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Generated Output

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OSHA CFR 29 1926.651 requires that the estimated location of underground utilities be determined before beginning the excavation or underground drilling operation. When the actual excavation or bore approaches an estimated utility location, the exact location of the underground installation must be determined by a safe, acceptable and dependable method. If the utility cannot be precisely located, it must be shut off by the utility company.

Input Summary

Start Coordinate	(130.00, 0.00, 157.20) ft
End Coordinate	(1014.10, 0.00, 158.50) ft
Project Length	884.10 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	2.375 in
Pipe DR	9.0
Pipe Thickness	0.26 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable Pipe Type: HDPE Classification: IPS Pipe OD: 2" (2.375") Pipe DR: 9 Pipe Length: 900.00 ft Internal Pressure: 0 psi Borehole Diameter: 0.531000018119812 ft Silo Width: 0.531000018119812 ft Surface Surcharge: 0 psi Short Term Modulus: 57500 psi Long Term Modulus: 28200 psi Short Term Poisson Ratio: 0.35 Long Term Poisson Ratio: 0.45 Pipe Unit Weight: 59.30500 lb/ft3 Allowable Tensile Stress (Short Term): 1200 psi Allowable Tensile Stress (Long Term): 1100 psi Allowable Compressive Stress (Short Term): 1150 psi Allowable Compressive Stress (Long Term): 1150 psi Surface-pipe friction coefficient at entrance: 0.5 Surface-pipe friction coefficient in borehole: 0.3 Pipe-soil friction angle: 30 Slurry Unit Weight: 93.64118 lb/ft3 Hydrokinetic Pressure: 10 psi Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	5.3	25.2
Water Pressure	0.4	0.4
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	5.6	25.6
Deflection		
Earth Load Deflection	1.434	6.870
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	1.463	6.900
Compressive Stress [psi]		
Compressive Wall Stress	25.3	115.1

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	857.6	857.6
Pullback Stress [psi]	490.0	490.0
Pullback Strain	8.522E-3	8.522E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	490.0	493.8
Tensile Strain	8.522E-3	8.687E-3

Net External Pressure = 21.6 [psi] Buoyant Deflection = 0.0 Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.463	7.5	5.1	OK
Unconstrained Collapse [psi]	23.7	121.1	5.1	OK
Compressive Wall Stress [psi]	25.3	1150.0	45.5	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	33.7	228.3	6.8	OK
Tensile Stress [psi]	493.8	1200.0	2.4	OK



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Project Summary

General:	CHPE HDD 25 Conduit 1		
	P3		
	Start Date: 12-10-2021		
	End Date: 12-10-2021		
Project Owner:	TDI		
Project Contractor:	Kiewit		
Designer:	AJB		
	СНА		
Description:	HDD 25 10-inch DR 9 Conduit 1		

Input Summary

Start Coordinate	(0.00, 0.00, 152.20) ft
End Coordinate	(1754.60, 0.00, 147.00) ft
Project Length	1754.60 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 6

Soil Layer #1 USCS, Sand (S), SP From Assistant Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3] Phi: 30.00, S.M.: 200.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Clay (C), CL From Assistant Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft3] Phi: 0.00, S.M.: 300.00, Coh: 7.30 [psi]

Soil Layer #3 USCS, Clay (C), CL From Assistant Unit Weight: 70.0000 (dry), 100.0000 (sat) [lb/ft3] Phi: 0.00, S.M.: 200.00, Coh: 7.30 [psi]

Soil Layer #4 USCS, Sand (S), SW From Assistant Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3] Phi: 34.00, S.M.: 500.00, Coh: 0.00 [psi]

Soil Layer #5 USCS, Sand (S), SW From Assistant Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3] Phi: 30.00, S.M.: 200.00, Coh: 0.00 [psi]

Soil Layer #6 Rock, Geological Classification, Sedimentary Rocks From Assistant Unit Weight: 107.8272 (dry), 177.6384 (sat) [lb/ft3] Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View







Load Verifier Input Summary:

Pipe Application: Electrical Cable Pipe Type: HDPE Classification: IPS Pipe OD: 10" (10.75") Pipe DR: 9 Pipe Length: 1785.00 ft Internal Pressure: 0 psi Borehole Diameter: 1.34400002161662 ft Silo Width: 1.34400002161662 ft Surface Surcharge: 0 psi Short Term Modulus: 57500 psi Long Term Modulus: 28200 psi Short Term Poisson Ratio: 0.35 Long Term Poisson Ratio: 0.45 Pipe Unit Weight: 59.30500 lb/ft3 Allowable Tensile Stress (Short Term): 1200 psi Allowable Tensile Stress (Long Term): 1100 psi Allowable Compressive Stress (Short Term): 1150 psi Allowable Compressive Stress (Long Term): 1150 psi Surface-pipe friction coefficient at entrance: 0.5 Surface-pipe friction coefficient in borehole: 0.3 Pipe-soil friction angle: 30 Slurry Unit Weight: 93.64118 lb/ft3 Hydrokinetic Pressure: 10 psi Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	11.9	24.7
Water Pressure	17.5	17.5
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	29.4	42.2
Deflection		
Earth Load Deflection	3.237	6.729
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	3.369	6.861
Compressive Stress [psi]		
Compressive Wall Stress	132.3	189.8

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	30380.6	30380.6
Pullback Stress [psi]	847.3	847.3
Pullback Strain	1.474E-2	1.474E-2
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	847.3	869.5
Tensile Strain	1.474E-2	1.557E-2

Net External Pressure = 38.4 [psi] Buoyant Deflection = 0.1 Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	3.369	7.5	2.2	OK
Unconstrained Collapse [psi]	44.0	102.2	2.3	OK
Compressive Wall Stress [psi]	132.3	1150.0	8.7	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	53.9	203.2	3.8	OK
Tensile Stress [psi]	869.5	1200.0	1.4	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	674.880 psi	1340.597 psi
1	8.00 in	12.00 in	674.785 psi	1340.444 psi
2	12.00 in	16.13 in	674.647 psi	1340.222 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 40.00 US (liquid) gallon/minDrill Fluid Density: 68.700 lb/ft3Rheological model: Bingham-PlasticPlastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 1202.0

Virtual Site



















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Input Summary

Start Coordinate	(0.00, 0.00, 152.20) ft
End Coordinate	(1754.60, 0.00, 147.00) ft
Project Length	1754.60 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	2.375 in
Pipe DR	9.0
Pipe Thickness	0.26 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable Pipe Type: HDPE Classification: IPS Pipe OD: 2" (2.375") Pipe DR: 9 Pipe Length: 1785.00 ft Internal Pressure: 0 psi Borehole Diameter: 0.531000018119812 ft Silo Width: 0.531000018119812 ft Surface Surcharge: 0 psi Short Term Modulus: 57500 psi Long Term Modulus: 28200 psi Short Term Poisson Ratio: 0.35 Long Term Poisson Ratio: 0.45 Pipe Unit Weight: 59.30500 lb/ft3 Allowable Tensile Stress (Short Term): 1200 psi Allowable Tensile Stress (Long Term): 1100 psi Allowable Compressive Stress (Short Term): 1150 psi Allowable Compressive Stress (Long Term): 1150 psi Surface-pipe friction coefficient at entrance: 0.5 Surface-pipe friction coefficient in borehole: 0.3 Pipe-soil friction angle: 30 Slurry Unit Weight: 93.64118 lb/ft3 Hydrokinetic Pressure: 10 psi Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	11.1	24.7
Water Pressure	17.5	17.5
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	28.6	42.2
Deflection		
Earth Load Deflection	3.018	6.729
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	3.047	6.758
Compressive Stress [psi]		
Compressive Wall Stress	128.7	189.8

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1592.5	1592.5
Pullback Stress [psi]	909.9	909.9
Pullback Strain	1.582E-2	1.582E-2
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	909.9	912.0
Tensile Strain	1.582E-2	1.596E-2

Net External Pressure = 38.4 [psi] Buoyant Deflection = 0.0 Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	3.047	7.5	2.5	OK
Unconstrained Collapse [psi]	44.0	105.1	2.4	OK
Compressive Wall Stress [psi]	128.7	1150.0	8.9	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	53.8	200.1	3.7	OK
Tensile Stress [psi]	912.0	1200.0	1.3	OK



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Project Summary

General:	CHPE HDD 25 Conduit 2	
	P3	
	Start Date: 12-10-2021	
	End Date: 12-10-2021	
Project Owner:	TDI	
Project Contractor:	Kiewit	
Project Consultant:	CHA/BCE	
Designer:	AB	
	СНА	
Description:	HDD 25 10-inch DR 9 Conduit 2	

Input Summary

Start Coordinate	(0.00, 0.00, 151.50) ft
End Coordinate	(1720.00, 0.00, 144.50) ft
Project Length	1720.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 6

Soil Layer #1 USCS, Sand (S), SP From Assistant Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3] Phi: 30.00, S.M.: 200.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Clay (C), CL From Assistant Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft3] Phi: 0.00, S.M.: 300.00, Coh: 7.30 [psi]

Soil Layer #3 USCS, Clay (C), CL From Assistant Unit Weight: 70.0000 (dry), 100.0000 (sat) [lb/ft3] Phi: 0.00, S.M.: 200.00, Coh: 7.30 [psi]

Soil Layer #4 USCS, Sand (S), SW From Assistant Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3] Phi: 34.00, S.M.: 500.00, Coh: 0.00 [psi]

Soil Layer #5 USCS, Sand (S), SW From Assistant Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3] Phi: 30.00, S.M.: 200.00, Coh: 0.00 [psi]

Soil Layer #6 Rock, Geological Classification, Sedimentary Rocks From Assistant Unit Weight: 107.8272 (dry), 177.6384 (sat) [lb/ft3] Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View






Load Verifier Input Summary:

Pipe Application: Electrical Cable Pipe Type: HDPE Classification: IPS Pipe OD: 10" (10.75") Pipe DR: 9 Pipe Length: 1740.00 ft Internal Pressure: 0 psi Borehole Diameter: 1.34400002161662 ft Silo Width: 1.34400002161662 ft Surface Surcharge: 0 psi Short Term Modulus: 57500 psi Long Term Modulus: 28200 psi Short Term Poisson Ratio: 0.35 Long Term Poisson Ratio: 0.45 Pipe Unit Weight: 59.30500 lb/ft3 Allowable Tensile Stress (Short Term): 1200 psi Allowable Tensile Stress (Long Term): 1100 psi Allowable Compressive Stress (Short Term): 1150 psi Allowable Compressive Stress (Long Term): 1150 psi Surface-pipe friction coefficient at entrance: 0.5 Surface-pipe friction coefficient in borehole: 0.3 Pipe-soil friction angle: 30 Slurry Unit Weight: 93.64118 lb/ft3 Hydrokinetic Pressure: 10 psi Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	7.1	29.2
Water Pressure	17.8	17.4
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	24.9	46.6
Deflection		
Earth Load Deflection	1.941	8.051
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	2.073	8.183
Compressive Stress [psi]		
Compressive Wall Stress	112.2	209.6

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	29462.3	29462.3
Pullback Stress [psi]	821.7	821.7
Pullback Strain	1.429E-2	1.429E-2
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	821.7	844.0
Tensile Strain	1.429E-2	1.513E-2

Net External Pressure = 38.4 [psi] Buoyant Deflection = 0.1 Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.073	7.5	3.6	OK
Unconstrained Collapse [psi]	44.0	114.7	2.6	OK
Compressive Wall Stress [psi]	112.2	1150.0	10.2	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	53.9	205.0	3.8	OK
Tensile Stress [psi]	844.0	1200.0	1.4	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	546.811 psi	1344.285 psi
1	8.00 in	12.00 in	546.765 psi	1344.171 psi
2	12.00 in	16.13 in	546.697 psi	1344.006 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 40.00 US (liquid) gallon/min
Drill Fluid Density: 68.700 lb/ft3
Rheological model: Bingham-Plastic
Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 1202.0

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Input Summary

Start Coordinate	(0.00, 0.00, 151.50) ft
End Coordinate	(1720.00, 0.00, 144.50) ft
Project Length	1720.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	2.375 in
Pipe DR	9.0
Pipe Thickness	0.26 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable Pipe Type: HDPE Classification: IPS Pipe OD: 2" (2.375") Pipe DR: 9 Pipe Length: 1740.00 ft Internal Pressure: 0 psi Borehole Diameter: 0.531000018119812 ft Silo Width: 0.531000018119812 ft Surface Surcharge: 0 psi Short Term Modulus: 57500 psi Long Term Modulus: 28200 psi Short Term Poisson Ratio: 0.35 Long Term Poisson Ratio: 0.45 Pipe Unit Weight: 59.30500 lb/ft3 Allowable Tensile Stress (Short Term): 1200 psi Allowable Tensile Stress (Long Term): 1100 psi Allowable Compressive Stress (Short Term): 1150 psi Allowable Compressive Stress (Long Term): 1150 psi Surface-pipe friction coefficient at entrance: 0.5 Surface-pipe friction coefficient in borehole: 0.3 Pipe-soil friction angle: 30 Slurry Unit Weight: 93.64118 lb/ft3 Hydrokinetic Pressure: 10 psi Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	3.1	29.2
Water Pressure	17.8	17.4
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	20.9	46.6
Deflection		
Earth Load Deflection	0.833	8.051
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.862	8.080
Compressive Stress [psi]		
Compressive Wall Stress	93.9	209.6

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1547.7	1547.7
Pullback Stress [psi]	884.3	884.3
Pullback Strain	1.538E-2	1.538E-2
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	884.3	886.6
Tensile Strain	1.538E-2	1.552E-2

Net External Pressure = 38.4 [psi] Buoyant Deflection = 0.0 Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.862	7.5	8.7	OK
Unconstrained Collapse [psi]	44.0	127.8	2.9	OK
Compressive Wall Stress [psi]	93.9	1150.0	12.2	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	53.9	202.5	3.8	OK
Tensile Stress [psi]	886.6	1200.0	1.4	OK



Generated Output

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Project Summary

General:	CHPE HDD 25A Conduit 1
	P3
	Start Date: 12-10-2021
	End Date: 12-10-2021
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	AJB
	СНА
Description:	HDD 25A 10-inch DR 9 Conduit 1

Input Summary

Start Coordinate	(0.00, 0.00, 141.93) ft
End Coordinate	(762.06, 0.00, 143.70) ft
Project Length	762.06 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 6

Soil Layer #1 USCS, Sand (S), SW Depth: 6.00 ft Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3] Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Clay (C), CL Depth: 4.00 ft Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft3] Phi: 0.00, S.M.: 145.00, Coh: 5.56 [psi]

Soil Layer #3 USCS, Silt (M), ML Depth: 2.00 ft Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft3] Phi: 0.00, S.M.: 145.00, Coh: 5.56 [psi]

Soil Layer #4 USCS, Sand (S), SM Depth: 9.00 ft Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3] Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #5 USCS, Sand (S), SC Depth: 6.00 ft Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3] Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #6 Rock, Geological Classification, Sedimentary Rocks Depth: 17.00 ft Unit Weight: 107.8272 (dry), 177.6384 (sat) [lb/ft3] Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]









Load Verifier Input Summary:

Pipe Application: Electrical Cable Pipe Type: HDPE Classification: IPS Pipe OD: 10" (10.75") Pipe DR: 9 Pipe Length: 780.00 ft Internal Pressure: 0 psi Borehole Diameter: 1.34400002161662 ft Silo Width: 1.34400002161662 ft Surface Surcharge: 0 psi Short Term Modulus: 57500 psi Long Term Modulus: 28200 psi Short Term Poisson Ratio: 0.35 Long Term Poisson Ratio: 0.45 Pipe Unit Weight: 59.30500 lb/ft3 Allowable Tensile Stress (Short Term): 1200 psi Allowable Tensile Stress (Long Term): 1100 psi Allowable Compressive Stress (Short Term): 1150 psi Allowable Compressive Stress (Long Term): 1150 psi Surface-pipe friction coefficient at entrance: 0.5 Surface-pipe friction coefficient in borehole: 0.3 Pipe-soil friction angle: 30 Slurry Unit Weight: 93.64118 lb/ft3 Hydrokinetic Pressure: 10 psi Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	4.4	28.0
Water Pressure	10.0	9.9
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	14.4	38.0
Deflection		
Earth Load Deflection	1.217	7.639
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.349	7.771
Compressive Stress [psi]		
Compressive Wall Stress	65.0	170.9

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	13451.5	13451.5
Pullback Stress [psi]	375.1	375.1
Pullback Strain	6.524E-3	6.524E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	375.1	399.6
Tensile Strain	6.524E-3	7.398E-3

Net External Pressure = 20.3 [psi] Buoyant Deflection = 0.1 Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.349	7.5	5.6	OK
Unconstrained Collapse [psi]	24.5	122.5	5.0	OK
Compressive Wall Stress [psi]	65.0	1150.0	17.7	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	34.5	233.4	6.8	OK
Tensile Stress [psi]	399.6	1200.0	3.0	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	531.544 psi	1335.839 psi
1	8.00 in	12.00 in	531.291 psi	1335.667 psi
2	12.00 in	16.13 in	530.925 psi	1335.418 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 40.00 US (liquid) gallon/minDrill Fluid Density: 68.700 lb/ft3Rheological model: Bingham-PlasticPlastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 1202.0

Virtual Site





















Generated Output

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Input Summary

Start Coordinate	(0.00, 0.00, 141.93) ft
End Coordinate	(762.06, 0.00, 143.70) ft
Project Length	762.06 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	2.375 in
Pipe DR	9.0
Pipe Thickness	0.26 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable Pipe Type: HDPE Classification: IPS Pipe OD: 2" (2.375") Pipe DR: 9 Pipe Length: 780.00 ft Internal Pressure: 0 psi Borehole Diameter: 0.531000018119812 ft Silo Width: 0.531000018119812 ft Surface Surcharge: 0 psi Short Term Modulus: 57500 psi Long Term Modulus: 28200 psi Short Term Poisson Ratio: 0.35 Long Term Poisson Ratio: 0.45 Pipe Unit Weight: 59.30500 lb/ft3 Allowable Tensile Stress (Short Term): 1200 psi Allowable Tensile Stress (Long Term): 1100 psi Allowable Compressive Stress (Short Term): 1150 psi Allowable Compressive Stress (Long Term): 1150 psi Surface-pipe friction coefficient at entrance: 0.5 Surface-pipe friction coefficient in borehole: 0.3 Pipe-soil friction angle: 30 Slurry Unit Weight: 93.64118 lb/ft3 Hydrokinetic Pressure: 10 psi Ballast Unit Weight: 62.42746 lb/ft3
In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	1.8	28.0
Water Pressure	10.0	9.9
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	11.8	38.0
Deflection		
Earth Load Deflection	0.558	7.639
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.588	7.668
Compressive Stress [psi]		
Compressive Wall Stress	52.9	170.9

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	766.2	766.2
Pullback Stress [psi]	437.8	437.8
Pullback Strain	7.613E-3	7.613E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	437.8	442.2
Tensile Strain	7.613E-3	7.789E-3

Net External Pressure = 20.3 [psi] Buoyant Deflection = 0.0 Hydrokinetic Force = 137.3 lb

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In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.588	7.5	12.8	OK
Unconstrained Collapse [psi]	24.5	132.0	5.4	OK
Compressive Wall Stress [psi]	52.9	1150.0	21.7	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	34.5	231.7	6.7	OK
Tensile Stress [psi]	442.2	1200.0	2.7	OK



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Project Summary

General:	CHPE HDD 25A Conduit 2
	Р3
	Start Date: 12-10-2021
	End Date: 12-10-2021
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	AB
	СНА
Description:	HDD 25A 10-inch DR 9 Conduit 2

Input Summary

Start Coordinate	(0.00, 0.00, 144.00) ft
End Coordinate	(762.06, 0.00, 143.70) ft
Project Length	762.06 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 6

Soil Layer #1 USCS, Sand (S), SW Depth: 6.00 ft Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3] Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Clay (C), CL Depth: 4.00 ft Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft3] Phi: 0.00, S.M.: 145.00, Coh: 5.56 [psi]

Soil Layer #3 USCS, Silt (M), ML Depth: 2.00 ft Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft3] Phi: 0.00, S.M.: 145.00, Coh: 5.56 [psi]

Soil Layer #4 USCS, Sand (S), SM Depth: 9.00 ft Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3] Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #5 USCS, Sand (S), SC Depth: 6.00 ft Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3] Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #6 Rock, Geological Classification, Sedimentary Rocks Depth: 17.00 ft Unit Weight: 107.8272 (dry), 177.6384 (sat) [lb/ft3] Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]









Load Verifier Input Summary:

Pipe Application: Electrical Cable Pipe Type: HDPE Classification: IPS Pipe OD: 10" (10.75") Pipe DR: 9 Pipe Length: 780.00 ft Internal Pressure: 0 psi Borehole Diameter: 1.34400002161662 ft Silo Width: 1.34400002161662 ft Surface Surcharge: 0 psi Short Term Modulus: 57500 psi Long Term Modulus: 28200 psi Short Term Poisson Ratio: 0.35 Long Term Poisson Ratio: 0.45 Pipe Unit Weight: 59.30500 lb/ft3 Allowable Tensile Stress (Short Term): 1200 psi Allowable Tensile Stress (Long Term): 1100 psi Allowable Compressive Stress (Short Term): 1150 psi Allowable Compressive Stress (Long Term): 1150 psi Surface-pipe friction coefficient at entrance: 0.5 Surface-pipe friction coefficient in borehole: 0.3 Pipe-soil friction angle: 30 Slurry Unit Weight: 93.64118 lb/ft3 Hydrokinetic Pressure: 10 psi Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	4.6	29.2
Water Pressure	10.7	10.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	15.3	39.9
Deflection		
Earth Load Deflection	1.253	7.961
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.385	8.093
Compressive Stress [psi]		
Compressive Wall Stress	68.7	179.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	13411.9	13411.9
Pullback Stress [psi]	374.0	374.0
Pullback Strain	6.505E-3	6.505E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	374.0	399.5
Tensile Strain	6.505E-3	7.397E-3

Net External Pressure = 22.6 [psi] Buoyant Deflection = 0.1 Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.385	7.5	5.4	OK
Unconstrained Collapse [psi]	26.2	122.1	4.7	OK
Compressive Wall Stress [psi]	68.7	1150.0	16.7	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	36.2	233.5	6.5	OK
Tensile Stress [psi]	399.5	1200.0	3.0	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	676.687 psi	1337.536 psi
1	8.00 in	12.00 in	676.406 psi	1337.367 psi
2	12.00 in	16.13 in	675.999 psi	1337.122 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 40.00 US (liquid) gallon/minDrill Fluid Density: 68.700 lb/ft3Rheological model: Bingham-PlasticPlastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 1202.0

Virtual Site



















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Input Summary

Start Coordinate	(0.00, 0.00, 144.00) ft
End Coordinate	(762.06, 0.00, 143.70) ft
Project Length	762.06 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	2.375 in
Pipe DR	9.0
Pipe Thickness	0.26 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable Pipe Type: HDPE Classification: IPS Pipe OD: 2" (2.375") Pipe DR: 9 Pipe Length: 780.00 ft Internal Pressure: 0 psi Borehole Diameter: 0.531000018119812 ft Silo Width: 0.531000018119812 ft Surface Surcharge: 0 psi Short Term Modulus: 57500 psi Long Term Modulus: 28200 psi Short Term Poisson Ratio: 0.35 Long Term Poisson Ratio: 0.45 Pipe Unit Weight: 59.30500 lb/ft3 Allowable Tensile Stress (Short Term): 1200 psi Allowable Tensile Stress (Long Term): 1100 psi Allowable Compressive Stress (Short Term): 1150 psi Allowable Compressive Stress (Long Term): 1150 psi Surface-pipe friction coefficient at entrance: 0.5 Surface-pipe friction coefficient in borehole: 0.3 Pipe-soil friction angle: 30 Slurry Unit Weight: 93.64118 lb/ft3 Hydrokinetic Pressure: 10 psi Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	1.8	29.2
Water Pressure	10.7	10.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	12.5	39.9
Deflection		
Earth Load Deflection	0.579	7.961
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.608	7.990
Compressive Stress [psi]		
Compressive Wall Stress	56.3	179.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	764.2	764.2
Pullback Stress [psi]	436.7	436.7
Pullback Strain	7.594E-3	7.594E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	436.7	442.1
Tensile Strain	7.594E-3	7.788E-3

Net External Pressure = 22.6 [psi] Buoyant Deflection = 0.0 Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.608	7.5	12.3	OK
Unconstrained Collapse [psi]	26.2	131.8	5.0	OK
Compressive Wall Stress [psi]	56.3	1150.0	20.4	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	36.2	231.7	6.4	OK
Tensile Stress [psi]	442.1	1200.0	2.7	OK



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Project Summary

General:	CHPE HDD 26
	J2105
	Start Date: 06-30-2022
	End Date: 06-30-2022
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA-BCE
Designer:	MDB
	BCE
	Amherst, MA
Description:	North to South 10" DR 9

Input Summary

Start Coordinate	(0.00, 0.00, 147.00) ft
End Coordinate	(2050.00, 0.00, 156.00) ft
Project Length	2050.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 4

Soil Layer #1 USCS, Sand (S), SW From Assistant Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3] Phi: 30.00, S.M.: 200.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Clay (C), CH From Assistant Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft3] Phi: 0.00, S.M.: 300.00, Coh: 5.50 [psi]

Soil Layer #3 USCS, Gravel (G), GW From Assistant Unit Weight: 120.0000 (dry), 140.0000 (sat) [lb/ft3] Phi: 37.00, S.M.: 500.00, Coh: 0.00 [psi]

Soil Layer #4 Rock, Geological Classification, Sedimentary Rocks From Assistant Unit Weight: 107.8272 (dry), 177.6384 (sat) [lb/ft3] Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



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Load Verifier Input Summary:

Pipe Application: Electrical Cable Pipe Type: HDPE Classification: IPS Pipe OD: 10" (10.75") Pipe DR: 9 Pipe Length: 2024.99 ft Internal Pressure: 0 psi Borehole Diameter: 1.34400002161662 ft Silo Width: 1.34400002161662 ft Surface Surcharge: 0 psi Short Term Modulus: 57500 psi Long Term Modulus: 28200 psi Short Term Poisson Ratio: 0.35 Long Term Poisson Ratio: 0.45 Pipe Unit Weight: 59.30500 lb/ft3 Allowable Tensile Stress (Short Term): 1200 psi Allowable Tensile Stress (Long Term): 1100 psi Allowable Compressive Stress (Short Term): 1150 psi Allowable Compressive Stress (Long Term): 1150 psi Surface-pipe friction coefficient at entrance: 0.5 Surface-pipe friction coefficient in borehole: 0.3 Pipe-soil friction angle: 30 Slurry Unit Weight: 93.64118 lb/ft3 Hydrokinetic Pressure: 10 psi Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	4.5	21.3
Water Pressure	13.2	13.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	17.7	34.4
Deflection		
Earth Load Deflection	1.737	5.793
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.869	5.925
Compressive Stress [psi]		
Compressive Wall Stress	79.7	155.0

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	36741.5	36741.5
Pullback Stress [psi]	1024.7	1024.7
Pullback Strain	1.782E-2	1.782E-2
Bending Stress [psi]	0.0	21.5
Bending Strain	0	3.733E-4
Tensile Stress [psi]	1024.7	1037.7
Tensile Strain	1.782E-2	1.833E-2

Net External Pressure = 31.5 [psi] Buoyant Deflection = 0.1 Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.869	7.5	4.0	OK
Unconstrained Collapse [psi]	32.5	121.0	3.7	OK
Compressive Wall Stress [psi]	79.7	1150.0	14.4	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	42.4	187.7	4.4	OK
Tensile Stress [psi]	1037.7	1200.0	1.2	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	875.909 psi	1333.356 psi
1	8.00 in	12.00 in	875.558 psi	1333.088 psi
2	12.00 in	16.13 in	875.048 psi	1332.698 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 40.00 US (liquid) gallon/min Drill Fluid Density: 68.700 lb/ft3 Rheological model: Power-Law

Fluid Consistency Index (K): 63.17

Power Law Exponent (n): 0.14

Effective Viscosity (cP): 859.3

Virtual Site




















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Input Summary

Start Coordinate	(0.00, 0.00, 147.00) ft
End Coordinate	(2050.00, 0.00, 156.00) ft
Project Length	2050.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	2.375 in
Pipe DR	9.0
Pipe Thickness	0.26 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable Pipe Type: HDPE Classification: IPS Pipe OD: 2" (2.375") Pipe DR: 9 Pipe Length: 2024.99 ft Internal Pressure: 0 psi Borehole Diameter: 0.531000018119812 ft Silo Width: 0.531000018119812 ft Surface Surcharge: 0 psi Short Term Modulus: 57500 psi Long Term Modulus: 28200 psi Short Term Poisson Ratio: 0.35 Long Term Poisson Ratio: 0.45 Pipe Unit Weight: 59.30500 lb/ft3 Allowable Tensile Stress (Short Term): 1200 psi Allowable Tensile Stress (Long Term): 1100 psi Allowable Compressive Stress (Short Term): 1150 psi Allowable Compressive Stress (Long Term): 1150 psi Surface-pipe friction coefficient at entrance: 0.5 Surface-pipe friction coefficient in borehole: 0.3 Pipe-soil friction angle: 30 Slurry Unit Weight: 93.64118 lb/ft3 Hydrokinetic Pressure: 10 psi Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	1.8	21.3
Water Pressure	13.2	13.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	15.0	34.4
Deflection		
Earth Load Deflection	0.902	5.793
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.931	5.822
Compressive Stress [psi]		
Compressive Wall Stress	67.4	155.0

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1902.9	1902.9
Pullback Stress [psi]	1087.3	1087.3
Pullback Strain	1.891E-2	1.891E-2
Bending Stress [psi]	0.0	4.7
Bending Strain	0	8.247E-5
Tensile Stress [psi]	1087.3	1087.8
Tensile Strain	1.891E-2	1.898E-2

Net External Pressure = 31.5 [psi] Buoyant Deflection = 0.0 Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.931	7.5	8.1	OK
Unconstrained Collapse [psi]	32.5	131.1	4.0	OK
Compressive Wall Stress [psi]	67.4	1150.0	17.1	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	42.4	184.2	4.3	OK
Tensile Stress [psi]	1087.8	1200.0	1.1	OK



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Project Summary

General:	CHPE HDD 27
	P3
	Start Date: 08-25-2022
	End Date: 08-25-2022
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	MB
	BCE
Description:	HDD 27 10-inch DR 9

Input Summary

Start Coordinate	(0.00, 0.00, 154.00) ft
End Coordinate	(1087.00, 0.00, 155.00) ft
Project Length	1087.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 4

Soil Layer #1 USCS, Sand (S), SW From Assistant Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3] Phi: 30.00, S.M.: 200.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Clay (C), CL From Assistant Unit Weight: 100.0000 (dry), 120.0000 (sat) [lb/ft3] Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Soil Layer #3 USCS, Sand (S), SW From Assistant Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3] Phi: 30.00, S.M.: 200.00, Coh: 0.00 [psi]

Soil Layer #4 USCS, Clay (C), CH From Assistant Unit Weight: 70.0000 (dry), 100.0000 (sat) [lb/ft3] Phi: 0.00, S.M.: 200.00, Coh: 3.13 [psi]

Bore Cross-Section View







Load Verifier Input Summary:

Pipe Application: Gas Pipe Type: HDPE Classification: IPS Pipe OD: 10" (10.75") Pipe DR: 9 Pipe Length: 1110.00 ft Internal Pressure: 0 psi Borehole Diameter: 1.34400002161662 ft Silo Width: 1.34400002161662 ft Surface Surcharge: 0 psi Short Term Modulus: 57500 psi Long Term Modulus: 28200 psi Short Term Poisson Ratio: 0.35 Long Term Poisson Ratio: 0.45 Pipe Unit Weight: 59.30500 lb/ft3 Allowable Tensile Stress (Short Term): 1200 psi Allowable Tensile Stress (Long Term): 1100 psi Allowable Compressive Stress (Short Term): 1150 psi Allowable Compressive Stress (Long Term): 1150 psi Surface-pipe friction coefficient at entrance: 0.5 Surface-pipe friction coefficient in borehole: 0.3 Pipe-soil friction angle: 30 Slurry Unit Weight: 93.64118 lb/ft3 Hydrokinetic Pressure: 10 psi Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	6.7	34.6
Water Pressure	17.4	17.4
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	24.0	52.0
Deflection		
Earth Load Deflection	1.811	9.420
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.943	9.552
Compressive Stress [psi]		
Compressive Wall Stress	108.2	233.9

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	19992.4	19992.4
Pullback Stress [psi]	557.6	557.6
Pullback Strain	9.697E-3	9.697E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	557.6	581.7
Tensile Strain	9.697E-3	1.056E-2

Net External Pressure = 41.9 [psi] Buoyant Deflection = 0.1 Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.943	7.5	3.9	OK
Unconstrained Collapse [psi]	47.5	116.0	2.4	OK
Compressive Wall Stress [psi]	108.2	1150.0	10.6	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	57.5	222.5	3.9	OK
Tensile Stress [psi]	581.7	1200.0	2.1	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	165.391 psi	86.663 psi
1	8.00 in	12.00 in	165.187 psi	86.540 psi
2	12.00 in	16.13 in	164.893 psi	86.361 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 40.00 US (liquid) gallon/min Drill Fluid Density: 68.670 lb/ft3 Rheological model: Power-Law

Fluid Consistency Index (K): 63.17

Power Law Exponent (n): 0.14

Effective Viscosity (cP): 859.3

Virtual Site



















Generated Output

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Input Summary

Start Coordinate	(0.00, 0.00, 154.00) ft
End Coordinate	(1087.00, 0.00, 155.00) ft
Project Length	1087.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	2.375 in
Pipe DR	9.0
Pipe Thickness	0.26 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Gas Pipe Type: HDPE Classification: IPS Pipe OD: 2" (2.375") Pipe DR: 9 Pipe Length: 1110.00 ft Internal Pressure: 0 psi Borehole Diameter: 0.531000018119812 ft Silo Width: 0.531000018119812 ft Surface Surcharge: 0 psi Short Term Modulus: 57500 psi Long Term Modulus: 28200 psi Short Term Poisson Ratio: 0.35 Long Term Poisson Ratio: 0.45 Pipe Unit Weight: 59.30500 lb/ft3 Allowable Tensile Stress (Short Term): 1200 psi Allowable Tensile Stress (Long Term): 1100 psi Allowable Compressive Stress (Short Term): 1150 psi Allowable Compressive Stress (Long Term): 1150 psi Surface-pipe friction coefficient at entrance: 0.5 Surface-pipe friction coefficient in borehole: 0.3 Pipe-soil friction angle: 30 Slurry Unit Weight: 93.64118 lb/ft3 Hydrokinetic Pressure: 10 psi Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	1.8	34.6
Water Pressure	19.4	17.4
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	21.2	52.0
Deflection		
Earth Load Deflection	0.868	9.420
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.898	9.449
Compressive Stress [psi]		
Compressive Wall Stress	95.3	233.9

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1085.4	1085.4
Pullback Stress [psi]	620.2	620.2
Pullback Strain	1.079E-2	1.079E-2
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	620.2	624.3
Tensile Strain	1.079E-2	1.096E-2

Net External Pressure = 41.9 [psi] Buoyant Deflection = 0.0 Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.898	7.5	8.4	OK
Unconstrained Collapse [psi]	47.5	129.1	2.7	OK
Compressive Wall Stress [psi]	95.3	1150.0	12.1	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	57.5	220.4	3.8	OK
Tensile Stress [psi]	624.3	1200.0	1.9	OK



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Project Summary

General:	CHPE HDD 28
	P3
	Start Date: 12-10-2021
	End Date: 12-10-2021
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	MB
	BCE
Description:	HDD 28 10-inch DR 9

Input Summary

Start Coordinate	(0.00, 0.00, 166.30) ft
End Coordinate	(636.00, 0.00, 165.00) ft
Project Length	636.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 3

Soil Layer #1 USCS, Sand (S), SM Depth: 2.00 ft Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3] Phi: 34.00, S.M.: 500.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Silt (M), ML Depth: 3.00 ft Unit Weight: 80.0000 (dry), 100.0000 (sat) [lb/ft3] Phi: 28.00, S.M.: 50.00, Coh: 0.00 [psi]

Soil Layer #3 USCS, Clay (C), CH Depth: 40.00 ft Unit Weight: 70.0000 (dry), 100.0000 (sat) [lb/ft3] Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]
Bore Cross-Section View







Load Verifier Input Summary:

Pipe Application: Electrical Cable Pipe Type: HDPE Classification: IPS Pipe OD: 10" (10.75") Pipe DR: 9 Pipe Length: 645.00 ft Internal Pressure: 0 psi Borehole Diameter: 1.34400002161662 ft Silo Width: 1.34400002161662 ft Surface Surcharge: 0 psi Short Term Modulus: 57500 psi Long Term Modulus: 28200 psi Short Term Poisson Ratio: 0.35 Long Term Poisson Ratio: 0.45 Pipe Unit Weight: 59.30500 lb/ft3 Allowable Tensile Stress (Short Term): 1200 psi Allowable Tensile Stress (Long Term): 1100 psi Allowable Compressive Stress (Short Term): 1150 psi Allowable Compressive Stress (Long Term): 1150 psi Surface-pipe friction coefficient at entrance: 0.5 Surface-pipe friction coefficient in borehole: 0.3 Pipe-soil friction angle: 30 Slurry Unit Weight: 93.64118 lb/ft3 Hydrokinetic Pressure: 10 psi Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	5.8	5.8
Water Pressure	7.7	7.7
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	13.5	13.5
Deflection		
Earth Load Deflection	1.874	1.878
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	2.006	2.010
Compressive Stress [psi]		
Compressive Wall Stress	60.5	60.5

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	10887.1	10887.1
Pullback Stress [psi]	303.6	303.6
Pullback Strain	5.280E-3	5.280E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	303.6	328.4
Tensile Strain	5.280E-3	6.159E-3

Net External Pressure = 17.4 [psi] Buoyant Deflection = 0.1 Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.006	7.5	3.7	OK
Unconstrained Collapse [psi]	19.4	118.5	6.1	OK
Compressive Wall Stress [psi]	60.5	1150.0	19.0	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	29.3	237.6	8.1	OK
Tensile Stress [psi]	328.4	1200.0	3.7	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	29.265 psi	29.265 psi
1	8.00 in	12.00 in	29.018 psi	29.018 psi
2	12.00 in	16.13 in	28.691 psi	28.691 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 40.00 US (liquid) gallon/min Drill Fluid Density: 68.700 lb/ft3 Rheological model: Power-Law

Fluid Consistency Index (K): 63.17

Power Law Exponent (n): 0.14

Effective Viscosity (cP): 859.3

Virtual Site

















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Generated Output

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Input Summary

Start Coordinate	(0.00, 0.00, 166.30) ft
End Coordinate	(636.00, 0.00, 165.00) ft
Project Length	636.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	2.375 in
Pipe DR	9.0
Pipe Thickness	0.26 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable Pipe Type: HDPE Classification: IPS Pipe OD: 2" (2.375") Pipe DR: 9 Pipe Length: 645.00 ft Internal Pressure: 0 psi Borehole Diameter: 0.531000018119812 ft Silo Width: 0.531000018119812 ft Surface Surcharge: 0 psi Short Term Modulus: 57500 psi Long Term Modulus: 28200 psi Short Term Poisson Ratio: 0.35 Long Term Poisson Ratio: 0.45 Pipe Unit Weight: 59.30500 lb/ft3 Allowable Tensile Stress (Short Term): 1200 psi Allowable Tensile Stress (Long Term): 1100 psi Allowable Compressive Stress (Short Term): 1150 psi Allowable Compressive Stress (Long Term): 1150 psi Surface-pipe friction coefficient at entrance: 0.5 Surface-pipe friction coefficient in borehole: 0.3 Pipe-soil friction angle: 30 Slurry Unit Weight: 93.64118 lb/ft3 Hydrokinetic Pressure: 10 psi Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	5.8	5.8
Water Pressure	7.7	7.7
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	13.5	13.5
Deflection		
Earth Load Deflection	1.874	1.878
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	1.903	1.907
Compressive Stress [psi]		
Compressive Wall Stress	60.5	60.5

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	641.0	641.0
Pullback Stress [psi]	366.2	366.2
Pullback Strain	6.369E-3	6.369E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	366.2	370.9
Tensile Strain	6.369E-3	6.550E-3

Net External Pressure = 17.4 [psi] Buoyant Deflection = 0.0 Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.903	7.5	3.9	OK
Unconstrained Collapse [psi]	19.4	119.6	6.2	OK
Compressive Wall Stress [psi]	60.5	1150.0	19.0	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	29.3	235.9	8.0	OK
Tensile Stress [psi]	370.9	1200.0	3.2	OK



Generated Output

WARNING: The accuracy of the data obtained by the BoreAid® system is highly dependent upon accurate data gathering, data input and proper use of the software. Vermeer is not responsible for that information. BoreAid® data is not intended to replace the need for future on-site utility locating, measuring and verification procedures, which are essential for accurate placement of new underground installations and avoidance of existing utilities.

CALL YOUR ONE-CALL SYSTEM FIRST

WARNING: Always contact your local One-Call system before the start of your digging project. The BoreAid® system is intended to be used with other utility locating methods, such as the use of the One-Call system and the exposing of existing utilities by potholing.

Locate utilities before drilling. Call 811 (U.S. only) or 1-888-258-0808 (U.S. or Canada) or local utility companies or national regulating authority.

Before you start any digging project, do not forget to call the local One-Call system in your area and any utility company that does not subscribe to the One-Call system. For areas not represented by One-Call Systems International, contact the appropriate utility companies or national regulating authority to locate and mark the underground installations. If you do not call, you may have an accident or suffer injuries; cause interruption of services; damage the environment; or experience job delays.

OSHA CFR 29 1926.651 requires that the estimated location of underground utilities be determined before beginning the excavation or underground drilling operation. When the actual excavation or bore approaches an estimated utility location, the exact location of the underground installation must be determined by a safe, acceptable and dependable method. If the utility cannot be precisely located, it must be shut off by the utility company.

Project Summary

General:	CHPE HDD 29
	Ref: Northumberland, NY, Saratoga cty
	J2105
	Start Date: 07-18-2022
	End Date: 07-18-2022
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA-BCE
Designer:	MDB
	BCE
	Amherst, MA
Description:	South to North 10" DR9

Input Summary

Start Coordinate	(0.00, 0.00, 168.00) ft
End Coordinate	(1050.00, 0.00, 175.00) ft
Project Length	1050.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 3

Soil Layer #1 USCS, Sand (S), SW From Assistant Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3] Phi: 30.00, S.M.: 200.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Sand (S), SW From Assistant Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3] Phi: 34.00, S.M.: 500.00, Coh: 0.00 [psi]

Soil Layer #3 USCS, Clay (C), CH From Assistant Unit Weight: 70.0000 (dry), 100.0000 (sat) [lb/ft3] Phi: 0.00, S.M.: 200.00, Coh: 3.13 [psi]

Bore Cross-Section View







Load Verifier Input Summary:

Pipe Application: Electrical Cable Pipe Type: HDPE Classification: IPS Pipe OD: 10" (10.75") Pipe DR: 9 Pipe Length: 1065.00 ft Internal Pressure: 0 psi Borehole Diameter: 1.34400002161662 ft Silo Width: 1.34400002161662 ft Surface Surcharge: 0 psi Short Term Modulus: 57500 psi Long Term Modulus: 28200 psi Short Term Poisson Ratio: 0.35 Long Term Poisson Ratio: 0.45 Pipe Unit Weight: 59.30500 lb/ft3 Allowable Tensile Stress (Short Term): 1200 psi Allowable Tensile Stress (Long Term): 1100 psi Allowable Compressive Stress (Short Term): 1150 psi Allowable Compressive Stress (Long Term): 1150 psi Surface-pipe friction coefficient at entrance: 0.5 Surface-pipe friction coefficient in borehole: 0.3 Pipe-soil friction angle: 30 Slurry Unit Weight: 93.64118 lb/ft3 Hydrokinetic Pressure: 10 psi Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	3.6	11.7
Water Pressure	12.4	12.1
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	16.0	23.8
Deflection		
Earth Load Deflection	0.994	3.194
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.127	3.326
Compressive Stress [psi]		
Compressive Wall Stress	72.1	107.3

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	17470.4	17470.4
Pullback Stress [psi]	487.2	487.2
Pullback Strain	8.473E-3	8.473E-3
Bending Stress [psi]	0.0	21.5
Bending Strain	0	3.733E-4
Tensile Stress [psi]	487.2	505.9
Tensile Strain	8.473E-3	9.172E-3

Net External Pressure = 20.1 [psi] Buoyant Deflection = 0.1 Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.127	7.5	6.7	OK
Unconstrained Collapse [psi]	23.6	124.9	5.3	OK
Compressive Wall Stress [psi]	72.1	1150.0	16.0	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	33.6	226.9	6.8	OK
Tensile Stress [psi]	505.9	1200.0	2.4	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	54.766 psi	47.176 psi
1	8.00 in	12.00 in	54.597 psi	41.647 psi
2	12.00 in	16.13 in	54.358 psi	39.649 psi

Note: The maximum bore pressures presented in this table are the maximum values along the length of the bore and not the maximum allowable at any point. The estimated maximum pressures should be compared to the estimated circulating pressures along the bore to determine potential locations of inadvertant returns.

Estimated Circulating Pressure Summary

Active	Shear Rate [rpm]	Shear Stress [Fann Degrees]
No	600	37
No	300	32
No	200	29
Yes	100	25
Yes	6	17
No	3	15

Flow Rate (Q): 40.00 US (liquid) gallon/minDrill Fluid Density: 68.700 lb/ft3Rheological model: Bingham-PlasticPlastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 1202.0

Virtual Site













