
Project Summary

General:	CHPE HDD 41 Conduit 1 P3 Start Date: 12-10-2021 End Date: 12-10-2021
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	AB CHA
Description:	HDD 41 10-inch DR 9 Conduit 1

Input Summary

Start Coordinate	(0.00, 0.00, 326.99) ft
End Coordinate	(709.00, 0.00, 322.00) ft
Project Length	709.00 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), SP

Depth: 8.50 ft

Unit Weight: 109.5552 (dry), 125.0000 (sat) [lb/ft3]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Sand (S), SM

Depth: 7.40 ft

Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]

Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #3 USCS, Silt (M), ML

Depth: 5.10 ft

Unit Weight: 100.0000 (dry), 120.0000 (sat) [lb/ft3]

Phi: 0.00, S.M.: 145.00, Coh: 8.33 [psi]

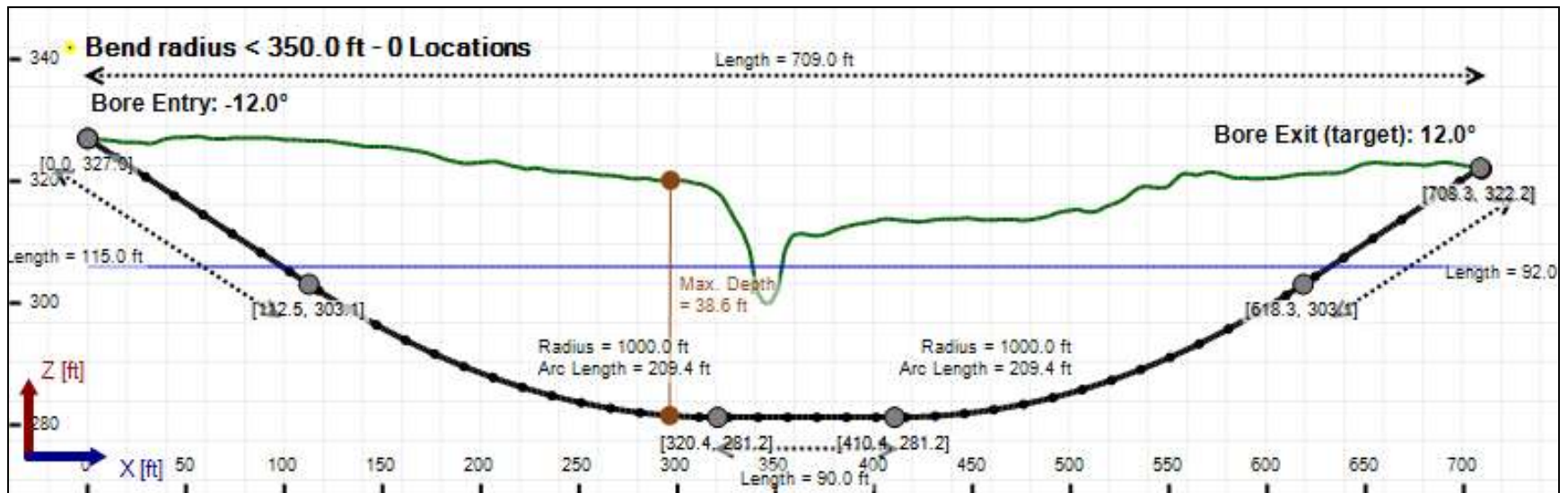
Soil Layer #4 USCS, Sand (S), SM

Depth: 28.50 ft

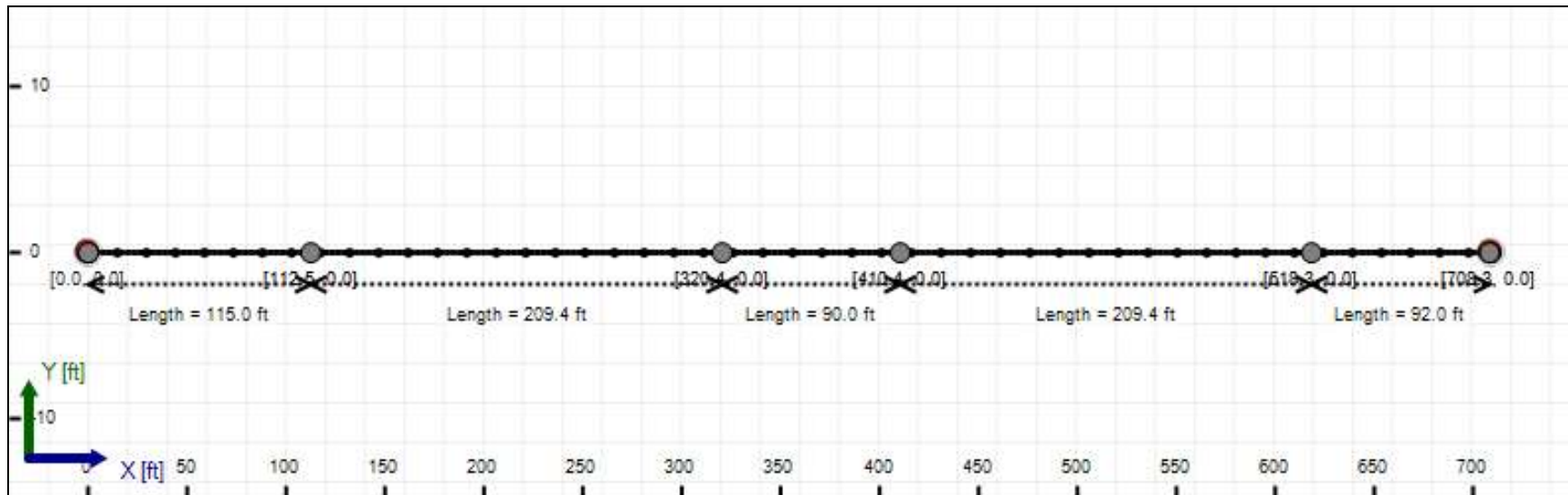
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 720.00 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	4.0	21.1
Water Pressure	10.7	10.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	14.8	31.7
Deflection		
Earth Load Deflection	1.411	5.767
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.543	5.899
Compressive Stress [psi]		
Compressive Wall Stress	66.4	142.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	12598.2	12598.2
Pullback Stress [psi]	351.3	351.3
Pullback Strain	6.110E-3	6.110E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	351.3	376.9
Tensile Strain	6.110E-3	7.004E-3

Net External Pressure = 24.2 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.543	7.5	4.9	OK
Unconstrained Collapse [psi]	29.7	123.7	4.2	OK
Compressive Wall Stress [psi]	66.4	1150.0	17.3	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	39.7	234.8	5.9	OK
Tensile Stress [psi]	376.9	1200.0	3.2	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	87.332 psi	91.431 psi
1	8.00 in	12.00 in	87.263 psi	91.356 psi
2	12.00 in	16.13 in	87.162 psi	91.249 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

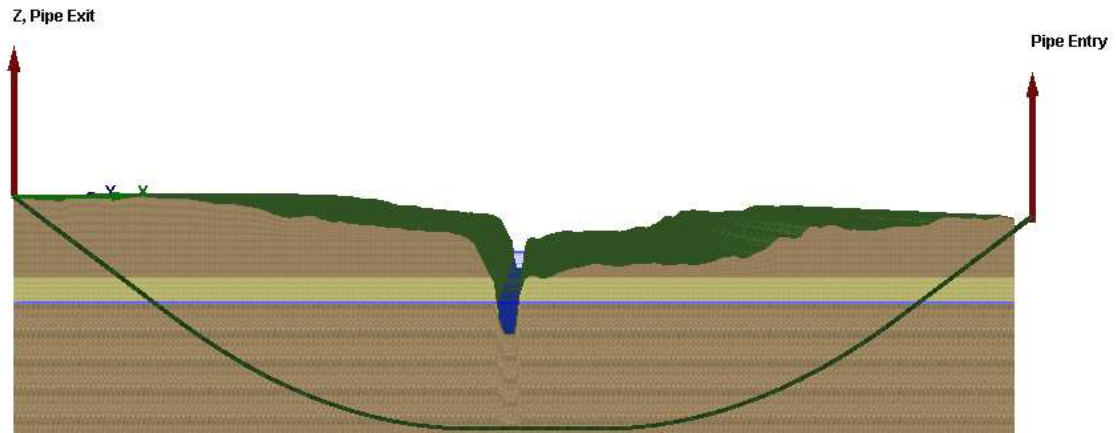
Rheological model: Power-Law

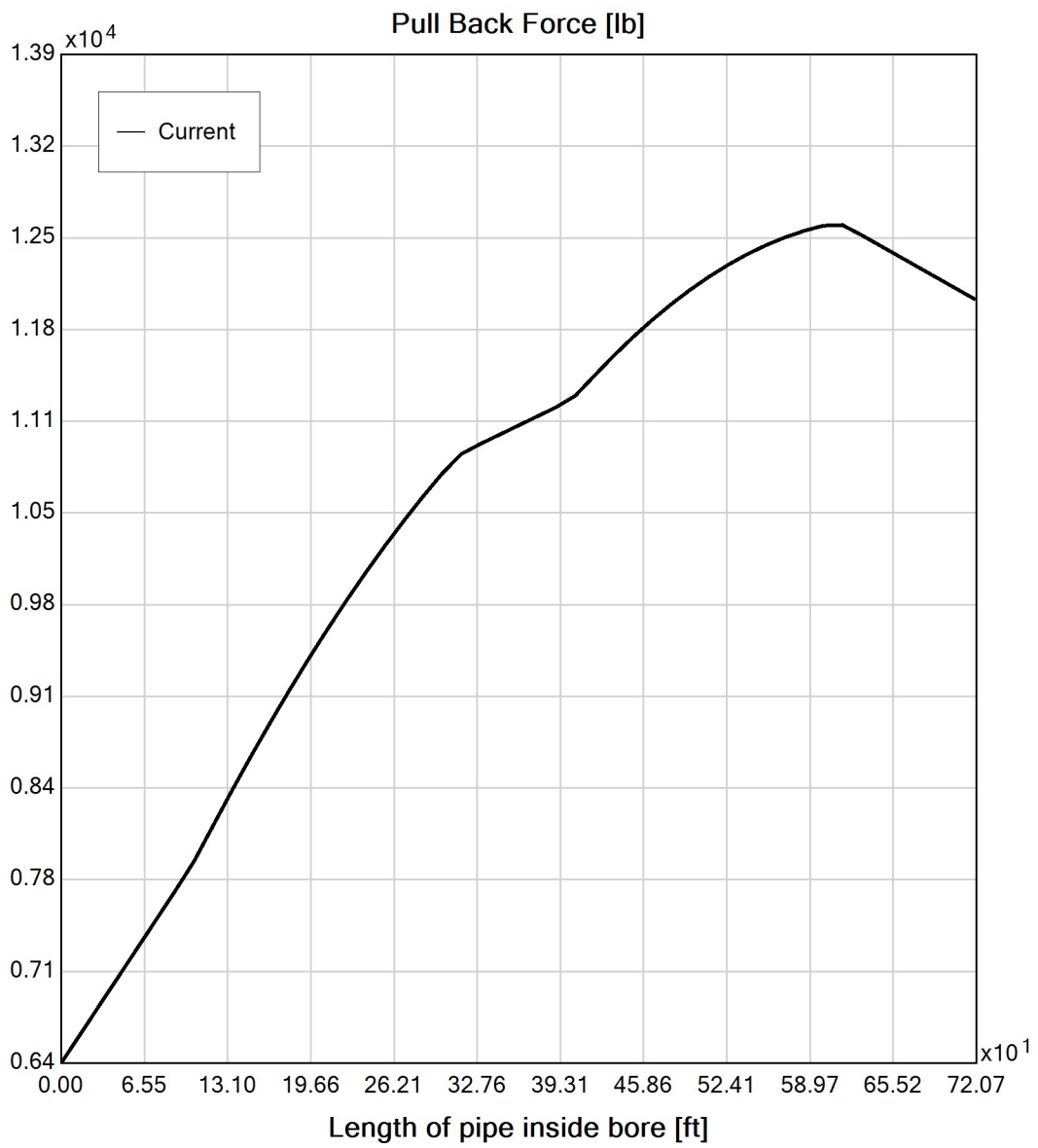
Fluid Consistency Index (K): 63.17

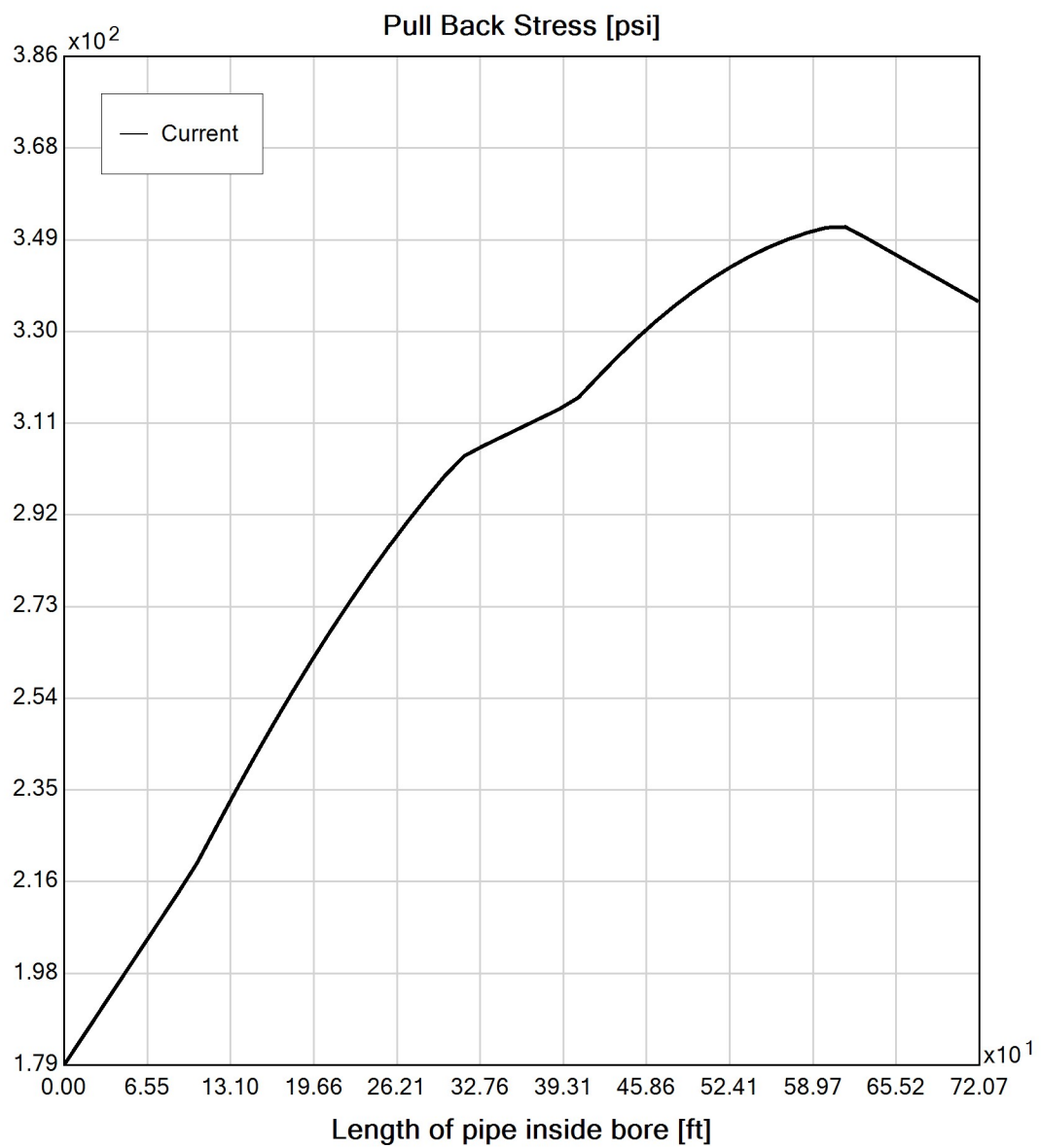
Power Law Exponent (n): 0.14

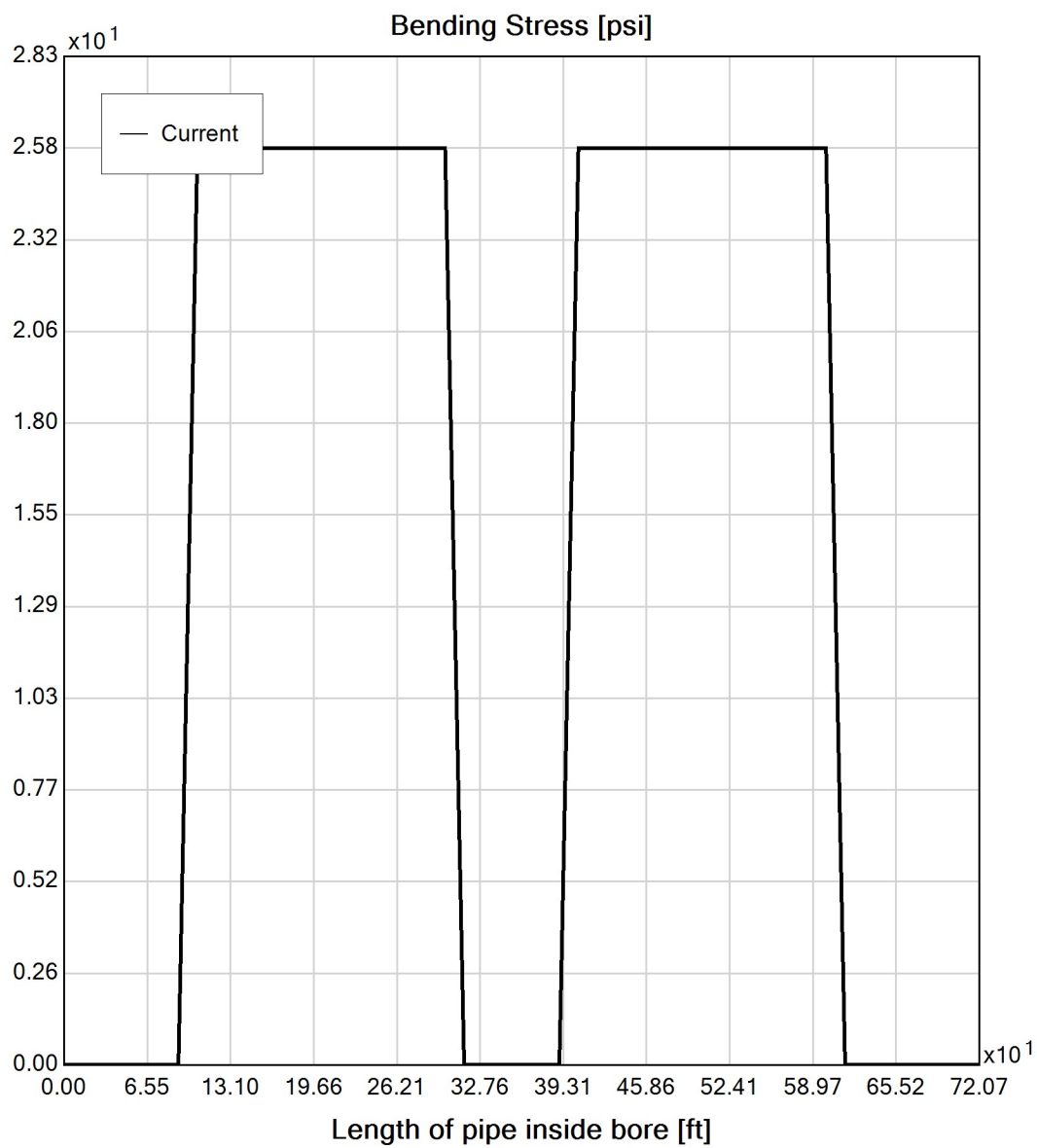
Effective Viscosity (cP): 859.3

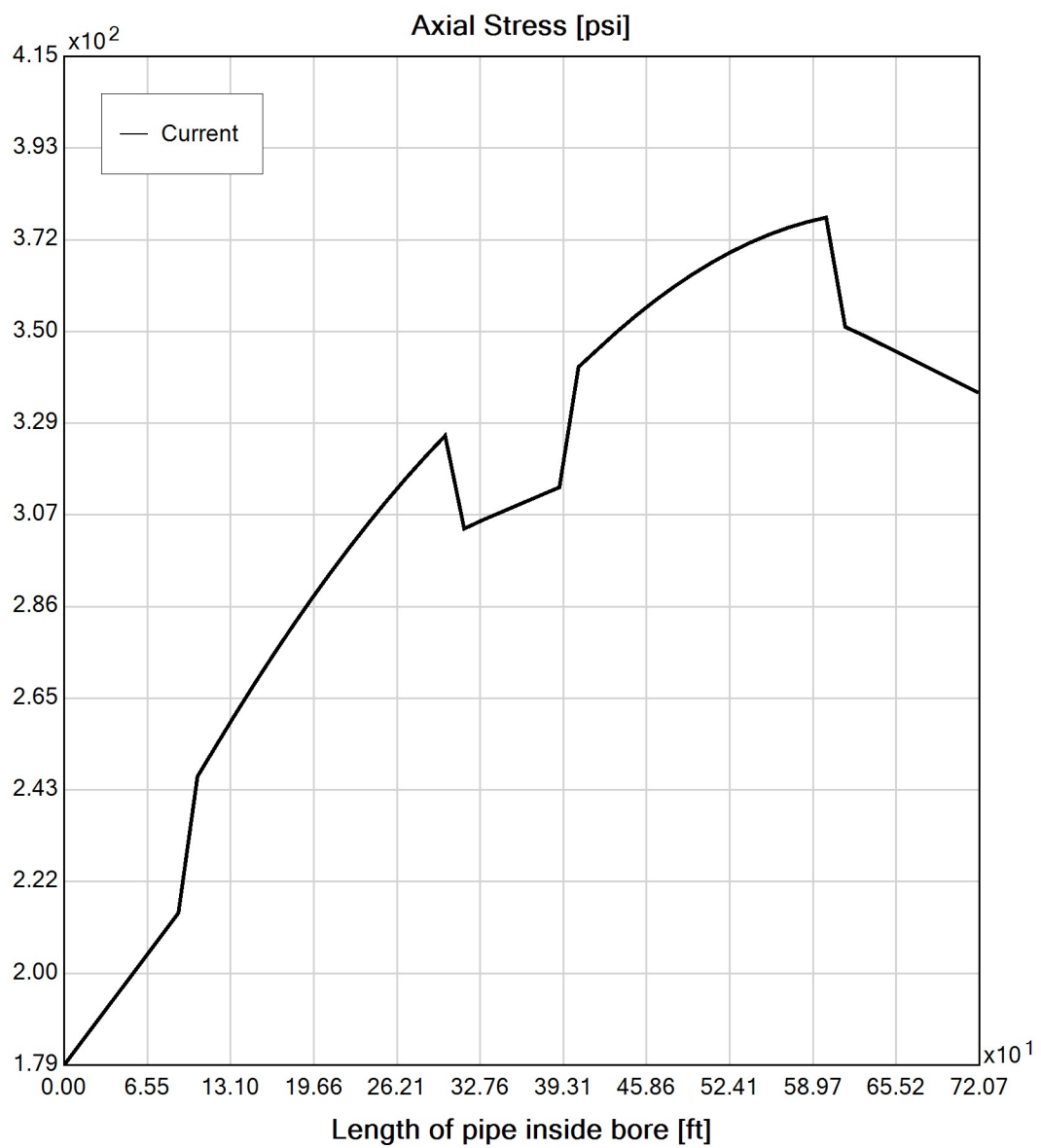
Virtual Site

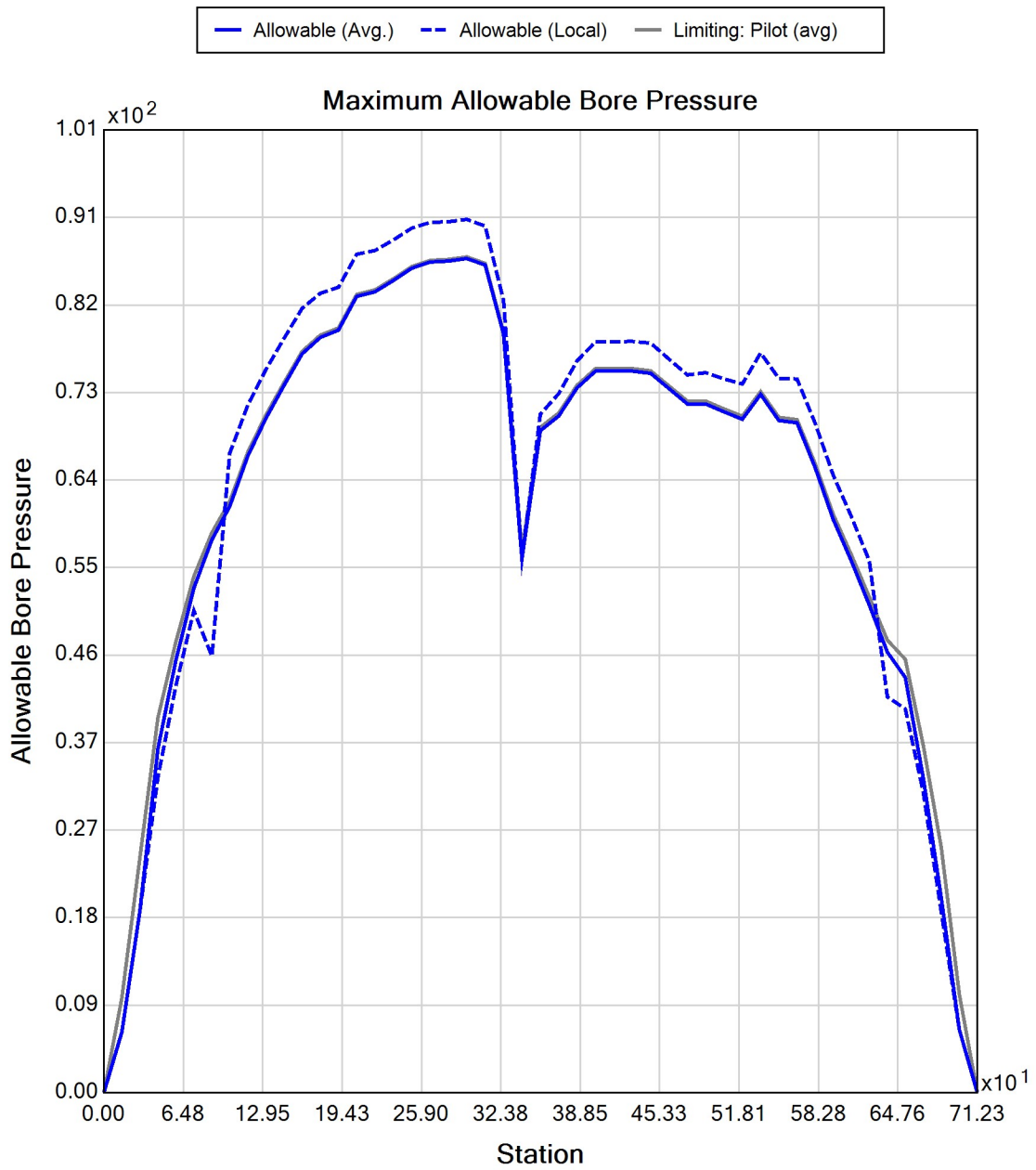


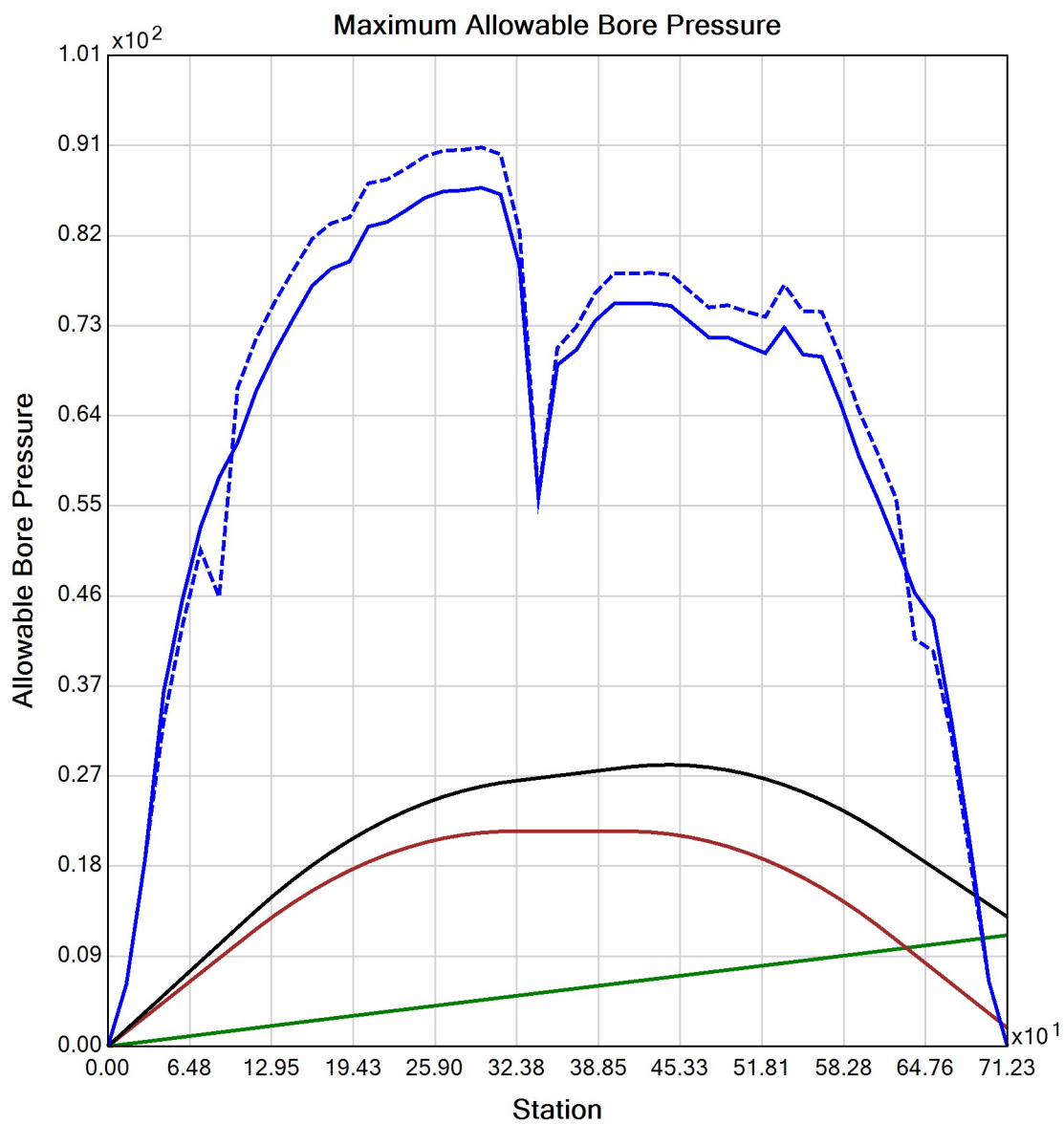














Generated Output



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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	(0.00, 0.00, 327.50) ft
End Coordinate	(709.00, 0.00, 323.00) ft
Project Length	709.00 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: 720.00 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	1.7	19.7
Water Pressure	8.6	8.5
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	10.2	28.2
Deflection		
Earth Load Deflection	0.623	5.366
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.652	5.395
Compressive Stress [psi]		
Compressive Wall Stress	46.1	126.8

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	709.0	709.0
Pullback Stress [psi]	405.1	405.1
Pullback Strain	7.046E-3	7.046E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	405.1	410.5
Tensile Strain	7.046E-3	7.238E-3

Net External Pressure = 20.1 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.652	7.5	11.5	OK
Unconstrained Collapse [psi]	25.6	132.3	5.2	OK
Compressive Wall Stress [psi]	46.1	1150.0	24.9	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	35.5	233.7	6.6	OK
Tensile Stress [psi]	410.5	1200.0	2.9	OK



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Project Summary

General:	CHPE HDD 41 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 CHA
Description:	HDD 41 10-inch DR 9 Conduit 2

Input Summary

Start Coordinate	(0.00, 0.00, 327.50) ft
End Coordinate	(709.00, 0.00, 323.00) ft
Project Length	709.00 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), SP

Depth: 8.50 ft

Unit Weight: 109.5552 (dry), 125.0000 (sat) [lb/ft³]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Sand (S), SM

Depth: 7.40 ft

Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft³]

Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #3 USCS, Silt (M), ML

Depth: 5.10 ft

Unit Weight: 100.0000 (dry), 120.0000 (sat) [lb/ft³]

Phi: 0.00, S.M.: 145.00, Coh: 8.33 [psi]

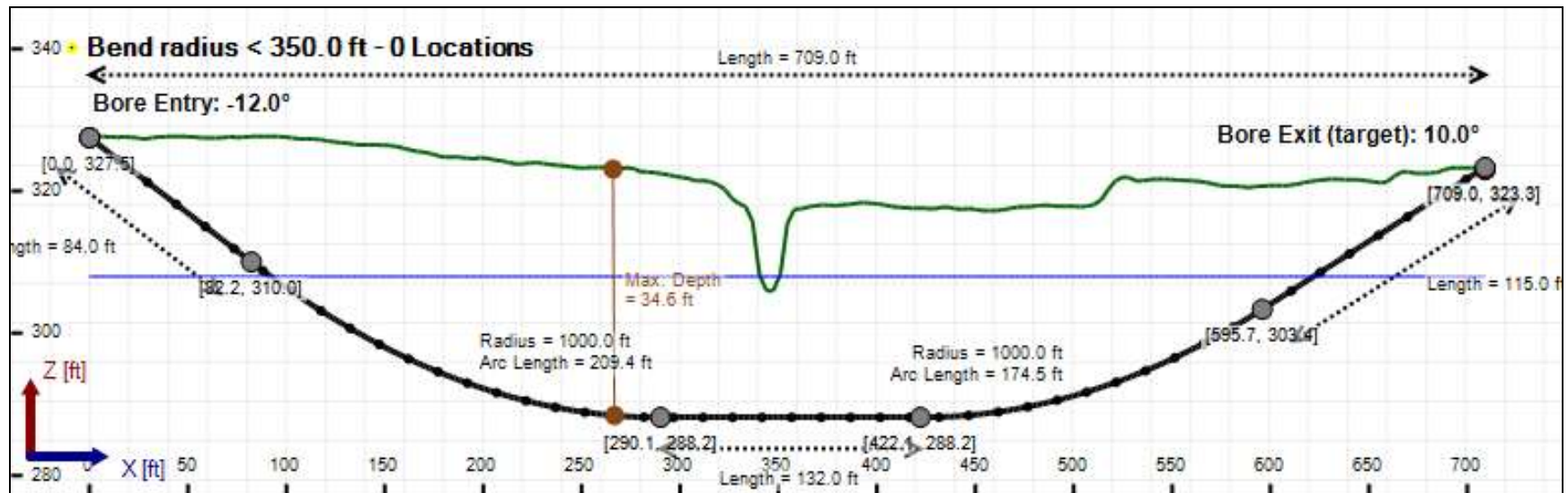
Soil Layer #4 USCS, Sand (S), SM

Depth: 28.50 ft

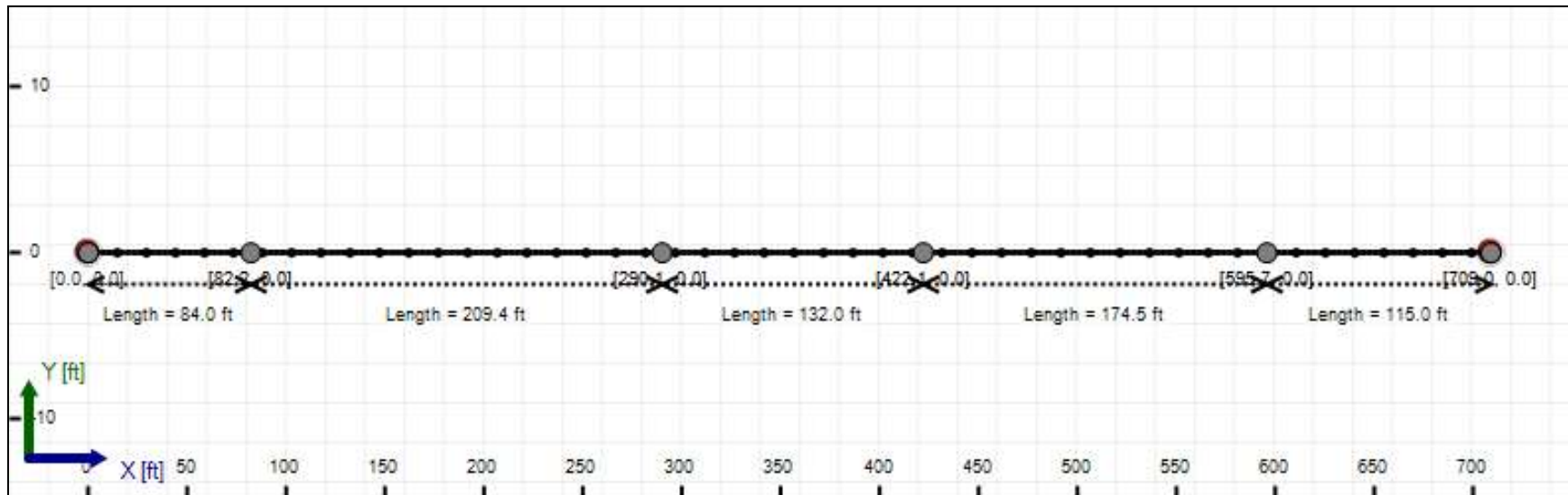
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft³]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 720.00 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	4.2	19.7
Water Pressure	8.6	8.5
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	12.8	28.2
Deflection		
Earth Load Deflection	1.405	5.366
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.538	5.498
Compressive Stress [psi]		
Compressive Wall Stress	57.4	126.8

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	12281.5	12281.5
Pullback Stress [psi]	342.5	342.5
Pullback Strain	5.957E-3	5.957E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	342.5	367.9
Tensile Strain	5.957E-3	6.847E-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 [%]	1.538	7.5	4.9	OK
Unconstrained Collapse [psi]	25.6	123.3	4.8	OK
Compressive Wall Stress [psi]	57.4	1150.0	20.0	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	35.5	235.4	6.6	OK
Tensile Stress [psi]	367.9	1200.0	3.3	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	81.482 psi	85.815 psi
1	8.00 in	12.00 in	81.394 psi	85.720 psi
2	12.00 in	16.13 in	81.268 psi	85.584 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

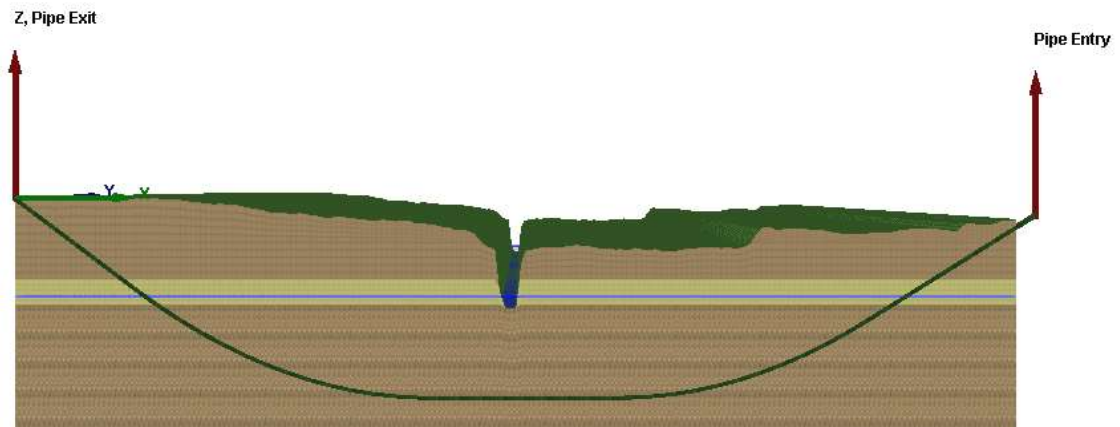
Rheological model: Bingham-Plastic

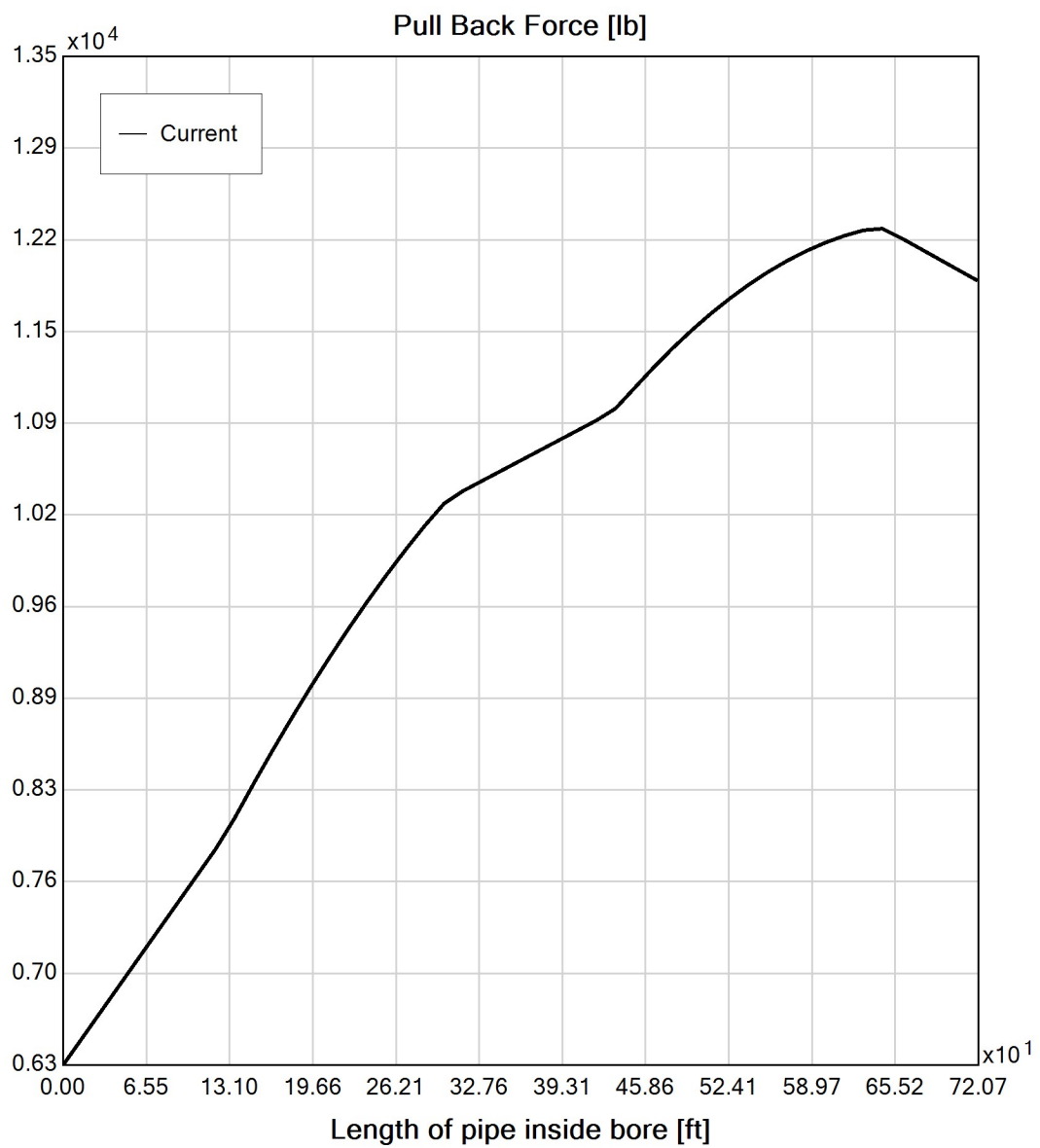
Plastic Viscosity (PV): 25.53

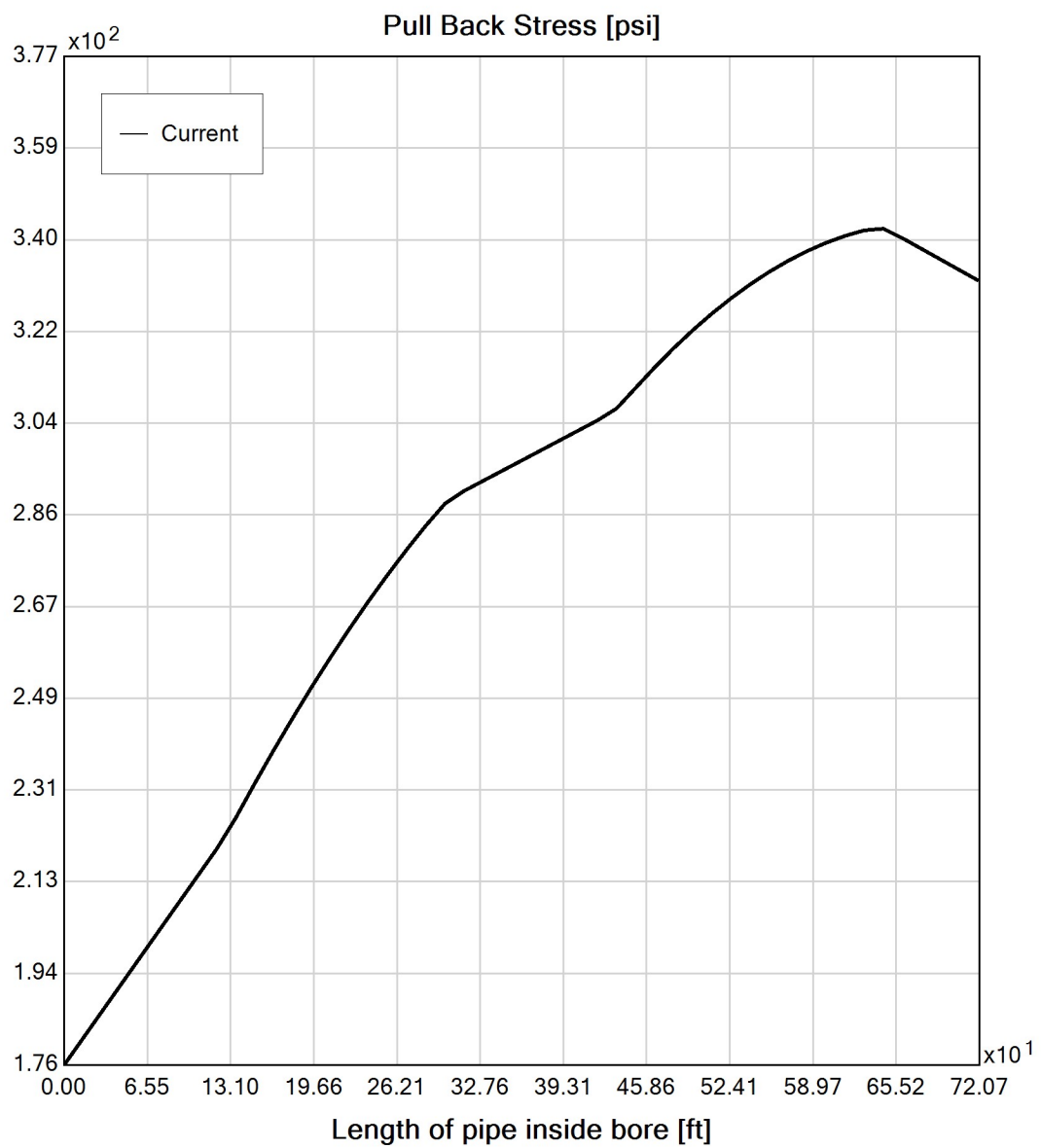
Yield Point (YP): 16.49

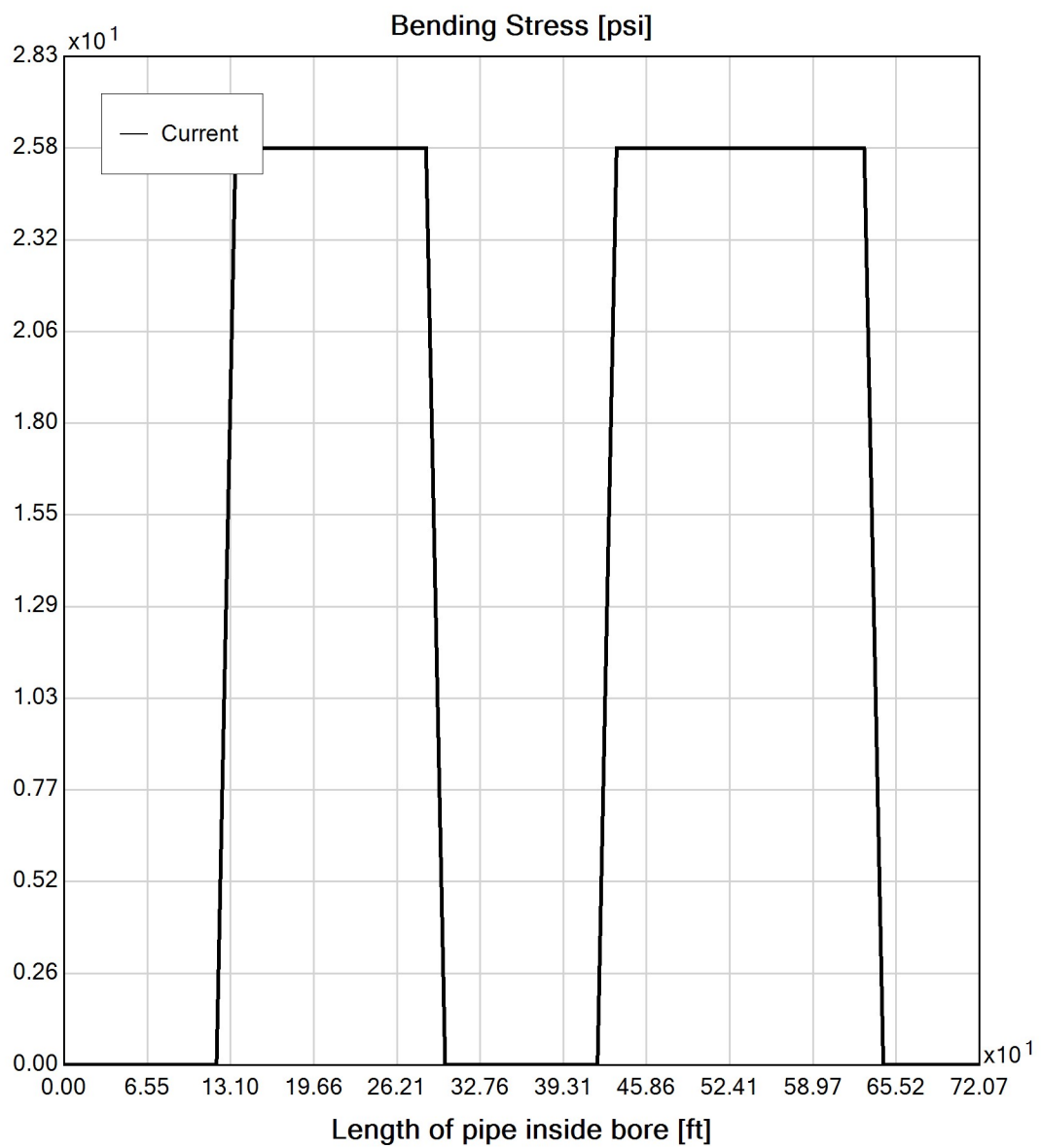
Effective Viscosity (cP): 1202.0

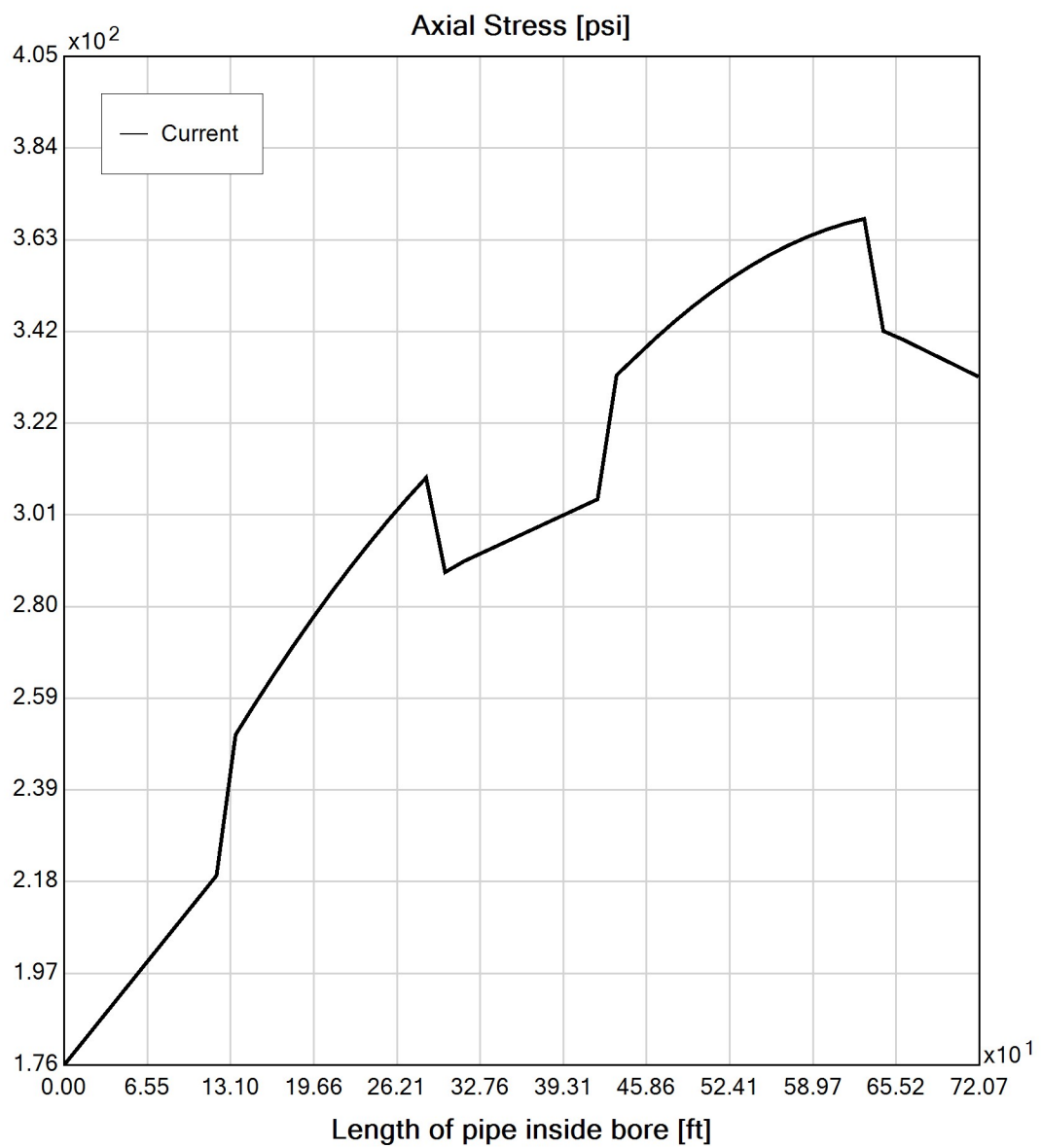
Virtual Site

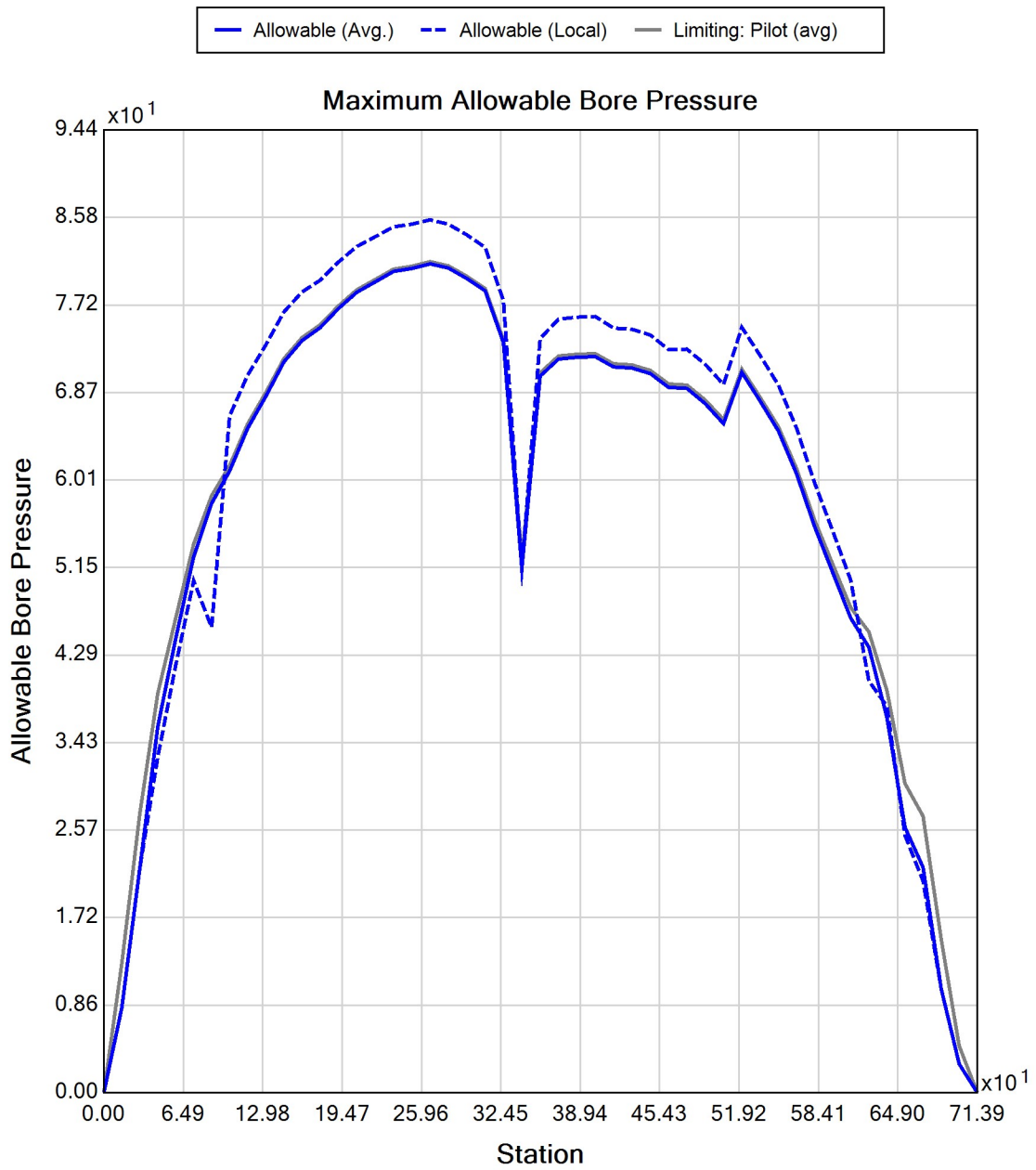


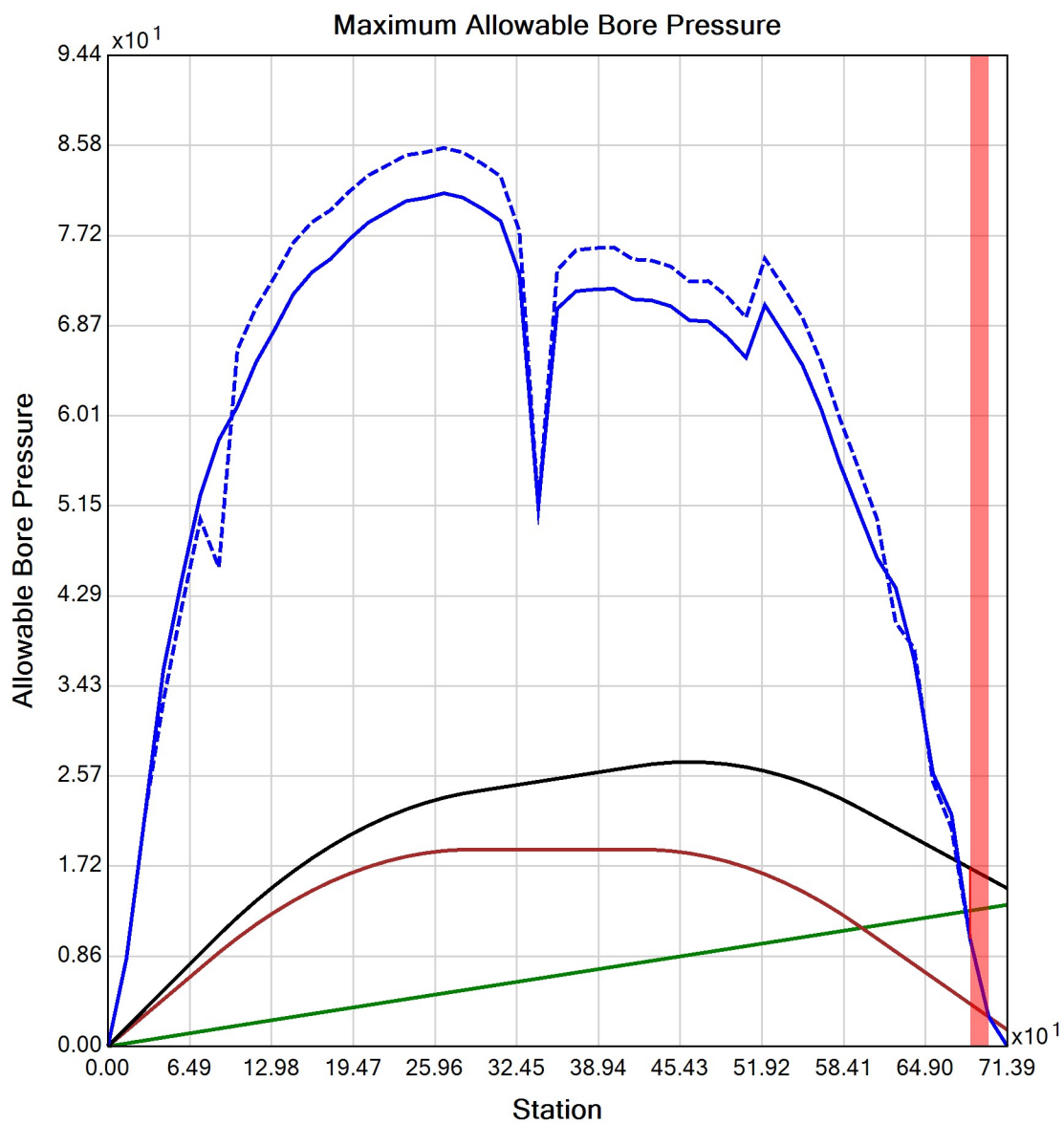














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Input Summary

Start Coordinate	(0.00, 0.00, 326.99) ft
End Coordinate	(709.00, 0.00, 322.00) ft
Project Length	709.00 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: 720.00 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	1.6	21.1
Water Pressure	10.7	10.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	12.3	31.7
Deflection		
Earth Load Deflection	0.623	5.767
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.652	5.796
Compressive Stress [psi]		
Compressive Wall Stress	55.4	142.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	724.5	724.5
Pullback Stress [psi]	414.0	414.0
Pullback Strain	7.199E-3	7.199E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	414.0	419.5
Tensile Strain	7.199E-3	7.395E-3

Net External Pressure = 24.2 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.652	7.5	11.5	OK
Unconstrained Collapse [psi]	29.7	132.5	4.5	OK
Compressive Wall Stress [psi]	55.4	1150.0	20.7	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	39.7	233.1	5.9	OK
Tensile Stress [psi]	419.5	1200.0	2.9	OK



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Project Summary

General: CHPE HDD 42 Conduit 1
Ref: BLANK
P3
Start Date: 12-10-2021
End Date: 12-10-2021

Project Owner: TDI
Project Contractor: Kiewit
Project Consultant: CHA/BCE

Designer: MCS
CHA
BLANK
BLANK, BLANK
BLANK BLANK
Phone: BLANK
Fax: BLANK
BLANK

Description: HDD 42 Conduit 1 10-inch DR 9

Input Summary

Start Coordinate	(0.00, 0.00, 327.46) ft
End Coordinate	(680.00, 0.00, 322.65) ft
Project Length	680.00 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), SM

Depth: 10.10 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, Sand (S), SP

Depth: 10.00 ft

Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]

Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #3 USCS, Sand (S), SM

Depth: 6.50 ft

Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

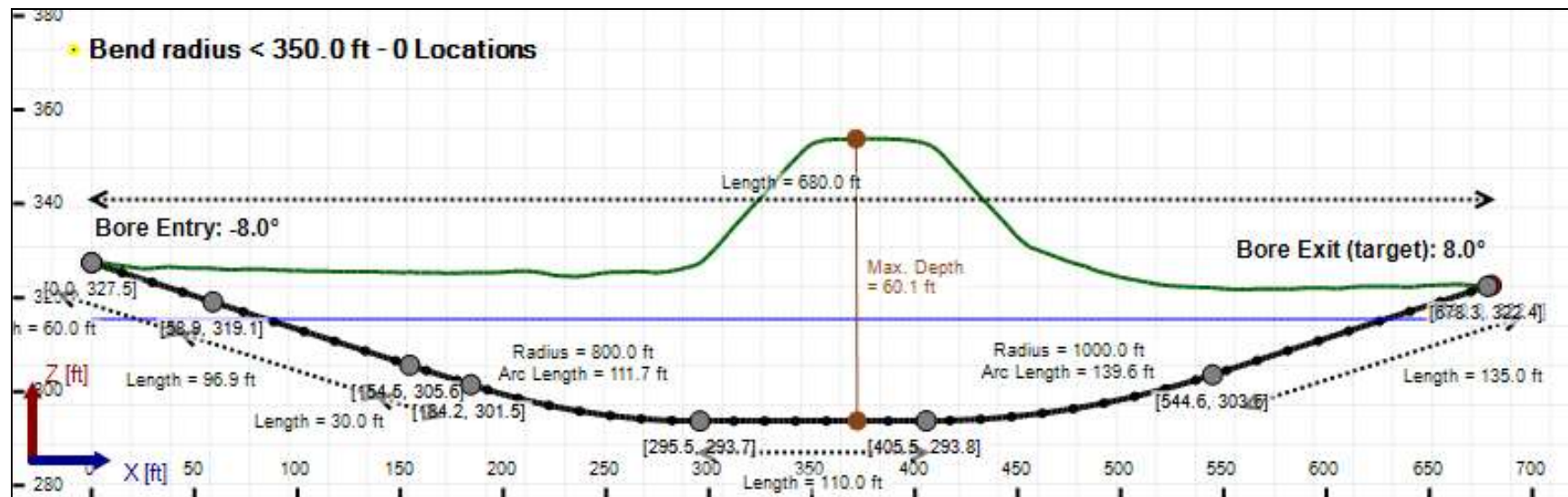
Soil Layer #4 USCS, Sand (S), SM

Depth: 30.00 ft

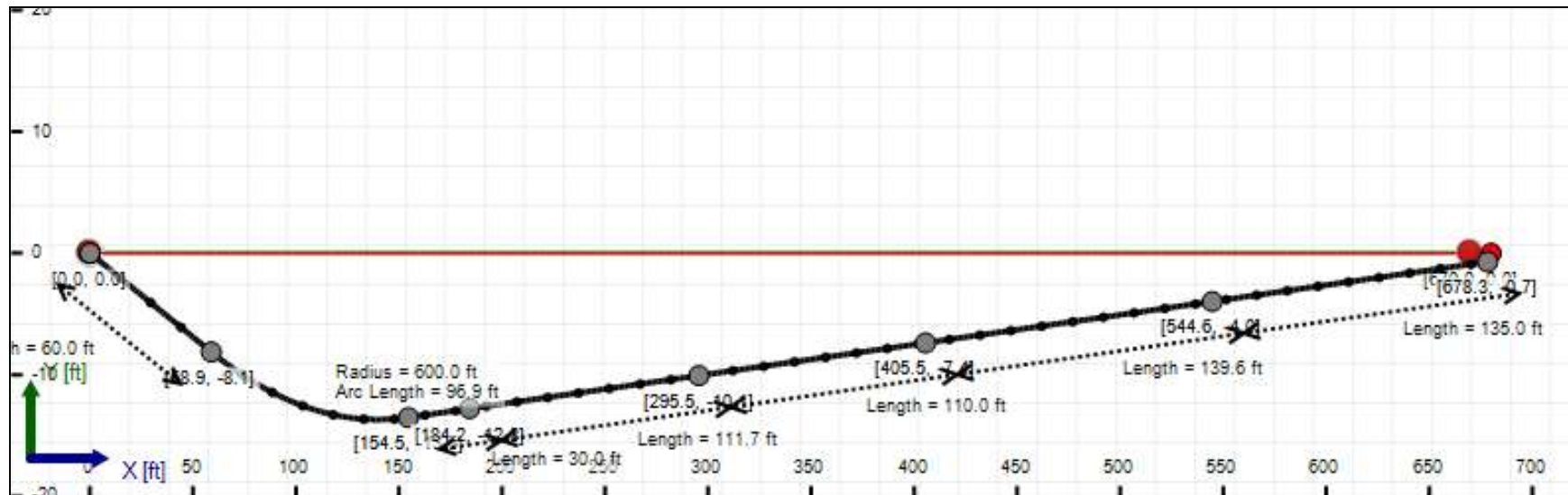
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 689.99 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	4.6	36.9
Water Pressure	9.4	9.4
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	14.0	46.2
Deflection		
Earth Load Deflection	1.264	10.039
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.396	10.171
Compressive Stress [psi]		
Compressive Wall Stress	63.1	208.1

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	11435.9	11435.9
Pullback Stress [psi]	318.9	318.9
Pullback Strain	5.547E-3	5.547E-3
Bending Stress [psi]	0.0	42.9
Bending Strain	0	7.465E-4
Tensile Stress [psi]	318.9	357.6
Tensile Strain	5.547E-3	6.965E-3

Net External Pressure = 14.1 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.396	7.5	5.4	OK
Unconstrained Collapse [psi]	21.9	121.9	5.6	OK
Compressive Wall Stress [psi]	63.1	1150.0	18.2	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	31.9	236.6	7.4	OK
Tensile Stress [psi]	357.6	1200.0	3.4	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	120.684 psi	125.054 psi
1	8.00 in	12.00 in	120.659 psi	125.028 psi
2	12.00 in	16.13 in	120.623 psi	124.992 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

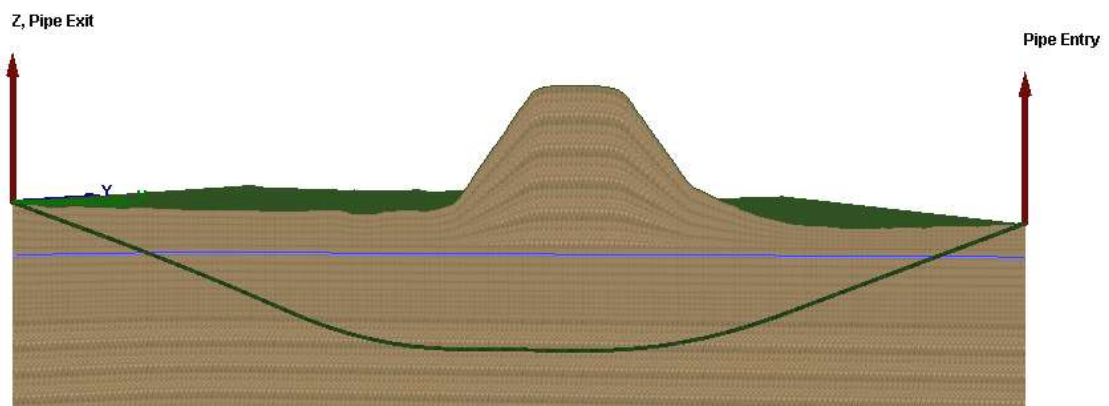
Rheological model: Bingham-Plastic

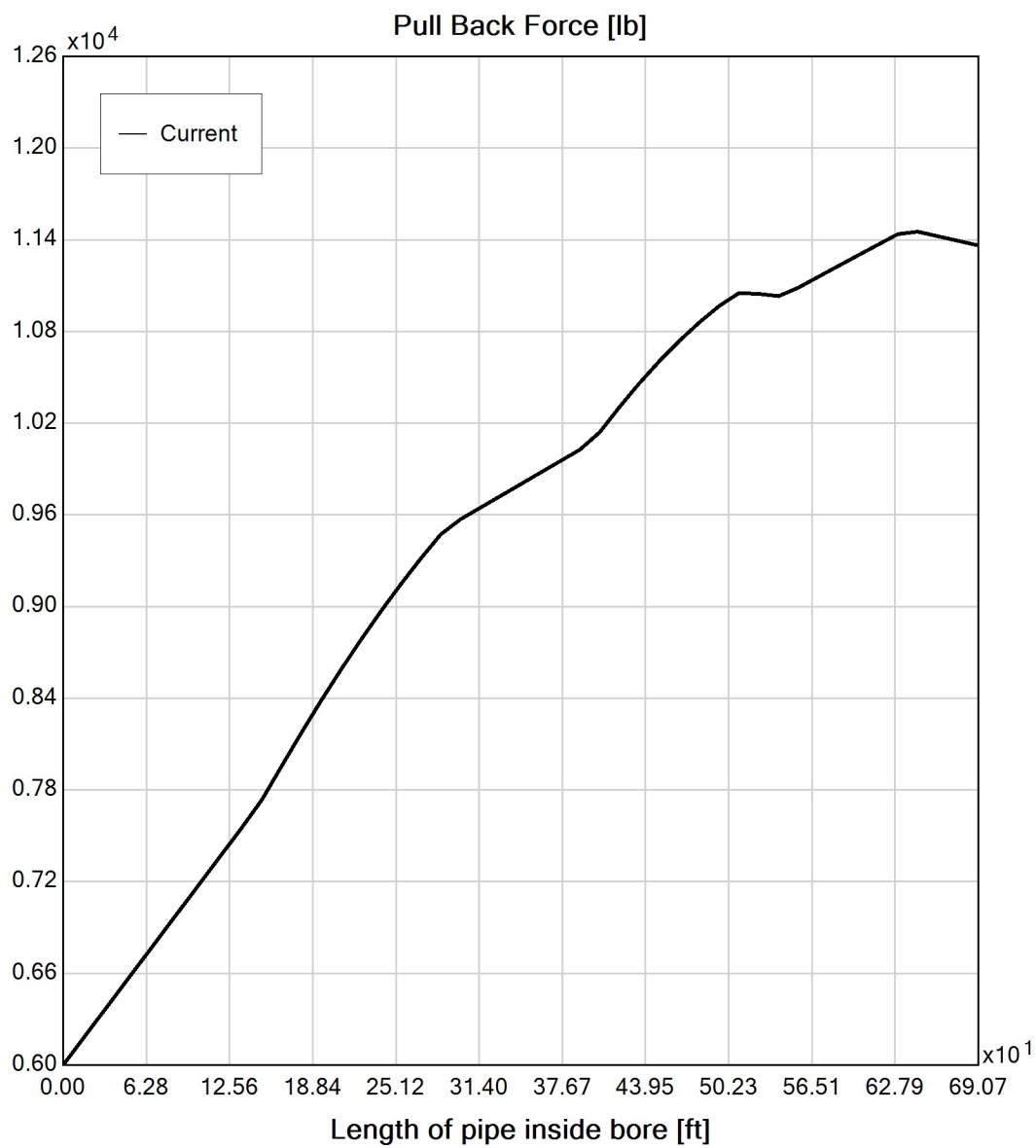
Plastic Viscosity (PV): 25.53

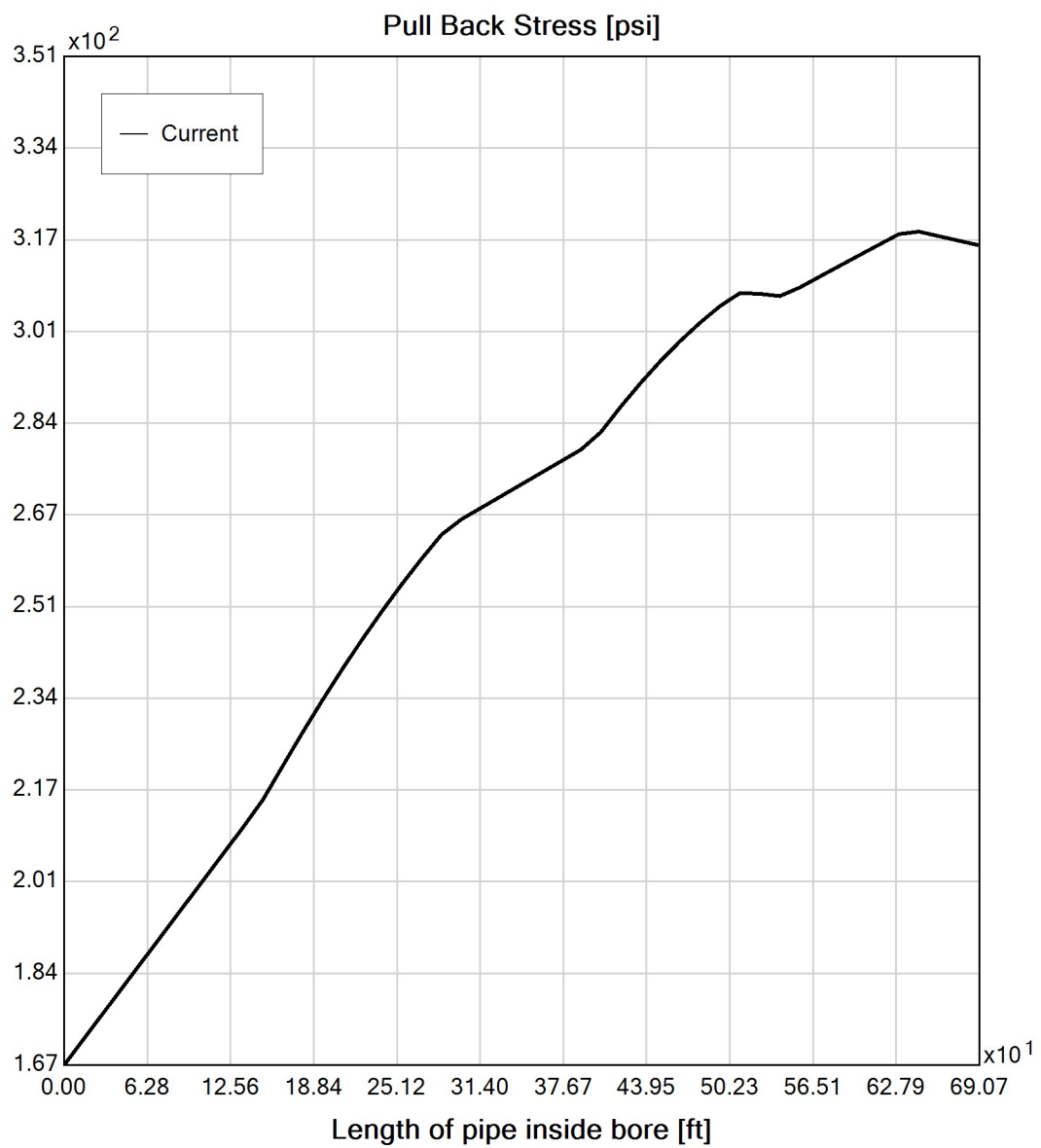
Yield Point (YP): 16.49

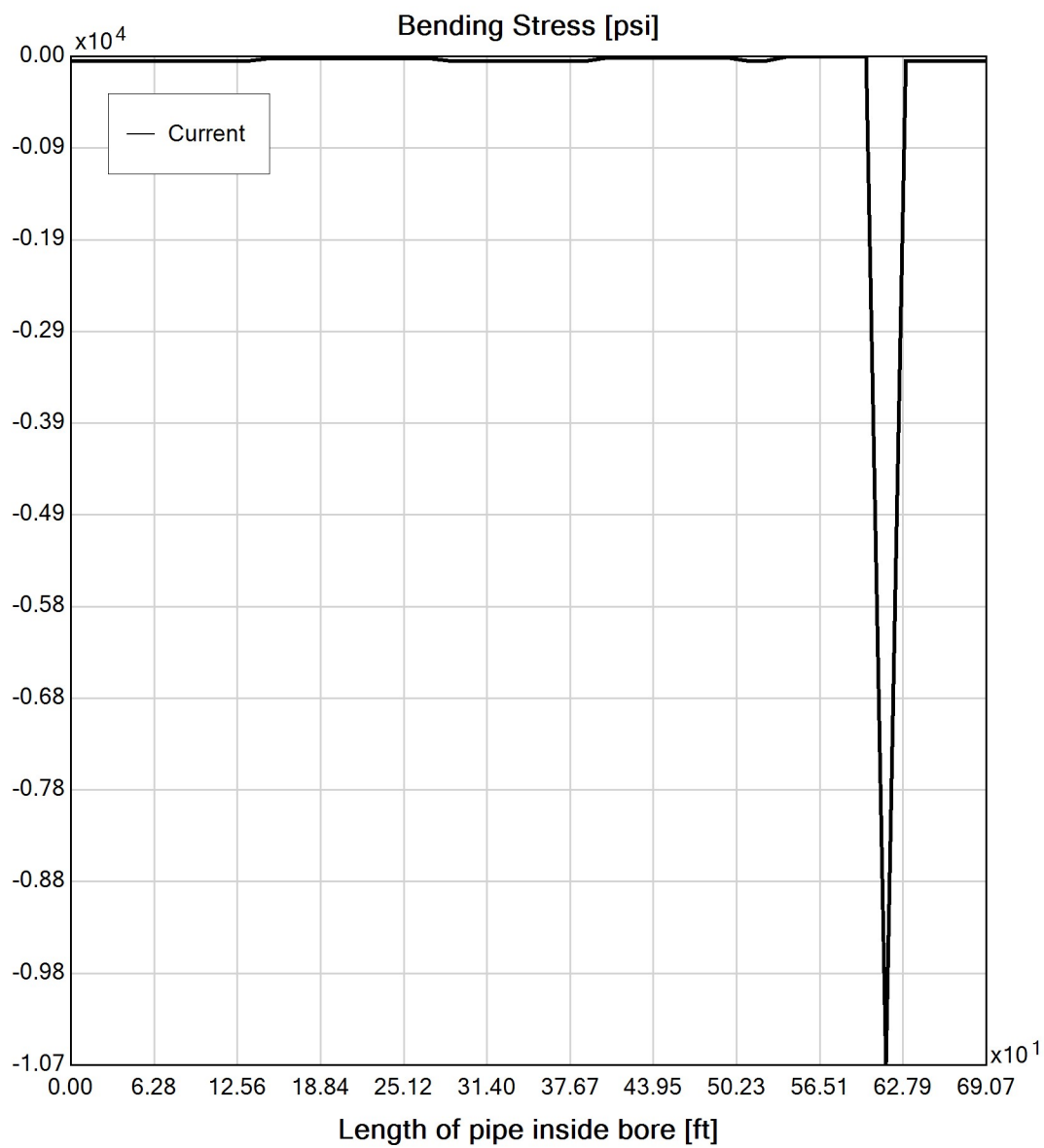
Effective Viscosity (cP): 1202.0

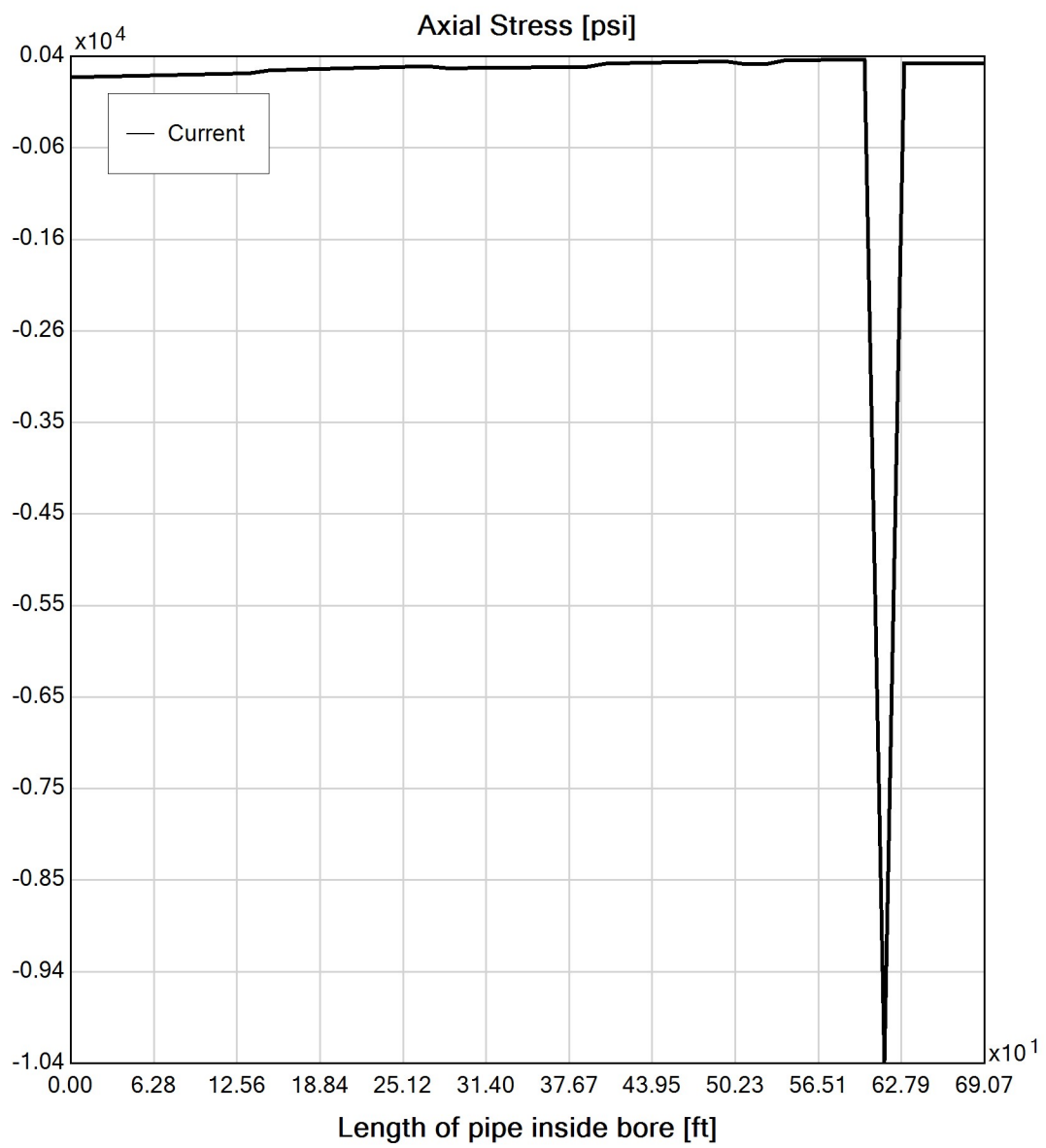
Virtual Site

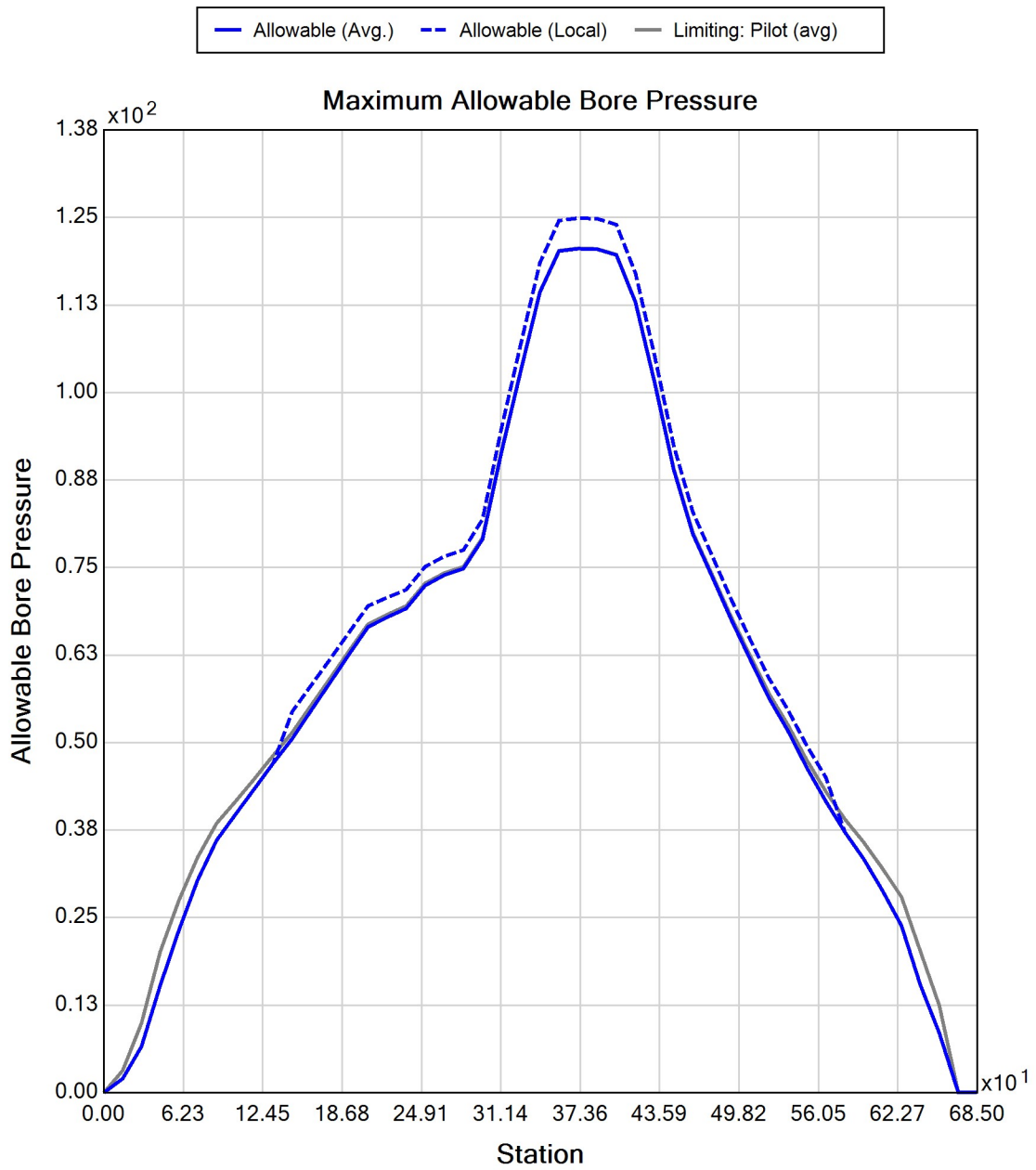


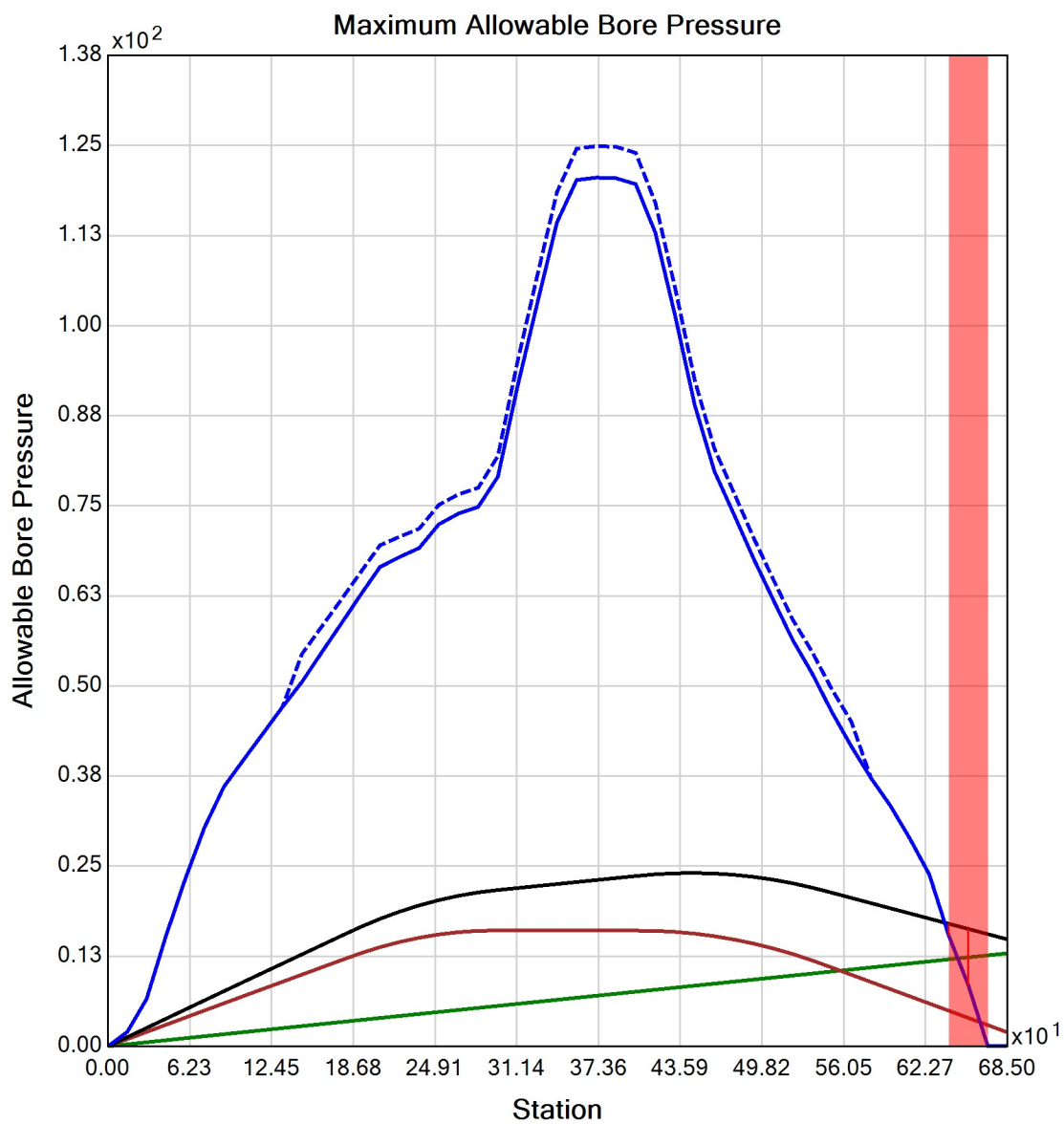














Generated Output



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Input Summary

Start Coordinate	(0.00, 0.00, 327.46) ft
End Coordinate	(680.00, 0.00, 322.65) ft
Project Length	680.00 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: 689.99 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	36.9
Water Pressure	9.4	9.4
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	11.2	46.2
Deflection		
Earth Load Deflection	0.564	10.039
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.593	10.068
Compressive Stress [psi]		
Compressive Wall Stress	50.4	208.1

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	667.8	667.8
Pullback Stress [psi]	381.5	381.5
Pullback Strain	6.636E-3	6.636E-3
Bending Stress [psi]	0.0	9.5
Bending Strain	0	1.649E-4
Tensile Stress [psi]	381.5	386.7
Tensile Strain	6.636E-3	6.891E-3

Net External Pressure = 14.1 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.593	7.5	12.7	OK
Unconstrained Collapse [psi]	21.9	131.7	6.0	OK
Compressive Wall Stress [psi]	50.4	1150.0	22.8	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	31.9	235.2	7.4	OK
Tensile Stress [psi]	386.7	1200.0	3.1	OK



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Project Summary

General:	CHPE HDD 42 Conduit 2 P3 Start Date: 12-10-2021 End Date: 12-10-2021
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	AJB CHA
Description:	HDD 42 10-inch DR 9 Conduit 2

Input Summary

Start Coordinate	(0.00, 0.00, 325.57) ft
End Coordinate	(560.00, 0.00, 322.60) ft
Project Length	560.00 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: 10.10 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, Sand (S), SP

Depth: 10.00 ft

Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]

Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

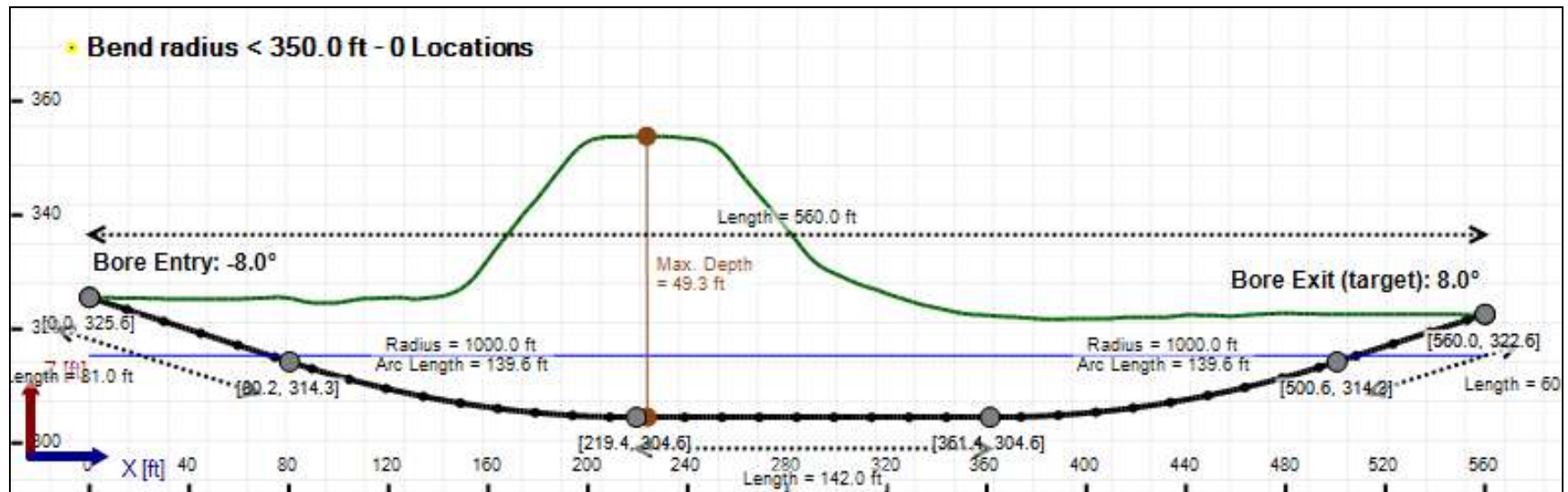
Soil Layer #3 USCS, Sand (S), SM

Depth: 6.50 ft

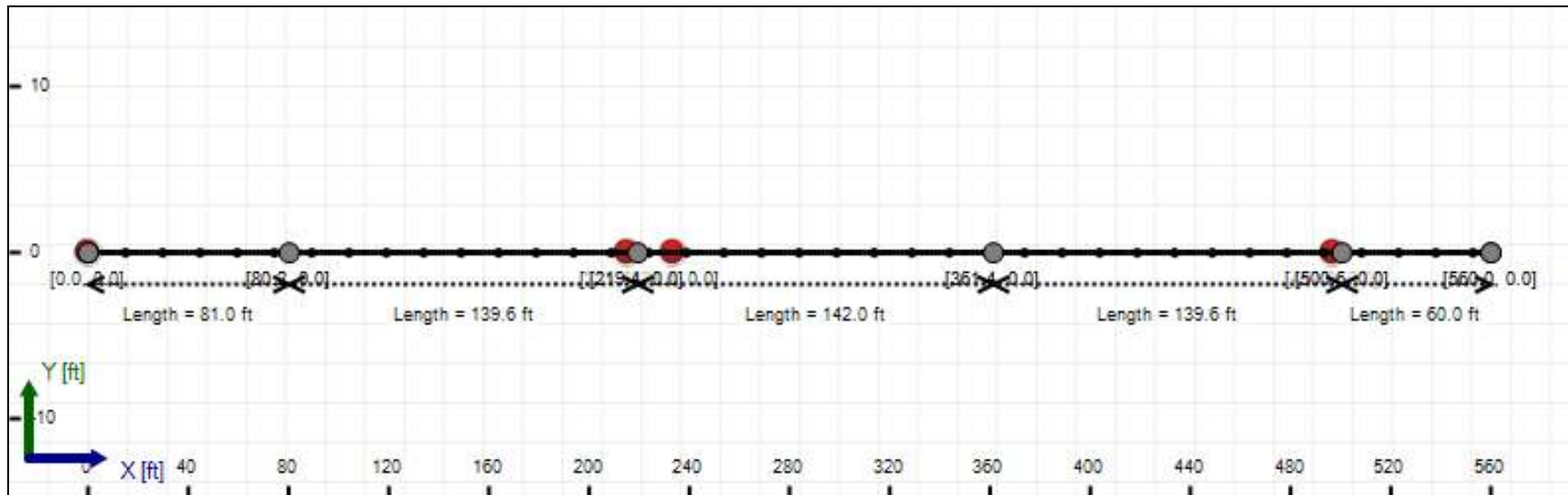
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 570.00 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	4.9	32.1
Water Pressure	4.7	4.7
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	9.6	36.8
Deflection		
Earth Load Deflection	1.331	8.731
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.463	8.863
Compressive Stress [psi]		
Compressive Wall Stress	43.1	165.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	9144.2	9144.2
Pullback Stress [psi]	255.0	255.0
Pullback Strain	4.435E-3	4.435E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	255.0	279.4
Tensile Strain	4.435E-3	5.307E-3

Net External Pressure = 16.8 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.463	7.5	5.1	OK
Unconstrained Collapse [psi]	13.7	121.1	8.9	OK
Compressive Wall Stress [psi]	43.1	1150.0	26.7	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	23.6	240.2	10.2	OK
Tensile Stress [psi]	279.4	1200.0	4.3	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	104.976 psi	110.459 psi
1	8.00 in	12.00 in	104.937 psi	110.420 psi
2	12.00 in	16.13 in	104.881 psi	110.363 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

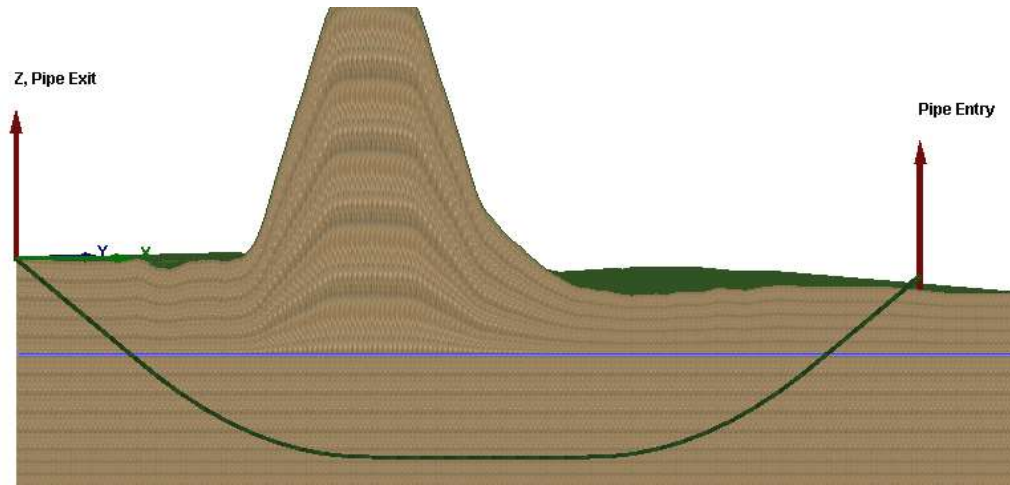
Rheological model: Bingham-Plastic

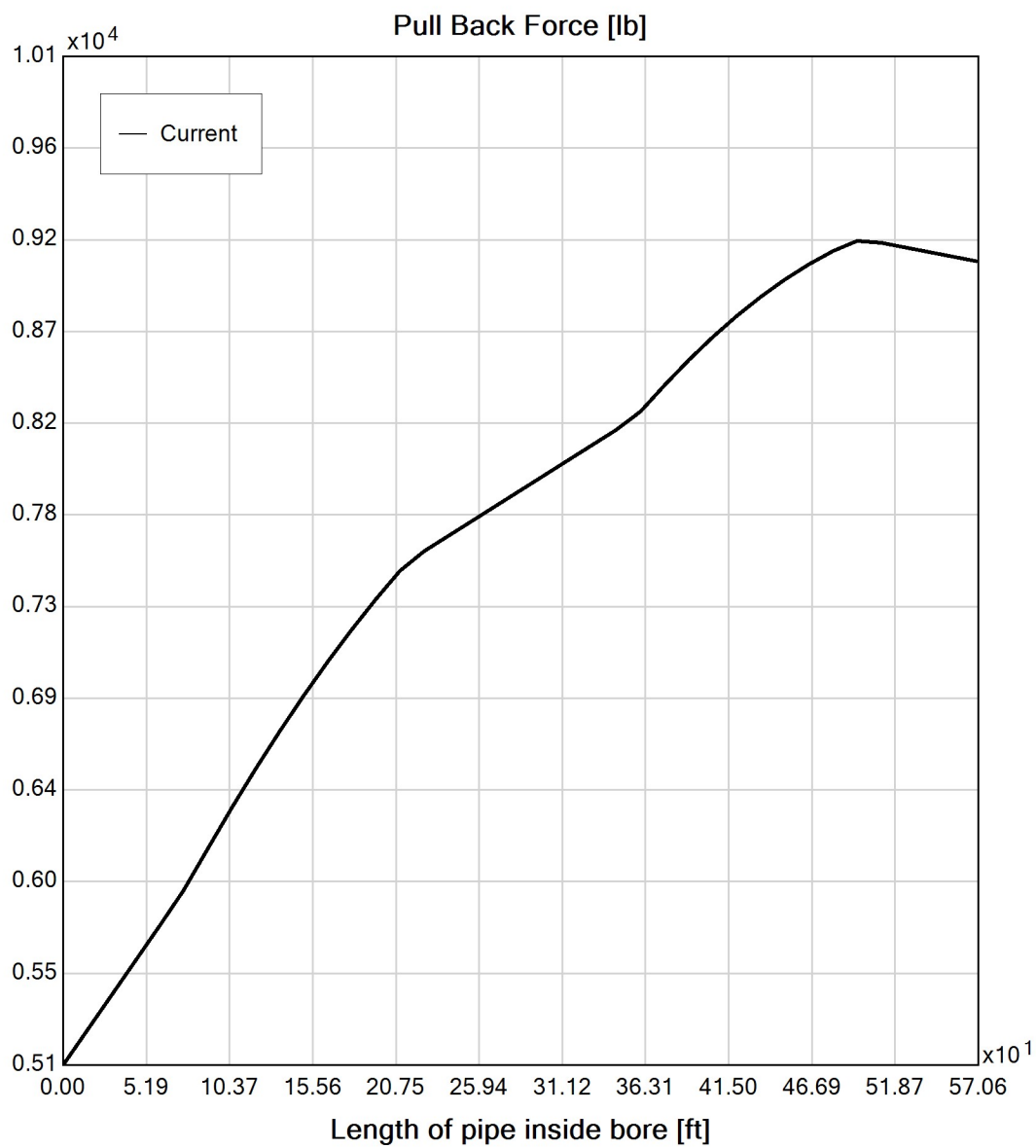
Plastic Viscosity (PV): 25.53

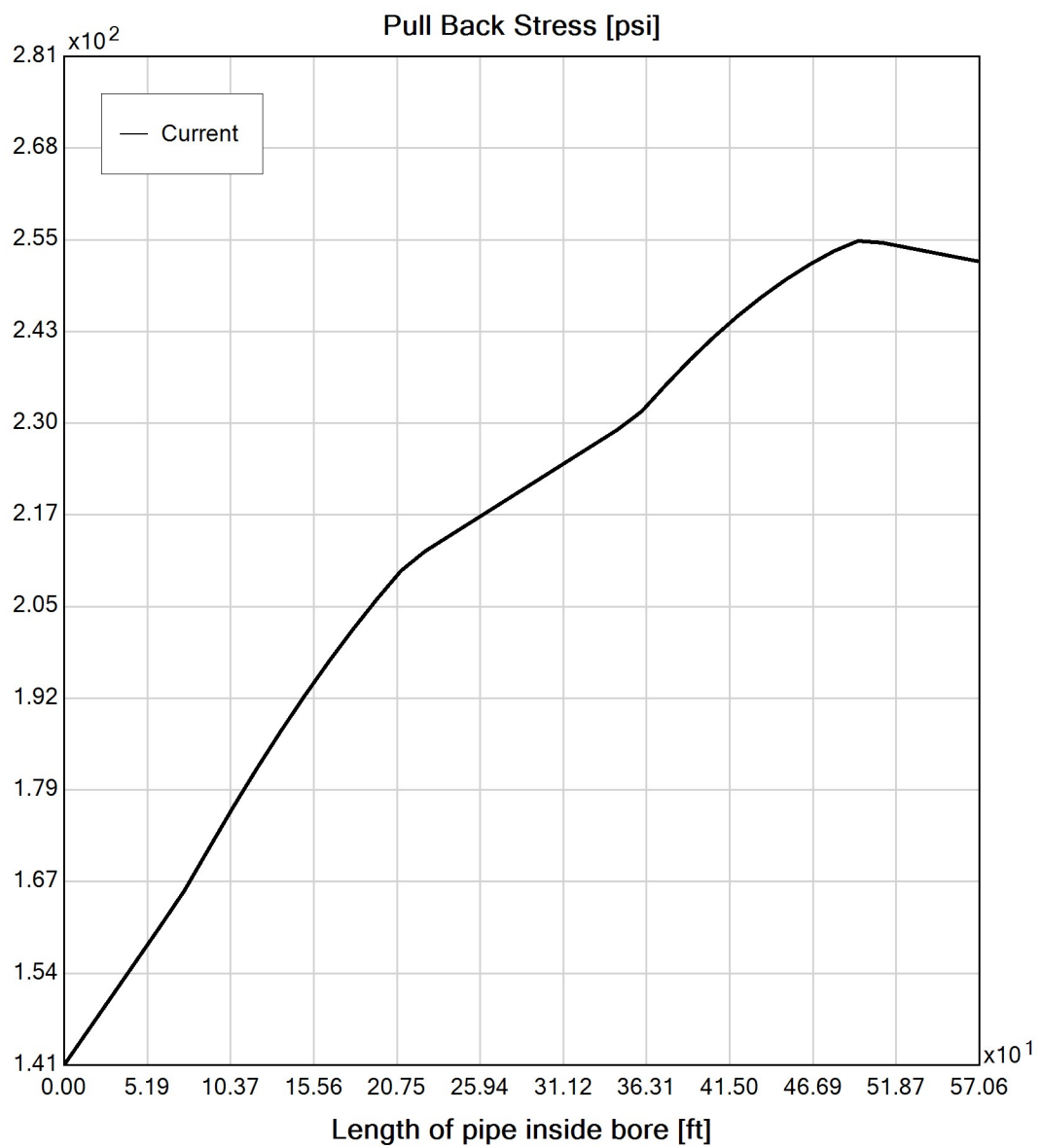
Yield Point (YP): 16.49

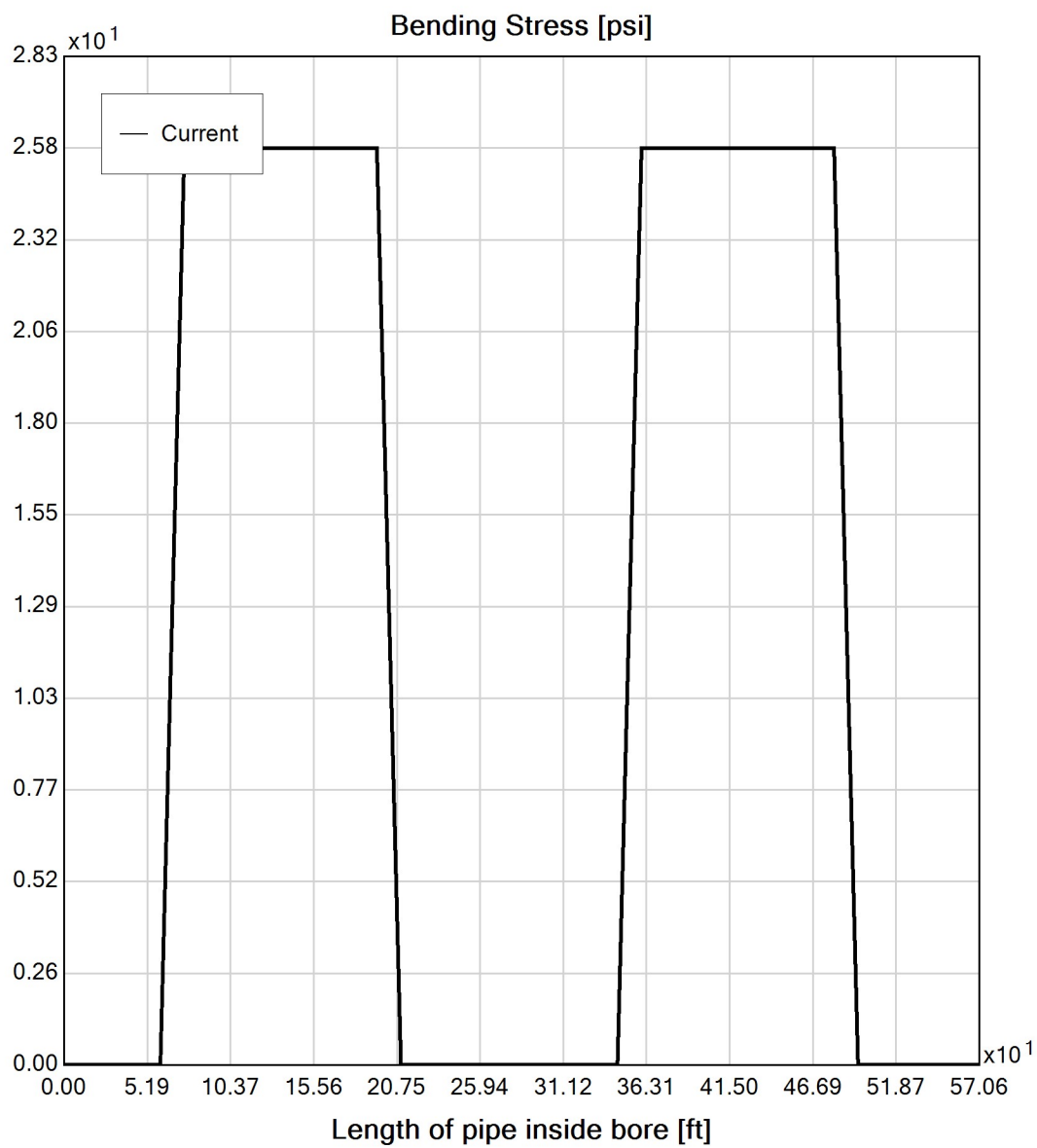
Effective Viscosity (cP): 1202.0

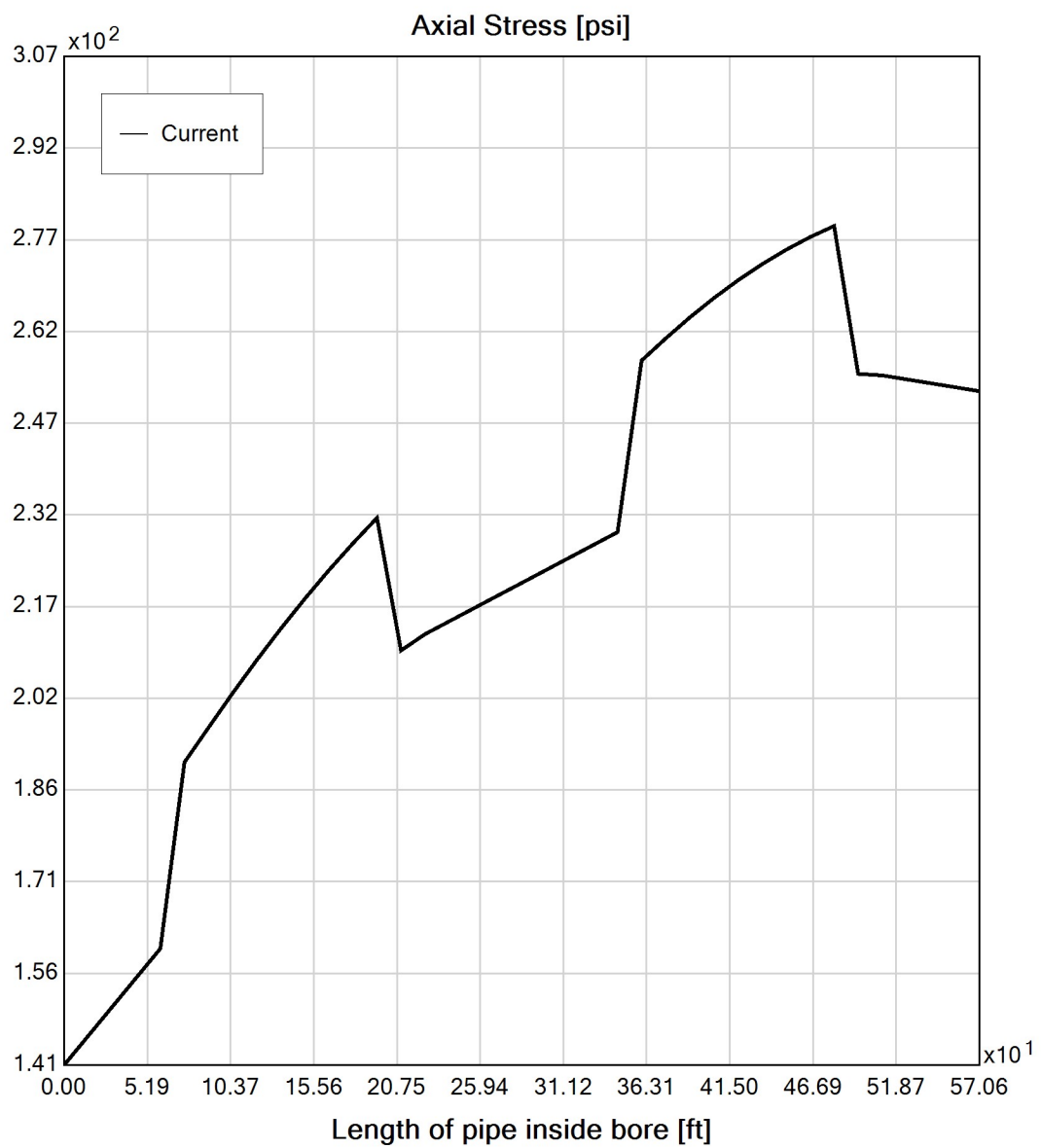
Virtual Site

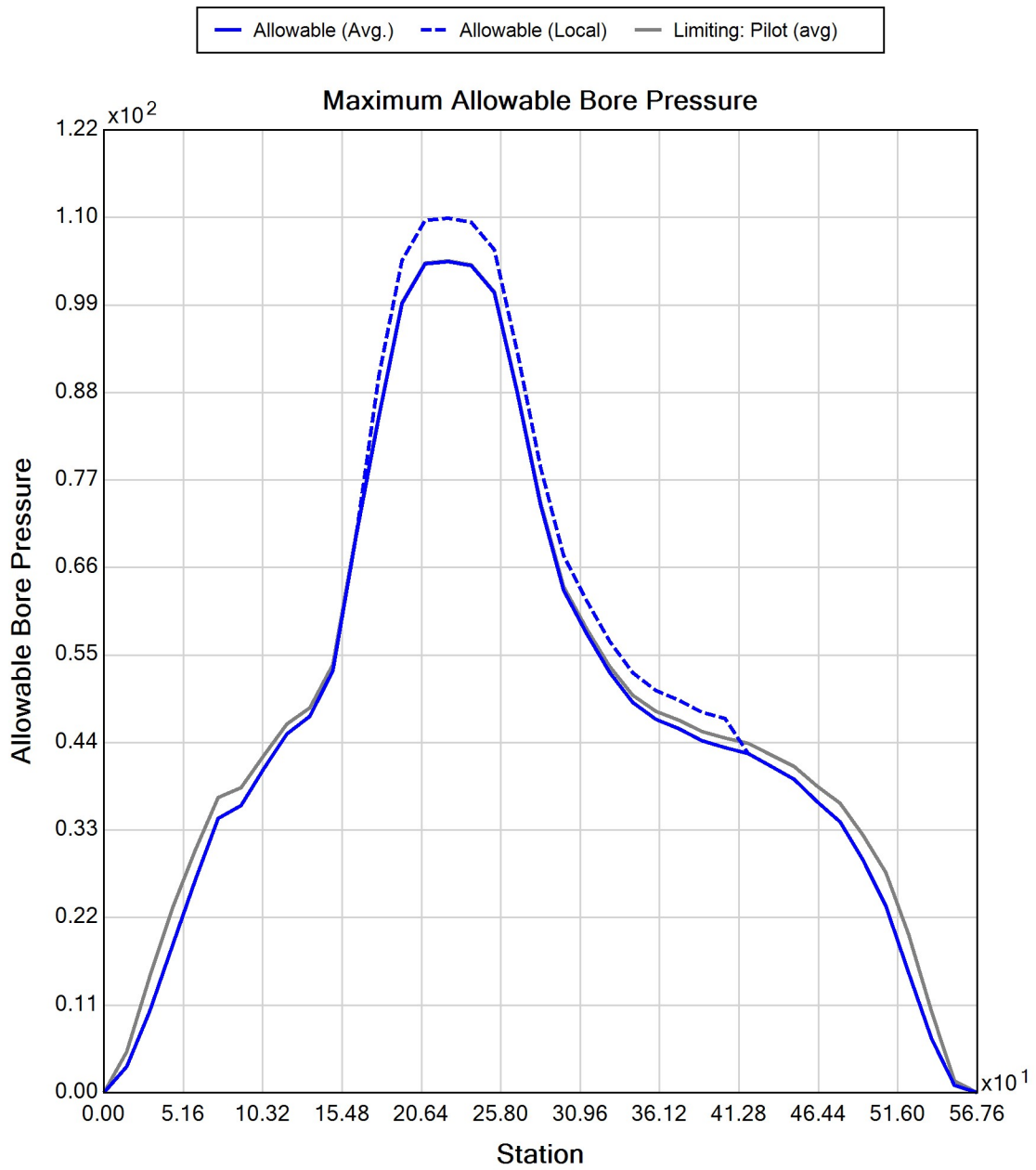


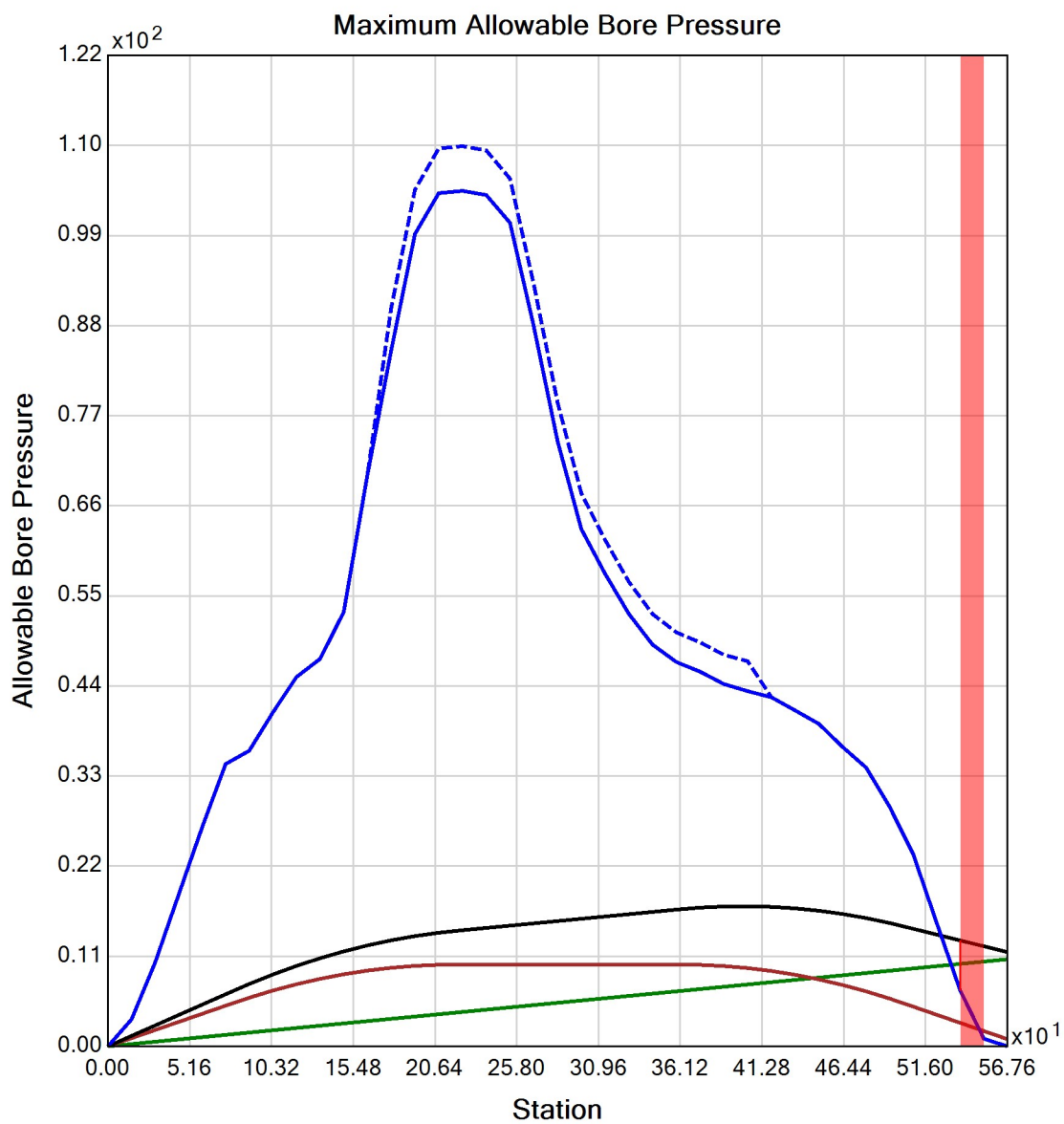














Generated Output



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Input Summary

Start Coordinate	(0.00, 0.00, 325.57) ft
End Coordinate	(560.00, 0.00, 322.60) ft
Project Length	560.00 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: 570.00 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	1.9	32.1
Water Pressure	4.7	4.7
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	6.6	36.8
Deflection		
Earth Load Deflection	0.566	8.731
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.595	8.761
Compressive Stress [psi]		
Compressive Wall Stress	29.8	165.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	555.9	555.9
Pullback Stress [psi]	317.6	317.6
Pullback Strain	5.524E-3	5.524E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	317.6	321.9
Tensile Strain	5.524E-3	5.698E-3

Net External Pressure = 16.8 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.595	7.5	12.6	OK
Unconstrained Collapse [psi]	13.7	131.4	9.6	OK
Compressive Wall Stress [psi]	29.8	1150.0	38.5	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	23.6	238.6	10.1	OK
Tensile Stress [psi]	321.9	1200.0	3.7	OK



Generated Output



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Project Summary

General: CHPE HDD 43
P3
Start Date: 12-10-2021
End Date: 12-10-2021

Project Owner: TDI
Project Contractor: Kiewit
Project Consultant: CHA/BCE

Designer: AJB
CHA

Description: HDD 43 10-inch DR 9

Input Summary

Start Coordinate	(0.00, 0.00, 320.64) ft
End Coordinate	(1050.00, 0.00, 320.62) 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), SP

Depth: 23.10 ft

Unit Weight: 109.5552 (dry), 125.0000 (sat) [lb/ft³]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Silt (M), MH

Depth: 5.00 ft

Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft³]

Phi: 0.00, S.M.: 145.00, Coh: 5.56 [psi]

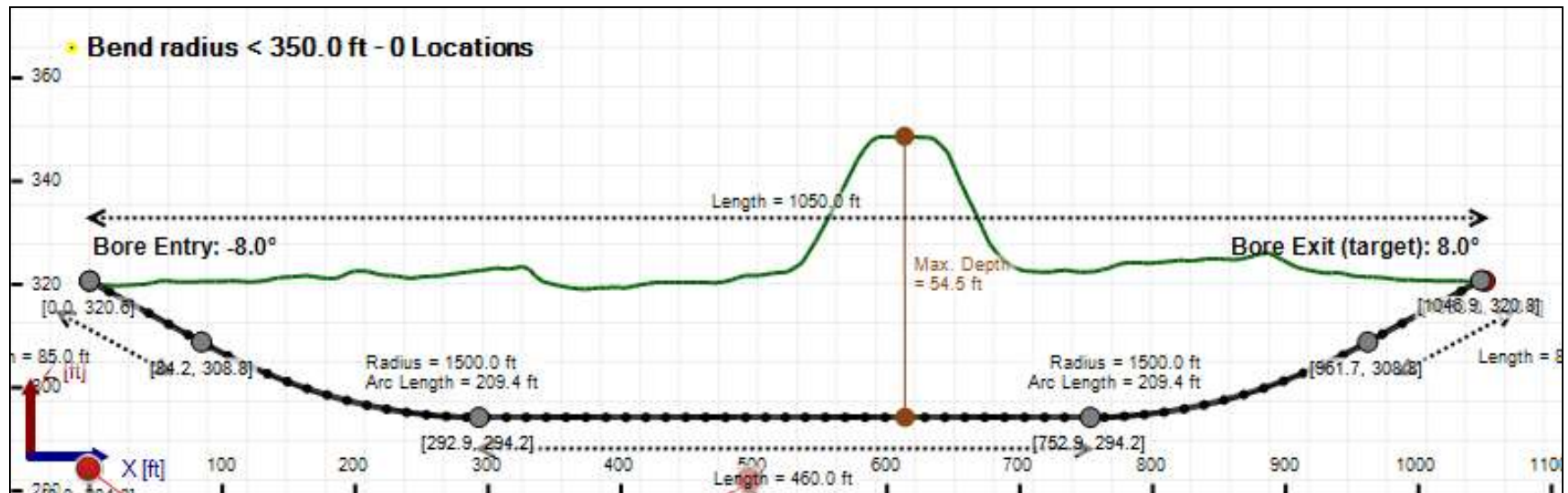
Soil Layer #3 USCS, Sand (S), SP

Depth: 11.50 ft

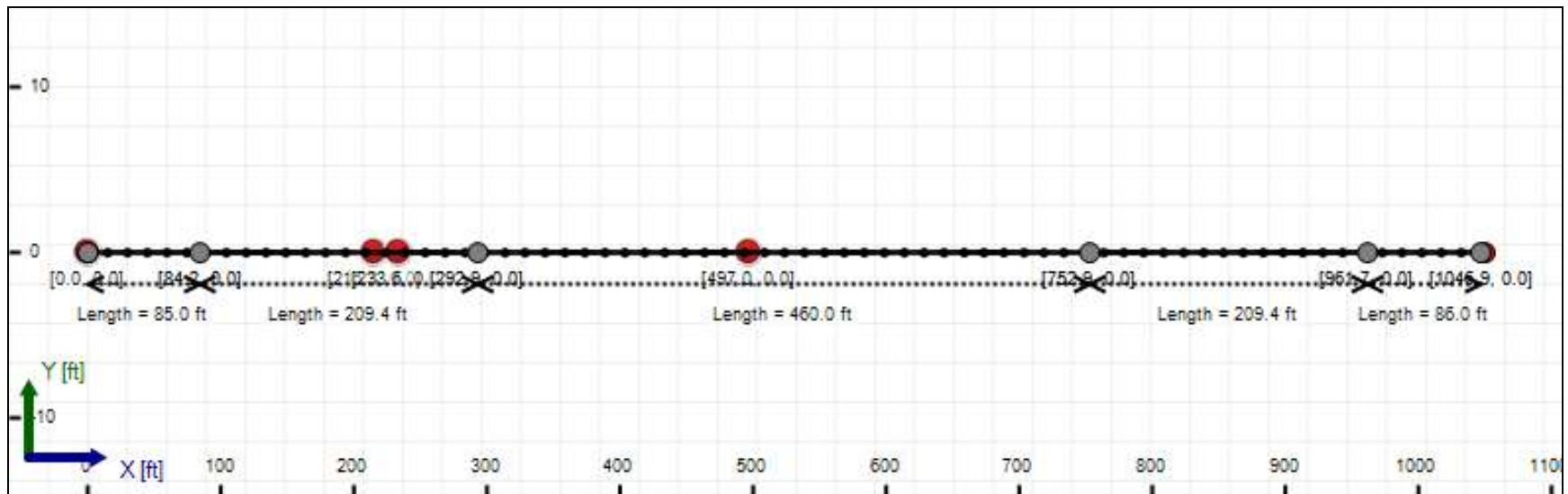
Unit Weight: 110.0000 (dry), 124.0000 (sat) [lb/ft³]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 1050.00 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	5.7	40.8
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	5.7	40.8
Deflection		
Earth Load Deflection	1.563	11.099
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.695	11.231
Compressive Stress [psi]		
Compressive Wall Stress	25.8	183.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	16406.8	16406.8
Pullback Stress [psi]	457.6	457.6
Pullback Strain	7.958E-3	7.958E-3
Bending Stress [psi]	0.0	17.2
Bending Strain	0	2.986E-4
Tensile Stress [psi]	457.6	473.3
Tensile Strain	7.958E-3	8.530E-3

Net External Pressure = 16.9 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.695	7.5	4.4	OK
Unconstrained Collapse [psi]	17.3	118.7	6.9	OK
Compressive Wall Stress [psi]	25.8	1150.0	44.5	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	27.3	228.9	8.4	OK
Tensile Stress [psi]	473.3	1200.0	2.5	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	120.952 psi	79.928 psi
1	8.00 in	12.00 in	120.923 psi	79.779 psi
2	12.00 in	16.13 in	120.880 psi	79.564 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

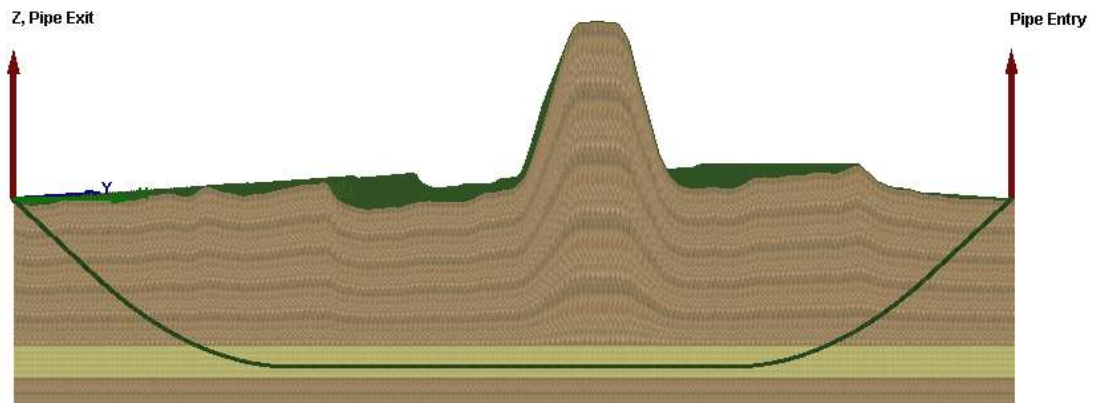
Rheological model: Bingham-Plastic

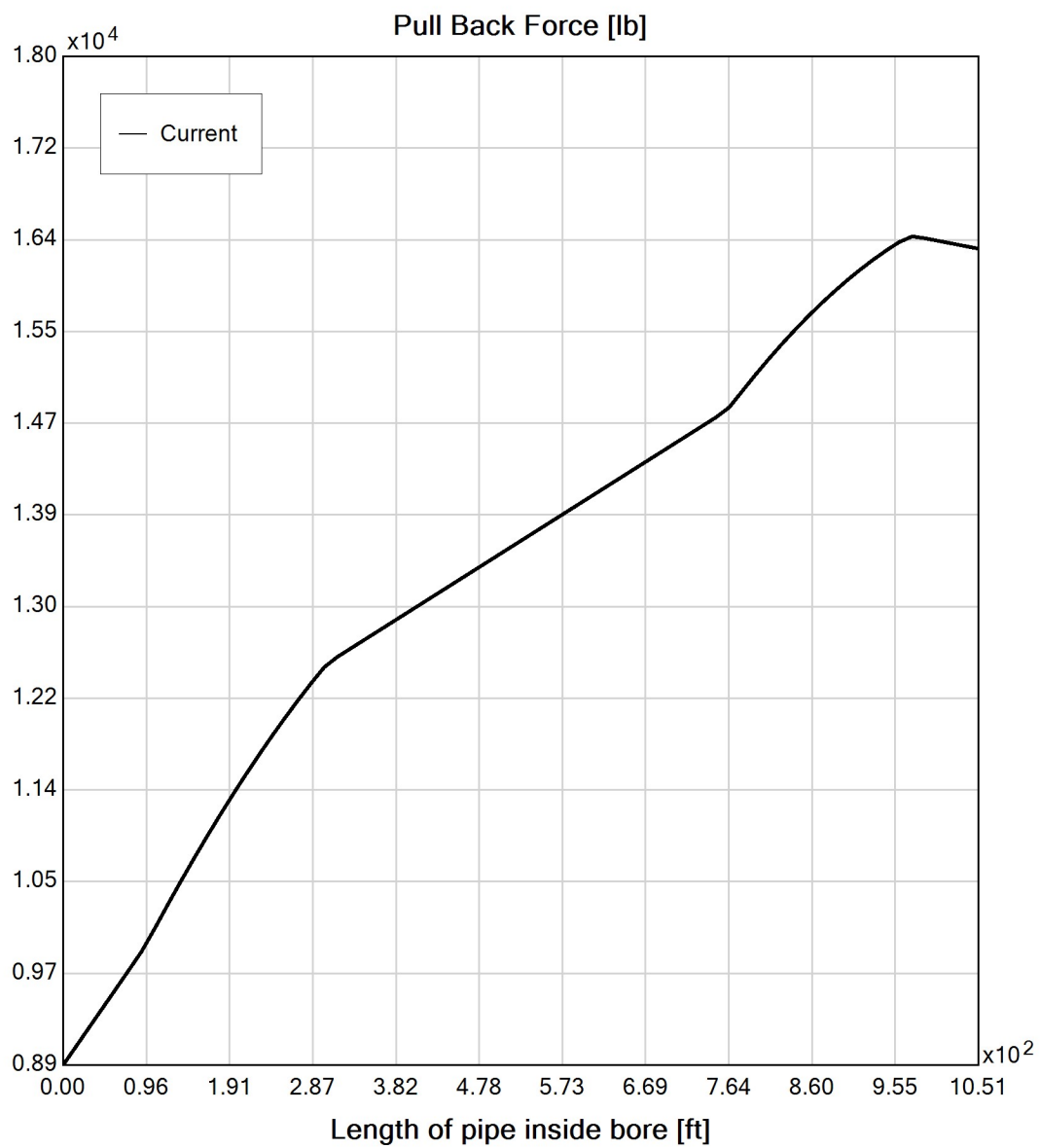
Plastic Viscosity (PV): 25.53

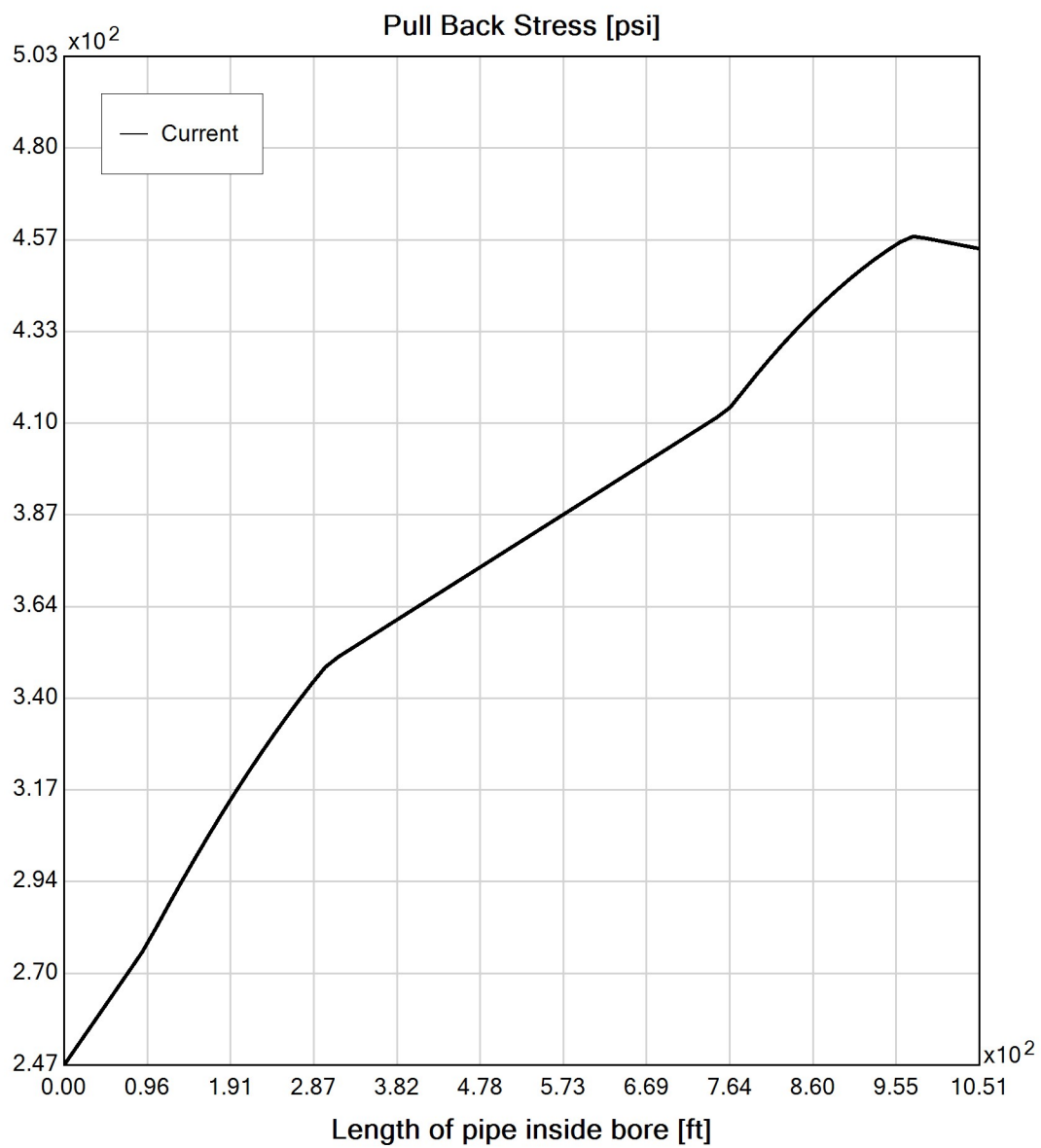
Yield Point (YP): 16.49

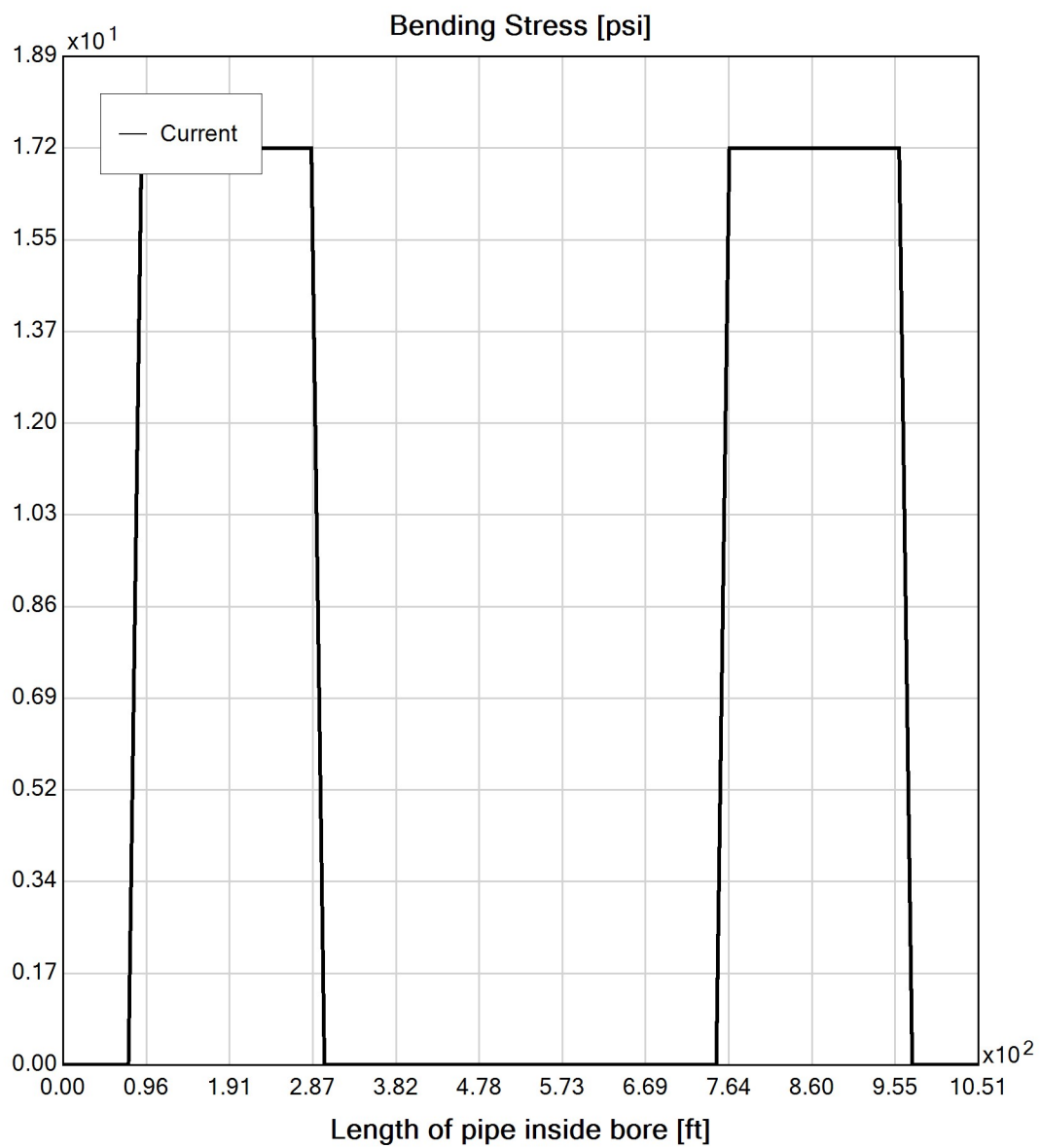
Effective Viscosity (cP): 1202.0

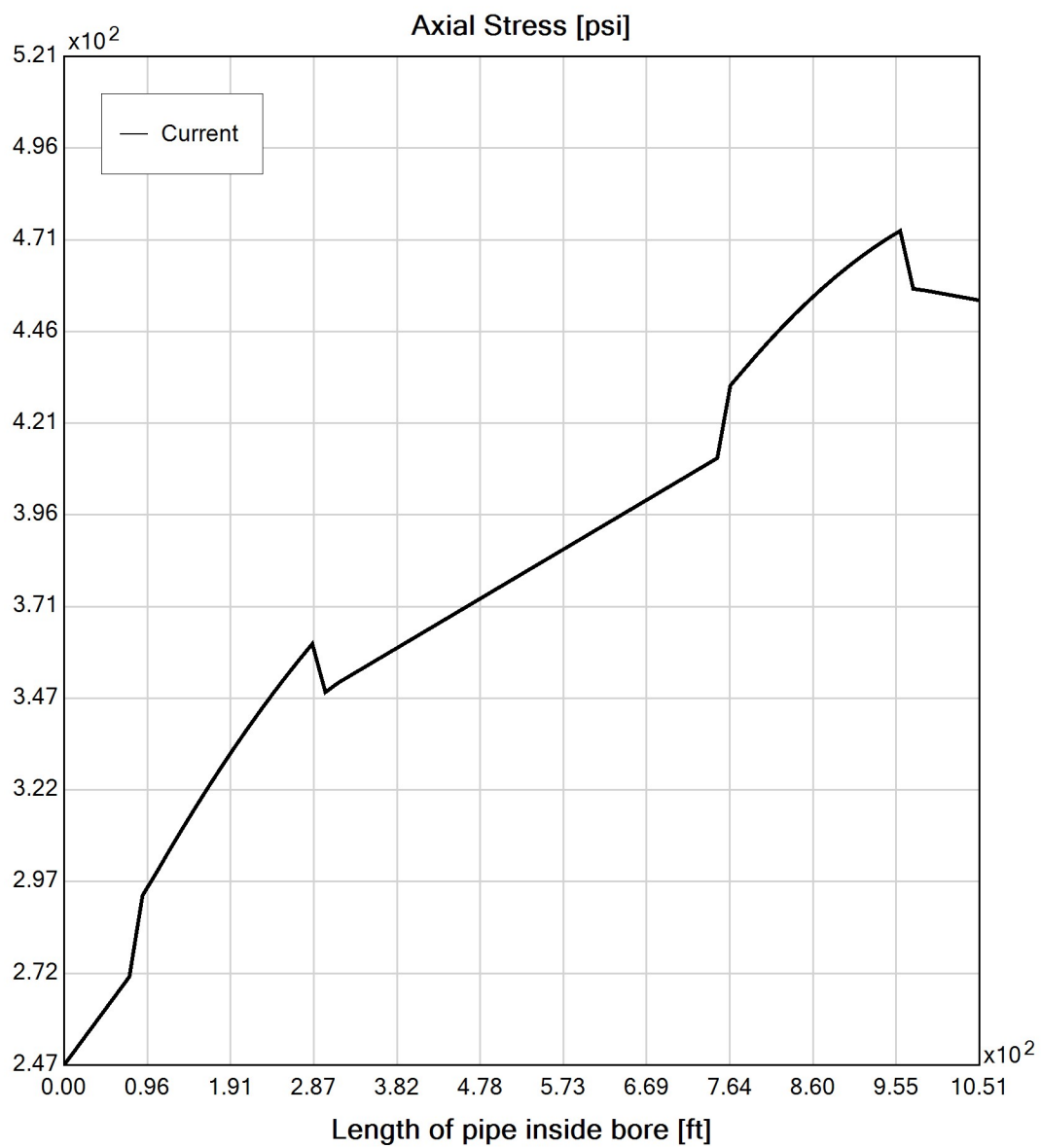
Virtual Site

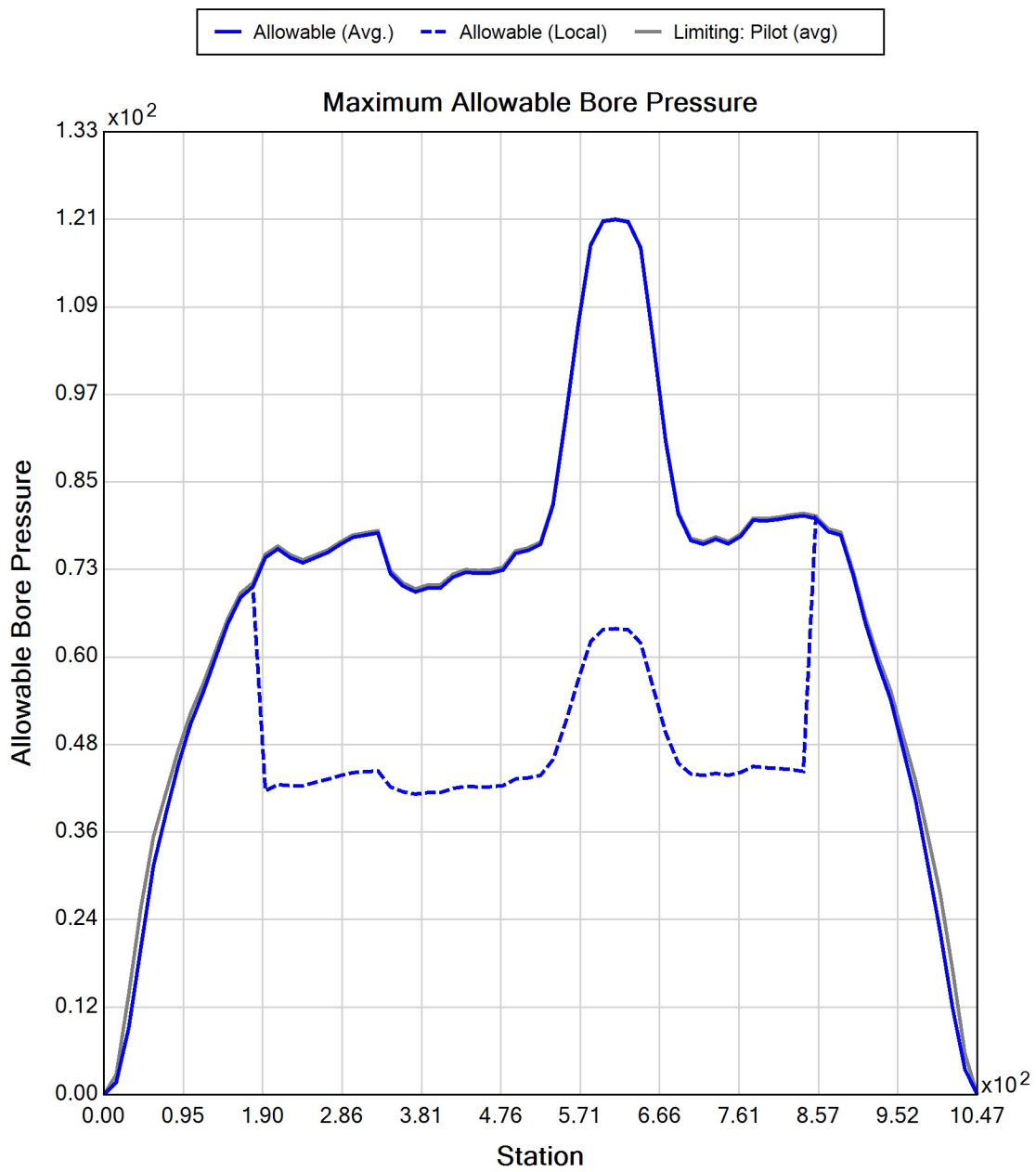


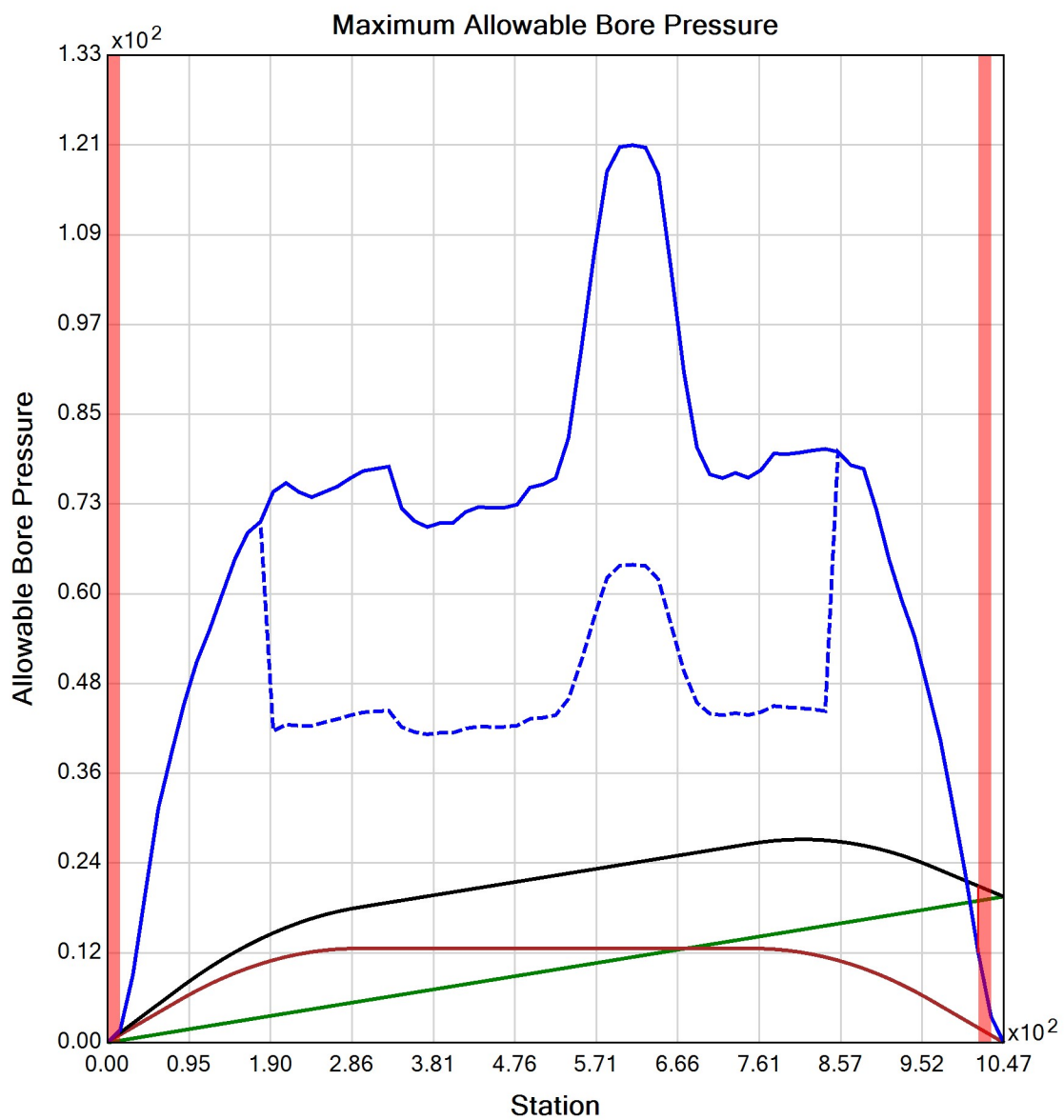














Generated Output



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Input Summary

Start Coordinate	(0.00, 0.00, 320.64) ft
End Coordinate	(1050.00, 0.00, 320.62) ft
Project Length	1050.00 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: 1050.00 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	2.3	40.8
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	2.3	40.8
Deflection		
Earth Load Deflection	0.636	11.099
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.666	11.128
Compressive Stress [psi]		
Compressive Wall Stress	10.5	183.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	910.4	910.4
Pullback Stress [psi]	520.2	520.2
Pullback Strain	9.047E-3	9.047E-3
Bending Stress [psi]	0.0	3.8
Bending Strain	0	6.597E-5
Tensile Stress [psi]	520.2	522.5
Tensile Strain	9.047E-3	9.154E-3

Net External Pressure = 16.9 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.666	7.5	11.3	OK
Unconstrained Collapse [psi]	17.3	130.4	7.5	OK
Compressive Wall Stress [psi]	10.5	1150.0	109.4	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	27.3	226.5	8.3	OK
Tensile Stress [psi]	522.5	1200.0	2.3	OK



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Project Summary

General: CHPE HDD 44
P3
Start Date: 12-10-2021
End Date: 12-10-2021

Project Owner: TDI
Project Contractor: Kiewit
Project Consultant: CHA/BCE

Designer: AB
CHA

Description: HDD 44 10-inch DR 9

Input Summary

Start Coordinate	(0.00, 0.00, 315.00) ft
End Coordinate	(540.00, 0.00, 314.00) ft
Project Length	540.00 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: 5

Soil Layer #1 USCS, Sand (S), SP

Depth: 0.90 ft

Unit Weight: 109.5552 (dry), 125.0000 (sat) [lb/ft3]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Sand (S), SP

Depth: 10.80 ft

Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]

Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #3 USCS, Sand (S), SW

Depth: 1.20 ft

Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]

Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #4 USCS, Silt (M), ML

Depth: 6.00 ft

Unit Weight: 80.0000 (dry), 100.0000 (sat) [lb/ft3]

Phi: 0.00, S.M.: 145.00, Coh: 3.13 [psi]

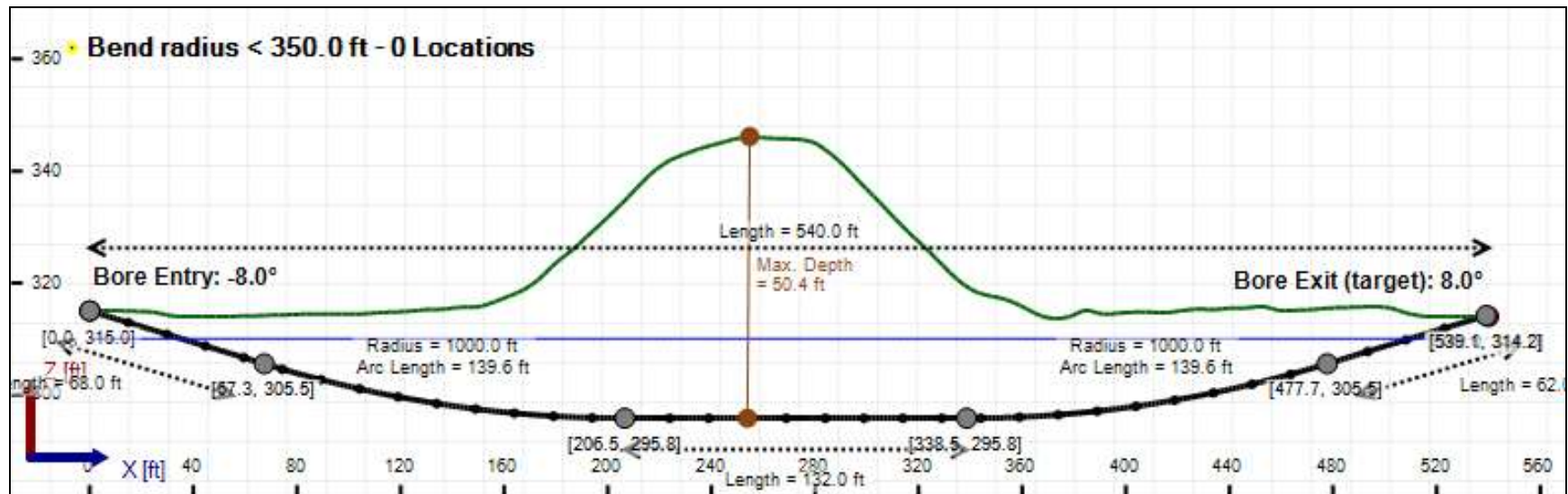
Soil Layer #5 USCS, Sand (S), SP

Depth: 13.00 ft

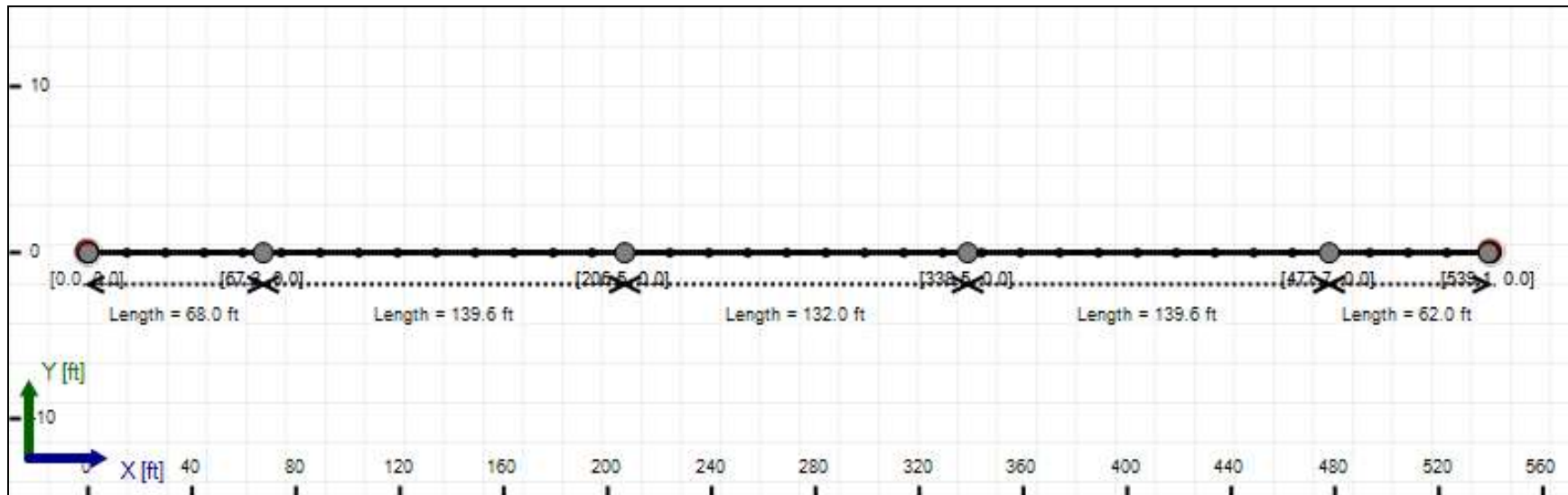
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 555.00 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	4.7	32.0
Water Pressure	6.2	6.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	10.9	38.1
Deflection		
Earth Load Deflection	1.293	8.708
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.425	8.840
Compressive Stress [psi]		
Compressive Wall Stress	49.1	171.6

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	9060.6	9060.6
Pullback Stress [psi]	252.7	252.7
Pullback Strain	4.395E-3	4.395E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	252.7	277.2
Tensile Strain	4.395E-3	5.269E-3

Net External Pressure = 16.1 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.425	7.5	5.3	OK
Unconstrained Collapse [psi]	13.2	121.5	9.2	OK
Compressive Wall Stress [psi]	49.1	1150.0	23.4	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	23.1	240.3	10.4	OK
Tensile Stress [psi]	277.2	1200.0	4.3	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	105.358 psi	111.737 psi
1	8.00 in	12.00 in	105.321 psi	111.699 psi
2	12.00 in	16.13 in	105.268 psi	111.644 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

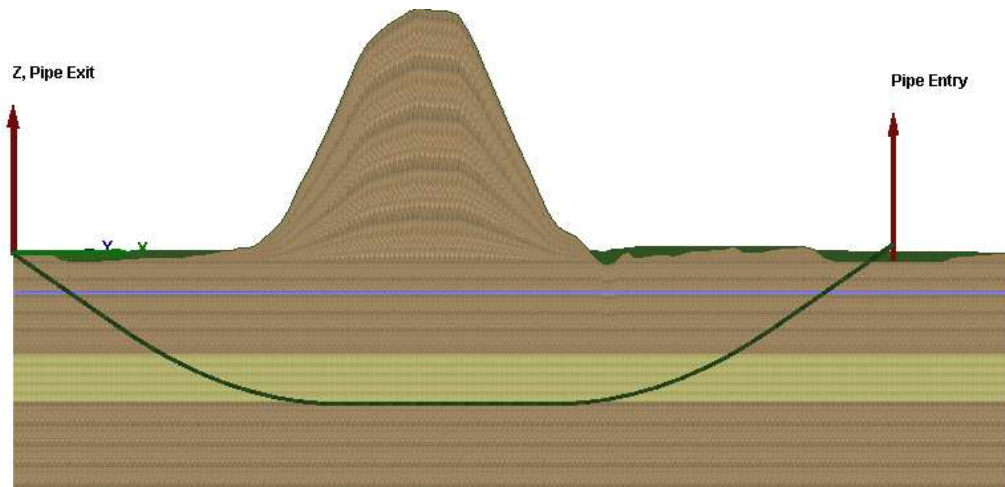
Rheological model: Bingham-Plastic

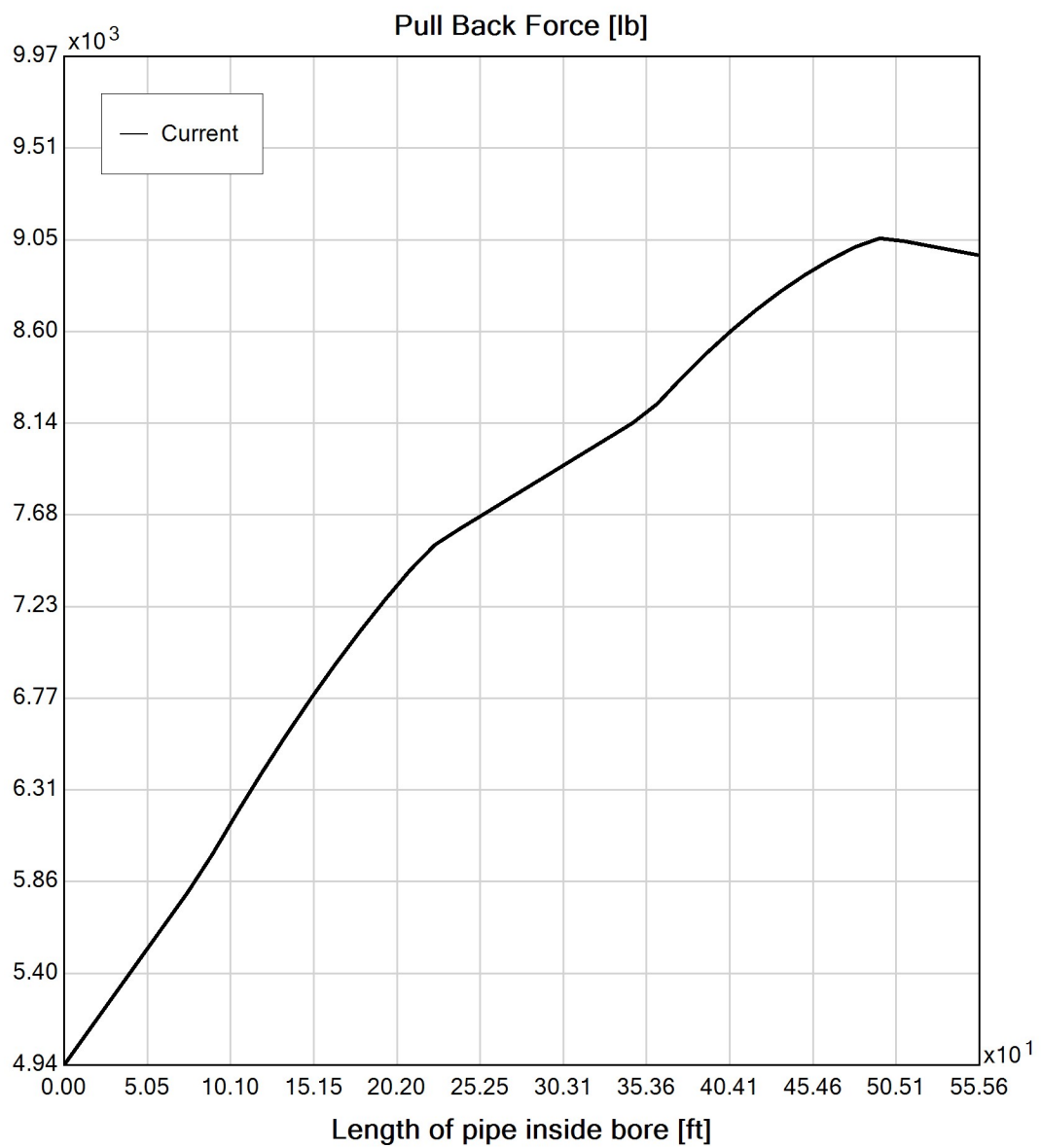
Plastic Viscosity (PV): 25.53

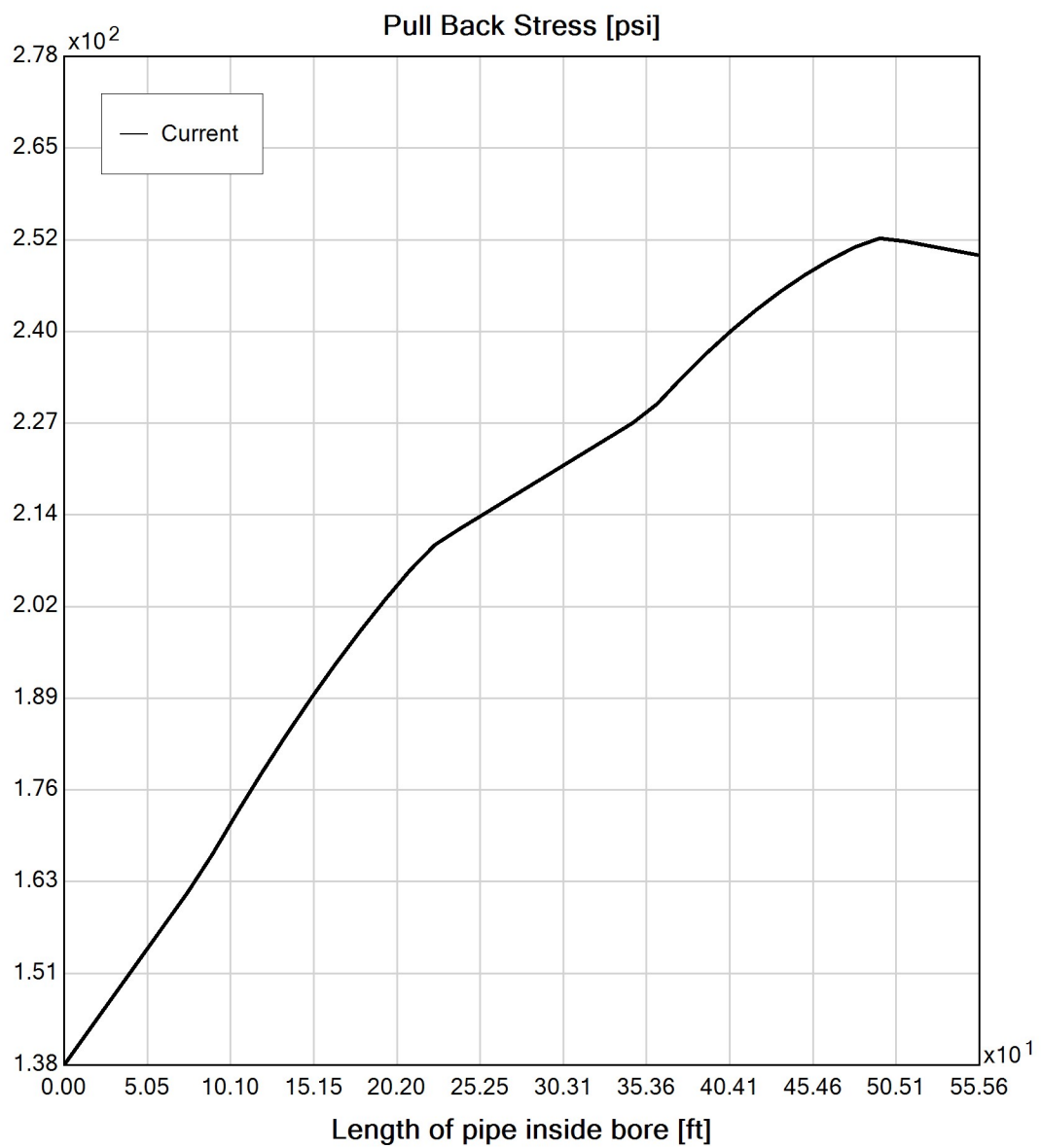
Yield Point (YP): 16.49

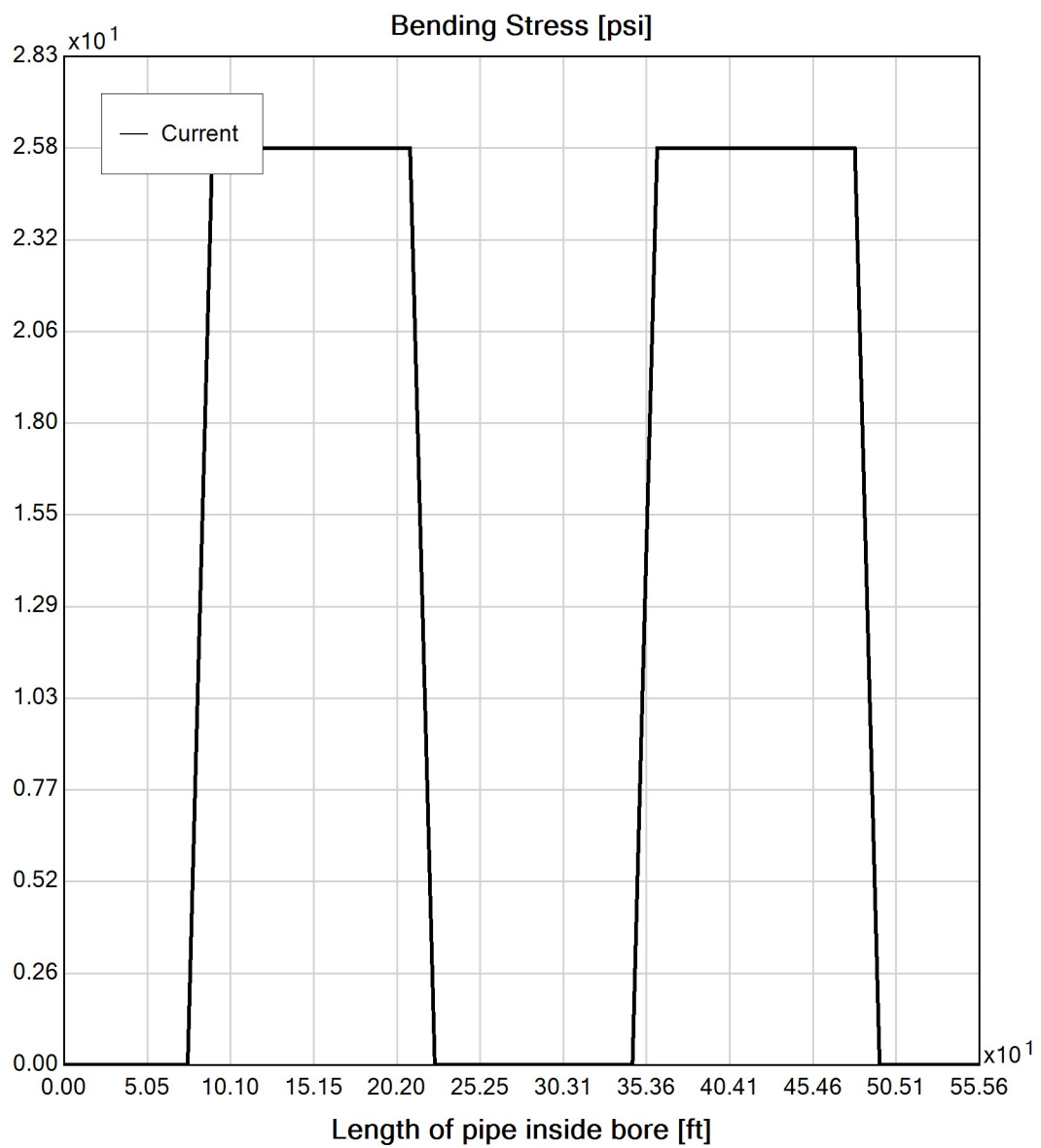
Effective Viscosity (cP): 1202.0

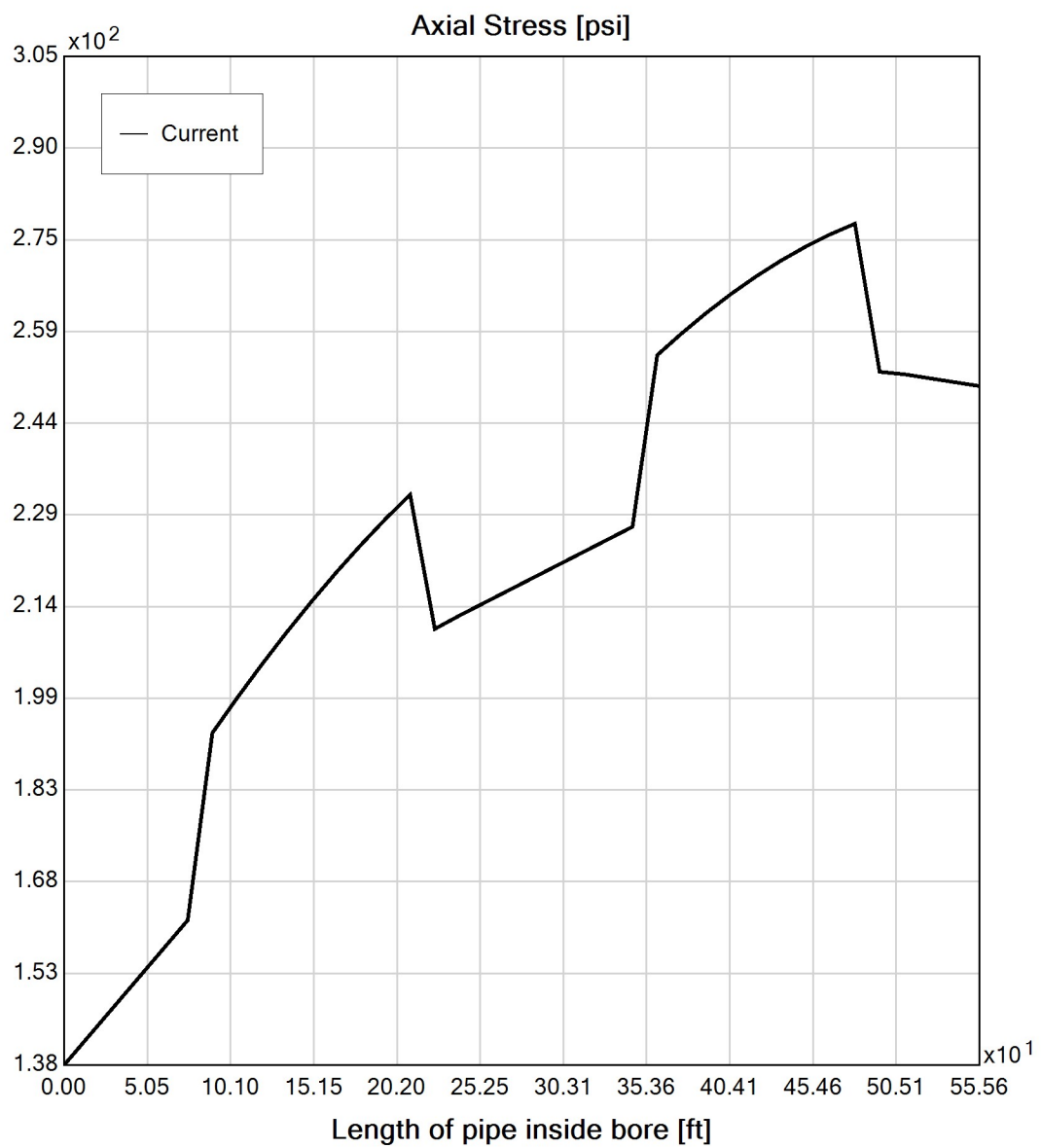
Virtual Site

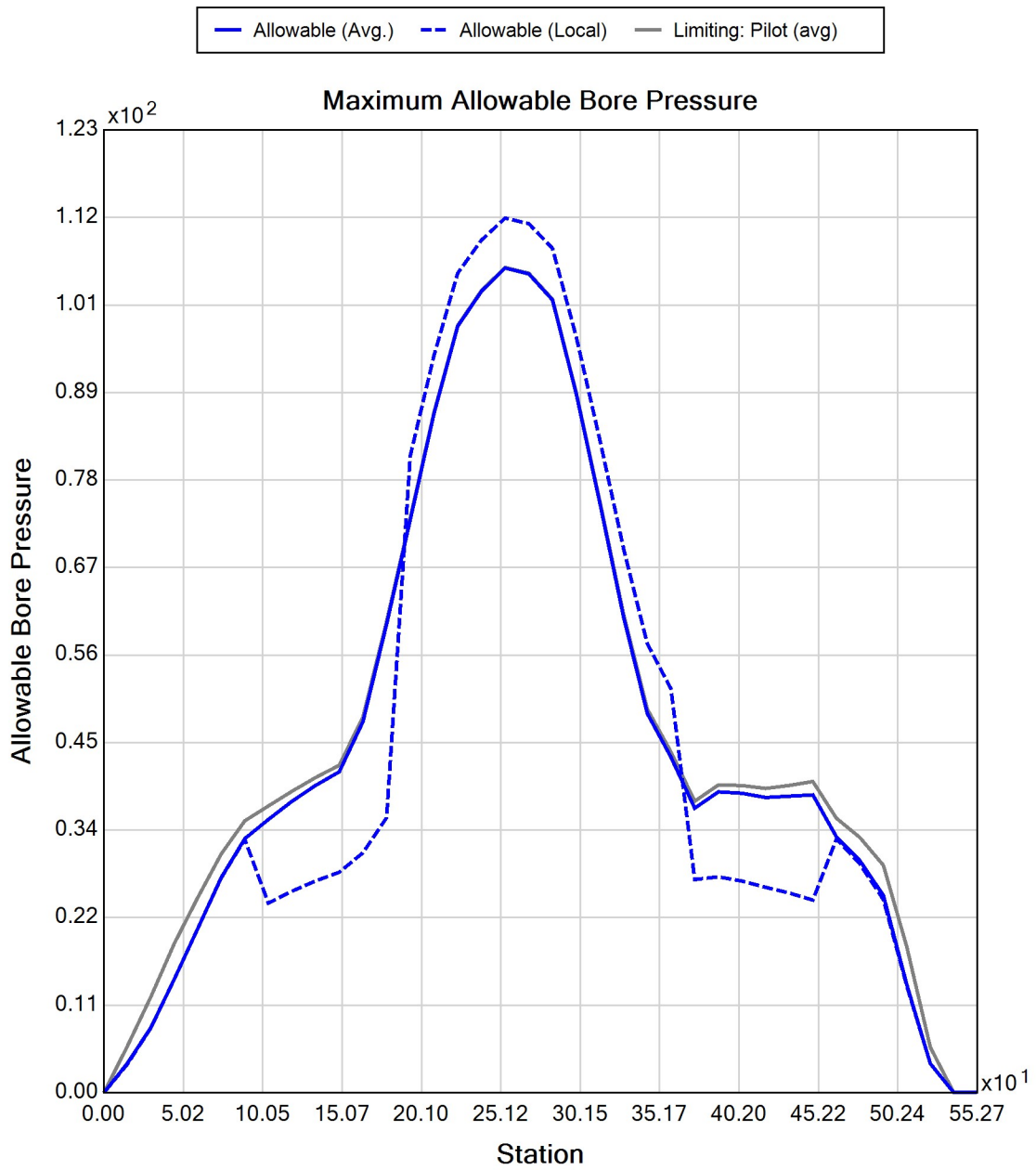


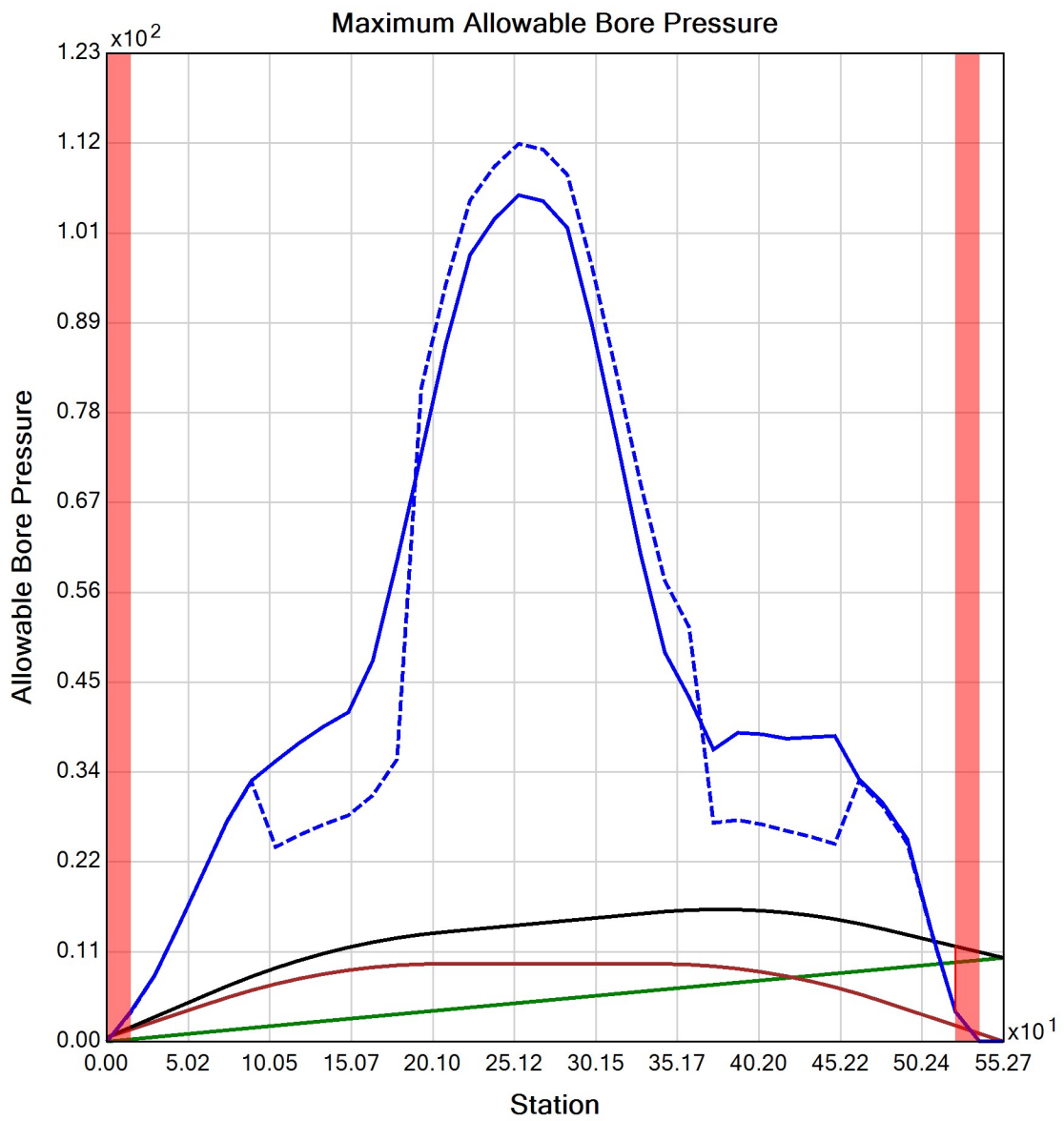














Generated Output



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Input Summary

Start Coordinate	(0.00, 0.00, 315.00) ft
End Coordinate	(540.00, 0.00, 314.00) ft
Project Length	540.00 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: 555.00 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	1.9	32.0
Water Pressure	6.2	6.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	8.0	38.1
Deflection		
Earth Load Deflection	0.511	8.708
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.541	8.737
Compressive Stress [psi]		
Compressive Wall Stress	36.1	171.6

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	551.8	551.8
Pullback Stress [psi]	315.3	315.3
Pullback Strain	5.484E-3	5.484E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	315.3	319.8
Tensile Strain	5.484E-3	5.660E-3

Net External Pressure = 16.1 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.541	7.5	13.9	OK
Unconstrained Collapse [psi]	13.2	131.6	10.0	OK
Compressive Wall Stress [psi]	36.1	1150.0	31.8	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	23.2	239.2	10.3	OK
Tensile Stress [psi]	319.8	1200.0	3.8	OK



Generated Output



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Project Summary

General: CHPE HDD 45
P3
Start Date: 12-10-2021
End Date: 12-10-2021

Project Owner: TDI
Project Contractor: Kiewit
Project Consultant: CHA/BCE

Designer: AB
CHA

Description: HDD 45 10-inch DR 9

Input Summary

Start Coordinate	(0.00, 0.00, 324.14) ft
End Coordinate	(620.00, 0.00, 318.50) ft
Project Length	620.00 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, Gravel (G), GP

Depth: 6.80 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, Sand (S), SW

Depth: 18.00 ft

Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

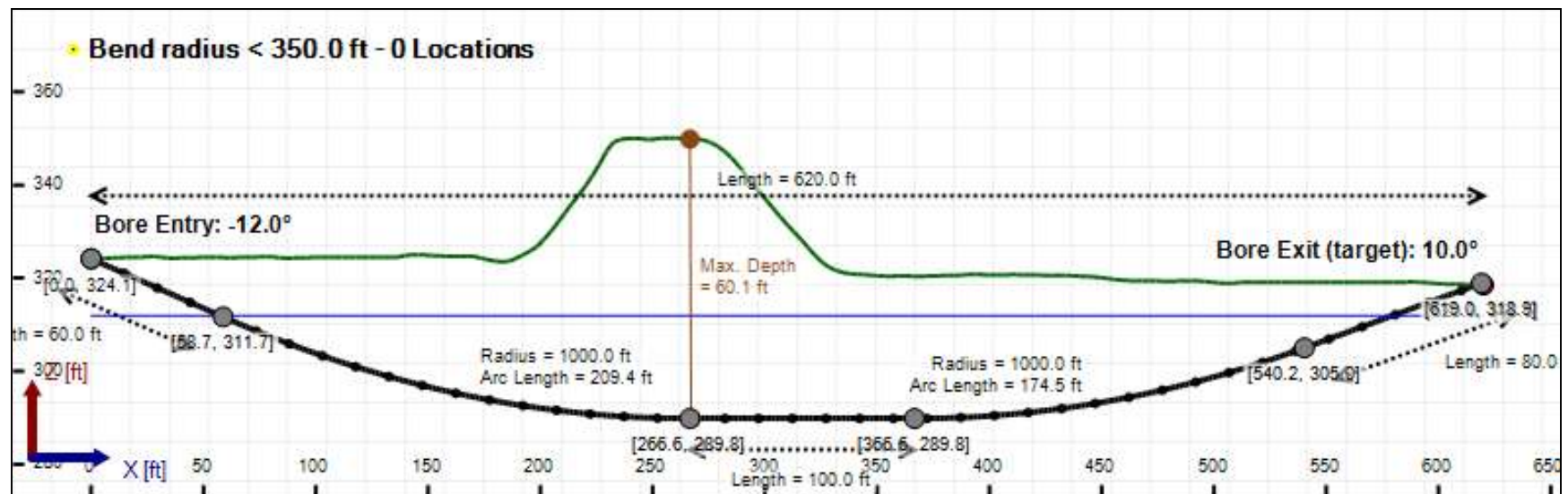
Soil Layer #3 USCS, Sand (S), SP

Depth: 17.00 ft

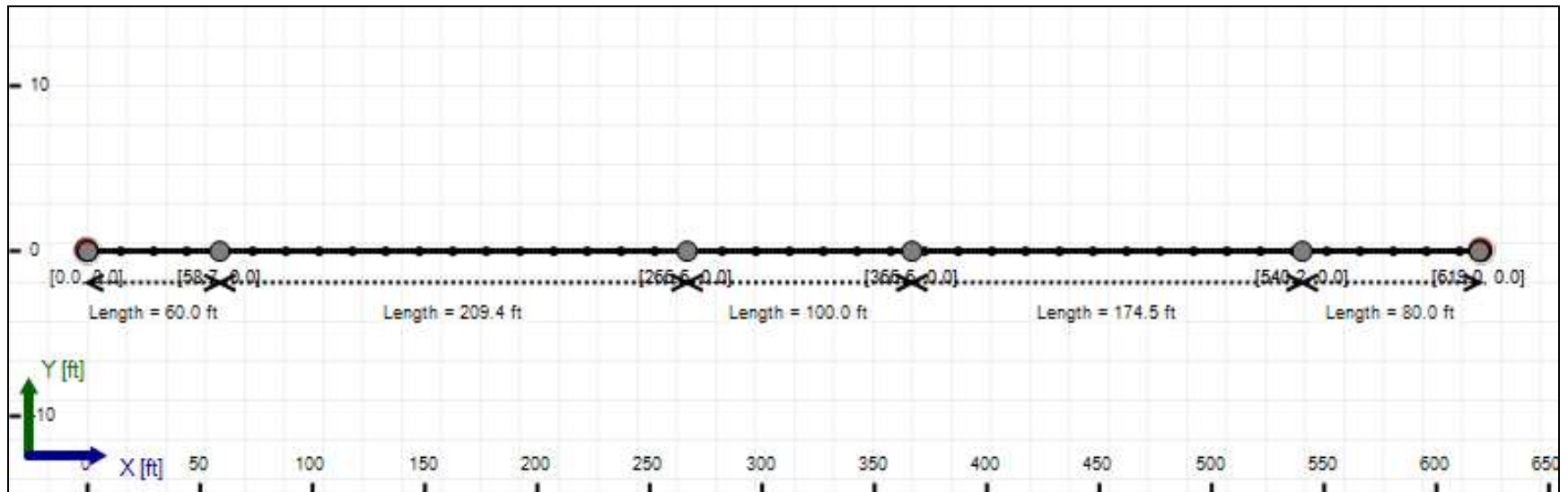
Unit Weight: 109.5552 (dry), 125.0000 (sat) [lb/ft3]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 630.00 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	4.8	37.5
Water Pressure	9.6	9.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	14.3	47.0
Deflection		
Earth Load Deflection	1.297	10.206
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.429	10.338
Compressive Stress [psi]		
Compressive Wall Stress	64.5	211.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	10665.1	10665.1
Pullback Stress [psi]	297.4	297.4
Pullback Strain	5.173E-3	5.173E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	297.4	322.6
Tensile Strain	5.173E-3	6.059E-3

Net External Pressure = 18.1 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.429	7.5	5.2	OK
Unconstrained Collapse [psi]	22.3	121.5	5.4	OK
Compressive Wall Stress [psi]	64.5	1150.0	17.8	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	32.3	237.9	7.4	OK
Tensile Stress [psi]	322.6	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	123.450 psi	126.470 psi
1	8.00 in	12.00 in	123.425 psi	126.444 psi
2	12.00 in	16.13 in	123.389 psi	126.408 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

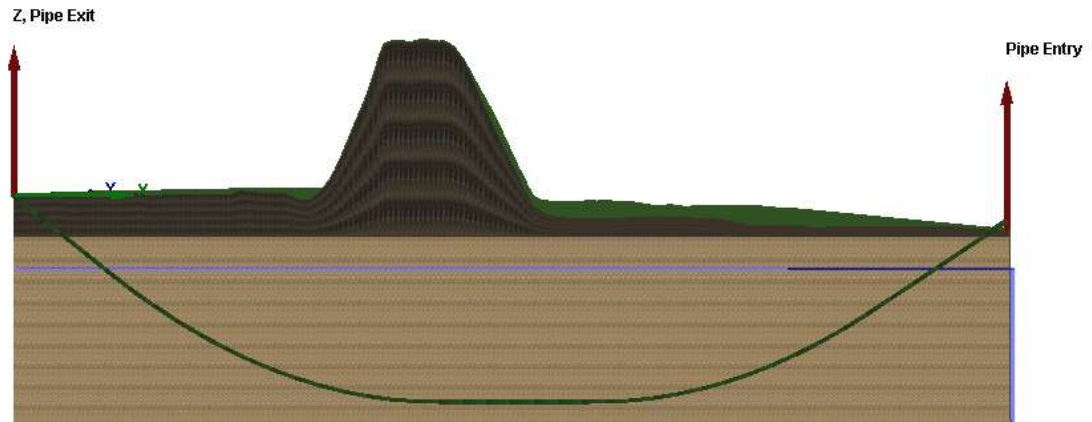
Rheological model: Bingham-Plastic

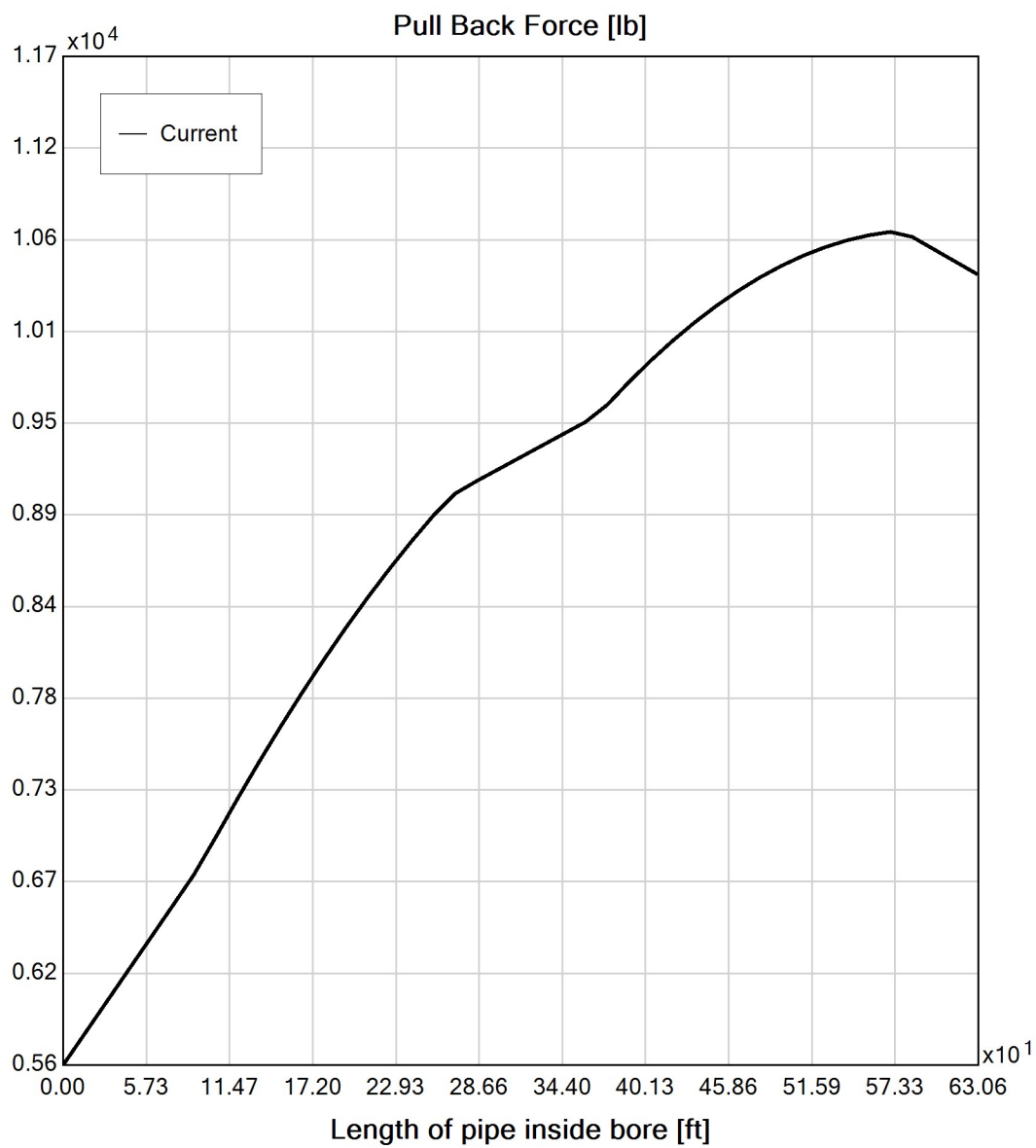
Plastic Viscosity (PV): 25.53

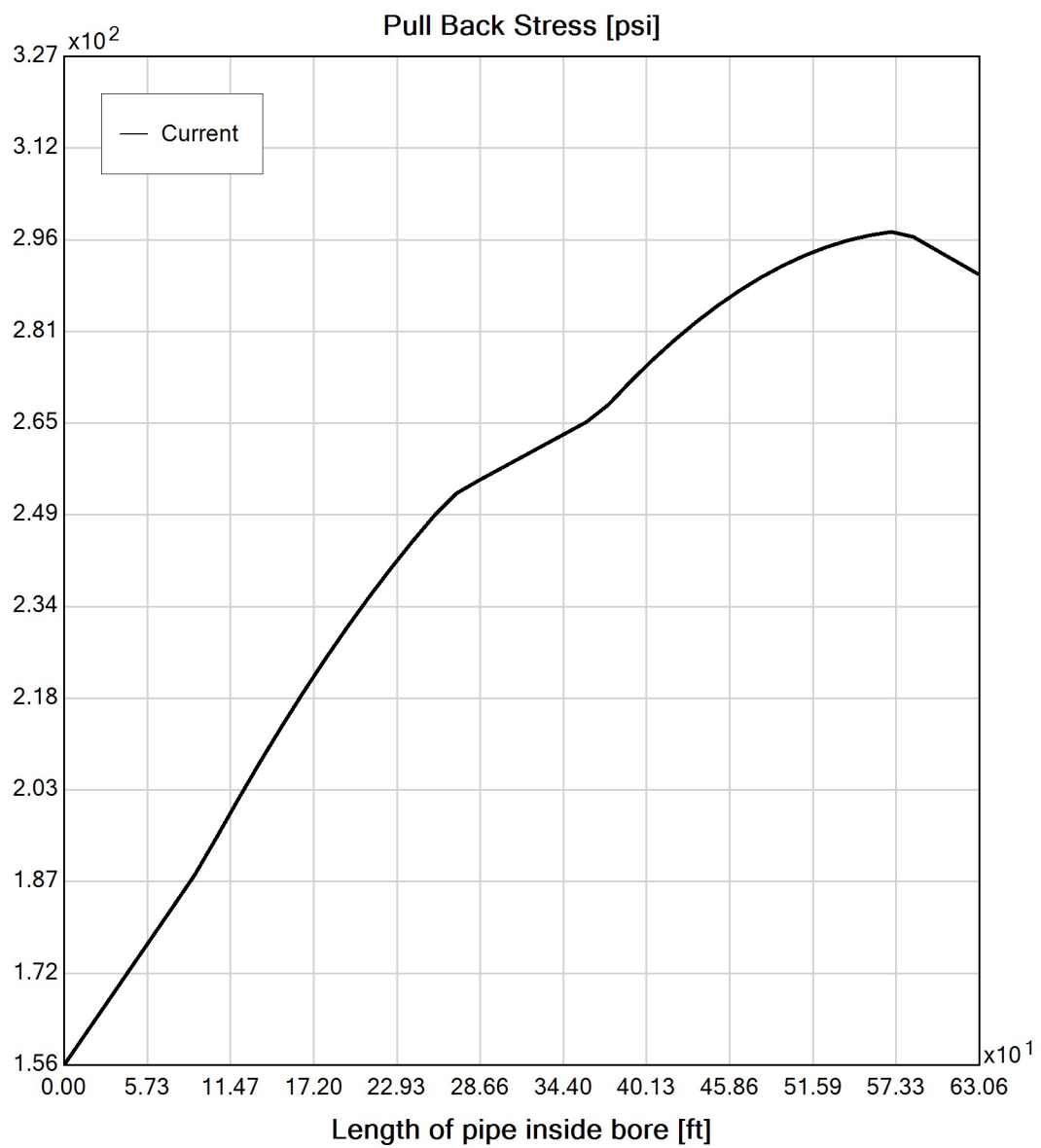
Yield Point (YP): 16.49

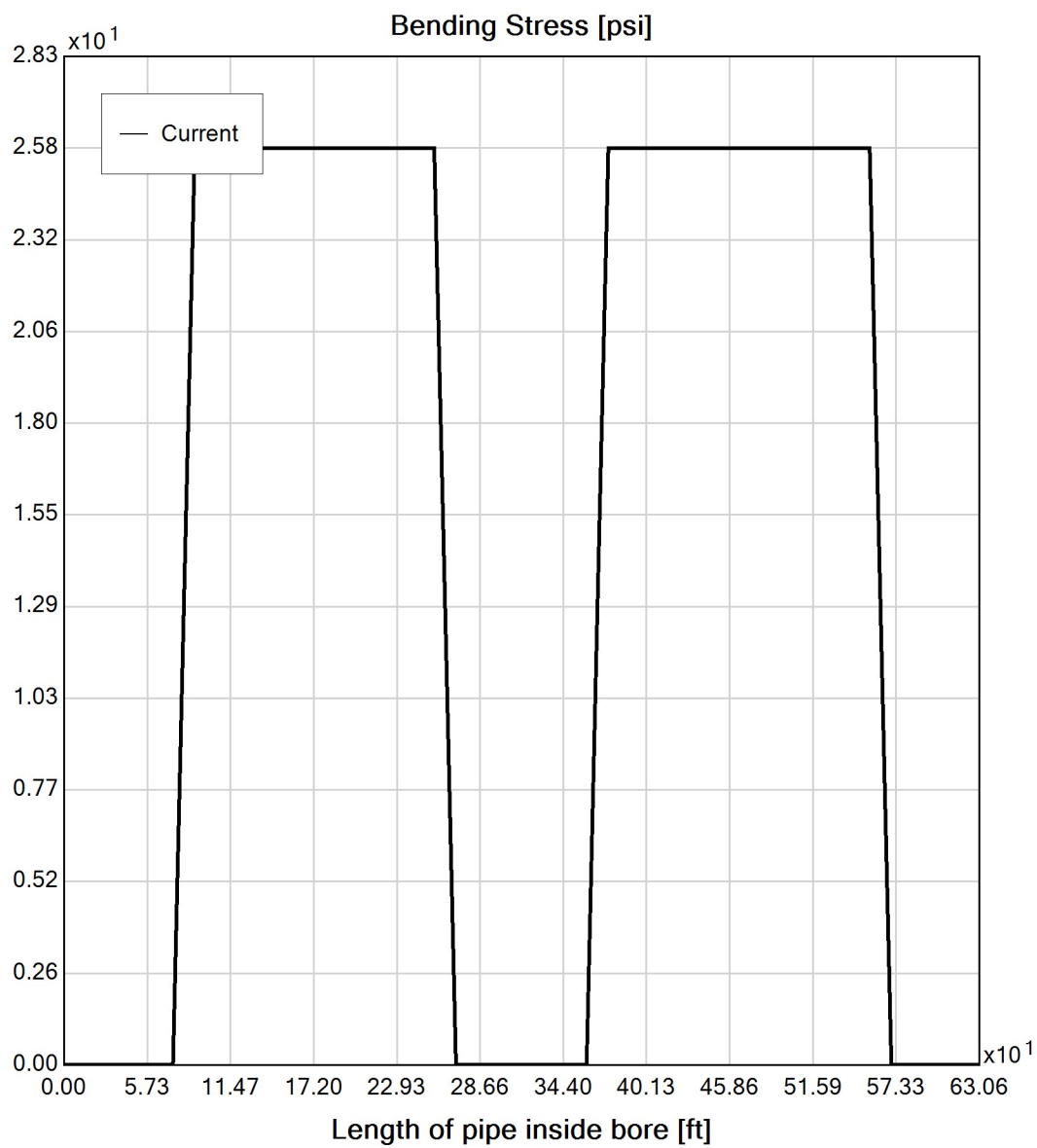
Effective Viscosity (cP): 1202.0

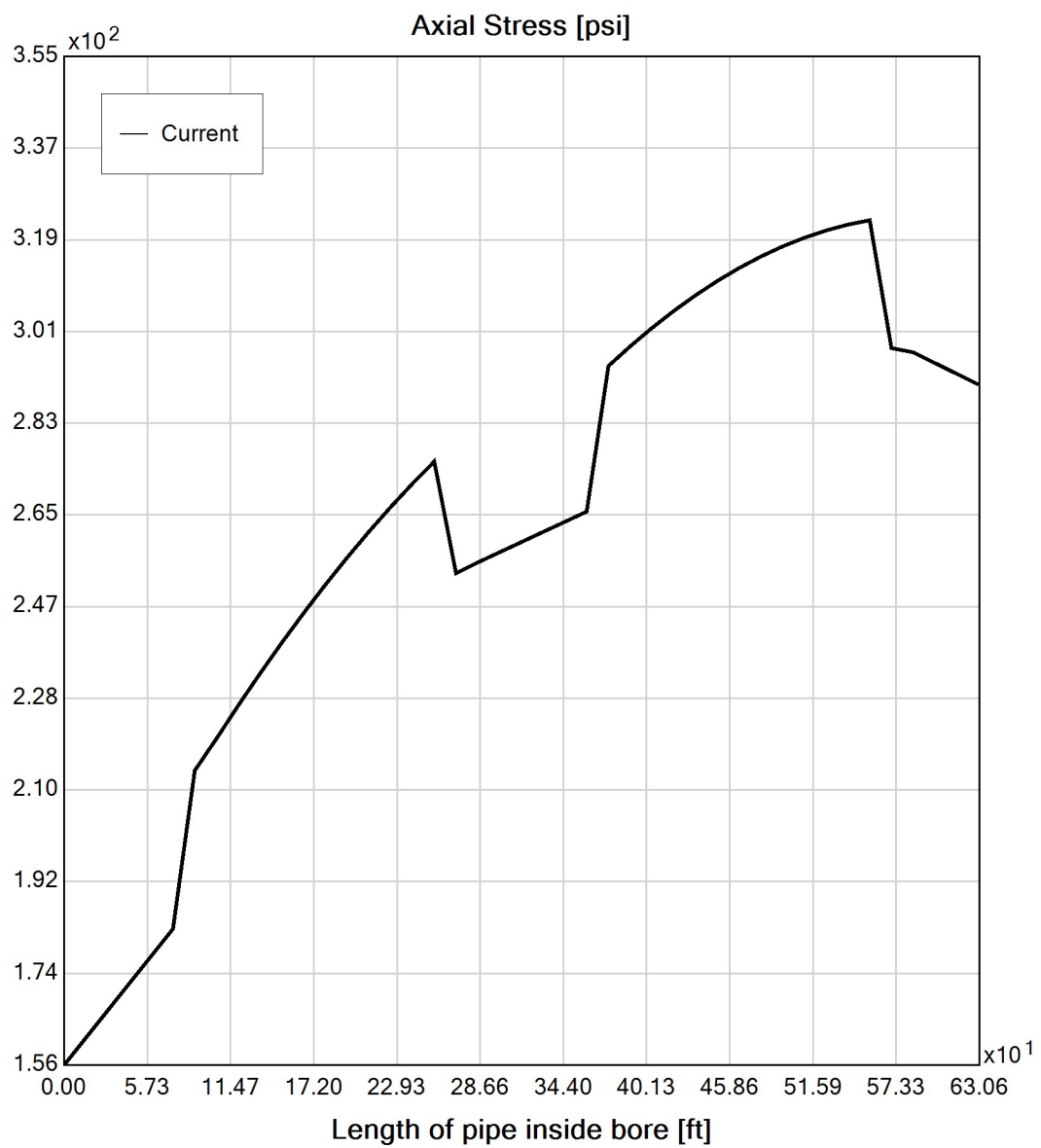
Virtual Site

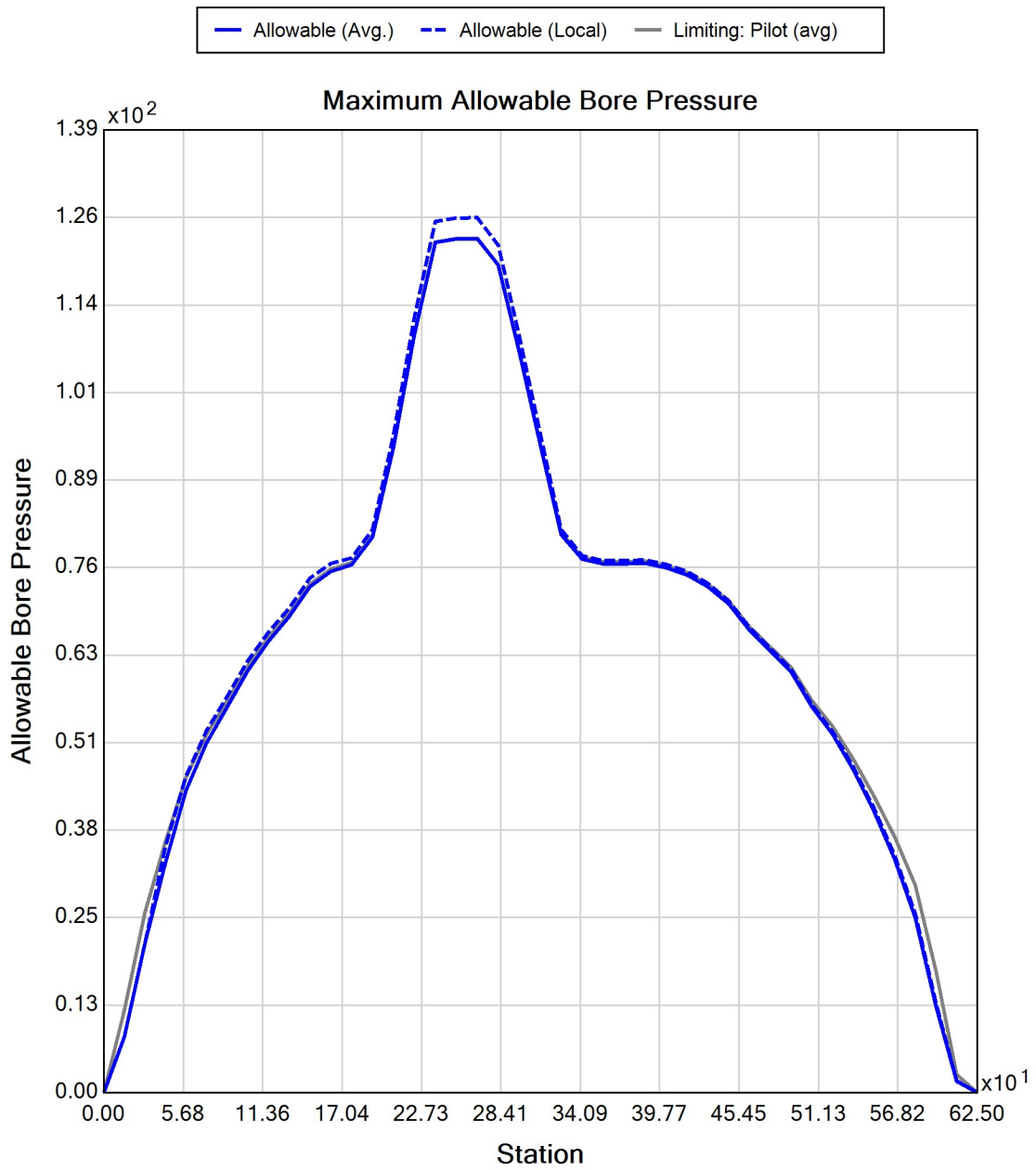


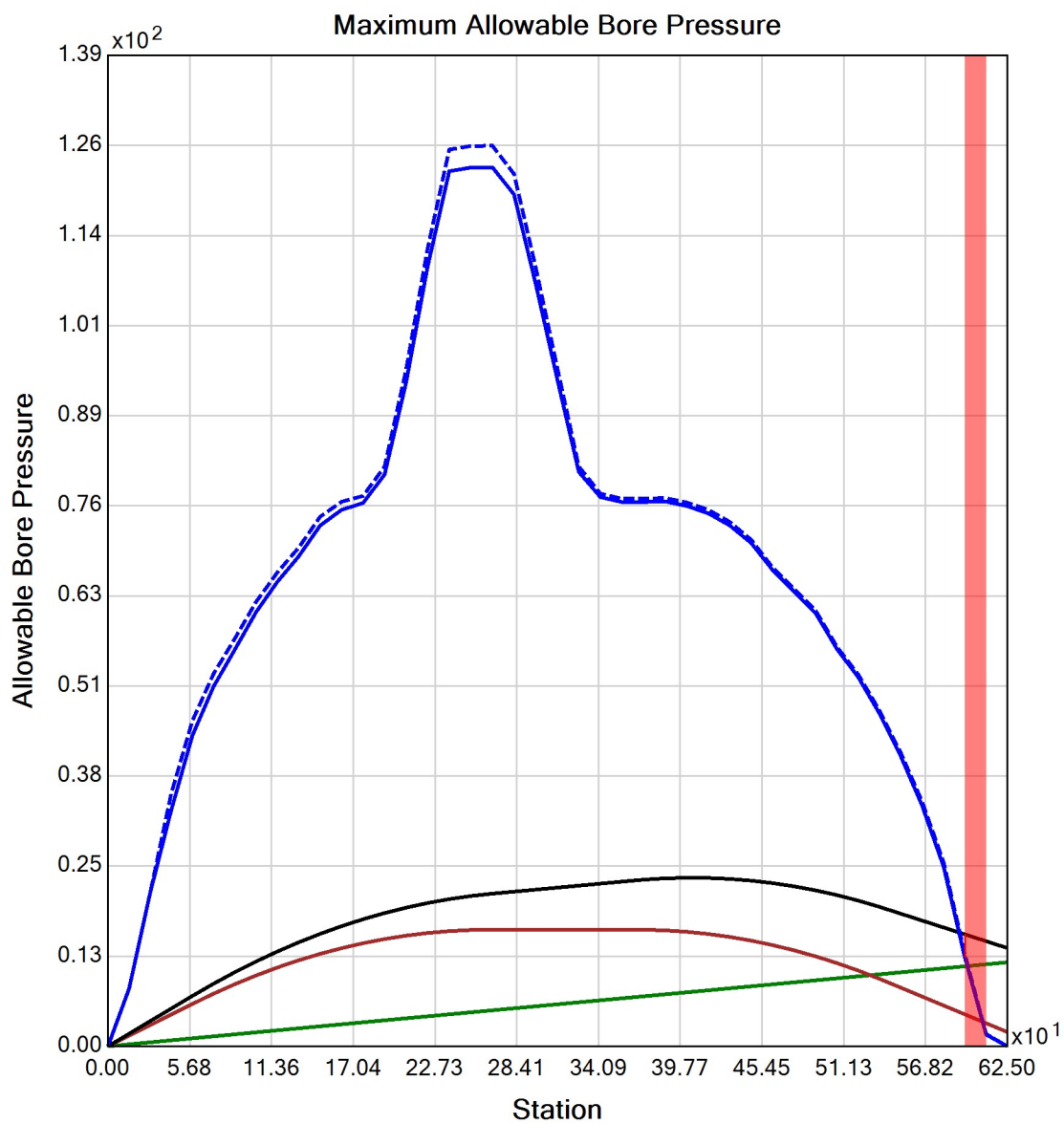














Generated Output



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Input Summary

Start Coordinate	(0.00, 0.00, 324.14) ft
End Coordinate	(620.00, 0.00, 318.50) ft
Project Length	620.00 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: 630.00 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	1.9	37.5
Water Pressure	9.6	9.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	11.5	47.0
Deflection		
Earth Load Deflection	0.596	10.206
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.626	10.235
Compressive Stress [psi]		
Compressive Wall Stress	51.5	211.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	630.2	630.2
Pullback Stress [psi]	360.1	360.1
Pullback Strain	6.262E-3	6.262E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	360.1	365.2
Tensile Strain	6.262E-3	6.450E-3

Net External Pressure = 18.1 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.626	7.5	12.0	OK
Unconstrained Collapse [psi]	22.3	131.6	5.9	OK
Compressive Wall Stress [psi]	51.5	1150.0	22.3	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	32.3	236.2	7.3	OK
Tensile Stress [psi]	365.2	1200.0	3.3	OK



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Project Summary

General: CHPE HDD 46
P3
Start Date: 06-30-2022
End Date: 06-30-2022

Project Owner: TDI
Project Contractor: Kiewit
Project Consultant: CHA/BCE

Designer: MB
BCE

Description: HDD 46 10-inch DR 9

Input Summary

Start Coordinate	(0.00, 0.00, 317.00) ft
End Coordinate	(3150.00, 0.00, 320.00) ft
Project Length	3150.00 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: 7

Soil Layer #1 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 #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, 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 #4 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 #5 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 #6 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]

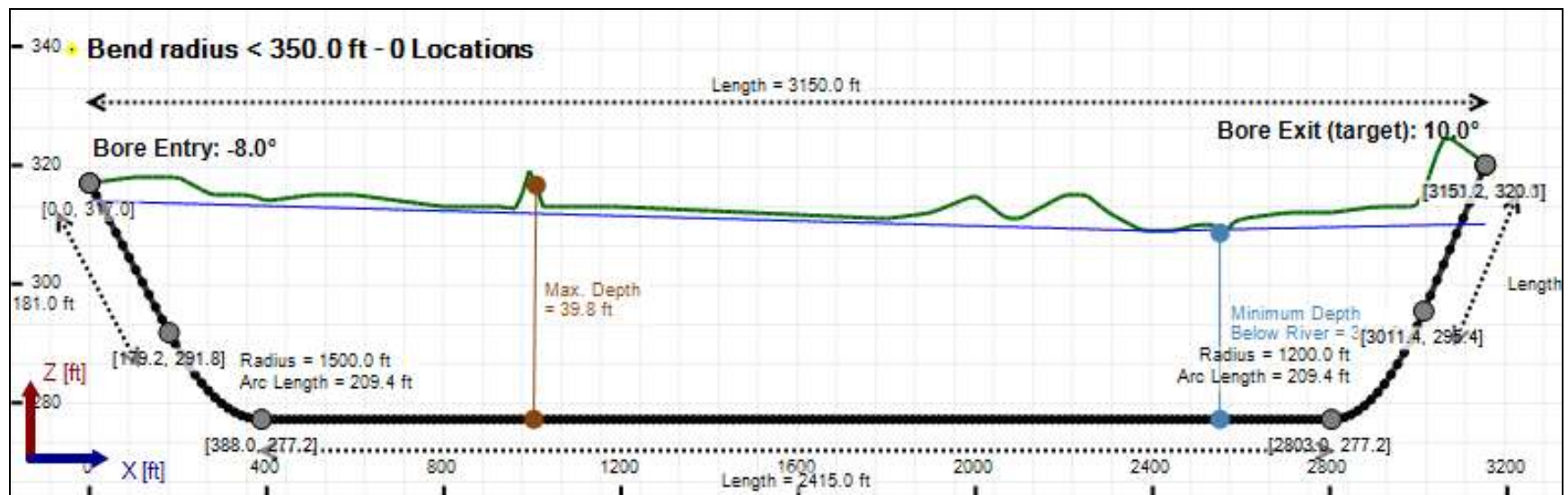
Soil Layer #7 Rock, Geological Classification, Sedimentary Rocks

From Assistant

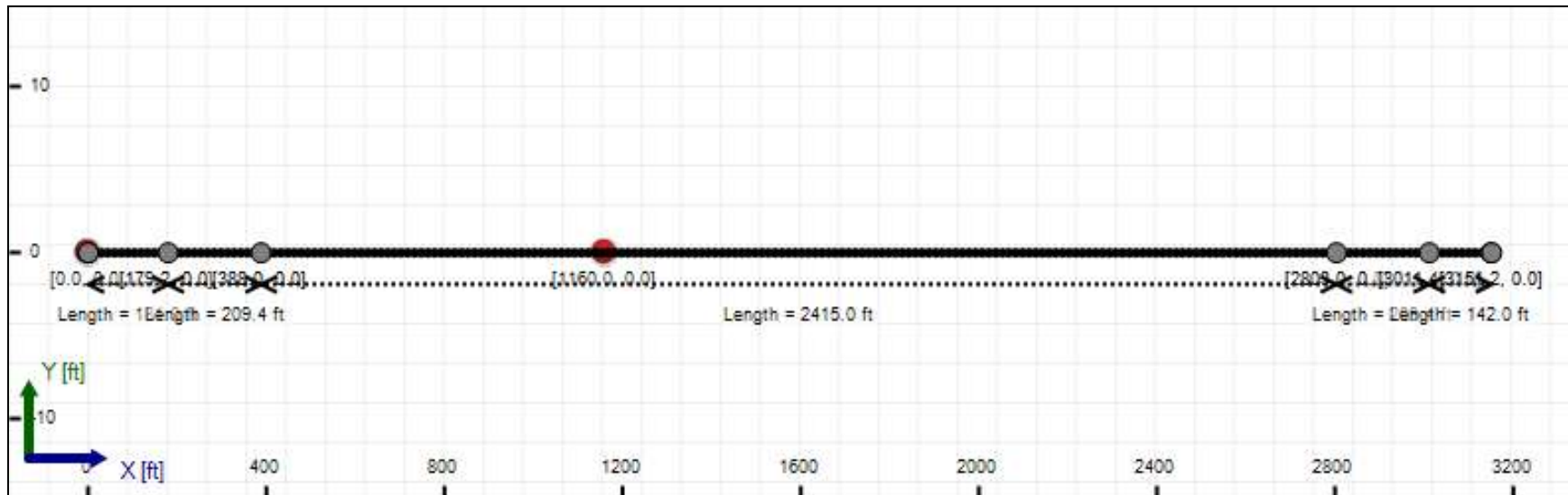
Unit Weight: 107.8272 (dry), 177.6384 (sat) [lb/ft³]

Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 3165.00 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	12.5	28.7
Water Pressure	11.5	15.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	24.0	43.8
Deflection		
Earth Load Deflection	3.395	7.828
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	3.527	7.960
Compressive Stress [psi]		
Compressive Wall Stress	108.0	197.1

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	29006.6	29006.6
Pullback Stress [psi]	809.0	809.0
Pullback Strain	1.407E-2	1.407E-2
Bending Stress [psi]	0.0	21.5
Bending Strain	0	3.733E-4
Tensile Stress [psi]	809.0	823.6
Tensile Strain	1.407E-2	1.470E-2

Net External Pressure = 19.6 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	3.527	7.5	2.1	OK
Unconstrained Collapse [psi]	24.9	100.7	4.0	OK
Compressive Wall Stress [psi]	108.0	1150.0	10.6	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	19.6	199.8	10.2	OK
Tensile Stress [psi]	823.6	1200.0	1.5	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	6.50 in	1231.507 psi	1341.558 psi
1	6.50 in	12.00 in	1231.119 psi	1341.283 psi
2	12.00 in	16.13 in	1230.677 psi	1340.969 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

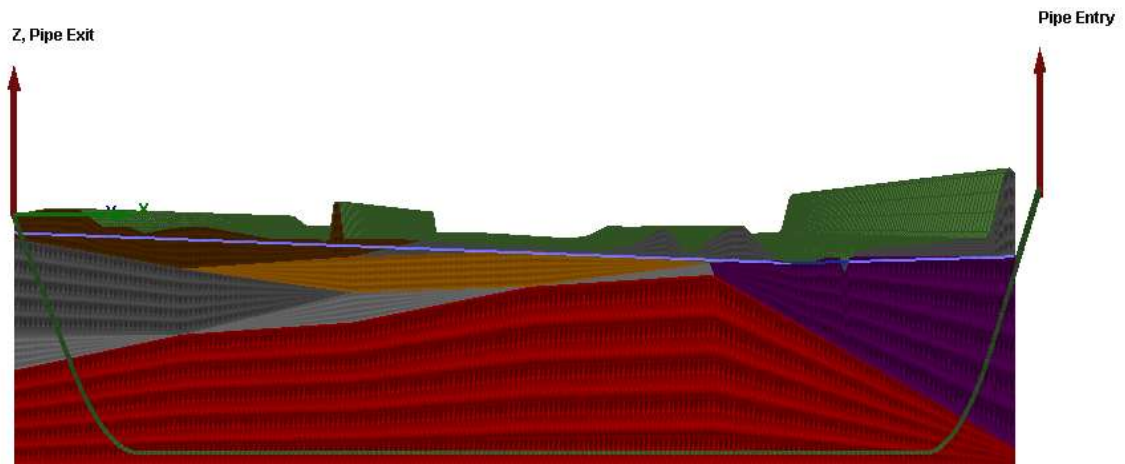
Rheological model: Power-Law

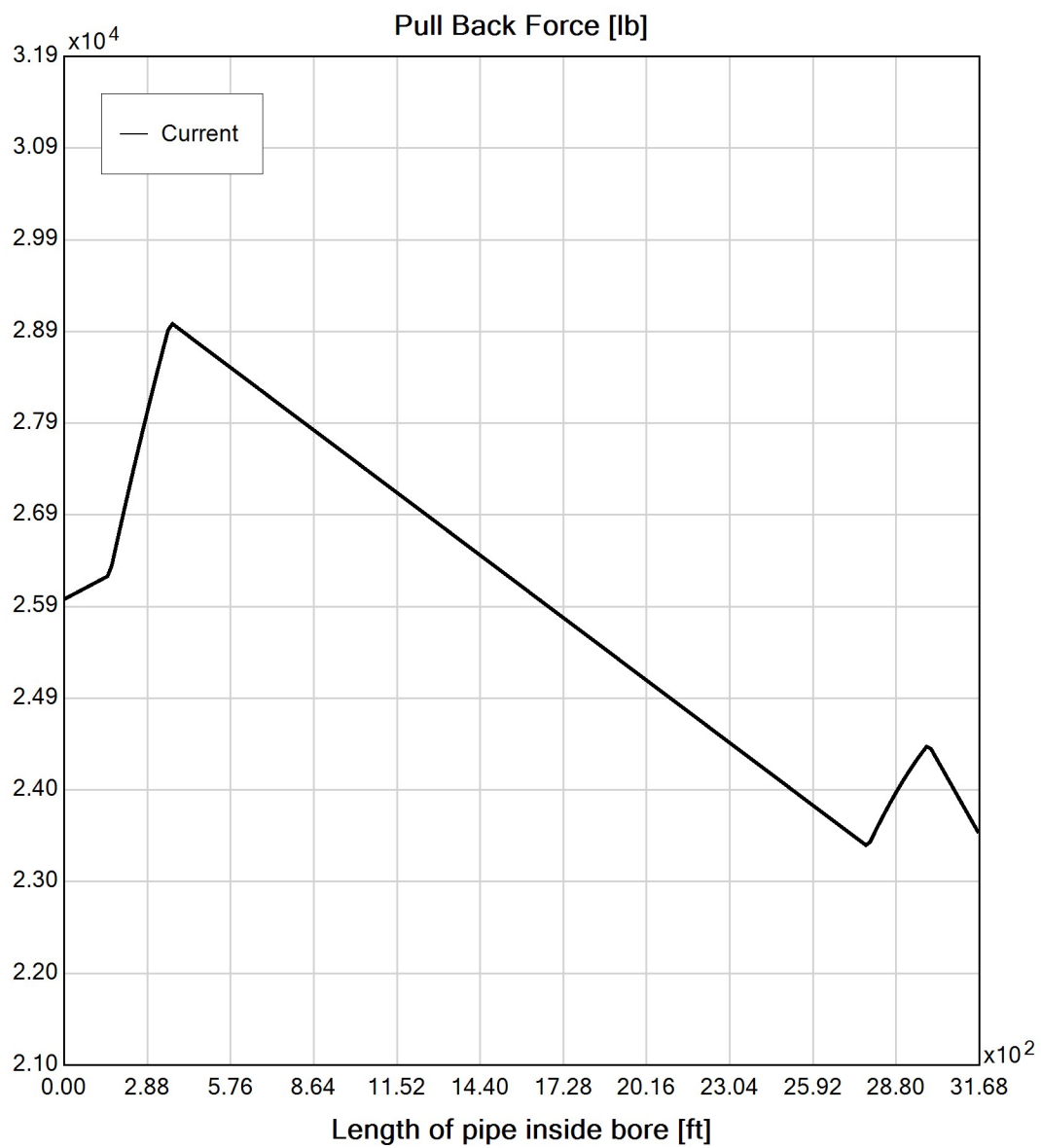
Fluid Consistency Index (K): 63.17

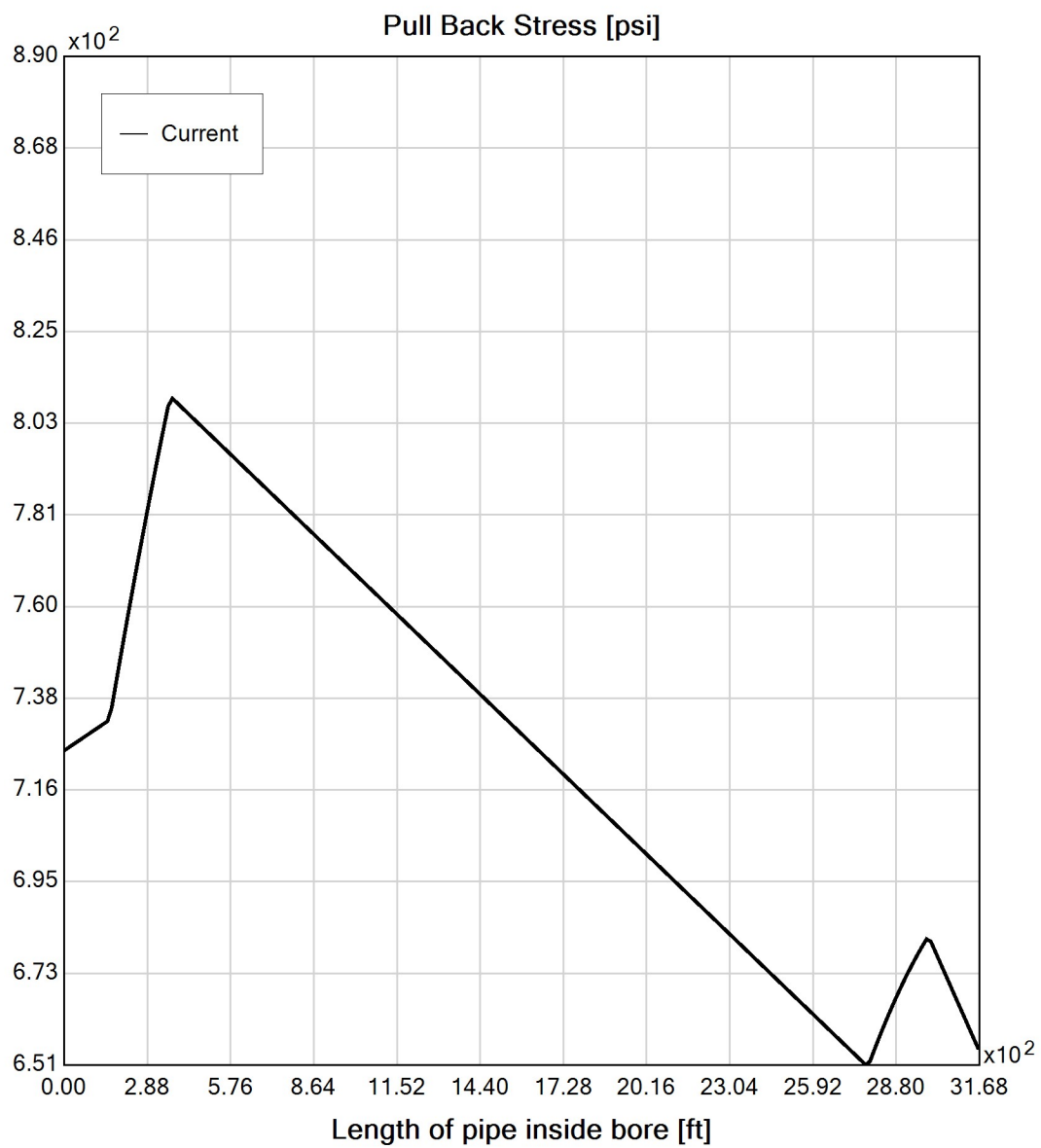
Power Law Exponent (n): 0.14

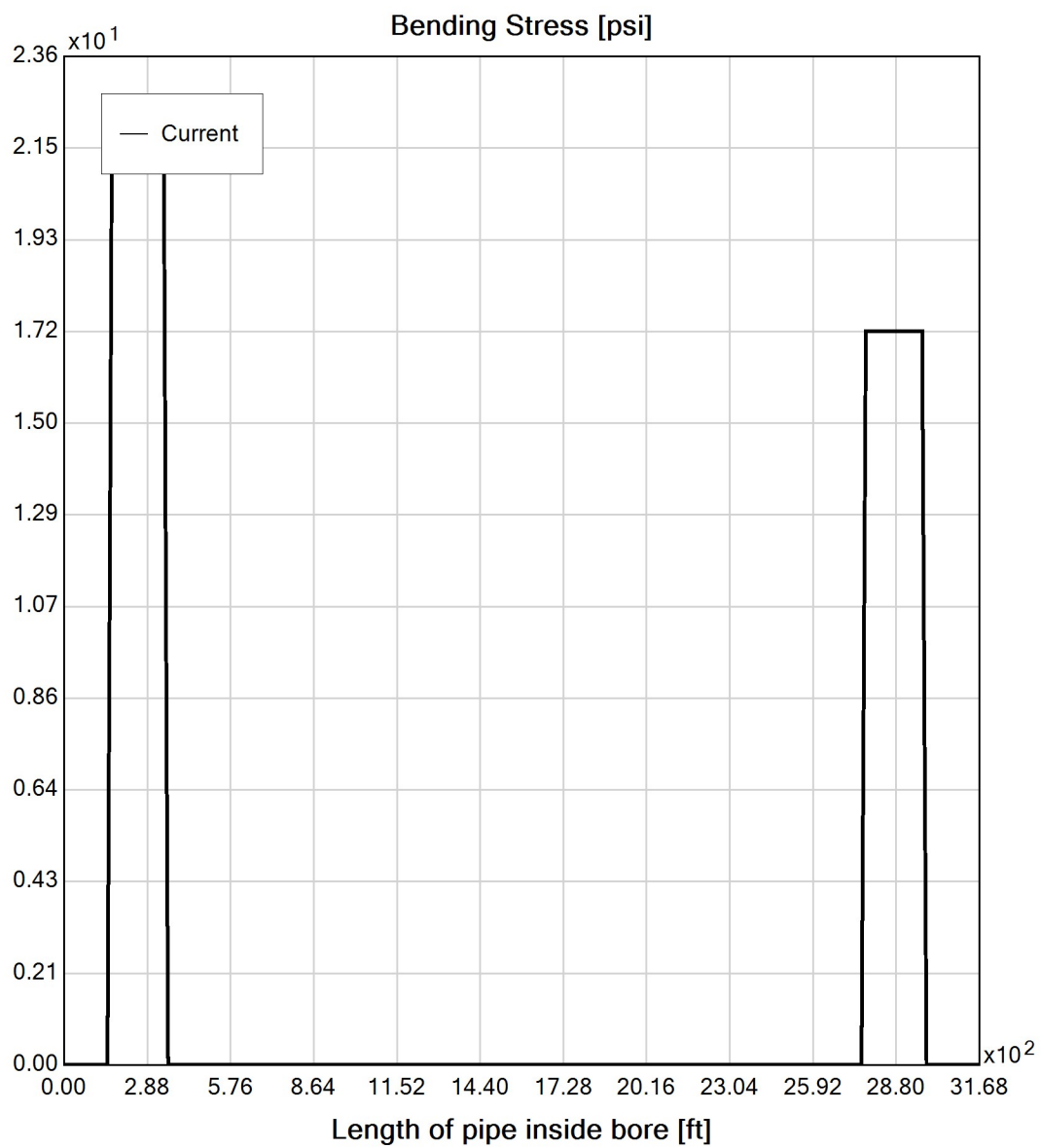
Effective Viscosity (cP): 378.3

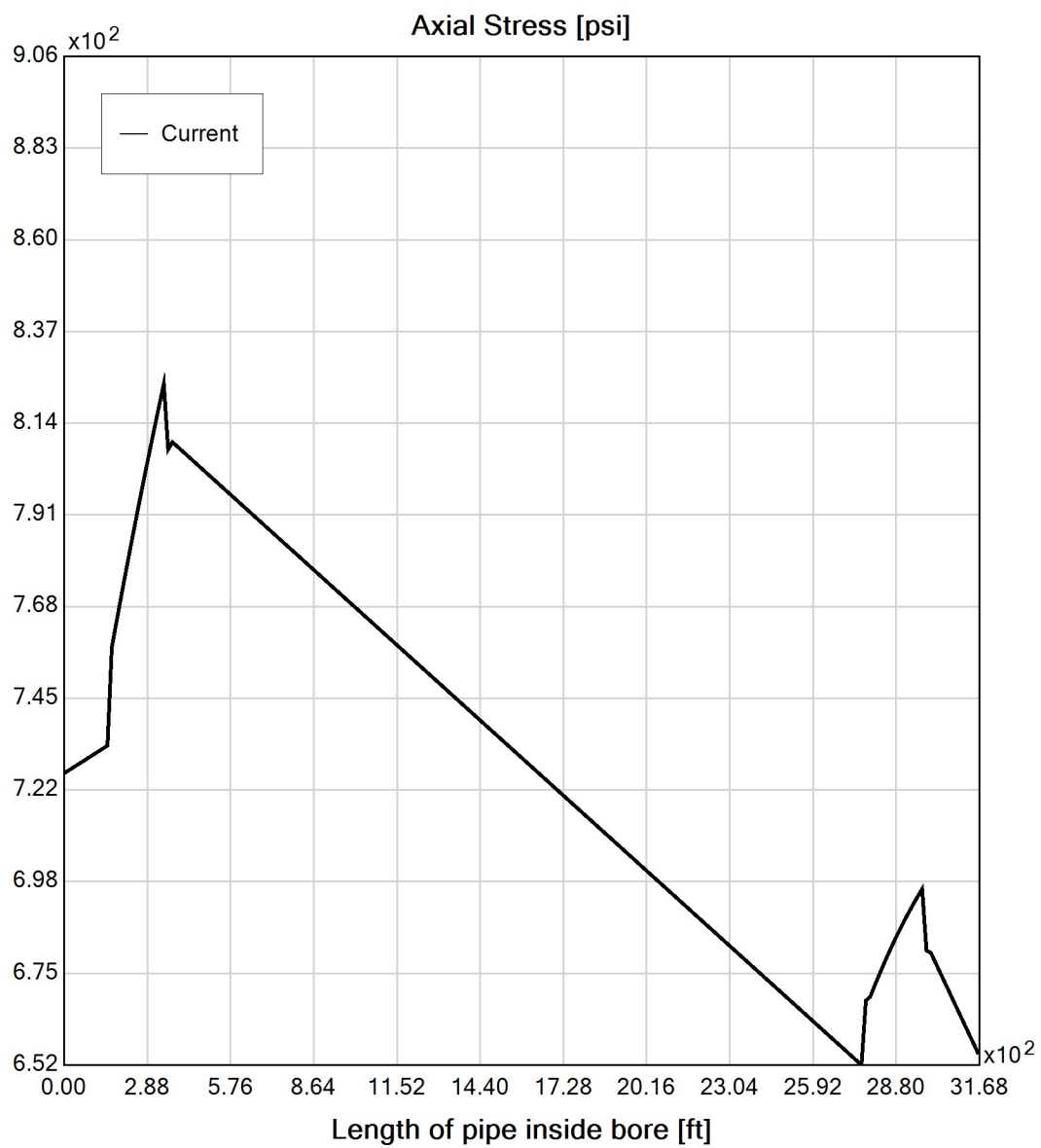
Virtual Site

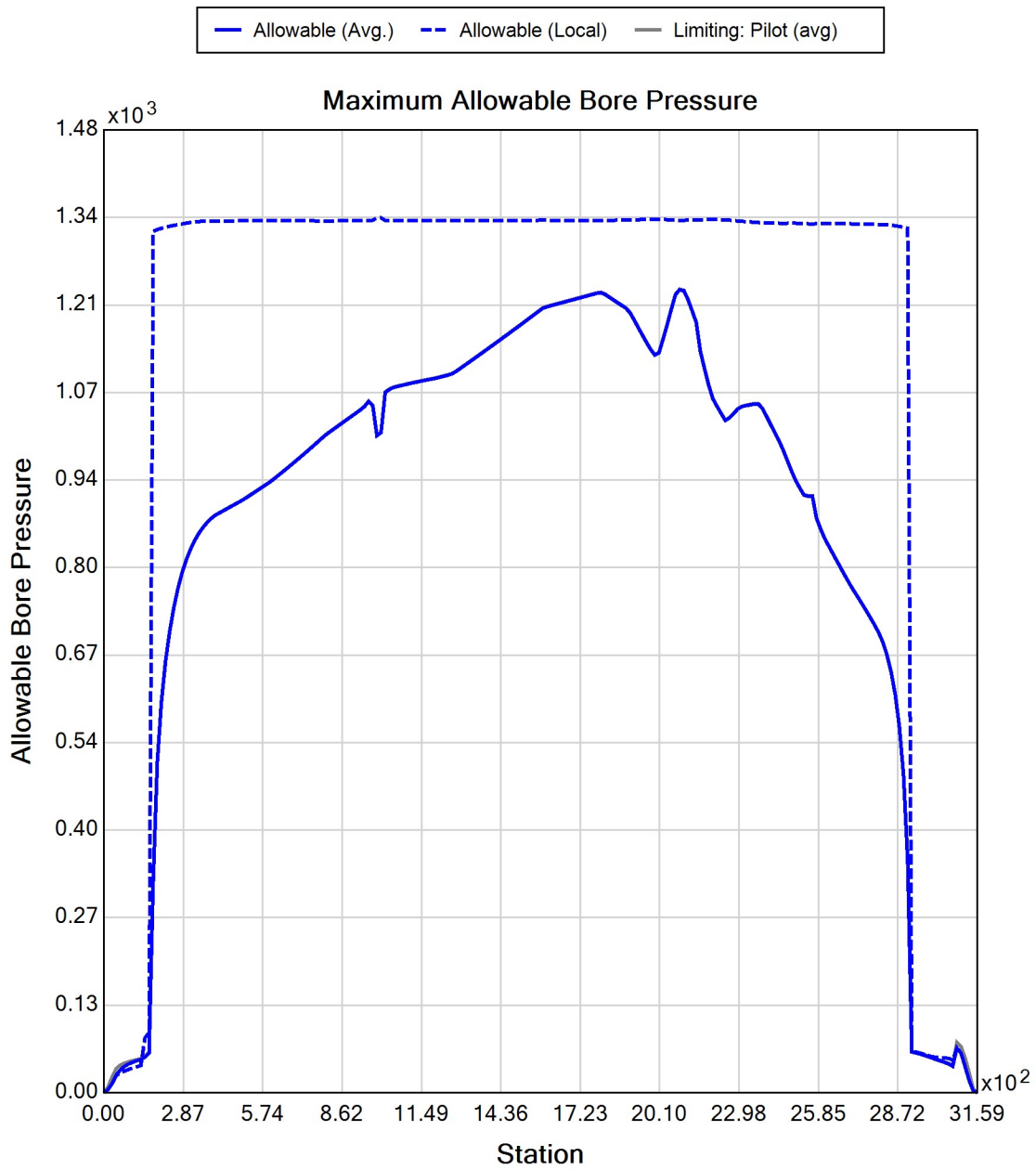


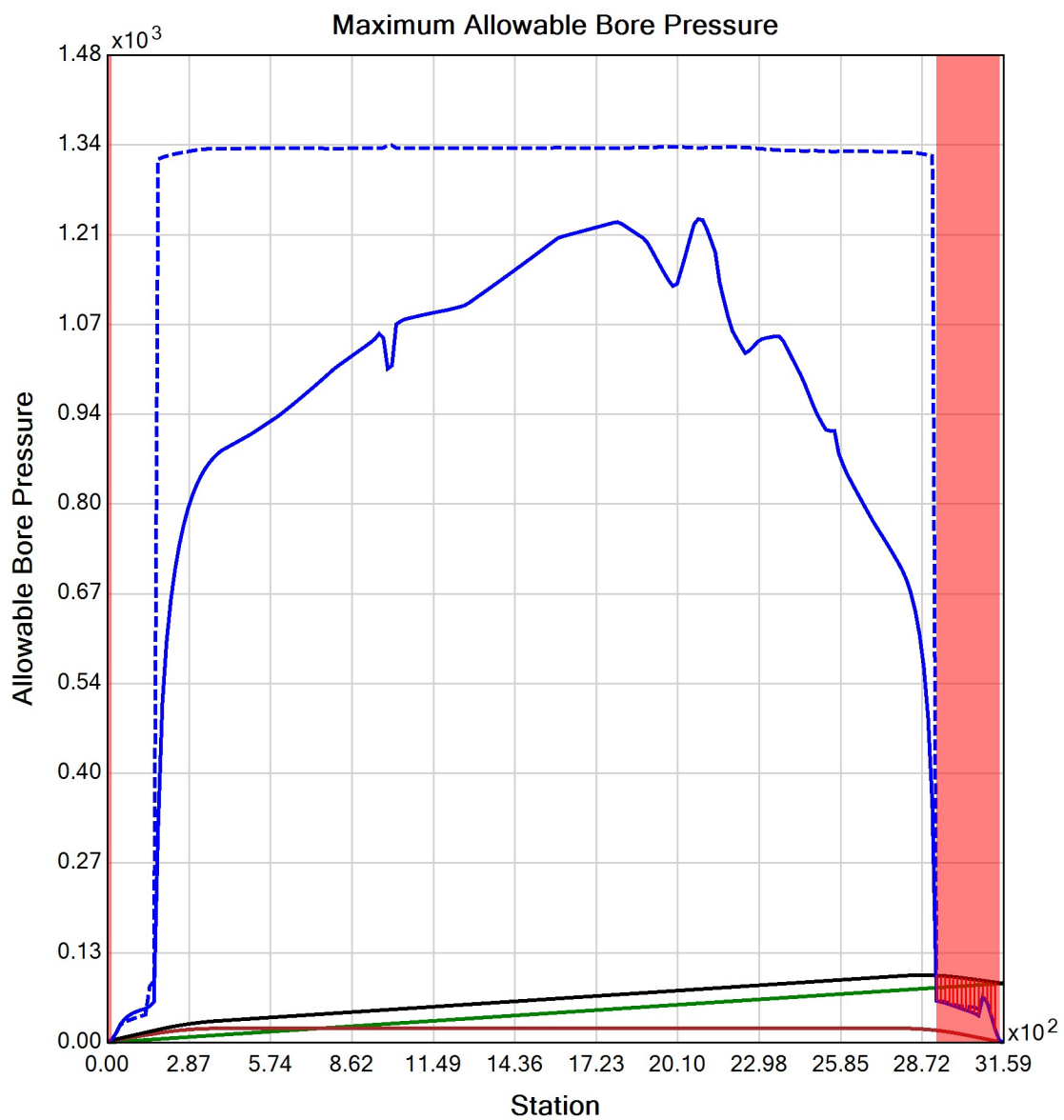














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Input Summary

Start Coordinate	(0.00, 0.00, 317.00) ft
End Coordinate	(3150.00, 0.00, 320.00) ft
Project Length	3150.00 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: 3165.00 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	12.5	28.7
Water Pressure	11.5	15.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	24.0	43.8
Deflection		
Earth Load Deflection	3.395	7.828
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	3.425	7.858
Compressive Stress [psi]		
Compressive Wall Stress	108.0	197.1

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1525.4	1525.4
Pullback Stress [psi]	871.6	871.6
Pullback Strain	1.516E-2	1.516E-2
Bending Stress [psi]	0.0	4.7
Bending Strain	0	8.247E-5
Tensile Stress [psi]	871.6	871.6
Tensile Strain	1.516E-2	1.520E-2

Net External Pressure = 19.6 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	3.425	7.5	2.2	OK
Unconstrained Collapse [psi]	24.9	101.7	4.1	OK
Compressive Wall Stress [psi]	108.0	1150.0	10.6	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	19.6	196.8	10.0	OK
Tensile Stress [psi]	871.6	1200.0	1.4	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 47
P3
Start Date: 12-10-2021
End Date: 12-10-2021

Project Owner: TDI
Project Contractor: Kiewit
Project Consultant: CHA/BCE

Designer: AB
CHA

Description: HDD 47 10-inch DR 9

Input Summary

Start Coordinate	(0.00, 0.00, 330.00) ft
End Coordinate	(570.00, 0.00, 318.00) ft
Project Length	570.00 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: 7

Soil Layer #1 USCS, Sand (S), SW

From Assistant

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, Sand (S), SP

From Assistant

Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]

Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #3 USCS, Gravel (G), GP

From Assistant

Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]

Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #4 USCS, Sand (S), SM

From Assistant

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), SP

From Assistant

Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #6 USCS, Sand (S), SW

From Assistant

Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

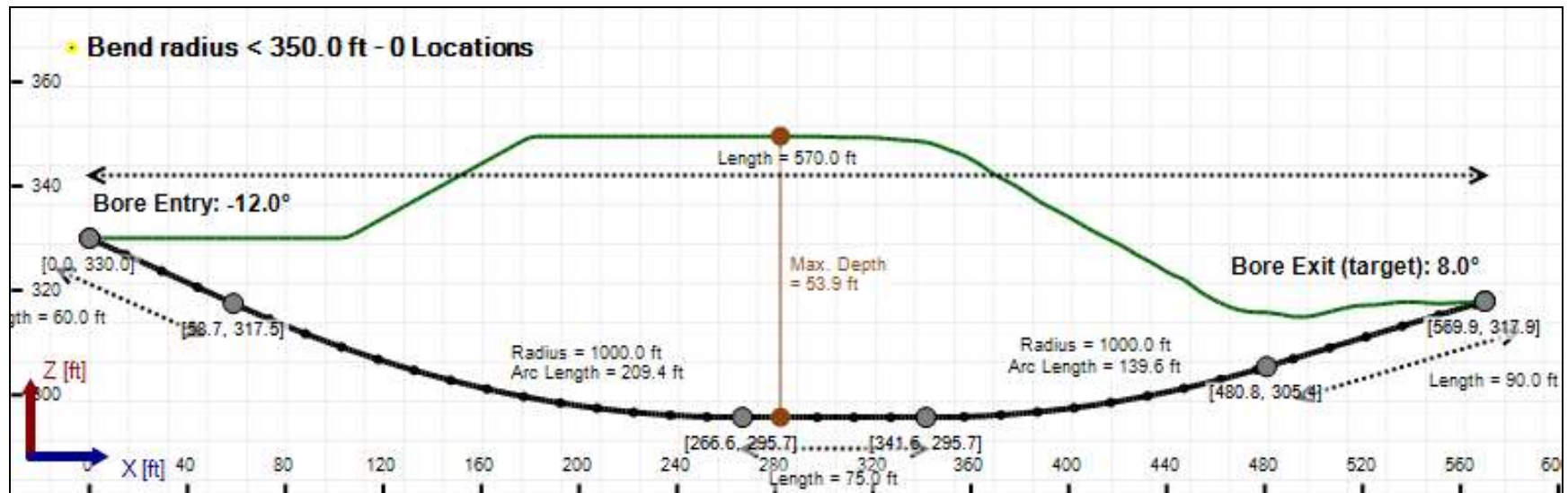
Soil Layer #7 USCS, Sand (S), SW

From Assistant

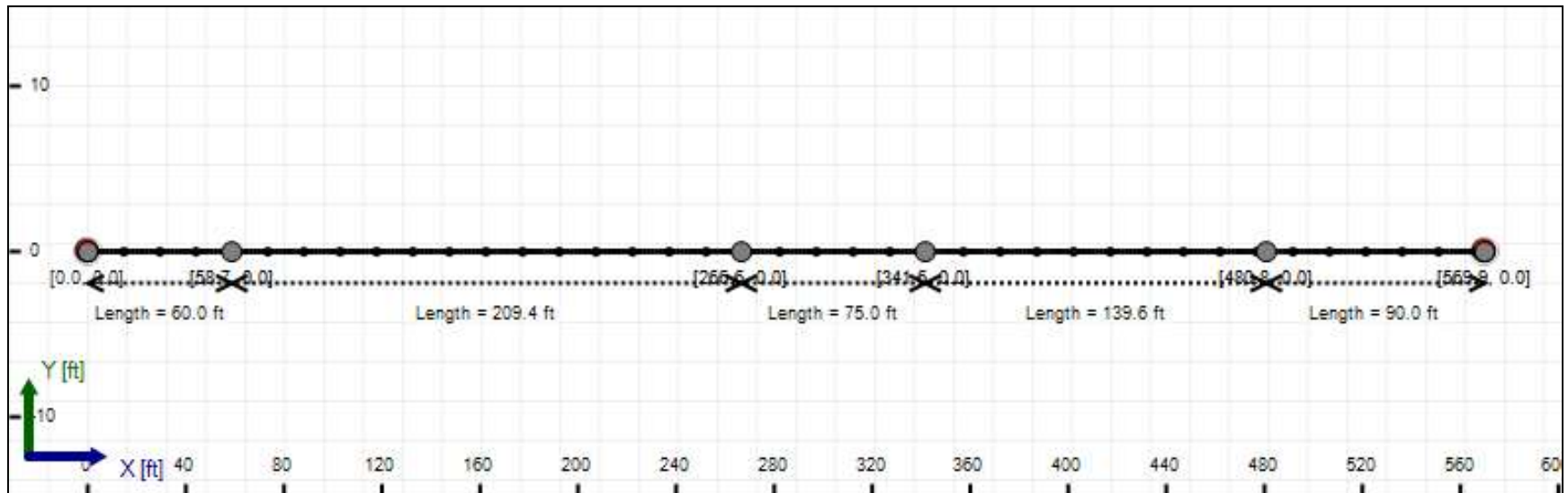
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft³]

Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 10" (10.75")
Pipe DR: 9
Pipe Length: 585.00 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	5.6	39.8
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	5.6	39.8
Deflection		
Earth Load Deflection	1.527	10.851
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.659	10.983
Compressive Stress [psi]		
Compressive Wall Stress	25.2	179.3

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	9485.8	9485.8
Pullback Stress [psi]	264.5	264.5
Pullback Strain	4.601E-3	4.601E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	264.5	289.9
Tensile Strain	4.601E-3	5.490E-3

Net External Pressure = 18.1 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.659	7.5	4.5	OK
Unconstrained Collapse [psi]	22.3	119.0	5.3	OK
Compressive Wall Stress [psi]	25.2	1150.0	45.6	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	32.3	239.8	7.4	OK
Tensile Stress [psi]	289.9	1200.0	4.1	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	117.566 psi	121.590 psi
1	8.00 in	12.00 in	117.536 psi	121.560 psi
2	12.00 in	16.13 in	117.492 psi	121.516 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

Virtual Site

