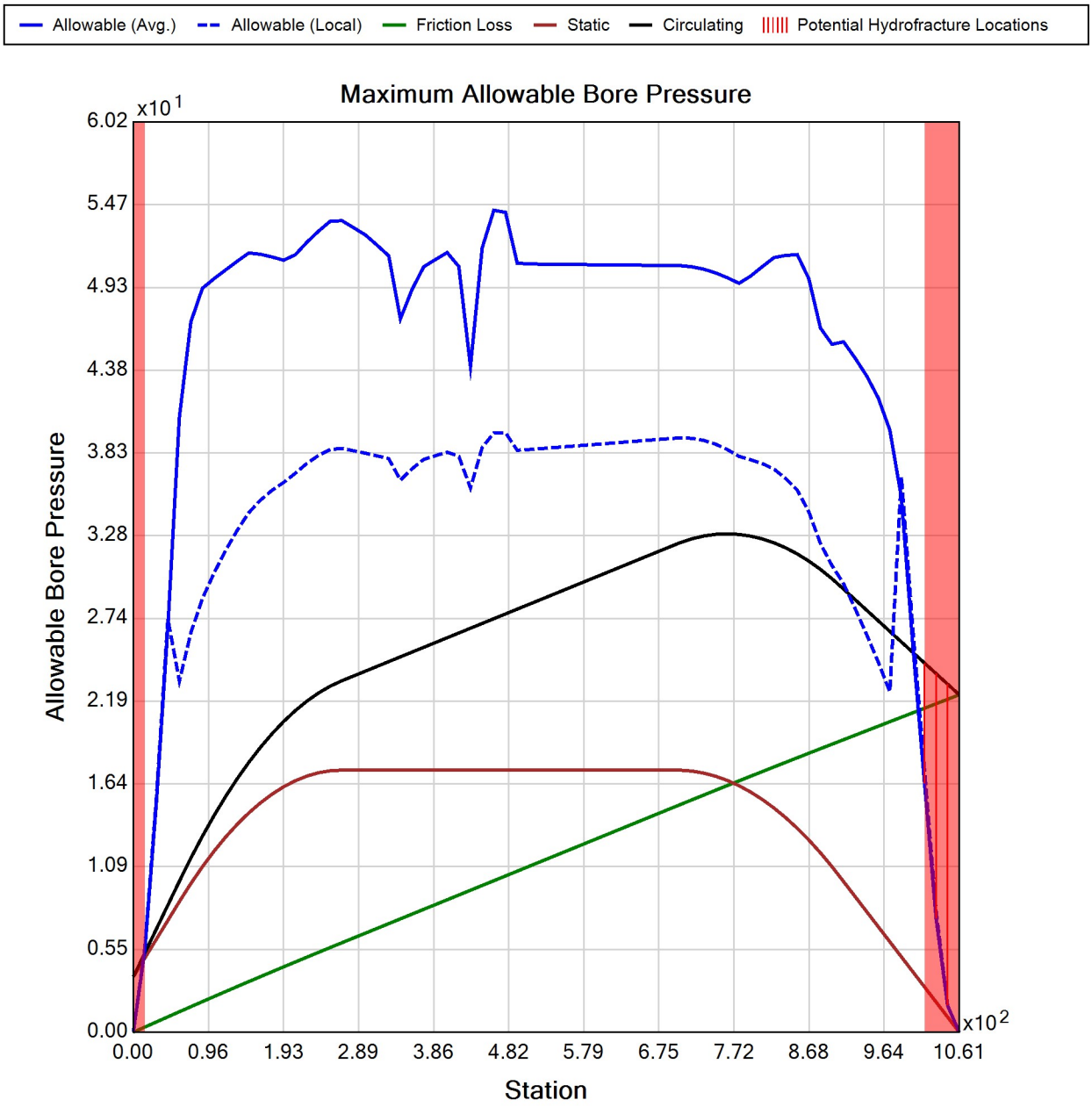


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# Generated Output

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## 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 | 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 |

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## Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 2" (2.375")
Pipe DR: 9
Pipe Length: 1065.00 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

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## In-service Load Summary:

| Pressure [psi] | Deformed | Collapsed |
|---|---|---|
| Earth Pressure | 1.5 | 11.7 |
| Water Pressure | 12.4 | 12.1 |
| Surface Surcharge | 0.0 | 0.0 |
| Internal Pressure | 0.0 | 0.0 |
| Net Pressure | 13.9 | 23.8 |
| **Deflection** | | |
| Earth Load Deflection | 0.505 | 3.194 |
| Buoyant Deflection | 0.029 | 0.029 |
| Reissner Effect | 0 | 0 |
| Net Deflection | 0.534 | 3.223 |
| **Compressive Stress [psi]** | | |
| Compressive Wall Stress | 62.5 | 107.3 |

## Installation Load Summary:

| Forces/Stresses | @Maximum Force | Absolute Maximum |
|---|---|---|
| Pullback Force [lb] | 962.3 | 962.3 |
| Pullback Stress [psi] | 549.8 | 549.8 |
| Pullback Strain | 9.562E-3 | 9.562E-3 |
| Bending Stress [psi] | 0.0 | 4.7 |
| Bending Strain | 0 | 8.247E-5 |
| Tensile Stress [psi] | 549.8 | 551.8 |
| Tensile Strain | 9.562E-3 | 9.679E-3 |

Net External Pressure = 20.1 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

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## In-service Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 0.534 | 7.5 | 14.0 | OK |
| Unconstrained Collapse [psi] | 23.6 | 132.8 | 5.6 | OK |
| Compressive Wall Stress [psi] | 62.5 | 1150.0 | 18.4 | OK |

## Installation Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 0.014 | 7.5 | 524.3 | OK |
| Unconstrained Collapse [psi] | 33.6 | 224.7 | 6.7 | OK |
| Tensile Stress [psi] | 551.8 | 1200.0 | 2.2 | OK |

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## Project Summary

| | |
|---|---|
| General: | CHPE HDD 30 |
| | P3 |
| | Start Date: 08-26-2022 |
| | End Date: 08-26-2022 |
| Project Owner: | TDI |
| Project Contractor: | Kiewit |
| Project Consultant: | CHA/BCE |
| Designer: | MB |
| | BCE |
| Description: | HDD 30 12-inch DR7 - 8-inch Pilot Bore |

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## Input Summary

| | |
|---|---|
| Start Coordinate | (0.00, 0.00, 197.00) ft |
| End Coordinate | (1920.00, 0.00, 220.00) ft |
| Project Length | 1920.00 ft |
| Pipe Type | HDPE |
| OD Classification | IPS |
| Pipe OD | 12.750 in |
| Pipe DR | 7.0 |
| Pipe Thickness | 1.82 in |
| Rod Length | 15.00 ft |
| Rod Diameter | 3.5 in |
| Drill Rig Location | (0.00, 0.00, 0.00) ft |

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## Soil Summary

Number of Layers: 5

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: 70.0000 (dry), 100.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 200.00, Coh: 3.13 [psi]

Soil Layer #3 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 #4 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 #5 Rock, Geological Classification, Sedimentary Rocks
From Assistant
Unit Weight: 165.0000 (dry), 177.0000 (sat) [lb/ft3]
Phi: 35.00, S.M.: 1450.40, Coh: 2900.80 [psi]

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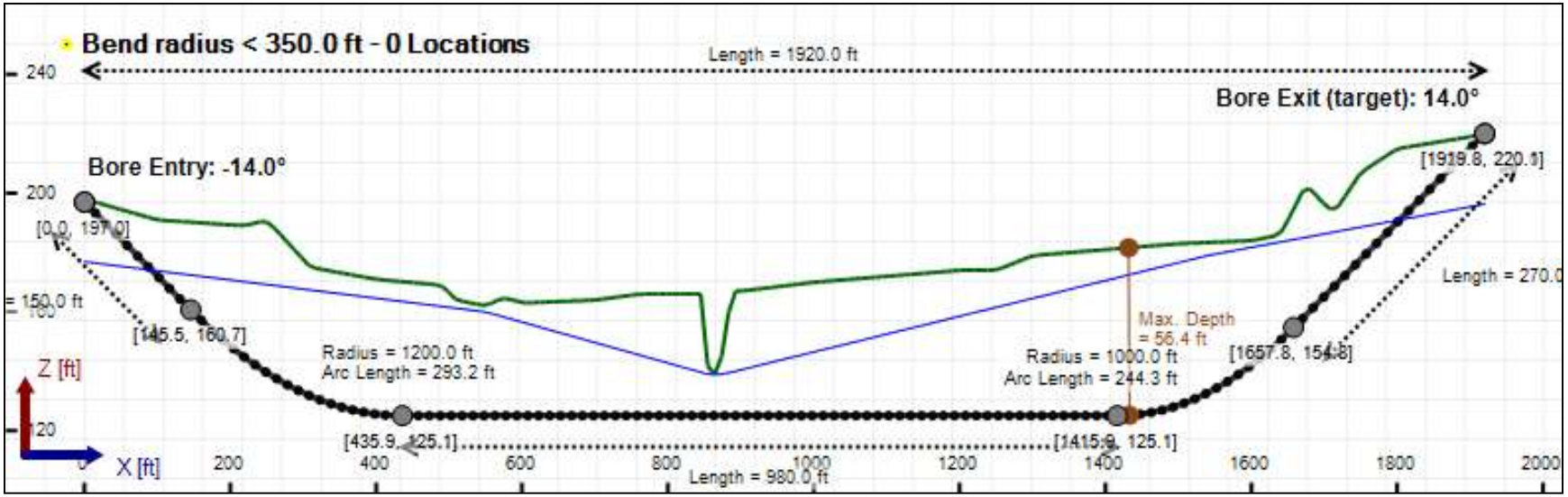
## Bore Cross-Section View

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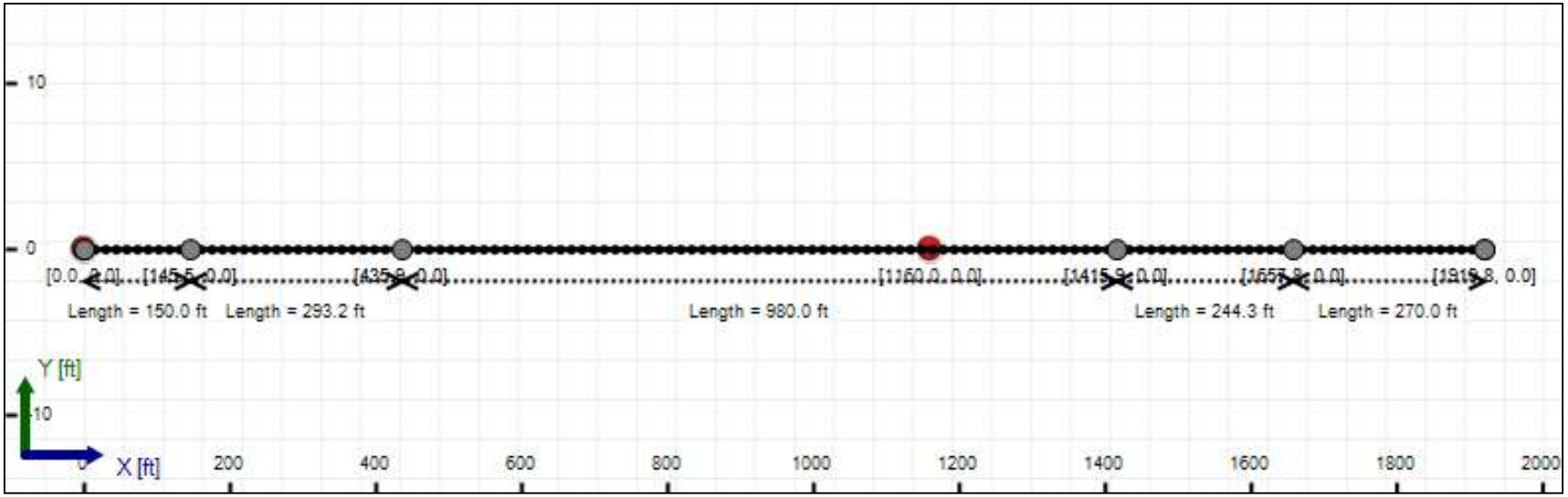
## Bore Plan View

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## Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 12" (12.75")
Pipe DR: 7
Pipe Length: 1950.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.59400002161662 ft
Silo Width: 1.59400002161662 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

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## In-service Load Summary:

| Pressure [psi] | Deformed | Collapsed |
|---|---|---|
| Earth Pressure | 21.5 | 31.9 |
| Water Pressure | 12.8 | 20.5 |
| Surface Surcharge | 0.0 | 0.0 |
| Internal Pressure | 0.0 | 0.0 |
| Net Pressure | 34.3 | 52.4 |
| **Deflection** | | |
| Earth Load Deflection | 2.472 | 3.673 |
| Buoyant Deflection | 0.074 | 0.074 |
| Reissner Effect | 0 | 0 |
| Net Deflection | 2.545 | 3.747 |
| **Compressive Stress [psi]** | | |
| Compressive Wall Stress | 120.0 | 183.5 |

## Installation Load Summary:

| Forces/Stresses | @Maximum Force | Absolute Maximum |
|---|---|---|
| Pullback Force [lb] | 47241.4 | 47241.4 |
| Pullback Stress [psi] | 755.4 | 755.4 |
| Pullback Strain | 1.314E-2 | 1.314E-2 |
| Bending Stress [psi] | 0.0 | 30.5 |
| Bending Strain | 0 | 5.313E-4 |
| Tensile Stress [psi] | 755.4 | 778.5 |
| Tensile Strain | 1.314E-2 | 1.398E-2 |

Net External Pressure = 50.6 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 798.4 lb

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## In-service Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 2.545 | 7.5 | 2.9 | OK |
| Unconstrained Collapse [psi] | 63.7 | 302.7 | 4.7 | OK |
| Compressive Wall Stress [psi] | 120.0 | 1150.0 | 9.6 | OK |

## Installation Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 0.036 | 7.5 | 207.6 | OK |
| Unconstrained Collapse [psi] | 73.6 | 495.6 | 6.7 | OK |
| Tensile Stress [psi] | 778.5 | 1200.0 | 1.5 | OK |

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## 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 | 1316.382 psi | 1349.726 psi |
| 1 | 8.00 in | 12.00 in | 1314.437 psi | 1349.608 psi |
| 2 | 12.00 in | 16.13 in | 1311.619 psi | 1349.435 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

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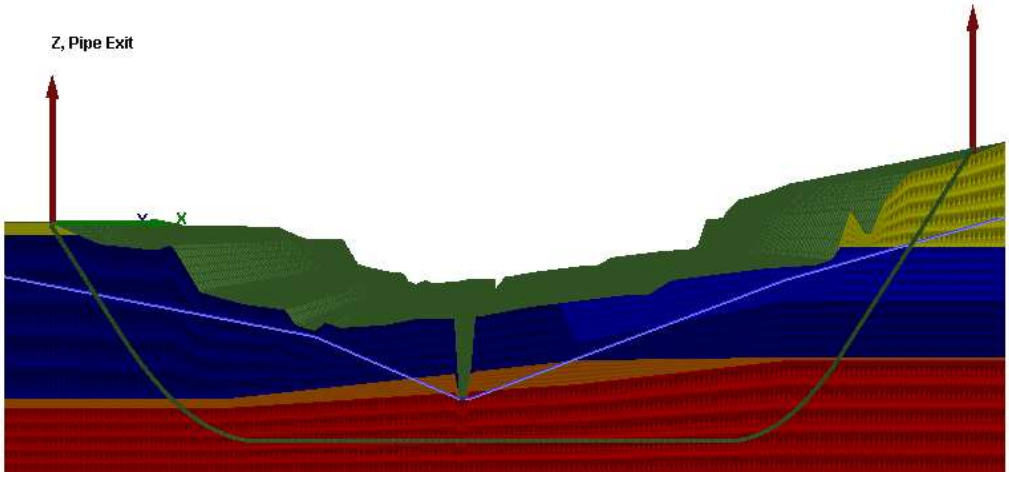
## Virtual Site

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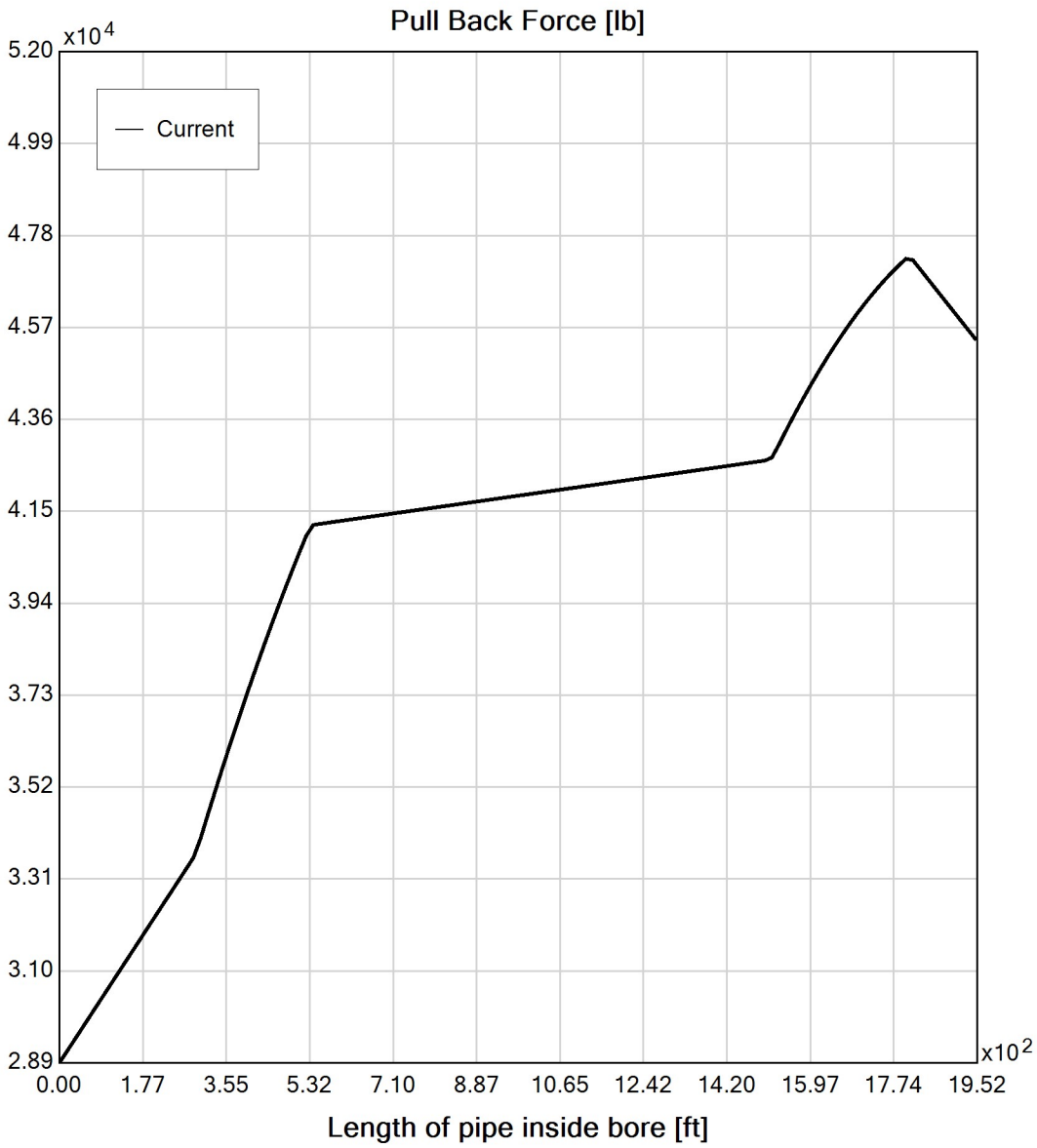


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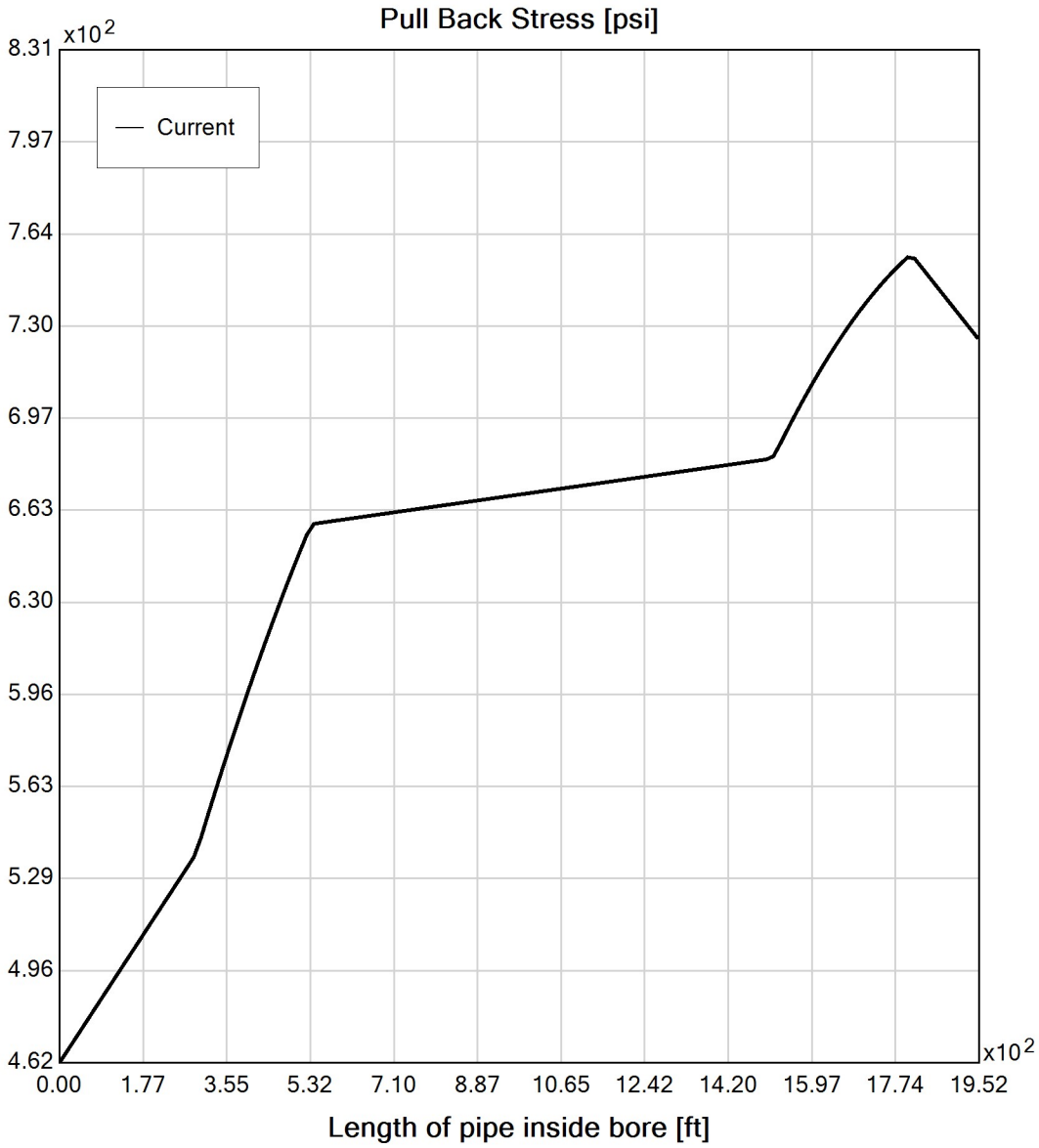


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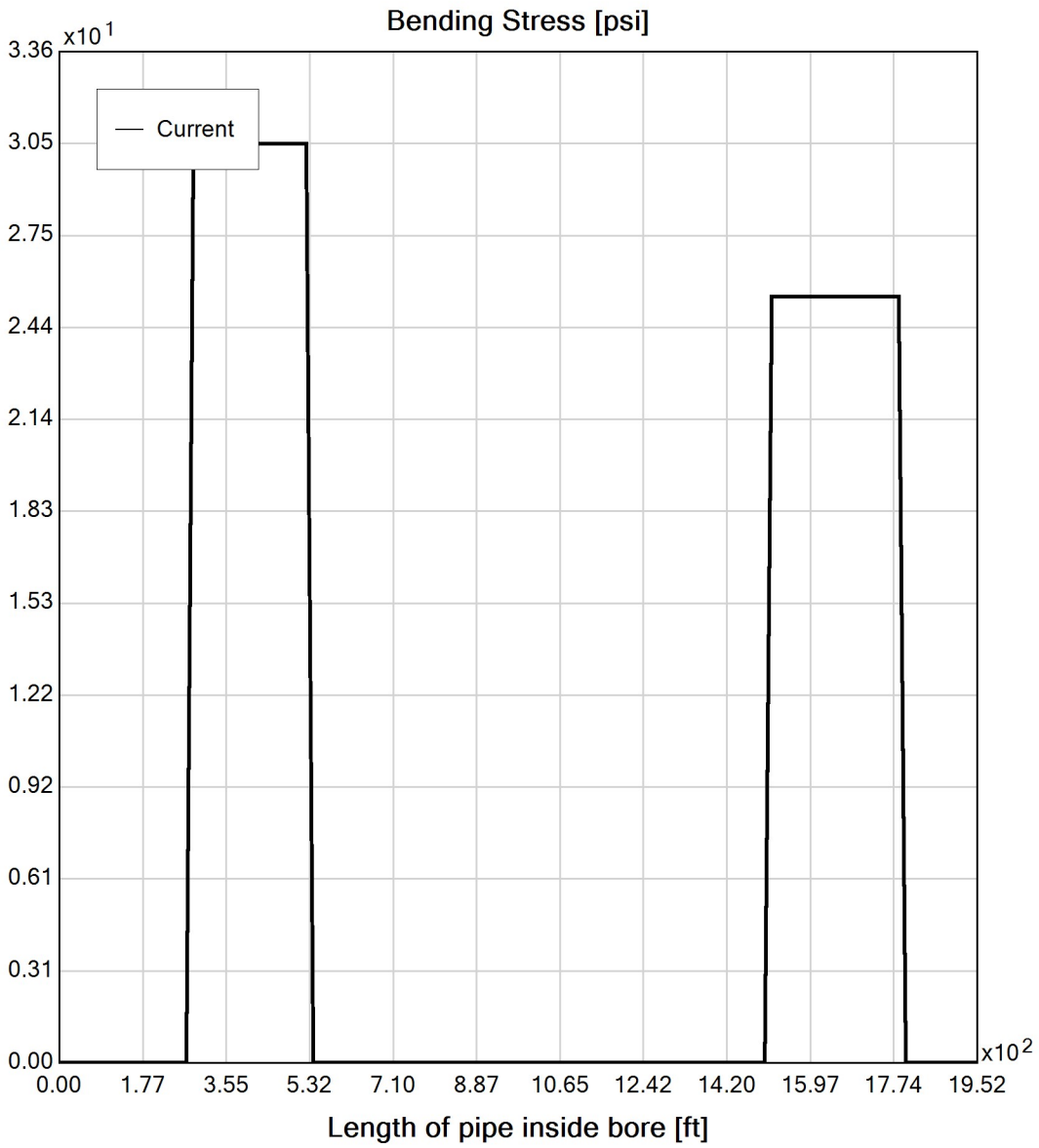


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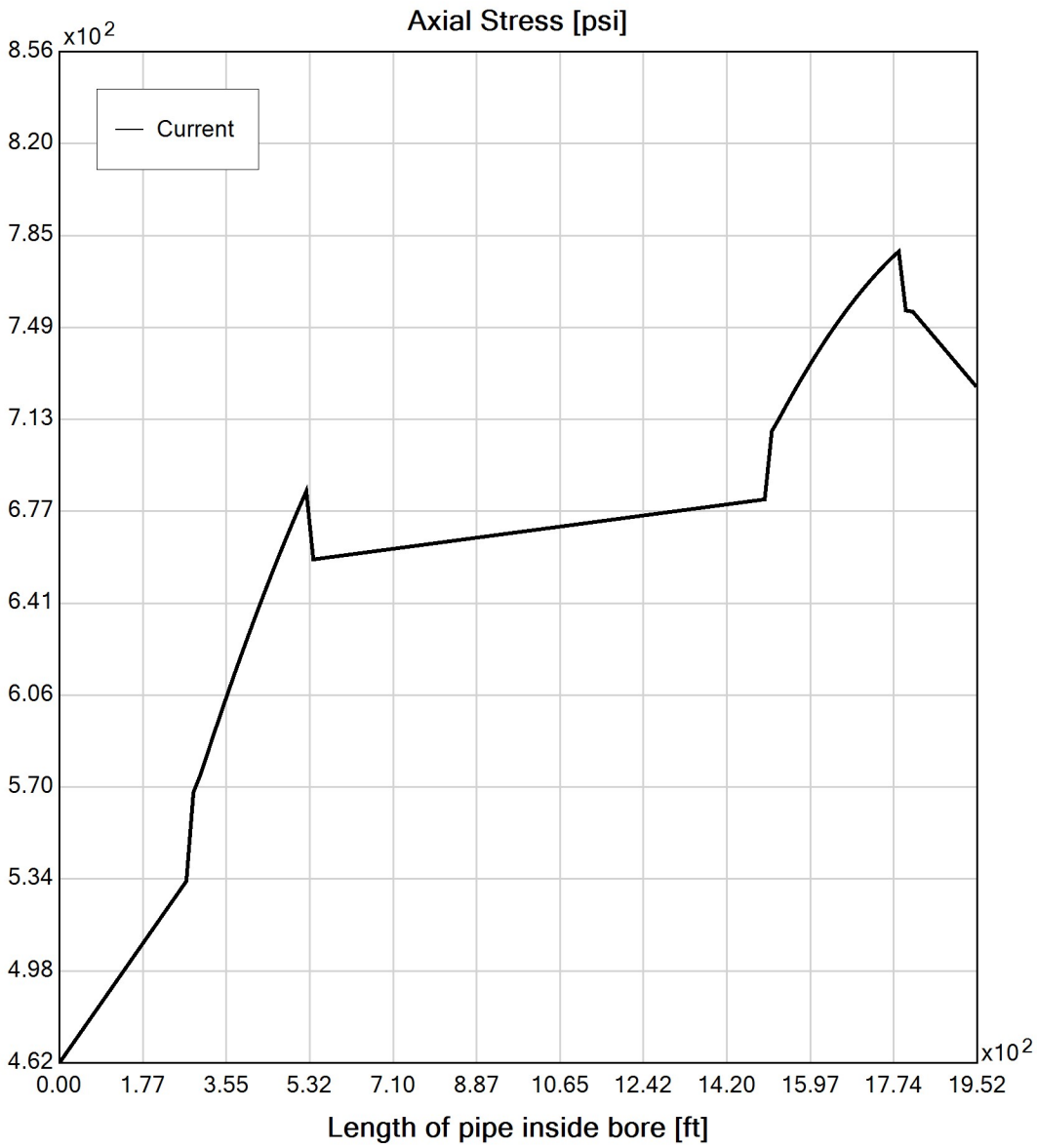


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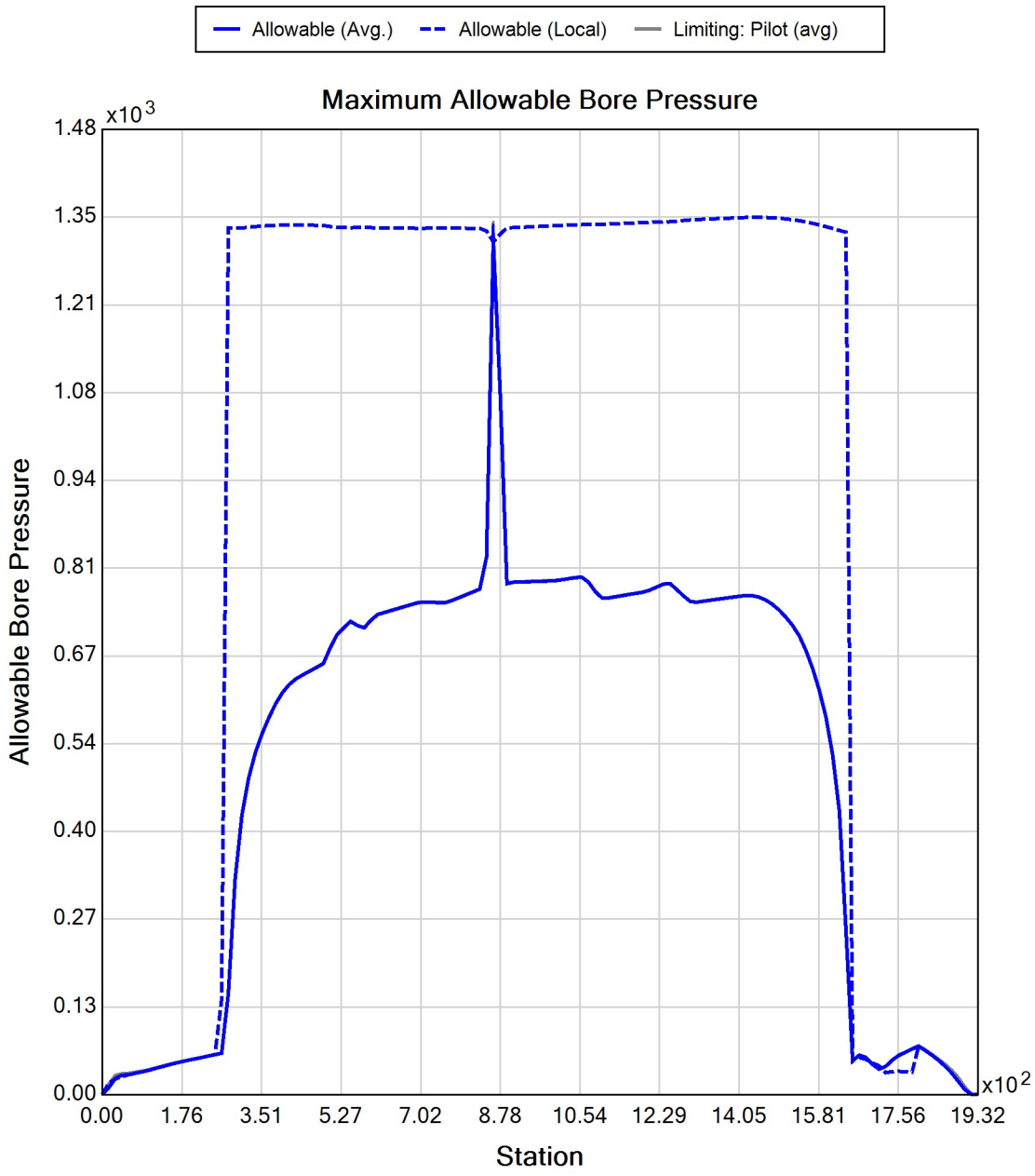


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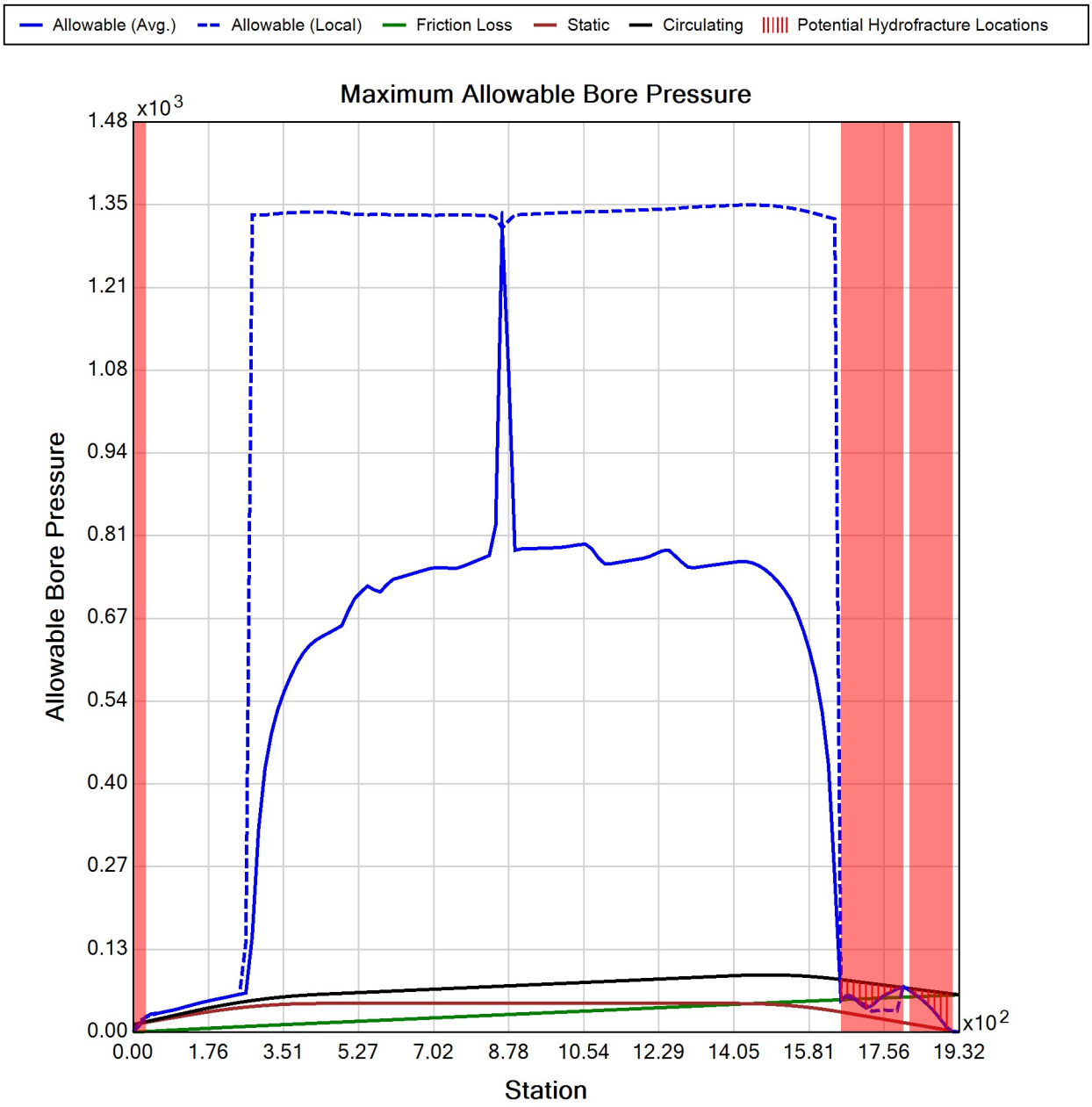


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## Input Summary

| | |
|---|---|
| Start Coordinate | (0.00, 0.00, 197.00) ft |
| End Coordinate | (1920.00, 0.00, 220.00) ft |
| Project Length | 1920.00 ft |
| Pipe Type | HDPE |
| OD Classification | IPS |
| Pipe OD | 3.500 in |
| Pipe DR | 7.0 |
| Pipe Thickness | 0.50 in |
| Rod Length | 15.00 ft |
| Rod Diameter | 3.5 in |
| Drill Rig Location | (0.00, 0.00, 0.00) ft |

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## Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 3" (3.5")
Pipe DR: 7
Pipe Length: 1950.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 0.625 ft
Silo Width: 0.625 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

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## In-service Load Summary:

| Pressure [psi] | Deformed | Collapsed |
|---|---|---|
| Earth Pressure | 21.5 | 31.9 |
| Water Pressure | 12.8 | 20.5 |
| Surface Surcharge | 0.0 | 0.0 |
| Internal Pressure | 0.0 | 0.0 |
| Net Pressure | 34.3 | 52.4 |
| **Deflection** | | |
| Earth Load Deflection | 2.472 | 3.673 |
| Buoyant Deflection | 0.020 | 0.020 |
| Reissner Effect | 0 | 0 |
| Net Deflection | 2.492 | 3.694 |
| **Compressive Stress [psi]** | | |
| Compressive Wall Stress | 120.0 | 183.5 |

## Installation Load Summary:

| Forces/Stresses | @Maximum Force | Absolute Maximum |
|---|---|---|
| Pullback Force [lb] | 3672.5 | 3672.5 |
| Pullback Stress [psi] | 779.3 | 779.3 |
| Pullback Strain | 1.355E-2 | 1.355E-2 |
| Bending Stress [psi] | 0.0 | 8.4 |
| Bending Strain | 0 | 1.458E-4 |
| Tensile Stress [psi] | 779.3 | 783.9 |
| Tensile Strain | 1.355E-2 | 1.375E-2 |

Net External Pressure = 50.6 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 172.8 lb

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## In-service Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 2.492 | 7.5 | 3.0 | OK |
| Unconstrained Collapse [psi] | 54.2 | 261.9 | 4.8 | OK |
| Compressive Wall Stress [psi] | 120.0 | 1150.0 | 9.6 | OK |

## Installation Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 0.010 | 7.5 | 756.1 | OK |
| Unconstrained Collapse [psi] | 73.6 | 495.7 | 6.7 | OK |
| Tensile Stress [psi] | 783.9 | 1200.0 | 1.5 | OK |

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## Project Summary

| | |
|---|---|
| General: | CHPE Package 3 HDD 31<br>Ref: Fort Ann, NY Washington cty<br>J2105<br>Start Date: 03-06-2023<br>End Date: 03-06-2023 |
| Project Owner: | TDI |
| Project Contractor: | Kiewit |
| Project Consultant: | CHA-BCE |
| Designer: | MDB<br>BCE<br>Amherst, MA |
| Description: | North to South<br>10" DR 9 updated |

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## Input Summary

| | |
|---|---|
| Start Coordinate | (0.00, 0.00, 269.00) ft |
| End Coordinate | (1059.00, 0.00, 270.00) ft |
| Project Length | 1059.00 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 |

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## Soil Summary

Number of Layers: 3

Soil Layer #1 USCS, Sand (S), SP
From Assistant
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 32.00, S.M.: 300.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Clay (C), CH
From Assistant
Unit Weight: 70.0000 (dry), 100.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

Soil Layer #3 USCS, Sand (S), SP
From Assistant
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 500.00, Coh: 0.00 [psi]

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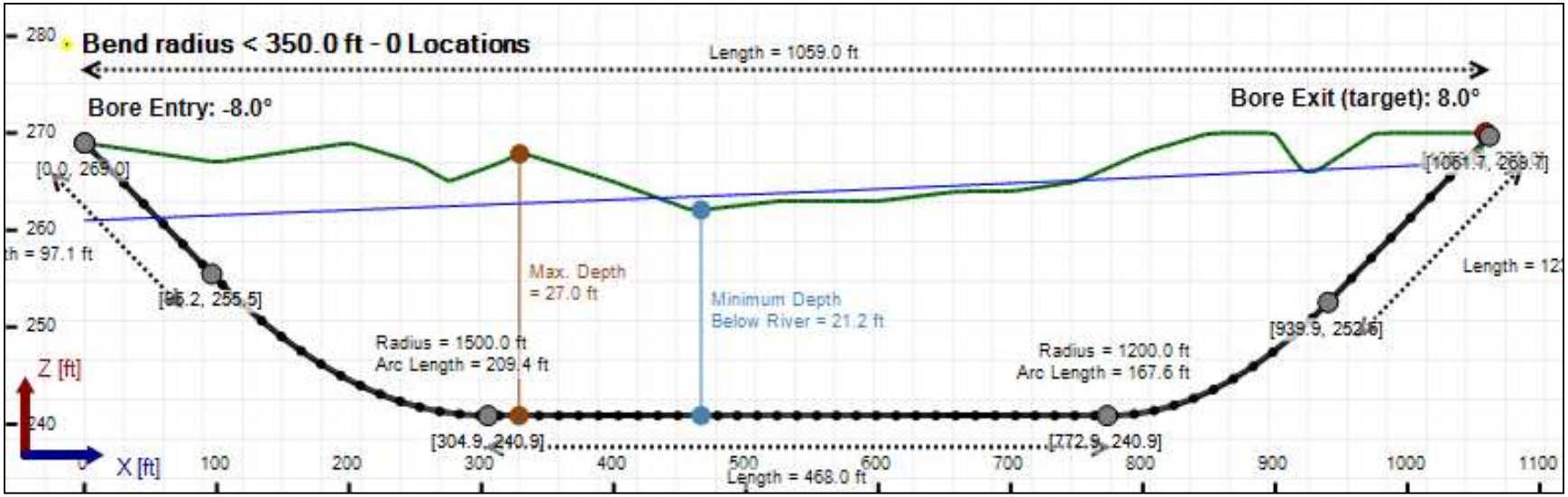
## Bore Cross-Section View

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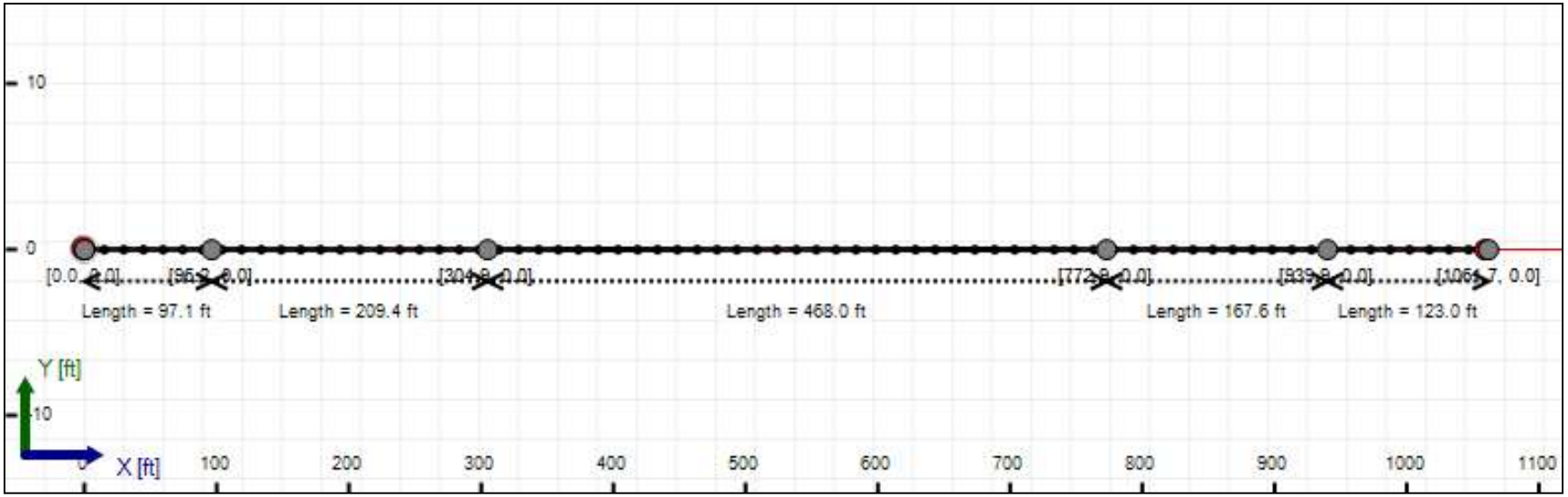
## Bore Plan View

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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: 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

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## In-service Load Summary:

| Pressure [psi] | Deformed | Collapsed |
|---|---|---|
| Earth Pressure | 2.9 | 9.4 |
| Water Pressure | 10.6 | 10.4 |
| Surface Surcharge | 0.0 | 0.0 |
| Internal Pressure | 0.0 | 0.0 |
| Net Pressure | 13.5 | 19.8 |
| **Deflection** | | |
| Earth Load Deflection | 0.925 | 2.774 |
| Buoyant Deflection | 0.132 | 0.132 |
| Reissner Effect | 0 | 0 |
| Net Deflection | 1.057 | 2.906 |
| **Compressive Stress [psi]** | | |
| Compressive Wall Stress | 60.5 | 89.1 |

## Installation Load Summary:

| Forces/Stresses | @Maximum Force | Absolute Maximum |
|---|---|---|
| Pullback Force [lb] | 16688.0 | 16688.0 |
| Pullback Stress [psi] | 465.4 | 465.4 |
| Pullback Strain | 8.094E-3 | 8.094E-3 |
| Bending Stress [psi] | 0.0 | 21.5 |
| Bending Strain | 0 | 3.733E-4 |
| Tensile Stress [psi] | 465.4 | 480.8 |
| Tensile Strain | 8.094E-3 | 8.660E-3 |

Net External Pressure = 18.6 [psi ]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

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## In-service Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 1.057 | 7.5 | 7.1 | OK |
| Unconstrained Collapse [psi] | 18.7 | 126.0 | 6.7 | 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] | 28.7 | 228.4 | 8.0 | OK |
| Tensile Stress [psi] | 480.8 | 1200.0 | 2.5 | OK |

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## 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 | 49.513 psi | 87.697 psi |
| 1 | 8.00 in | 12.00 in | 49.267 psi | 86.697 psi |
| 2 | 12.00 in | 16.13 in | 48.924 psi | 85.328 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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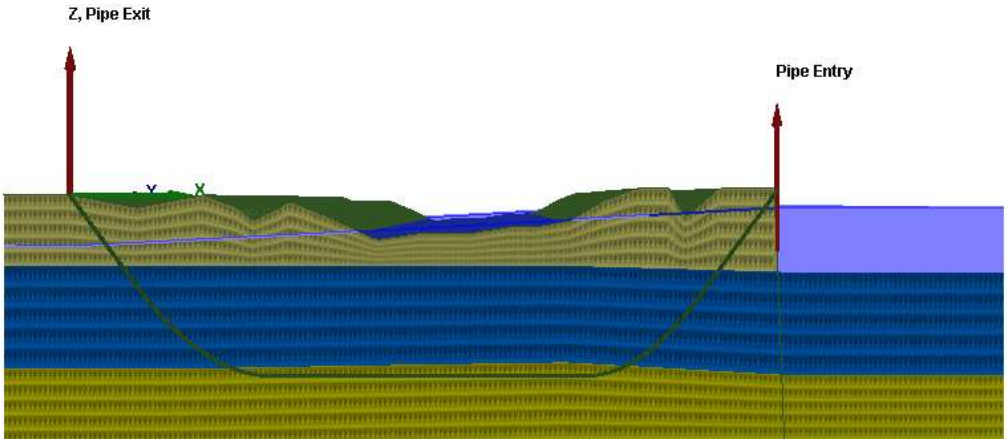
## Virtual Site

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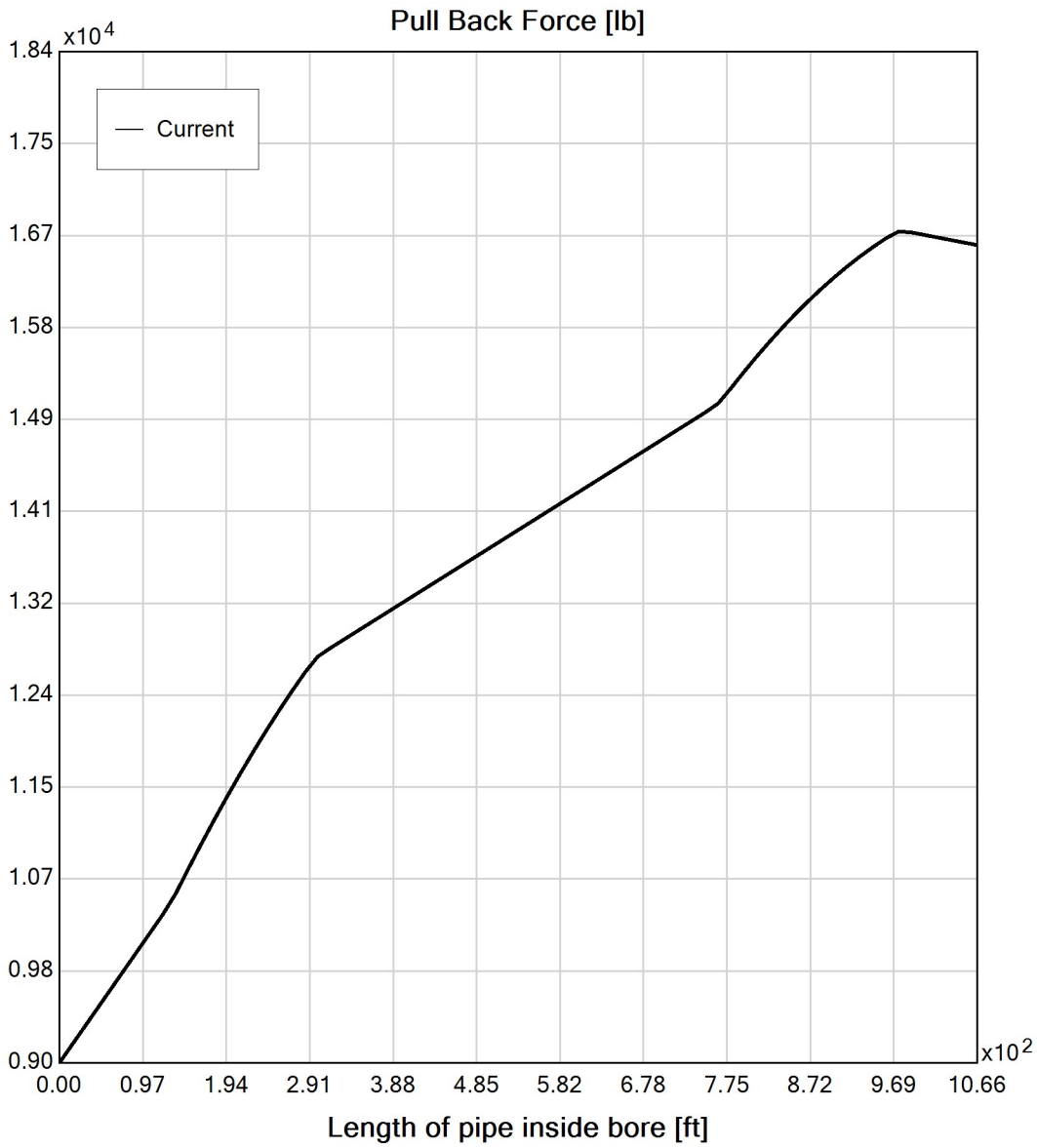


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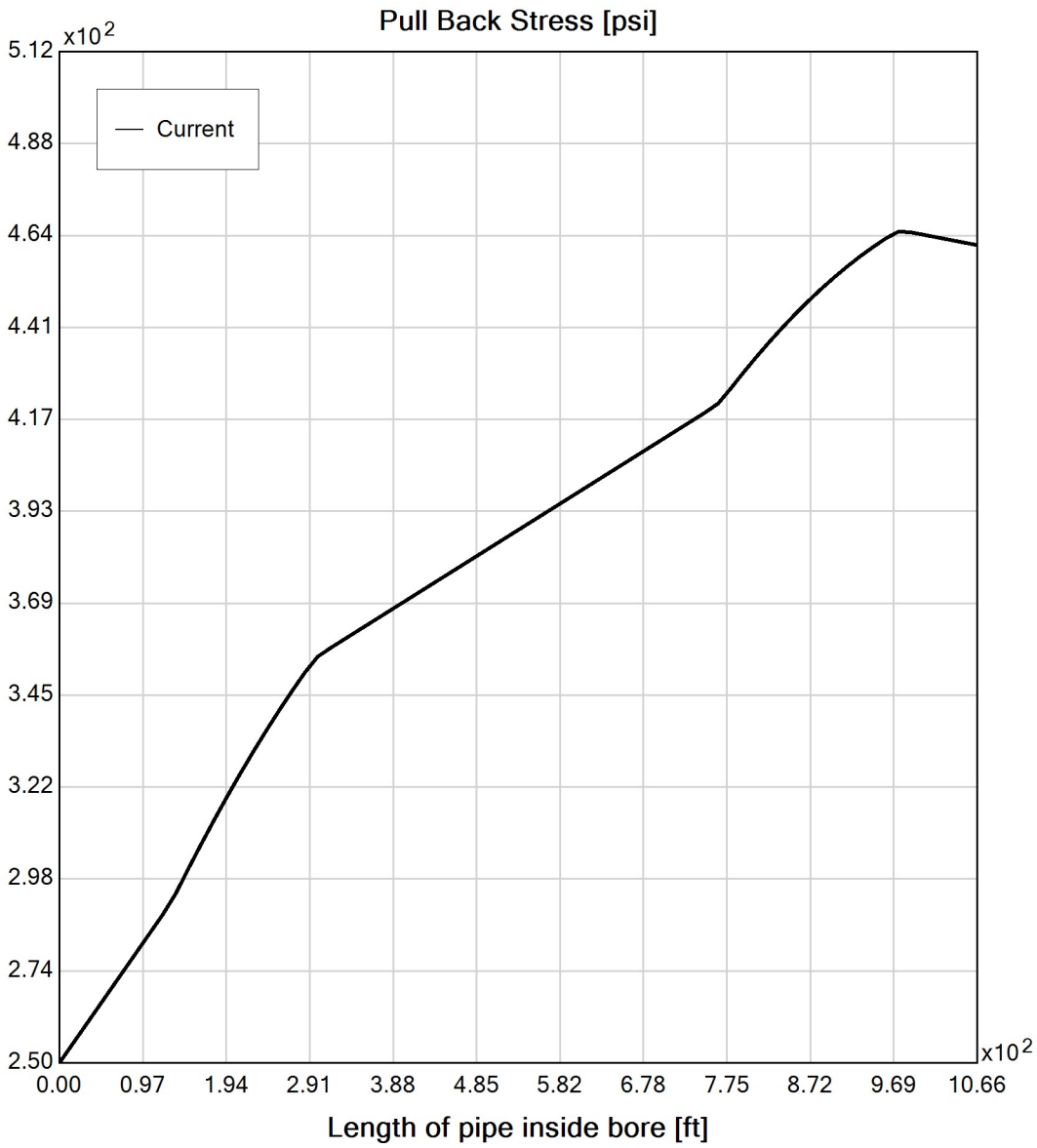


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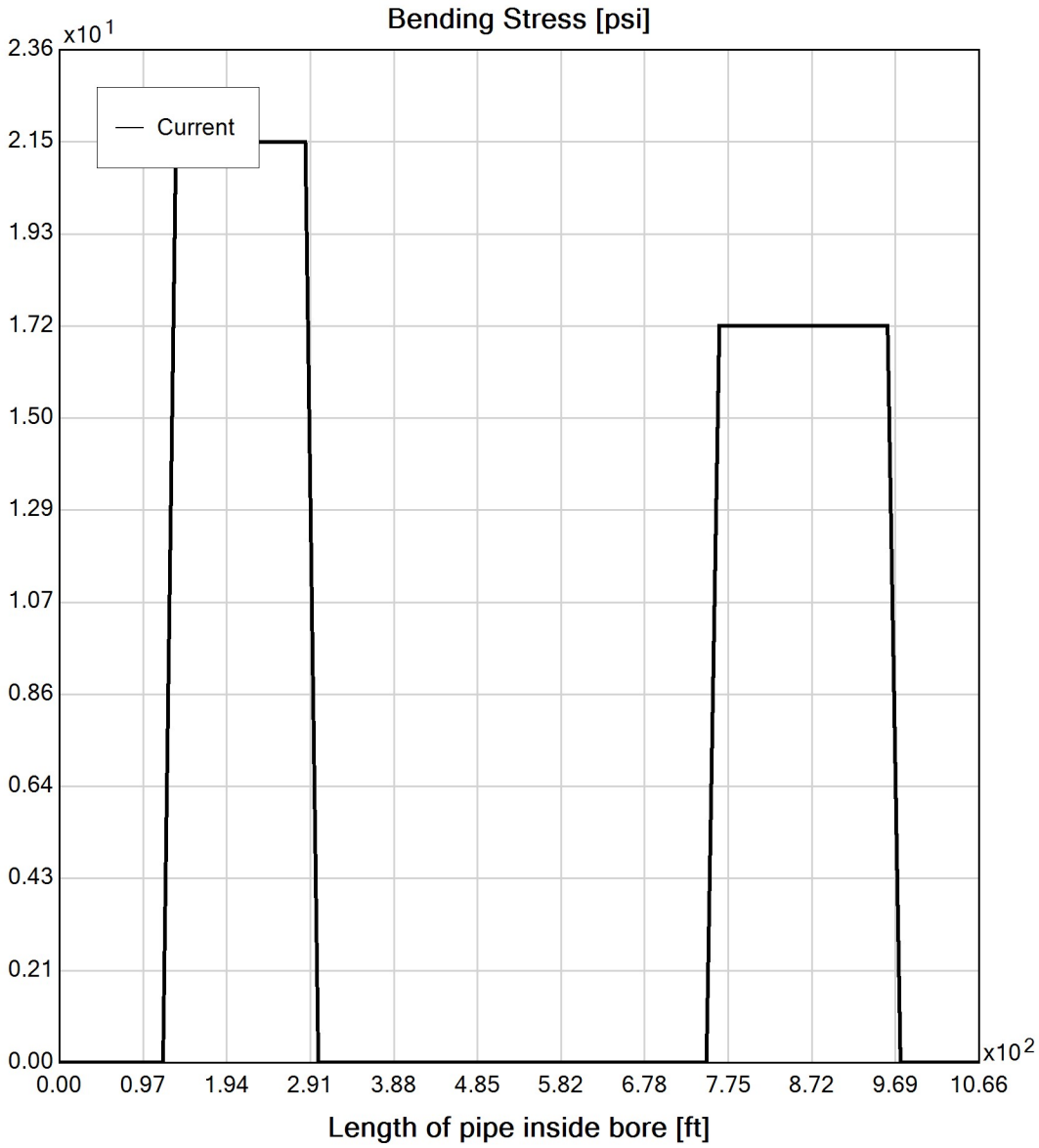


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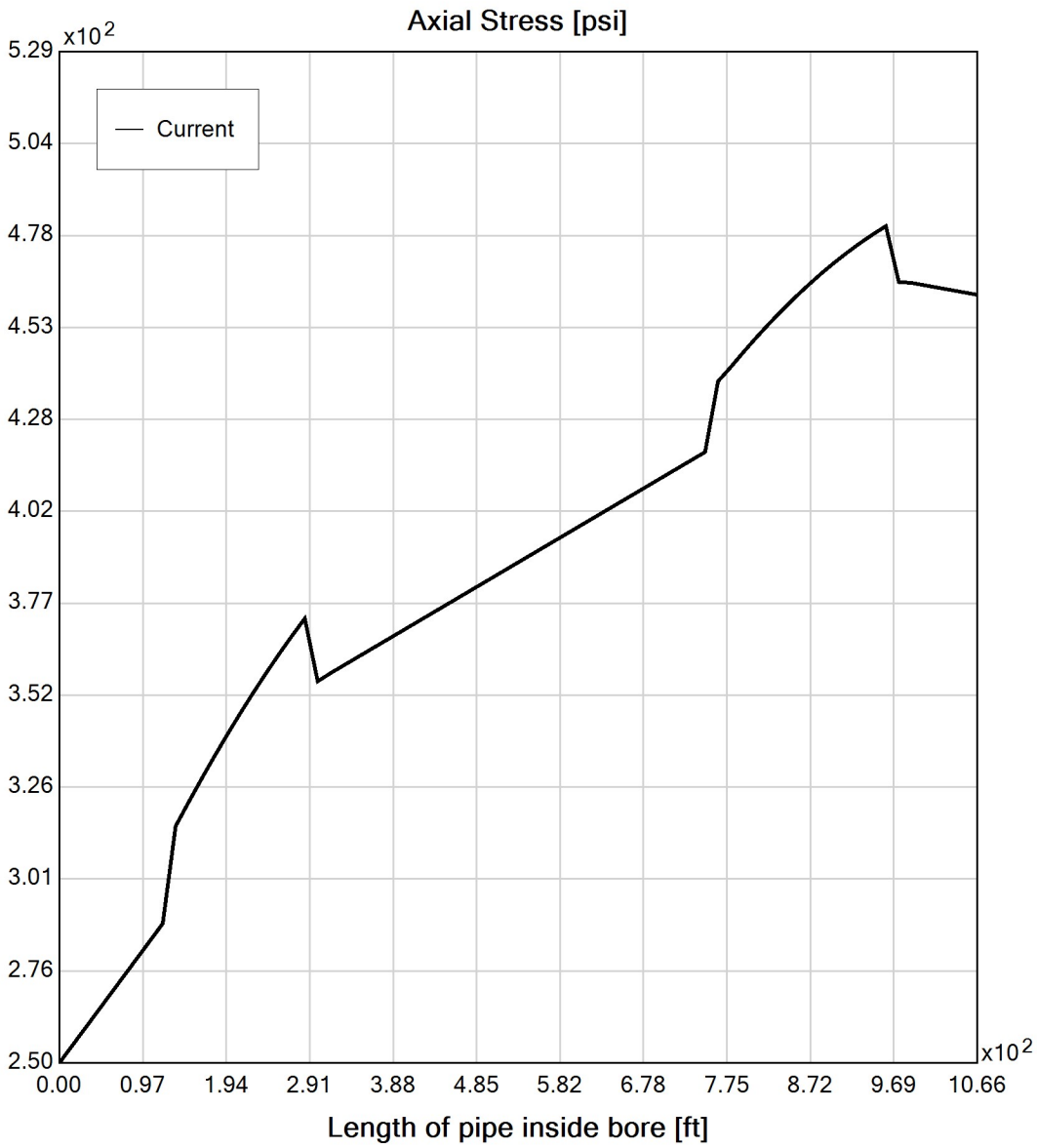


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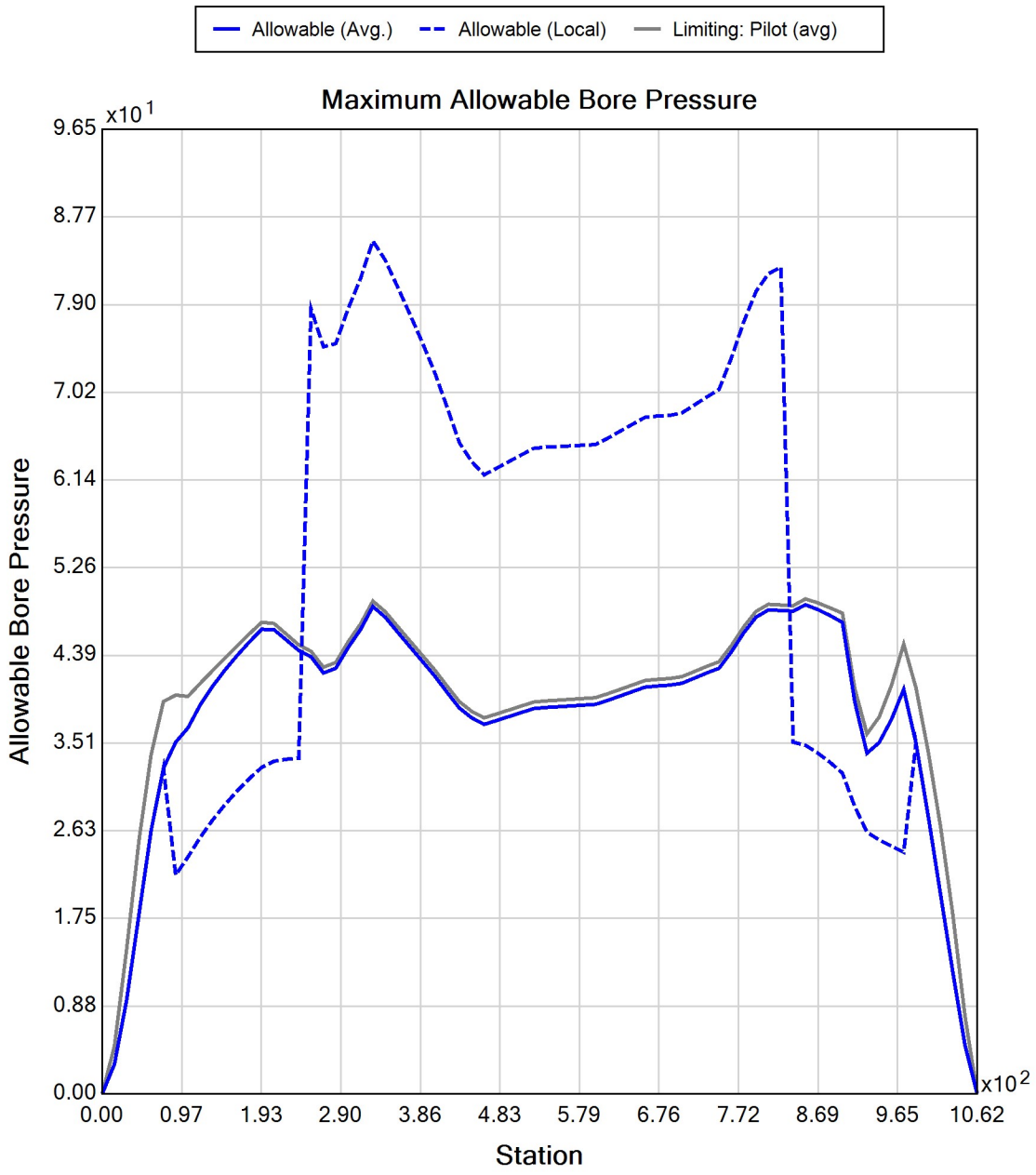


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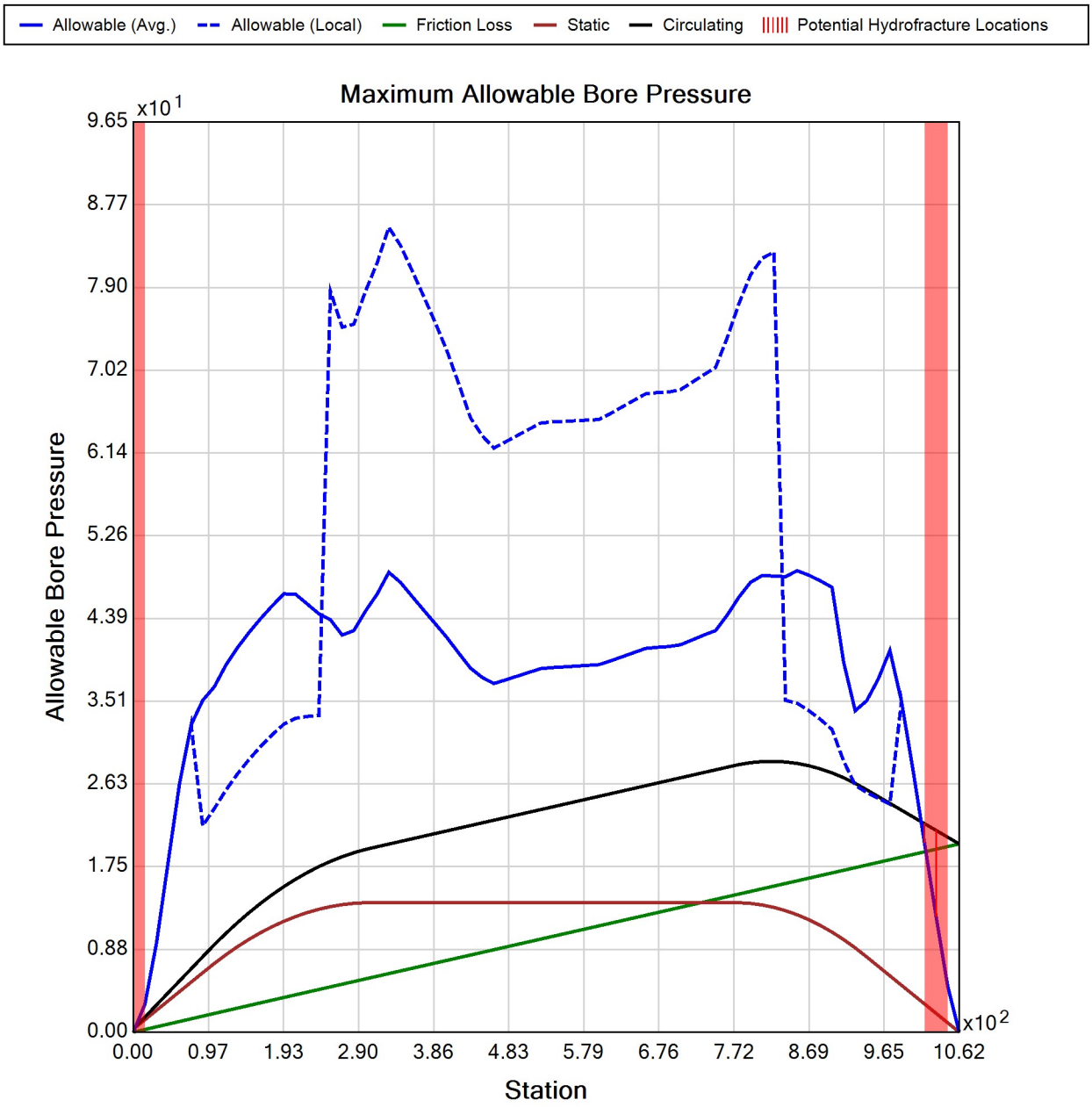


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# Generated Output

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## Input Summary

| | |
|---|---|
| Start Coordinate | (0.00, 0.00, 269.00) ft |
| End Coordinate | (1059.00, 0.00, 270.00) ft |
| Project Length | 1059.00 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 |

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## Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 2" (2.375")
Pipe DR: 9
Pipe Length: 1065.00 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

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## In-service Load Summary:

| Pressure [psi] | Deformed | Collapsed |
|---|---|---|
| Earth Pressure | 1.2 | 9.4 |
| Water Pressure | 10.6 | 10.4 |
| Surface Surcharge | 0.0 | 0.0 |
| Internal Pressure | 0.0 | 0.0 |
| Net Pressure | 11.8 | 19.8 |
| **Deflection** | | |
| Earth Load Deflection | 0.518 | 2.774 |
| Buoyant Deflection | 0.029 | 0.029 |
| Reissner Effect | 0 | 0 |
| Net Deflection | 0.547 | 2.803 |
| **Compressive Stress [psi]** | | |
| Compressive Wall Stress | 53.0 | 89.1 |

## Installation Load Summary:

| Forces/Stresses | @Maximum Force | Absolute Maximum |
|---|---|---|
| Pullback Force [lb] | 924.1 | 924.1 |
| Pullback Stress [psi] | 528.0 | 528.0 |
| Pullback Strain | 9.183E-3 | 9.183E-3 |
| Bending Stress [psi] | 0.0 | 4.7 |
| Bending Strain | 0 | 8.247E-5 |
| Tensile Stress [psi] | 528.0 | 530.0 |
| Tensile Strain | 9.183E-3 | 9.284E-3 |

Net External Pressure = 18.6 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

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## In-service Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 0.547 | 7.5 | 13.7 | OK |
| Unconstrained Collapse [psi] | 18.7 | 133.2 | 7.1 | OK |
| Compressive Wall Stress [psi] | 53.0 | 1150.0 | 21.7 | OK |

## Installation Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 0.014 | 7.5 | 524.3 | OK |
| Unconstrained Collapse [psi] | 28.7 | 226.1 | 7.9 | OK |
| Tensile Stress [psi] | 530.0 | 1200.0 | 2.3 | OK |

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# Generated Output

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## Project Summary

| | |
|---|---|
| General: | CHPE HDD 32 |
| | 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 32 10-inch DR 9 |

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## Input Summary

| | |
|---|---|
| Start Coordinate | (0.00, 0.00, 305.13) ft |
| End Coordinate | (872.00, 0.00, 306.14) ft |
| Project Length | 872.00 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 |

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## Soil Summary

Number of Layers: 3

Soil Layer #1 USCS, Sand (S), SW
Depth: 2.00 ft
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Sand (S), SM
Depth: 13.00 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: 23.00 ft
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

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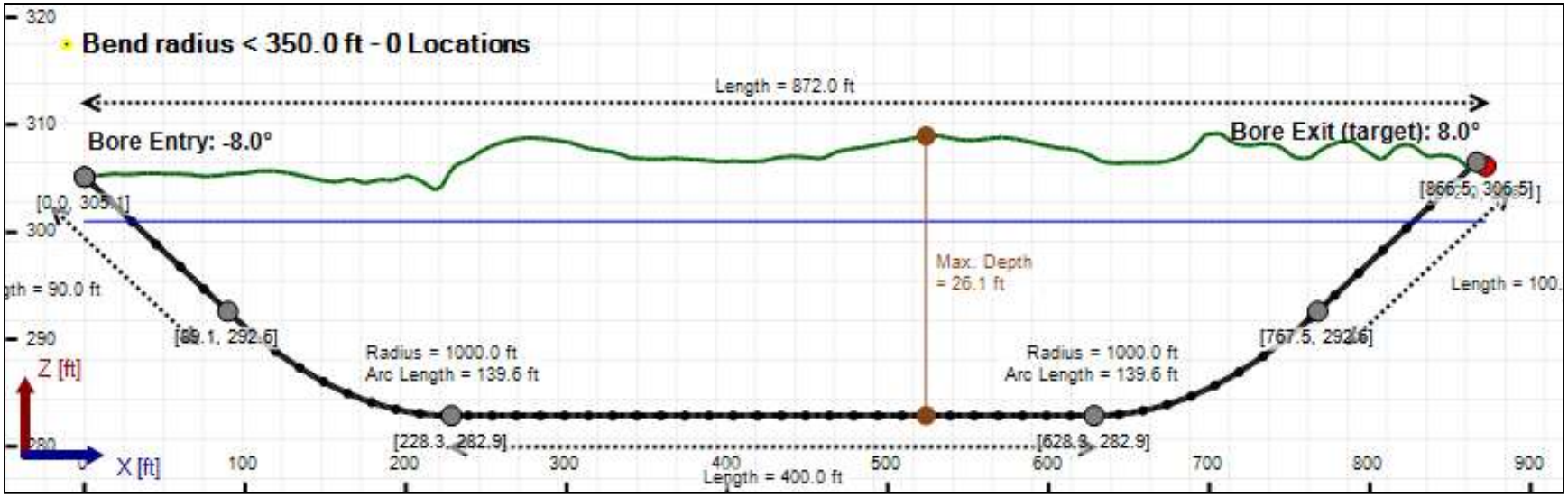
## Bore Cross-Section View

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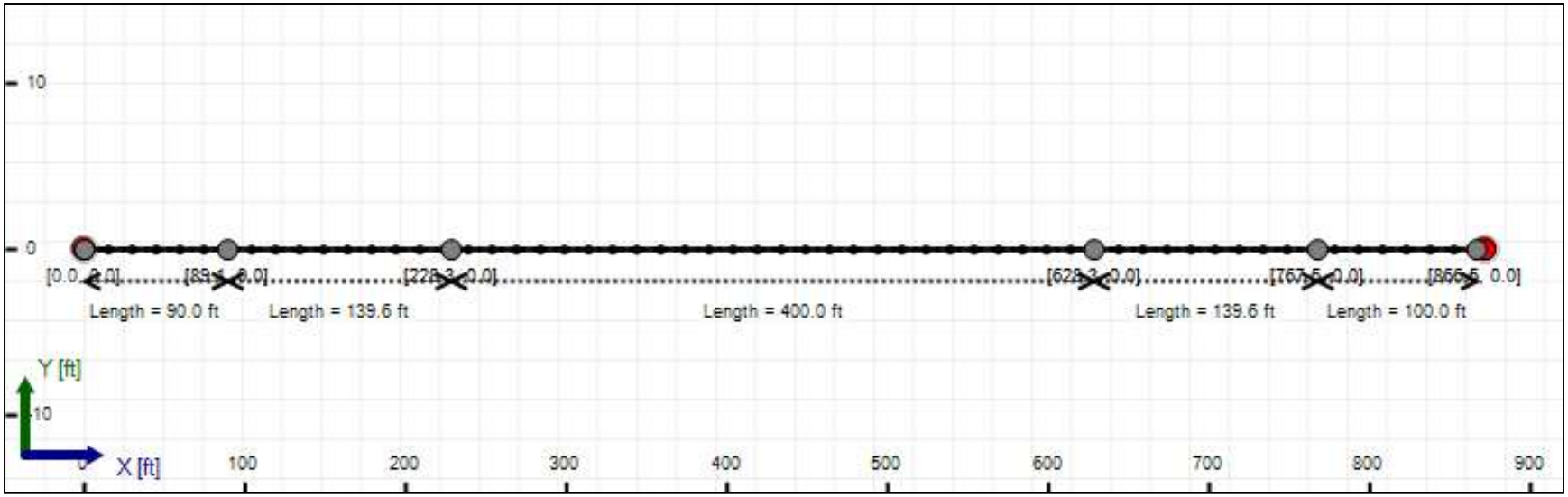
## Bore Plan View

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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: 870.00 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

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## In-service Load Summary:

| Pressure [psi] | Deformed | Collapsed |
|---|---|---|
| Earth Pressure | 3.7 | 13.1 |
| Water Pressure | 7.9 | 7.9 |
| Surface Surcharge | 0.0 | 0.0 |
| Internal Pressure | 0.0 | 0.0 |
| Net Pressure | 11.6 | 21.0 |
| **Deflection** | | |
| Earth Load Deflection | 1.017 | 3.576 |
| Buoyant Deflection | 0.132 | 0.132 |
| Reissner Effect | 0 | 0 |
| Net Deflection | 1.149 | 3.708 |
| **Compressive Stress [psi]** | | |
| Compressive Wall Stress | 52.1 | 94.5 |

## Installation Load Summary:

| Forces/Stresses | @Maximum Force | Absolute Maximum |
|---|---|---|
| Pullback Force [lb] | 13804.1 | 13804.1 |
| Pullback Stress [psi] | 385.0 | 385.0 |
| Pullback Strain | 6.695E-3 | 6.695E-3 |
| Bending Stress [psi] | 0.0 | 25.8 |
| Bending Strain | 0 | 4.479E-4 |
| Tensile Stress [psi] | 385.0 | 406.9 |
| Tensile Strain | 6.695E-3 | 7.524E-3 |

Net External Pressure = 17.8 [psi ]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

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## In-service Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 1.149 | 7.5 | 6.5 | OK |
| Unconstrained Collapse [psi] | 15.4 | 124.6 | 8.1 | OK |
| Compressive Wall Stress [psi] | 52.1 | 1150.0 | 22.1 | OK |

## Installation Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 0.065 | 7.5 | 115.8 | OK |
| Unconstrained Collapse [psi] | 25.4 | 232.6 | 9.1 | OK |
| Tensile Stress [psi] | 406.9 | 1200.0 | 2.9 | OK |

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## 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 | 65.228 psi | 67.382 psi |
| 1 | 8.00 in | 12.00 in | 65.041 psi | 67.191 psi |
| 2 | 12.00 in | 16.13 in | 64.773 psi | 66.918 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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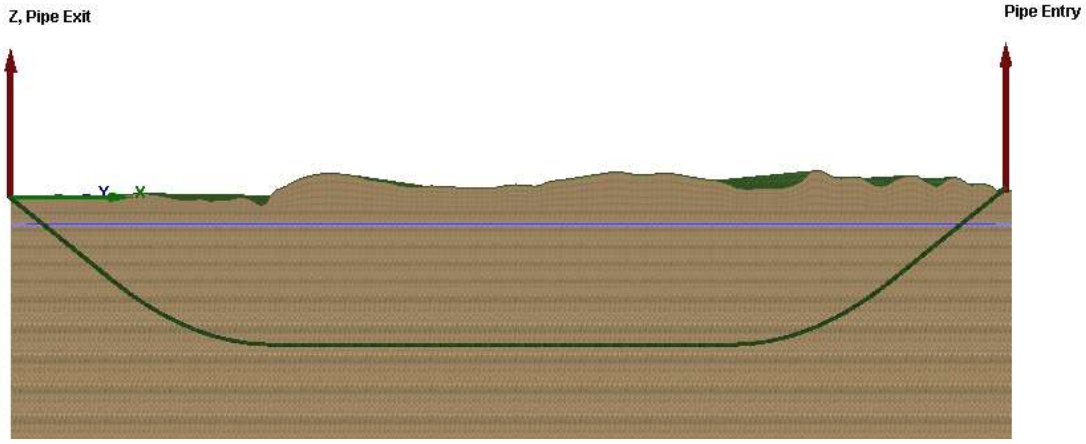
## Virtual Site

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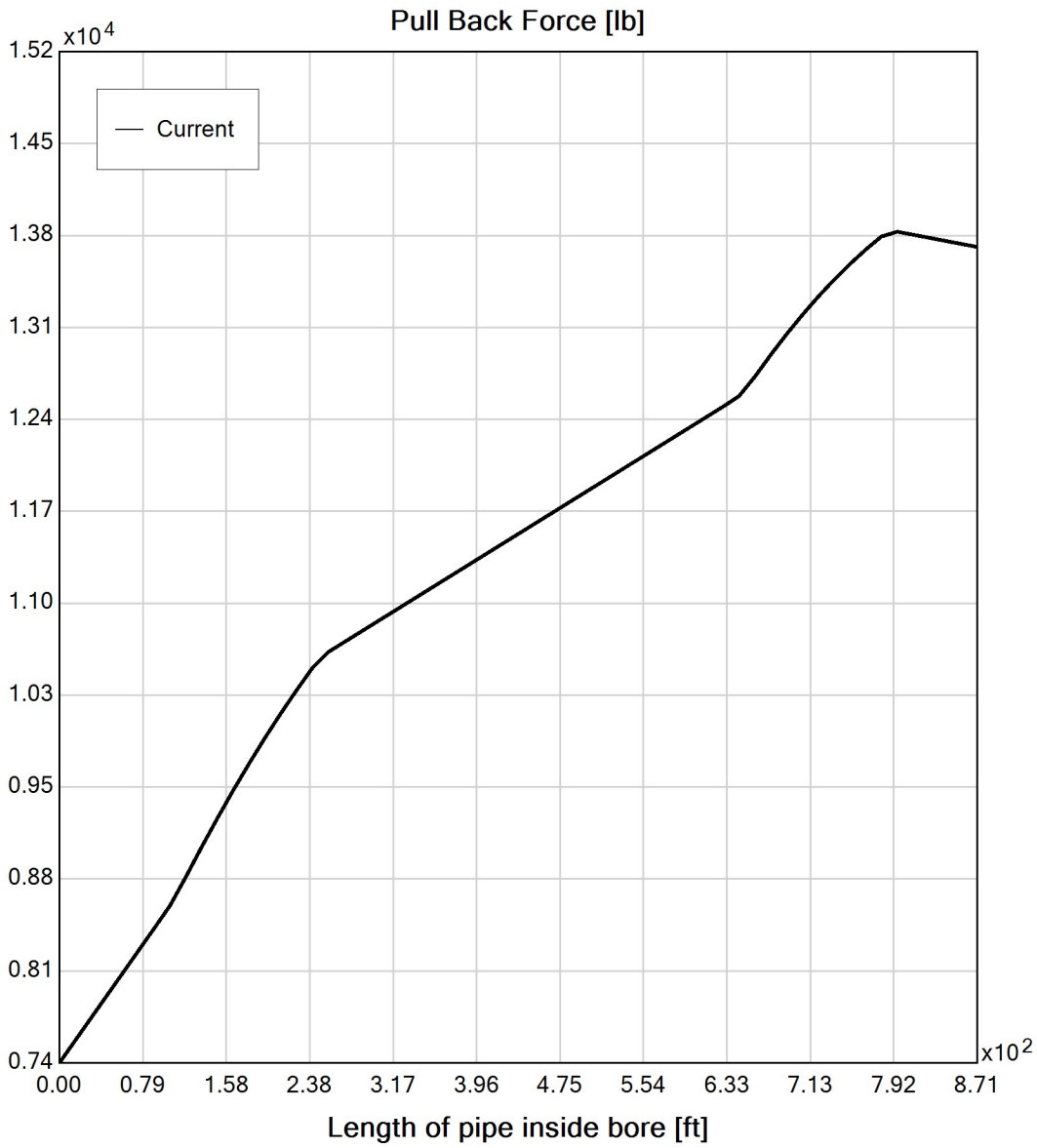


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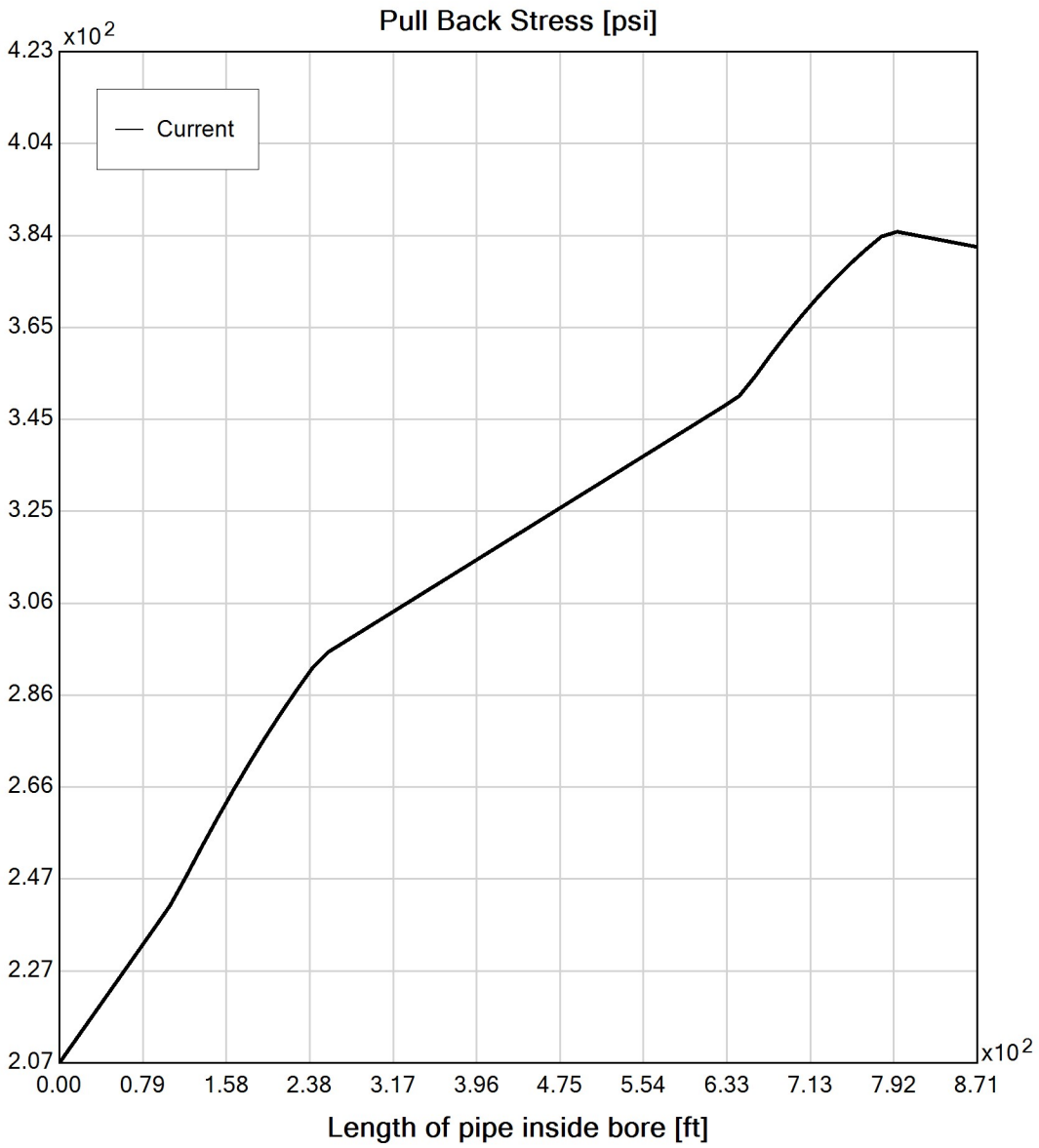


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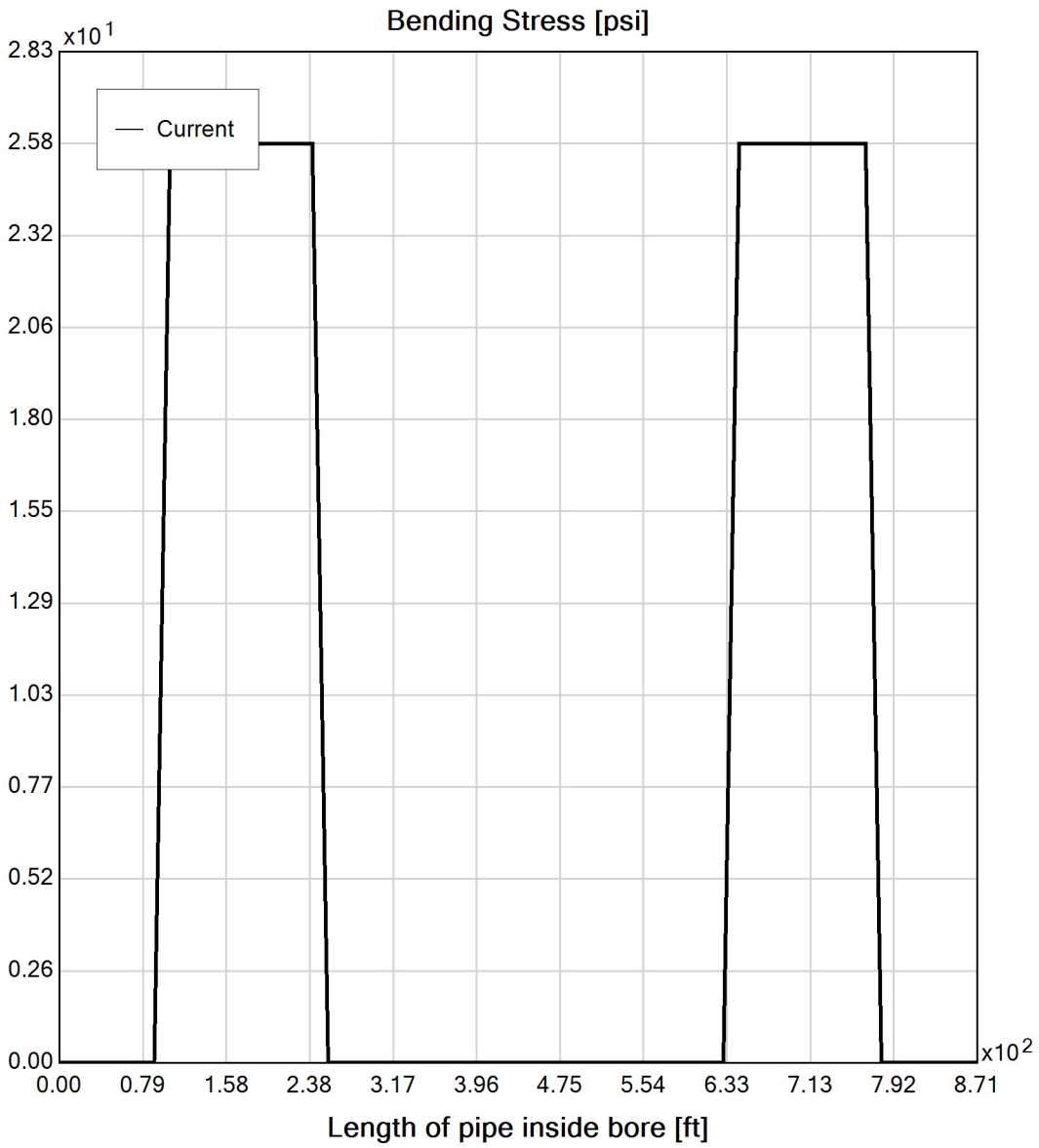


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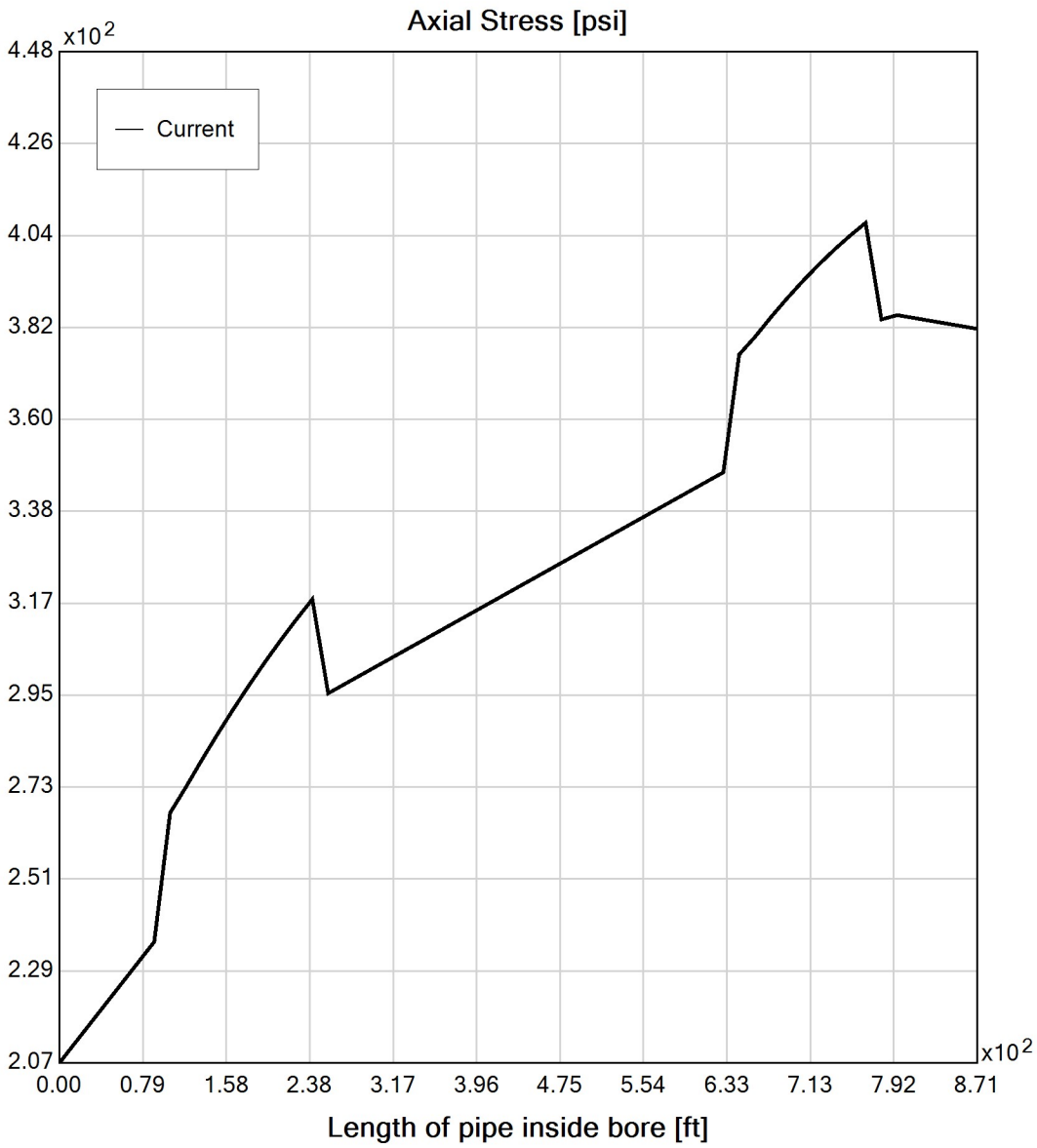


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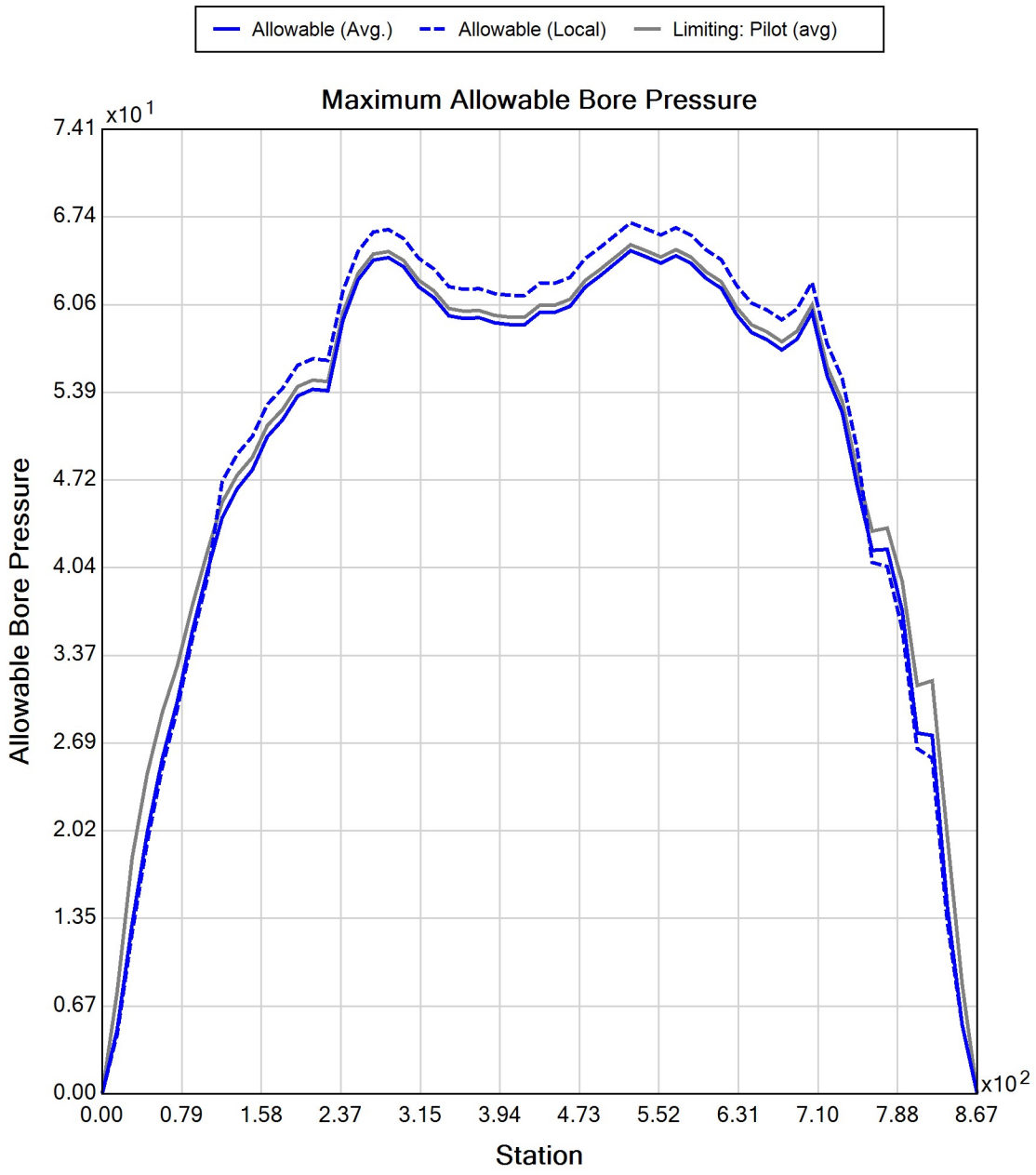


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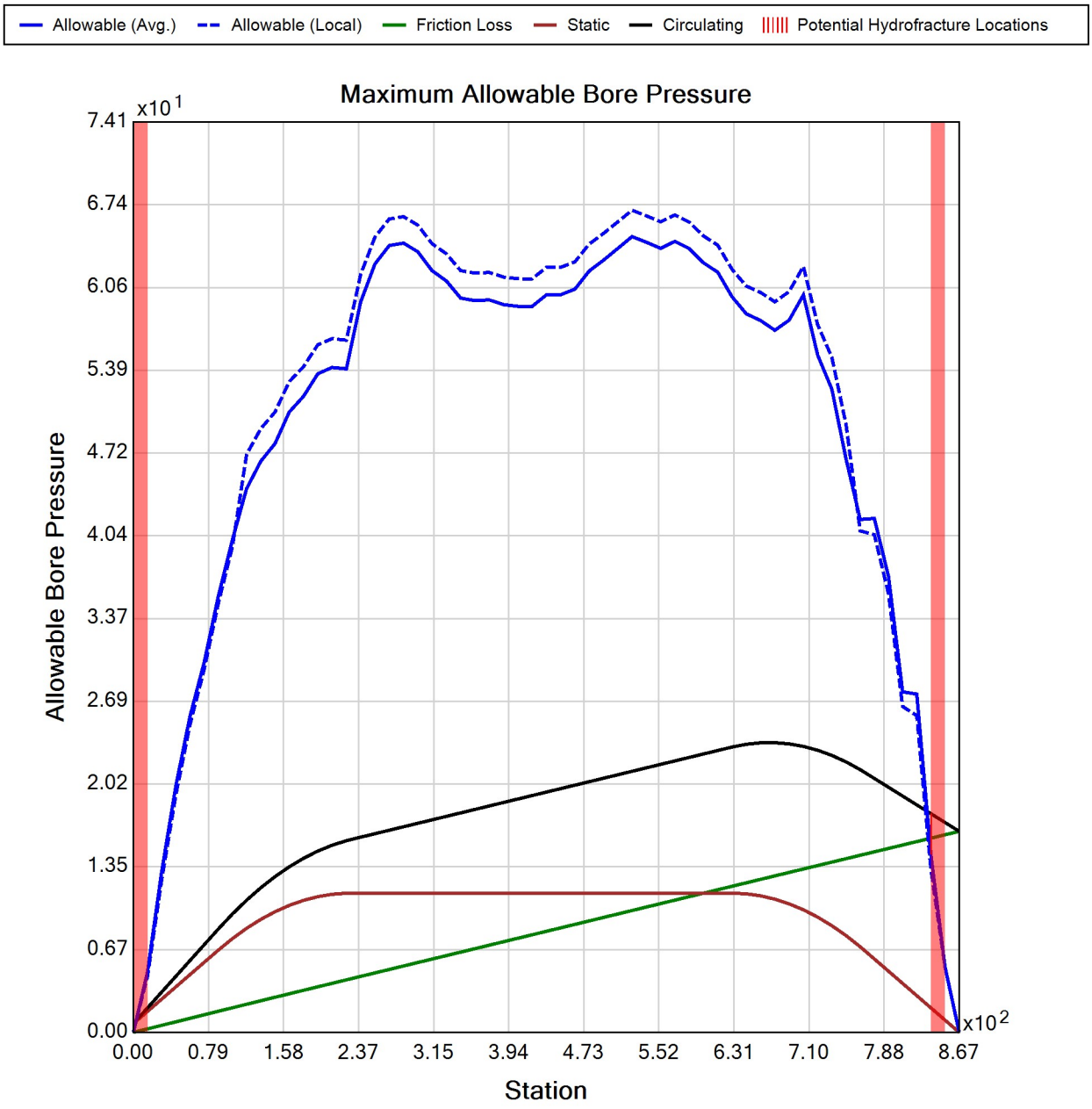


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## Input Summary

| | |
|---|---|
| Start Coordinate | (0.00, 0.00, 305.13) ft |
| End Coordinate | (872.00, 0.00, 306.14) ft |
| Project Length | 872.00 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 |

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## Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 2" (2.375")
Pipe DR: 9
Pipe Length: 870.00 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

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## In-service Load Summary:

| Pressure [psi] | Deformed | Collapsed |
|---|---|---|
| Earth Pressure | 1.5 | 13.1 |
| Water Pressure | 7.9 | 7.9 |
| Surface Surcharge | 0.0 | 0.0 |
| Internal Pressure | 0.0 | 0.0 |
| Net Pressure | 9.4 | 21.0 |
| **Deflection** | | |
| Earth Load Deflection | 0.550 | 3.576 |
| Buoyant Deflection | 0.029 | 0.029 |
| Reissner Effect | 0 | 0 |
| Net Deflection | 0.579 | 3.605 |
| **Compressive Stress [psi]** | | |
| Compressive Wall Stress | 42.2 | 94.5 |

## Installation Load Summary:

| Forces/Stresses | @Maximum Force | Absolute Maximum |
|---|---|---|
| Pullback Force [lb] | 783.4 | 783.4 |
| Pullback Stress [psi] | 447.6 | 447.6 |
| Pullback Strain | 7.784E-3 | 7.784E-3 |
| Bending Stress [psi] | 0.0 | 5.7 |
| Bending Strain | 0 | 9.896E-5 |
| Tensile Stress [psi] | 447.6 | 449.4 |
| Tensile Strain | 7.784E-3 | 7.915E-3 |

Net External Pressure = 17.8 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

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## In-service Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 0.579 | 7.5 | 13.0 | OK |
| Unconstrained Collapse [psi] | 15.4 | 132.7 | 8.6 | OK |
| Compressive Wall Stress [psi] | 42.2 | 1150.0 | 27.3 | OK |

## Installation Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 0.014 | 7.5 | 524.3 | OK |
| Unconstrained Collapse [psi] | 25.4 | 230.8 | 9.1 | OK |
| Tensile Stress [psi] | 449.4 | 1200.0 | 2.7 | OK |

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# Generated Output

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## Project Summary

| | |
|---|---|
| General: | CHPE HDD 32A |
| | 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 32A 10-inch DR 9 |

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## Input Summary

| | |
|---|---|
| Start Coordinate | (0.00, 0.00, 305.50) ft |
| End Coordinate | (633.00, 0.00, 301.50) ft |
| Project Length | 633.00 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 |

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## Soil Summary

Number of Layers: 2

Soil Layer #1 USCS, Sand (S), SP
Depth: 2.70 ft
Unit Weight: 110.0000 (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: 35.00 ft
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

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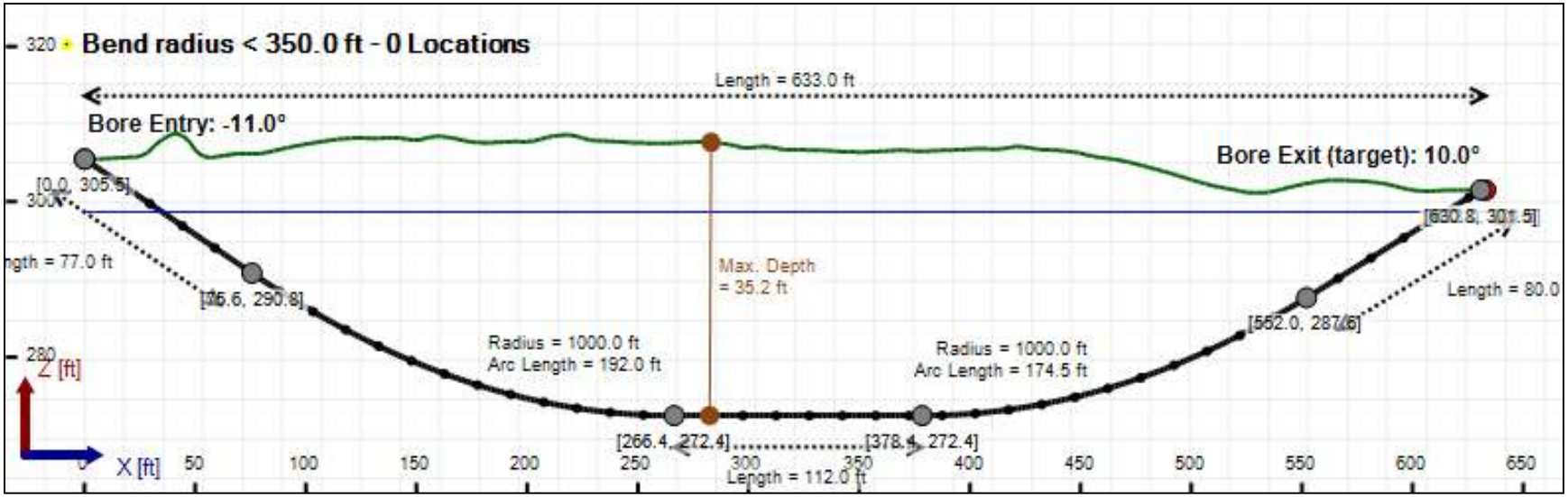
## Bore Cross-Section View

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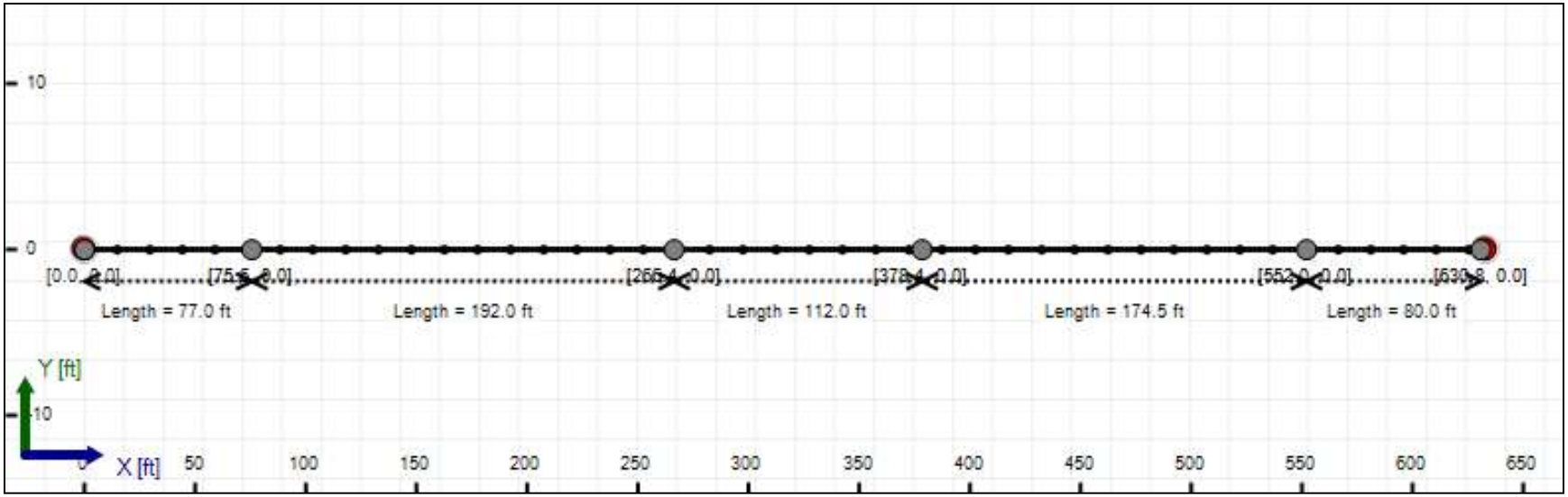
## Bore Plan View

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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: 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

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## In-service Load Summary:

| Pressure [psi] | Deformed | Collapsed |
|---|---|---|
| Earth Pressure | 3.5 | 16.3 |
| Water Pressure | 11.4 | 11.4 |
| Surface Surcharge | 0.0 | 0.0 |
| Internal Pressure | 0.0 | 0.0 |
| Net Pressure | 14.8 | 27.7 |
| **Deflection** | | |
| Earth Load Deflection | 1.122 | 4.499 |
| Buoyant Deflection | 0.132 | 0.132 |
| Reissner Effect | 0 | 0 |
| Net Deflection | 1.254 | 4.631 |
| **Compressive Stress [psi]** | | |
| Compressive Wall Stress | 66.8 | 124.6 |

## Installation Load Summary:

| Forces/Stresses | @Maximum Force | Absolute Maximum |
|---|---|---|
| Pullback Force [lb] | 10914.1 | 10914.1 |
| Pullback Stress [psi] | 304.4 | 304.4 |
| Pullback Strain | 5.294E-3 | 5.294E-3 |
| Bending Stress [psi] | 0.0 | 25.8 |
| Bending Strain | 0 | 4.479E-4 |
| Tensile Stress [psi] | 304.4 | 329.2 |
| Tensile Strain | 5.294E-3 | 6.173E-3 |

Net External Pressure = 19.3 [psi ]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

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## In-service Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 1.254 | 7.5 | 6.0 | OK |
| Unconstrained Collapse [psi] | 21.5 | 125.4 | 5.8 | OK |
| Compressive Wall Stress [psi] | 66.8 | 1150.0 | 17.2 | OK |

## Installation Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 0.065 | 7.5 | 115.8 | OK |
| Unconstrained Collapse [psi] | 31.4 | 237.5 | 7.6 | OK |
| Tensile Stress [psi] | 329.2 | 1200.0 | 3.6 | OK |

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## 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 | 76.085 psi | 75.295 psi |
| 1 | 8.00 in | 12.00 in | 75.990 psi | 75.200 psi |
| 2 | 12.00 in | 16.13 in | 75.851 psi | 75.063 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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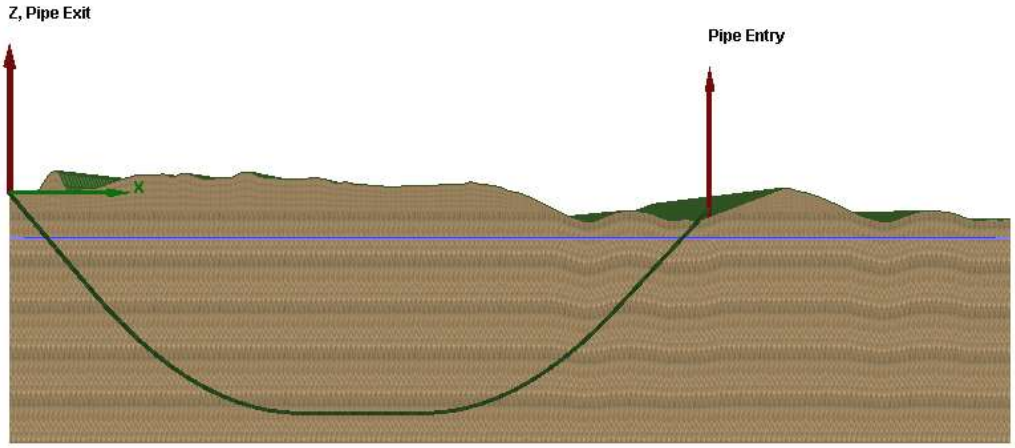
## Virtual Site

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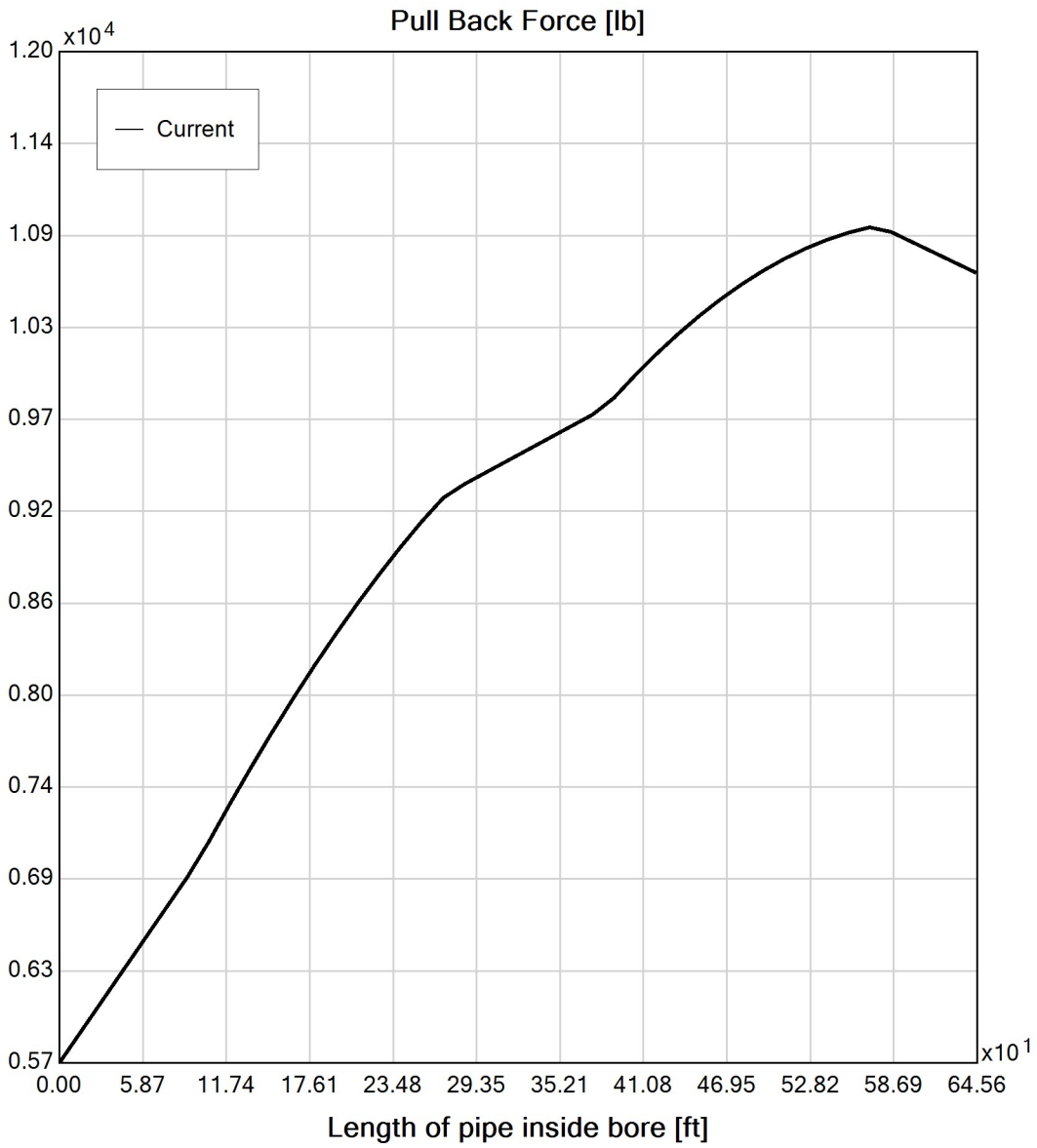


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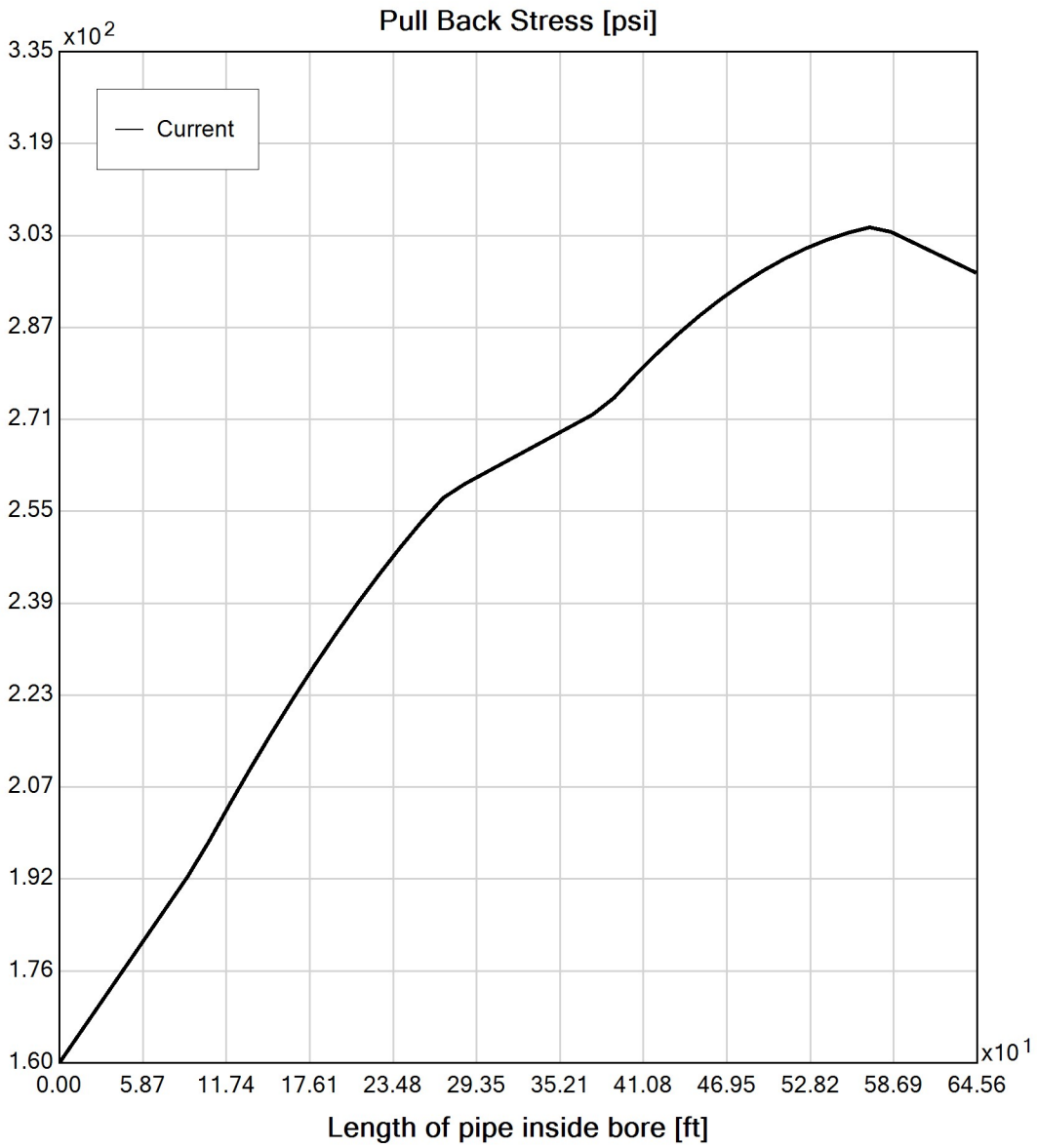


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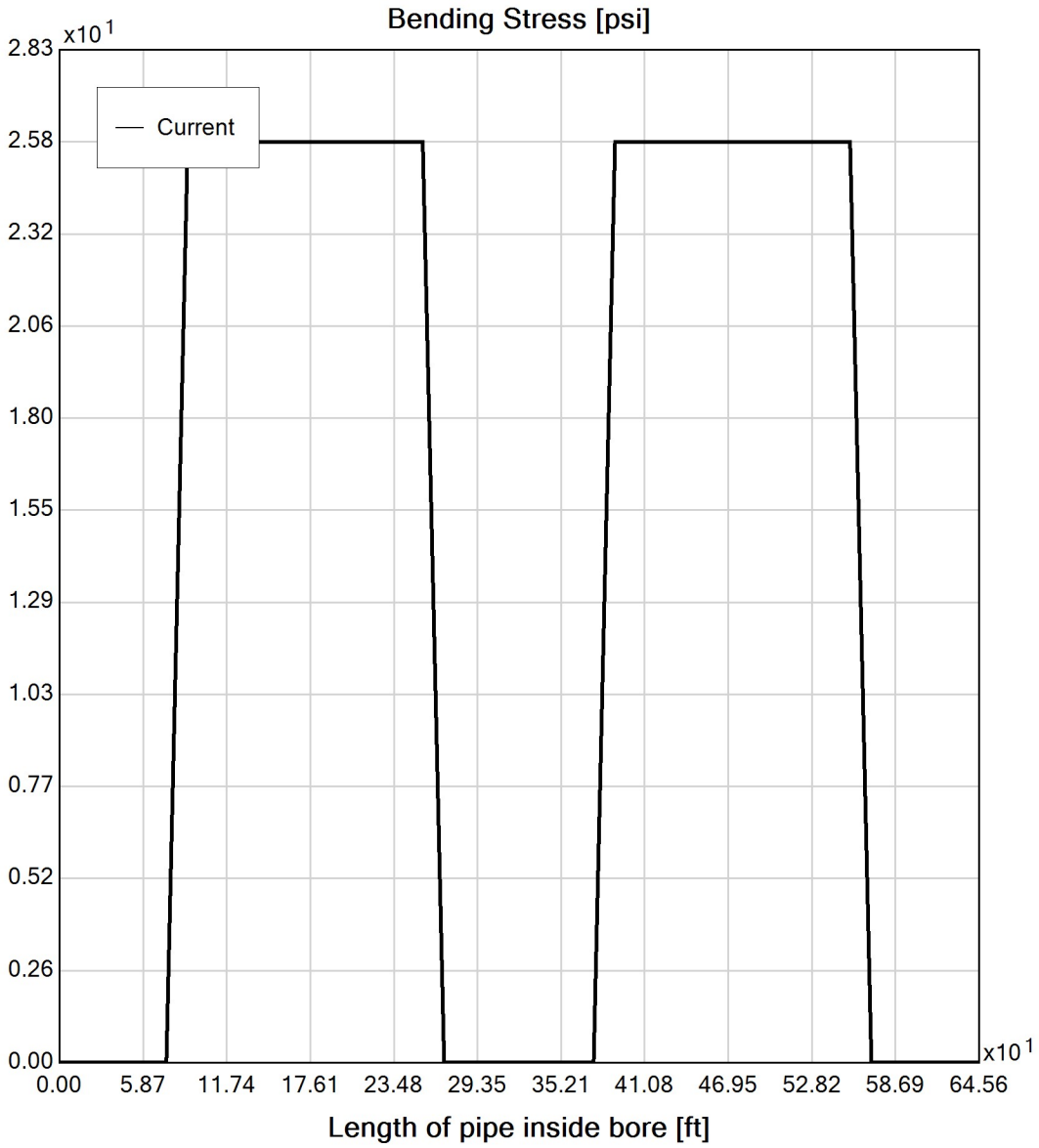


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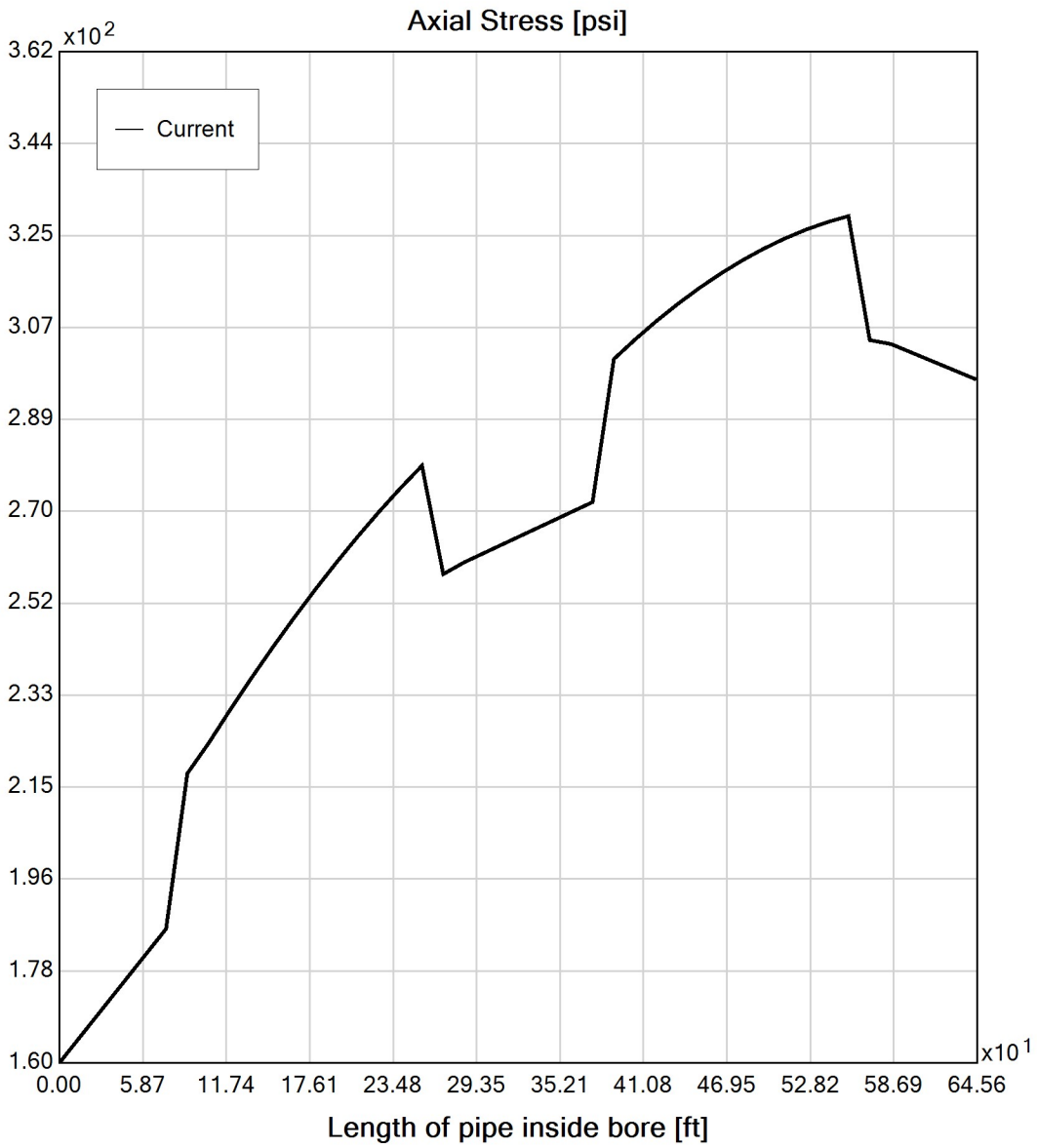


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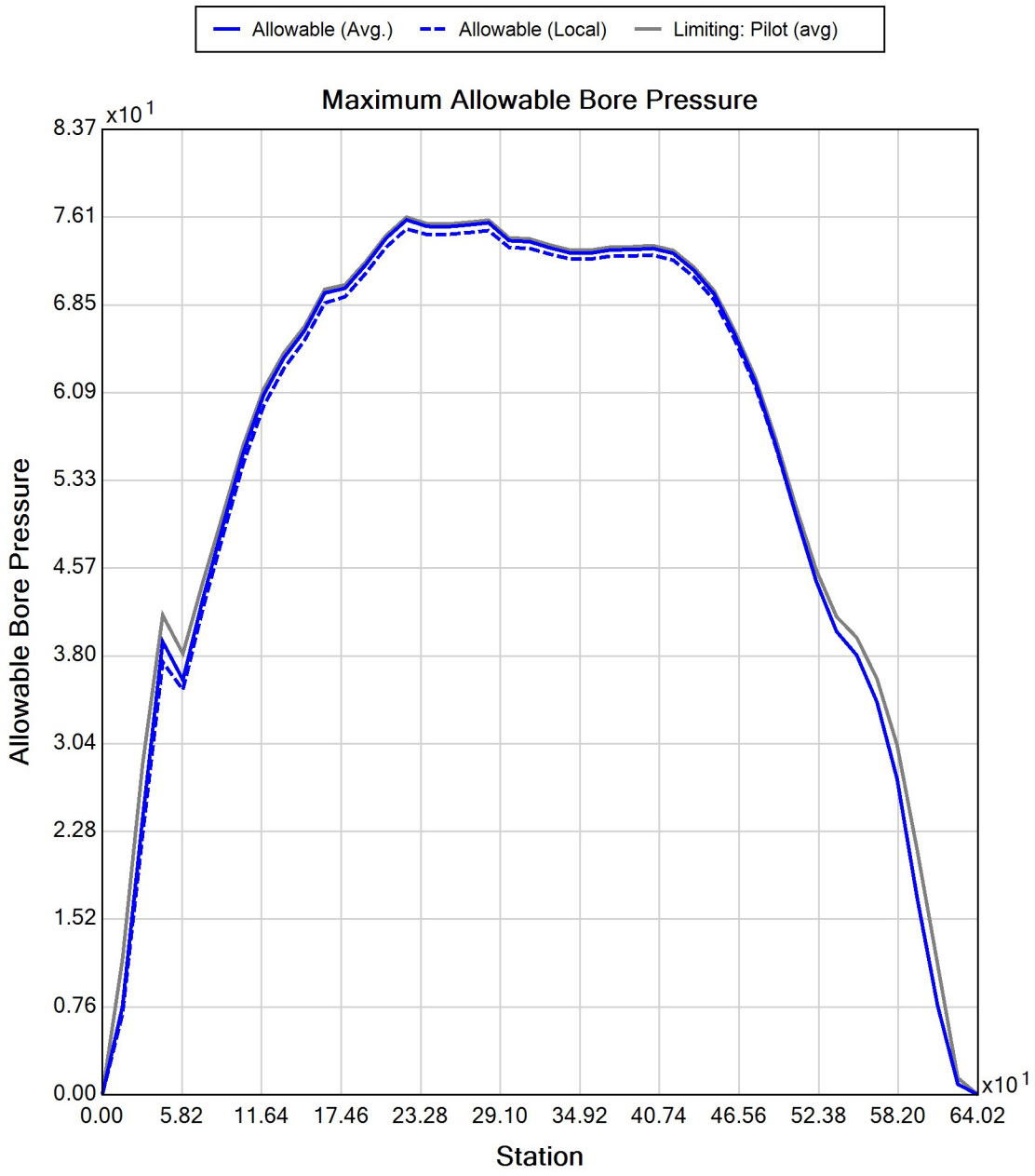


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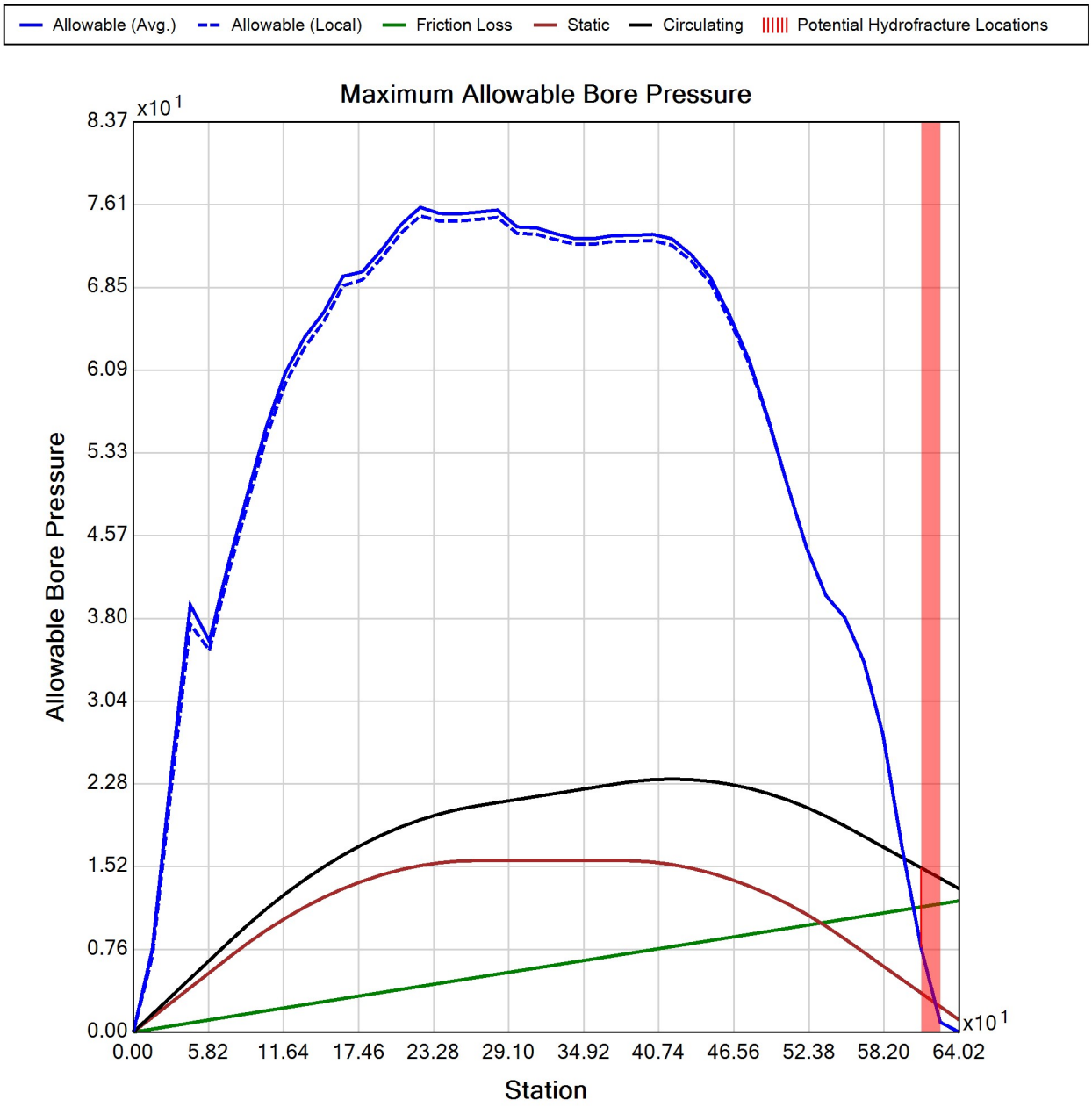


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## Input Summary

| | |
|---|---|
| Start Coordinate | (0.00, 0.00, 305.50) ft |
| End Coordinate | (633.00, 0.00, 301.50) ft |
| Project Length | 633.00 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 |

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## 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

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## In-service Load Summary:

| Pressure [psi] | Deformed | Collapsed |
|---|---|---|
| Earth Pressure | 1.4 | 16.3 |
| Water Pressure | 11.4 | 11.4 |
| Surface Surcharge | 0.0 | 0.0 |
| Internal Pressure | 0.0 | 0.0 |
| Net Pressure | 12.8 | 27.7 |
| **Deflection** | | |
| Earth Load Deflection | 0.555 | 4.499 |
| Buoyant Deflection | 0.029 | 0.029 |
| Reissner Effect | 0 | 0 |
| Net Deflection | 0.584 | 4.529 |
| **Compressive Stress [psi]** | | |
| Compressive Wall Stress | 57.4 | 124.6 |

## Installation Load Summary:

| Forces/Stresses | @Maximum Force | Absolute Maximum |
|---|---|---|
| Pullback Force [lb] | 642.3 | 642.3 |
| Pullback Stress [psi] | 367.0 | 367.0 |
| Pullback Strain | 6.383E-3 | 6.383E-3 |
| Bending Stress [psi] | 0.0 | 5.7 |
| Bending Strain | 0 | 9.896E-5 |
| Tensile Stress [psi] | 367.0 | 371.8 |
| Tensile Strain | 6.383E-3 | 6.564E-3 |

Net External Pressure = 19.3 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

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## In-service Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 0.584 | 7.5 | 12.8 | OK |
| Unconstrained Collapse [psi] | 21.5 | 133.2 | 6.2 | OK |
| Compressive Wall Stress [psi] | 57.4 | 1150.0 | 20.0 | OK |

## Installation Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 0.014 | 7.5 | 524.3 | OK |
| Unconstrained Collapse [psi] | 31.4 | 235.8 | 7.5 | OK |
| Tensile Stress [psi] | 371.8 | 1200.0 | 3.2 | OK |

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## Project Summary

| | |
|---|---|
| General: | CHPE HDD 33 Conduit 1 |
| | P3 |
| | Start Date: 11-04-2022 |
| | End Date: 11-04-2022 |
| Project Owner: | TDI |
| Project Contractor: | Kiewit |
| Project Consultant: | CHA/BCE |
| Designer: | MB |
| | BCE |
| Description: | HDD 33 Conduit 1 10-inch DR 9 |

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## Input Summary

| | |
|---|---|
| Start Coordinate | (0.00, 0.00, 318.00) ft |
| End Coordinate | (1843.00, 0.00, 313.00) ft |
| Project Length | 1843.00 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 |

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## Soil Summary

Number of Layers: 4

Soil Layer #1 USCS, Gravel (G), GM
From Assistant
Unit Weight: 120.0000 (dry), 140.0000 (sat) [lb/ft3]
Phi: 37.00, S.M.: 1000.00, Coh: 0.00 [psi]

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

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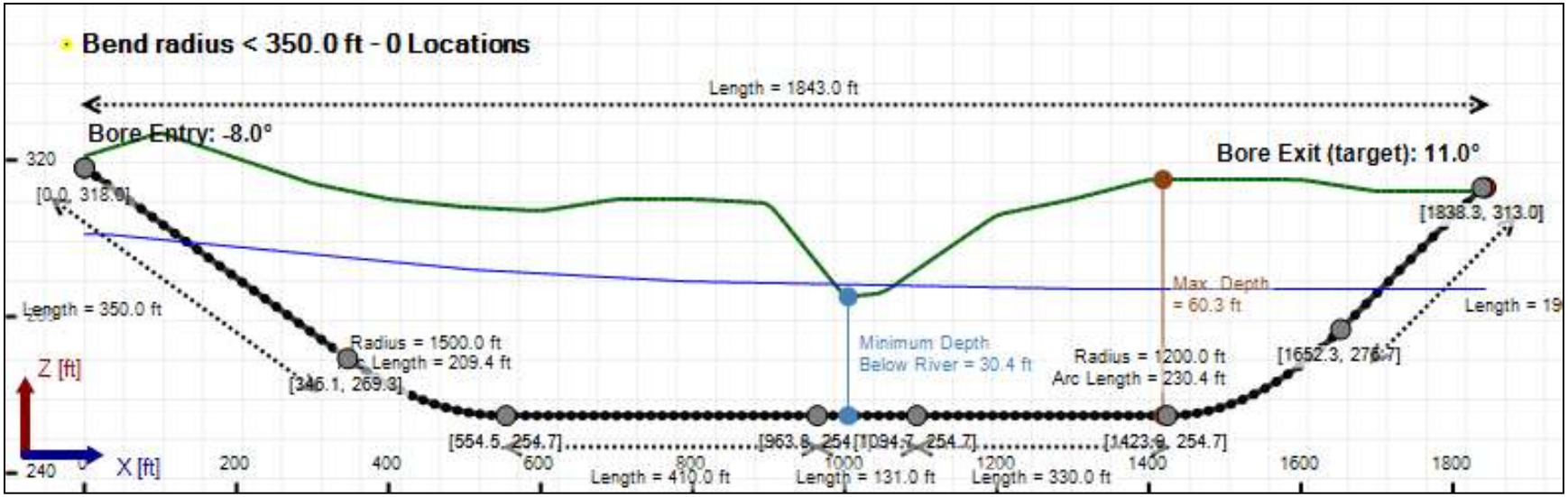
## Bore Cross-Section View

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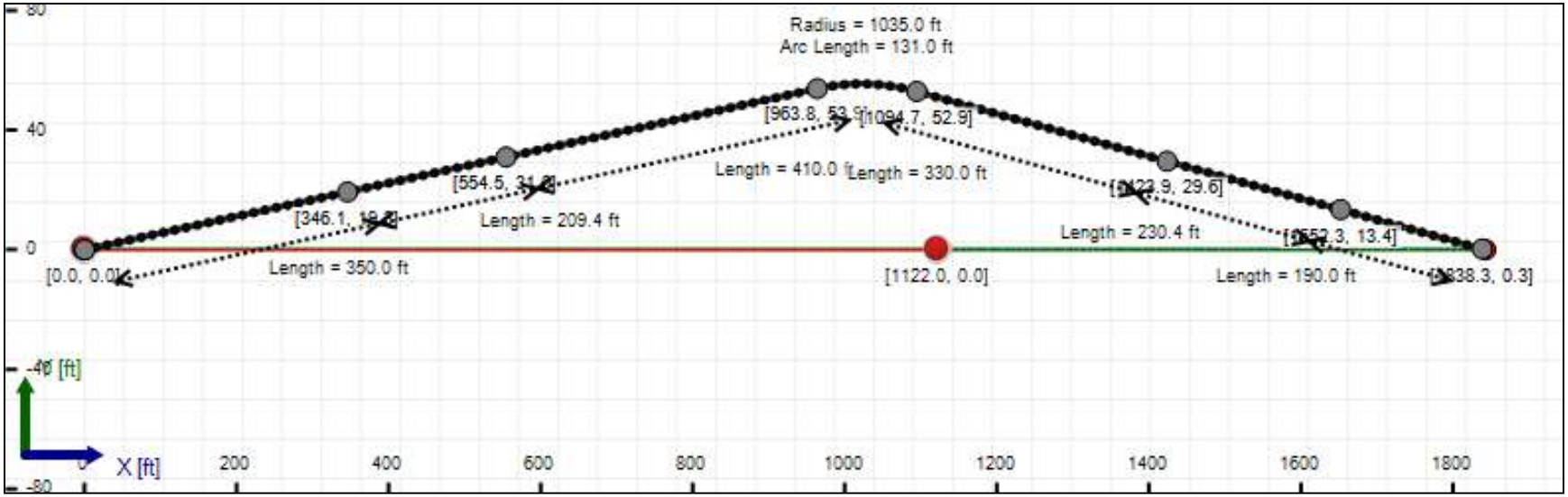
## Bore Plan View

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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: 1860.00 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

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## In-service Load Summary:

| Pressure [psi] | Deformed | Collapsed |
|---|---|---|
| Earth Pressure | 3.9 | 35.1 |
| Water Pressure | 16.0 | 14.0 |
| Surface Surcharge | 0.0 | 0.0 |
| Internal Pressure | 0.0 | 0.0 |
| Net Pressure | 19.9 | 49.1 |
| **Deflection** | | |
| Earth Load Deflection | 1.681 | 9.554 |
| Buoyant Deflection | 0.132 | 0.132 |
| Reissner Effect | 0 | 0 |
| Net Deflection | 1.813 | 9.686 |
| **Compressive Stress [psi]** | | |
| Compressive Wall Stress | 89.4 | 220.9 |

## Installation Load Summary:

| Forces/Stresses | @Maximum Force | Absolute Maximum |
|---|---|---|
| Pullback Force [lb] | 30370.6 | 30370.6 |
| Pullback Stress [psi] | 847.0 | 847.0 |
| Pullback Strain | 1.473E-2 | 1.473E-2 |
| Bending Stress [psi] | 0.0 | 24.9 |
| Bending Strain | 0 | 4.328E-4 |
| Tensile Stress [psi] | 847.0 | 860.2 |
| Tensile Strain | 1.473E-2 | 1.526E-2 |

Net External Pressure = 39.9 [psi ]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

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## In-service Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 1.813 | 7.5 | 4.1 | OK |
| Unconstrained Collapse [psi] | 41.2 | 122.3 | 3.0 | OK |
| Compressive Wall Stress [psi] | 89.4 | 1150.0 | 12.9 | OK |

## Installation Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 0.065 | 7.5 | 115.8 | OK |
| Unconstrained Collapse [psi] | 51.1 | 201.8 | 4.0 | OK |
| Tensile Stress [psi] | 860.2 | 1200.0 | 1.4 | OK |

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## 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 | 178.654 psi | 188.618 psi |
| 1 | 8.00 in | 12.00 in | 178.539 psi | 188.481 psi |
| 2 | 12.00 in | 16.13 in | 178.371 psi | 188.283 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

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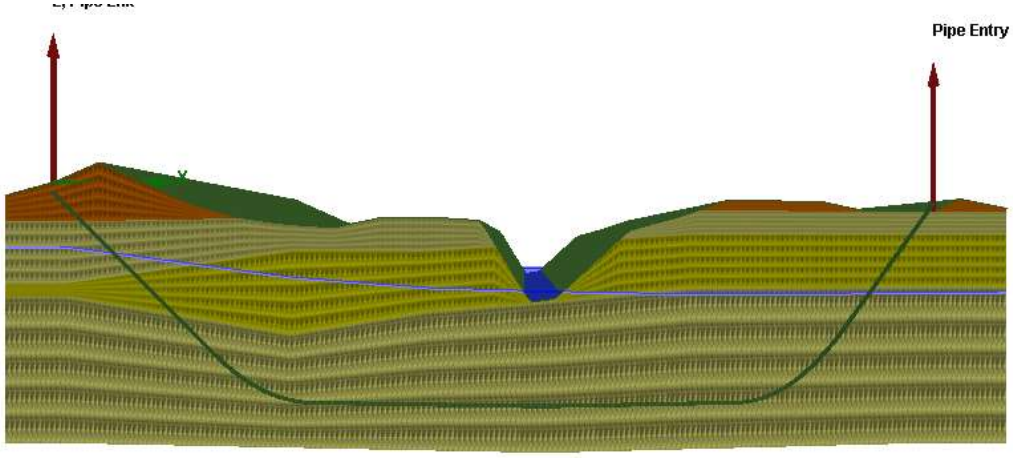
## Virtual Site

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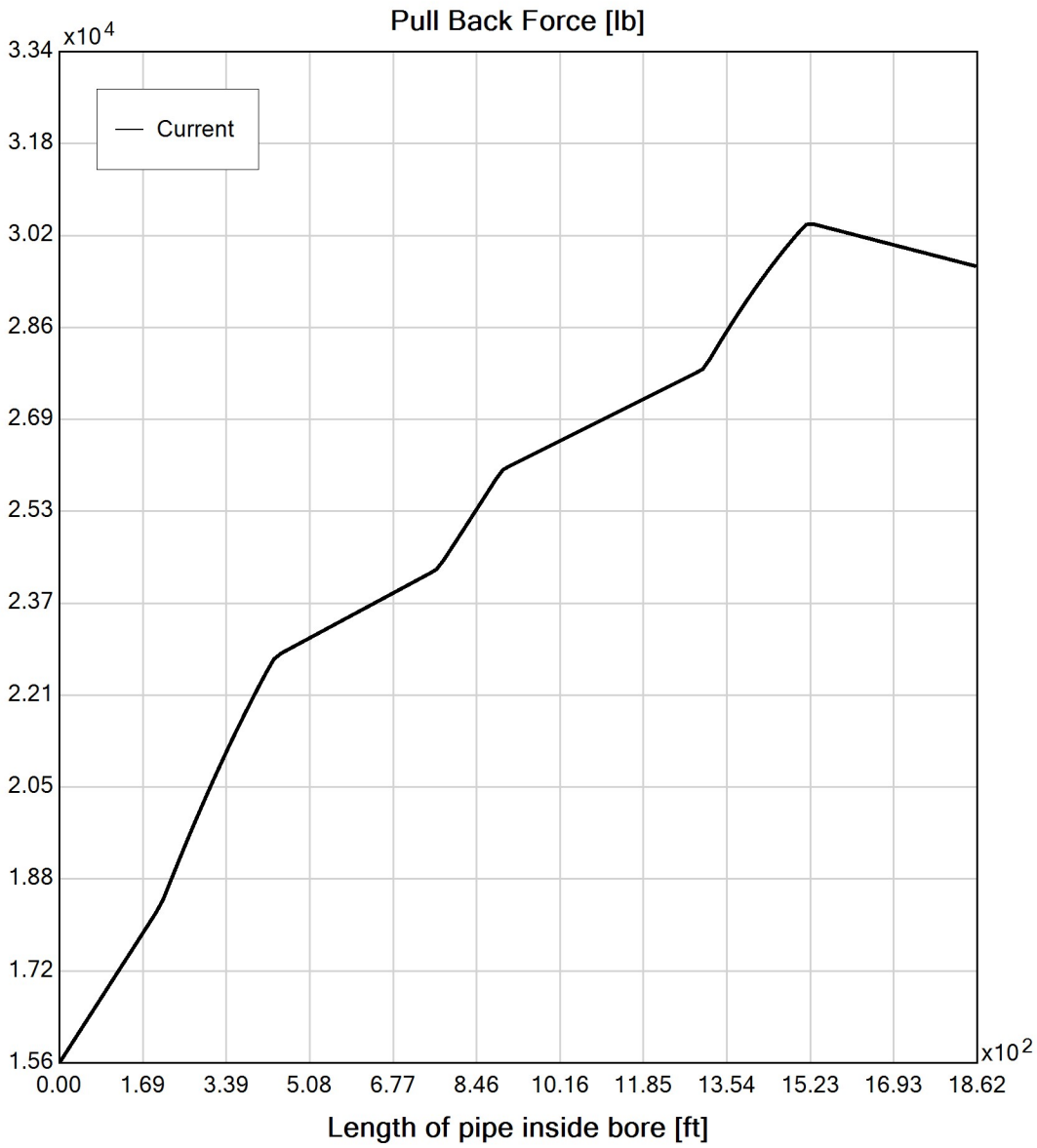


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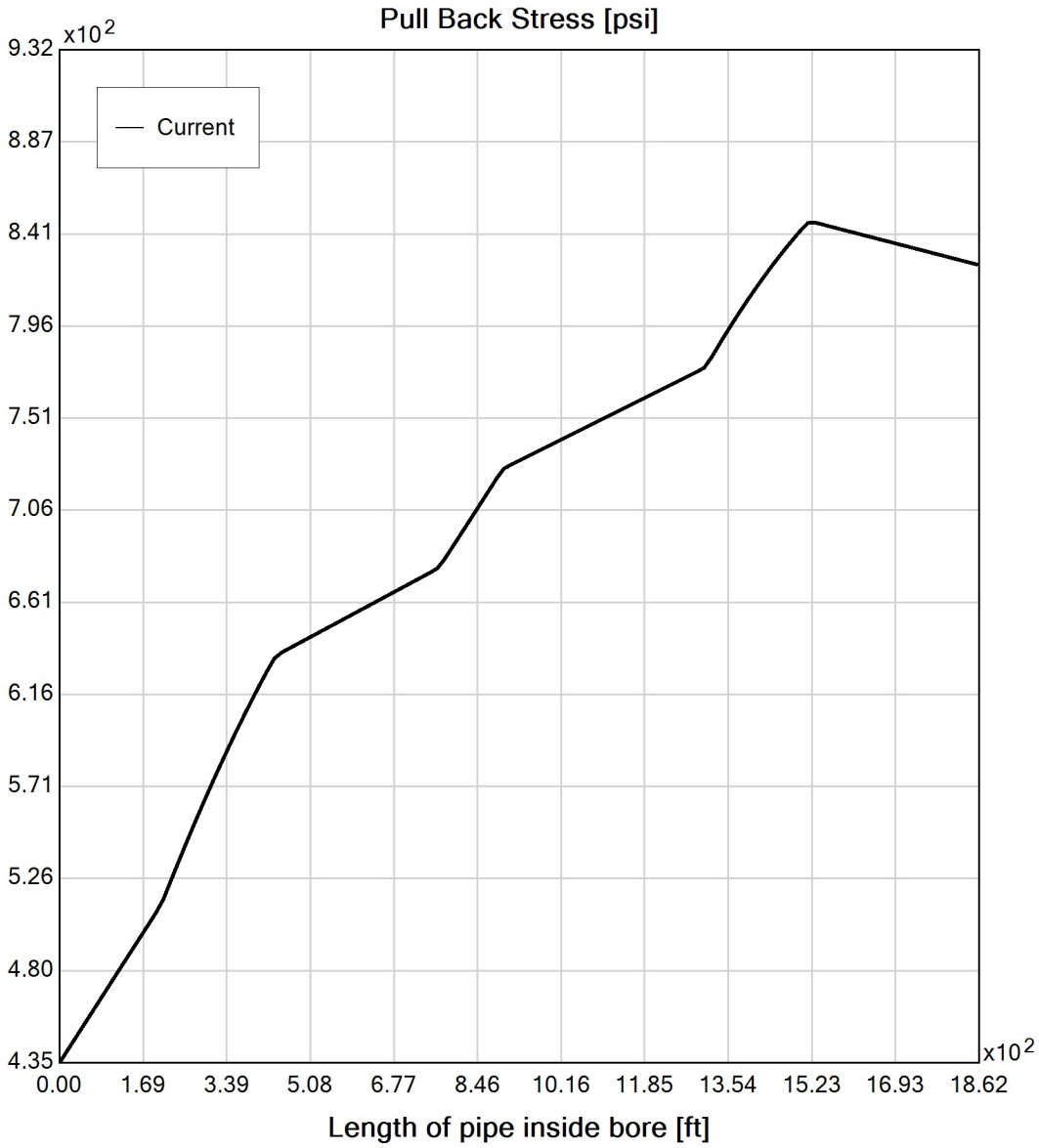


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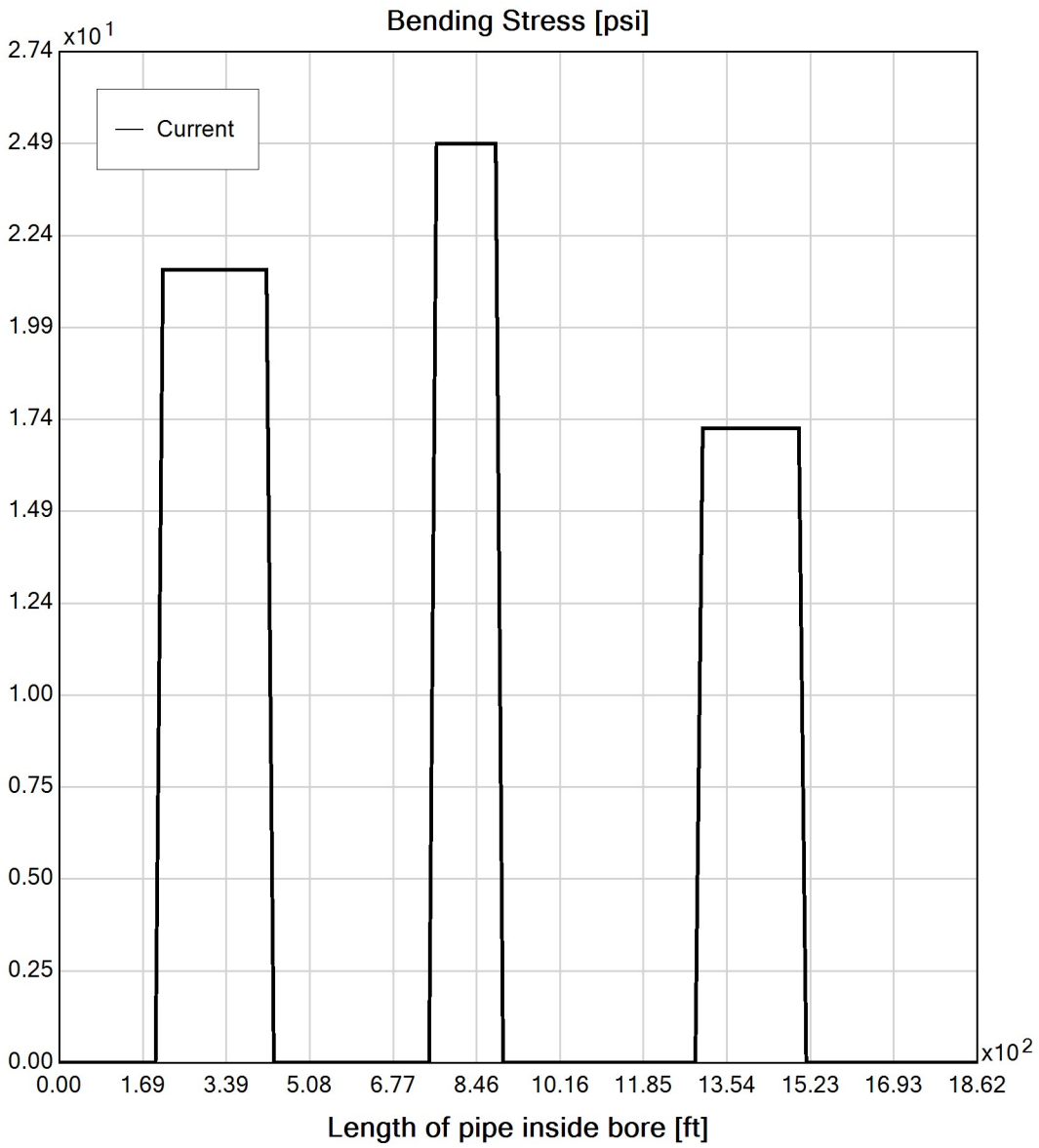


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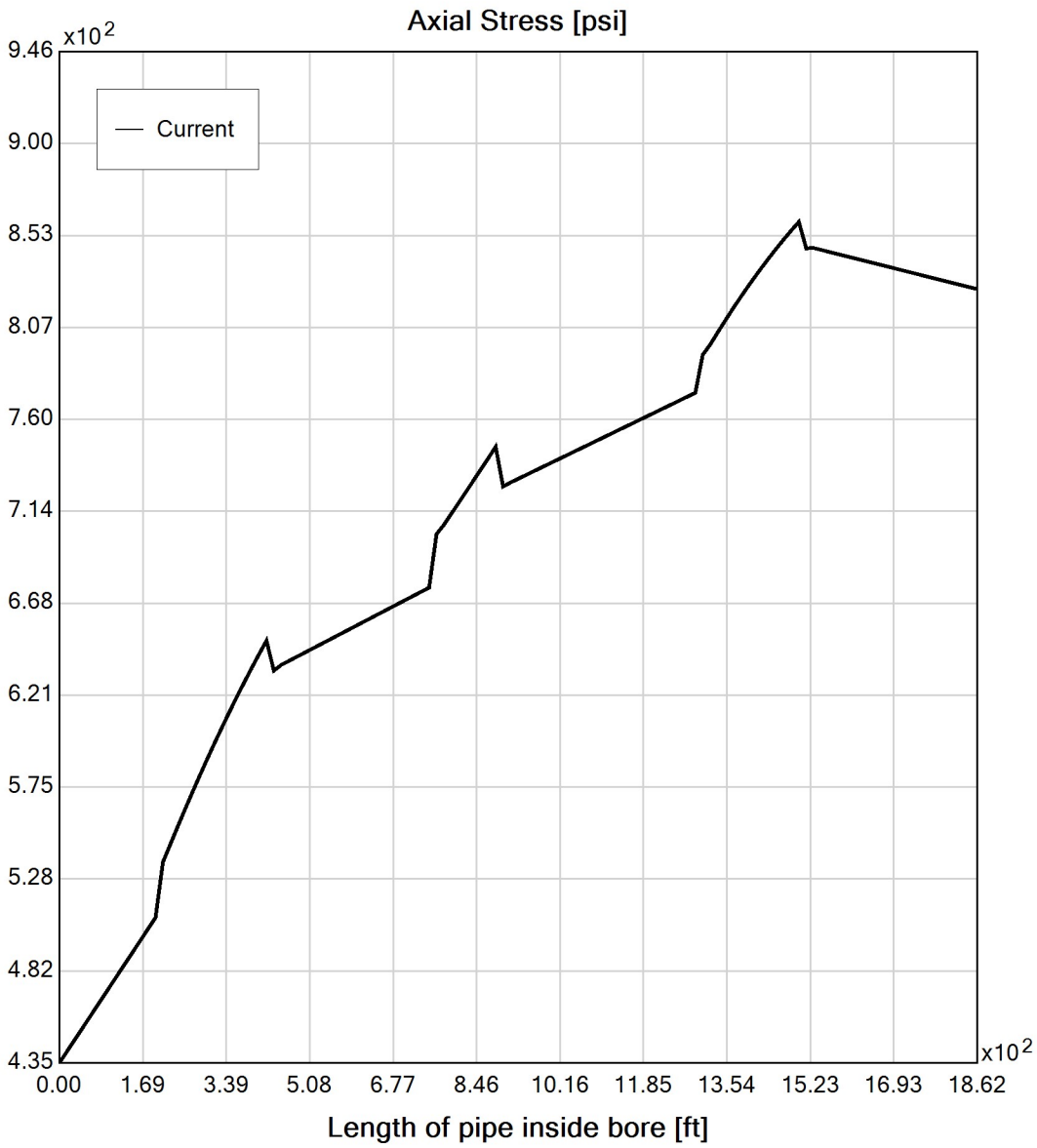


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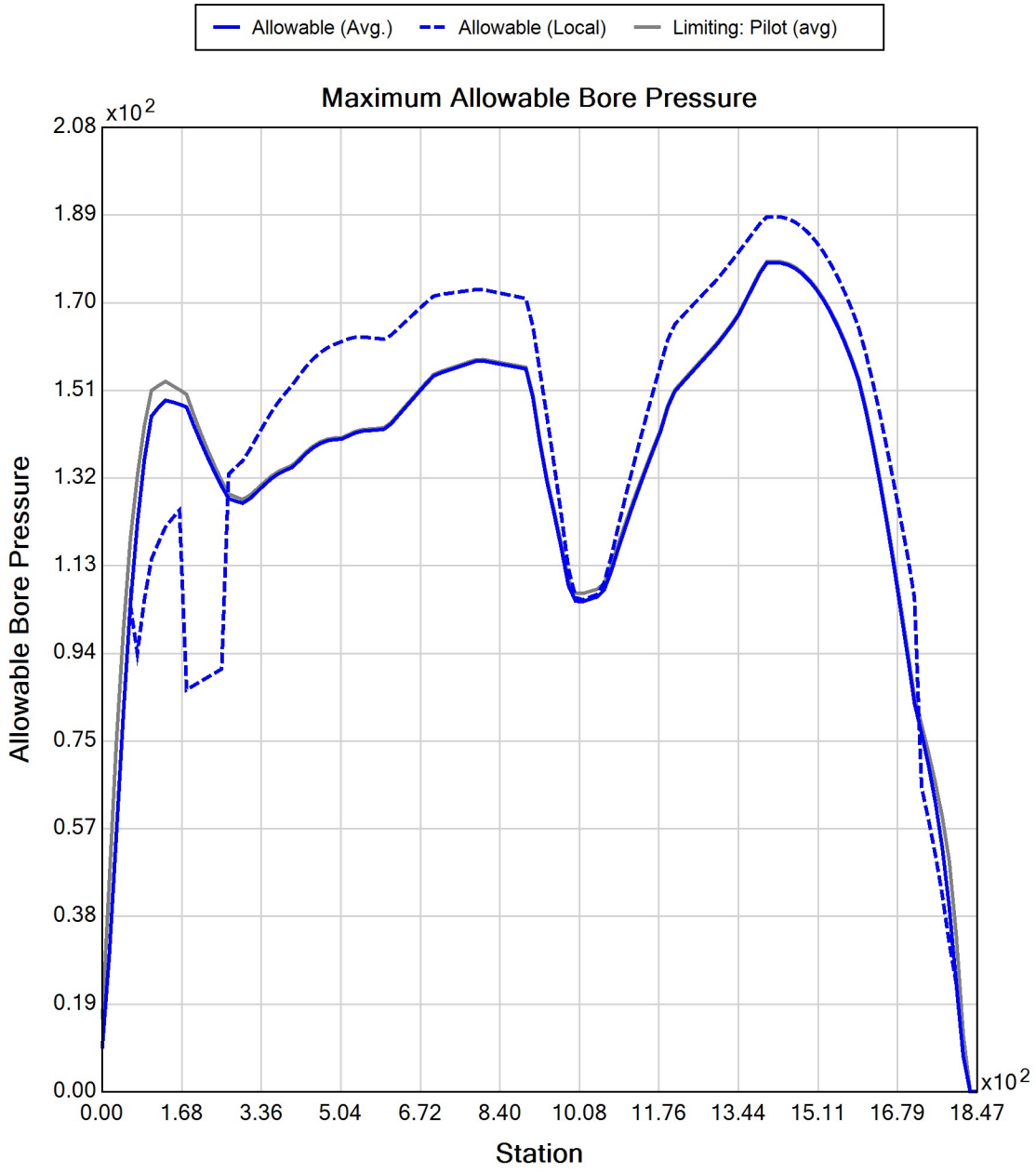


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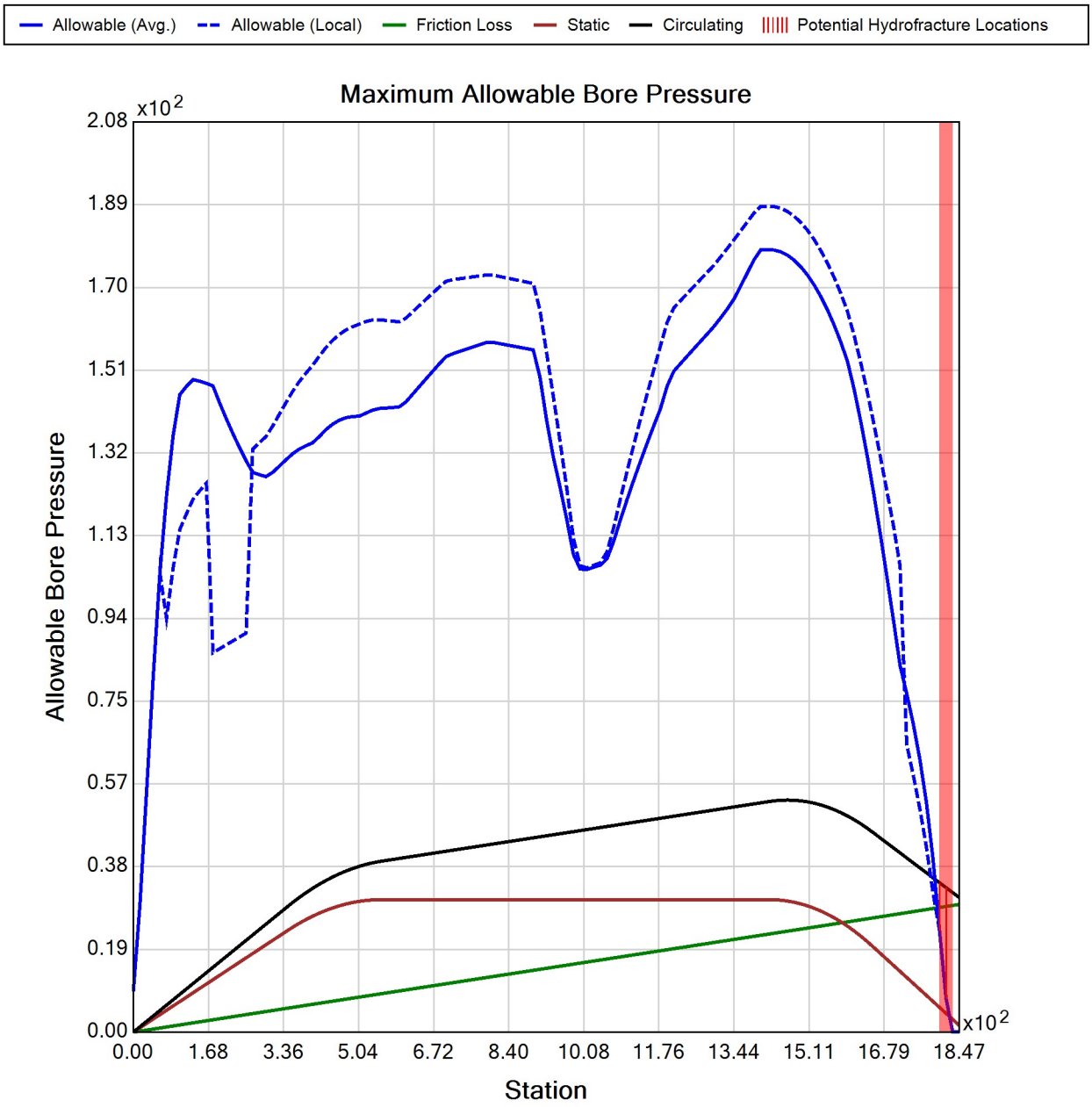


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# Generated Output

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## Input Summary

| | |
|---|---|
| Start Coordinate | (0.00, 0.00, 318.00) ft |
| End Coordinate | (1843.00, 0.00, 313.00) ft |
| Project Length | 1843.00 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 |

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## Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 2" (2.375")
Pipe DR: 9
Pipe Length: 1860.00 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

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## In-service Load Summary:

| Pressure [psi] | Deformed | Collapsed |
|---|---|---|
| Earth Pressure | 1.5 | 35.1 |
| Water Pressure | 16.0 | 14.0 |
| Surface Surcharge | 0.0 | 0.0 |
| Internal Pressure | 0.0 | 0.0 |
| Net Pressure | 17.5 | 49.1 |
| **Deflection** | | |
| Earth Load Deflection | 0.718 | 9.554 |
| Buoyant Deflection | 0.029 | 0.029 |
| Reissner Effect | 0 | 0 |
| Net Deflection | 0.747 | 9.583 |
| **Compressive Stress [psi]** | | |
| Compressive Wall Stress | 78.9 | 220.9 |

## Installation Load Summary:

| Forces/Stresses | @Maximum Force | Absolute Maximum |
|---|---|---|
| Pullback Force [lb] | 1592.0 | 1592.0 |
| Pullback Stress [psi] | 909.6 | 909.6 |
| Pullback Strain | 1.582E-2 | 1.582E-2 |
| Bending Stress [psi] | 0.0 | 5.5 |
| Bending Strain | 0 | 9.561E-5 |
| Tensile Stress [psi] | 909.6 | 909.6 |
| Tensile Strain | 1.582E-2 | 1.588E-2 |

Net External Pressure = 39.9 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

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## In-service Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 0.747 | 7.5 | 10.0 | OK |
| Unconstrained Collapse [psi] | 41.2 | 131.9 | 3.2 | OK |
| Compressive Wall Stress [psi] | 78.9 | 1150.0 | 14.6 | OK |

## Installation Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 0.014 | 7.5 | 524.3 | OK |
| Unconstrained Collapse [psi] | 51.1 | 198.8 | 3.9 | OK |
| Tensile Stress [psi] | 909.6 | 1200.0 | 1.3 | OK |

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# Generated Output

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## Project Summary

| | |
|---|---|
| General: | CHPE HDD 33 Conduit 2 |
| | P3 |
| | Start Date: 11-04-2022 |
| | End Date: 11-04-2022 |
| Project Owner: | TDI |
| Project Contractor: | Kiewit |
| Project Consultant: | CHA/BCE |
| Designer: | MB |
| | BCE |
| Description: | HDD 33 Conduit 2 10-inch DR 9 |

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## Input Summary

| | |
|---|---|
| Start Coordinate | (0.00, 0.00, 318.00) ft |
| End Coordinate | (1843.00, 0.00, 313.00) ft |
| Project Length | 1843.00 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 |

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## Soil Summary

Number of Layers: 5

Soil Layer #1 USCS, Gravel (G), GM
From Assistant
Unit Weight: 120.0000 (dry), 140.0000 (sat) [lb/ft3]
Phi: 37.00, S.M.: 1000.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Sand (S), SP
From Assistant
Unit Weight: 1.0000 (dry), 15.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 500.00, Coh: 0.00 [psi]

Soil Layer #3 USCS, Sand (S), SM
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, Sand (S), SP
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), SP
From Assistant
Unit Weight: 110.0000 (dry), 124.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 500.00, Coh: 0.00 [psi]

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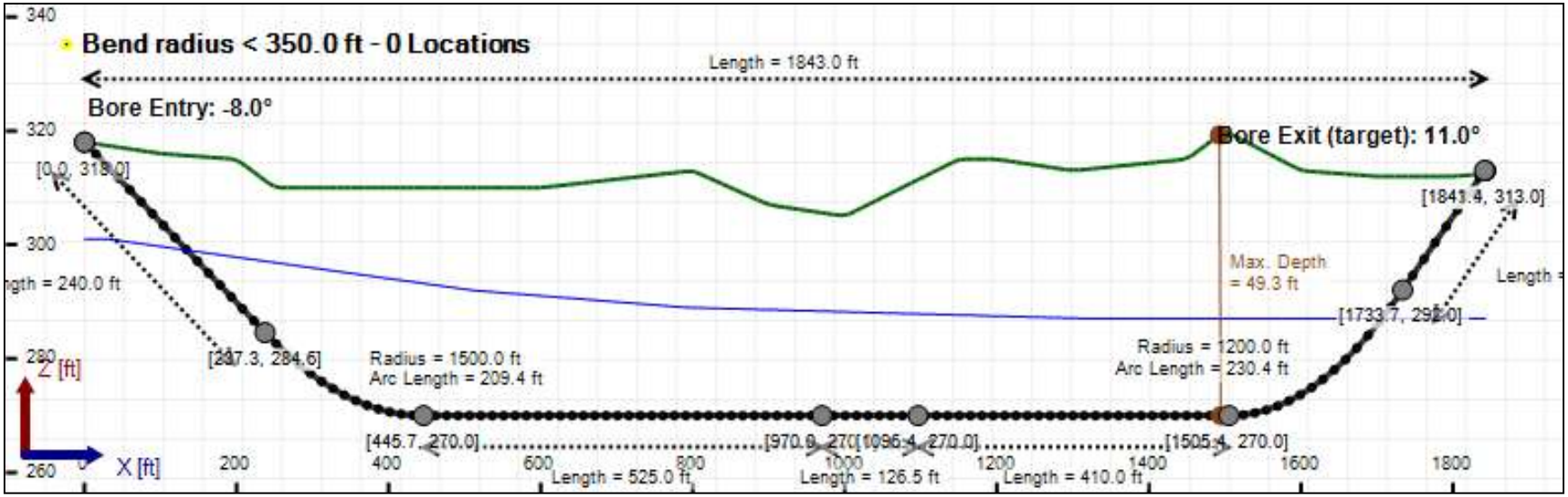
## Bore Cross-Section View

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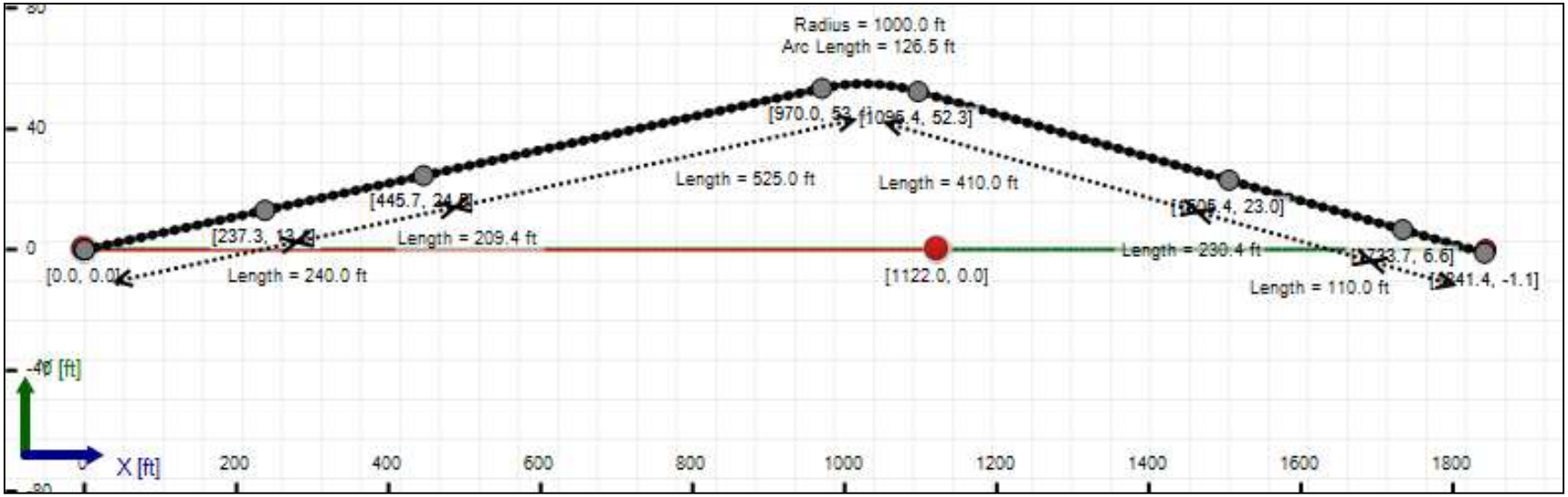
## Bore Plan View

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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: 1860.00 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

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## In-service Load Summary:

| Pressure [psi] | Deformed | Collapsed |
|---|---|---|
| Earth Pressure | 2.4 | 26.8 |
| Water Pressure | 10.1 | 7.4 |
| Surface Surcharge | 0.0 | 0.0 |
| Internal Pressure | 0.0 | 0.0 |
| Net Pressure | 12.6 | 34.2 |
| **Deflection** | | |
| Earth Load Deflection | 1.137 | 7.307 |
| Buoyant Deflection | 0.132 | 0.132 |
| Reissner Effect | 0 | 0 |
| Net Deflection | 1.269 | 7.439 |
| **Compressive Stress [psi]** | | |
| Compressive Wall Stress | 56.5 | 153.9 |

## Installation Load Summary:

| Forces/Stresses | @Maximum Force | Absolute Maximum |
|---|---|---|
| Pullback Force [lb] | 29961.4 | 29961.4 |
| Pullback Stress [psi] | 835.6 | 835.6 |
| Pullback Strain | 1.453E-2 | 1.453E-2 |
| Bending Stress [psi] | 0.0 | 25.8 |
| Bending Strain | 0 | 4.479E-4 |
| Tensile Stress [psi] | 835.6 | 847.2 |
| Tensile Strain | 1.453E-2 | 1.503E-2 |

Net External Pressure = 30.4 [psi ]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

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## In-service Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 1.269 | 7.5 | 5.9 | OK |
| Unconstrained Collapse [psi] | 31.2 | 123.2 | 3.9 | OK |
| Compressive Wall Stress [psi] | 56.5 | 1150.0 | 20.3 | OK |

## Installation Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 0.065 | 7.5 | 115.8 | OK |
| Unconstrained Collapse [psi] | 41.2 | 202.9 | 4.9 | OK |
| Tensile Stress [psi] | 847.2 | 1200.0 | 1.4 | OK |

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## 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 | 149.451 psi | 154.309 psi |
| 1 | 8.00 in | 12.00 in | 149.243 psi | 154.085 psi |
| 2 | 12.00 in | 16.13 in | 148.943 psi | 153.764 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

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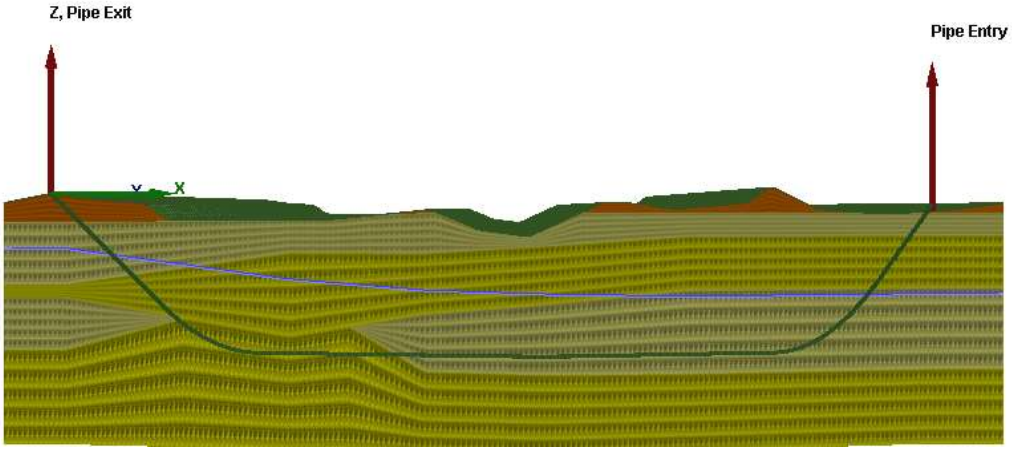
## Virtual Site

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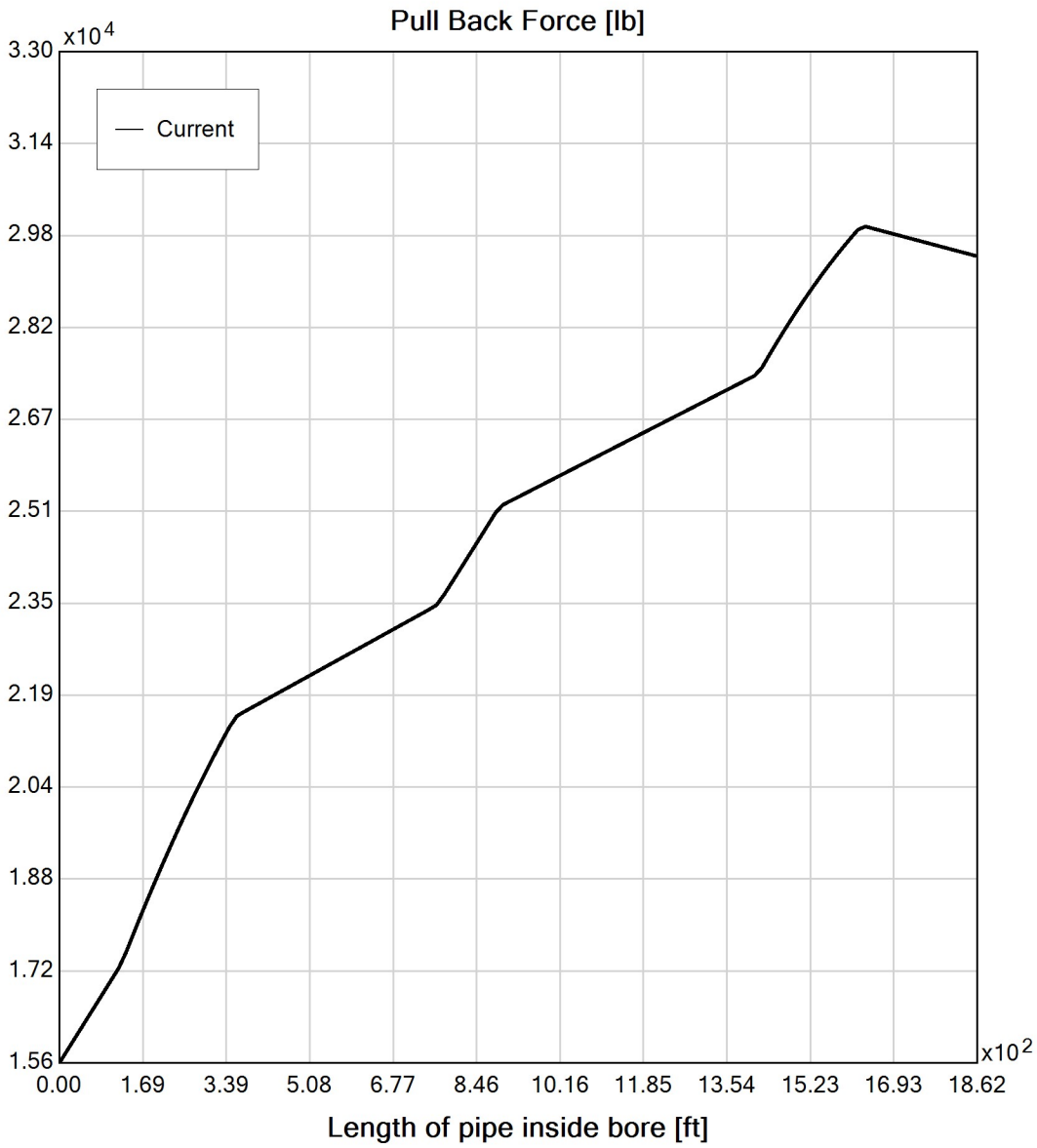


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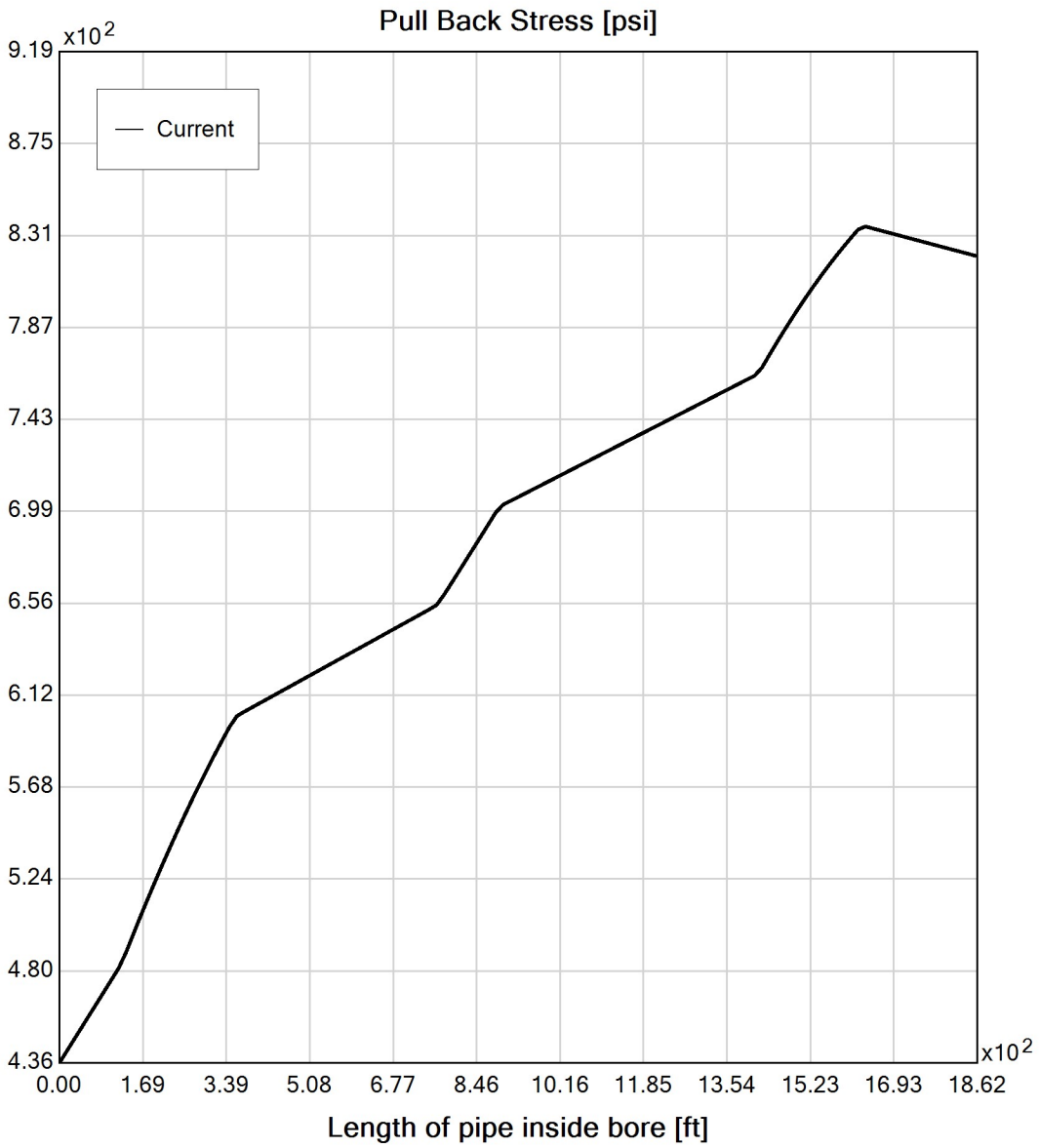


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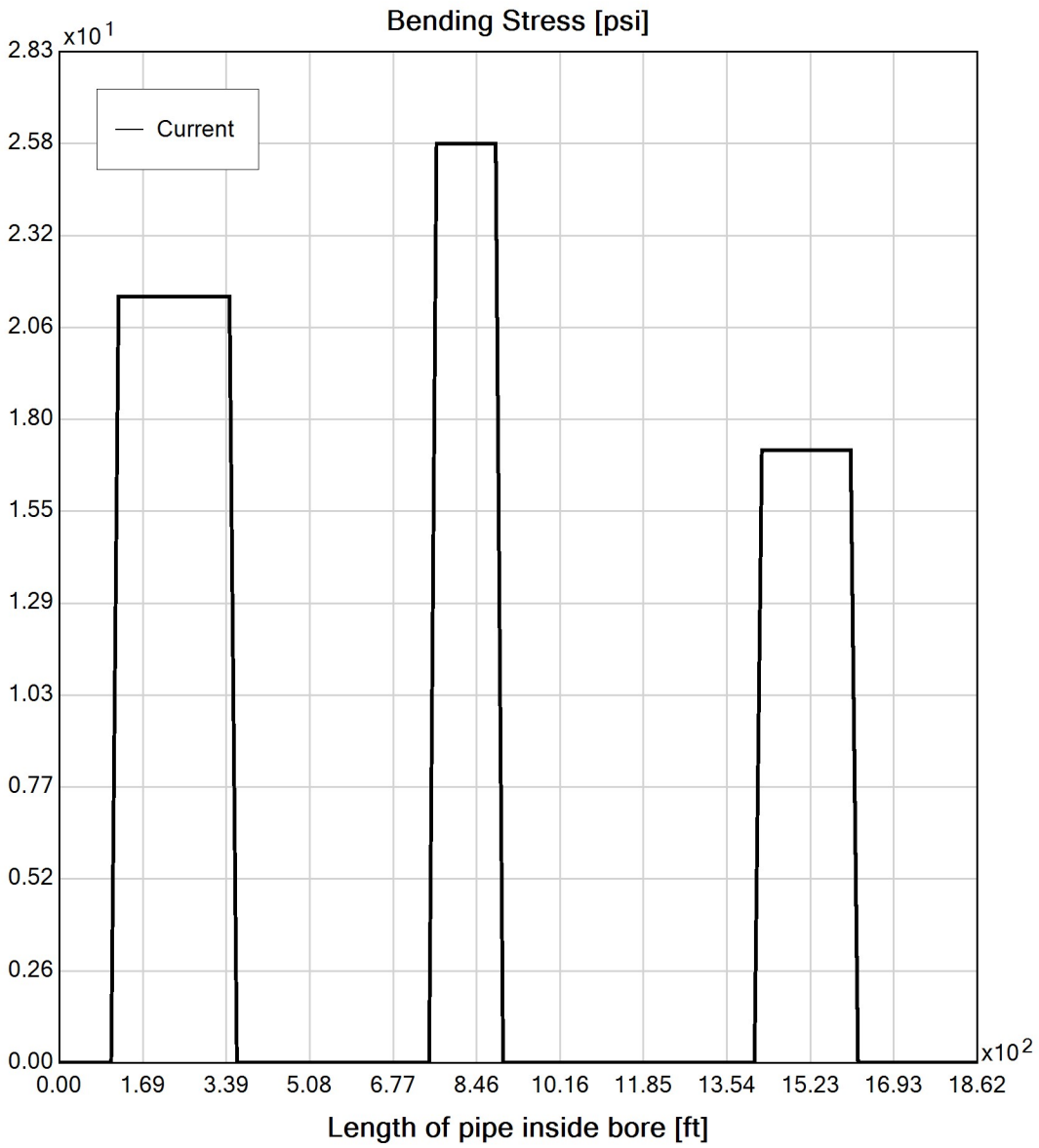


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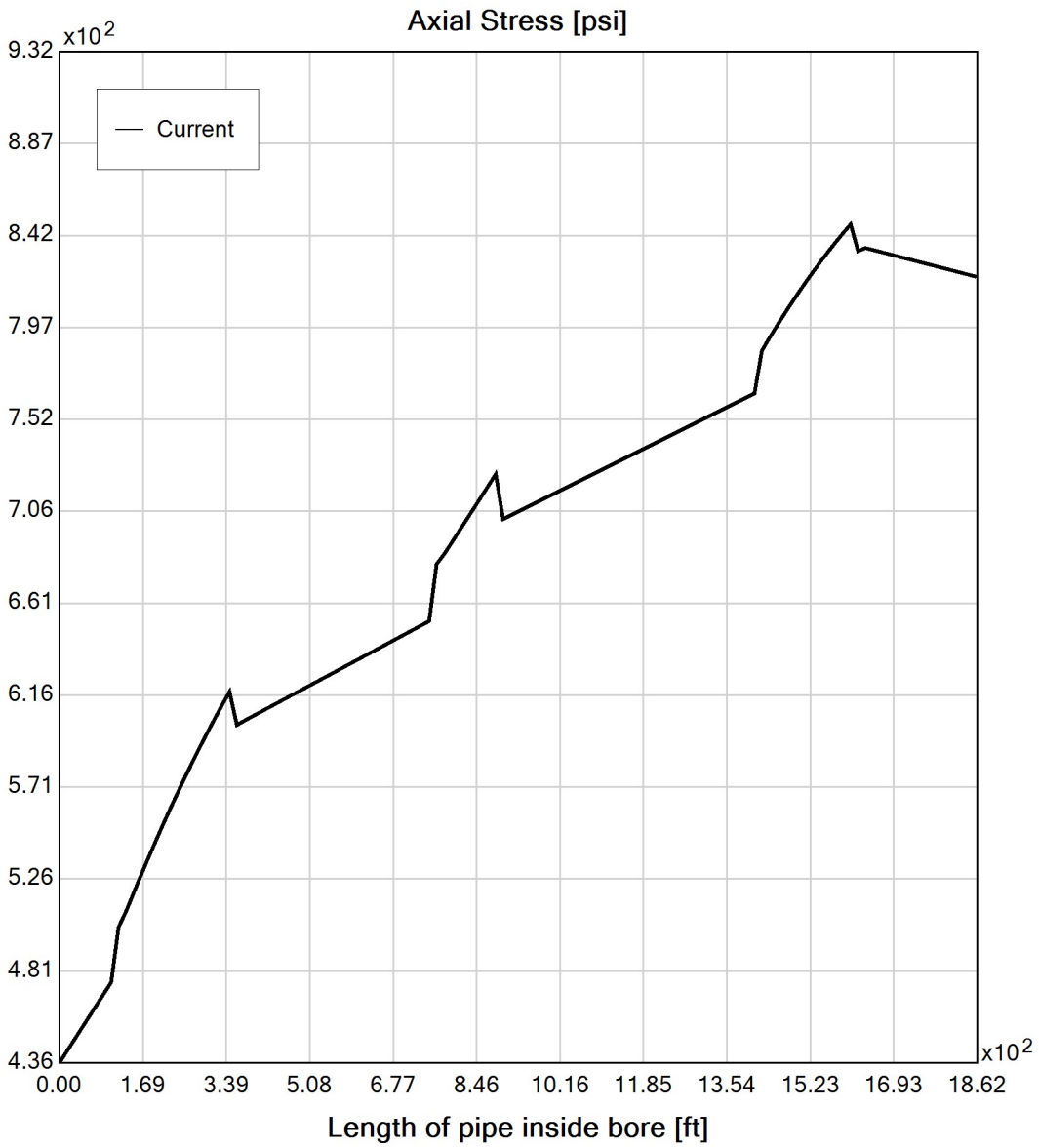


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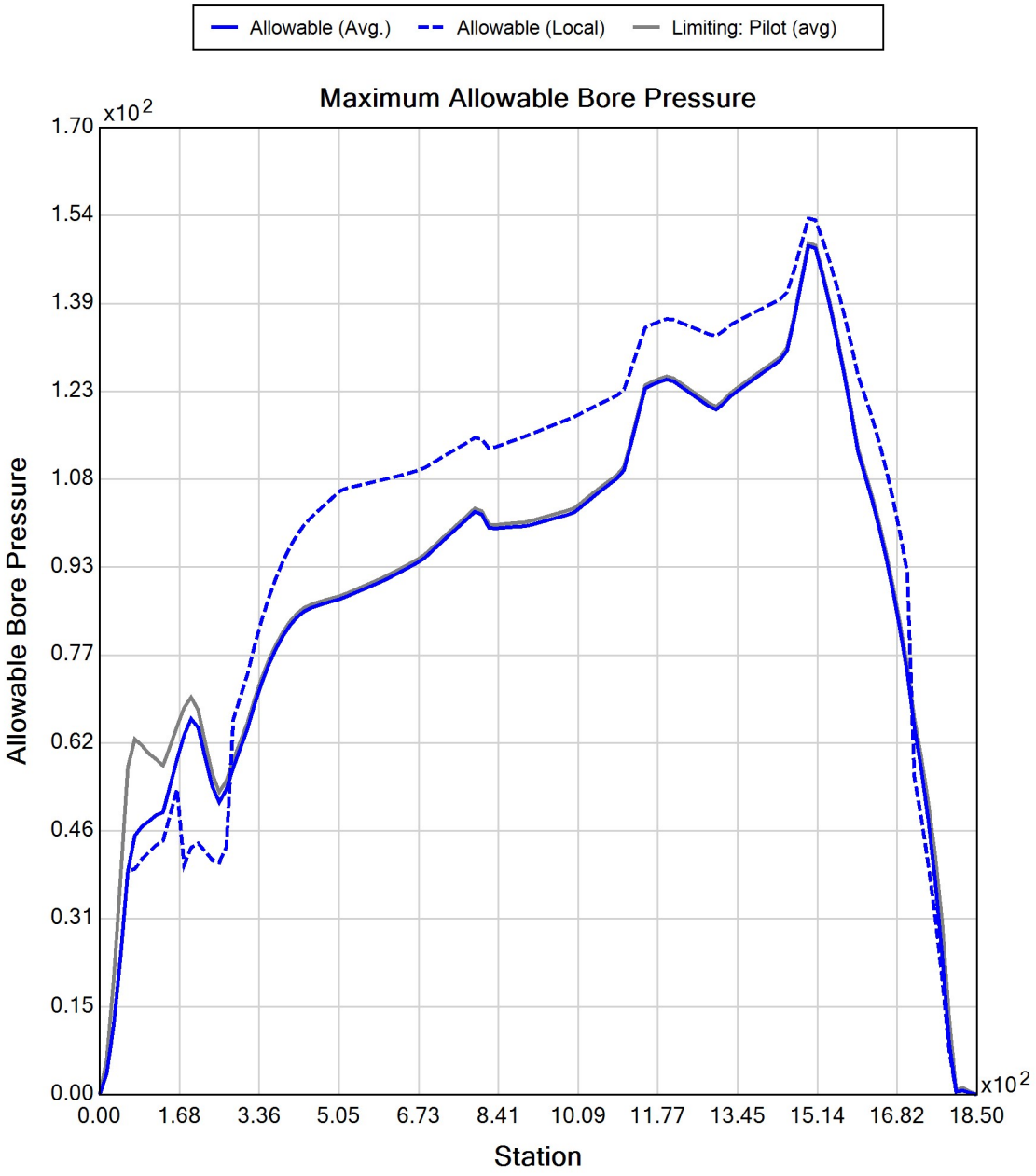


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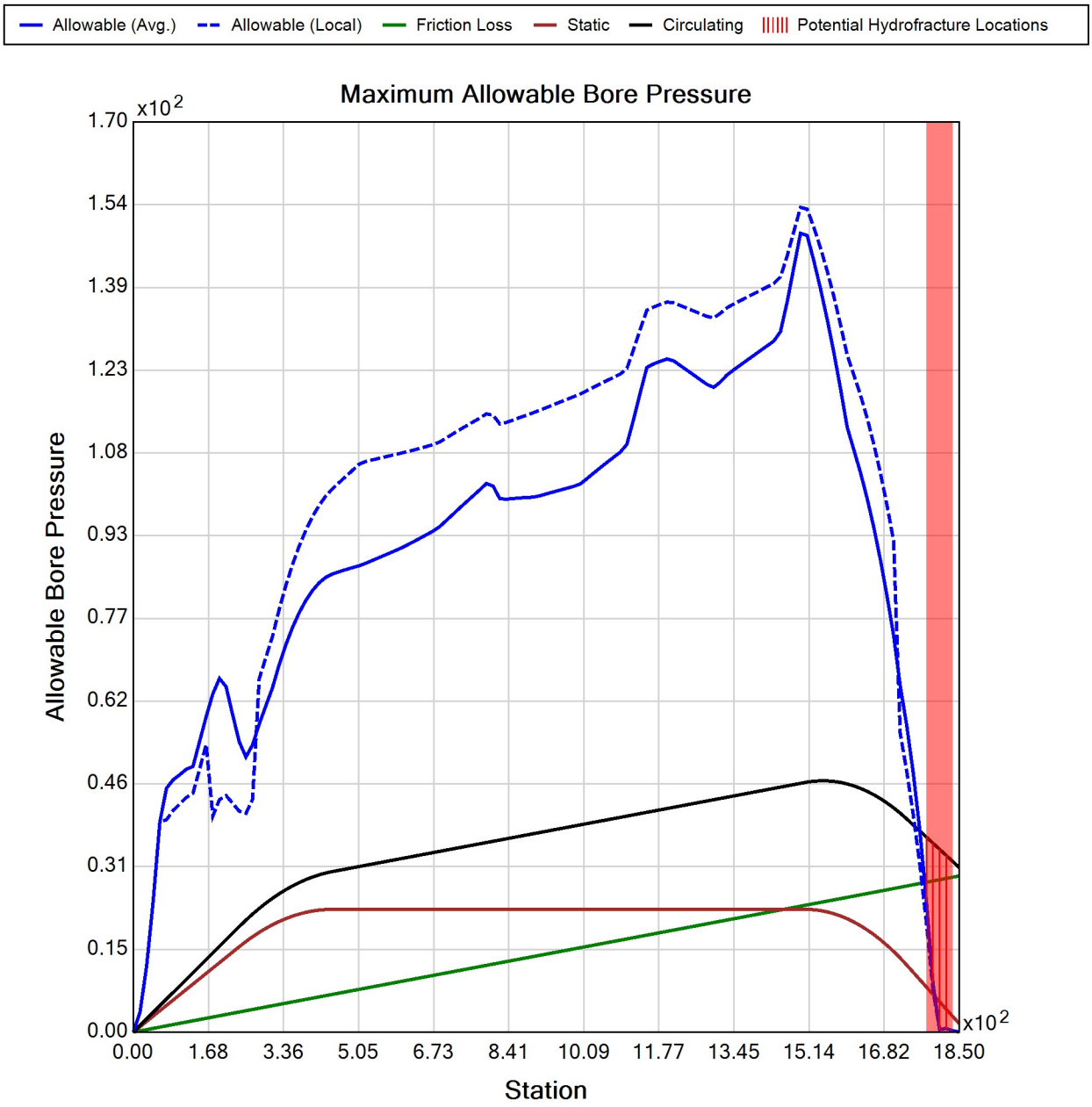


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## Input Summary

| | |
|---|---|
| Start Coordinate | (0.00, 0.00, 318.00) ft |
| End Coordinate | (1843.00, 0.00, 313.00) ft |
| Project Length | 1843.00 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 |

Powered by Vermeer | BoreAid®

## Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 2" (2.375")
Pipe DR: 9
Pipe Length: 1860.00 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

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## In-service Load Summary:

| Pressure [psi] | Deformed | Collapsed |
|---|---|---|
| Earth Pressure | 0.9 | 26.8 |
| Water Pressure | 10.2 | 7.4 |
| Surface Surcharge | 0.0 | 0.0 |
| Internal Pressure | 0.0 | 0.0 |
| Net Pressure | 11.1 | 34.2 |
| **Deflection** | | |
| Earth Load Deflection | 0.648 | 7.307 |
| Buoyant Deflection | 0.029 | 0.029 |
| Reissner Effect | 0 | 0 |
| Net Deflection | 0.677 | 7.336 |
| **Compressive Stress [psi]** | | |
| Compressive Wall Stress | 50.0 | 153.9 |

## Installation Load Summary:

| Forces/Stresses | @Maximum Force | Absolute Maximum |
|---|---|---|
| Pullback Force [lb] | 1572.0 | 1572.0 |
| Pullback Stress [psi] | 898.2 | 898.2 |
| Pullback Strain | 1.562E-2 | 1.562E-2 |
| Bending Stress [psi] | 0.0 | 5.7 |
| Bending Strain | 0 | 9.896E-5 |
| Tensile Stress [psi] | 898.2 | 898.2 |
| Tensile Strain | 1.562E-2 | 1.566E-2 |

Net External Pressure = 30.4 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

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## In-service Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 0.677 | 7.5 | 11.1 | OK |
| Unconstrained Collapse [psi] | 31.2 | 132.3 | 4.2 | OK |
| Compressive Wall Stress [psi] | 50.0 | 1150.0 | 23.0 | OK |

## Installation Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 0.014 | 7.5 | 524.3 | OK |
| Unconstrained Collapse [psi] | 41.2 | 199.8 | 4.9 | OK |
| Tensile Stress [psi] | 898.2 | 1200.0 | 1.3 | OK |

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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.

## Project Summary

| | |
|---|---|
| General: | CHPE HDD 35<br>Ref: Fort Ann, NY Washington cty<br>J2105<br>Start Date: 11-14-2022<br>End Date: 11-14-2022 |
| Project Owner: | TDI |
| Project Contractor: | Kiewit |
| Project Consultant: | CHA-BCE |
| Designer: | MDB<br>BCE<br>Amherst, MA |
| Description: | North to South<br>10" DR9 |

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## Input Summary

| | |
|---|---|
| Start Coordinate | (0.00, 0.00, 319.50) ft |
| End Coordinate | (2550.00, 0.00, 324.30) ft |
| Project Length | 2550.00 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 |

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## Soil Summary

Number of Layers: 5

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

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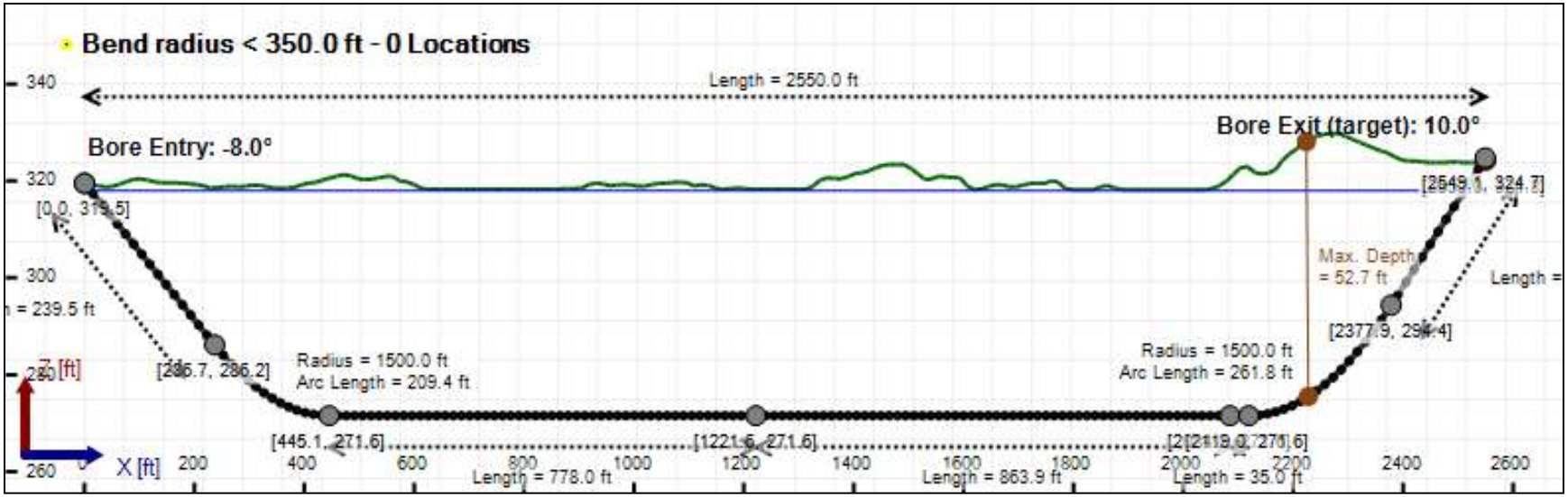
## Bore Cross-Section View

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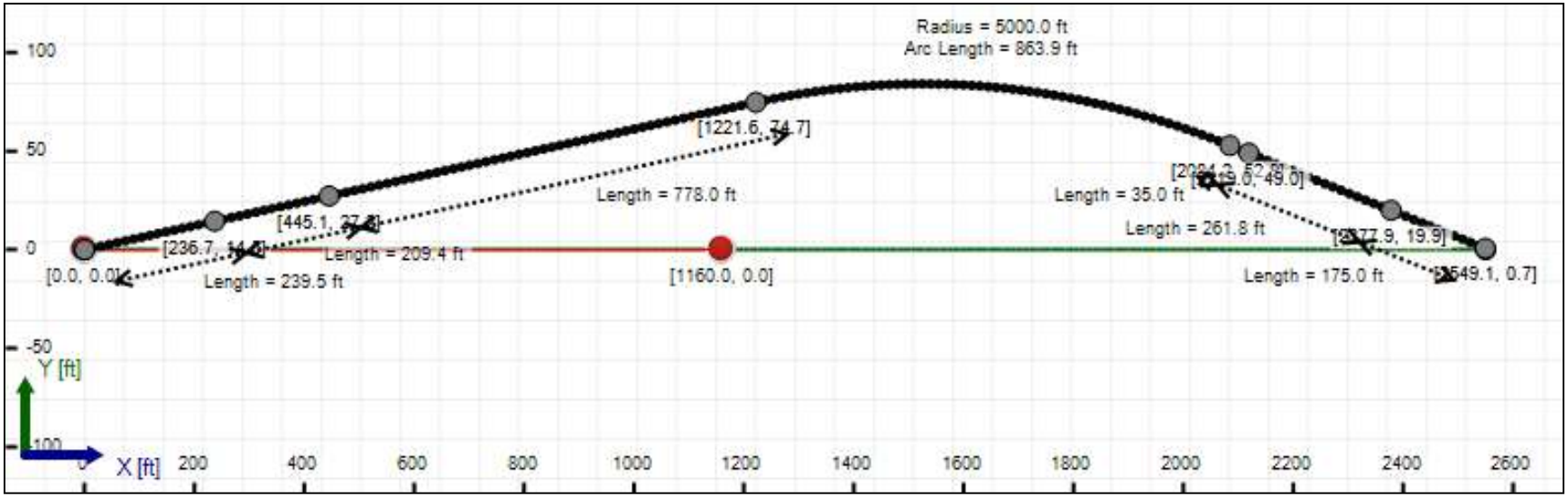
## Bore Plan View

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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: 2565.00 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

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## In-service Load Summary:

| Pressure [psi] | Deformed | Collapsed |
|---|---|---|
| Earth Pressure | 3.5 | 23.5 |
| Water Pressure | 20.1 | 20.1 |
| Surface Surcharge | 0.0 | 0.0 |
| Internal Pressure | 0.0 | 0.0 |
| Net Pressure | 23.6 | 43.6 |
| **Deflection** | | |
| Earth Load Deflection | 0.963 | 6.606 |
| Buoyant Deflection | 0.132 | 0.132 |
| Reissner Effect | 0 | 0 |
| Net Deflection | 1.095 | 6.738 |
| **Compressive Stress [psi]** | | |
| Compressive Wall Stress | 106.2 | 196.3 |

## Installation Load Summary:

| Forces/Stresses | @Maximum Force | Absolute Maximum |
|---|---|---|
| Pullback Force [lb] | 41099.6 | 41099.6 |
| Pullback Stress [psi] | 1146.2 | 1146.2 |
| Pullback Strain | 1.993E-2 | 1.993E-2 |
| Bending Stress [psi] | 0.0 | 17.2 |
| Bending Strain | 0 | 2.986E-4 |
| Tensile Stress [psi] | 1146.2 | 1160.7 |
| Tensile Strain | 1.993E-2 | 2.048E-2 |

Net External Pressure = 34.0 [psi ]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

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## In-service Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 1.095 | 7.5 | 6.8 | OK |
| Unconstrained Collapse [psi] | 34.8 | 125.4 | 3.6 | OK |
| Compressive Wall Stress [psi] | 106.2 | 1150.0 | 10.8 | OK |

## Installation Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 0.065 | 7.5 | 115.8 | OK |
| Unconstrained Collapse [psi] | 44.7 | 177.8 | 4.0 | OK |
| Tensile Stress [psi] | 1160.7 | 1200.0 | 1.0 | OK |

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## 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 | 143.434 psi | 155.089 psi |
| 1 | 8.00 in | 12.00 in | 143.271 psi | 154.877 psi |
| 2 | 12.00 in | 16.13 in | 143.036 psi | 154.570 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

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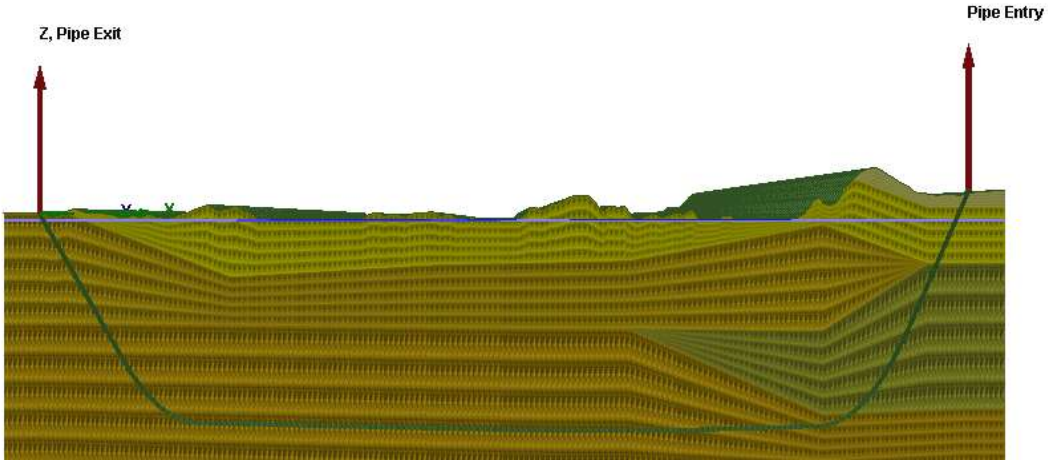
## Virtual Site

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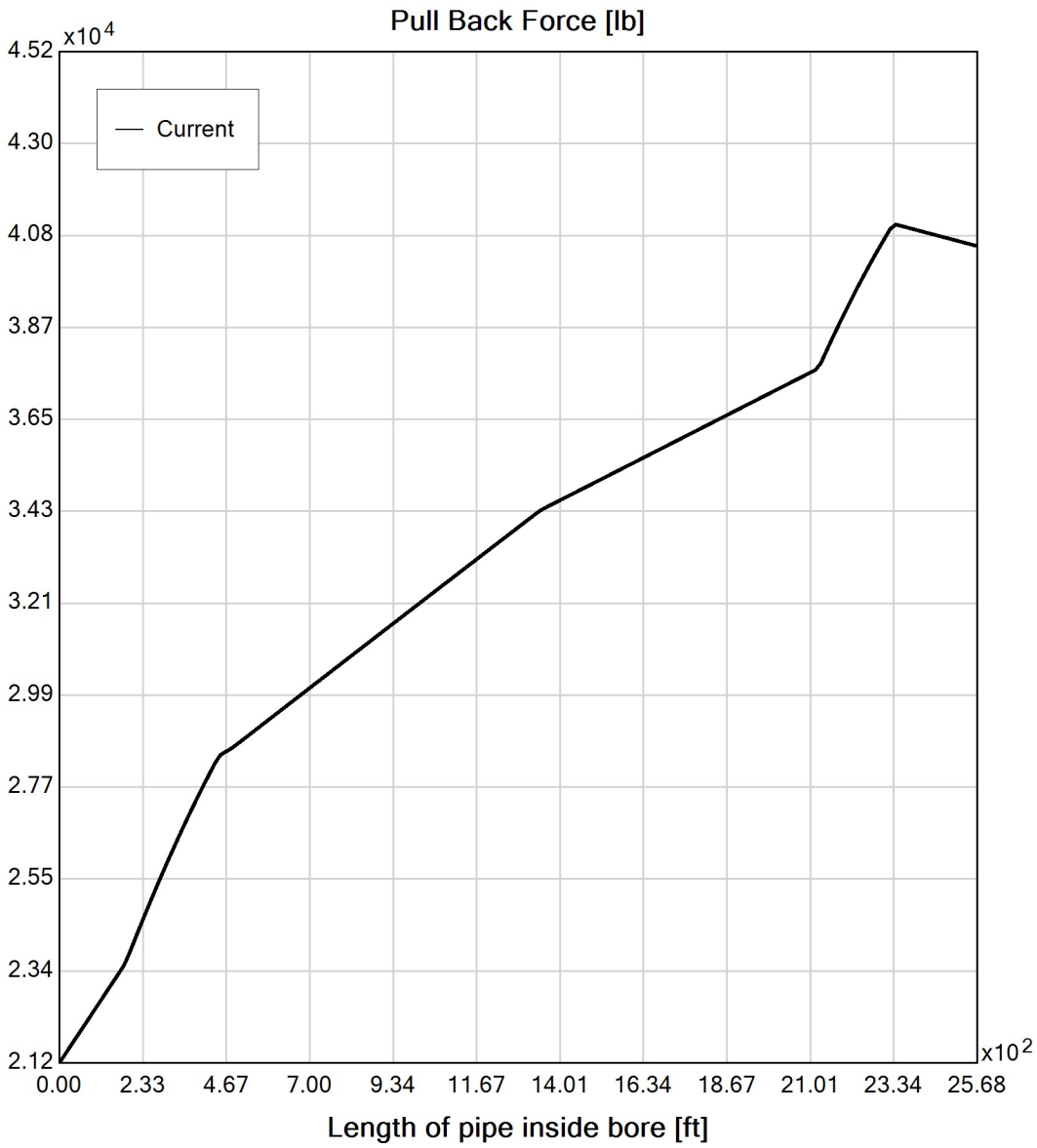


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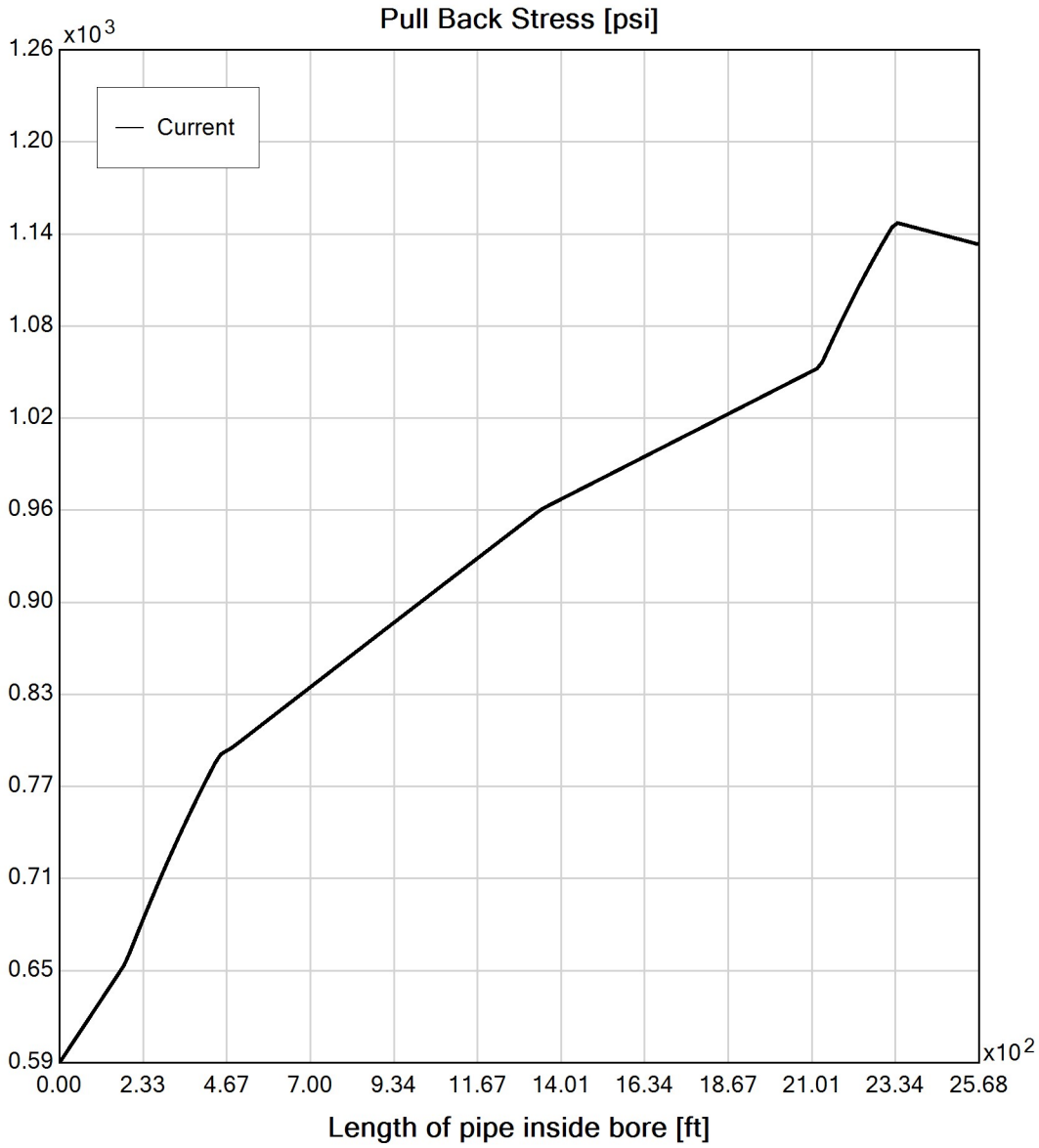


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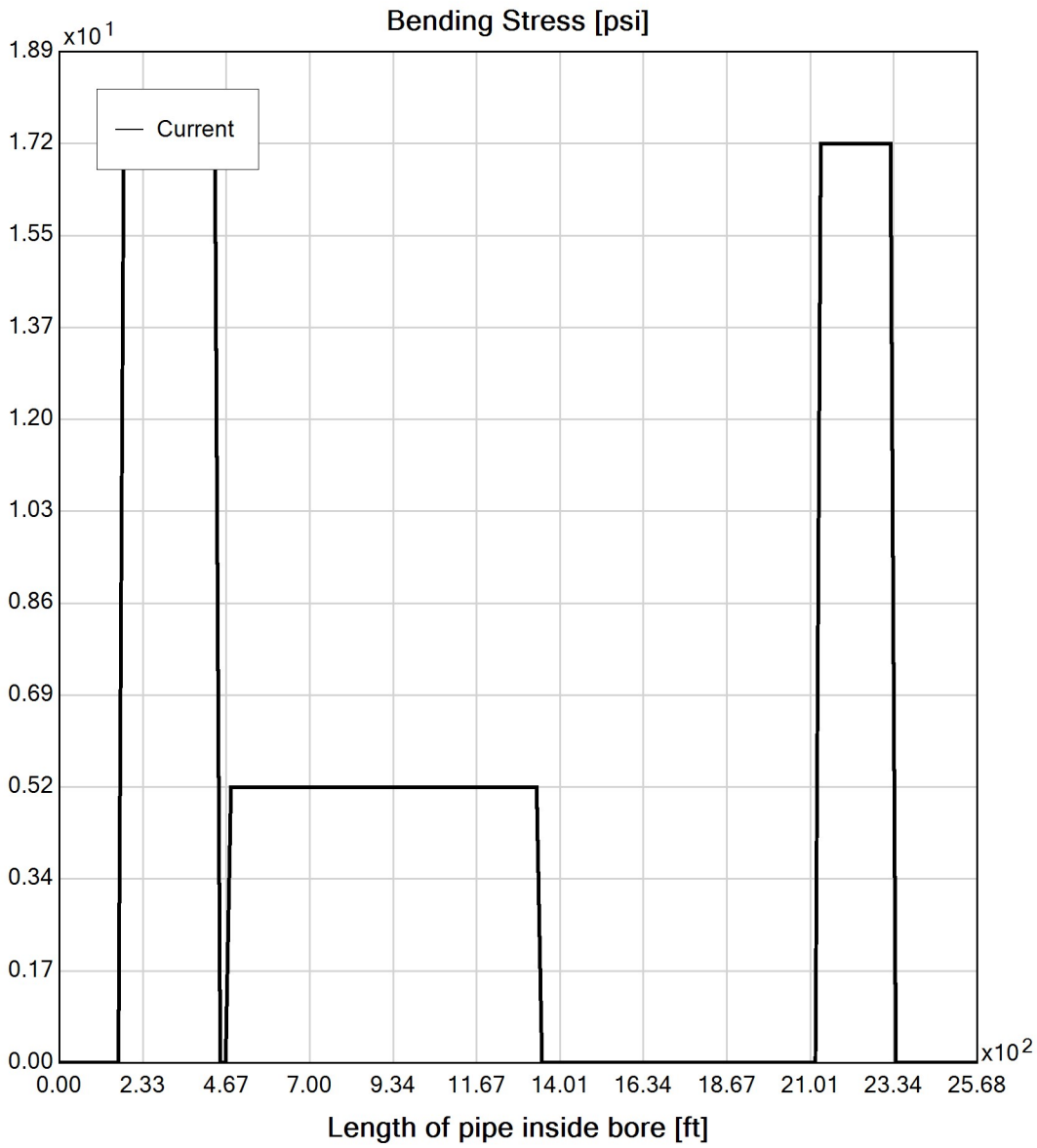


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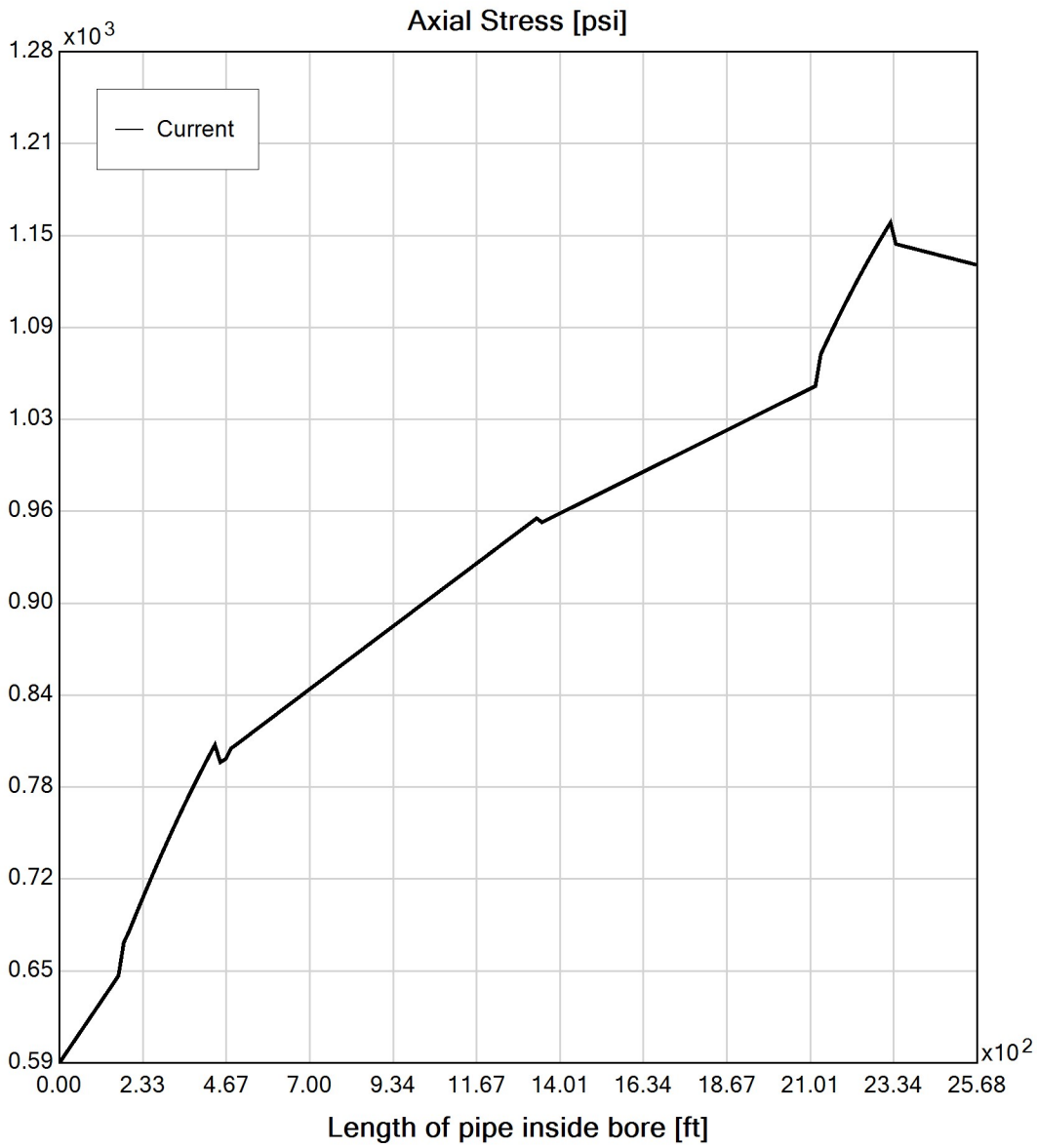


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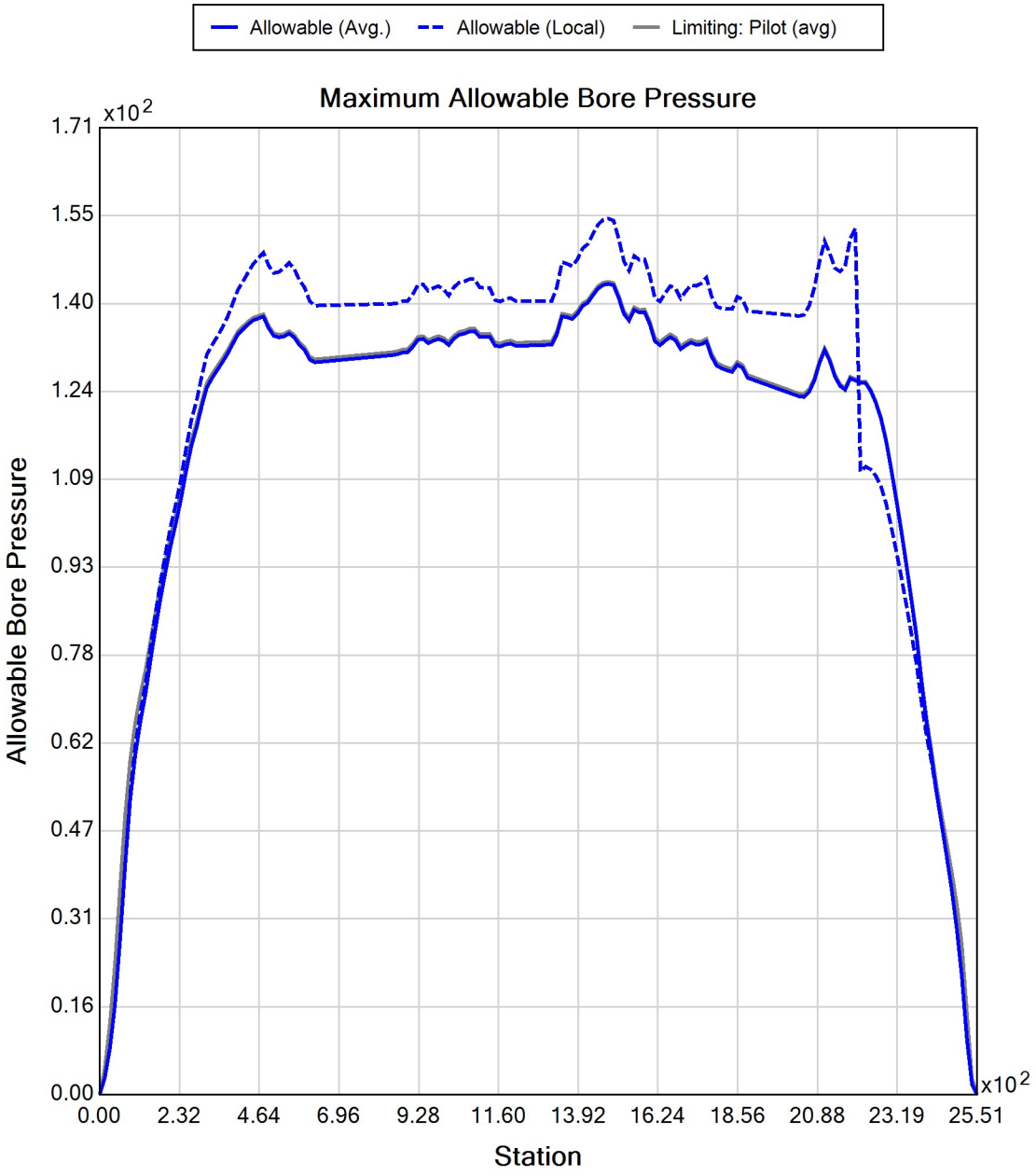


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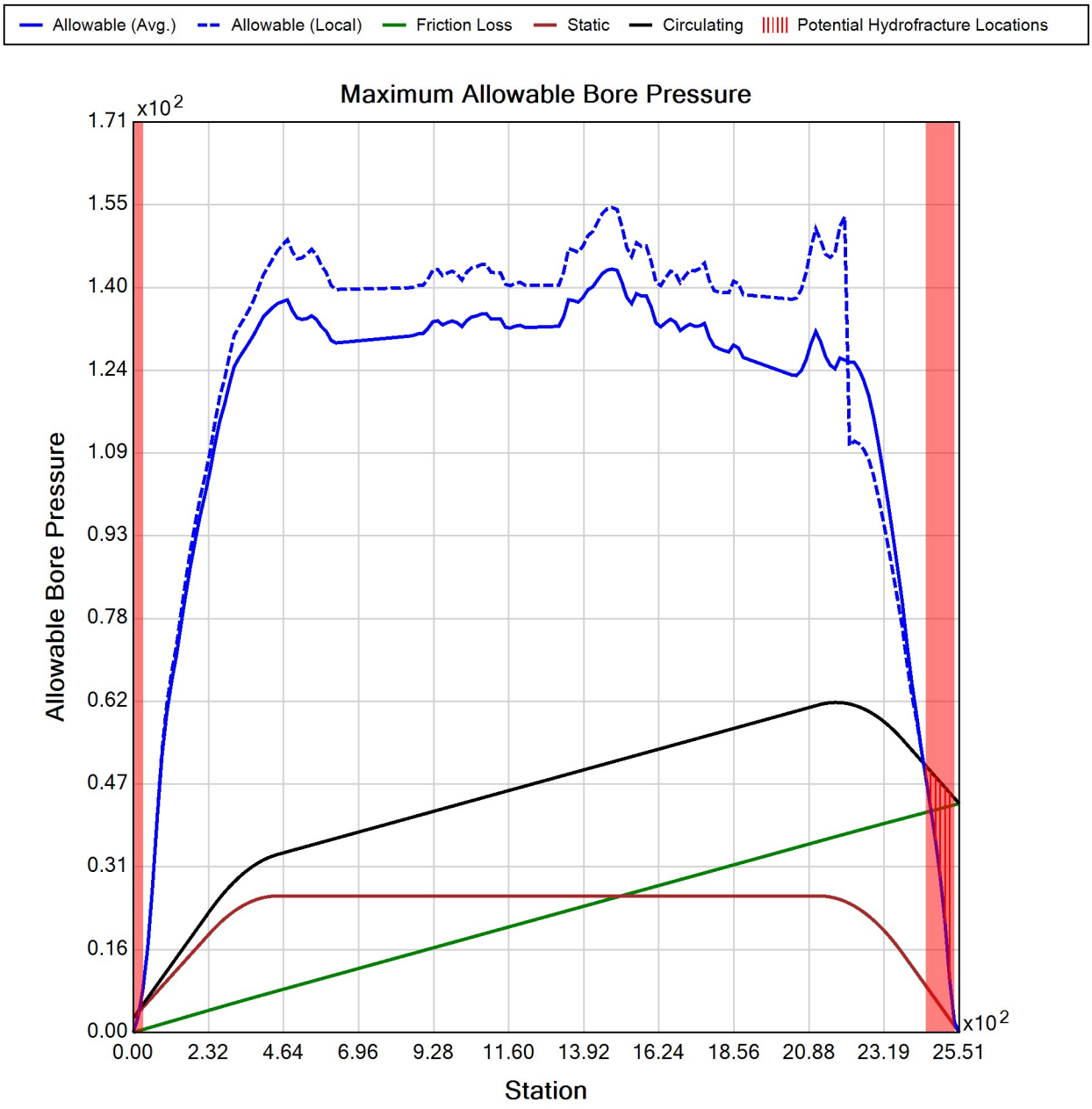


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## Input Summary

| | |
|---|---|
| Start Coordinate | (0.00, 0.00, 319.50) ft |
| End Coordinate | (2550.00, 0.00, 324.30) ft |
| Project Length | 2550.00 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 |

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## Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 2" (2.375")
Pipe DR: 9
Pipe Length: 2565.00 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

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## In-service Load Summary:

| Pressure [psi] | Deformed | Collapsed |
|---|---|---|
| Earth Pressure | 1.4 | 23.5 |
| Water Pressure | 20.1 | 20.1 |
| Surface Surcharge | 0.0 | 0.0 |
| Internal Pressure | 0.0 | 0.0 |
| Net Pressure | 21.5 | 43.6 |
| **Deflection** | | |
| Earth Load Deflection | 0.497 | 6.606 |
| Buoyant Deflection | 0.029 | 0.029 |
| Reissner Effect | 0 | 0 |
| Net Deflection | 0.526 | 6.635 |
| **Compressive Stress [psi]** | | |
| Compressive Wall Stress | 96.8 | 196.3 |

## Installation Load Summary:

| Forces/Stresses | @Maximum Force | Absolute Maximum |
|---|---|---|
| Pullback Force [lb] | 2115.7 | 2115.7 |
| Pullback Stress [psi] | 1208.8 | 1208.8 |
| Pullback Strain | 2.102E-2 | 2.102E-2 |
| Bending Stress [psi] | 0.0 | 3.8 |
| Bending Strain | 0 | 6.597E-5 |
| Tensile Stress [psi] | 1208.8 | 1209.9 |
| Tensile Strain | 2.102E-2 | 2.111E-2 |

Net External Pressure = 34.0 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

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## In-service Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 0.526 | 7.5 | 14.3 | OK |
| Unconstrained Collapse [psi] | 34.8 | 133.2 | 3.8 | OK |
| Compressive Wall Stress [psi] | 96.8 | 1150.0 | 11.9 | OK |

## Installation Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 0.014 | 7.5 | 524.3 | OK |
| Unconstrained Collapse [psi] | 44.7 | 174.0 | 3.9 | OK |
| Tensile Stress [psi] | 1209.9 | 1200.0 | 1.0 | OK |

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## Project Summary

| | |
|---|---|
| General: | CHPE HDD 36 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 36 Conduit 1 10-inch DR 9 |

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## Input Summary

| | |
|---|---|
| Start Coordinate | (0.00, 0.00, 313.75) ft |
| End Coordinate | (621.00, 0.00, 324.25) ft |
| Project Length | 621.00 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 |

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## Soil Summary

Number of Layers: 3

Soil Layer #1 USCS, Sand (S), SM
Depth: 9.20 ft
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Sand (S), SP
Depth: 9.50 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: 13.50 ft
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

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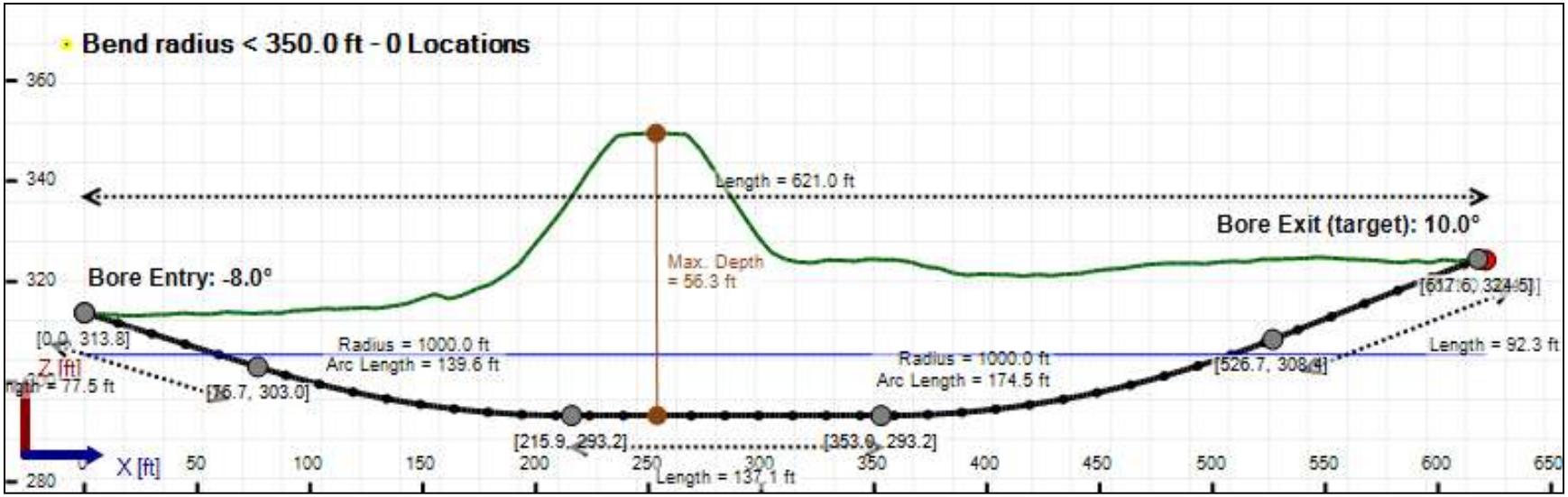
## Bore Cross-Section View

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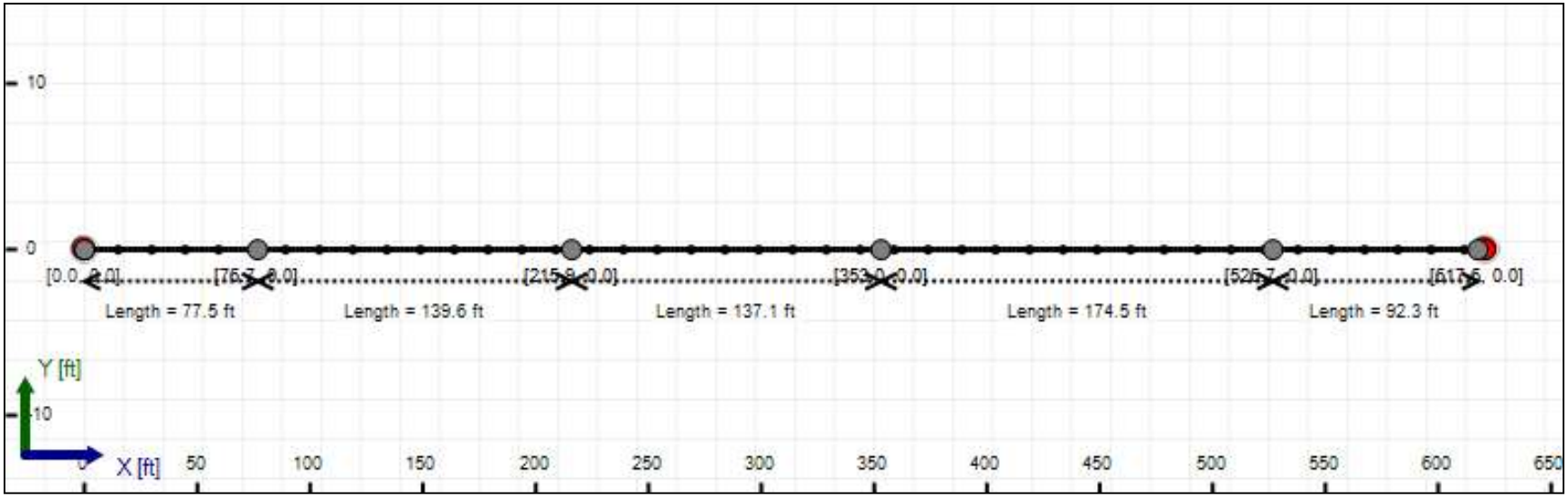
## Bore Plan View




Powered by | BoreAid

## 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

Powered by Vermeer | BoreAid®

## In-service Load Summary:

| Pressure [psi] | Deformed | Collapsed |
|---|---|---|
| Earth Pressure | 4.9 | 36.6 |
| Water Pressure | 5.3 | 5.3 |
| Surface Surcharge | 0.0 | 0.0 |
| Internal Pressure | 0.0 | 0.0 |
| Net Pressure | 10.2 | 41.9 |
| **Deflection** | | |
| Earth Load Deflection | 1.367 | 9.972 |
| Buoyant Deflection | 0.132 | 0.132 |
| Reissner Effect | 0 | 0 |
| Net Deflection | 1.499 | 10.104 |
| **Compressive Stress [psi]** | | |
| Compressive Wall Stress | 45.7 | 188.5 |

## Installation Load Summary:

| Forces/Stresses | @Maximum Force | Absolute Maximum |
|---|---|---|
| Pullback Force [lb] | 10937.7 | 10937.7 |
| Pullback Stress [psi] | 305.0 | 305.0 |
| Pullback Strain | 5.305E-3 | 5.305E-3 |
| Bending Stress [psi] | 0.0 | 25.8 |
| Bending Strain | 0 | 4.479E-4 |
| Tensile Stress [psi] | 305.0 | 328.7 |
| Tensile Strain | 5.305E-3 | 6.164E-3 |

Net External Pressure = 23.4 [psi ]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

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## In-service Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 1.499 | 7.5 | 5.0 | OK |
| Unconstrained Collapse [psi] | 21.3 | 121.1 | 5.7 | OK |
| Compressive Wall Stress [psi] | 45.7 | 1150.0 | 25.1 | OK |

## Installation Analysis

| | Calculated | Allowable | Factor of Safety | Check |
|---|---|---|---|---|
| Deflection [%] | 0.065 | 7.5 | 115.8 | OK |
| Unconstrained Collapse [psi] | 31.3 | 237.3 | 7.6 | OK |
| Tensile Stress [psi] | 328.7 | 1200.0 | 3.7 | OK |

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## 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 | 114.735 psi | 114.735 psi |
| 1 | 8.00 in | 12.00 in | 114.707 psi | 114.707 psi |
| 2 | 12.00 in | 16.13 in | 114.666 psi | 114.666 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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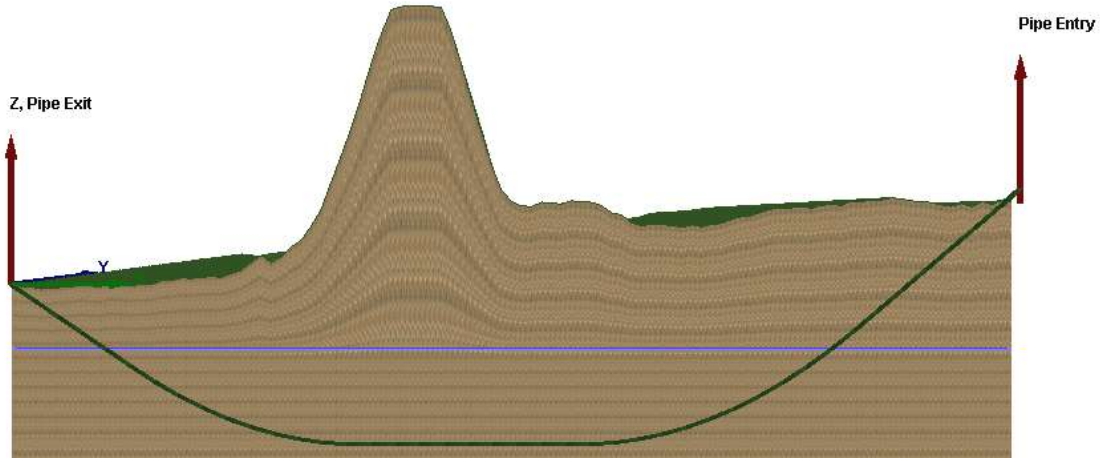
## Virtual Site

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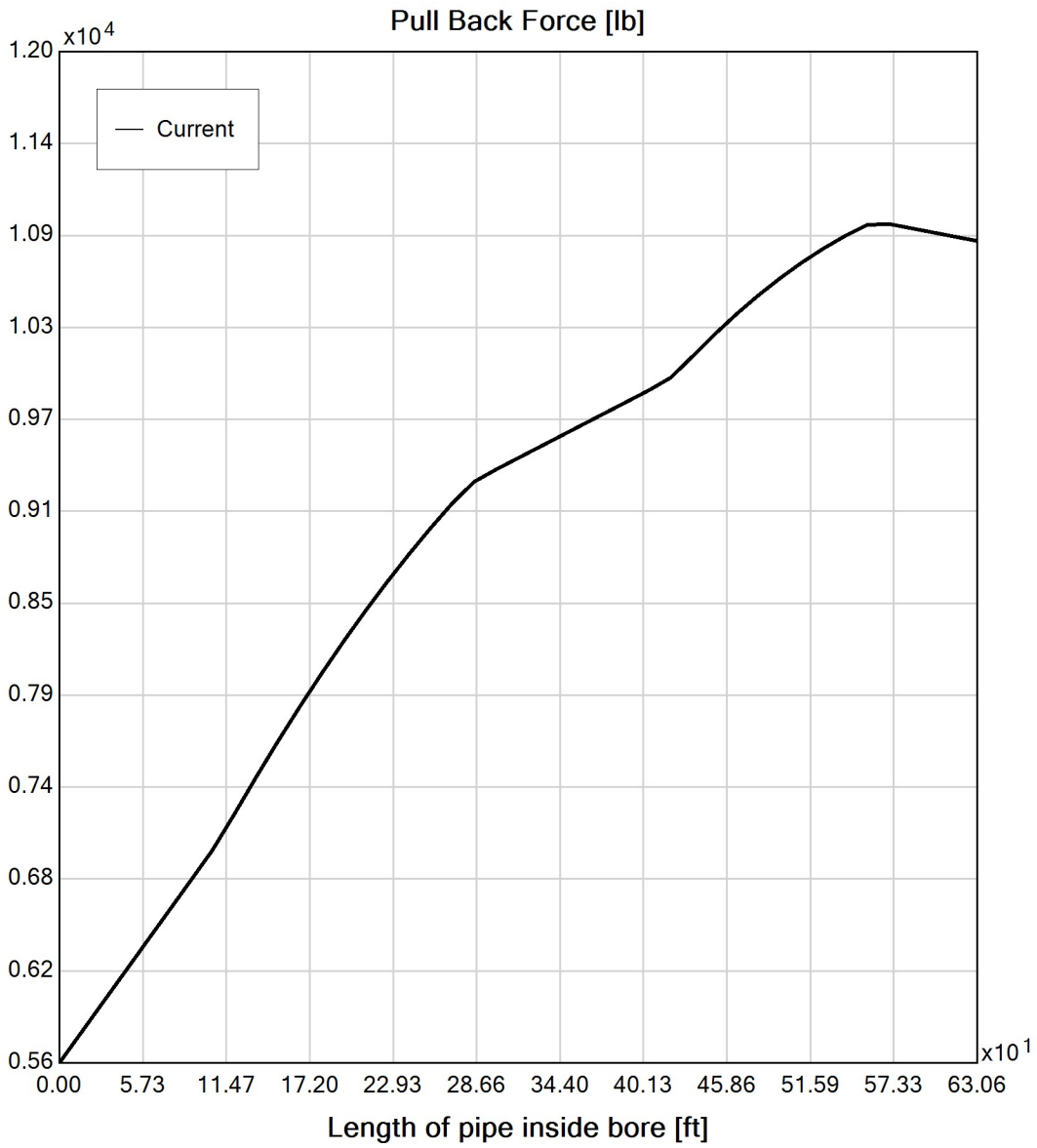


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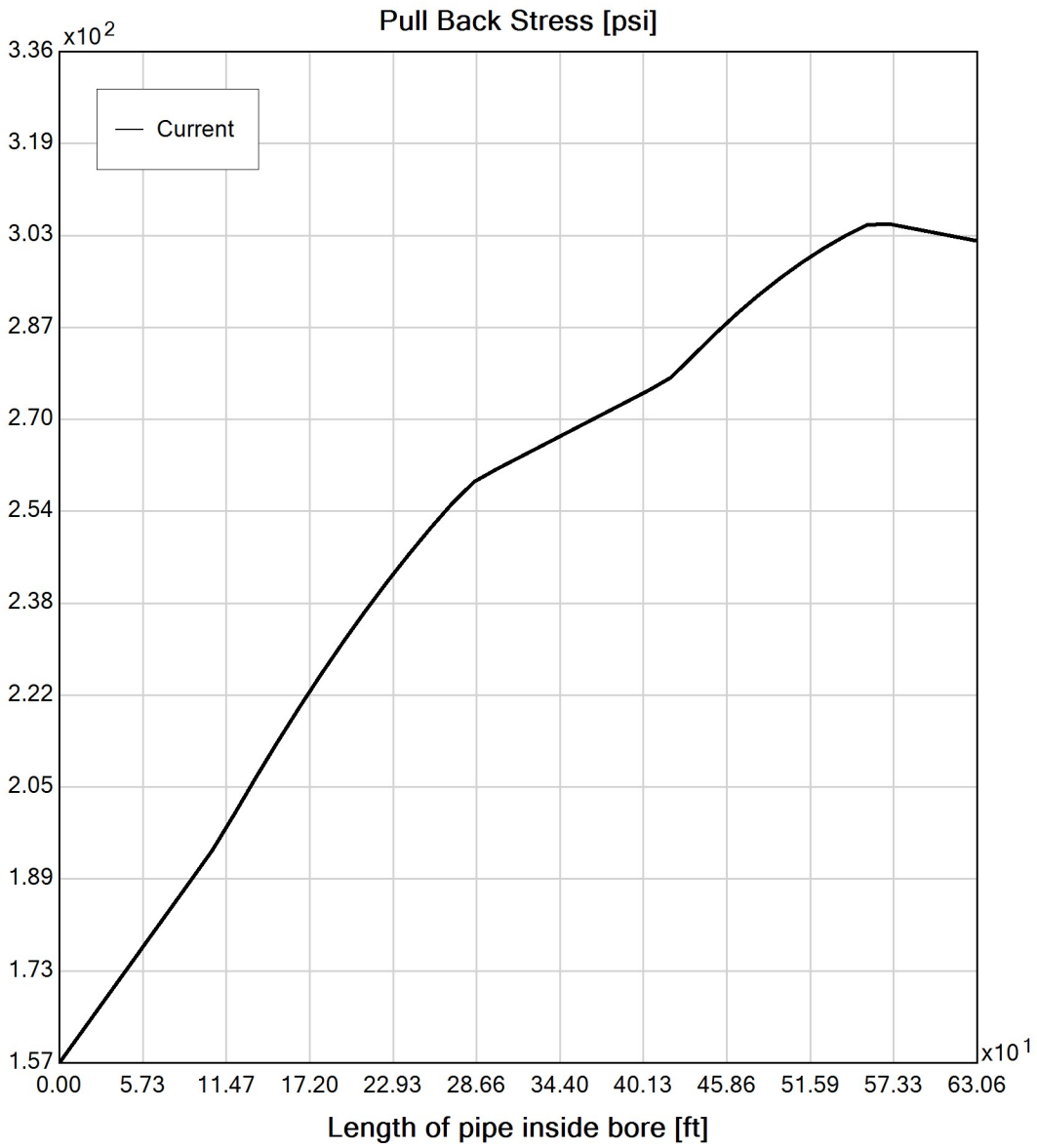


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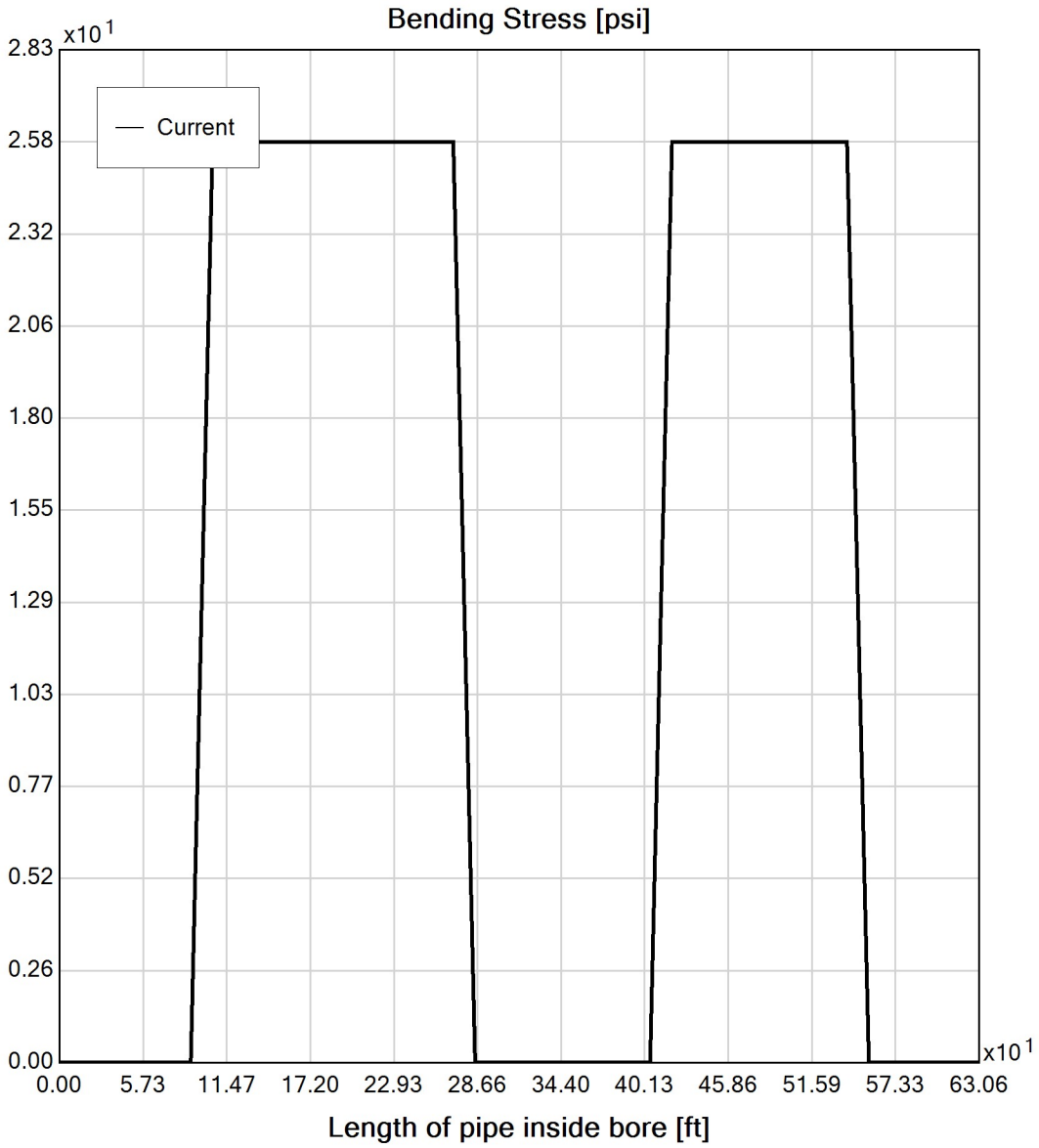


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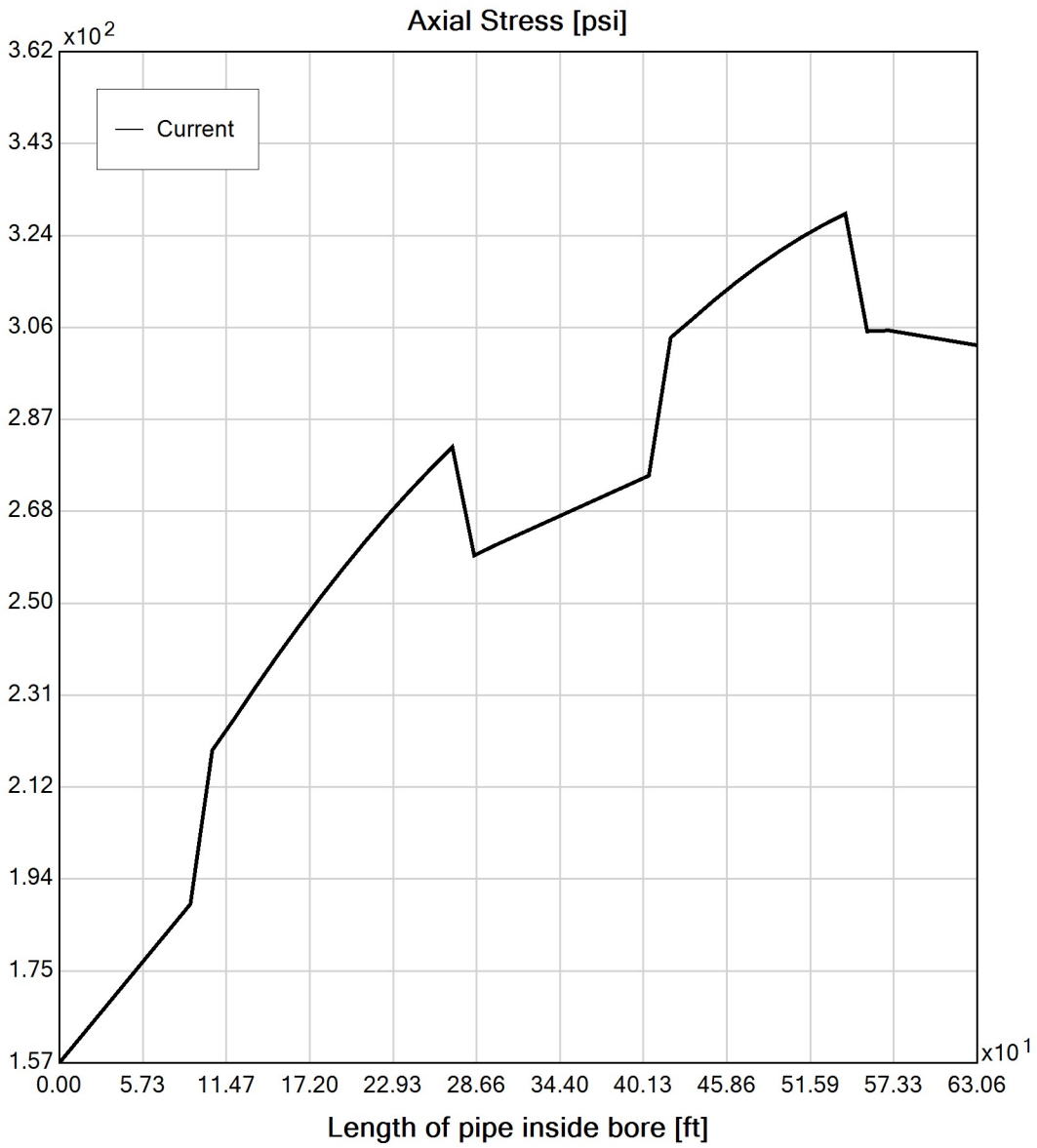


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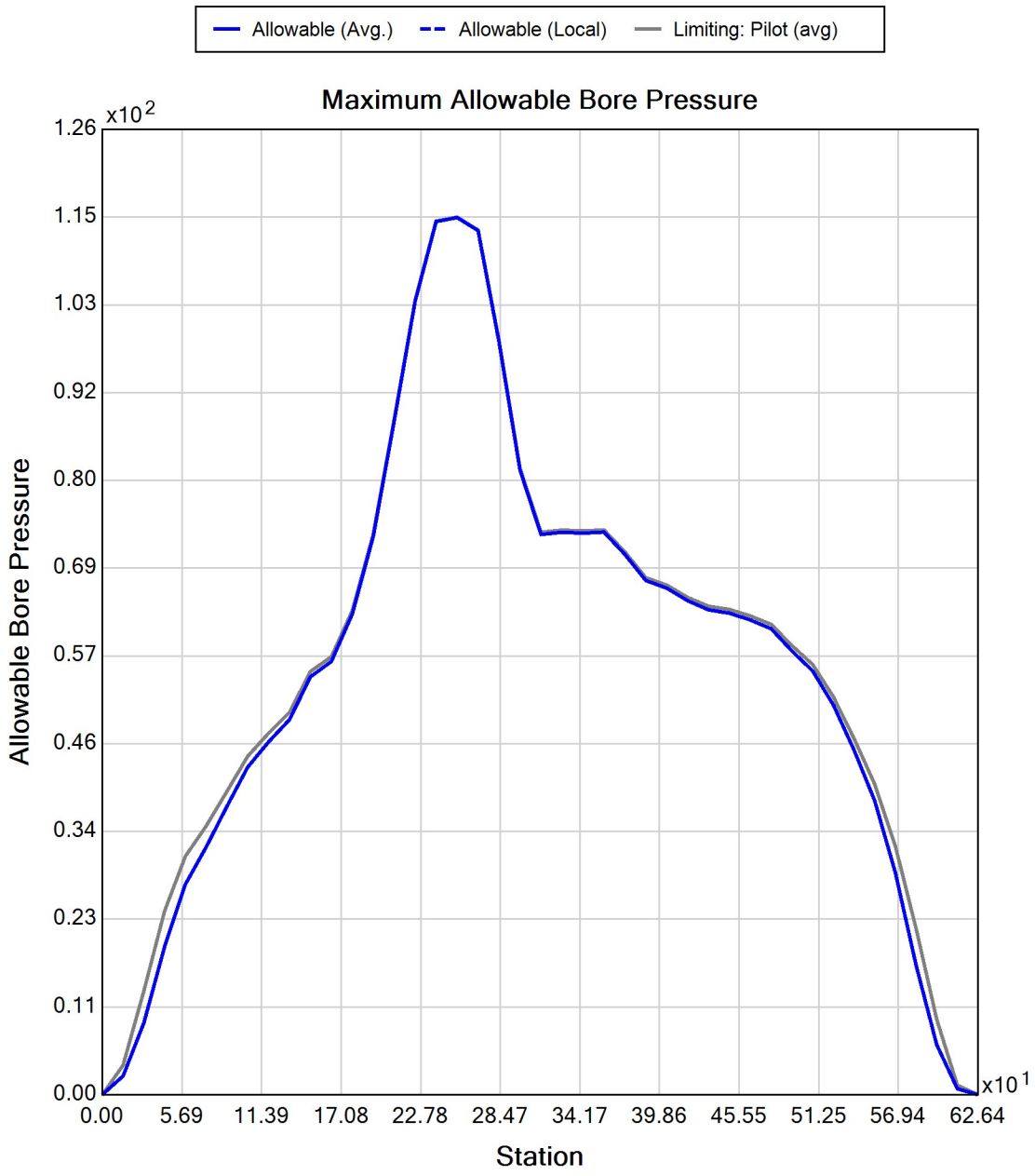


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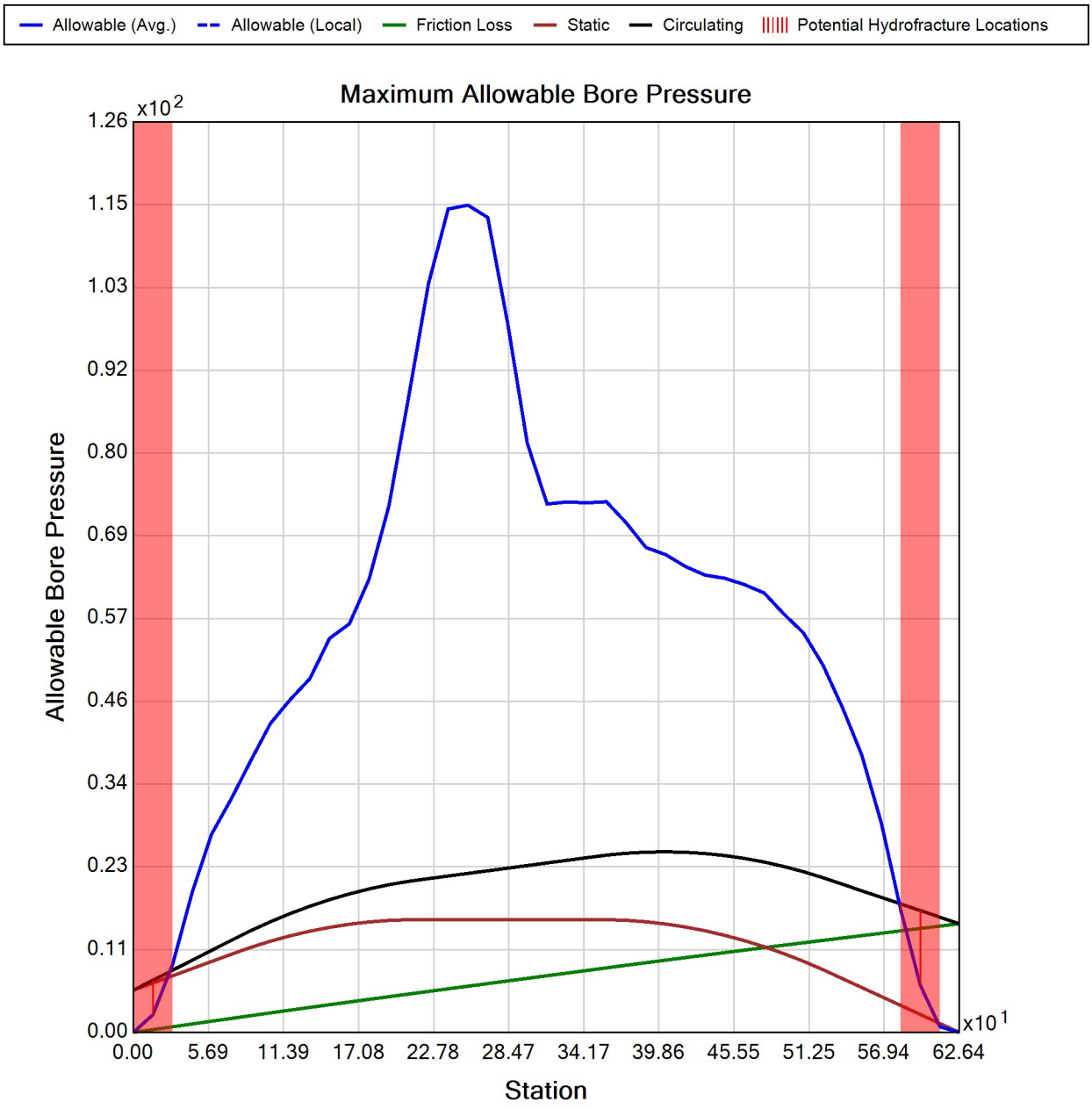


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