16.6						
15	POORLY GRADED GRAVEL WITH SAND (GP): dark brown; moist; medium dense to very dense.	15.0	16.3						
25	LIMESTONE; tan to light gray; vuggy; clay infilled joints.	25.5	23.1						22
30	32.0 ft: 1/4-inch clay seam.		2.5	160.6		1280.9			43
35									62
40	37.5 ft: trace fossils.								68
45									47
50	50.0 ft: 1/4-inch coal seam.								93
55									73
60	Bottom of Boring at 60.0 feet	60.0							77
65									

Graphic Log / Sample Type & Rec. / STANDARD PENETRATION TEST DATA (N in blows/ft): 5, 10, 12, 20, 17, 18, 12, 11, >> 50/5"

WATER CONTENT %: PL, LL; 16, 29

SIEVE ANALYSIS: GRAVEL, SAND, SILT, CLAY, FINES

Completion Depth:	60.0
Date Boring Started:	4/14/18
Date Boring Completed:	4/14/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4545328.4m, E:329526.3m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; ROCK CORE

WATER LEVELS (ft): At Time of Drilling; before coringDry

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING GEO-033

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL – LL)	SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
Surface Elev.:	0	TOPSOIL (CL): brown; moist; trace roots.										3		
		0.2												
	5	LEAN CLAY (CL): brown; moist; stiff to hard; with sand; few gravel; gray mottling; black and orange oxidation staining.			6, 15, 19, 32							4.5, 4.5		
	10	LEAN CLAY (CL): gray to dark gray; moist to wet; medium stiff to stiff; with sand; few gravel.			18, 8			16.2				4.5, 3.5		
	15													
	20				8			16.8				2		
	25				9			16.9	114.9		2.1	2, 2.5		
	30	LEAN CLAY (CL): gray to dark gray; moist to wet; stiff to very stiff; with sand; few gravel.			12, 20			16.4				2, 3.5		
	35													
	40				15							4.5		
	45				14			16				3		
	50				16							3		
	55				17							3		
	60	60.5 ft: thin seam of wet fine sand.			14			23.7						
		61.5												
	65	Bottom of Boring at 61.5 feet												

Completion Depth:	61.5
Date Boring Started:	4/23/18
Date Boring Completed:	4/23/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4551644.0m, E:337479.1m
Datum:	NAD83

Remarks:

SAMPLE TYPES

SPLIT SPOON | 3-inch Shelby Tube

WATER LEVELS (ft)

End of Drilling 44.0

At Time of Drilling 60.5

LEGEND

MC Moisture Content
γ Dry Unit Weight
ϕ Friction Angle
Q_u Unconfined Compression
Q_p Hand Penetrometer UC
Gs Specific Gravity
RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING GEO-034

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Depth, feet	Material Description (ASTM D2488)	Graphic Log	Sample Type & Rec.	N in blows/ft	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
Surface Elev.:											
0	TOPSOIL (CL): brown; moist; trace roots. 0.2			5					2		
	LEAN CLAY (CL): brown; moist; very stiff; gray mottling; orange and black oxidation staining; with sand; few gravel.			18					4.5		
5				21					4.5		
				21	15.5				4.5		
10				21					4.5		
				9	16.2				3		
15	LEAN CLAY (CL): gray to dark gray; moist to wet; stiff; with sand; few gravel. 13.0										
				9	16.4				2		
20					16.1	111.3					
				13					2		
25				12					3		
				10	17.6				2.5		
30					15.8	117.3		3	4.5		
				14					4.5		
35				13					4		
	SILTY SAND (SM): fine grained; gray to dark gray; wet; medium dense. 46.0										
40	LEAN CLAY (CL): gray to dark gray; moist to wet; very stiff to hard; with sand; few gravel. 50.0			24	13.9				4.5		
				34					4.5		
45				37					4.5		
	Bottom of Boring at 61.5 feet 61.5										
50											
55											
60											
65											

WATER CONTENT %: PL, LL; 20 40 60

SIEVE ANALYSIS: GRAVEL SAND SILT CLAY FINES; 20 40 60 80

Completion Depth:	61.5
Date Boring Started:	4/23/18
Date Boring Completed:	4/23/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4551541.8m, E:337992.8m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube

WATER LEVELS (ft): End of Drilling 30.0; At Time of Drilling 20.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Barr Engineering Company
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-035

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL–LL)	SIEVE ANALYSIS (GRAVEL / SAND / SILT / CLAY / FINES)	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
0	TOPSOIL (CL): brown; moist; trace roots.	0.2	4, 19, 19, 26	18, 36						4.5		
5	LEAN CLAY (CL): brown; moist; very stiff; gray mottling; with sand; few gravel; orange and black oxidation staining.									4.5		
10	LEAN CLAY (CL): gray to dark gray; moist to wet; medium stiff to stiff; with sand; few gravel.	10.0	12, 10, 10			15.7				4.5		
15										3		
20			8, 11			17.8	112.8		2.2	2.5		
25						17.6				2		
30			8			17	114.9		2.8	2.5		
35			7							3		
40			12			17				2		
45			9							1.5		
50			11			17.5	114		2.3	2		
55	SILTY SAND (SM): fine grained; gray to dark gray; wet; medium dense; with gravel.	52.0	18							1.25		
60	LEAN CLAY (CL): dark gray; moist to wet; very stiff; with sand; occasional thin veins of sand.	58.0	20			16.4				3		
65	Bottom of Boring at 61.5 feet	61.5				16.5				3.5		

Completion Depth:	61.5
Date Boring Started:	5/2/18
Date Boring Completed:	5/2/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4550629.4m, E:338124.3m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube

WATER LEVELS (ft): End of Drilling 51.0; At Time of Drilling 25.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-036

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL – LL)	SIEVE ANALYSIS (GRAVEL / SAND / SILT / CLAY / FINES)	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
		Surface Elev.:												
	0	TOPSOIL (CL): brown; moist; trace roots.										2.5		
	0.5	LEAN CLAY (CL): grown; moist; very stiff; gray mottling; with sand; few gravel; orange and black oxidation staining.			5, 17, 20, 22, 24							3, 3, 4.5		
	10							16.3				4.5		
	12.5	LEAN CLAY (CL): gray to dark gray; moist to wet; medium stiff to hard; with sand; few gravel.			14, 8, 12							2.5, 2, 1		
	20													
	25				11		1.8 – 17.2 – 63.5	17.9				2		
	30				8							1.5		
	35				13			17.3	113.8		2.1	3, 2		
	40				12			17				2		
	45				12							2		
	50				12							2		
	55				40			7.2						
	60													
	61.5	Bottom of Boring at 61.5 feet												
	65													

Completion Depth:	61.5
Date Boring Started:	4/24/18
Date Boring Completed:	4/24/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4550103.1m, E:338202.1m
Datum:	NAD83

Remarks:

SAMPLE TYPES
- SPLIT SPOON
- 3-inch Shelby Tube

WATER LEVELS (ft)
- End of Drilling: Dry
- At Time of Drilling: 20.0

LEGEND
- MC Moisture Content
- γ Dry Unit Weight
- ϕ Friction Angle
- Q_u Unconfined Compression
- Q_p Hand Penetrometer UC
- Gs Specific Gravity
- RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Telephone: 952-832-2600

LOG OF BORING GEO-037

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
0	TOPSOIL (CL): brown; moist; trace roots.					2		
0.5	LEAN CLAY (CL): brown; moist; stiff to very stiff; gray mottling; with sand; few gravel; orange and black oxidation staining.					4.5		
5						4.5		
10		17.3				4.5		
15						4.5		
15.0	LEAN CLAY (CL): dark gray to gray; moist to wet; medium stiff to stiff; with sand; few gravel.	17	115		3.2	3.5		
20						3		
25		17				2.5		
30						1.75		
35		17.3	113.7		3	2		
40		17				3		
45						3		
50						1.5		
55		18.3						
55.0	POORLY GRADED SAND WITH SILT (SP-SM): fine grained; dark gray; wet; medium dense to dense; with gravel; heaving in augers; trace cobbles.							
60								
61.5	Bottom of Boring at 61.5 feet							
65								

STANDARD PENETRATION TEST DATA (N in blows/ft): 5, 17, 19, 17, 14, 13, 9, 15, 7, 8, 13, 10, 13, 11, 25, 41

WATER CONTENT % (PL – LL)

SIEVE ANALYSIS: GRAVEL, SAND, SILT, CLAY, FINES

Completion Depth:	61.5
Date Boring Started:	4/25/18
Date Boring Completed:	4/25/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4549927.6m, E:338928.3m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube

WATER LEVELS (ft): End of Drilling 37.0; At Time of Drilling 15.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING GEO-038

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL – LL)	SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)	Physical Properties WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
Surface Elev.:															
	0	TOPSOIL (CL): brown; moist; trace roots.	0.2			7							4.5		
	5	LEAN CLAY (CL): brown; moist; stiff to very stiff; gray mottling; with sand; few gravel; orange and black oxidation staining.				15, 18, 15							4.5		
	10					20			19.3				4.5		
	15	LEAN CLAY (CL): gray to dark gray; moist to wet; medium stiff to very stiff; with sand; few gravel.	12.5			6			17	115.5		2.2	1.5 4		
	20					9			17				2		
	25					8							1.5		
	30					7							1.5		
	35	36.5 ft: thin wet sand seam.				8			16.6				1.75		
	40					15							4.5		
	45					26			11.1				4.5		
	50					16							4.5		
	55	LEAN CLAY (CL): gray to dark gray; moist to wet; hard; trace sand; trace gravel.	55.0			>> 50/5.5"							4.5		
	60					>> 50/5"			7						
	65	Bottom of Boring at 61.5 feet	61.5												

Completion Depth:	61.5
Date Boring Started:	4/25/18
Date Boring Completed:	4/25/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4549899.6m, E:339979.5m
Datum:	NAD83

Remarks:

SAMPLE TYPES
- SPLIT SPOON
- 3-inch Shelby Tube

WATER LEVELS (ft)
- End of Drilling
- Dry
- At Time of Drilling 36.5

LEGEND
- MC Moisture Content
- γ Dry Unit Weight
- ϕ Friction Angle
- Q_u Unconfined Compression
- Q_p Hand Penetrometer UC
- Gs Specific Gravity
- RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Telephone: 952-832-2600

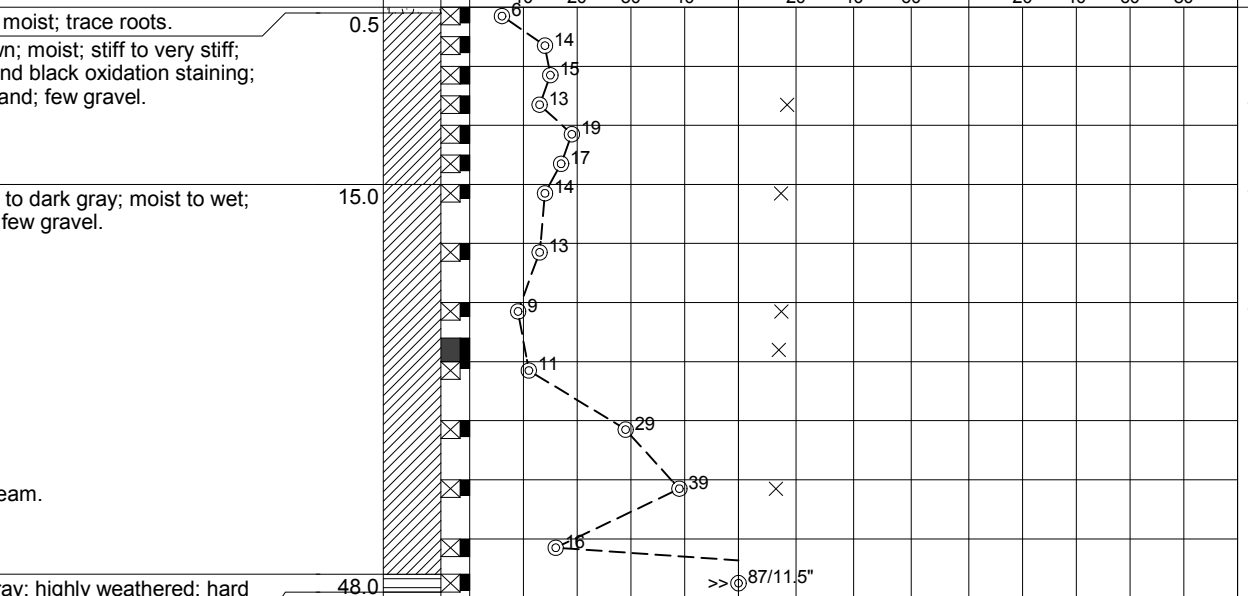
LOG OF BORING GEO-039

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	0	TOPSOIL (CL): brown; moist; trace roots.	0.5					3		
		LEAN CLAY (CL): brown; moist; stiff to very stiff; gray mottling; orange and black oxidation staining; white inclusions; with sand; few gravel.						4.5		
	5							4.5		
				16.9				4.5		
	10							4.5		
								4		
	15	LEAN CLAY (CL): gray to dark gray; moist to wet; stiff to hard; with sand; few gravel.	15.0	14.8				3.5		
								4.5		
	25			14.9				3.5		
				14	123.1		2.5	2		
	30							3.5		
	35							4.5		
	40	40.0 ft: thin wet sand seam.		13				4.5		
	45							4		
		SHALE; gray to dark gray; highly weathered; hard drilling; auger refusal.	48.0					4.5		
	50	Bottom of Boring at 48.0 feet	49.5							
	55									
	60									
	65									



Physical Properties

Completion Depth:	48.0
Date Boring Started:	4/28/18
Date Boring Completed:	4/28/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4554829.0m, E:339283.5m
Datum:	NAD83

Remarks:

SAMPLE TYPES

SPLIT SPOON | 3-inch Shelby Tube

WATER LEVELS (ft)

End of Drilling 32.0

At Time of Drilling 40.0

LEGEND

MC Moisture Content
γ Dry Unit Weight
ϕ Friction Angle
Q_u Unconfined Compression
Q_p Hand Penetrometer UC
Gs Specific Gravity
RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Barr Engineering Company
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Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-040

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
0	TOPSOIL (CL): brown to dark brown; moist; trace roots.					2.5		
0.5	LEAN CLAY (CL): brown; moist; stiff to very stiff; gray mottling; with sand; few gravel; orange and black oxidation staining.					4.5		
5						4.5		
10		16.5				4.5		
15						4.5		
15.0	LEAN CLAY (CL): gray to dark gray; moist to wet; medium stiff to very stiff; with sand; few gravel.	16				2		
20						1.75		
25		16.6	115.8		2.9	1.5		
		16.3				3		
30						3		
35		17.1				3		
40								
45	46.3 ft: thin wet sand seam.					2.5		
50		17.8						
55	SILTY SAND (SM): fine grained; gray to dark gray; wet; medium dense; heaving into borehole.							
55.0								
59.0	LEAN CLAY WITH GRAVEL (CL): gray with black; moist to wet; hard; strong sulfur odor; gravel is comprised of coal fragments.	11.2						
61.5								
65	Bottom of Boring at 61.5 feet							

STANDARD PENETRATION TEST DATA (N in blows/ft): 5, 15, 21, 17, 13, 17, 8, 8, 13, 11, 10, 12, 9, 32, 22, >>55

WATER CONTENT % (PL – LL)

SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)

Completion Depth:	61.5
Date Boring Started:	4/26/18
Date Boring Completed:	4/26/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4551698.0m, E:340823.8m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube

WATER LEVELS (ft): End of Drilling 35.0; At Time of Drilling 25.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Minneapolis, MN 55435
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LOG OF BORING GEO-041

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	0	TOPSOIL (CL): brown; moist; trace roots.	0.7					2.5		
		LEAN CLAY (CL): brown; moist; medium stiff to very stiff; gray mottling; with sand; few gravel; orange and black oxidation staining.						2.5		
	5							4.5		
				13.1				4.5		
	10							4.5		
								2.5		
	15	LEAN CLAY (CL): dark gray to gray; moist; medium stiff to stiff; with sand; few gravel.	12.5	17.5	114.3		2.6	2.5		
	20			17.4				2.5		
	25							2		
	30			17.1				2.5		
	35							2		
	40			15.8				2		
	45							2.5		
	50							3.5		
	55	LEAN CLAY (CL): dark gray to gray; moist to wet; very stiff; with sand; trace gravel. 56.3 ft: encountered thin wet sand seam.	53.5	14.6				1.5		
	60	Bottom of Boring at 61.5 feet	61.5							
	65									

STANDARD PENETRATION TEST DATA: N in blows/ft (10, 20, 30, 40)

WATER CONTENT %: PL — LL (20, 40, 60)

SIEVE ANALYSIS: GRAVEL, SAND, SILT, CLAY, FINES (20, 40, 60, 80)

Physical Properties

Completion Depth:	61.5
Date Boring Started:	4/26/18
Date Boring Completed:	4/26/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4548942.9m, E:341288.9m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube

WATER LEVELS (ft): Wet Cave-in Depth 43.0; End of Drilling 37.5; At Time of Drilling 56.3

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-042

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL – LL)	SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
		Surface Elev.:												
	0	TOPSOIL (CL): brown; moist; trace roots.										3.5		
	0.7	LEAN CLAY (CL): brown; moist; medium stiff to stiff; gray mottling; with sand; few gravel; orange and black oxidation staining.			7, 10, 9, 14, 13							4.5, 4.5		
	5													
	10				8			20.3				4.5, 4.5		
	12.0	LEAN CLAY (CL): gray to dark gray; moist to wet; medium stiff to very stiff; with sand; few gravel.			7							2.5, 1.5		
	15							17.1	114.5		2.2	2		
	20				8							2		
	25				7									
	30				6							2		
	35				6							1.5		
	40				8			18.3	112.3		1.8	2.5, 1.75		
	45	46.0 ft: with wet sand veins.			8							2		
	50				8							2		
	55				13			17.2				4.5		
	60				16							4.5		
	61.5	Bottom of Boring at 61.5 feet												
	65													

Completion Depth:	61.5
Date Boring Started:	5/8/18
Date Boring Completed:	5/8/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4548991.7m, E:344231.2m
Datum:	NAD83

Remarks:

SAMPLE TYPES

SPLIT SPOON | 3-inch Shelby Tube

WATER LEVELS (ft)

End of Drilling 38.0

At Time of Drilling 46.0

LEGEND

MC Moisture Content
γ Dry Unit Weight
ϕ Friction Angle
Q_u Unconfined Compression
Q_p Hand Penetrometer UC
Gs Specific Gravity
RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-043

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL, LL)	SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)	Physical Properties WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
0	0	TOPSOIL (CL): brown; moist; trace roots.	0.5			6							2		
		LEAN CLAY (CL): brown; moist; stiff to very stiff; gray mottling; with sand; trace gravel; black and orange oxidation staining.				17, 19, 20, 17, 15, 14	16, 32	2.1, 20.7, 64.7	15.4				4.5		
20	20	LEAN CLAY (CL): gray to dark gray; moist to wet; medium stiff to very stiff; with sand; few gravel.	20.0			11, 8, 8, 8, 9, 9, 8			13				4.5		
									17.9				2		
									18.6	112.2		2	3		
									18.8				1.25		
									17.3				3		
55	55	LEAN CLAY (CL): gray to dark gray; moist to wet; hard; with sand; few gravel.	57.0			17, 42							2.75		
		61.0 ft: encountered fine wet sand seam.											1.25		
60	60	Bottom of Boring at 61.5 feet	61.5										4.5		
65	65														

Completion Depth:	61.5
Date Boring Started:	4/29/18
Date Boring Completed:	4/29/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4548203.7m, E:343986.5m
Datum:	NAD83

Remarks:

SAMPLE TYPES

SPLIT SPOON; 3-inch Shelby Tube

WATER LEVELS (ft)

End of Drilling	54.0
At Time of Drilling	55.0

LEGEND

MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Barr Engineering Company
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-044

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL – LL)	SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)	Physical Properties WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
		Surface Elev.:													
	0	TOPSOIL (CL): brown; moist; trace roots.	0.5			6							3		
	5	LEAN CLAY (CL): brown; moist to wet; stiff to very stiff; gray mottling; with sand; few gravel; orange and black oxidation staining.				14, 19, 22							4.5, 4.5		
	10					18, 17			15.1, 15.9				4.5, 4.5		
	15	13.5 ft: 4-inch wet sand seam. 15.0 ft: thin wet fine sand seams.				13							4		
	20	LEAN CLAY (CL): gray to dark gray; moist to wet; stiff; with sand; few gravel.	20.0			10			17.7				2.5		
	25					11			17.7	113.8		2.8	2		
	30					10							2.5, 2		
	35					9			18.5				2.5		
	40					13							3		
	45	LEAN CLAY (CL): gray to dark gray; moist to wet; stiff to hard; with sand; few gravel.	45.0			18			16.7						
	50	50.0 ft: thin wet sand seam.				15							3.5		
	55					20							4.5		
	60					42			10.5				4.5		
		Bottom of Boring at 61.5 feet	61.5												
	65														

Completion Depth:	61.5
Date Boring Started:	4/29/18
Date Boring Completed:	4/29/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4548181.0m, E:344107.0m
Datum:	NAD83

Remarks:

SAMPLE TYPES

SPLIT SPOON | 3-inch Shelby Tube

WATER LEVELS (ft)

End of Drilling 55.0

At Time of Drilling 12.5

LEGEND

MC Moisture Content
γ Dry Unit Weight
ϕ Friction Angle
Q_u Unconfined Compression
Q_p Hand Penetrometer UC
Gs Specific Gravity
RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-045

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL — LL)	SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)	Physical Properties: WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	0	Surface Elev.:												
		TOPSOIL (CL): brown; moist; trace roots.										0.5		
	5	LIMESTONE: brown; moist; medium stiff to stiff; trace sand; trace gravel; orange and black oxidation staining.			4, 7, 13							0.75		
		0.5												
	10	SILTY SAND (SM): fine to coarse grained; light gray; moist; dense to very dense; with gravel; highly weathered limestone.			48, 51, 50/2"			19.6				4		
		7.8												
	15													
	20	LIMESTONE; light gray; very hard; faint wavy bedding; occasional dark gray laminations.												59
	25	27.0 ft: crystalline matrix.												39
		17.5												77
	30													78
	35	37.0 ft: some larger vugs (1/2-inch).												99
	40													73
	45													90
	50													45
	55													68
	60	LIMESTONE; light gray; lost water circulation to surface and never re-established; some brecciated zones; occasional slickensided fractures.												
		57.0												
		60.0												
	65	Bottom of Boring at 60.0 feet												

Completion Depth:	60.0
Date Boring Started:	4/4/18
Date Boring Completed:	4/5/18
Logged By:	BWL
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4542927.6m, E:326484.0m
Datum:	NAD83

Remarks: Several small sinkholes 1-5 ft diameter and 1-2 feet deep observed 300 feet southeast of boring location in waterway.

SAMPLE TYPES

SPLIT SPOON | ROCK CORE

WATER LEVELS (ft)

At Time of Drilling 8.0

14 hrs After Drilling 2.0

LEGEND

MC Moisture Content
γ Dry Unit Weight
ϕ Friction Angle
Q_u Unconfined Compression
Q_p Hand Penetrometer UC
Gs Specific Gravity
RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Barr Engineering Company
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Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-047

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/ft	WATER CONTENT % PL LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
		Surface Elev.:												
	0	TOPSOIL (CL): brown; moist; roots.			4							3		
		0.5			6							4.5		
	5	LEAN CLAY (CL): brown; moist; medium stiff; with iron and manganese oxidation; gray mottling; trace sand.			6							1.5		
		4.5			5							1		
	10	CLAYEY SAND (SC): fine to medium grained; brown; wet; very loose to loose; orange oxidation; few gravel; occasional clay seams.			4			22.3	93.3		1.3	2.5		
	15				3									
	20				>> 50/1"			13.8						0
		LIMESTONE; light brownish gray; fresh fractures; crystalline inclusions; occasional thin wavy black laminations; occasional small vugs.												7
		20.5												
	25													
	30	LIMESTONE; gray; occasional calcite seams; trace pyrite. 32.0 - 33.0 ft: large concentration of vugs.												57
		28.0												36
	35													
	40													47
		LIMESTONE; brown and gray; massive; soft to hard; occasional thin wavy black laminations. 43.0 - 44.0 ft: lost water circulation to surface. 44.0 - 58.0 ft: limited water circulation to surface. 49.0 - 54.0 ft: several zones with vugs up to 1 cm.												52
	45													
	50													73
	55													39
	60	58.0 - 59.0 ft: very vuggy; void observed; lost water circulation to surface and never re-established.												19
		61.0												
	65	Bottom of Boring at 61.0 feet												

Completion Depth:	61.0
Date Boring Started:	4/6/18
Date Boring Completed:	4/7/18
Logged By:	DJZ / BWL
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4542157.5m, E:324459.5m
Datum:	NAD83

Remarks:

SAMPLE TYPES

SPLIT SPOON | 3-inch Shelby Tube | ROCK CORE

WATER LEVELS (ft)

At Time of Drilling	4.5
After Drilling	20.0
10 hrs After Drilling	15.0

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-048

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Depth, feet	Material Description (ASTM D2488)	Elevation, feet
0	Surface Elev.:	
0	TOPSOIL (CL): brown; moist; roots.	
1.0	LEAN CLAY (CL): brown with gray mottling; moist; soft to medium stiff; few sand; orange oxidation; black oxidation staining.	
6.0	CLAYEY SAND (SC): fine grained; dark brown with gray; wet; medium dense; grades to clay in a few zones.	
12.0	POORLY GRADED SAND WITH CLAY (SP-SC): fine to coarse grained; dark brown to gray; moist to wet; loose to dense; few to little gravel; occasional clay seams.	
22.0	LIMESTONE; light tan to brown with gray; occasional small vugs; faint black laminations; hard; no water circulation to surface.	
	35.0 ft: few 1 to 2-inch voids observed. 36.5 -37.5 ft: very vuggy.	
43.0	LIMESTONE; gray with tan; fresh; massive; calcite filled vugs; highly vuggy; faint laminations.	
	57.5 ft: 6-inch void observed.	
60.0	Bottom of Boring at 60.0 feet	

Graphic Log | Sample Type & Rec. | STANDARD PENETRATION TEST DATA (N in blows/ft) | WATER CONTENT % (PL – LL) | SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)

Depth, feet	N in blows/ft	WC %	Qp tsf	RQD %
5	5, 7, 3		1.5, 4	
15	13, 17, 32, 29			
20	10, >> 50/0.5"			
25				38
30				55
35				52
40				10
45				0
50				11
55				44
60				0

Physical Properties: WC %, γ_d pcf, ϕ °, Q_u tsf, Q_p tsf, Gs, RQD %

Completion Depth:	60.0
Date Boring Started:	4/7/18
Date Boring Completed:	4/8/18
Logged By:	DJZ / BWL
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4542147.8m, E:324163.3m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube; ROCK CORE

WATER LEVELS (ft): At Time of Drilling 6.0; After Drilling 15.5; 12 hrs After Drilling 17.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Barr Engineering Company
4300 MarketPointe Drive Suite 200
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Telephone: 952-832-2600

LOG OF BORING GEO-049

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL — LL)	SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)	Physical Properties: WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	0	Surface Elev.:													
		SANDY LEAN CLAY (CL): brown; moist.				6, 15, >>50/4"									
	5	SILTY SAND (SM): fine grained; light gray; moist; medium dense.	2.7 4.8												0
	10	LIMESTONE; light gray with tan; fresh; hard; faint bedding; trace small vugs.													39
	15														63
	20														76
	25														46
	30														24
	35														35
	40	LIMESTONE; light tan with gray; fresh; occasional vugs along fractures; faint laminations.	36.0												66
	45														47
	50														44
	55														43
	60	BRECCIA; light brown to gray; fresh; trace medium sized vugs; very hard.	58.0 60.0												86
	65	Bottom of Boring at 60.0 feet													

Completion Depth:	60.0
Date Boring Started:	4/9/18
Date Boring Completed:	4/10/18
Logged By:	BAA / BWL
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4544539.9m, E:326421.6m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; ROCK CORE

WATER LEVELS (ft): At Time of Drilling 5.0; 12 hrs After Drilling 5.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Barr Engineering Company
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-050

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	0	TOPSOIL (CL): brown; moist; trace roots.	0.5					4.5		
	5	LEAN CLAY (CL): brown; moist to wet; stiff to very stiff; trace to few sand; with gray mottling; with trace gravel. 3.0 ft: crystalline gravel. 10.0 ft: color transitions to gray.						4.5		
	10							4.5		
	10							4.5		
	10			17.9	115.6		2.7	4		0
	15	LIMESTONE; gray with gray; intensely fractured; horizontal bedding; occasional brecciated zones.	11.5							17
	20	LIMESTONE; brown with gray; very hard; some faint bedding; occasional faint wavy laminations.	18.0							0
	25									35
	30									57
	35									50
	40	LIMESTONE; light brown; vuggy; with siltstone seams.	36.5							76
	45	SILTSTONE; light gray with tan and brown; occasional vuggy zones; very hard; occasional brecciated zones.	43.0							63
	50									69
	55									67
	60	Bottom of Boring at 60.0 feet	60.0							66
	65									

STANDARD PENETRATION TEST DATA: N in blows/ft (10, 20, 30, 40); 5, 14, 21, 21, 12, >>50/1"

WATER CONTENT %: PL — LL (20, 40, 60)

SIEVE ANALYSIS: GRAVEL, SAND, SILT, CLAY, FINES (20, 40, 60, 80)

Completion Depth:	60.0
Date Boring Started:	4/5/18
Date Boring Completed:	4/6/18
Logged By:	DJZ / BWL
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4544111.4m, E:325884.5m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; ROCK CORE

WATER LEVELS (ft): At Time of Drilling 7.8; After Drilling 8.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING GEO-051

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	
	0	TOPSOIL (CL): brown; moist; trace roots.	0.5
	5	LEAN CLAY (CL): brown; moist to wet; stiff to very stiff; gray mottling; orange and black oxidation staining; few to little sand; trace to few gravel.	
	10		
	15	CLAYEY SAND (SC): fine to coarse grained; brown; wet; loose to dense; few gravel.	12.0
	20	20.0 ft: increase in gravel and stone fragments.	
	25	LIMESTONE; light gray and brown; very hard; vuggy.	24.0
	30	LIMESTONE; gray to dark gray with brown; very hard.	30.3
	35		
	40	39.0 - 45.0 ft: frequent brecciated zones.	
	45	45.0 ft: 2-inch void observed with tooling drop - no lost water circulation to surface.	
	50	50.7 - 54.0 ft: light gray.	
	55	LIMESTONE; light gray to light brown; massive; vuggy; faint laminations.	54.0
	60		
	65	Bottom of Boring at 62.0 feet	62.0

Graphic Log | Sample Type & Rec.

STANDARD PENETRATION TEST DATA — N in blows/ft (10, 20, 30, 40)

WATER CONTENT % — PL, LL (20, 40, 60)

SIEVE ANALYSIS — GRAVEL, SAND, SILT, CLAY, FINES (20, 40, 60, 80)

Physical Properties	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
					4.5		
					4.5		
					4.5		
					4.5		
	16.3				4.5		
	14.7						36
							34
							34
							62
							62
							59
							83
							69

Completion Depth:	62.0
Date Boring Started:	4/5/18
Date Boring Completed:	4/5/18
Logged By:	DJZ / BWL
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4543626.0m, E:325869.2m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; ROCK CORE

WATER LEVELS (ft): At Time of Drilling 12.5; After Drilling 8.5

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Barr Engineering Company
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-052

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL – LL)	SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)	Physical Properties: WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
		Surface Elev.:												
	0	TOPSOIL (CL): brown; moist; trace roots.			4							2		
	0.7	LEAN CLAY (CL): brown; moist; stiff to very stiff; gray mottling; with sand; few gravel; orange and black oxidation staining.			9							2		
	5				19							4.5		
					20							4.5		
	10				13							4.5		
	10.0	LEAN CLAY (CL): gray to dark gray; moist; medium stiff to stiff; with sand; few gravel.			13			14.4				4.5		
					12							4		
	15													
	20				6							1.5		
								17.3	114		2.3	1.5		
	25				7							1.5		
	30				6							1.5		
	35				7			19.3				1.5		
												4		
	40				8							2		
	45				7							2		
	50				9							2.5		
	55				6			19				1.5		
	60				14									
	61.5	Bottom of Boring at 61.5 feet												
	65													

Completion Depth:	61.5
Date Boring Started:	5/8/18
Date Boring Completed:	5/8/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4548866.6m, E:343529.1m
Datum:	NAD83

Remarks:

SAMPLE TYPES
- SPLIT SPOON
- 3-inch Shelby Tube

WATER LEVELS (ft)
- End of Drilling: Dry
- At Time of Drilling: Dry

LEGEND
- MC Moisture Content
- γ Dry Unit Weight
- ϕ Friction Angle
- Q_u Unconfined Compression
- Q_p Hand Penetrometer UC
- Gs Specific Gravity
- RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Barr Engineering Company
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Telephone: 952-832-2600

LOG OF BORING GEO-053

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL–LL)	SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)	Physical Properties: WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	0	TOPSOIL (CL): dark brown; moist; trace roots.												
	0.5	LEAN CLAY (CL): brown; moist.												
	2.5	LEAN CLAY (CL): dark brown; moist; stiff to hard; few thin silt partings; gray mottling. 11.0 ft: color transitions to gray.			4, 11, 14, 25, >>51			17	114.6		4.9			
	15.0	SILTY SAND (SM): fine grained; gray; moist; medium dense; occasional brown zones; with gravel.			27, 15, 8			4.9						
	25.0	POORLY GRADED SAND (SP): medium to coarse grained; gray and black; wet; loose to medium dense; few to some gravel.			13, 12, 10, 16			18.5						
	35.0	LEAN CLAY (CL): gray; moist to wet; stiff to very stiff; trace sand; trace gravel. 40.5 ft: 1-inch thick sand seam.			38, 34, >>60			14	122.3		3.2			
	50.0	POORLY GRADED SAND (SP): fine grained; gray; moist to wet; dense; trace gravel; trace cobbles.						14.4						
	55.0	CLAYEY GRAVEL (GC): gray; wet; dense; with sand.						9.5						
	58.0	WEATHERED LIMESTONE: gray; wet; dense.												
	61.5	Bottom of Boring at 61.5 feet												

Completion Depth:	61.5
Date Boring Started:	4/10/18
Date Boring Completed:	4/10/18
Logged By:	BAA
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4544801.8m, E:319596.9m
Datum:	NAD83

Remarks:

SAMPLE TYPES

SPLIT SPOON; 3-inch Shelby Tube

WATER LEVELS (ft)

At Time of Drilling 25.0

After Drilling 17.5

LEGEND

MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Barr Engineering Company
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-056

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Elevation, feet
0	TOPSOIL (CL): brown; moist; trace roots.	0.5
5	LEAN CLAY (CL): brown; moist; stiff to very stiff; gray mottling; with sand; few gravel; orange and black oxidation staining.	
10	LEAN CLAY (CL): gray to dark gray; moist to wet; medium stiff to stiff; with sand; few gravel. 12.0 - 14.0 ft: with frequent fine sand seams.	10.0
15		
20		
25		
30		
35	35.5 ft: thin wet sand seam.	
40		
45	45.0 ft: heaving sand and gravel in augers.	
50	LEAN CLAY (CL): gray to dark gray; moist to wet; stiff to very stiff; with sand; few gravel.	50.0
55		
60	Bottom of Boring at 61.5 feet	61.5
65		

Graphic Log | Sample Type & Rec.

STANDARD PENETRATION TEST DATA — N in blows/ft (10 20 30 40)

WATER CONTENT % — PL, LL (20 40 60)

SIEVE ANALYSIS — GRAVEL, SAND, SILT, CLAY, FINES (20 40 60 80)

Physical Properties	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
					3		
					4.5		
					4.5		
	16.6				4.5		
					4		
					4.5		
	16.5				3		
	17.1	115.4		2.9	1.5		
					1.5		
	17.4				1		
					0.5		
					2		
					0.5		
	16.7	116.9		1.7	1.5		
	16.2				2.5		
					4.5		
					4.5		

Completion Depth:	61.5
Date Boring Started:	4/25/18
Date Boring Completed:	4/25/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4550364.6m, E:339674.3m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube

WATER LEVELS (ft): End of Drilling 50.0; At Time of Drilling 35.5

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-059

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL – LL)	SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
0	TOPSOIL (CL): brown; moist; with sand; trace roots.			2							4		
1.0	LEAN CLAY (CL): brown; moist; stiff to very stiff; gray mottling; with sand; few gravel; orange and black oxidation staining.			11, 19, 17, 21, 19							4.5, 4.5, 4.5		
14.0	LEAN CLAY (CL): gray to dark gray; moist; stiff; with sand; few gravel.			9, 11, 12, 12, 14			17.2, 17, 12.6, 13.5	115.3		3.5	4.5, 3, 4.5, 4.5, 4		
40.0	LEAN CLAY (CL): gray; moist to wet; medium stiff to stiff; with sand; few gravel.			9, 6			18, 14.8	119.9		4	1.5, 2.5, 1.5		
	56.0 ft: 2-inch seam of wet sand.			9			12.7				3.5		
	60.5 ft: 6-inch seam of wet sand.			5							1.5		
61.5	Bottom of Boring at 61.5 feet												

Completion Depth:	61.5
Date Boring Started:	4/27/18
Date Boring Completed:	4/27/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4547019.2m, E:345658.2m
Datum:	NAD83

Remarks:

SAMPLE TYPES
- SPLIT SPOON
- 3-inch Shelby Tube

WATER LEVELS (ft)
- End of Drilling: Dry
- At Time of Drilling: 40.0

LEGEND
- MC Moisture Content
- γ Dry Unit Weight
- ϕ Friction Angle
- Q_u Unconfined Compression
- Q_p Hand Penetrometer UC
- Gs Specific Gravity
- RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-060

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	
	0	Surface Elev.:	
		LEAN CLAY (CL): brown; moist; few to little sand.	
	5	LEAN CLAY (CL): brown with gray mottling; moist to wet; medium stiff to hard; some sand; trace gravel.	3.0
	10	7.5 ft: fractured rock fragments.	9.0
	15	LIMESTONE; tan with gray; fresh; very hard; trace occasional vugs; faint bedding; weathered joints with slight dissolution.	
	20		
	25	23.5 - 24.5 ft: several vuggy zones.	
	30		
	35	LIMESTONE; light gray with tan; massive; occasional faint bedding; few thin brecciated zones; rough joints; trace vugs.	33.0
	40	34.6 ft: trace pyrite.	
	45		
	50	51.0 - 55.0 ft: some small vuggy zones.	
	55		
	60	58.0 - 61.0 ft: observed several 2 to 3-inch voids.	
		Bottom of Boring at 61.0 feet	61.0
	65		

Graphic Log | Sample Type & Rec.

STANDARD PENETRATION TEST DATA — N in blows/ft: 10 20 30 40 — 4, 5, 14, >>52

WATER CONTENT % — PL — LL: 20 40 60

SIEVE ANALYSIS — GRAVEL SAND SILT CLAY FINES: 20 40 60 80

Physical Properties	WC	γ_d	ϕ	Q_u	Q_p	Gs	RQD
	%	pcf	°	tsf	tsf		%
					2.5		
					1		
							52
							55
							29
							43
							48
							45
							83
							68
							65
							59
							25

Completion Depth:	61.0
Date Boring Started:	4/5/18
Date Boring Completed:	4/7/18
Logged By:	DJZ / BWL
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4543949.2m, E:325266.8m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; ROCK CORE

WATER LEVELS (ft): At Time of Drilling 3.0; After Drilling 14.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Telephone: 952-832-2600

LOG OF BORING GEO-061

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL – LL)	SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
0	TOPSOIL (CL): dark brown; moist; trace roots.		3							2		
0.5	LEAN CLAY (CL): brown; moist; stiff to very stiff; gray mottling; with sand; few gravel; orange and black oxidation staining.		17							4.5		
5			22							4.5		
			23							4.5		
10			22			15.9				4.5		
			17							4.5		
15			14							4		
17.5	LEAN CLAY (CL): gray to dark gray; moist; stiff to very stiff; with sand; few gravel.		17			14.8						
20			17									
25			13			14.1						
30			18							4.5		
35			22							2		
40	40.0 ft: few fine sand seams.		19			12.4				4.5		
45			>> 50/2"									
50	Auger refusal on bedrock.											
51.5	Bottom of Boring at 51.5 feet											
55												
60												
65												

Completion Depth:	51.5
Date Boring Started:	4/21/18
Date Boring Completed:	4/21/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4553223.6m, E:336017.9m
Datum:	NAD83

Remarks:

SAMPLE TYPES
- SPLIT SPOON

WATER LEVELS (ft)
- End of Drilling: Dry
- At Time of Drilling: Dry

LEGEND
- MC Moisture Content
- γ Dry Unit Weight
- ϕ Friction Angle
- Q_u Unconfined Compression
- Q_p Hand Penetrometer UC
- Gs Specific Gravity
- RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING GEO-062

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	
0	TOPSOIL (CL): brown; moist; trace roots.	0.5
5	LEAN CLAY (CL): brown; moist; stiff to very stiff; with sand; gray mottling; few gravel; orange and black oxidation staining.	
20		
25	LEAN CLAY (CL): gray to dark gray; moist to wet; stiff to very stiff; with sand; few gravel.	22.5
40		
50	LEAN CLAY (CL): gray to dark gray; moist to wet; very stiff; with sand; few gravel.	50.0
60	Bottom of Boring at 61.5 feet	61.5
65		

Graphic Log | Sample Type & Rec. | STANDARD PENETRATION TEST DATA (N in blows/ft)

Depth, feet	N in blows/ft
0	7
5	20
10	27, 28
15	23, 23, 23
20	15
25	12
30	12, 16
35	10
40	14
50	30
55	26
60	27

WATER CONTENT % (PL — LL)

SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)

Physical Properties

Depth, feet	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
0					4.5		
5					4.5		
10	15				4.5		
15	15.2				4.5		
20					4.5		
25					4.5		
30					4.5		
35	16.8				2		
40					2		
50					3		
55	14.6				1		
60					4		
65	15.6				4.5		

Completion Depth:	61.5
Date Boring Started:	5/1/18
Date Boring Completed:	5/1/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4548686.1m, E:328618.5m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON

WATER LEVELS (ft): End of Drilling 41.0; At Time of Drilling 22.5

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING GEO-063

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		N in blows/ft	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
0	TOPSOIL (CL): brown; moist; trace roots.	0.5	4					1		
	LEAN CLAY (CL): brown; moist; stiff to very stiff; with sand; few gravel; gray mottling; orange and black oxidation staining.		12					4.5		
5			20					4.5		
			24					4.5		
10			18	17.4				4.5		
			15					4.5		
15			13					4.5		
20	LEAN CLAY (CL): gray to dark gray; moist; stiff; with sand; few gravel.	20.0	9	17.3				2.5		
			11	16.6	115.6		2.7	2.5		
25								2		
30			10					2.5		
35			14	15.8				4.5		
40			12					4.5		
45	CLAYEY SAND (SC): fine grained; gray; wet; heaving into augers- added water to control heave.	44.0 45.0	7					2		
50	SILTY LEAN CLAY (CL-ML): gray; moist; medium stiff; with sand; like playdoh.	48.5	33	13.4				4.5		
55	LEAN CLAY (CL): gray to dark gray; moist to wet; very stiff to hard; with sand; few gravel.		23					4		
60			36					4.5		
	Bottom of Boring at 61.5 feet	61.5								
65										

Completion Depth:	61.5
Date Boring Started:	4/22/18
Date Boring Completed:	4/22/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4552372.8m, E:337543.9m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube

WATER LEVELS (ft): End of Drilling 37.0; At Time of Drilling 44.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-066

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL — LL)	SIEVE ANALYSIS (GRAVEL / SAND / SILT / CLAY / FINES)	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	0	Surface Elev.:												
		LEAN CLAY (CL): brown; moist; medium stiff; gray mottling.			8									
	5	SILTY SAND (SM): light brown to gray; moist; very dense; weathered limestone. (1.6 – 2.2)			>> 50/5"									0
	10	LIMESTONE; gray with brown and tan; fresh; massive; calcite infill and staining in some fractures; few to no vugs; faint bedding.												0
	15	12.0 ft: vuggy zone.												23
	20													8
	25													7
	30	30.0 ft: few small voids observed.												50
	35	32.0 - 42.5 ft: vuggy; limited recovery in core barrel.												15
	40													7
	45	42.5 ft: 0.2-ft thick clay seam.												15
	50													39
	55	LIMESTONE; tan with brown and gray; fresh; vuggy. (55.0)												24
	60	57.5 ft: small void observed. (60.0)												13
		Bottom of Boring at 60.0 feet												
	65													

Completion Depth:	60.0
Date Boring Started:	4/9/18
Date Boring Completed:	4/9/18
Logged By:	BAA / BWL
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4543617.4m, E:324704.8m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; ROCK CORE

WATER LEVELS (ft): End of Drilling — Dry; At Time of Drilling — Dry; 40 hrs After Drilling after coring — 4.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-068

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Depth, feet
	0	Surface Elev.:	
	0	CLAYEY TO SILTY SAND (SC-SM): brown; moist; trace roots.	2.4
	5	CLAYEY SAND (SC): fine grained; brown; moist; loose; lenses of lean clay and poorly graded sand; gray mottling.	5.0 / 6.5
	10	SANDY LEAN CLAY (CL): brown; moist; medium stiff; with lenses of clayey sand; trace sand.	12.7
	15	SILTY SAND WITH GRAVEL (SM): fine grained; light gray; moist; very dense; weathered limestone.	
	20	LIMESTONE; light brown with gray; fresh; trace pyrite; faint bedding; trace small vugs throughout.	
	25		
	30		
	35		
	40	41.5 ft: wavy bedding and brecciated zones.	
	45		
	50	LIMESTONE; dark gray; slightly weathered.	49.5
	55	LIMESTONE; light brown; fresh; massive; trace vugs; some black veinlets.	52.0
	60	Bottom of Boring at 60.5 feet	60.5
	65		

Graphic Log | Sample Type & Rec.

STANDARD PENETRATION TEST DATA — N in blows/ft (10 20 30 40)
4
5
6
>>60
>>54
>>50/3"

WATER CONTENT % — PL ×—— LL (20 40 60)

SIEVE ANALYSIS — GRAVEL SAND SILT CLAY / FINES (20 40 60 80)

Physical Properties

WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
17.6						
						69
						55
						93
						57
						89
						78
						34
						23
						39
						55

Completion Depth:	60.5
Date Boring Started:	4/9/18
Date Boring Completed:	4/10/18
Logged By:	BAA / BWL
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4544367.3m, E:326870.1m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; ROCK CORE

WATER LEVELS (ft)

At Time of Drilling	6.5
After Drilling	7.5
12 hrs After Drilling	4.8

LEGEND

MC Moisture Content	Q_u Unconfined Compression
γ Dry Unit Weight	Q_p Hand Penetrometer UC
ϕ Friction Angle	Gs Specific Gravity
	RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-069

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	
Surface Elev.:		
0	TOPSOIL (CL): brown; moist; trace roots.	0.5
5	LEAN CLAY (CL): brown; moist; medium stiff to very stiff; little sand; trace gravel.	
15	LEAN CLAY (CL): gray; moist to wet; very stiff; little gravel.	15.0
20	POORLY GRADED SAND WITH SILT (SP-SM): fine grained; brown; wet; medium dense.	20.0
25	POORLY GRADED SAND WITH SILT (SP-SM): fine grained; brown; wet; very dense; highly weathered limestone.	23.5 / 26.4
30	LIMESTONE; tan to gray; occasional black laminations; intensely fractured to 35.0 ft.	
40	37.5 ft: some clay infilling in vugs.	
60	Bottom of Boring at 60.0 feet	60.0

STANDARD PENETRATION TEST DATA (N in blows/ft): 4, 7, 11, 19, 16, 24, 14, >> 80/11"

WATER CONTENT % (PL – LL)

SIEVE ANALYSIS: GRAVEL, SAND, SILT, CLAY, FINES

Depth, feet	WC %	RQD %
10	18.8	
20	14.5	
30		32
35		37
40		40
45		43
50		85
55		80
60		97

Completion Depth:	60.0
Date Boring Started:	4/16/18
Date Boring Completed:	4/16/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4546020.7m, E:329629.2m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; ROCK CORE

WATER LEVELS (ft): End of Drilling 18.7; At Time of Drilling 18.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Barr Engineering Company
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Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-070

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL – LL)	SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
		Surface Elev.:													
	0	TOPSOIL (CL): brown; moist; trace roots.	0.2			4							2.25		
	5	LEAN CLAY (CL): brown; moist; stiff to very stiff; trace gravel; with sand.				14, 16, 18							4.5		
	10					14, 16			16.4				4.5		
	15					13			19.9				4.5		
	20	LEAN CLAY (CL): gray to dark gray; moist; medium stiff to stiff; with sand; trace gravel.	20.0			7							1.75		
	25								17	115.2		2.2	2.5		
	30					8			17.7				0.75		
	35					9							0.5		
	40	LIMESTONE; tan with light gray; fresh; vuggy; clay infilled fractures.	41.0			>> 67/10"									25
	45														8
	50														48
	55														51
	60	Bottom of Boring at 60.5 feet	60.5												92
	65														

Completion Depth:	60.5
Date Boring Started:	4/21/18
Date Boring Completed:	4/21/18
Logged By:	IGM / DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4547759.0m, E:328810.0m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube; ROCK CORE

WATER LEVELS (ft): After Drilling before coring 32.0; At Time of Drilling Dry

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Barr Engineering Company
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-071

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
0	TOPSOIL (CL): brown; moist; trace roots.	0.5					2		
0	LEAN CLAY (CL): brown; moist; very stiff; gray mottling; with sand; few gravel; orange and black oxidation staining.						4.5		
5							4.5		
10							4.5		
10			16.8				4.5		
10							2.5		
15	LEAN CLAY (CL): gray to dark gray; moist to wet; medium stiff to very stiff; with sand; few gravel.	12.5	16.4	116.3		2.6	2.5		
20			17.1				3		
20							3.5		
25							3.5		
30	31.0 ft: 2-inch wet sand seam.						3.5		
35	35.0 ft: increase in sand content.		14				2.5		
40							4.5		
45	LEAN CLAY (CL): gray to dark gray; moist to wet; very soft to hard; with sand; few gravel.	45.0	14.1				3.5		
50							3.5		
55							3.5		
60	Bottom of Boring at 61.5 feet	61.5	14				4.5		
65									

STANDARD PENETRATION TEST DATA — N in blows/ft: 3, 19, 19, 21, 24, 11, 9, 24, 13, 8, 19, 22, 22, 15, 49

WATER CONTENT % — PL, LL

SIEVE ANALYSIS — GRAVEL, SAND, SILT, CLAY, FINES

Completion Depth:	61.5
Date Boring Started:	4/21/18
Date Boring Completed:	4/21/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4553213.4m, E:336408.8m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube

WATER LEVELS (ft): End of Drilling 35.0; At Time of Drilling 31.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Telephone: 952-832-2600

LOG OF BORING GEO-072

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Physical Properties WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
0	TOPSOIL (CL): brown; moist; trace roots.	0.5					1.5		
	LEAN CLAY (CL): brown; moist; very stiff; gray mottling; with sand; few gravel; orange and black oxidation staining.						4.5		
5							4.5		
							4.5		
10			15.6				4.5		
							4.5		
15	LEAN CLAY (CL): gray to dark gray; moist; medium stiff to stiff; with sand; few gravel.	15.0					3.5		
			16.6	115.9		3.1	4.5		
20			16.5				2		
							2		
25									
			22.9	103.4		7	2.5		
30	SILTY LEAN CLAY (CL-ML): gray to dark gray; wet; medium stiff; with sand.	29.0					1.5		
	LEAN CLAY (CL): gray to dark gray; moist to wet; very stiff to hard; with sand; few gravel.	34.0					4.5		
35									
			13.5				4.5		
40									
							4.5		
45									
	CLAYEY SAND (SC): fine grained; dark gray; wet; very dense; slightly heaving into augers.	48.0	14.3						
50									
	Auger refusal on bedrock.	55.5							
55	Bottom of Boring at 55.5 feet								
60									
65									

STANDARD PENETRATION TEST DATA — N in blows/ft: 10 20 30 40

WATER CONTENT % — PL LL: 20 40 60

SIEVE ANALYSIS — GRAVEL SAND SILT CLAY FINES: 20 40 60 80

Completion Depth:	55.5
Date Boring Started:	4/21/18
Date Boring Completed:	4/21/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4553078.1m, E:336837.0m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube

WATER LEVELS (ft): End of Drilling 29.0; At Time of Drilling 29.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING GEO-074

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

MATERIAL DESCRIPTION (ASTM D2488)

Surface Elev.:

0 — TOPSOIL (CL): brown; moist; trace roots. — 0.5

LEAN CLAY (CL): brown; moist; very stiff; gray mottling; with sand; few gravel; orange and black oxidation staining.

20.0 — LEAN CLAY (CL): gray to dark gray; moist; stiff to very stiff; with sand; few gravel.

55 — 56.0 — SILTY LEAN CLAY (CL-ML): grayish brown; wet; stiff; with sand. — 58.0

LEAN CLAY (CL): dark gray; moist to wet; hard; with sand; trace gravel. — 61.5

Bottom of Boring at 61.5 feet

STANDARD PENETRATION TEST DATA — N in blows/ft: 6, 21, 20, 21, 23, 17, 17, 10, 14, 17, 13, 11, 13, 14, 14, 46

WATER CONTENT % — PL, LL

SIEVE ANALYSIS — GRAVEL, SAND, SILT, CLAY, FINES

Physical Properties	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
					2.5		
					4.5		
					4.5		
	14.9				4.5		
					4.5		
					4.5		
	17.2				4.5		
					3.5		
	16.9	115.3		2.6	2.5		
					2		
	18.2						
					3		
					3		
	13.4				4.5		
					3.5		
					3.5		
	12.8				4.5		

Completion Depth:	61.5
Date Boring Started:	4/22/18
Date Boring Completed:	4/22/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4552379.1m, E:337006.9m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube

WATER LEVELS (ft): End of Drilling Dry; At Time of Drilling 56.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING GEO-075

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/ft	WATER CONTENT % PL LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	Physical Properties WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
		Surface Elev.:													
	0	TOPSOIL (CL): brown; moist; trace roots.	0.5			5							3		
	5	LEAN CLAY (CL): brown; moist; stiff to very stiff; gray mottling; with sand; few gravel; orange and black oxidation staining.				13, 18, 17, 17, 15							4.5, 4.5, 4.5, 4.5		
	10								15.3				4.5, 3.75		
	15	LEAN CLAY (CL): gray to dark gray; moist to wet; medium stiff to stiff; with sand; few gravel.	15.0			11							3.5		
	20					8			16.9				2.5		
	25					8							1.75		
	30	31.5 ft: encountered wet seam.				10							2.5		
	35	CLAYEY SAND (SC): fine grained; dark gray to gray; wet; loose.	35.0			10			19.8				2.5		
	40	LEAN CLAY (CL): gray to dark gray; moist to wet; stiff to very stiff; with sand; few gravel.	40.0			9							2.5		
	45					10							3		
	50	50.0 ft: encountered heaving sand in augers.				16							4		
	55					16			14.4				4.5		
	60					19							4.5		
		Bottom of Boring at 61.5 feet	61.5												
	65														

Completion Depth:	61.5
Date Boring Started:	5/9/18
Date Boring Completed:	5/9/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4551391.1m, E:338409.0m
Datum:	NAD83

Remarks:

SAMPLE TYPES

SPLIT SPOON

WATER LEVELS (ft)

Wet Cave-in Depth	47.0
End of Drilling	42.0
At Time of Drilling	31.5

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING GEO-076

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
0	TOPSOIL (CL): brown; moist; trace roots.	0.7					2		
5	LEAN CLAY (CL): brown; moist; soft to very stiff; gray mottling; with sand; few gravel; orange and black oxidation staining. 8.0 - 9.0 ft: with thin wet sand seams.						4.5		
10			12.3				4.5		
15	LEAN CLAY (CL): gray to dark gray; moist; medium stiff; with sand; few gravel.	12.5	17.7	113.7		1.9	4.5		
20	CLAYEY SAND (SC): fine grained; brown; wet; medium dense; few gravel.	20.5					2		
25	SILTY LEAN CLAY (CL-ML): gray to dark gray; wet; stiff; with sand.	23.0					2		
30	LEAN CLAY (CL): gray to dark gray; moist to wet; stiff; with sand; few gravel. 31.5 ft: thin wet sand seam.	28.0					2.5		
35							2.5		
40							3		
45			18				2		
50							2		
55							3.5		
60			20				2.5		
65	Bottom of Boring at 61.5 feet	61.5					3.5		

STANDARD PENETRATION TEST DATA (N in blows/ft): 4, 10, 20, 14, 20, 8, 27, 11, 14, 18, 11, 11, 11, 9, 12, 9, 11

WATER CONTENT %: PL – LL

SIEVE ANALYSIS: GRAVEL, SAND, SILT, CLAY, FINES

Completion Depth:	61.5
Date Boring Started:	5/8/18
Date Boring Completed:	5/8/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4548968.7m, E:343381.3m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube

WATER LEVELS (ft): End of Drilling Dry; At Time of Drilling 8.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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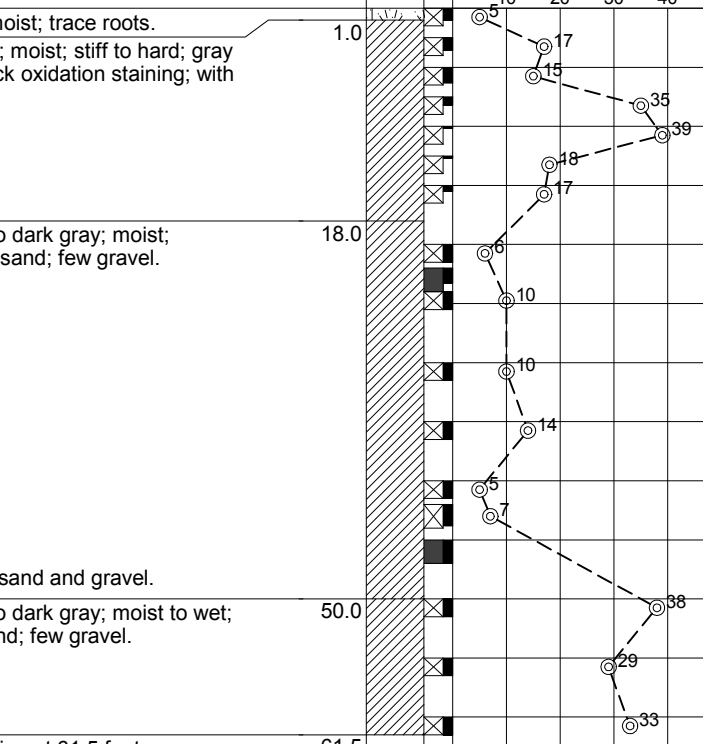
LOG OF BORING GEO-077

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	Surface Elev.:								
0	TOPSOIL (CL): brown; moist; trace roots.	1.0					4		
5	LEAN CLAY (CL): brown; moist; stiff to hard; gray mottling; orange and black oxidation staining; with sand; few gravel.						4.5		
10							4.5		
15							4.5		
20	LEAN CLAY (CL): gray to dark gray; moist; medium stiff to stiff; with sand; few gravel.	18.0					2.5		
25			17.4	114.2		2.1	2.5		
30							3.5		
35							4.5		
40							1		
45	47.0 ft: thin wet seam of sand and gravel.		16.9	117.2		1.7	4		
50	LEAN CLAY (CL): gray to dark gray; moist to wet; very stiff to hard; with sand; few gravel.	50.0							
55							4.5		
60							4.5		
65	Bottom of Boring at 61.5 feet	61.5							

Graphic Log / Sample Type & Rec. / STANDARD PENETRATION TEST DATA (N in blows/ft, 10 20 30 40) / WATER CONTENT % (PL — LL, 20 40 60) / SIEVE ANALYSIS (GRAVEL SAND SILT CLAY; FINES; 20 40 60 80)



Completion Depth:	61.5
Date Boring Started:	4/27/18
Date Boring Completed:	4/27/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4548935.4m, E:344812.7m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube

WATER LEVELS (ft): End of Drilling 43.0; At Time of Drilling 40.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Telephone: 952-832-2600

LOG OF BORING GEO-078

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
0	TOPSOIL (CL): dark brown; moist; trace roots.	1.0							
	LEAN CLAY (CL): brown; moist; gray mottling.	2.5							
5	LEAN CLAY (CL): brown; moist; medium stiff to stiff; trace gravel; with sand.	7.0	19.8						
10	LIMESTONE; light tan with brown mottling; fresh; massive; faint bedding; trace small vugs.								0
15									54
20									78
25									95
30									99
35	LIMESTONE; gray with tan and brown; fresh; calcite lenses; trace small vugs. 36.0 ft: lost water circulation to surface and never re-established.	34.0							84
40									94
45	LIMESTONE; light tan with gray and brown; fresh; calcite crystalization; faint bedding and wavy laminations; hard with few soft zones; trace small vugs.	43.5							96
50									77
55									78
60	Bottom of Boring at 60.0 feet	60.0							85
65									

STANDARD PENETRATION TEST DATA: N in blows/ft (10, 20, 30, 40); 3, 11, 5, >>50/1"

WATER CONTENT %: PL — LL (20, 40, 60)

SIEVE ANALYSIS: GRAVEL, SAND, SILT, CLAY, FINES (20, 40, 60, 80)

Completion Depth:	60.0
Date Boring Started:	4/13/18
Date Boring Completed:	4/13/18
Logged By:	BAA / BWL
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4545354.8m, E:328297.0m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; ROCK CORE

WATER LEVELS (ft): At Time of Drilling; before coringDry

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING GEO-079

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/ft	WATER CONTENT % PL LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	Physical Properties WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	0	TOPSOIL (CL): brown; moist; trace roots.	0.2			6							4.5		
	5	LEAN CLAY (CL): brown; moist; stiff to very stiff; with sand; trace gravel.				19, 19, 22							4.5		
	10					17, 15, 12			17.2				4.5		
	15								17.7				3.5		
	20								17.2	114.8		2.8	4		
	25	LEAN CLAY (CL): gray; moist; stiff to very stiff; with sand; trace gravel.	25.0			10							2.5		
	30					11			17.1				2.25		
	35								17.6	113.9		2.9	1.75		
	40	40.5 ft: thin sand seams.				14							1.5		
	45					13			18.3				0.75		
	50	51.5 ft: wet sand seam.				18							2.75		
	55	CLAYEY GRAVEL WITH SAND (GC): dark gray; wet; medium dense.	55.0			16							2		
	60	POORLY GRADED SAND WITH SILT (SP-SM): fine to medium grained; dark gray; wet; medium dense.	58.5 61.5			15			13.1				3		
	65	Bottom of Boring at 61.5 feet													

Completion Depth:	61.5
Date Boring Started:	4/20/18
Date Boring Completed:	4/20/18
Logged By:	IGM
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4546147.4m, E:325270.7m
Datum:	NAD83

Remarks:

SAMPLE TYPES
SPLIT SPOON; 3-inch Shelby Tube

WATER LEVELS (ft)
End of Drilling 50.0
At Time of Drilling 51.5

LEGEND
MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING GEO-081

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
0	TOPSOIL (CL): brown; moist; trace roots.	0.3							
	LEAN CLAY (CL): brown; moist; stiff to very stiff; gray mottling; with sand; few gravel; orange and black oxidation staining.		16.3						
20	LEAN CLAY (CL): gray to dark gray; moist to wet; stiff; with sand; few gravel.	20.0	16.8	115.9		1.8			
25			18.6						
40	47.0 ft: hard drilling; cobbles encountered.		17.4				3		
45							1.5		
50							1.5		
55	POORLY GRADED SAND WITH GRAVEL (SP): fine to coarse grained; dark gray to gray; wet; medium dense to dense.	55.0							
60	Bottom of Boring at 61.5 feet	61.5	10.3						
65									

STANDARD PENETRATION TEST DATA (N in blows/ft): 2, 10, 22, 30, 23, 16, 15, 9, 11, 13, 12, 13, 13, 13, 15, 33

WATER CONTENT %: PL, LL; 15, 30

SIEVE ANALYSIS: GRAVEL, SAND, SILT, CLAY, FINES

Completion Depth:	61.5
Date Boring Started:	4/17/18
Date Boring Completed:	4/17/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4547664.2m, E:326388.0m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube

WATER LEVELS (ft): End of Drilling 40.0; At Time of Drilling 25.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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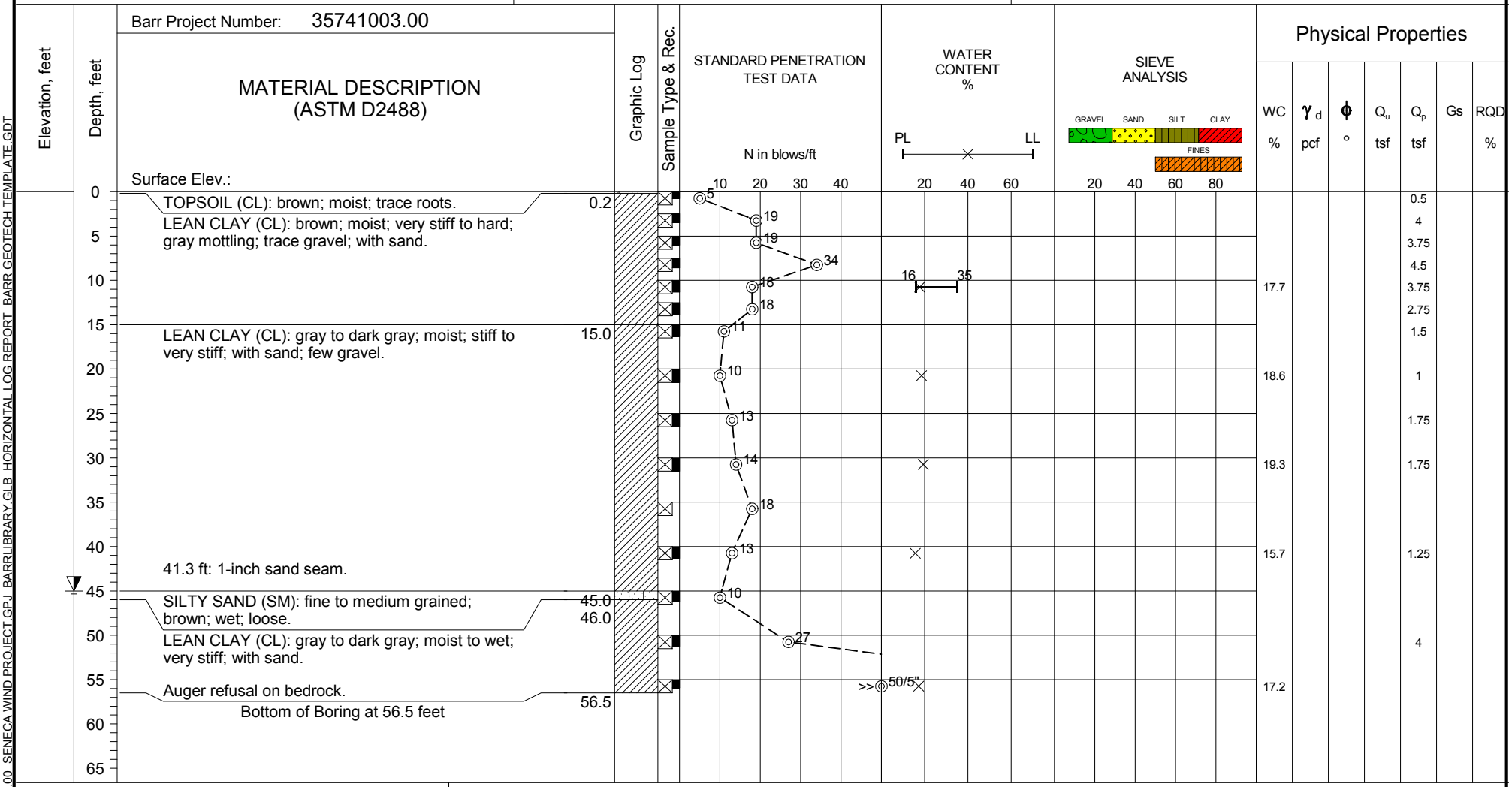
LOG OF BORING GEO-082

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00



Completion Depth:	56.5
Date Boring Started:	4/18/18
Date Boring Completed:	4/18/18
Logged By:	IGM
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA / Mud rotary
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4546818.3m, E:326235.2m
Datum:	NAD83

Remarks:

SAMPLE TYPES
- SPLIT SPOON

WATER LEVELS (ft)
- End of Drilling
- Dry
- At Time of Drilling 45.0

LEGEND
- MC Moisture Content
- γ Dry Unit Weight
- ϕ Friction Angle
- Q_u Unconfined Compression
- Q_p Hand Penetrometer UC
- Gs Specific Gravity
- RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Barr Engineering Company
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-083

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Depth, feet
	0	TOPSOIL (CL): brown; moist; trace roots.	0.3
	5	LEAN CLAY (CL): brown; moist; very stiff; with sand; few gravel; gray mottling.	
	10		
	15	LEAN CLAY (CL): gray; moist; medium stiff to stiff; with sand; few gravel.	12.5
	20		
	25	POORLY GRADED SAND WITH SILT (SP-SM): fine grained; brown; wet; dense.	21.0
		LEAN CLAY (CL): gray; moist to wet; very stiff; with sand; trace gravel.	25.0
	30	SILTY SAND (SM): fine grained; gray; wet; medium dense; trace to some gravel; heaved into augers.	30.0
	35		
	40		
	45	SILTY SAND (SM): fine grained; gray; wet; very dense; weathered limestone.	45.0
	50	Auger refusal on bedrock.	50.0
		Bottom of Boring at 50.0 feet	
	55		
	60		
	65		

Graphic Log | Sample Type & Rec.

STANDARD PENETRATION TEST DATA — N in blows/ft (10, 20, 30, 40)

Depth, feet	N in blows/ft
2.5	5
5	19
7.5	19
10	30
12.5	20
15	14
17.5	5
20	31
25	19
30	19
35	12
40	11
45	>> 50/4"
50	>> 50/0.5"

WATER CONTENT % — PL, LL (20, 40, 60)

SIEVE ANALYSIS — GRAVEL, SAND, SILT, CLAY, FINES (20, 40, 60, 80)

Physical Properties

Depth, feet	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
12.5	15.7						
17.5	17.5	114		2.3			
20	15.9						
30	16.8						

Completion Depth:	50.0
Date Boring Started:	4/16/18
Date Boring Completed:	4/16/18
Logged By:	CRL
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4546775.0m, E:326708.0m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube

WATER LEVELS (ft): End of Drilling Dry; At Time of Drilling 21.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-084

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL – LL)	SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)	Physical Properties: WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	0	LEAN CLAY (CL): brown with gray mottling; moist; stiff to very stiff; with orange and black oxidation staining; few sand.			7, 13, 18, 19, 13, 9							2.5		
	5	6.0 ft: oxidized soil fractures.										2.5		
	10											4.5		
	15				>> 50/0.5"			19.3				4.5		
		LIMESTONE; brown with tan and gray; fresh; massive; trace pyrite; trace to no vugs.										2.5		
								18.1	111.3		3.9			30
	20													76
	25	23.0 ft: thin bedding.												59
	30													71
	35	34.0 - 35.2 ft: quartz seam.												22
	40													71
	45													47
	50													65
	55	54.0 ft: several vuggy zones.												43
	60	Bottom of Boring at 60.0 feet												0
	65													

15.5

60.0

Completion Depth:	60.0
Date Boring Started:	4/7/18
Date Boring Completed:	4/8/18
Logged By:	DJZ / BWL
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4542846.9m, E:324876.3m
Datum:	NAD83

Remarks:

SAMPLE TYPES

SPLIT SPOON | 3-inch Shelby Tube | ROCK CORE

WATER LEVELS (ft)

At Time of Drilling	12.0
After Drilling	14.0
12 hrs After Drilling	4.0

LEGEND

MC Moisture Content
γ Dry Unit Weight
ϕ Friction Angle
Q_u Unconfined Compression
Q_p Hand Penetrometer UC
Gs Specific Gravity
RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-085

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Physical Properties WC %
0	TOPSOIL (CL): brown; moist; trace roots.	0.2	
5	LEAN CLAY (CL): brown; moist; stiff to very stiff; gray mottling; with sand; few gravel; black and orange oxidation staining.		15.7
15	LEAN CLAY (CL): gray to dark gray; moist to wet; stiff to very stiff; with sand; few gravel.	15.0	15.4
35	35.0 ft: thin wet sand seams.		16.9
45	45.0 ft: increase in sand and gravel content.		
50	LEAN CLAY (CL): gray to dark gray; moist to wet; very stiff to hard; with sand; with gravel.	50.0	14.2
61.5	Bottom of Boring at 61.5 feet	61.5	

Graphic Log | Sample Type & Rec. | STANDARD PENETRATION TEST DATA (N in blows/ft): 4, 14, 24, 26, 30, 21, 15, 15, 17, 15, 15, 16, 17, 30, 26, 27 | WATER CONTENT % (PL, LL) | SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)

Physical Properties: WC %, γ_d pcf, ϕ °, Q_u tsf, Q_p tsf, Gs, RQD %

Completion Depth:	61.5
Date Boring Started:	4/17/18
Date Boring Completed:	4/17/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4547740.3m, E:327077.5m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON

WATER LEVELS (ft): End of Drilling Dry; At Time of Drilling 35.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Telephone: 952-832-2600

LOG OF BORING GEO-086

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/ft	WATER CONTENT % PL LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
		Surface Elev.:													
	0	TOPSOIL (CL): dark brown; moist; trace roots.	0.3												
	5	LEAN CLAY (CL): brown; moist; medium stiff to stiff; with sand; gray mottling.	7.0			7, 9, 8			18.3						
	10	SILTY SAND (SM): fine grained; gray; moist; very dense; weathered limestone.	8.5			>>50/4"									13
	15	LIMESTONE; brown with light gray; fresh to slightly weathered; hard to soft; faint wavy bedding; trace small to large vugs.													56
	20	18.5 ft: lost water circulation to surface and never re-established. 20.5 - 21.5 ft: white, softer zone.													68
	25														77
	30	28.5 ft: shell fragments.													86
	35														56
	40														93
	45														93
	50														78
	55														81
	60	Bottom of Boring at 61.5 feet	61.5												96
	65														

Completion Depth:	61.5
Date Boring Started:	4/12/18
Date Boring Completed:	4/12/18
Logged By:	BAA / BWL
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4545922.4m, E:327750.9m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; ROCK CORE

WATER LEVELS (ft): At Time of Drilling; before coringDry

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING GEO-087

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		N in blows/ft	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
0	TOPSOIL (CL): brown; moist; trace roots.	0.2						2.5		
	LEAN CLAY (CL): brown; moist; very stiff; gray mottling; with sand; few gravel; orange and black oxidation staining.		8, 18, 28, 30					4.5		
5								4.5		
10			23, 21	16.3				4.5		
								3.5		
15	LEAN CLAY (CL): gray to dark gray; moist to wet; stiff to very stiff; with sand; few gravel.	15.0	10, 18	17.1	115		2.4	2		
20				16.4				4		
								2		
25			13					3		
30			11	15.4				1.5		
35	LEAN CLAY (CL): gray to dark gray; moist to wet; very stiff; with sand; few gravel.	35.0	25					4.5		
40			23							
45	CLAYEY SAND (SC): fine to medium grained; gray; wet; very dense; few gravel.	45.0	>>57	14.8						
50	Auger refusal on bedrock.	50.0	>>50/1"							
	Bottom of Boring at 50.0 feet									
55										
60										
65										

Graphic Log; Sample Type & Rec.; STANDARD PENETRATION TEST DATA; WATER CONTENT %; SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES); Physical Properties

Completion Depth:	50.0
Date Boring Started:	4/20/18
Date Boring Completed:	4/20/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4547804.6m, E:327652.3m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; 3-inch Shelby Tube

WATER LEVELS (ft): End of Drilling 30.0; At Time of Drilling 20.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Telephone: 952-832-2600

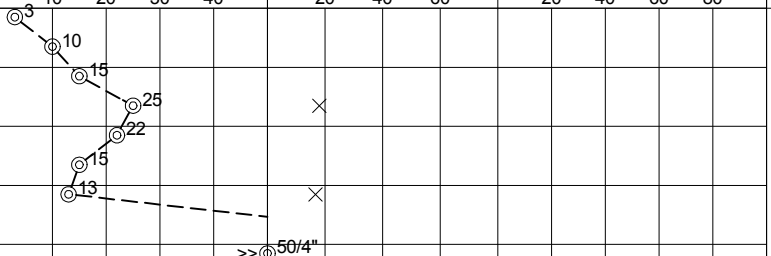
LOG OF BORING GEO-088

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
		Surface Elev.:								
	0	TOPSOIL (CL): brown; moist; trace roots.	0.3							
	5	LEAN CLAY (CL): brown; moist; stiff to very stiff; orange oxidation staining; some sand; trace gravel.		18						
	10									
	15	LEAN CLAY (CL): gray; moist; stiff; with sand; few gravel.	12.5	16.7						
	20	LIMESTONE; gray to light gray; hard.	21.0							15
	25									52
	30	LIMESTONE; tan with gray; hard.	30.0							50
	35									95
	40									42
	45									63
	50									92
	55									78
	60	Bottom of Boring at 60.0 feet	60.0							
	65									

Graphic Log | Sample Type & Rec. | STANDARD PENETRATION TEST DATA (N in blows/ft: 10 20 30 40) | WATER CONTENT % (PL — LL; 20 40 60) | SIEVE ANALYSIS (GRAVEL SAND SILT CLAY; FINES; 20 40 60 80)



Completion Depth:	60.0
Date Boring Started:	4/14/18
Date Boring Completed:	4/15/18
Logged By:	CRL / ZZ2
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4545185.4m, E:329414.1m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; ROCK CORE

WATER LEVELS (ft): At Time of Drilling; before coringDry

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING GEO-089

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL – LL)	SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)	Physical Properties WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
		Surface Elev.:													
	0	TOPSOIL (CL): dark brown; moist; trace roots; some sand.	0.5												
	5	LEAN CLAY (CL): brown; moist; gray mottling; little sand.	2.5												
	10	LEAN CLAY (CL): brown; moist to wet; stiff to hard; gray mottling; little sand; trace gravel.				3, 11, 13, 17, 14, 19, 36, 31, >>50/5.5"			18.9	110.7		4.9			
	15	LIMESTONE; tan to light gray; trace fossils to 44.0 ft; trace vugs; clay infilled fractures.	15.0						13.7						25
	20														32
	25														80
	30														90
	35														63
	40														85
	45														93
	50														87
	55														83
	60	57.0 ft: thin clay seam.													83
	65	Bottom of Boring at 61.0 feet	61.0												

Completion Depth:	61.0
Date Boring Started:	4/13/18
Date Boring Completed:	4/14/18
Logged By:	BAA / DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4545293.9m, E:328728.7m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; ROCK CORE

WATER LEVELS (ft): After Drilling 0.5 before coring, sat overnight; At Time of Drilling 14.0

LEGEND: MC Moisture Content; γ Dry Unit Weight; ϕ Friction Angle; Q_u Unconfined Compression; Q_p Hand Penetrometer UC; Gs Specific Gravity; RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Minneapolis, MN 55435
Telephone: 952-832-2600

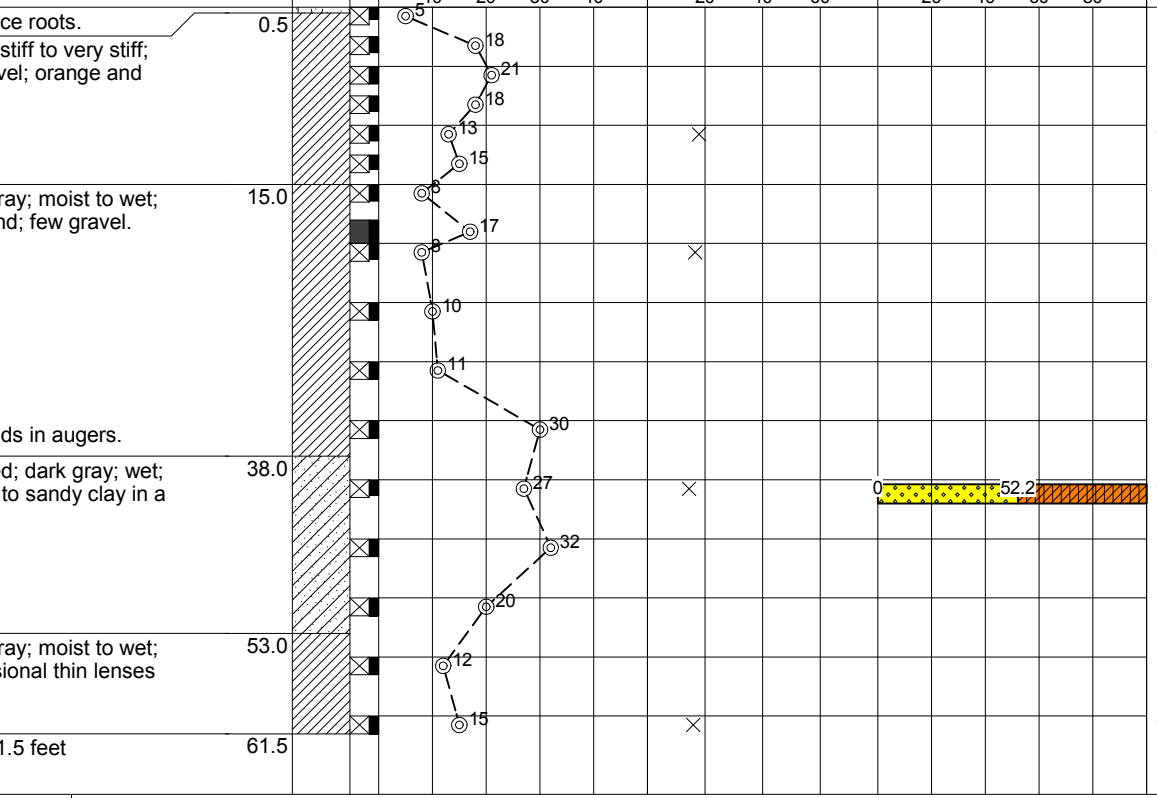
LOG OF BORING GEO-090

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Physical Properties WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
0	TOPSOIL (CL): brown; moist; trace roots.	0.5					3		
5	LEAN CLAY (CL): brown; moist; stiff to very stiff; gray mottling; with sand; few gravel; orange and black oxidation staining.						4.5		
10			17.9				4.5		
15	LEAN CLAY (CL): gray to dark gray; moist to wet; medium stiff to very stiff; with sand; few gravel. 18.0 - 18.5 ft: wet sandy seam.	15.0					3		
20			16.5				2		
25							2		
30							2		
35	35.0 ft: encountered heaving sands in augers.						2.5		
40	CLAYEY SAND (SC): fine grained; dark gray; wet; medium dense to dense; grades to sandy clay in a few zones.	38.0	14.4				4.5		
45							4		
50									
55	LEAN CLAY (CL): gray to dark gray; moist to wet; stiff; with sand; few gravel; occasional thin lenses of sand.	53.0							
60			15.9				4.5		
65	Bottom of Boring at 61.5 feet	61.5							



Completion Depth:	61.5
Date Boring Started:	5/9/18
Date Boring Completed:	5/9/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4550571.2m, E:339008.4m
Datum:	NAD83

Remarks:

SAMPLE TYPES

SPLIT SPOON | 3-inch Shelby Tube

WATER LEVELS (ft)

End of Drilling 35.0

At Time of Drilling 18.0

LEGEND

MC Moisture Content
γ Dry Unit Weight
ϕ Friction Angle
Q_u Unconfined Compression
Q_p Hand Penetrometer UC
Gs Specific Gravity
RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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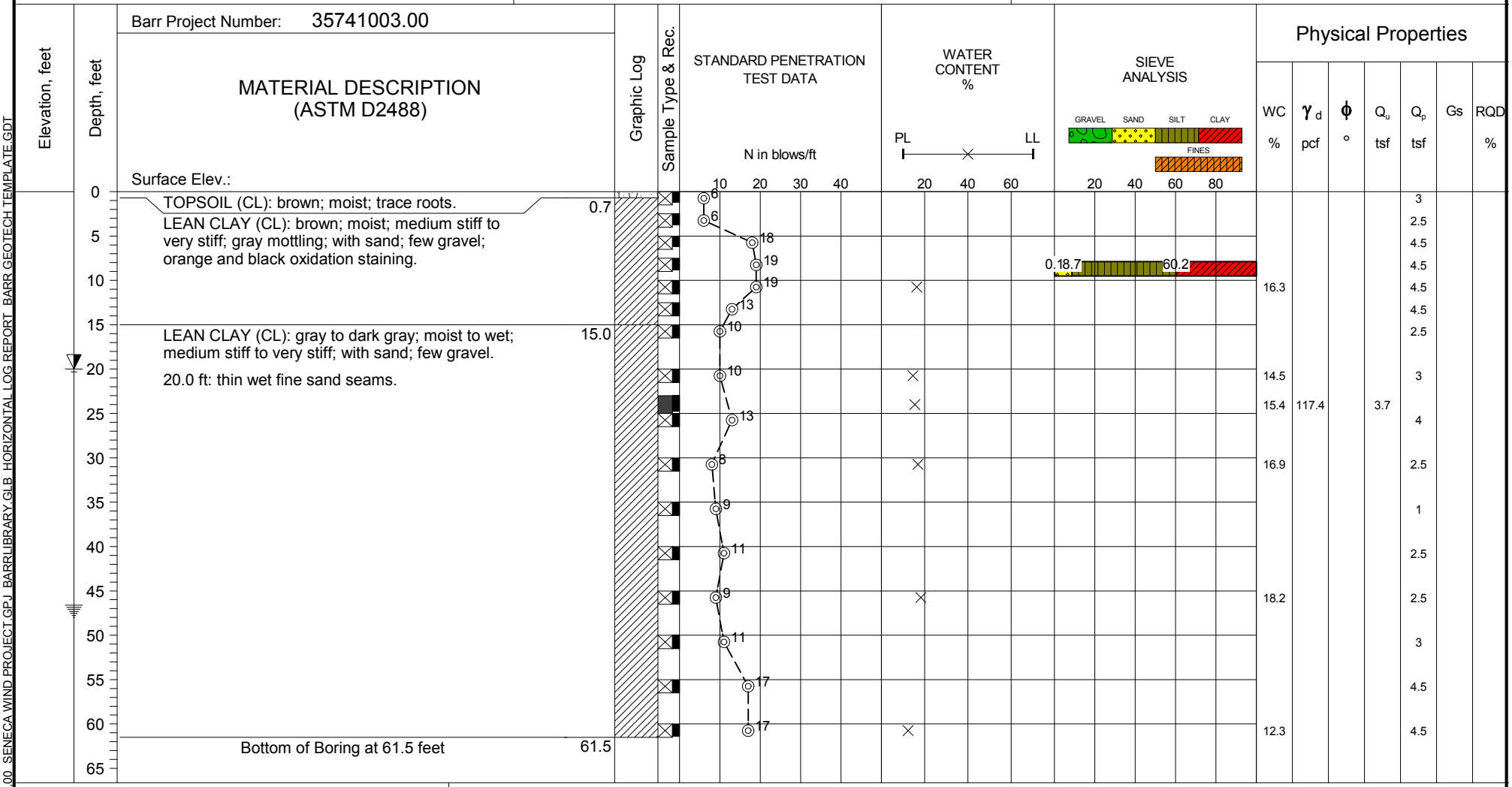
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-091

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00



Completion Depth:	61.5
Date Boring Started:	4/28/18
Date Boring Completed:	4/28/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4548037.1m, E:345589.1m
Datum:	NAD83

Remarks:

SAMPLE TYPES

SPLIT SPOON | 3-inch Shelby Tube

WATER LEVELS (ft)

Wet Cave-in Depth 48.0
End of Drilling
Dry
At Time of Drilling 20.0

LEGEND

MC Moisture Content
γ Dry Unit Weight
ϕ Friction Angle
Qu Unconfined Compression
Qp Hand Penetrometer UC
Gs Specific Gravity
RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Barr Engineering Company
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-092

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL, LL)	SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)	WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
		Surface Elev.:												
	0	TOPSOIL (CL): brown; moist; trace roots.			5							2.5		
		0.5			13							4.5		
	5	LEAN CLAY (CL): brown; moist; stiff to very stiff; gray mottling; with sand; few gravel; orange and black oxidation staining.			15							4.5		
					20			16.6				4.5		
	10				18							4.5		
					19							4.5		
	15				15			15.4				4.5		
					7							2		
	20	LEAN CLAY (CL): gray to dark gray; moist to wet; medium stiff to hard; with sand; few gravel.			9			17.1	114.6		2.6	2.5		
		20.0										1.75		
	25													
					10			18.1				2.5		
	30													
					8							2		
	35													
					10							2.5		
	40													
					7			18.9				1		
	45							17.9	113.1		2.5			
					12							3		
	50													
					50							4.5		
	55													
		SILTY SAND (SM): fine grained; grayish brown; wet; dense.			34			27						
		58.0												
	60	Bottom of Boring at 61.5 feet												
		61.5												
	65													

Completion Depth:	61.5
Date Boring Started:	4/29/18
Date Boring Completed:	4/29/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4548374.3m, E:343629.4m
Datum:	NAD83

Remarks:

SAMPLE TYPES

SPLIT SPOON | 3-inch Shelby Tube

WATER LEVELS (ft)

End of Drilling in augers: 57.0
At Time of Drilling: 30.0

LEGEND

MC Moisture Content
γ Dry Unit Weight
ϕ Friction Angle
Q_u Unconfined Compression
Q_p Hand Penetrometer UC
Gs Specific Gravity
RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

M:\GINT\PROJECTS\35741003.00_SENECA WIND PROJECT.GPJ_BARR\LIBRARY.GLB_HORIZONTAL LOG REPORT_BARR GEOTECH TEMPLATE.GDT

Barr Engineering Company
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-093

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/ft	WATER CONTENT % PL LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	Physical Properties WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
		Surface Elev.:													
	0	TOPSOIL (CL): brown; moist; trace roots.	0.3			7							4		
	5	LEAN CLAY (CL): brown; moist; stiff to very stiff; gray mottling; with sand; few gravel; orange and black oxidation staining.				13, 21, 16, 16							4.5, 4.5, 4.5		
	10	LEAN CLAY (CL): gray to dark gray; moist to wet; medium stiff to hard; with sand; few gravel.	12.0			9, 11			16.1				4, 2.5		
	15					9							3.5		
	20					7, 11			17				2.5		
	25					7							2.5		
	30					11			18	113.2		1	2.5		
	35					7							2		
	40					8			18.3				2.5		
	45					9							2.5		
	50					10							2.5		
	55	55.5 - 56.3 ft: wet sand seam.				23		2.8, 66.5	14.3						
	60	Bottom of Boring at 61.5 feet	61.5			26									
	65														

Completion Depth:	61.5
Date Boring Started:	4/29/18
Date Boring Completed:	4/29/18
Logged By:	DJZ
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4548322.8m, E:343634.7m
Datum:	NAD83

Remarks:

SAMPLE TYPES
SPLIT SPOON
3-inch Shelby Tube

WATER LEVELS (ft)
End of Drilling 25.5
At Time of Drilling 30.0

LEGEND
MC Moisture Content
γ Dry Unit Weight
ϕ Friction Angle
Q_u Unconfined Compression
Q_p Hand Penetrometer UC
Gs Specific Gravity
RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Barr Engineering Company
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-094

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Surface Elev.:

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL – LL)	SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)	Physical Properties WC %	γ_d pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
0	0	LEAN CLAY (CL): brown; moist; stiff to very stiff; with orange and black oxidation staining; trace sand; gray mottling.				3, 13, 18, 16, 16							1.5, 4, 4.5, 4.5		
	10	10.0 ft: transition to mainly gray with orange oxidation.				>>50/5"			14.2				4		
	15	CLAYEY SAND (SC): fine grained; brown; wet; very dense; few to little gravel.	15.0			>>54									
	20	SILTY SAND (SM): brown; wet; very dense; weathered and fractured limestone.	17.0			>>57			12.3						
	25	LIMESTONE; light brown with gray; hard to soft; some wavy bedding; trace small vugs; trace pyrite.	24.5			>>50/0.5"									23
	30														83
	35														82
	40														85
	45														100
	50														74
	55														100
	60	Bottom of Boring at 60.5 feet	60.5												82
	65														

Completion Depth:	60.5
Date Boring Started:	4/8/18
Date Boring Completed:	4/9/18
Logged By:	DJZ / BWL
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4542142.6m, E:325974.7m
Datum:	NAD83

Remarks:

SAMPLE TYPES: SPLIT SPOON; ROCK CORE

WATER LEVELS (ft)

At Time of Drilling	12.5
After Drilling	9.5
12 hrs After Drilling	9.0

LEGEND

MC	Moisture Content	Q_u	Unconfined Compression
γ	Dry Unit Weight	Q_p	Hand Penetrometer UC
ϕ	Friction Angle	Gs	Specific Gravity
		RQD	Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Barr Engineering Company
4300 MarketPointe Drive Suite 200
Minneapolis, MN 55435
Telephone: 952-832-2600

LOG OF BORING GEO-096

Project: Seneca Wind Project | Location: Seneca County, Ohio | Client: sPower

Barr Project Number: 35741003.00

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION (ASTM D2488)		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA (N in blows/ft)	WATER CONTENT % (PL – LL)	SIEVE ANALYSIS (GRAVEL, SAND, SILT, CLAY, FINES)	Physical Properties WC %	RQD %
	0	Surface Elev.:								
	0	TOPSOIL (CL): dark gray; moist; trace roots.	0.4			4, 8, 10				
	5	LEAN CLAY (CL): brown; moist; medium stiff; gray mottling.	6.0			>> 50/5"			17.8	
	10	SILTY SAND (SM): fine grained; gray; moist; very dense; weathered limestone.	8.4							
	15	LIMESTONE; light brown with gray; fresh; faint bedding; trace small and large vugs.								43
	20									68
	25									90
	30									62
	35									19
	40	41.5 ft: lost water circulation to surface and never re-established.								90
	45									80
	50	LIMESTONE; gray and tan with light brown; fresh; massive; occasional small to medium vugs; few brecciated zones.	49.5							92
	55									56
	60	Bottom of Boring at 60.0 feet	60.0							80
	65									

Completion Depth:	60.0
Date Boring Started:	4/10/18
Date Boring Completed:	4/11/18
Logged By:	BAA / BWL
Drilling Contractor:	EPC Engineering and Testing
Drilling Method:	HSA and NQ Core
Ground Surface Elevation:	
Coordinates:	UTM 17 N:4543010.5m, E:326543.0m
Datum:	NAD83

Remarks:

SAMPLE TYPES

SPLIT SPOON | ROCK CORE

WATER LEVELS (ft)

After Drilling	6.5
At Time of Drilling	6.5
12 hrs After Drilling	4.0

LEGEND

MC Moisture Content
γ Dry Unit Weight
ϕ Friction Angle
Q_u Unconfined Compression
Q_p Hand Penetrometer UC
Gs Specific Gravity
RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

M:\GINT\PROJECTS\35741003.00 SENECA WIND PROJECT.GPJ BARRLIBRARY.GLB HORIZONTAL LOG REPORT BARR GEOTECH TEMPLATE.GDT

Appendix C

Geophysical Survey Report

May 11, 2018

Robb J. Roy
BARR
Geotechnical Engineer
4700 West 77th Street
Minneapolis, MN 55435
(952) 842-3695

RE: MASW and Seismic Refraction Survey
Seneca Wind Project
Seneca County, Ohio
THG Project No. 881-6820

Dear Mr. Roy:

THG Geophysics, Ltd. (THG) collected seismic velocity data at the proposed Seneca Wind Project located in Seneca County, Ohio on April 30 - May 1, 2018 (Figure 1). The work scope included the collection of shear wave velocity data (s-wave) using multichannel analysis of surface wave methods (MASW) and compressional body-wave velocity data (p-wave) using a refraction method. THG conducted MASW shear-wave tests and seismic refraction tests at 6 turbine locations throughout the site.

MASW

Multichannel Analysis of Surface Waves (MASW) is a method of collecting shear-wave data using surface wave velocity analysis (Xia, et al., 2000). One-dimensional (MASW) data were collected at six locations (Figures 2-7). Elastic waves were initiated using a 16-pound sledge hammer striking a 10" by 10" aluminum plate. The velocity data were collected using a 24-channel, 4.5-Hz geophone spread with 32 geophones and a 5-foot array.

MASW theory holds that the penetration depth of a surface wave increases with wavelength. Further, propagation velocity (i.e., phase velocity) is determined mainly by shear-wave velocity of penetrated materials; consequently, surface waves have nearly the same velocity as shear wave at depth. Through the use of dispersion curves, or the change of propagation speed (i.e., phase velocity) with wavelength (or frequency), the shear wave velocity with depth can be derived. Four events (5 stacks each) were recorded and post-processed using SurfSeis 4.24. These data were then inverted to obtain the associated shear wave velocities (Figures 2-7).

REFRACTION

Seismic tomographic imaging is a refraction seismic method for showing p-wave velocity at depth in a profile format. A 24-channel (Geometrics Geode) seismograph using 10 Hz geophones collected p-wave velocity data with a 3-meter (10-ft) takeout distance. Five events on each seismic line were initiated with a 16-lb sledge hammer, collected and stacked (5 records) for post processing at each of the 6 locations (Figures 8-13).

Post-processing used of a proprietary processing program, RayFract®, a seismic refraction tomography software that provides reliable imaging of subsurface velocity. The "smoothin-version" algorithm tomographic method is based on physically meaningful modeling of seismic first break energy refraction, transmission and diffraction. Both p-wave and s-wave propagation is modeled with wave paths (also known as Fresnel volumes) instead of conventional seismic rays. This increases the numerical robustness of the method. A smooth initial 1-D gradient model is determined directly from the traveltime data, by averaging Delta-t-V (improved Wiechert-Herglotz) method 1-D velocity-depth profiles along the seismic line. This procedure delivers reliable smoothed models even in case of velocity inversions. The initial model is then refined with true 2-D WET (Wavepath Eikonal Traveltime) tomography.

QUALITY ASSURANCE AND QUALITY CONTROL

The interpretation of geophysically-generated data is not an exact science since the responses to induced disturbance is affected by many phenomena including buried material, operator error, precipitation, wind and net changes in ground saturation conditions. Some sources of spurious data can be overcome through a QA/QC program and use of multiple geophysical methods. The quality control program employed with this study included frequent checks of the equipment and resurveys of lines and locations. The QA/QC program indicates that all geophysical equipment functioned as designed during the survey program.

ANALYSIS

Geophysical data collected at the Seneca Wind Project site was of good quality. S-wave velocities range from approximately 600 ft/s to 4,500 ft/s and p-wave velocities from 3,000 ft/s to 14,500 ft/s (Table 1). The resulting velocities can be grouped into two different categories at the site. Turbine locations GEO-013, GEO-033, GEO-061, and GEO-085 exhibit slower velocities at shallower depths and GEO-003 and GEO-066 exhibit much faster velocities at shallower depths indicating shallower bedrock at turbine locations GEO-003 and GEO-066.

MASW data at all six turbine test locations were used to perform seismic hazard classification (IBS, 2018). All six sites meet the specification of a Site Class C: Very dense soil and soft rock (Table 2).

Should you have any questions or require additional information, please contact our office at (724) 325-3996 or via e-mail hlk@thggeophysics.com.

Respectfully,
THG Geophysics, Ltd.

Heather Krivos, G.I.T.
Senior Geophysicist

Enclosures

REFERENCES

IBS, (2018). International Building Code; International Code Council, Inc.

Xia, J.; Miller, R. D.; Park, C. B.; Hunter J. A.; Harris, J. B.; and Ivanov, J., (2002), Comparing shear-wave velocity profiles inverted from multi-channel surface wave with borehole measurements: *Soil Dynamics Earthquake Engineering*, Vol. 22, pp. 181-190.

Geophysical investigations are a non-invasive method of interpreting physical properties of the shallow earth using electrical, electromagnetic, or mechanical energy. This document contains geophysical interpretations of responses to induced or real-world phenomena. As such, the measured phenomenon may be impacted by variables not readily identified in the field that can result in a false-positive and/or false-negative interpretation. THG makes no representations or warranties as to the accuracy of the interpretations.

Table 1

Seneca Wind Project
Seneca County, Ohio

s-wave and p-wave Velocity Table

DEPTH (ft below grade)	GEO-003		GEO-013		GEO-033	
	s-wave velocity (ft/sec)	p-wave velocity (ft/sec)	s-wave velocity (ft/sec)	p-wave velocity (ft/sec)	s-wave velocity (ft/sec)	p-wave velocity (ft/sec)
-10	987	3,169	1,530	3,126	782	3,992
-20	955	6,125	1,357	3,499	673	5,344
-30	1,299	7,903	1,186	4,076	1,021	5,647
-40	1,629	10,121	1,413	4,579	1,021	5,865
-50	1,842	11,844	2,050	5,190	1,360	6,312
-60	2,163	13,365	2,050	6,113	1,564	
-70	2,163	14,644	2,403	7,450	1,564	
-80	2,691		2,403	8,671	1,651	
-90	2,691		2,297	9,705	1,651	
-100	4,529		2,297		2,070	
-110	4,529		2,981		2,070	
-120	4,529		2,981			

DEPTH (ft below grade)	GEO-061		GEO-066		GEO-085	
	s-wave velocity (ft/sec)	p-wave velocity (ft/sec)	s-wave velocity (ft/sec)	p-wave velocity (ft/sec)	s-wave velocity (ft/sec)	p-wave velocity (ft/sec)
-10	830	3,803	2,251	6,209	830	4,232
-20	617	4,519	2,299	8,340	643	5,431
-30	1,067	4,597	2,439		810	5,018
-40	1,762	5,007	2,492		1,353	5,444
-50	1,984	5,923	2,272		1,629	6,079
-60	1,746	6,618	1,833		1,576	6,861
-70	1,746	7,585	1,833		1,576	8,371
-80	1,584	8,489	1,784		1,573	9,252
-90	1,584		1,784		1,753	
-100	3,123		3,399		1,753	
-110	3,123		3,399		2,846	
-120	3,123		3,399		2,846	

Table 2

Seneca Wind Project
Seneca County, Ohio

MASW Seismic Site Classification

GEO-003			GEO-013			GEO-033		
Depth (ft)	**Velocity (ft/sec)**	**Weight**	**Depth (ft)**	**Velocity (ft/sec)**	**Weight**	**Depth (ft)**	**Velocity (ft/sec)**	**Weight**
-3.8	1,059	0.04	-4.1	1,542	0.04	-3.6	807	0.04
-8.6	1,128	0.05	-9.2	1,585	0.05	-8.1	831	0.05
-14.6	987	0.06	-15.6	1,530	0.06	-13.8	782	0.06
-22.1	955	0.08	-23.6	1,357	0.08	-20.8	673	0.07
-31.4	1,299	0.09	-33.6	1,186	0.10	-29.7	685	0.09
-43.1	1,629	0.12	-46.1	1,413	0.13	-40.7	1,021	0.11
-57.7	1,842	0.15	-61.7	2,050	0.16	-54.5	1,360	0.14
-76.0	2,163	0.18	-81.2	2,403	0.20	-71.7	1,564	0.17
-98.8	2,691	0.23	-100.0	2,297	0.19	-93.2	1,651	0.22
-100.0	4,529	0.01				-100.0	2,070	0.07
Weighted Average (ft/sec)		**1,869**	Weighted Average (ft/sec)		**1,866**	Weighted Average (ft/sec)		**1,284**

GEO-061			GEO-066			GEO-085		
Depth (ft)	**Velocity (ft/sec)**	**Weight**	**Depth (ft)**	**Velocity (ft/sec)**	**Weight**	**Depth (ft)**	**Velocity (ft/sec)**	**Weight**
-3.7	894	0.04	-3.8	2,328	0.04	-3.9	944	0.04
-8.4	918	0.05	-8.5	2,303	0.05	-8.7	952	0.05
-14.2	830	0.06	-14.4	2,251	0.06	-14.8	830	0.06
-21.4	617	0.07	-21.8	2,299	0.07	-22.3	643	0.08
-30.5	1,067	0.09	-31.1	2,439	0.09	-31.8	810	0.10
-41.9	1,762	0.11	-42.7	2,492	0.12	-43.6	1,353	0.12
-56.1	1,984	0.14	-57.1	2,272	0.14	-58.4	1,629	0.15
-73.8	1,746	0.18	-75.2	1,833	0.18	-76.9	1,576	0.19
-96.0	1,584	0.22	-97.8	1,784	0.23	-100.0	1,573	0.23
-100.0	3,123	0.04	-100.0	3,399	0.02			
Weighted Average (ft/sec)		**1,534**	Weighted Average (ft/sec)		**2,152**	Weighted Average (ft/sec)		**1,314**

Legend

Geophysical Test Location

0 mi 1.5 mi 3 mi 4.5 mi

Notes

Geophysical survey conducted April 30 - May 1, 2018.

MASW data collected using Geometrics Geode 24-channel seismograph, 4.5 Hz geophones, 5-ft stepout and SurfSeis 4.24 software.

Seismic refraction data collected using Geometrics Geode 24-channel seismograph, 10 Hz geophones, 10-foot stepout and RayFract 3.15 software.

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DRN	HLK	5/8/18
DES	HLK	5/8/18
CHK	PJH	5/10/18
REV		
PROJ. MGR.	HLK	5/8/18

SCALE: As Noted

SOURCE:

PROJECT:
Geophysical Investigation
Seneca Wind Project
Seneca Co, Ohio

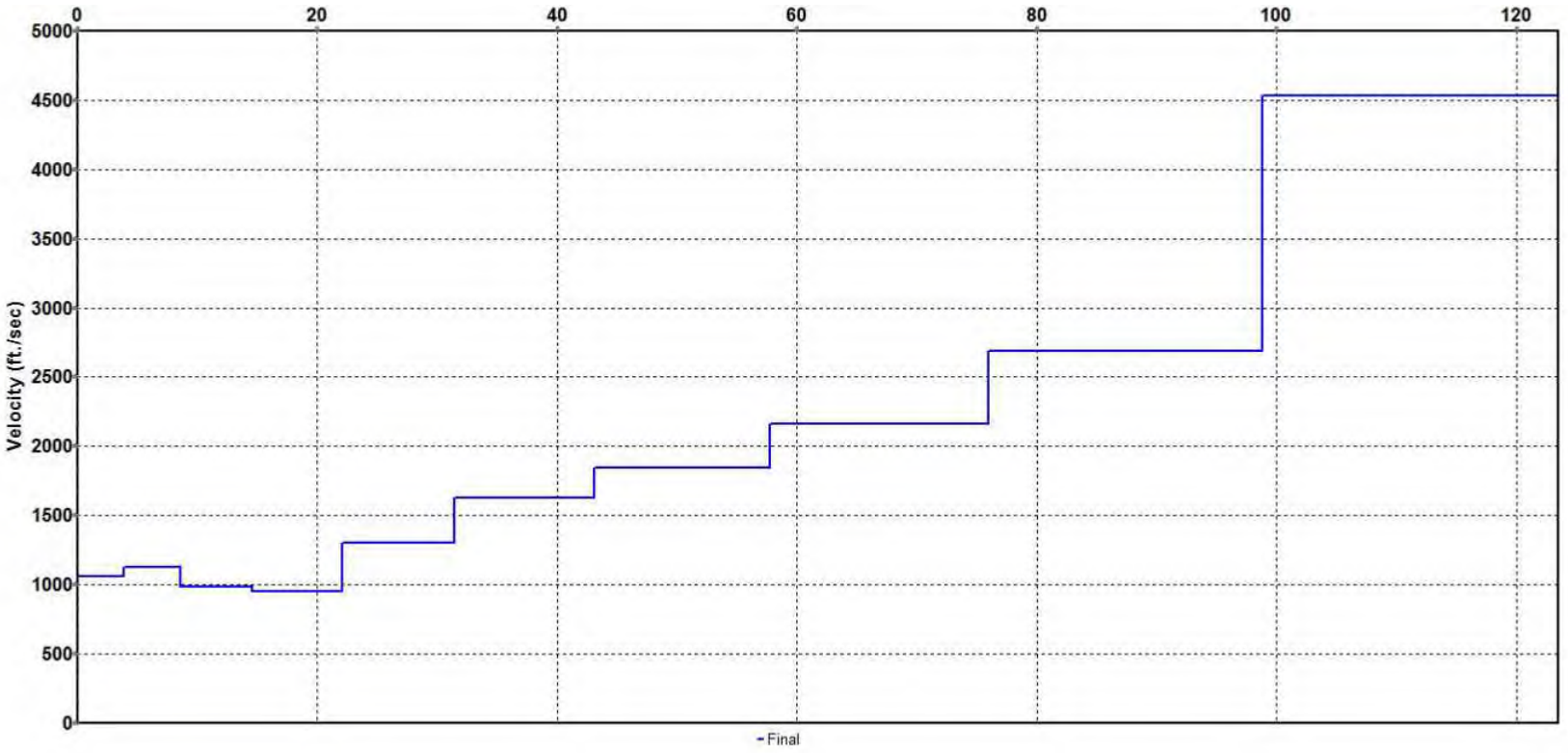
DRAWING NO:
Figure 1
Site Layout

PREPARED FOR: BARR

PROJECT NO: 881-6820

SHEET TITLE: DWG6820F1

s-Wave Velocity Profile
Depth (feet)



s-WAVE VELOCITY

Depth (ft)	Velocity (ft/s)
-3.8	1,059
-8.6	1,128
-14.6	987
-22.1	955
-31.4	1,299
-43.1	1,629
-57.7	1,842
-76.0	2,163
-98.8	2,691
-123.5	4,529

Notes

Geophysical survey conducted April 30 - May 1, 2018.

MASW data collected using Geometrics Geode 24-channel seismograph, 4.5 Hz geophones, 5-ft stepout and SurfSeis 4.24 software.

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DRN	HLK	5/8/18
DES	HLK	5/8/18
CHK	PJH	5/10/18
REV		
PROJ. MGR.	HLK	5/8/18

SCALE: As Noted

SOURCE:

PROJECT:
Geophysical Investigation
Seneca Wind Project
Seneca Co., Ohio

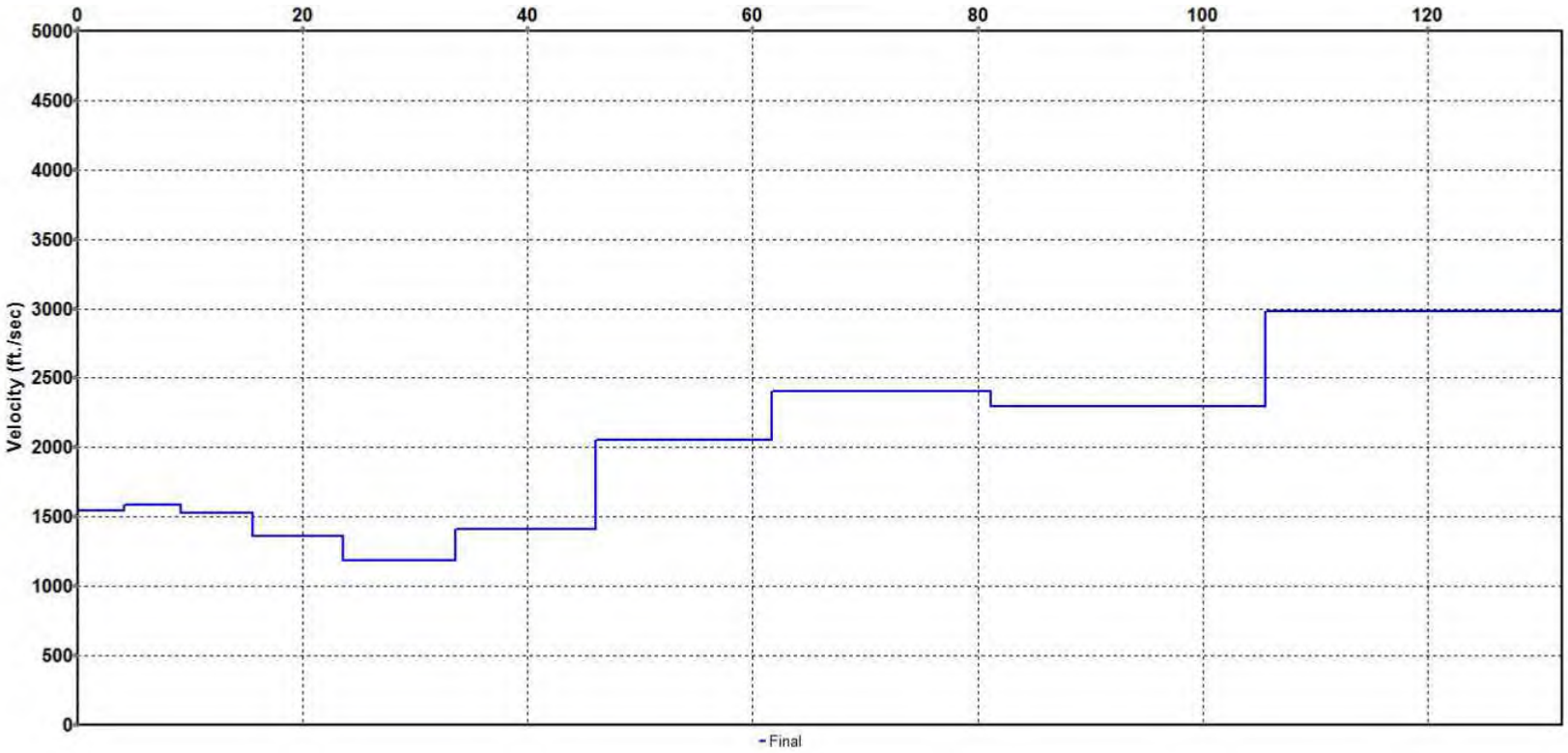
DRAWING NO:
Figure 2
s-Wave Velocity Profile
GEO-003

PREPARED FOR: BARR

PROJECT NO: 881-6820

SHEET TITLE: DWG6820F2

s-Wave Velocity Profile
Depth (feet)



s-WAVE VELOCITY

Depth (ft)	Velocity (ft/s)
-4.1	1,542
-9.2	1,585
-15.6	1,530
-23.6	1,357
-33.6	1,186
-46.1	1,413
-61.7	2,050
-81.2	2,403
-105.6	2,297
-132.0	2,981

Notes

Geophysical survey conducted April 30 - May 1, 2018.

MASW data collected using Geometrics Geode 24-channel seismograph, 4.5 Hz geophones, 5-ft stepout and SurfSeis 4.24 software.

Seismic refraction data collected using Geometrics Geode 24-channel seismograph, 10 Hz geophones, 10-foot stepout and RayFract 3.15 software.

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DRN	HLK	5/8/18
DES	HLK	5/8/18
CHK	PJH	5/10/18
REV		
PROJ. MGR.	HLK	5/8/18

SCALE: As Noted

SOURCE:

PROJECT:
Geophysical Investigation
Seneca Wind Project
Seneca Co., Ohio

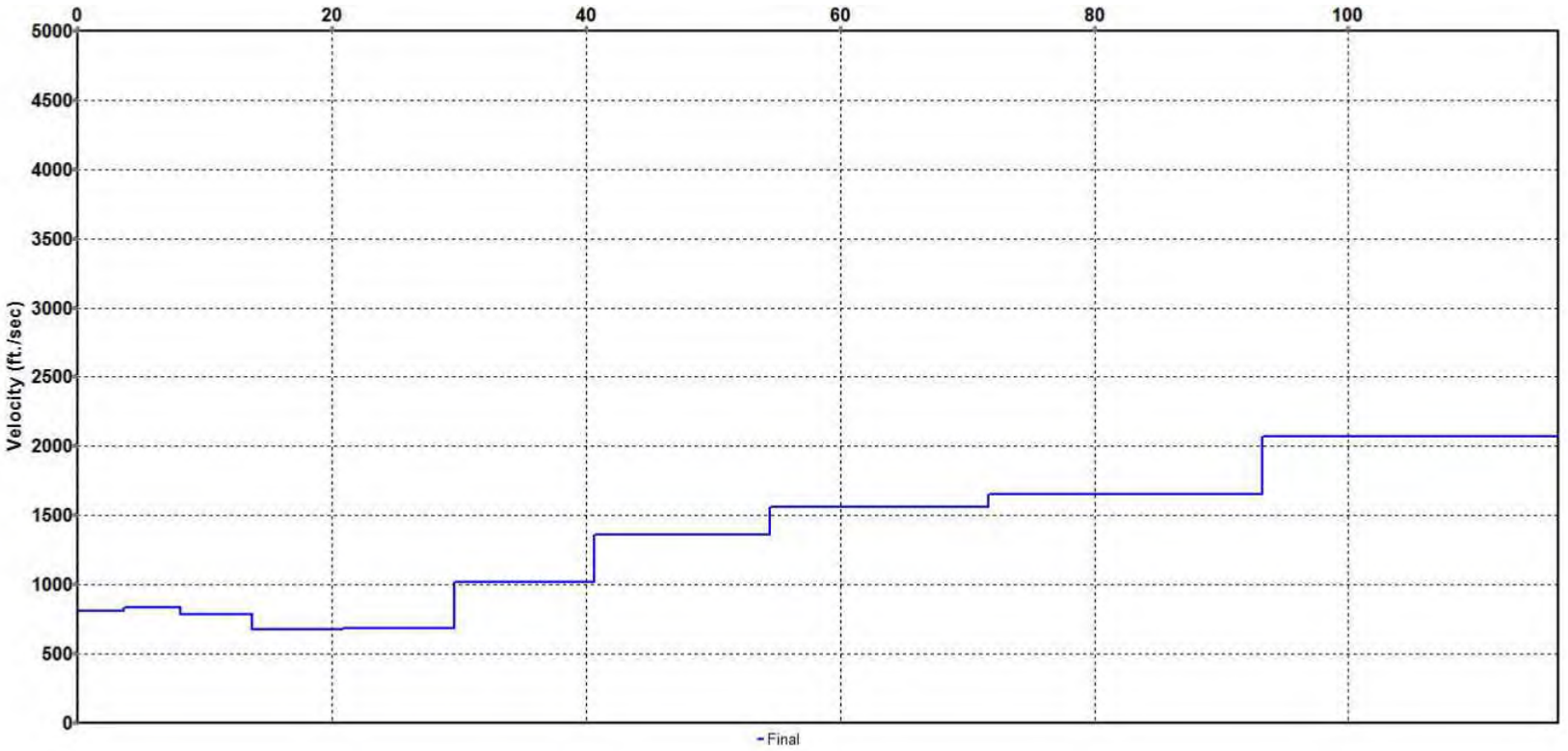
DRAWING NO:
Figure 3
s-Wave Velocity Profile
GEO-013

PREPARED FOR: BARR

PROJECT NO: 881-6820

SHEET TITLE: DWG6820F3

s-Wave Velocity Profile
Depth (feet)



s-WAVE VELOCITY

Depth (ft)	Velocity (ft/s)
-3.6	807
-8.1	831
-13.8	782
-20.8	673
-29.7	685
-40.7	1,021
-54.5	1,360
-71.7	1,564
-93.2	1,651
-116.5	2,070

Notes

Geophysical survey conducted April 30 - May 1, 2018.

MASW data collected using Geometrics Geode 24-channel seismograph, 4.5 Hz geophones, 5-ft stepout and SurfSeis 4.24 software.

Seismic refraction data collected using Geometrics Geode 24-channel seismograph, 10 Hz geophones, 10-foot stepout and RayFract 3.15 software.

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DRN	HLK	5/8/18
DES	HLK	5/8/18
CHK	PJH	5/10/18
REV		
PROJ. MGR.	HLK	5/8/18

SCALE: As Noted

SOURCE:

PROJECT:
Geophysical Investigation
Seneca Wind Project
Seneca Co., Ohio

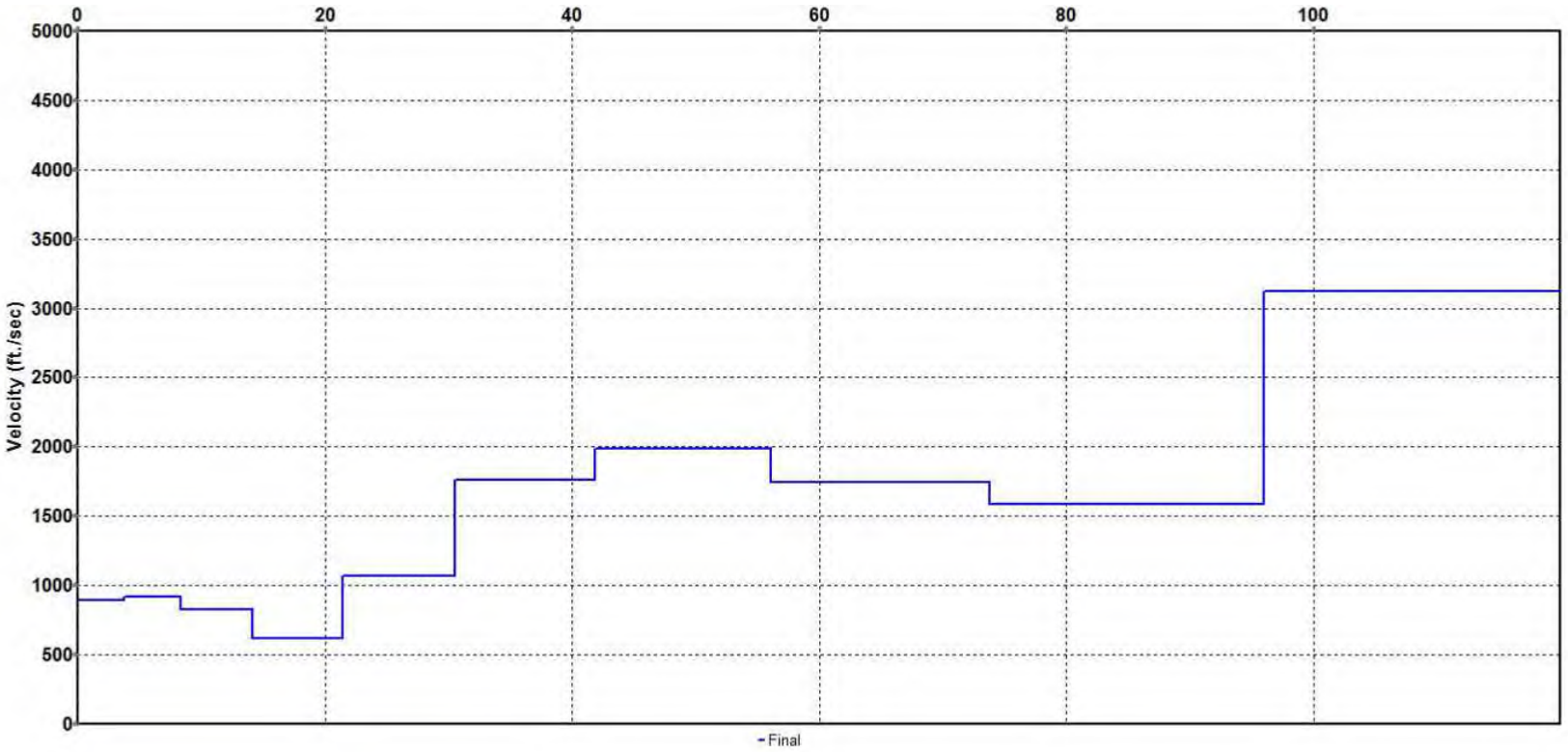
DRAWING NO:
Figure 4
s-Wave Velocity Profile
GEO-033

PREPARED FOR: BARR

PROJECT NO: 881-6820

SHEET TITLE: DWG6820F4

s-Wave Velocity Profile
Depth (feet)



s-WAVE VELOCITY

Depth (ft)	Velocity (ft/s)
-3.7	894
-8.4	918
-14.2	830
-21.4	617
-30.5	1,067
-41.9	1,762
-56.1	1,984
-73.8	1,746
-96.0	1,584
-120.0	3,123

Notes

Geophysical survey conducted April 30 - May 1, 2018.

MASW data collected using Geometrics Geode 24-channel seismograph, 4.5 Hz geophones, 5-ft stepout and SurfSeis 4.24 software.

Seismic refraction data collected using Geometrics Geode 24-channel seismograph, 10 Hz geophones, 10-foot stepout and RayFract 3.15 software.

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DRN	HLK	5/8/18
DES	HLK	5/8/18
CHK	PJH	5/10/18
REV		
PROJ. MGR.	HLK	5/8/18

SCALE: As Noted

SOURCE:

PROJECT:
Geophysical Investigation
Seneca Wind Project
Seneca Co., Ohio

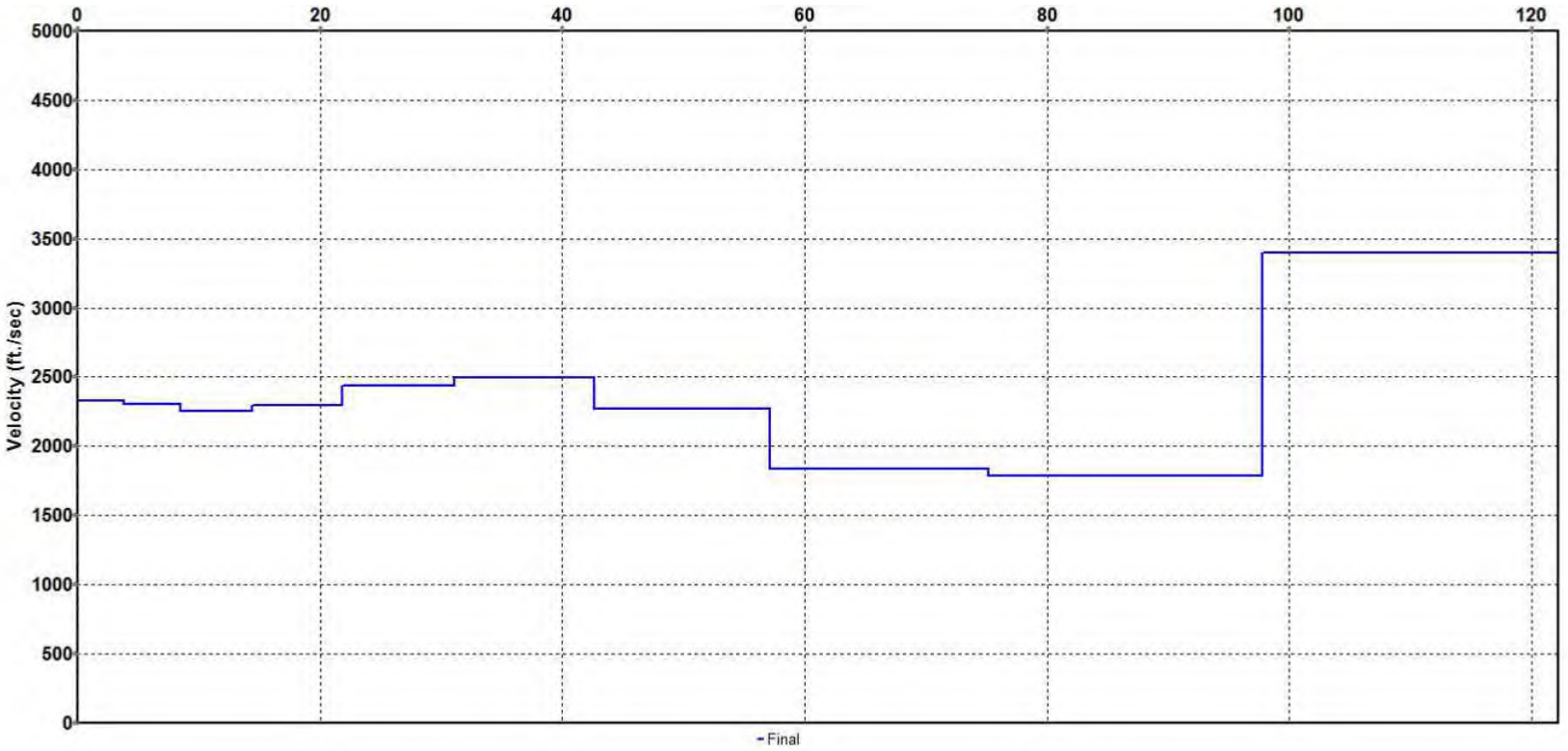
DRAWING NO:
Figure 5
s-Wave Velocity Profile
GEO-061

PREPARED FOR: BARR

PROJECT NO: 881-6820

SHEET TITLE: DWG6820F5

s-Wave Velocity Profile
Depth (feet)



s-WAVE VELOCITY

Depth (ft)	Velocity (ft/s)
-3.8	2,328
-8.5	2,303
-14.4	2,251
-21.8	2,299
-31.1	2,439
-42.7	2,492
-57.1	2,272
-75.2	1,833
-97.8	1,784
-122.2	3,399

Notes

Geophysical survey conducted April 30 - May 1, 2018.

MASW data collected using Geometrics Geode 24-channel seismograph, 4.5 Hz geophones, 5-ft stepout and SurfSeis 4.24 software.

Seismic refraction data collected using Geometrics Geode 24-channel seismograph, 10 Hz geophones, 10-foot stepout and RayFract 3.15 software.

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DRN	HLK	5/8/18
DES	HLK	5/8/18
CHK	PJH	5/10/18
REV		
PROJ. MGR.	HLK	5/8/18

SCALE: As Noted

SOURCE:

PROJECT:
Geophysical Investigation
Seneca Wind Project
Seneca Co., Ohio

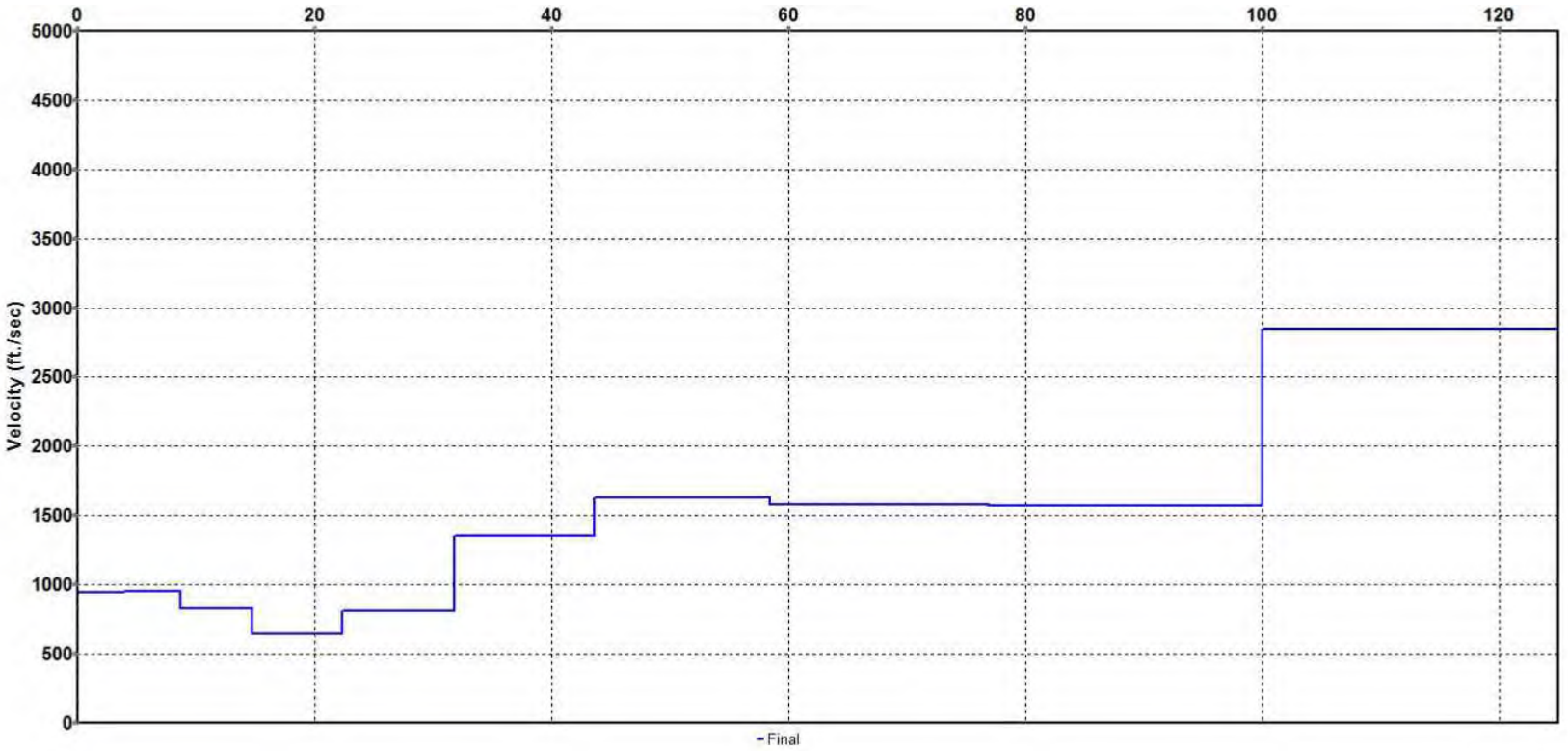
DRAWING NO:
Figure 6
s-Wave Velocity Profile
GEO-066

PREPARED FOR: BARR

PROJECT NO: 881-6820

SHEET TITLE: DWG6820F6

s-Wave Velocity Profile
Depth (feet)



s-WAVE VELOCITY

Depth (ft)	Velocity (ft/s)
-3.9	944
-8.7	952
-14.8	830
-22.3	643
-31.8	810
-43.6	1,353
-58.4	1,629
-76.9	1,576
-100.0	1,573
-125.0	2,846

Notes

Geophysical survey conducted April 30 - May 1, 2018.

MASW data collected using Geometrics Geode 24-channel seismograph, 4.5 Hz geophones, 5-ft stepout and SurfSeis 4.24 software.

Seismic refraction data collected using Geometrics Geode 24-channel seismograph, 10 Hz geophones, 10-foot stepout and RayFract 3.15 software.

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DRN	HLK	5/8/18
DES	HLK	5/8/18
CHK	PJH	5/10/18
REV		
PROJ. MGR.	HLK	5/8/18

SCALE: As Noted

SOURCE:

PROJECT:
Geophysical Investigation
Seneca Wind Project
Seneca Co., Ohio

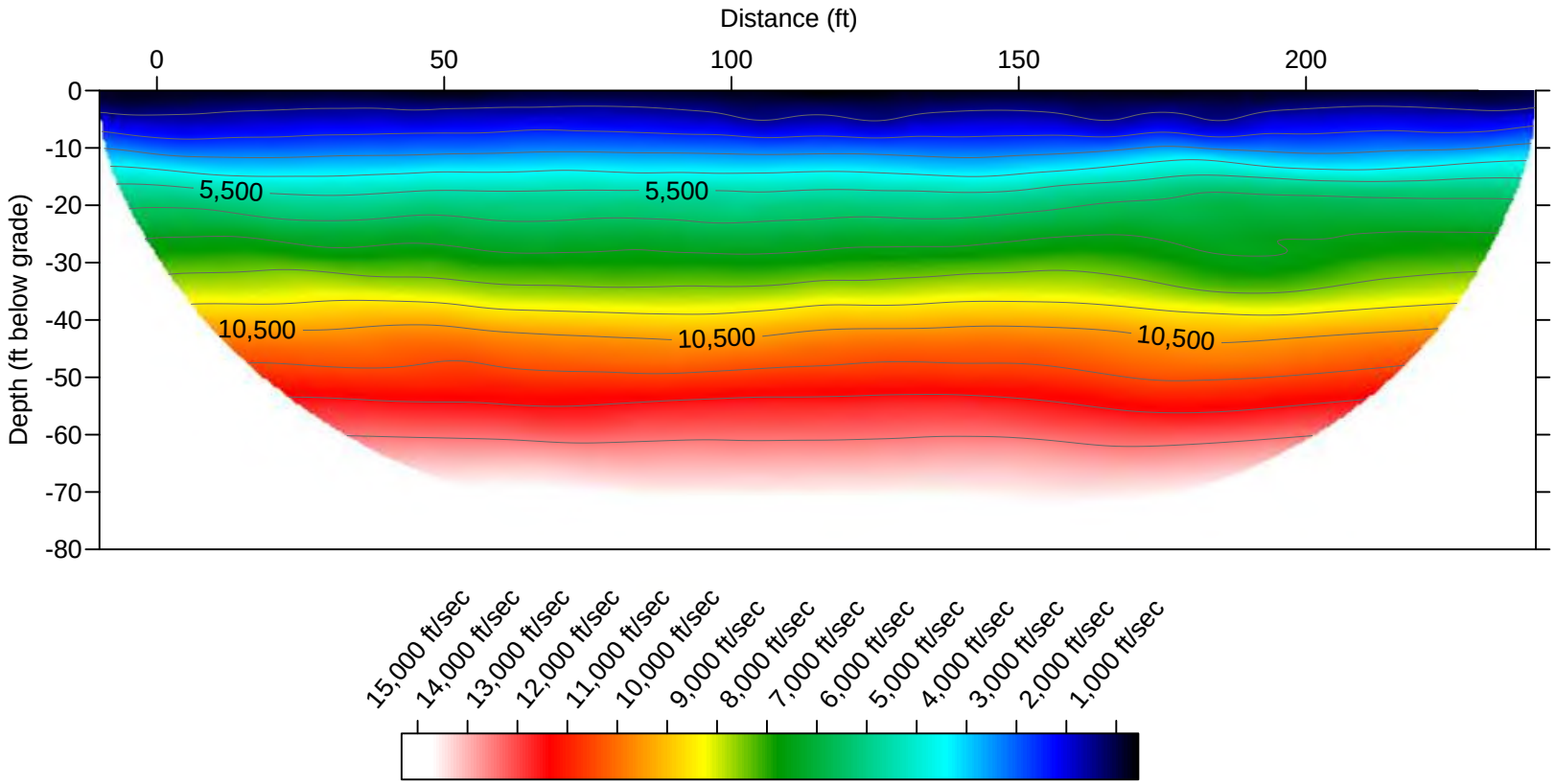
DRAWING NO:
Figure 7
s-Wave Velocity Profile
GEO-085

PREPARED FOR: BARR

PROJECT NO: 881-6820

SHEET TITLE: DWG6820F7

p-Wave Velocity Profile



p-WAVE VELOCITY

Depth (ft)	Velocity (ft/s)
-10	3,169
-20	6,125
-30	7,903
-40	10,121
-50	11,844
-60	13,365
-70	14,644

Notes

Geophysical survey conducted April 30 - May 1, 2018.

MASW data collected using Geometrics Geode 24-channel seismograph, 4.5 Hz geophones, 5-ft stepout and SurfSeis 4.24 software.

Seismic refraction data collected using Geometrics Geode 24-channel seismograph, 10 Hz geophones, 10-foot stepout and RayFract 3.15 software.

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DRN	HLK	5/8/18
DES	HLK	5/8/18
CHK	PJH	5/10/18
REV		
PROJ. MGR.	HLK	5/8/18

SCALE: As Noted

SOURCE:

PROJECT:
Geophysical Investigation
Seneca Wind Project
Seneca Co, Ohio

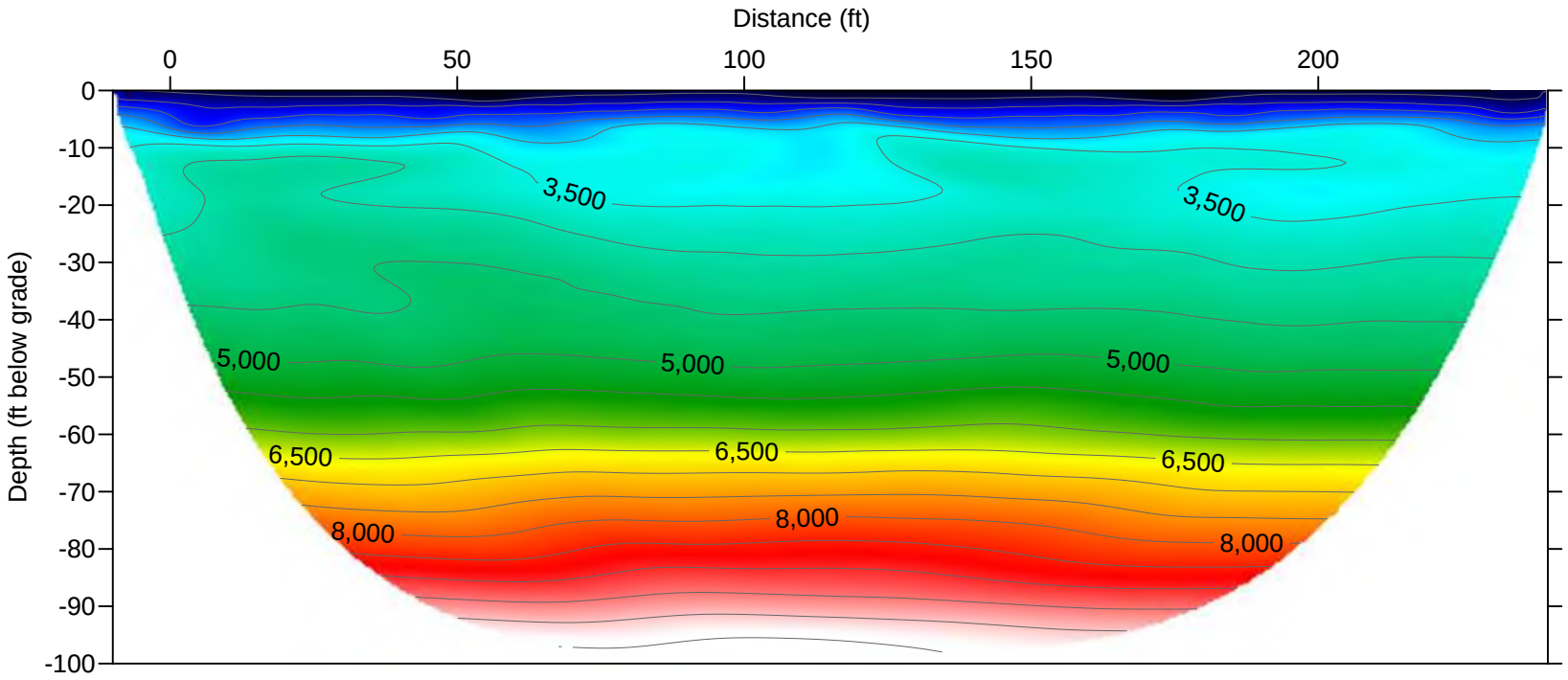
DRAWING NO:
Figure 8
p-Wave Velocity Profile
GEO-003

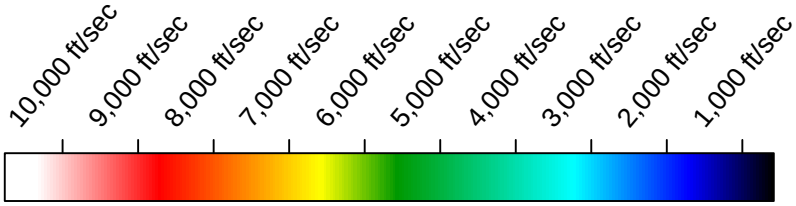
PREPARED FOR: BARR

PROJECT NO: 881-6820

SHEET TITLE: DWG6820F8

p-Wave Velocity Profile





p-WAVE VELOCITY

Depth (ft)	Velocity (ft/s)
-10	3,126
-20	3,499
-30	4,076
-40	4,579
-50	5,190
-60	6,113
-70	7,450
-80	8,671
-90	9,705

Notes

Geophysical survey conducted April 30 - May 1, 2018.

MASW data collected using Geometrics Geode 24-channel seismograph, 4.5 Hz geophones, 5-ft stepout and SurfSeis 4.24 software.

Seismic refraction data collected using Geometrics Geode 24-channel seismograph, 10 Hz geophones, 10-foot stepout and RayFract 3.15 software.

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DRN	HLK	5/8/18
DES	HLK	5/8/18
CHK	PJH	5/10/18
REV		
PROJ. MGR.	HLK	5/8/18

SCALE: As Noted

SOURCE:

PROJECT:
Geophysical Investigation
Seneca Wind Project
Seneca Co, Ohio

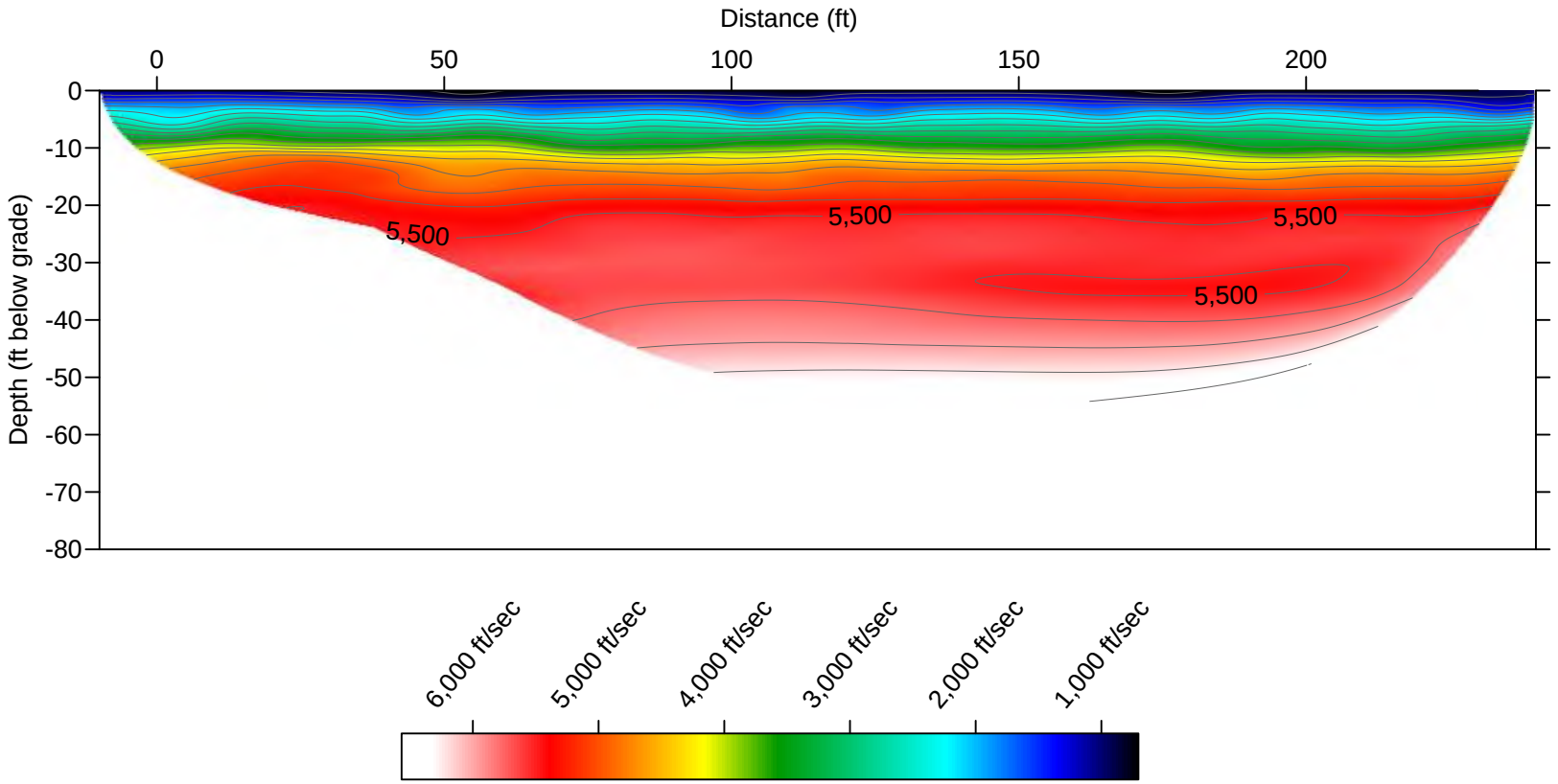
DRAWING NO:
Figure 9
p-Wave Velocity Profile
GEO-013

PREPARED FOR: BARR

PROJECT NO: 881-6820

SHEET TITLE: DWG6820F9

p-Wave Velocity Profile



p-WAVE VELOCITY

Depth (ft)	Velocity (ft/s)
-10	3,992
-20	5,344
-30	5,647
-40	5,865
-50	6,312

Notes

Geophysical survey conducted April 30 - May 1, 2018.

MASW data collected using Geometrics Geode 24-channel seismograph, 4.5 Hz geophones, 5-ft stepout and SurfSeis 4.24 software.

Seismic refraction data collected using Geometrics Geode 24-channel seismograph, 10 Hz geophones, 10-foot stepout and RayFract 3.15 software.

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DRN	HLK	5/8/18
DES	HLK	5/8/18
CHK	PJH	5/10/18
REV		
PROJ. MGR.	HLK	5/8/18

SCALE: As Noted

SOURCE:

PROJECT:
Geophysical Investigation
Seneca Wind Project
Seneca Co, Ohio

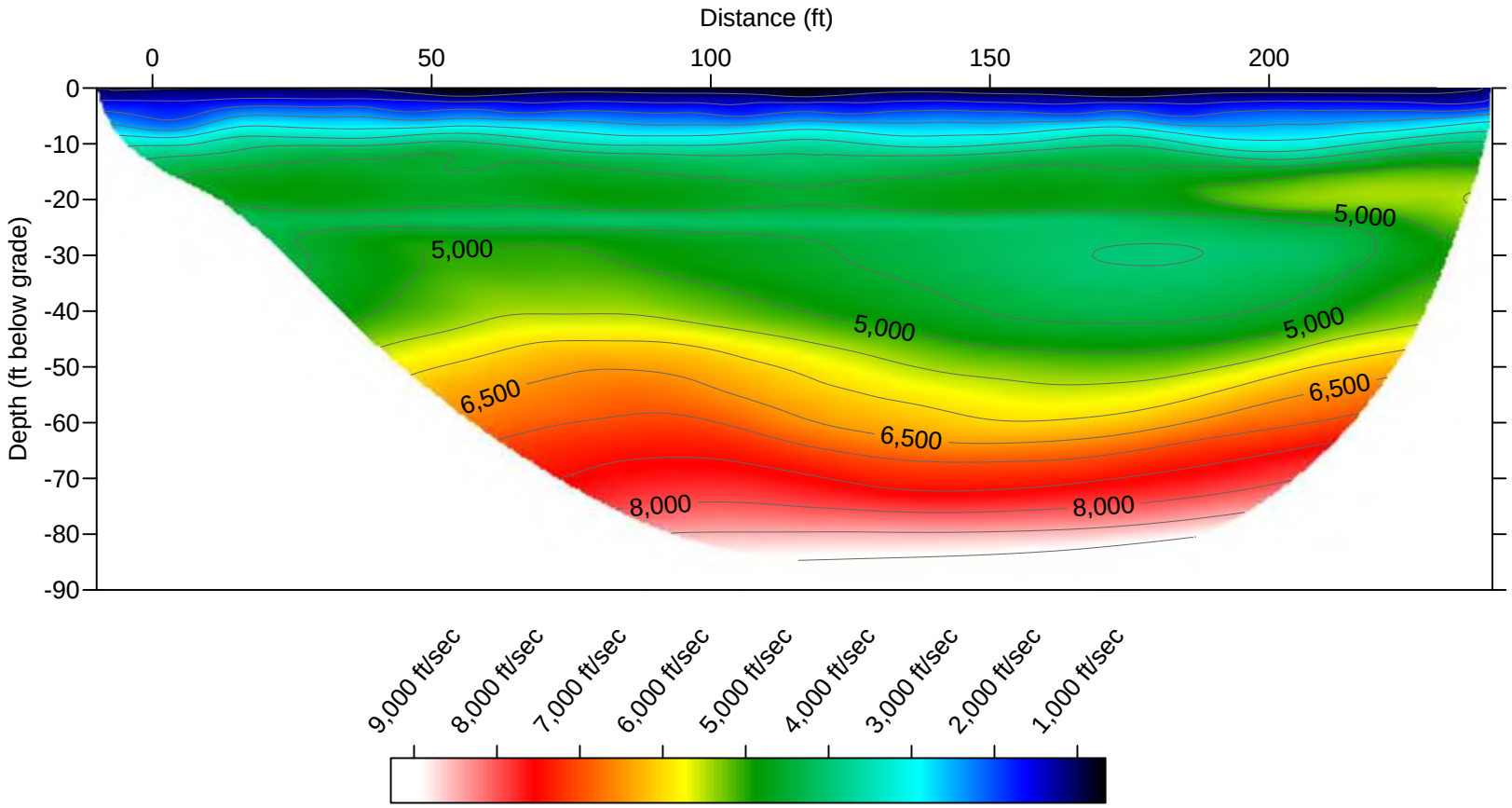
DRAWING NO:
Figure 10
p-Wave Velocity Profile
GEO-033

PREPARED FOR: BARR

PROJECT NO: 881-6820

SHEET TITLE: DWG6820F10

p-Wave Velocity Profile



p-WAVE VELOCITY

Depth (ft)	Velocity (ft/s)
-10	3,803
-20	4,519
-30	4,597
-40	5,007
-50	5,923
-60	6,618
-70	7,585
-80	8,489

Notes

Geophysical survey conducted April 30 - May 1, 2018.

MASW data collected using Geometrics Geode 24-channel seismograph, 4.5 Hz geophones, 5-ft stepout and SurfSeis 4.24 software.

Seismic refraction data collected using Geometrics Geode 24-channel seismograph, 10 Hz geophones, 10-foot stepout and RayFract 3.15 software.

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DRN	HLK	5/8/18
DES	HLK	5/8/18
CHK	PJH	5/10/18
REV		
PROJ. MGR.	HLK	5/8/18

SCALE: As Noted

SOURCE:

PROJECT:
Geophysical Investigation
Seneca Wind Project
Seneca Co, Ohio

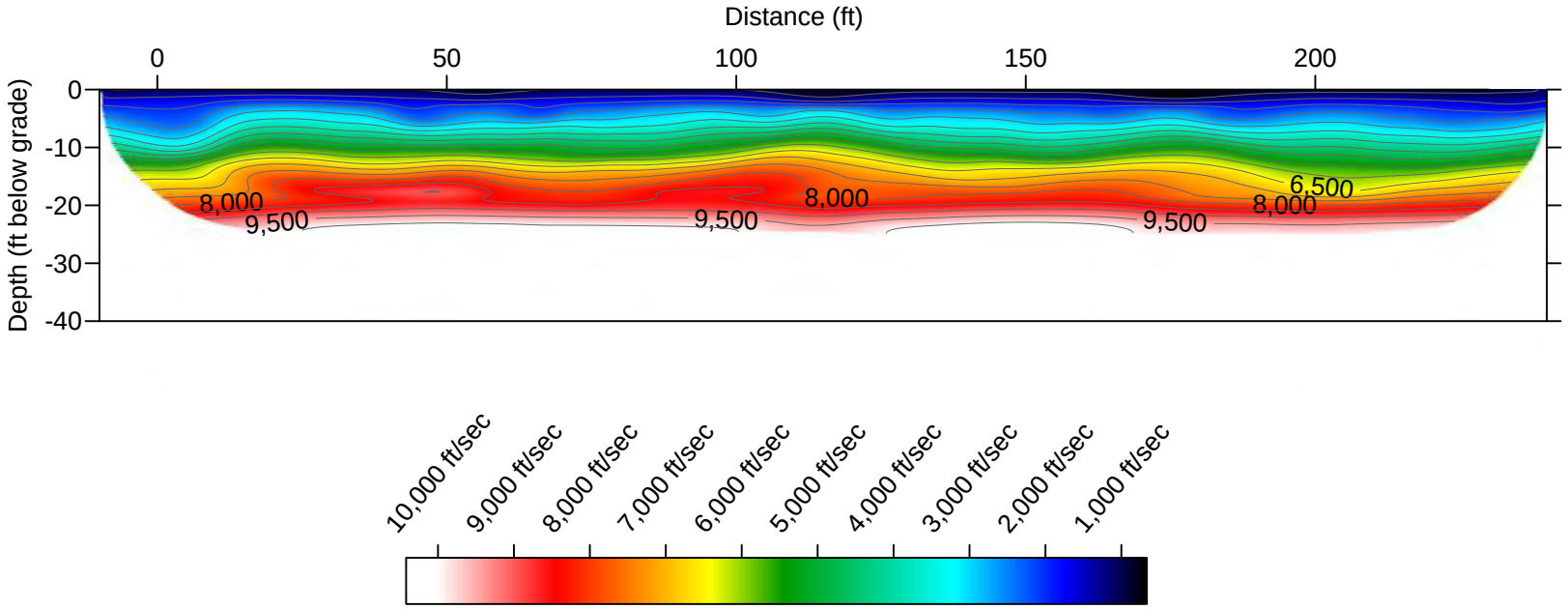
DRAWING NO:
Figure 11
p-Wave Velocity Profile
GEO-061

PREPARED FOR: BARR

PROJECT NO: 881-6820

SHEET TITLE: DWG6820F11

p-Wave Velocity Profile



p-WAVE VELOCITY

Depth (ft)	Velocity (ft/s)
-10	6,209
-20	8,340

Notes

Geophysical survey conducted April 30 - May 1, 2018.

MASW data collected using Geometrics Geode 24-channel seismograph, 4.5 Hz geophones, 5-ft stepout and SurfSeis 4.24 software.

Seismic refraction data collected using Geometrics Geode 24-channel seismograph, 10 Hz geophones, 10-foot stepout and RayFract 3.15 software.

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DRN	HLK	5/8/18
DES	HLK	5/8/18
CHK	PJH	5/10/18
REV		
PROJ. MGR.	HLK	5/8/18

SCALE: As Noted

SOURCE:

PROJECT:
Geophysical Investigation
Seneca Wind Project
Seneca Co, Ohio

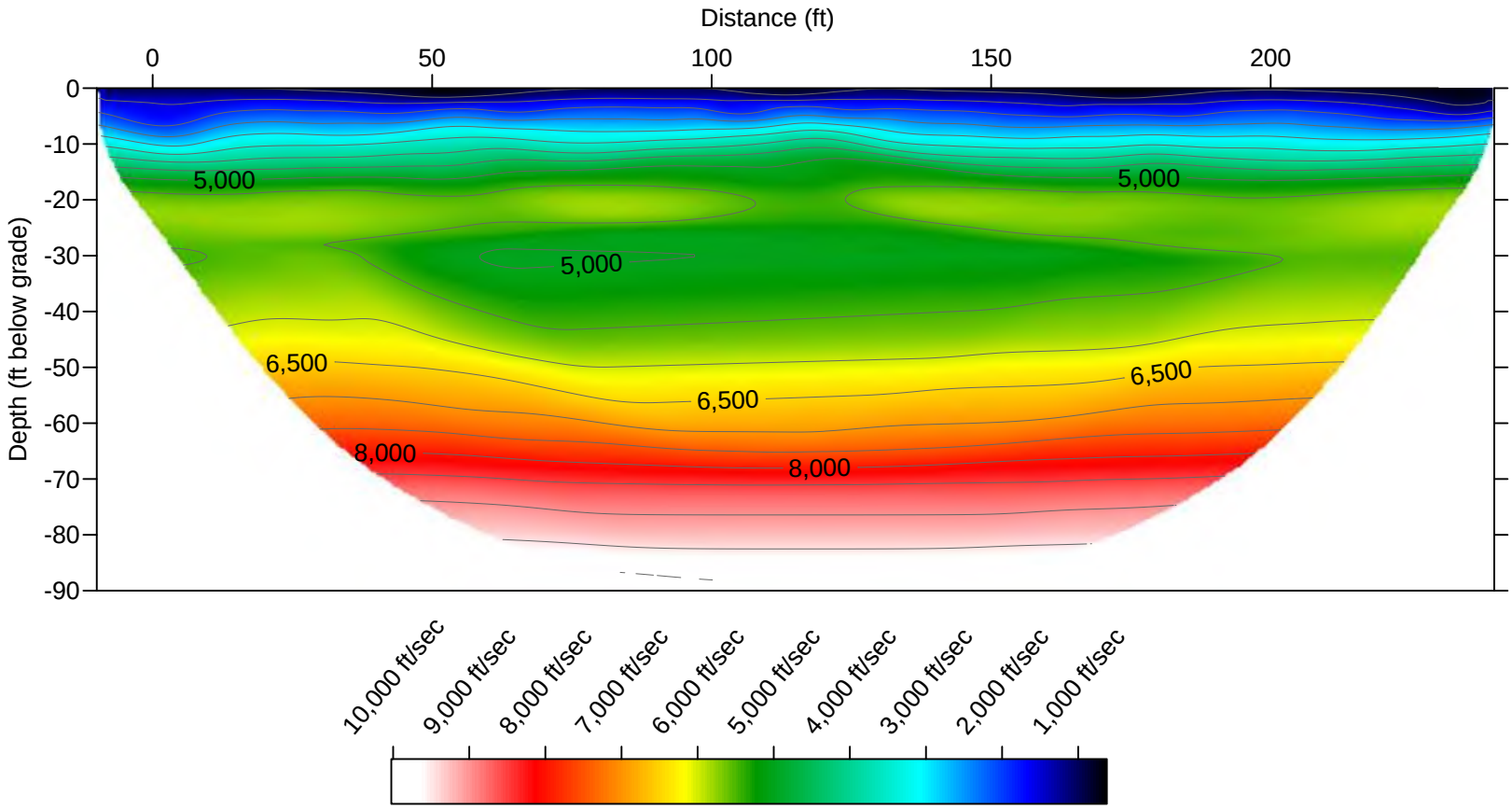
DRAWING NO:
Figure 12
p-Wave Velocity Profile
GEO-066

PREPARED FOR: BARR

PROJECT NO: 881-6820

SHEET TITLE: DWG6820F12

p-Wave Velocity Profile



p-WAVE VELOCITY

Depth (ft)	Velocity (ft/s)
-10	4,232
-20	5,431
-30	5,018
-40	5,444
-50	6,079
-60	6,861
-70	8,371
-80	9,252

Notes

Geophysical survey conducted April 30 - May 1, 2018.

MASW data collected using Geometrics Geode 24-channel seismograph, 4.5 Hz geophones, 5-ft stepout and SurfSeis 4.24 software.

Seismic refraction data collected using Geometrics Geode 24-channel seismograph, 10 Hz geophones, 10-foot stepout and RayFract 3.15 software.

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DRN	HLK	5/8/18
DES	HLK	5/8/18
CHK	PJH	5/10/18
REV		
PROJ. MGR.	HLK	5/8/18

SCALE: As Noted

SOURCE:

PROJECT:
Geophysical Investigation
Seneca Wind Project
Seneca Co, Ohio

DRAWING NO:
Figure 13
p-Wave Velocity Profile
GEO-085

PREPARED FOR: BARR

PROJECT NO: 881-6820

SHEET TITLE: DWG6820F13

Appendix D

Physical Laboratory Test Results

Moisture Contents

Water Content Test Summary (ASTM:D2216)

Project: Seneca Wind Job: 11376

Client Barr Engineering Company Date: 4/18/2018

Sample Information & Classification								
Boring #	Geo-001	Geo-001	Geo-003	Geo-014	Geo-014	Geo-018	Geo-019	Geo-020
Sample #								
Depth (ft)	24-25.5	35-36.5	15-16.5	10-11.5	35-36.5	7.5-9	7.5-9	7.5-9
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Sandy Lean Clay (CL)	Sand w/gravel (SP/SP-SM)	Clayey Sand w/a little gravel (SC)	Sandy Lean Clay w/a little gravel (CL)	Lean Clay w/sand (CL)
Water Content (%)	17.3	16.7	12.3	16.6	13.6	17.3	19.6	17.1

Sample Information & Classification								
Boring #	Geo-020	Geo-021	Geo-022	Geo-022	Geo-045	Geo-047	Geo-051	Geo-051
Sample #								
Depth (ft)	15-16.5	7.5-9	12.5-14	20-20.5	10-11.5	20-21.5	10-11.5	20-21.5
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Lean Clay w/sand (CL)	Sandy Lean Clay (CL)	Lean Clay w/sand (CL)	Gravel (GP)	Clayey Sand w/gravel (SC)	Sandy Lean Clay w/gravel (CL/SC)	Sandy Lean Clay (CL)	Clayey Sand w/gravel (SC/SP-SC)
Water Content (%)	15.3	16.2	12.0	13.0	19.6	13.8	16.3	14.7

Sample Information & Classification								
Boring #	Geo-53	Geo-053	Geo-053	Geo-053	Geo-068	Geo-078	Geo-084	Geo-086
Sample #								
Depth (ft)	15-17.5	25-26.5	45-46.5	55-56.5	10-11.5	5-6.5	10-11.5	5-6.5
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Gravel w/sand and silt (GP-GM)	Sand (SP/SP-SM)	Sandy Lean Clay (CL)	Clayey Sand w/gravel (SC)	Sandy Silt w/gravel (ML)	Sandy Lean Clay (CL)	Lean Clay (CL)	Lean Clay w/sand (CL)
Water Content (%)	4.9	18.5	14.4	9.5	17.6	19.8	19.3	18.3

Sample Information & Classification								
Boring #	Geo-089	Geo-094	Geo-094	Geo-096				
Sample #								
Depth (ft)	15-16.5	10-11.5	20-21.5	7.5-9				
Type	Bag	Bag	Bag	Bag				
Material Classification	Lean Clay w/sand and a trace of gravel (CL)	Lean Clay w/sand (CL)	Clayey Gravel (GC)	Sandy Silt (ML/CL-ML)				
Water Content (%)	13.7	14.2	12.3	17.8				

Water Content Test Summary (ASTM:D2216)

Project: Seneca Wind Job: 11376

Client Barr Engineering Company Date: 5/16/2018

Sample Information & Classification								
Boring #	Geo-002	Geo-002	Geo-002	Geo-002	Geo-002	Geo-004	Geo-004	Geo-004
Sample #								
Depth (ft)	7.5-9	15-16.5	30-31.5	45-46.5	55-56.5	7.5-9	15-16.5	35-36.5
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Sandy Lean Clay (CL)	Sandy Lean Clay (CL)	Sandy Lean Clay (CL)	Silty Sand w/a little gravel (SM)	Sandy Lean Clay w/a little gravel (CL)	Sandy Lean Clay w/a little gravel (CL)	Sandy Lean Clay (CL)	Sandy Lean Clay (CL)
Water Content (%)	16.3	16.2	16.6	4.6	12.8	15.8	14.6	18.5
Sample Information & Classification								
Boring #	Geo-005	Geo-005	Geo-005	Geo-006	Geo-006	Geo-006	Geo-006	Geo-007
Sample #								
Depth (ft)	12.5-14	20-21.5	35-36.5	10-11.5	30-31.5	40-41.5	55-57	7.5-9
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Sandy Lean Clay (CL)	Sandy Lean Clay w/a little gravel (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Sandy Lean Clay w/a little gravel (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Sandy Lean Clay (CL)	Sandy Lean Clay (CL)	Sandy Lean Clay w/a trace of gravel (CL)
Water Content (%)	15.9	16.7	16.4	16.7	16.2	15.7	16.9	16.6
Sample Information & Classification								
Boring #	Geo-007	Geo-007	Geo-008	Geo-008	Geo-008	Geo-013	Geo-013	Geo-013
Sample #								
Depth (ft)	12.5-14	25-26.5	10-11.5	15-16.5	30-31.5	7.5-9	20-21.5	30-31.5
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Sandy Lean Clay (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Sandy Lean Clay (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Sandy Lean Clay w/gravel (CL)	Lean Clay w/sand (CL)	Gravel w/silt and sand (GP-GM)
Water Content (%)	15.3	15.0	18.2	17.5	14.2	15.8	14.5	11.3
Sample Information & Classification								
Boring #	Geo-013	Geo-013	Geo-015	Geo-015	Geo-015	Geo-015	Geo-015	Geo-016
Sample #								
Depth (ft)	40-41.5	50-51.5	7.5-9	15-16.5	25-26.5	40-41.5	48-48.5	10-11.5
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Sandy Lean Clay (CL)	Clayey Sand w/gravel (SC)	Lean Clay w/sand (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Sandy Lean Clay w/gravel (CL)	Clayey Gravel (GC)	Clayey Sand w/gravel (SC)	Sandy Lean Clay w/a trace of gravel (CL)
Water Content (%)	24.2	11.6	16.8	18.1	16.3	8.9	12.6	15.0

9530 James Ave South

SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

Water Content Test Summary (ASTM:D2216)

Project: Seneca Wind Job: 11376

Client Barr Engineering Company Date: 5/16/2018

Sample Information & Classification								
Boring #	Geo-016	Geo-016	Geo-016	Geo-024	Geo-024	Geo-024	Geo-024	Geo-024
Sample #								
Depth (ft)	20-21.5	30-31.5	45-46.5	7.5-9	12.5-14	20-21.5	30-31.5	40-41.5
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Sandy Lean Clay (CL)	Lean Clay w/sand (CL)	Gravel w/sand and silt (GP-GM)	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Sand w/silt (SP-SM)
Water Content (%)	17.1	18.3	5.4	18.5	18.0	20.9	13.9	17.7

Sample Information & Classification								
Boring #	Geo-025	Geo-025	Geo-025	Geo-030	Geo-030	Geo-030	Geo-030	Geo-031
Sample #								
Depth (ft)	7.5-9	15-16.5	30-31.5	10-11.5	20-21.5	30-31.5	40-41.5	7.5-9
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Silty Sand (SM)	Sandy Lean Clay (CL)	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Silty Sand (SM)	Sandy Lean Clay (CL)
Water Content (%)	17.2	17.1	14.5	10.3	18.0	15.1	15.0	16.6

Sample Information & Classification								
Boring #	Geo-031	Geo-031	Geo-033	Geo-033	Geo-033	Geo-033	Geo-033	Geo-034
Sample #								
Depth (ft)	15-16.5	25-26.5	10-11.5	20-21.5	35-36.5	45-46.5	60-61.5	7.5-9
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Lean Clay w/sand (CL)	Silty Sand w/gravel (SM)	Sandy Lean Clay w/a little gravel (CL)	Lean Clay w/sand and a trace of gravel (CL)	Lean Clay w/sand and a trace of gravel (CL)	Lean Clay w/sand (CL)	Sandy Silt (ML)	Sandy Lean Clay w/a little gravel (CL)
Water Content (%)	16.3	23.1	16.2	16.8	16.4	16.0	23.7	15.5

Sample Information & Classification								
Boring #	Geo-034	Geo-034	Geo-034	Geo-034	Geo-035	Geo-035	Geo-035	Geo-035
Sample #								
Depth (ft)	12.5-14	20-21.5	35-36.5	50-51.5	10-11.5	20-21.5	30-31.5	50-51.5
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Clayey Sand (SC)	Sandy Lean Clay (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Sandy Lean Clay w/a trace of gravel (CL)
Water Content (%)	16.2	16.4	17.6	13.9	15.7	17.6	17.0	16.4

Water Content Test Summary (ASTM:D2216)

Project: Seneca Wind Job: 11376

Client Barr Engineering Company Date: 5/16/2018

Sample Information & Classification								
Boring #	Geo-035	Geo-036	Geo-036	Geo-036	Geo-036	Geo-037	Geo-037	Geo-037
Sample #								
Depth (ft)	60-61.5	10-11.5	25-26.5	40	55	10-11.5	25-26.5	40-41.5
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Sandy Lean Clay w/a trace of gravel (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Silty Sand w/gravel (SM)	Sandy Lean Clay (CL)	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)
Water Content (%)	16.5	16.3	17.9	17.0	7.2	17.3	17.0	17.0
Sample Information & Classification								
Boring #	Geo-037	Geo-038	Geo-038	Geo-038	Geo-038	Geo-038	Geo-039	Geo-039
Sample #								
Depth (ft)	55-56.5	10-11.5	20-21.5	35-36.5	45-46.5	60-61.5	7.5-9	15-16.5
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Sand w/silt (SP-SM)	Sandy Lean Clay (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Sandy Lean Clay (CL)	Sandy Lean Clay (CL)	Clayey Gravel (GC)	Sandy Lean Clay (CL)	Sandy Lean Clay (CL)
Water Content (%)	18.3	19.3	17.0	16.6	11.1	7.0	16.9	14.8
Sample Information & Classification								
Boring #	Geo-039	Geo-039	Geo-040	Geo-040	Geo-040	Geo-040	Geo-040	Geo-040
Sample #								
Depth (ft)	25-26.5	40-41.5	10-11.5	15-16.5	25-26.5	35-36.5	50-51.5	60-61.5
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Sandy Lean Clay (CL)	Sandy Lean Clay (CL)	Sandy Lean Clay (CL)	Sandy Lean Clay (CL)	Sandy Lean Clay (CL)	Sandy Lean Clay (CL)	Lean Clay w/sand (CL)	Gravel w/clay and silt (GC-GM)
Water Content (%)	14.9	13.0	16.5	16.0	16.3	17.1	17.8	11.2
Sample Information & Classification								
Boring #	Geo-041	Geo-041	Geo-041	Geo-041	Geo-041	Geo-043	Geo-043	Geo-043
Sample #								
Depth (ft)	7.5-9	20-21.5	30-31.5	40-41.5	55-56.5	7.5-9	15-16.5	25-26.5
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Sandy Lean Clay w/a little gravel (CL)	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Sandy Lean Clay (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Lean Clay w/sand and a trace of gravel (CL)	Lean Clay w/sand (CL)
Water Content (%)	13.1	17.4	17.1	15.8	14.6	15.4	13.0	17.9

Water Content Test Summary (ASTM:D2216)

Project: Seneca Wind Job: 11376

Client Barr Engineering Company Date: 5/16/2018

Sample Information & Classification								
Boring #	Geo-043	Geo-043	Geo-044	Geo-044	Geo-044	Geo-044	Geo-044	Geo-044
Sample #								
Depth (ft)	35-36.5	50-51.5	7.5-9	12.5-14	20-21.5	35-36.5	45-46.5	60-61.5
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Lean Clay w/sand (CL)	Sandy Lean Clay (CL)	Sandy Lean Clay (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Lean Clay w/sand and a trace of gravel (CL)	Lean Clay w/sand (CL)	Sandy Lean Clay (CL)
Water Content (%)	18.8	17.3	15.1	15.9	17.7	18.5	16.7	10.5
Sample Information & Classification								
Boring #	Geo-056	Geo-056	Geo-056	Geo-056	Geo-059	Geo-059	Geo-059	Geo-059
Sample #								
Depth (ft)	7.5-9	15-16.5	25-26.5	45-46.5	7.5-9	12.5-14	20-21.5	30-31.5
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Lean Clay w/sand (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Sandy Lean Clay (CL)	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Sandy Lean Clay w/a trace of gravel (CL)
Water Content (%)	16.6	16.5	17.4	16.2	16.4	17.2	12.6	13.5
Sample Information & Classification								
Boring #	Geo-059	Geo-059	Geo-061	Geo-061	Geo-061	Geo-061	Geo-062	Geo-062
Sample #								
Depth (ft)	45-46.5	55-56.5	10-11.5	20-21.5	30-31.5	45-46.5	7.5-9	15-16.5
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Sandy Lean Clay w/a trace of gravel (CL)	Clayey Sand w/a little gravel (SC)	Sandy Lean Clay (CL)	Sandy Lean Clay (CL)	Sandy Lean Clay (CL)	Sandy Lean Clay (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Sandy Lean Clay w/a trace of gravel (CL)
Water Content (%)	18.0	12.7	15.9	14.8	14.1	12.4	15.0	15.2
Sample Information & Classification								
Boring #	Geo-062	Geo-062	Geo-062	Geo-063	Geo-063	Geo-063	Geo-063	Geo-069
Sample #								
Depth (ft)	30-31.5	45-46.5	60-61.5	10-11.5	20-21.5	35-36.5	50-51.5	10-11.5
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Sandy Lean Clay w/a trace of gravel (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Lean Clay w/sand and a trace of gravel (CL)	Sandy Lean Clay (CL)	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Sandy Lean Clay (CL)	Lean Clay w/sand (CL)
Water Content (%)	16.8	14.6	15.6	17.4	17.3	15.8	13.4	18.8

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SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

Water Content Test Summary (ASTM:D2216)

Project: Seneca Wind Job: 11376

Client Barr Engineering Company Date: 5/16/2018

Sample Information & Classification								
Boring #	Geo-069	Geo-070	Geo-070	Geo-070	Geo-071	Geo-071	Geo-071	Geo-071
Sample #								
Depth (ft)	20-21.5	7.5-9	15-16.5	30-31.5	10-11.5	20-21.5	35-36.5	45-46.5
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Silty Sand (SM)	Sandy Lean Clay (CL)	Lean Clay (CL)	Lean Clay w/sand (CL)	Sandy Lean Clay (CL)	Sandy Lean Clay (CL)	Clayey Sand (SC)	Sandy Lean Clay w/a little gravel (CL)
Water Content (%)	14.5	16.4	19.9	17.7	16.8	17.1	14.0	14.1

Sample Information & Classification								
Boring #	Geo-071	Geo-072	Geo-072	Geo-072	Geo-072	Geo-074	Geo-074	Geo-074
Sample #								
Depth (ft)	60-61.5	10-11.5	20-21.5	40-41.5	50-51.5	7.5-9	15-16.5	30-31.5
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Sandy Lean Clay w/a little gravel (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Sand w/silt (SP-SM)	Sandy Lean Clay w/a trace of gravel (CL)	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)
Water Content (%)	14.0	15.9	16.5	13.5	14.3	14.9	17.2	18.2

Sample Information & Classification								
Boring #	Geo-074	Geo-074	Geo-079	Geo-079	Geo-079	Geo-079	Geo-079	Geo-081
Sample #								
Depth (ft)	45-46.5	60-61.5	7.5-9	15-16.5	30-31.5	45-46.5	60-61.5	10-11.5
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Sandy Lean Clay w/a little gravel (CL)	Sandy Lean Clay w/a little gravel (CL)	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Lean Clay w/sand and a trace of gravel (CL)	Sand (SP)	Lean Clay w/sand (CL)
Water Content (%)	13.4	12.8	17.2	17.7	17.1	18.3	13.1	16.3

Sample Information & Classification								
Boring #	Geo-081	Geo-081	Geo-081	Geo-082	Geo-082	Geo-082	Geo-082	Geo-082
Sample #								
Depth (ft)	24-25.5	40-41.5	60-61.5	10-11.5	20-21.5	30-31.5	40-41.5	55-55.9
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Lean Clay w/sand (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Sand w/silt and gravel (SP-SM)	Sandy Lean Clay w/a trace of gravel (CL)	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Lean Clay w/sand and pockets of clayey sand (CL)	Lean Clay w/sand (CL)
Water Content (%)	18.6	17.4	10.3	17.7	18.6	19.3	15.7	17.2

Water Content Test Summary (ASTM:D2216)

Project: Seneca Wind Job: 11376

Client Barr Engineering Company Date: 5/16/2018

Sample Information & Classification								
Boring #	Geo-083	Geo-083	Geo-083	Geo-085	Geo-085	Geo-085	Geo-085	Geo-087
Sample #								
Depth (ft)	10-11.5	20-21.5	30-31.5	7.5-9	15-16.5	30-31.5	50-51.5	10-11.5
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Lean Clay w/sand (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Silt w/sand (ML)	Lean Clay w/sand and a trace of gravel (CL)	Lean Clay w/sand and a trace of gravel (CL)	Lean Clay w/sand and a trace of gravel (CL)	Lean Clay w/sand and a trace of gravel (CL)	Lean Clay w/sand and a trace of gravel (CL)
Water Content (%)	15.7	15.9	16.8	15.7	15.4	16.9	14.2	16.3

Sample Information & Classification								
Boring #	Geo-087	Geo-087	Geo-087	Geo-088	Geo-088	Geo-091	Geo-091	Geo-091
Sample #								
Depth (ft)	20-21.5	30-31.5	45-46.5	7.5-9	15-16.5	10-11.5	20-21.5	30-31.5
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Lean Clay w/sand (CL)	Sandy Lean Clay (CL)	Sand w/silt and a little gravel (SP-SM)	Sandy Lean Clay (CL)	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Sandy Lean Clay w/a trace of gravel (CL)	Lean Clay w/sand (CL)
Water Content (%)	16.4	15.4	14.8	18.0	16.7	16.3	14.5	16.9

Sample Information & Classification								
Boring #	Geo-091	Geo-091	Geo-092	Geo-092	Geo-092	Geo-092	Geo-092	Geo-093
Sample #								
Depth (ft)	45-46.5	60-61.5	7.5-9	15-16.5	30-31.5	45-46.5	60-61.5	10-11.5
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Lean Clay w/sand (CL)	Sandy Lean Clay (CL)	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Lean Clay w/sand and a trace of gravel (CL)	Silt (ML)	Lean Clay w/sand and a trace of gravel (CL)
Water Content (%)	18.2	12.3	16.6	15.4	18.1	18.9	27.0	16.1

Sample Information & Classification								
Boring #	Geo-093	Geo-093	Geo-093					
Sample #								
Depth (ft)	20-21.5	40-41.5	55-56.5					
Type	Bag	Bag	Bag					
Material Classification	Lean Clay w/sand and a trace of gravel (CL)	Lean Clay w/sand and a trace of gravel (CL)	Silty Sand w/occasional pieces of clay and a trace of gravel (SM)					
Water Content (%)	17.0	18.3	14.3					

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SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

Water Content Test Summary (ASTM:D2216)

Project: Seneca Wind Job: 11376

Client Barr Engineering Company Date: 5/25/2018

Sample Information & Classification								
Boring #	Geo-009	Geo-009	Geo-009	Geo-042	Geo-042	Geo-052	Geo-052	Geo-052
Sample #								
Depth (ft)	7.5-9	35-36.5	55-56.5	7.5-9	55-56.5	10-11.5	35-36.5	55-56.5
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Lean Clay w/sand and a trace of gravel (CL)	Lean Clay (CL)	Lean Clay (CL)	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)
Water Content (%)	16.6	16.3	14.5	20.3	17.2	14.4	19.3	19.0

Sample Information & Classification								
Boring #	Geo-075	Geo-075	Geo-075	Geo-075	Geo-076	Geo-076	Geo-076	Geo-076
Sample #								
Depth (ft)	10-11.5	20-21.5	35-36.5	55-56.5	7.5-9	25-26.5	40-41.5	55-56.5
Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Lean Clay (CL)	Lean Clay w/sand and a trace of gravel (CL)	Lean Clay w/sand and pockets of sand (CL)	Silty Clayey (CL-ML/ML)	Lean Clay w/sand (CL)	Lean Clay w/a trace of gravel (CL)
Water Content (%)	15.3	16.9	19.8	14.4	12.3	16.8	18.0	20.0

Sample Information & Classification								
Boring #	Geo-090	Geo-090	Geo-090	Geo-090				
Sample #								
Depth (ft)	10-11.5	20-21.5	40-41.5	60-61.5				
Type	Bag	Bag	Bag	Bag				
Material Classification	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Silty Sand (SM)	Lean Clay w/sand (CL)				
Water Content (%)	17.9	16.5	14.4	15.9				

Sample Information & Classification								
Boring #								
Sample #								
Depth (ft)								
Type								
Material Classification								
Water Content (%)								

Atterberg Limits

Laboratory Test Summary

Project: Seneca Wind Job: 11376

Client: Barr Engineering Company Date: 4/19/2018

Sample Information & Classification

Boring #	Geo-001	Geo-003	Geo-089					
Sample #								
Depth (ft)	12.5-14	15-16.5	10-11.5					
Sample Type	Bag	Bag	Bag					
Material Classification	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Sandy Lean Clay (CL)					

Atterberg Limits (ASTM:D4318)

Liquid Limit	31	27	36					
Plastic Limit	16	15	19					
Plasticity Index	15	12	17					

Sample Information & Classification

Boring #								
Sample #								
Depth (ft)								
Sample Type								
Material Classification								

Atterberg Limits (ASTM:D4318)

Liquid Limit								
Plastic Limit								
Plasticity Index								

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Laboratory Test Summary

Project: Seneca Wind Job: 11376

Client: Barr Engineering Company Date: 5/18/2018

Sample Information & Classification

Boring #	Geo-024	Geo-025	Geo-031	Geo-035	Geo-043	Geo-056	Geo-081	Geo-082
Sample #								
Depth (ft)	20-21.5	15-16.5	15-16.5	7.5-9	10-11.5	55-56.5	24-25.5	10-11.5
Sample Type	Bag	Bag	Bag	Bag	Bag	Bag	Bag	Bag
Material Classification	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Sandy Lean Clay (CL)	Sandy Lean Clay (CL)	Lean Clay w/sand (CL)	Lean Clay w/sand (CL)	Sandy Lean Clay w/a trace of gravel (CL)

Atterberg Limits (ASTM:D4318)

Liquid Limit	31	32	29	36	32	26	30	35
Plastic Limit	16	16	16	18	16	16	15	16
Plasticity Index	15	16	13	18	16	10	15	19

Sample Information & Classification

Boring #								
Sample #								
Depth (ft)								
Sample Type								
Material Classification								

Atterberg Limits (ASTM:D4318)

Liquid Limit								
Plastic Limit								
Plasticity Index								

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Laboratory Test Summary

Project: Seneca Wind Job: 11376

Client: Barr Engineering Company Date: 5/25/2018

Sample Information & Classification

Boring #	Geo-076							
Sample #								
Depth (ft)	25-26.5							
Sample Type	Bag							
Material Classification	Silty Clay (CL-ML/ML)							

Atterberg Limits (ASTM:D4318)

Liquid Limit	18							
Plastic Limit	14							
Plasticity Index	4							

Sample Information & Classification

Boring #								
Sample #								
Depth (ft)								
Sample Type								
Material Classification								

Atterberg Limits (ASTM:D4318)

Liquid Limit								
Plastic Limit								
Plasticity Index								

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SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

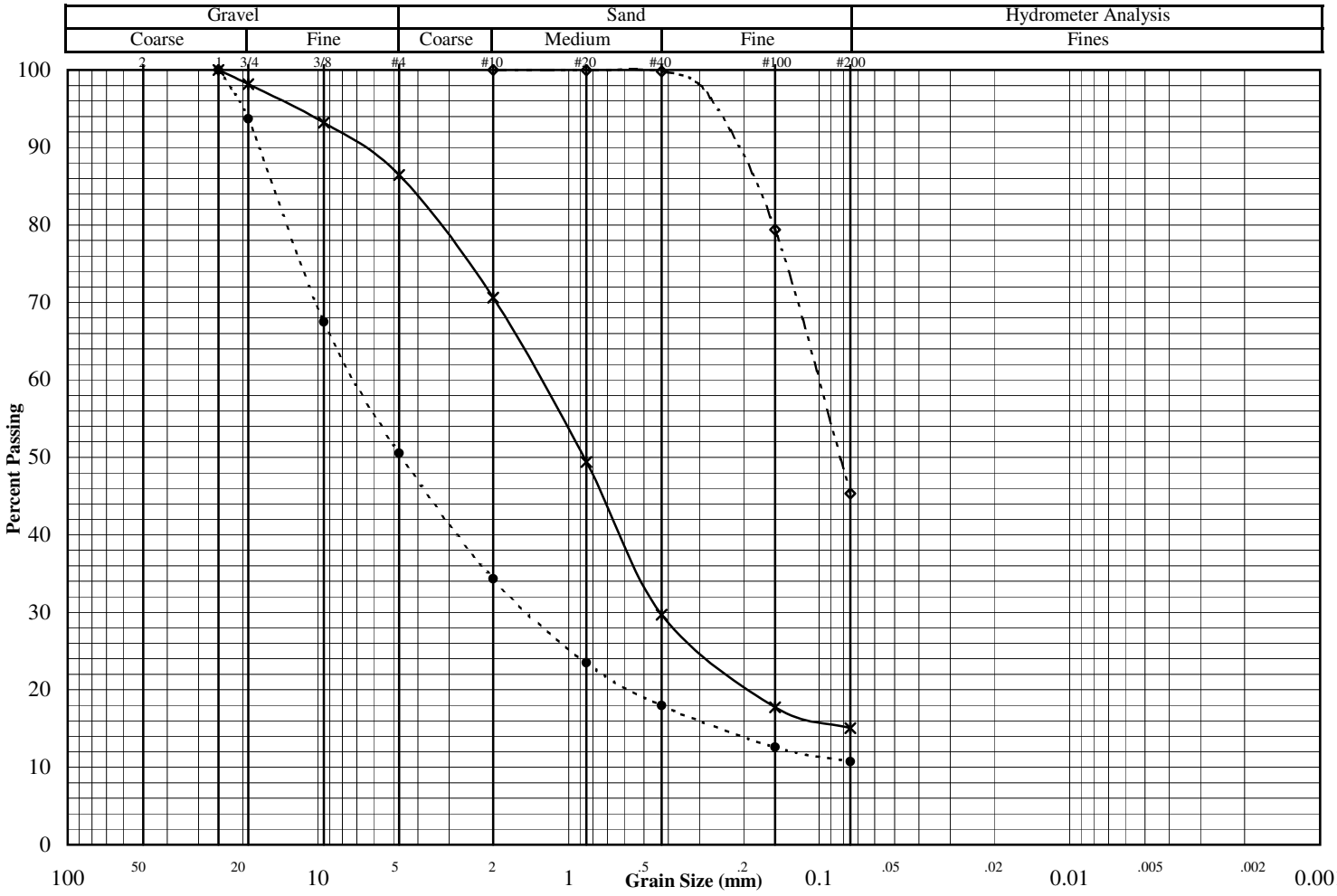
Grain Size

Grain Size Distribution ASTM D422

Job No. : **11376**

Project:	Seneca Wind	Test Date:	5/7/18
Reported To:	Barr Engineering Company	Report Date:	5/14/18

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	Geo-002		45-46.5	Bag	Silty Sand w/a little gravel (SM)
●	Geo-013		30-31.5	Bag	Gravel w/silt and sand (GP-GM)
◇	Geo-025		30-31.5	Bag	Silty Sand (SM)



Other Tests

	*	●	◇
Liquid Limit			
Plastic Limit			
Plasticity Index			
Water Content	4.6	11.3	14.5
Dry Density (pcf)			
Specific Gravity			
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	687.3	400.3	151.2
2"			
1.5"			
1"	100.0	100.0	
3/4"	98.2	93.7	
3/8"	93.2	67.5	
#4	86.4	50.5	
#10	70.6	34.3	100.0
#20	49.4	23.5	100.0
#40	29.7	18.0	99.8
#100	17.7	12.6	79.4
#200	15.1	10.7	45.3

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

9530 James Ave South

SOIL ENGINEERING TESTING, INC.

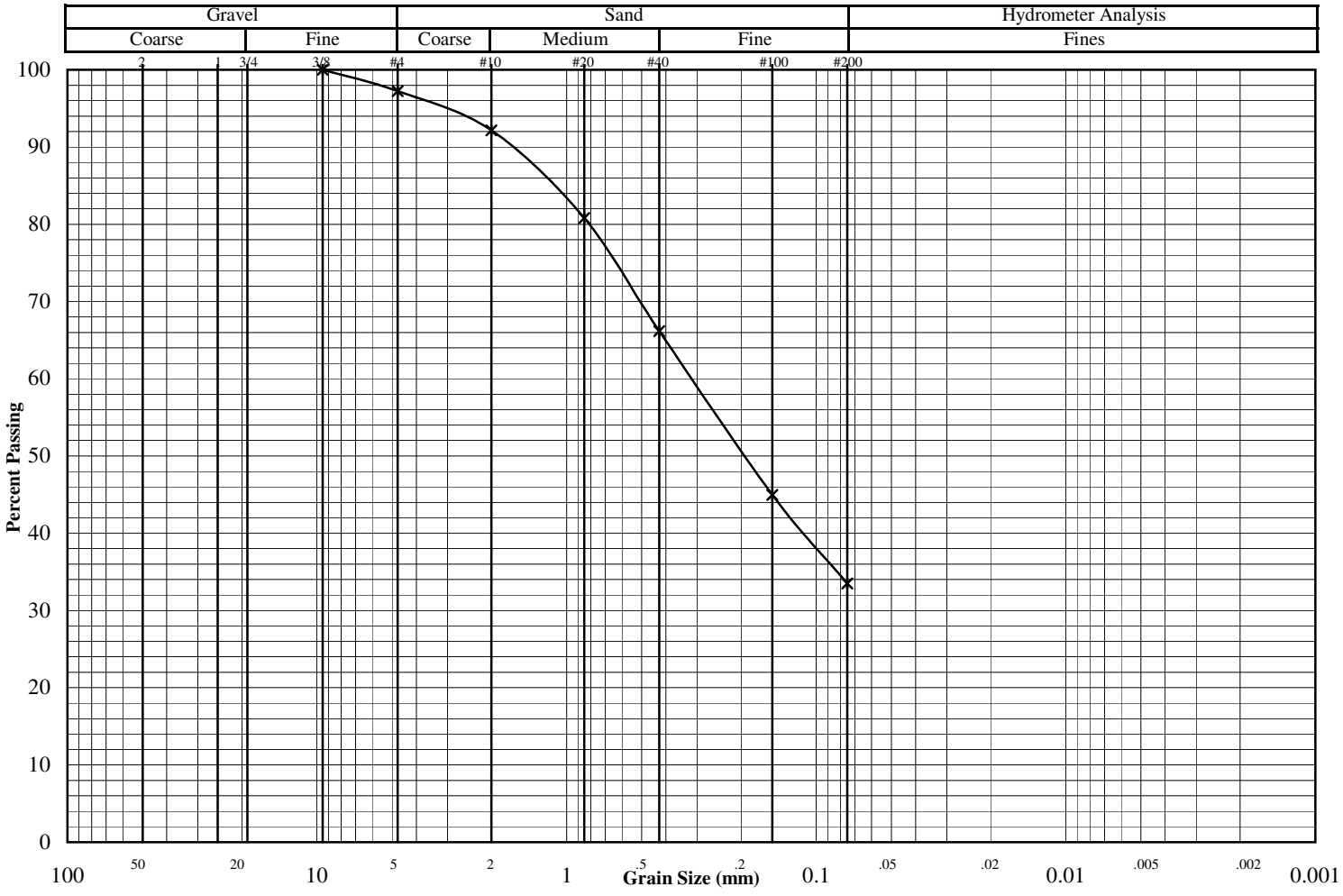
Bloomington, MN 55431

Grain Size Distribution ASTM D422

Job No. : **11376**

Project:	Seneca Wind	Test Date:	5/9/18
Reported To:	Barr Engineering Company	Report Date:	5/14/18

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	Geo-093		55-56.5	Bag	Silty Sand w/occasional pieces of clay and a trace of gravel (SM)
●					
◇					



Other Tests

	*	●	◇
Liquid Limit			
Plastic Limit			
Plasticity Index			
Water Content	14.3		
Dry Density (pcf)			
Specific Gravity			
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	220.6		
2"			
1.5"			
1"			
3/4"			
3/8"	100.0		
#4	97.2		
#10	92.2		
#20	80.8		
#40	66.2		
#100	44.9		
#200	33.5		

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

9530 James Ave South

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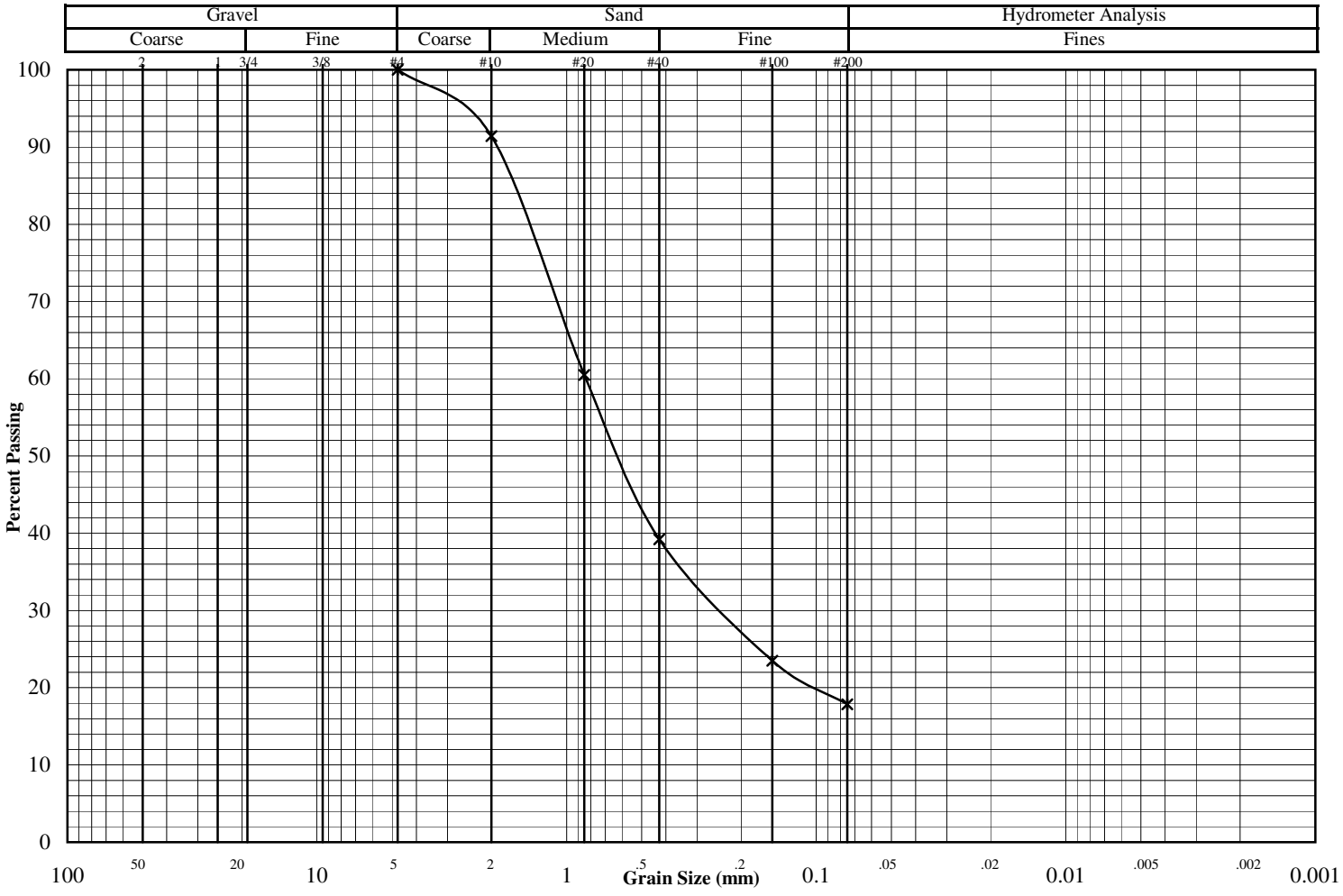
Bloomington, MN 55431

Grain Size Distribution ASTM D422

Job No. : **11376**

Project:	Seneca Wind	Test Date:	4/17/18
Reported To:	Barr Engineering Company	Report Date:	4/19/18

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	Geo-014		45-46.5	Bag	Silty Sand (SM)
●					
◇					



Other Tests	*	●	◇
Liquid Limit			
Plastic Limit			
Plasticity Index			
Water Content			
Dry Density (pcf)			
Specific Gravity			
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing	*	●	◇
Mass (g)	265.4		
2"			
1.5"			
1"			
3/4"			
3/8"			
#4	100.0		
#10	91.4		
#20	60.5		
#40	39.2		
#100	23.5		
#200	17.9		

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

9530 James Ave South

SOIL ENGINEERING TESTING, INC.

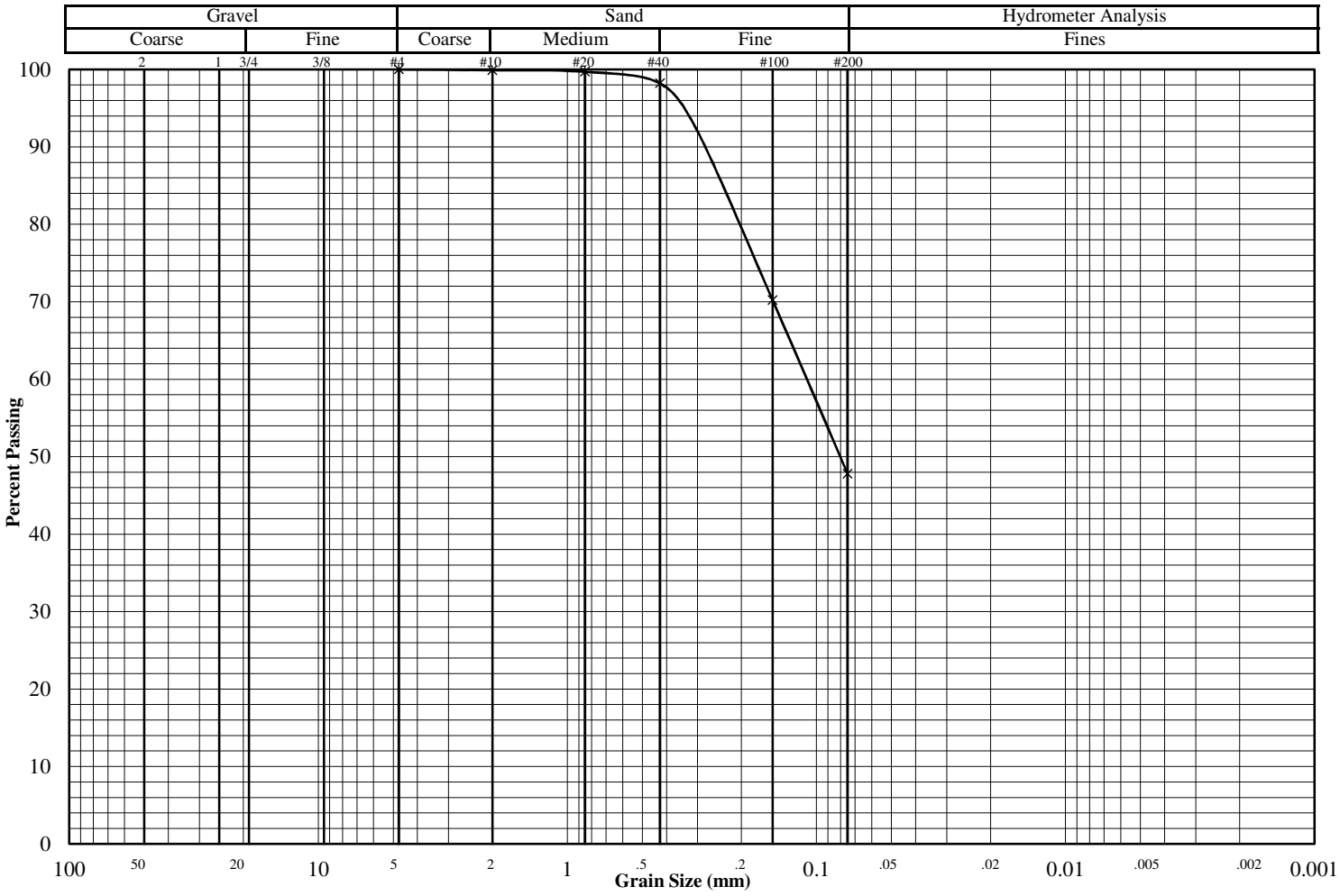
Bloomington, MN 55431

Grain Size Distribution ASTM D422

Job No. : **11376**

Project:	Seneca Wind	Test Date:	5/22/18
Reported To:	Barr Engineering Company	Report Date:	5/25/18

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	Geo-090		40-41.5	Bag	Silty Sand (SM)
●					
◇					



Other Tests

	*	●	◇
Liquid Limit			
Plastic Limit			
Plasticity Index			
Water Content	14.4		
Dry Density (pcf)			
Specific Gravity			
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	158.8		
2"			
1.5"			
1"			
3/4"			
3/8"			
#4	100.0		
#10	99.9		
#20	99.7		
#40	98.2		
#100	70.2		
#200	47.8		

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

9530 James Ave South

SOIL ENGINEERING TESTING, INC.

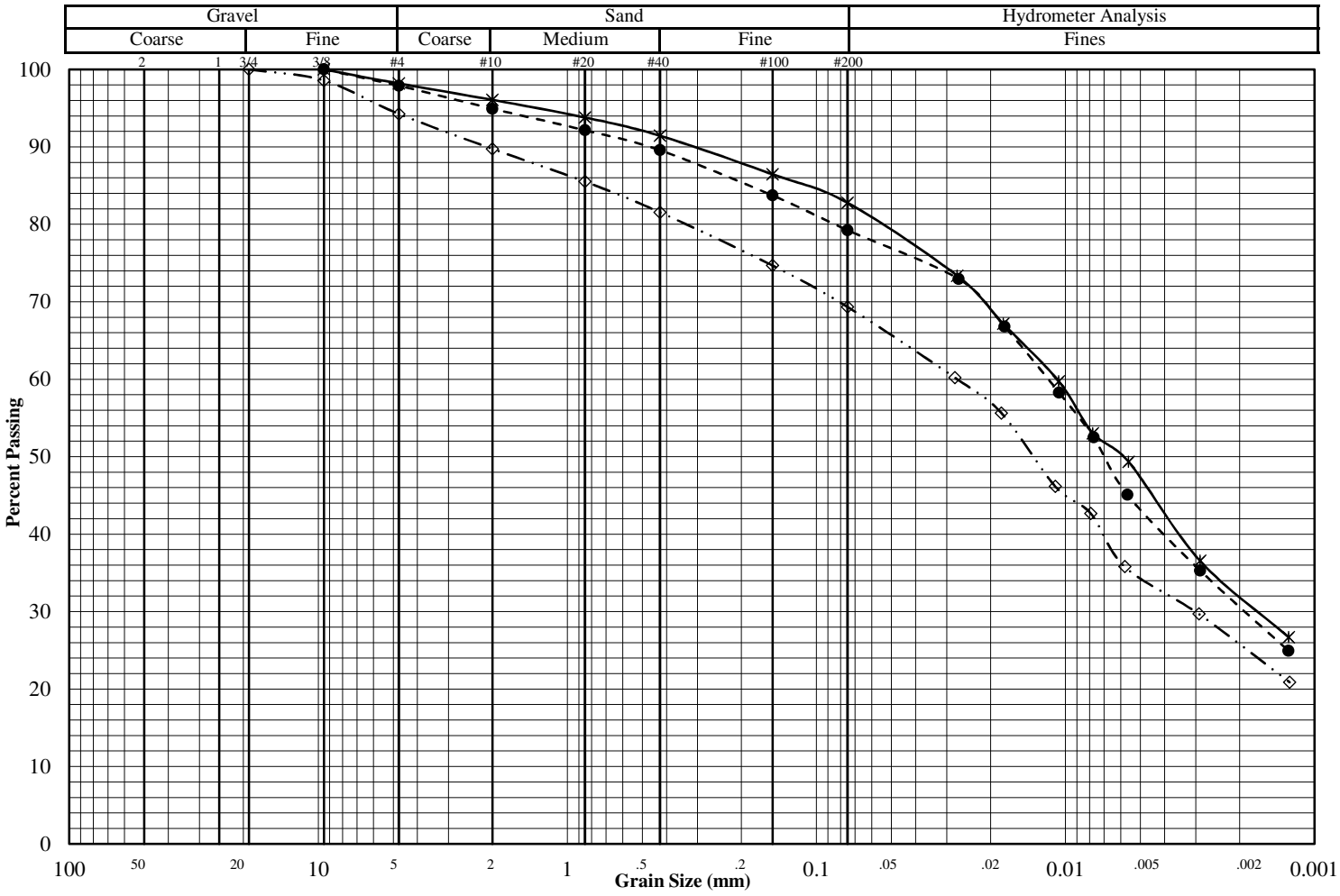
Bloomington, MN 55431

Grain Size Distribution ASTM D422

Job No. : **11376**

Project:	Seneca Wind	Test Date:	5/11/18
Reported To:	Barr Engineering Company	Report Date:	5/17/18

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	Geo-036		25-26.5	Bag	Lean Clay w/sand (CL)
●	Geo-043		15-16.5	Bag	Lean Clay w/sand and a trace of gravel (CL)
◇	Geo-056		60-61.5	Bag	Sandy Lean Clay w/a little gravel (CL)



Other Tests

	*	●	◇
Liquid Limit			
Plastic Limit			
Plasticity Index			
Water Content	17.9	13.0	
Dry Density (pcf)			
Specific Gravity	2.68*	2.68*	2.68*
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	154.4	199.5	277.4
2"			
1.5"			
1"			
3/4"			100.0
3/8"	100.0	100.0	98.6
#4	98.2	97.9	94.3
#10	96.1	94.9	89.7
#20	93.8	92.1	85.5
#40	91.5	89.6	81.6
#100	86.5	83.7	74.7
#200	82.8	79.3	69.3

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

9530 James Ave South

SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

Grain Size Distribution ASTM D422

Job No. : **11376**

Project:	Seneca Wind	Test Date:	5/11/18
Reported To:	Barr Engineering Company	Report Date:	5/17/18

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1	Geo-036		25-26.5	Bag	Lean Clay w/sand (CL)
Spec 2	Geo-043		15-16.5	Bag	Lean Clay w/sand and a trace of gravel (CL)
Spec 3	Geo-056		60-61.5	Bag	Sandy Lean Clay w/a little gravel (CL)

Sieve Data

Specimen 1		Specimen 2		Specimen 3	
Sieve	% Passing	Sieve	% Passing	Sieve	% Passing
2"		2"		2"	
1.5"		1.5"		1.5"	
1"		1"		1"	
3/4"		3/4"		3/4"	100.0
3/8"	100.0	3/8"	100.0	3/8"	98.6
#4	98.2	#4	97.9	#4	94.3
#10	96.1	#10	94.9	#10	89.7
#20	93.8	#20	92.1	#20	85.5
#40	91.5	#40	89.6	#40	81.6
#100	86.5	#100	83.7	#100	74.7
#200	82.8	#200	79.3	#200	69.3

Hydrometer Data

Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.027	73.4	0.027	72.9	0.028	60.2
0.018	67.2	0.018	66.8	0.018	55.6
0.011	59.7	0.011	58.3	0.011	46.2
0.008	53.0	0.008	52.5	0.008	42.7
0.006	49.3	0.006	45.1	0.006	35.8
0.003	36.5	0.003	35.3	0.003	29.7
0.001	26.7	0.001	24.9	0.001	20.9

Remarks

Specimen 1	Specimen 2	Specimen 3

9530 James Ave South

SOIL ENGINEERING TESTING, INC.

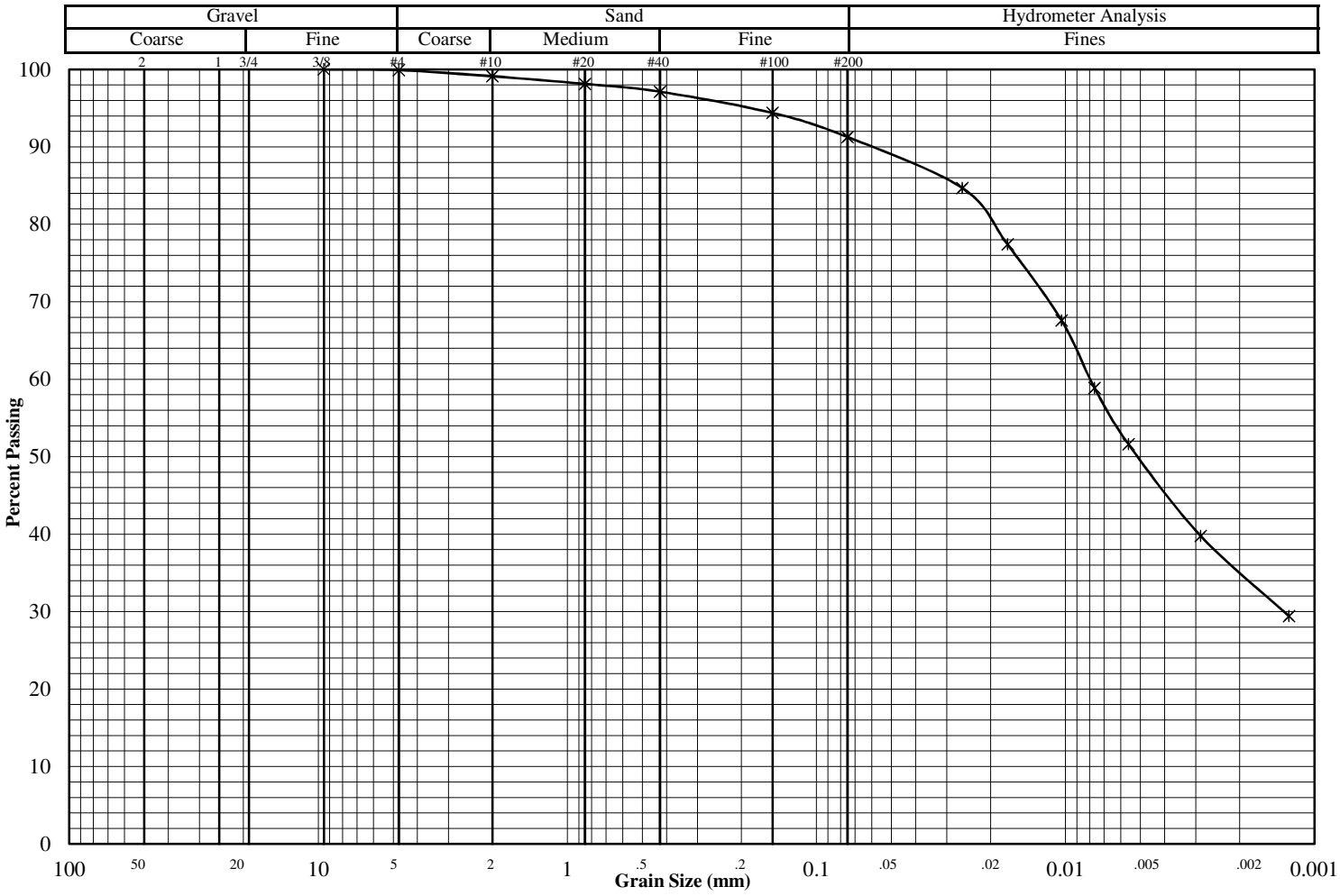
Bloomington, MN 55431

Grain Size Distribution ASTM D422

Job No. : **11376**

Project:	Seneca Wind	Test Date:	5/11/18
Reported To:	Barr Engineering Company	Report Date:	5/17/18

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	Geo-091		7.5-9	Bag	Lean Clay (CL)
●					
◇					



Other Tests	*	●	◇
Liquid Limit			
Plastic Limit			
Plasticity Index			
Water Content			
Dry Density (pcf)			
Specific Gravity	2.68*		
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing	*	●	◇
Mass (g)	176.7		
2"			
1.5"			
1"			
3/4"			
3/8"	100.0		
#4	99.9		
#10	99.1		
#20	98.1		
#40	97.1		
#100	94.4		
#200	91.3		

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

9530 James Ave South

SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

Grain Size Distribution ASTM D422

Job No. : **11376**

Project:	Seneca Wind	Test Date:	5/11/18
Reported To:	Barr Engineering Company	Report Date:	5/17/18

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1	Geo-091		7.5-9	Bag	Lean Clay (CL)
Spec 2					
Spec 3					

Sieve Data

Specimen 1		Specimen 2		Specimen 3	
Sieve	% Passing	Sieve	% Passing	Sieve	% Passing
2"		2"		2"	
1.5"		1.5"		1.5"	
1"		1"		1"	
3/4"		3/4"		3/4"	
3/8"	100.0	3/8"		3/8"	
#4	99.9	#4		#4	
#10	99.1	#10		#10	
#20	98.1	#20		#20	
#40	97.1	#40		#40	
#100	94.4	#100		#100	
#200	91.3	#200		#200	

Hydrometer Data

Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.026	84.7				
0.017	77.4				
0.010	67.6				
0.008	58.9				
0.006	51.6				
0.003	39.8				
0.001	29.4				

Remarks

Specimen 1	Specimen 2	Specimen 3

9530 James Ave South

SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

Dry Unit Weight

Laboratory Test Summary

Project: Seneca Wind **Job:** 11376

Client: Barr Engineering Company **Date:** 5/22/18

Sample Information & Classification

Boring #	Geo-034						
Sample #							
Depth (ft)	24-25						
Type or BPF	TWT						
Classification	Sandy Lean Clay w/a trace of gravel (CL)						

Water Content, Dry Density (ASTM:D7263)

Water Content (%)	16.1						
Dry Density (pcf)	111.3						

Sample Information & Classification

Boring #							
Sample #							
Depth (ft)							
Type or BPF							
Classification							

Water Content, Dry Density (ASTM:D7263)

Water Content (%)							
Dry Density (pcf)							

Sample Information & Classification

Boring #							
Sample #							
Depth (ft)							
Type or BPF							
Classification							

Water Content, Dry Density (ASTM:D7263)

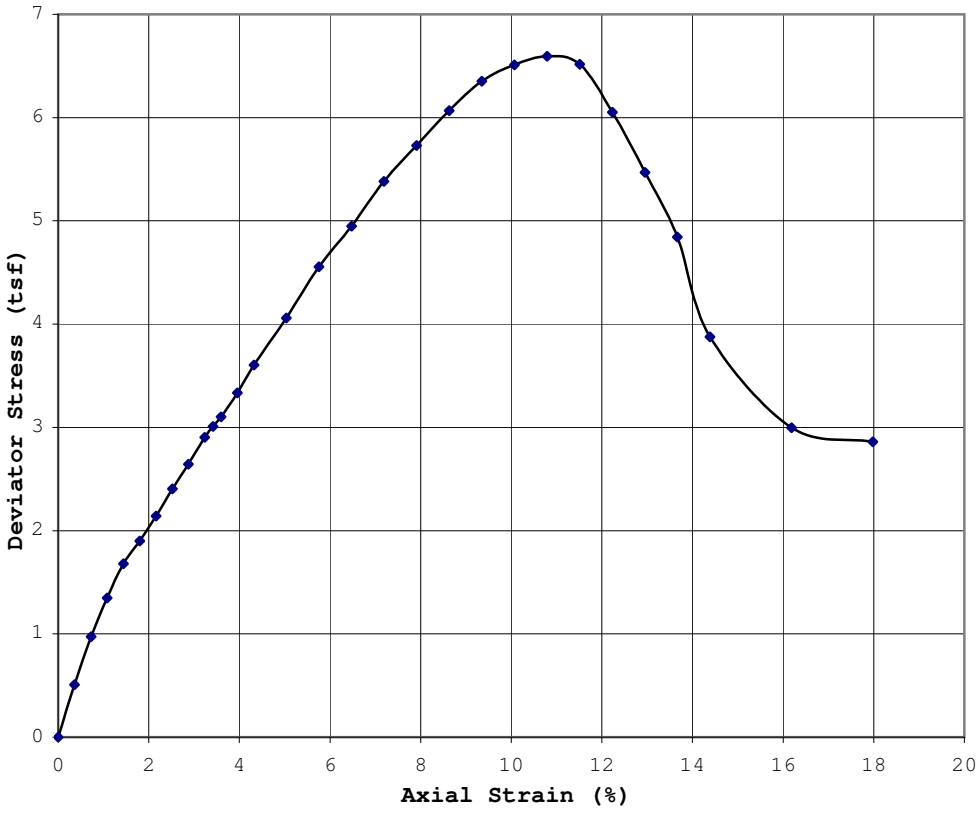
Water Content (%)							
Dry Density (pcf)							

Unconfined Compressive Shear Strength

Unconfined Stress/Strain Curves

ASTM: D2166

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 4/23/18
Remarks:



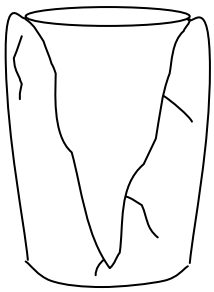
Boring: Geo-003 Depth: 7.5-9
Sample #:
Soil Type: Sandy Lean Clay (CL)

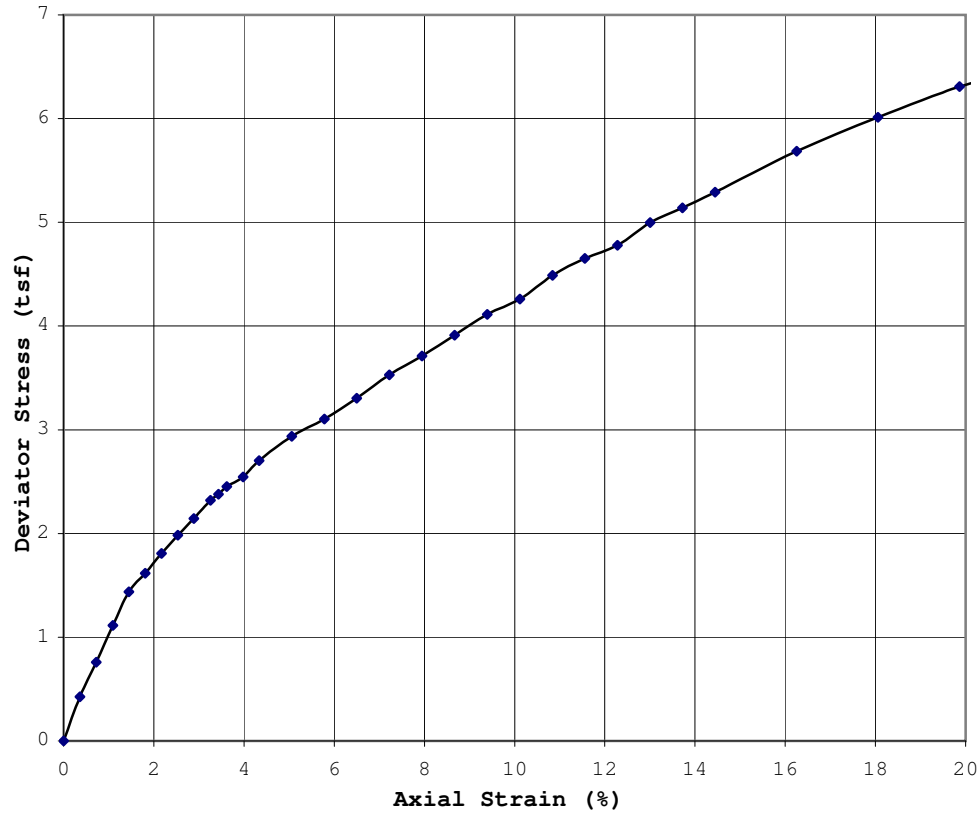
Strain Rate (in/min): 0.030
Sample Type: SB
Dia. (in) 1.39 Ht. (in) 2.78
Height to Diameter Ratio: 2.0

Unconfined Comp. Strength: 6.59 tsf
Strain at Failure (%): 10.8

W.C. (%): 14.4
Yd (pcf): 120.4

Sketch of Specimen After Failure





Boring: Geo-014 Depth: 20-21.5
Sample #:
Soil Type: Lean Clay w/sand (CL)

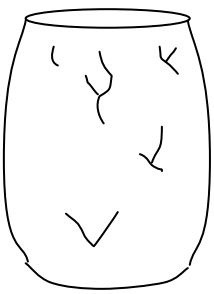
Strain Rate (in/min): 0.030
Sample Type: SB

Dia. (in): 1.35 Ht. (in): 2.77
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 6.32 tsf
Strain at Failure (%): 20.0

W.C. (%): 14.9
Yd (pcf): 120.5

Sketch of Specimen After Failure



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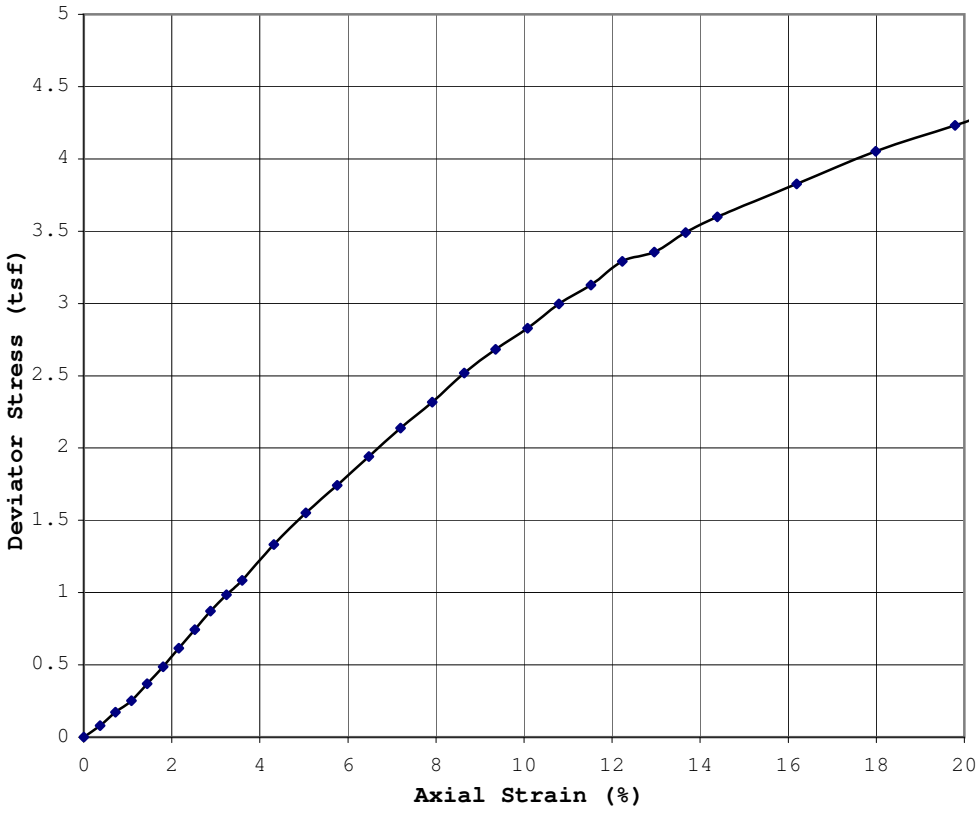
Unconfined Stress/Strain Curves

ASTM: D2166

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 4/23/18
Remarks:



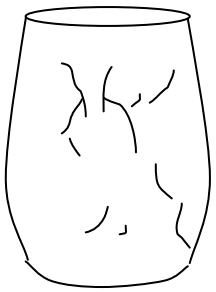
Boring: Geo-021 Depth: 12.5-14
Sample #:
Soil Type: Lean Clay w/sand (CL)

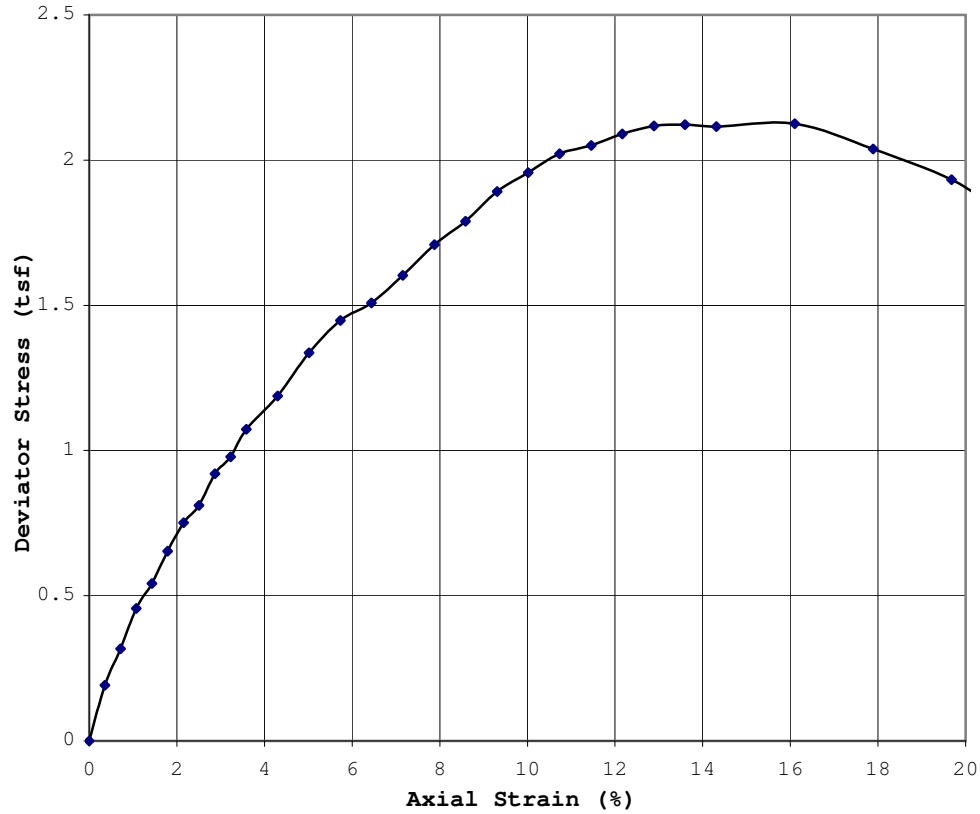
Strain Rate (in/min): 0.030
Sample Type: SB
Dia. (in) 1.35 Ht. (in) 2.78
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 4.25 tsf
Strain at Failure (%): 20.0

W.C. (%): 13.0
Yd (pcf): 125.2

Sketch of Specimen After Failure





Boring: Geo-026 Depth: 10-11.5
Sample #:
Soil Type: Lean Clay w/sand (CL)

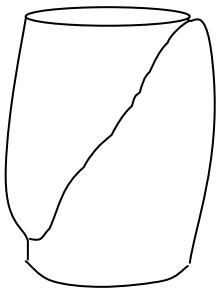
Strain Rate (in/min): 0.030
Sample Type: SB

Dia. (in): 1.38 Ht. (in): 2.80
Height to Diameter Ratio: 2.0

Unconfined Comp. Strength: 2.13 tsf
Strain at Failure (%): 16.1

W.C. (%): 22.5
Yd (pcf): 105.2

Sketch of Specimen After Failure



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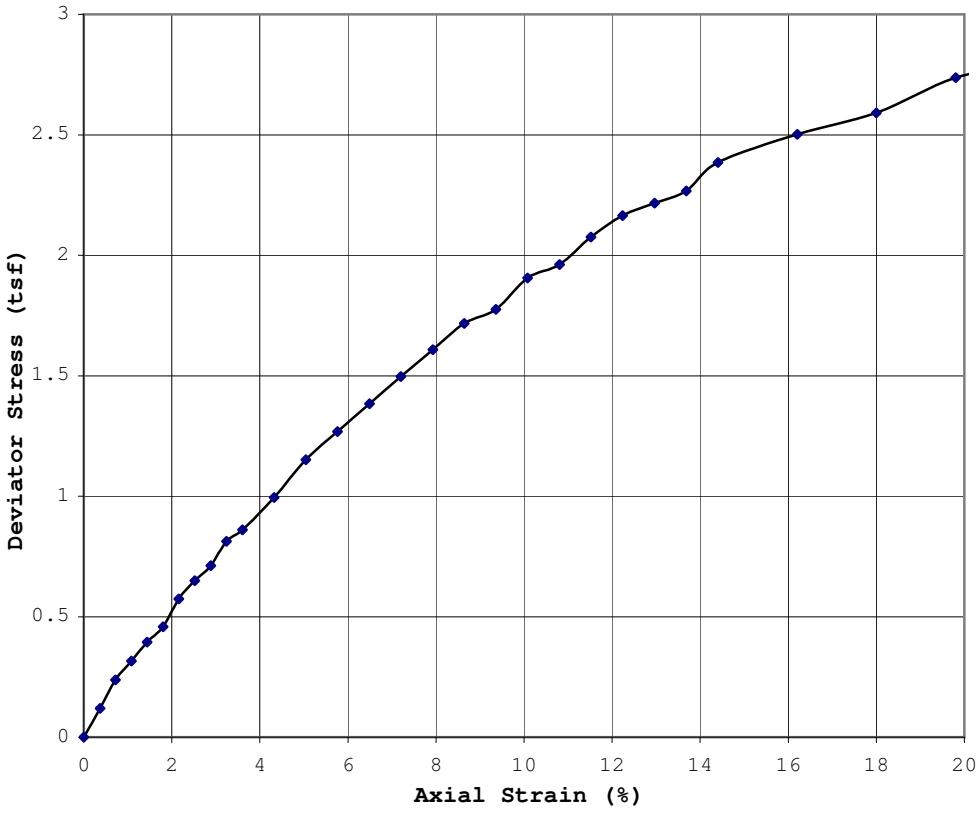
Unconfined Stress/Strain Curves

ASTM: D2166

Project: Seneca Wind | Job: 11376
Client: Barr Engineering Company | Date: 4/23/18
Remarks:



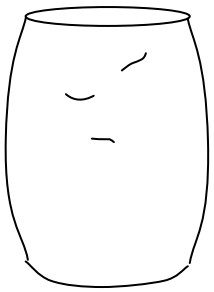
Boring: Geo-050 Depth: 10-11.5
Sample #:
Soil Type: Lean Clay w/sand (CL)

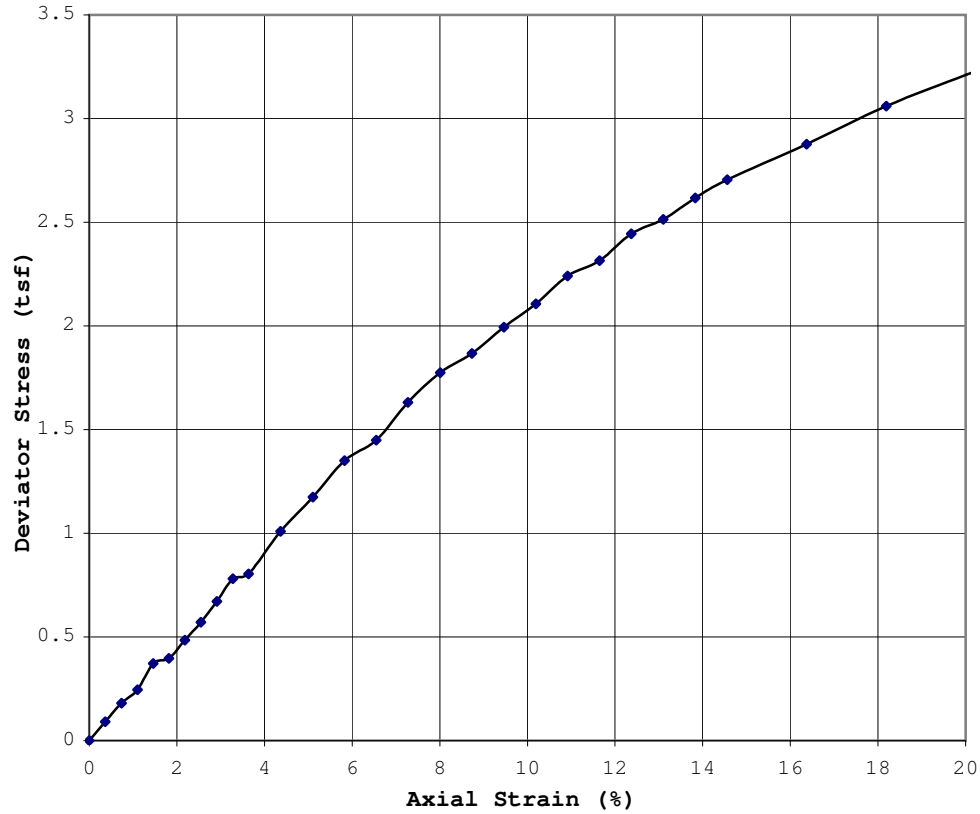
Strain Rate (in/min): 0.030
Sample Type: SB
Dia. (in) 1.35 Ht. (in) 2.78
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.74 tsf
Strain at Failure (%): 20.0

W.C. (%): 17.8
Yd (pcf): 115.6

Sketch of Specimen After Failure





Boring: Geo-053 Depth: 35-36.5
Sample #:
Soil Type: Lean Clay w/sand (CL)

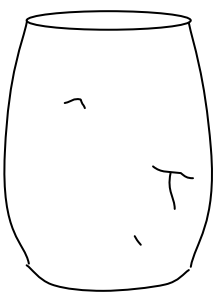
Strain Rate (in/min): 0.030
Sample Type: SB

Dia. (in): 1.37 Ht. (in): 2.75
Height to Diameter Ratio: 2.0

Unconfined Comp. Strength: 3.21 tsf
Strain at Failure (%): 20.0

W.C. (%): 14.0
Yd (pcf): 122.3

Sketch of Specimen After Failure



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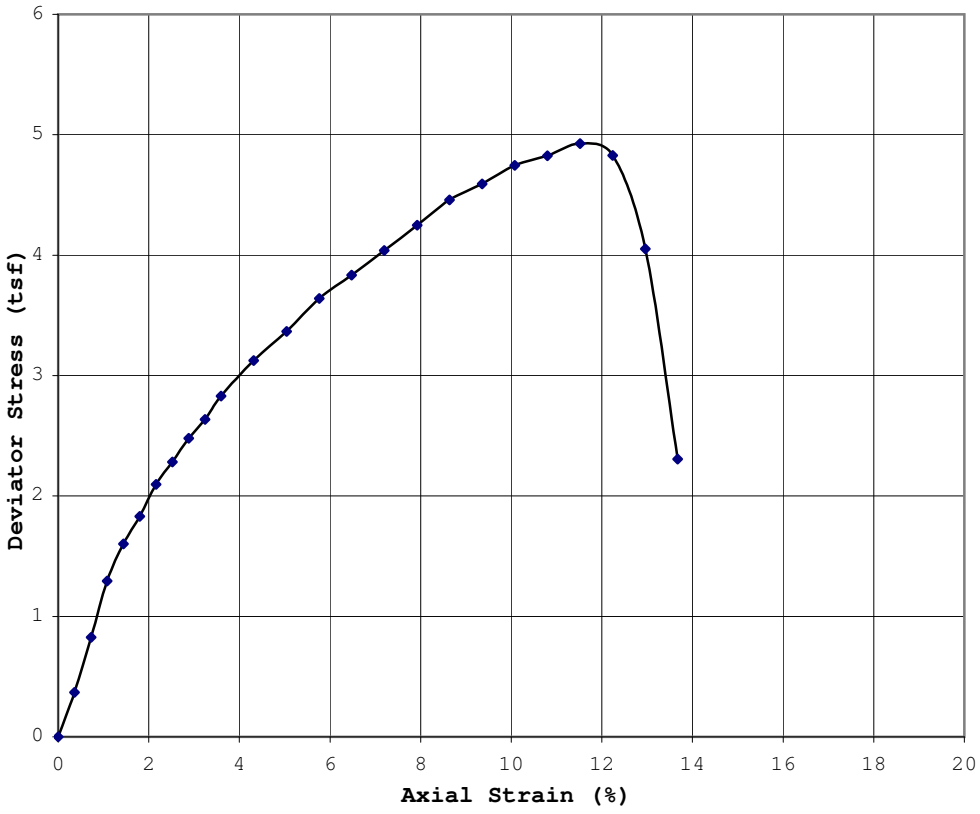
SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

Unconfined Stress/Strain Curves

ASTM: D2166

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 4/23/18
Remarks:



Boring: Geo-089 Depth: 10-11.5
Sample #:
Soil Type: Sandy Lean Clay (CL)

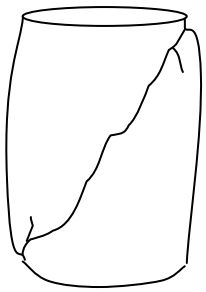
Strain Rate (in/min): 0.030
Sample Type: SB
Dia. (in) 1.36 Ht. (in) 2.78
Height to Diameter Ratio: 2.0

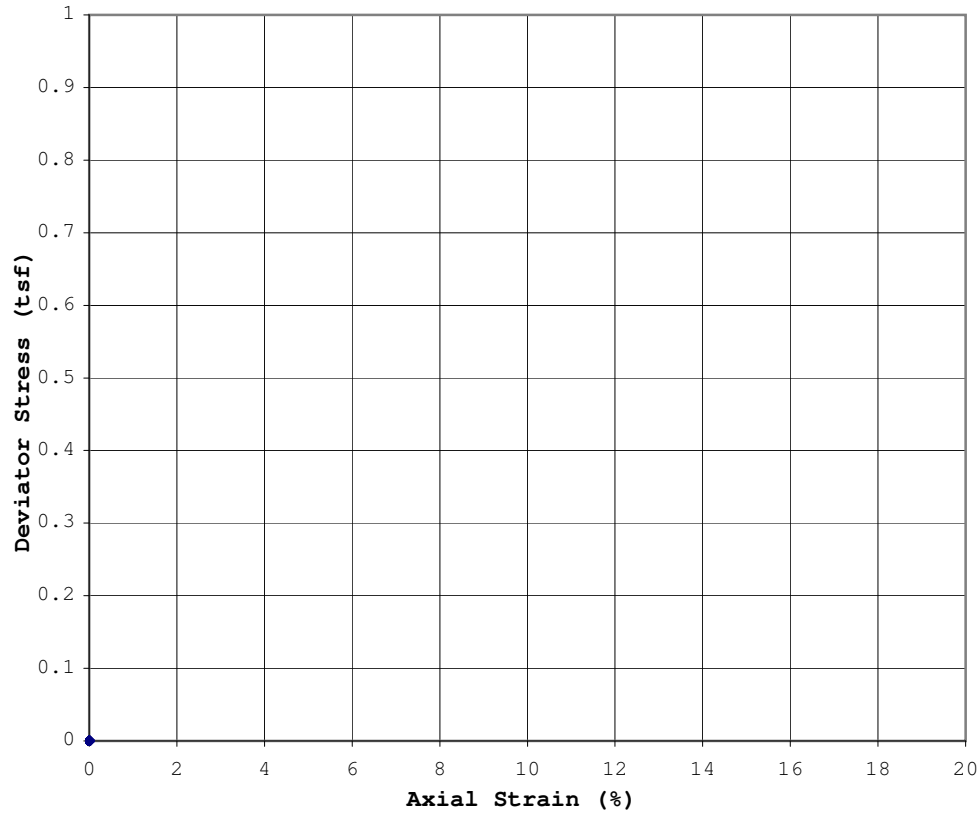
Unconfined Comp. Strength: 4.93 tsf
Strain at Failure (%): 11.5

W.C. (%): 18.9
Yd (pcf): 110.7

LL: 36
PL: 19
PI: 17

Sketch of Specimen After Failure





Boring: Depth:
Sample #:
Soil Type:

Strain Rate (in/min):
Sample Type:

Dia. (in): Ht. (in):
Height to Diameter Ratio:

Unconfined Comp. Strength: tsf
Strain at Failure (%):

W.C. (%):
Yd (pcf):

Sketch of Specimen After Failure

9530 James Ave South

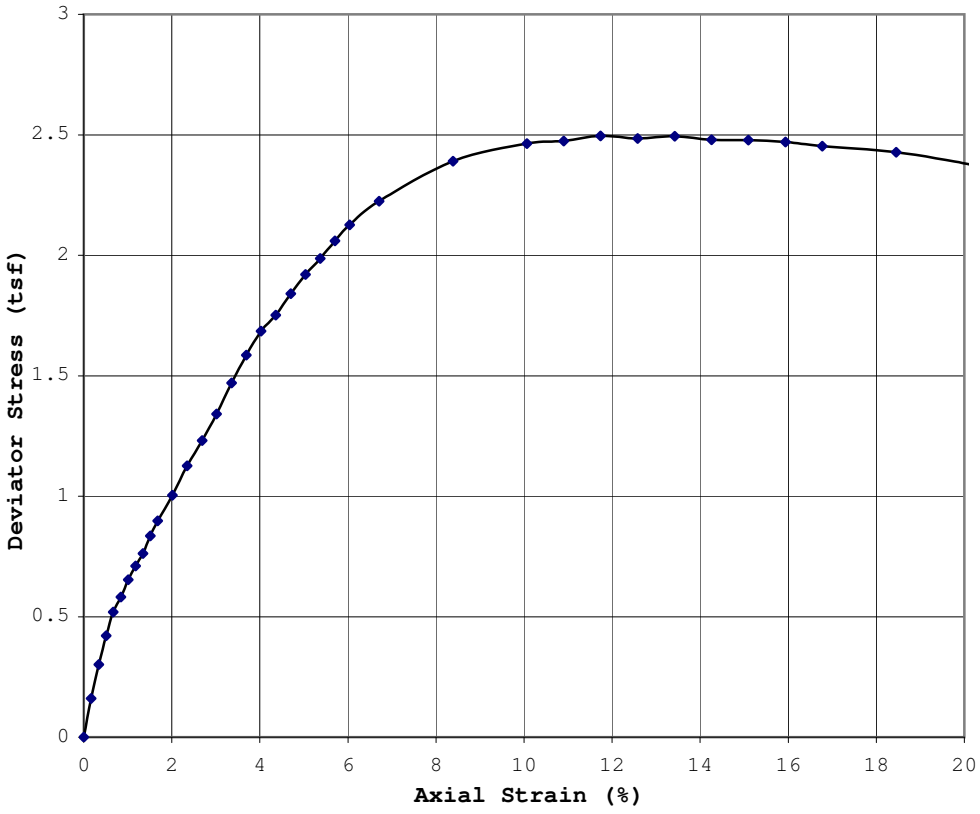
SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

Unconfined Stress/Strain Curves

ASTM: D2166

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 5/22/18
Remarks:



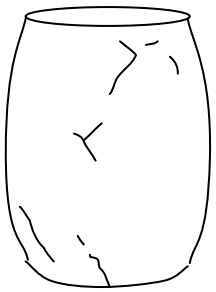
Boring: Geo-005 Depth: 25-26
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

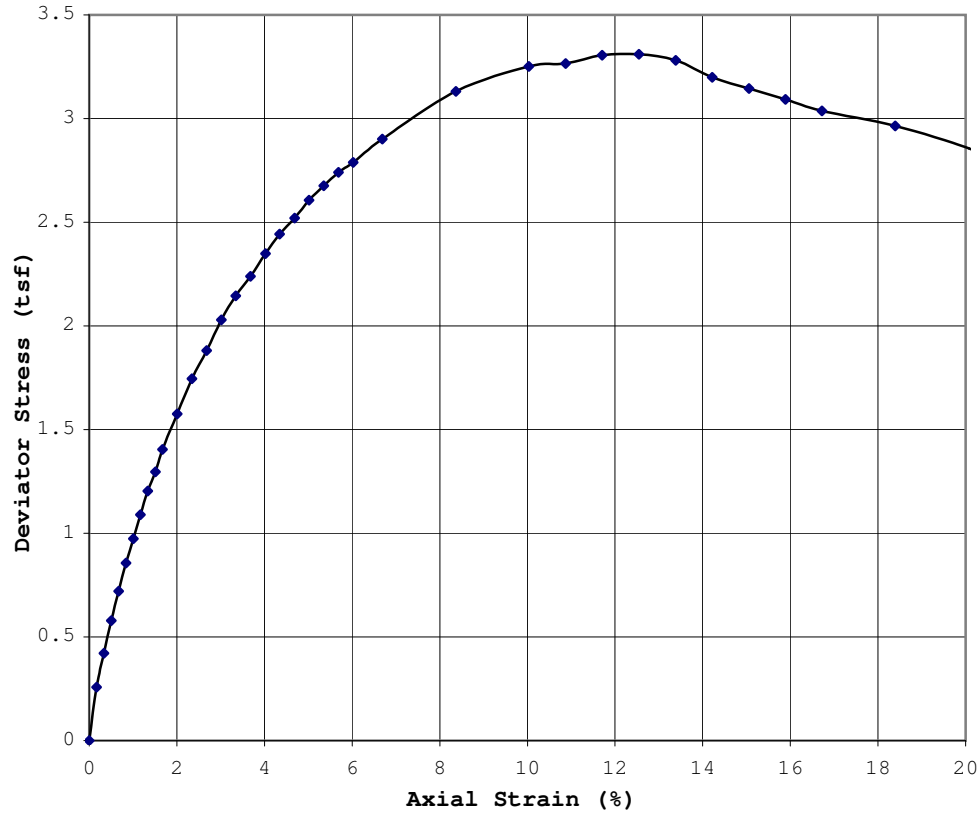
Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.88 Ht. (in) 5.96
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.50 tsf
Strain at Failure (%): 11.7

W.C. (%): 16.8
Yd (pcf): 115.0

Sketch of Specimen After Failure





Boring: Geo-006 Depth: 20-21.7
Sample #:
Soil Type: Lean Clay w/sand and a little gravel (CL)

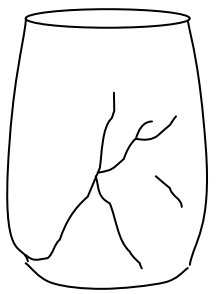
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.88 Ht. (in): 5.98
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 3.31 tsf
Strain at Failure (%): 12.5

W.C. (%): 16.6
Yd (pcf): 115.9

Sketch of Specimen After Failure

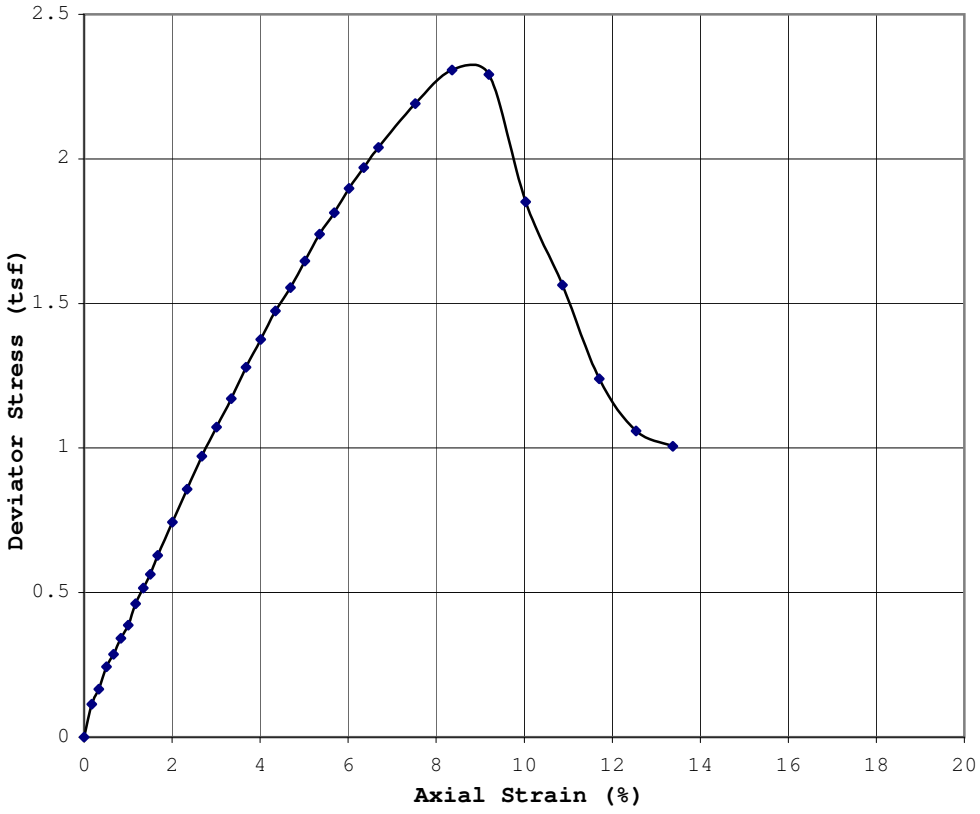


9530 James Ave South
SOIL ENGINEERING TESTING, INC.
Bloomington, MN 55431

Unconfined Stress/Strain Curves

ASTM: D2166

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 5/22/18
Remarks:



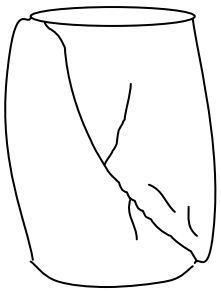
Boring: Geo-006 Depth: 45-47
Sample #:
Soil Type: Lean Clay w/sand, a little gravel, and a patch of sand (CL)

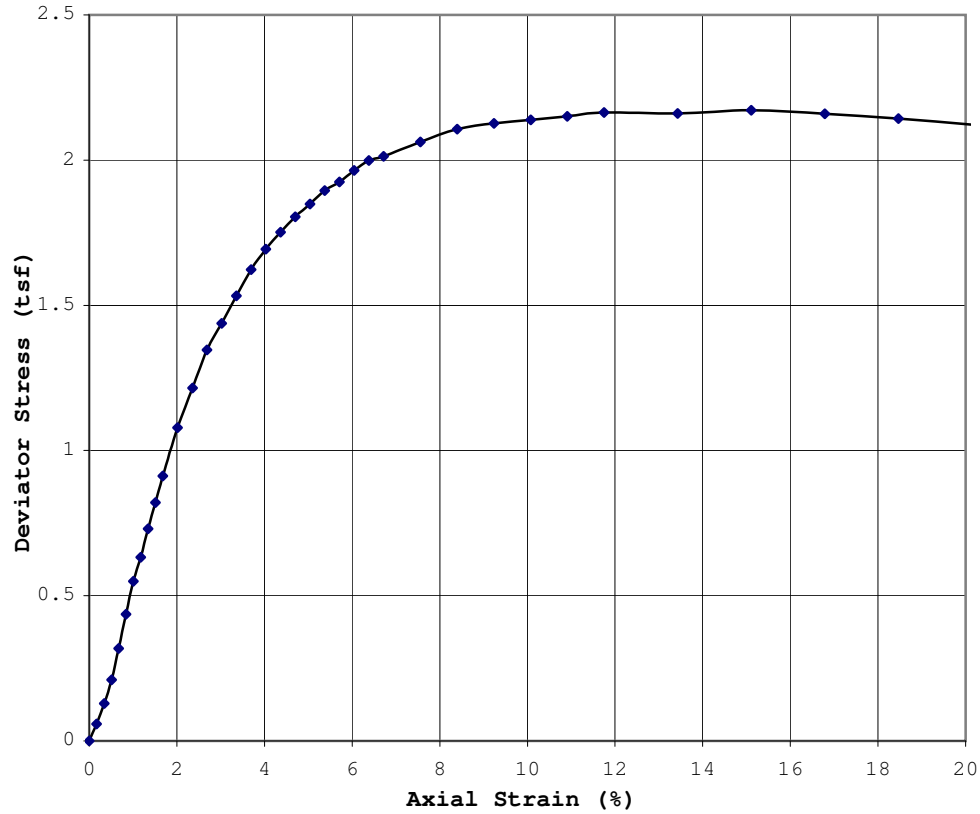
Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.89 Ht. (in) 5.98
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.31 tsf
Strain at Failure (%): 8.4

W.C. (%): 16.7
Yd (pcf): 114.8

Sketch of Specimen After Failure





Boring: Geo-008 Depth: 20-22
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

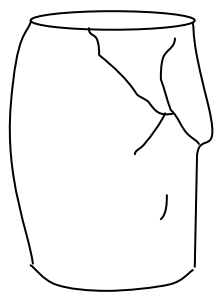
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.88 Ht. (in): 5.96
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.17 tsf
Strain at Failure (%): 15.1

W.C. (%): 18.5
Yd (pcf): 112.2

Sketch of Specimen After Failure



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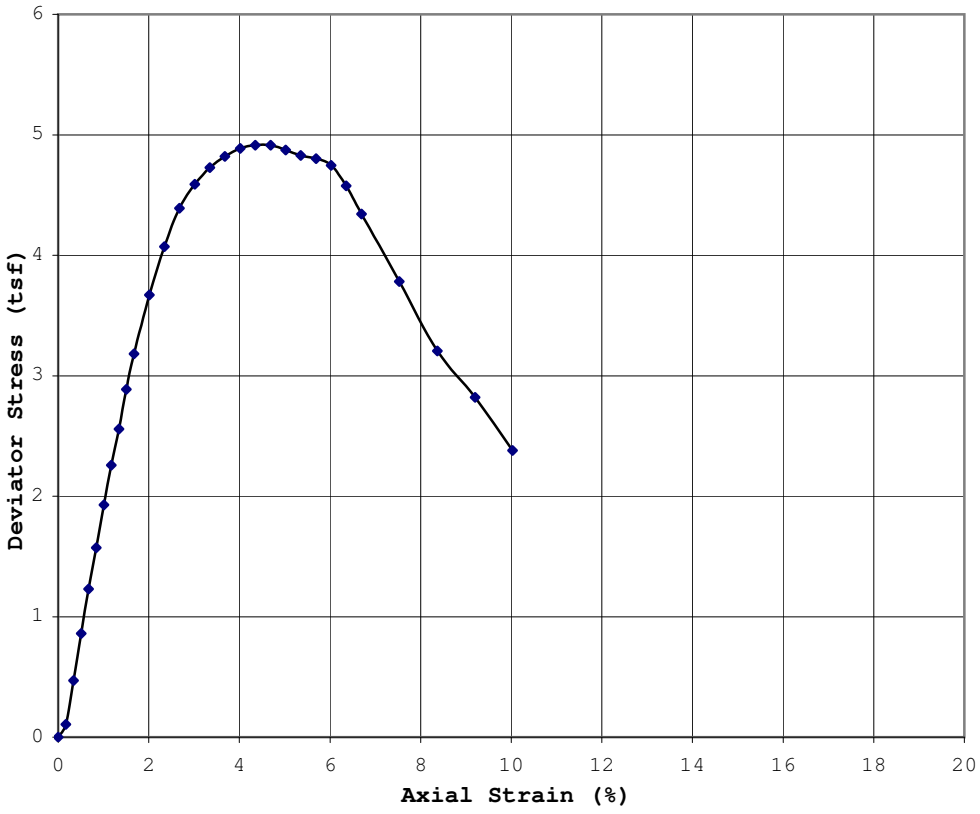
SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

Unconfined Stress/Strain Curves

ASTM: D2166

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 5/22/18
Remarks:



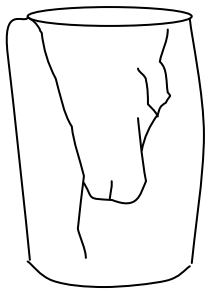
Boring: Geo-013 Depth: 15-16.5
Sample #:
Soil Type: Lean Clay w/sand and a little gravel (CL)

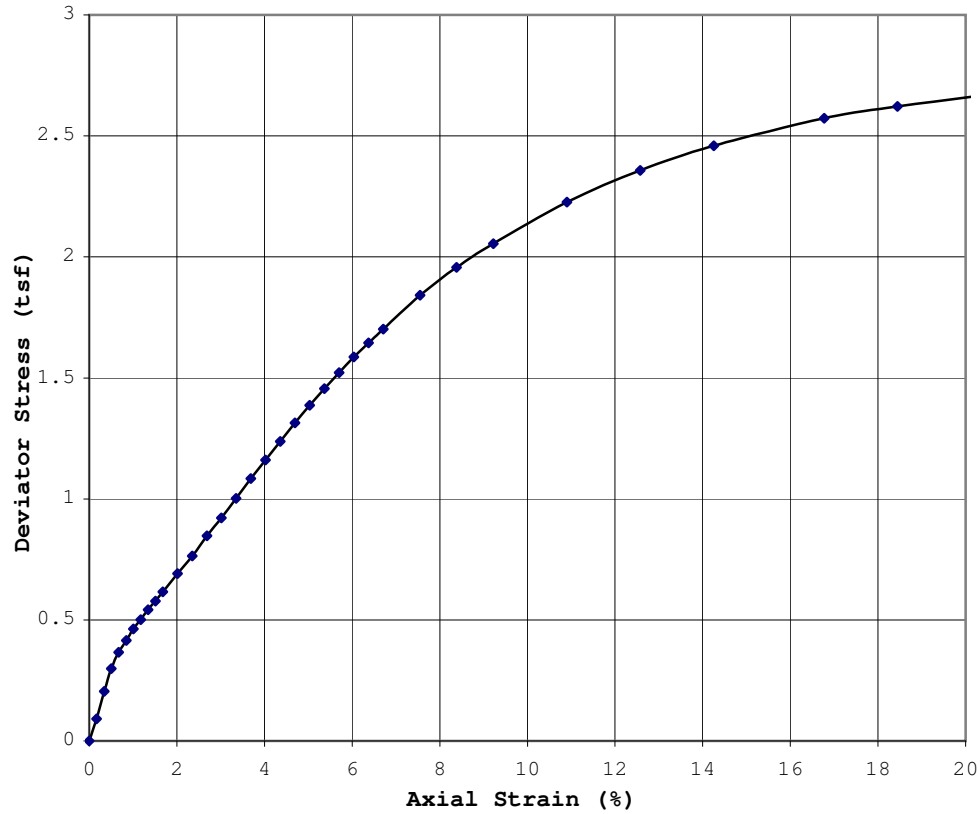
Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.88 Ht. (in) 5.98
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 4.91 tsf
Strain at Failure (%): 4.7

W.C. (%): 16.6
Yd (pcf): 115.2

Sketch of Specimen After Failure





Boring: Geo-016 Depth: 28-30
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

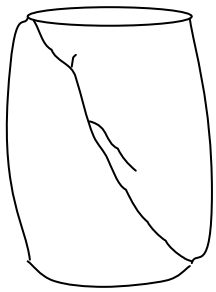
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.89 Ht. (in): 5.97
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.66 tsf
Strain at Failure (%): 20.0

W.C. (%): 16.9
Yd (pcf): 115.5

Sketch of Specimen After Failure



9530 James Ave South

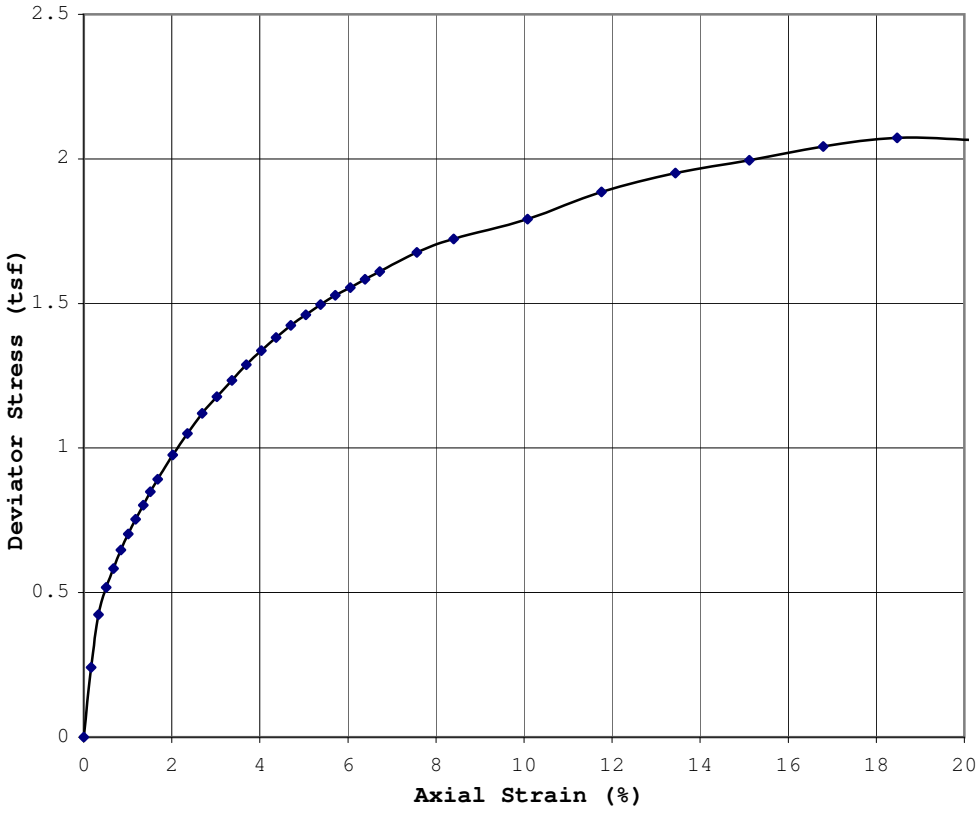
SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

Unconfined Stress/Strain Curves

ASTM: D2166

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 5/22/18
Remarks:



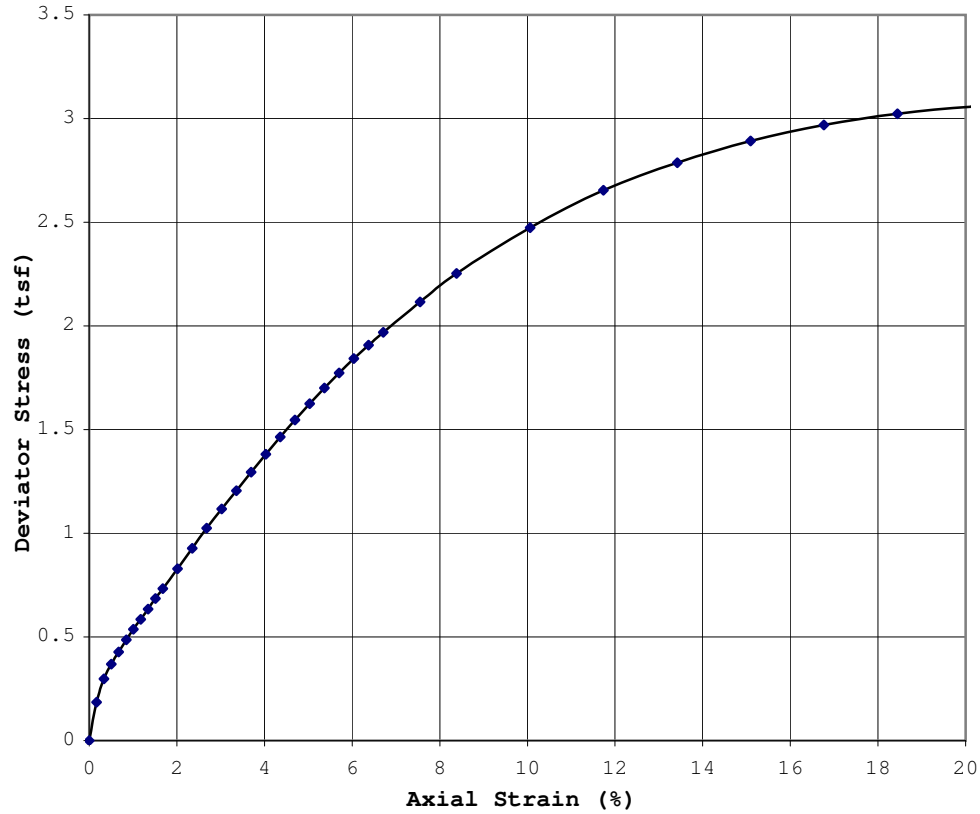
Boring: Geo-033 Depth: 23-25
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.90 Ht. (in) 5.95
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.07 tsf
Strain at Failure (%): 18.5

W.C. (%): 16.9
Yd (pcf): 114.9

Sketch of Specimen After Failure



Boring: Geo-034 Depth: 38-40
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

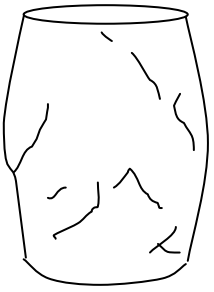
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.89 Ht. (in): 5.96
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 3.04 tsf
Strain at Failure (%): 20.0

W.C. (%): 15.8
Yd (pcf): 117.3

Sketch of Specimen After Failure



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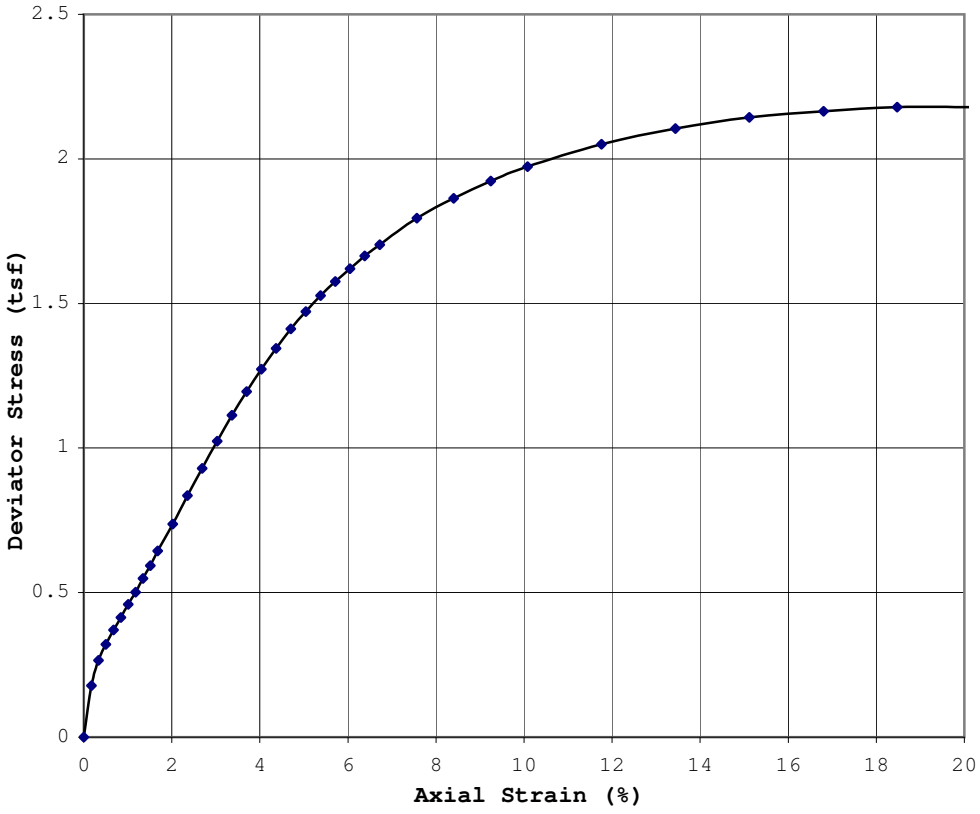
Bloomington, MN 55431

Unconfined Stress/Strain Curves

ASTM: D2166

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 5/22/18
Remarks:



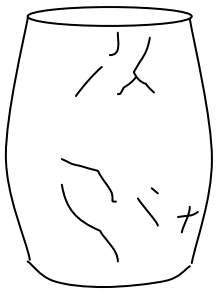
Boring: Geo-035 Depth: 18-20
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

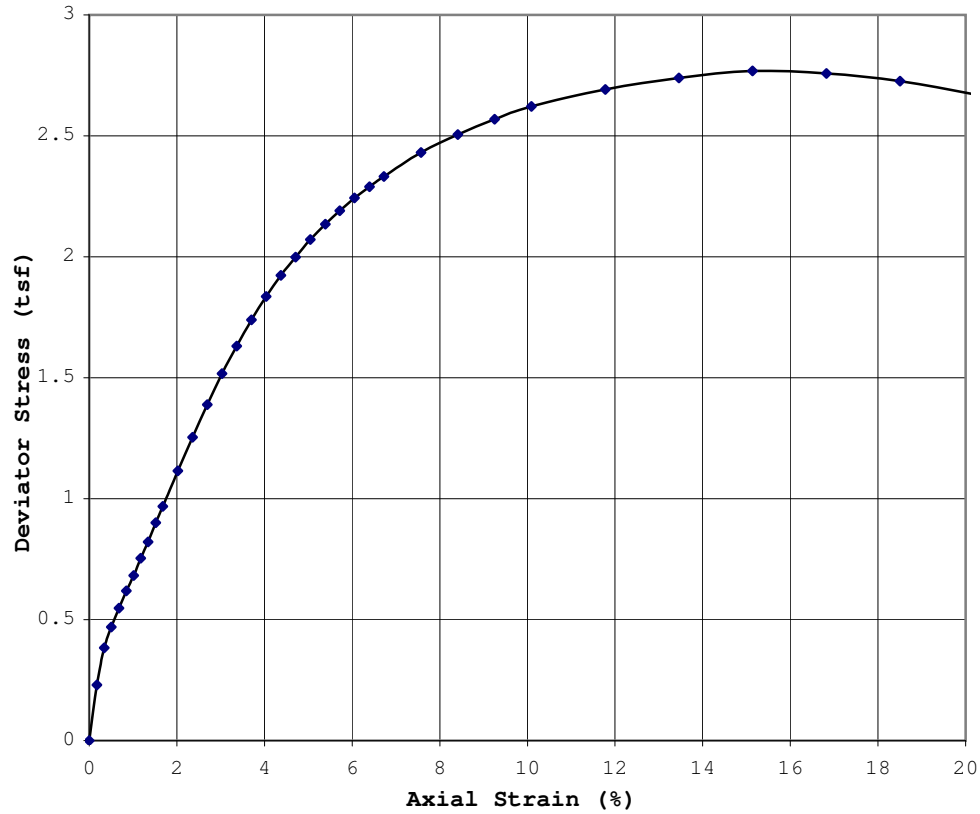
Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.90 Ht. (in) 5.95
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.18 tsf
Strain at Failure (%): 20.0

W.C. (%): 17.8
Yd (pcf): 112.8

Sketch of Specimen After Failure





Boring: Geo-035 Depth: 22-24
Sample #:
Soil Type: Lean Clay w/sand and a little gravel (CL)

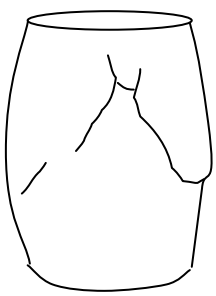
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.89 Ht. (in): 5.95
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.77 tsf
Strain at Failure (%): 15.1

W.C. (%): 17.0
Yd (pcf): 114.9

Sketch of Specimen After Failure



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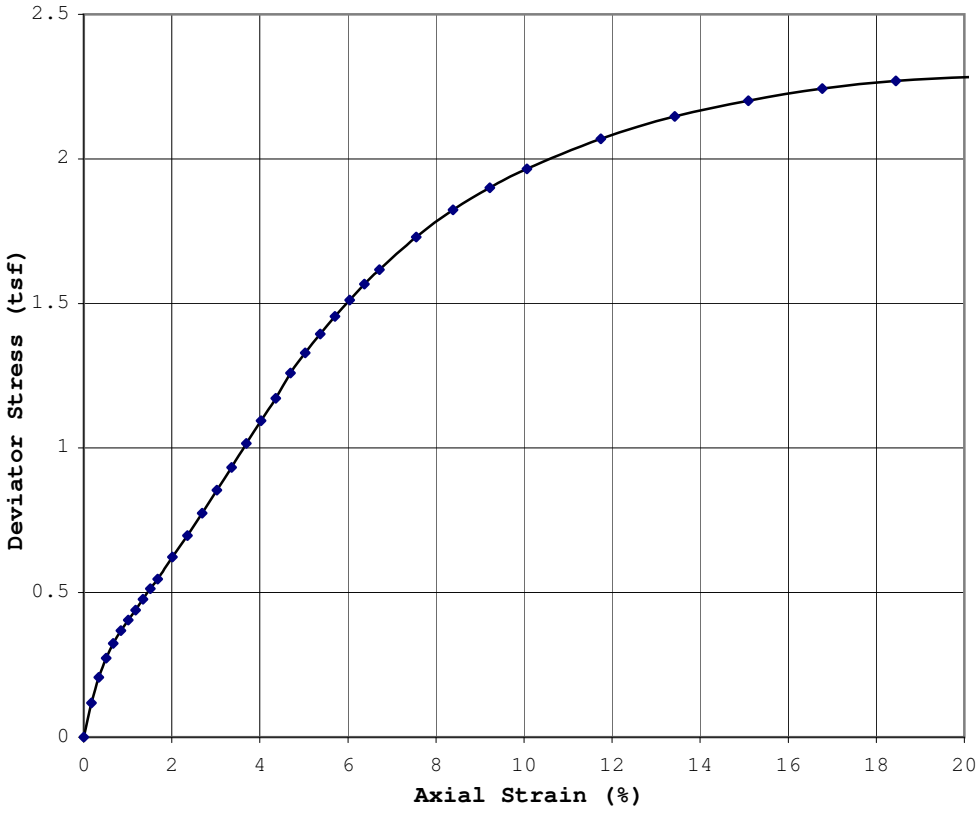
Unconfined Stress/Strain Curves

ASTM: D2166

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 5/22/18
Remarks:



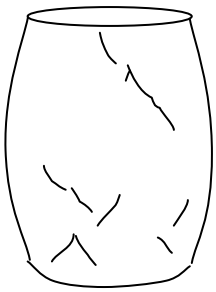
Boring: Geo-035 Depth: 37-39
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

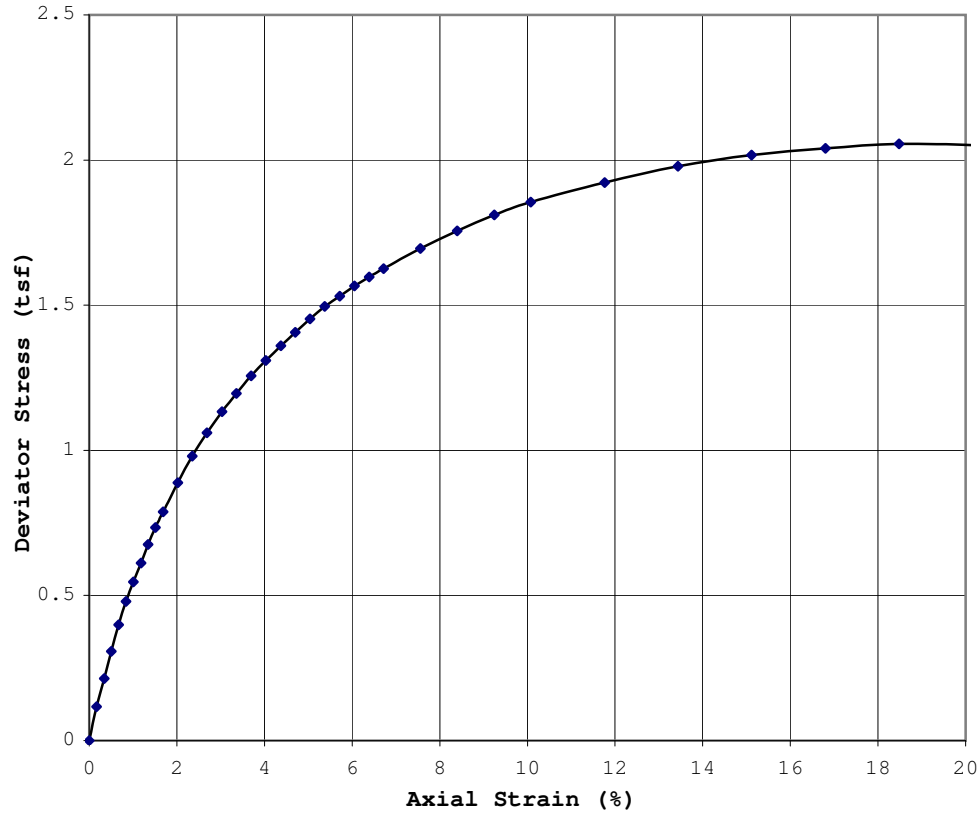
Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.90 Ht. (in) 5.96
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.28 tsf
Strain at Failure (%): 20.0

W.C. (%): 17.5
Yd (pcf): 114.0

Sketch of Specimen After Failure





Boring: Geo-036 Depth: 33-35
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

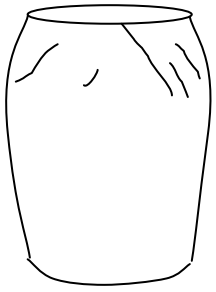
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.88 Ht. (in): 5.95
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.06 tsf
Strain at Failure (%): 18.5

W.C. (%): 17.3
Yd (pcf): 113.8

Sketch of Specimen After Failure



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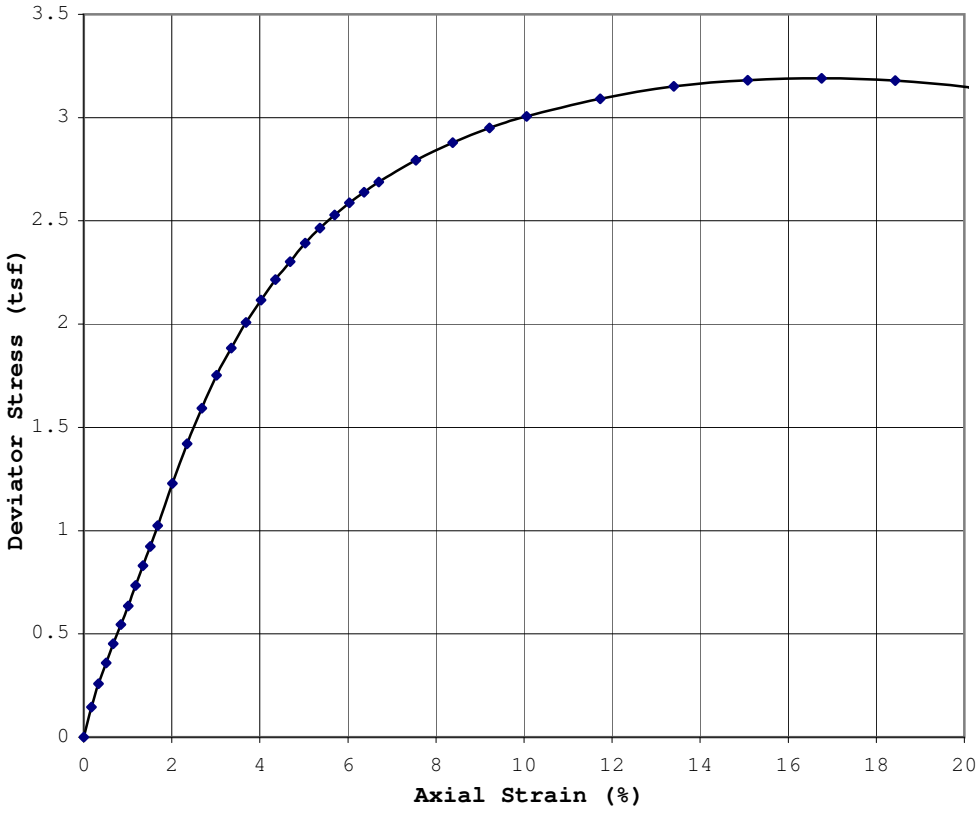
Bloomington, MN 55431

Unconfined Stress/Strain Curves

ASTM: D2166

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 5/22/18
Remarks:



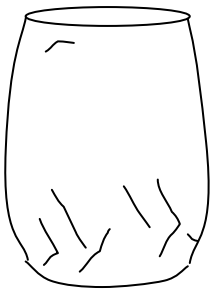
Boring: Geo-037 Depth: 17-19
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

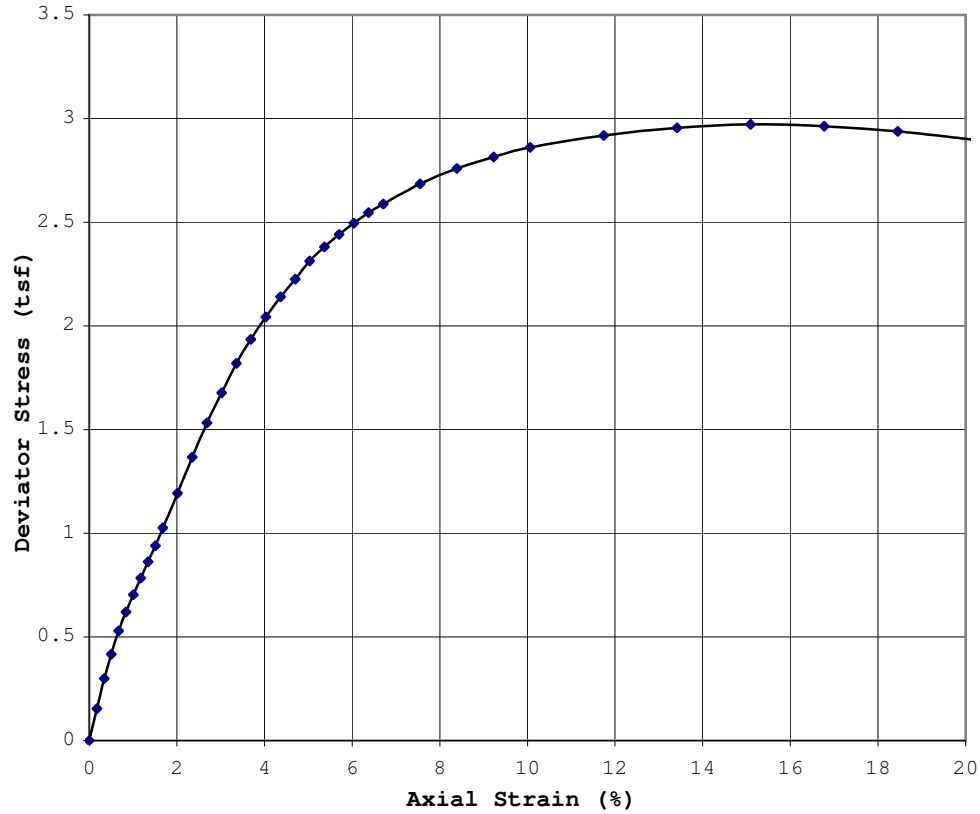
Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.88 Ht. (in) 5.97
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 3.19 tsf
Strain at Failure (%): 16.8

W.C. (%): 17.0
Yd (pcf): 115.0

Sketch of Specimen After Failure





Boring: Geo-037 Depth: 33-35
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

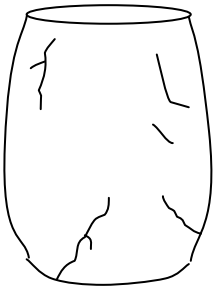
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.88 Ht. (in): 5.96
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.97 tsf
Strain at Failure (%): 15.1

W.C. (%): 17.3
Yd (pcf): 113.7

Sketch of Specimen After Failure



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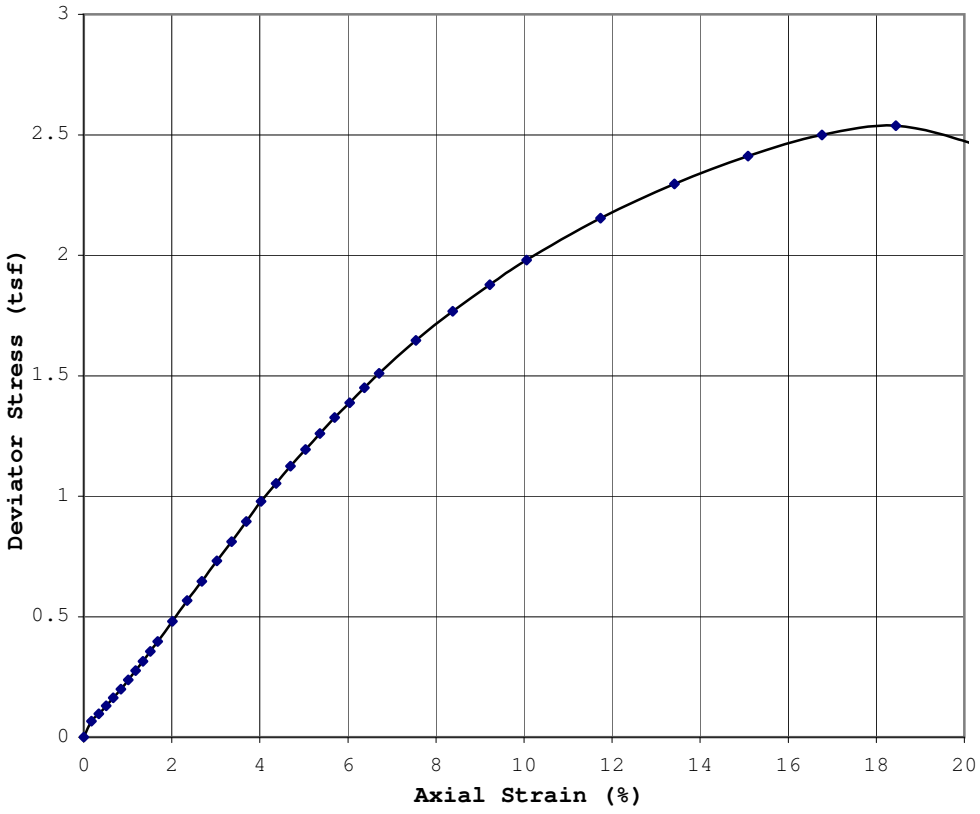
Bloomington, MN 55431

Unconfined Stress/Strain Curves

ASTM: D2166

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 5/22/18
Remarks:



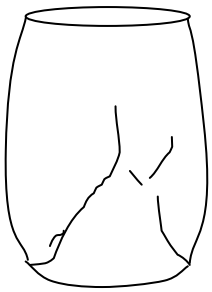
Boring: Geo-039 Depth: 28-30
Sample #:
Soil Type: Sandy Lean Clay w/a little gravel (CL)

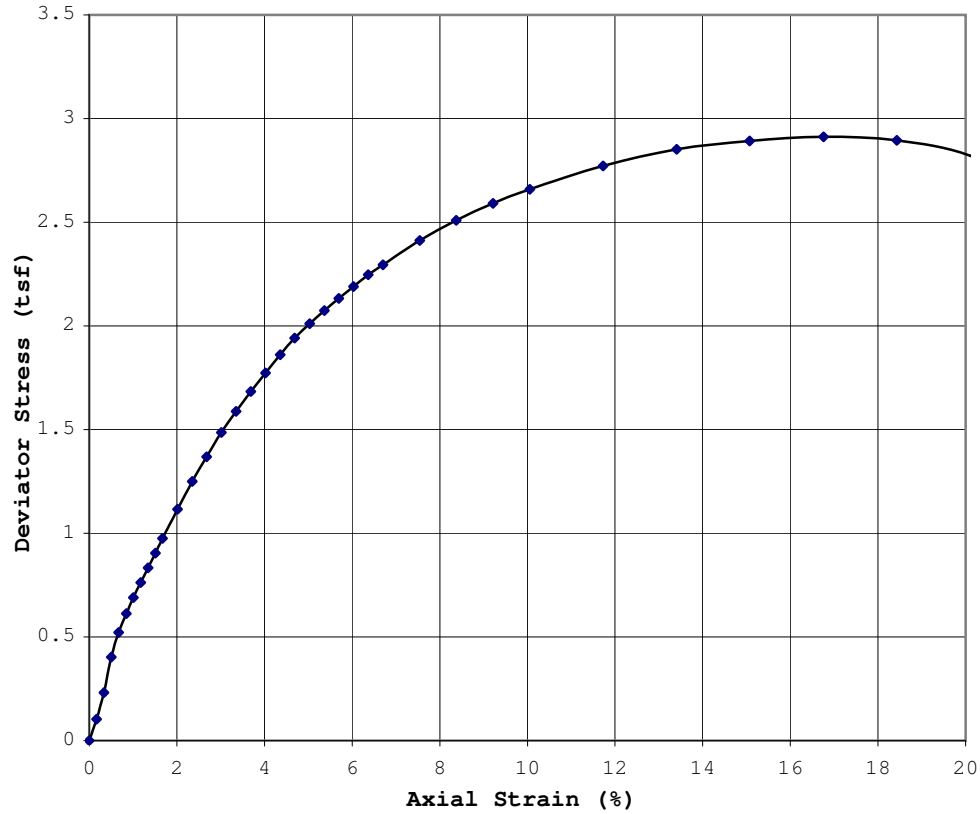
Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.88 Ht. (in) 5.97
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.54 tsf
Strain at Failure (%): 18.4

W.C. (%): 14.0
Yd (pcf): 123.1

Sketch of Specimen After Failure





Boring: Geo-040 Depth: 23-25
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

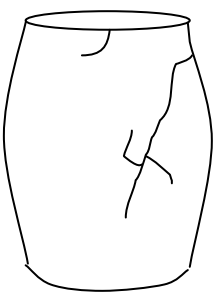
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.89 Ht. (in): 5.97
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.91 tsf
Strain at Failure (%): 16.8

W.C. (%): 16.6
Yd (pcf): 115.8

Sketch of Specimen After Failure



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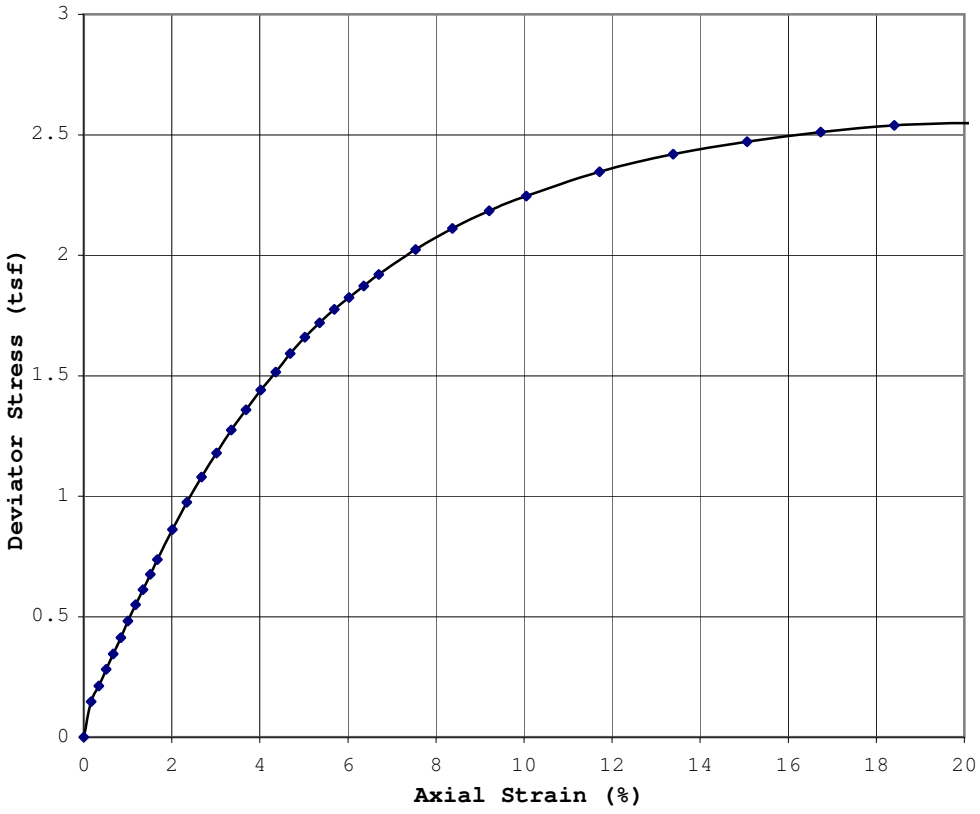
Bloomington, MN 55431

Unconfined Stress/Strain Curves

ASTM: D2166

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 5/22/18
Remarks:



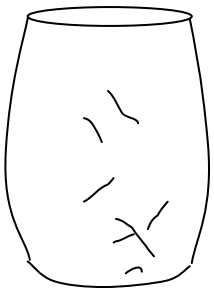
Boring: Geo-041 Depth: 15-17
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

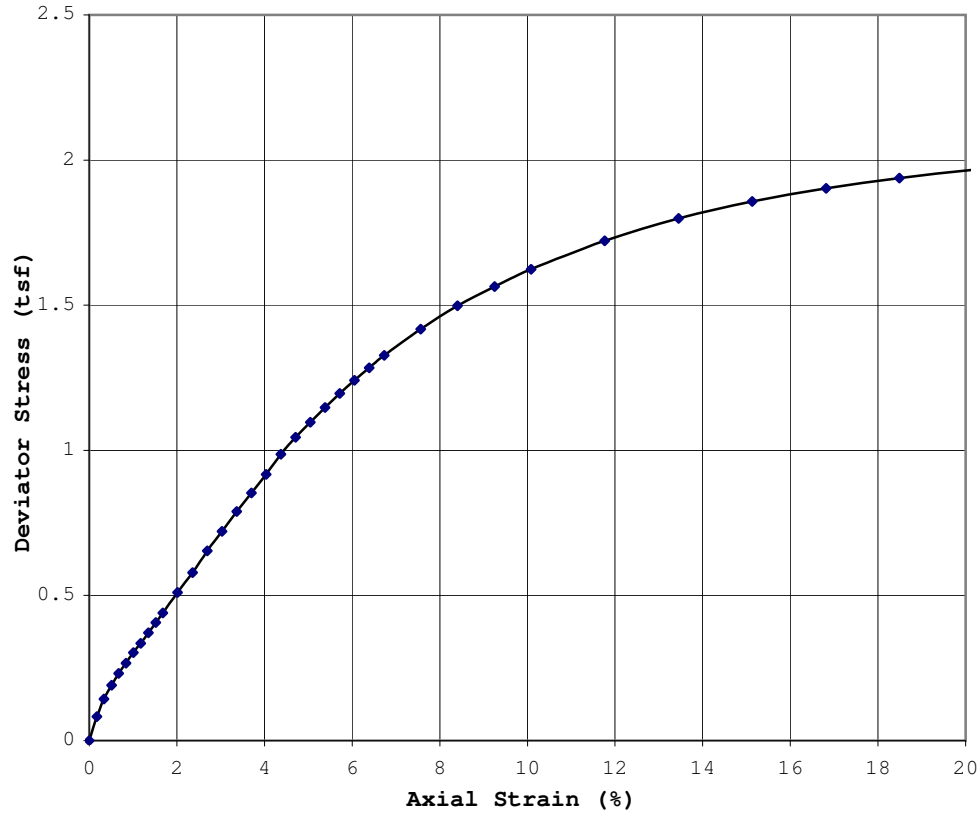
Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.88 Ht. (in) 5.98
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.55 tsf
Strain at Failure (%): 20.0

W.C. (%): 17.5
Yd (pcf): 114.3

Sketch of Specimen After Failure





Boring: Geo-043 Depth: 30-32
Sample #:
Soil Type: Lean Clay w/a trace of gravel (CL)

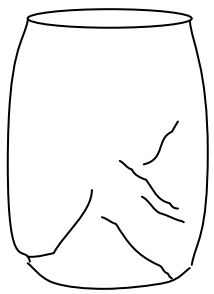
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.89 Ht. (in): 5.95
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 1.97 tsf
Strain at Failure (%): 20.0

W.C. (%): 18.6
Yd (pcf): 112.2

Sketch of Specimen After Failure



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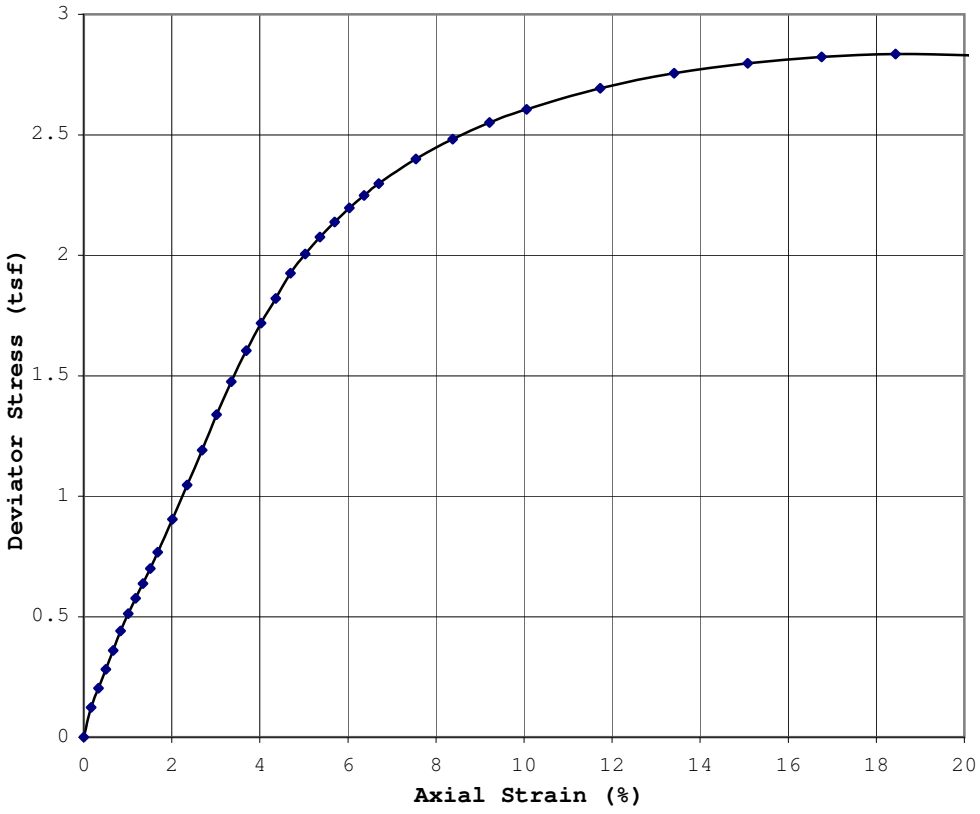
Unconfined Stress/Strain Curves

ASTM: D2166

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 5/22/18
Remarks:



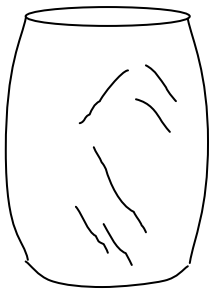
Boring: Geo-044 Depth: 25-27
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

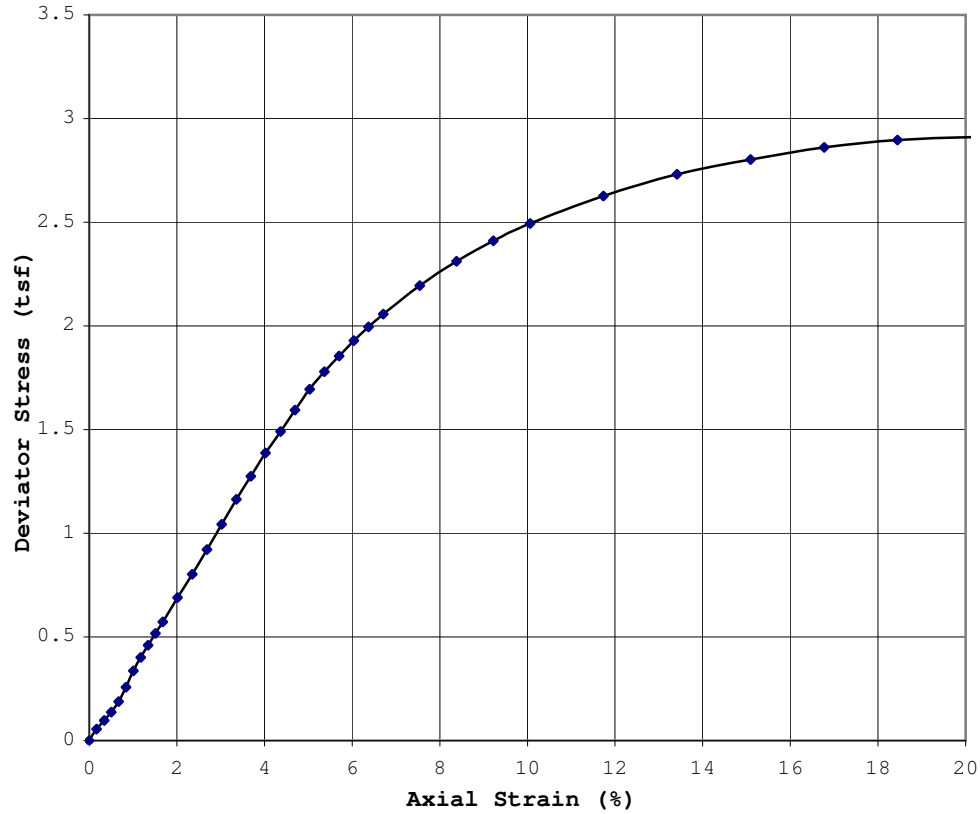
Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.89 Ht. (in) 5.97
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.84 tsf
Strain at Failure (%): 18.4

W.C. (%): 17.7
Yd (pcf): 113.8

Sketch of Specimen After Failure





Boring: Geo-056 Depth: 17-19
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

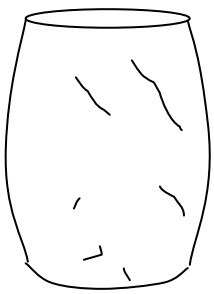
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.88 Ht. (in): 5.96
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.90 tsf
Strain at Failure (%): 20.0

W.C. (%): 17.1
Yd (pcf): 115.4

Sketch of Specimen After Failure



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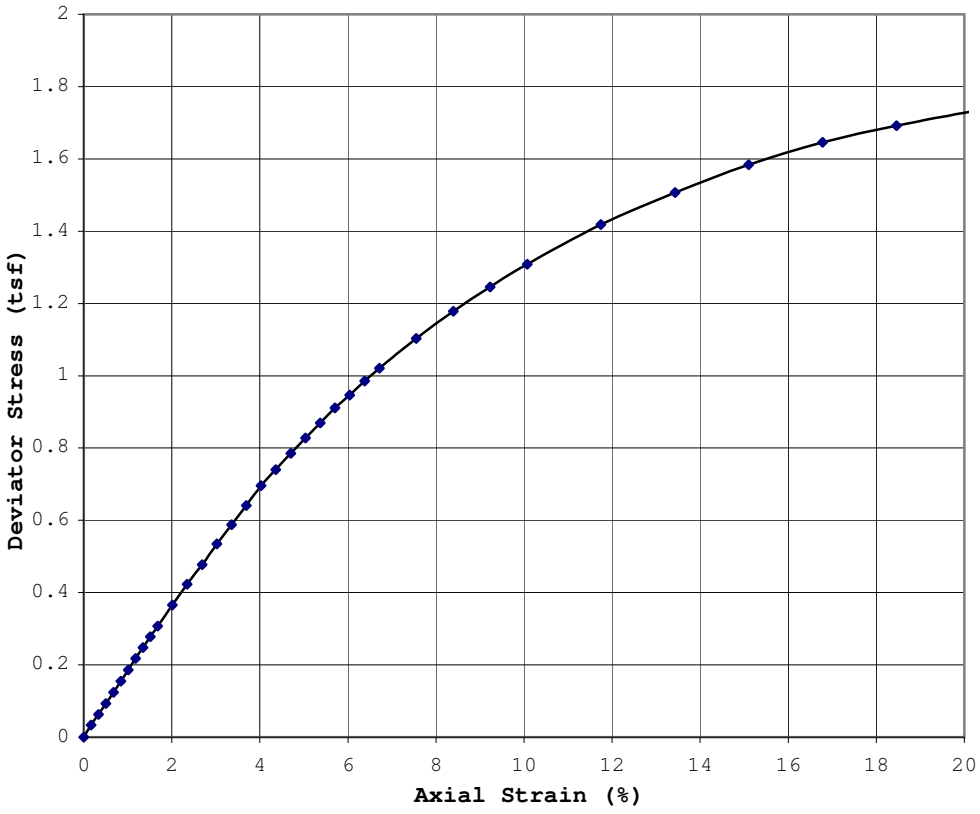
Unconfined Stress/Strain Curves

ASTM: D2166

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 5/22/18
Remarks:



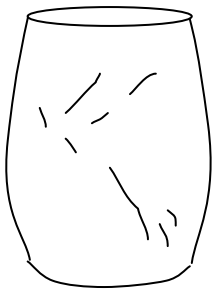
Boring: Geo-056 Depth: 43-45
Sample #:
Soil Type: Sandy Lean Clay w/a little gravel (CL)

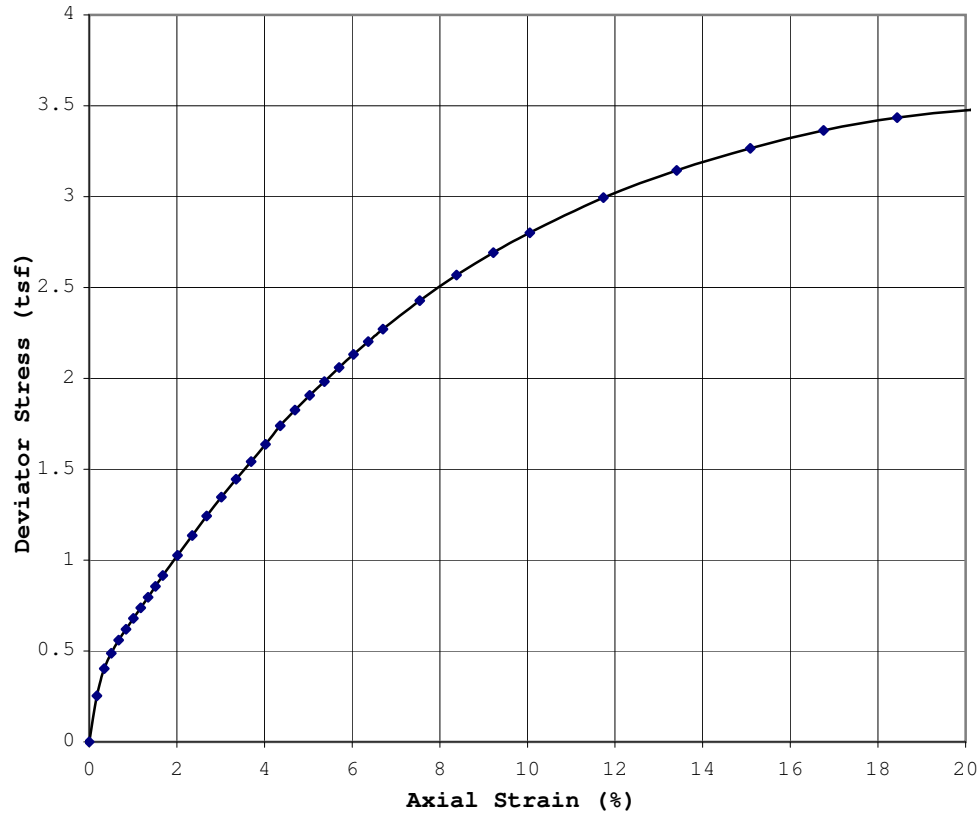
Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.88 Ht. (in) 5.96
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 1.73 tsf
Strain at Failure (%): 20.0

W.C. (%): 16.7
Yd (pcf): 116.9

Sketch of Specimen After Failure





Boring: Geo-059 Depth: 18-20
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

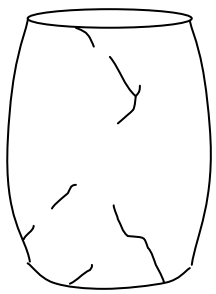
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.89 Ht. (in): 5.97
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 3.47 tsf
Strain at Failure (%): 20.0

W.C. (%): 17.0
Yd (pcf): 115.3

Sketch of Specimen After Failure



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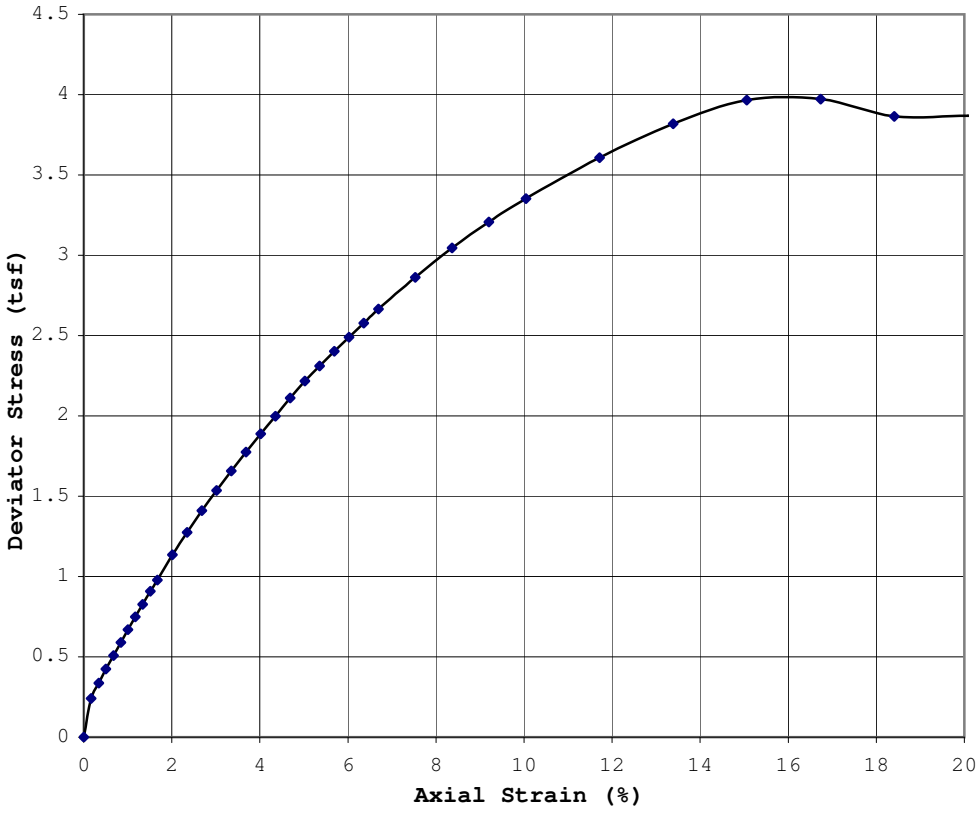
Unconfined Stress/Strain Curves

ASTM: D2166

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 5/22/18
Remarks:



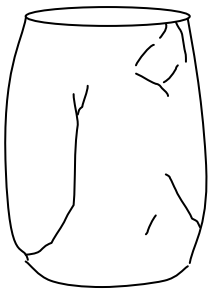
Boring: Geo-059 Depth: 47-49
Sample #:
Soil Type: Lean Clay w/sand and a little gravel (CL)

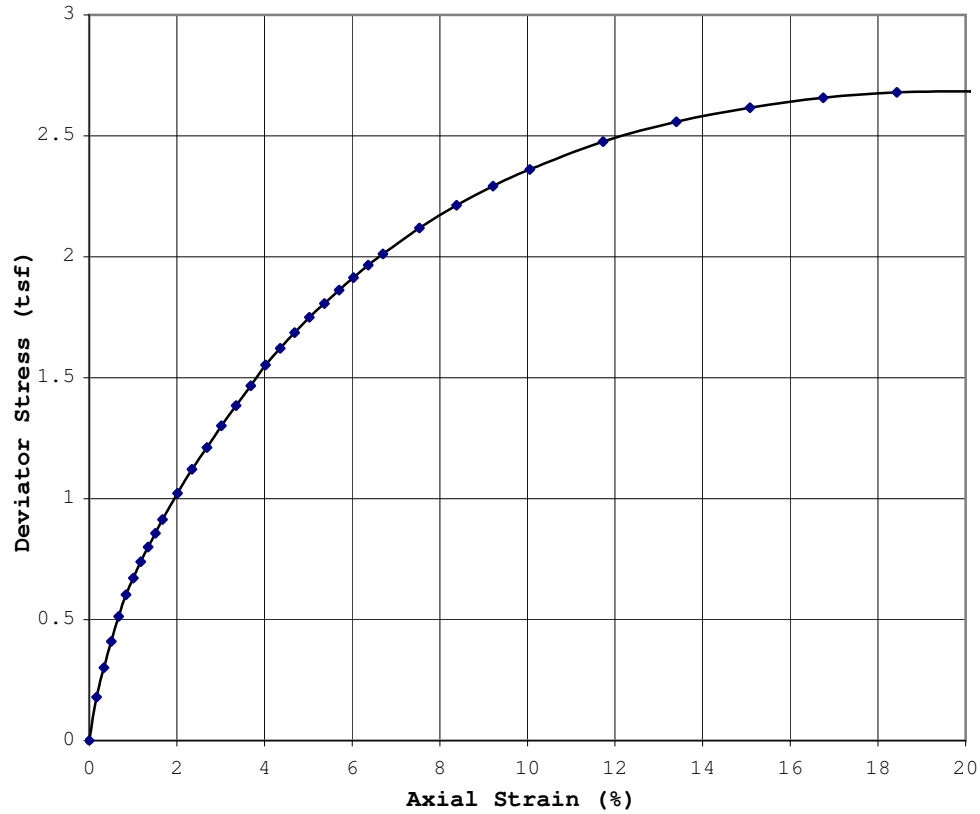
Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.89 Ht. (in) 5.98
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 3.97 tsf
Strain at Failure (%): 16.7

W.C. (%): 14.8
Yd (pcf): 119.9

Sketch of Specimen After Failure





Boring: Geo-063 Depth: 23-25
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

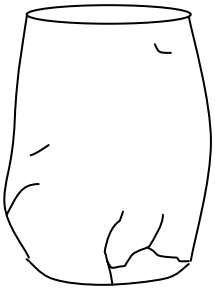
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.89 Ht. (in): 5.97
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.68 tsf
Strain at Failure (%): 20.0

W.C. (%): 16.6
Yd (pcf): 115.6

Sketch of Specimen After Failure



9530 James Ave South

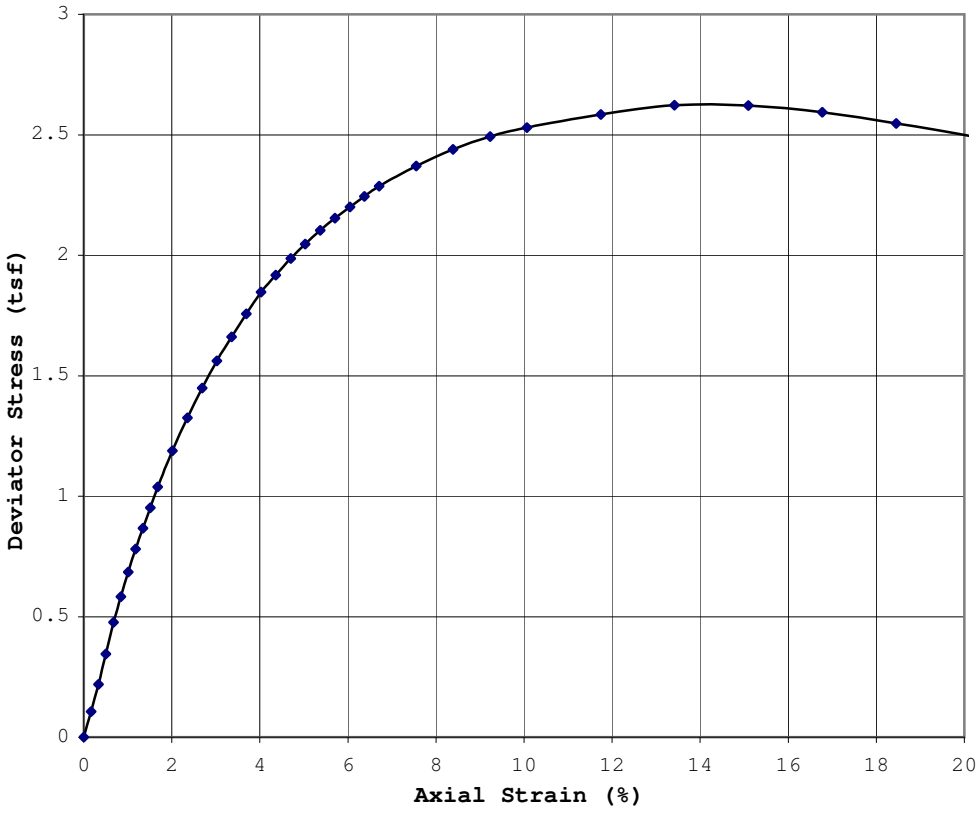
SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

Unconfined Stress/Strain Curves

ASTM: D2166

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 5/22/18
Remarks:



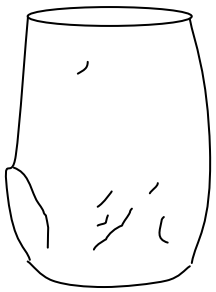
Boring: Geo-071 Depth: 15-17
Sample #:
Soil Type: Lean Clay w/sand and a little gravel (CL)

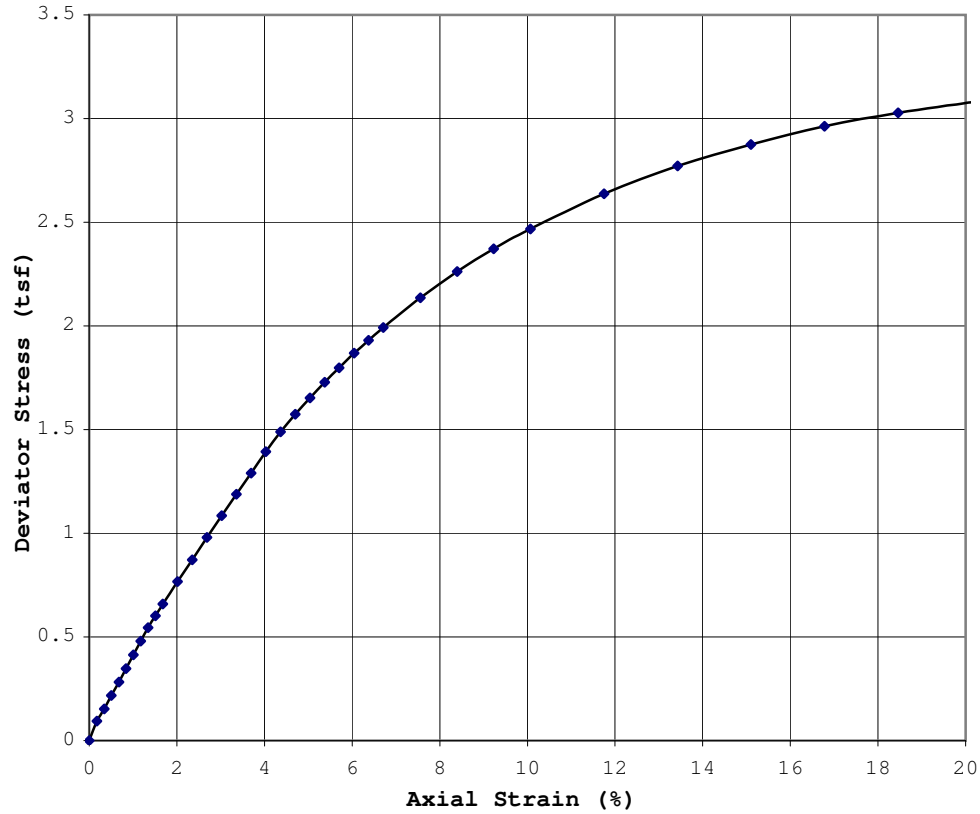
Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.89 Ht. (in) 5.96
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.62 tsf
Strain at Failure (%): 13.4

W.C. (%): 16.4
Yd (pcf): 116.3

Sketch of Specimen After Failure





Boring: Geo-072 Depth: 18-20
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

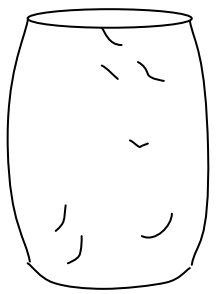
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.89 Ht. (in): 5.96
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 3.09 tsf
Strain at Failure (%): 20.0

W.C. (%): 16.6
Yd (pcf): 115.9

Sketch of Specimen After Failure



9530 James Ave South

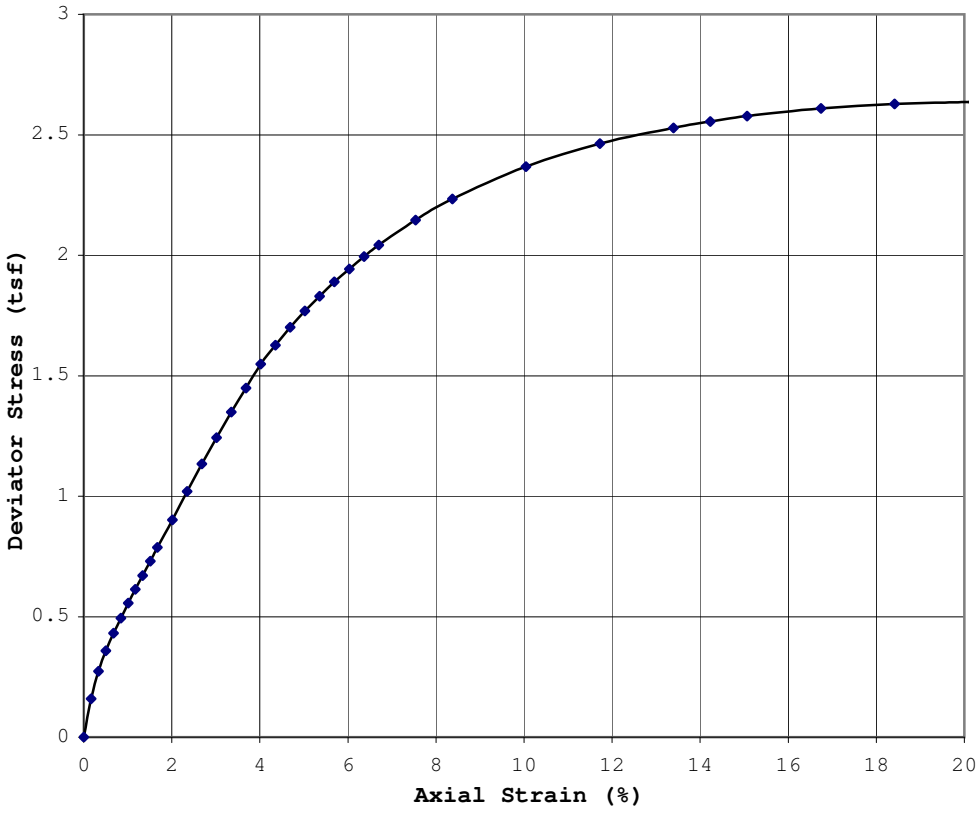
SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

Unconfined Stress/Strain Curves

ASTM: D2166

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 5/22/18
Remarks:



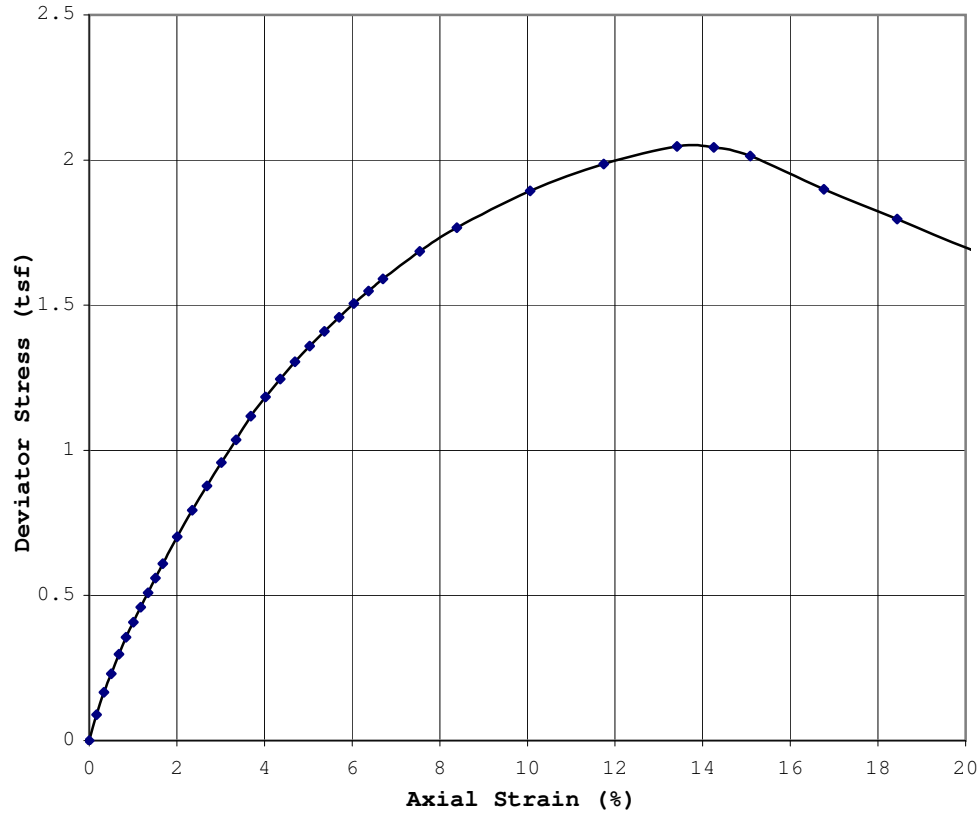
Boring: Geo-074 — Depth: 23-25
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.89 — Ht. (in) 5.97
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.64 tsf
Strain at Failure (%): 20.0

W.C. (%): 16.9
Yd (pcf): 115.3

Sketch of Specimen After Failure



Boring: Geo-077 — Depth: 22-24
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

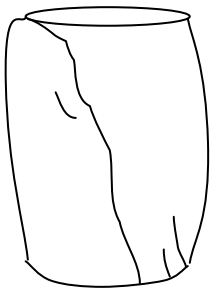
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.89 — Ht. (in): 5.97
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.05 tsf
Strain at Failure (%): 13.4

W.C. (%): 17.4
Yd (pcf): 114.2

Sketch of Specimen After Failure



9530 James Ave South

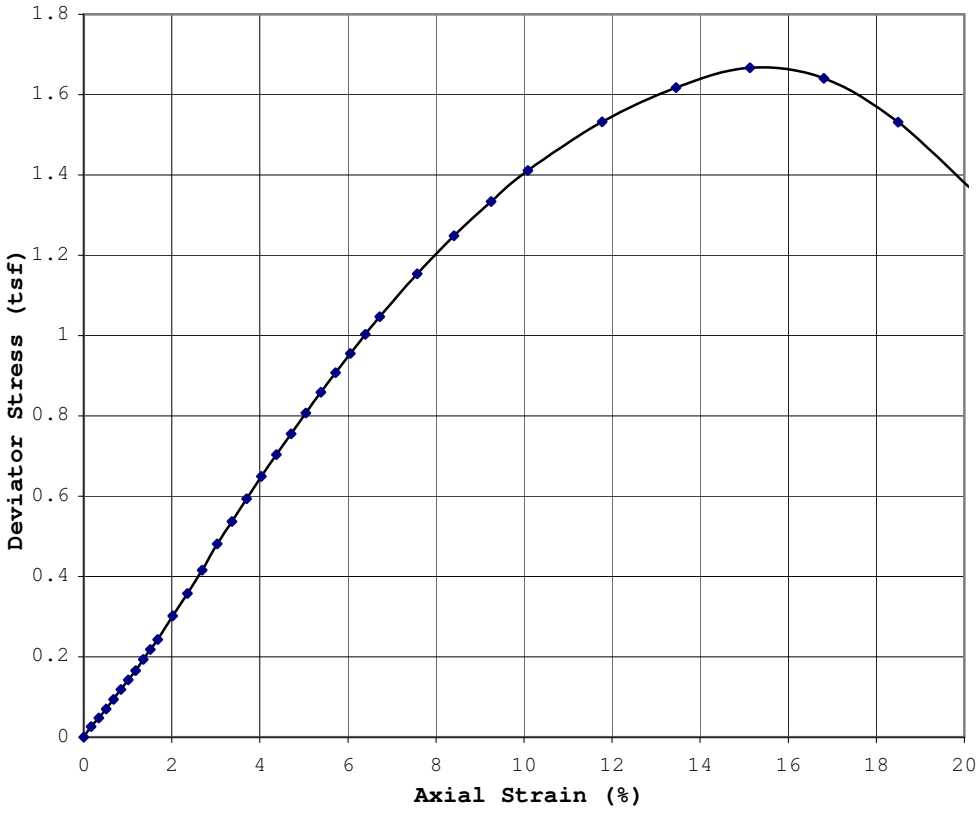
SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

Unconfined Stress/Strain Curves

ASTM: D2166

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 5/22/18
Remarks:



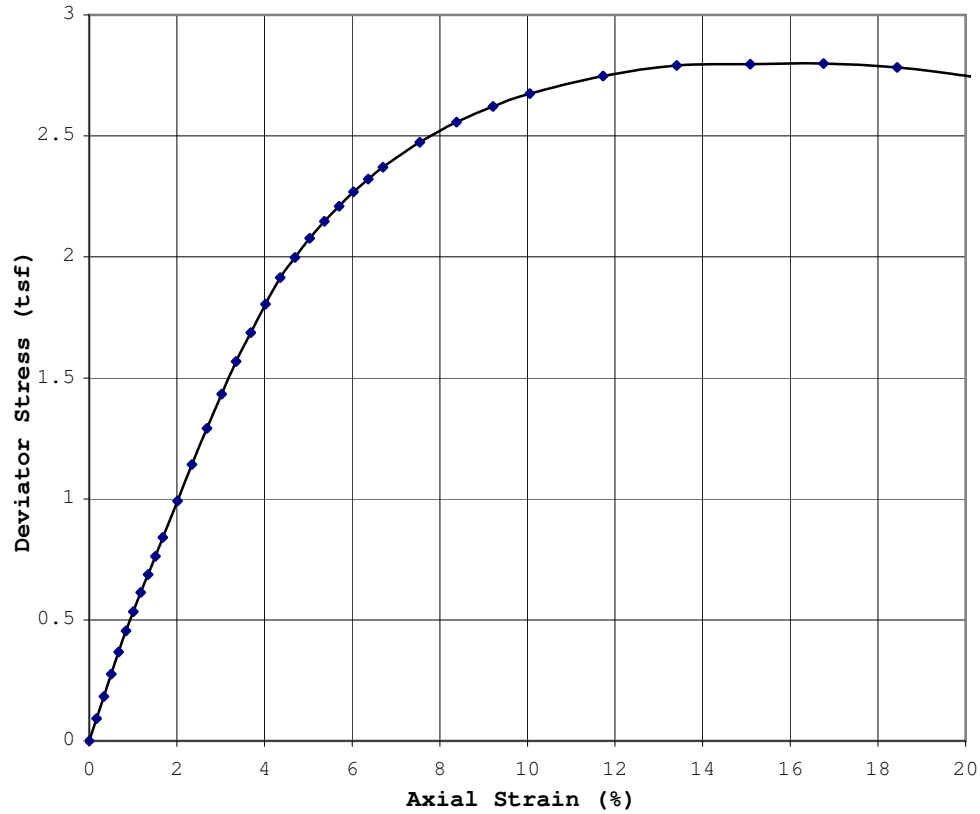
Boring: Geo-077 Depth: 45-47
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.88 Ht. (in) 5.95
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 1.67 tsf
Strain at Failure (%): 15.1

W.C. (%): 16.9
Yd (pcf): 117.2

Sketch of Specimen After Failure



Boring: Geo-079 Depth: 20-22
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

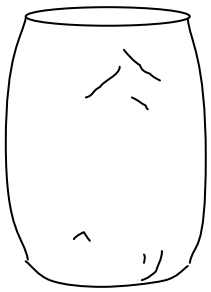
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.89 Ht. (in): 5.97
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.80 tsf
Strain at Failure (%): 16.8

W.C. (%): 17.2
Yd (pcf): 114.8

Sketch of Specimen After Failure



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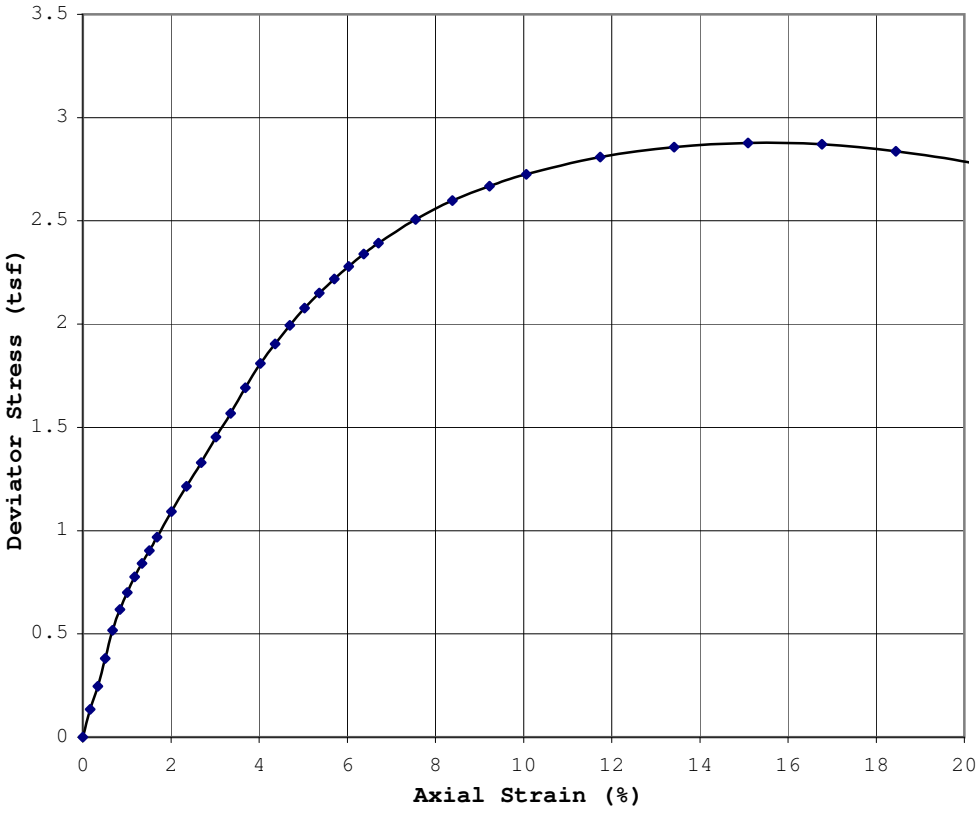
SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

Unconfined Stress/Strain Curves

ASTM: D2166

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 5/22/18
Remarks:



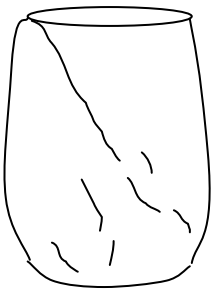
Boring: Geo-079 Depth: 35-37
Sample #:
Soil Type: Lean Clay w/sand and a little gravel (CL)

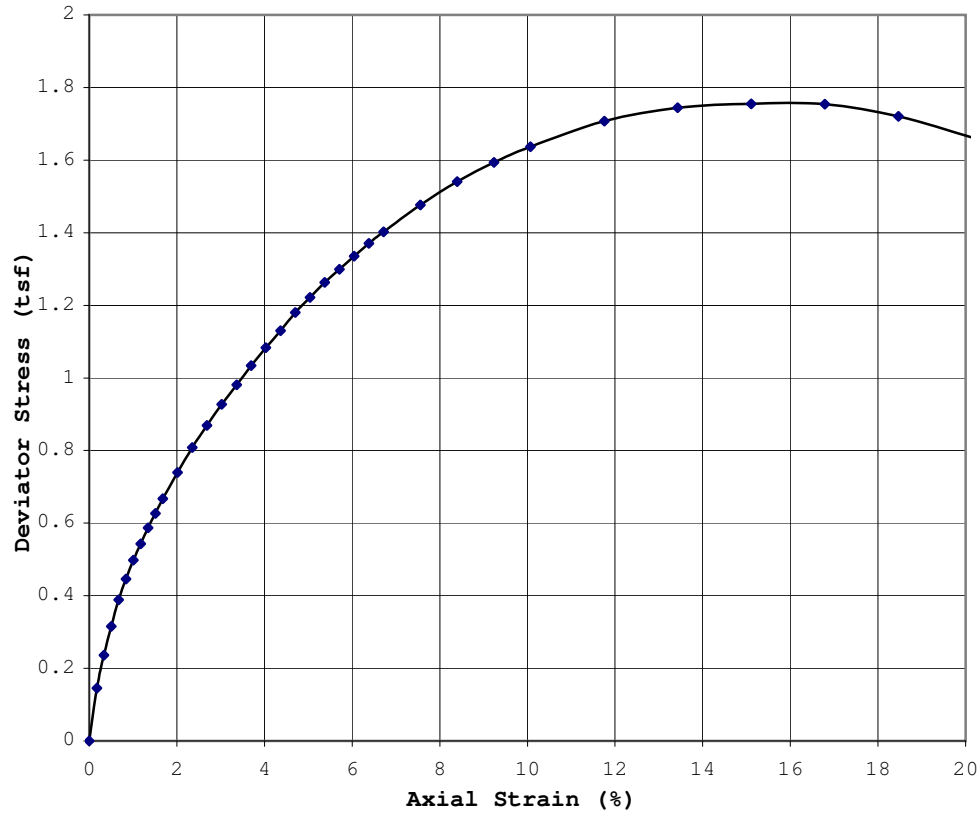
Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.89 Ht. (in) 5.96
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.88 tsf
Strain at Failure (%): 15.1

W.C. (%): 17.6
Yd (pcf): 113.9

Sketch of Specimen After Failure





Boring: Geo-081 Depth: 22-24
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.90 Ht. (in): 5.96
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 1.75 tsf
Strain at Failure (%): 15.1

W.C. (%): 16.8
Yd (pcf): 115.9

Sketch of Specimen After Failure

9530 James Ave South

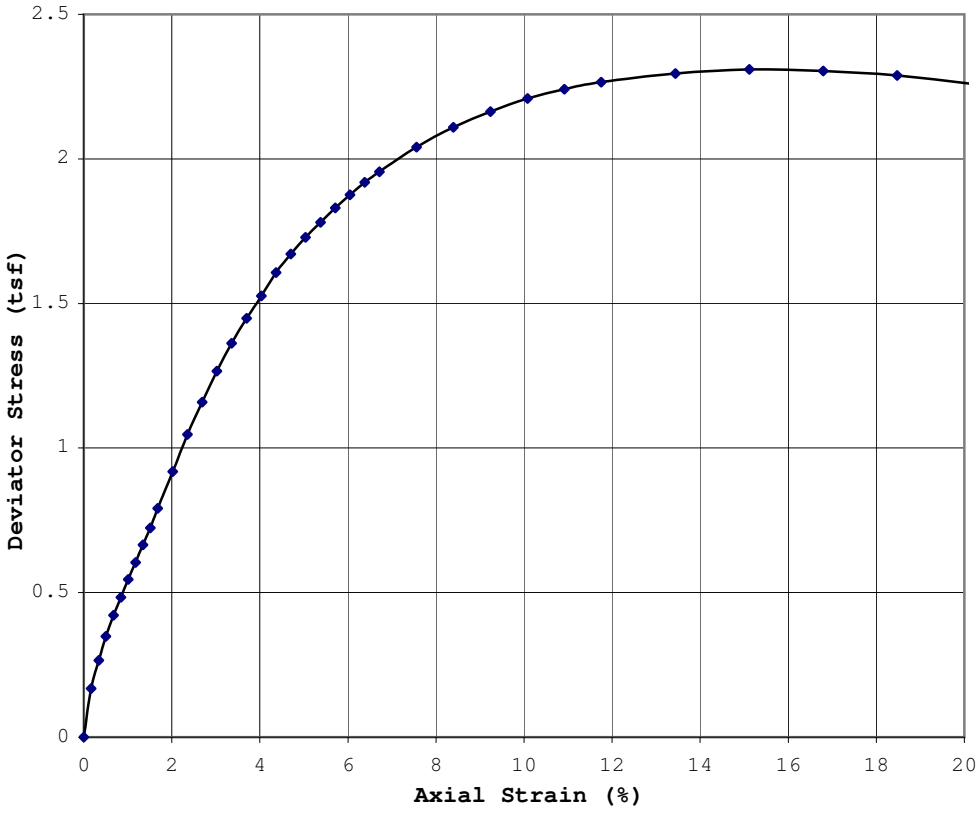
SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

Unconfined Stress/Strain Curves

ASTM: D2166

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 5/22/18
Remarks:



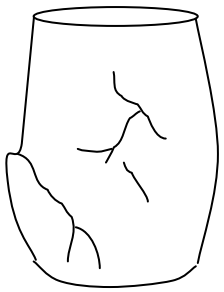
Boring: Geo-083 Depth: 18-20
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

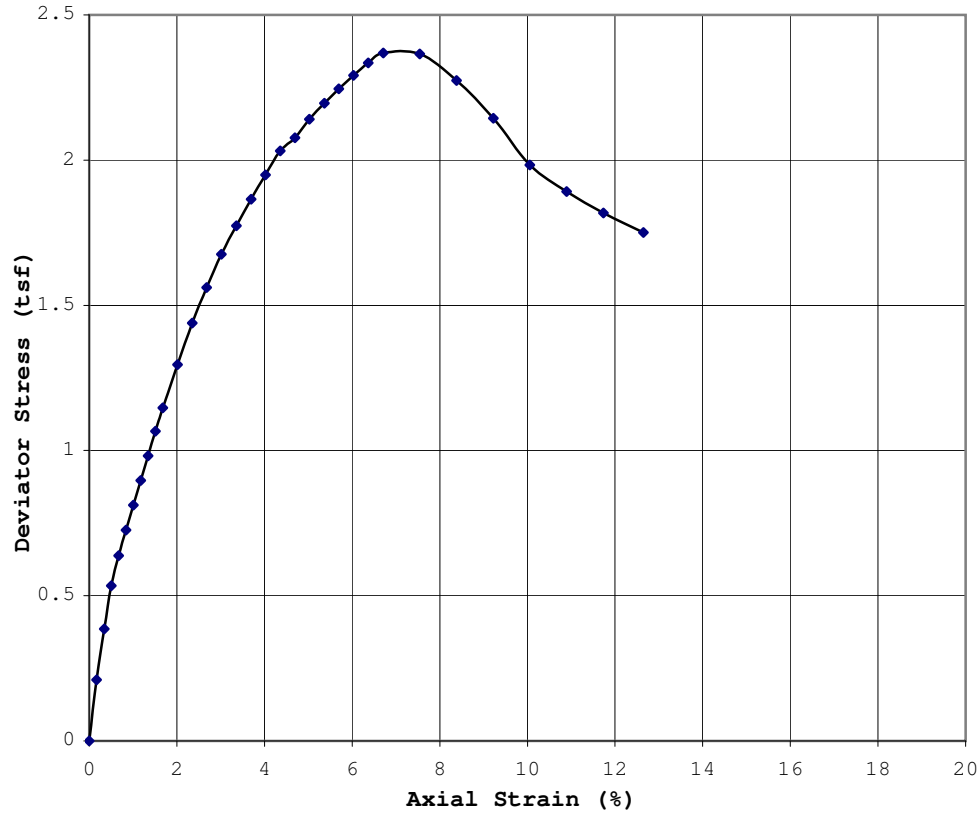
Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.89 Ht. (in) 5.96
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.31 tsf
Strain at Failure (%): 15.1

W.C. (%): 17.5
Yd (pcf): 114.0

Sketch of Specimen After Failure





Boring: Geo-087 Depth: 18-20
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

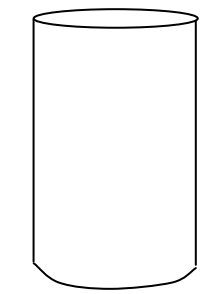
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.89 Ht. (in): 5.97
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.37 tsf
Strain at Failure (%): 6.7

W.C. (%): 17.1
Yd (pcf): 115.0

Sketch of Specimen After Failure



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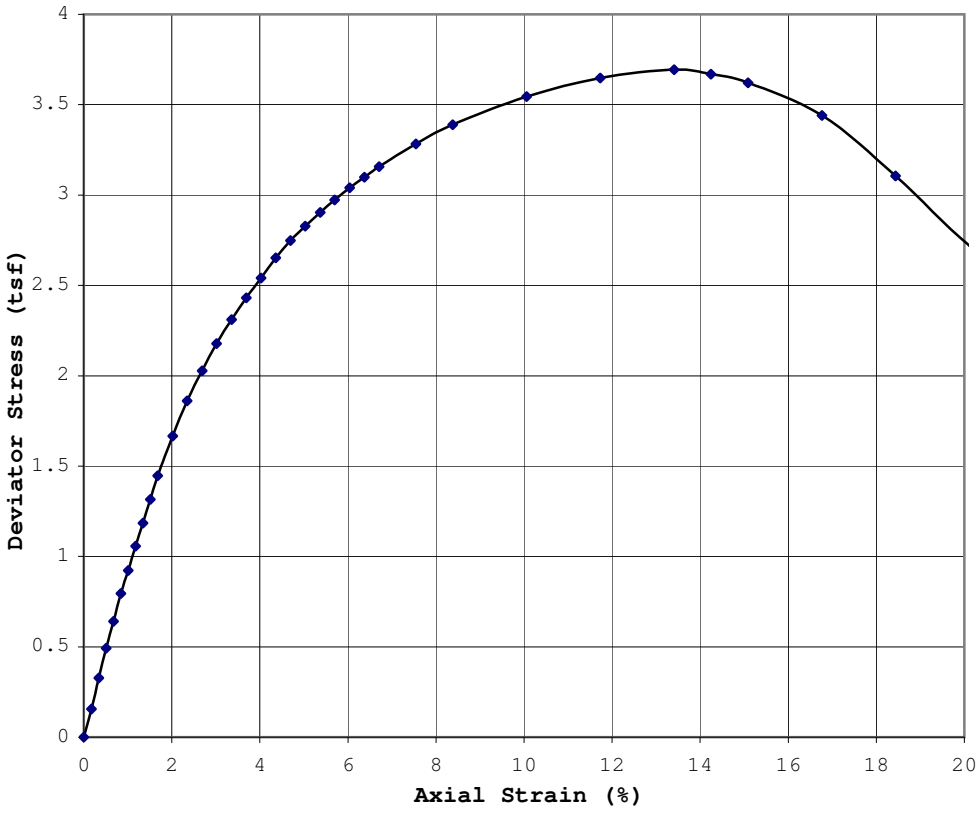
Bloomington, MN 55431

Unconfined Stress/Strain Curves

ASTM: D2166

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 5/22/18
Remarks:



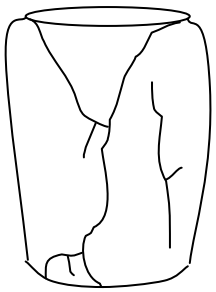
Boring: Geo-091 Depth: 23-25
Sample #:
Soil Type: Lean Clay w/sand and a little gravel (CL)

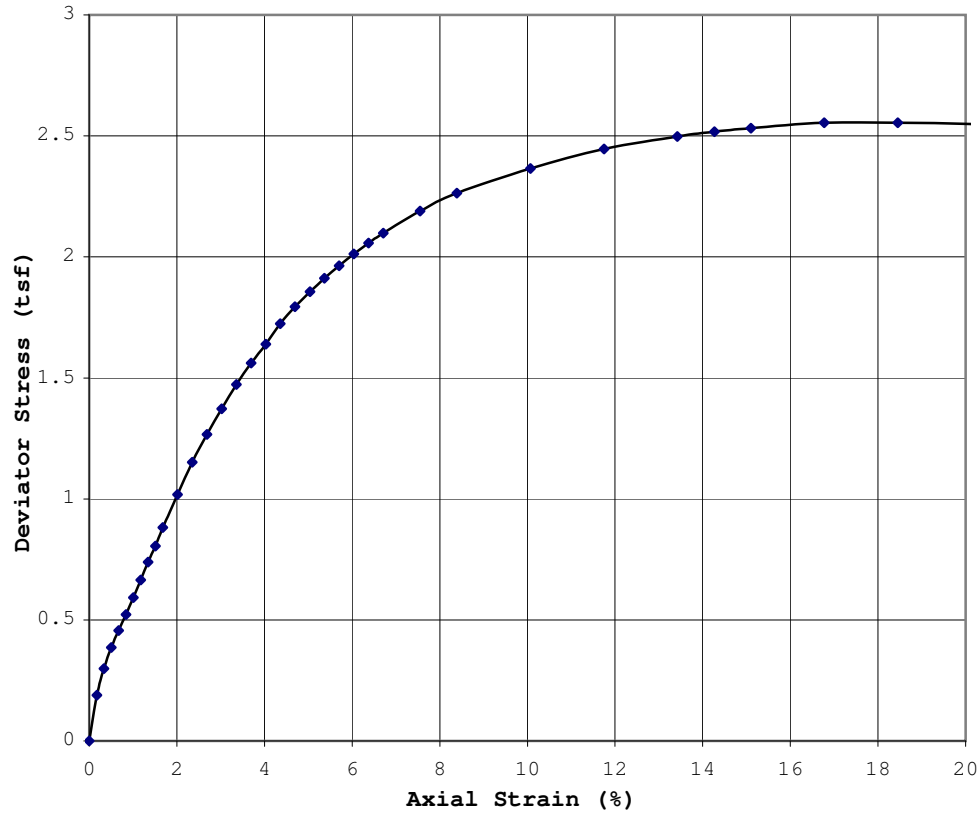
Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.89 Ht. (in) 5.97
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 3.69 tsf
Strain at Failure (%): 13.4

W.C. (%): 15.4
Yd (pcf): 117.4

Sketch of Specimen After Failure





Boring: Geo-092 Depth: 22-24
Sample #:
Soil Type: Lean Clay w/sand and a little gravel (CL)

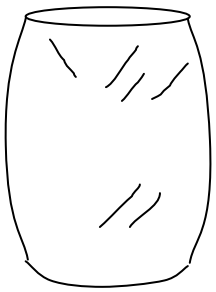
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.89 Ht. (in): 5.96
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.55 tsf
Strain at Failure (%): 18.5

W.C. (%): 17.1
Yd (pcf): 114.6

Sketch of Specimen After Failure



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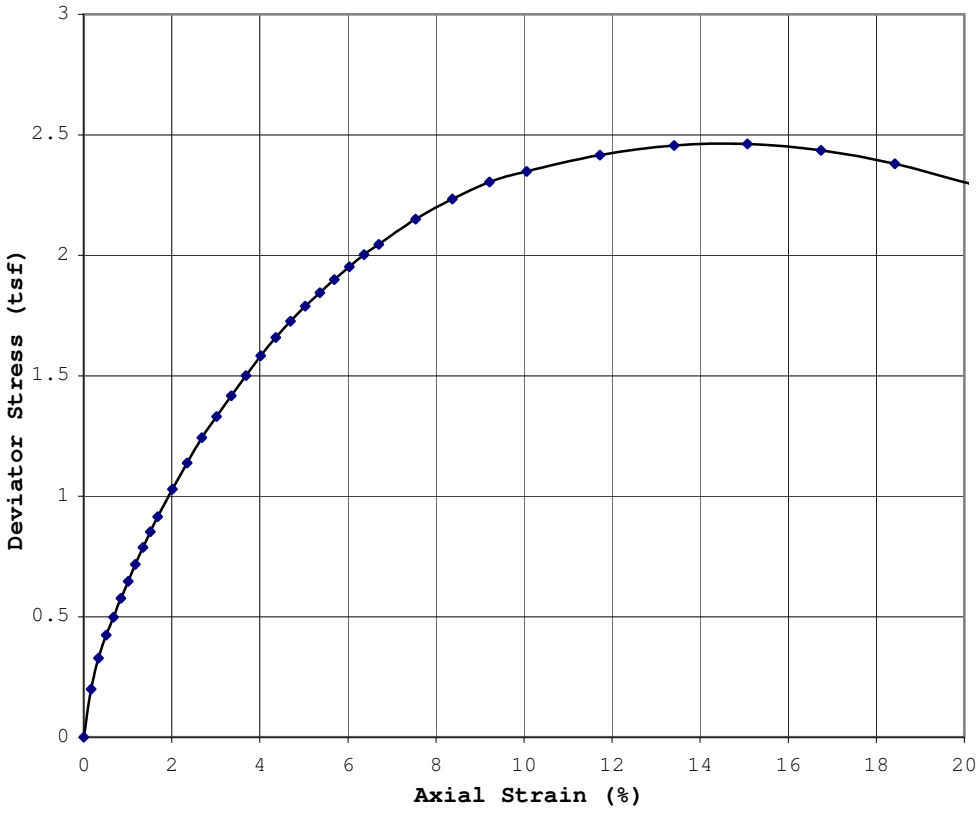
Bloomington, MN 55431

Unconfined Stress/Strain Curves

ASTM: D2166

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 5/22/18
Remarks:



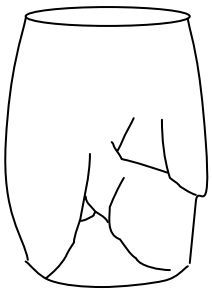
Boring: Geo-092 Depth: 47-49
Sample #:
Soil Type: Lean Clay w/sand and a little gravel (CL)

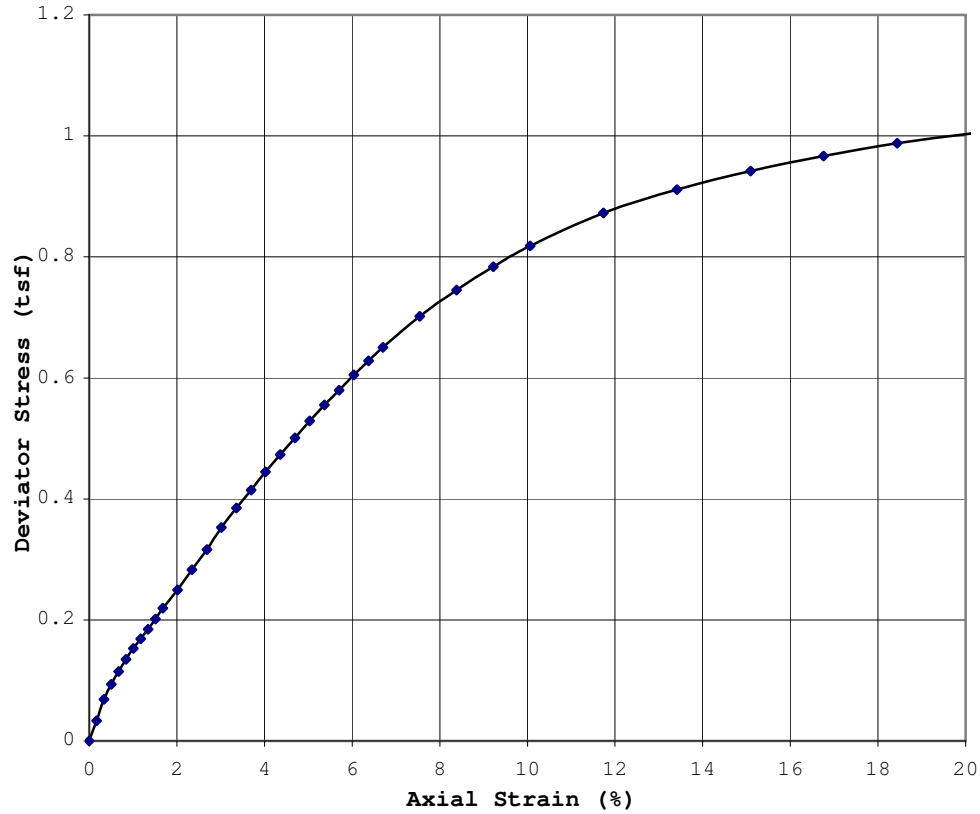
Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.88 Ht. (in) 5.97
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.46 tsf
Strain at Failure (%): 15.1

W.C. (%): 17.9
Yd (pcf): 113.1

Sketch of Specimen After Failure





Boring: Geo-093 Depth: 27-29
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

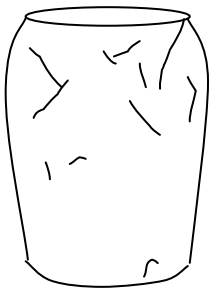
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.89 Ht. (in): 5.97
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 1.00 tsf
Strain at Failure (%): 20.0

W.C. (%): 18.0
Yd (pcf): 113.2

Sketch of Specimen After Failure



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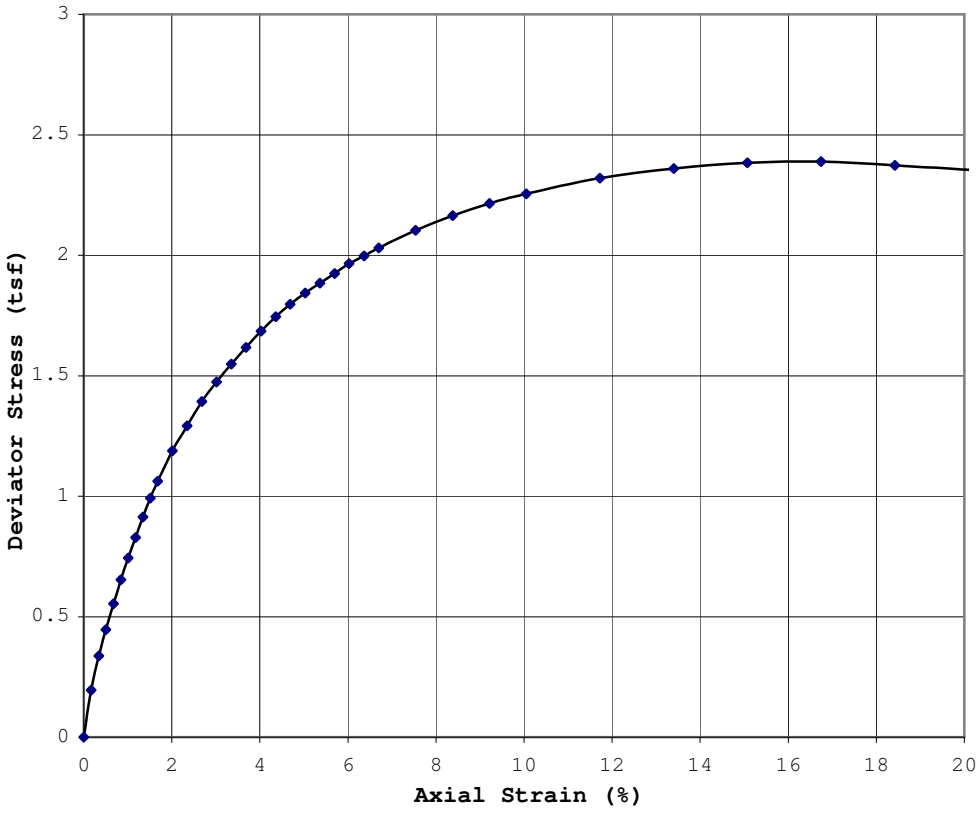
SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

Unconfined Stress/Strain Curves

ASTM: D2166

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 5/22/18
Remarks:



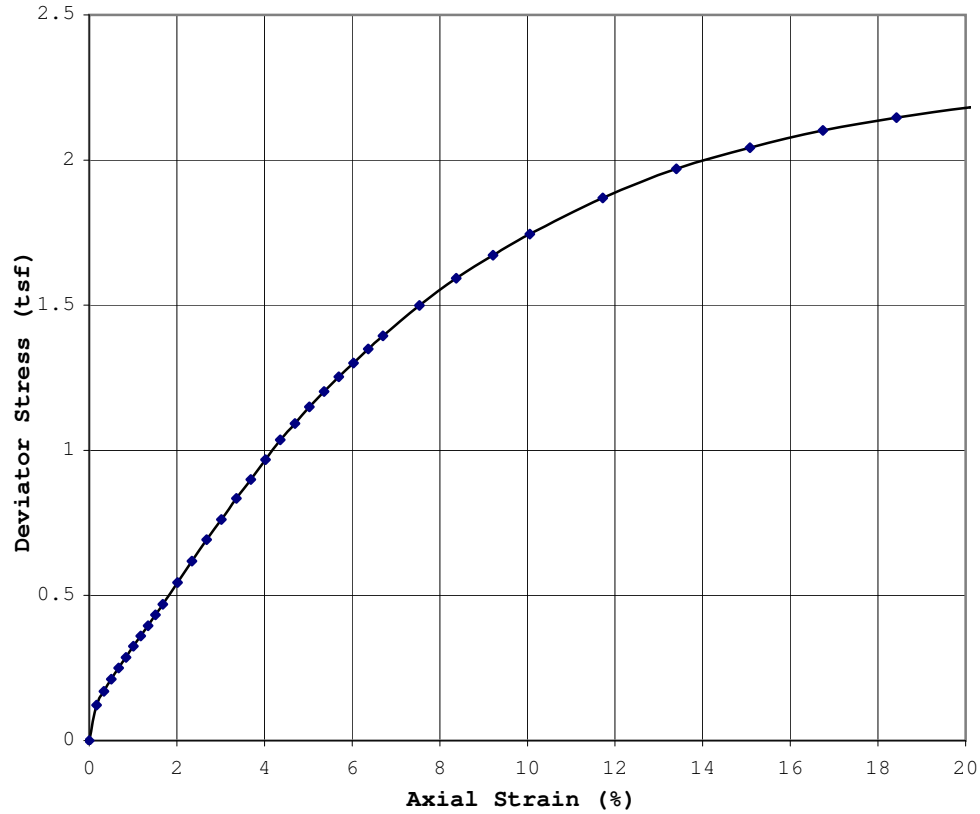
Boring: Geo-009 — Depth: 22-24
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.89 — Ht. (in) 5.97
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.39 tsf
Strain at Failure (%): 16.7

W.C. (%): 16.8
Yd (pcf): 115.3

Sketch of Specimen After Failure



Boring: Geo-042 — Depth: 17-19
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

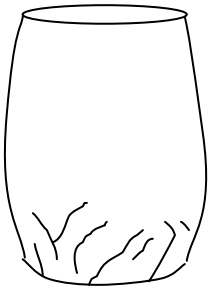
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.88 — Ht. (in): 5.97
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 2.18 tsf
Strain at Failure (%): 20.0

W.C. (%): 17.1
Yd (pcf): 114.5

Sketch of Specimen After Failure



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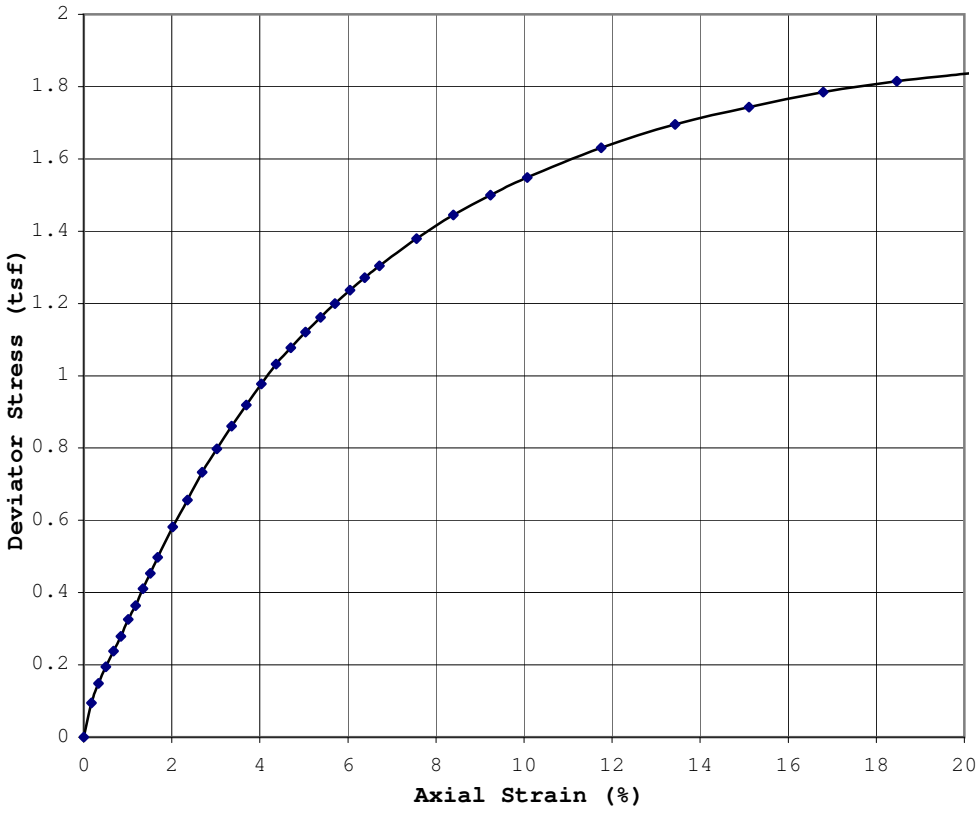
Unconfined Stress/Strain Curves

ASTM: D2166

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 5/22/18
Remarks:



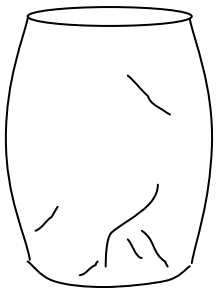
Boring: Geo-042 — Depth: 37-39
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

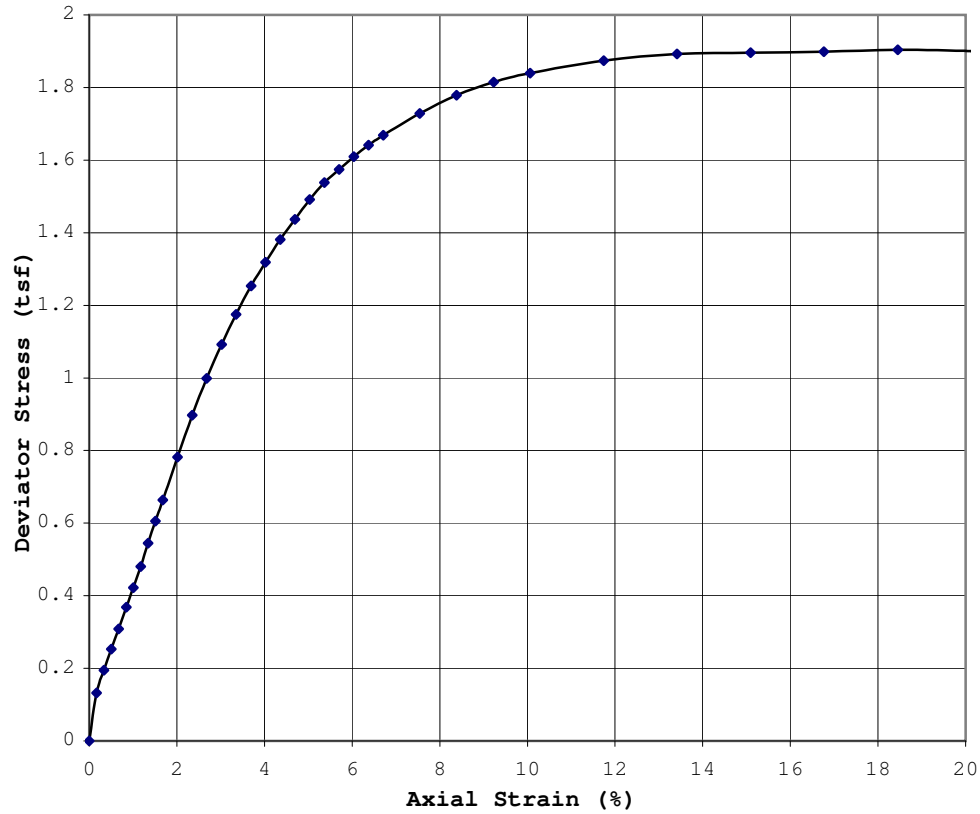
Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.88 — Ht. (in) 5.96
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 1.83 tsf
Strain at Failure (%): 20.0

W.C. (%): 18.3
Yd (pcf): 112.3

Sketch of Specimen After Failure





Boring: Geo-076 — Depth: 15-17
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

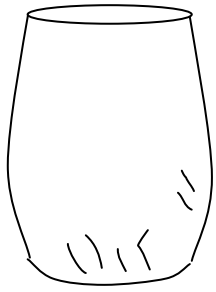
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.88 — Ht. (in): 5.96
Height to Diameter Ratio: 2.1

Unconfined Comp. Strength: 1.90 tsf
Strain at Failure (%): 18.5

W.C. (%): 17.7
Yd (pcf): 113.7

Sketch of Specimen After Failure



9530 James Ave South

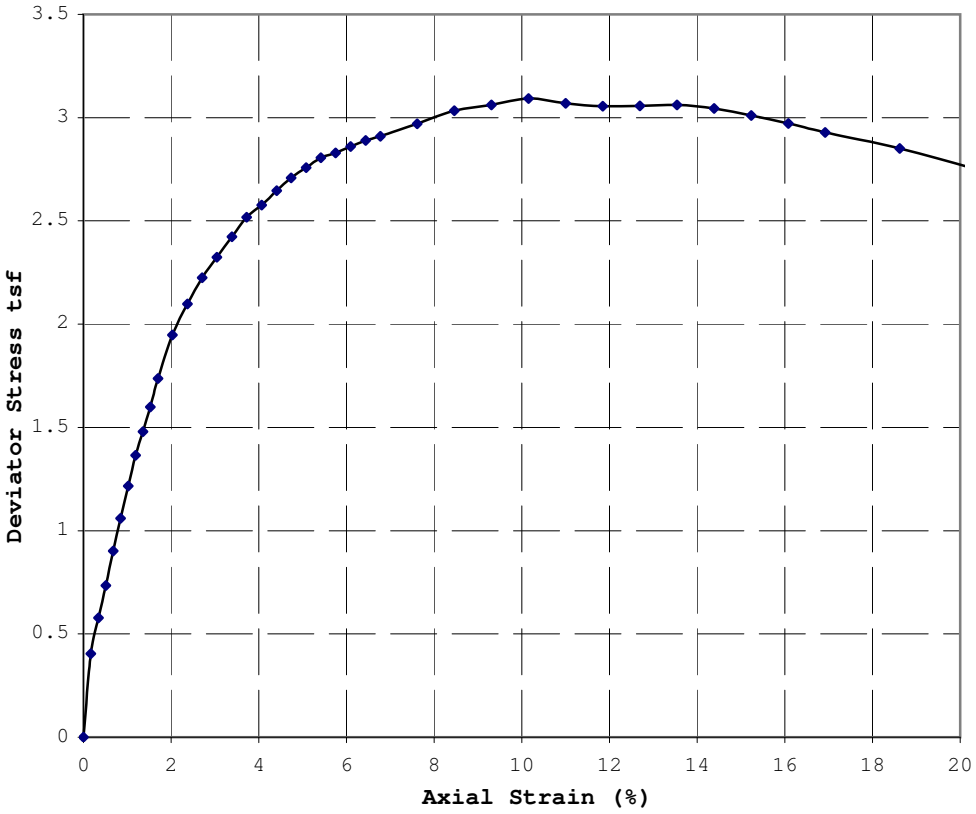
SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

Unconsolidated-Undrained Triaxial Compressive Strength

Triaxial U-U Stress/Strain Curves (ASTM:D2850)

Project: Seneca Wind | Job: 11376
Client: Barr Engineering Company | Date: 4/23/18
Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.



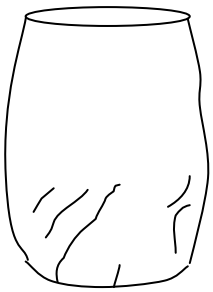
Boring: Geo-001 Depth: 17-19
Sample #:
Soil Type: Lean Clay w/sand and a little gravel (CL)

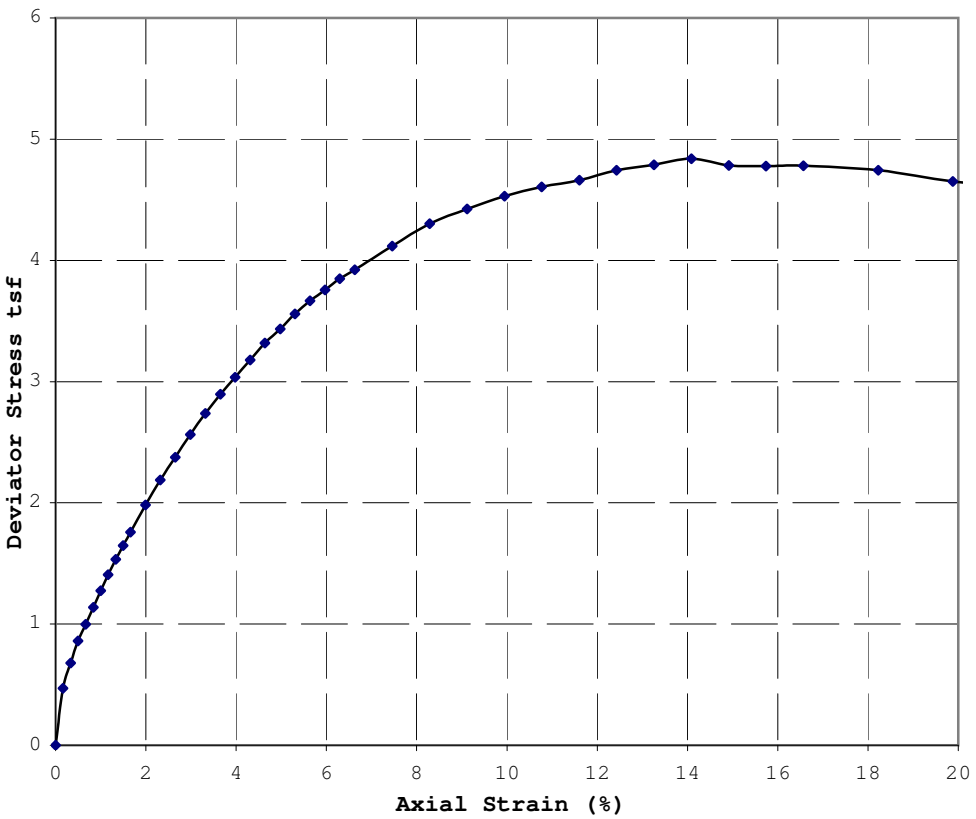
Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.89 Ht. (in) 5.91
Height to Diameter Ratio: 2.04

Max Deviator Stress: 3.09 tsf
Strain at Failure (%): 10.2
Confining Pressure: 0.95 tsf

W.C. (%) 17.1
Yd (pcf): 114.6

Sketch of Specimen After Failure





Boring: Geo-001 Depth: 43-44.5
Sample #:
Soil Type: Lean Clay w/sand and a little gravel (CL)

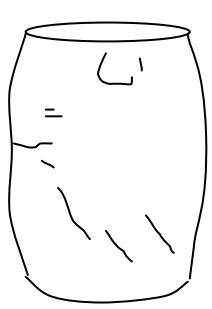
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.88 Ht. (in): 6.04
Height to Diameter Ratio: 2.09

Max Deviator Stress: 4.84 tsf
Strain at Failure (%): 14.1
Confining Pressure: 2.23 tsf

W.C. (%): 16.1
Yd (pcf): 117.5

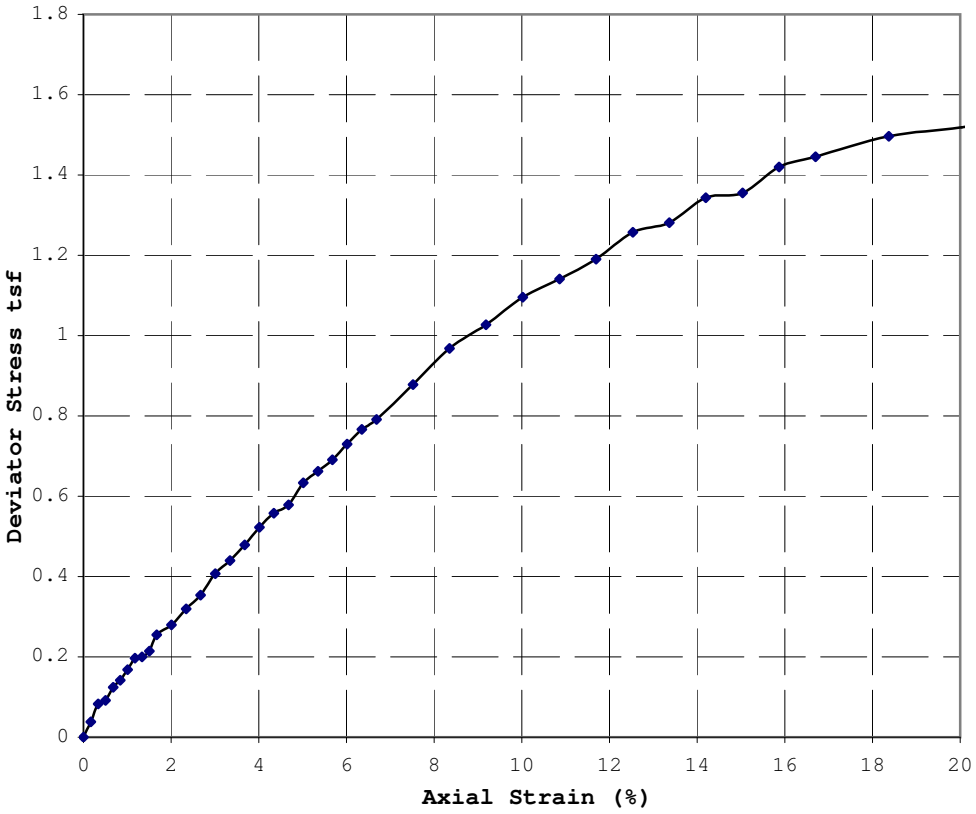
Sketch of Specimen After Failure



9530 James Ave South
SOIL ENGINEERING TESTING, INC.
Bloomington, MN 55431

Triaxial U-U Stress/Strain Curves (ASTM:D2850)

Project: Seneca Wind | Job: 11376
Client: Barr Engineering Company | Date: 4/24/18
Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.



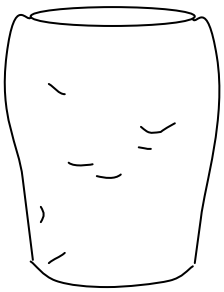
Boring: Geo-003 Depth: 16.5-17.5
Sample #:
Soil Type: Sandy Lean Clay w/a little gravel (CL)

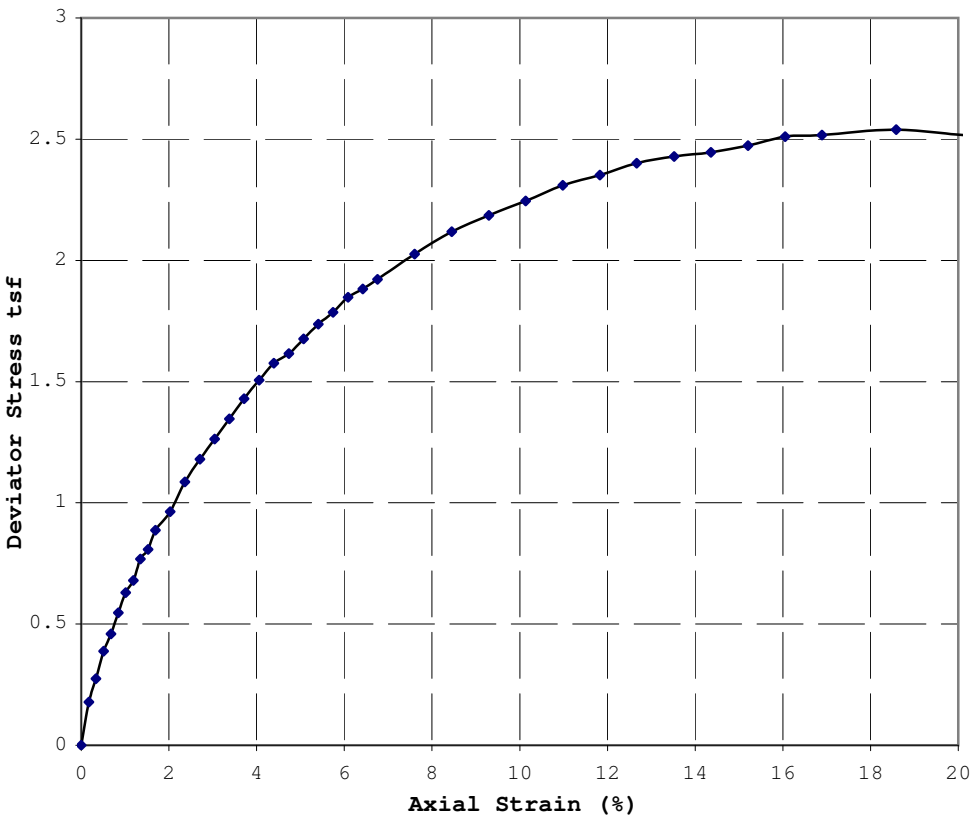
Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.86 Ht. (in) 5.99
Height to Diameter Ratio: 2.09

Max Deviator Stress: 1.52 tsf
Strain at Failure (%): 20.0
Confining Pressure: 0.88 tsf

W.C. (%) 14.7
Yd (pcf): 120.1

Sketch of Specimen After Failure





Boring: Geo-019 Depth: 12-14
Sample #:
Soil Type: Lean Clay w/sand and a little gravel (CL)

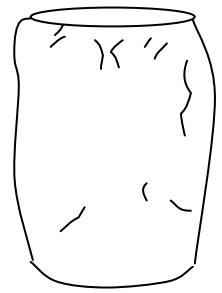
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.89 Ht. (in): 5.92
Height to Diameter Ratio: 2.05

Max Deviator Stress: 2.54 tsf
Strain at Failure (%): 20.0
Confining Pressure: 0.7 tsf

W.C. (%): 14.5
Yd (pcf): 119.8

Sketch of Specimen After Failure



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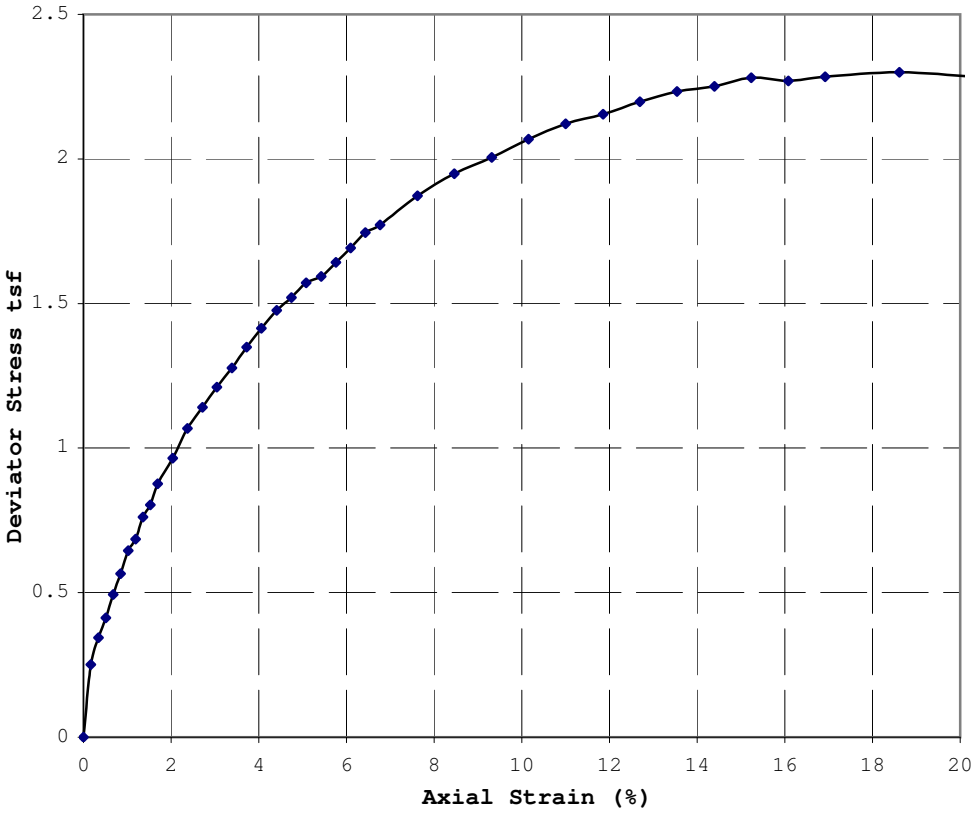
Bloomington, MN 55431

Triaxial U-U Stress/Strain Curves (ASTM:D2850)

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 4/24/18
Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.



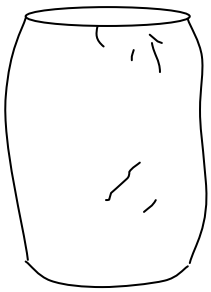
Boring: Geo-020 — Depth: 16.5-18.5
Sample #:
Soil Type: Sandy Lean Clay w/a little gravel (CL)

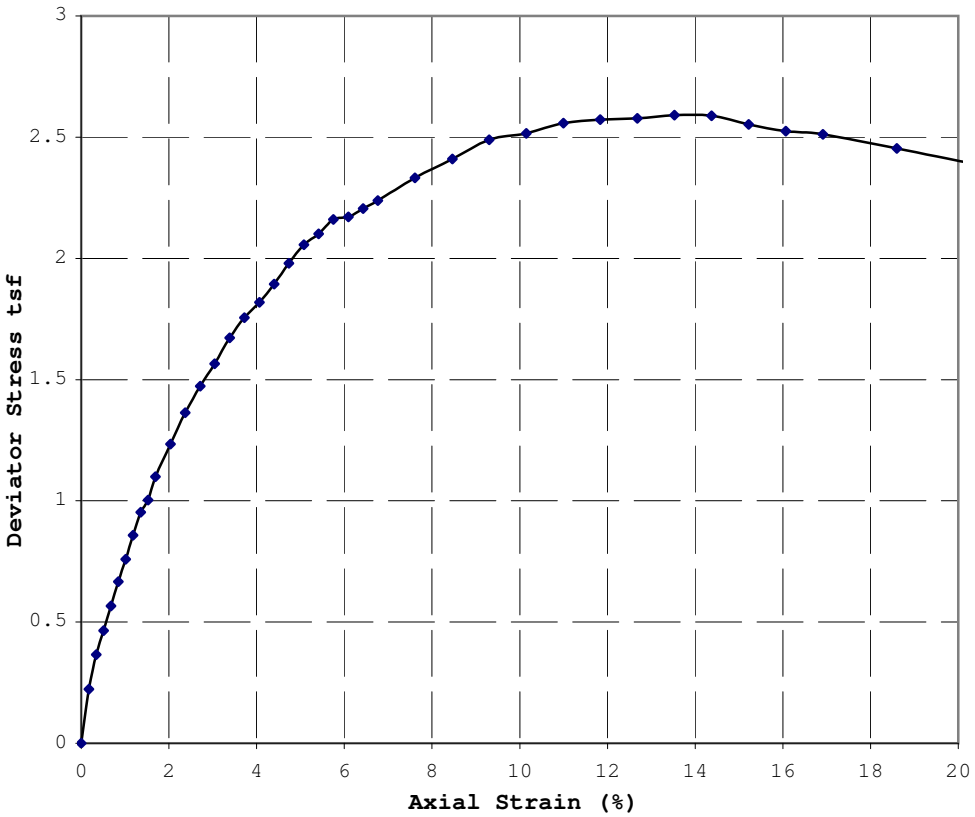
Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.89 — Ht. (in) 5.91
Height to Diameter Ratio: 2.05

Max Deviator Stress: 2.30 tsf
Strain at Failure (%): 18.6
Confining Pressure: 0.93 tsf

W.C. (%) 14.6
Yd (pcf): 120.5

Sketch of Specimen After Failure





Boring: Geo-022 — Depth: 7.5-9.5
Sample #:
Soil Type: Sandy Lean Clay w/a little gravel (CL)

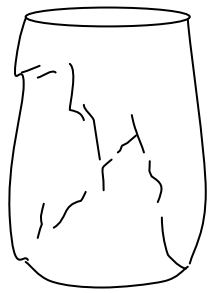
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.88 — Ht. (in): 5.91
Height to Diameter Ratio: 2.05

Max Deviator Stress: 2.59 tsf
Strain at Failure (%): 13.5
Confining Pressure: 0.48 tsf

W.C. (%): 18.5
Yd (pcf): 111.0

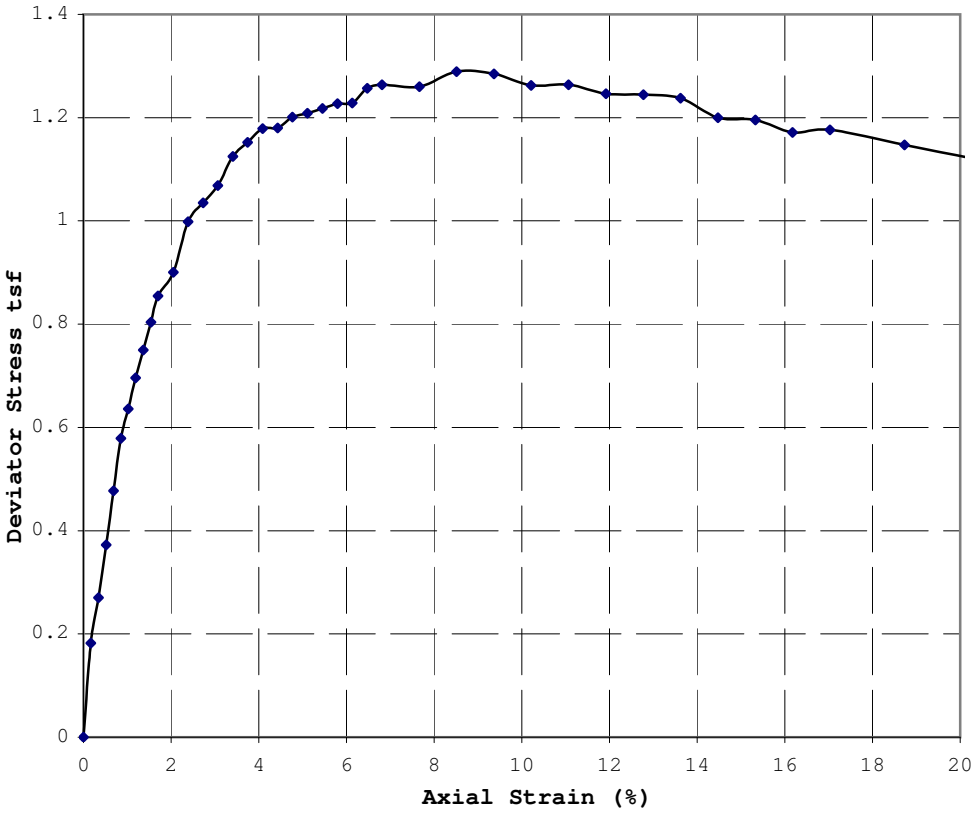
Sketch of Specimen After Failure



9530 James Ave South — SOIL ENGINEERING TESTING, INC. — Bloomington, MN 55431

Triaxial U-U Stress/Strain Curves (ASTM:D2850)

Project: Seneca Wind | Job: 11376
Client: Barr Engineering Company | Date: 4/24/18
Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.



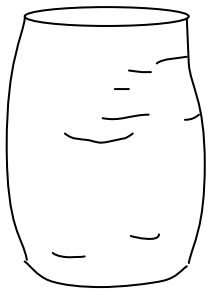
Boring: Geo-047 Depth: 10-12
Sample #:
Soil Type: Silty Sand w/layers of Lean Clay (SM)

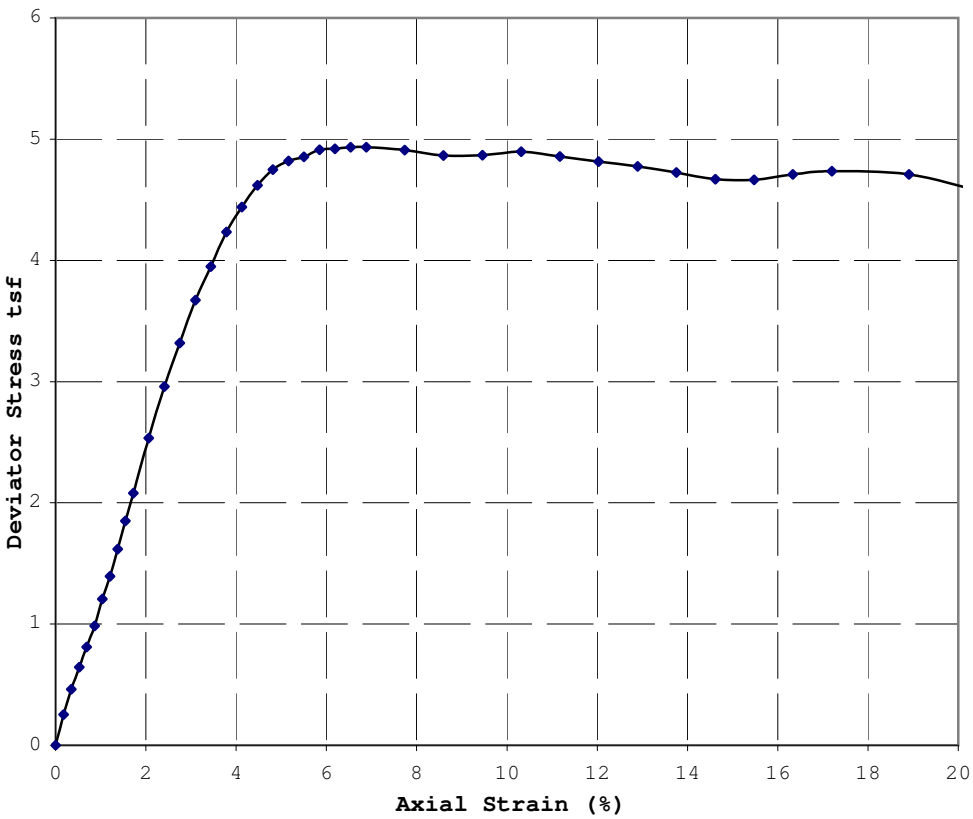
Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.88 Ht. (in) 5.87
Height to Diameter Ratio: 2.04

Max Deviator Stress: 1.29 tsf
Strain at Failure (%): 8.5
Confining Pressure: 0.6 tsf

W.C. (%) 22.3
Yd (pcf): 93.3

Sketch of Specimen After Failure





Boring: Geo-053 Depth: 7.5-8.5
Sample #:
Soil Type: Lean Clay w/sand and a little gravel (CL)

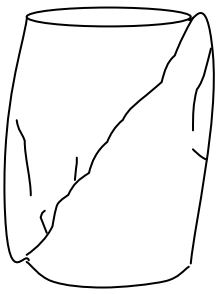
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.89 Ht. (in): 5.82
Height to Diameter Ratio: 2.02

Max Deviator Stress: 4.93 tsf
Strain at Failure (%): 6.9
Confining Pressure: 0.43 tsf

W.C. (%): 17.0
Yd (pcf): 114.6

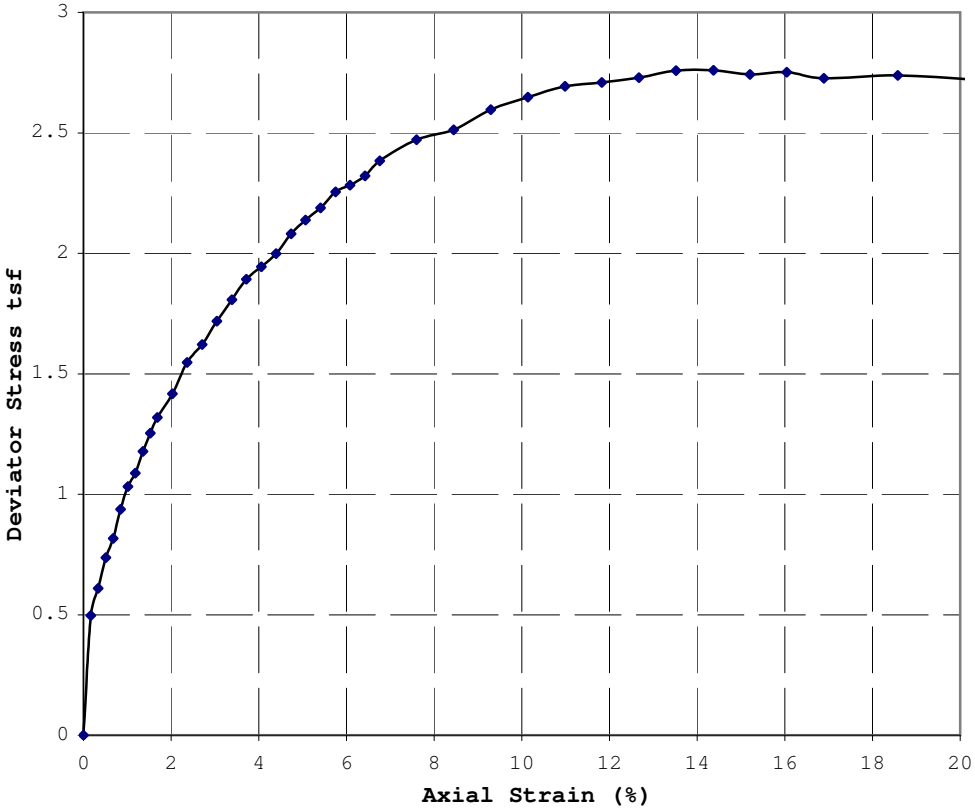
Sketch of Specimen After Failure



9530 James Ave South
SOIL ENGINEERING TESTING, INC.
Bloomington, MN 55431

Triaxial U-U Stress/Strain Curves (ASTM:D2850)

Project: Seneca Wind — Job: 11376
Client: Barr Engineering Company — Date: 5/22/18
Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.



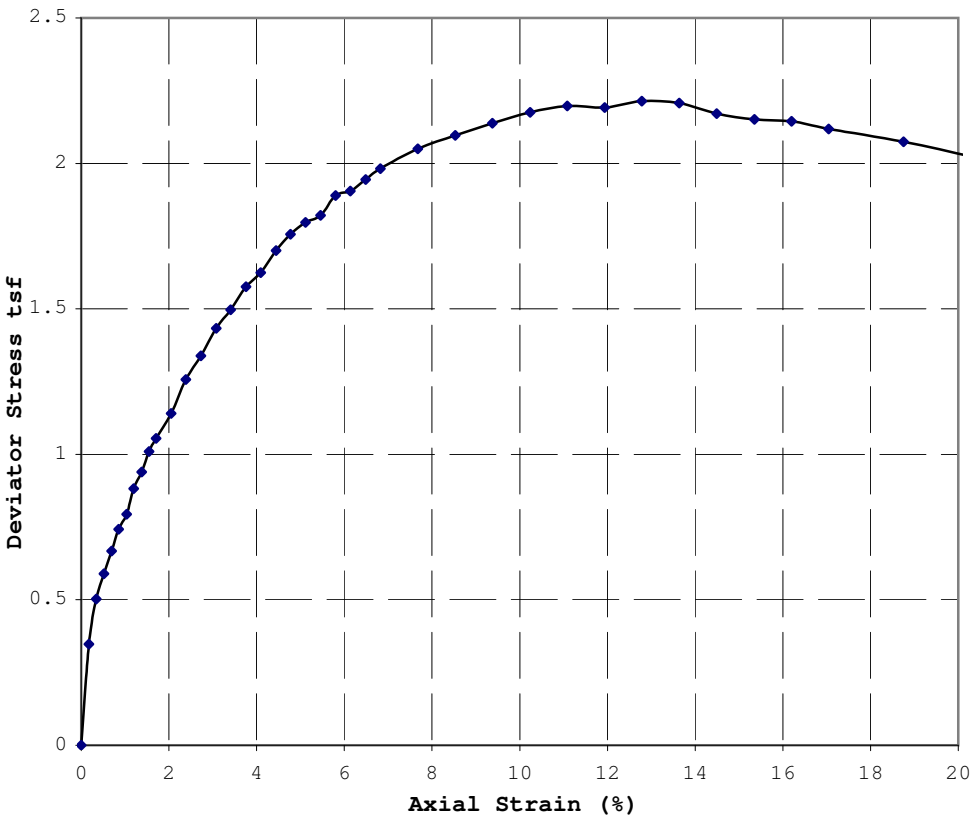
Boring: Geo-007 — Depth: 27-29
Sample #:
Soil Type: Lean Clay w/sand and a little gravel (CL)

Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.89 — Ht. (in) 5.92
Height to Diameter Ratio: 2.05

Max Deviator Stress: 2.76 tsf
Strain at Failure (%): 14.4
Confining Pressure: 1.5 tsf

W.C. (%) 12.8
Yd (pcf): 124.0

Sketch of Specimen After Failure



Boring: Geo-038 — Depth: 14.5-16.5
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

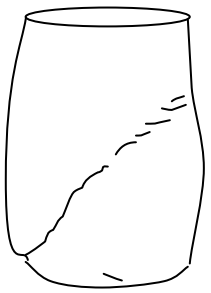
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.88 — Ht. (in): 5.87
Height to Diameter Ratio: 2.04

Max Deviator Stress: 2.21 tsf
Strain at Failure (%): 12.8
Confining Pressure: 0.75 tsf

W.C. (%): 17.0
Yd (pcf): 115.5

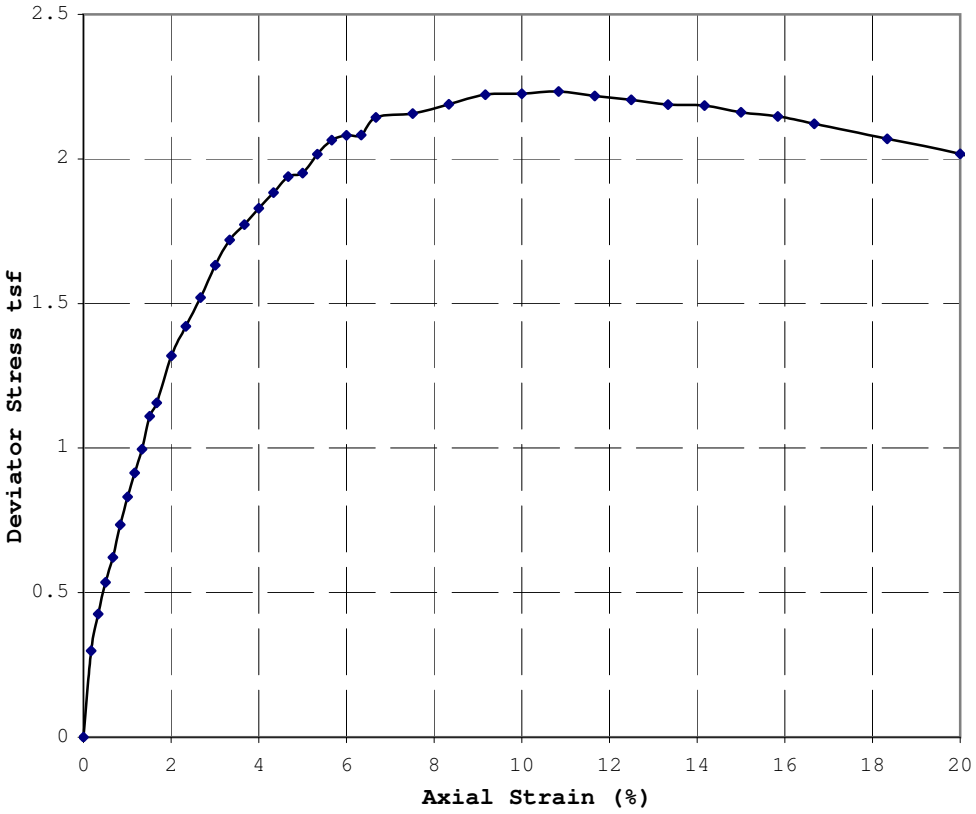
Sketch of Specimen After Failure



9530 James Ave South — SOIL ENGINEERING TESTING, INC. — Bloomington, MN 55431

Triaxial U-U Stress/Strain Curves (ASTM:D2850)

Project: Seneca Wind | Job: 11376
Client: Barr Engineering Company | Date: 5/22/18
Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.



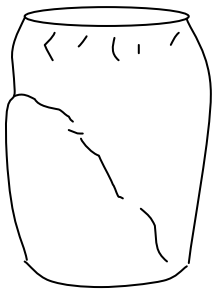
Boring: Geo-070 Depth: 25-27
Sample #:
Soil Type: Lean Clay w/sand and a little gravel (CL)

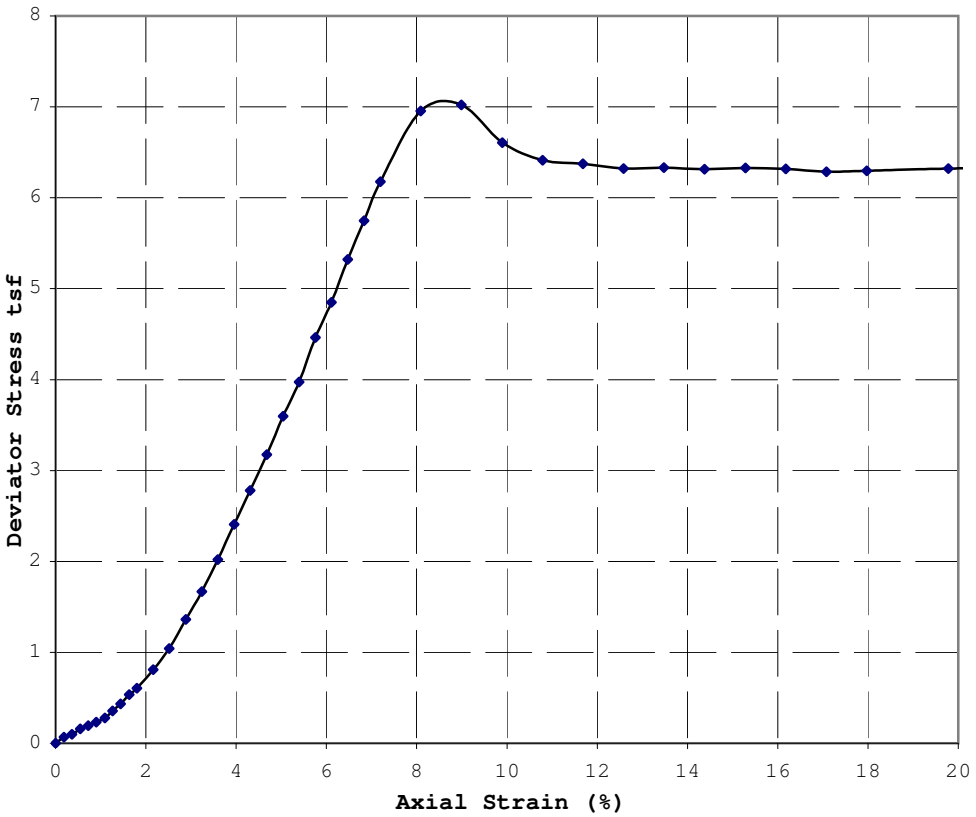
Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.89 Ht. (in) 6.00
Height to Diameter Ratio: 2.08

Max Deviator Stress: 2.23 tsf
Strain at Failure (%): 10.8
Confining Pressure: 1.25 tsf

W.C. (%) 17.0
Yd (pcf): 115.2

Sketch of Specimen After Failure





Boring: Geo-072 Depth: 28-30
Sample #:
Soil Type: Silty Clay (CL-ML/ML)

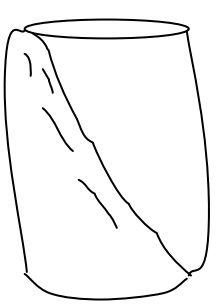
Strain Rate (in/min): 0.060
Sample Type: 3T

Dia. (in): 2.91 Ht. (in): 5.56
Height to Diameter Ratio: 1.91

Max Deviator Stress: 7.02 tsf
Strain at Failure (%): 9.0
Confining Pressure: 1.5 tsf

W.C. (%): 22.9
Yd (pcf): 103.4

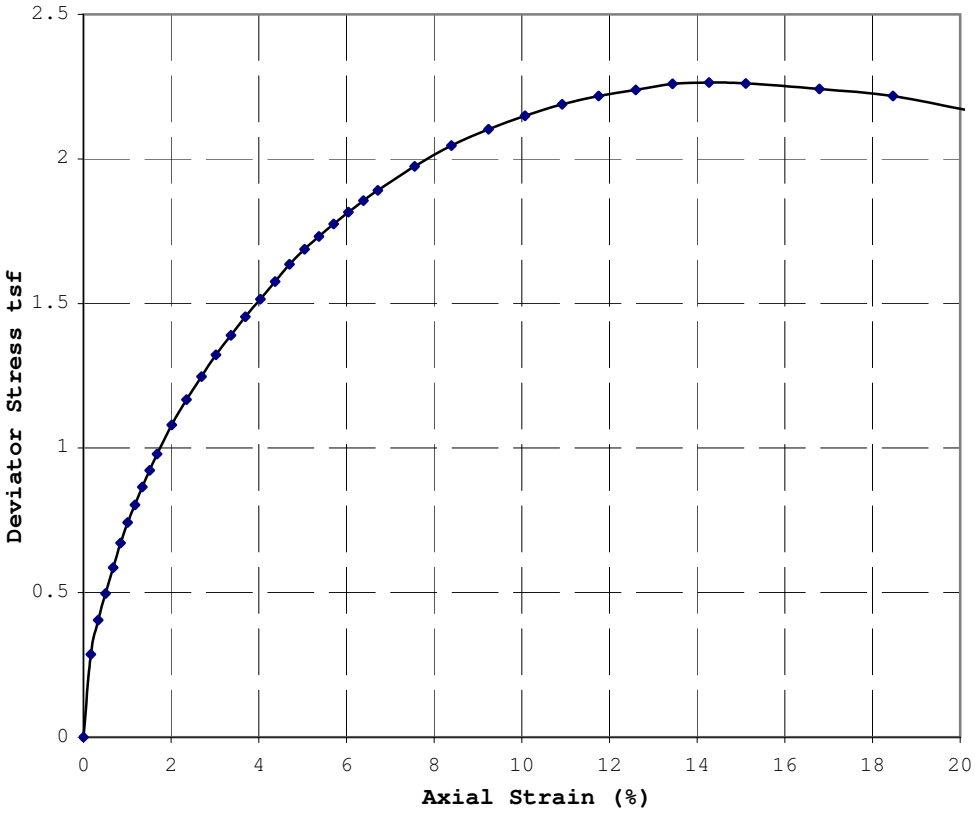
Sketch of Specimen After Failure



9530 James Ave South
SOIL ENGINEERING TESTING, INC.
Bloomington, MN 55431

Triaxial U-U Stress/Strain Curves (ASTM:D2850)

Project: Seneca Wind | Job: 11376
Client: Barr Engineering Company | Date: 5/22/18
Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.

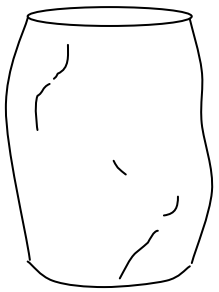


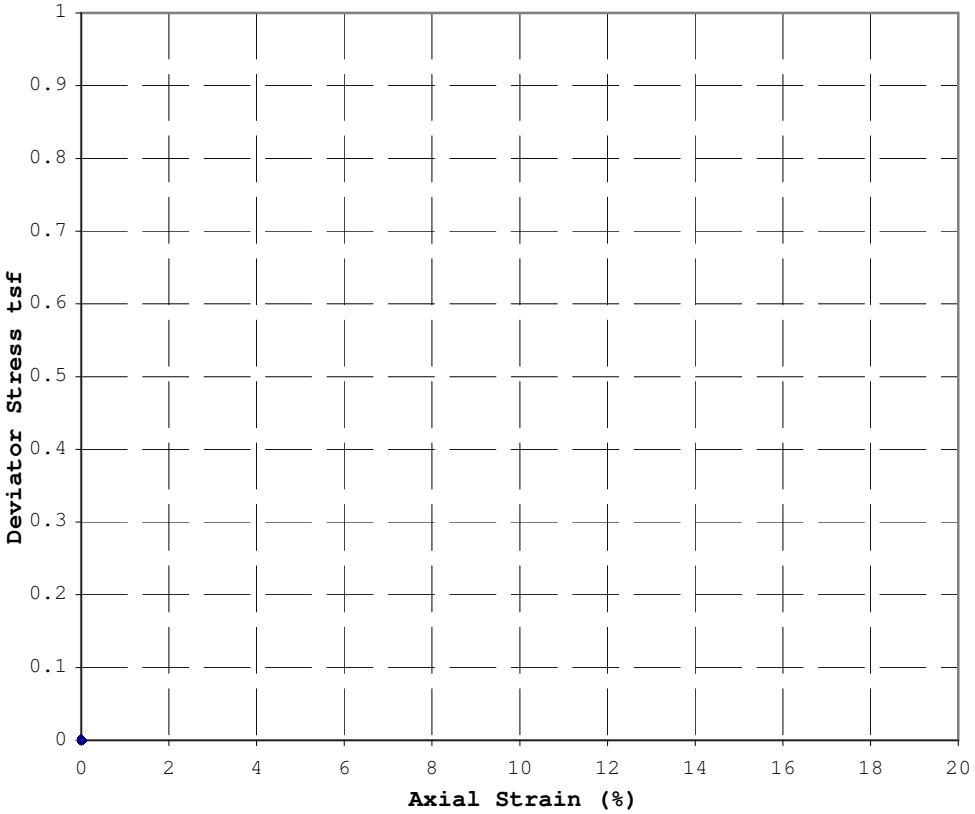
Boring: Geo-052 Depth: 22-24
Sample #:
Soil Type: Lean Clay w/sand and a little gravel (CL)

Strain Rate (in/min): 0.060
Sample Type: 3T
Dia. (in) 2.90 Ht. (in) 5.96
Height to Diameter Ratio: 2.06

Max Deviator Stress: 2.26 tsf
Strain at Failure (%): 14.3
Confining Pressure: 1.25 tsf
W.C. (%) 17.3
Yd (pcf): 114.0

Sketch of Specimen After Failure





Boring: Depth:
Sample #:
Soil Type:

Strain Rate (in/min):
Sample Type:

Dia. (in): Ht. (in):
Height to Diameter Ratio:

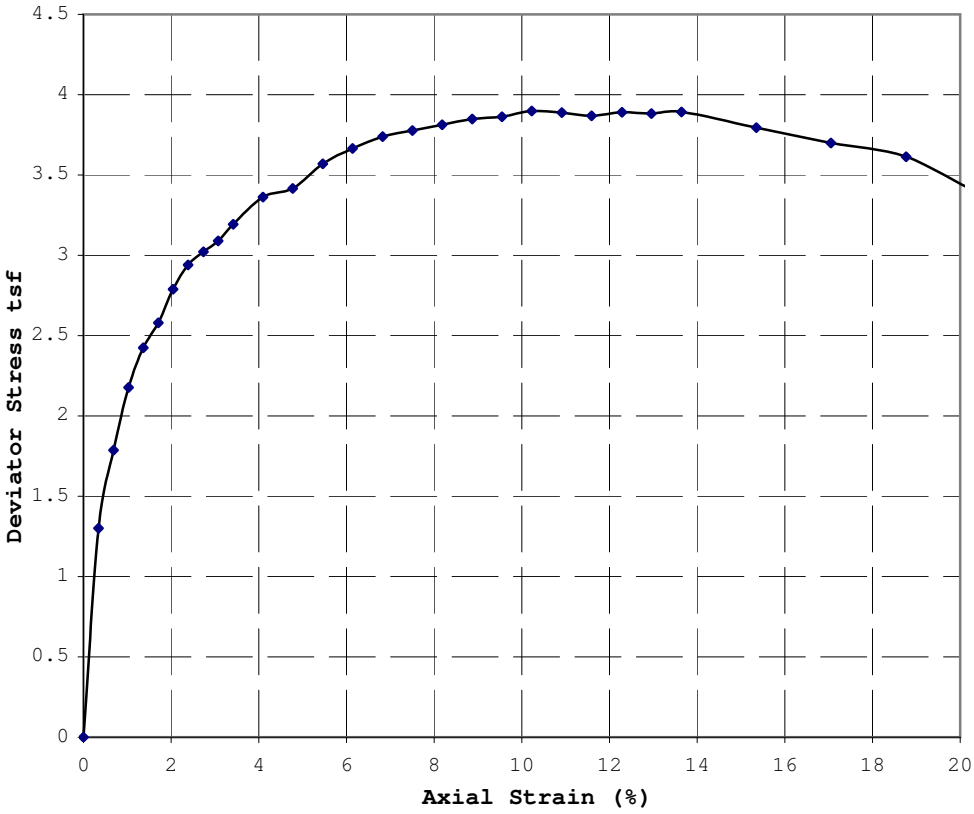
Max Deviator Stress: tsf
Strain at Failure (%):
Confining Pressure: tsf
W.C. (%):
Yd (pcf):

Sketch of Specimen After Failure

9530 James Ave South
SOIL ENGINEERING TESTING, INC.
Bloomington, MN 55431

Triaxial U-U Stress/Strain Curves (ASTM:D2850)

Project: Seneca Wind | Job: 11376
Client: Barr Engineering Company | Date: 4/30/18
Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.



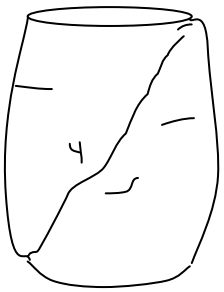
Boring: Geo-084 Depth: 15-15.5
Sample #:
Soil Type: Lean Clay w/sand and a trace of gravel (CL)

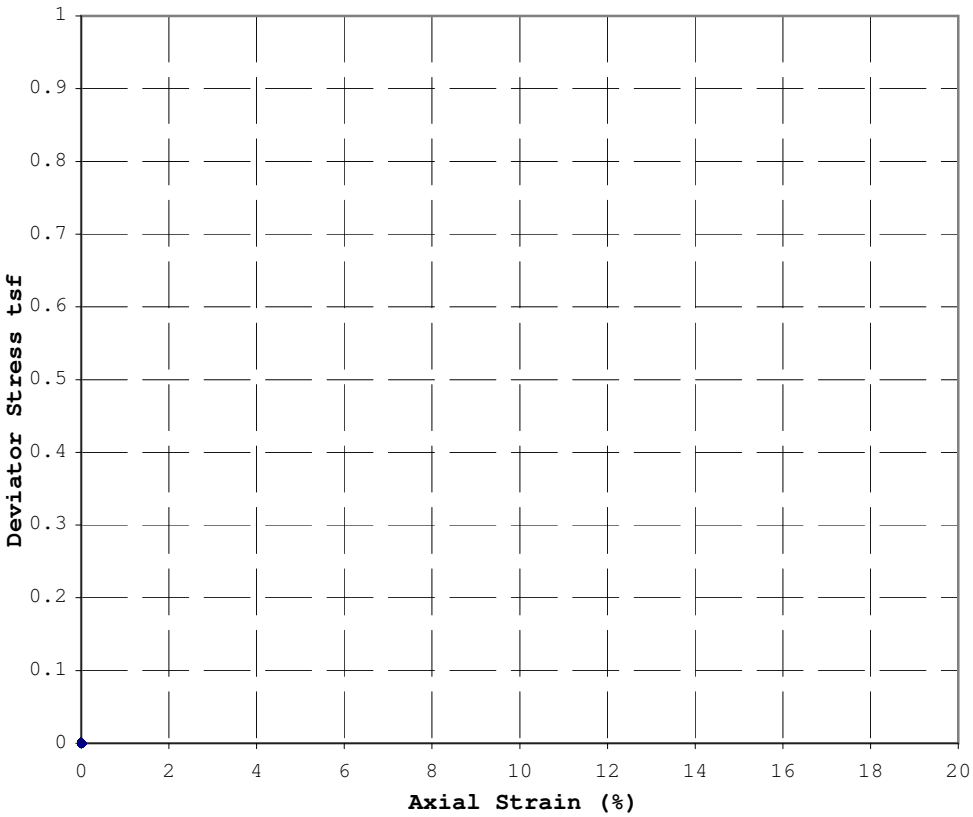
Strain Rate (in/min): 0.030
Sample Type: 3T
Dia. (in) 1.44 Ht. (in) 2.93
Height to Diameter Ratio: 2.04

Max Deviator Stress: 3.90 tsf
Strain at Failure (%): 10.2
Confining Pressure: 0.78 tsf

W.C. (%) 18.1
Yd (pcf): 111.3

Sketch of Specimen After Failure





Boring: Depth:
Sample #:
Soil Type:

Strain Rate (in/min):
Sample Type:

Dia. (in): Ht. (in):
Height to Diameter Ratio:

Max Deviator Stress: tsf
Strain at Failure (%):
Confining Pressure: tsf

W.C. (%):
Yd (pcf):

Sketch of Specimen After Failure

9530 James Ave South
SOIL ENGINEERING TESTING, INC.
Bloomington, MN 55431

Direct Shear

Direct Shear Test

ASTM: D3080

Job No.: 11376

Project/Client: **Seneca Wind / Barr Engineering Company**

Boring No.: **Geo-030** Depth (ft): **40-41.5,45-46.5**

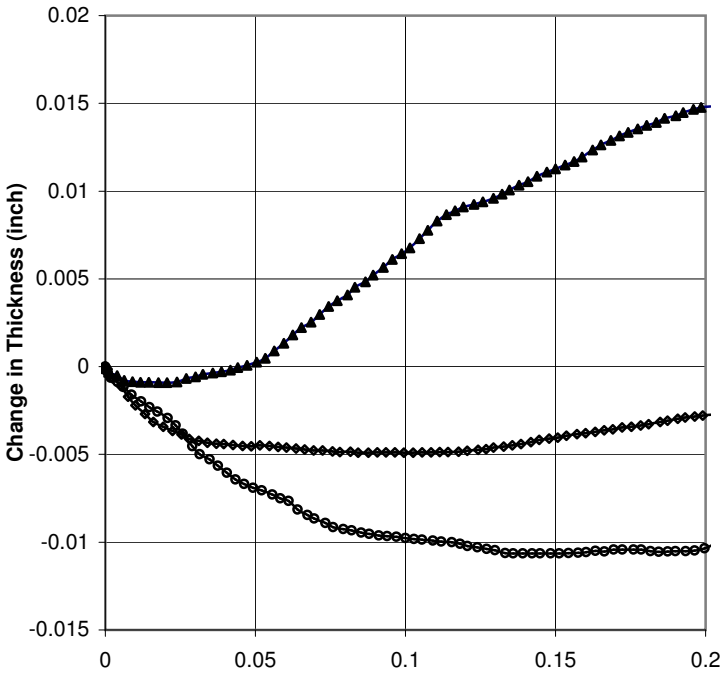
Sample: **Composite** Sample Type: **Bags**

Soil Type: **Silty Sand with Gravel (SW-SM)**

Test Date:	**5/8/2018**
Date Reported:	**5/18/2018**
Shear Rate	
0.003 (in/min)	
Liquid Limit:	
Plastic Limit:	
Plasticity Index:	
Specific Gravity (*):	**2.67**

Remarks: Specimens reconstituted given density using -#4 material; Inundated after applying normal load. Consolidated and sheared to given displacements at constant rate of 0.003inches/minute.

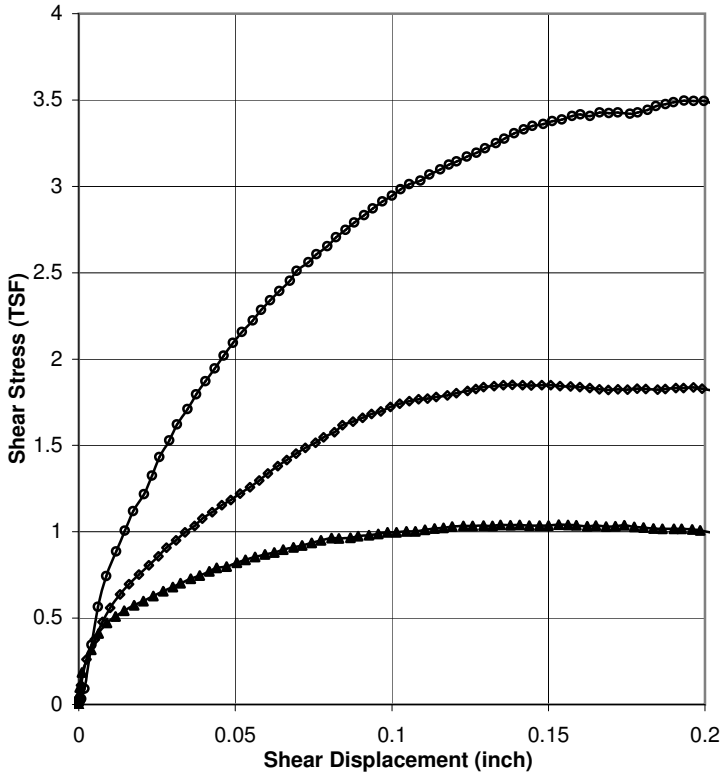
(*) = Assumed Specific Gravity

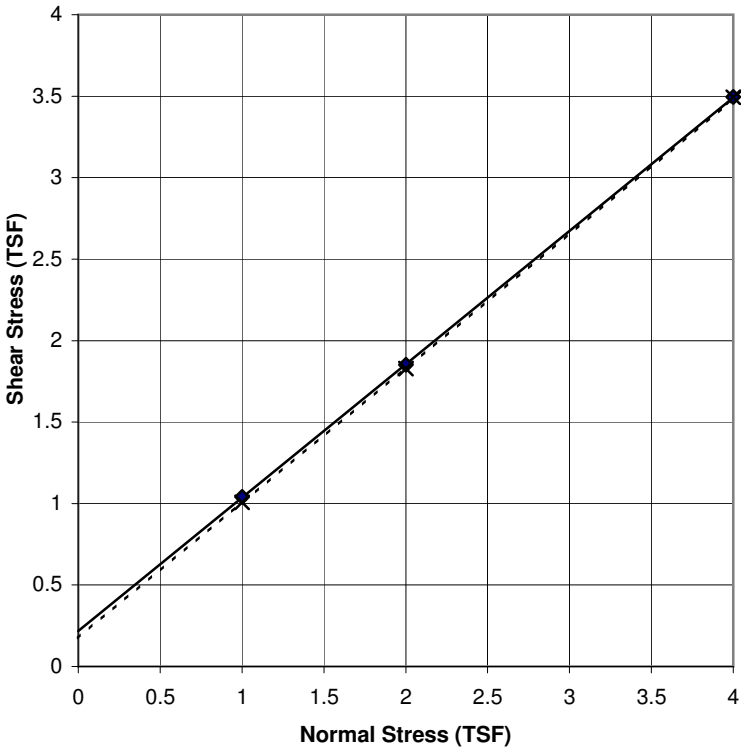


Failure Criterion:				
Max Stress	A	B	C	D
Initial	▲	◇	○	X
Diameter (In.)	2.50	2.50	2.50	
Thickness (In.)	0.97	0.97	0.97	
Water Content (%)	12.0	12.0	12.0	
Dry Density (pcf)	114.9	114.9	114.9	
Before Shear				
Thickness (In.)	0.95	0.93	0.92	
Water Content (%)	15.9	15.2	14.6	
Dry Density (pcf)	116.9	118.6	119.9	
Normal Stress	1.00	2.00	4.00	
Shear Stress (Peak)	1.04	1.85	3.50	

"These tests are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design."

♦ Peak Conditions		x At Given Shear Disp. Of: 0.2	
Friction Angle:	ϕ= **39.3 deg.**	Friction Angle:	ϕ= **39.6 deg.**
Apparent Cohesion	**0.218 TSF**	Apparent Cohesion	**0.174 TSF**





9530 James Ave. South

SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

Uniaxial Compressive Shear Strength of Rock

Unconfined Compressive Strength of Intact Rock (ASTM:D7012) Method C

Job: 11376
Date: 05/18/18

Project: Seneca Wind
Client: Barr Engineering Company

Sample Identification

Boring: Geo-025 **Location:**
Sample: **Depth:** 47.5-48

Laboratory Analysis

Visual Classification: Core

Specimen Dimensions	
Ht (in):	5.01
Dia (in):	1.99
Area (in2):	3.11
Moisture Content %	3.2%
Wet Density (PCF)	159.3
Dry Density (PCF)	154.3
Ht to Dia. Ratio:	2.5 : 1

Peak Strength

867.5	TSF	12048	PSI

Remarks:: Specimen cut to given dimension without the use of water.

Before Test

After Test

Unconfined Compressive Strength of Intact Rock (ASTM:D7012) Method C

Job: 11376
Date: 05/18/18

Project: Seneca Wind
Client: Barr Engineering Company

Sample Identification

Boring: Geo-025 **Location:**
Sample: **Depth:** 58-58.5

Laboratory Analysis

Visual Classification: Core

Specimen Dimensions	
Ht (in):	4.54
Dia (in):	1.99
Area (in2):	3.12
Moisture Content %	1.9%
Wet Density (PCF)	165.3
Dry Density (PCF)	162.3
Ht to Dia. Ratio:	2.3 : 1

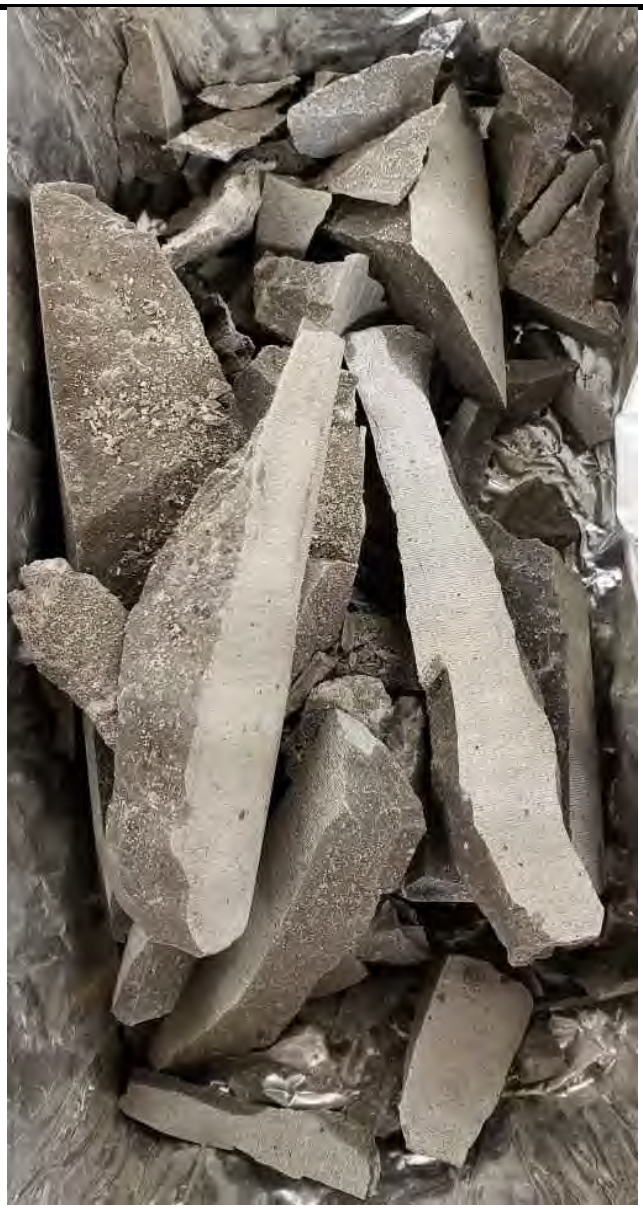
Peak Strength

874.1	TSF	12140	PSI

Remarks:: Specimen cut to given dimension without the use of water.

Before Test

After Test



Unconfined Compressive Strength of Intact Rock (ASTM:D7012) Method C

Job: 11376
Date: 05/18/18

Project: Seneca Wind
Client: Barr Engineering Company

Sample Identification

Boring: Geo-031 **Location:**
Sample: **Depth:** 28

Laboratory Analysis

Visual Classification: Core

Specimen Dimensions	
Ht (in):	4.61
Dia (in):	2.00
Area (in2):	3.13
Moisture Content %	2.5%
Wet Density (PCF)	164.6
Dry Density (PCF)	160.6
Ht to Dia. Ratio:	2.3 : 1

Peak Strength

1280.9	TSF	17790	PSI

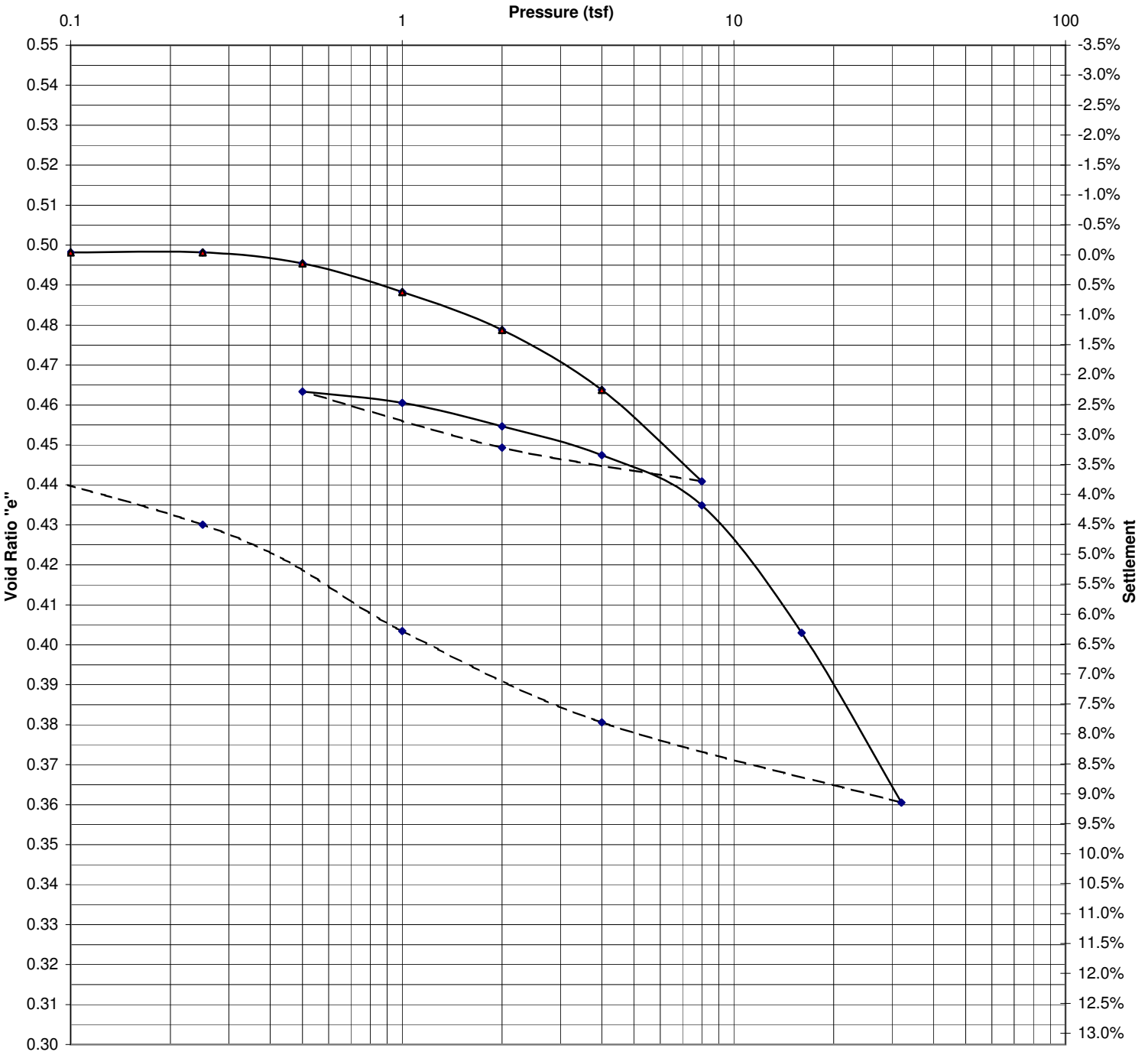
Remarks:: Specimen cut to given dimension without the use of water.

Before Test

After Test

Consolidation Testing

Void Ratio and % Settlement vs. Log of Pressure



Project: Seneca Wind / Barr Engineering Company				Date: 5/24/18
Sample #:	Boring #: Geo-037	Depth ft: 17-19		Job #: 11376
Soil Type: Lean Clay w/a trace of gravel (CL)				
Initial W/C (%): 18.0	Dry Density (pcf): 113.4	LL:	PL:	PI:	Gs: 2.72 (Assumed)
Organic Content (%):	Initial Height (in.): 0.743	Diameter (in.): 2.503	e_o= 0.498	
Preconsolidation Pressure (Pc): 4.0 tsf	Compression Index (Cc): 0.13	Recompression Index (Cr): 0.02		

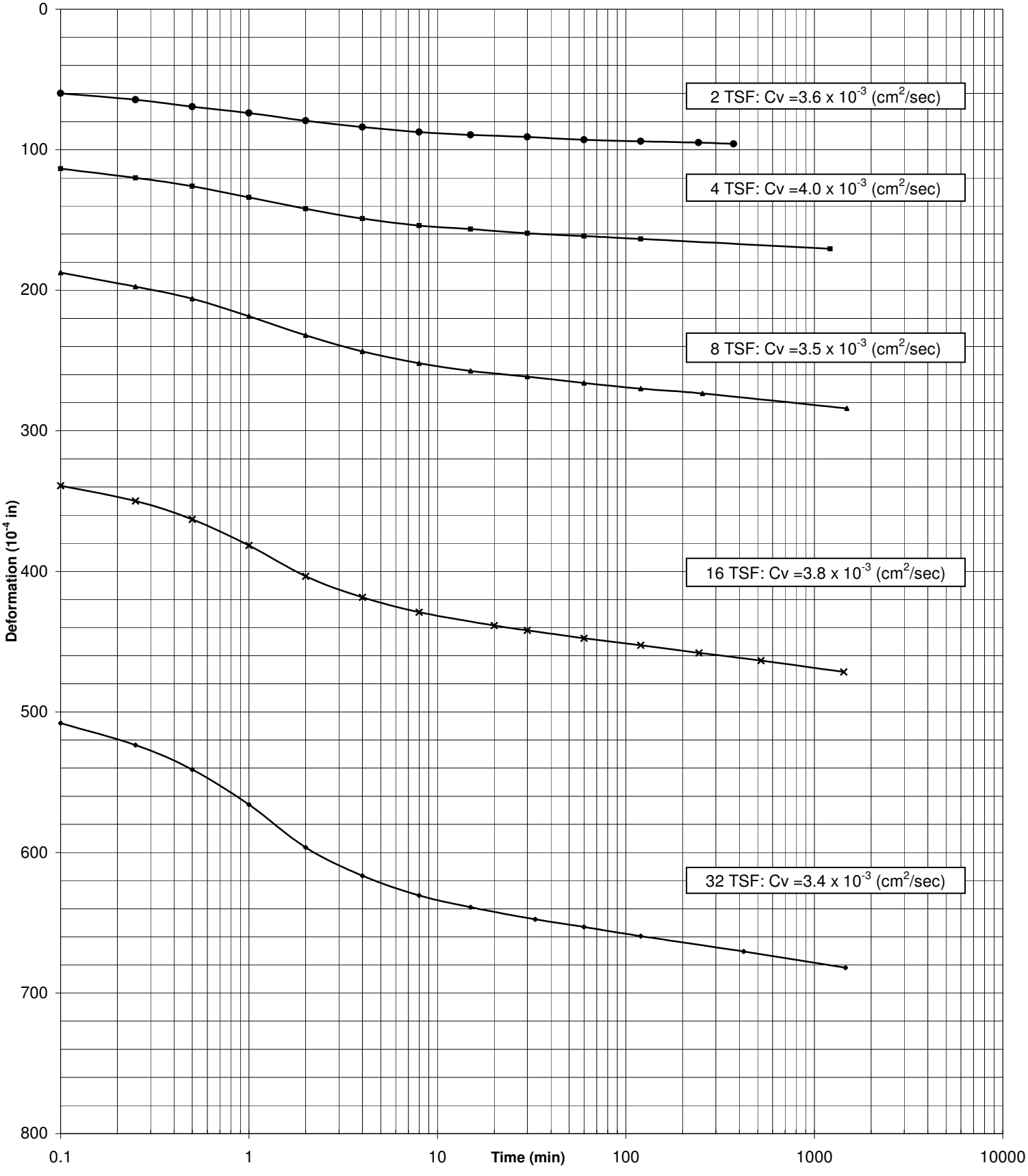
Remarks: Testing performed in general accordance with ASTM:D2435

9530 James Avenue South

SOIL ENGINEERING TESTING, INC.

Bloomington, Minnesota 55431

Consolidation Log of Time Curves



Project: Seneca Wind / Barr Engineering Company			Date: 5/24/18
Sample #:	Boring #: Geo-037	Depth ft: 17-19	Job #: 11376

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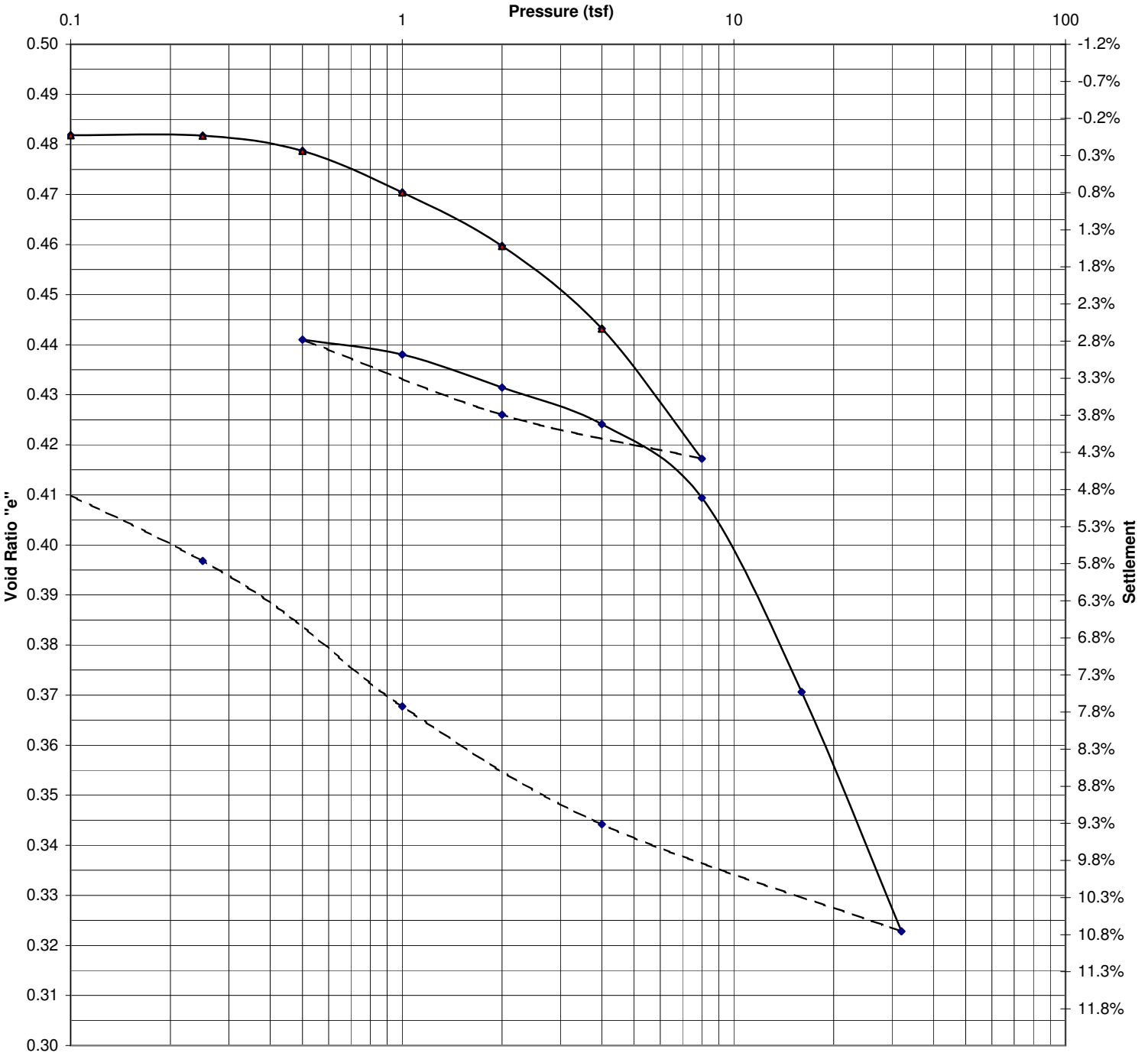
SOIL ENGINEERING TESTING, INC.

Bloomington, Minnesota 55431

Void Ratio and % Settlement vs. Log of Pressure



Project: Seneca Wind / Barr Engineering Company			Date: 5/22/18
Sample #:	Boring #: Geo-079	Depth ft: 20-22	Job #: 11376
Soil Type: Lean Clay w/a trace of gravel (CL)			
Initial W/C (%): 18.0	Dry Density (pcf): 113.7	LL: PL: PI:	Gs: 2.70 (Assumed)
Organic Content (%):	Initial Height (in.): 0.741	Diameter (in.): 2.506	e_o= 0.482
Preconsolidation Pressure (Pc): 4.2 tsf	Compression Index (Cc): 0.16	Recompression Index (Cr): 0.03	

Remarks: Testing performed in general accordance with ASTM:D2435

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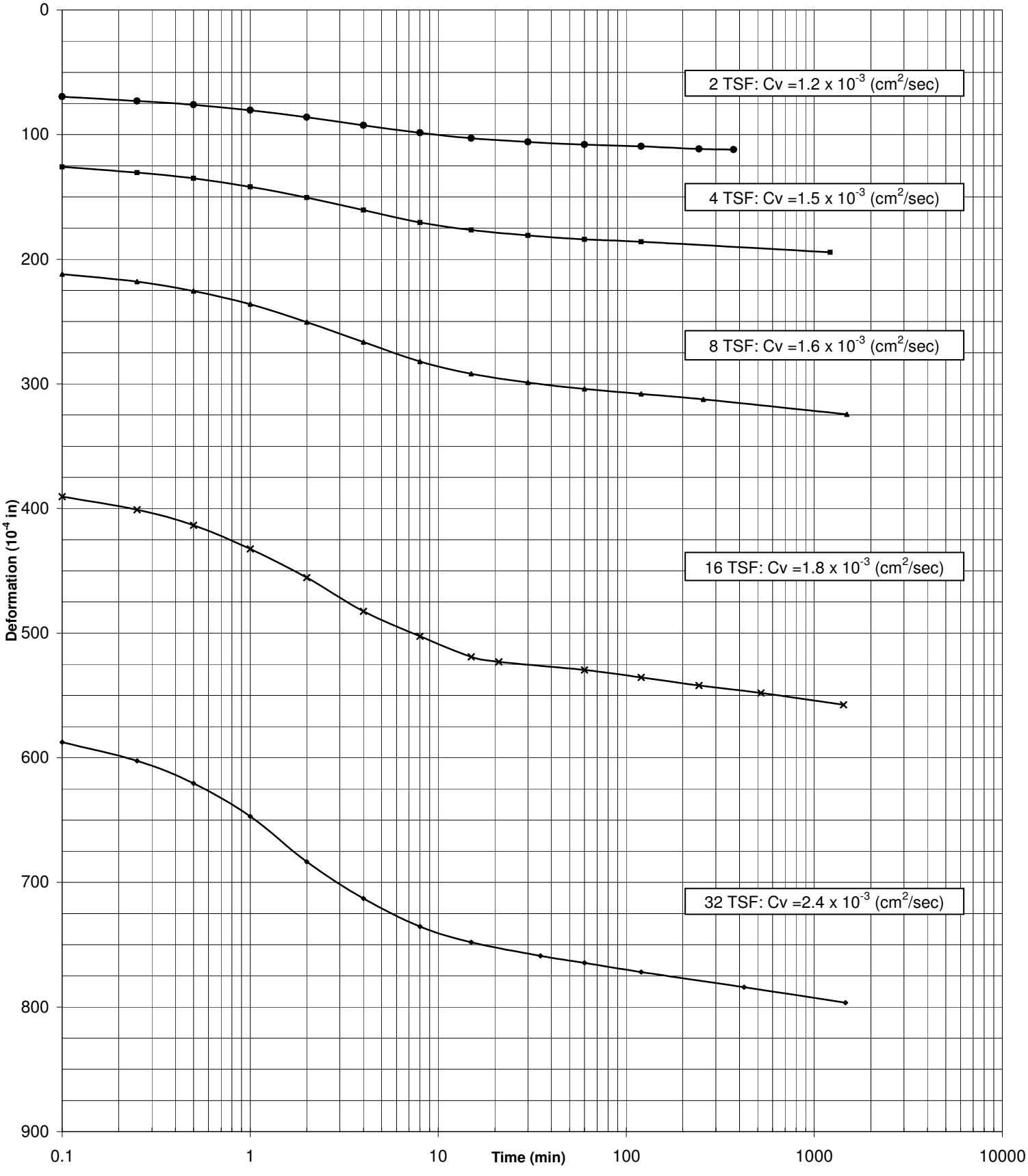
Bloomington, Minnesota 55431

Consolidation Log of Time Curves



Project: Seneca Wind / Barr Engineering Company			Date: 5/22/18
Sample #:	Boring #: Geo-079	Depth ft: 20-22	Job #: 11376

9530 James Avenue South

SOIL ENGINEERING TESTING, INC.

Bloomington, Minnesota 55431

Chemical Testing

pH Testing Summary Sheet (ASTM:D4972)

Project: **Seneca Wind** Job: **11376**

Client: **Barr Engineering Company** Date: **5/18/2018**

Boring / Location	Sample	Sample Type	Depth (ft)	pH	Visual Classification
Geo-005		**Bulk**	**1-3**	**5.2**	**Lean Clay (CL)**
Geo-006		**Bulk**	**1-3**	**5.5**	**Lean Clay (CL)**
Geo-015		**Bulk**	**1-3**	**5.0**	**Lean Clay (CL/CH)**
Geo-038		**Bulk**	**1-3**	**4.6**	**Lean Clay w/sand and a trace of gravel (CL)**
Geo-087		**Bulk**	**1-3**	**6.4**	**Lean Clay (CL)**
Geo-089		**Bulk**	**1-3**	**5.1**	**Lean Clay (CL/CH)**
Sub-1		**Bulk**	**1-3**	**7.1**	**Lean Clay (CL/CH)**

9530 James Ave South

SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

ANALYTICAL REPORT

May 22, 2018

Soil Engineering Testing, Inc.

Sample Delivery Group:	L993601
Samples Received:	05/12/2018
Project Number:	11376
Description:	Seneca Wind

Report To: John Whelan
9530 James Ave. South
Bloomington, MN 55431

Entire Report Reviewed By:

John Hawkins
Technical Service Representative

Results relate only to the items tested or calibrated and are reported as rounded values. This test report shall not be reproduced, except in full, without written approval of the laboratory. Where applicable, sampling conducted by ESC is performed per guidance provided in laboratory standard operating procedures: 060302, 060303, and 060304.

TABLE OF CONTENTS

GEO-005 L993601-01 Solid

			Collected by	Collected date/time	Received date/time
				05/11/18 10:00	05/12/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9056A	WG1110773	1	05/14/18 16:02	05/15/18 06:50	MAJ

GEO-006 L993601-02 Solid

			Collected by	Collected date/time	Received date/time
				05/11/18 10:00	05/12/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9056A	WG1114584	1	05/21/18 14:15	05/21/18 20:13	MAJ

GEO-015 L993601-03 Solid

			Collected by	Collected date/time	Received date/time
				05/11/18 10:00	05/12/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9056A	WG1114584	1	05/21/18 14:15	05/21/18 20:30	MAJ

GEO-038 L993601-04 Solid

			Collected by	Collected date/time	Received date/time
				05/11/18 10:00	05/12/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9056A	WG1114584	1	05/21/18 14:15	05/21/18 21:35	MAJ

GEO-087 L993601-05 Solid

			Collected by	Collected date/time	Received date/time
				05/11/18 10:00	05/12/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9056A	WG1114584	1	05/21/18 14:15	05/21/18 21:52	MAJ

GEO-089 L993601-06 Solid

			Collected by	Collected date/time	Received date/time
				05/11/18 10:00	05/12/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9056A	WG1114584	1	05/21/18 14:15	05/21/18 22:08	MAJ

SUB-01 L993601-07 Solid

			Collected by	Collected date/time	Received date/time
				05/11/18 10:00	05/12/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9056A	WG1114584	1	05/21/18 14:15	05/21/18 22:25	MAJ

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times, unless qualified or notated within the report. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All radiochemical sample results for solids are reported on a dry weight basis with the exception of tritium, carbon-14 and radon, unless wet weight was requested by the client. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.

John V Hawkins

John Hawkins
Technical Service Representative

Wet Chemistry by Method 9056A

Analyte	Result	Qualifier	RDL	Dilution	Analysis	Batch
	mg/kg		mg/kg		date / time	
Chloride	249		10.0	1	05/15/2018 06:50	WG1110773
Sulfate	ND		50.0	1	05/15/2018 06:50	WG1110773

Wet Chemistry by Method 9056A

Analyte	Result	Qualifier	RDL	Dilution	Analysis	Batch
	mg/kg		mg/kg		date / time	
Chloride	148		10.0	1	05/21/2018 20:13	WG1114584
Sulfate	69.4		50.0	1	05/21/2018 20:13	WG1114584

Wet Chemistry by Method 9056A

Analyte	Result	Qualifier	RDL	Dilution	Analysis	Batch
	mg/kg		mg/kg		date / time	
Chloride	85.2	J3	10.0	1	05/21/2018 20:30	WG1114584
Sulfate	73.0		50.0	1	05/21/2018 20:30	WG1114584

Wet Chemistry by Method 9056A

Analyte	Result	Qualifier	RDL	Dilution	Analysis	Batch
	mg/kg		mg/kg		date / time	
Chloride	110		10.0	1	05/21/2018 21:35	WG1114584
Sulfate	ND		50.0	1	05/21/2018 21:35	WG1114584

Wet Chemistry by Method 9056A

Analyte	Result	Qualifier	RDL	Dilution	Analysis	Batch
	mg/kg		mg/kg		date / time	
Chloride	169		10.0	1	05/21/2018 21:52	WG1114584
Sulfate	ND		50.0	1	05/21/2018 21:52	WG1114584

Wet Chemistry by Method 9056A

Analyte	Result	Qualifier	RDL	Dilution	Analysis	Batch
	mg/kg		mg/kg		date / time	
Chloride	106		10.0	1	05/21/2018 22:08	WG1114584
Sulfate	77.7		50.0	1	05/21/2018 22:08	WG1114584

Wet Chemistry by Method 9056A

Analyte	Result	Qualifier	RDL	Dilution	Analysis	Batch
	mg/kg		mg/kg		date / time	
Chloride	104		10.0	1	05/21/2018 22:25	WG1114584
Sulfate	ND		50.0	1	05/21/2018 22:25	WG1114584

Method Blank (MB)

(MB) R3309824-1 05/14/18 22:53

Analyte	MB Result	MB Qualifier	MB MDL	MB RDL
	mg/kg		mg/kg	mg/kg
Chloride	U		0.795	10.0
Sulfate	U		0.570	50.0

L993598-02 Original Sample (OS) • Duplicate (DUP)

(OS) L993598-02 05/15/18 02:13 • (DUP) R3309824-6 05/15/18 02:28

Analyte	Original Result	DUP Result	Dilution	DUP RPD	DUP Qualifier	DUP RPD Limits
	mg/kg	mg/kg		%		%
Chloride	154	208	1	29.8	J3	15
Sulfate	ND	18.3	1	0.000		15

L993600-08 Original Sample (OS) • Duplicate (DUP)

(OS) L993600-08 05/15/18 06:20 • (DUP) R3309824-7 05/15/18 06:35

Analyte	Original Result	DUP Result	Dilution	DUP RPD	DUP Qualifier	DUP RPD Limits
	mg/kg	mg/kg		%		%
Chloride	68.9	67.2	1	2.56		15
Sulfate	ND	33.9	1	0.000		15

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3309824-2 05/14/18 23:08 • (LCSD) R3309824-3 05/14/18 23:23

Analyte	Spike Amount	LCS Result	LCSD Result	LCS Rec.	LCSD Rec.	Rec. Limits	LCS Qualifier	LCSD Qualifier	RPD	RPD Limits
	mg/kg	mg/kg	mg/kg	%	%	%			%	%
Chloride	200	208	191	104	95.5	80.0-120			8.49	15
Sulfate	200	194	191	97.0	95.3	80.0-120			1.78	15

Method Blank (MB)

(MB) R3312026-1 05/21/18 18:02

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Chloride	U		0.795	10.0
Sulfate	U		0.570	50.0

L993601-03 Original Sample (OS) • Duplicate (DUP)

(OS) L993601-03 05/21/18 20:30 • (DUP) R3312026-4 05/21/18 20:46

Analyte	Original Result mg/kg	DUP Result mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	85.2	111	1	26.2	J3	15
Sulfate	73.0	81.2	1	10.6		15

L993605-09 Original Sample (OS) • Duplicate (DUP)

(OS) L993605-09 05/22/18 01:42 • (DUP) R3312026-5 05/22/18 01:58

Analyte	Original Result mg/kg	DUP Result mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	45.1	47.9	1	6.06		15

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3312026-2 05/21/18 18:18 • (LCSD) R3312026-3 05/21/18 18:35

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Chloride	200	211	211	105	105	80.0-120			0.0584	15
Sulfate	200	215	214	107	107	80.0-120			0.119	15

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Abbreviations and Definitions

MDL	Method Detection Limit.
ND	Not detected at the Reporting Limit (or MDL where applicable).
RDL	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
U	Not detected at the Reporting Limit (or MDL where applicable).
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, the sample preparation volume or weight values differ from the standard, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state “ND” (Not Detected) or “BDL” (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
J3	The associated batch QC was outside the established quality control range for precision.

ESC Lab Sciences is the only environmental laboratory accredited/certified to support your work nationwide from one location. One phone call, one point of contact, one laboratory. No other lab is as accessible or prepared to handle your needs throughout the country. Our capacity and capability from our single location laboratory is comparable to the collective totals of the network laboratories in our industry. The most significant benefit to our one location design is the design of our laboratory campus. The model is conducive to accelerated productivity, decreasing turn-around time, and preventing cross contamination, thus protecting sample integrity. Our focus on premium quality and prompt service allows us to be YOUR LAB OF CHOICE.
* Not all certifications held by the laboratory are applicable to the results reported in the attached report.
* Accreditation is only applicable to the test methods specified on each scope of accreditation held by ESC Lab Sciences.

State Accreditations

Alabama	40660	Nebraska	NE-OS-15-05
Alaska	17-026	Nevada	TN-03-2002-34
Arizona	AZ0612	New Hampshire	2975
Arkansas	88-0469	New Jersey–NELAP	TN002
California	2932	New Mexico [1]	n/a
Colorado	TN00003	New York	11742
Connecticut	PH-0197	North Carolina	Env375
Florida	E87487	North Carolina [1]	DW21704
Georgia	NELAP	North Carolina [3]	41
Georgia [1]	923	North Dakota	R-140
Idaho	TN00003	Ohio–VAP	CL0069
Illinois	200008	Oklahoma	9915
Indiana	C-TN-01	Oregon	TN200002
Iowa	364	Pennsylvania	68-02979
Kansas	E-10277	Rhode Island	LAO00356
Kentucky [1 6]	90010	South Carolina	84004
Kentucky [2]	16	South Dakota	n/a
Louisiana	AI30792	Tennessee [1 4]	2006
Louisiana [1]	LA180010	Texas	T 104704245-17-14
Maine	TN0002	Texas [5]	LAB0152
Maryland	324	Utah	TN00003
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	460132
Minnesota	047-999-395	Washington	C847
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	9980939910
Montana	CERT0086	Wyoming	A2LA

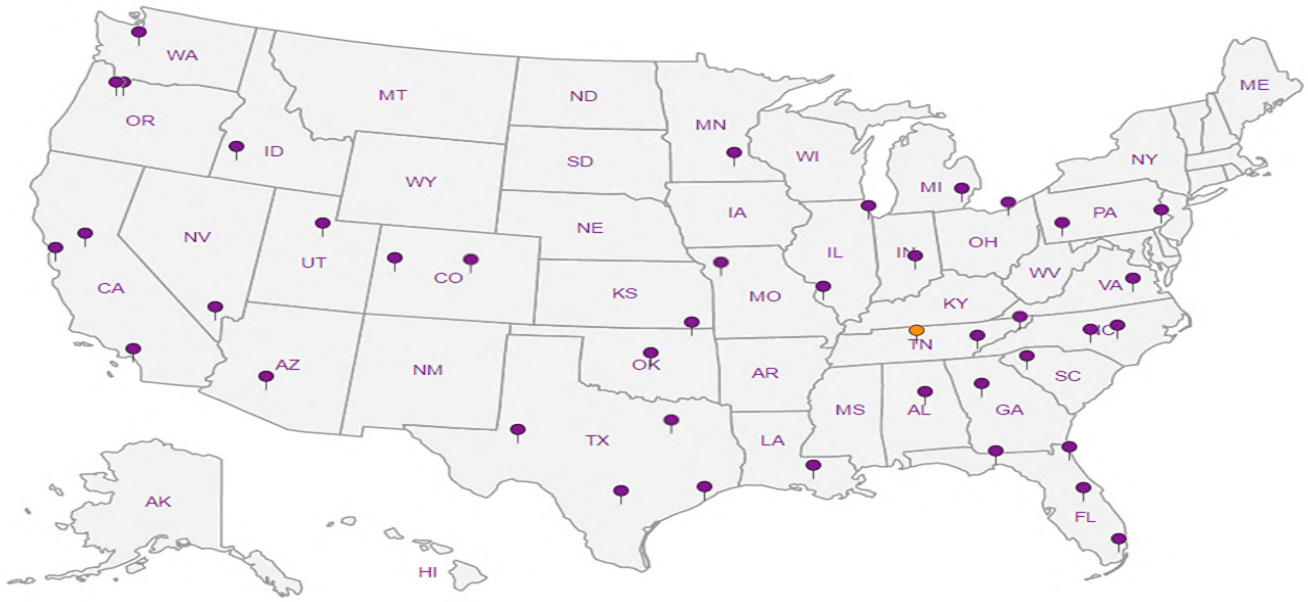
Third Party Federal Accreditations

A2LA – ISO 17025	1461.01	AIHA-LAP,LLC EMLAP	100789
A2LA – ISO 17025 [5]	1461.02	DOD	1461.01
Canada	1461.01	USDA	P330-15-00234
EPA–Crypto	TN00003		

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [6] Wastewater n/a Accreditation not applicable

Our Locations

ESC Lab Sciences has sixty-four client support centers that provide sample pickup and/or the delivery of sampling supplies. If you would like assistance from one of our support offices, please contact our main office. ESC Lab Sciences performs all testing at our central laboratory.



Soil Engineering Testing, Inc.

9530 James Ave. South
Bloomington, MN 55431

Billing Information:
John Whelan
9530 James Ave. South
Bloomington, MN 55431

Analysis / Container / Preservative

Chain of Custody Page __ of __

ESC LAB SCIENCES

12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

Report to: JOHN WHELAN

Email To: jwhelan@soilengineeringtesting.com

Project Description: SENECA WIND

City/State Collected:

Phone: 952-884-6833
Fax: 952-884-6923

Client Project #: 11376

Lab Project #:

L# 953601

H198

Acctnum: SOIENG8MN

Template:

Prelogin:

TSR: 341 - John Hawkins

PB:

Shipped Via:

Collected by (print):

Site/Facility ID #:

P.O. #:

Collected by (signature):

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #:

Date Results Needed

Immediately Packed on Ice N ___ Y ___

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	SULFATE ION	CHLORIDE ION								Remarks	Sample # (lab only)
GEO-005		SS	1-3'	5/11/18	10:00	1	X	X									01
GEO-006		↓	↓	↓	↓	1	X	X									02
GEO-015		↓	↓	↓	↓	1	X	X									03
GEO-038		↓	↓	↓	↓	1	X	X									04
GEO-087		↓	↓	↓	↓	1	X	X									05
GEO-089		↓	↓	↓	↓	1	X	X									06
SUB-01		↓	↓	↓	↓	1	X	X									07

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other______

Remarks:

pH ______ Temp ______

Flow ______ Other ______

Samples returned via:
__ UPS X FedEx __ Courier ______

Tracking # 4276 0145 0A29

Sample Receipt Checklist
COC Seal Present/Intact: NP _Y _N
COC Signed/Accurate: _Y _N
Bottles arrive intact: _Y _N
Correct bottles used: _Y _N
Sufficient volume sent: _Y _N
If Applicable
VOA Zero Headspace: _Y _N
Preservation Correct/Checked: _Y _N

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Trip Blank Received: Yes / No HCL / MeoH TBR
[signature]	5/11/18	15:00		

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Temp: Amb °C	Bottles Received: 7	If preservation required by Login: Date/Time

Relinquished by: (Signature)	Date	Time	Received for lab by: (Signature)	Date	Time	Hold	Condition NCF / OK
			Kathryn Crown	5/12/18	0845		OK

Appendix E

Electrical Resistivity Report

resourceful. naturally.
engineering and environmental consultants

BARR

May 24, 2018

Mr. Mike Goodwin
Construction Manager
sPower
2180 South 1300 East, Suite 600
Salt Lake City, Utah 84106

Re: Soil Electrical Resistivity Testing
Seneca Wind Project
Seneca County, Ohio

Dear Mr. Goodwin:

Barr Engineering Co. (Barr), under contract and authorization from sPower, performed soil electrical resistivity measurements at the Seneca Wind Project site in April of 2018 as part of the design phase geotechnical investigation. This letter presents the methods and results of the requested testing.

Methods

A total of seven sets of electrical resistivity tests were conducted at the site by Barr personnel. Six tests were performed at proposed turbine locations, and one test was performed at the proposed substation location. Test locations were provided by s-Power prior to beginning the field investigation.

Barr personnel verified the test locations with a handheld GPS unit. Barr personnel located the electrical resistivity sample locations based on the provided coordinates for the corresponding boring locations.

The test locations are shown on Figure 1. Coordinates of each test location and other pertinent information can be found in Table 1.

Table 1 Testing Conditions and Coordinates

Resistivity Testing Conditions		UTM Coordinates, Zone 17 [m] [NAD83]	
Geotech ID (Turbine ID-4/4/18 Array)	Ambient Air Temperature [°F]	Easting	Northing
GEO-005 (2.3-5)	50	330232.5	4550876.8
GEO-006 (2.3-6)	50	334368.0	4551577.3
GEO-015 (3.8-3)	55	323462.6	4546020.6
GEO-038 (3.8-24)	50	339979.5	4549899.6
GEO-087 (3.8-16)	55	327652.3	4547804.6
GEO-089 (3.8-37)	50	328728.7	4545293.9
SUB-Res	55	327329.0	4547035.0

Barr conducted the work in accordance with ASTM method G57 "Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method" (equivalent to IEEE Std. 81). A

single resistivity array orientation was utilized at each test location and resistivity measurements in the array orientation were obtained. Each measurement at the tested locations corresponded to one of five electrode ("a") spacings: 2.5, 5, 10, 20, and 40 feet.

The equipment used to collect the data consisted of a resistivity meter, four metal electrodes and connecting wire. A Mini-Res Ultra resistivity meter manufactured by L & R Instruments, Inc. was used to collect the data. The resistivity meter read in resistance (Ω) directly, and did not require the conversion of electrical potential (V) and inductance (I) to calculate resistance (V/I in Ω). Before and after each array was completed, the resistivity meter was connected to a resistor of known resistance, and the resulting values were compared to the known resistance value for quality assurance and quality control purposes. The meter was properly calibrated for all test locations and no instrument adjustments had to be made.

Co-linear arrays of four electrodes were placed in the ground for each measurement. Electrical current was input to the ground through the two outer electrodes of the array. The voltage drop produced by the resulting electrical field was measured across the two inner electrodes. The "a" spacing was increased with each measurement, expanding the array about a common center for the tested locations. Increasing the electrode separation increases the depth of investigation and indicates vertical variation in resistivity.

Apparent resistivity (ρ_a) was calculated for each measurement and corresponding electrode spacing (a) using the resistance measurement (Ω) and the geometric factor (K) as follows:

$\rho_a = K(V/I)$ where $K = 2\pi a$

All field measurements and calculated values of apparent resistivity are presented in the attachments.

Results and Discussion

Soil resistivity variations are likely associated with differences in soil type, layer thicknesses, and degree of water saturation or frost in the near surface soils. Higher moisture contents generally reduce the electrical resistivity of a soil. Sandy soils generally have a higher resistivity than clayey and silty soils. Clay soils with moderate moisture contents tend to exhibit lower resistivity on the order of 1,000 to 5,000 ohm-centimeters (Ω-cm). Bedrock tends to exhibit relatively high resistivgity values on the order of 10,000 to over 100,000 Ω-cm.

Apparent resistivity measurements at the turbine locations ranged from 2,246 to 16,183 (Ω-cm), with an average of 4,317 Ω-cm. Apparent resistivity measurements at the substation location ranged from 2,662 to 3,827 Ω-cm, with an average of 3,379 Ω-cm.

The test results indicate some variability with the smaller "a" spacings, but in general, the apparent resistivity was relatively consistent across the site. Most of the readings fell within a relatively tight range of about 3,000 to 5,000 Ω-cm, with the exception of measurements at "a" spacings of 20 and 40 feet at GEO-089, which indicated much higher values, likely indicative of relatively shallow bedrock, which was confirmed during the soil borings.

In general, apparent resistivity measurements in soil that are less than 2,000 Ω-cm indicate that the soil could be considered corrosive when in direct contact with steel foundations. The apparent resistivity measurements at the tested locations indicate that the soil is not likely to be corrosive for steel in direct contact with native soils at all tested locations.

Table 2 provides a summary of the range found in apparent resistivity with electrode "a" spacing at the turbine locations.

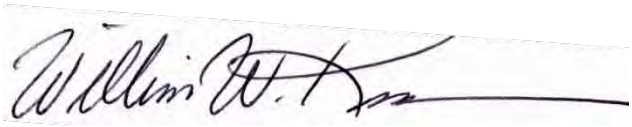
Table 2 Summary of Apparent Resistivity versus Electrode Spacing at Turbine Locations

Turbine Locations	Apparent Resistivity [Ω-cm]		
Electrode Spacing [Feet]	Range	Mean	Standard Deviation
2.5	2,921 – 8,015	4,268	1,469
5	2,969 – 5,693	3,815	863
10	2,856 – 5,875	3,810	1,036
20	2,388 – 8,750	4,109	2,188
40	2,246 – 16,183	5,585	4,884

Closing

Thank you for the opportunity to provide this service. Please call me at 952-832-2797 with questions or requests for additional information.

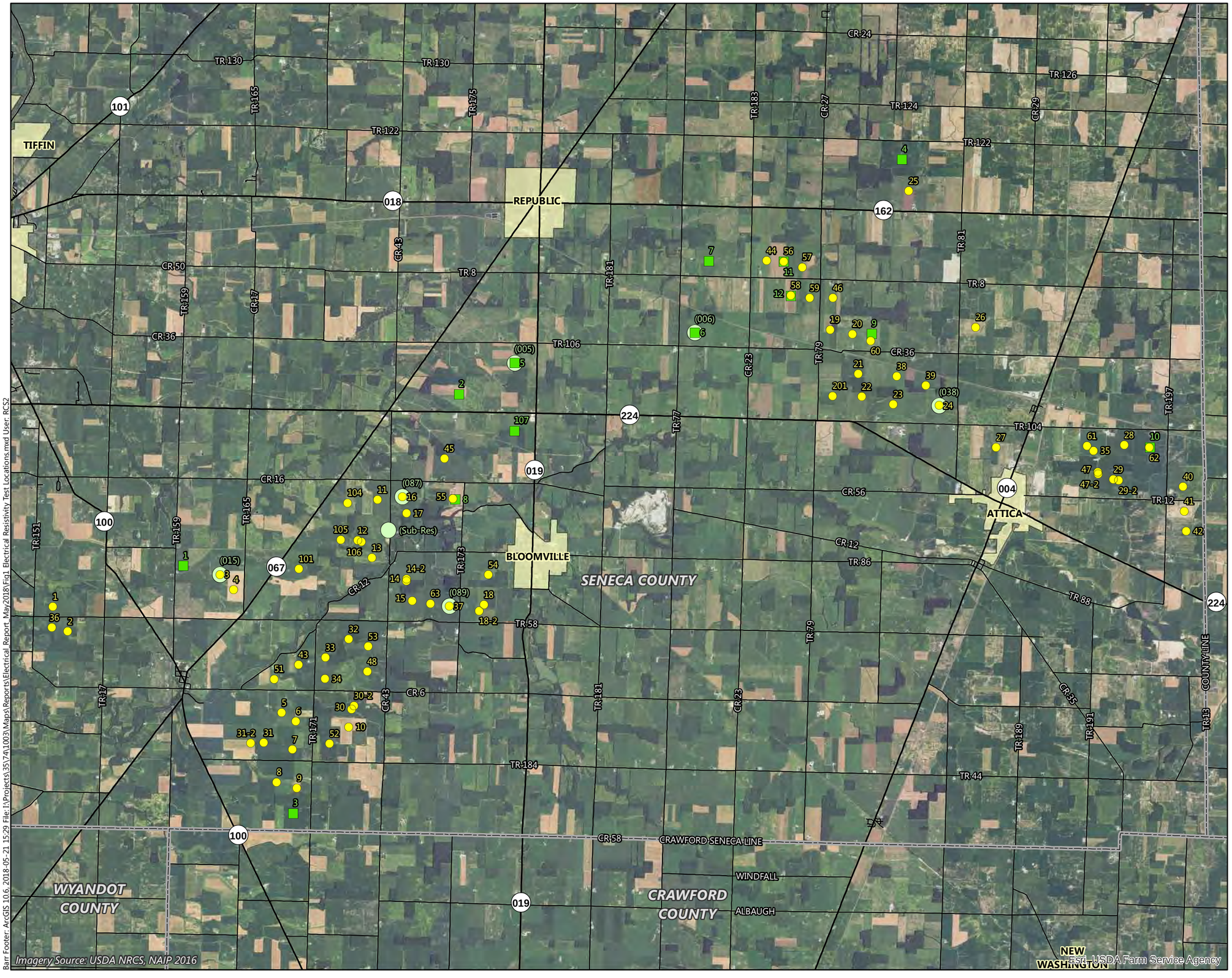
Sincerely,



William W. Kussmann

Attachments:

Electrical Resistivity Testing Results
Figure 1: Electrical Resistivity Testing Locations



Turbine Location - 3.8 (4/4/2018)

Turbine Location - 2.3 (4/4/2018)

City Boundary

County Boundary

Electrical Resistivity Test Locations

*Note: Labeled with GEO- ID in parentheses.

Feet

7,000 0 7,000

Meters

2,000 0 2,000

Figure 1

ELECTRICAL RESISTIVITY TEST LOCATIONS

Seneca Wind Project

S-Power

Seneca County, Ohio

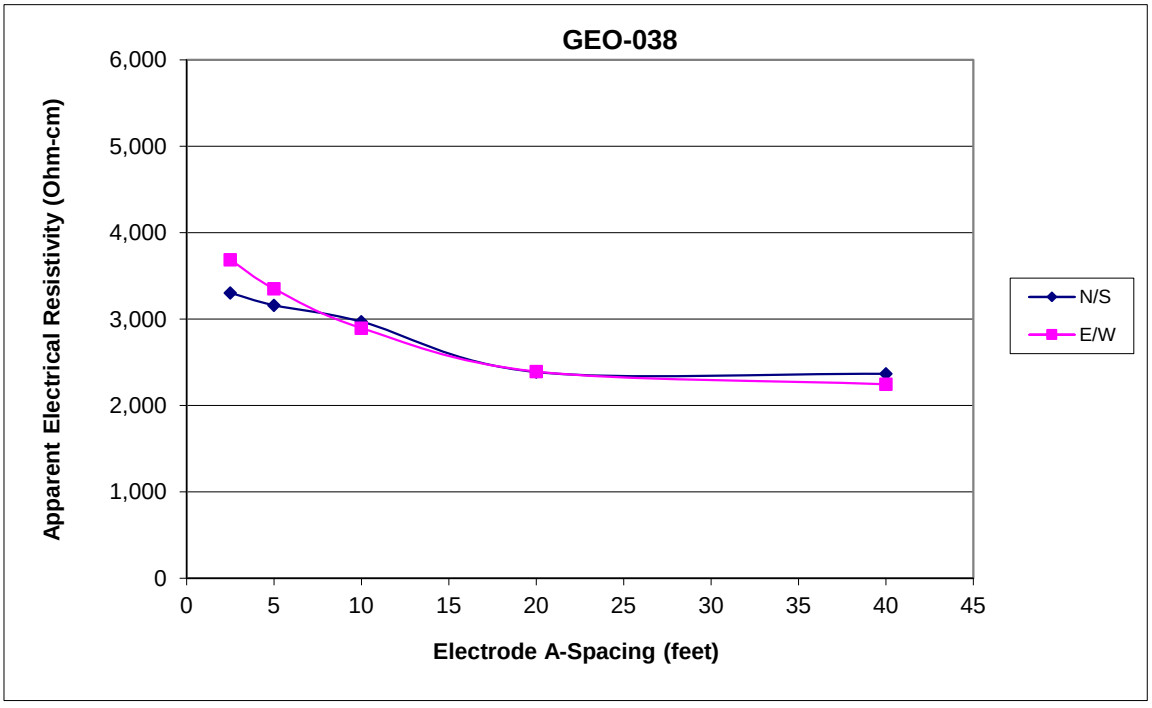
Barr Footer: ArcGIS 10.6, 2018-05-21 15:29 File: I:\Projects\35Y7A1003\Maps\Reports\Electrical_Report_May2018\Fig1_Electrical_Resistivity_Test_Locations.mxd User: RCS2

WENNER SOUNDING
PROJECT: **Seneca Wind Project**

Sounding No. **1** **Date** **4/26/2018**
Observer **IGM**
Location **GEO-038**

Electrode Spacing "a"	Resistance V/I	Geometric Factor K=2 πa	Apparent Resistivity ρ_a=K(V/I)	Apparent Resistivity ρ_a=K(V/I)
feet	Ohms	feet	Ohm-feet	Ohm-cm
N/S Orientation				
2.5	6.900	15.71	108.38	3304.4
5	3.300	31.42	103.67	3160.7
10	1.551	62.83	97.43	2970.3
20	0.623	125.66	78.31	2387.6
40	0.309	251.33	77.64	2366.9
E/W Orientation				
2.5	7.700	15.71	120.95	3687.5
5	3.500	31.42	109.96	3352.3
10	1.512	62.83	95.01	2896.8
20	0.625	125.66	78.49	2393.0
40	0.293	251.33	73.66	2245.9

Cultural Features	None
Ground Cover	Bean crop
Weather	50F
Line Location and Bearing	NS/EW



WENNER SOUNDING

PROJECT: **Seneca Wind Project**

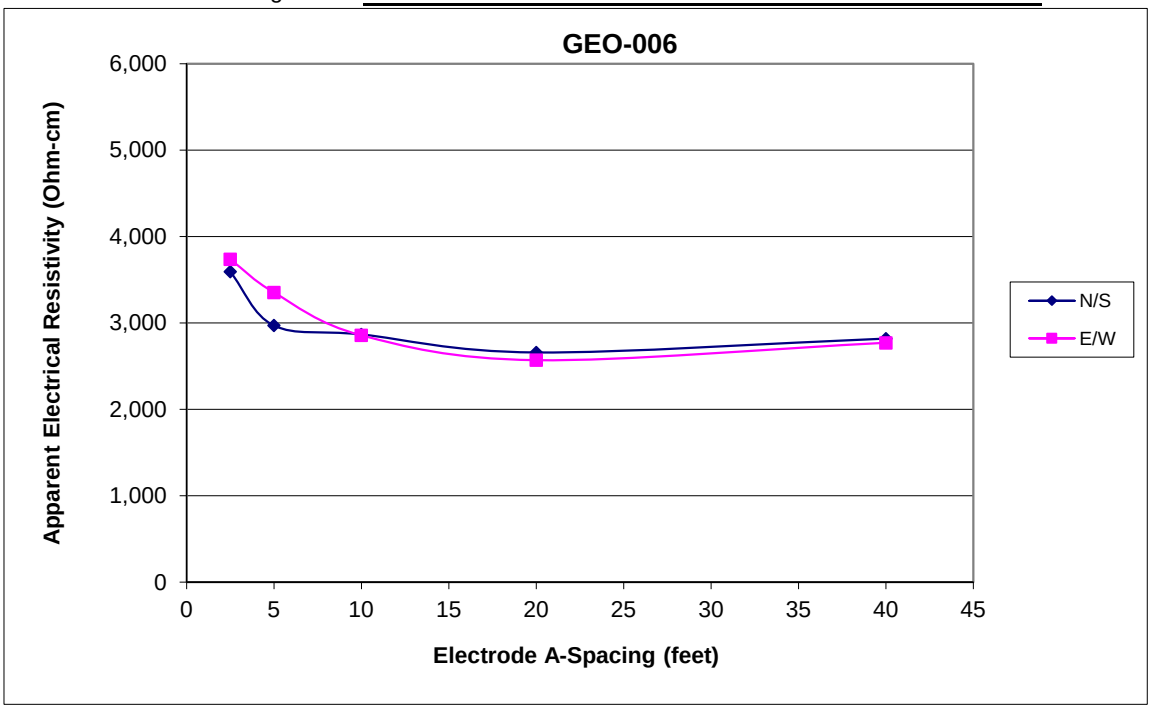
Sounding No. **2** **Date** **4/26/2018**

Observer **IGM**

Location **GEO-006**

Electrode Spacing "a"	Resistance V/I	Geometric Factor K=2 πa	Apparent Resistivity ρ_a=K(V/I)	Apparent Resistivity ρ_a=K(V/I)
feet	Ohms	feet	Ohm-feet	Ohm-cm
N/S Orientation				
2.5	7.500	15.71	117.81	3591.8
5	3.100	31.42	97.39	2969.2
10	1.496	62.83	94.01	2866.1
20	0.694	125.66	87.17	2657.7
40	0.368	251.33	92.44	2818.2
E/W Orientation				
2.5	7.800	15.71	122.52	3735.4
5	3.500	31.42	109.96	3352.3
10	1.491	62.83	93.69	2856.4
20	0.670	125.66	84.24	2568.4
40	0.362	251.33	90.85	2770.0

Cultural Features	None
Ground Cover	Corn field
Weather	50F
Line Location and Bearing	NS/EW



WENNER SOUNDING

PROJECT: **Seneca Wind Project**

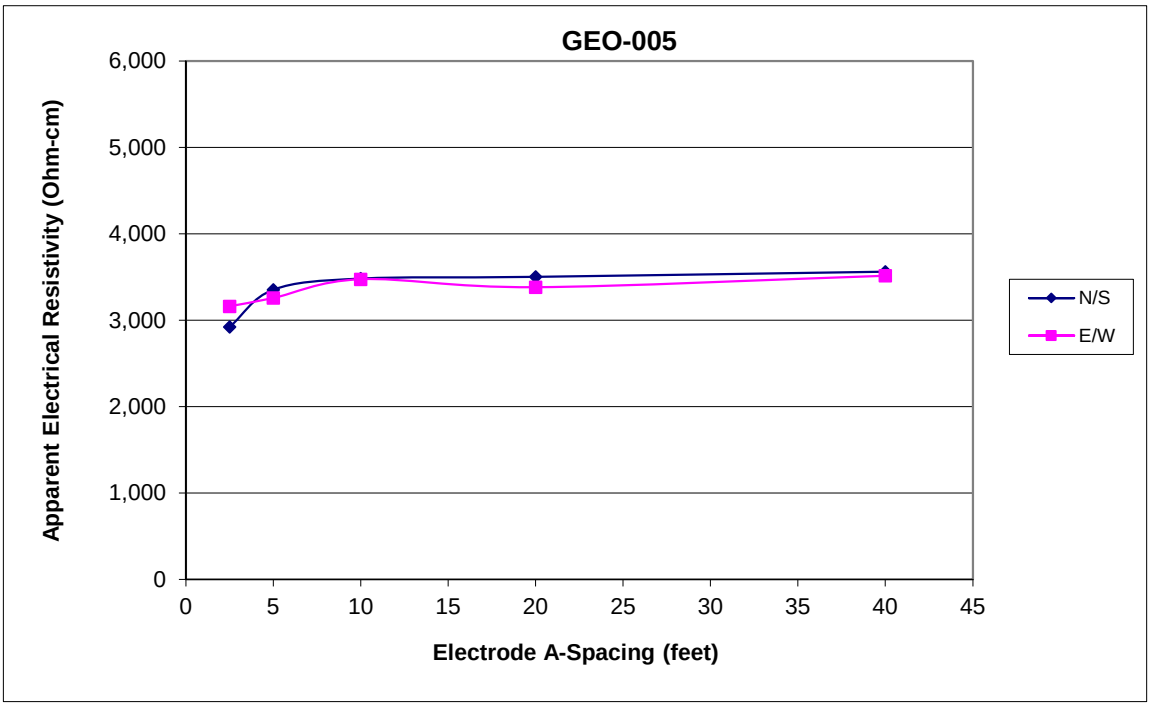
Sounding No. **3** **Date** **4/26/2018**

Observer **IGM**

Location **GEO-005**

Electrode Spacing "a"	Resistance V/I	Geometric Factor K=2 πa	Apparent Resistivity ρ_a=K(V/I)	Apparent Resistivity ρ_a=K(V/I)
feet	Ohms	feet	Ohm-feet	Ohm-cm
N/S Orientation				
2.5	6.100	15.71	95.82	2921.3
5	3.500	31.42	109.96	3352.3
10	1.817	62.83	114.18	3481.2
20	0.914	125.66	114.84	3501.3
40	0.465	251.33	116.79	3560.7
E/W Orientation				
2.5	6.600	15.71	103.67	3160.7
5	3.400	31.42	106.81	3256.5
10	1.813	62.83	113.94	3473.8
20	0.883	125.66	110.91	3381.4
40	0.459	251.33	115.26	3514.0

Cultural Features	None
Ground Cover	Bean field
Weather	50F
Line Location and Bearing	NS/EW

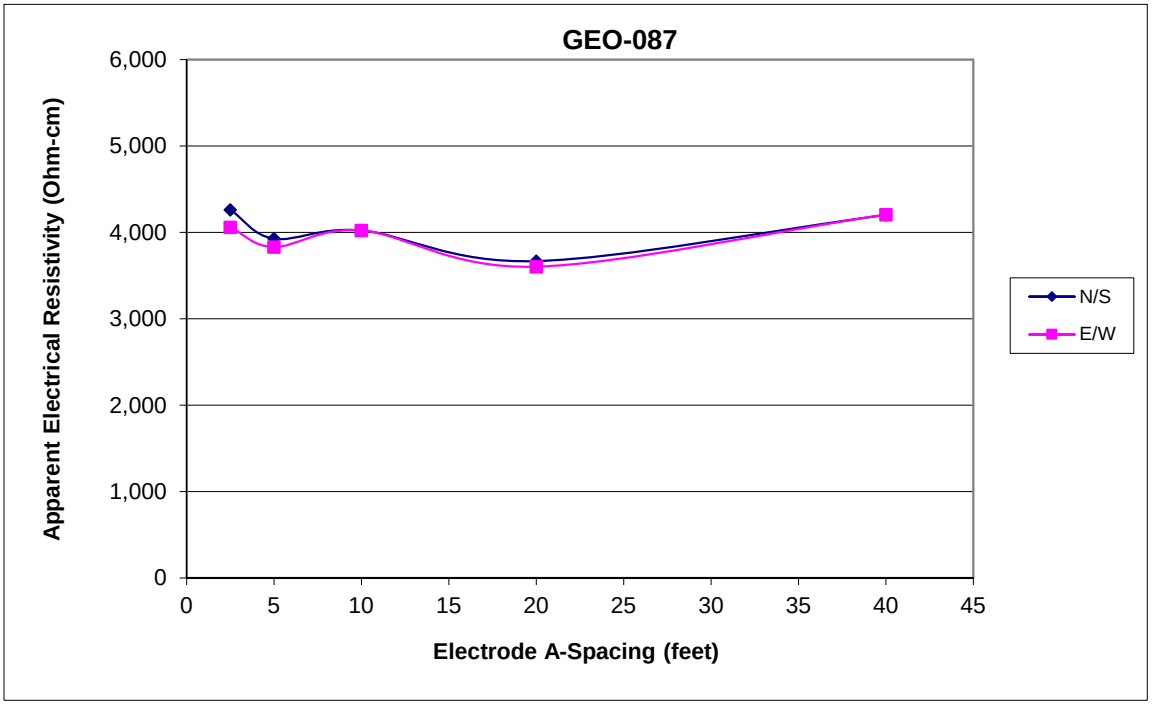


WENNER SOUNDING
PROJECT: **Seneca Wind Project**

Sounding No. **4** **Date** **4/26/2018**
Observer **IGM**
Location **GEO-087**

Electrode Spacing "a"	Resistance V/I	Geometric Factor K=2 πa	Apparent Resistivity ρ_a=K(V/I)	Apparent Resistivity ρ_a=K(V/I)
feet	Ohms	feet	Ohm-feet	Ohm-cm
N/S Orientation				
2.5	8.900	15.71	139.80	4262.2
5	4.100	31.42	128.81	3927.0
10	2.100	62.83	131.95	4022.8
20	0.957	125.66	120.31	3668.0
40	0.548	251.33	137.83	4202.1
E/W Orientation				
2.5	8.477	15.71	133.16	4059.6
5	4.000	31.42	125.66	3831.2
10	2.100	62.83	131.95	4022.8
20	0.941	125.66	118.19	3603.3
40	0.549	251.33	137.98	4206.7

Cultural Features	None
Ground Cover	Cornfield
Weather	55F
Line Location and Bearing	NS/EW

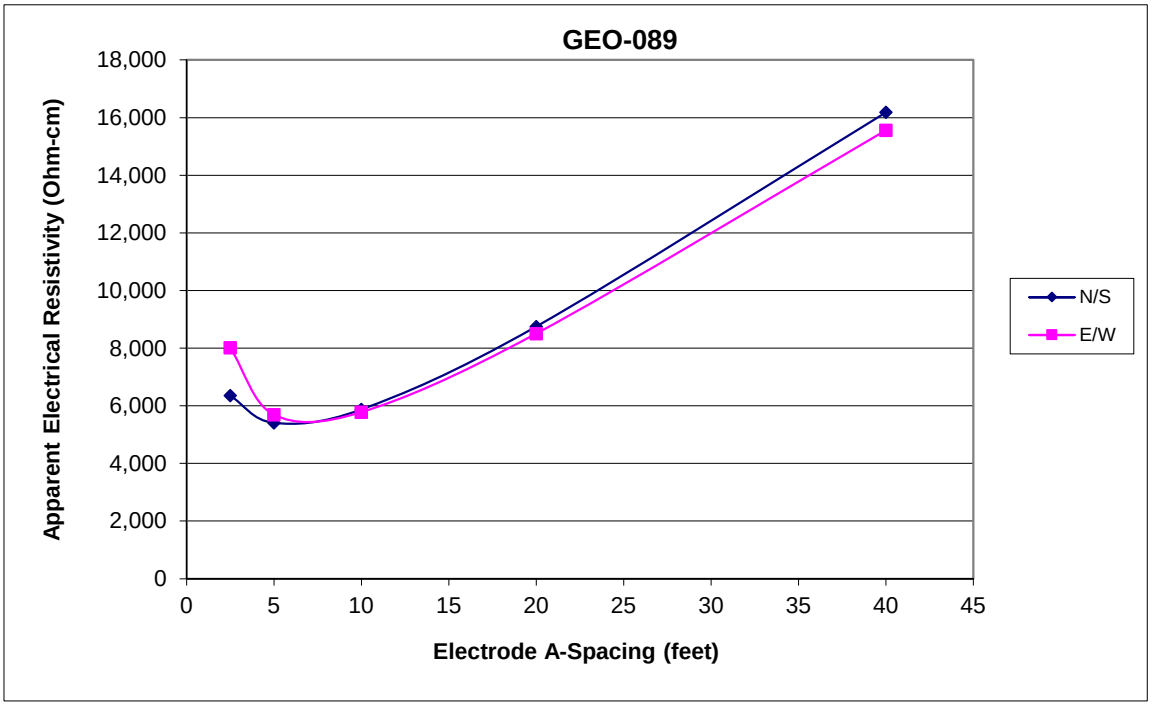


WENNER SOUNDING
PROJECT: **Seneca Wind Project**

Sounding No. **5** **Date** **4/27/2018**
Observer **IGM**
Location **GEO-089**

Electrode Spacing "a"	Resistance V/I	Geometric Factor K=2 πa	Apparent Resistivity ρ_a=K(V/I)	Apparent Resistivity ρ_a=K(V/I)
feet	Ohms	feet	Ohm-feet	Ohm-cm
N/S Orientation				
2.5	13.264	15.71	208.35	6352.1
5	5.648	31.42	177.44	5409.7
10	3.067	62.83	192.71	5875.2
20	2.284	125.66	287.02	8750.5
40	2.112	251.33	530.80	16183.0
E/W Orientation				
2.5	16.737	15.71	262.90	8015.4
5	5.944	31.42	186.74	5693.2
10	3.018	62.83	189.63	5781.3
20	2.220	125.66	278.97	8505.3
40	2.031	251.33	510.45	15562.4

Cultural Features	None
Ground Cover	Grassfield
Weather	50F
Line Location and Bearing	NS/EW



WENNER SOUNDING

PROJECT: **Seneca Wind Project**

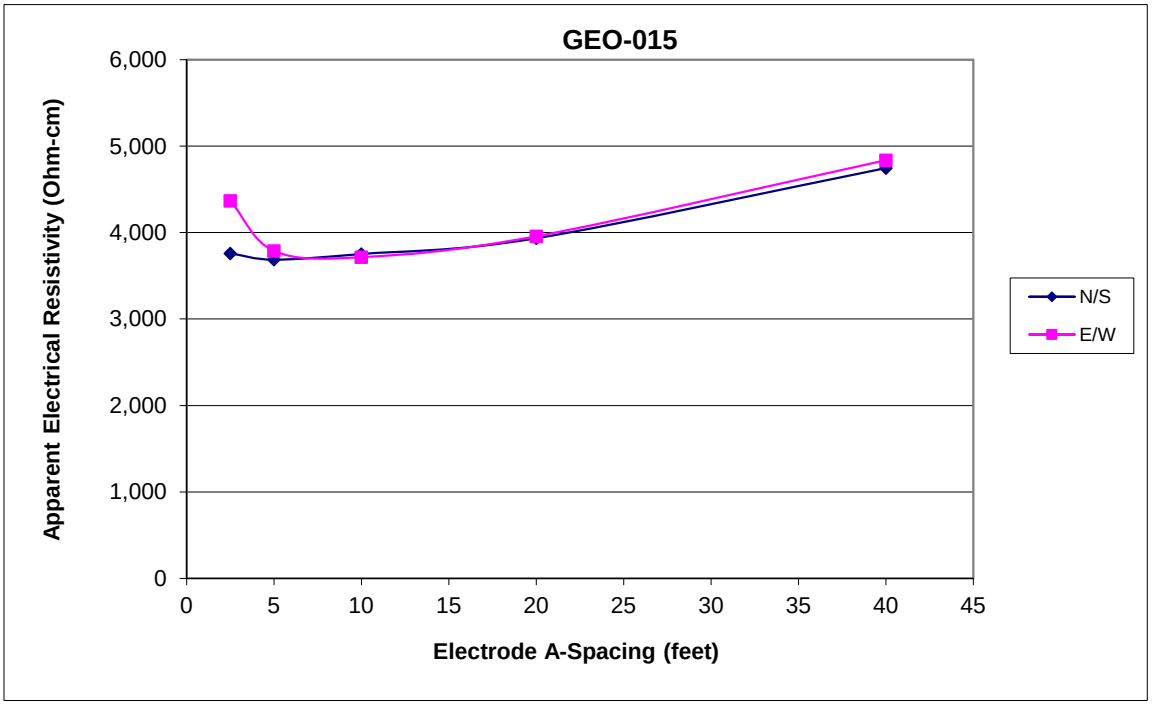
Sounding No. **6** **Date** **4/27/2018**

Observer **IGM**

Location **GEO-015**

Electrode Spacing "a"	Resistance V/I	Geometric Factor K=2 πa	Apparent Resistivity ρ_a=K(V/I)	Apparent Resistivity ρ_a=K(V/I)
feet	Ohms	feet	Ohm-feet	Ohm-cm
N/S Orientation				
2.5	7.851	15.71	123.32	3759.9
5	3.850	31.42	120.95	3687.5
10	1.959	62.83	123.09	3752.7
20	1.027	125.66	129.07	3935.0
40	0.620	251.33	155.70	4746.9
E/W Orientation				
2.5	9.124	15.71	143.32	4369.5
5	3.956	31.42	124.28	3789.1
10	1.940	62.83	121.89	3716.3
20	1.033	125.66	129.82	3958.0
40	0.631	251.33	158.69	4838.1

Cultural Features	None
Ground Cover	Grass field
Weather	55F
Line Location and Bearing	NS/EW



WENNER SOUNDING

PROJECT: **Seneca Wind Project**

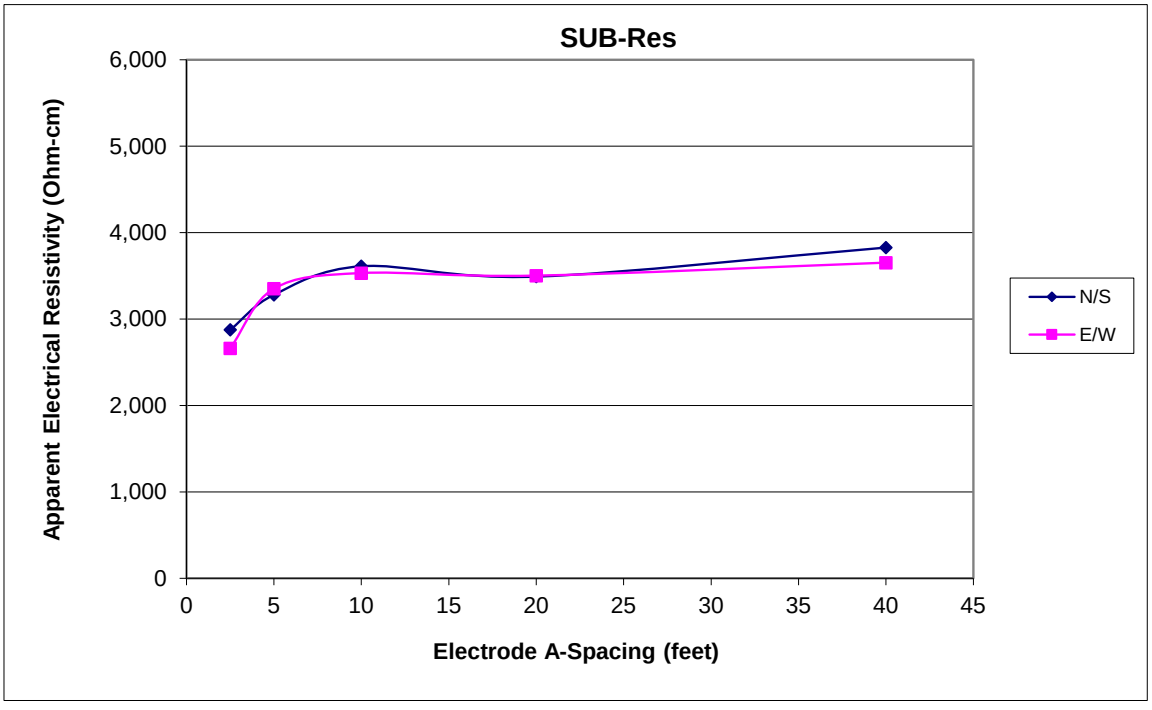
Sounding No. **7** **Date** **4/27/2018**

Observer **IGM**

Location **SUB-Res**

Electrode Spacing "a"	Resistance V/I	Geometric Factor K=2 πa	Apparent Resistivity ρ_a=K(V/I)	Apparent Resistivity ρ_a=K(V/I)
feet	Ohms	feet	Ohm-feet	Ohm-cm
N/S Orientation				
2.5	6.005	15.71	94.33	2875.8
5	3.425	31.42	107.60	3280.5
10	1.885	62.83	118.44	3610.9
20	0.911	125.66	114.50	3491.0
40	0.500	251.33	125.54	3827.4
E/W Orientation				
2.5	5.559	15.71	87.32	2662.2
5	3.499	31.42	109.92	3351.4
10	1.844	62.83	115.86	3532.4
20	0.914	125.66	114.88	3502.5
40	0.477	251.33	119.81	3652.7

Cultural Features	None
Ground Cover	Grass field
Weather	55F
Line Location and Bearing	NS/EW



Electrical Resistivity Test Results
Summary Table
Seneca Wind Project
Seneca County, Ohio
35741003.00

Summary of Electrical Resistivity Test Results:

	Electrode "a" Spacing [feet]	GEO-005 Resistivity $\rho_a = K(V/I)$ Ohm-cm	GEO-006 Resistivity $\rho_a = K(V/I)$ Ohm-cm	GEO-015 Resistivity $\rho_a = K(V/I)$ Ohm-cm	GEO-038 Resistivity $\rho_a = K(V/I)$ Ohm-cm	GEO-087 Resistivity $\rho_a = K(V/I)$ Ohm-cm	GEO-089 Resistivity $\rho_a = K(V/I)$ Ohm-cm
N/S Orientation	2.5	2,921	3,592	3,760	3,304	4,262	6,352
	5	3,352	2,969	3,688	3,161	3,927	5,410
	10	3,481	2,866	3,753	2,970	4,023	5,875
	20	3,501	2,658	3,935	2,388	3,668	8,750
	40	3,561	2,818	4,747	2,367	4,202	16,183
E/W Orientation	2.5	3,161	3,735	4,369	3,688	4,060	8,015
	5	3,257	3,352	3,789	3,352	3,831	5,693
	10	3,474	2,856	3,716	2,897	4,023	5,781
	20	3,381	2,568	3,958	2,393	3,603	8,505
	40	3,514	2,770	4,838	2,246	4,207	15,562
	Average:	**3,360**	**3,019**	**4,055**	**2,877**	**3,981**	**8,613**

Statistical Summary - Apparent Resistivity Averages (Ohm-cm)				
Electrode "a" Spacing [feet]	**Max**	**Min**	**Mean (All Directions)**	**St Dev (All Directions)**
2	8,015	2,921	4,268	1,469
5	5,693	2,969	3,815	863
10	5,875	2,856	3,810	1,036
20	8,750	2,388	4,109	2,188
40	16,183	2,246	5,585	4,884

Apparent Resistivity Average - Turbines - Ohm-cm:	**4,317**

Appendix F

Thermal Resistivity Report

resourceful. naturally.
engineering and environmental consultants

BARR

May 24, 2018

Mr. Mike Goodwin
Construction Manager
sPower
2180 South 1300 East, Suite 600
Salt Lake City, Utah 84106

Re: Soil Thermal Resistivity Testing Results
Seneca Wind Project
Seneca County, Ohio

Dear Mr. Goodwin:

Barr Engineering Co. (Barr), under contract and authorization from sPower, collected soil samples from select locations at the Seneca Wind Project site in April of 2018. Thermal resistivity laboratory testing was completed on the samples in April and May of 2018. This letter presents the methods and results of the requested testing.

Methods

Six bulk soil samples were collected at select turbine locations and one bulk soil sample was collected the proposed substation location. Sample locations were selected by Barr with approval from sPower Barr prior to beginning the sample collection. Bulk samples were obtained from below the highly organic topsoil at depths of 1 to 3 feet below the ground surface. Bulk samples were placed in 5-gallon buckets and sealed in the field to preserve the in situ moisture content. The samples were transported to Soil Engineering Testing, Inc. (SET) of Bloomington, Minnesota, for laboratory testing.

Barr personnel verified the test sites based on the coordinates using a hand-held GPS unit, which was generally very close to the staked locations. The sample locations are shown on Figure 1. Coordinates of each test location and sample depth can be found in Table 1.

Table 1 Thermal Resistivity Sample Information

Geotech ID (Turbine ID-4/4/18 Array)	Sample Depth [feet]	UTM Coordinates, Zone 17N [m] [NAD83]	
		Northing	Easting
GEO-005 (2.3-5)	1-3	4550876.8	330232.5
GEO-006 (2.3-6)	1-3	4551577.3	334368.0
GEO-015 (3.8-3)	1-3	4546020.6	323462.6
GEO-038 (3.8-24)	1-3	4549899.6	339979.5
GEO-087 (3.8-16)	1-3	4547804.6	327652.3
GEO-089 (3.8-37)	1-3	4545293.9	328728.7
SUB-Res	1-3	4547035.0	327329.0

Laboratory testing included measurement of the soil's in-situ moisture content, standard Proctor density and optimum moisture content, and thermal dryout characteristics. All of the bulk samples collected were re-compacted to a density equivalent to approximately 90 percent of standard Proctor maximum dry density near the optimum moisture content for testing. The soil specimens were compacted in four layers in test molds (75 mm diameter by 150 mm high) to minimize contact resistance at the soil/probe interface and to provide for a uniform density.

Thermal dryout characteristics were measured according to ASTM D5334 using a laboratory type thermal needle held central and vertical in the base plate. Thermal resistivity measurements were conducted starting at the remolded moisture content of the soil sample to the totally dry condition. At the end of each drying stage, samples were sealed and brought to thermal equilibrium with the ambient air to maintain uniform moisture re-distribution through the sample. Tests were conducted using a KD2 Pro Thermal Property Analyzer. The instrument was calibrated prior to testing.

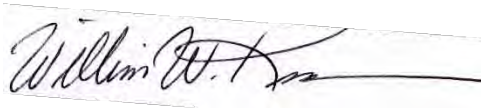
Results

The resulting laboratory soil thermal resistivity measurements presented with full dryout curves are included in the attachments.

Closing

Thank you for the opportunity to provide this service. Please call me at 952-832-2797 with questions or requests for additional information.

Sincerely,



William W. Kussmann
Barr Engineering Co.

Attachments:

Figure 1: Thermal Resistivity Test Locations
Thermal Resistivity Test Results

Turbine Location - 3.8 (4/4/2018)

Turbine Location - 2.3 (4/4/2018)

City Boundary

County Boundary

Thermal Resistivity Test Locations

*Note: Labeled with GEO- ID in parentheses.

Feet

7,000 0 7,000

Meters

2,000 0 2,000

Figure 1

THERMAL RESISTIVITY TEST LOCATIONS

Seneca Wind Project

S-Power

Seneca County, Ohio

Imagery Source: USDA NRCS, NAIP 2016

Esri, USDA Farm Service Agency

Barr Footer: ArcGIS 10.6, 2018-05-21 15:31, File: I:\Projects\35Y7A1003\Maps\Reports\Thermal_Report_May2018\Fig1 Thermal Resistivity Test Locations.mxd User: RCS2

Thermal Resistivity Report ASTM D:5334

Project: **Seneca Wind** Job #: **11376**

Client: **Barr Engineering Company** Date: **5/21/18**

Boring	Specimen Type	Depth (ft)	Type	Classification	Initial Conditions			Dry
					Dry Density (PCF)	WC (%)	Thermal Resistivity (ºC-cm/W)	Thermal Resistivity (ºC-cm/W)
Geo-005	**Reconstituted**	**1-3**	**Bulk**	**Lean Clay (CL)**	**93.8**	**24.7%**	**62**	**171**
Geo-006	**Reconstituted**	**1-3**	**Bulk**	**Lean Clay (CL)**	**92.9**	**23.3%**	**66**	**175**
Geo-015	**Reconstituted**	**1-3**	**Bulk**	**Lean Clay (CL/CH)**	**92.3**	**23.7%**	**63**	**161**
Geo-038	**Reconstituted**	**1-3**	**Bulk**	**Lean Clay (CL)**	**92.6**	**24.5%**	**66**	**170**
	Specimens reconstituted to approximately 90% of maximum standard proctor density near the greater of the as received or optimum moisture content.							

9530 James Ave South SOIL ENGINEERING TESTING, INC. Bloomington, MN 55431

http://www.soilengineeringtesting.com

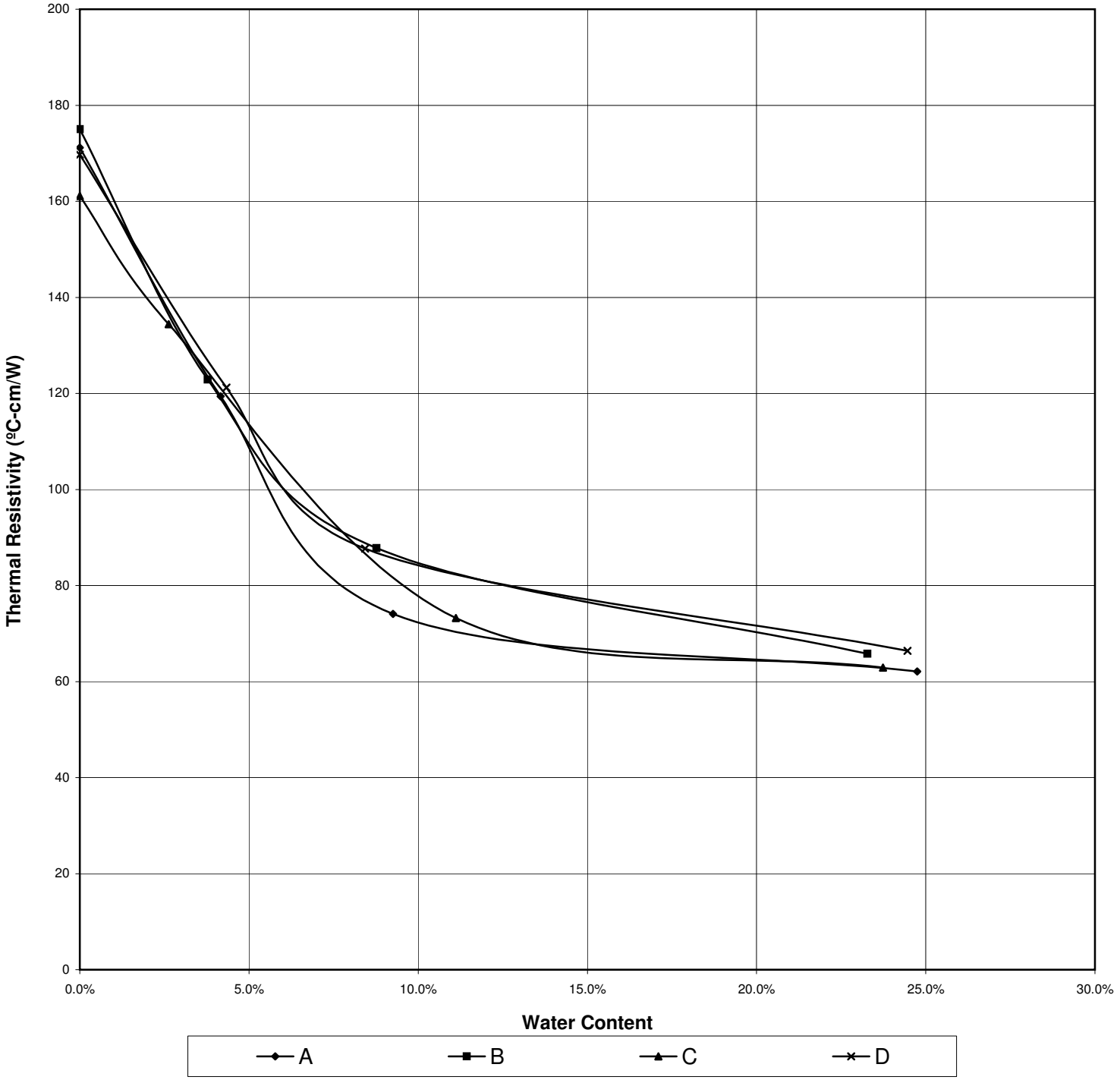
Thermal Resistivity Report ASTM D:5334

Project: Seneca Wind — Job: 11376

Client: Barr Engineering Company — Date: 5/21/18

	Boring	Depth (ft)
Specimen A:	Geo-005	1-3
Specimen B:	Geo-006	1-3
Specimen C:	Geo-015	1-3
Specimen D:	Geo-038	1-3

Thermal Dryout Curves (Water Content vs. Resistivity)



9530 James Ave South

SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

http://www.soilengineeringtesting.com

Thermal Resistivity Report ASTM D:5334

Project: **Seneca Wind** Job #: **11376**

Client: **Barr Engineering Company** Date: **5/21/18**

Boring	Specimen Type	Depth (ft)	Type	Classification	Initial Conditions			Dry
					Dry Density (PCF)	WC (%)	Thermal Resistivity (ºC-cm/W)	Thermal Resistivity (ºC-cm/W)
Geo-087	**Reconstituted**	**1-3**	**Bulk**	**Lean Clay (CL/CH)**	**92.6**	**22.9%**	**74**	**195**
Geo-089	**Reconstituted**	**1-3**	**Bulk**	**Lean Clay with sand and a trace of gravel (CL)**	**94.7**	**21.9%**	**61**	**174**
Sub-1	**Reconstituted**	**1-3**	**Bulk**	**Lean Clay (CL/CH)**	**90.7**	**25.4%**	**68**	**180**
	Specimens reconstituted to approximately 90% of maximum standard proctor density near the greater of the as received or optimum moisture content.							

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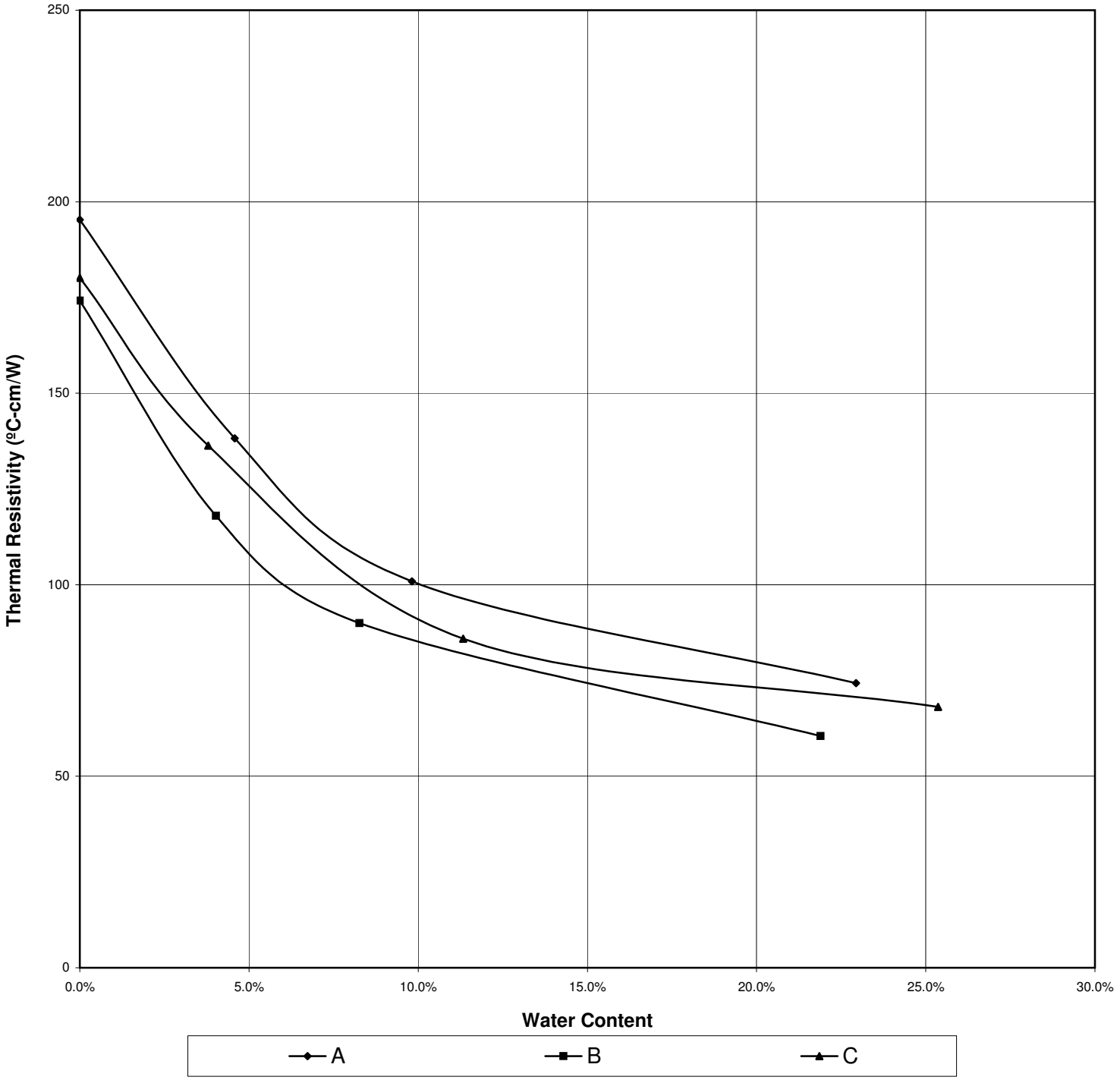
Thermal Resistivity Report ASTM D:5334

Project: Seneca Wind — Job: 11376

Client: Barr Engineering Company — Date: 5/21/18

	Boring	Depth (ft)
Specimen A:	Geo-087	1-3
Specimen B:	Geo-089	1-3
Specimen C:	Sub-1	1-3

Thermal Dryout Curves (Water Content vs. Resistivity)



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Moisture Density Curve ASTM: D698, Method B

Project: **Seneca Wind** Date: **5/4/18**

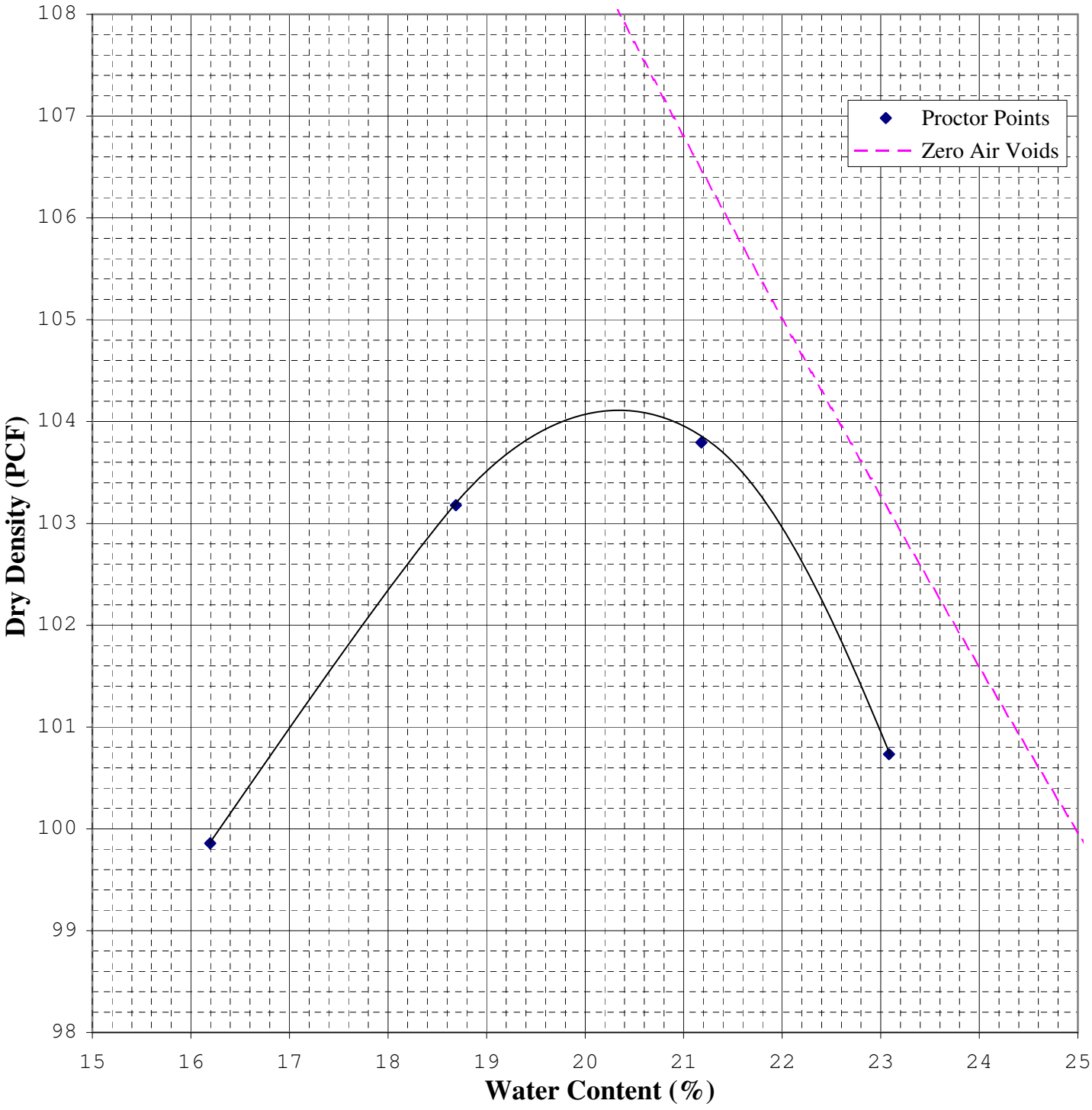
Client: **Barr Engineering Company** Job No. **11376**

Boring No. **Geo-005** Sample: Depth(ft): **1-3** Location:

Soil Type: **Lean Clay (CL)**

As Received W.C. (%): **24.9** LL: PL: PI: Specific Gravity: **2.67** *Assumed

Maximum Dry Density (pcf): **104.1** Opt. Water Content (%): **20.4**



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Moisture Density Curve ASTM: D698, Method B

Project: **Seneca Wind** Date: **5/4/18**

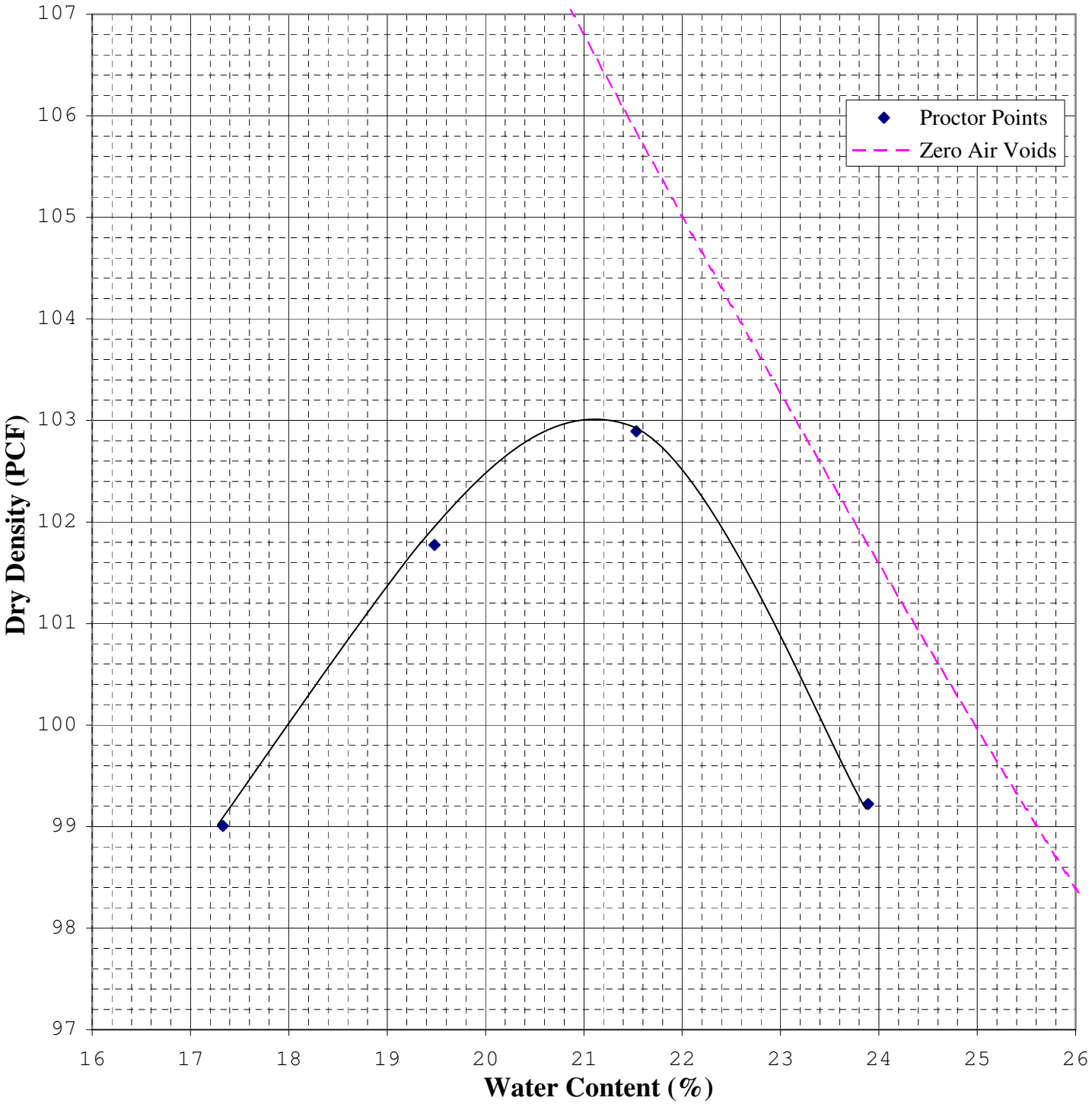
Client: **Barr Engineering Company** Job No. **11376**

Boring No. **Geo-006** Sample: Depth(ft): **1-3** Location:

Soil Type: **Lean Clay (CL)**

As Received W.C. (%): **23.4** LL: PL: PI: Specific Gravity: **2.67** *Assumed

Maximum Dry Density (pcf): **103.0** Opt. Water Content (%): **21.1**



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Bloomington, MN 55431

Moisture Density Curve ASTM: D698, Method B

Project: **Seneca Wind** Date: **5/4/18**

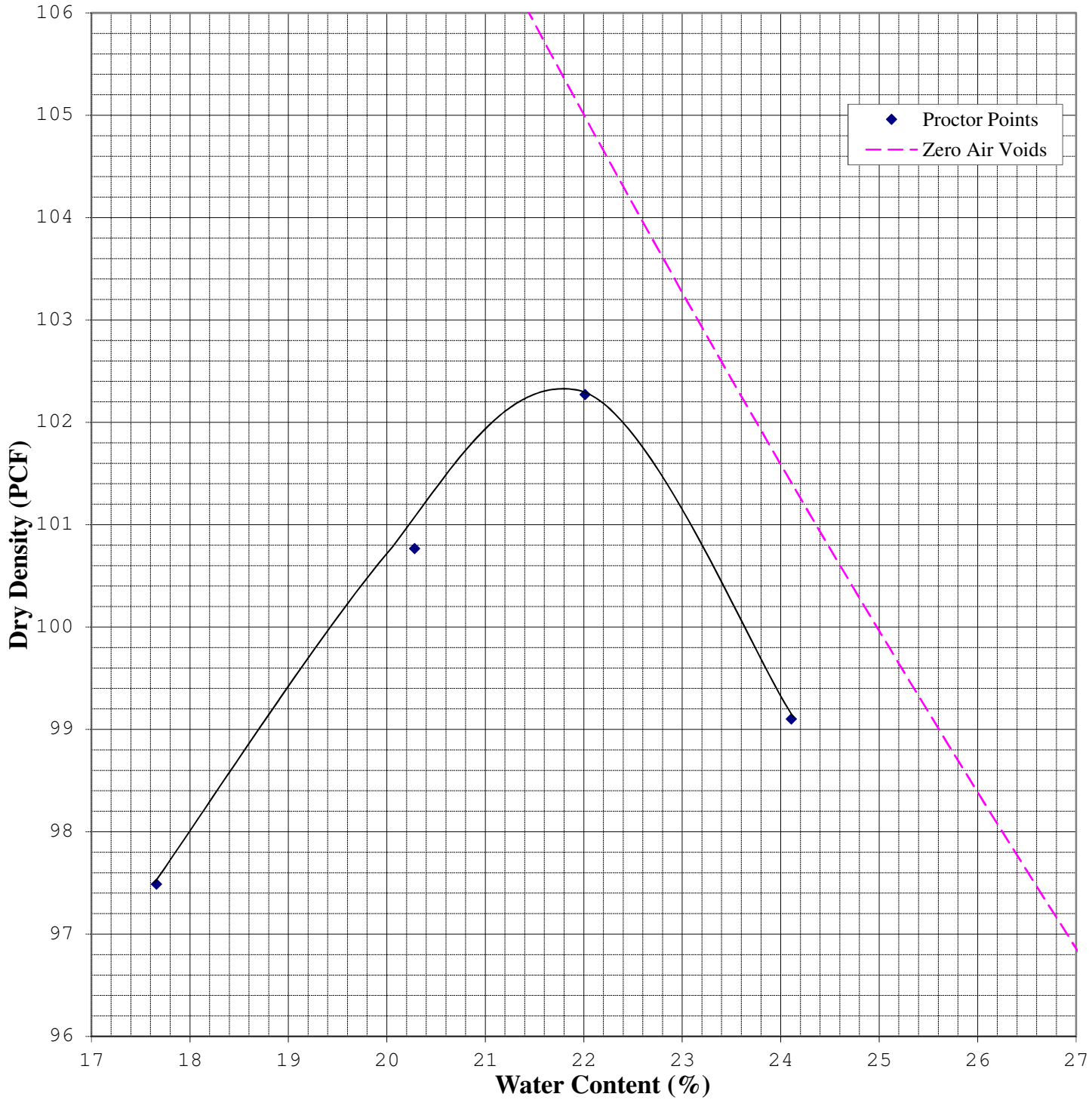
Client: **Barr Engineering Company** Job No. **11376**

Boring No. **Geo-015** Sample: Depth(ft): **1-3** Location:

Soil Type: **Lean Clay (CL/CH)**

As Received W.C. (%): **23.9** LL: PL: PI: Specific Gravity: **2.67** *Assumed

Maximum Dry Density (pcf): **102.3** Opt. Water Content (%): **21.8**



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Moisture Density Curve ASTM: D698, Method B

Project: **Seneca Wind** Date: **5/6/18**

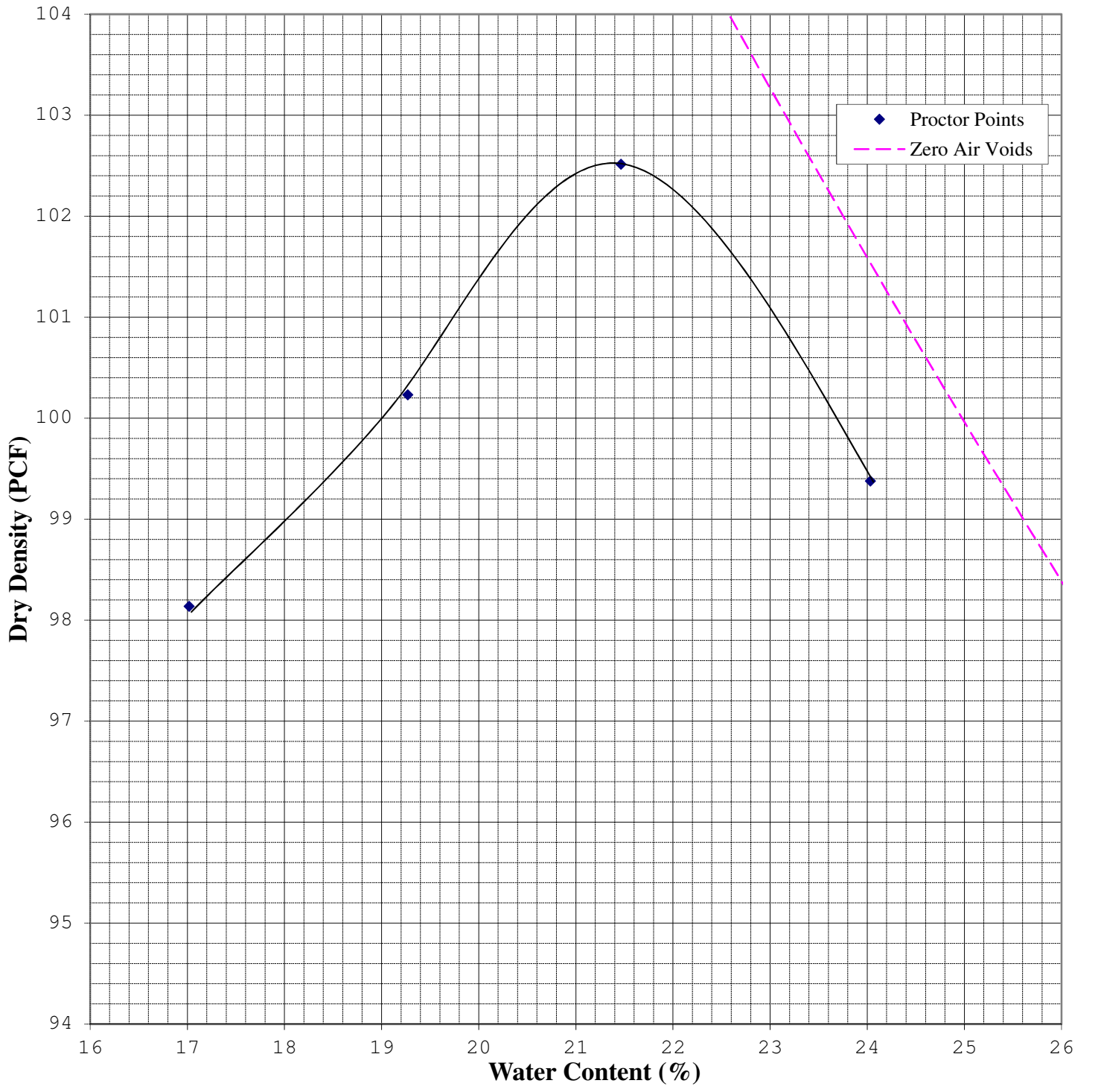
Client: **Barr Engineering Company** Job No. **11376**

Boring No. **Geo-038** Sample: Depth(ft): **1-3** Location:

Soil Type: **Lean Clay (CL)**

As Received W.C. (%): **24.8** LL: PL: PI: Specific Gravity: **2.67** *Assumed

Maximum Dry Density (pcf): **102.5** Opt. Water Content (%): **21.4**



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Bloomington, MN 55431

Moisture Density Curve ASTM: D698, Method B

Project: **Seneca Wind** Date: **5/4/18**

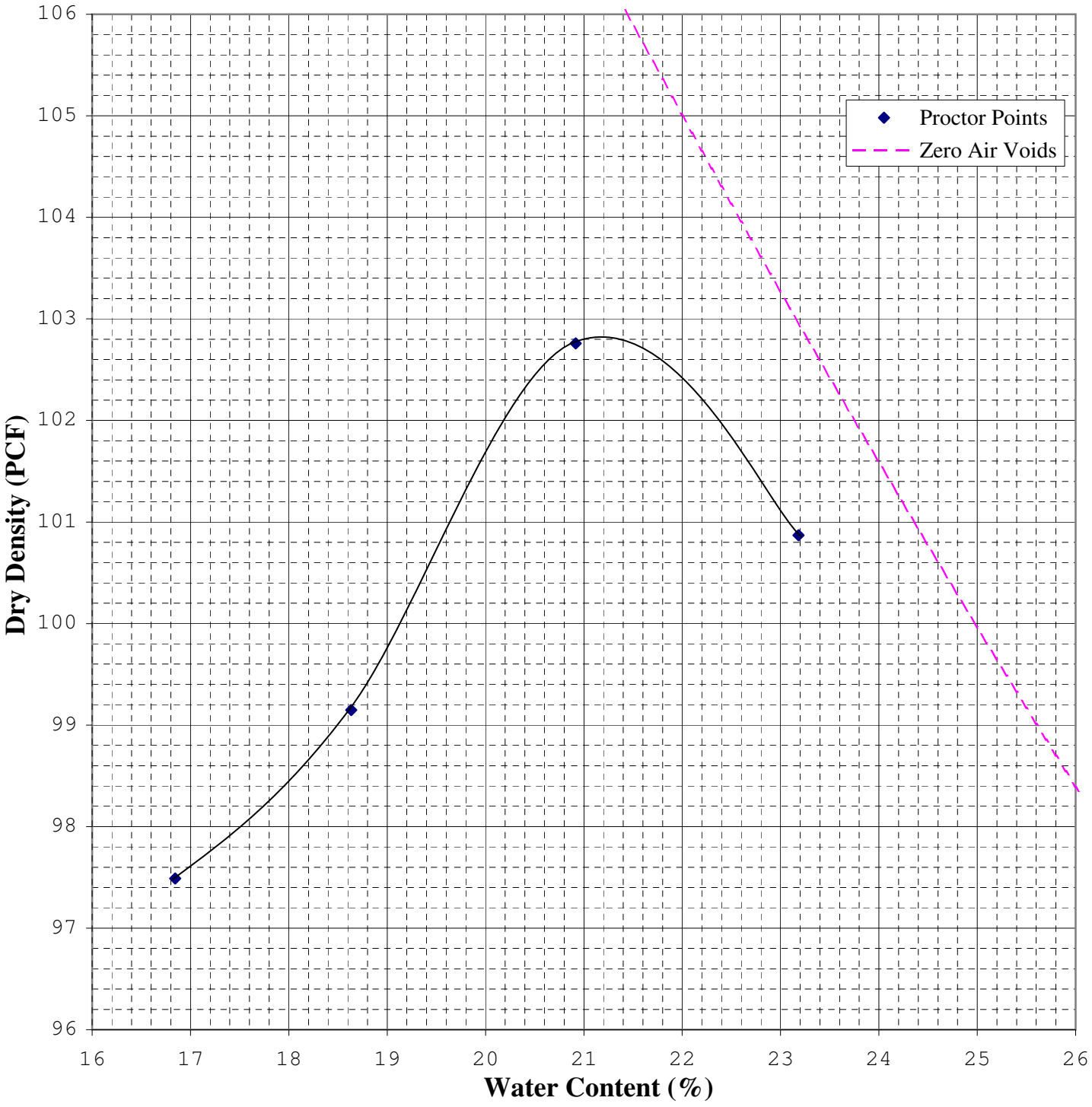
Client: **Barr Engineering Company** Job No. **11376**

Boring No. **Geo-087** Sample: Depth(ft): **1-3** Location:

Soil Type: **Lean Clay (CL/CH)**

As Received W.C. (%): **23.1** LL: PL: PI: Specific Gravity: **2.67** *Assumed

Maximum Dry Density (pcf): **102.8** Opt. Water Content (%): **21.2**



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Bloomington, MN 55431

SET-R18a

Moisture Density Curve ASTM: D698, Method B

Project: **Seneca Wind** Date: **5/4/18**

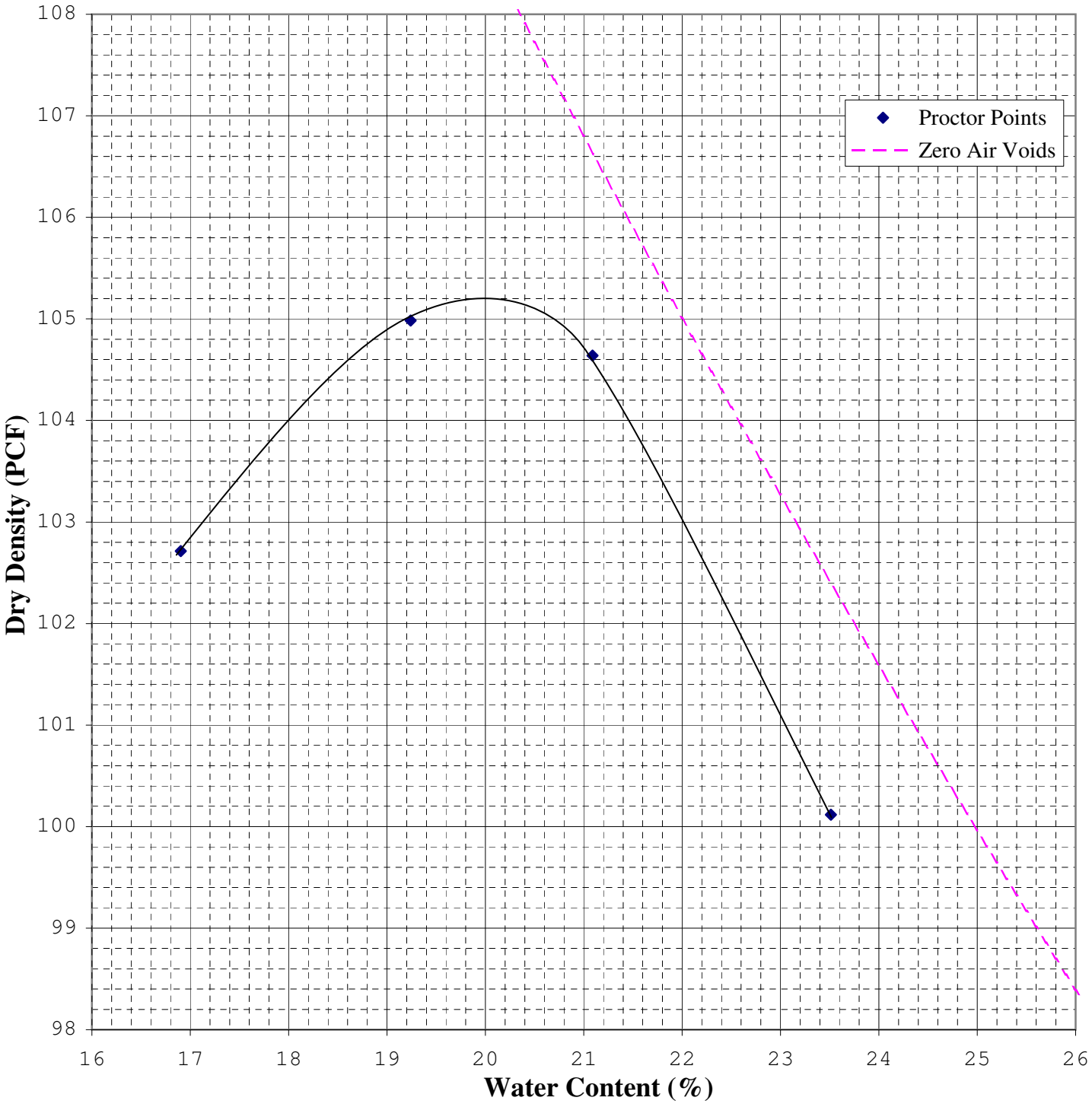
Client: **Barr Engineering Company** Job No. **11376**

Boring No. **Geo-089** Sample: Depth(ft): **1-3** Location:

Soil Type: **Lean Clay w/sand and a trace of gravel (CL)**

As Received W.C. (%): **22.2** LL: PL: PI: Specific Gravity: **2.67** *Assumed

Maximum Dry Density (pcf): **105.0** Opt. Water Content (%): **20.0**



9530 James Ave South

SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

SET-R18a

Moisture Density Curve ASTM: D698, Method B

Project: **Seneca Wind** Date: **5/6/18**

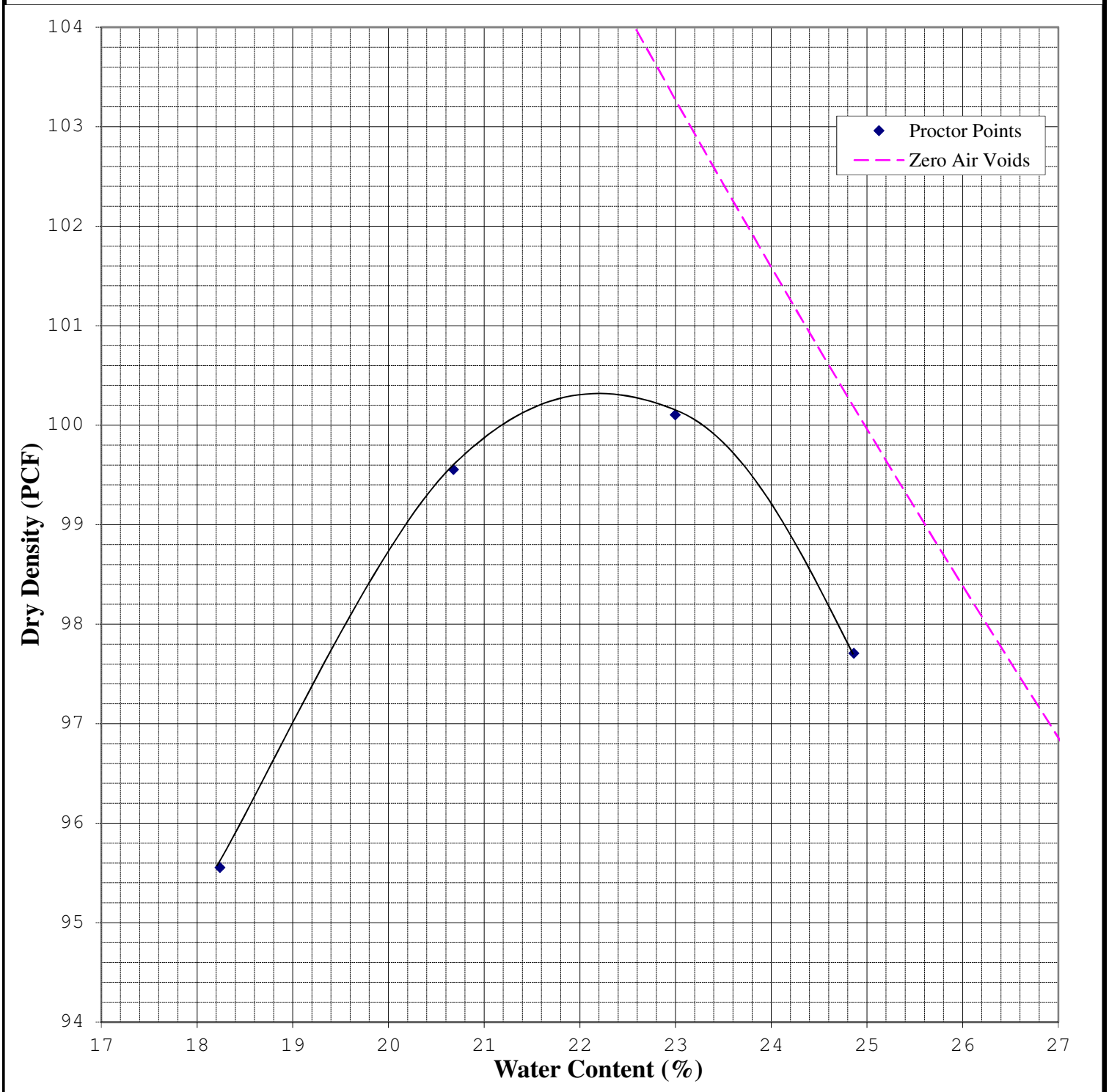
Client: **Barr Engineering Company** Job No. **11376**

Boring No. **Sub-1** Sample: Depth(ft): **1-3** Location:

Soil Type: **Lean Clay (CL/CH)**

As Received W.C. (%): **25.8** LL: PL: PI: Specific Gravity: **2.67** *Assumed

Maximum Dry Density (pcf): **100.3** Opt. Water Content (%): **22.2**



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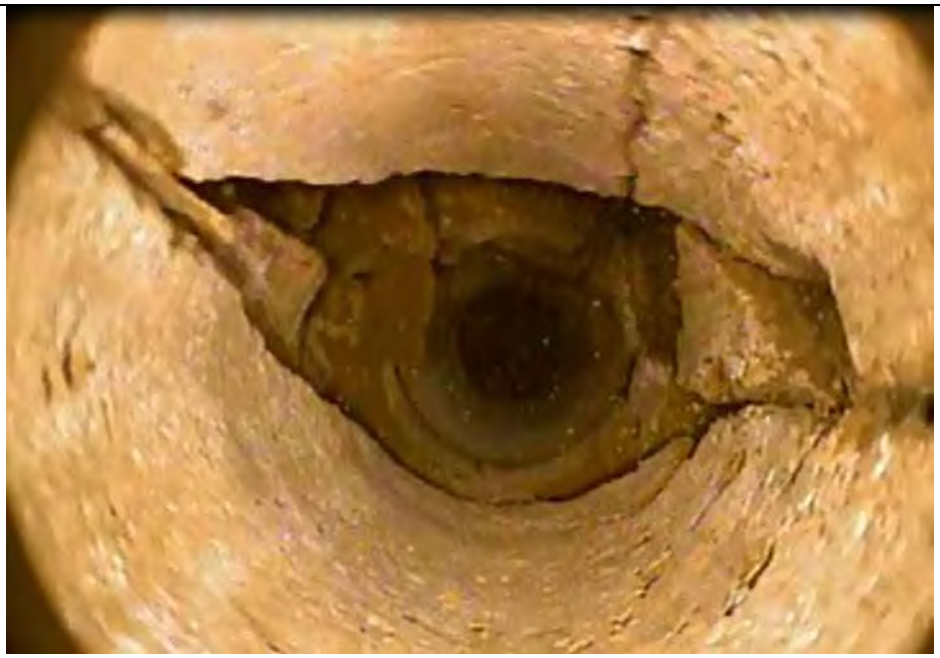
Appendix G

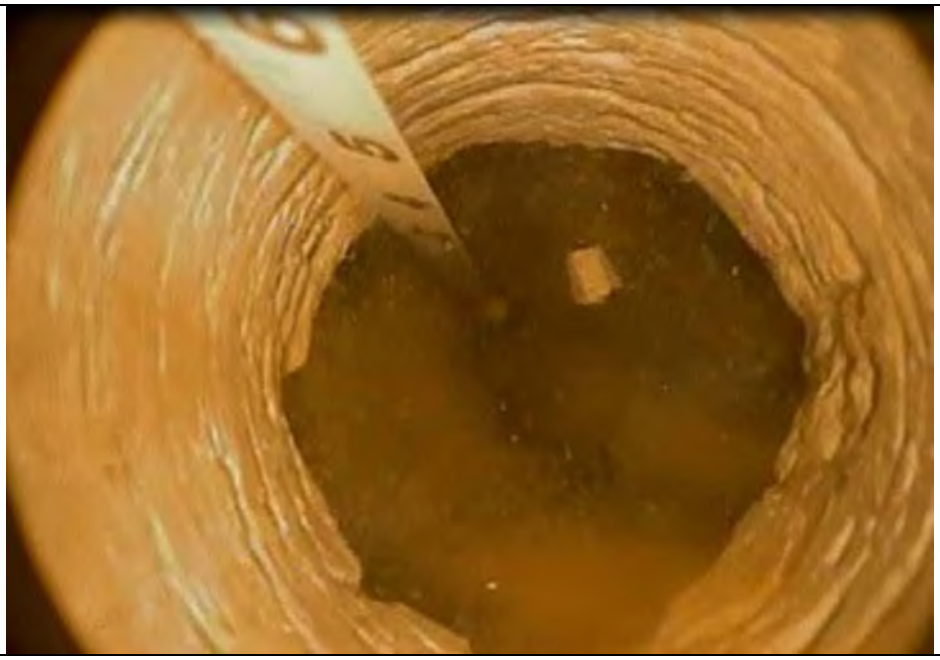
Photographs of Downhole Video Footage



GEO-021, 7:10
28 ft, Very broken rock with missing pieces, has back

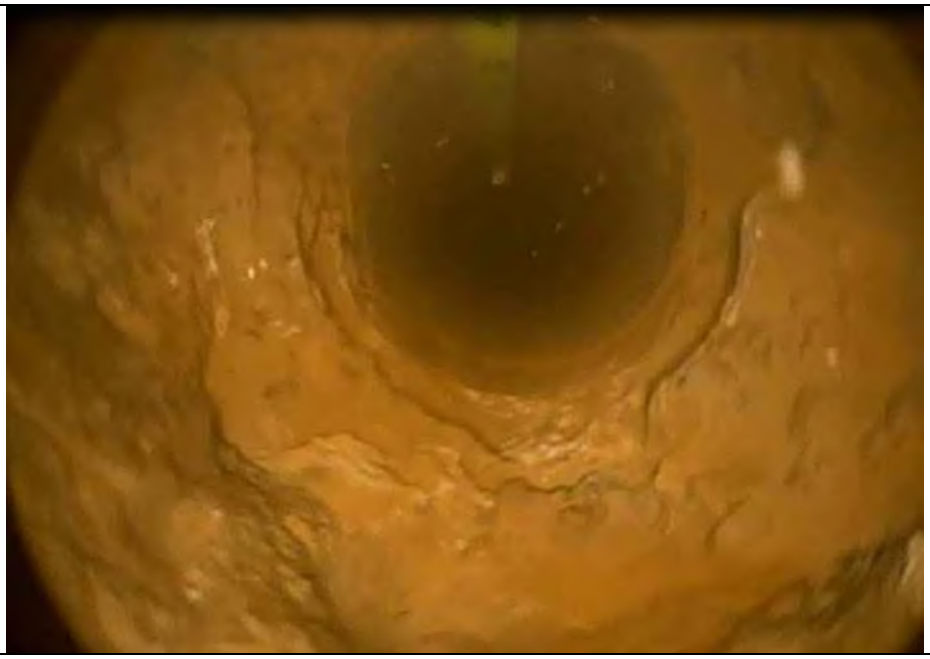
GEO-021, 7:52
30 ft, View of void observed during drilling, collapsed borehole

GEO-021, 10:21
31.5 ft, View of tubular opening, camera could not see end of tube

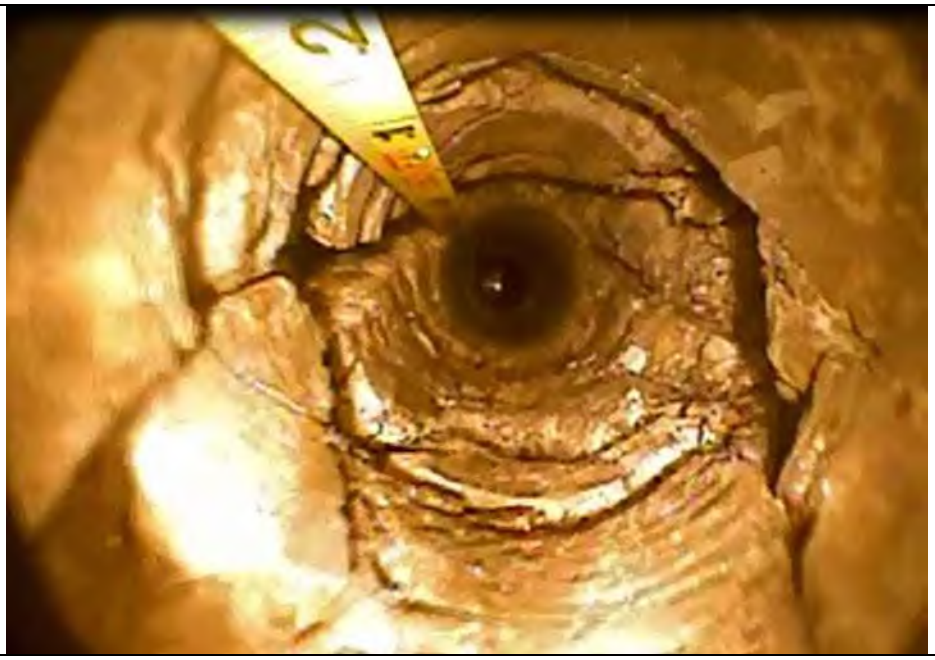


GEO-022, 2:16
26 ft, Large washout, had back

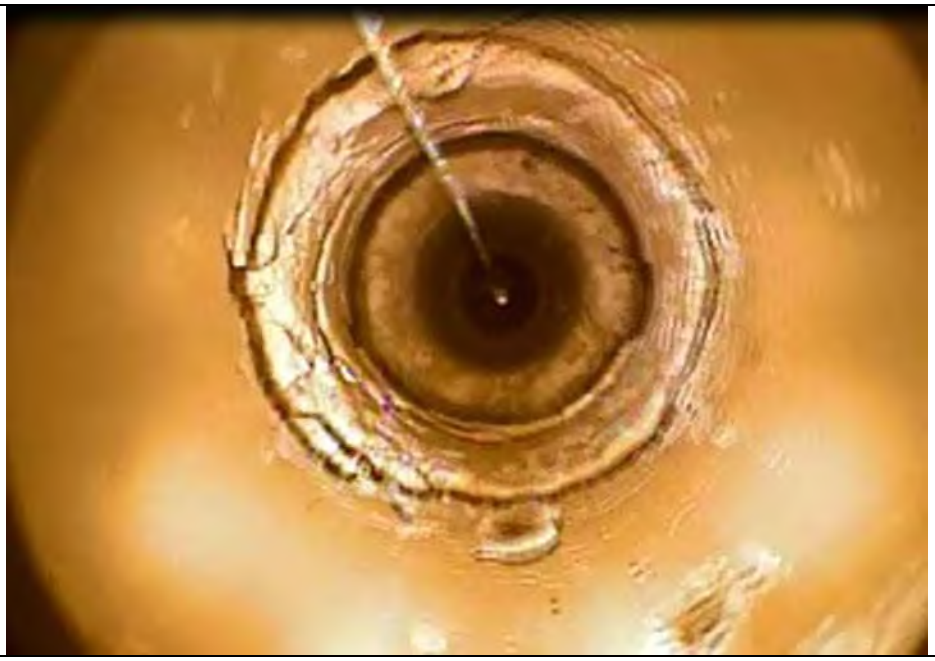
GEO-022, 3:14
37 ft, Large washout, had back



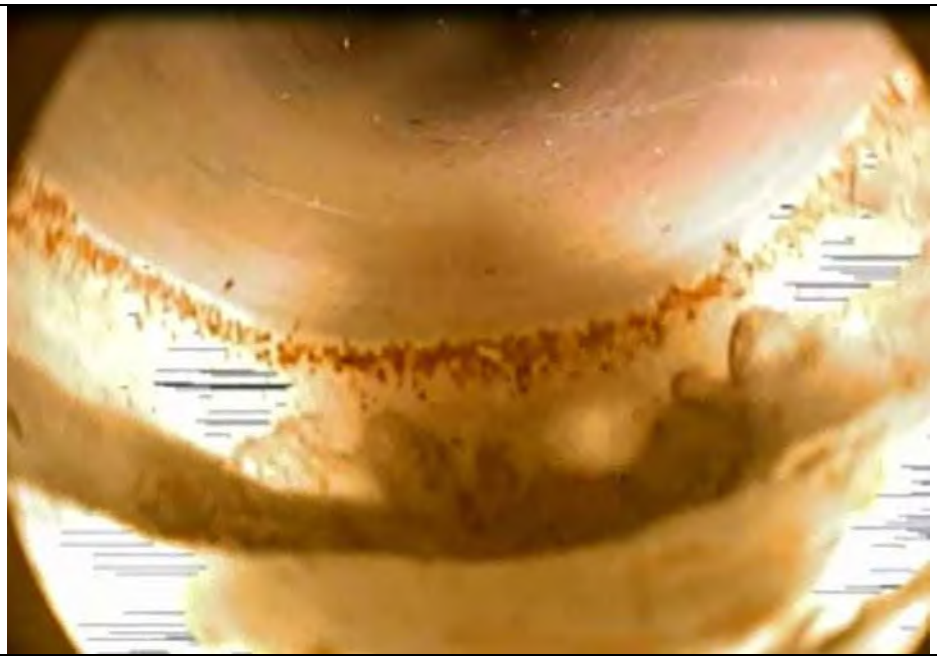
GEO-022, 4:31
40 ft, Large washout, view of sidewalls with back



GEO-028, 2:25
9.5 ft, Where water loss occurred. Highly fractured rock.

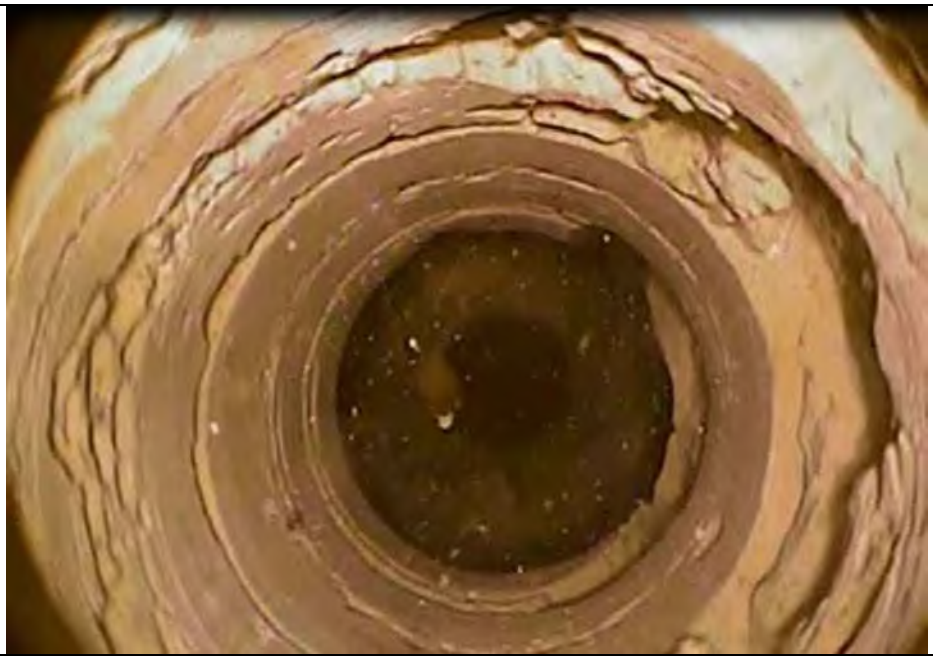


GEO-028, 3:36
15.5 ft, 3-inch opening, lots of gravel sized pieces within



GEO-008, 6:28
33 ft, View of thin opening in sidewall, had back

GEO-047, 4:20
Typical borehole in upper 40 feet. Fractures and small openings have backs



GEO-047, 13:05
58 ft, view of “void” noted on log

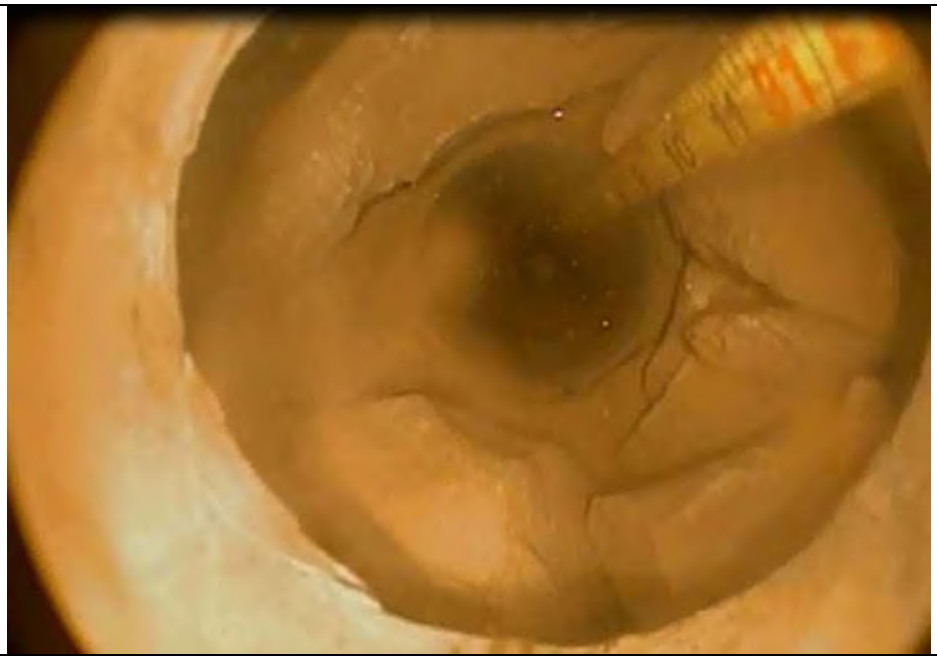
GEO-047, 13:50
58 ft, view of sidewall of “void”, rugged dissolution features, had back

GEO-048, 5:53
26 ft, typical open fracture, had back, several observed to 35 ft in this location

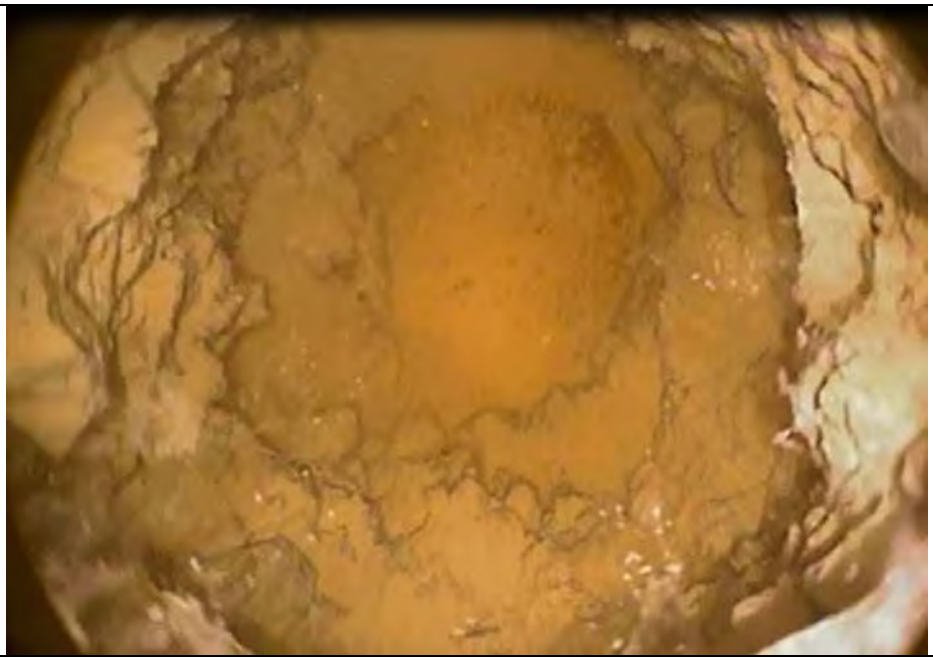
GEO-048, 13:44
45-46 ft, rugged borehole.

GEO-048, 19:37
58.5 ft, washout observed near depth where geotechnical log indicated, collection of rock debris at base of hole, possible small “void”

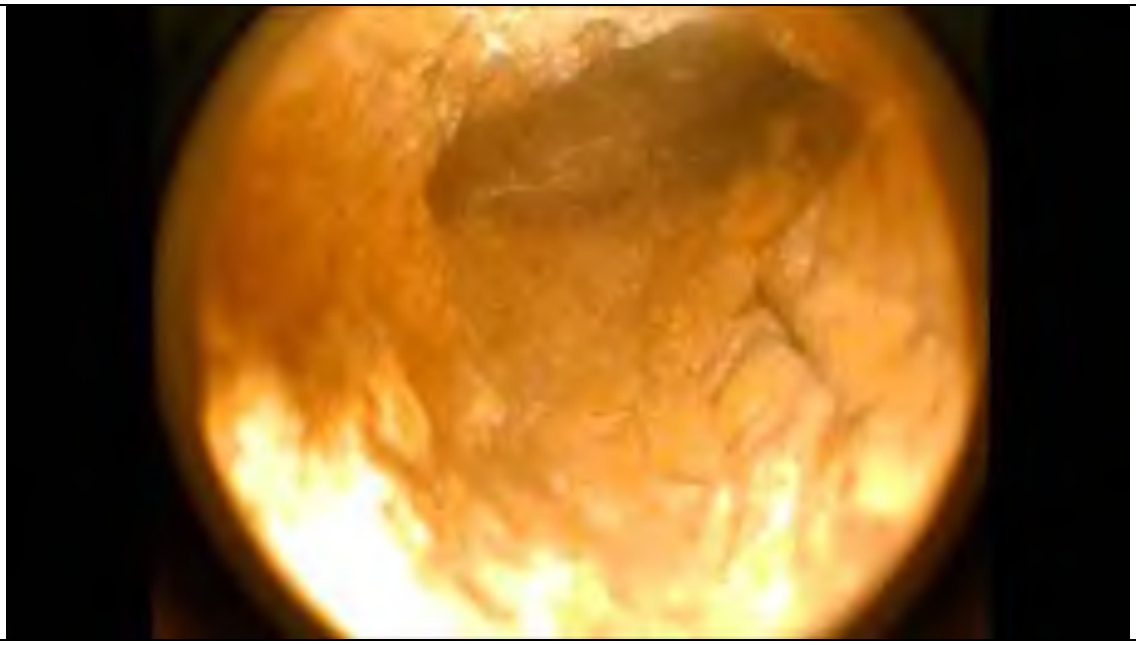
GEO-060, 2:20
15 ft, View of thin opening, note soil on bottom of opening, likely thin soil filled void



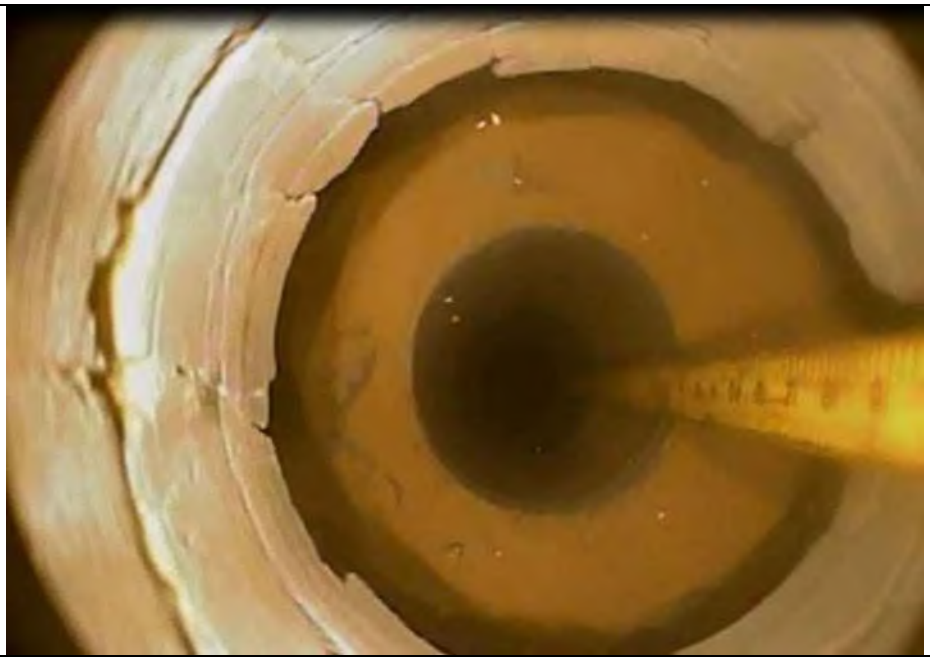
GEO-060, 6:43
25 ft, Collection of platy rock debris



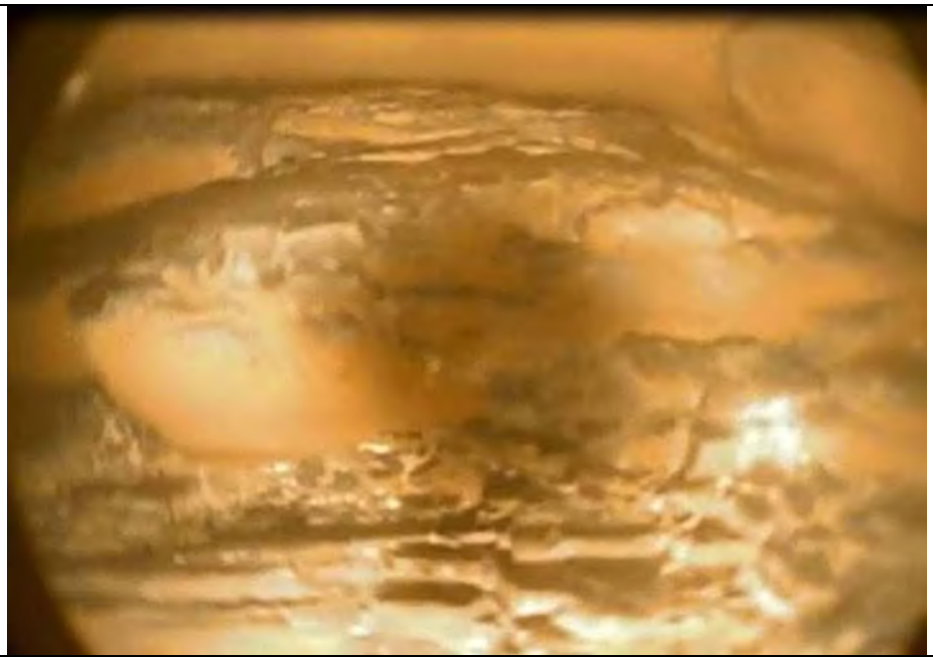
GEO-060, 12:56
58 ft, view of bottom of borehole where “voids” were noted, rugged dissolution features, had back



GEO-066, 7:27
31.5 ft, smaller void, 1” high, 2-3” deep. May be open on right side



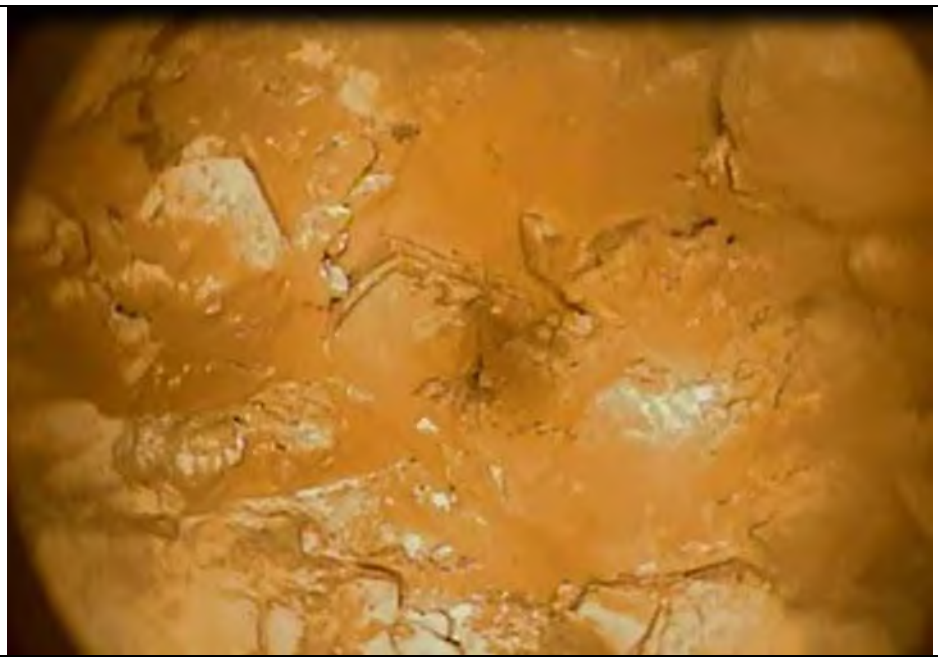
GEO-066, 4:35
19.5 ft, typical opening ranging from 2 to 4 inches, frequently observed in video from 10 to 40 feet



GEO-066, 23:22
19.5 ft, typical view looking in to openings, had back

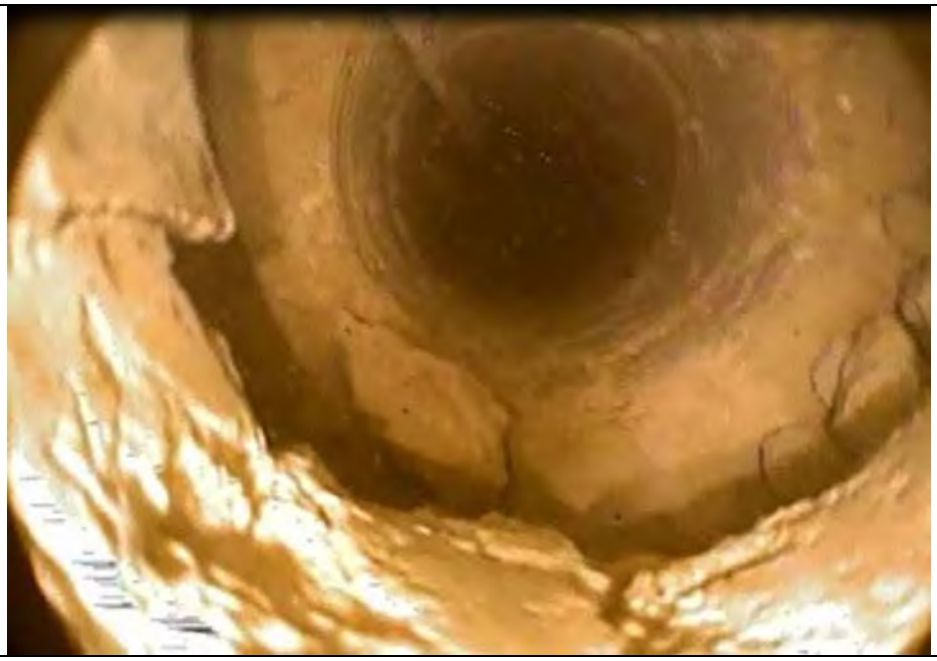
GEO-066, 8:16
31 ft, “void” identified in geotechnical boring

GEO-066, 12:28
42 ft, rugged borehole with large opening and missing pieces, dissolution features



GEO-066, 20:35
43 ft, view of sidewall of opening, had back

GEO-078, 6:41
36 ft, where circulation was lost during coring, too narrow to see into opening

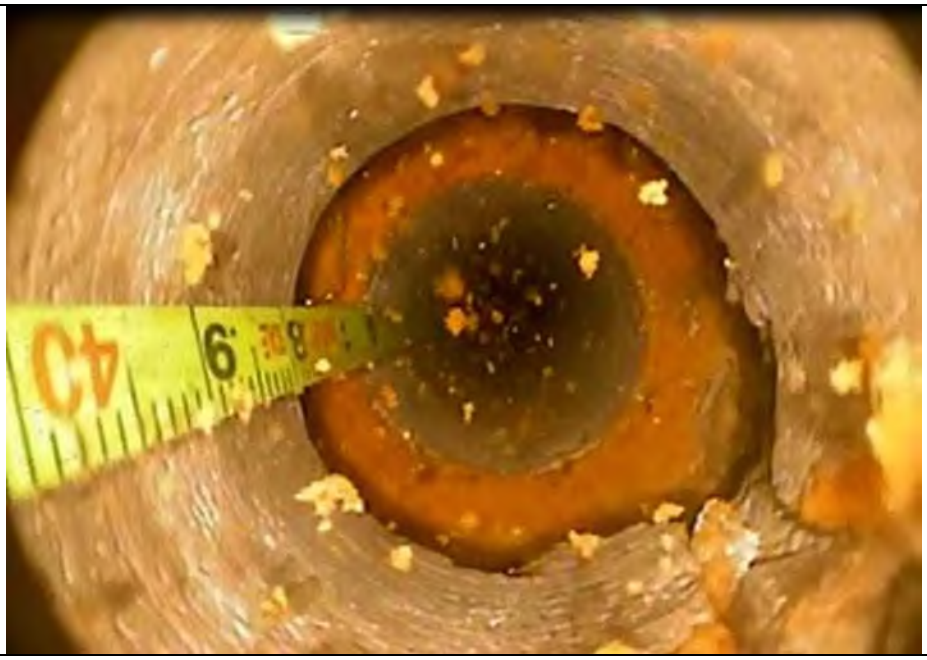


GEO-078, 4:17
18 ft, small opening with soil and gravel infill and missing pieces, had back

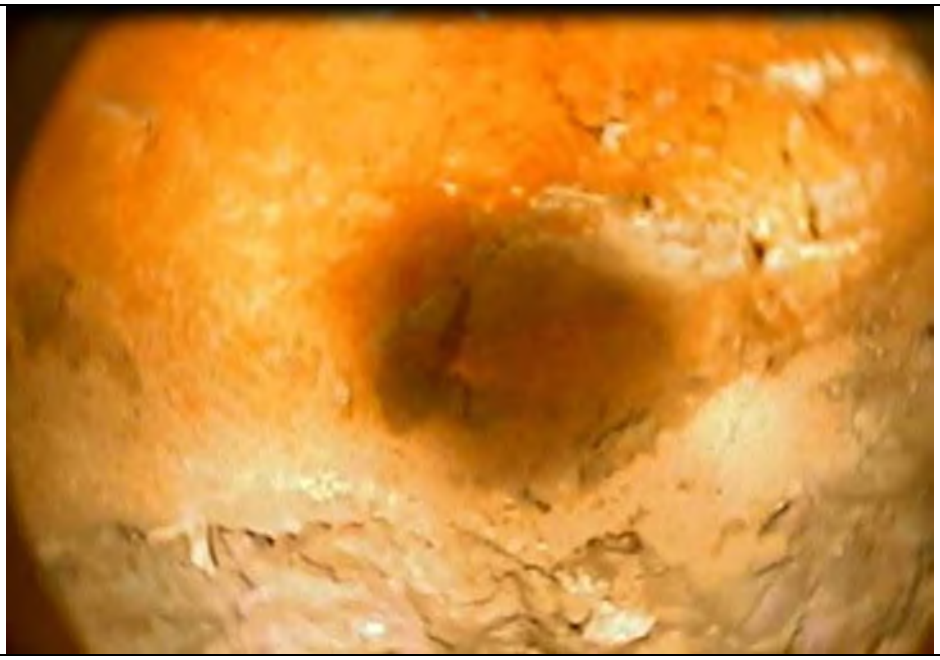
GEO-086, 2:04
11.5 ft, 2-inch opening

GEO-086, 3:21
15.5 ft, highly fractured, rugged borehole with pieces missing, near depth where drilling fluid circulation was lost

GEO-086, 9:46
38 ft, small opening, similar observed at 14 and 25 feet



GEO-096, 6:51
20.5 ft, small opening, similar observed at 16.5, 26, 28, 32.5, 43, 43.5, 44.5, 48, and 49.5 ft



GEO-096, 7:04
20.5 ft, view into opening, had back

GEO-096, 14:28
42.5 ft, near where drilling fluid circulation was lost, small opening with some missing limestone pieces

Appendix H

Further Analysis of Lower Strength Zones

Appendix H: Further Analysis of Lower Strength Zones

Further analysis of the following turbine locations was performed.

1.1.1 GEO-007

A slightly lower strength zone was identified from about 25 to 26.5 feet in the soil boring completed for investigated location GEO-007 through SPT testing. Further review of the soil boring indicates that the other SPT tests indicated that the undrained shear strength met the design value. The results of a laboratory unconfined compressive strength test indicated that the undrained shear strength just below the lower strength layer was approximately 2,800 psf, which meets the design value. The lower strength zone is anticipated to be relatively thin, and is not likely to lead to a bearing capacity failure. Therefore, no soil remediation is recommended at this location.

1.1.2 GEO-008

A slightly lower strength zone was identified from about 25 to 26.5 feet in the soil boring completed for investigated location GEO-008 through hand penetrometer testing. Further review of the soil boring indicates that the other SPT and hand penetrometer tests indicated that the undrained shear strength met the design value. The results of a laboratory unconfined compressive strength test indicated that the undrained shear strength just above the lower strength layer was approximately 2,200 psf, which meets the design value. The lower strength zone is anticipated to be relatively thin, and other measures of shear strength indicate that the strength will meet the design value, and is not likely to lead to a bearing capacity failure. Therefore, no soil remediation is recommended at this location.

1.1.3 GEO-009

A slightly lower strength zone was identified from about 30 to 31.5 feet in the soil boring completed for investigated location GEO-009 through hand penetrometer testing. Further review of the soil boring indicates that the other SPT and hand penetrometer tests indicated that the undrained shear strength met the design value. The results of a laboratory unconfined compressive strength test indicated that the undrained shear strength just above the lower strength layer was approximately 2,400 psf, which meets the design value. The lower strength zone is anticipated to be relatively thin, and other measures of shear strength indicate that the strength will meet the design value, and is not likely to lead to a bearing capacity failure. Therefore, no soil remediation is recommended at this location.

1.1.4 GEO-036

A slightly lower strength zone was identified from about 20 to 21.5 feet in the soil boring completed for investigated location GEO-036 through hand penetrometer testing. Further review of the soil boring indicates that the other SPT and hand penetrometer tests indicated that the undrained shear strength met the design value. The results of a laboratory unconfined compressive strength test indicated that the undrained shear strength just below the lower strength layer was approximately 2,100 psf, which meets the design value. The lower strength zone is anticipated to be relatively thin, and other measures of shear strength indicate that the strength will meet the design value, and is not likely to lead to a bearing capacity failure. Therefore, no soil remediation is recommended at this location.

1.1.5 GEO-042

A slightly lower strength zone was identified from about 30 to 37 feet in the soil boring completed for investigated location GEO-042 through SPT testing. Further review of the soil boring indicates that the other SPT tests indicated that the undrained shear strength met the design value. The results of a laboratory unconfined compressive strength test indicated that the undrained shear strength within the lower strength layer was approximately 1,800 psf, which meets the design value. The lower strength zone is anticipated to be relatively thin, and is not likely to lead to a bearing capacity failure. Therefore, no soil remediation is recommended at this location.

1.1.6 GEO-047

A slightly lower strength zone was identified from about 8 to 20.5 feet in the soil boring completed for investigated location GEO-047 through SPT testing. The results of the soil boring indicate that the sand in that interval is relatively loose, and may be subject to excessive settlement. Barr performed a settlement analysis, and the results indicate that the estimated settlement will be less than the typical threshold for industry standards. Therefore, no soil remediation is recommended at this location.

1.1.7 GEO-052

A slightly lower strength zone was identified from about 20 to 35 feet and 55 to 56.5 feet in the soil boring completed for investigated location GEO-052 through SPT testing. Further review of the soil boring indicates that the other SPT tests indicated that the undrained shear strength met the design value. The results of a laboratory unconfined compressive strength test indicated that the undrained shear strength within the lower strength layer was approximately 2,300 psf, which meets the design value. The lower strength zone at 55 feet is anticipated to be relatively thin and located well below the embedment depth of the foundation, and is not likely to lead to a bearing capacity failure. Therefore, no soil remediation is recommended at this location.

1.1.8 GEO-056

A slightly lower strength zone was identified from about 25 to 35 feet and 40 to 41.5 feet in the soil boring completed for investigated location GEO-056 through SPT testing and hand penetrometer testing. Further review of the soil boring indicates that the other SPT and hand penetrometer tests indicated that the undrained shear strength met the design value. The results of laboratory unconfined compressive strength tests indicated that the undrained shear strength within the lower strength layers ranged from approximately 1,700 to 2,900 psf, which meets the design value. Based on an overall consideration of the field and laboratory test results, no soil remediation is recommended at this location.

1.1.9 GEO-059

A slightly lower strength zone was identified from about 45 to 46.5 feet and 60 to 61.5 feet in the soil boring completed for investigated location GEO-059 through SPT testing. Further review of the soil boring indicates that the other SPT and hand penetrometer tests indicated that the undrained shear strength met the design value. The results of laboratory unconfined compressive strength tests indicated that the undrained shear strength within the lower strength layer was approximately 4,000 psf, which meets the

design value. The lower strength zones are anticipated to be relatively thin and located well below the embedment depth of the foundation, and is not likely to lead to a bearing capacity failure. Therefore, no soil remediation is recommended at this location.

1.1.10 GEO-062

A slightly lower strength zone was identified from about 40 to 41.5 feet in the soil boring completed for investigated location GEO-062 through hand penetrometer testing. Further review of the soil boring indicates that the other SPT and hand penetrometer tests indicated that the undrained shear strength met the design value. The lower strength zone is anticipated to be relatively thin, and other measures of shear strength indicate that the strength will meet the design value, and is not likely to lead to a bearing capacity failure. Therefore, no soil remediation is recommended at this location.

1.1.11 GEO-070

A slightly lower strength zone was identified from about 30 to 36.5 feet in the soil boring completed for investigated location GEO-070 through hand penetrometer testing. Further review of the soil boring indicates that the other SPT and hand penetrometer tests indicated that the undrained shear strength met the design value. The results of a laboratory unconfined compressive strength test indicated that the undrained shear strength just above the lower strength layer was approximately 2,200 psf, which meets the design value. The lower strength zone is anticipated to be relatively thin, and other measures of shear strength indicate that the strength will meet the design value, and is not likely to lead to a bearing capacity failure. Therefore, no soil remediation is recommended at this location.

1.1.12 GEO-077

A slightly lower strength zone was identified from about 20 to 21.5 feet and 40 to 41.5 feet in the soil boring completed for investigated location GEO-077 through SPT and hand penetrometer testing. Further review of the soil boring indicates that the other SPT and hand penetrometer tests indicated that the undrained shear strength met the design value. The results of a laboratory unconfined compressive strength test indicated that the undrained shear strength just below the lower strength layer at 20 feet was approximately 2,100 psf, which meets the design value. The lower strength zones are anticipated to be relatively thin, and other measures of shear strength indicate that the strength will meet the design value, and is not likely to lead to a bearing capacity failure. Therefore, no soil remediation is recommended at this location.

1.1.13 GEO-079

A slightly lower strength zone was identified from about 35 to 36.5 feet in the soil boring completed for investigated location GEO-079 through hand penetrometer testing. Further review of the soil boring indicates that the other SPT and hand penetrometer tests indicated that the undrained shear strength met the design value. The results of a laboratory unconfined compressive strength test indicated that the undrained shear strength within the lower strength layer was approximately 2,900 psf, which meets the design value. The lower strength zone is anticipated to be relatively thin, and other measures of shear

strength indicate that the strength will meet the design value, and is not likely to lead to a bearing capacity failure. Therefore, no soil remediation is recommended at this location.

1.1.14 GEO-082

A slightly lower strength zone was identified from about 20 to 21.5 feet in the soil boring completed for investigated location GEO-082 through hand penetrometer testing. Further review of the soil boring indicates that the other SPT and hand penetrometer tests indicated that the undrained shear strength met the design value. The lower strength zone is anticipated to be relatively thin, and other measures of shear strength indicate that the strength will meet the design value, and is not likely to lead to a bearing capacity failure. Therefore, no soil remediation is recommended at this location.

1.1.15 GEO-083

A slightly lower strength zone was identified from about 15 to 16.5 feet in the soil boring completed for investigated location GEO-083 through SPT testing. Further review of the soil boring indicates that the other SPT tests indicated that the undrained shear strength met the design value. The results of a laboratory unconfined compressive strength test indicated that the undrained shear strength just below the lower strength layer was approximately 2,300 psf, which meets the design value. The lower strength zone is anticipated to be relatively thin, and is not likely to lead to a bearing capacity failure. Therefore, no soil remediation is recommended at this location.

1.1.16 GEO-091

A slightly lower strength zone was identified from about 35 to 36.5 feet in the soil boring completed for investigated location GEO-091 through hand penetrometer testing. Further review of the soil boring indicates that the other SPT and hand penetrometer tests indicated that the undrained shear strength met the design value. The results of a laboratory unconfined compressive strength test indicated that the undrained shear strength just above the lower strength layer was approximately 3,700 psf, which meets the design value. The lower strength zone is anticipated to be relatively thin, and other measures of shear strength indicate that the strength will meet the design value, and is not likely to lead to a bearing capacity failure. Therefore, no soil remediation is recommended at this location.

1.1.17 GEO-092

A slightly lower strength zone was identified from about 45 to 46.5 feet in the soil boring completed for investigated location GEO-092 through hand penetrometer testing. Further review of the soil boring indicates that the other SPT and hand penetrometer tests indicated that the undrained shear strength met the design value. The results of a laboratory unconfined compressive strength test indicated that the undrained shear strength just below the lower strength layer was approximately 2,500 psf, which meets the design value. The lower strength zone is anticipated to be relatively thin, and other measures of shear strength indicate that the strength will meet the design value, and is not likely to lead to a bearing capacity failure. Therefore, no soil remediation is recommended at this location.

1.1.18 GEO-093

A slightly lower strength zone was identified from about 27 to 29 feet in the soil boring completed for investigated location GEO-092 through laboratory testing. Further review of the soil boring indicates that the other SPT and hand penetrometer tests indicated that the undrained shear strength met the design value. The results of a laboratory unconfined compressive strength test indicated that the undrained shear strength in that interval was approximately 1,000 psf, which does not meet the design value. Barr performed a two-layer bearing capacity analysis for the weaker soils, and determined that the resultant bearing capacity would meet the design value. Therefore, no soil remediation is recommended at this location.

Summary: Application Appendix H Part 2 electronically filed by Teresa Orahood on behalf of Dylan F. Borchers