



## Generated Output



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## Project Summary

General:	CHPE HDD 67 P4B Start Date: 12-10-2021 End Date: 12-10-2021
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	TAR CHA
Description:	HDD 67 2-inch DR9 Conduit 2

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## Input Summary

Start Coordinate	(138.00, 0.00, 291.30) ft
End Coordinate	(1022.20, 0.00, 289.00) ft
Project Length	884.20 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: 900.00 ft  
Internal Pressure: 0 psi  
Borehole Diameter: 0.531000018119812 ft  
Silo Width: 0.531000018119812 ft  
Surface Surcharge: 0 psi  
Short Term Modulus: 57500 psi  
Long Term Modulus: 28200 psi  
Short Term Poisson Ratio: 0.35  
Long Term Poisson Ratio: 0.45  
Pipe Unit Weight: 59.30500 lb/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

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### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	1.6	25.9
Water Pressure	16.7	16.7
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	18.3	42.6
Deflection		
Earth Load Deflection	0.617	7.054
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.647	7.083
Compressive Stress [psi]		
Compressive Wall Stress	82.2	191.7

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	824.9	824.9
Pullback Stress [psi]	471.3	471.3
Pullback Strain	8.197E-3	8.197E-3
Bending Stress [psi]	0.0	4.7
Bending Strain	0	8.247E-5
Tensile Stress [psi]	471.3	473.8
Tensile Strain	8.197E-3	8.322E-3

Net External Pressure = 33.1 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

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### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.647	7.5	11.6	OK
Unconstrained Collapse [psi]	32.4	132.6	4.1	OK
Compressive Wall Stress [psi]	82.2	1150.0	14.0	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	42.4	229.4	5.4	OK
Tensile Stress [psi]	473.8	1200.0	2.5	OK





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## Project Summary

General:	CHPE HDD 68 P4B Start Date: 05-15-2023 End Date: 03-13-2023
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	MDB BCE
Description:	HDD 68 8-inch DR17 FPVC Conduit 1 Estimated using DR18

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## Input Summary

Start Coordinate	(0.00, 0.00, 232.00) ft
End Coordinate	(1900.00, 0.00, 280.00) ft
Project Length	1900.00 ft
Pipe Type	PVC
OD Classification	IPS
Pipe OD	8.625 in
Pipe DR	18.0
Pipe Thickness	0.48 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

From Assistant

Unit Weight: 125.0000 (dry), 135.0000 (sat) [lb/ft<sup>3</sup>]

Phi: 36.00, S.M.: 700.00, Coh: 0.00 [psi]

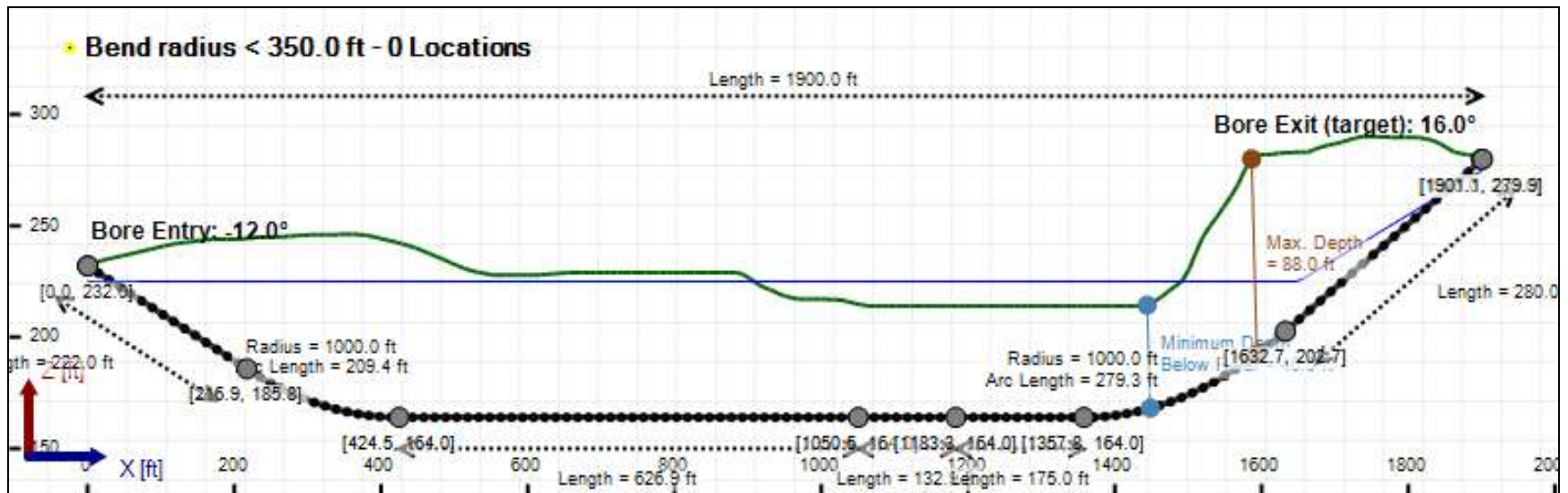
Soil Layer #2 USCS, Sand (S), SP

From Assistant

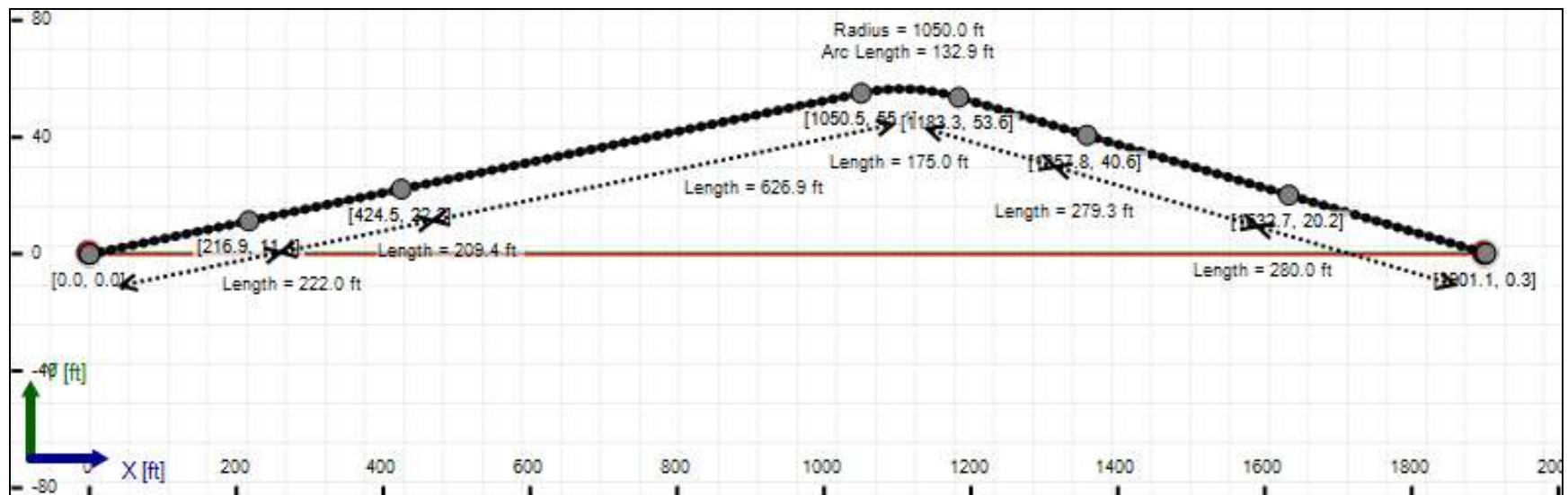
Unit Weight: 120.0000 (dry), 130.0000 (sat) [lb/ft<sup>3</sup>]

Phi: 35.00, S.M.: 600.00, Coh: 0.00 [psi]

### Bore Cross-Section View



## Bore Plan View



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## Load Verifier Input Summary:

Pipe Application: Electrical Cable  
Pipe Type: PVC  
Classification: IPS  
Pipe OD: 8" (8.625")  
Pipe DR: 18  
Pipe Length: 1934.99 ft  
Internal Pressure: 0 psi  
Borehole Diameter: 1.07799990971883 ft  
Silo Width: 1.07799990971883 ft  
Surface Surcharge: 0 psi  
Short Term Modulus: 400000 psi  
Long Term Modulus: 400000 psi  
Short Term Poisson Ratio: 0.38  
Long Term Poisson Ratio: 0.38  
Pipe Unit Weight: 87.40220 lb/ft<sup>3</sup>  
Allowable Tensile Stress (Short Term): 2800 psi  
Allowable Tensile Stress (Long Term): 2800 psi  
Allowable Compressive Stress (Short Term): 3200 psi  
Allowable Compressive Stress (Long Term): 3200 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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

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### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	5.4	65.3
Water Pressure	26.2	14.1
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	31.6	79.4
<b>Deflection</b>		
Earth Load Deflection	0.991	12.024
Buoyant Deflection	0.060	0.060
Reissner Effect	0	0
Net Deflection	1.051	12.084
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	284.6	714.7

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	10795.2	10795.2
Pullback Stress [psi]	880.4	880.4
Pullback Strain	2.201E-3	2.201E-3
Bending Stress [psi]	0.0	143.8
Bending Strain	0	3.594E-4
Tensile Stress [psi]	880.4	1015.1
Tensile Strain	2.201E-3	2.887E-3

Net External Pressure = 35.7 [psi ]

Buoyant Deflection = 0.1

Hydrokinetic Force = 365.0 lb



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### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.051	7.5	7.1	OK
Unconstrained Collapse [psi]	77.1	178.5	2.3	OK
Compressive Wall Stress [psi]	284.6	3200.0	11.2	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.060	7.5	125.5	OK
Unconstrained Collapse [psi]	35.7	170.1	4.8	OK
Tensile Stress [psi]	1015.1	2800.0	2.8	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	313.735 psi	296.416 psi
1	8.00 in	14.00 in	313.608 psi	296.310 psi
2	14.00 in	19.13 in	313.445 psi	296.174 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): 184.00 US (liquid) gallon/min

Drill Fluid Density: 68.700 lb/ft<sup>3</sup>

Rheological model: Bingham-Plastic

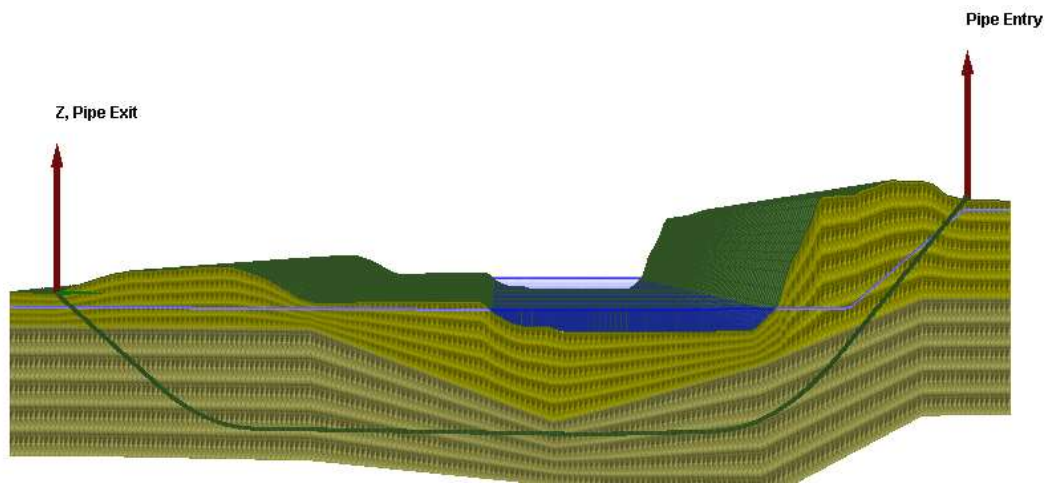
Plastic Viscosity (PV): 25.53

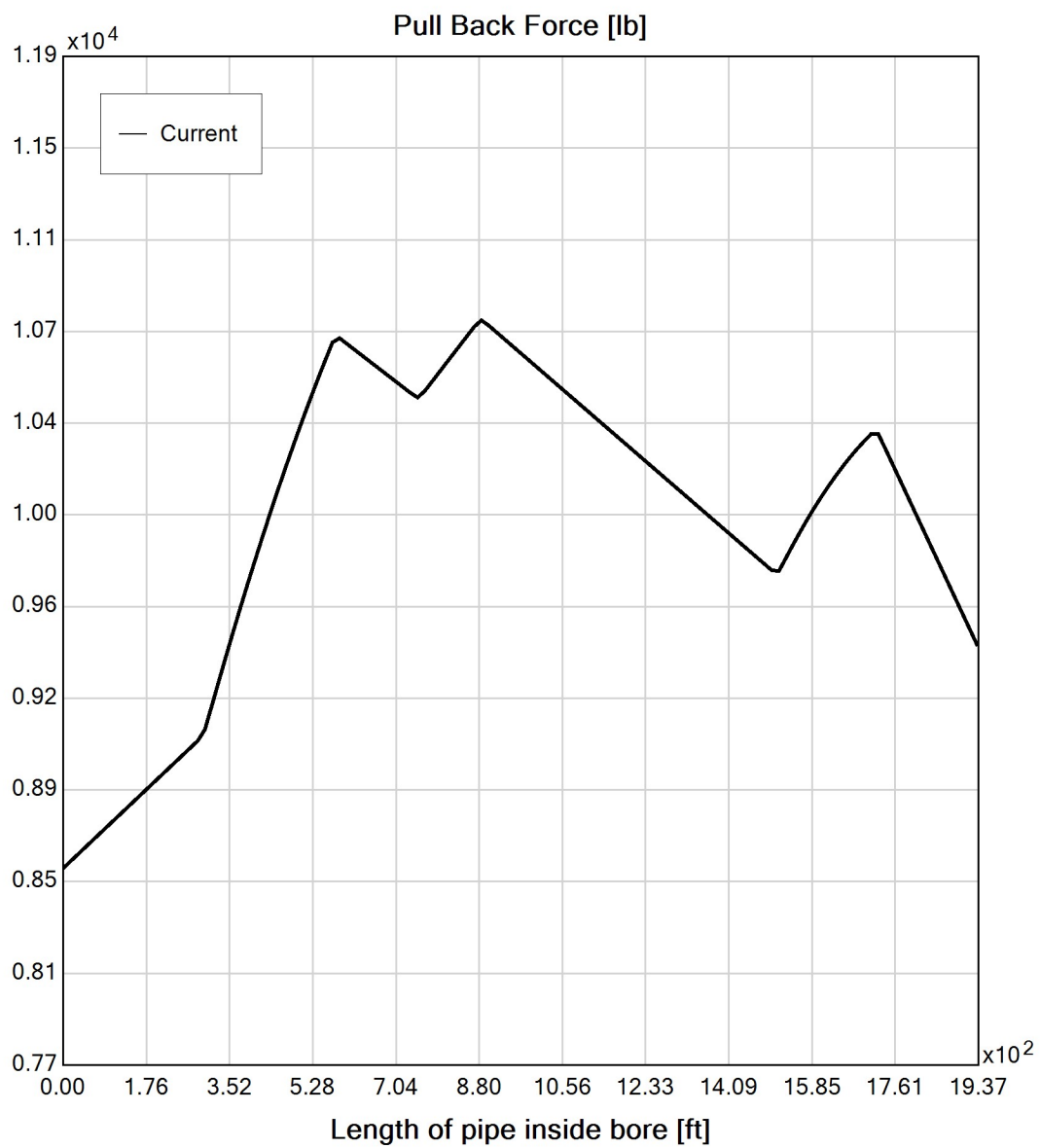
Yield Point (YP): 16.49

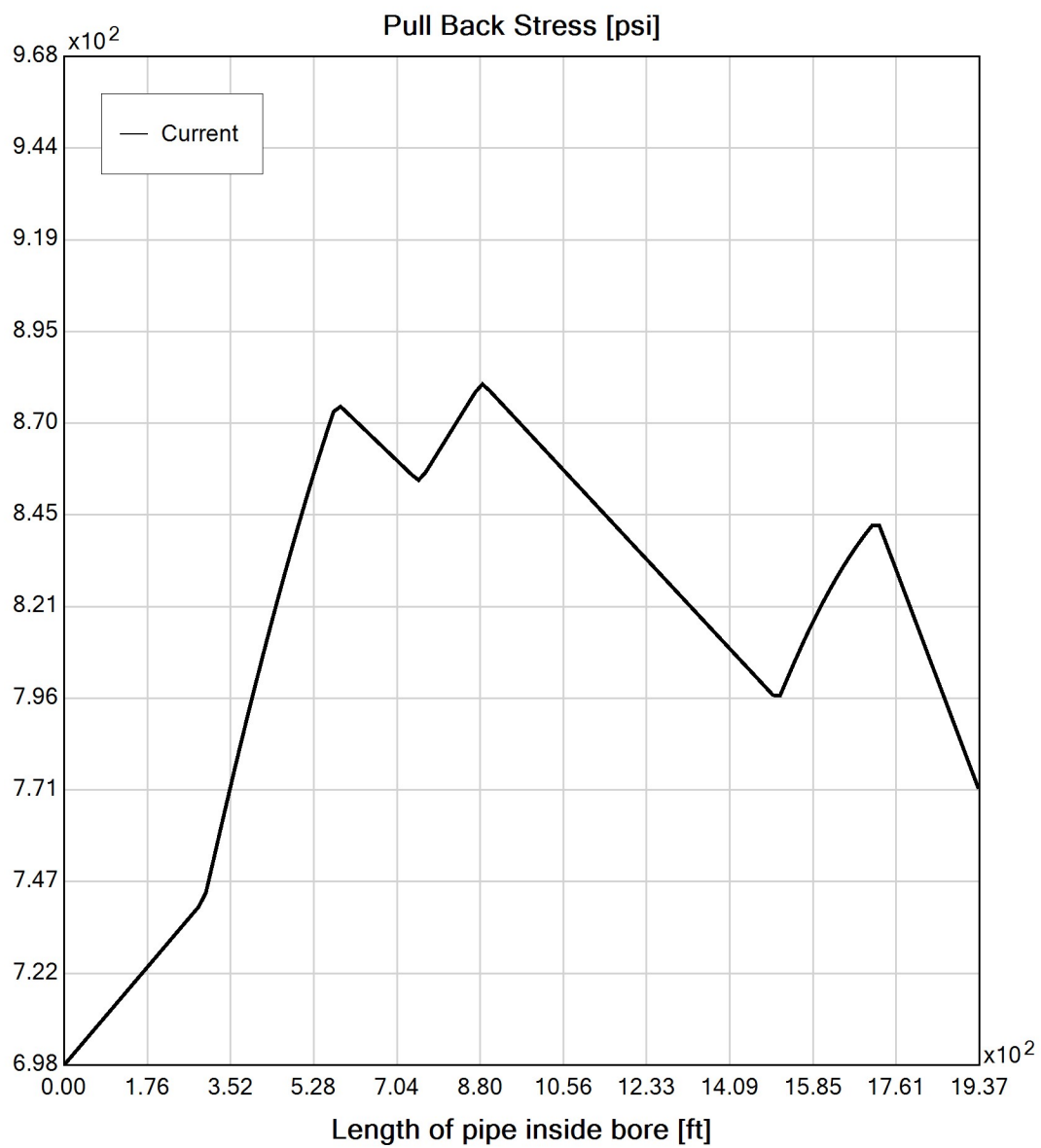
Effective Viscosity (cP): 281.3

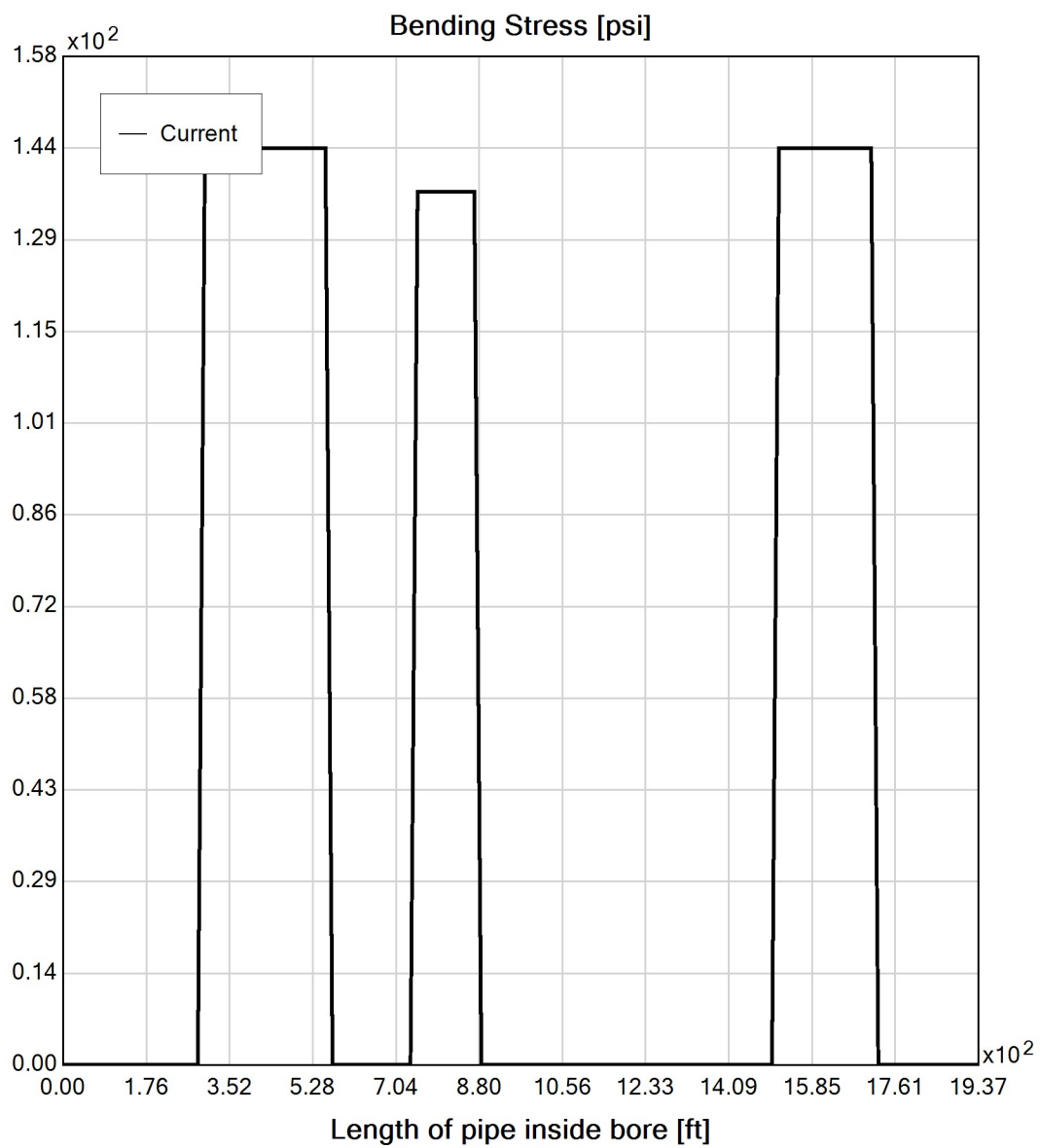
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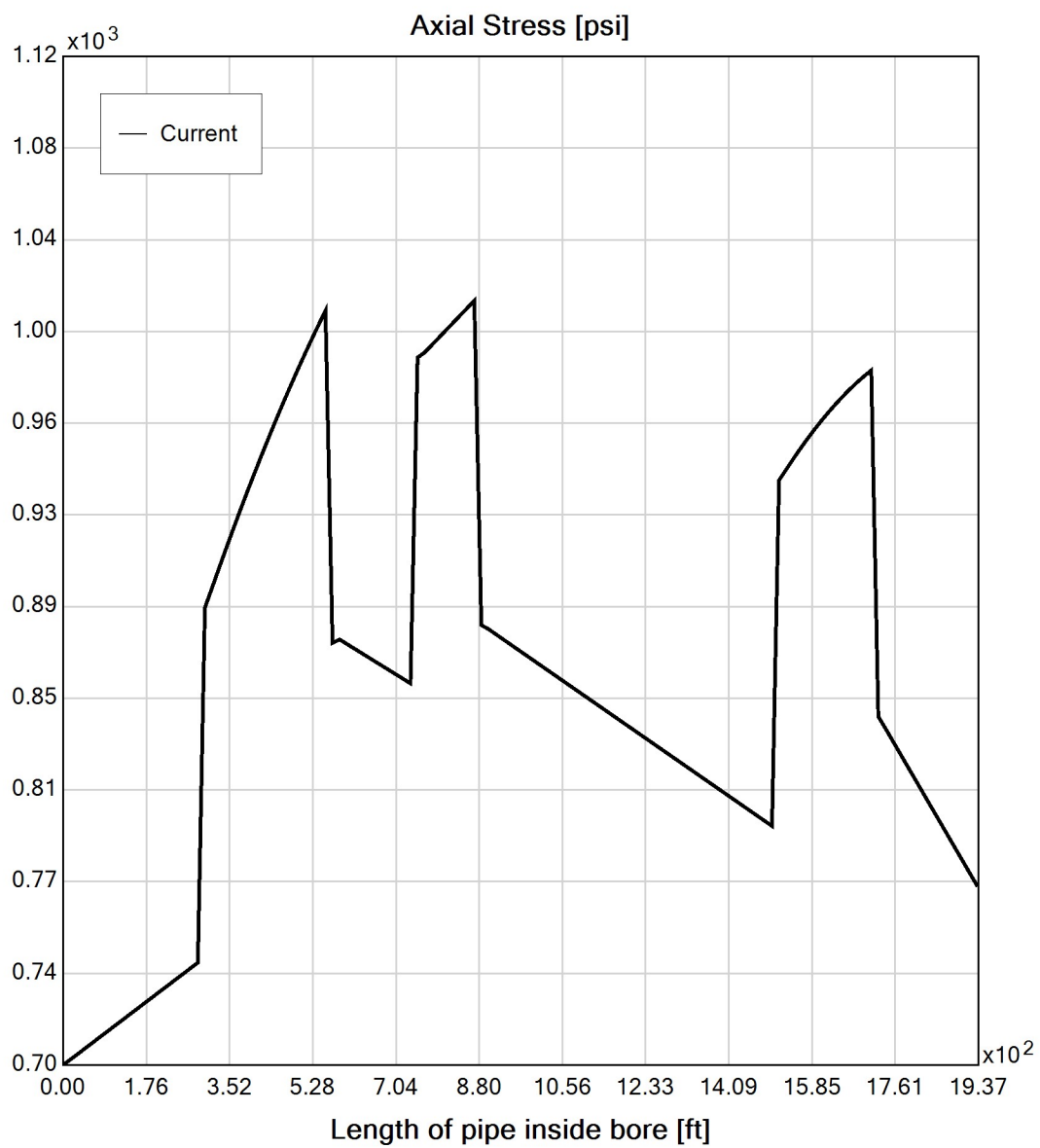
## Virtual Site

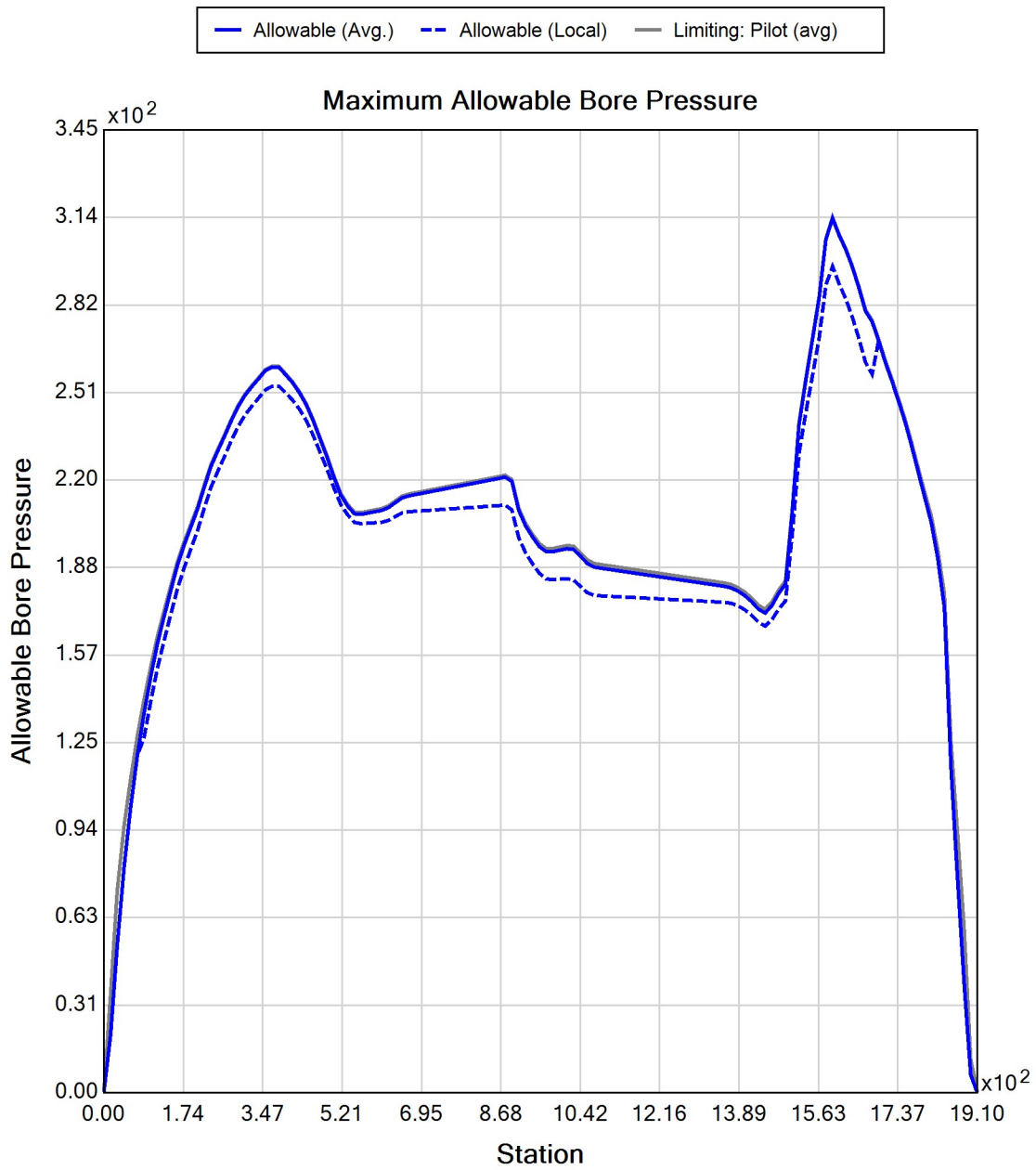




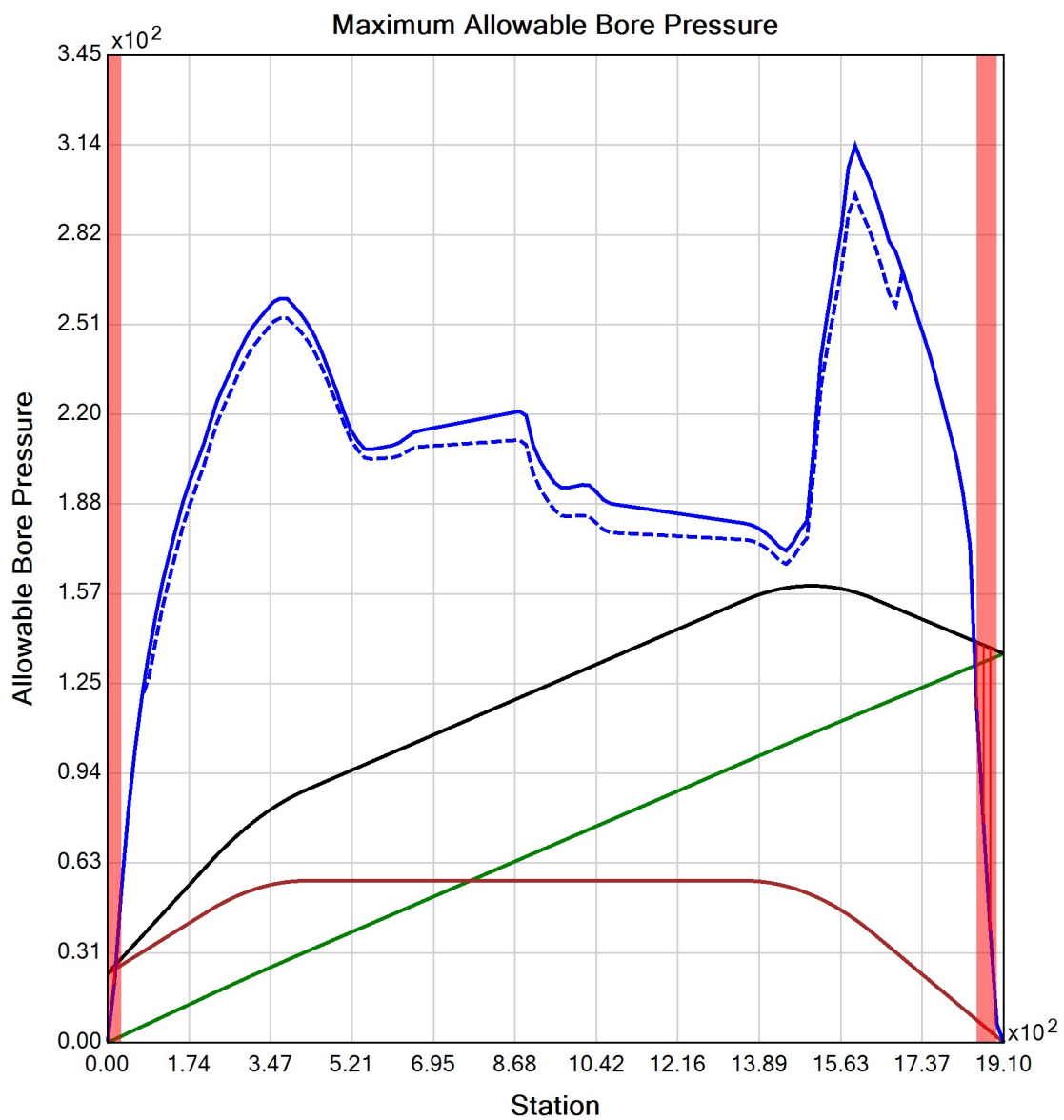














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Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	MDB BCE
Description:	HDD 68 3-inch HDPE DR 7 Conduit 1

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## Input Summary

Start Coordinate	(0.00, 0.00, 232.00) ft
End Coordinate	(1900.00, 0.00, 280.00) ft
Project Length	1900.00 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: 1934.99 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

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### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	3.2	65.3
Water Pressure	26.2	14.1
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	29.4	79.4
<b>Deflection</b>		
Earth Load Deflection	0.367	7.498
Buoyant Deflection	0.020	0.020
Reissner Effect	0	0
Net Deflection	0.388	7.518
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	102.9	277.9

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	2687.6	2687.6
Pullback Stress [psi]	570.3	570.3
Pullback Strain	9.919E-3	9.919E-3
Bending Stress [psi]	0.0	8.4
Bending Strain	0	1.458E-4
Tensile Stress [psi]	570.3	575.4
Tensile Strain	9.919E-3	1.015E-2

Net External Pressure = 35.7 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 172.8 lb

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### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.388	7.5	19.4	OK
Unconstrained Collapse [psi]	77.1	319.9	4.2	OK
Compressive Wall Stress [psi]	102.9	1150.0	11.2	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.010	7.5	756.1	OK
Unconstrained Collapse [psi]	35.7	521.2	14.6	OK
Tensile Stress [psi]	575.4	1200.0	2.1	OK



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Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA
Designer:	MDB BCE
Description:	HDD 69 Conduit 1 8-inch DR14 PVC DIPS 9 inch drill bit

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## Input Summary

Start Coordinate	(0.00, 0.00, 230.00) ft
End Coordinate	(2221.00, 0.00, 357.00) ft
Project Length	2221.00 ft
Pipe Type	PVC
OD Classification	DIPS
Pipe OD	9.050 in
Pipe DR	14.0
Pipe Thickness	0.65 in
Rod Length	20.00 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: 6

Soil Layer #1 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 #2 USCS, Gravel (G), GM

From Assistant

Unit Weight: 130.0000 (dry), 140.0000 (sat) [lb/ft3]

Phi: 37.00, S.M.: 1000.00, Coh: 0.00 [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]

Soil Layer #4 USCS, Gravel (G), GW

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 #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]

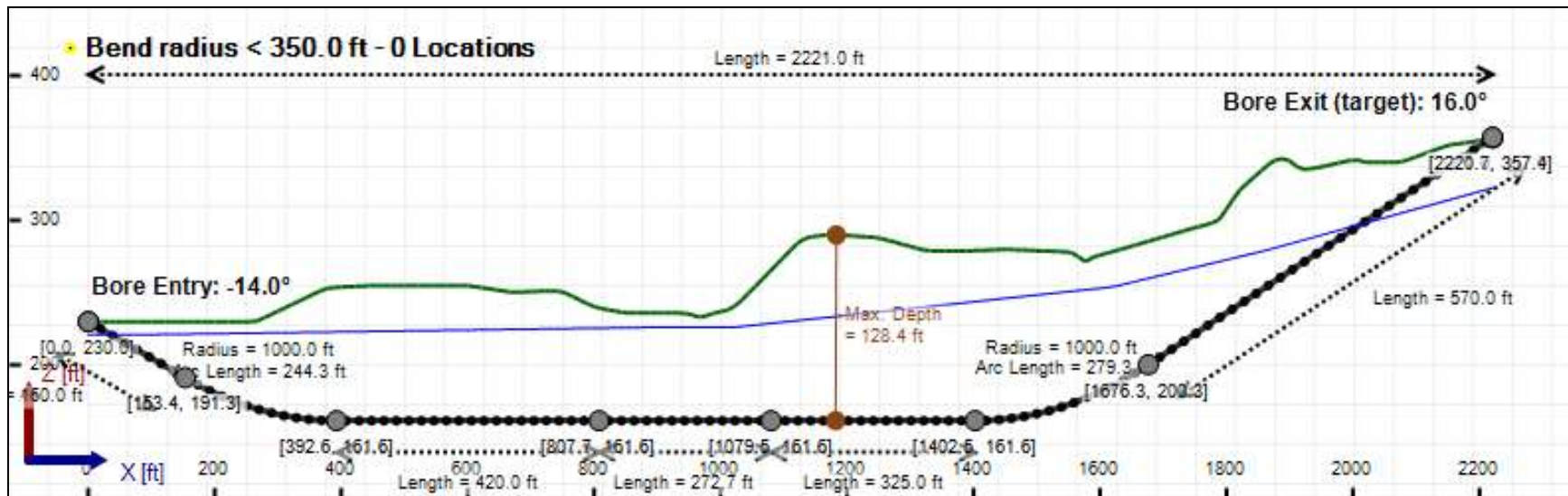
Soil Layer #6 Rock, Geological Classification, Sedimentary Rocks

From Assistant

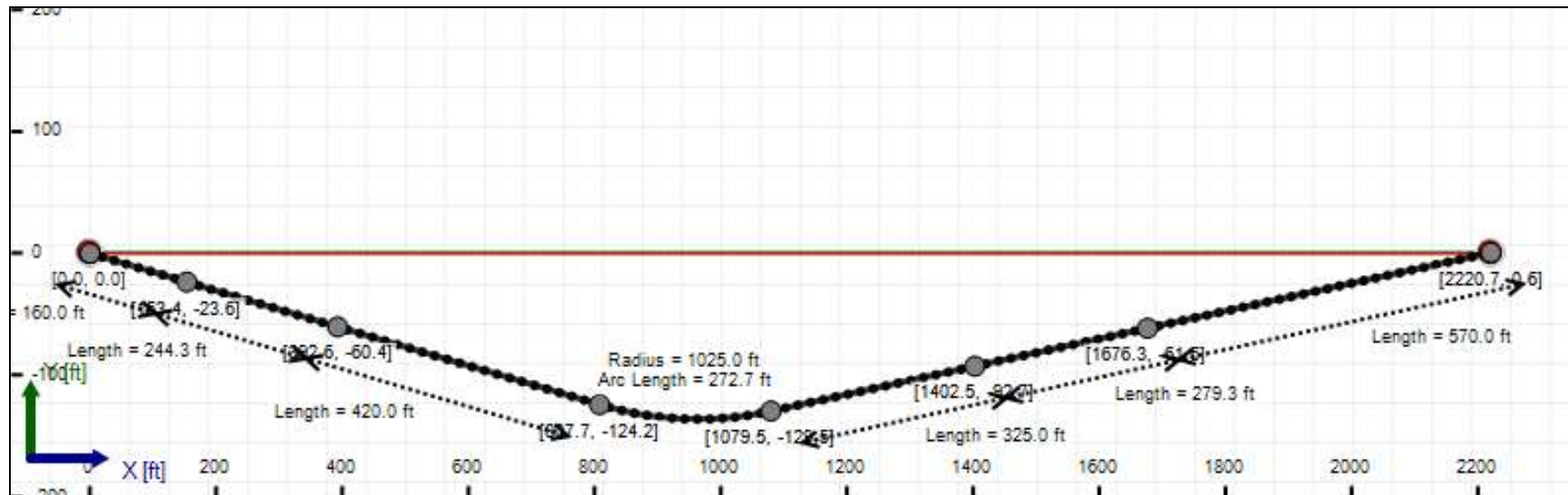
Unit Weight: 160.0000 (dry), 170.0000 (sat) [lb/ft3]

Phi: 37.00, S.M.: 2000.00, Coh: 3000.00 [psi]

### Bore Cross-Section View



## Bore Plan View



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## Load Verifier Input Summary:

Pipe Application: Electrical Cable  
Pipe Type: PVC  
Classification: DIPS  
Pipe OD: 8" (9.05")  
Pipe DR: 14  
Pipe Length: 2279.99 ft  
Internal Pressure: 0 psi  
Borehole Diameter: 1.13100004196167 ft  
Silo Width: 1.13100004196167 ft  
Surface Surcharge: 0 psi  
Short Term Modulus: 400000 psi  
Long Term Modulus: 400000 psi  
Short Term Poisson Ratio: 0.38  
Long Term Poisson Ratio: 0.38  
Pipe Unit Weight: 87.40220 lb/ft<sup>3</sup>  
Allowable Tensile Stress (Short Term): 2800 psi  
Allowable Tensile Stress (Long Term): 2800 psi  
Allowable Compressive Stress (Short Term): 3200 psi  
Allowable Compressive Stress (Long Term): 3200 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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

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### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	4.5	84.5
Water Pressure	56.1	32.4
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	60.7	116.9
<b>Deflection</b>		
Earth Load Deflection	0.380	7.009
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.409	7.038
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	424.6	818.2

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	37328.3	37328.3
Pullback Stress [psi]	2187.3	2187.3
Pullback Strain	5.468E-3	5.468E-3
Bending Stress [psi]	0.0	150.8
Bending Strain	0	3.771E-4
Tensile Stress [psi]	2187.3	2292.5
Tensile Strain	5.468E-3	6.108E-3

Net External Pressure = 116.5 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 401.7 lb

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### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.409	7.5	18.3	OK
Unconstrained Collapse [psi]	128.9	410.7	3.2	OK
Compressive Wall Stress [psi]	424.6	3200.0	7.5	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.029	7.5	254.3	OK
Unconstrained Collapse [psi]	138.3	321.9	2.3	OK
Tensile Stress [psi]	2292.5	2800.0	1.2	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	9.00 in	1367.916 psi	2088.522 psi
1	9.00 in	14.00 in	1367.851 psi	2088.470 psi
2	14.00 in	19.13 in	1367.756 psi	2088.393 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): 120.00 US (liquid) gallon/min

Drill Fluid Density: 68.700 lb/ft<sup>3</sup>

Rheological model: Bingham-Plastic

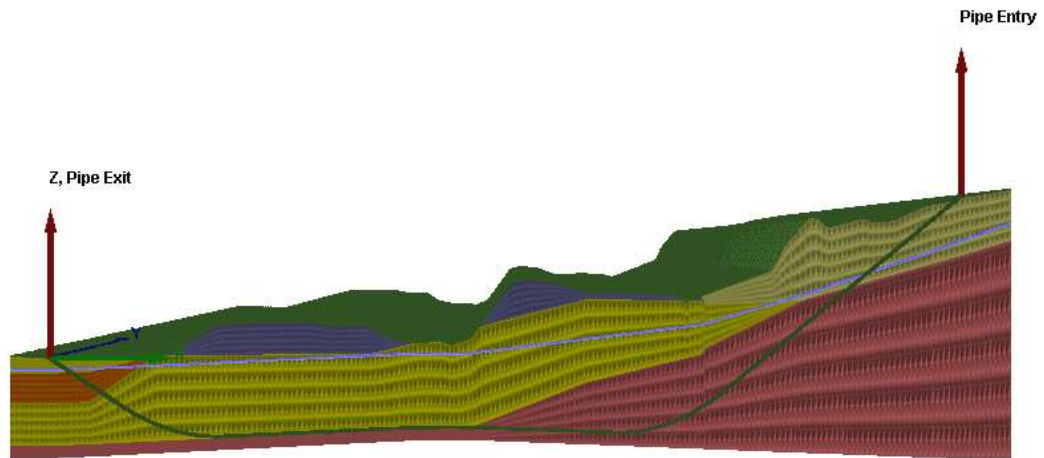
Plastic Viscosity (PV): 25.53

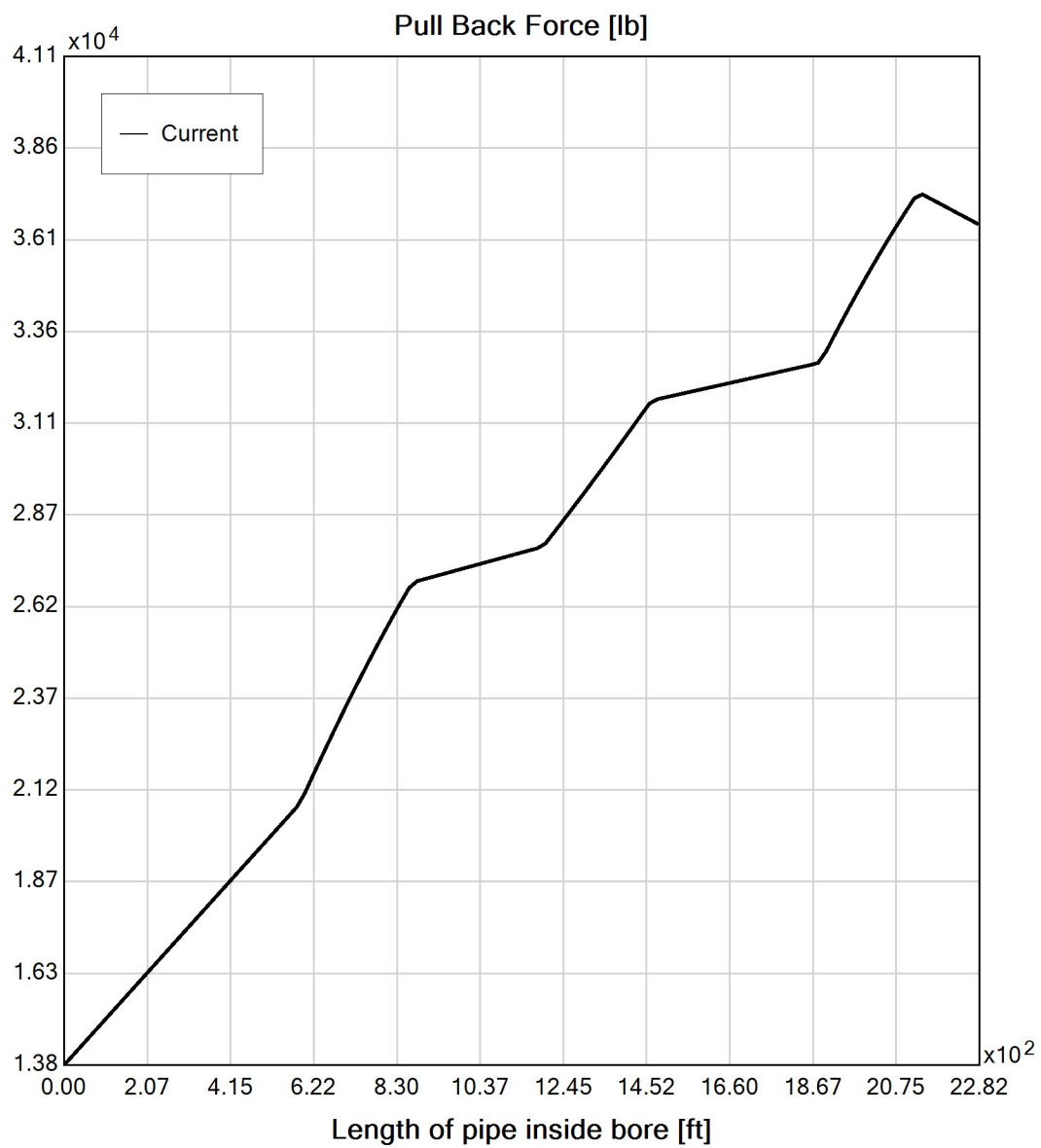
Yield Point (YP): 16.49

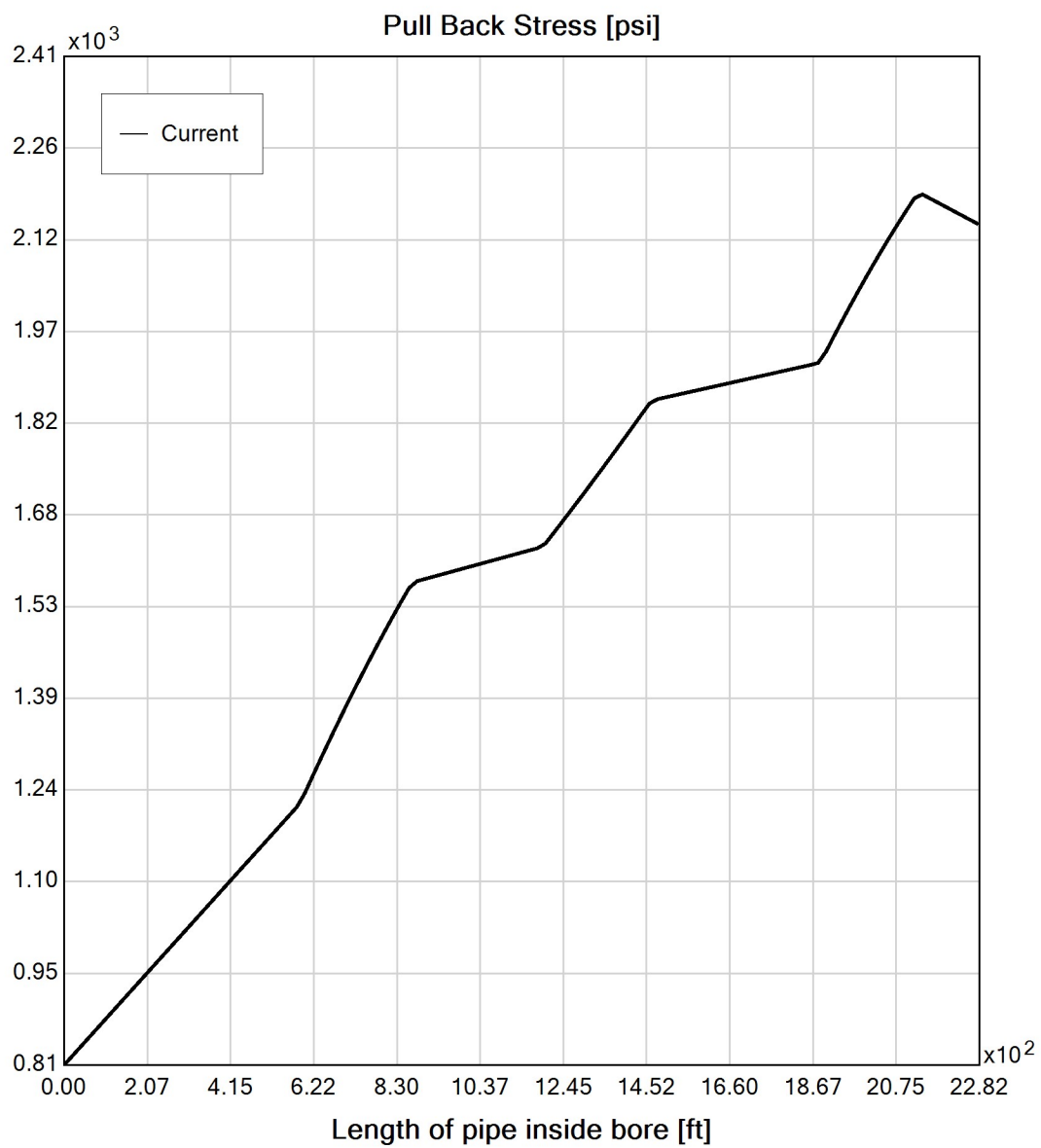
Effective Viscosity (cP): 662.3

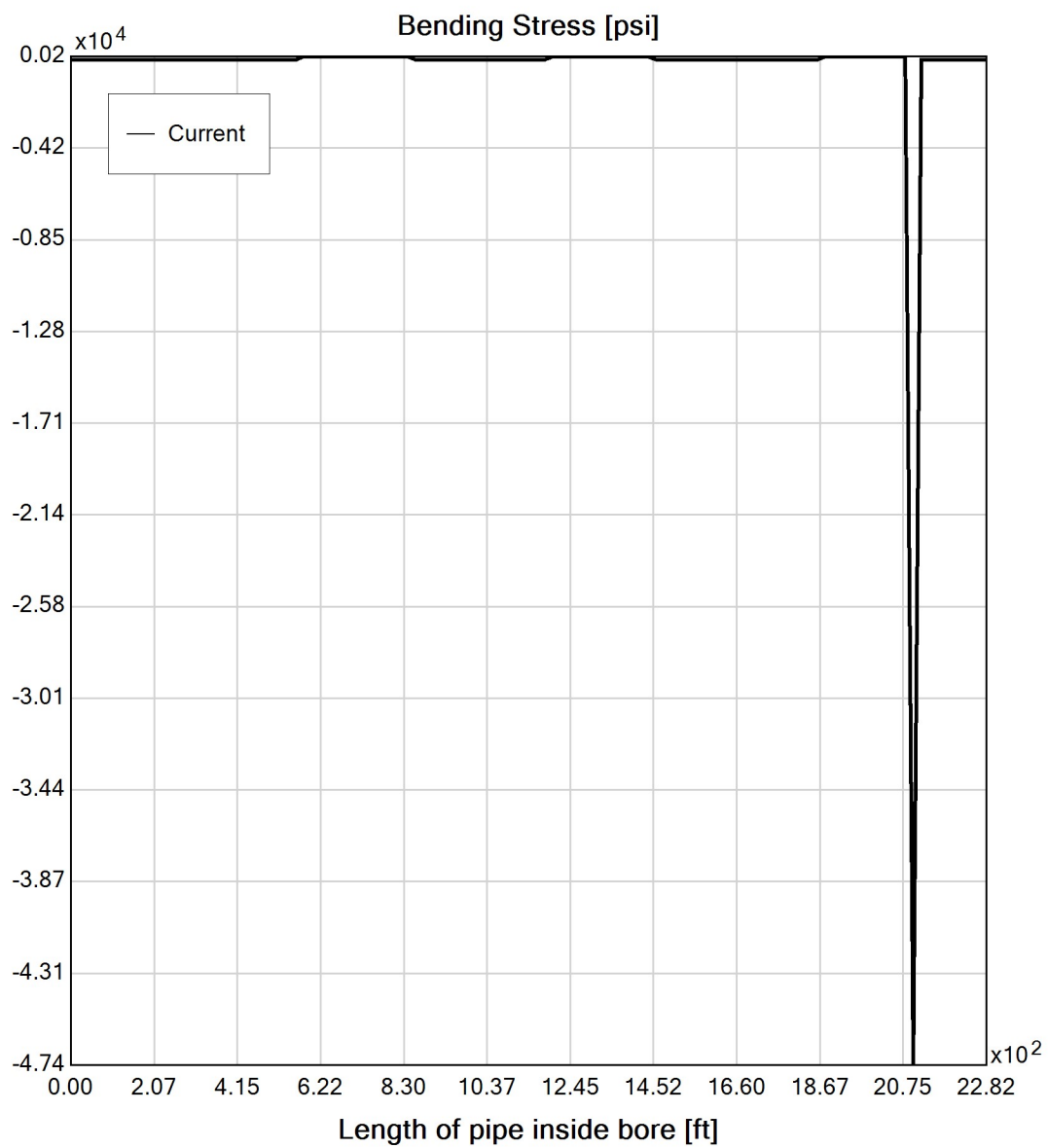
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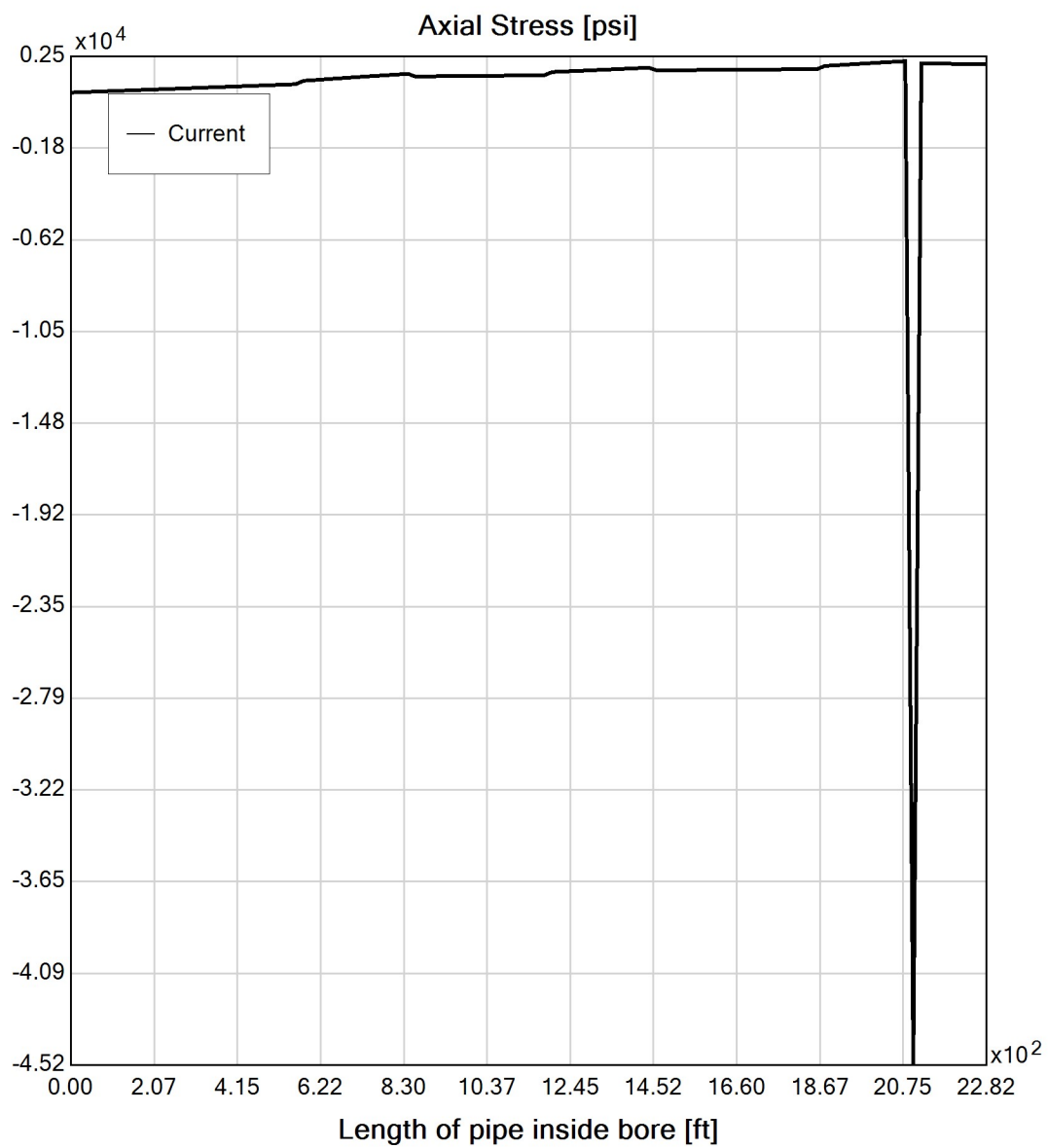
## Virtual Site

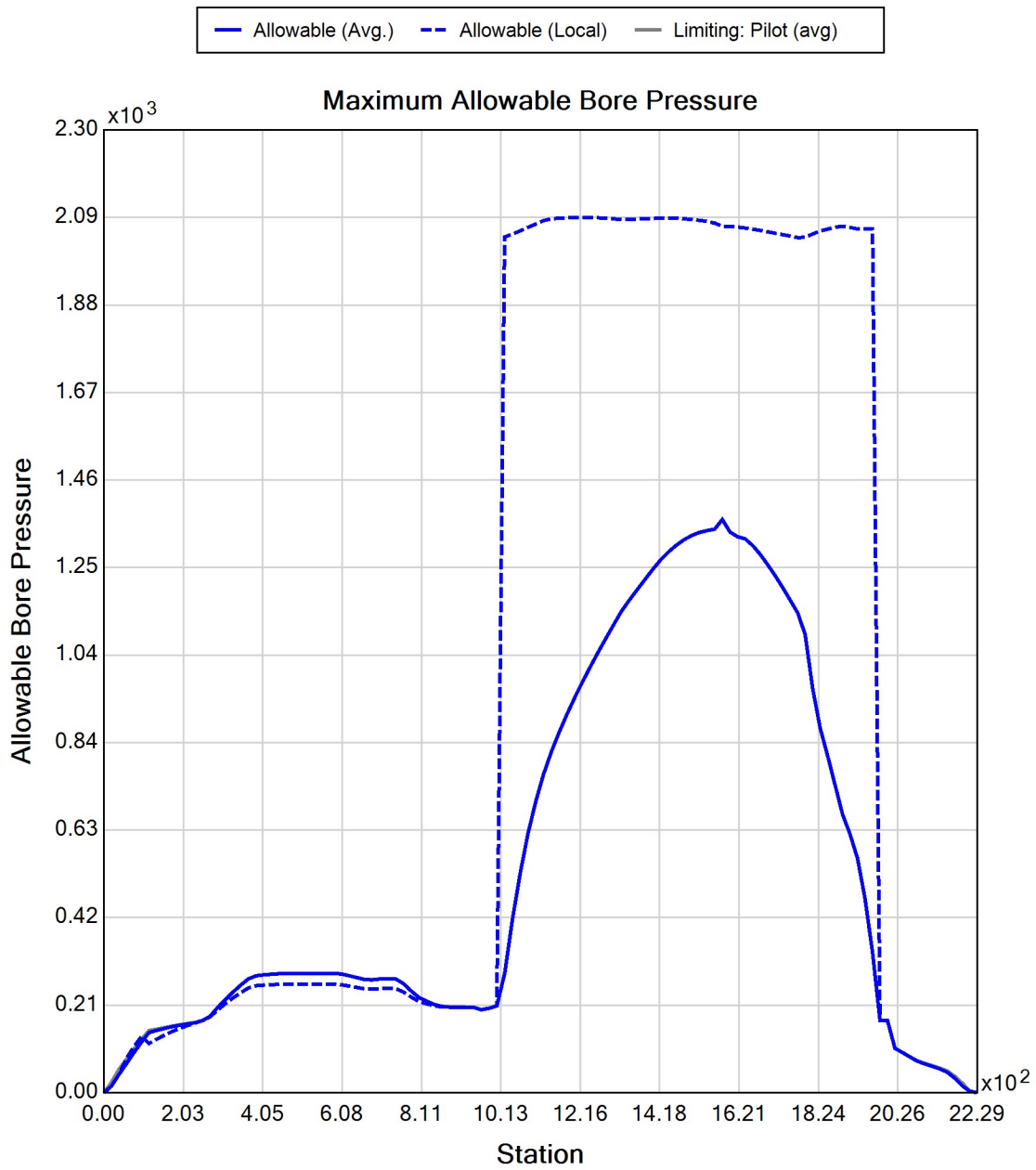


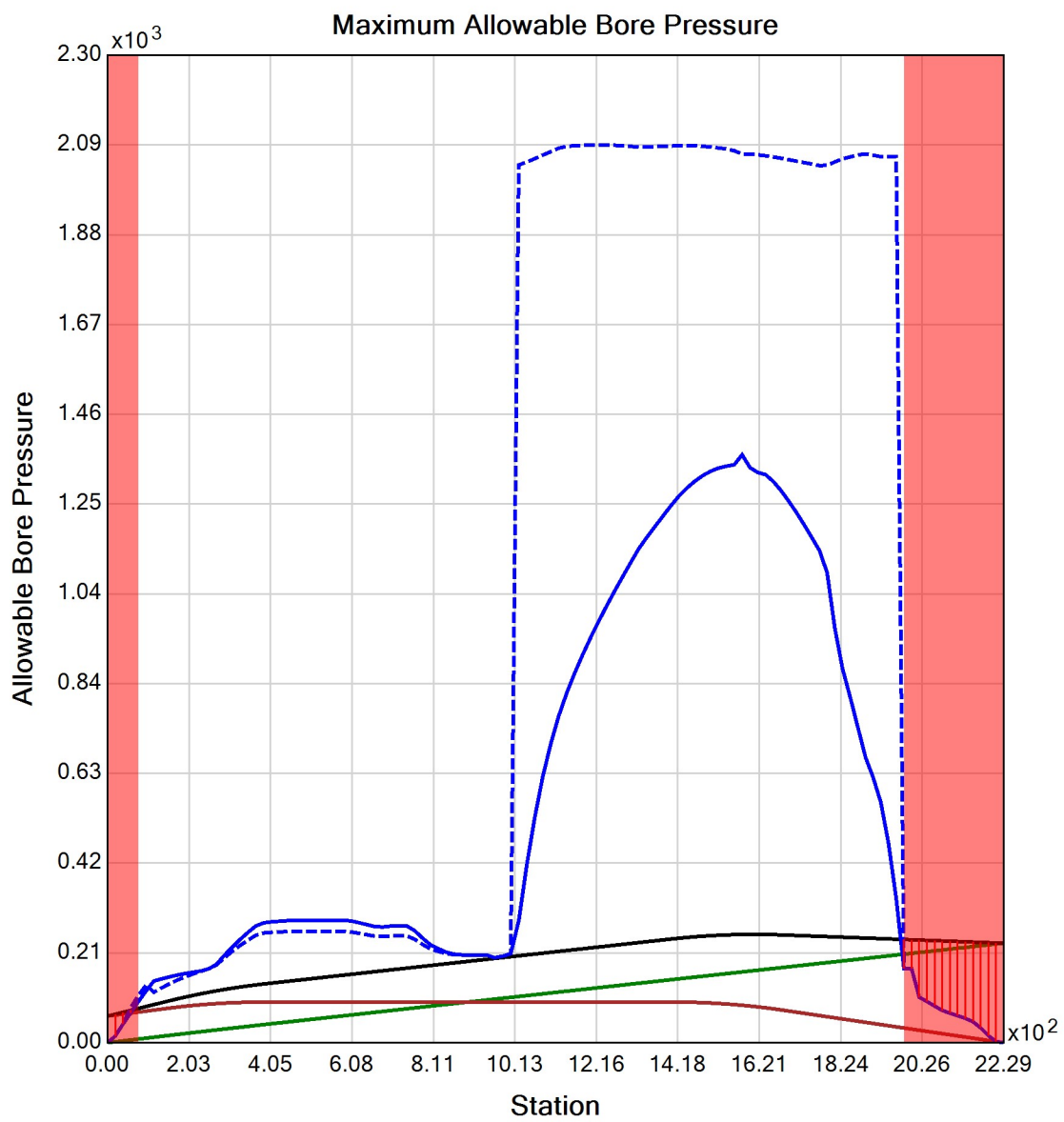
















## Generated Output



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---

## Project Summary

General:	CHPE HDD 69 P4B Start Date: 04-14-2023 End Date: 04-14-2023
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA
Designer:	MDB BCE
Description:	HDD 69 Conduit1 3-inch HDPE DR 7

---

## Input Summary

Start Coordinate	(0.00, 0.00, 230.00) ft
End Coordinate	(2221.00, 0.00, 357.00) ft
Project Length	2221.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	3.500 in
Pipe DR	7.0
Pipe Thickness	0.50 in
Rod Length	20.00 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: 3" (3.5")  
Pipe DR: 7  
Pipe Length: 2279.99 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	2.5	84.5
Water Pressure	56.1	32.4
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	58.6	116.9
<b>Deflection</b>		
Earth Load Deflection	0.293	9.774
Buoyant Deflection	0.020	0.020
Reissner Effect	0	0
Net Deflection	0.313	9.794
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	205.2	409.1

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	5375.5	5375.5
Pullback Stress [psi]	1140.7	1140.7
Pullback Strain	1.984E-2	1.984E-2
Bending Stress [psi]	0.0	8.4
Bending Strain	0	1.458E-4
Tensile Stress [psi]	1140.7	1140.7
Tensile Strain	1.984E-2	1.984E-2

Net External Pressure = 116.5 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 172.8 lb

---

### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.313	7.5	23.9	OK
Unconstrained Collapse [psi]	128.9	318.6	2.5	OK
Compressive Wall Stress [psi]	205.2	1150.0	5.6	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.010	7.5	756.1	OK
Unconstrained Collapse [psi]	137.6	427.5	3.1	OK
Tensile Stress [psi]	1140.7	1200.0	1.1	OK



## Generated Output



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## Project Summary

General:	CHPE HDD 69 P4B Start Date: 04-14-2023 End Date: 04-14-2023
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA
Designer:	MDB BCE Amherst, MA
Description:	HDD 69 Conduit 2 8-inch DR14 PVC DIPS 9 inch drill bit



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## Input Summary

Start Coordinate	(0.00, 0.00, 231.00) ft
End Coordinate	(2214.00, 0.00, 355.00) ft
Project Length	2214.00 ft
Pipe Type	PVC
OD Classification	DIPS
Pipe OD	9.050 in
Pipe DR	14.0
Pipe Thickness	0.65 in
Rod Length	20.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

---

## Soil Summary

Number of Layers: 6

Soil Layer #1 USCS, Sand (S), 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 #2 USCS, Gravel (G), GM

From Assistant

Unit Weight: 130.0000 (dry), 140.0000 (sat) [lb/ft3]

Phi: 37.00, S.M.: 1000.00, Coh: 0.00 [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]

Soil Layer #4 USCS, Gravel (G), GW

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 #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]

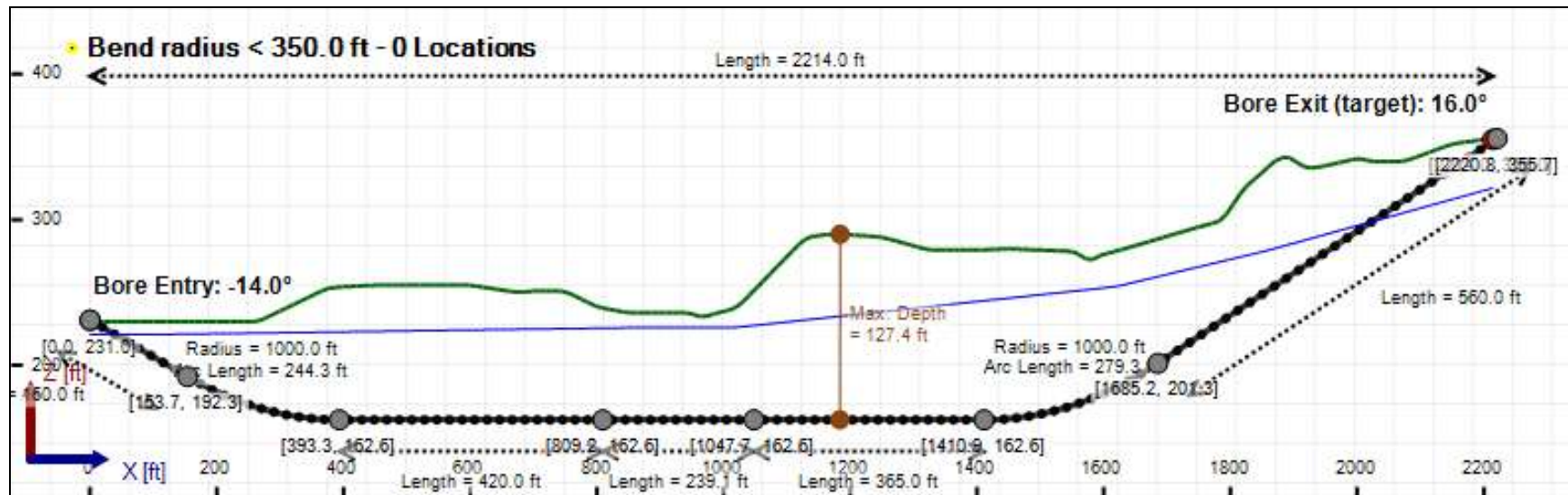
Soil Layer #6 Rock, Geological Classification, Sedimentary Rocks

From Assistant

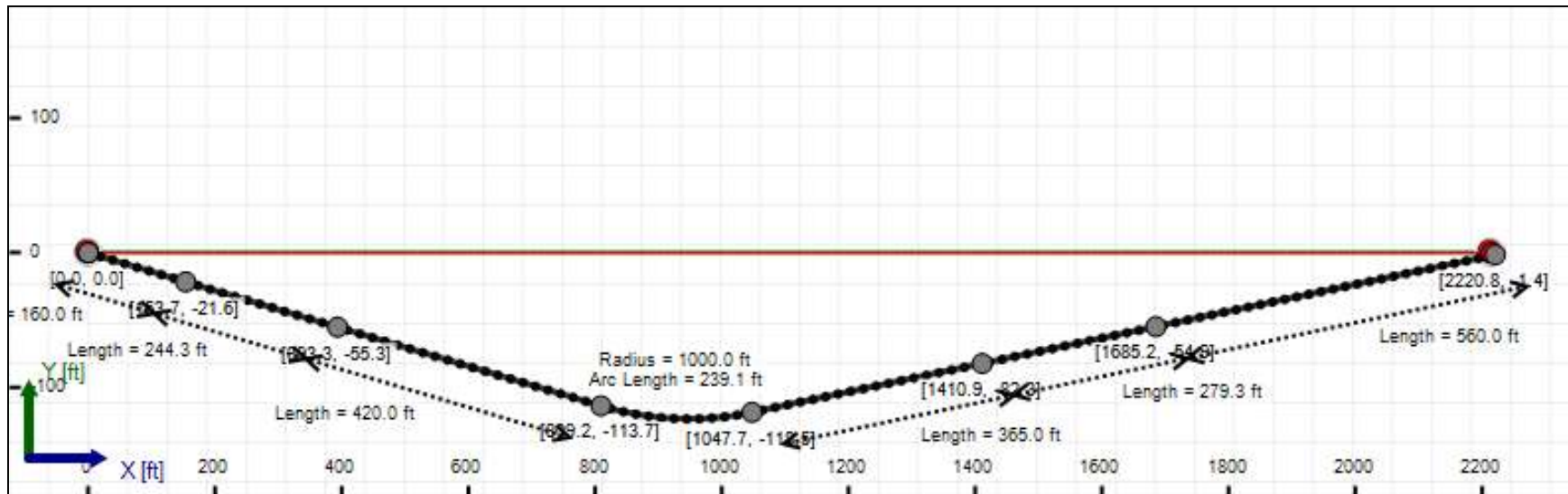
Unit Weight: 160.0000 (dry), 170.0000 (sat) [lb/ft3]

Phi: 37.00, S.M.: 2000.00, Coh: 3000.00 [psi]

## Bore Cross-Section View



## Bore Plan View



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## Load Verifier Input Summary:

Pipe Application: Electrical Cable  
Pipe Type: PVC  
Classification: DIPS  
Pipe OD: 8" (9.05")  
Pipe DR: 14  
Pipe Length: 2279.99 ft  
Internal Pressure: 0 psi  
Borehole Diameter: 1.13100004196167 ft  
Silo Width: 1.13100004196167 ft  
Surface Surcharge: 0 psi  
Short Term Modulus: 400000 psi  
Long Term Modulus: 400000 psi  
Short Term Poisson Ratio: 0.38  
Long Term Poisson Ratio: 0.38  
Pipe Unit Weight: 87.40220 lb/ft<sup>3</sup>  
Allowable Tensile Stress (Short Term): 2800 psi  
Allowable Tensile Stress (Long Term): 2800 psi  
Allowable Compressive Stress (Short Term): 3200 psi  
Allowable Compressive Stress (Long Term): 3200 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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	4.6	83.7
Water Pressure	58.5	32.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	63.1	115.7
<b>Deflection</b>		
Earth Load Deflection	0.379	6.949
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.409	6.978
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	441.8	810.0

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	36919.9	36919.9
Pullback Stress [psi]	2163.3	2163.3
Pullback Strain	5.408E-3	5.408E-3
Bending Stress [psi]	0.0	150.8
Bending Strain	0	3.771E-4
Tensile Stress [psi]	2163.3	2269.1
Tensile Strain	5.408E-3	6.050E-3

Net External Pressure = 115.3 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 401.7 lb

---

### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.409	7.5	18.3	OK
Unconstrained Collapse [psi]	127.8	410.7	3.2	OK
Compressive Wall Stress [psi]	441.8	3200.0	7.2	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.029	7.5	254.3	OK
Unconstrained Collapse [psi]	137.1	323.2	2.4	OK
Tensile Stress [psi]	2269.1	2800.0	1.2	OK

---

## Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	9.00 in	1367.724 psi	2087.412 psi
1	9.00 in	14.00 in	1367.661 psi	2087.359 psi
2	14.00 in	19.13 in	1367.567 psi	2087.281 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): 120.00 US (liquid) gallon/min

Drill Fluid Density: 68.700 lb/ft<sup>3</sup>

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

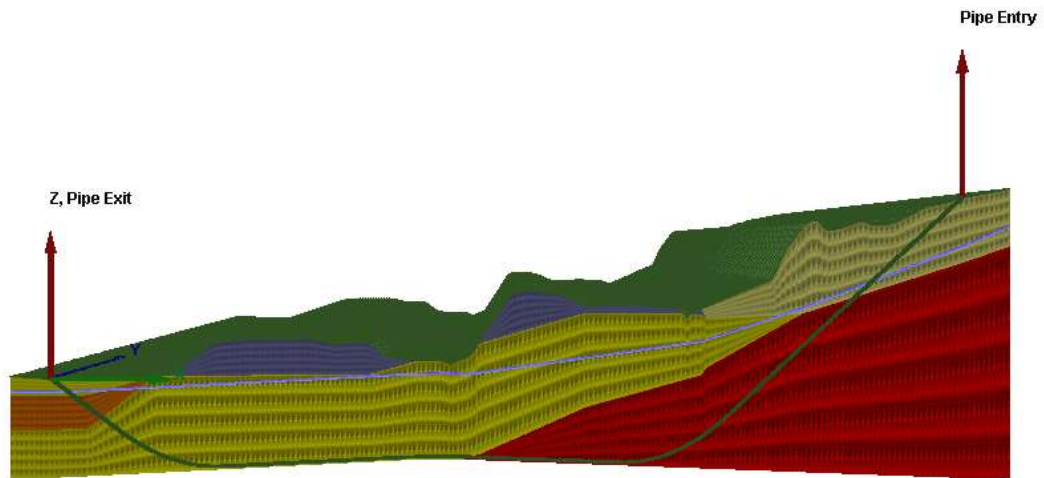
Yield Point (YP): 16.49

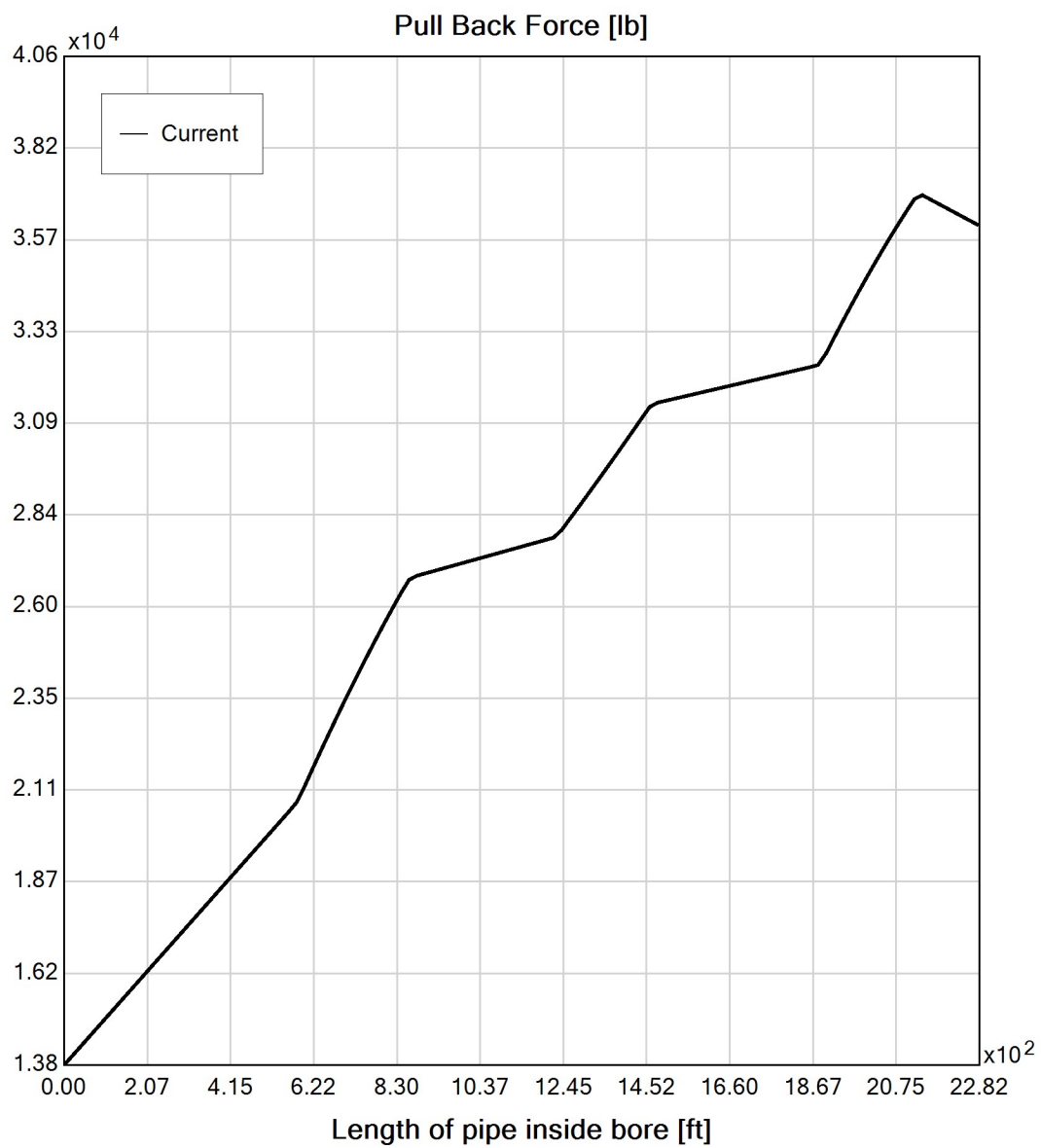
Effective Viscosity (cP): 662.3

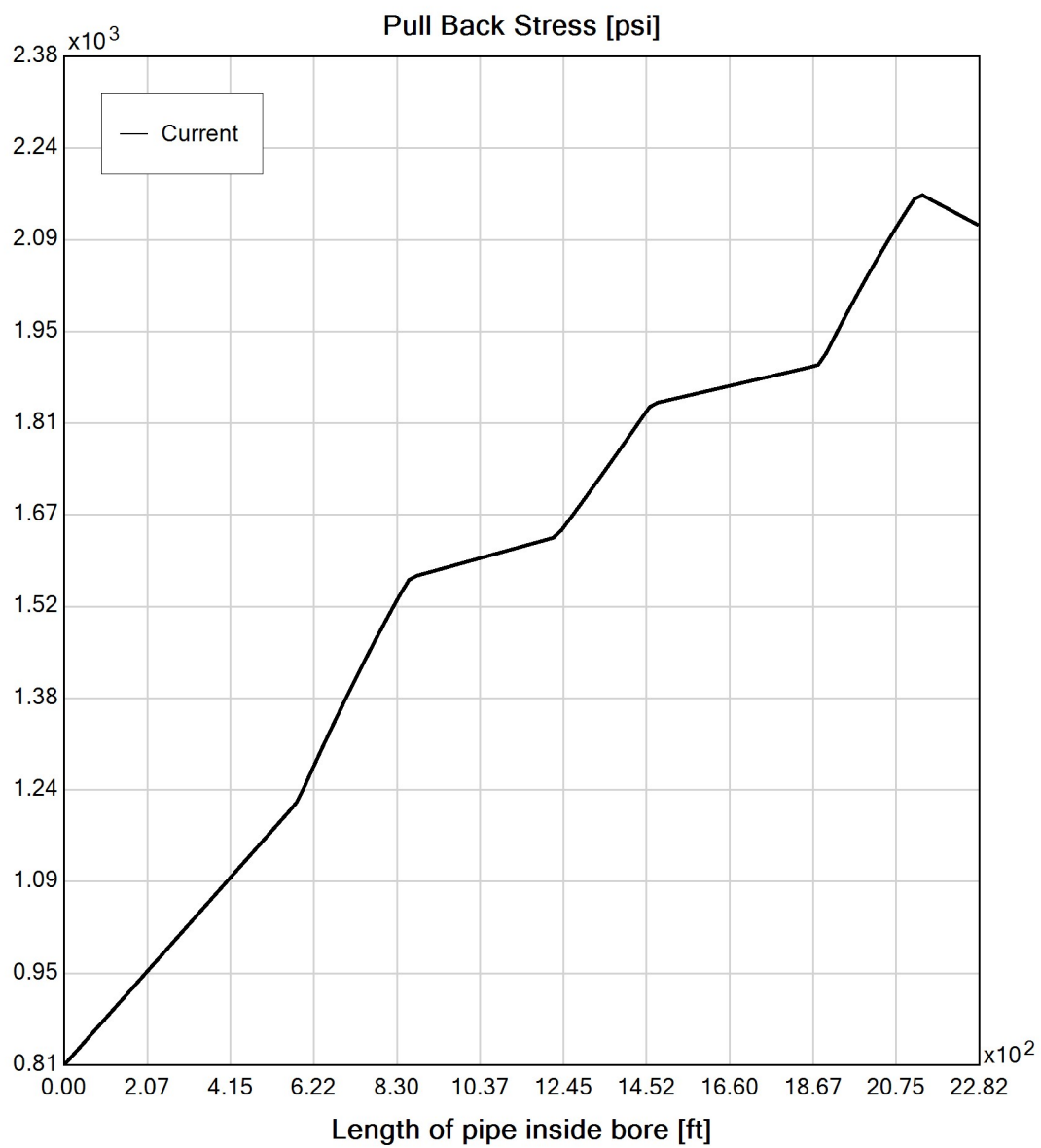


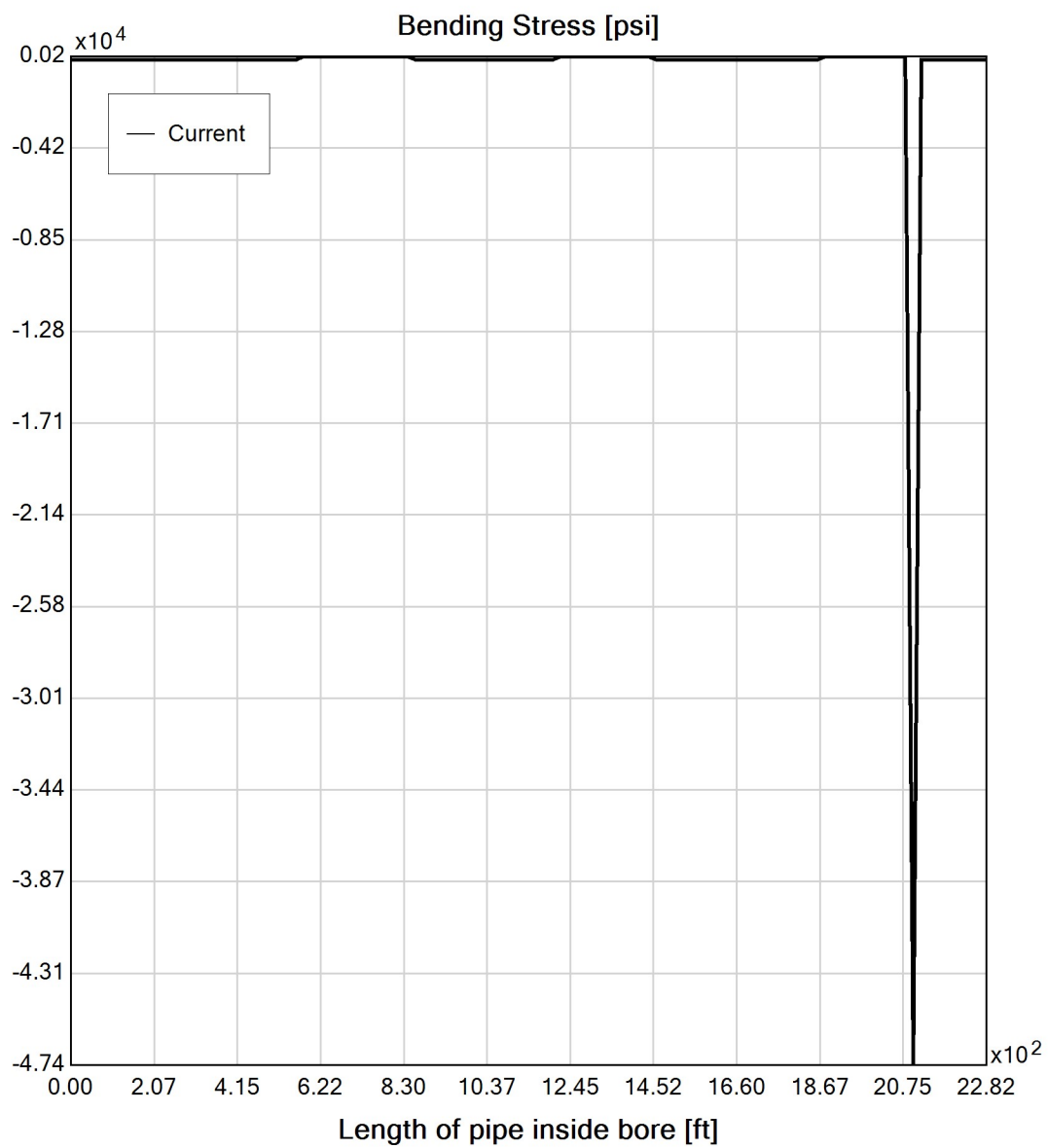
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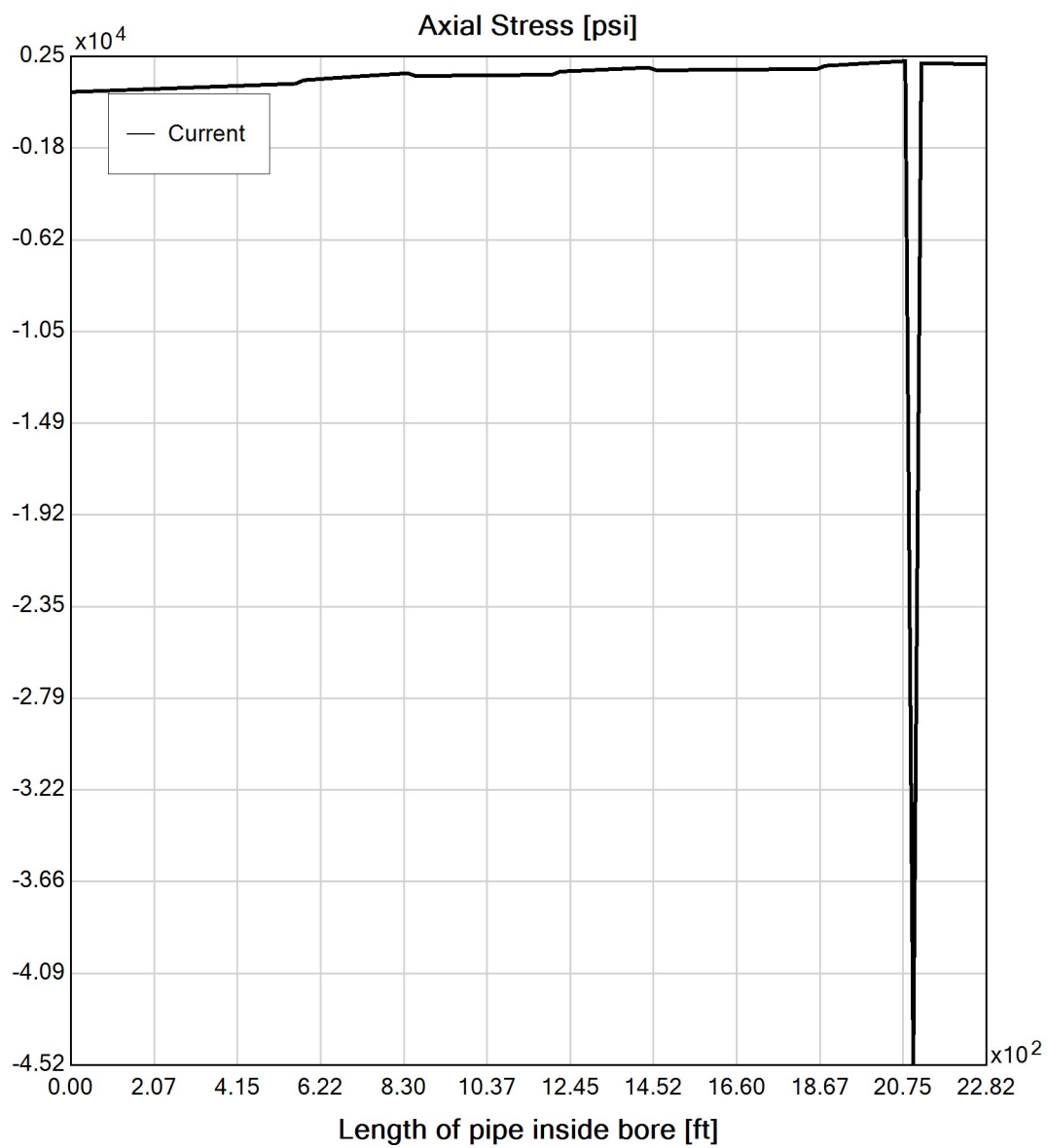
## Virtual Site

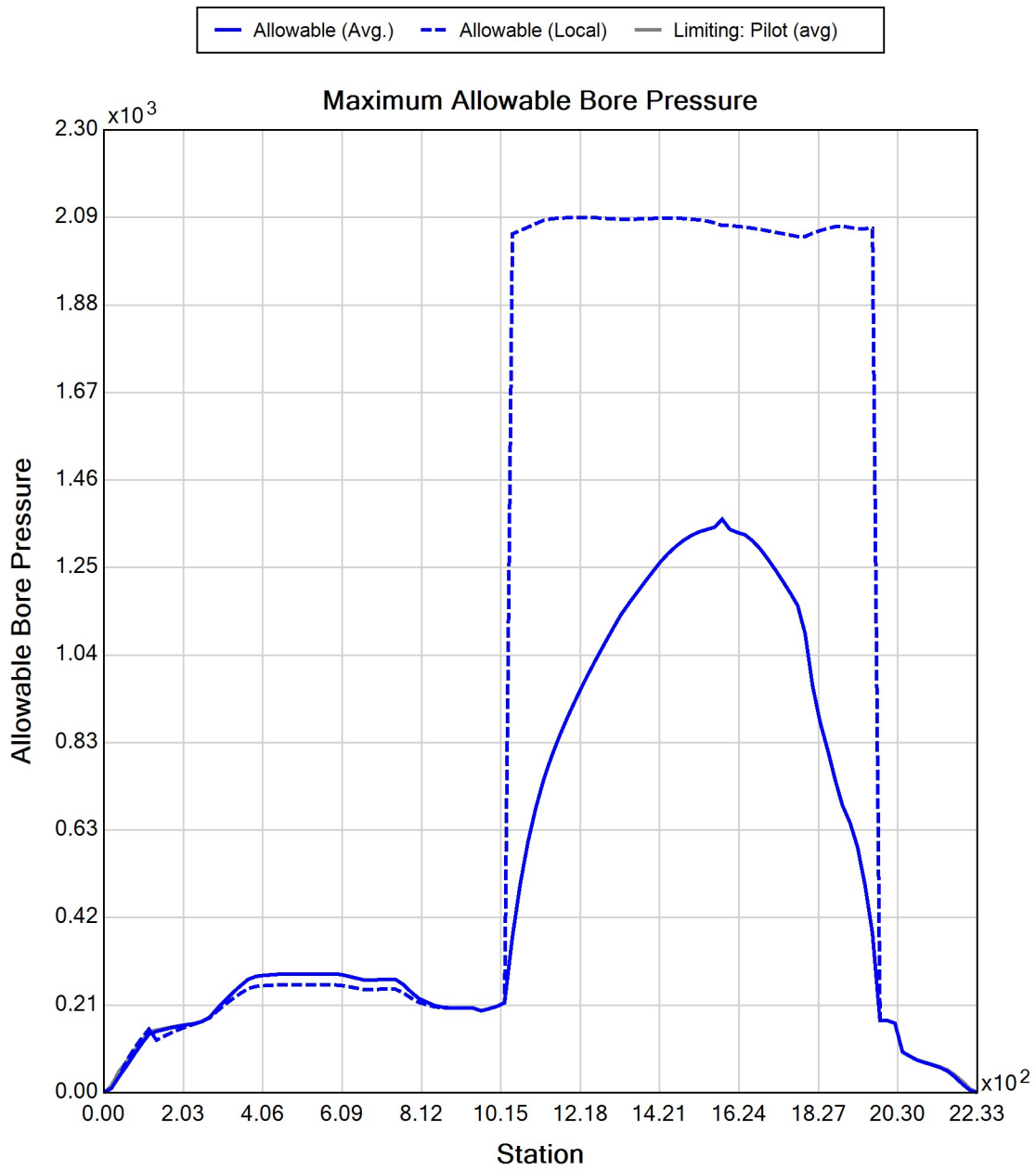


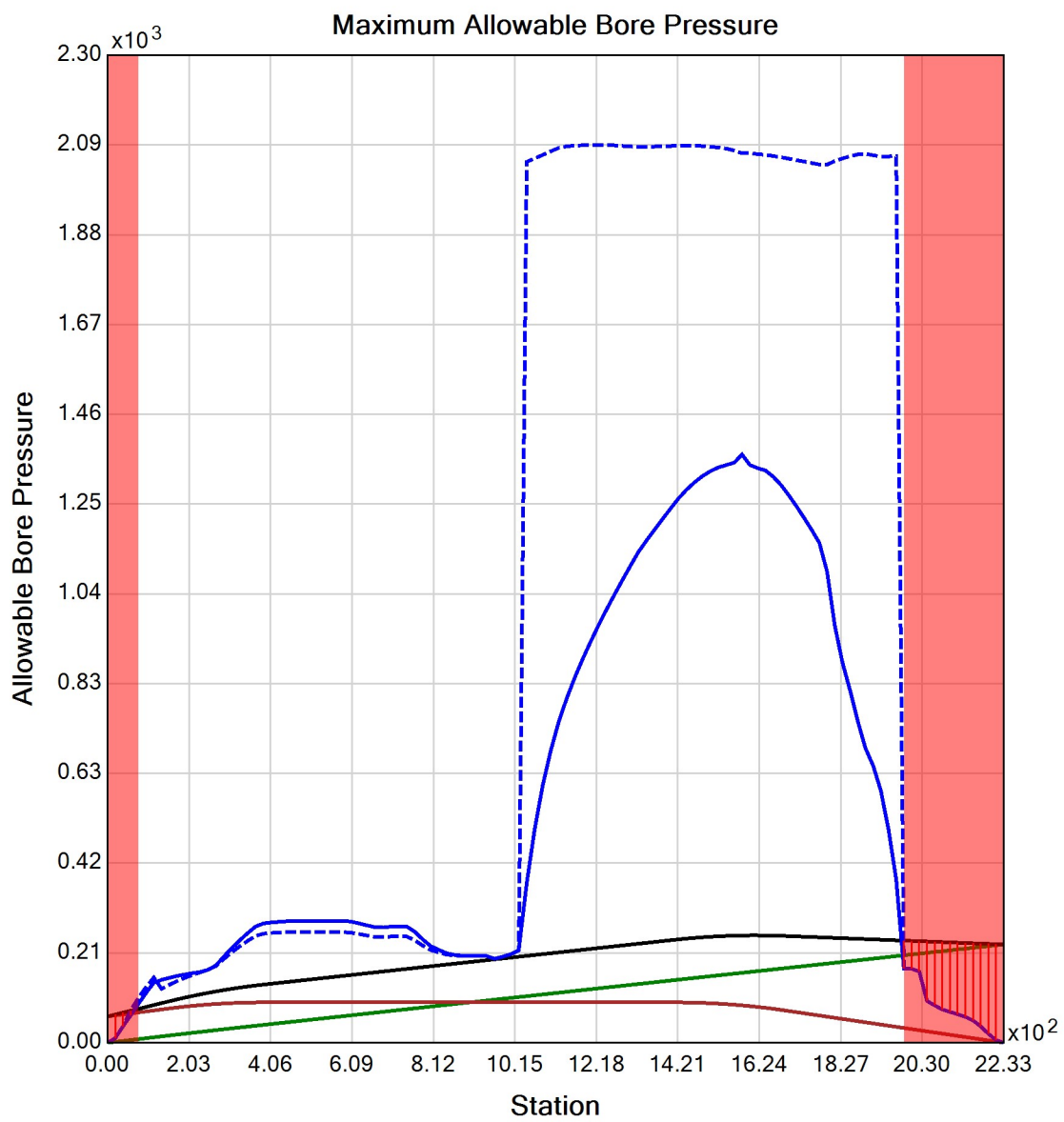














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---

## Project Summary

General:	CHPE HDD 69 P4B Start Date: 04-14-2023 End Date: 04-14-2023
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA
Designer:	MDB BCE Amherst, MA
Description:	HDD 69 Conduit 2 3-inch HDPE DR 7 9 inch drill bit

---

## Input Summary

Start Coordinate	(0.00, 0.00, 231.00) ft
End Coordinate	(2214.00, 0.00, 355.00) ft
Project Length	2214.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	3.500 in
Pipe DR	7.0
Pipe Thickness	0.50 in
Rod Length	20.00 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: 3" (3.5")  
Pipe DR: 7  
Pipe Length: 2279.99 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	2.5	83.7
Water Pressure	58.5	32.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	61.1	115.7
<b>Deflection</b>		
Earth Load Deflection	0.293	9.691
Buoyant Deflection	0.020	0.020
Reissner Effect	0	0
Net Deflection	0.313	9.711
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	213.7	405.0

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	5316.0	5316.0
Pullback Stress [psi]	1128.1	1128.1
Pullback Strain	1.962E-2	1.962E-2
Bending Stress [psi]	0.0	8.4
Bending Strain	0	1.458E-4
Tensile Stress [psi]	1128.1	1128.1
Tensile Strain	1.962E-2	1.962E-2

Net External Pressure = 115.3 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 172.8 lb

---

### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.313	7.5	23.9	OK
Unconstrained Collapse [psi]	127.8	318.6	2.5	OK
Compressive Wall Stress [psi]	213.7	1150.0	5.4	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.010	7.5	756.1	OK
Unconstrained Collapse [psi]	136.4	430.0	3.2	OK
Tensile Stress [psi]	1128.1	1200.0	1.1	OK



| BoreAid®

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## Project Summary

General: CHPE HDD 69A  
P4B  
Start Date: 05-26-2023  
End Date: 05-26-2023

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

Designer: MDB  
BCE  
Amhesrst, MA

Description: CHPE HDD 69A DR 18 IPS PVC, representative of DR17 and representative of both conduit 1 and 2

---

## Input Summary

Start Coordinate	(0.00, 0.00, 356.10) ft
End Coordinate	(2332.00, 0.00, 380.00) ft
Project Length	2332.00 ft
Pipe Type	PVC
OD Classification	IPS
Pipe OD	8.625 in
Pipe DR	18.0
Pipe Thickness	0.48 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: 2

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

From Assistant

Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft<sup>3</sup>]

Phi: 34.00, S.M.: 500.00, Coh: 0.00 [psi]

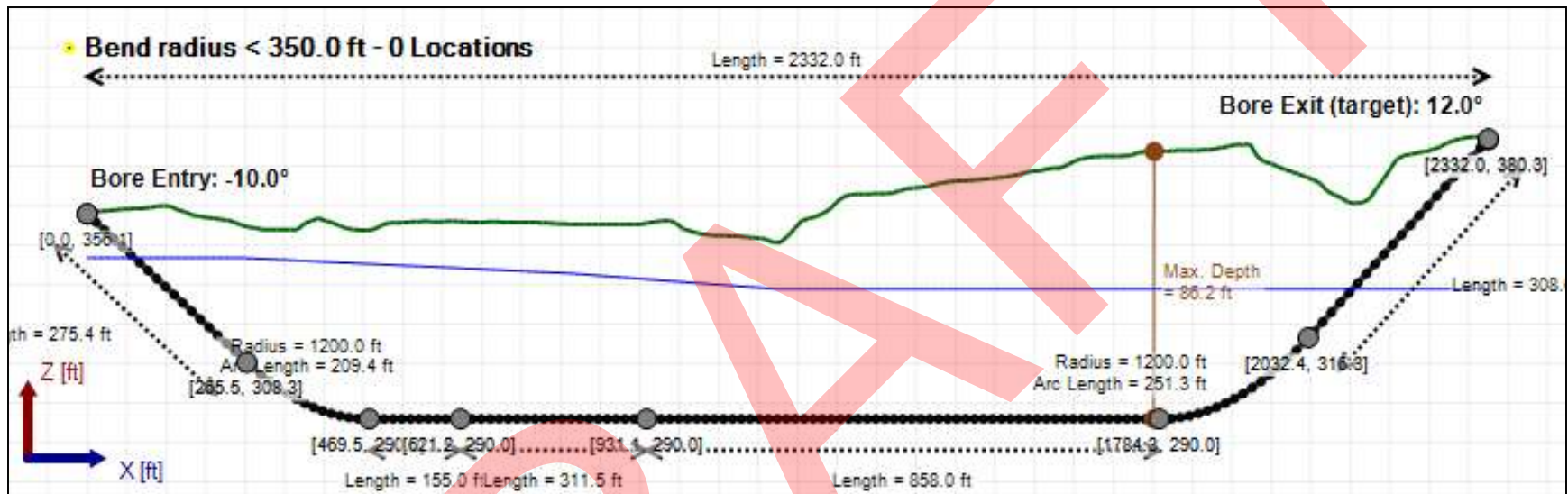
Soil Layer #2 Rock, Geological Classification, Sedimentary Rocks

From Assistant

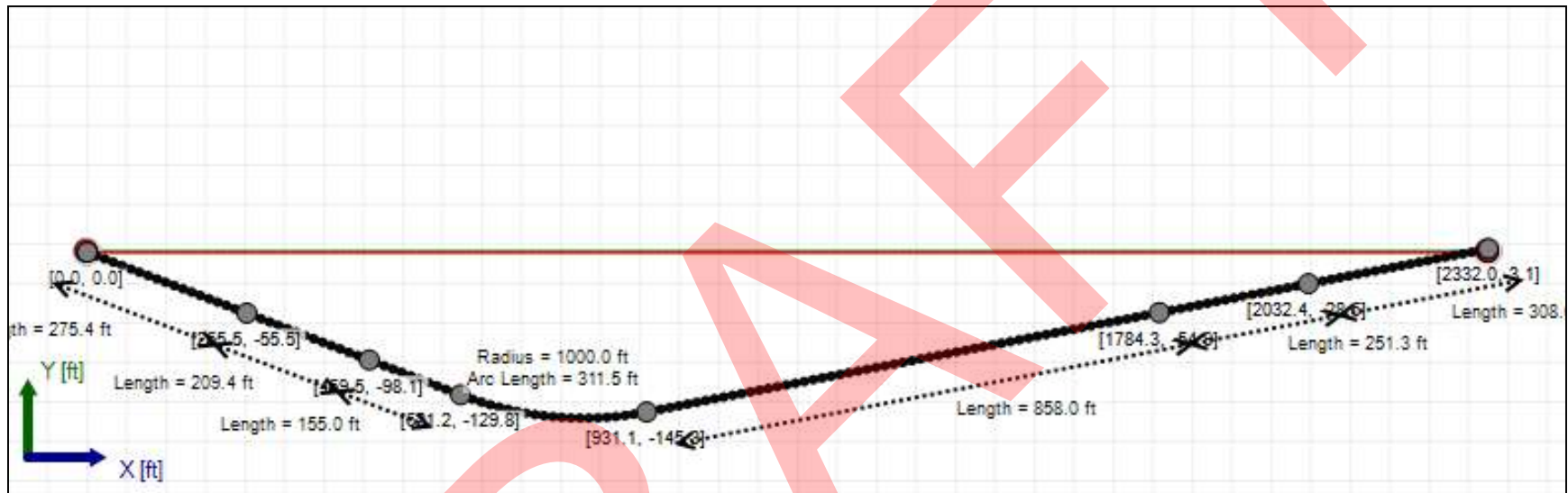
Unit Weight: 160.0000 (dry), 170.0000 (sat) [lb/ft<sup>3</sup>]

Phi: 37.00, S.M.: 2000.00, Coh: 3000.00 [psi]

## Bore Cross-Section View



## Bore Plan View



---

## Load Verifier Input Summary:

Pipe Application: Electrical Cable  
Pipe Type: PVC  
Classification: IPS  
Pipe OD: 8" (8.625")  
Pipe DR: 18  
Pipe Length: 2369.99 ft  
Internal Pressure: 0 psi  
Borehole Diameter: 1.07799990971883 ft  
Silo Width: 1.07799990971883 ft  
Surface Surcharge: 0 psi  
Short Term Modulus: 400000 psi  
Long Term Modulus: 400000 psi  
Short Term Poisson Ratio: 0.38  
Long Term Poisson Ratio: 0.38  
Pipe Unit Weight: 87.40220 lb/ft<sup>3</sup>  
Allowable Tensile Stress (Short Term): 2800 psi  
Allowable Tensile Stress (Long Term): 2800 psi  
Allowable Compressive Stress (Short Term): 3200 psi  
Allowable Compressive Stress (Long Term): 3200 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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

## In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	4.9	62.1
Water Pressure	21.7	18.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	26.6	80.3
<b>Deflection</b>		
Earth Load Deflection	0.922	11.436
Buoyant Deflection	0.060	0.060
Reissner Effect	0	0
Net Deflection	0.982	11.496
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	239.2	722.4

## Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	29873.3	29873.3
Pullback Stress [psi]	2436.2	2436.2
Pullback Strain	6.090E-3	6.090E-3
Bending Stress [psi]	0.0	143.8
Bending Strain	0	3.594E-4
Tensile Stress [psi]	2436.2	2538.5
Tensile Strain	6.090E-3	6.646E-3

Net External Pressure = 54.7 [psi ]

Buoyant Deflection = 0.1

Hydrokinetic Force = 365.0 lb

---

## In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.982	7.5	7.6	OK
Unconstrained Collapse [psi]	58.9	174.2	3.0	OK
Compressive Wall Stress [psi]	239.2	3200.0	13.4	OK

## Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.060	7.5	125.5	OK
Unconstrained Collapse [psi]	68.5	137.5	2.0	OK
Tensile Stress [psi]	2538.5	2800.0	1.1	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	1834.555 psi	2053.486 psi
1	8.00 in	10.00 in	1834.492 psi	2053.451 psi
2	10.00 in	12.94 in	1834.372 psi	2053.386 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): 120.00 US (liquid) gallon/min

Drill Fluid Density: 68.700 lb/ft3

Rheological model: Bingham-Plastic

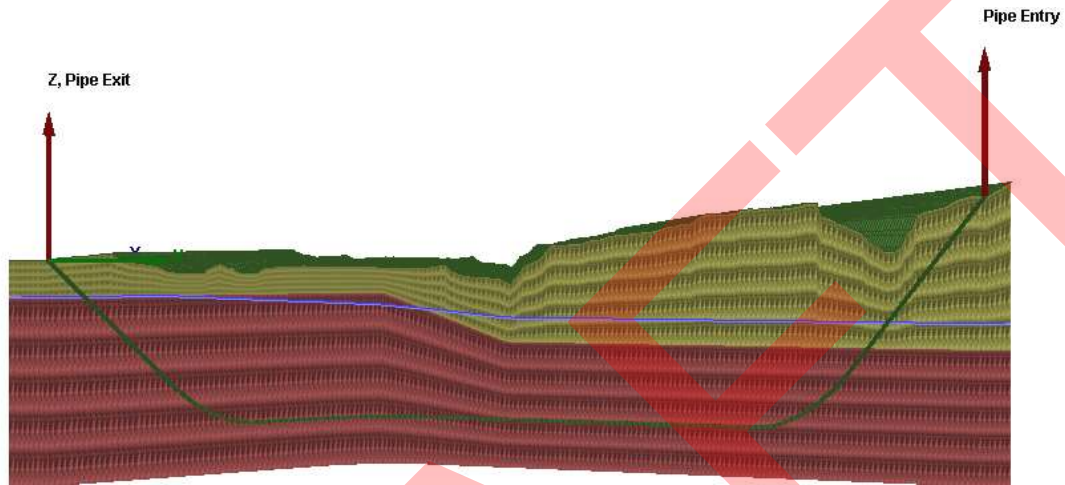
Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

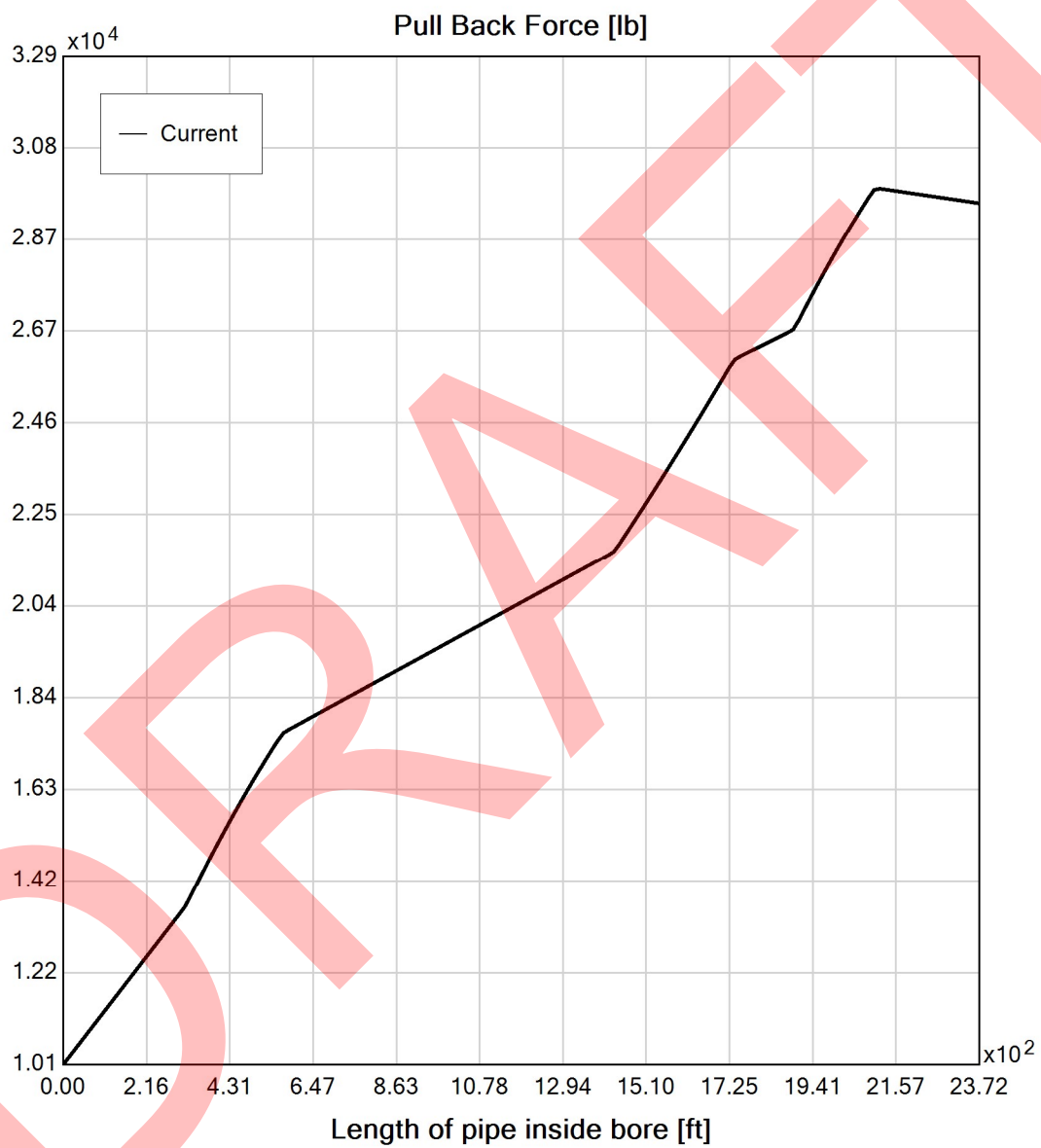
Effective Viscosity (cP): 417.7

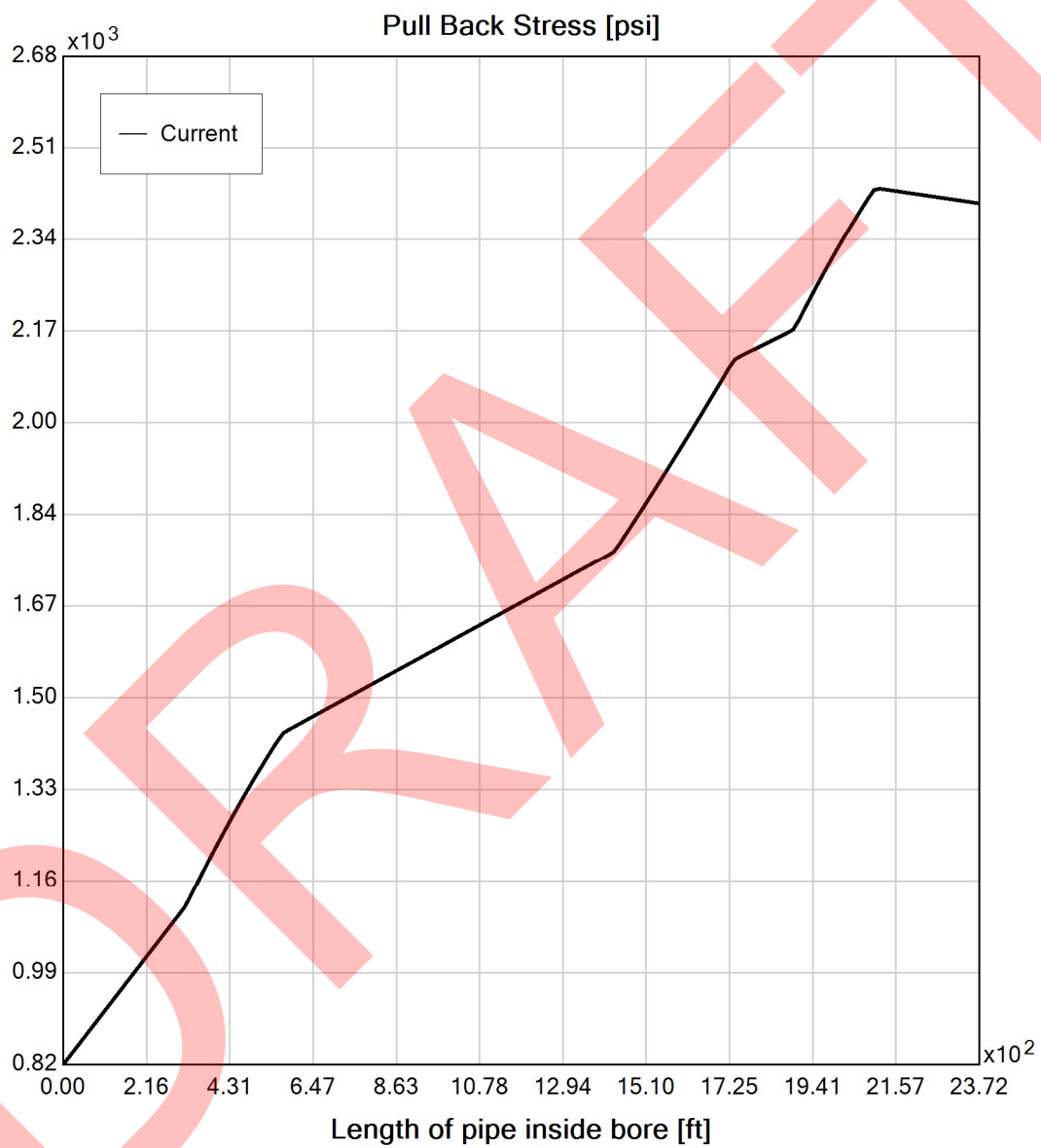
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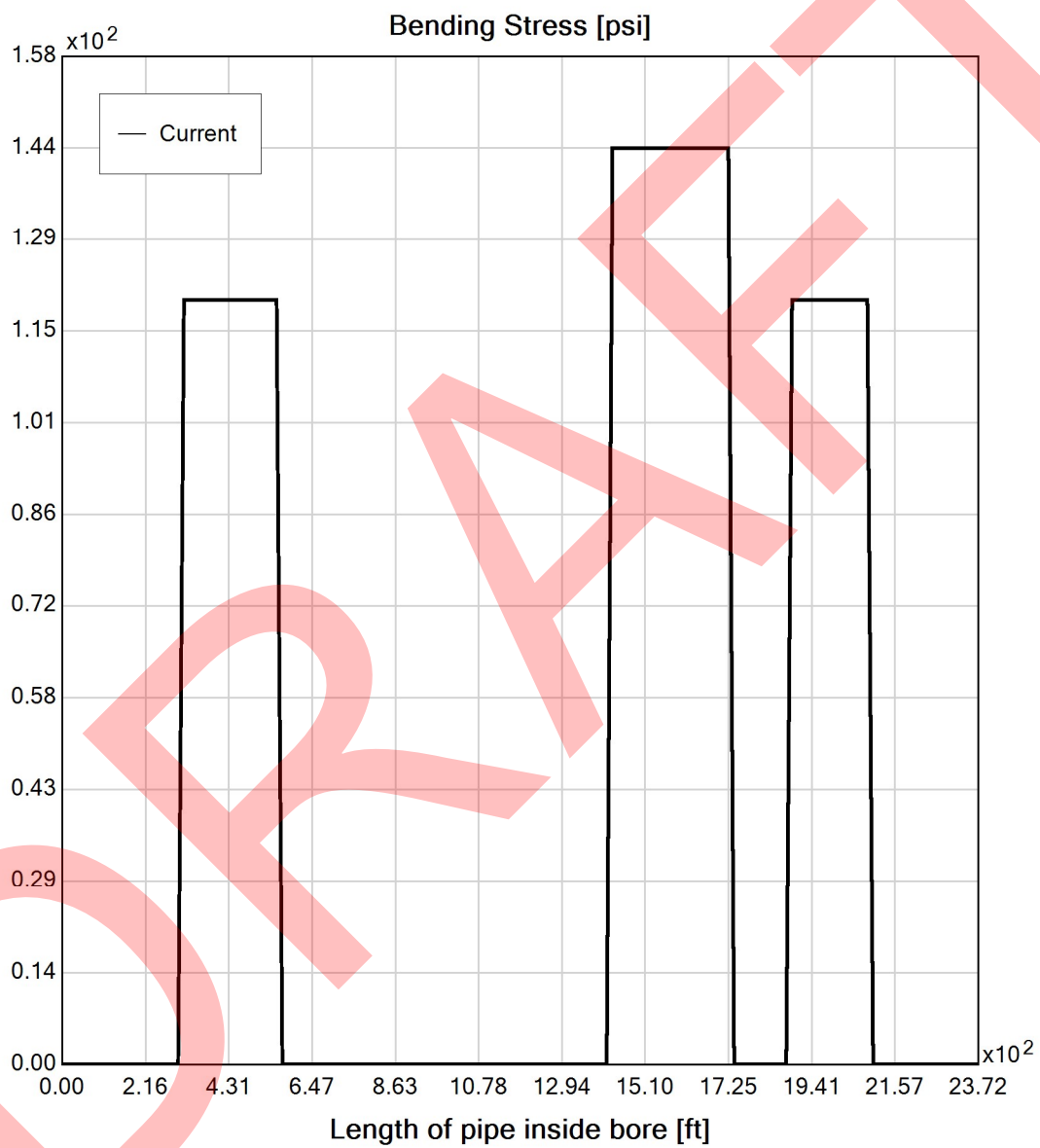
## Virtual Site

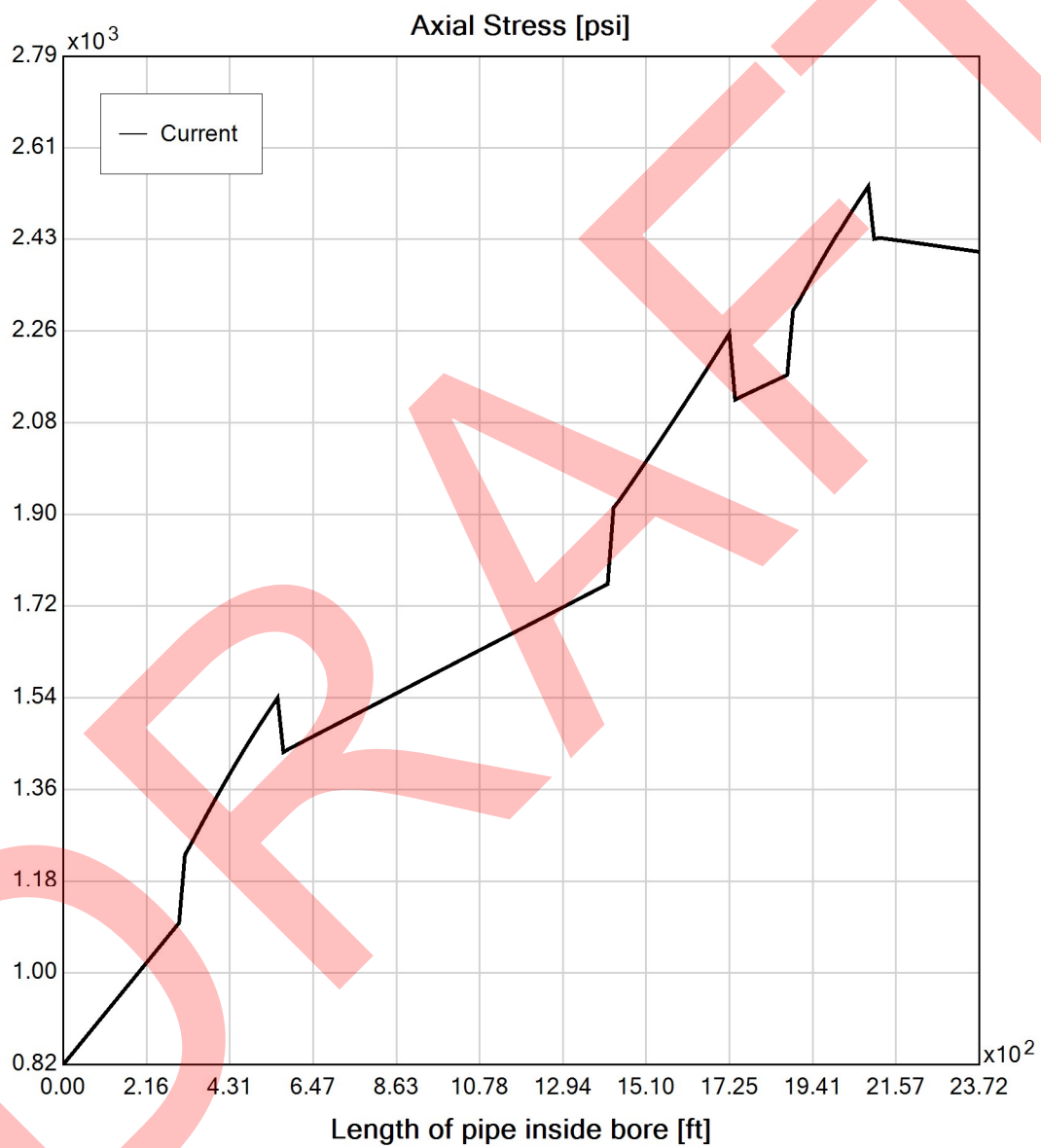


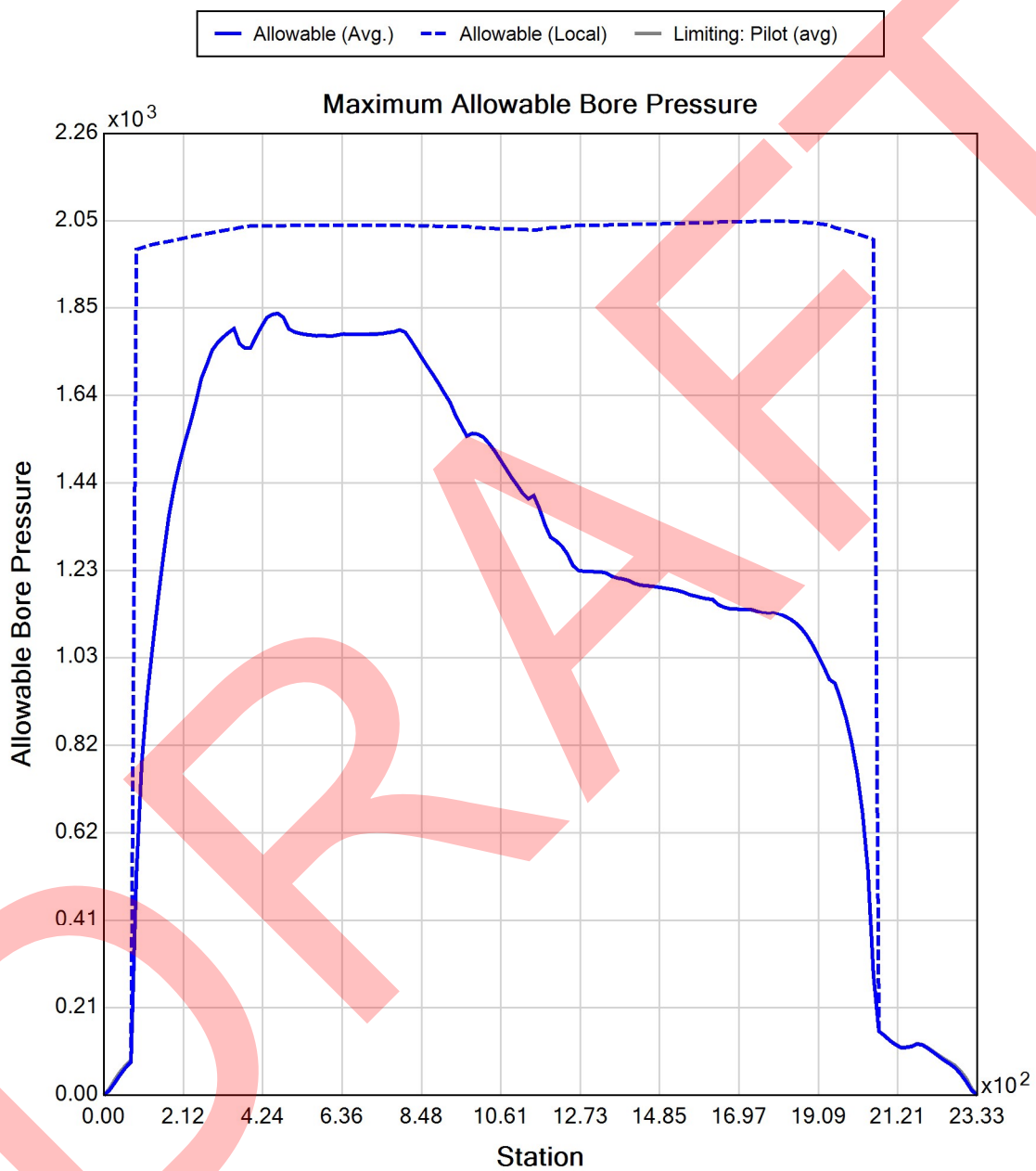


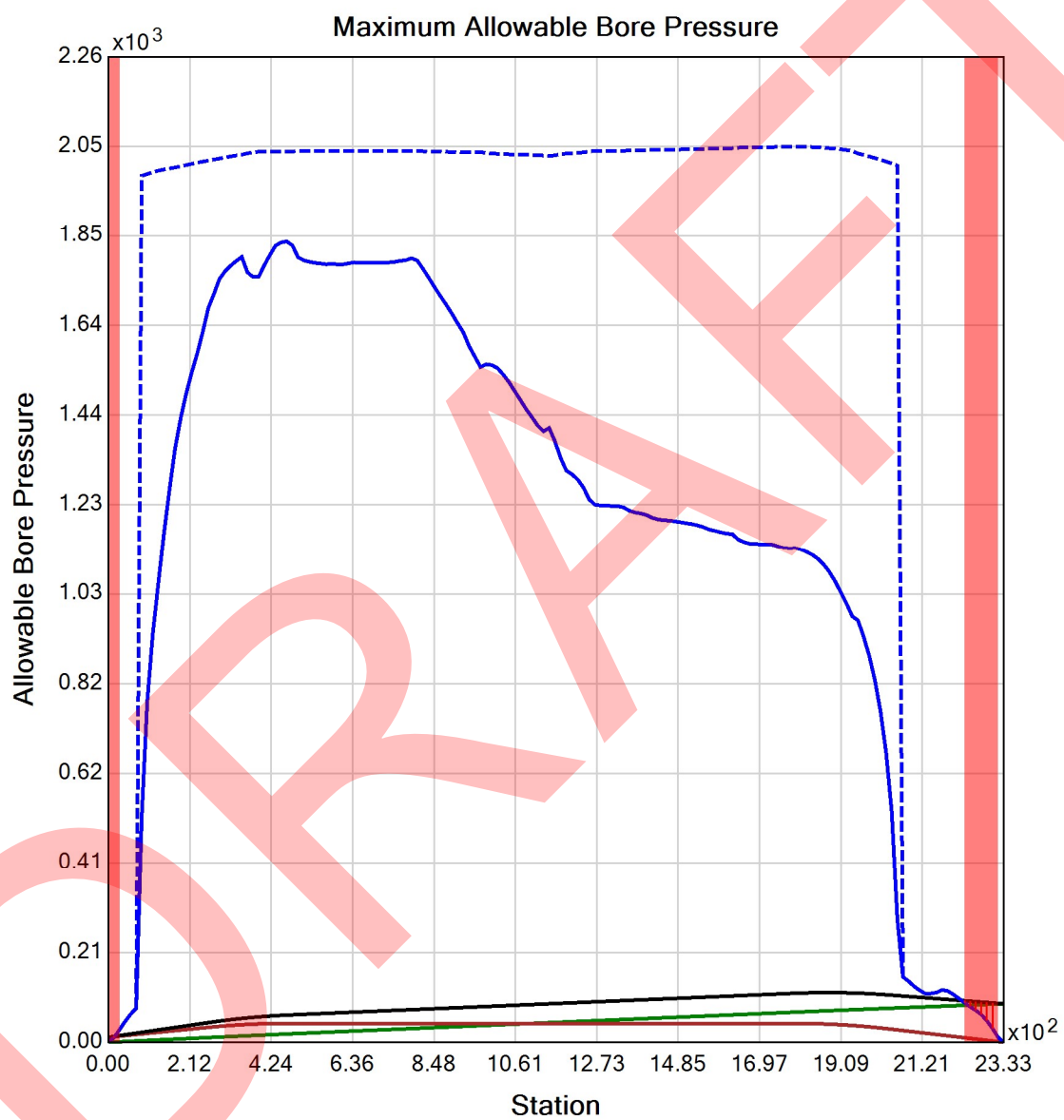














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## Generated Output



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---

## Project Summary

General: CHPE HDD 69A  
P4B  
Start Date: 05-26-2023  
End Date: 05-26-2023

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

Designer: MDB  
BCE  
Amhesrst, MA

Description: CHPE HDD 69A 3-inch HDPE DR 7



---

## Input Summary

Start Coordinate	(0.00, 0.00, 356.10) ft
End Coordinate	(2332.00, 0.00, 380.00) ft
Project Length	2332.00 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

---

## Load Verifier Input Summary:

Pipe Application: Electrical Cable  
Pipe Type: HDPE  
Classification: IPS  
Pipe OD: 3" (3.5")  
Pipe DR: 7  
Pipe Length: 2369.99 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

## In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	2.8	62.1
Water Pressure	21.7	18.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	24.5	80.3
<b>Deflection</b>		
Earth Load Deflection	0.334	7.132
Buoyant Deflection	0.020	0.020
Reissner Effect	0	0
Net Deflection	0.354	7.152
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	85.8	280.9

## Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	4626.4	4626.4
Pullback Stress [psi]	981.8	981.8
Pullback Strain	1.707E-2	1.707E-2
Bending Stress [psi]	0.0	8.4
Bending Strain	0	1.458E-4
Tensile Stress [psi]	981.8	984.6
Tensile Strain	1.707E-2	1.724E-2

Net External Pressure = 56.4 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 172.8 lb

---

## In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.354	7.5	21.2	OK
Unconstrained Collapse [psi]	58.9	317.2	5.4	OK
Compressive Wall Stress [psi]	85.8	1150.0	13.4	OK

## Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.010	7.5	756.1	OK
Unconstrained Collapse [psi]	68.8	457.4	6.7	OK
Tensile Stress [psi]	984.6	1200.0	1.2	OK



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## Generated Output



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---

## Project Summary

General: CHPE HDD 70A C1  
P4B  
Start Date: 12-10-2021  
End Date: 12-10-2021

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

Designer: MCS  
CHA

Description: HDD 70A Conduit 1 10-inch DR9

---

## Input Summary

Start Coordinate	(0.00, 0.00, 357.00) ft
End Coordinate	(1794.00, 0.00, 351.00) ft
Project Length	1794.00 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: 2

Soil Layer #1 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 #2 Rock, Geological Classification, Sedimentary Rocks

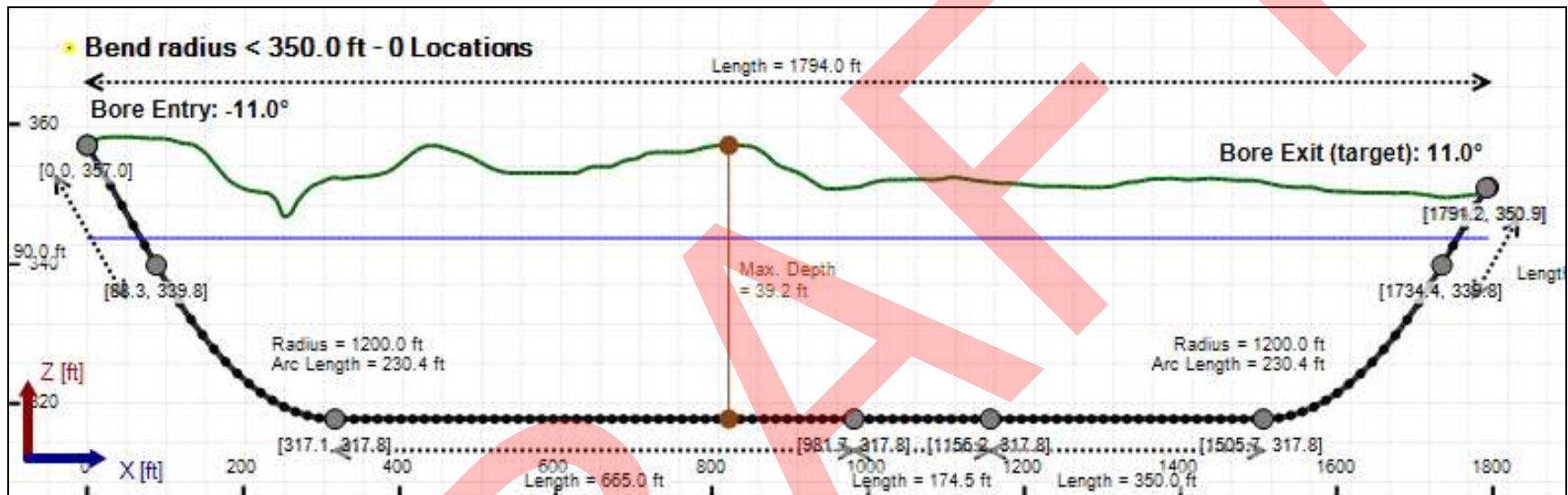
From Assistant

Unit Weight: 160.0000 (dry), 170.0000 (sat) [lb/ft3]

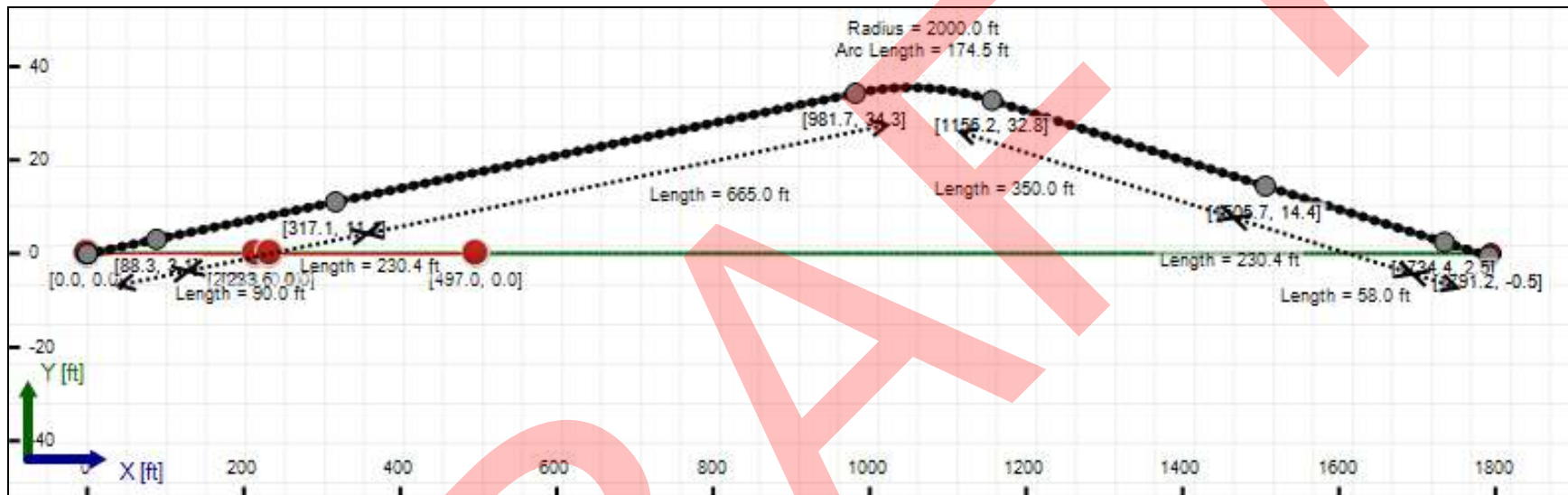
Phi: 37.00, S.M.: 2000.00, Coh: 3000.00 [psi]



### 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: 1800.00 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

## In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	6.0	29.4
Water Pressure	11.2	11.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	17.2	40.7
<b>Deflection</b>		
Earth Load Deflection	1.653	8.014
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.785	8.146
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	77.5	183.0

## Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	29178.7	29178.7
Pullback Stress [psi]	813.8	813.8
Pullback Strain	1.415E-2	1.415E-2
Bending Stress [psi]	0.0	21.5
Bending Strain	0	3.733E-4
Tensile Stress [psi]	813.8	830.0
Tensile Strain	1.415E-2	1.481E-2

Net External Pressure = 19.3 [psi ]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

---

## In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.785	7.5	4.2	OK
Unconstrained Collapse [psi]	25.5	117.9	4.6	OK
Compressive Wall Stress [psi]	77.5	1150.0	14.8	OK

## Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	35.5	205.6	5.8	OK
Tensile Stress [psi]	830.0	1200.0	1.4	OK

---

## Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	1973.538 psi	2015.919 psi
1	8.00 in	12.00 in	1972.760 psi	2015.540 psi
2	12.00 in	16.13 in	1971.630 psi	2014.989 psi

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

## Estimated Circulating Pressure Summary

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

Flow Rate (Q): 40.00 US (liquid) gallon/min

Drill Fluid Density: 68.670 lb/ft<sup>3</sup>

Rheological model: Bingham-Plastic

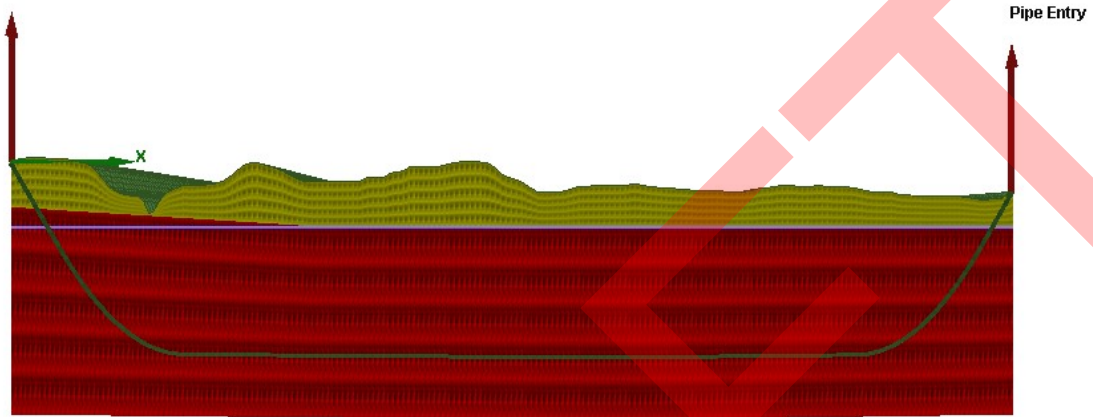
Plastic Viscosity (PV): 25.53

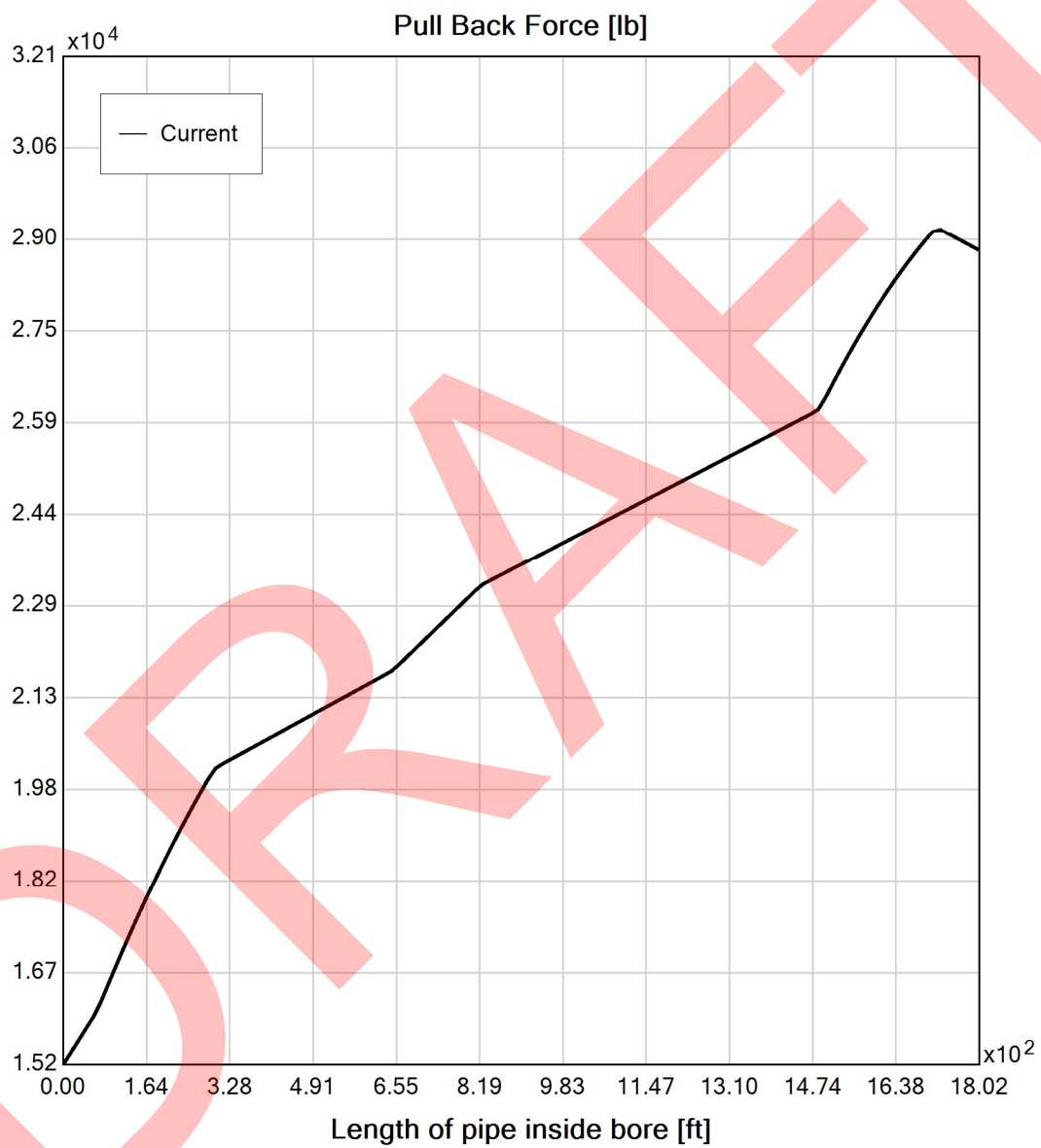
Yield Point (YP): 16.49

Effective Viscosity (cP): 1202.0

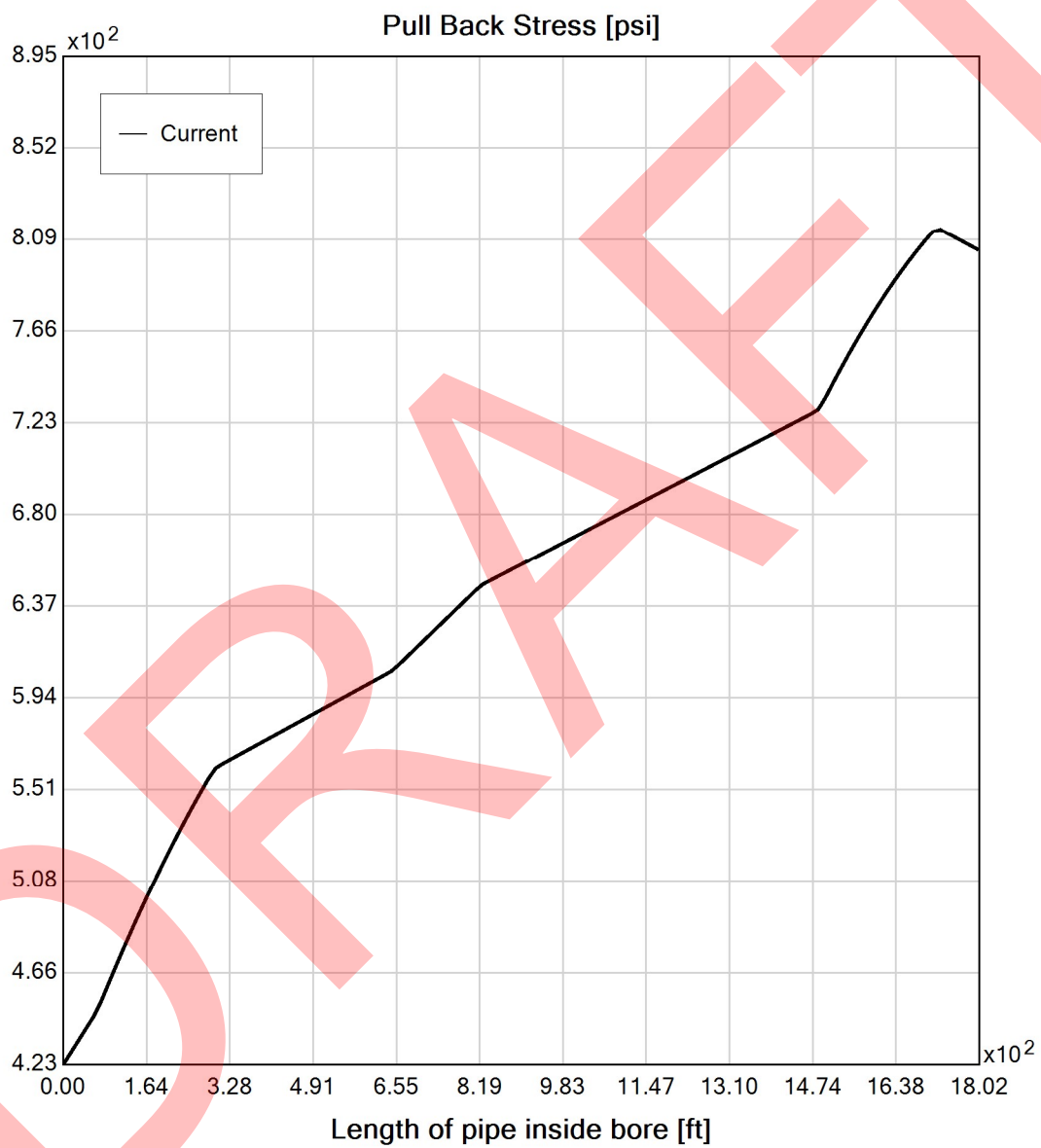
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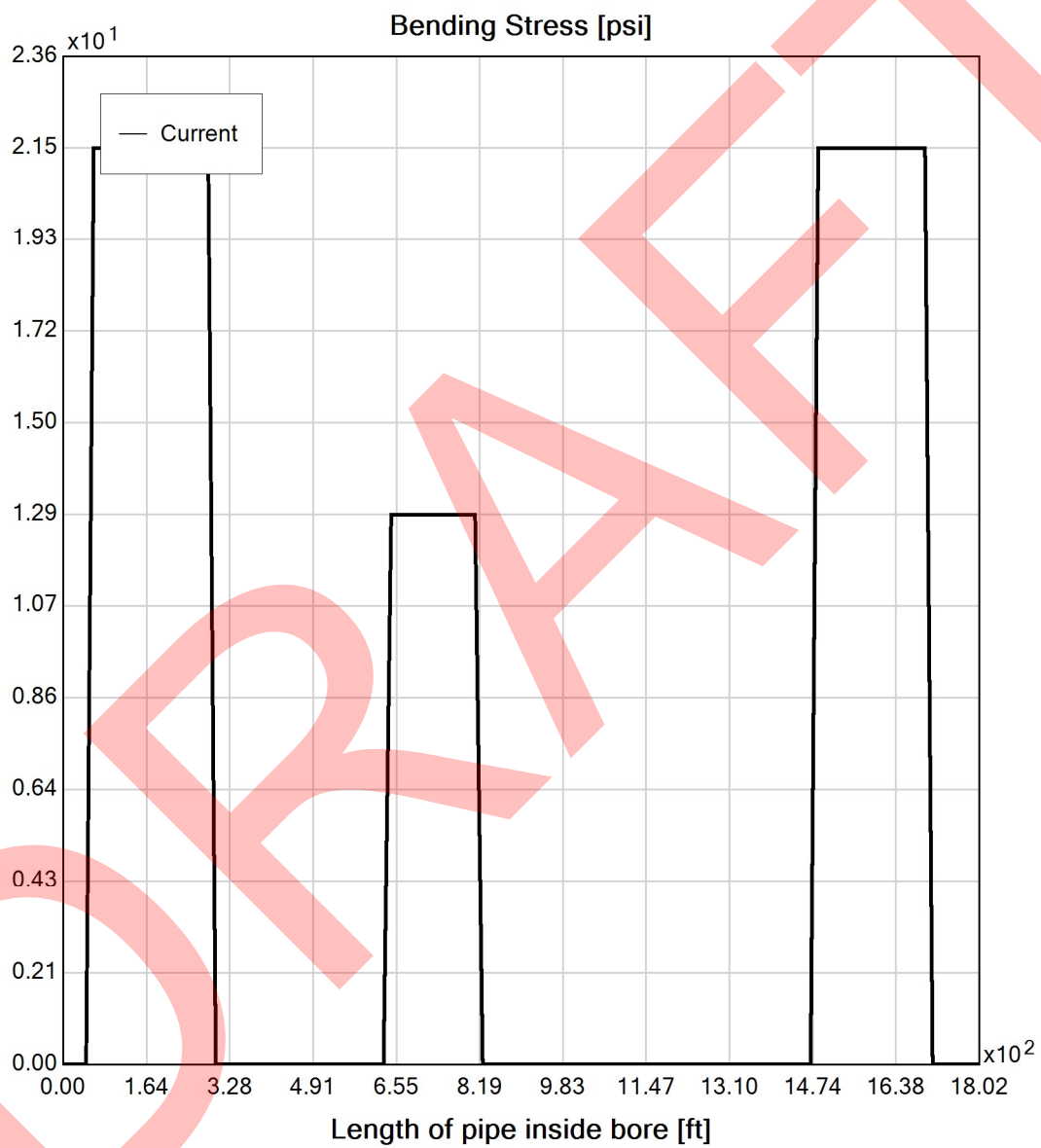
## Virtual Site

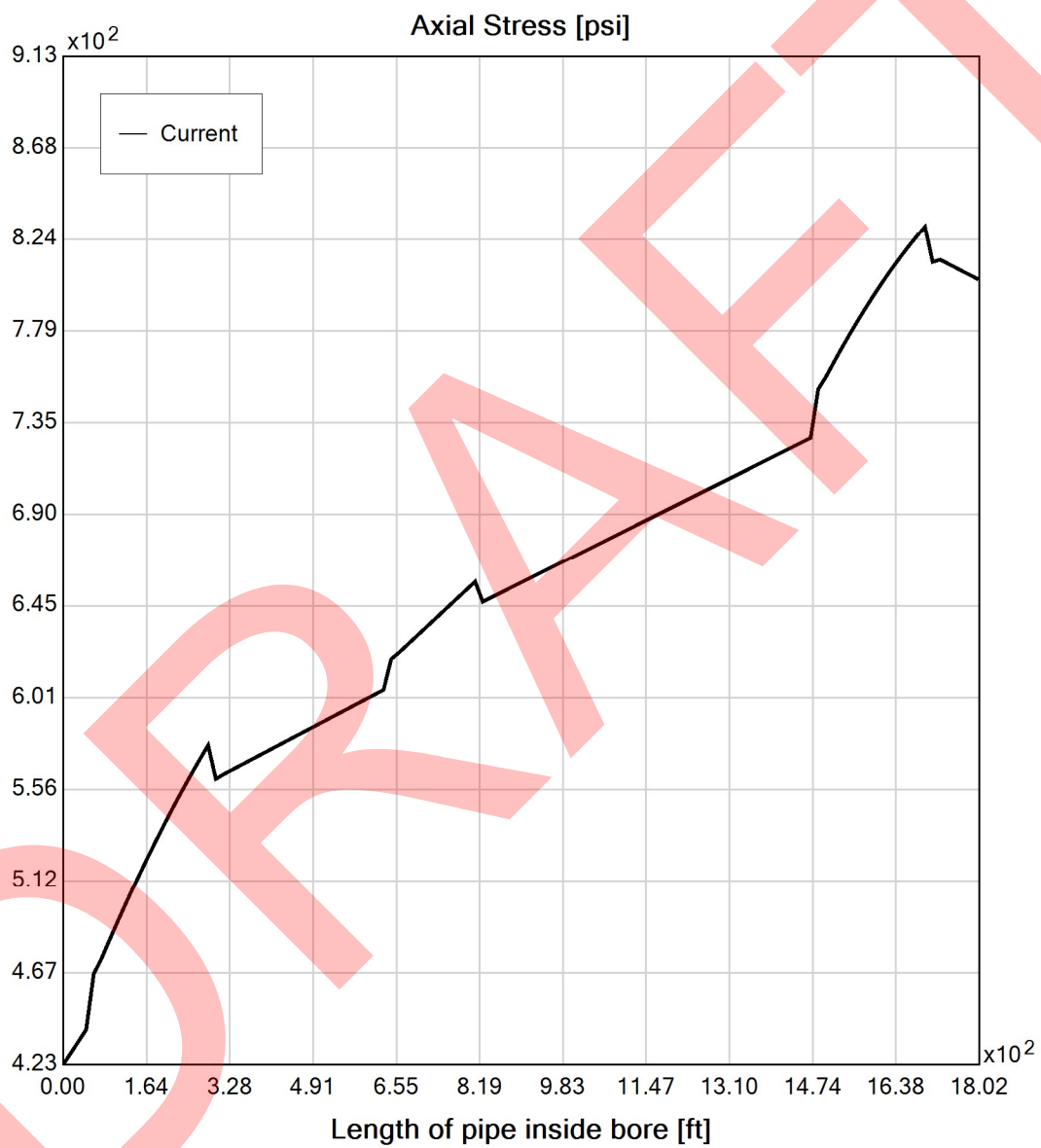


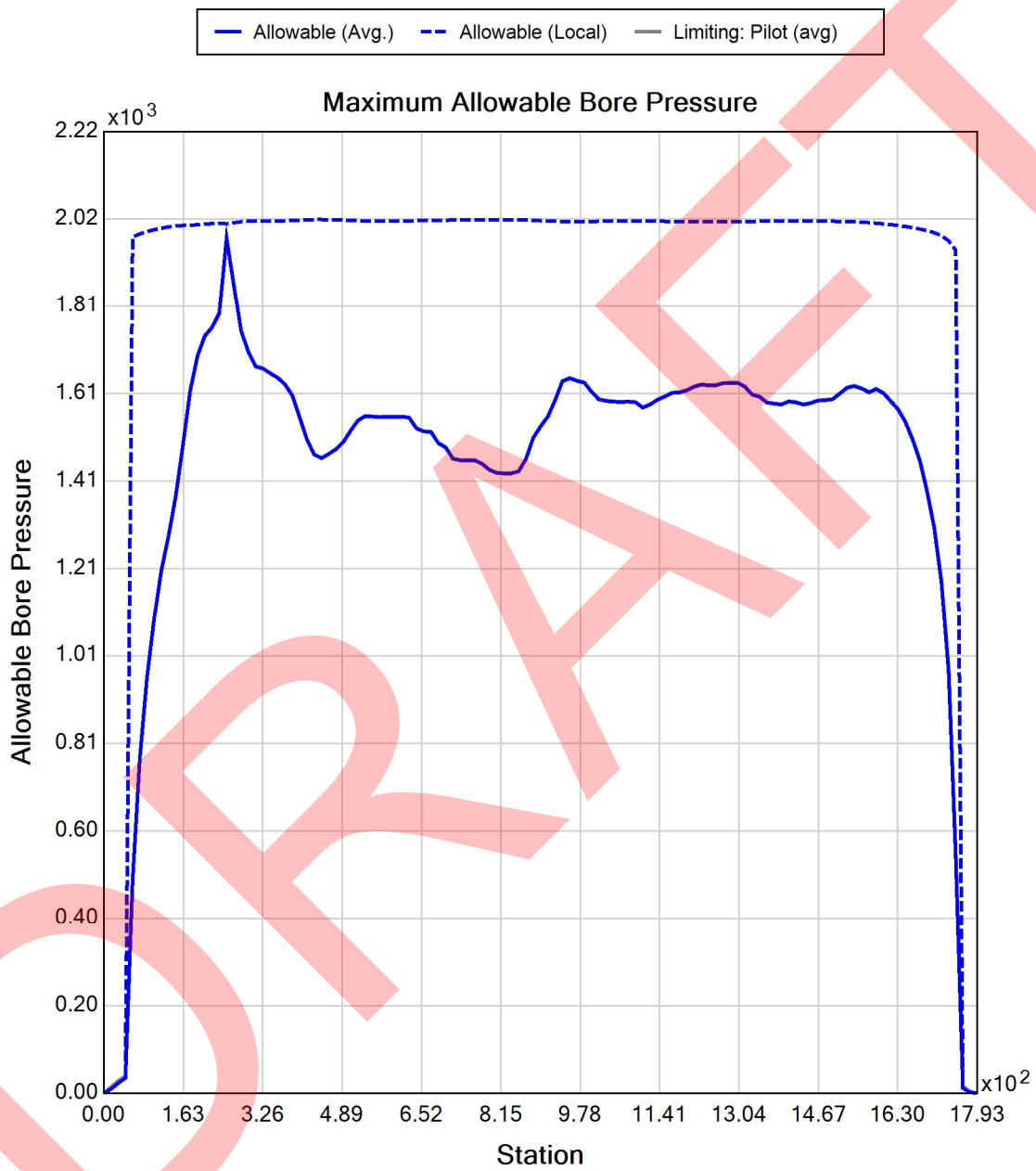


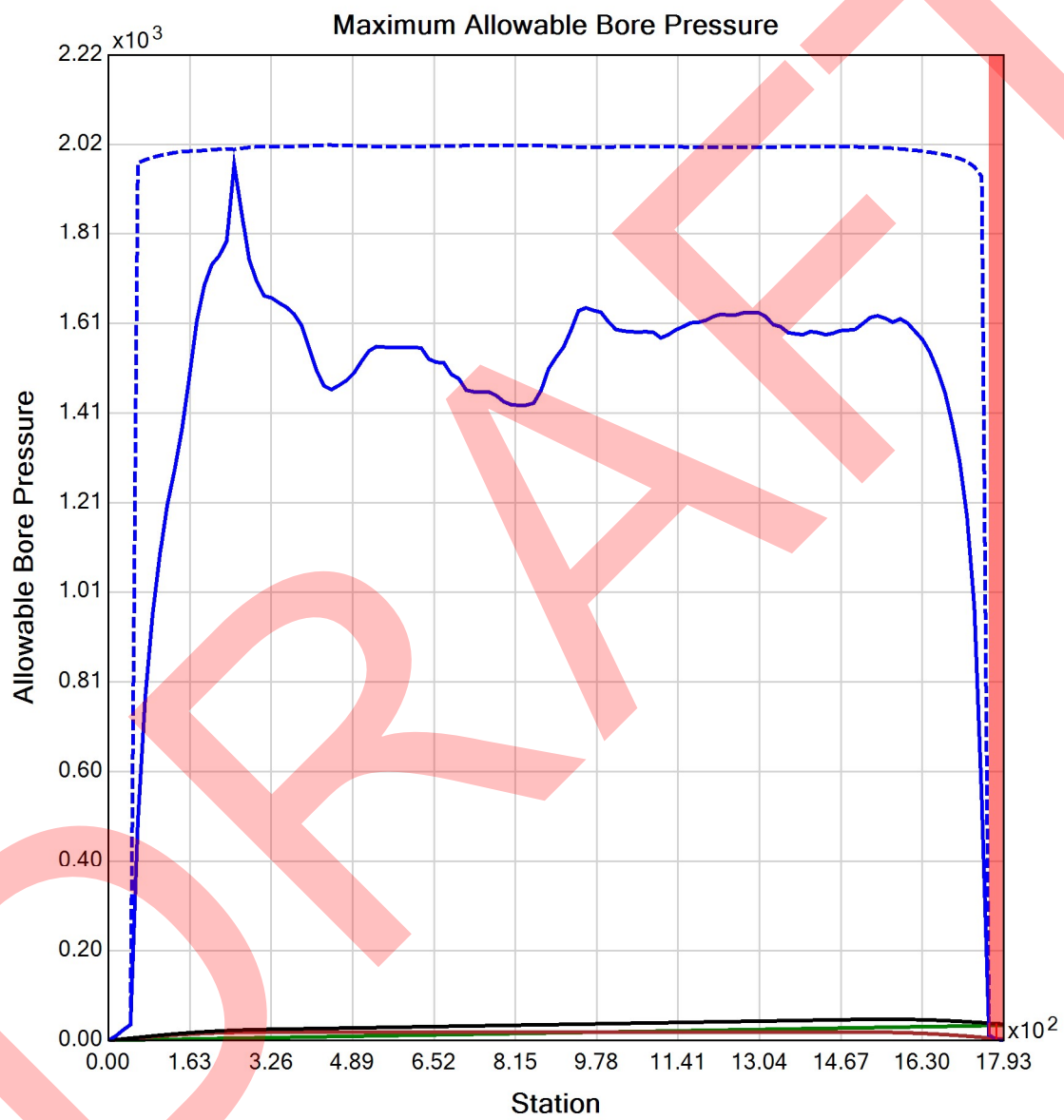














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## Project Summary

General: CHPE HDD 70A C1  
P4B  
Start Date: 12-10-2021  
End Date: 12-10-2021

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

Designer: MCS  
CHA

Description: HDD 70A REV 1 2-inch DR9

---

## Input Summary

Start Coordinate	(0.00, 0.00, 357.00) ft
End Coordinate	(1794.00, 0.00, 351.00) ft
Project Length	1794.00 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: 1800.00 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

## In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	2.4	29.4
Water Pressure	11.2	11.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	13.6	40.7
<b>Deflection</b>		
Earth Load Deflection	0.676	8.014
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.706	8.044
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	61.3	183.0

## Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1533.8	1533.8
Pullback Stress [psi]	876.4	876.4
Pullback Strain	1.524E-2	1.524E-2
Bending Stress [psi]	0.0	4.7
Bending Strain	0	8.247E-5
Tensile Stress [psi]	876.4	876.4
Tensile Strain	1.524E-2	1.532E-2

Net External Pressure = 19.3 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

---

## In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.706	7.5	10.6	OK
Unconstrained Collapse [psi]	25.5	129.9	5.1	OK
Compressive Wall Stress [psi]	61.3	1150.0	18.7	OK

## Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	35.5	202.9	5.7	OK
Tensile Stress [psi]	876.4	1200.0	1.4	OK



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---

## Project Summary

General: CHPE HDD 70A C2  
P4B  
Start Date: 12-10-2021  
End Date: 12-10-2021

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

Designer: MCS  
CHA

Description: HDD 70A 10-inch DR9 - Conduit 2

---

## Input Summary

Start Coordinate	(0.00, 0.00, 357.00) ft
End Coordinate	(1794.00, 0.00, 351.00) ft
Project Length	1794.00 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: 2

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

From Assistant

Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft<sup>3</sup>]

Phi: 30.00, S.M.: 200.00, Coh: 0.00 [psi]

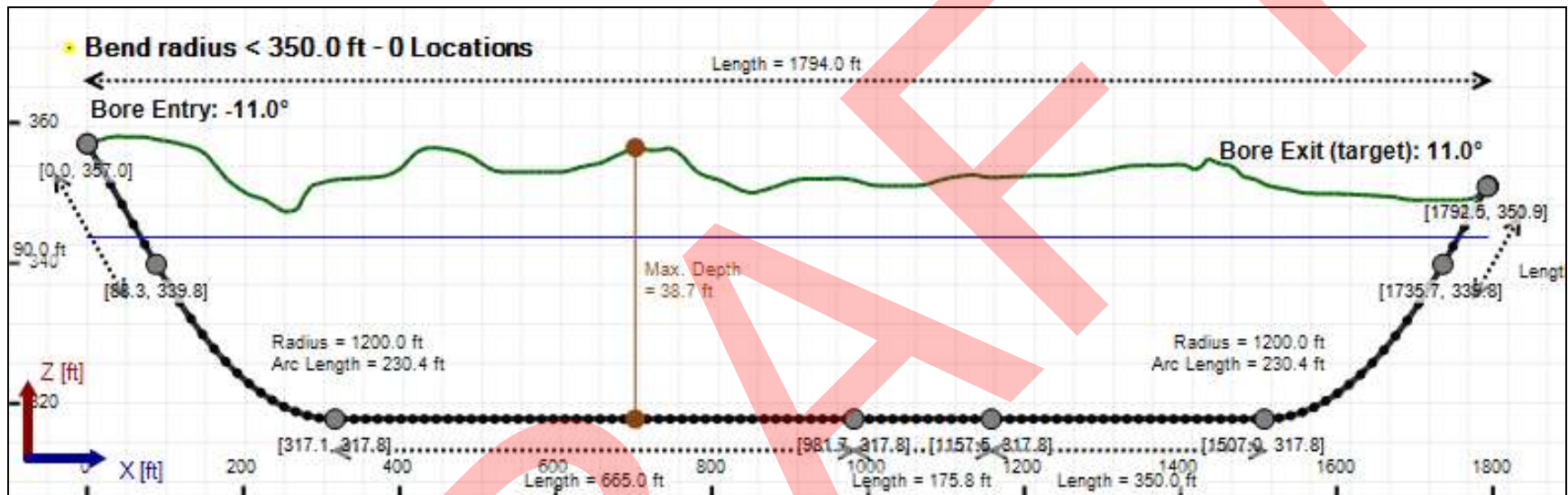
Soil Layer #2 Rock, Geological Classification, Sedimentary Rocks

From Assistant

Unit Weight: 160.0000 (dry), 170.0000 (sat) [lb/ft<sup>3</sup>]

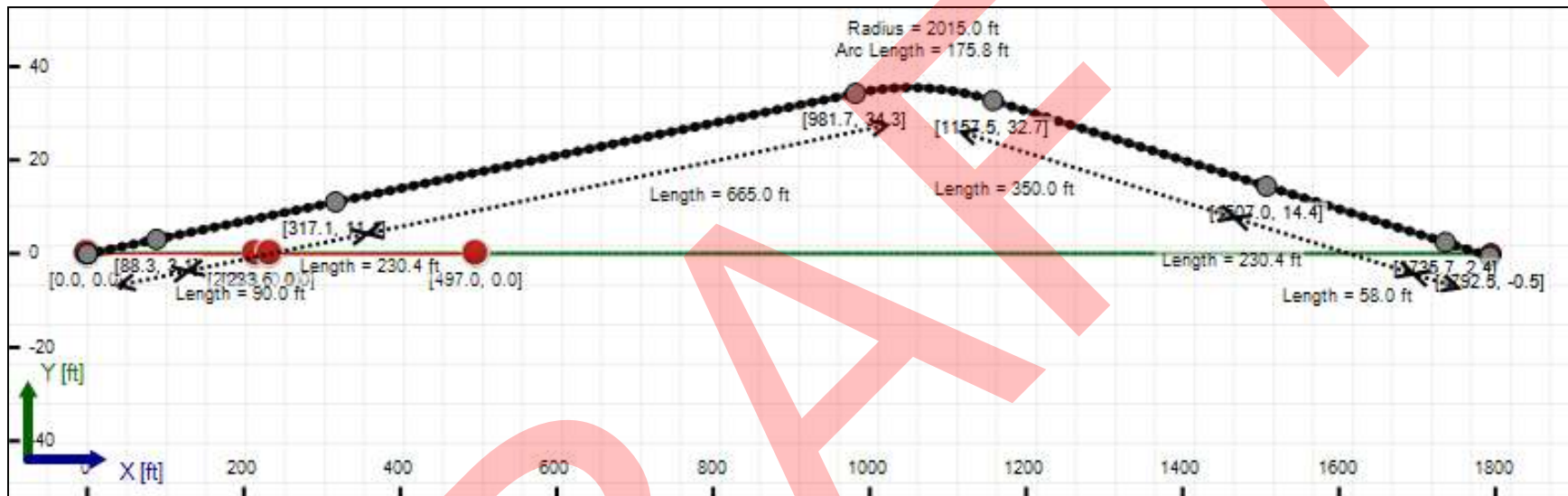
Phi: 37.00, S.M.: 2000.00, Coh: 3000.00 [psi]

### 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: 1800.00 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

## In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	6.0	29.0
Water Pressure	11.2	11.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	17.2	40.3
<b>Deflection</b>		
Earth Load Deflection	1.655	7.910
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.787	8.042
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	77.6	181.3

## Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	29162.2	29162.2
Pullback Stress [psi]	813.3	813.3
Pullback Strain	1.414E-2	1.414E-2
Bending Stress [psi]	0.0	21.5
Bending Strain	0	3.733E-4
Tensile Stress [psi]	813.3	829.5
Tensile Strain	1.414E-2	1.480E-2

Net External Pressure = 19.3 [psi ]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

---

## In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.787	7.5	4.2	OK
Unconstrained Collapse [psi]	25.5	117.9	4.6	OK
Compressive Wall Stress [psi]	77.6	1150.0	14.8	OK

## Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	35.5	205.6	5.8	OK
Tensile Stress [psi]	829.5	1200.0	1.4	OK

---

## Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	1938.835 psi	2015.554 psi
1	8.00 in	12.00 in	1938.106 psi	2015.164 psi
2	12.00 in	16.13 in	1937.050 psi	2014.598 psi

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

## Estimated Circulating Pressure Summary

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

Flow Rate (Q): 40.00 US (liquid) gallon/min

Drill Fluid Density: 68.670 lb/ft<sup>3</sup>

Rheological model: Bingham-Plastic

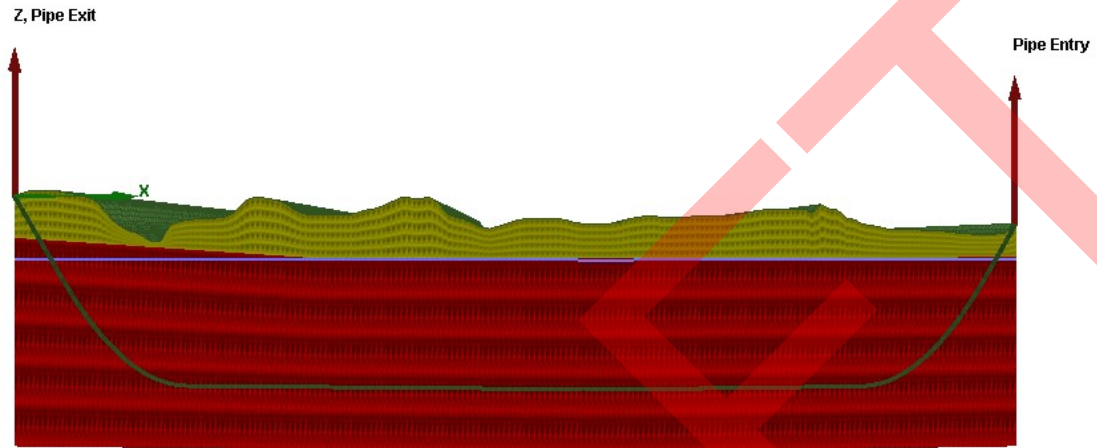
Plastic Viscosity (PV): 25.53

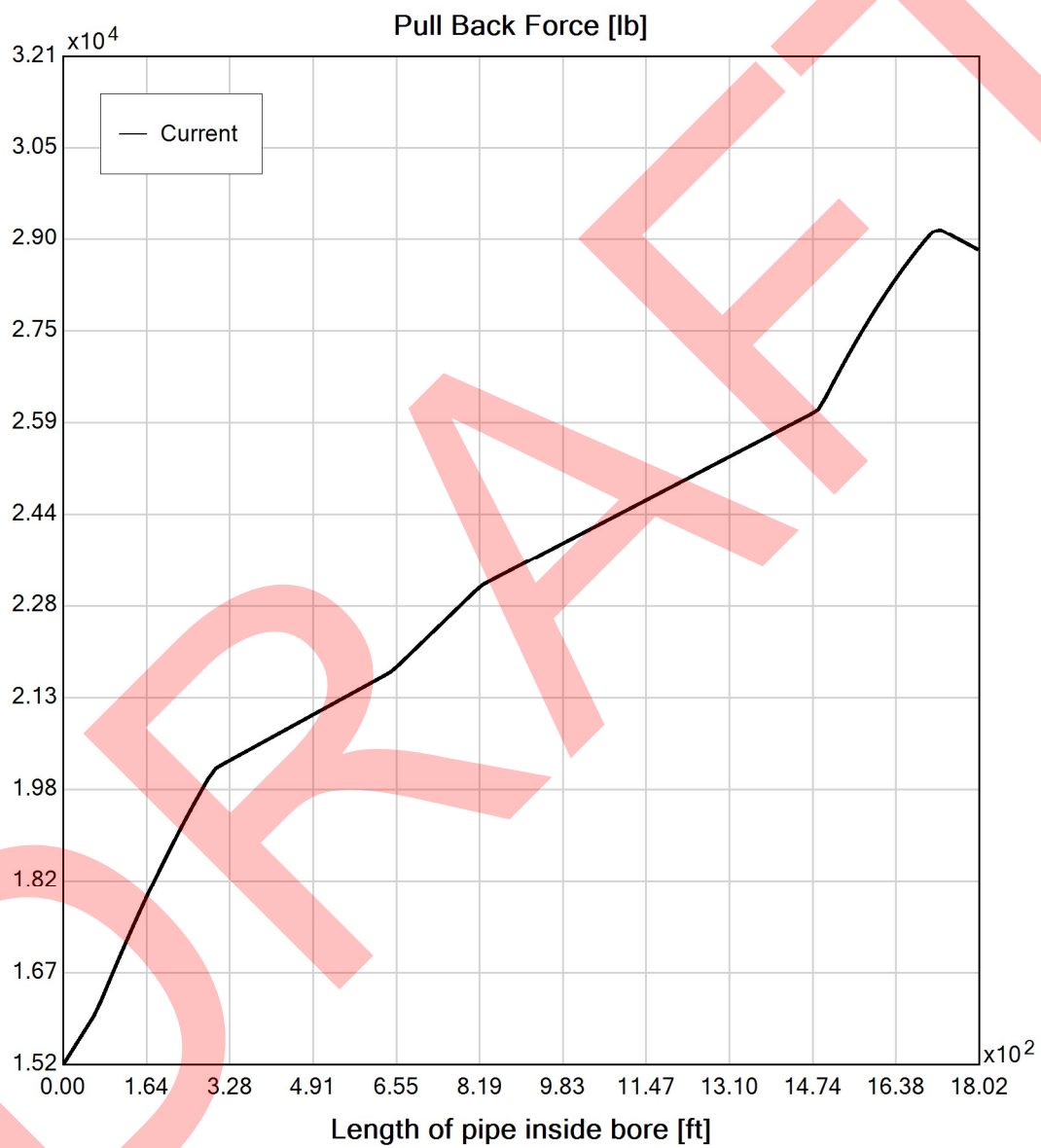
Yield Point (YP): 16.49

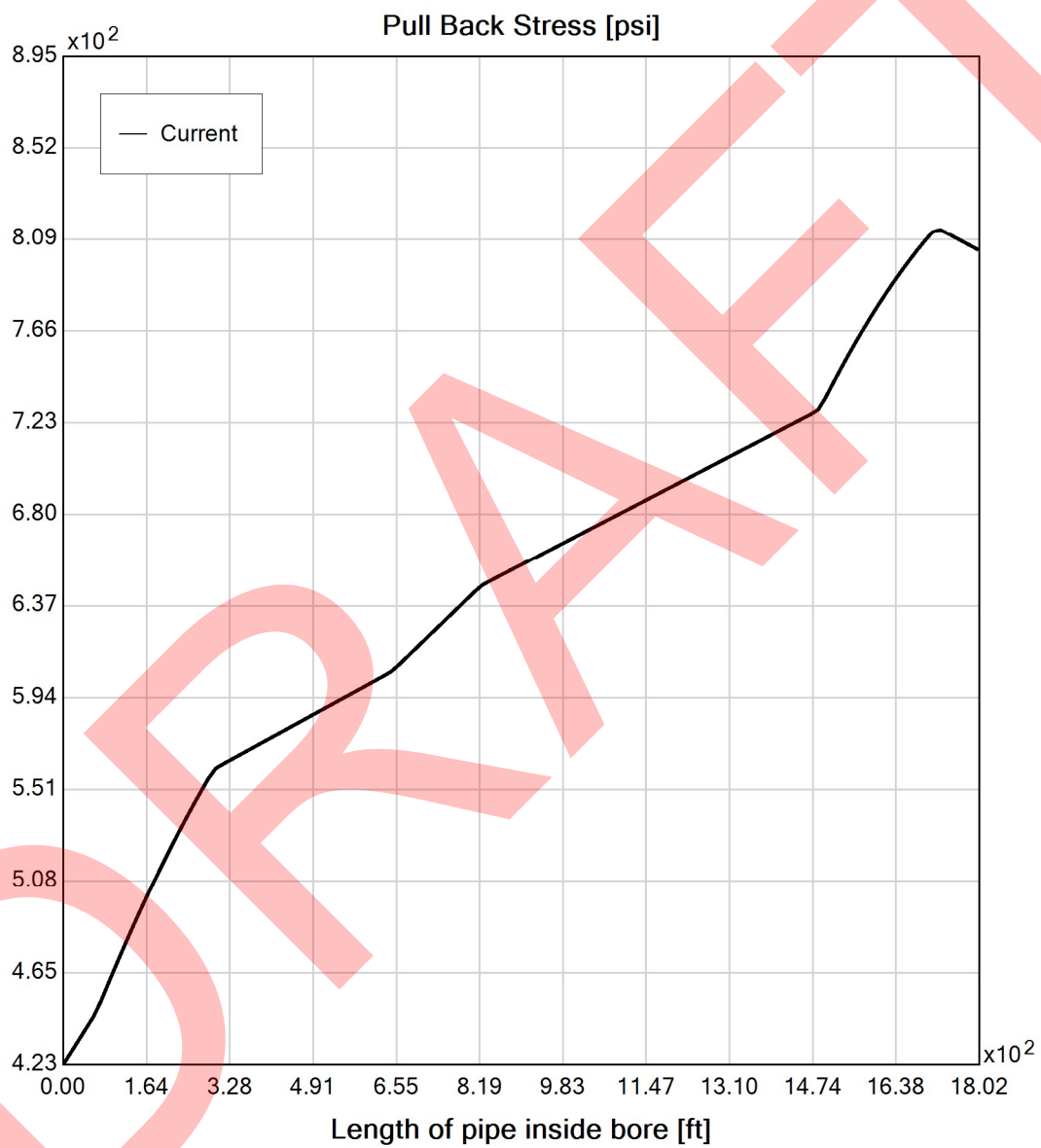
Effective Viscosity (cP): 1202.0

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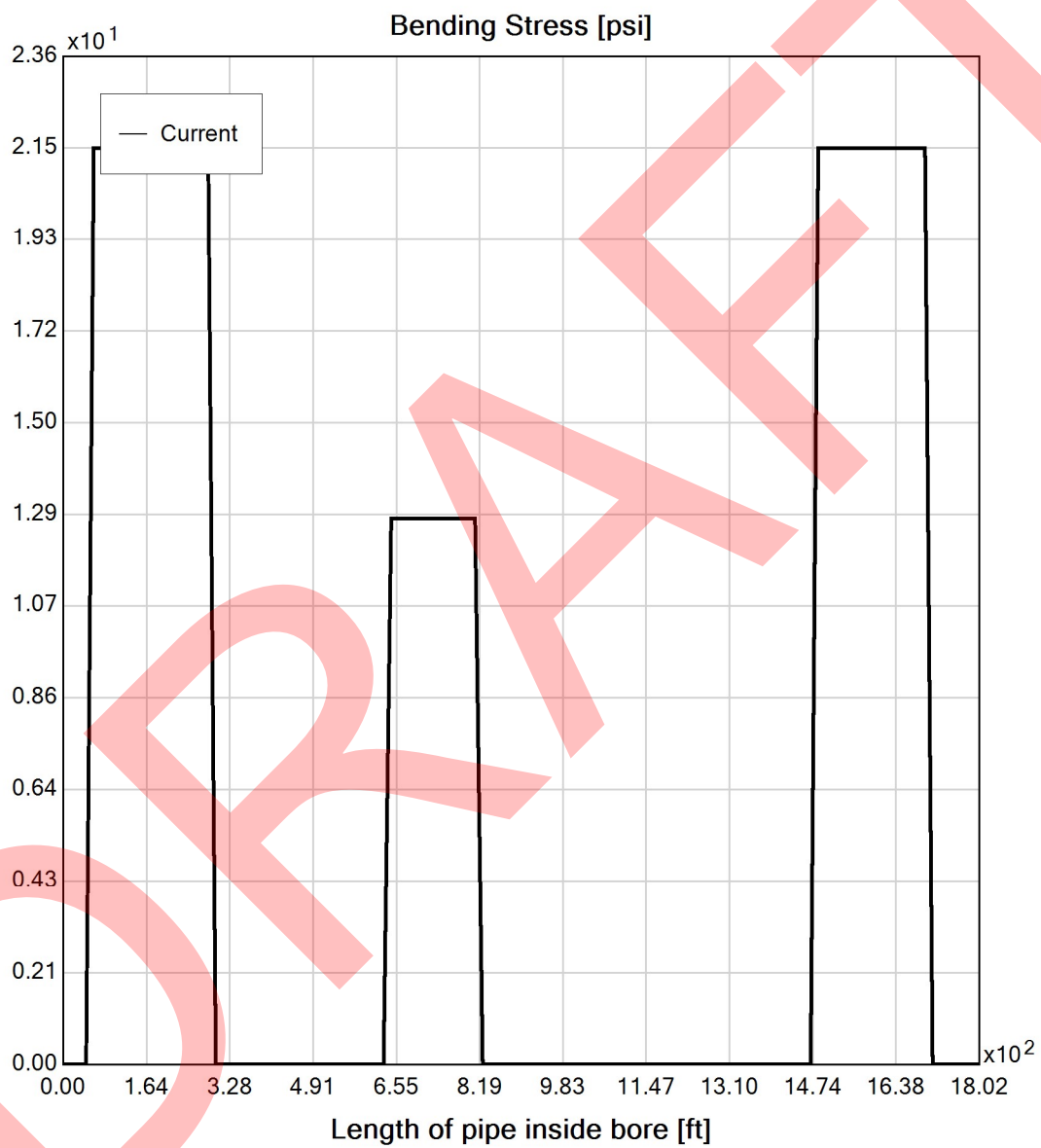
## Virtual Site

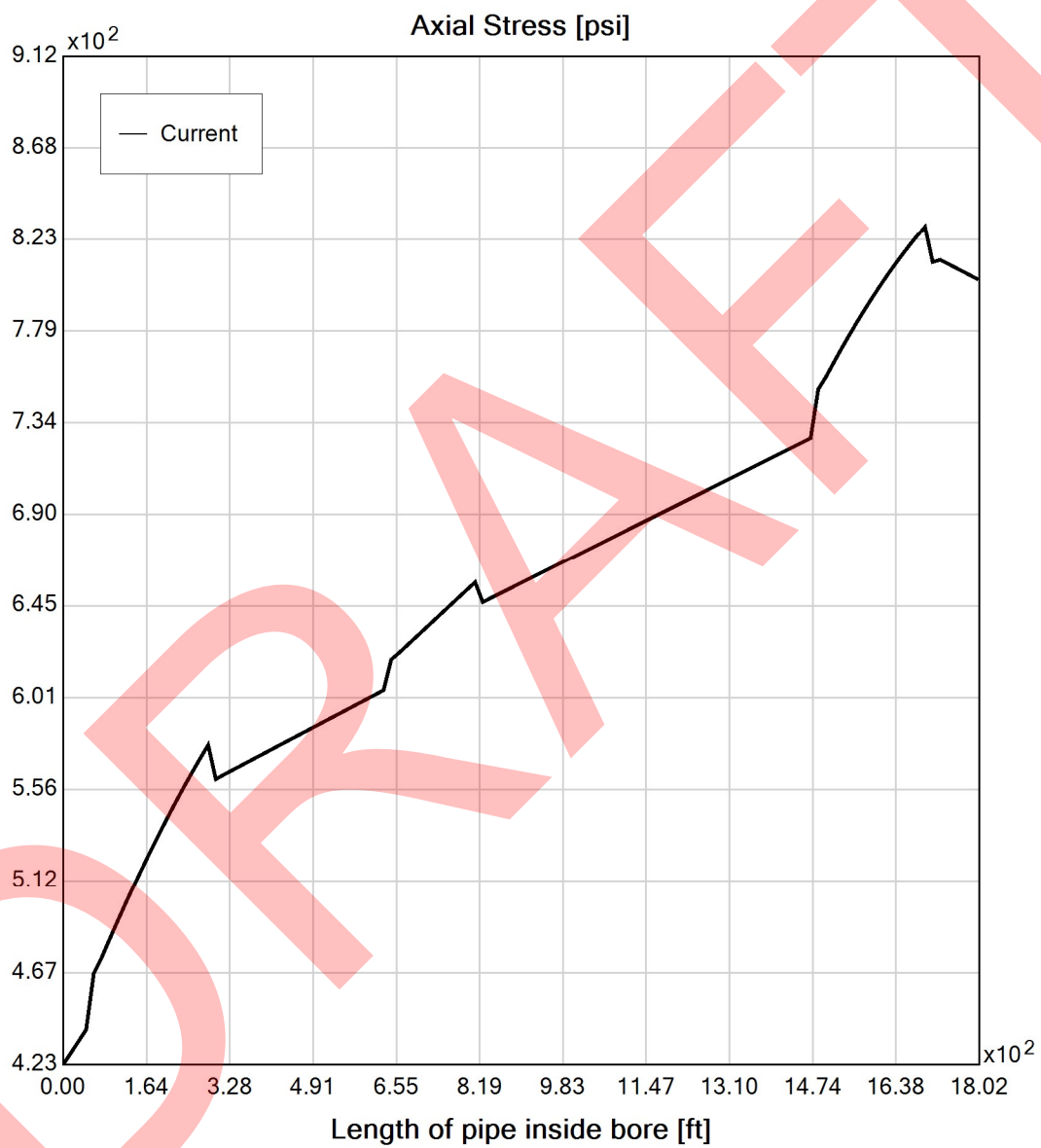


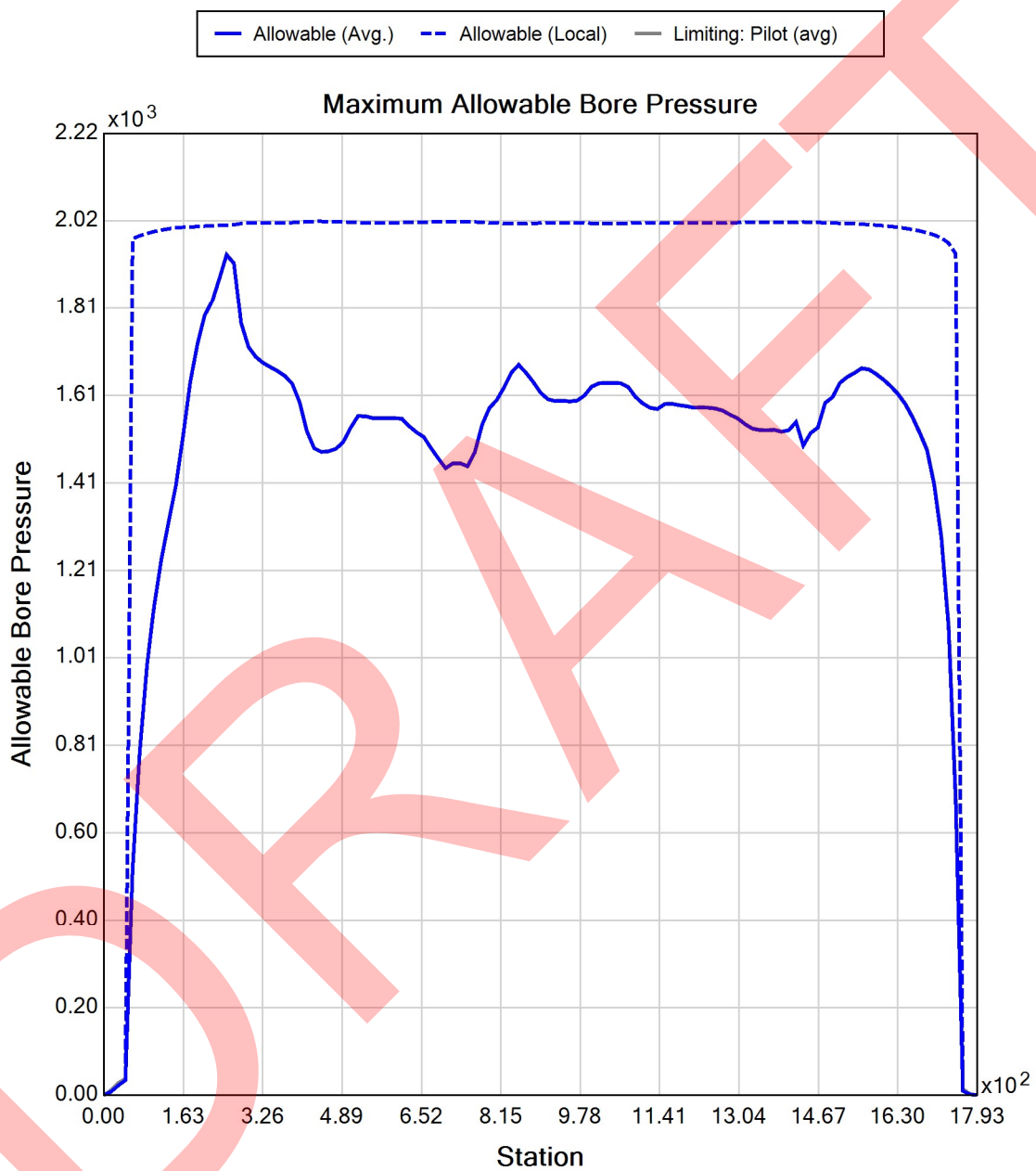


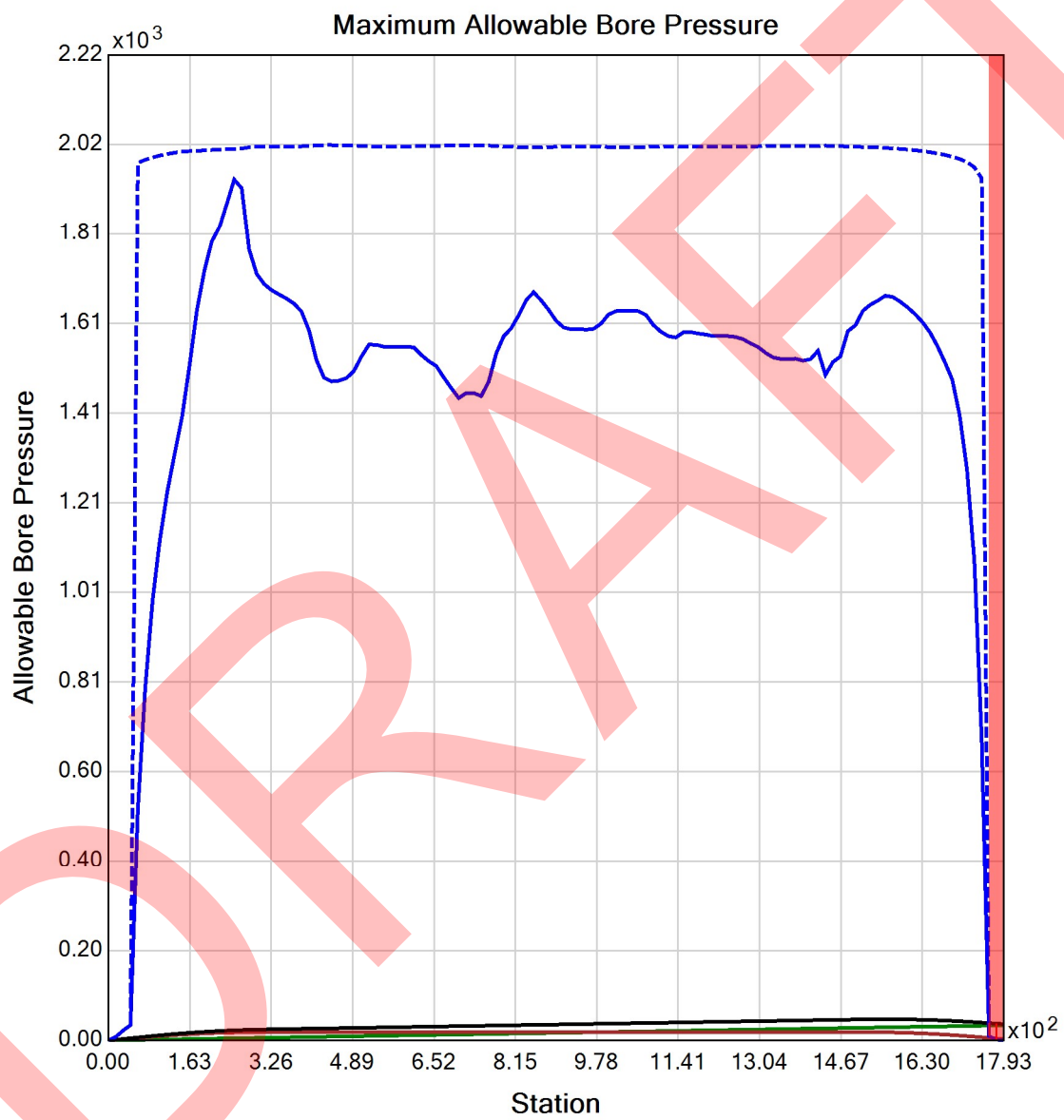














| BoreAid®

## Generated Output



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---

## Project Summary

General: CHPE HDD 70A C1  
P4B  
Start Date: 12-10-2021  
End Date: 12-10-2021

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

Designer: MCS  
CHA

Description: HDD 70A REV 1 2-inch DR9

---

## Input Summary

Start Coordinate	(0.00, 0.00, 357.00) ft
End Coordinate	(1794.00, 0.00, 351.00) ft
Project Length	1794.00 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: 1800.00 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>



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## In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	2.4	29.4
Water Pressure	11.2	11.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	13.6	40.7
<b>Deflection</b>		
Earth Load Deflection	0.676	8.014
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.706	8.044
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	61.3	183.0

## Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1533.8	1533.8
Pullback Stress [psi]	876.4	876.4
Pullback Strain	1.524E-2	1.524E-2
Bending Stress [psi]	0.0	4.7
Bending Strain	0	8.247E-5
Tensile Stress [psi]	876.4	876.4
Tensile Strain	1.524E-2	1.532E-2

Net External Pressure = 19.3 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

---

## In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.706	7.5	10.6	OK
Unconstrained Collapse [psi]	25.5	129.9	5.1	OK
Compressive Wall Stress [psi]	61.3	1150.0	18.7	OK

## Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	35.5	202.9	5.7	OK
Tensile Stress [psi]	876.4	1200.0	1.4	OK



## Generated Output



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---

## Project Summary

General:	CHPE HDD 70B P4B Start Date: 12-10-2021 End Date: 12-10-2021
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	TAR CHA
Description:	HDD 70B 10-inch DR9

---

## Input Summary

Start Coordinate	(100.00, 0.00, 356.90) ft
End Coordinate	(700.00, 0.00, 356.20) ft
Project Length	600.00 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

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, Gravel (G), GP

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 #3 USCS, Sand (S), SM

From Assistant

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

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

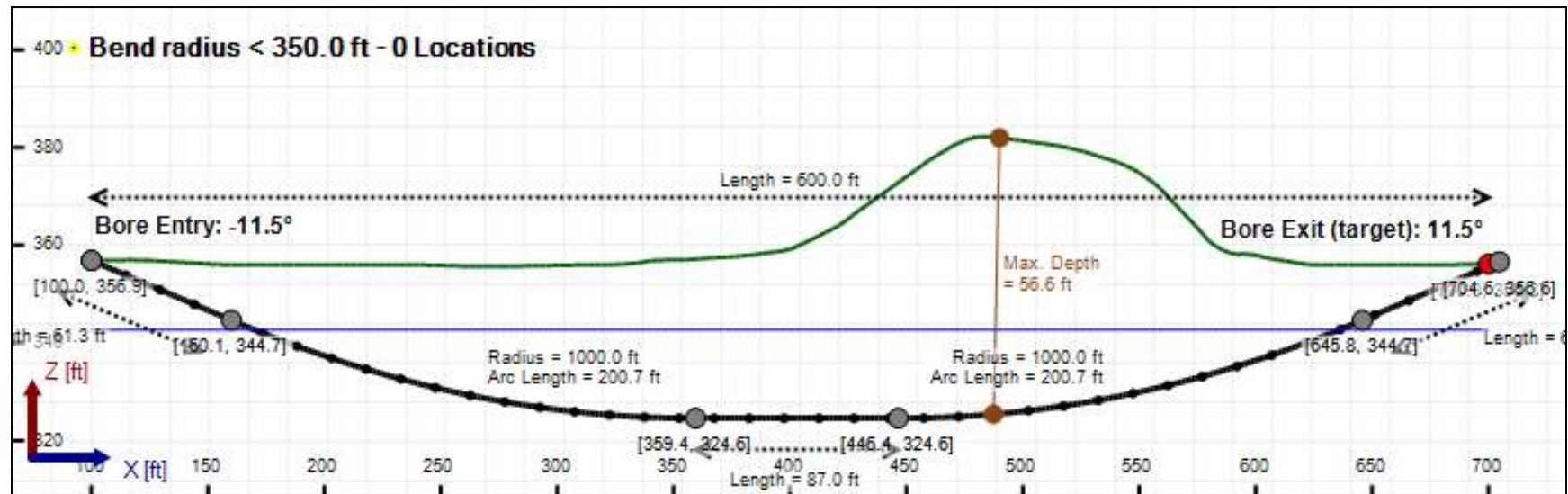
Soil Layer #4 USCS, Gravel (G), GP

From Assistant

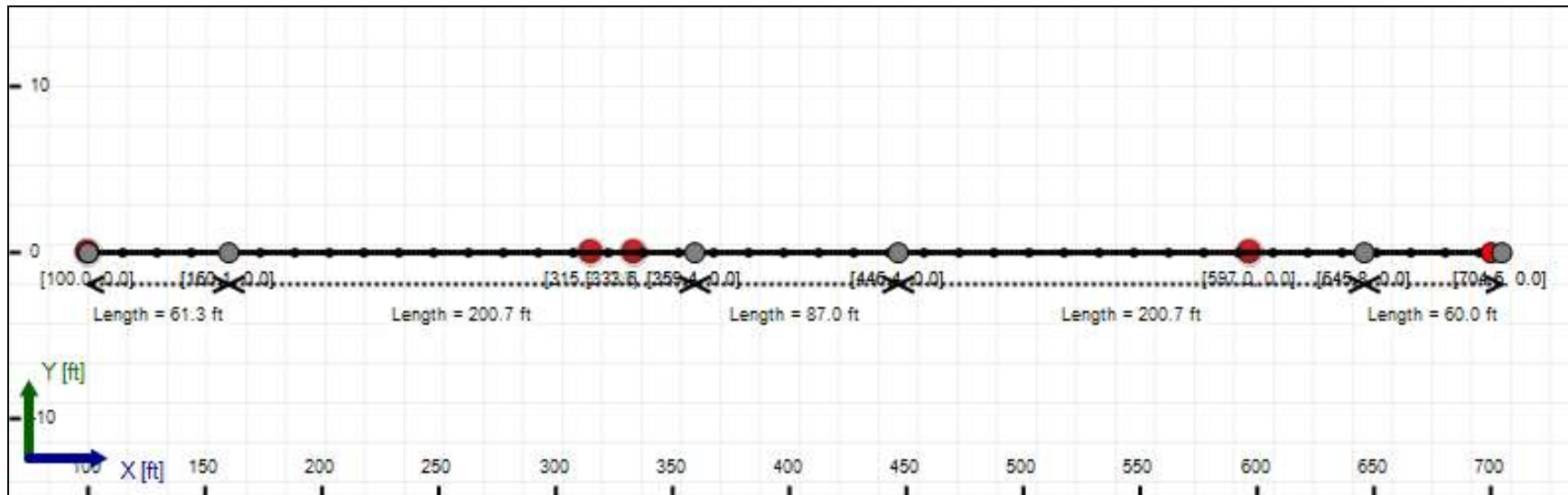
Unit Weight: 120.0000 (dry), 140.0000 (sat) [lb/ft3]

Phi: 37.00, 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: 615.00 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	4.9	37.1
Water Pressure	7.8	7.5
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	12.7	44.5
<b>Deflection</b>		
Earth Load Deflection	1.358	10.095
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.490	10.227
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	57.3	200.5

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	10726.3	10726.3
Pullback Stress [psi]	299.1	299.1
Pullback Strain	5.202E-3	5.202E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	299.1	324.2
Tensile Strain	5.202E-3	6.087E-3

Net External Pressure = 18.3 [psi ]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

---

### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.490	7.5	5.0	OK
Unconstrained Collapse [psi]	21.5	121.3	5.6	OK
Compressive Wall Stress [psi]	57.3	1150.0	20.1	OK

### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	31.5	237.8	7.5	OK
Tensile Stress [psi]	324.2	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	120.793 psi	127.414 psi
1	8.00 in	12.00 in	120.765 psi	127.386 psi
2	12.00 in	16.13 in	120.724 psi	127.345 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/ft<sup>3</sup>

Rheological model: Bingham-Plastic

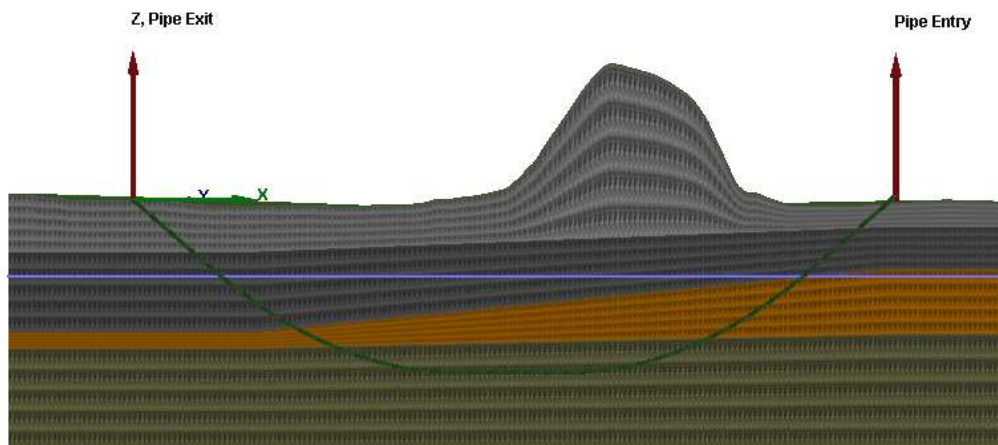
Plastic Viscosity (PV): 25.53

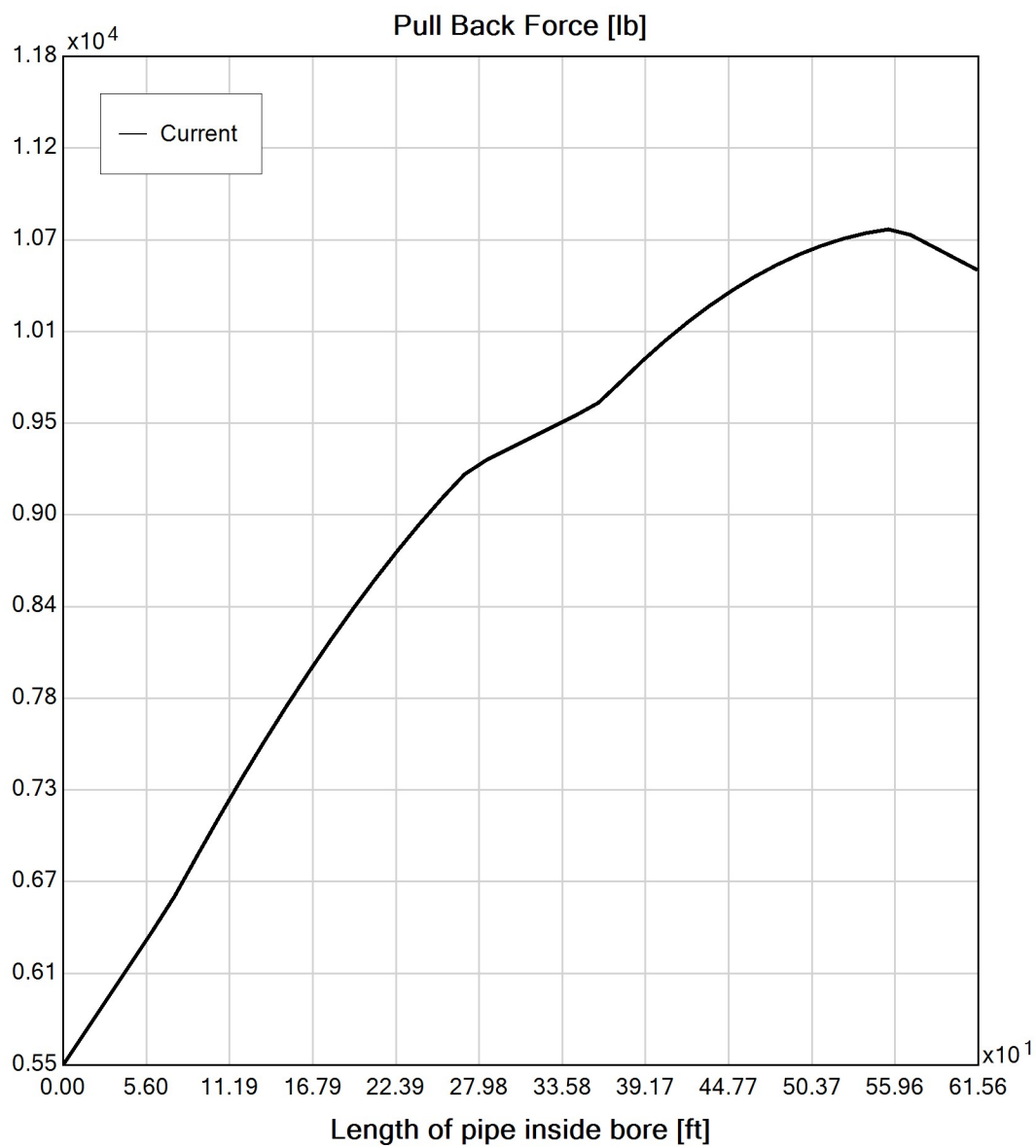
Yield Point (YP): 16.49

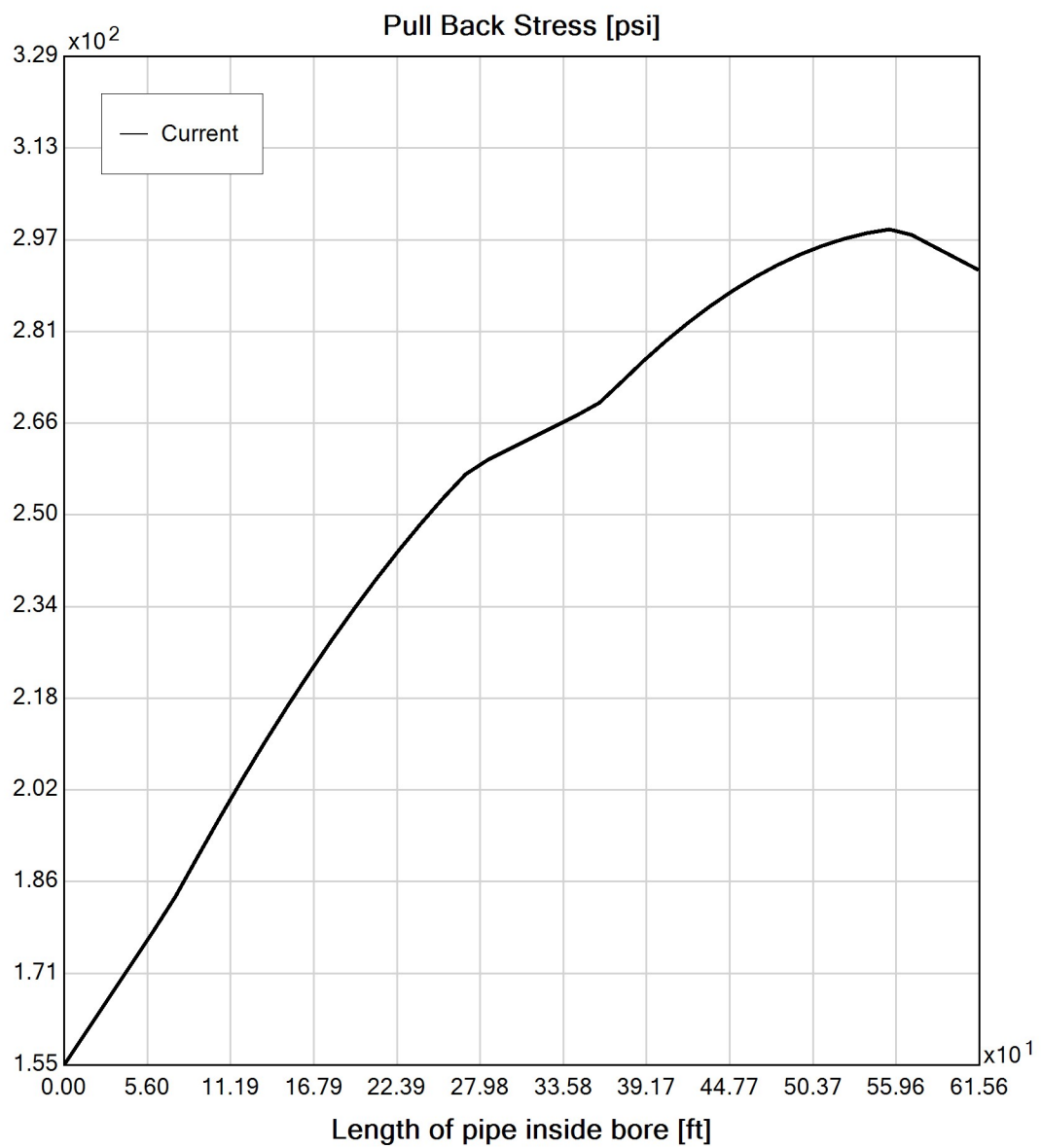
Effective Viscosity (cP): 1202.0

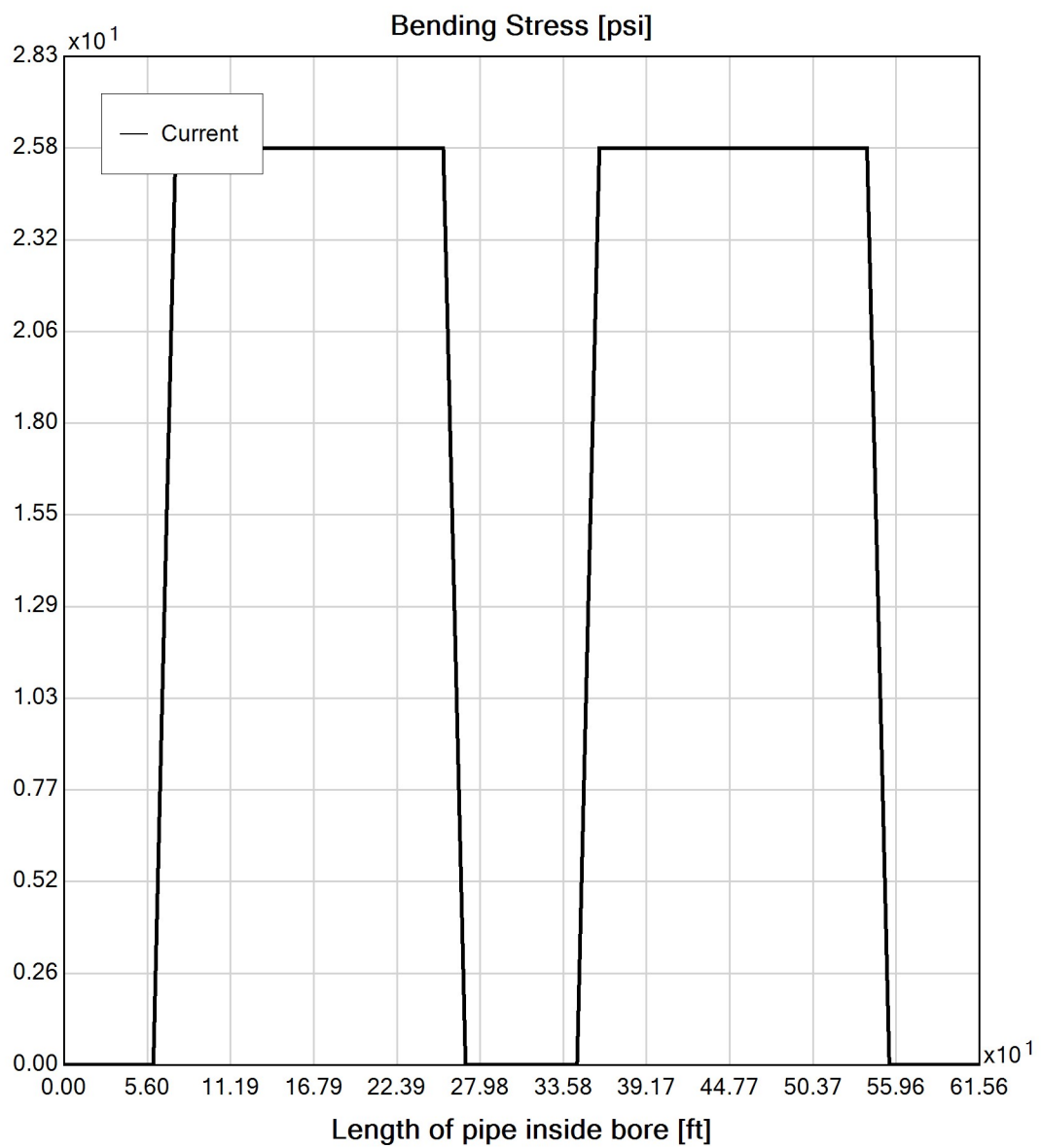
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## Virtual Site

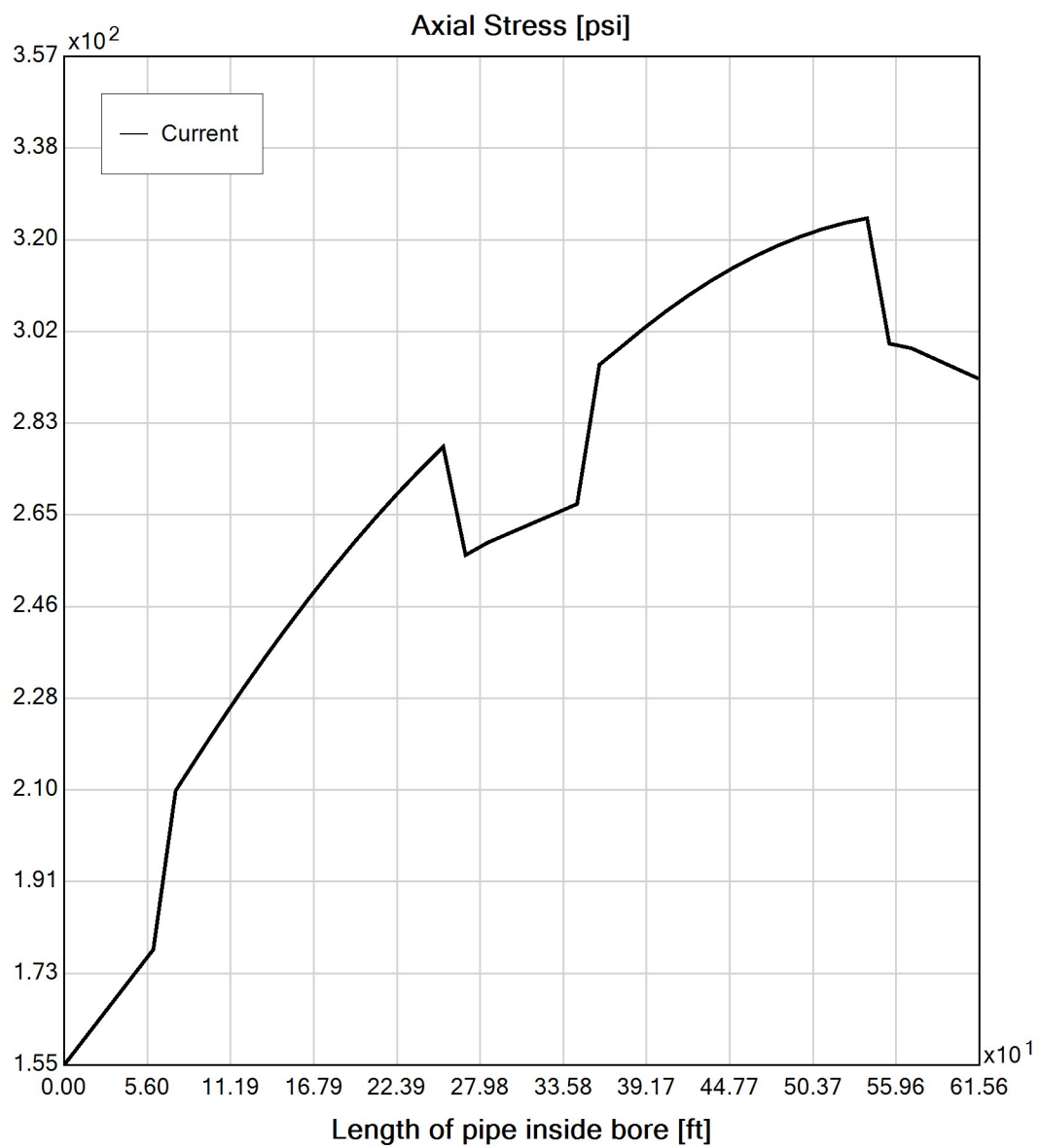


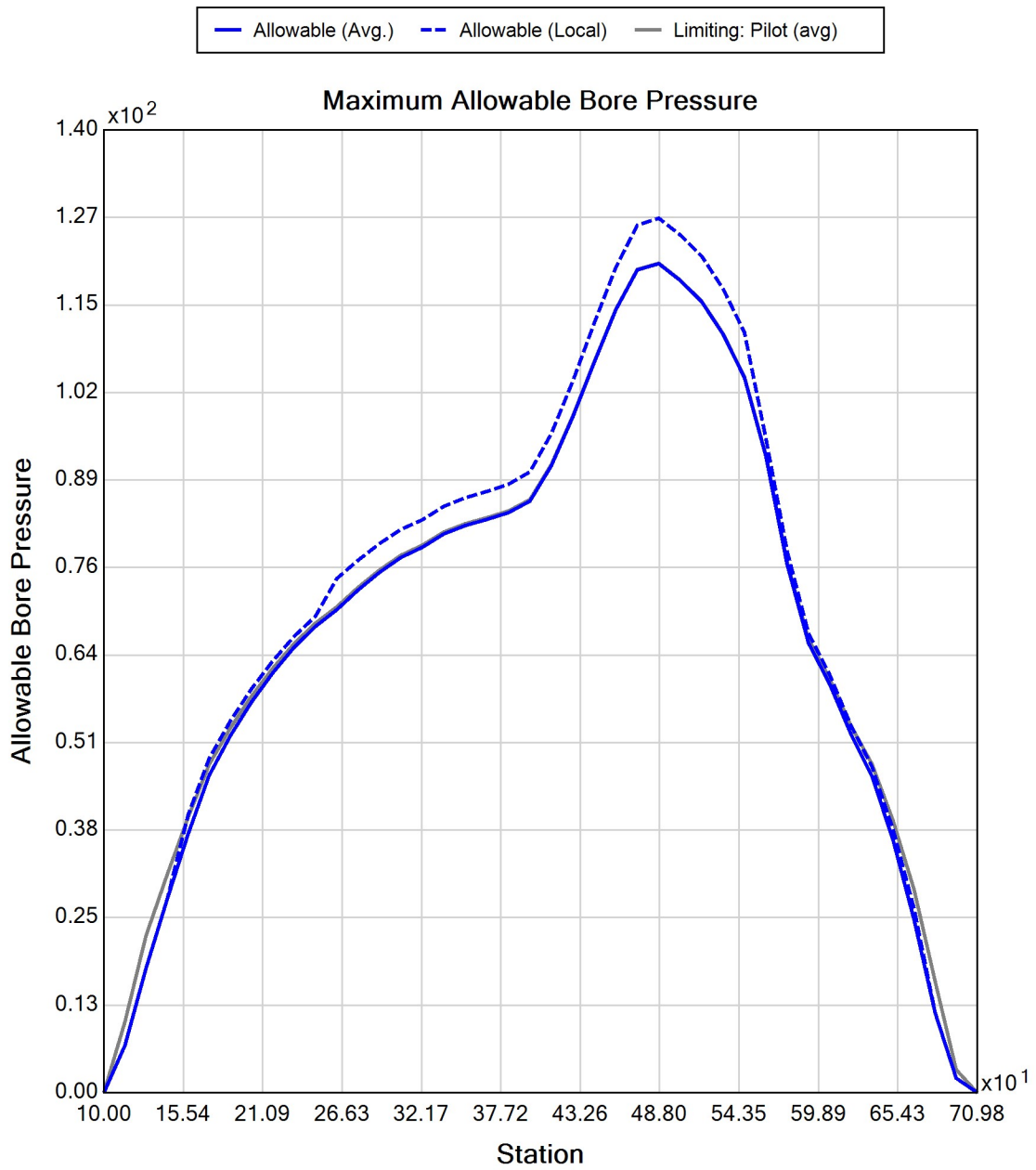


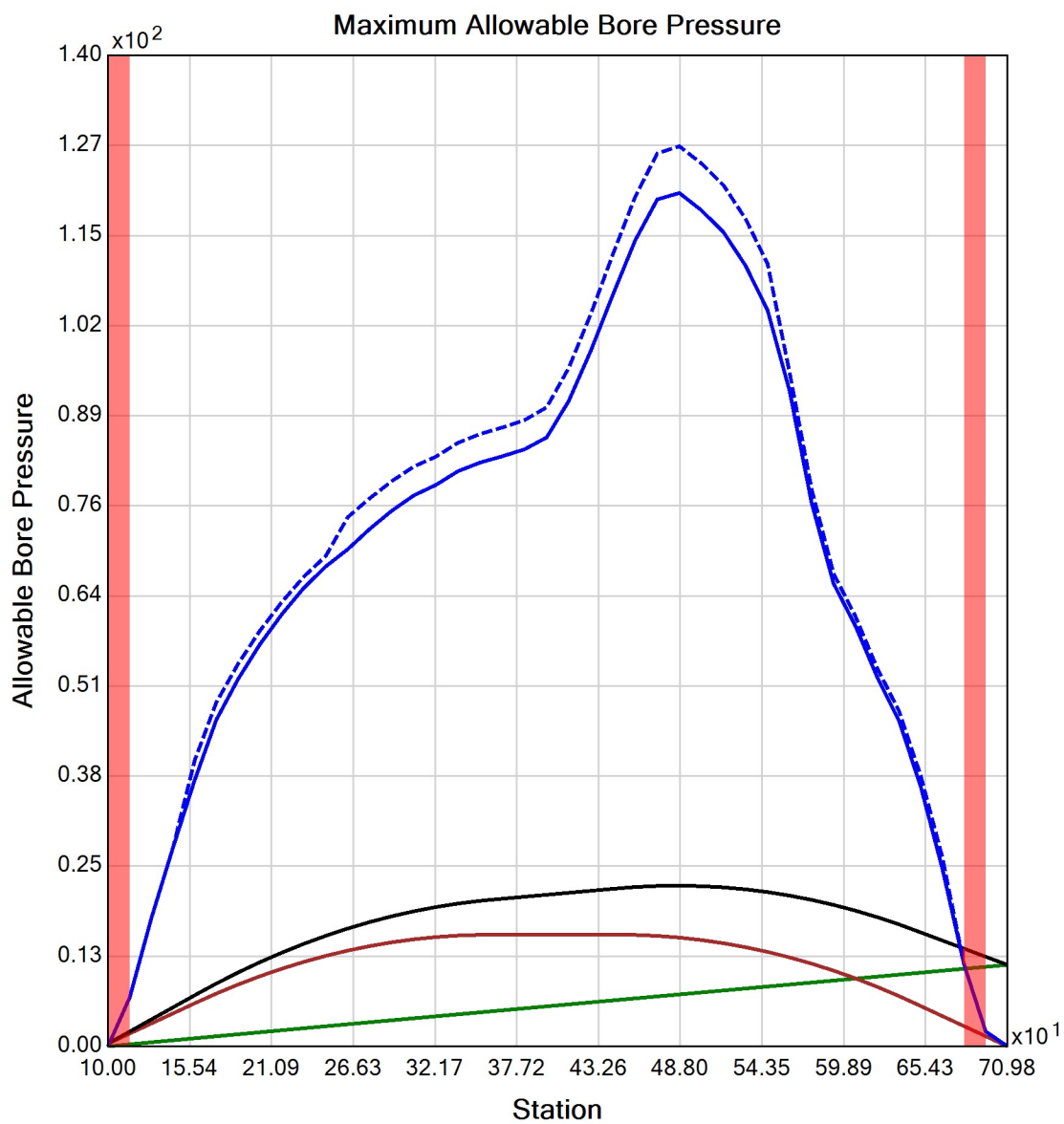














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---

## Project Summary

General: CHPE HDD 70B  
P4B  
Start Date: 12-10-2021  
End Date: 12-10-2021

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

Designer: TAR  
CHA

Description: HDD 70B 2-inch DR9

---

## Input Summary

Start Coordinate	(100.00, 0.00, 356.90) ft
End Coordinate	(700.00, 0.00, 356.20) ft
Project Length	600.00 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: 615.00 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/ft<sup>3</sup>  
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/ft<sup>3</sup>  
Hydrokinetic Pressure: 10 psi  
Ballast Unit Weight: 62.42746 lb/ft<sup>3</sup>

---

### In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	1.9	37.1
Water Pressure	7.8	7.5
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	9.8	44.5
<b>Deflection</b>		
Earth Load Deflection	0.612	10.095
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.641	10.124
<b>Compressive Stress [psi]</b>		
Compressive Wall Stress	43.9	200.5

### Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	633.1	633.1
Pullback Stress [psi]	361.8	361.8
Pullback Strain	6.291E-3	6.291E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	361.8	366.8
Tensile Strain	6.291E-3	6.478E-3

Net External Pressure = 18.3 [psi ]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb



---

### In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.641	7.5	11.7	OK
Unconstrained Collapse [psi]	21.5	131.4	6.1	OK
Compressive Wall Stress [psi]	43.9	1150.0	26.2	OK

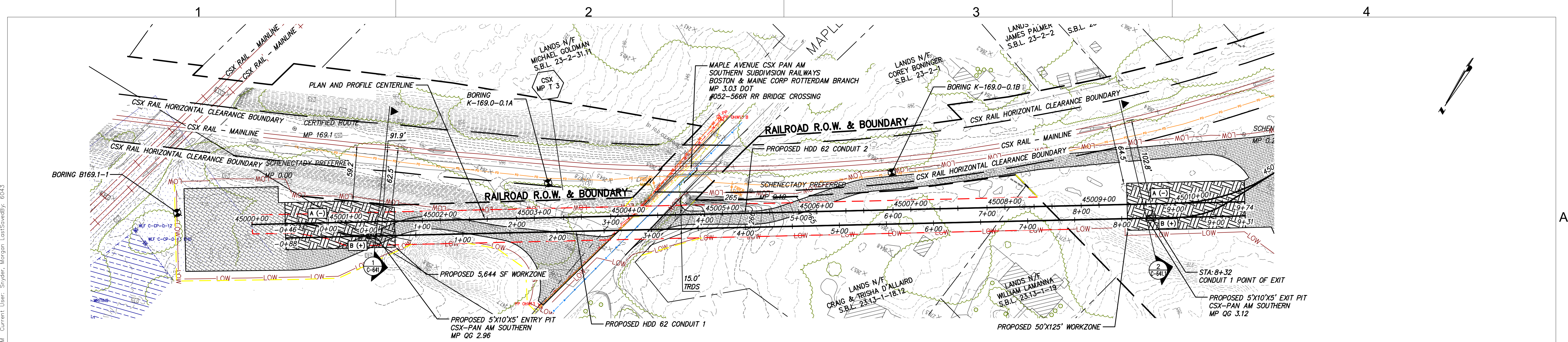
### Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	31.5	236.2	7.5	OK
Tensile Stress [psi]	366.8	1200.0	3.3	OK

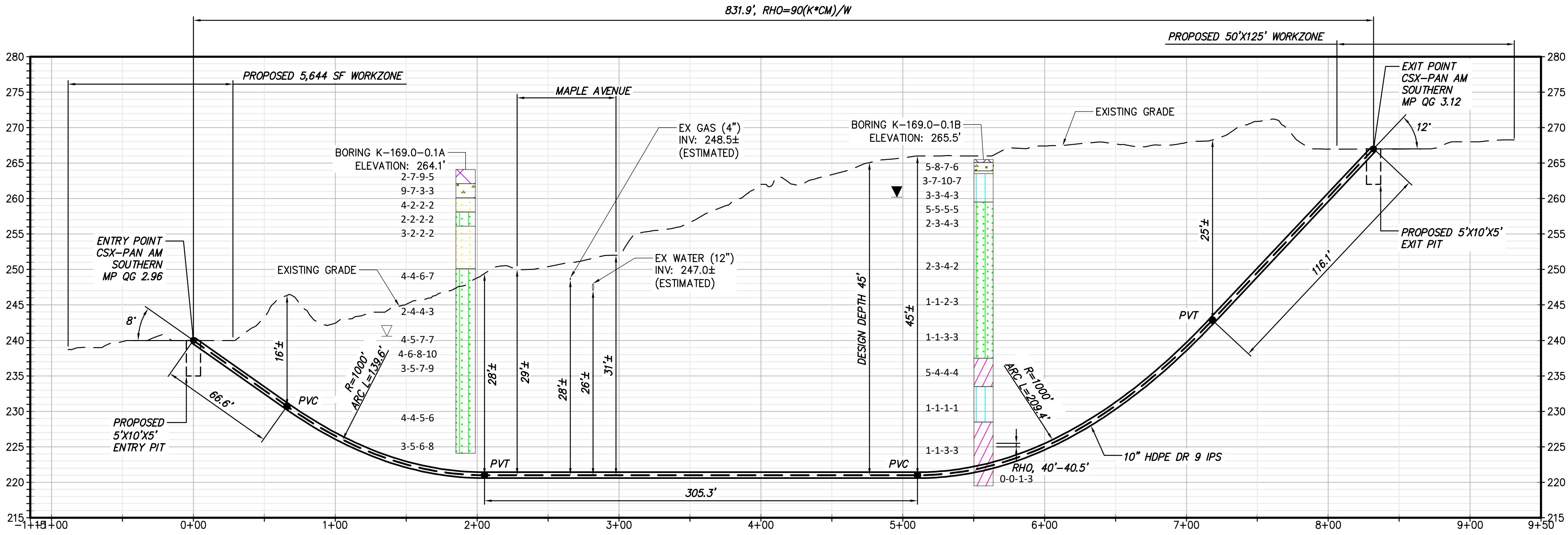
## Appendix E

### HDD Design Drawings



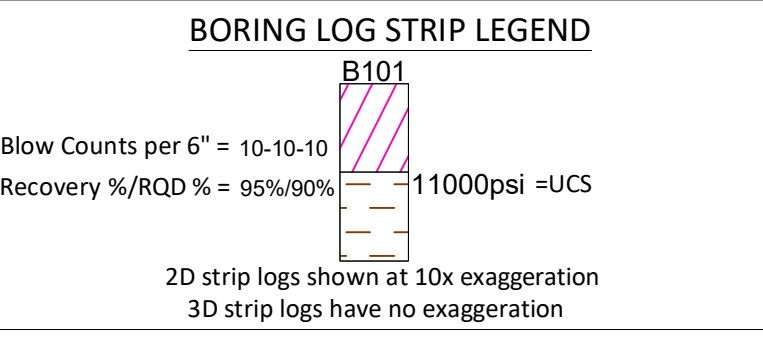


PROPOSED HDD 62 PLAN VIEW  
CONDUIT 1



PROPOSED HDD 62 PROFILE  
CONDUIT 1

NOTES:  
1. CONTRACTOR SHALL PREPARE PLANS AND CONTINGENCIES TO MANAGE THE POTENTIAL VARIATION IN MUD/SLURRY RETURNS TO THE ENTRY DUE TO THE ELEVATION GAIN ENTRY TO EXIT.  
2. A CONDUCTOR CASING IS RECOMMENDED ON THE EXIT TANGENT TO MAINTAIN THE HOLE AND PREVENT COLLAPSE IN THE ABSENCE OF HYDROSTATIC PRESSURE.



Legend		
	ASPHALT	Asphalt
	Bedrock	Bedrock
	Boulder	Boulder
	CH	Fat CLAY
	CH-MH	SILTY Fat CLAY
	CL	Lean CLAY
	CL-ML	SILTY CLAY
	CONCRETE	Concrete
	FILL	Fill
	GC	CLAYEY GRAVEL
	GC-GM	SILTY CLAYEY GRAVEL
	GM	SILTY GRAVEL
	GP	Poorly Graded GRAVEL
	GP-GC	Poorly Graded Gravel with CLAY
	GP-GM	Poorly Graded GRAVEL with SILT
	GW	Well Graded GRAVEL
	GW-GC	Well Graded GRAVEL with CLAY
	GW-GM	Well Graded GRAVEL with SILT
	Limestone	Limestone
	MH	Elastic SILT
	ML	SILT
	OH	ORGANIC Fat CLAY
	OL	ORGANIC Lean CLAY
	OL/OH	ORGANIC SOIL
	PT	PEAT
	Rock	Rock
	Sandstone	Sandstone
	SC	CLAYEY SAND
	SC-SM	SILT, CLAYEY SAND
	SHALE	Shale
	SILTSTONE	Siltstone
	SM	SILTY SAND
	SP	Poorly Graded SAND
	SP-SC	Poorly Graded SAND with CLAY
	SP-SM	Poorly Graded SAND with SILT
	SW	Well graded SAND
	SW-SC	Well Graded SAND with CLAY
	SW-SM	Well Graded SAND with SILT
	Topsoil	Topsoil
	USGS 601	Gravel or Conglomerate 1
	USGS 654	Subgraywacke
	USGS 670	Interbedded Sandstone and Shale
	USGS 702	Quartzite
	USGS 705	Schist
	USGS 705	Schist
	USGS 708	Gneiss
	USGS 708	Gneiss
	USGS 718	Granite 1
	Void	Void
	Water	Water
	Weathered Rock	Undefined
	Water Table during drilling	Water Table during drilling
	Delayed Water Table	Water Table after drilling



