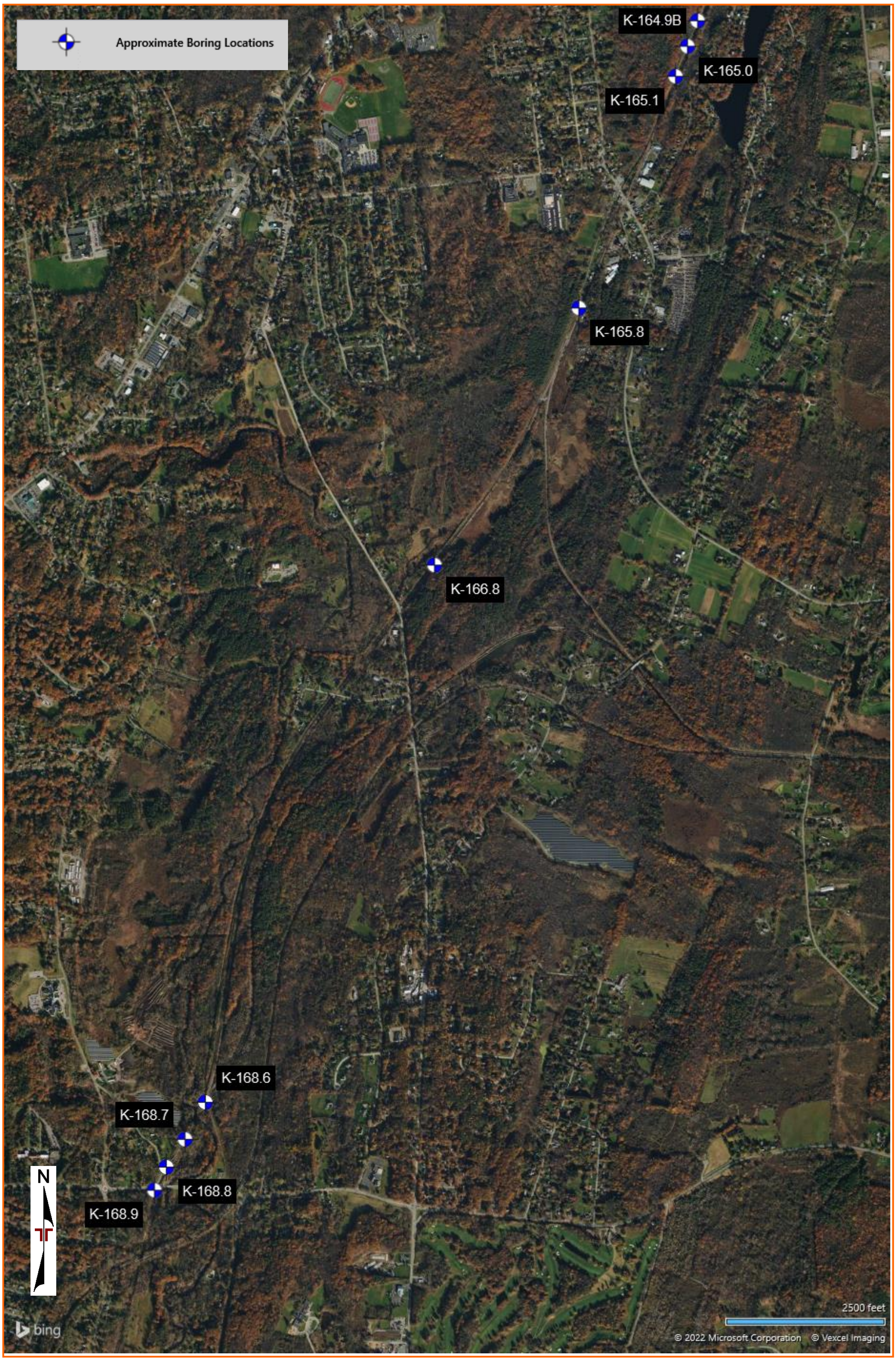


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

BORING LOG NO. K-168.6

PROJECT: Champlain-Hudson Power Express Design Package 4a

CLIENT: Kiewit Engineering (NY) Corp.

SITE: Champlain to Hudson HDD Crossings Ballston - Clifton Park - Glenville, NY

LOCATION See Exploration Plan

Latitude: 42.8708° Longitude: -73.9004°

Surface Elev.: 247.05 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
0.5	246.5	**BALLAST**
		FILL - WELL GRADED SAND WITH GRAVEL, contains ash throughout, black, very loose to medium dense
		Spoon bouncing at 3 feet on abandoned utility. Offset 4 feet and augerd to 4 feet and began sampling.
10.0	237	**SILTY SAND (SM)**, organics noted, tan, very loose
15.0	232	**LEAN CLAY WITH SAND (CL)**, occasional sand partings, brown, medium stiff
17.0	230	**SILTY SAND (SM)**, contains cobbles and boulders, and sand seams, gray, dense to very dense, (GLACIAL TILL)

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		10	9-8-8-6 N=16			
		3	4-10			
5		10	2-2-2-3 N=4			
		12	1-2-1-2 N=3	17.7		5
		1	4-2-2-3 N=4			
10		12	1/12"-1/12"	31.1		46
15		10	3-3-3-9 N=6	26.5	37-22-15	83
20		28	12-14-16-16 N=30			
25		15	17-53-50/4"			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4 1/4 ID HSA

Abandonment Method:
Boring backfilled with bentonite grout upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by Kiewit

Notes:

Logged by JCH
Hammer Efficiency Summary:
Energy Transfer Ratio: 84.7% +/-5.0%
Hammer Efficiency Correction (CE):1.41

WATER LEVEL OBSERVATIONS

No measurable groundwater prior to grouting

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 04-11-2022
Boring Completed: 04-11-2022
Drill Rig: Diedrich D-50
Driller: S. Morey
Project No.: JB215256A

BORING LOG NO. K-168.6

PROJECT: Champlain-Hudson Power Express Design Package 4a

CLIENT: Kiewit Engineering (NY) Corp.

SITE: Champlain to Hudson HDD Crossings Ballston - Clifton Park - Glenville, NY

LOCATION See Exploration Plan

Latitude: 42.8708° Longitude: -73.9004°

Surface Elev.: 247.05 (Ft.)

DEPTH ELEVATION (Ft.)

GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), contains cobbles and boulders, and sand seams, gray, dense to very dense, (GLACIAL TILL) *(continued)*									
	30			1	13-50/1"				
	35			14	27-42-50/4"				
	40			14	26-34-50/4"		12.2		47
	45			10	45-50/4"				
				22	3" Split Spoon Bulk Sample				
	50			24	17-46-50/4" 3" Split Spoon Bulk Sample				
				22	3" Split Spoon Bulk Sample				
	55			10	25-50/4"		7.7		24

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4 1/4 ID HSA

Abandonment Method:
Boring backfilled with bentonite grout upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by Kiewit

Notes:

Logged by JCH
Hammer Efficiency Summary:
Energy Transfer Ratio: 84.7% +/-5.0%
Hammer Efficiency Correction (CE):1.41
3 back to back 3" split spoons taken from 48 to 54 feet to collect bulk samples

WATER LEVEL OBSERVATIONS

No measurable groundwater prior to grouting

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 04-11-2022 Boring Completed: 04-11-2022

Drill Rig: Diedrich D-50 Driller: S. Morey

Project No.: JB215256A

BORING LOG NO. K-168.6

PROJECT: Champlain-Hudson Power Express Design Package 4a

CLIENT: Kiewit Engineering (NY) Corp.

SITE: Champlain to Hudson HDD Crossings Ballston - Clifton Park - Glenville, NY

LOCATION See Exploration Plan

Latitude: 42.8708° Longitude: -73.9004°

Surface Elev.: 247.05 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILTY SAND (SM), contains cobbles and boulders, and sand seams, gray, dense to very dense, (GLACIAL TILL) *(continued)*		60								
	61.8	185.5				14	23-25-50 N=75				
	Boring Terminated at 61.8 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4 1/4 ID HSA

Abandonment Method:
Boring backfilled with bentonite grout upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by Kiewit

Notes:

Logged by JCH
Hammer Efficiency Summary:
Energy Transfer Ratio: 84.7% +/-5.0%
Hammer Efficiency Correction (CE):1.41

WATER LEVEL OBSERVATIONS

No measurable groundwater prior to grouting

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 04-11-2022 | Boring Completed: 04-11-2022

Drill Rig: Diedrich D-50 | Driller: S. Morey

Project No.: JB215256A

BORING LOG NO. K-168.7

PROJECT: Champlain-Hudson Power Express Design Package 4a

CLIENT: Kiewit Engineering (NY) Corp.

SITE: Champlain to Hudson HDD Crossings Ballston - Clifton Park - Glenville, NY

LOCATION See Exploration Plan

Latitude: 42.8692° Longitude: -73.9016°

Surface Elev.: 244.54 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
0.5	244	**CRUSHED STONE**
		FILL - SILTY SAND WITH GRAVEL, occasional cobbles and boulders, orange and brown, loose to medium dense
8.0	236.5	**SANDY SILT (ML)**, organics noted, orange and brown, medium stiff
15.0	229.5	**LEAN CLAY WITH SAND (CL)**, brown, soft
20.0	224.5	**SILTY SAND WITH GRAVEL (SM)**, occasional cobbles and boulders, gray, very dense, (GLACIAL TILL)

DEPTH (Ft.)	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	6	2-6-3-3 N=9			
	10	6-8-14-4 N=22			
5	18	7-16-12-11 N=28			
	18	11-6-5-9 N=11			
	18	1-2-2-3 N=4			
10	20	2-3-3-4 N=6	28.1		62
15	18	1-1-2-18 N=3	29.8	33-22-11	76
20	8	13-50/4"			
25	16	12-21-45 N=66			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4 1/4" ID HSA

Abandonment Method:
Boring backfilled with bentonite grout upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by Kiewit

Notes:

Logged by JCH
Hammer Efficiency Summary:
Energy Transfer Ratio: 91.3% +/-2.7%
Hammer Efficiency Correction (CE):1.52

WATER LEVEL OBSERVATIONS

No measurable groundwater prior to grouting

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 04-06-2022
Boring Completed: 04-06-2022
Drill Rig: CME 750x
Driller: J. Lamm
Project No.: JB215256A

BORING LOG NO. K-168.7

PROJECT: Champlain-Hudson Power Express Design Package 4a

CLIENT: Kiewit Engineering (NY) Corp.

SITE: Champlain to Hudson HDD Crossings Ballston - Clifton Park - Glenville, NY

LOCATION See Exploration Plan

Latitude: 42.8692° Longitude: -73.9016°

Surface Elev.: 244.54 (Ft.)

DEPTH ELEVATION (Ft.)

GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND WITH GRAVEL (SM), occasional cobbles and boulders, gray, very dense, (GLACIAL TILL) *(continued)*									
	30			18	17-26-31 N=57		5.6		39
	35			10	20-50/4"				
	40			11	37-50/5"				
	45			8	6-50/4"				
				20	3" Split Spoon With Ring Sampler				
	50			8	27-50/4" 3" Split Spoon				
				24	3" Split Spoon				
	55			10	20-27-35		8.2		17

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4 1/4" ID HSA

Abandonment Method:
Boring backfilled with bentonite grout upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by Kiewit

Notes:

Logged by JCH
Hammer Efficiency Summary:
Energy Transfer Ratio: 91.3% +/-2.7%
Hammer Efficiency Correction (CE):1.52
One ring sampler obtained from 48' to 48.5' and back to back
3" split spoons taken to 54' to collect bulk samples

WATER LEVEL OBSERVATIONS

No measurable groundwater prior to grouting

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 04-06-2022 | Boring Completed: 04-06-2022

Drill Rig: CME 750x | Driller: J. Lamm

Project No.: JB215256A

BORING LOG NO. K-168.7

PROJECT: Champlain-Hudson Power Express Design Package 4a

CLIENT: Kiewit Engineering (NY) Corp.

SITE: Champlain to Hudson HDD Crossings Ballston - Clifton Park - Glenville, NY

LOCATION See Exploration Plan

Latitude: 42.8692° Longitude: -73.9016°

Surface Elev.: 244.54 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILTY SAND WITH GRAVEL (SM), occasional cobbles and boulders, gray, very dense, (GLACIAL TILL) *(continued)*						N=62				
	60.9	183.5	60			6	50-50/5"				
	Boring Terminated at 60.9 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4 1/4" ID HSA

Abandonment Method:
Boring backfilled with bentonite grout upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by Kiewit

Notes:

Logged by JCH
Hammer Efficiency Summary:
Energy Transfer Ratio: 91.3% +/-2.7%
Hammer Efficiency Correction (CE):1.52

WATER LEVEL OBSERVATIONS

No measurable groundwater prior to grouting

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 04-06-2022 | Boring Completed: 04-06-2022

Drill Rig: CME 750x | Driller: J. Lamm

Project No.: JB215256A

Summary of Laboratory Results

BORING ID	Depth (Ft.)	Organic Content (%)
K-160.1	4-6	0.8
K-165.8	2-4	75.5
K-168.6	4-6	7.4

PROJECT: Champlain-Hudson Power Express Design Package 4a

SITE: Champlain to Hudson HDD Crossings Ballston - Clifton Park - Glenville, NY

Terracon
30 Corporate Cir Ste 201
Albany, NY

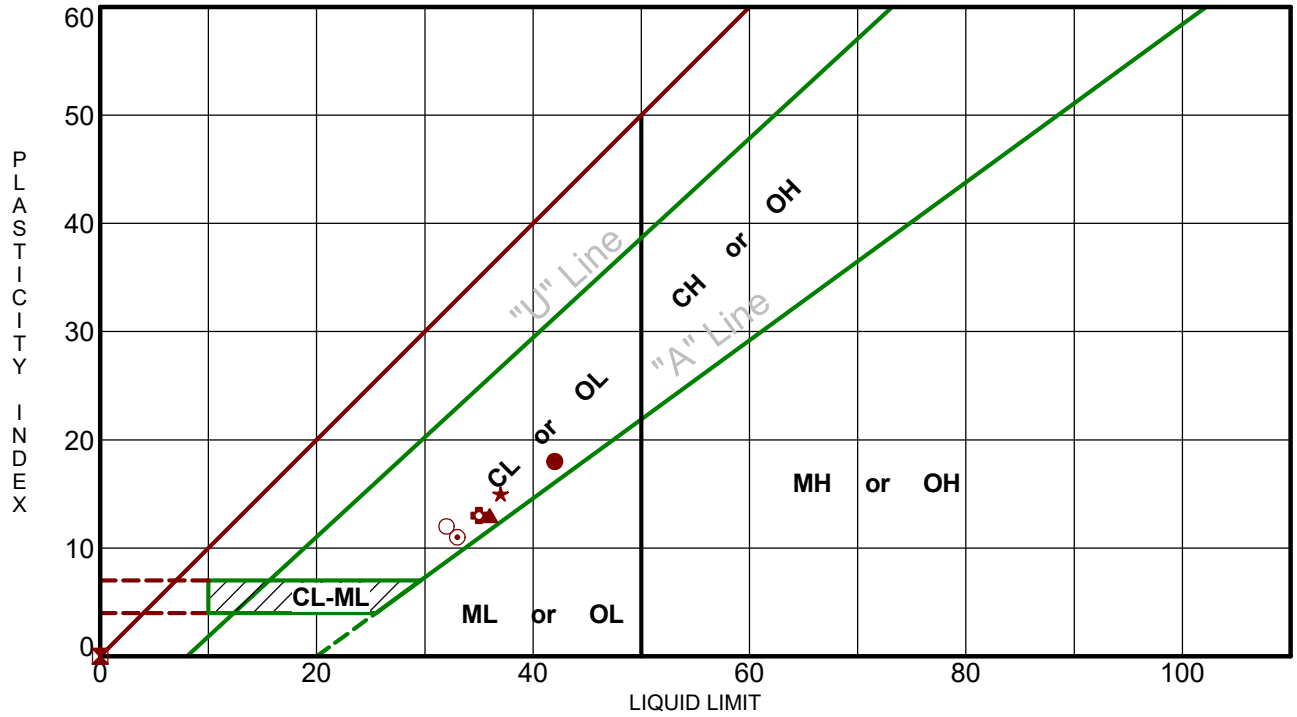
PROJECT NUMBER: JB215256A

CLIENT: Kiewit Engineering (NY) Corp.

EXHIBIT: B-1

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID		Depth (Ft)	LL	PL	PI	Fines	USCS	Description
●	K-164.9B	4 - 6	42	24	18	59.2	CL	SANDY LEAN CLAY
⊠	K-165.1	6 - 8	NP	NP	NP	15.9	GM	SILTY GRAVEL with SAND
▲	K-165.8	4 - 6	36	23	13	85.3	CL	LEAN CLAY
★	K-168.6	15 - 17	37	22	15	82.9	CL	LEAN CLAY with SAND
⊙	K-168.7	15 - 17	33	22	11	76.4	CL	LEAN CLAY with SAND
✿	K-168.8	15 - 17	35	22	13	92.5	CL	LEAN CLAY
○	K-168.9	6 - 8	32	20	12	79.6	CL	LEAN CLAY with SAND

PROJECT: Champlain-Hudson Power Express
Design Package 4a

SITE: Champlain to Hudson HDD Crossings
Ballston - Clifton Park - Glenville, NY

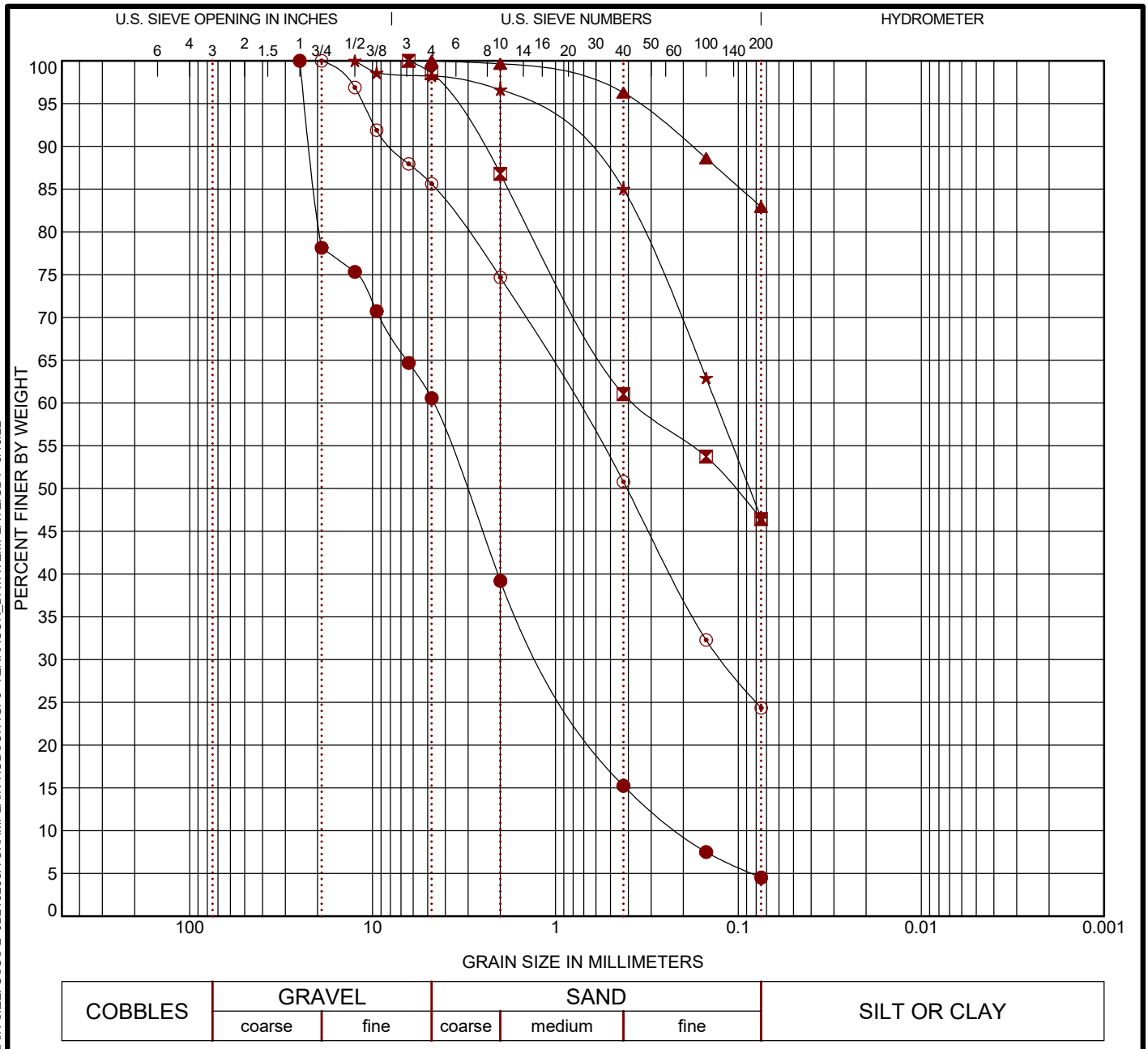
Terracon
30 Corporate Cir Ste 201
Albany, NY

PROJECT NUMBER: JB215256A

CLIENT: Kiewit Engineering (NY) Corp.

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth (Ft)	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	K-168.6	6 - 8	WELL-GRADED SAND with GRAVEL (SW)	17.7				1.25	22.11
⊠	K-168.6	10 - 12	SILTY SAND (SM)	31.1					
▲	K-168.6	15 - 17	LEAN CLAY with SAND (CL)	26.5	37	22	15		
★	K-168.6	40 - 41.3	SILTY SAND (SM)	12.2					
⊙	K-168.6	55 - 55.8	SILTY SAND (SM)	7.7					

	Boring ID	Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
●	K-168.6	6 - 8	25	4.643	1.104	0.21	0.0	39.4	56.0		4.5	
⊠	K-168.6	10 - 12	6.35	0.367			0.0	1.4	52.1		46.4	
▲	K-168.6	15 - 17	4.75				0.0	0.0	17.1		82.9	
★	K-168.6	40 - 41.3	12.5	0.133			0.0	1.8	51.7		46.6	
⊙	K-168.6	55 - 55.8	19	0.772	0.123		0.0	14.4	61.3		24.3	

PROJECT: Champlain-Hudson Power Express Design Package 4a

SITE: Champlain to Hudson HDD Crossings Ballston - Clifton Park - Glenville, NY

Terracon
30 Corporate Cir Ste 201
Albany, NY

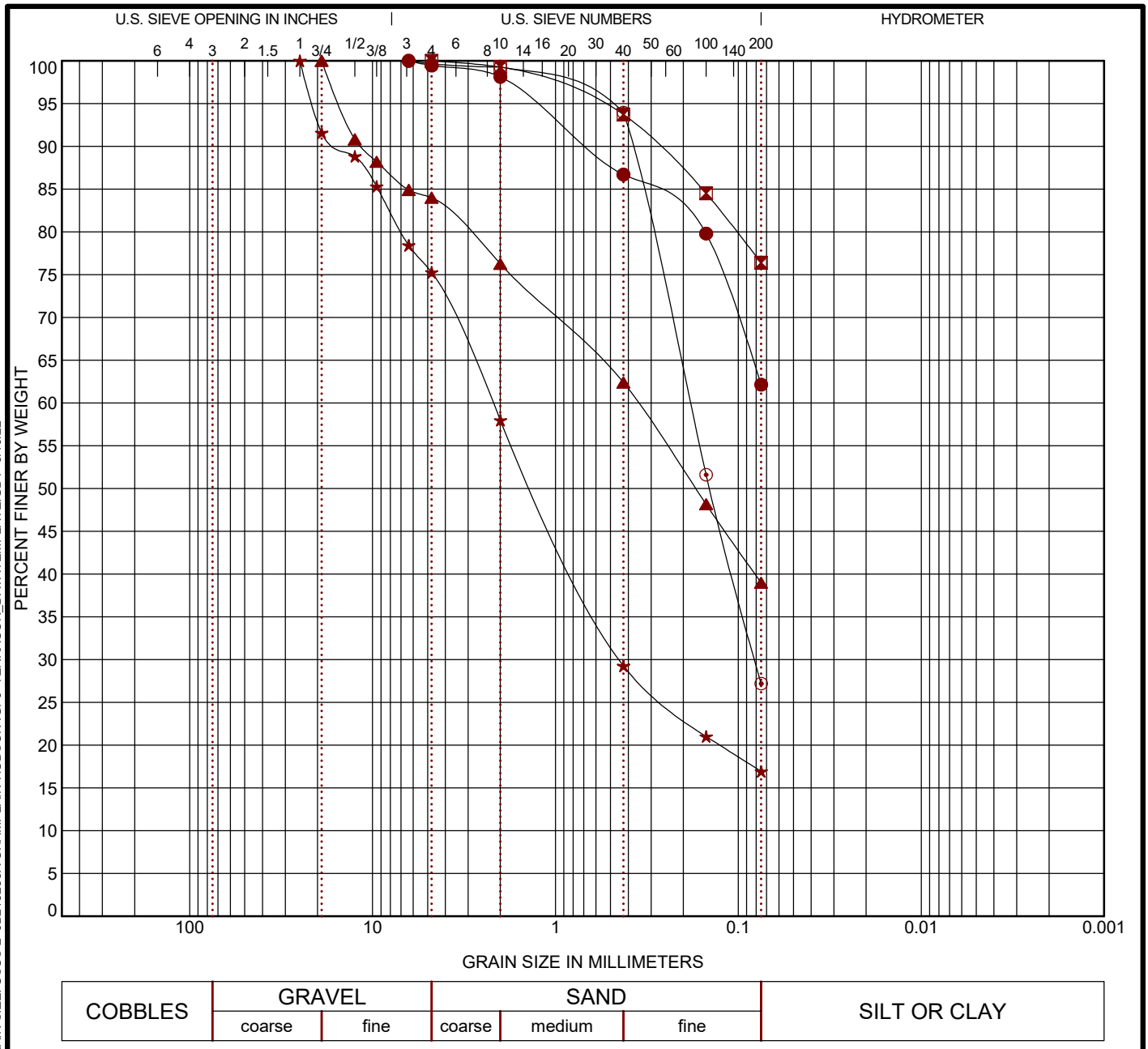
PROJECT NUMBER: JB215256A

CLIENT: Kiewit Engineering (NY) Corp.

EXHIBIT: B-3

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth (Ft)	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	K-168.7	10 - 12	SANDY SILT (ML)	28.1					
⊠	K-168.7	15 - 17	LEAN CLAY with SAND (CL)	29.8	33	22	11		
▲	K-168.7	30 - 31.5	SILTY SAND with GRAVEL (SM)	5.6					
★	K-168.7	55 - 56.5	SILTY SAND with GRAVEL (SM)	8.2					
⊙	K-168.8	6 - 8	SILTY SAND (SM)	21.7					

	Boring ID	Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
●	K-168.7	10 - 12	6.35				0.0	0.6	37.3		62.1	
⊠	K-168.7	15 - 17	4.75				0.0	0.0	23.6		76.4	
▲	K-168.7	30 - 31.5	19	0.357			0.0	16.0	45.0		39.0	
★	K-168.7	55 - 56.5	25	2.213	0.442		0.0	24.7	58.3		16.9	
⊙	K-168.8	6 - 8	6.35	0.184	0.081		0.0	0.4	72.4		27.2	

PROJECT: Champlain-Hudson Power Express Design Package 4a

SITE: Champlain to Hudson HDD Crossings Ballston - Clifton Park - Glenville, NY

Terracon
30 Corporate Cir Ste 201
Albany, NY

PROJECT NUMBER: JB215256A

CLIENT: Kiewit Engineering (NY) Corp.

EXHIBIT: B-4

Kiewit

MEMORANDUM

DATE: January 19, 2023

TO: Antonio Marruso, P.E.; CHA Consulting, Inc.

FROM: Matthew Hawley, P.E.; Kiewit Engineering (NY) Corp. MKH
Jaren Knighton; Kiewit Engineering (NY) Corp.

SUBJECT: Geotechnical Data: Segment 6 – Package 4A – HDD Crossing 61 – Revision 1
Champlain Hudson Power Express Project
East Glenville, New York

Kiewit Engineering is providing the attached geotechnical data for use in the horizontal direction drill (HDD) design for the Champlain Hudson Power Express project in Upstate New York. This HDD crossing is located in East Glenville, New York. The approximate station for the start of HDD crossing Number 61 is STA 40521+00 (42.8681°N, 73.9028°W).

The geotechnical data at this HDD crossing is attached. The available data is from the previous investigation by TRC and from a recent investigation by Terracon, referenced below.

- TRC, Geotechnical Data Report, Champlain Hudson Power Express, Canadian Pacific Railway Borings MP 113.1-177.1, dated March 29, 2013.
- Terracon, Results of Field Exploration, Champlain Hudson Power Express, Ballston – Clifton Park – Glenville, NY, dated June 22, 2022

Contact us if you have questions or require additional information.

HDD 61
Borings K-168.8, B168.86-1,
K-168.9
Segment 6 - Design Package 4A

CHPE Segment 6 Package 4A
Soil Boring Coordinates and Elevations

Firm	Boring	Northing (feet)	Easting (feet)	Ground Surface Elevation (feet)
TRC*	A162.1-1	1502786.734	664476.477	284.0
	B158.87-1	1519228.136	669050.444	288.3
	B159.1-1	1517722.124	668720.464	291.0
	B159.5-1	1516012.300	668217.400	295.8
	B160.3-1	1511903.990	667182.915	294.6
	B160.7-1	1509749.417	666636.945	295.0
	B161.4-1	1506284.600	665799.100	288.0
	B163.3-1	1496630.400	662351.700	280.2
	B164.4-1	1490795.529	661205.362	267.5
	B165.5-1	1485722.400	659432.900	277.6
	B165.8-1	1484324.089	658853.809	275.4
	B166.5-1	1480752.600	656954.600	263.5
	B166.9-1	1479253.700	655902.600	265.4
	B167.1-1	1478553.300	655364.300	261.0
	B168.0-1	1474529.400	653290.100	251.4
	B168.64-1	1471082.866	652655.655	245.2
	B168.86-1	1470035.900	652059.906	231.6
AECOM**	BM-1	1500593.800	663479.000	283.4
	BM-1B	1513675.554	667631.458	293.5
	BM-1C	1508115.700	666263.900	291.9
	BM-1D	1504574.200	665267.500	283.4
	BM-1E	1511220.853	667016.761	294.1
	BM-2	1494386.900	661852.400	271.4
	BM-2A	1498788.900	662752.200	279.1
	BM-2B	1492715.315	661511.300	269.7
	BM-3	1487269.097	659995.860	275.1
	BM-3A	1488755.829	660606.619	270.8
	BM-3B	1482501.900	658059.300	273.6
	BM-3C	1480192.269	656553.384	263.2
	BM-4	1477890.500	654882.600	260.5

Notes:
- Northings and Eastings are provided in NAD83 New York State Plane East Zone.
- Elevations are referenced to the NAVD88 datum.

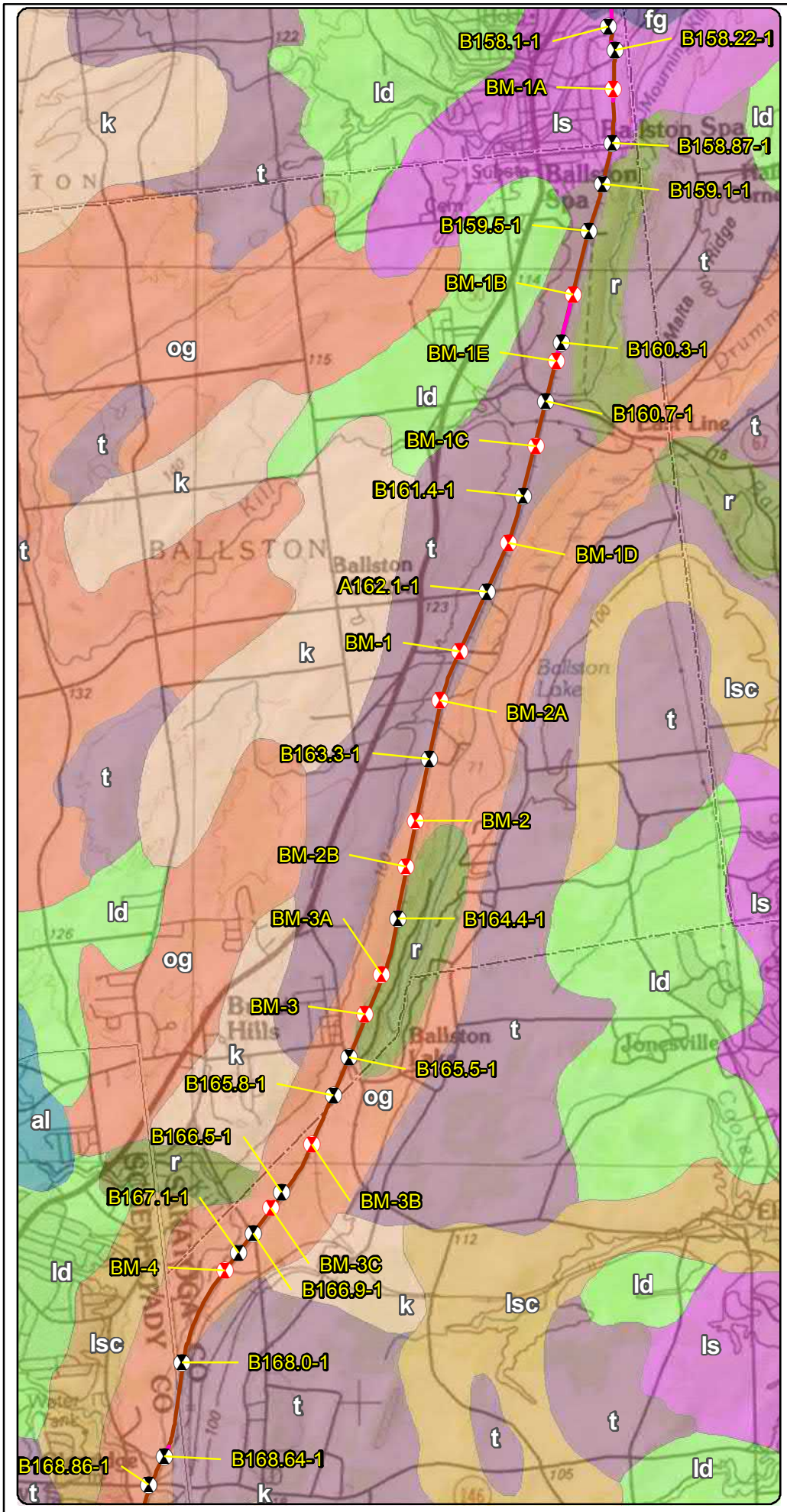
* TRC boring coordinates as shown in Table 1-6 in AECOM report (reference below). Boring elevations estimated from November 2021 topographic survey by Williams Aerial.

** AECOM boring coordinates and elevations as shown in Table 1-6 in AECOM report.

*** Kiewit boring coordinates and elevations are noted on the boring logs.

Reference:

AECOM, Geotechnical Data Report, Upland Segments: Putnam Station, Washington County, to Cementon, Green County, NY, Champlain Hudson Power Express, dated May 28, 2021.



LEGEND

- 2021 Boring Location
- Previous (2013) Boring Location
- Terrestrial Route HVDC
- Submarine Route HVDC
- Terrestrial Route HVAC
- Preliminary HDD Locations
- Preliminary Pipe Bridge Location
- Town Boundary
- County Boundary

Surficial Geology

- al - Recent alluvium
- fg - Fluvial sand and/or gravel
- k - Kame deposits
- ld - Lacustrine delta
- ls - Lacustrine sand
- lsc - Lacustrine silt and clay
- og - Outwash sand and gravel
- r - Bedrock
- t - Till

N

0.5 0.25 0 0.5 Miles

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

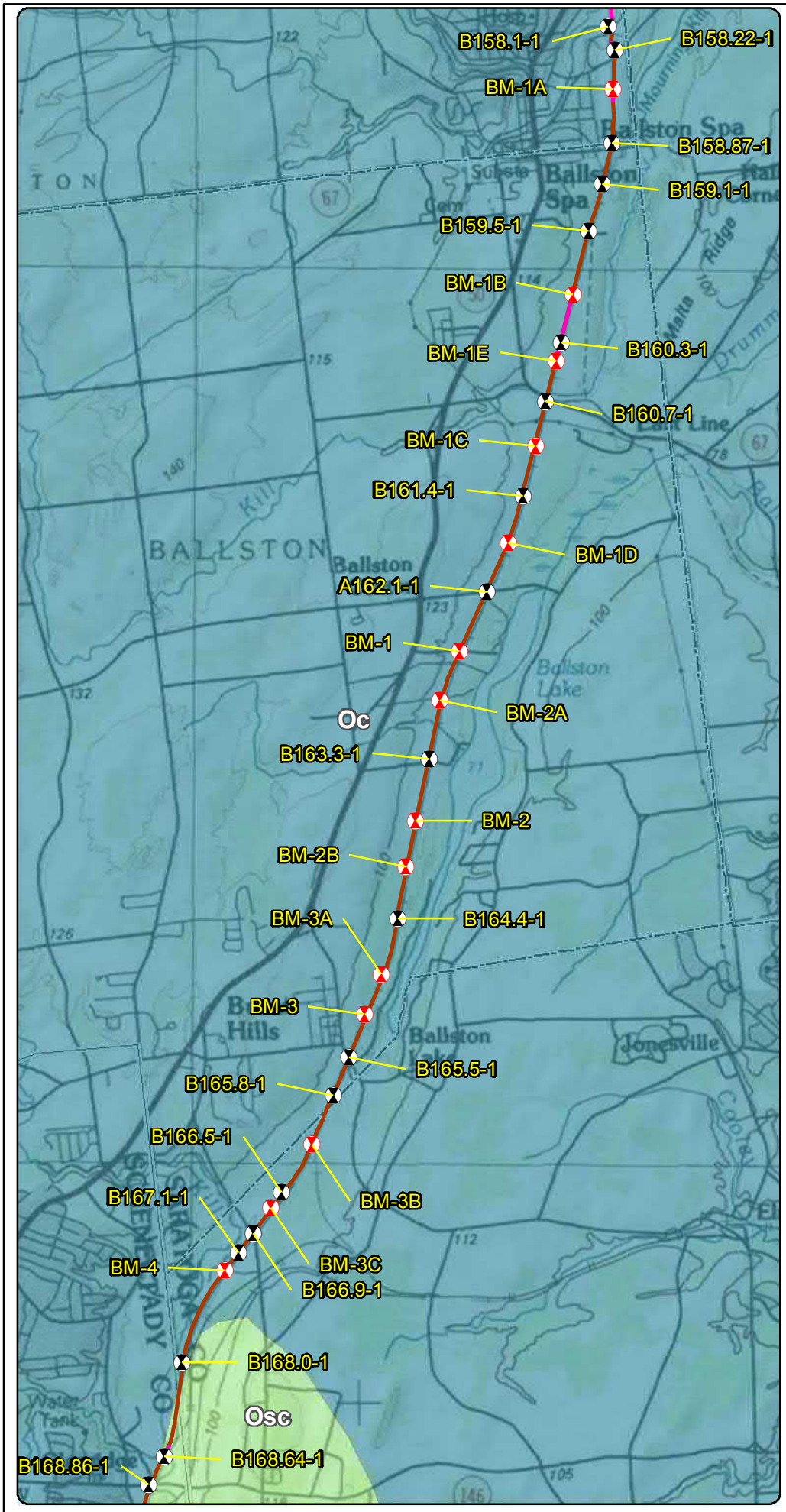
Surficial Geology and Geotechnical Borings Ballston to Mohawk River Figure 3-6

Prepared on 5/5/2021

by: AECOM

DATA SOURCES: ESRI, NYSDOT, NOAA, USACE, NYDOS, TDI, TRC

Y:\Projects\CHPE\\Route\Consensus_Alternative_Routes\MXD\Alt_5_Routes_DZ_20190\Boring_Locations\Maps_for_May_2021_Report\Ballston_to_Mohawk_Boring_Locations_Surficial_May_2021_Report.mxd



LEGEND

- 2021 Boring Location
- Previous (2013) Boring Location
- Terrestrial Route HVDC
- Submarine Route HVDC
- Terrestrial Route HVAC
- Preliminary HDD Locations
- Preliminary Pipe Bridge Location
- Town Boundary
- County Boundary

Bedrock Geology

- Oc - Canajoharie Shale
- Osc - Schenectady Formation

* Schenectady Formation includes: graywacke, sandstone, siltstone, shale

N

0.5 0.25 0 0.5 Miles

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Bedrock Geology and Geotechnical Borings Ballston to Mohawk River Figure 4-6

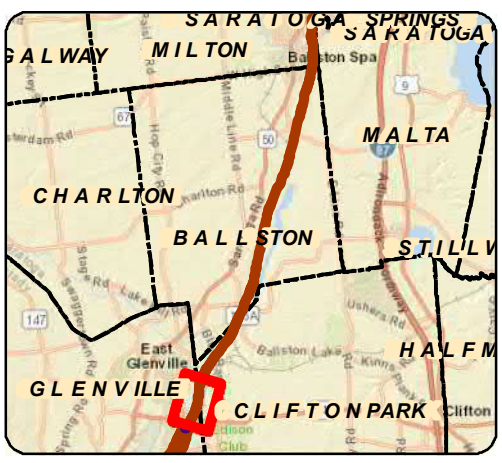
Prepared on 5/5/2021

by: AECOM

DATA SOURCES: ESRI, NYSDOT, NOAA, USACE, NYDOS, TDI, TRC

Y:\Projects\CHPE\Route\Consensus_Alternative_Routes\MXD\Alt_5_Routes_DZ_20190\Boring_Locations\Maps_for_May_2021_Report\Ballston_to_Mohawk_Boring_Locations_Bedrock_May_2021_Report.mxd

167.8
167.9
B168.0-1
168
168.1
168.2
CLIFTON PARK
168.3
168.4
GLENVILLE
168.5
168.6
B168.64-1
168.7
168.8
B168.86-1
169
Brady Rd
Hetcheltown Rd
Maple Ave
Glenridge Rd
Madison Ave
Bracket Ave
Bruce Dr
Deerfield Ct
Rail Systems
0
1,000
Feet



LEGEND

- 111.8 Certified Milepost - Tenths
- 135 Certified Milepost
- 111.8 Preferred Alternative Milepost - Tenths
- 135 Preferred Alternative Milepost
- Terrestrial Route HVDC
- Submarine Route HVDC
- Terrestrial Route HVAC
- Preliminary HDD Locations
- Preliminary Pipe Bridge Location
- 2021 Boring Location
- Previous (2013) Boring Location
- Streams/Ditches
- Railroad ROW
- Deviation Zone
- Deviation Zone Outside ROW
- Preferred Alternative Deviation Zone
- Preferred Alternative Deviation Zone Outside ROW
- Town Boundary
- Village Boundary
- State Park (OPRHP)

Parcel Ownership: TOWN NAME

Road Name: Village Name

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

BORING LOCATION PLAN

Ballston to Mohawk River

Figure A-6

Sheet 9 of 9

Prepared by: AECOM 5/19/2021

DATA SOURCES: ESRI, NETWORK MAPPING 2010, NYSDOT, OPRHP, TDI, TRC

Y:\Projects\CHPE\Route\Consensus_Alternative_Routes\MXD\Alt_5_Routes_DZ_201909\Boring_Locations\Maps_for_May_2021_Report\Ballston_to_Mohawk_Boring_Locations_Mapset_May_2021_Report.mxd

TEST BORING LOG

PROJECT: TDI CHAMPLAIN HUDSON POWER EXPRESS
LOCATION: CP RAILROAD ROW, NY

BORING	**B168.86-1**
G.S. ELEV.	N/A
FILE	195651
SHEET	1 OF 1

GROUNDWATER DATA			
FIRST ENCOUNTERED 8.0 '			
DEPTH	HOUR	DATE	ELAPSED TIME
16.0'	3:55	2/12	6HR

METHOD OF ADVANCING BOREHOLE				
a	FROM	0.0 '	TO	4.0 '
d	FROM	4.0 '	TO	29.4 '

DRILLER	T. FARRELL
HELPER	J. LANGDON
INSPECTOR	C. POPPE
DATE STARTED	02/12/2013
DATE COMPLETED	02/12/2013

DEPTH	A	B	C	DESCRIPTION	Wn	REMARKS
	S-1	12 18 13 9		***BROWN/BLACK SILT, SM F/GRAVEL, TR TO SM F/SAND (FILL)*** 2.0		
	S-2	6 5 6 5		***GRAY SILT*** 4.0	23.6	
5	S-3	4 5 4 5			25.8	
	S-4	4 4 5 5			26.6	
10	S-5	WH 1 1 2		***LIGHT BROWN TO GRAY SILT, SM CLAY*** 13.5	34.7	
15	S-6	1 2 2			28.8	
20	S-7	11 15 20		***BROWN F/M SAND, TR SILT, TR F/ GRAVEL*** 23.5		
25	S-8	10 19 22				
	S-9	35 50/.4		***BLUE GREY SILT AND F/C GRAVEL SIZED ROCK FRAGMENTS, TR TO SM F/SAND (TILL)*** 29.4		
30				***END OF BORING AT 29.4'***		
35						

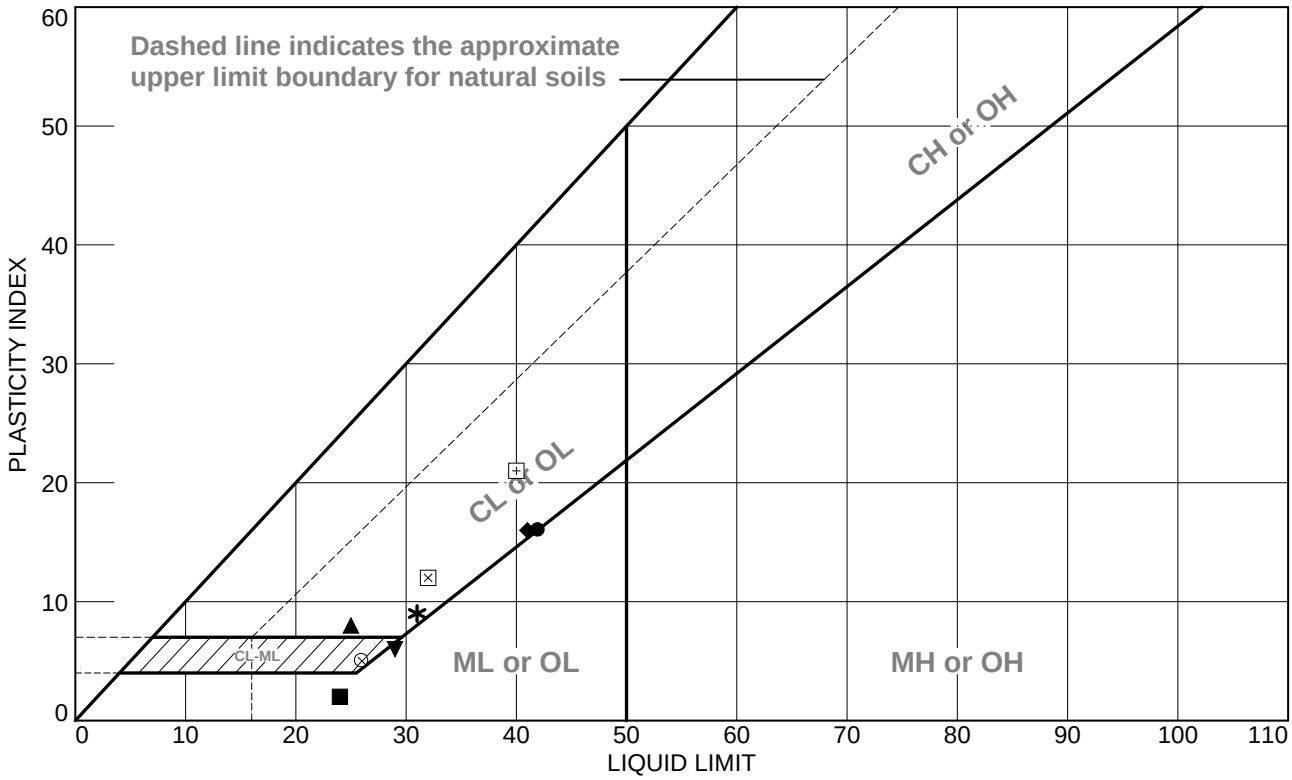
DRN.	JPB
CKD.	PWK

SUMMARY OF LABORATORY TEST DATA

Project Name: TDI Champlain Hudson Power Express – CP
Client Name: Transmission Developers, Inc.
TRC Project #: 195651

SAMPLE IDENTIFICATION			Soil Group (USCS System)	GRAIN SIZE DISTRIBUTION				PLASTICITY				Specific Gravity	Moisture Content (%)	Unit Weight (pcf)	Compressive Strength (tsf)	Organic Content (%)
Boring #	Sample #	Depth (ft)		Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Liquidity Index)					
	S-6	13.5-15.0	CL	-	-	-	-	41	25	16	0.1	-	27.2	-	-	-
B168.86-1	S-2	2.0-4.0	-	-	-	-	-	-	-	-	-	-	23.6	-	-	-
	S-3	4.0-6.0	-	-	-	-	-	-	-	-	-	-	25.8	-	-	-
	S-4	6.0-8.0	ML	-	-	-	-	29	23	6	0.6	-	26.6	-	-	-
	S-5	8.0-10.0	-	-	-	-	-	-	-	-	-	-	34.7	-	-	-
	S-6	13.5-15.0	SP-SM	1.1	93.2	5.7		-	-	-	-	-	28.8	-	-	-
B169.1-1	S-7	18.5-20.0	SM	13.6	65.6	20.8		-	-	-	-	-	20.5	-	-	-
B169.65-1	S-2	2.0-4.0	-	-	-	-	-	-	-	-	-	-	24.9	-	-	-
	S-4	6.0-8.0	-	-	-	-	-	-	-	-	-	-	37.3	90.7	-	-
	S-6	13.5-15.0	CL	-	-	-	-	31	22	9	0.9	-	30.1	-	-	-
B170.1-1	S-1	0.0-2.0	-	-	-	-	-	-	-	-	-	-	17.7	-	-	-
	S-3	4.0-6.0	-	-	-	-	-	-	-	-	-	-	29.0	-	-	-
	S-4	6.0-8.0	-	-	-	-	-	-	-	-	-	-	21.9	105.7	-	-

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

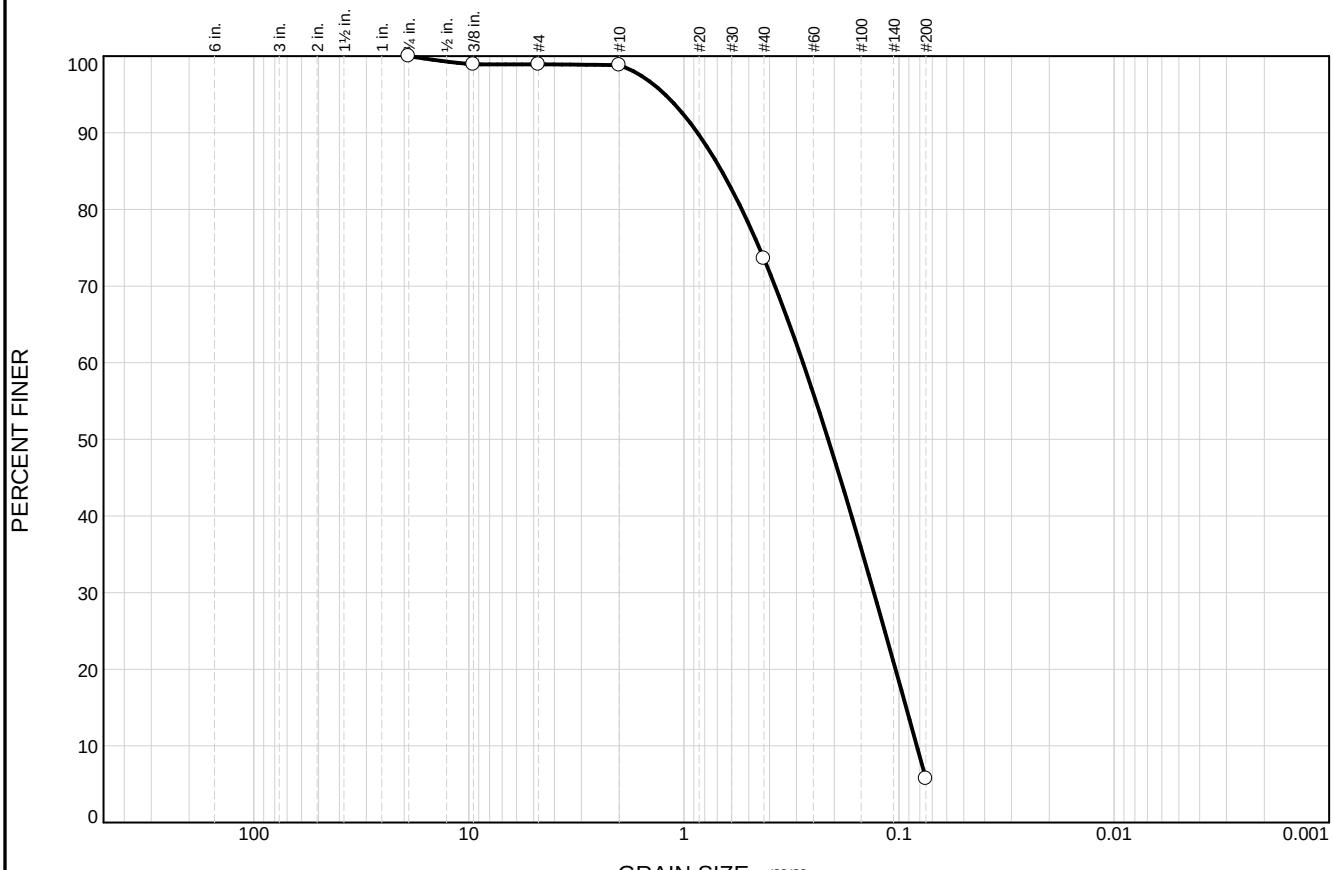
	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	B151.58-1	S-3	4.0-6.0 FT	32.5	26	42	16	CL/ML
■	B157.9-1	S-5	8.0-10.0 FT	19.5	22	24	2	ML
▲	B161.4-1	S-3	4.0-6.0 FT	14.3	17	25	8	CL
◆	B168.64-1	S-6	13.5-15.0 FT	27.2	25	41	16	CL
▼	B168.86-1	S-4	6.0-8.0 FT	26.6	23	29	6	ML
✱	B169.65-1	S-6	13.5-15.0 FT	30.1	22	31	9	CL
⊕	B172.8-1	S-6	13.5-15.0 FT	18.3	NP	NV	NP	
⊞	B173.1-1	S-7	18.5-20.0 FT	26.3	19	40	21	CL
⊗	B173.9-1	S-6	13.5-15.0 FT	27.4	21	26	5	CL-ML
⊠	B176.4-1	S-7	13.5-15.0 FT	31.2	20	32	12	CL

TRC
Engineers, Inc.
Mt. Laurel, NJ

Client: TDI CHAMPLAIN HUDSON POWER EXPRESS - CP
Project: TRANSMISSION DEVELOPERS, INC.

Project No.: 195651 **Figure** 3

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	1.1	0.1	25.2	67.9	5.7	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.6674	0.2796	0.2136	0.1309	0.0926	0.0826	0.74	3.38

Material Description	USCS	AASHTO
○ BROWN F/M SAND, TR SILT, TR F/ GRAVEL	SP-SM	

Project No. 195651 **Client:** TDI CHAMPLAIN HUDSON POWER EXPRESS - CP
Project: TRANSMISSION DEVELOPERS, INC.

○ **Source of Sample:** B168.86-1 **Depth:** 13.5-15.0 FT **Sample Number:** S-6

Remarks:
○SAMPLE DESCRIPTION BASED ON VISUAL IDENTIFICATION AND LABORATORY ANALYSIS

TRC Engineers, Inc.

Mt. Laurel, NJ

Figure 89

Tested By: BMH 02/21/13 **Checked By:** _____

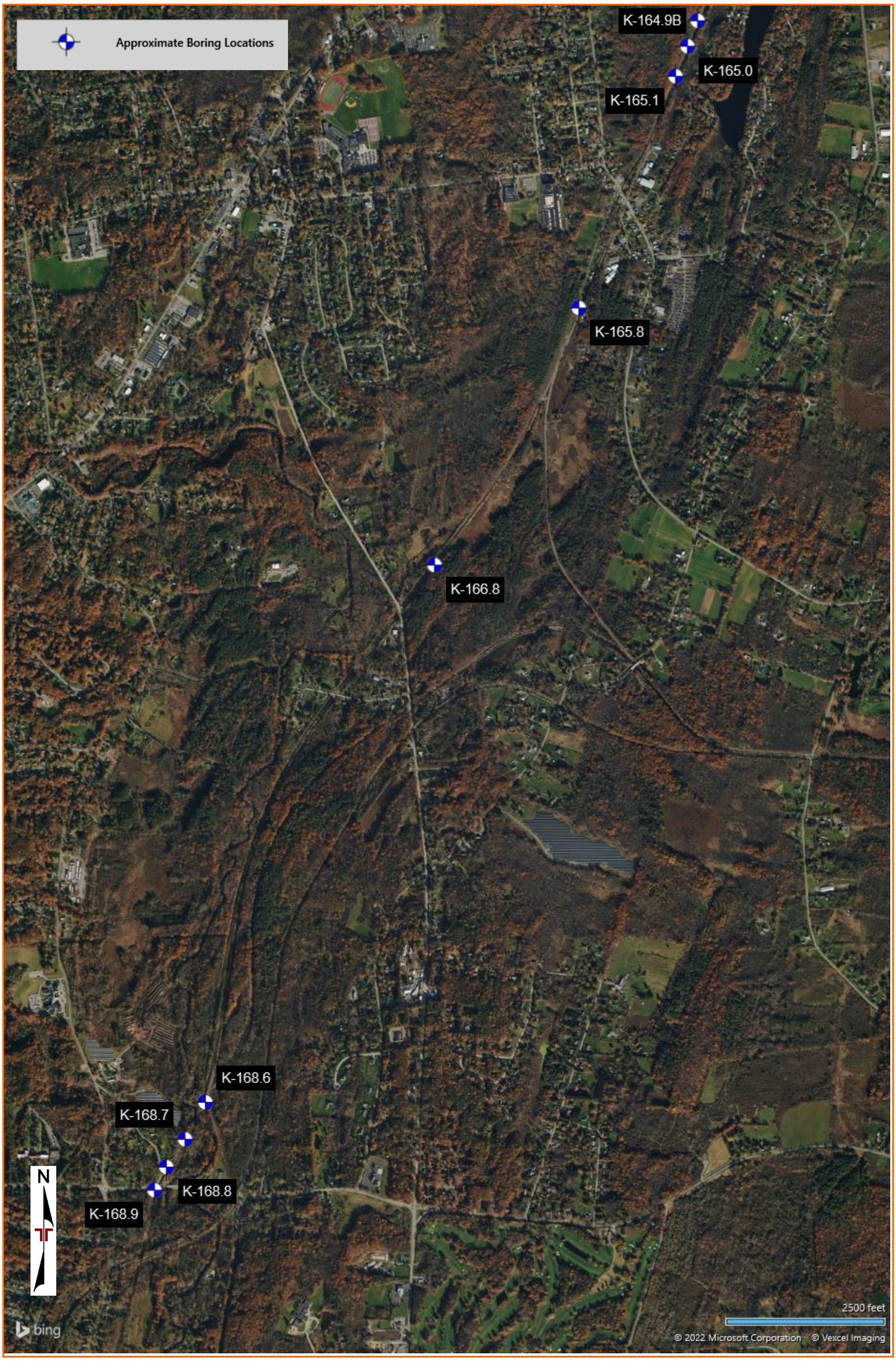


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

BORING LOG NO. K-168.8

PROJECT: Champlain-Hudson Power Express Design Package 4a

CLIENT: Kiewit Engineering (NY) Corp.

SITE: Champlain to Hudson HDD Crossings Ballston - Clifton Park - Glenville, NY

LOCATION See Exploration Plan

Latitude: 42.8680° Longitude: -73.9027°

Surface Elev.: 237.54 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
		FILL - POORLY GRADED SAND, contains concrete and bricks, black, medium dense
6.0	231.5	
		SILTY SAND (SM), brown, loose to medium dense
10.0	227.5	
		LEAN CLAY (CL), brown, soft to medium stiff
		grades gray
20.0	217.5	
		SILTY SAND (SM), occasional cobbles and boulders, gray, medium dense to very dense, (GLACIAL TILL)

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
			17	6-7-11-11 N=18				
			12	11-8-9-10 N=17				
5			20	11-8-9-7 N=17				
			20	7-6-4-4 N=10		21.7		27
	▽		22	2-2-3-4 N=5				
10			12	5-2-3-3 N=5				
15			19	2-1-2-1 N=3		38.3	35-22-13	92
20			24	6-8-5-11 N=13				
25			8	18-30-25-11 N=55				

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4 1/4" HSA

Abandonment Method:
Boring backfilled with bentonite grout upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by Kiewit

Notes:

Logged by MO
Hammer Efficiency Summary:
Energy Transfer Ratio: 77.4% +/-2.7%
Hammer Efficiency Correction (CE):1.29

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 04-04-2022	Boring Completed: 04-04-2022
Drill Rig: CME 550x	Driller: B. Duffy
Project No.: JB215256A	

BORING LOG NO. K-168.8

PROJECT: Champlain-Hudson Power Express Design Package 4a

CLIENT: Kiewit Engineering (NY) Corp.

SITE: Champlain to Hudson HDD Crossings Ballston - Clifton Park - Glenville, NY

LOCATION See Exploration Plan

Latitude: 42.8680° Longitude: -73.9027°

Surface Elev.: 237.54 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	PERCENT FINES
SILTY SAND (SM), occasional cobbles and boulders, gray, medium dense to very dense, (GLACIAL TILL) *(continued)*		30					
				17	20-25-42-54 N=67	5.4	35
				NR	32-50 3" Split Spoon Bulk Sample		
		35		NR	50-100 3" Split Spoon Bulk Sample		
40.7	197	40		8	47-50/2"		
Boring Terminated at 40.7 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4 1/4" HSA

Abandonment Method:
Boring backfilled with bentonite grout upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by Kiewit

Notes:

Logged by MO
Hammer Efficiency Summary:
Energy Transfer Ratio: 77.4% +/-2.7%
Hammer Efficiency Correction (CE):1.29
NR = Not Recorded. Sample for bulk testing only

WATER LEVEL OBSERVATIONS

While drilling

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 04-04-2022 | Boring Completed: 04-04-2022

Drill Rig: CME 550x | Driller: B. Duffy

Project No.: JB215256A

BORING LOG NO. K-168.9

PROJECT: Champlain-Hudson Power Express Design Package 4a

CLIENT: Kiewit Engineering (NY) Corp.

SITE: Champlain to Hudson HDD Crossings Ballston - Clifton Park - Glenville, NY

LOCATION See Exploration Plan

Latitude: 42.8670° Longitude: -73.9034°

Surface Elev.: 232.15 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
		FILL - LEAN CLAY, with gravel and silt, brown, medium stiff to stiff
4.0	228	
		FILL - LEAN CLAY WITH SAND, brown and gray, soft to stiff
12.0	220	
		POORLY GRADED SAND WITH SILT (SP-SM), gray, medium dense
24.0	208	
		SILTY SAND WITH GRAVEL (SM), gray, very dense, (GLACIAL TILL)

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		14	2-4-4-5 N=8			
		13	6-5-6-8 N=11			
5		15	8-8-7-8 N=15			
		24	6-5-5-5 N=10	29.6	32-20-12	80
		24	4-3-3-3 N=6			
10		24	1-2-2-2 N=4			
15		24	6-4-13-15 N=17	24.7		7
20		10	5-5-5-3 3" Split Spoon			
		10	3-5-5-3 N=10			
25		16	5-28-38-53 3" Split Spoon With Ring Sampler	8.3		33

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4 1/4" HSA

Abandonment Method:
Boring backfilled with bentonite grout upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by Kiewit

Notes:

Logged by MO
Hammer Efficiency Summary:
Energy Transfer Ratio: 77.4% +/-2.7%
Hammer Efficiency Correction (CE):1.29
Attempted TR Sample 22 to 24, running sands encountered, did not stay in the spoon during withdrawal. Drove 3" Spoon with rings from 24 to 26. Obtained ring sample and bulk sample.

WATER LEVEL OBSERVATIONS

No measurable groundwater prior to grouting

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 04-06-2022 | Boring Completed: 04-07-2022

Drill Rig: CME 550x | Driller: B. Duffy

Project No.: JB215256A

BORING LOG NO. K-168.9

PROJECT: Champlain-Hudson Power Express Design Package 4a

CLIENT: Kiewit Engineering (NY) Corp.

SITE: Champlain to Hudson HDD Crossings Ballston - Clifton Park - Glenville, NY

LOCATION See Exploration Plan

Latitude: 42.8670° Longitude: -73.9034°

Surface Elev.: 232.15 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILTY SAND WITH GRAVEL (SM), gray, very dense, (GLACIAL TILL) *(continued)*										
			30			13	12-25-50/5"				
			35			1	50/1"				
			40			17	13-19-53 N=72		9.4		
	42.0	190									
	Boring Terminated at 42 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4 1/4" HSA

Abandonment Method:
Boring backfilled with bentonite grout upon completion

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by Kiewit

Notes:

Logged by MO
Hammer Efficiency Summary:
Energy Transfer Ratio: 77.4% +/-2.7%
Hammer Efficiency Correction (CE):1.29
Attempted TR Sample 22 to 24, running sands encountered, did not stay in the spoon during withdrawal. Drove 3" Spoon with rings from 24 to 26. Obtained ring sample and bulk sample.

WATER LEVEL OBSERVATIONS

No measurable groundwater prior to grouting

Terracon
30 Corporate Cir Ste 201
Albany, NY

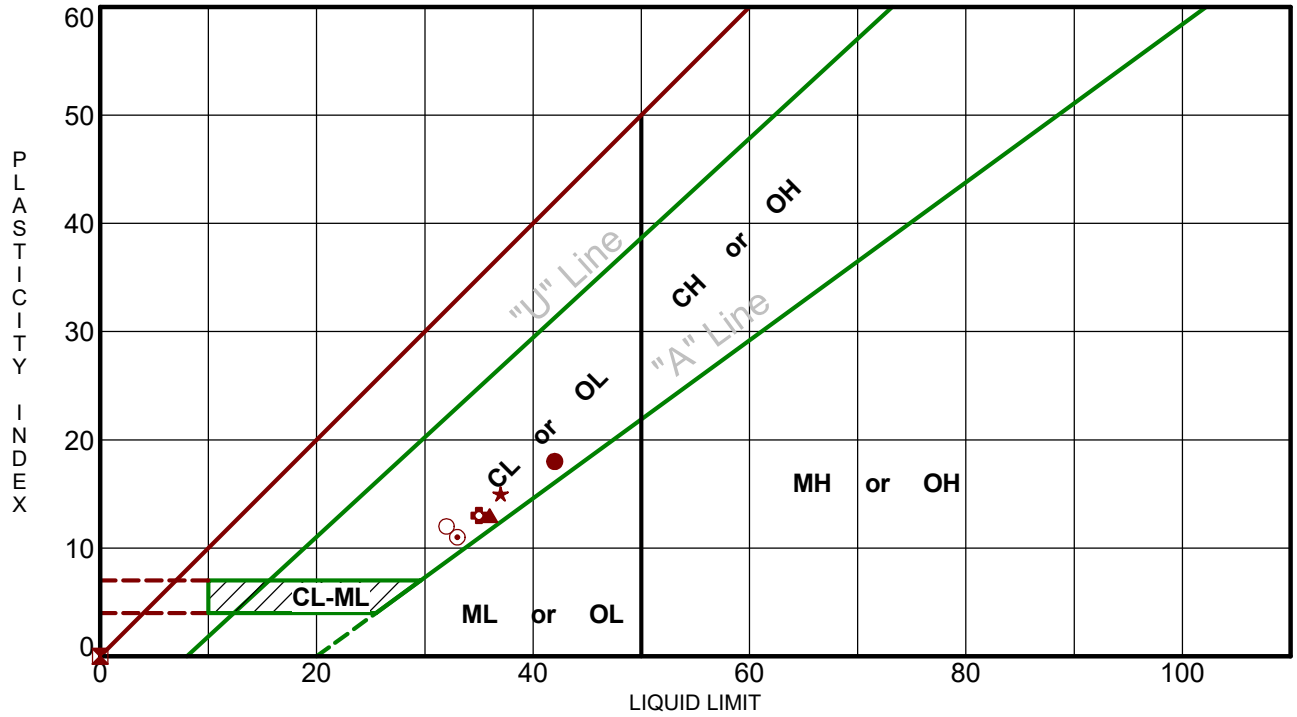
Boring Started: 04-06-2022 | Boring Completed: 04-07-2022

Drill Rig: CME 550x | Driller: B. Duffy

Project No.: JB215256A

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID		Depth (Ft)	LL	PL	PI	Fines	USCS	Description
●	K-164.9B	4 - 6	42	24	18	59.2	CL	SANDY LEAN CLAY
⊠	K-165.1	6 - 8	NP	NP	NP	15.9	GM	SILTY GRAVEL with SAND
▲	K-165.8	4 - 6	36	23	13	85.3	CL	LEAN CLAY
★	K-168.6	15 - 17	37	22	15	82.9	CL	LEAN CLAY with SAND
⊙	K-168.7	15 - 17	33	22	11	76.4	CL	LEAN CLAY with SAND
✿	K-168.8	15 - 17	35	22	13	92.5	CL	LEAN CLAY
○	K-168.9	6 - 8	32	20	12	79.6	CL	LEAN CLAY with SAND

PROJECT: Champlain-Hudson Power Express
Design Package 4a

SITE: Champlain to Hudson HDD Crossings
Ballston - Clifton Park - Glenville, NY

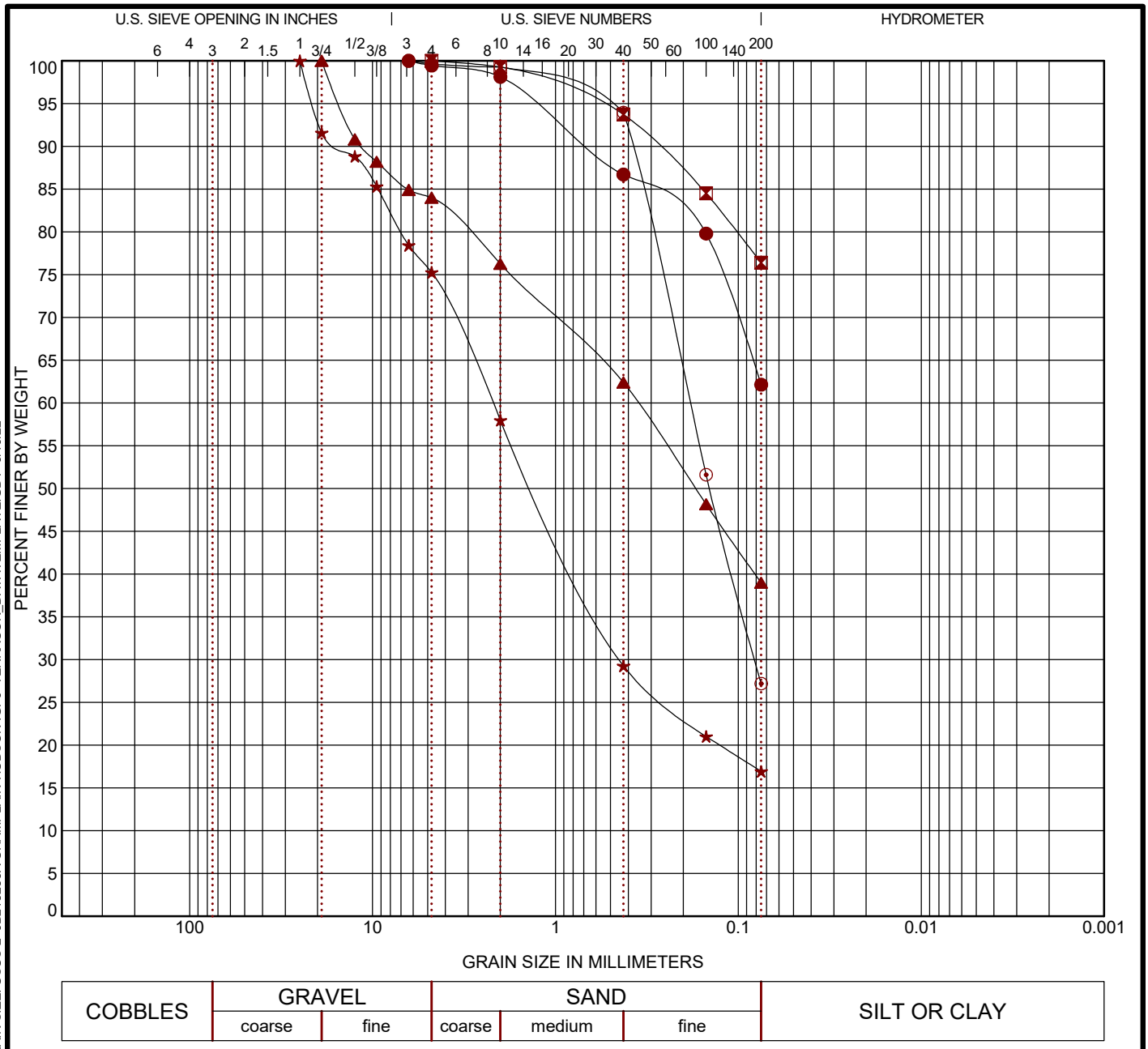
Terracon
30 Corporate Cir Ste 201
Albany, NY

PROJECT NUMBER: JB215256A

CLIENT: Kiewit Engineering (NY) Corp.

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth (Ft)	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	K-168.7	10 - 12	SANDY SILT (ML)	28.1					
⊠	K-168.7	15 - 17	LEAN CLAY with SAND (CL)	29.8	33	22	11		
▲	K-168.7	30 - 31.5	SILTY SAND with GRAVEL (SM)	5.6					
★	K-168.7	55 - 56.5	SILTY SAND with GRAVEL (SM)	8.2					
⊙	K-168.8	6 - 8	SILTY SAND (SM)	21.7					

	Boring ID	Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
●	K-168.7	10 - 12	6.35				0.0	0.6	37.3		62.1	
⊠	K-168.7	15 - 17	4.75				0.0	0.0	23.6		76.4	
▲	K-168.7	30 - 31.5	19	0.357			0.0	16.0	45.0		39.0	
★	K-168.7	55 - 56.5	25	2.213	0.442		0.0	24.7	58.3		16.9	
⊙	K-168.8	6 - 8	6.35	0.184	0.081		0.0	0.4	72.4		27.2	

PROJECT: Champlain-Hudson Power Express Design Package 4a

SITE: Champlain to Hudson HDD Crossings Ballston - Clifton Park - Glenville, NY

Terracon
30 Corporate Cir Ste 201
Albany, NY

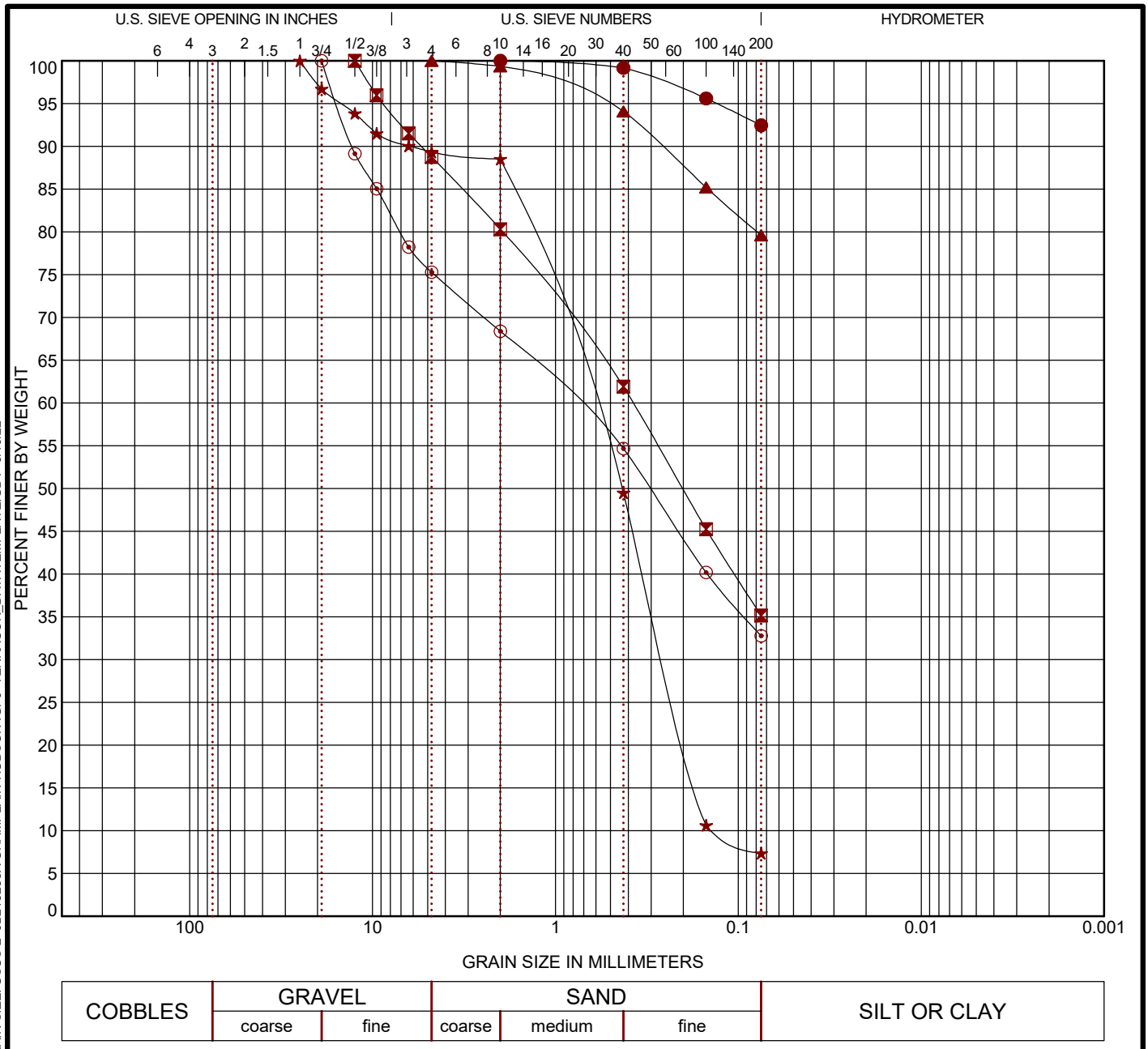
PROJECT NUMBER: JB215256A

CLIENT: Kiewit Engineering (NY) Corp.

EXHIBIT: B-4

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth (Ft)	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	K-168.8	15 - 17	LEAN CLAY (CL)	38.3	35	22	13		
⊠	K-168.8	30 - 32	SILTY SAND (SM)	5.4					
▲	K-168.9	6 - 8	LEAN CLAY with SAND (CL)	29.6	32	20	12		
★	K-168.9	15 - 17	POORLY GRADED SAND with SILT (SP-SM)	24.7				0.75	4.91
⊙	K-168.9	24 - 26	SILTY SAND with GRAVEL (SM)	8.3					

	Boring ID	Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
●	K-168.8	15 - 17	2				0.0	0.0	7.5		92.5	
⊠	K-168.8	30 - 32	12.5	0.377			0.0	11.2	53.6		35.2	
▲	K-168.9	6 - 8	4.75				0.0	0.0	20.4		79.6	
★	K-168.9	15 - 17	25	0.644	0.252	0.131	0.0	10.7	82.0		7.4	
⊙	K-168.9	24 - 26	19	0.776			0.0	24.7	42.5		32.8	

PROJECT: Champlain-Hudson Power Express Design Package 4a

SITE: Champlain to Hudson HDD Crossings Ballston - Clifton Park - Glenville, NY

Terracon
30 Corporate Cir Ste 201
Albany, NY

PROJECT NUMBER: JB215256A

CLIENT: Kiewit Engineering (NY) Corp.

EXHIBIT: B-5

Appendix D

BoreAid HDD Simulation Output

Generated Output

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Project Summary

General:	CHPE HDD 51
	P4A
	Start Date: 04-25-2023
	End Date: 04-25-2023
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA
Designer:	MDB
	BCE
	Amherst, MA
Description:	HDD 51 Conduit 1 10-inch DR9 reversed

Input Summary

Start Coordinate	(0.00, 0.00, 293.00) ft
End Coordinate	(1907.00, 0.00, 283.00) ft
Project Length	1907.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

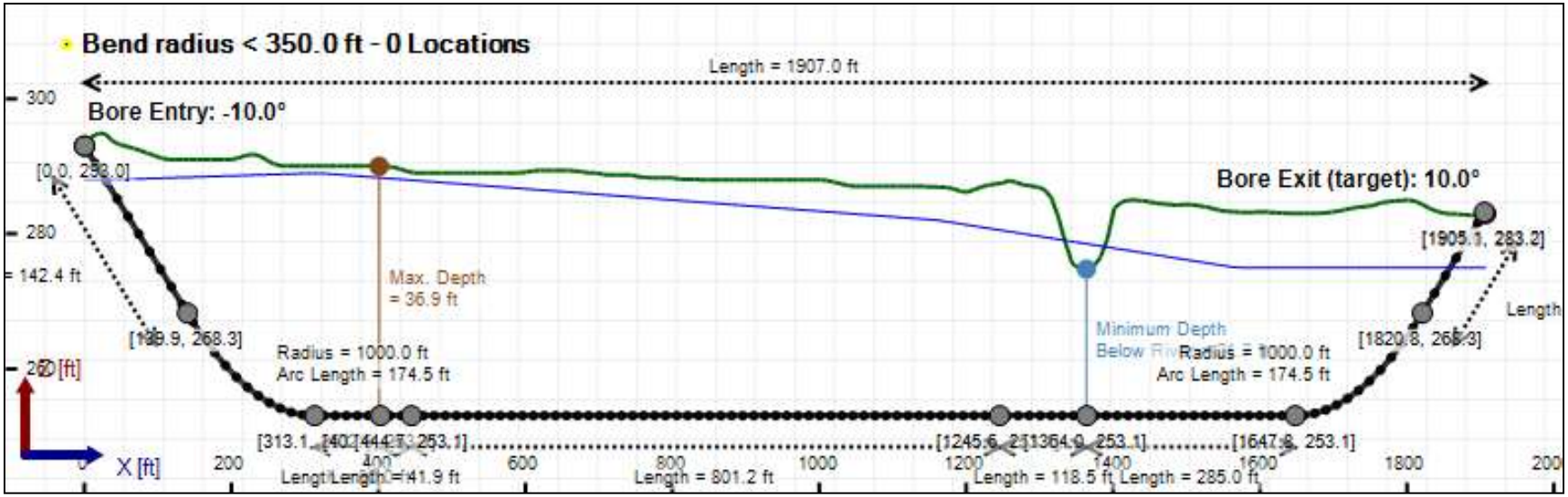
Number of Layers: 3

Soil Layer #1 USCS, Sand (S), SP
From Assistant
Unit Weight: 110.0000 (dry), 120.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 300.00, Coh: 0.00 [psi]

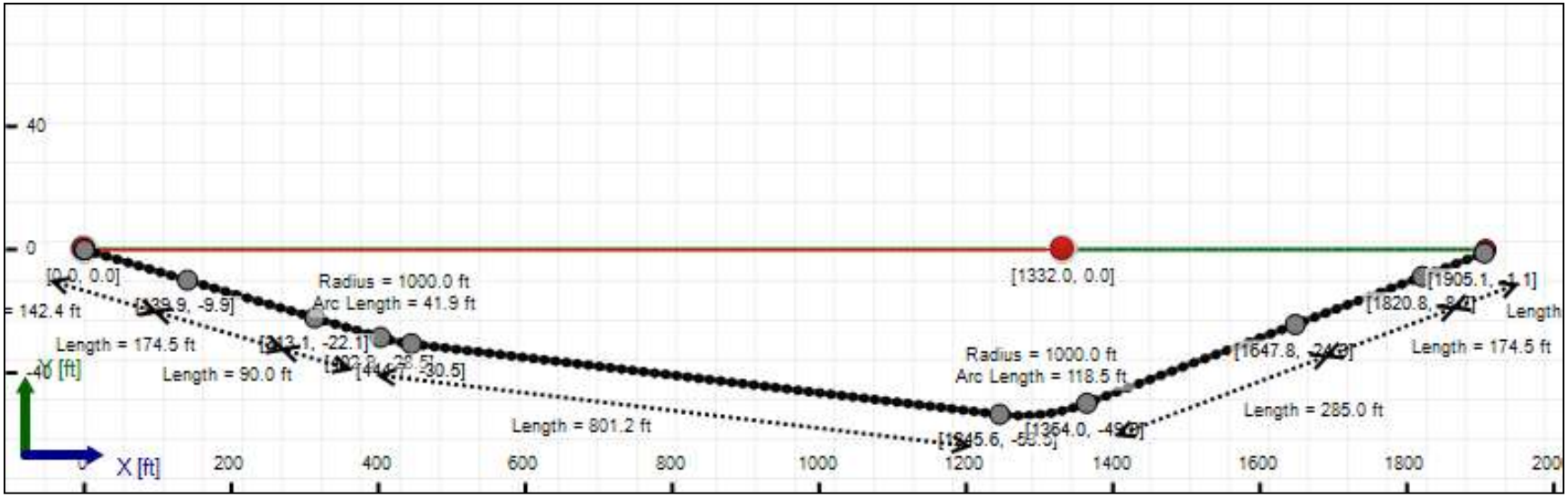
Soil Layer #2 USCS, Gravel (G), GP
From Assistant
Unit Weight: 125.0000 (dry), 140.0000 (sat) [lb/ft3]
Phi: 35.00, S.M.: 1000.00, Coh: 0.00 [psi]

Soil Layer #3 Rock, Geological Classification, Sedimentary Rocks
From Assistant
Unit Weight: 160.0000 (dry), 170.0000 (sat) [lb/ft3]
Phi: 37.00, S.M.: 3000.00, Coh: 2000.80 [psi]

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 10" (10.75")

Pipe DR: 9

Pipe Length: 1920.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.34400002161662 ft

Silo Width: 1.34400002161662 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 59.30500 lb/ft3

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 93.64118 lb/ft3

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	5.2	24.5
Water Pressure	15.6	15.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	20.8	40.0
Deflection		
Earth Load Deflection	1.596	6.697
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.728	6.829
Compressive Stress [psi]		
Compressive Wall Stress	93.6	180.1

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	31170.4	31170.4
Pullback Stress [psi]	869.3	869.3
Pullback Strain	1.512E-2	1.512E-2
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	869.3	889.9
Tensile Strain	1.512E-2	1.592E-2

Net External Pressure = 25.2 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.728	7.5	4.3	OK
Unconstrained Collapse [psi]	26.0	118.3	4.6	OK
Compressive Wall Stress [psi]	93.6	1150.0	12.3	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	36.0	200.9	5.6	OK
Tensile Stress [psi]	889.9	1200.0	1.3	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	6.50 in	2340.302 psi	2779.576 psi
1	6.50 in	12.00 in	2337.514 psi	2778.472 psi
2	12.00 in	16.13 in	2334.339 psi	2777.214 psi

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

Estimated Circulating Pressure Summary

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

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

Drill Fluid Density: 68.700 lb/ft3

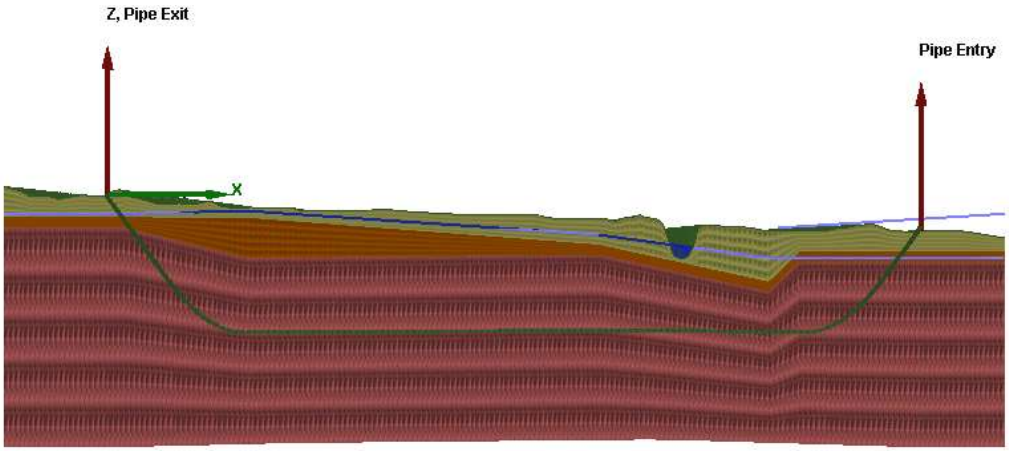
Rheological model: Power-Law

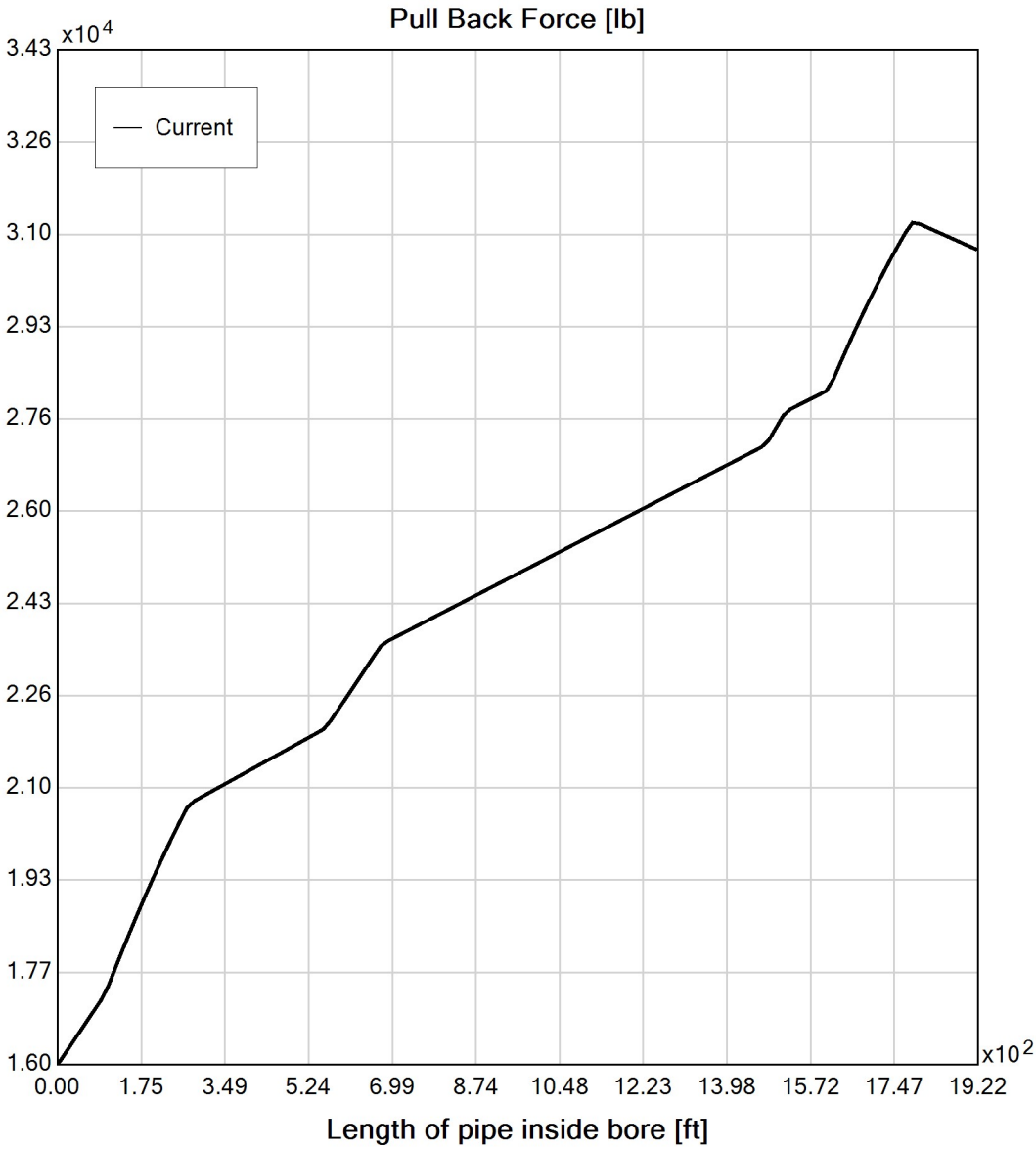
Fluid Consistency Index (K): 63.17

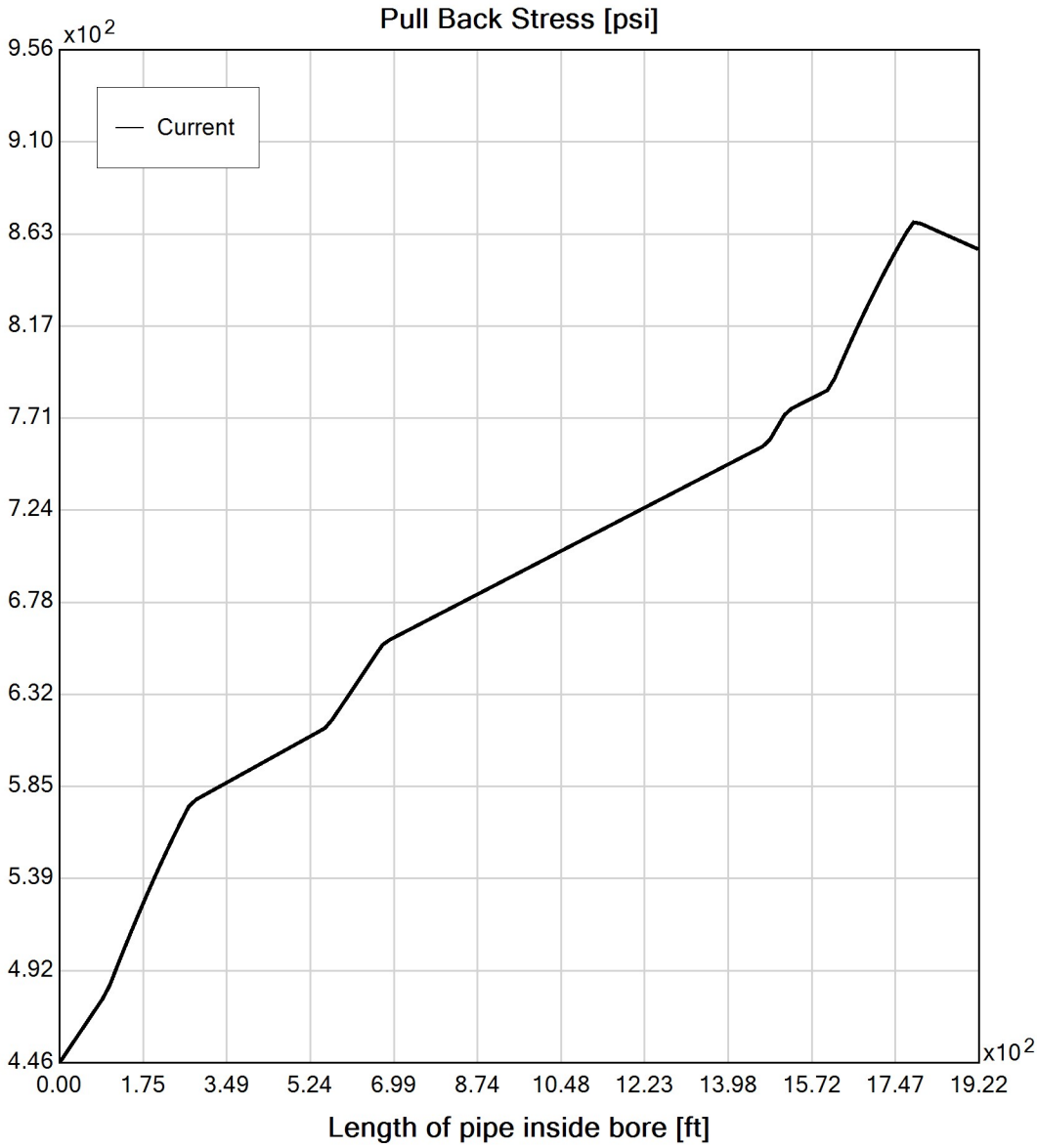
Power Law Exponent (n): 0.14

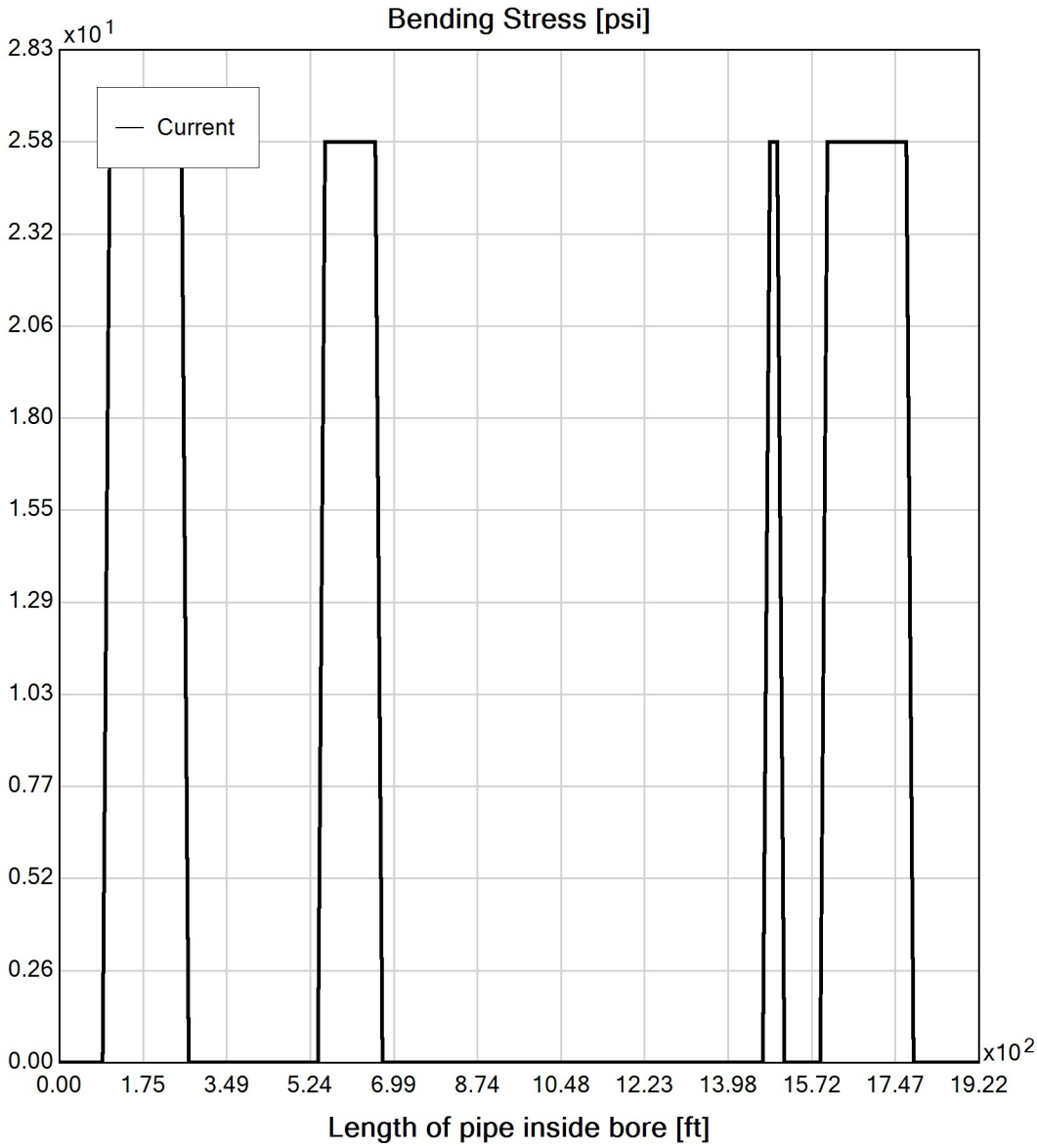
Effective Viscosity (cP): 378.3

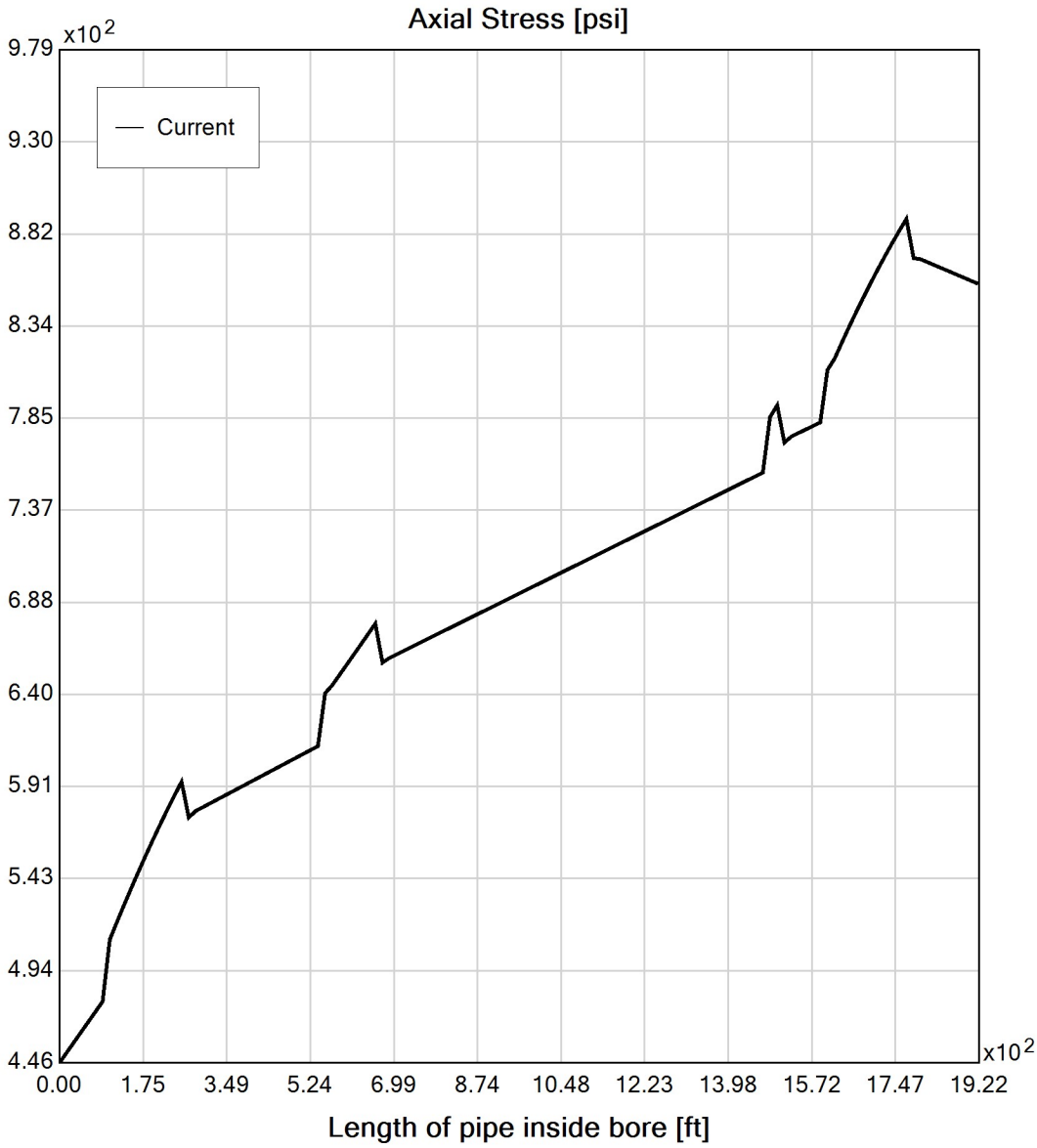
Virtual Site

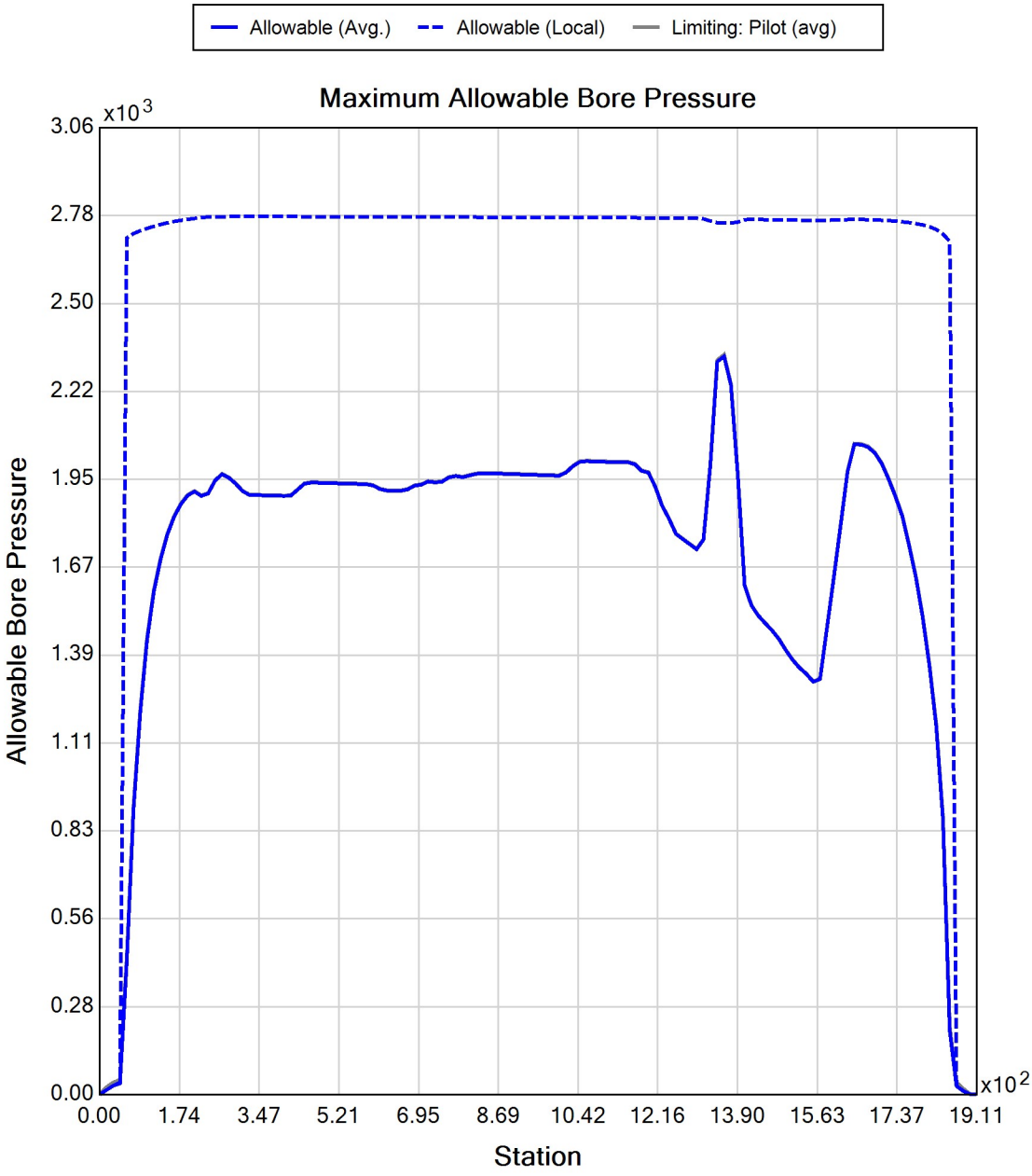


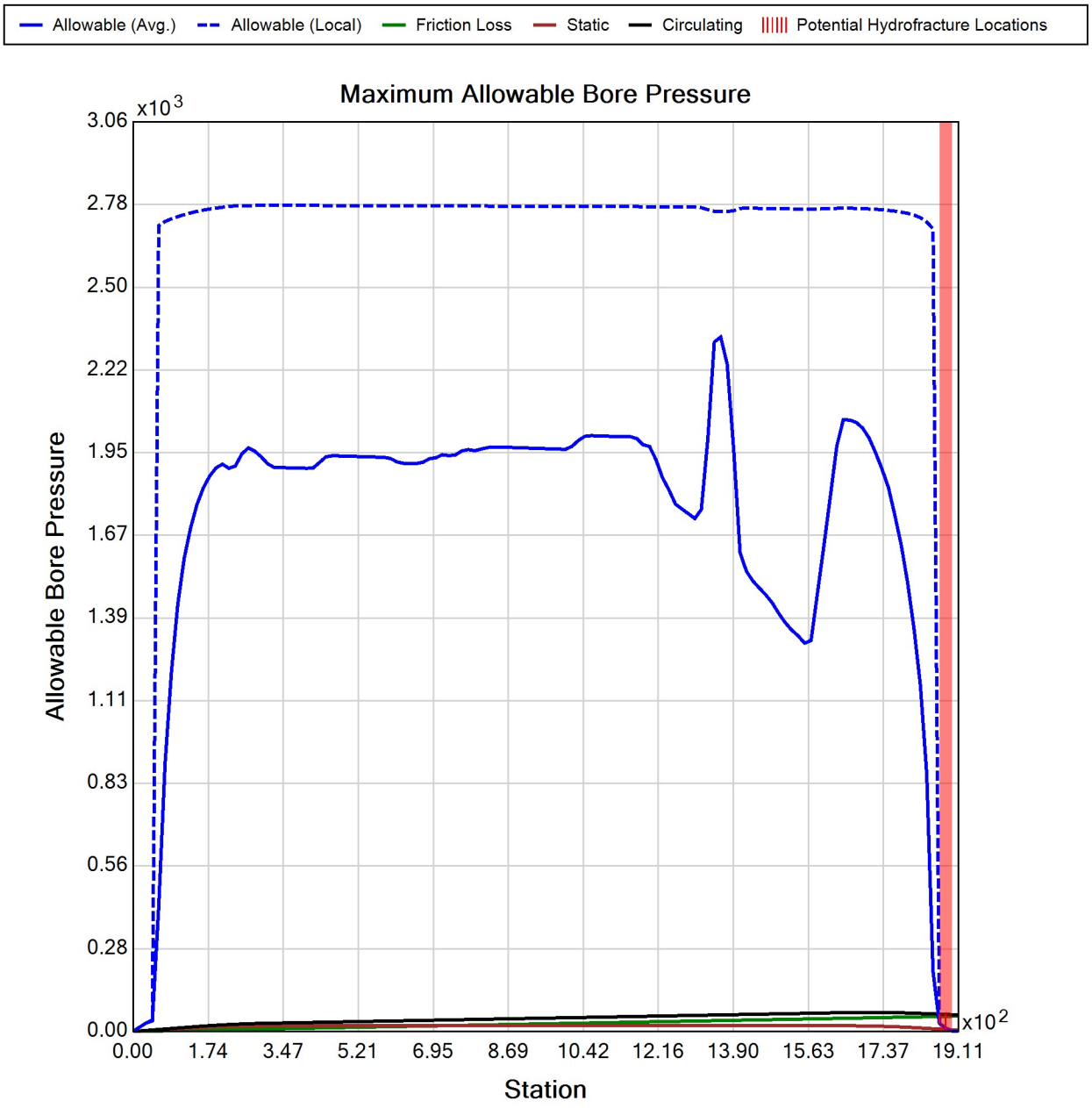












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Project Summary

General:	CHPE HDD 51
	P4A
	Start Date: 04-25-2023
	End Date: 04-25-2023
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA
Designer:	MDB
	BCE
	Amherst, MA
Description:	HDD 51 Conduit 1 2-inch DR9 reversed

Input Summary

Start Coordinate	(0.00, 0.00, 293.00) ft
End Coordinate	(1907.00, 0.00, 283.00) ft
Project Length	1907.00 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: 1920.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 0.531000018119812 ft

Silo Width: 0.531000018119812 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 59.30500 lb/ft3

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 93.64118 lb/ft3

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	2.1	24.5
Water Pressure	15.6	15.6
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	17.6	40.0
Deflection		
Earth Load Deflection	0.646	6.697
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.675	6.726
Compressive Stress [psi]		
Compressive Wall Stress	79.4	180.1

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1631.0	1631.0
Pullback Stress [psi]	931.9	931.9
Pullback Strain	1.621E-2	1.621E-2
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	931.9	932.4
Tensile Strain	1.621E-2	1.632E-2

Net External Pressure = 25.2 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.675	7.5	11.1	OK
Unconstrained Collapse [psi]	26.0	130.0	5.0	OK
Compressive Wall Stress [psi]	79.4	1150.0	14.5	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	36.0	198.3	5.5	OK
Tensile Stress [psi]	932.4	1200.0	1.3	OK

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Project Contractor:	Kiewit
Project Consultant:	CHA
Designer:	MDB
	BCE
	Amherst, MA
Description:	HDD 51 Conduit 2 10-inch DR9 reversed

Input Summary

Start Coordinate	(0.00, 0.00, 293.00) ft
End Coordinate	(2018.00, 0.00, 283.00) ft
Project Length	2018.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

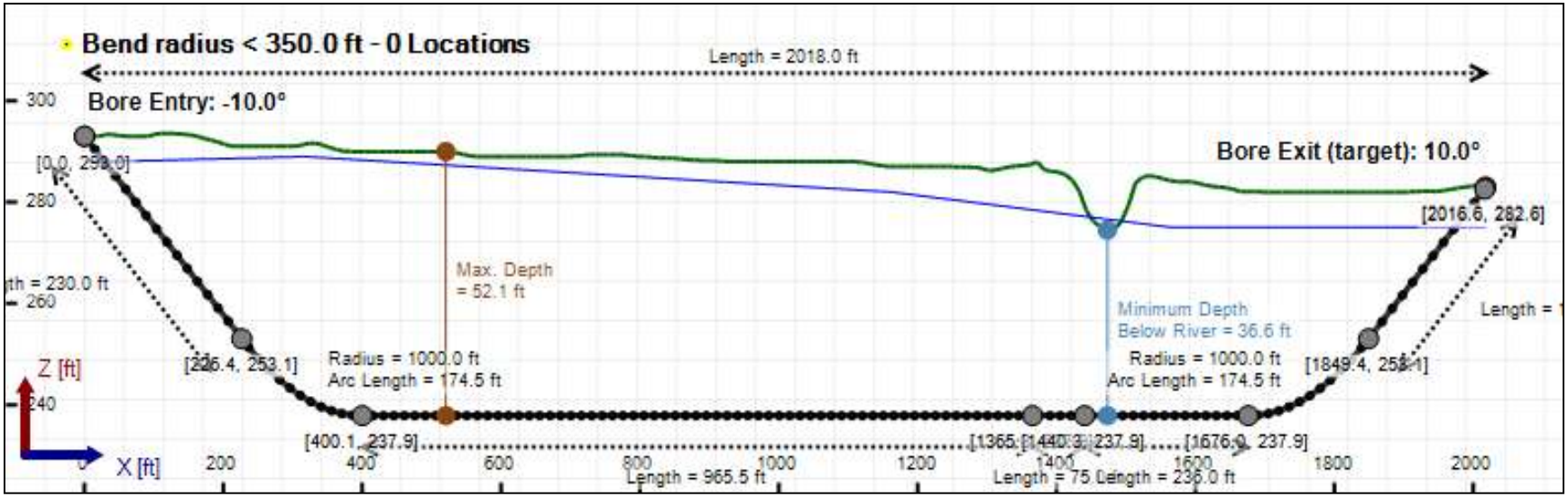
Number of Layers: 3

Soil Layer #1 USCS, Sand (S), SP
From Assistant
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 300.00, Coh: 0.00 [psi]

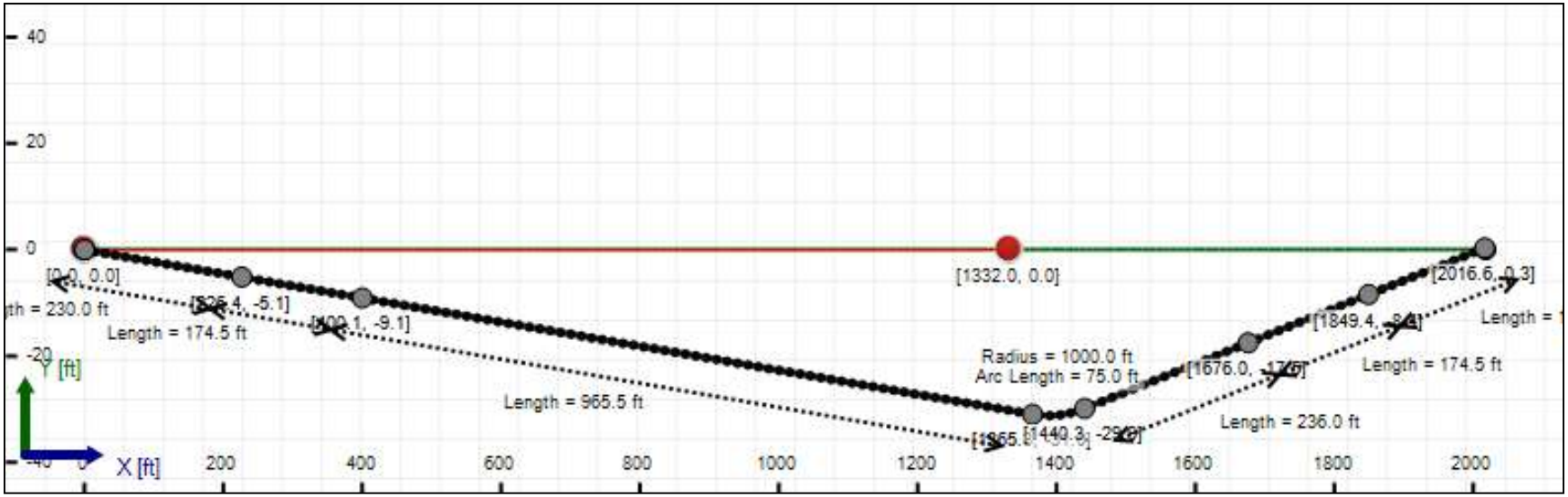
Soil Layer #2 USCS, Gravel (G), GP
From Assistant
Unit Weight: 125.0000 (dry), 140.0000 (sat) [lb/ft3]
Phi: 35.00, S.M.: 1000.00, Coh: 0.00 [psi]

Soil Layer #3 Rock, Geological Classification, Sedimentary Rocks
From Assistant
Unit Weight: 160.0000 (dry), 170.0000 (sat) [lb/ft3]
Phi: 37.00, S.M.: 3000.00, Coh: 2000.00 [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: 2040.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.34400002161662 ft

Silo Width: 1.34400002161662 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 59.30500 lb/ft3

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 93.64118 lb/ft3

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	5.5	36.0
Water Pressure	21.9	21.9
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	27.4	57.9
Deflection		
Earth Load Deflection	1.632	9.875
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.764	10.007
Compressive Stress [psi]		
Compressive Wall Stress	123.3	260.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	32850.6	32850.6
Pullback Stress [psi]	916.2	916.2
Pullback Strain	1.593E-2	1.593E-2
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	916.2	935.4
Tensile Strain	1.593E-2	1.672E-2

Net External Pressure = 33.7 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.764	7.5	4.3	OK
Unconstrained Collapse [psi]	35.9	117.9	3.3	OK
Compressive Wall Stress [psi]	123.3	1150.0	9.3	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	45.8	197.1	4.3	OK
Tensile Stress [psi]	935.4	1200.0	1.3	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	6.50 in	2363.910 psi	2800.405 psi
1	6.50 in	12.00 in	2363.244 psi	2799.852 psi
2	12.00 in	16.13 in	2362.485 psi	2799.221 psi

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

Estimated Circulating Pressure Summary

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

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

Drill Fluid Density: 68.700 lb/ft3

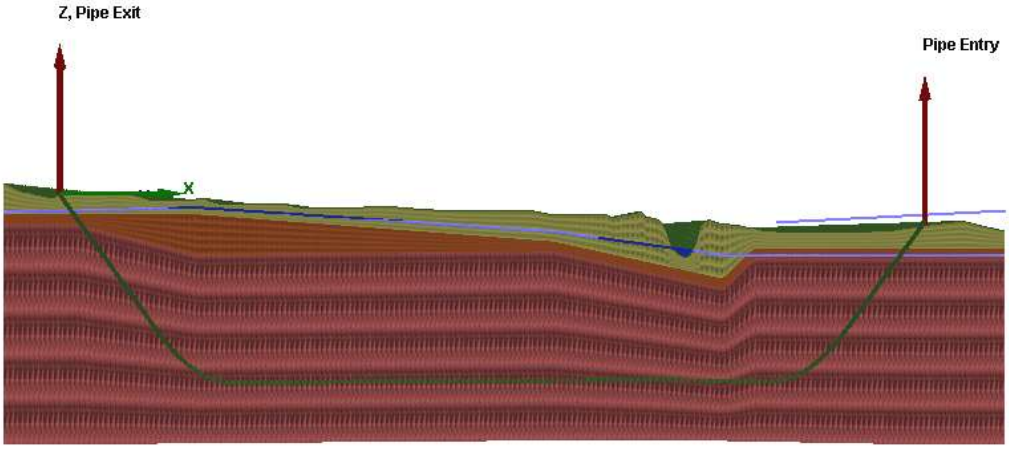
Rheological model: Power-Law

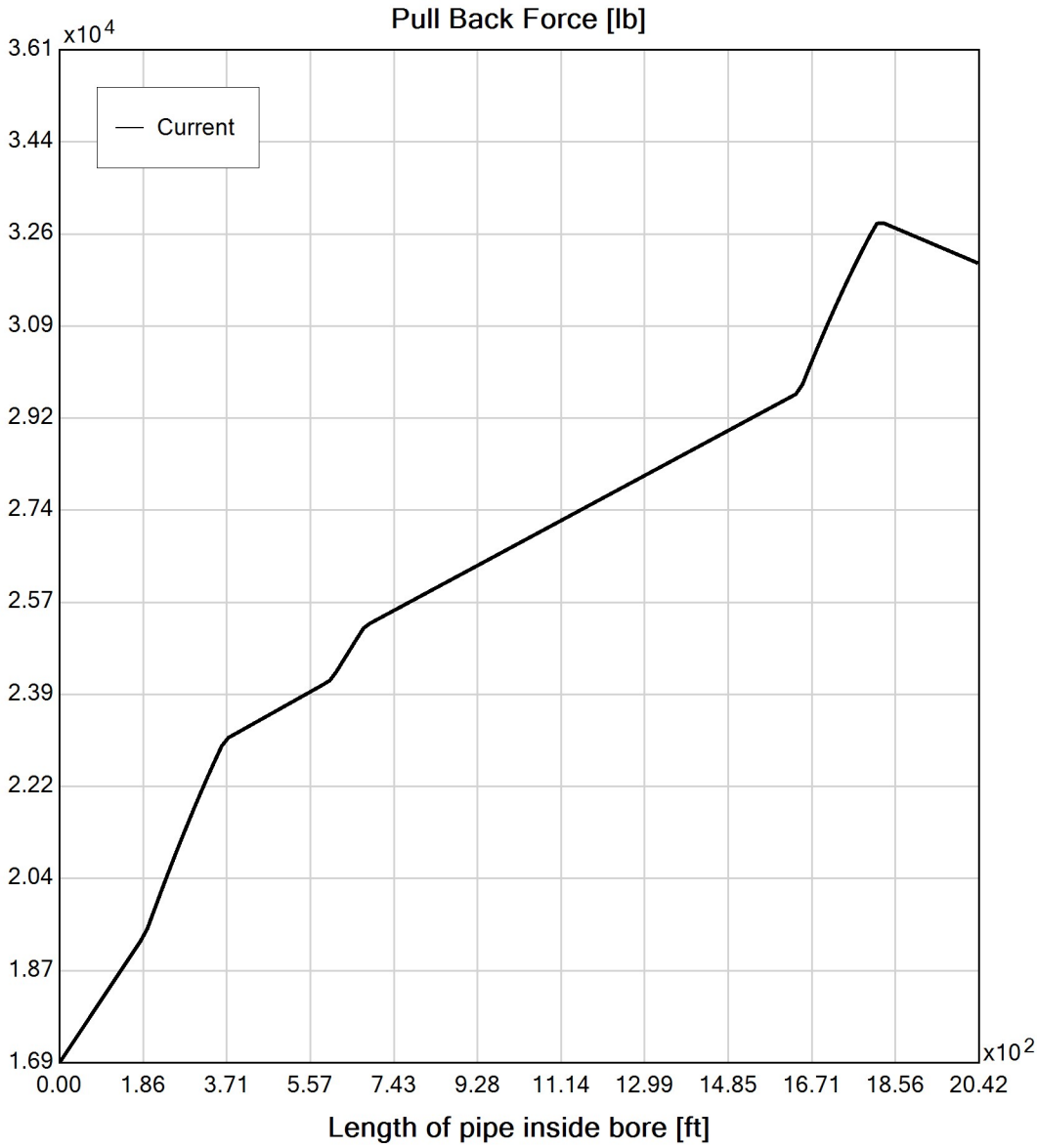
Fluid Consistency Index (K): 63.17

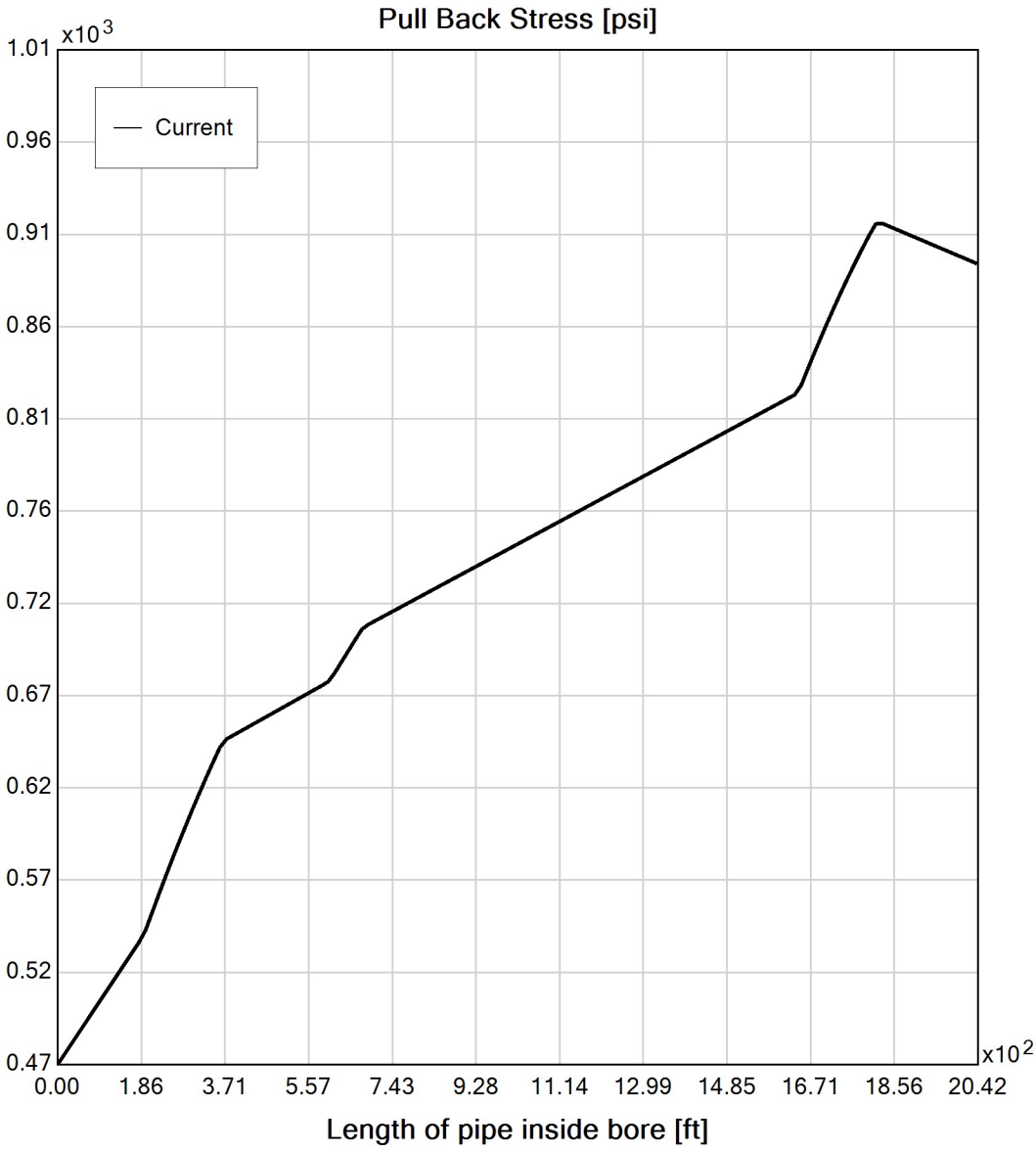
Power Law Exponent (n): 0.14

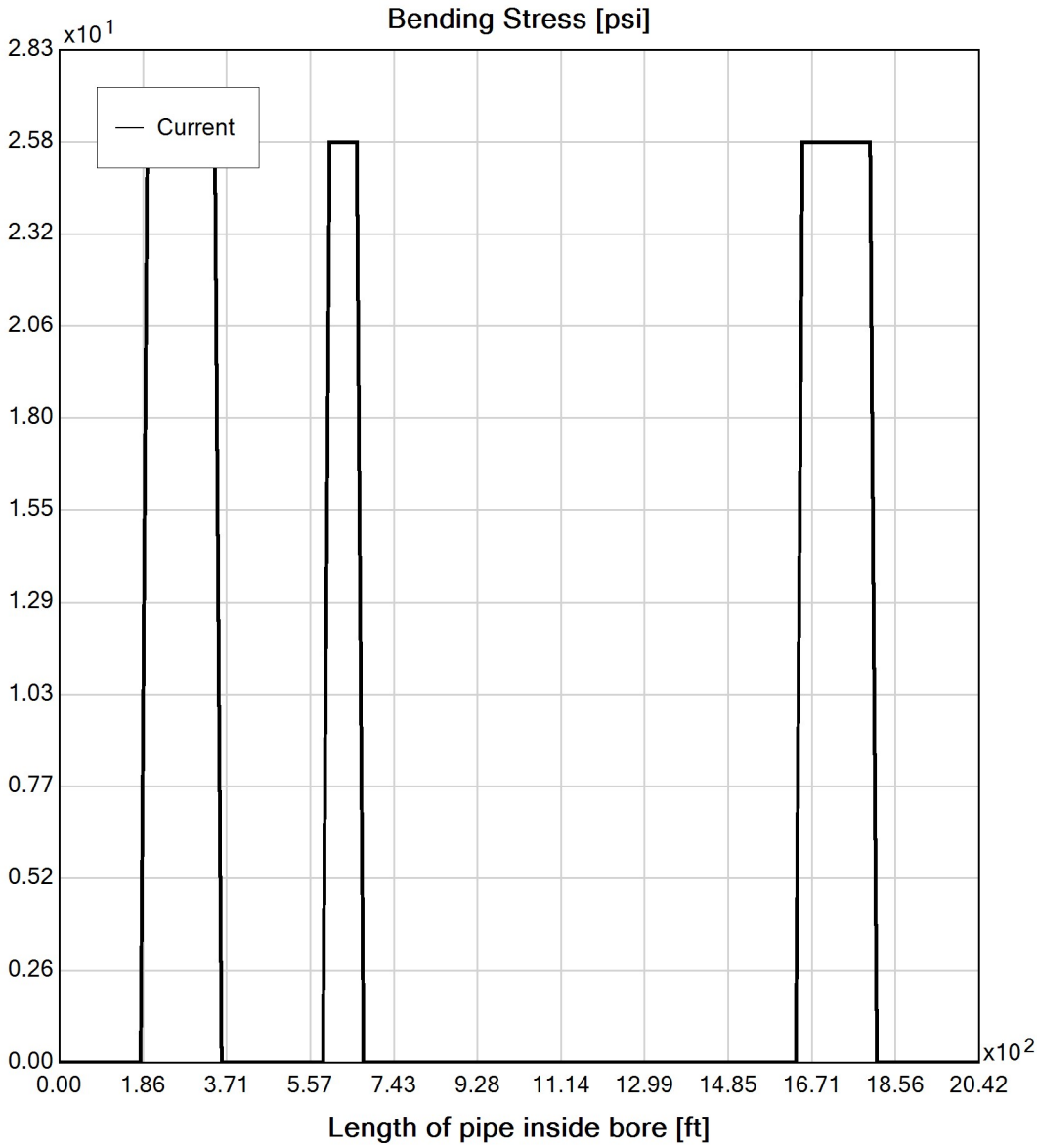
Effective Viscosity (cP): 378.3

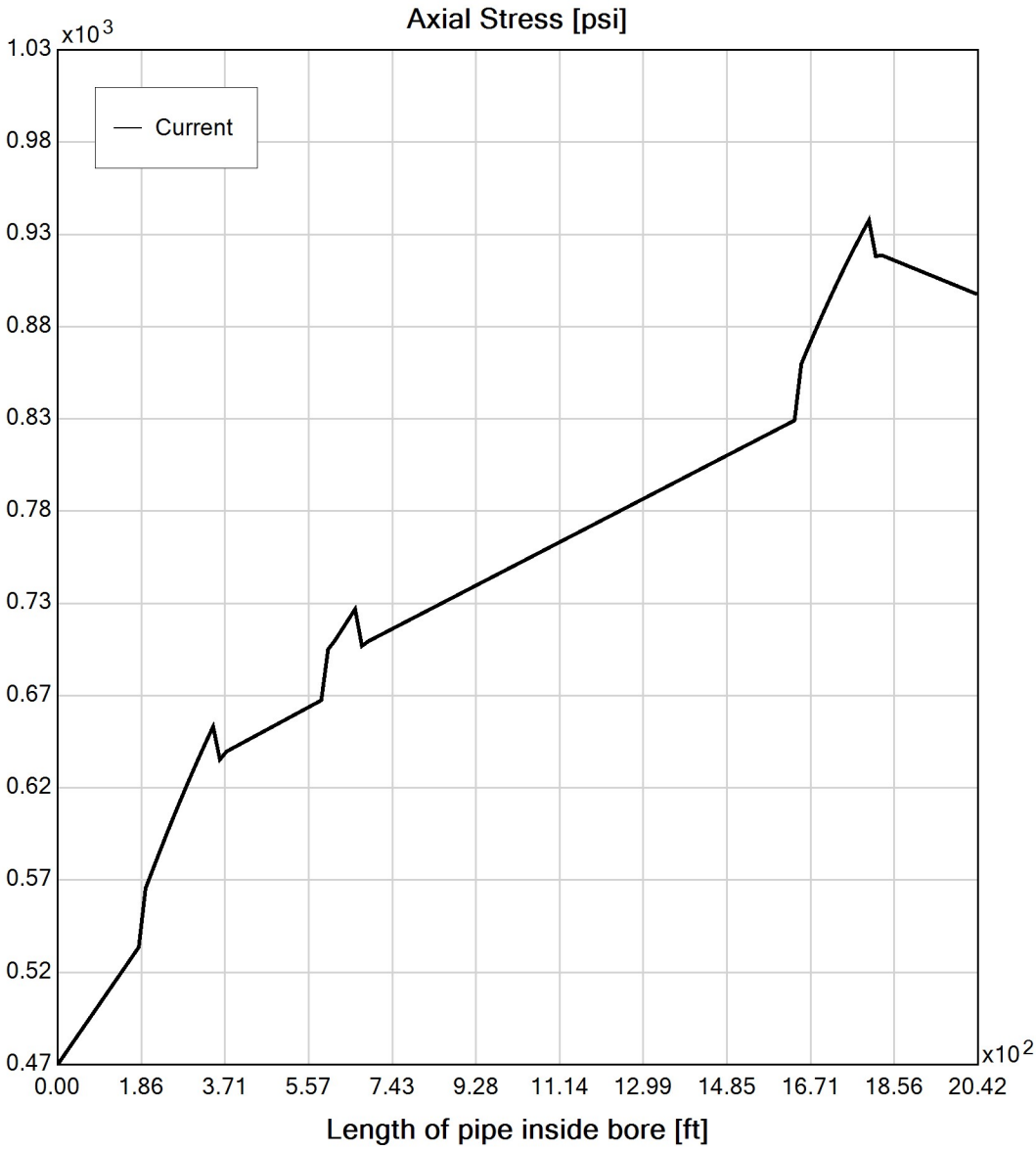
Virtual Site

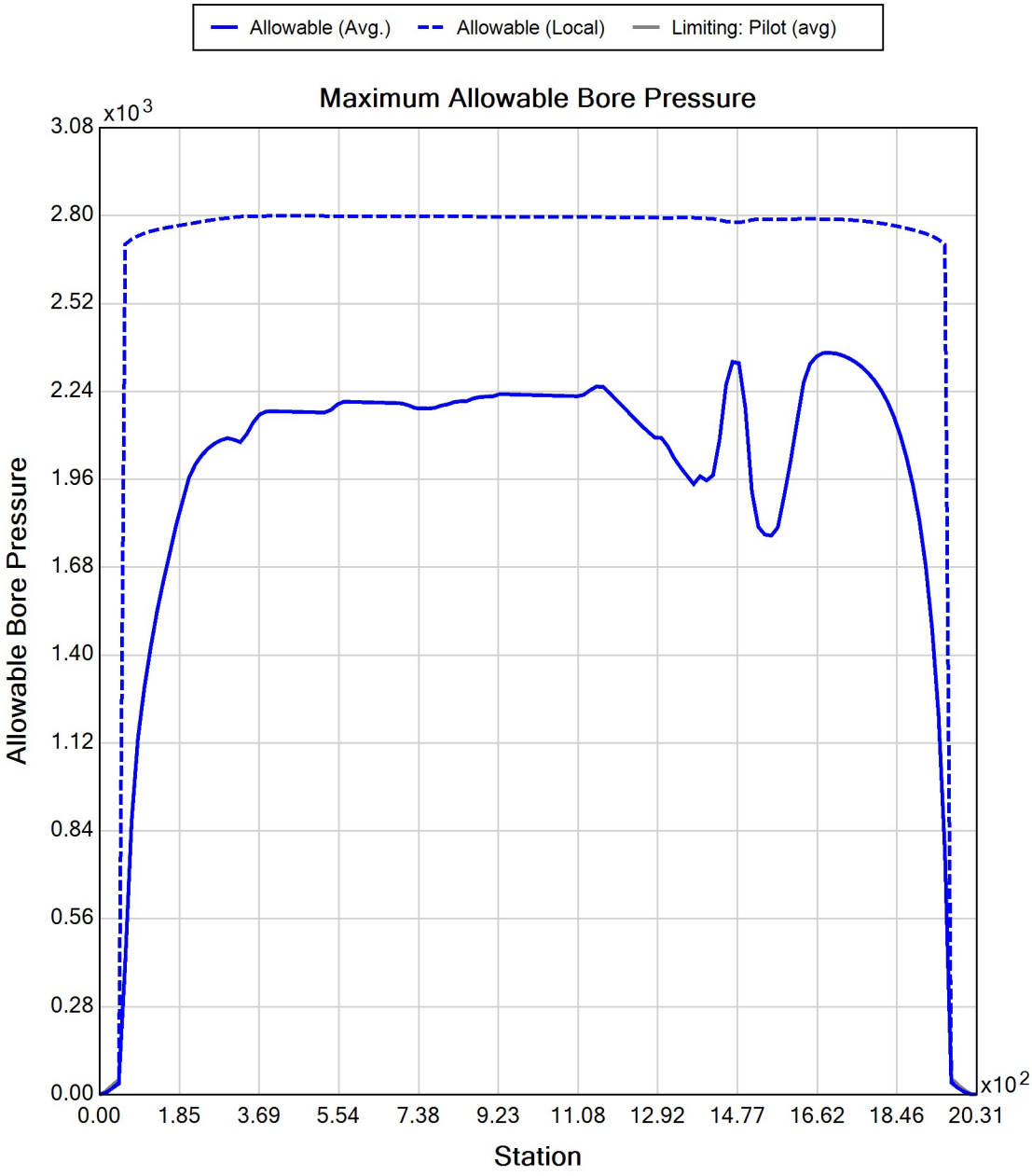


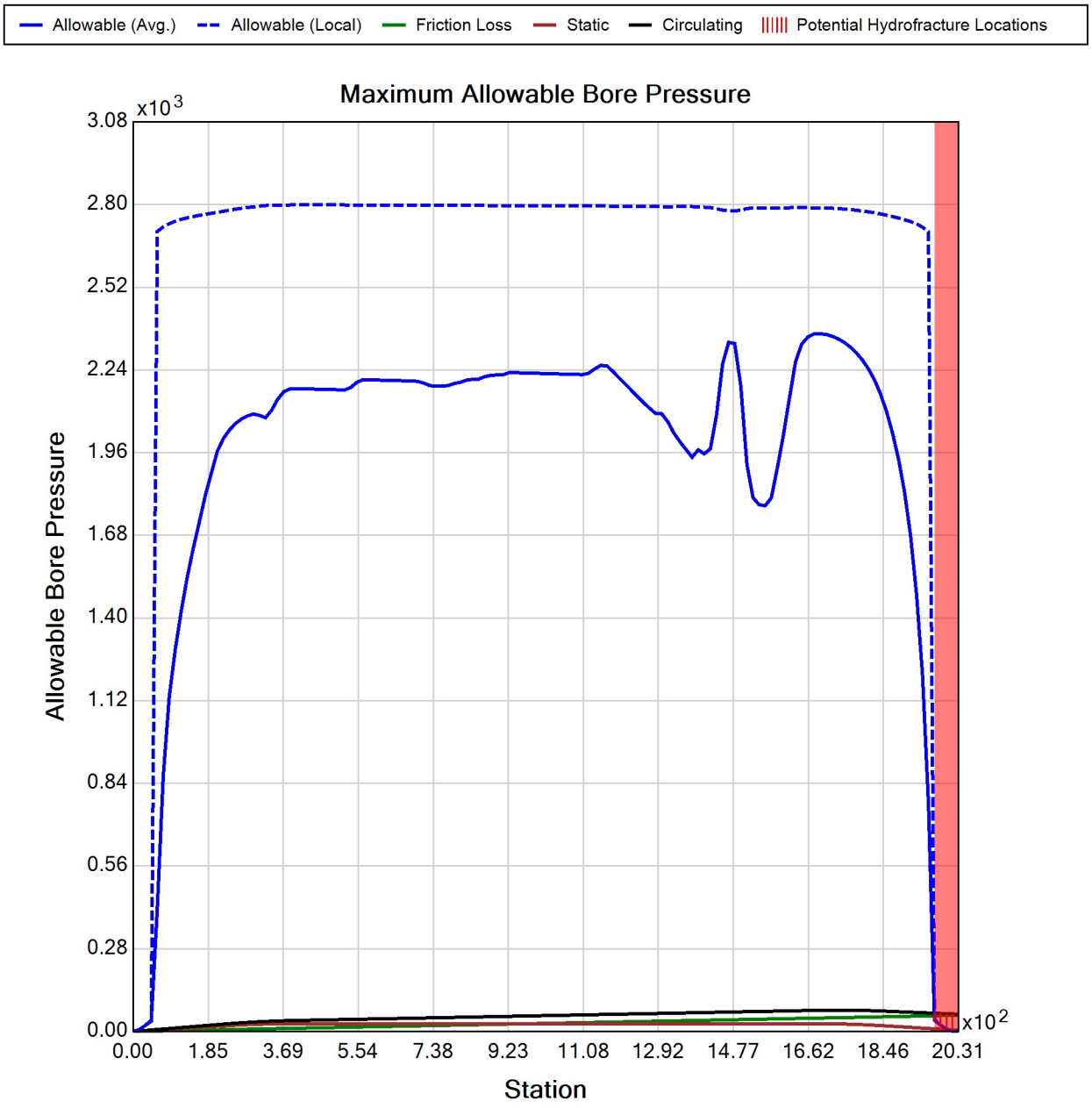












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Project Summary

General:	CHPE HDD 51
	P4A
	Start Date: 04-25-2023
	End Date: 04-25-2023
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA
Designer:	MDB
	BCE
	Amherst, MA
Description:	HDD 51 Conduit 2 2-inch DR9 reversed

Input Summary

Start Coordinate	(0.00, 0.00, 293.00) ft
End Coordinate	(2018.00, 0.00, 283.00) ft
Project Length	2018.00 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: 2040.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 0.531000018119812 ft

Silo Width: 0.531000018119812 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 59.30500 lb/ft3

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 93.64118 lb/ft3

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	2.2	36.0
Water Pressure	21.9	21.9
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	24.1	57.9
Deflection		
Earth Load Deflection	0.647	9.875
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.676	9.904
Compressive Stress [psi]		
Compressive Wall Stress	108.3	260.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1713.0	1713.0
Pullback Stress [psi]	978.8	978.8
Pullback Strain	1.702E-2	1.702E-2
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	978.8	978.8
Tensile Strain	1.702E-2	1.711E-2

Net External Pressure = 33.7 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.676	7.5	11.1	OK
Unconstrained Collapse [psi]	35.9	130.0	3.6	OK
Compressive Wall Stress [psi]	108.3	1150.0	10.6	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	45.8	194.4	4.2	OK
Tensile Stress [psi]	978.8	1200.0	1.2	OK

Generated Output

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Project Summary

General:	CHPE HDD 52
	P4A
	Start Date: 06-07-2023
	End Date: 06-07-2023
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA
Designer:	MDB
	BCE
	Amherst, MA
Description:	HDD 52 Reverse Conduit 10-inch DR9

Input Summary

Start Coordinate	(0.00, 0.00, 297.00) ft
End Coordinate	(2701.00, 0.00, 294.00) ft
Project Length	2701.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

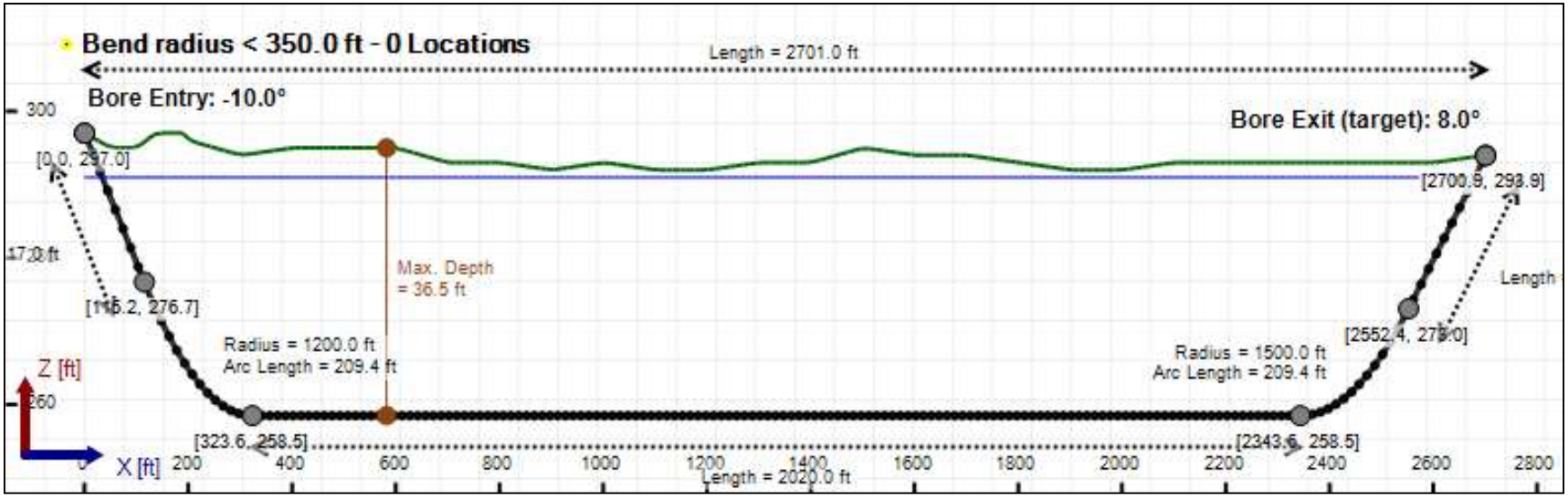
Number of Layers: 3

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

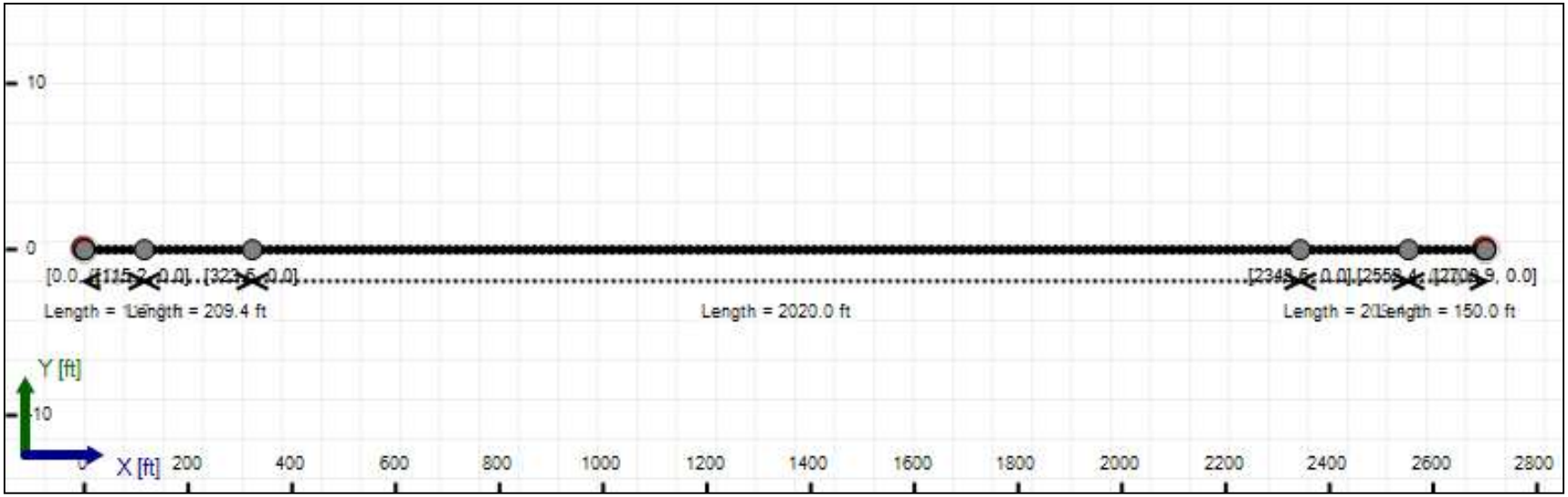
Soil Layer #2 USCS, Sand (S), SW
From Assistant
Unit Weight: 130.0000 (dry), 140.0000 (sat) [lb/ft3]
Phi: 37.00, S.M.: 1000.00, Coh: 0.00 [psi]

Soil Layer #3 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: 2715.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.34400002161662 ft

Silo Width: 1.34400002161662 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 59.30500 lb/ft3

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 93.64118 lb/ft3

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	5.7	25.8
Water Pressure	14.1	14.1
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	19.8	39.9
Deflection		
Earth Load Deflection	1.545	7.033
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.678	7.165
Compressive Stress [psi]		
Compressive Wall Stress	89.0	179.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	42140.2	42140.2
Pullback Stress [psi]	1175.2	1175.2
Pullback Strain	2.044E-2	2.044E-2
Bending Stress [psi]	0.0	21.5
Bending Strain	0	3.733E-4
Tensile Stress [psi]	1175.2	1192.1
Tensile Strain	2.044E-2	2.111E-2

Net External Pressure = 21.9 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.678	7.5	4.5	OK
Unconstrained Collapse [psi]	25.1	118.8	4.7	OK
Compressive Wall Stress [psi]	89.0	1150.0	12.9	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	34.9	176.8	5.1	OK
Tensile Stress [psi]	1192.1	1200.0	1.0	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	1766.759 psi	2015.390 psi
1	8.00 in	14.00 in	1766.030 psi	2014.671 psi
2	14.00 in	16.13 in	1765.677 psi	2014.322 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): 280.00 US (liquid) gallon/min

Drill Fluid Density: 68.700 lb/ft3

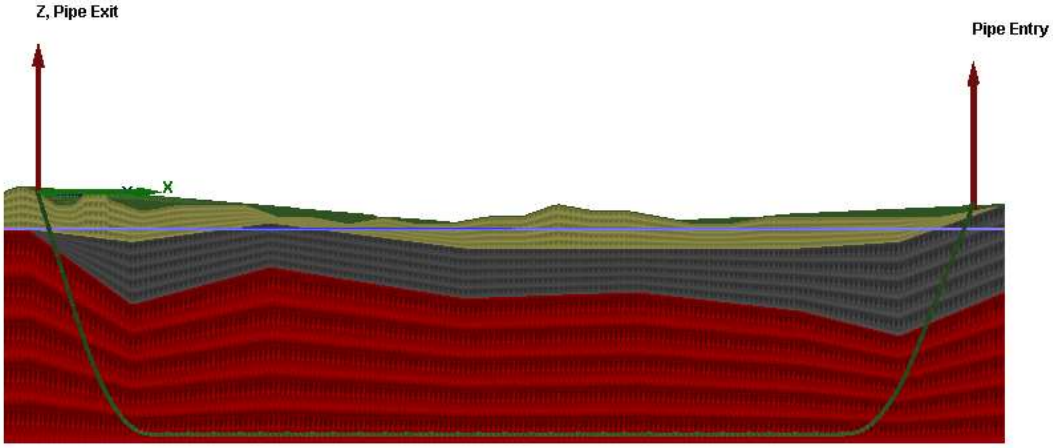
Rheological model: Bingham-Plastic

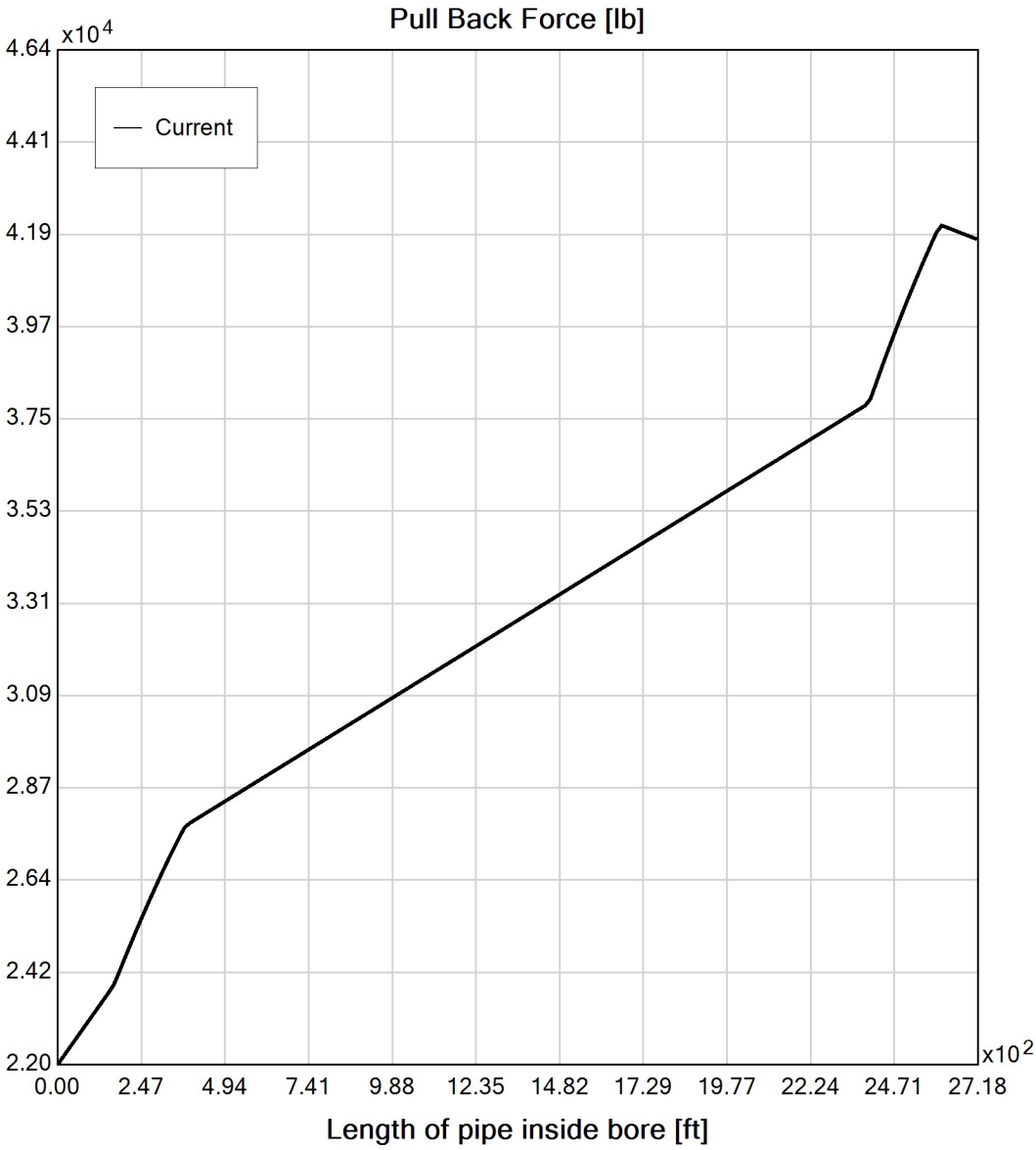
Plastic Viscosity (PV): 25.53

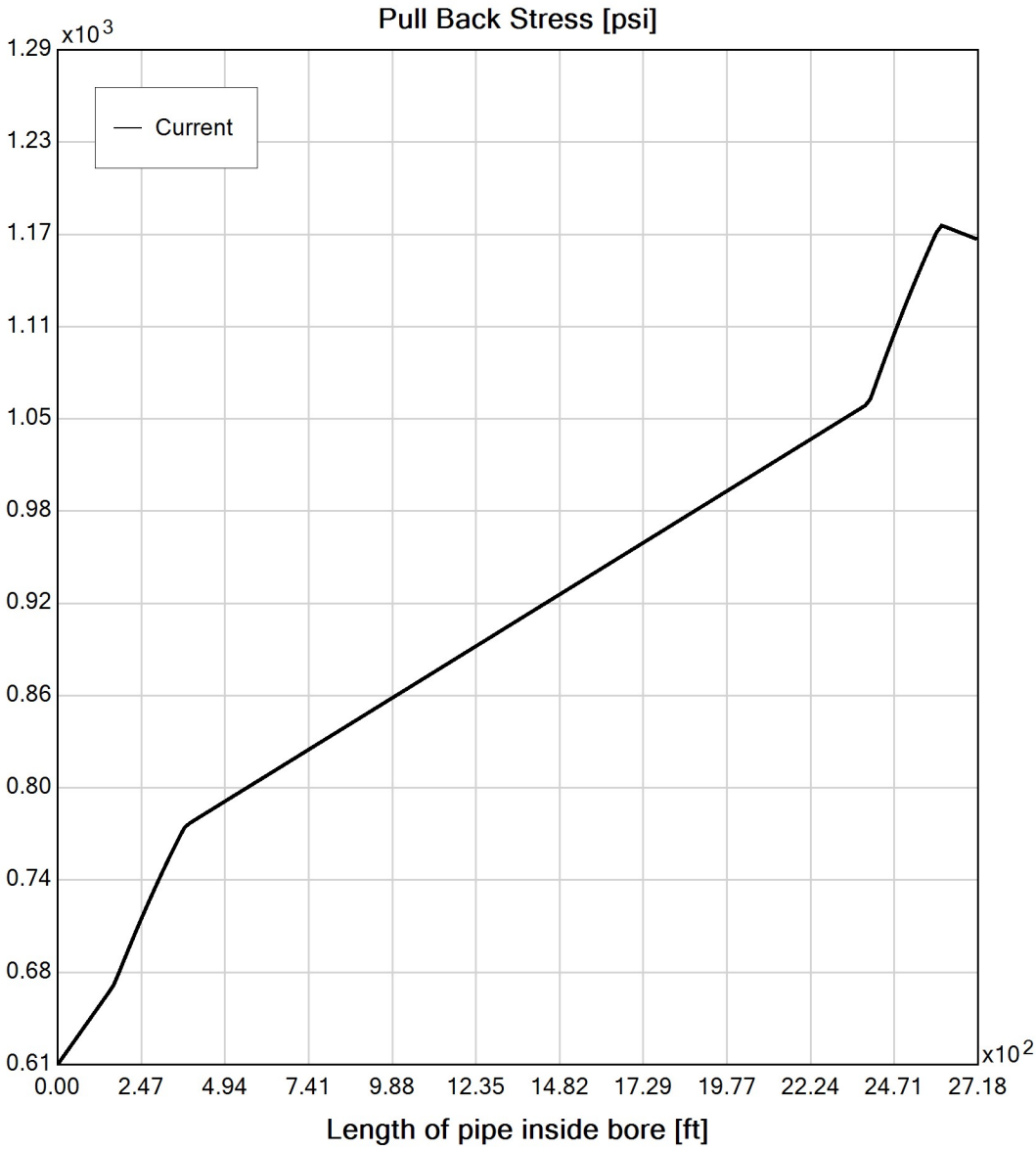
Yield Point (YP): 16.49

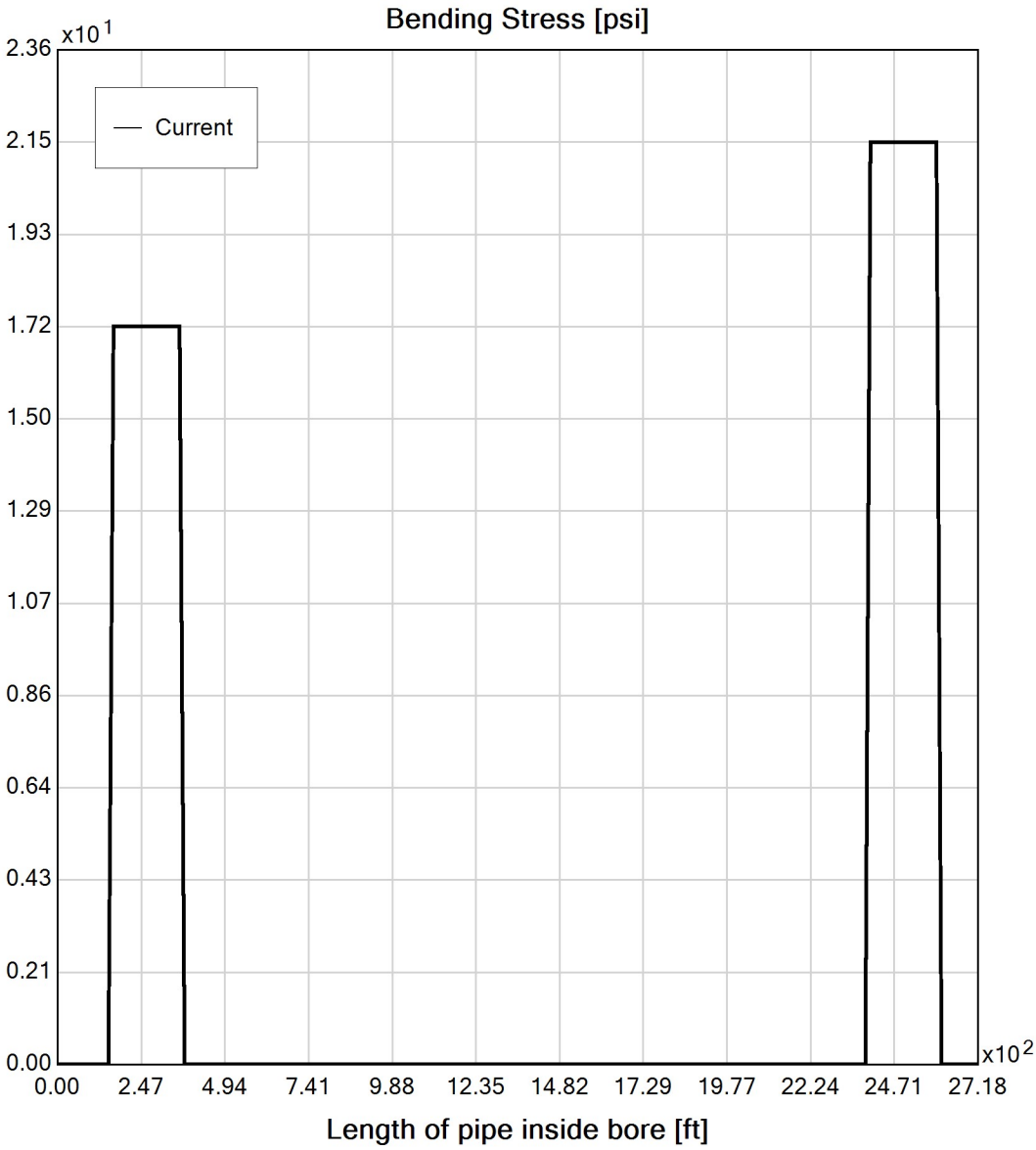
Effective Viscosity (cP): 193.6

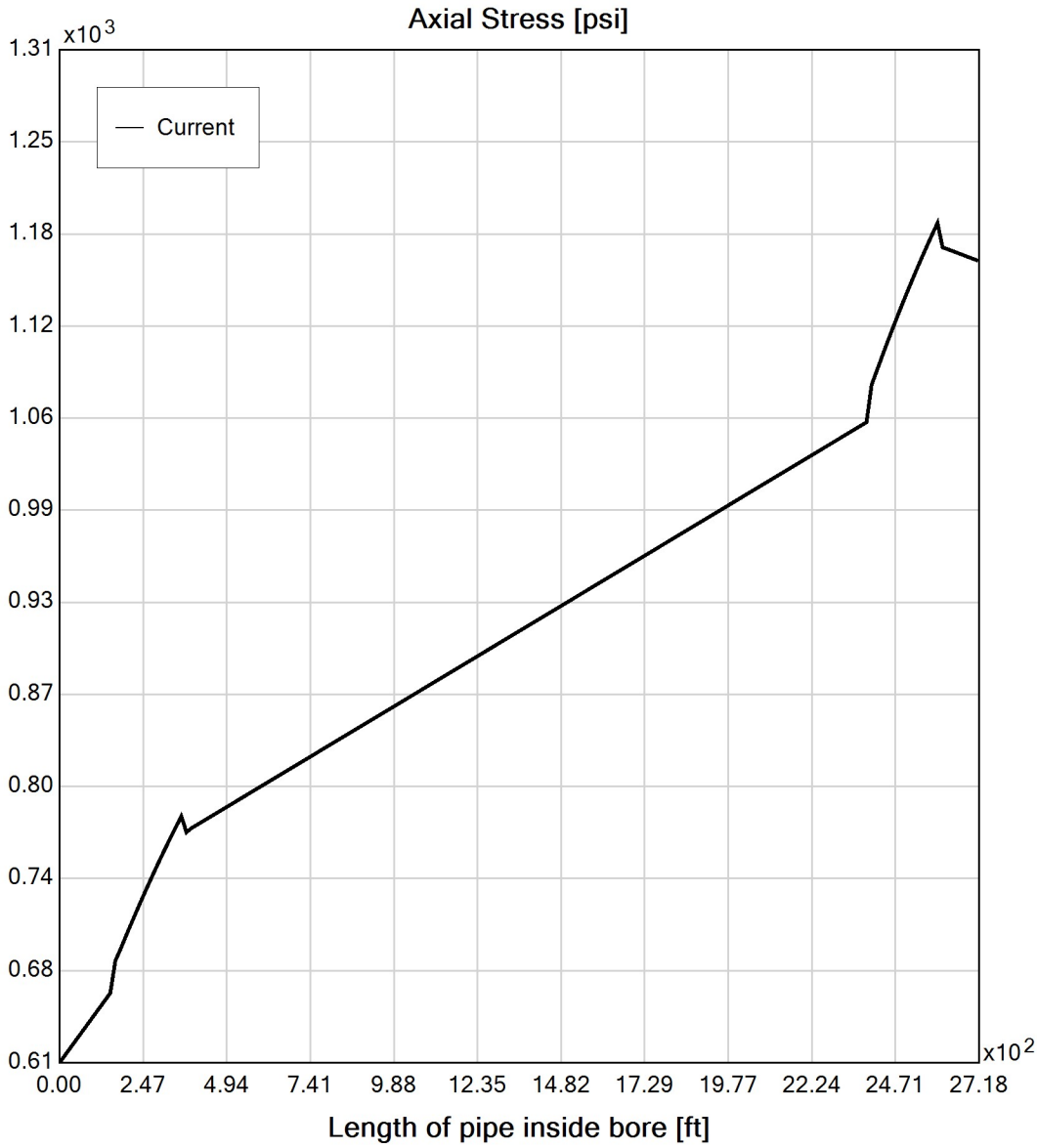
Virtual Site

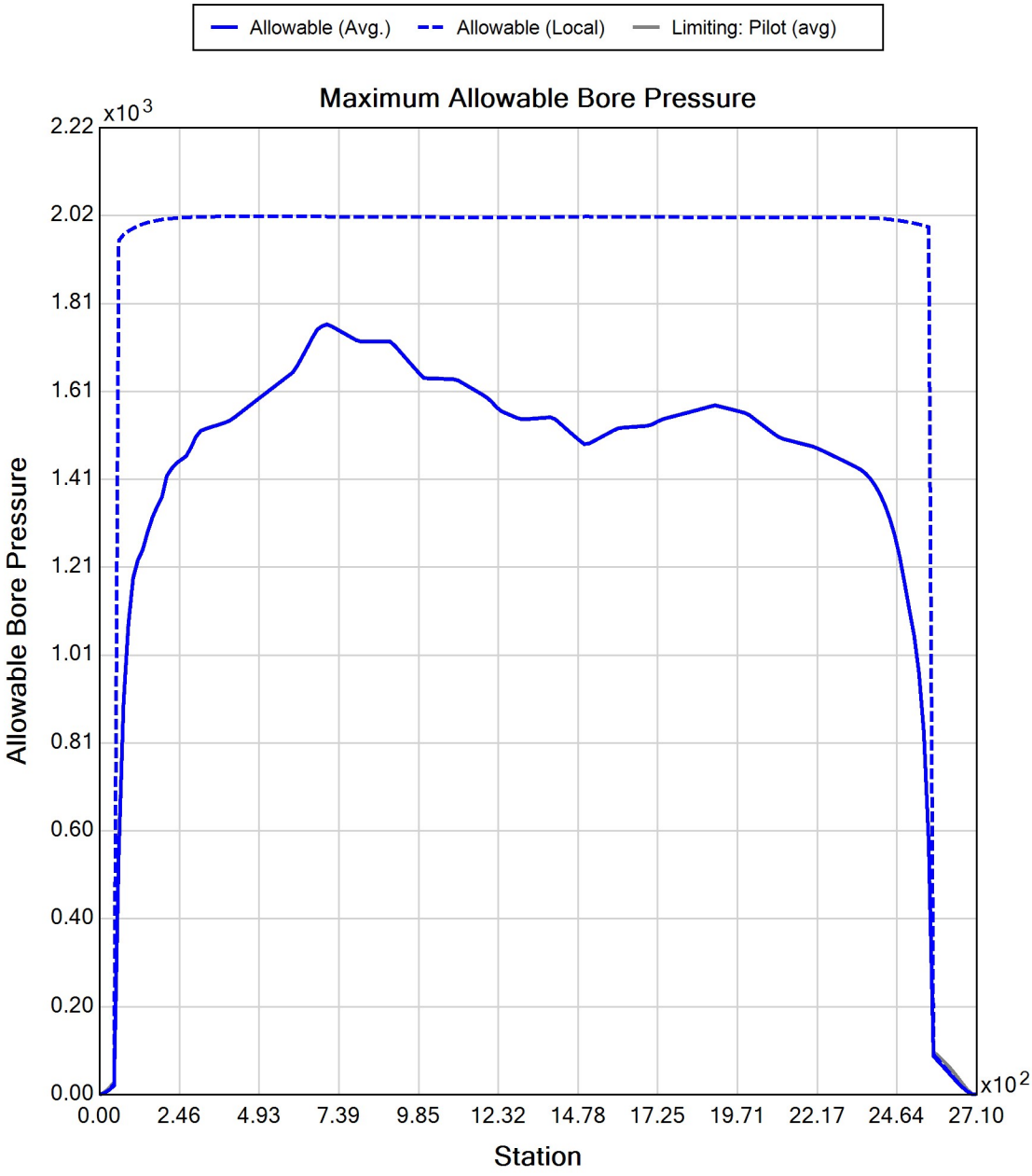


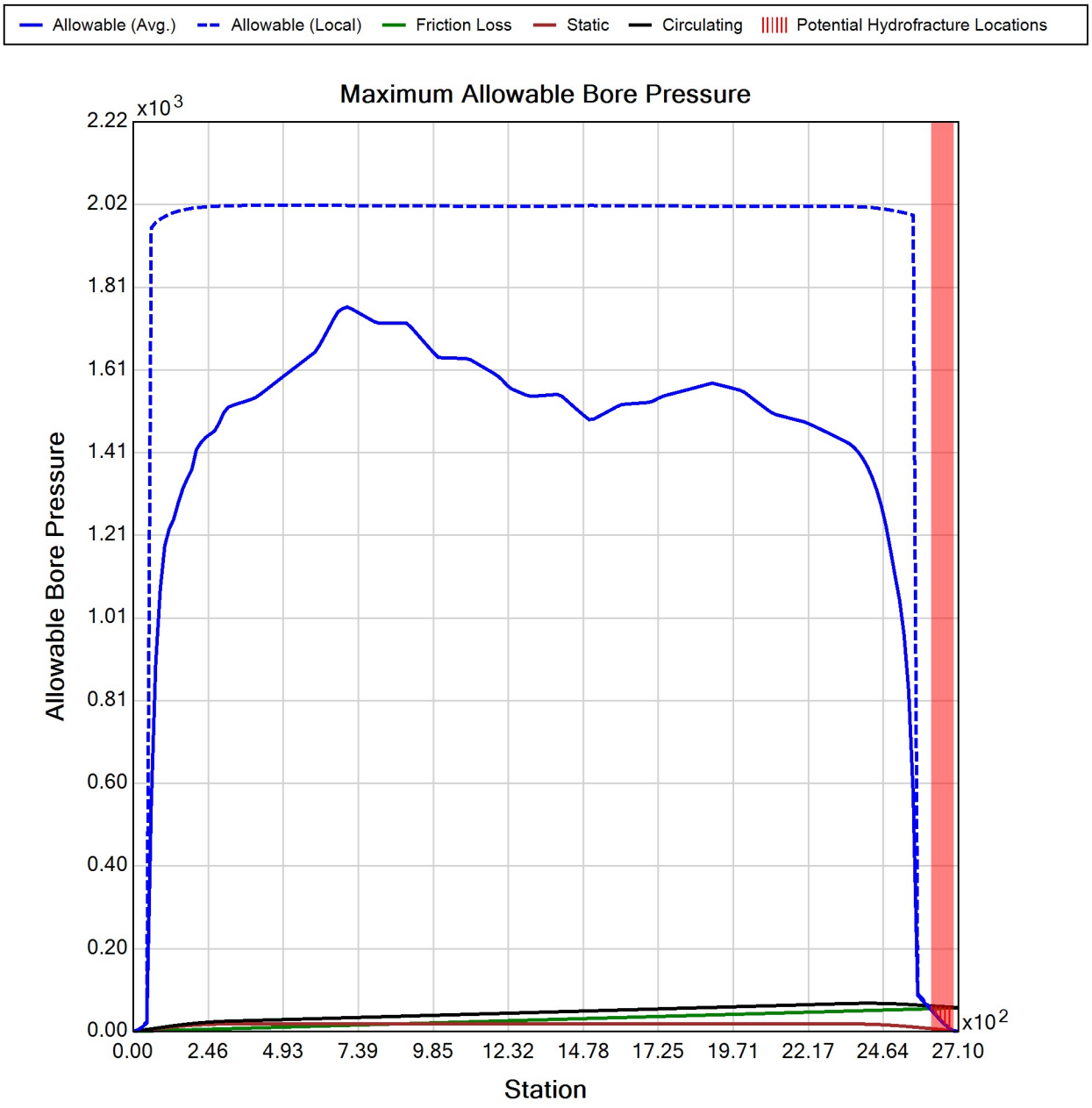












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Project Summary

General:	CHPE HDD 52
	P4A
	Start Date: 06-07-2023
	End Date: 06-07-2023
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA
Designer:	MDB
	BCE
	Amherst, MA
Description:	HDD 52 Reverse Conduit 2-inch DR9

Input Summary

Start Coordinate	(0.00, 0.00, 297.00) ft
End Coordinate	(2701.00, 0.00, 294.00) ft
Project Length	2701.00 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: 2715.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 0.531000018119812 ft

Silo Width: 0.531000018119812 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 59.30500 lb/ft3

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 93.64118 lb/ft3

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	2.3	25.8
Water Pressure	14.1	14.1
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	16.4	39.9
Deflection		
Earth Load Deflection	0.618	7.033
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.648	7.063
Compressive Stress [psi]		
Compressive Wall Stress	73.7	179.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	2166.5	2166.5
Pullback Stress [psi]	1237.8	1237.8
Pullback Strain	2.153E-2	2.153E-2
Bending Stress [psi]	0.0	4.7
Bending Strain	0	8.247E-5
Tensile Stress [psi]	1237.8	1238.0
Tensile Strain	2.153E-2	2.161E-2

Net External Pressure = 21.9 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.648	7.5	11.6	OK
Unconstrained Collapse [psi]	25.1	130.3	5.2	OK
Compressive Wall Stress [psi]	73.7	1150.0	15.6	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	34.9	173.3	5.0	OK
Tensile Stress [psi]	1238.0	1200.0	1.0	OK

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Project Summary

General:	HDD 53
	P4A
	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 53 10-Inch DR 9 Conduit 1

Input Summary

Start Coordinate	(0.00, 0.00, 296.00) ft
End Coordinate	(815.00, 0.00, 295.00) ft
Project Length	815.00 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

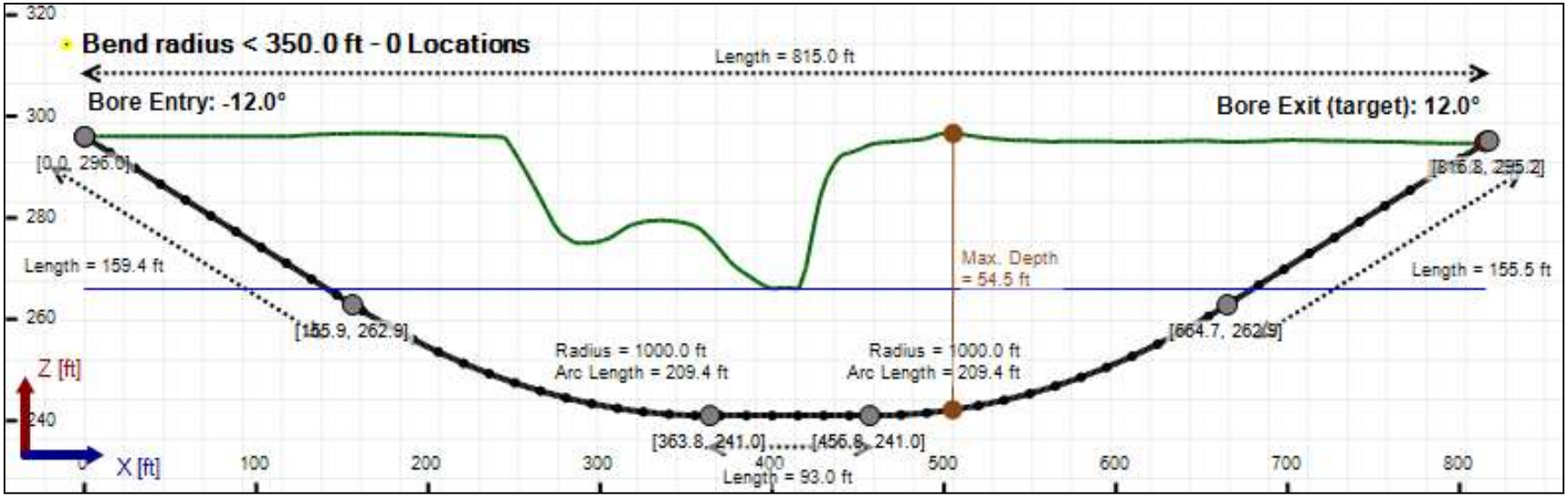
Soil Layer #1 USCS, Silt (M), ML
Depth: 5.00 ft
Unit Weight: 80.0000 (dry), 100.0000 (sat) [lb/ft3]
Phi: 28.00, S.M.: 50.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Sand (S), SM
Depth: 9.50 ft
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

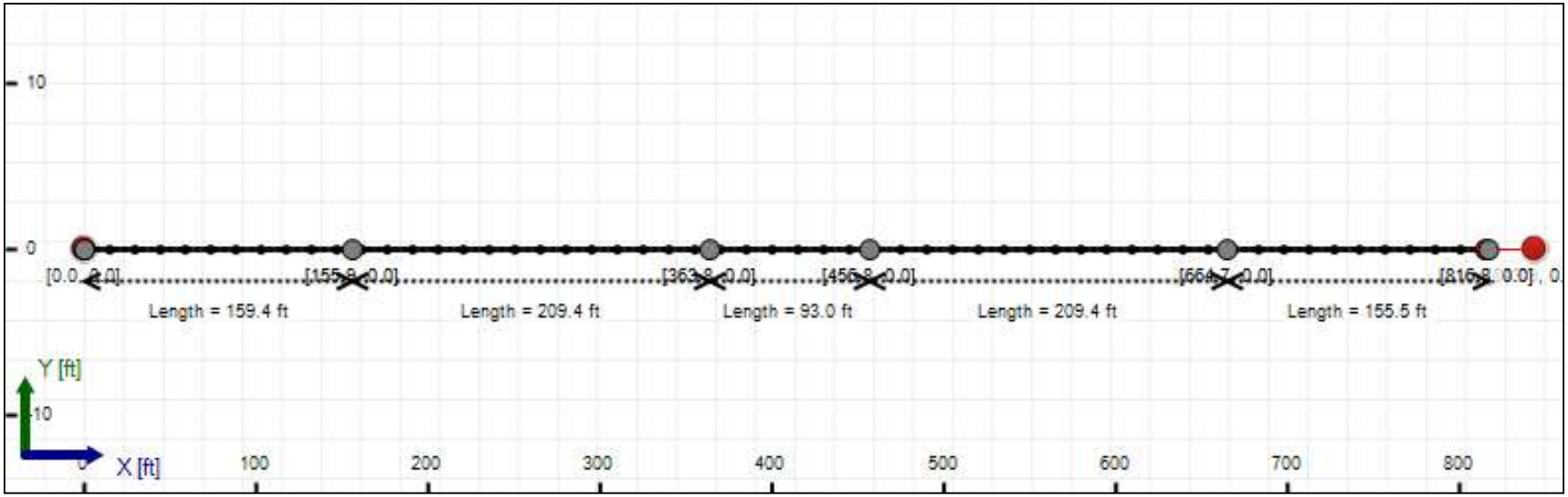
Soil Layer #3 USCS, Silt (M), ML
Depth: 1.50 ft
Unit Weight: 120.0000 (dry), 140.0000 (sat) [lb/ft3]
Phi: 37.00, S.M.: 1000.00, Coh: 0.00 [psi]

Soil Layer #4 Rock, Geological Classification, Sedimentary Rocks
Depth: 50.00 ft
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: 840.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.34400002161662 ft

Silo Width: 1.34400002161662 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 59.30500 lb/ft3

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 93.64118 lb/ft3

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	6.9	44.9
Water Pressure	10.8	10.8
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	17.8	55.6
Deflection		
Earth Load Deflection	1.926	12.254
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	2.058	12.386
Compressive Stress [psi]		
Compressive Wall Stress	79.9	250.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	15173.5	15173.5
Pullback Stress [psi]	423.2	423.2
Pullback Strain	7.359E-3	7.359E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	423.2	448.2
Tensile Strain	7.359E-3	8.242E-3

Net External Pressure = 31.5 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.058	7.5	3.6	OK
Unconstrained Collapse [psi]	37.0	115.3	3.1	OK
Compressive Wall Stress [psi]	79.9	1150.0	14.4	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	47.0	230.6	4.9	OK
Tensile Stress [psi]	448.2	1200.0	2.7	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	2019.045 psi	2029.982 psi
1	8.00 in	12.00 in	2018.644 psi	2029.782 psi
2	12.00 in	16.13 in	2018.063 psi	2029.492 psi

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

Estimated Circulating Pressure Summary

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

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

Drill Fluid Density: 68.700 lb/ft3

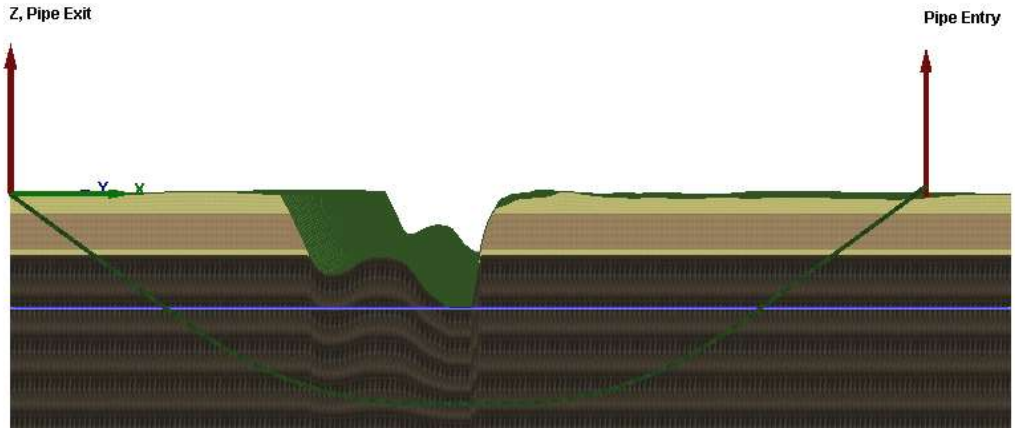
Rheological model: Bingham-Plastic

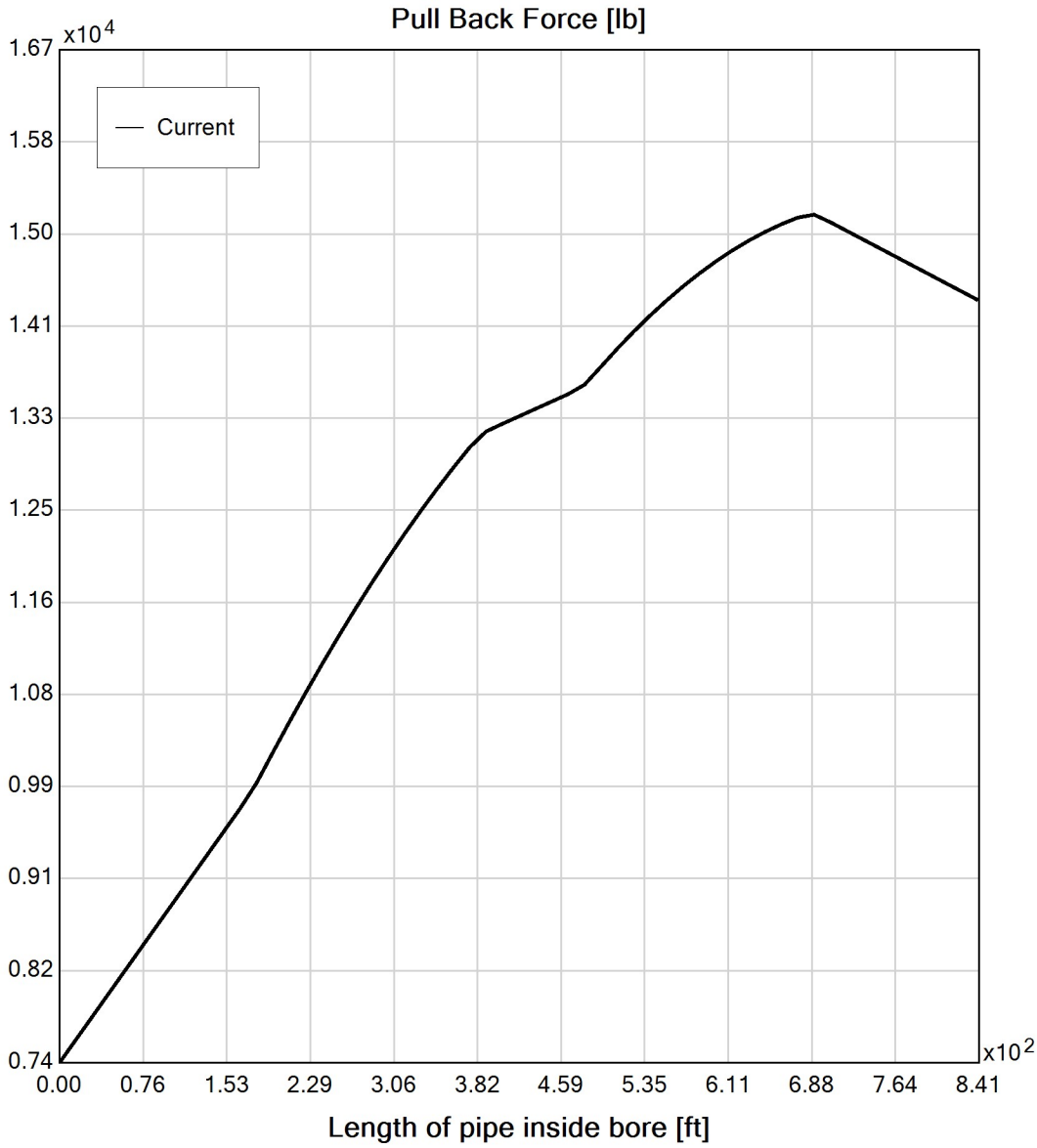
Plastic Viscosity (PV): 25.53

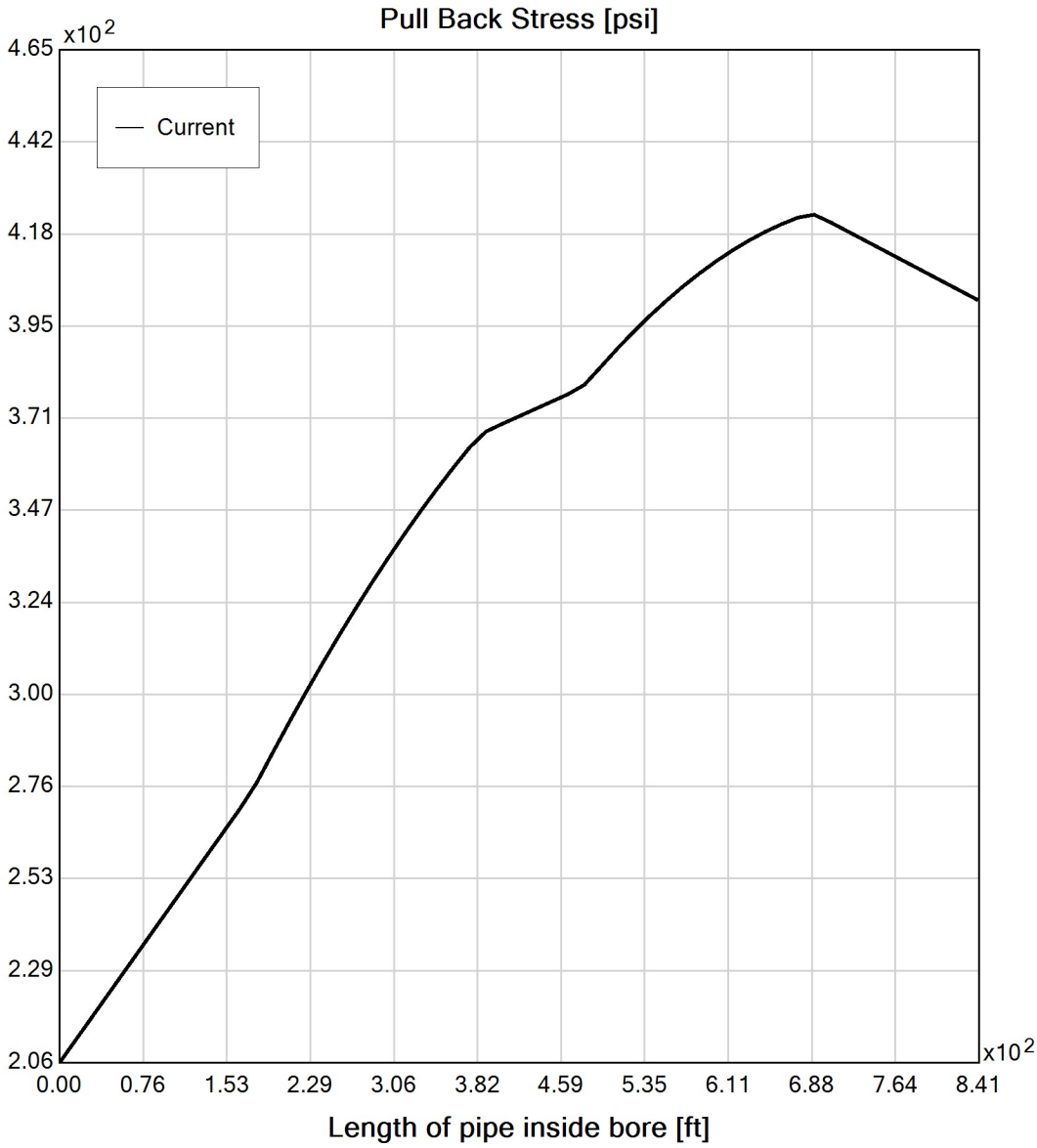
Yield Point (YP): 16.49

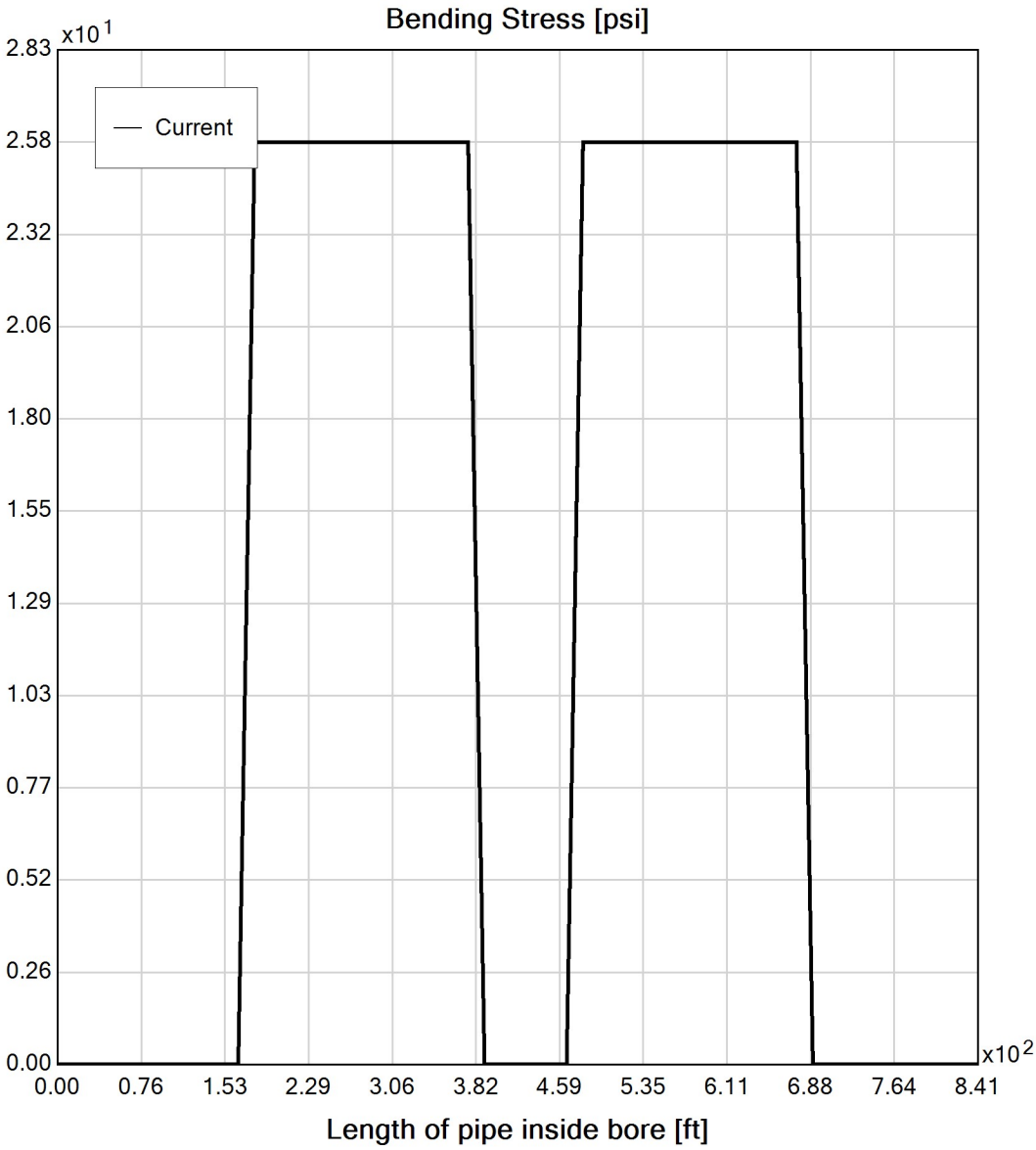
Effective Viscosity (cP): 1202.0

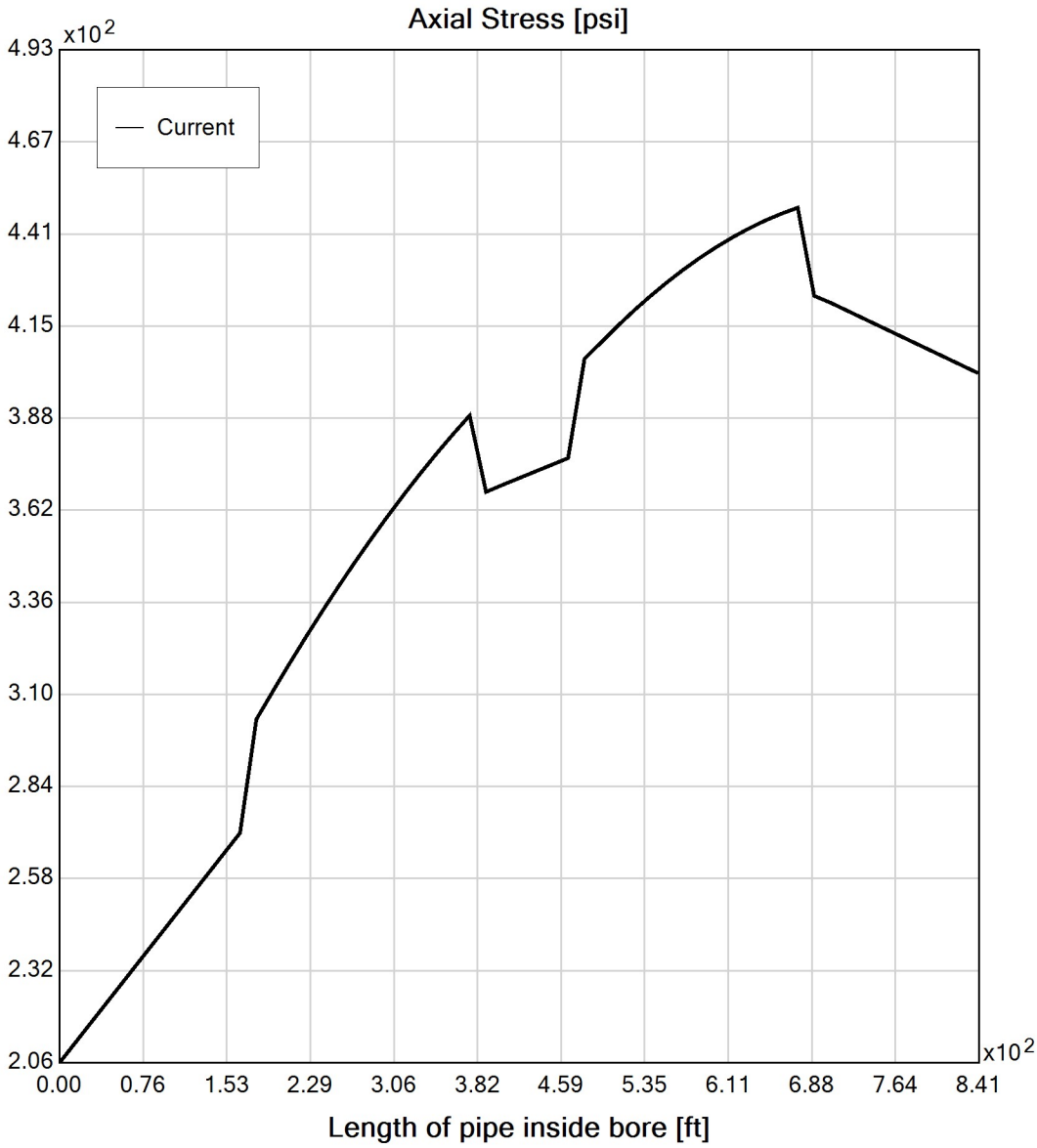
Virtual Site

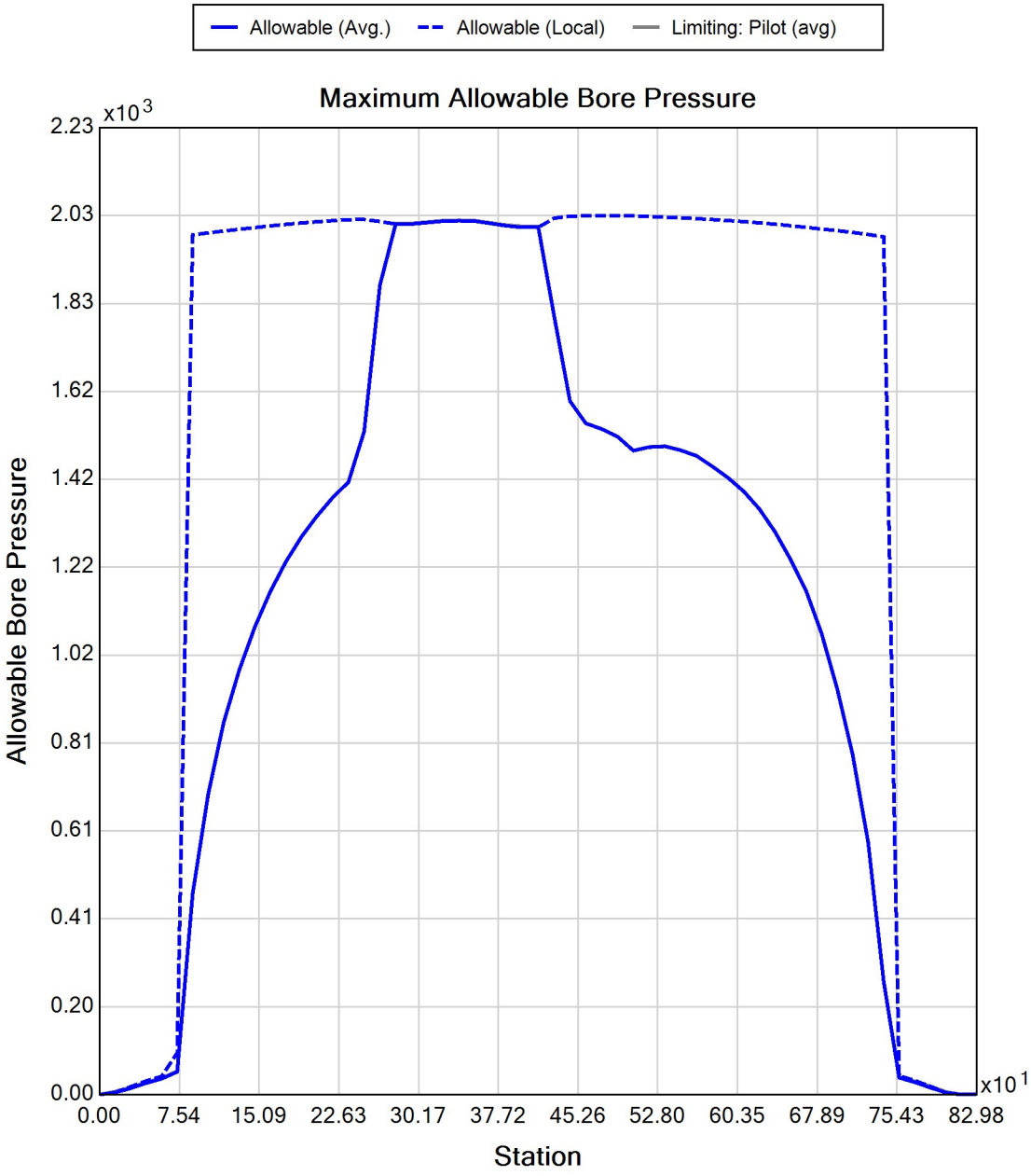


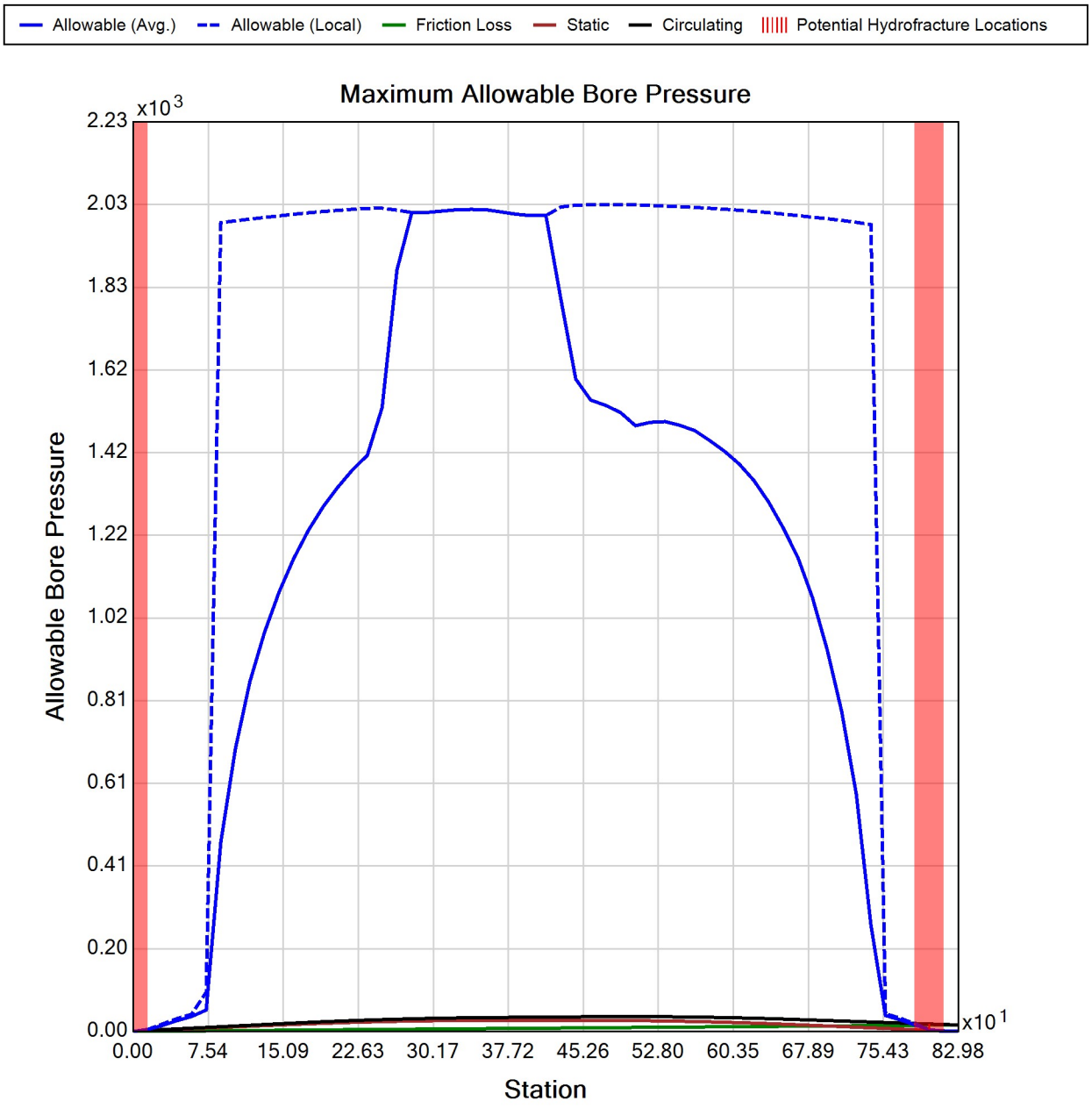












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Project Summary

General:	HDD 53
	P4A
	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 53 2-Inch DR 9 Conduit 1

Input Summary

Start Coordinate	(0.00, 0.00, 296.00) ft
End Coordinate	(815.00, 0.00, 295.00) ft
Project Length	815.00 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: 840.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 0.531000018119812 ft

Silo Width: 0.531000018119812 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 59.30500 lb/ft3

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 93.64118 lb/ft3

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	2.8	44.9
Water Pressure	10.8	10.8
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	13.6	55.6
Deflection		
Earth Load Deflection	0.768	12.254
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.797	12.283
Compressive Stress [psi]		
Compressive Wall Stress	61.1	250.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	850.2	850.2
Pullback Stress [psi]	485.8	485.8
Pullback Strain	8.448E-3	8.448E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	485.8	490.7
Tensile Strain	8.448E-3	8.633E-3

Net External Pressure = 31.5 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.797	7.5	9.4	OK
Unconstrained Collapse [psi]	37.0	128.8	3.5	OK
Compressive Wall Stress [psi]	61.1	1150.0	18.8	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	47.0	228.8	4.9	OK
Tensile Stress [psi]	490.7	1200.0	2.4	OK

Generated Output

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Project Summary

General:	HDD 53
	P4A
	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 53 10-inch DR 9 Conduit 2

Input Summary

Start Coordinate	(0.00, 0.00, 295.50) ft
End Coordinate	(815.00, 0.00, 294.30) ft
Project Length	815.00 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

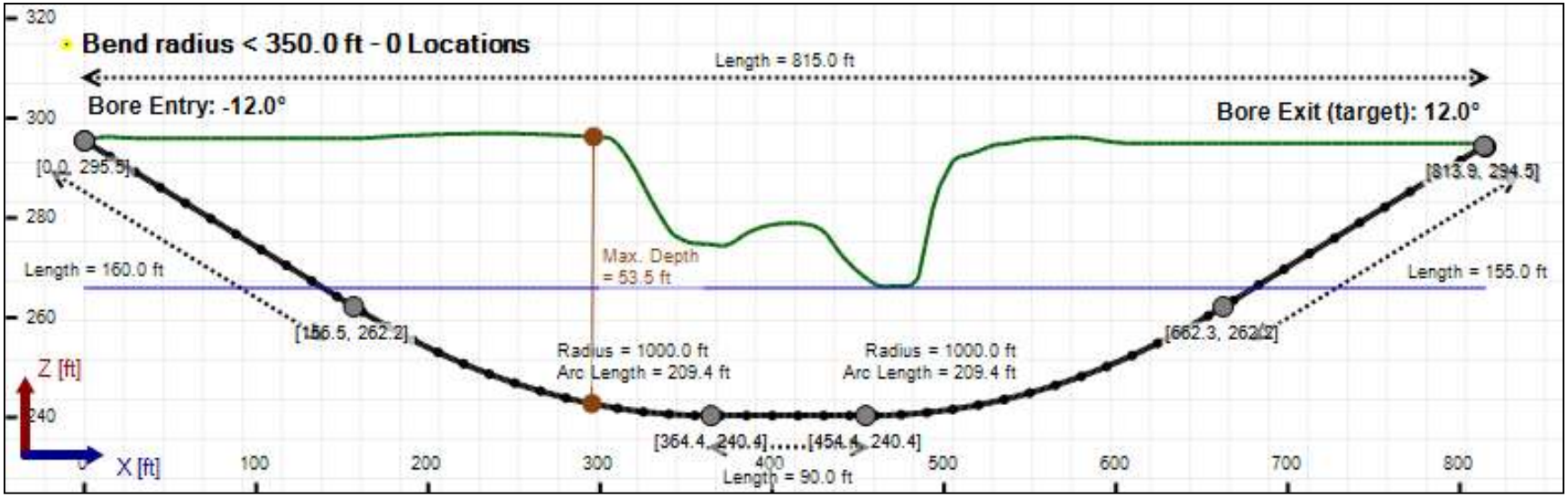
Soil Layer #1 USCS, Silt (M), ML
Depth: 5.00 ft
Unit Weight: 80.0000 (dry), 100.0000 (sat) [lb/ft3]
Phi: 28.00, S.M.: 50.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Sand (S), SM
Depth: 9.50 ft
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

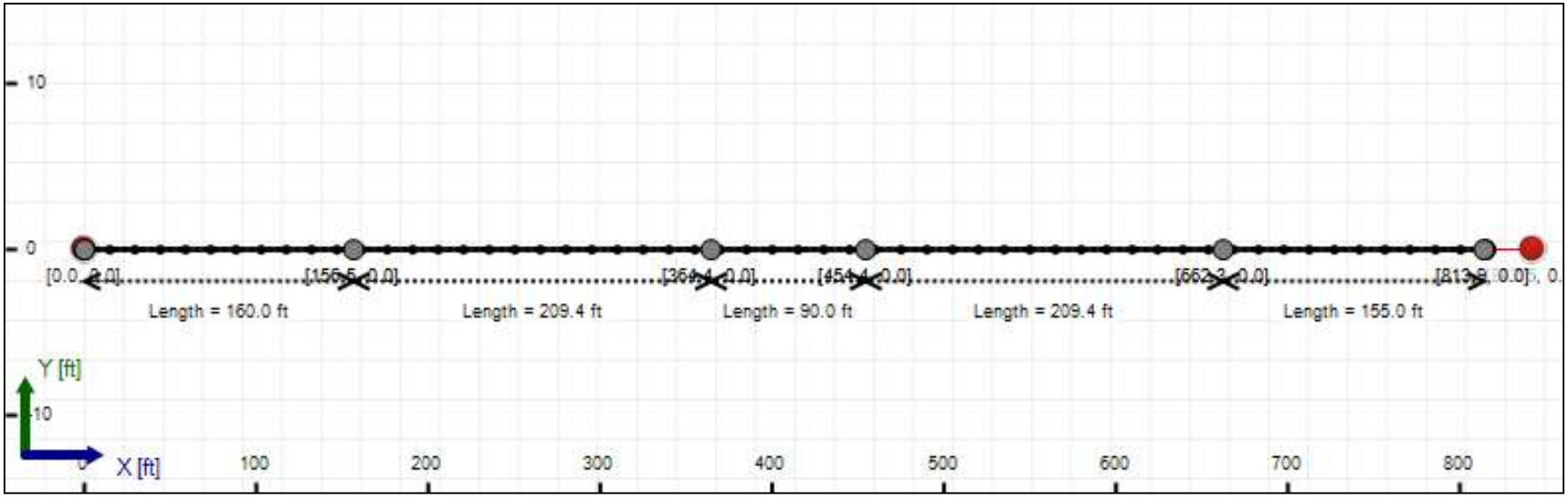
Soil Layer #3 USCS, Silt (M), ML
Depth: 1.50 ft
Unit Weight: 120.0000 (dry), 140.0000 (sat) [lb/ft3]
Phi: 37.00, S.M.: 1000.00, Coh: 0.00 [psi]

Soil Layer #4 Rock, Geological Classification, Sedimentary Rocks
Depth: 50.00 ft
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: 825.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.34400002161662 ft

Silo Width: 1.34400002161662 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 59.30500 lb/ft3

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 93.64118 lb/ft3

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	7.0	44.0
Water Pressure	11.1	10.5
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	18.1	54.4
Deflection		
Earth Load Deflection	1.897	12.007
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	2.029	12.139
Compressive Stress [psi]		
Compressive Wall Stress	81.3	244.9

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	14772.1	14772.1
Pullback Stress [psi]	412.0	412.0
Pullback Strain	7.165E-3	7.165E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	412.0	437.2
Tensile Strain	7.165E-3	8.051E-3

Net External Pressure = 30.3 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.029	7.5	3.7	OK
Unconstrained Collapse [psi]	35.8	115.1	3.2	OK
Compressive Wall Stress [psi]	81.3	1150.0	14.1	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	45.8	231.3	5.0	OK
Tensile Stress [psi]	437.2	1200.0	2.7	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	2019.615 psi	2028.817 psi
1	8.00 in	12.00 in	2019.224 psi	2028.610 psi
2	12.00 in	16.13 in	2018.657 psi	2028.310 psi

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

Estimated Circulating Pressure Summary

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

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

Drill Fluid Density: 68.700 lb/ft3

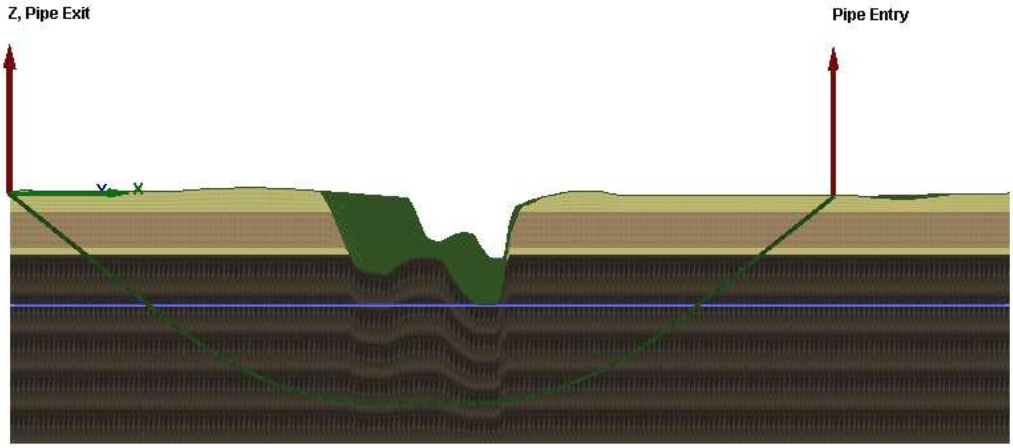
Rheological model: Bingham-Plastic

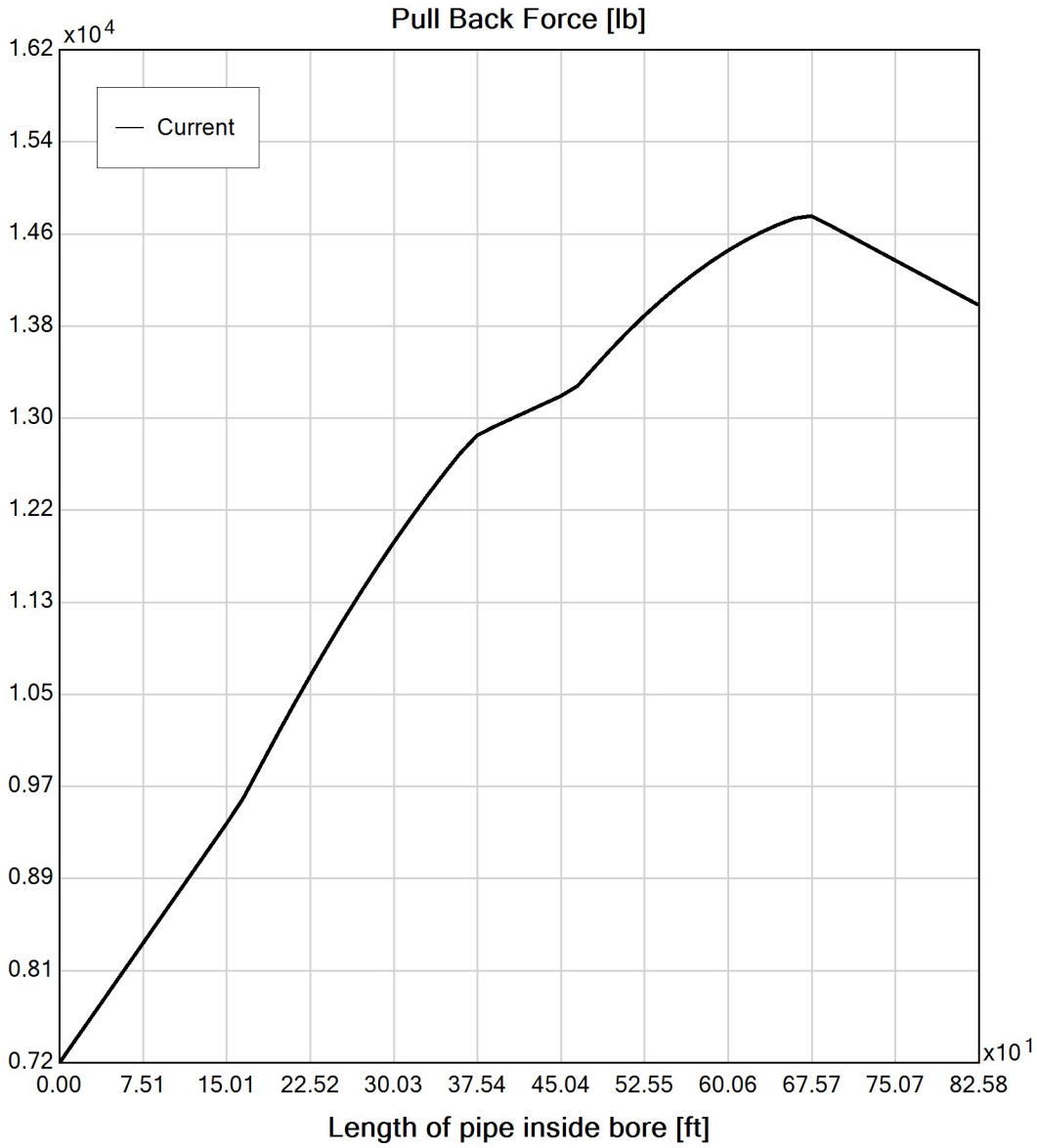
Plastic Viscosity (PV): 25.53

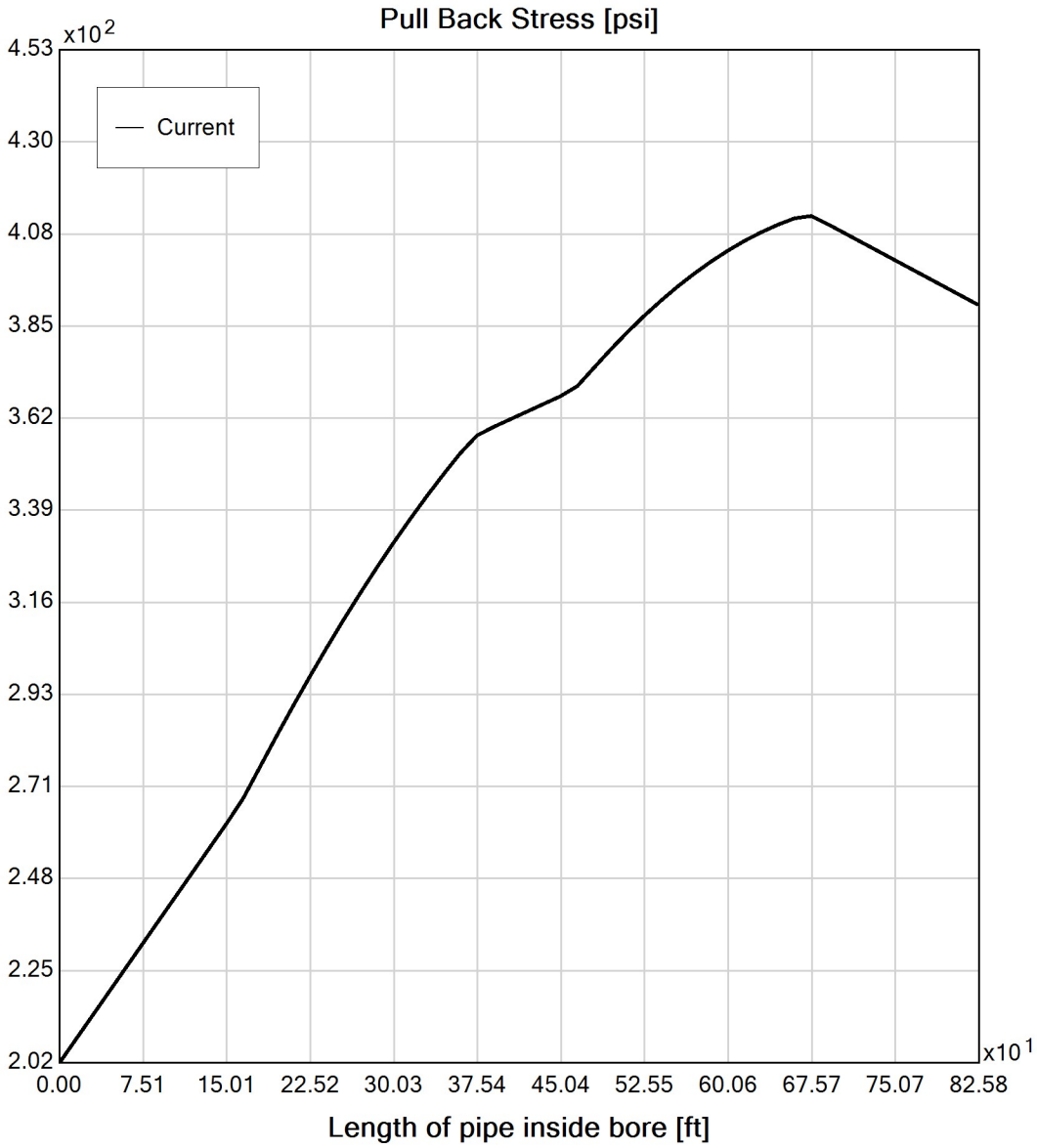
Yield Point (YP): 16.49

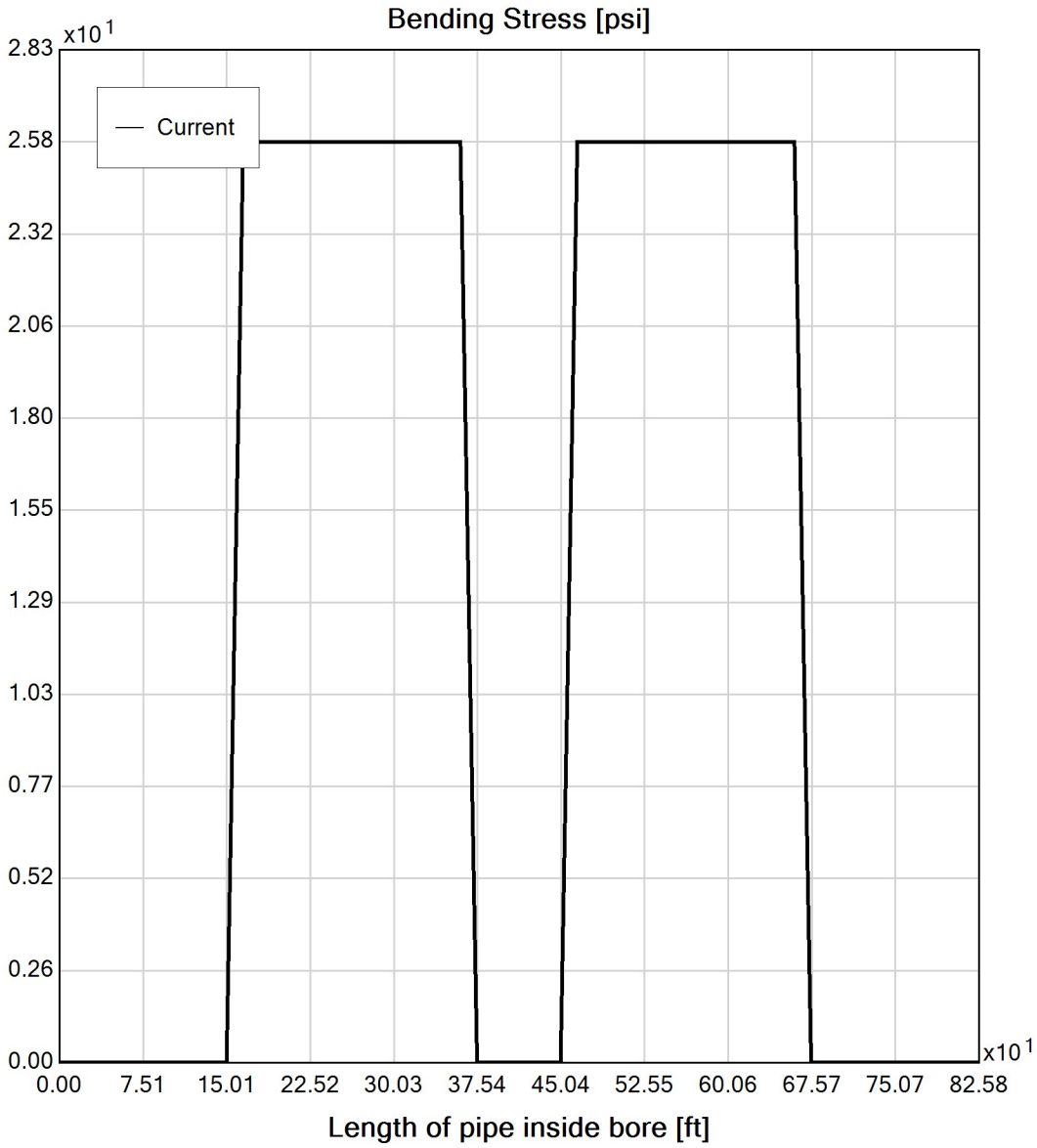
Effective Viscosity (cP): 1202.0

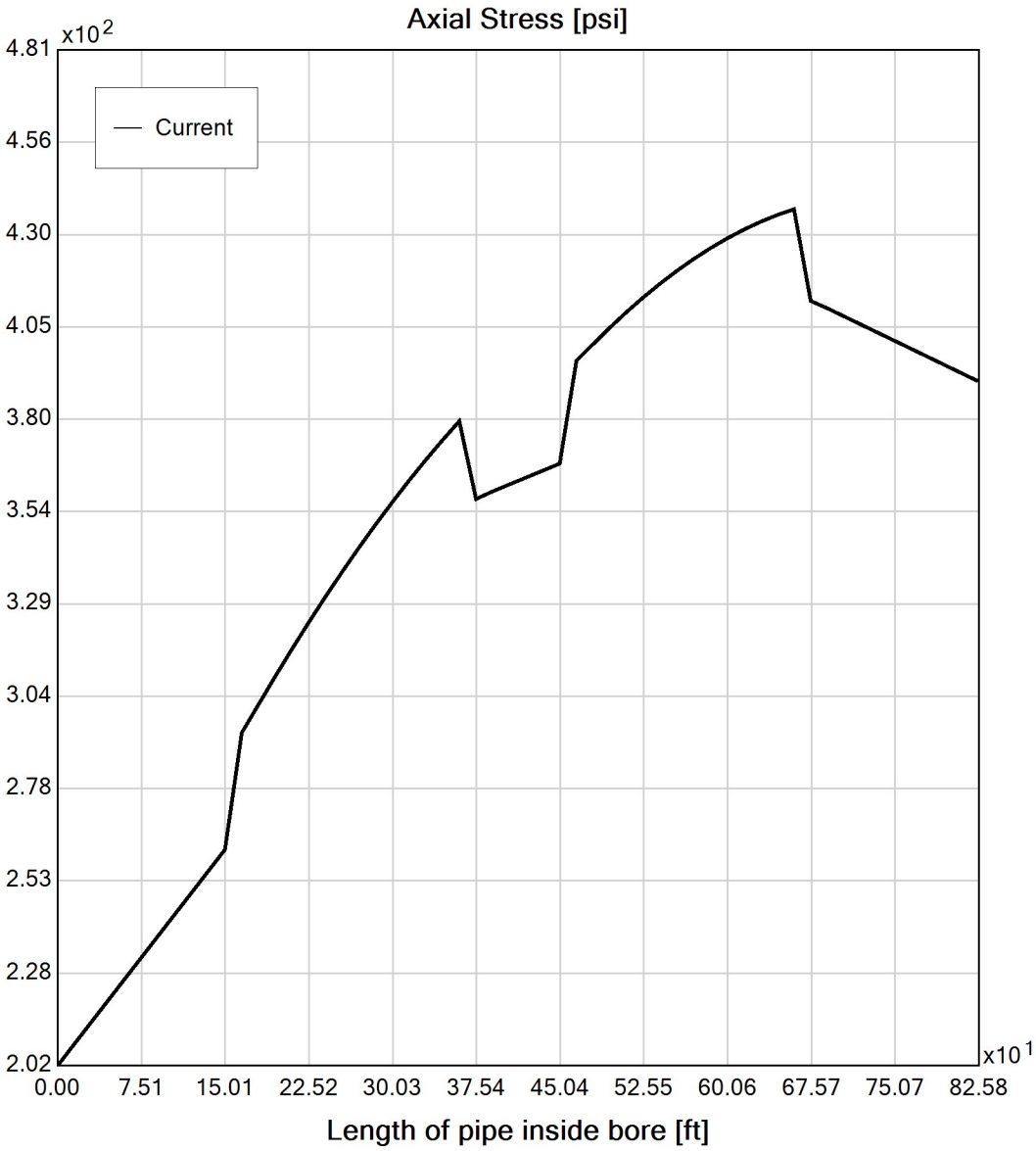
Virtual Site

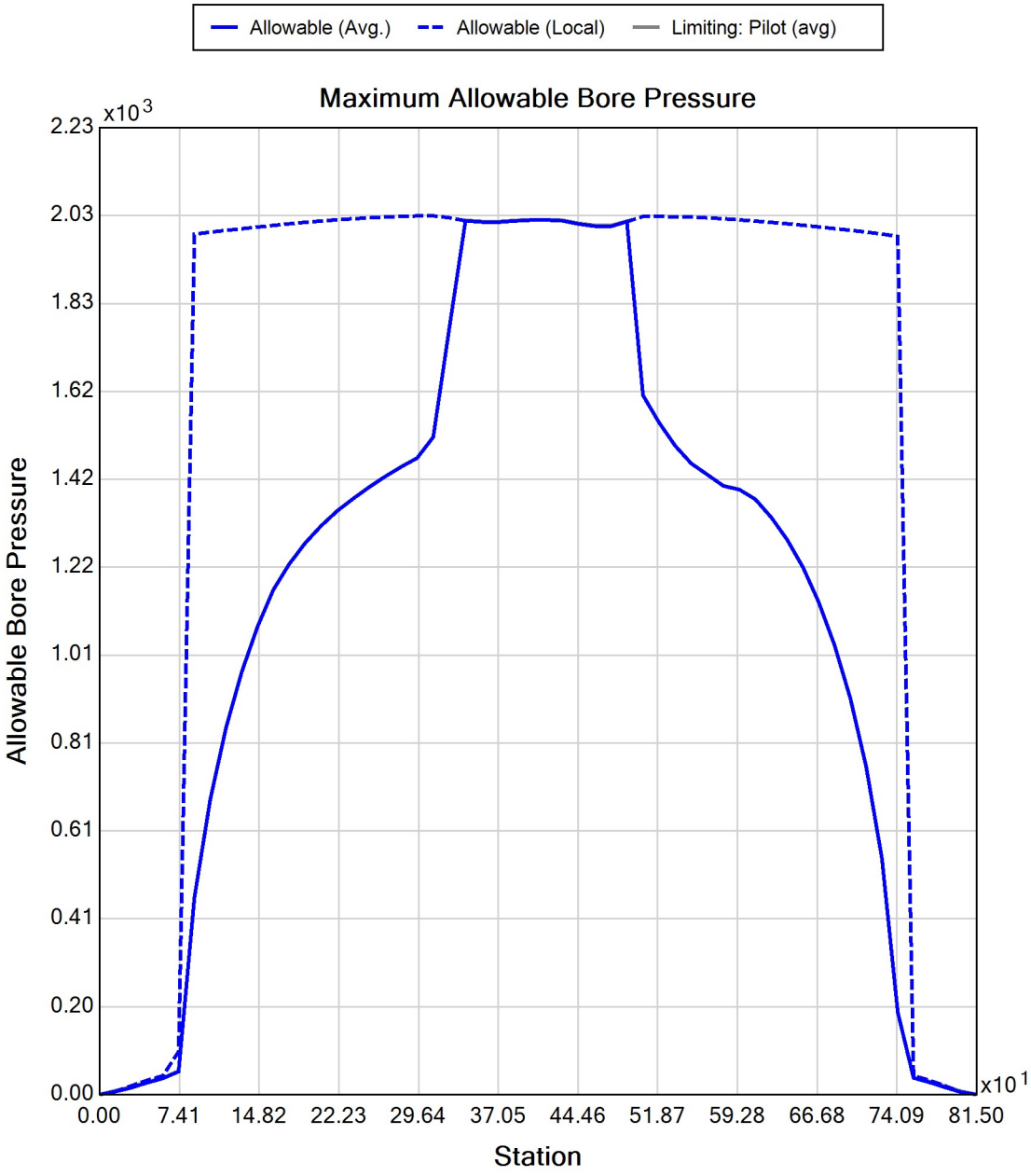


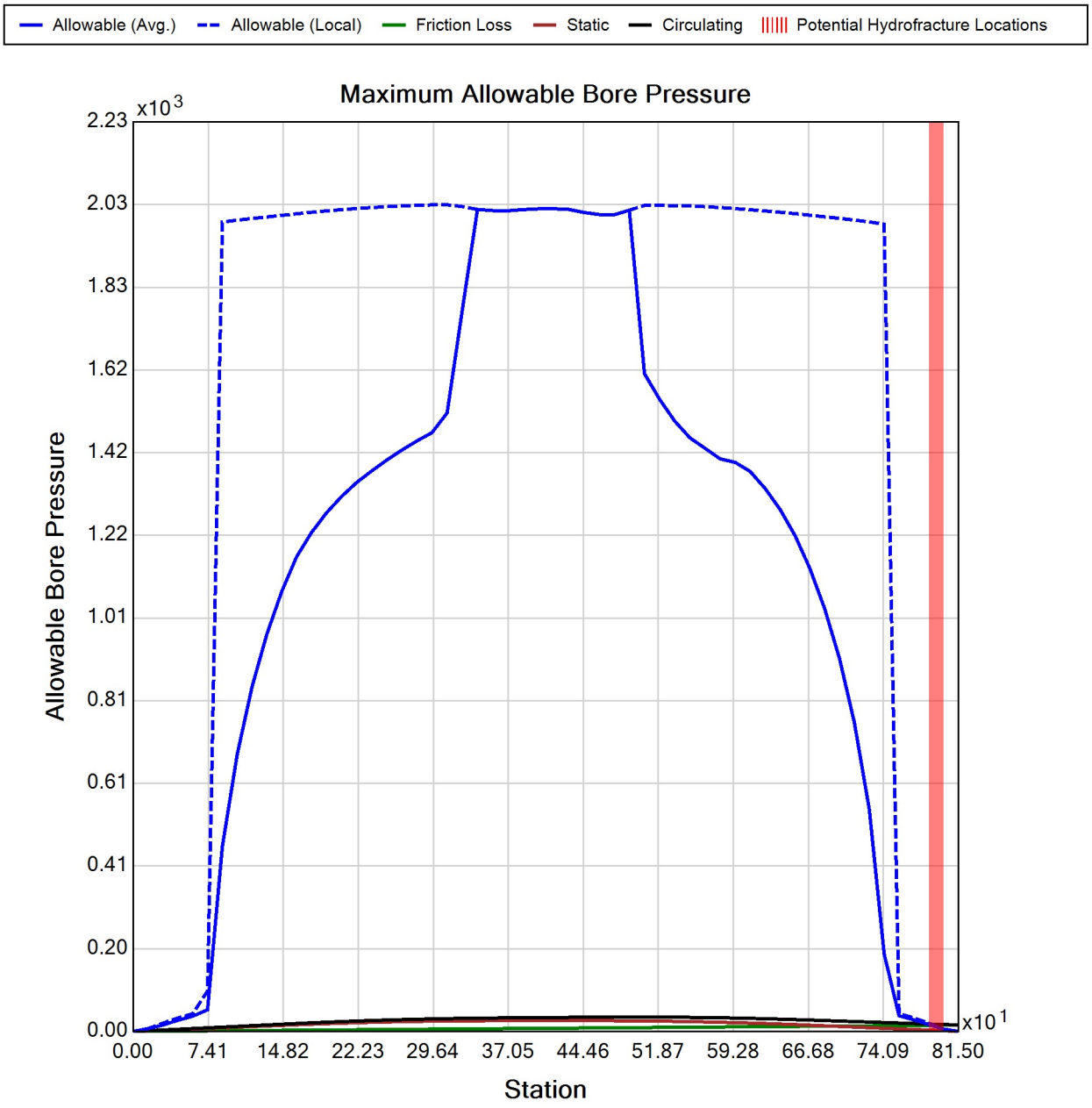












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Project Summary

General:	HDD 53
	P4A
	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 53 2-inch DR 9 Conduit 2

Input Summary

Start Coordinate	(0.00, 0.00, 295.50) ft
End Coordinate	(815.00, 0.00, 294.30) ft
Project Length	815.00 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: 825.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 0.531000018119812 ft

Silo Width: 0.531000018119812 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 59.30500 lb/ft3

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 93.64118 lb/ft3

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	2.8	44.0
Water Pressure	11.1	10.5
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	13.9	54.4
Deflection		
Earth Load Deflection	0.756	12.007
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.785	12.036
Compressive Stress [psi]		
Compressive Wall Stress	62.5	244.9

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	830.6	830.6
Pullback Stress [psi]	474.6	474.6
Pullback Strain	8.254E-3	8.254E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	474.6	479.7
Tensile Strain	8.254E-3	8.442E-3

Net External Pressure = 30.3 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.785	7.5	9.6	OK
Unconstrained Collapse [psi]	35.8	128.7	3.6	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]	45.8	229.5	5.0	OK
Tensile Stress [psi]	479.7	1200.0	2.5	OK

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Project Summary

General:	HDD 53A
	P4A
	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 53A 10-inch DR9

Input Summary

Start Coordinate	(0.00, 0.00, 276.30) ft
End Coordinate	(626.20, 0.00, 276.50) ft
Project Length	626.20 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 4

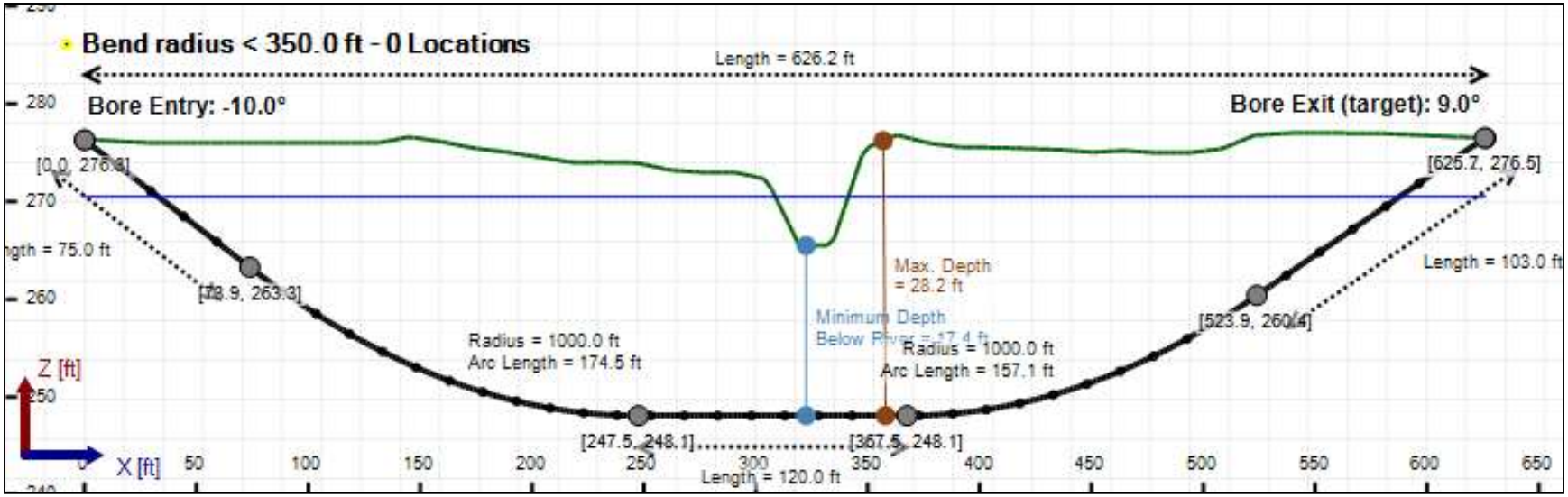
Soil Layer #1 USCS, Sand (S), SP
From Assistant
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 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]

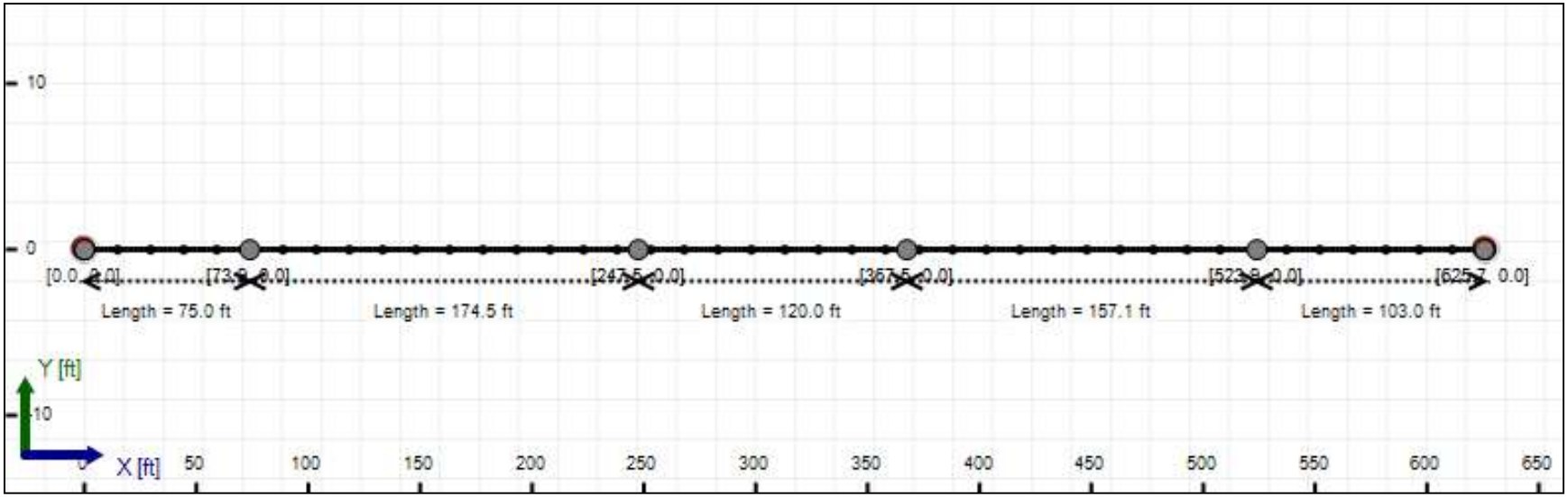
Soil Layer #3 USCS, Gravel (G), GP
From Assistant
Unit Weight: 120.0000 (dry), 140.0000 (sat) [lb/ft3]
Phi: 37.00, S.M.: 1000.00, Coh: 0.00 [psi]

Soil Layer #4 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: 630.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.34400002161662 ft

Silo Width: 1.34400002161662 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 59.30500 lb/ft3

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 93.64118 lb/ft3

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	17.4	22.3
Water Pressure	9.7	9.7
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	27.1	32.0
Deflection		
Earth Load Deflection	4.740	6.065
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	4.872	6.197
Compressive Stress [psi]		
Compressive Wall Stress	122.0	143.9

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	10562.9	10562.9
Pullback Stress [psi]	294.6	294.6
Pullback Strain	5.123E-3	5.123E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	294.6	319.1
Tensile Strain	5.123E-3	5.997E-3

Net External Pressure = 18.6 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	4.872	7.5	1.5	OK
Unconstrained Collapse [psi]	27.1	89.4	3.3	OK
Compressive Wall Stress [psi]	122.0	1150.0	9.4	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	28.5	238.1	8.4	OK
Tensile Stress [psi]	319.1	1200.0	3.8	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	1038.270 psi	2006.495 psi
1	8.00 in	12.00 in	1036.096 psi	2004.577 psi
2	12.00 in	16.13 in	1032.958 psi	2001.796 psi

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

Estimated Circulating Pressure Summary

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

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

Drill Fluid Density: 68.700 lb/ft3

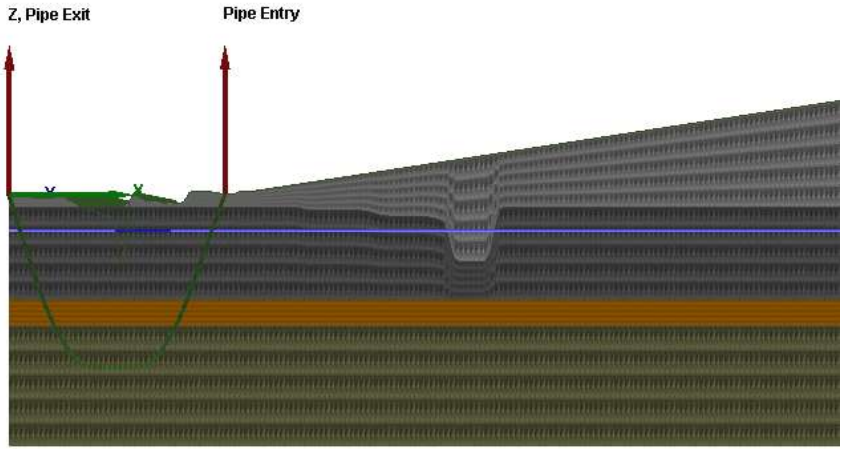
Rheological model: Bingham-Plastic

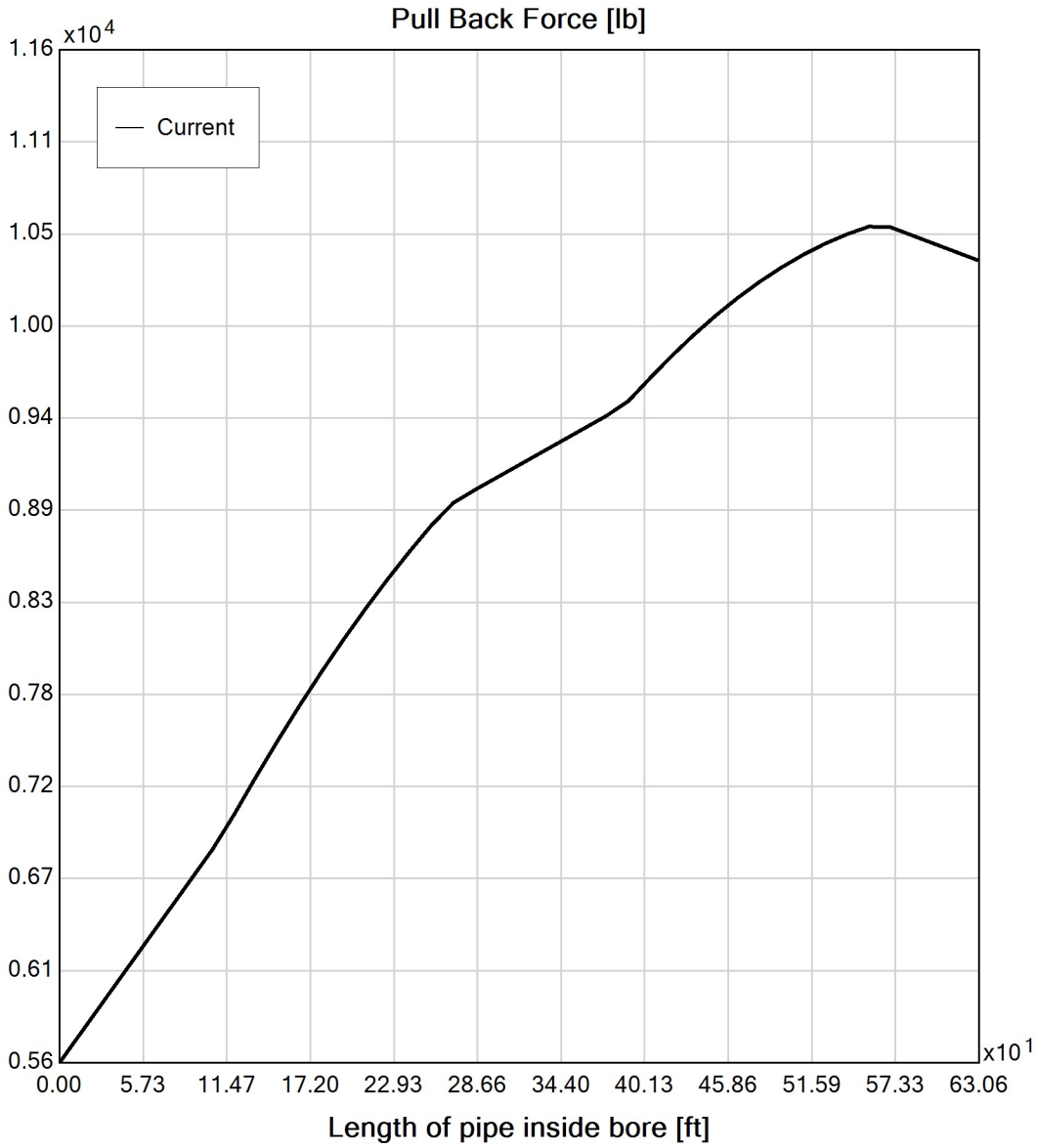
Plastic Viscosity (PV): 25.53

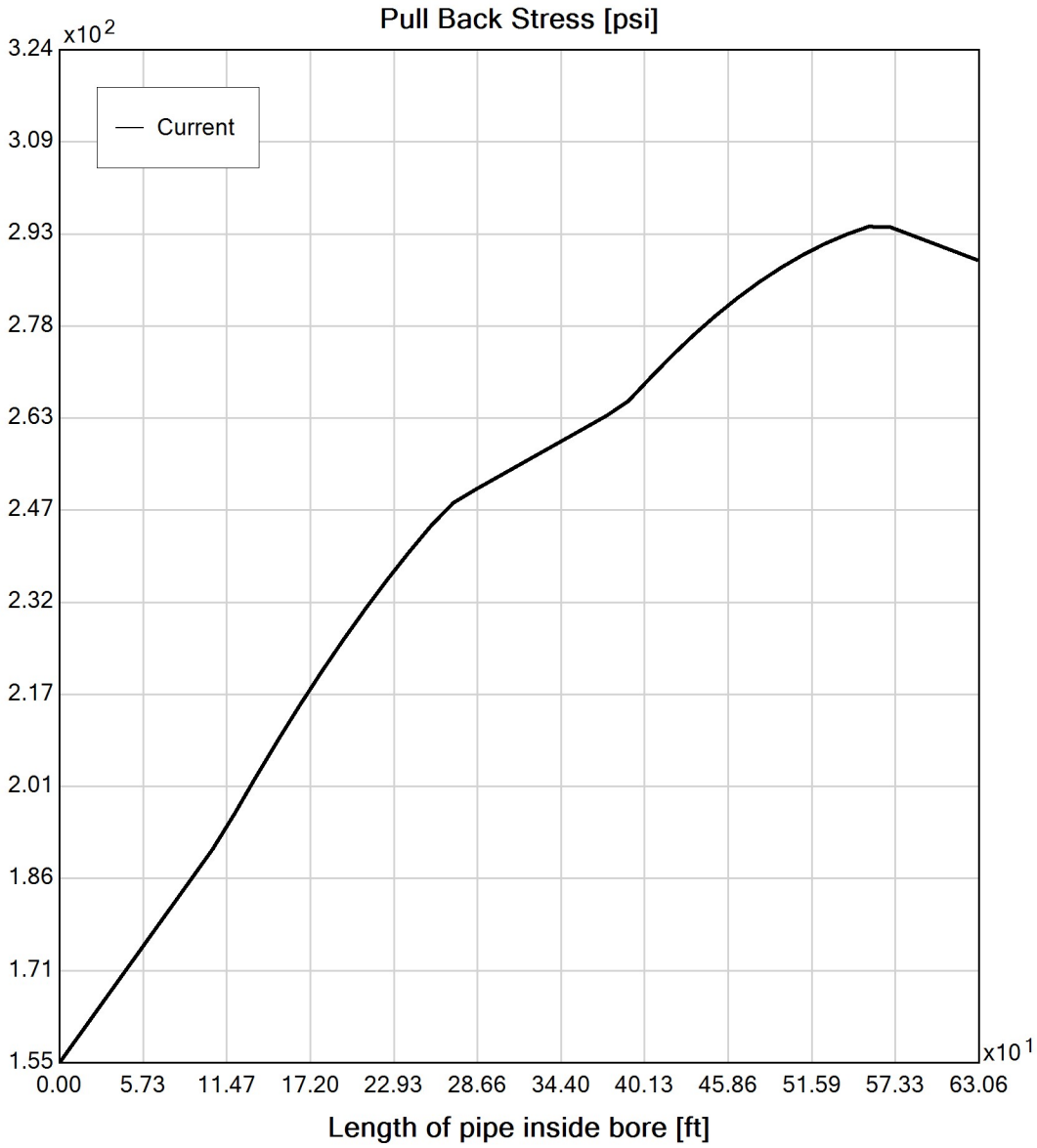
Yield Point (YP): 16.49

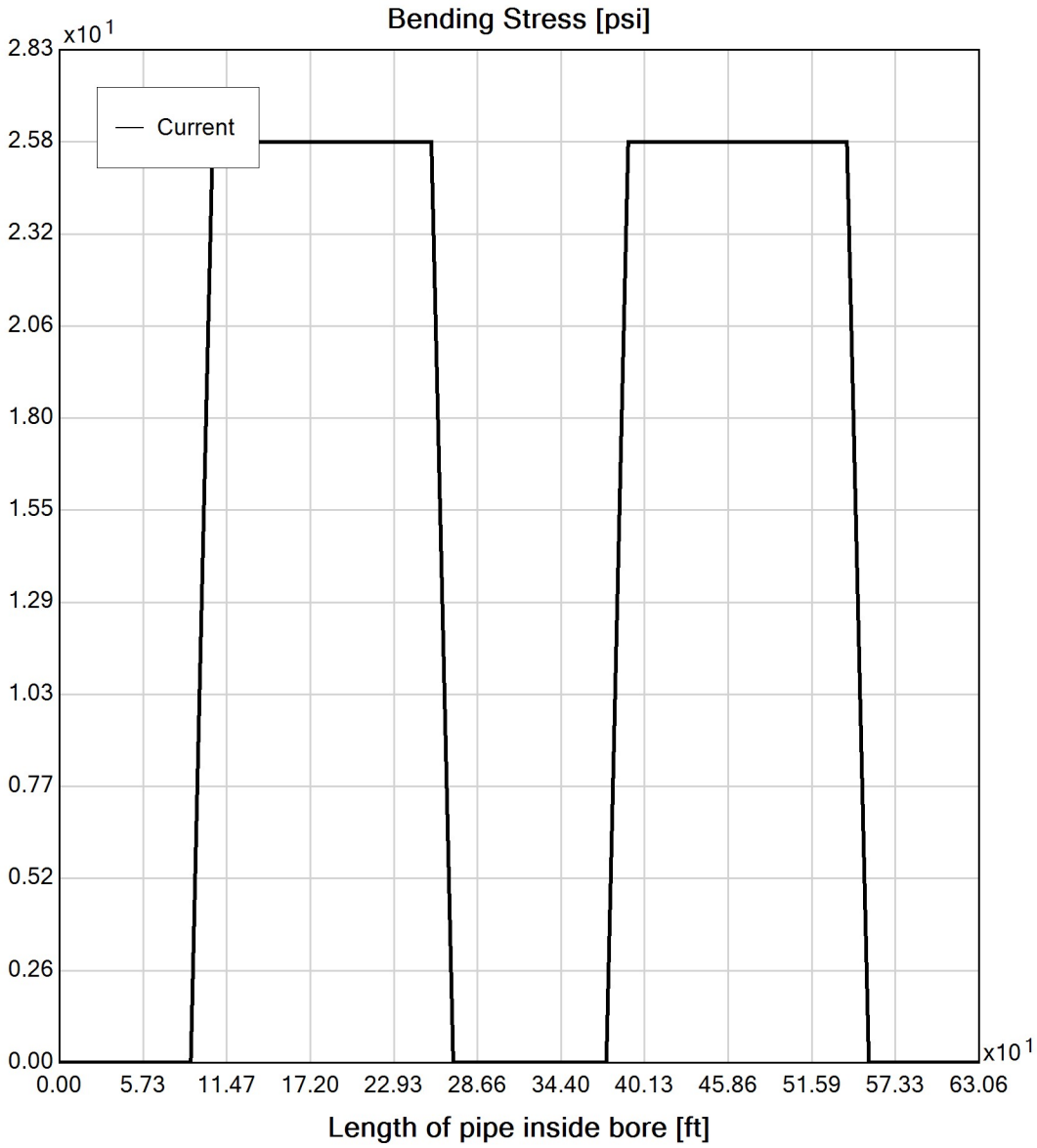
Effective Viscosity (cP): 1202.0

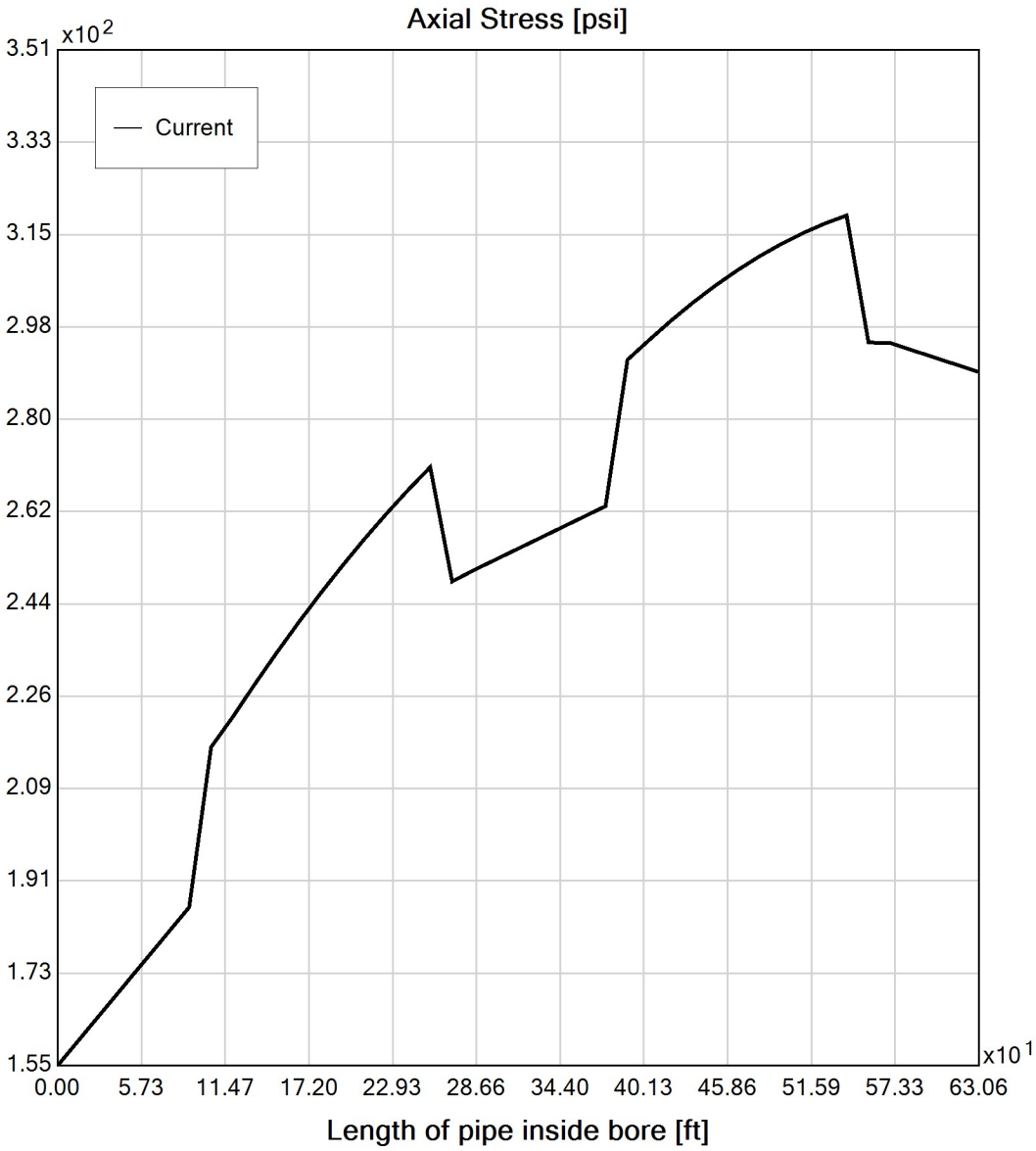
Virtual Site

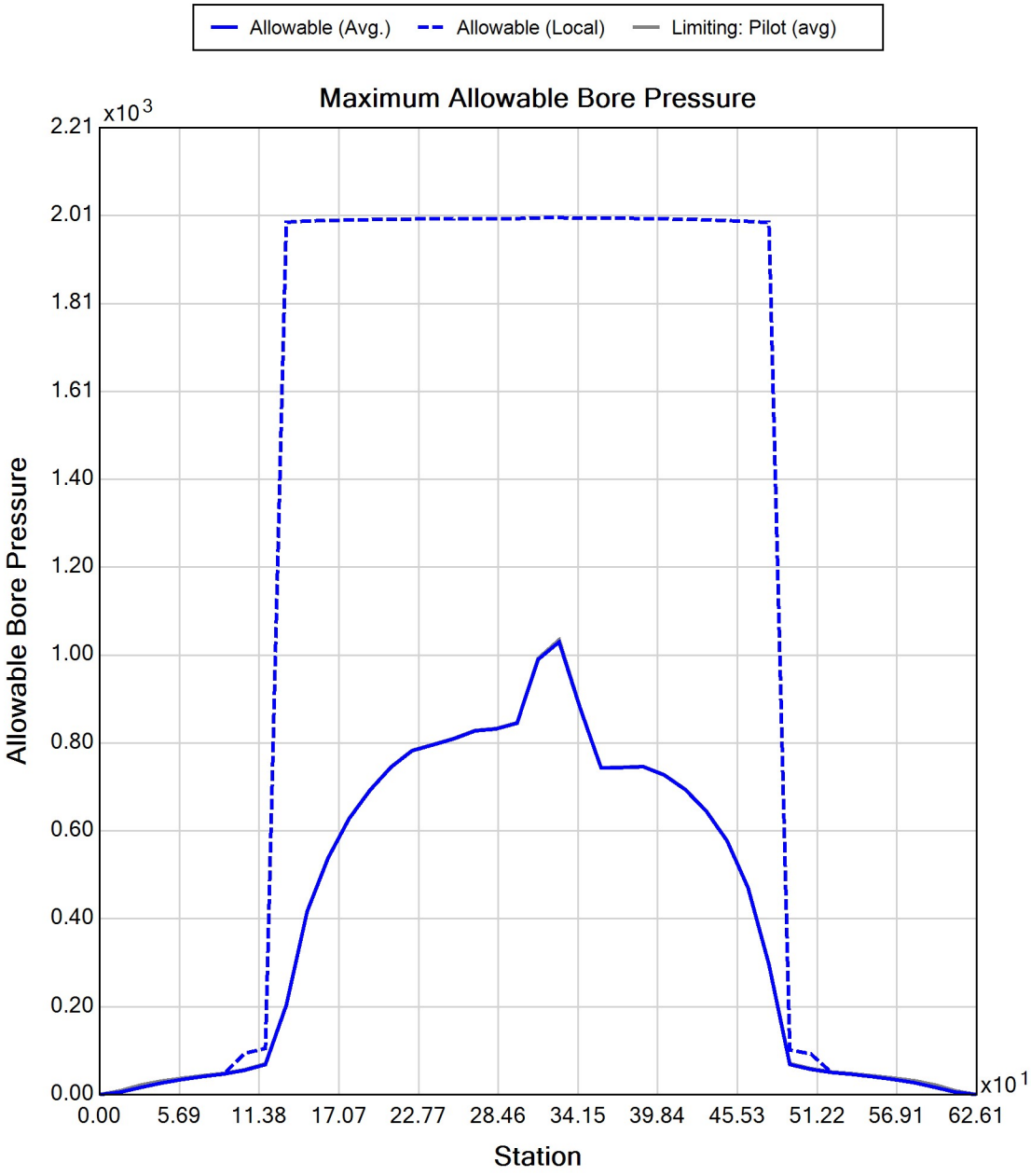


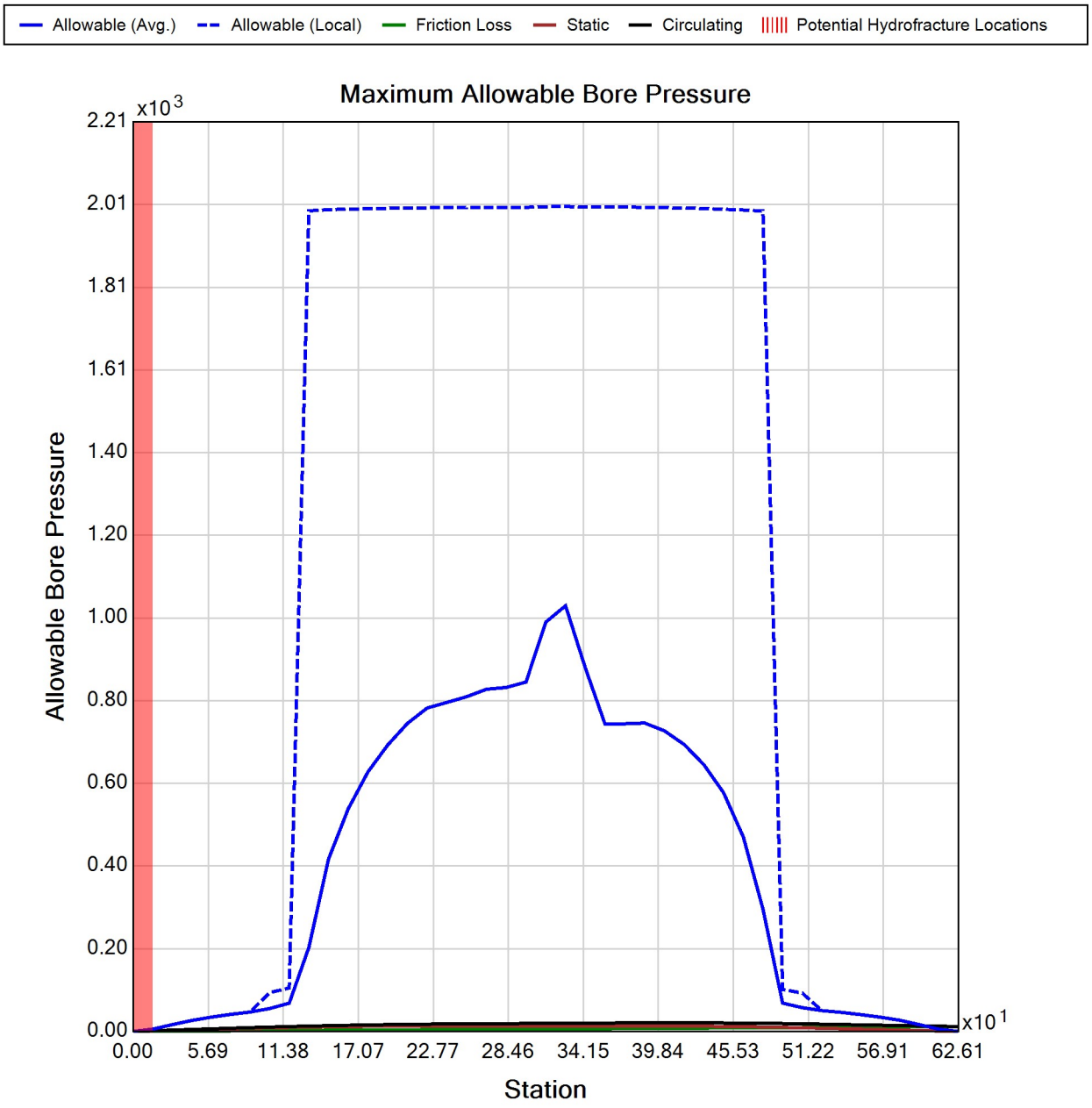












Generated Output

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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:	HDD 53A
	P4A
	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 53A 2-inch DR9

Input Summary

Start Coordinate	(0.00, 0.00, 276.30) ft
End Coordinate	(626.20, 0.00, 276.50) ft
Project Length	626.20 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

Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 2" (2.375")

Pipe DR: 9

Pipe Length: 630.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 0.531000018119812 ft

Silo Width: 0.531000018119812 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 59.30500 lb/ft3

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 93.64118 lb/ft3

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	12.4	22.3
Water Pressure	9.7	9.7
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	22.2	32.0
Deflection		
Earth Load Deflection	3.389	6.065
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	3.418	6.094
Compressive Stress [psi]		
Compressive Wall Stress	99.7	143.9

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	625.2	625.2
Pullback Stress [psi]	357.2	357.2
Pullback Strain	6.212E-3	6.212E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	357.2	361.6
Tensile Strain	6.212E-3	6.388E-3

Net External Pressure = 18.6 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	3.418	7.5	2.2	OK
Unconstrained Collapse [psi]	22.2	101.7	4.6	OK
Compressive Wall Stress [psi]	99.7	1150.0	11.5	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	28.5	236.4	8.3	OK
Tensile Stress [psi]	361.6	1200.0	3.3	OK

Generated Output

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Project Summary

General:	CHPE HDD 59
	P4A
	Start Date: 06-07-2023
	End Date: 06-07-2023
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA
Designer:	MDB
	BCE
	Amherst, MA
Description:	HDD 59 Reversed Conduit 1 10-inch DR-9

Input Summary

Start Coordinate	(0.00, 0.00, 260.00) ft
End Coordinate	(1124.00, 0.00, 269.00) ft
Project Length	1124.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 4

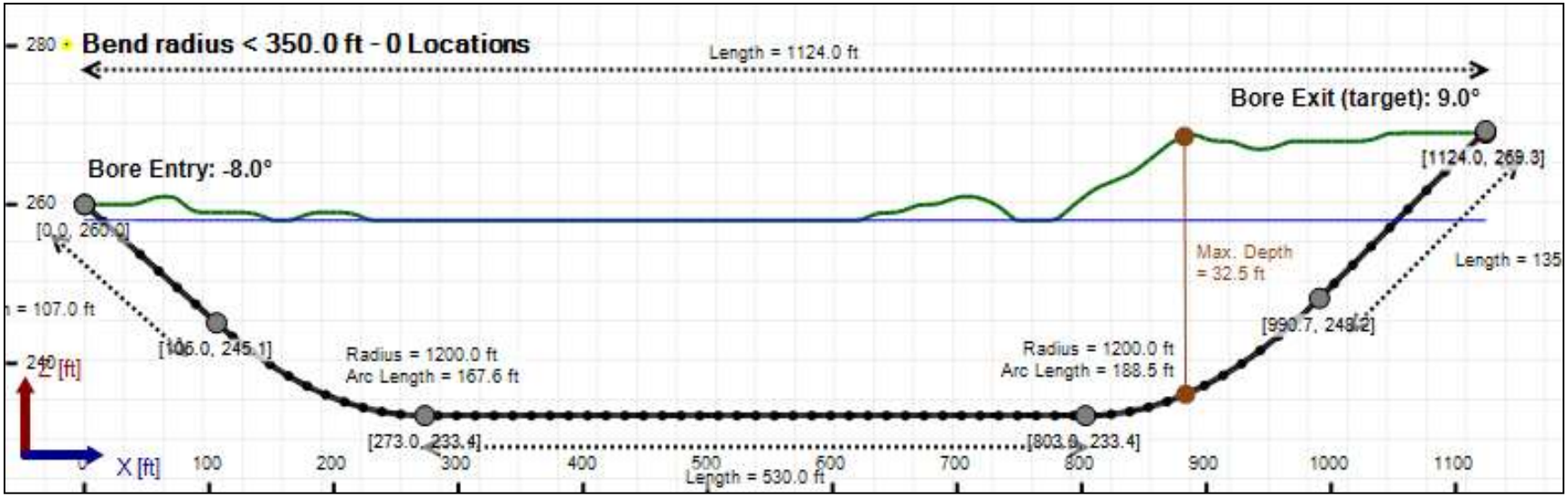
Soil Layer #1 USCS, Sand (S), SP
From Assistant
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 500.00, Coh: 0.00 [psi]

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

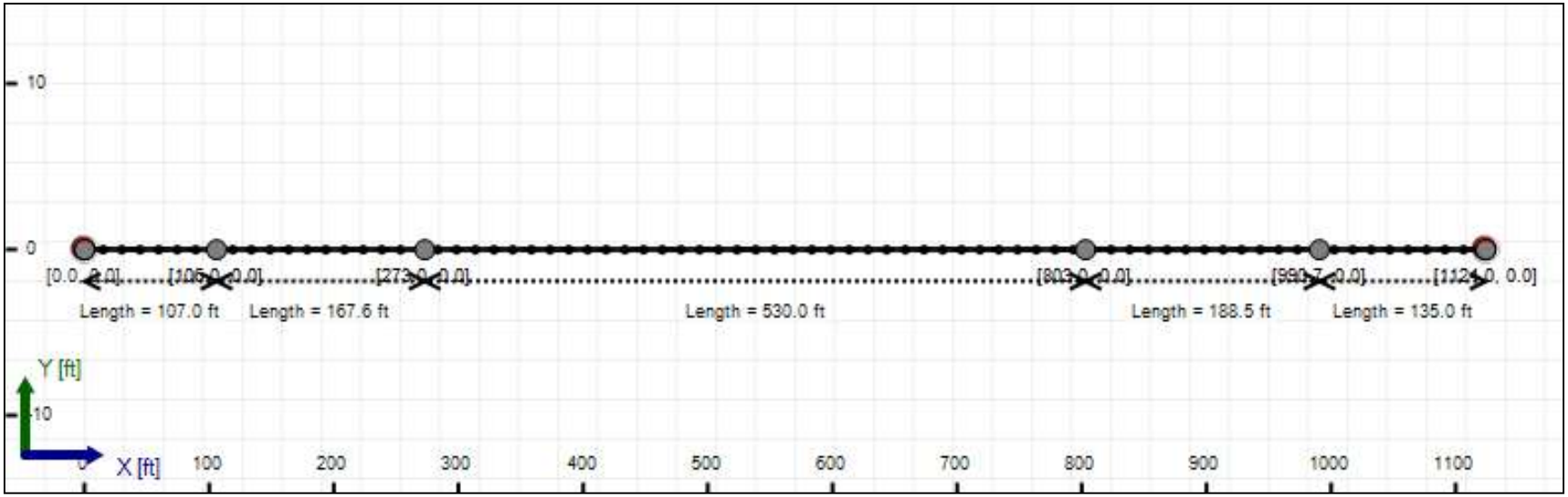
Soil Layer #3 USCS, Gravel (G), GP
From Assistant
Unit Weight: 120.0000 (dry), 140.0000 (sat) [lb/ft3]
Phi: 37.00, S.M.: 1000.00, Coh: 0.00 [psi]

Soil Layer #4 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: 1140.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.34400002161662 ft

Silo Width: 1.34400002161662 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 59.30500 lb/ft3

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 93.64118 lb/ft3

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	5.6	24.0
Water Pressure	10.7	9.9
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	16.3	33.9
Deflection		
Earth Load Deflection	1.558	6.619
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.690	6.751
Compressive Stress [psi]		
Compressive Wall Stress	73.3	152.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	18496.3	18496.3
Pullback Stress [psi]	515.8	515.8
Pullback Strain	8.971E-3	8.971E-3
Bending Stress [psi]	0.0	21.5
Bending Strain	0	3.733E-4
Tensile Stress [psi]	515.8	533.5
Tensile Strain	8.971E-3	9.651E-3

Net External Pressure = 25.4 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.690	7.5	4.4	OK
Unconstrained Collapse [psi]	24.6	118.9	4.8	OK
Compressive Wall Stress [psi]	73.3	1150.0	15.7	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	34.6	224.8	6.5	OK
Tensile Stress [psi]	533.5	1200.0	2.2	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	1951.828 psi	2009.351 psi
1	8.00 in	12.00 in	1950.883 psi	2008.789 psi
2	12.00 in	16.13 in	1949.513 psi	2007.974 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

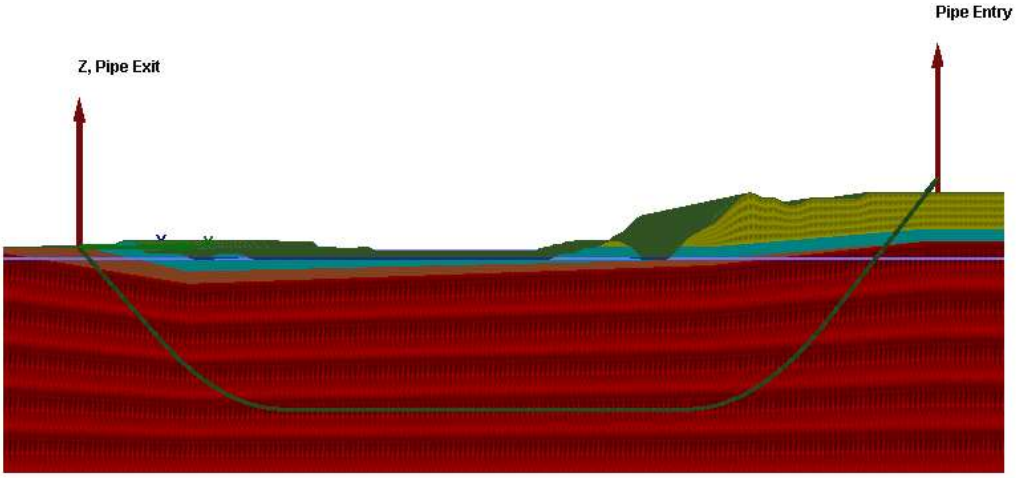
Rheological model: Bingham-Plastic

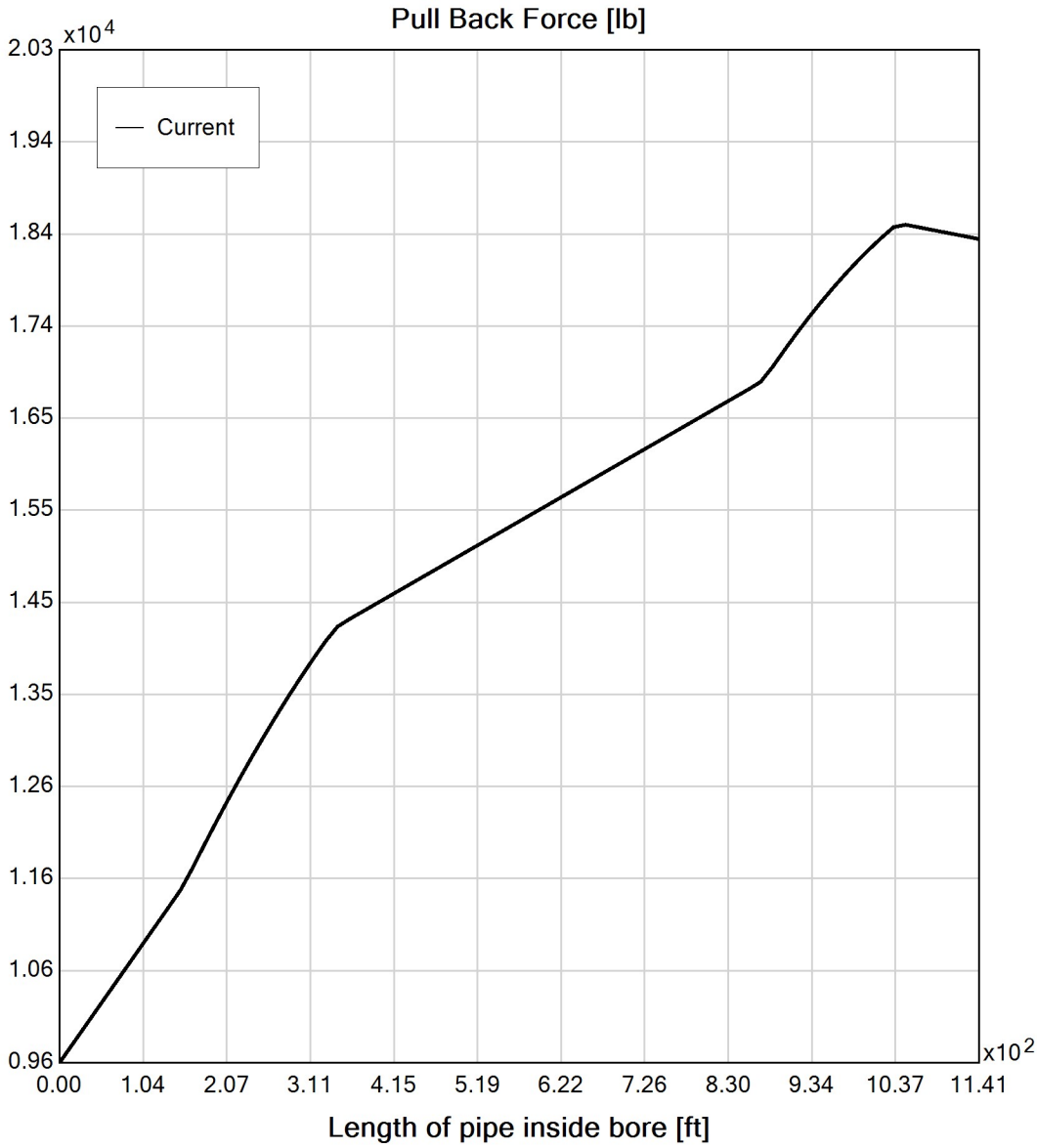
Plastic Viscosity (PV): 25.53

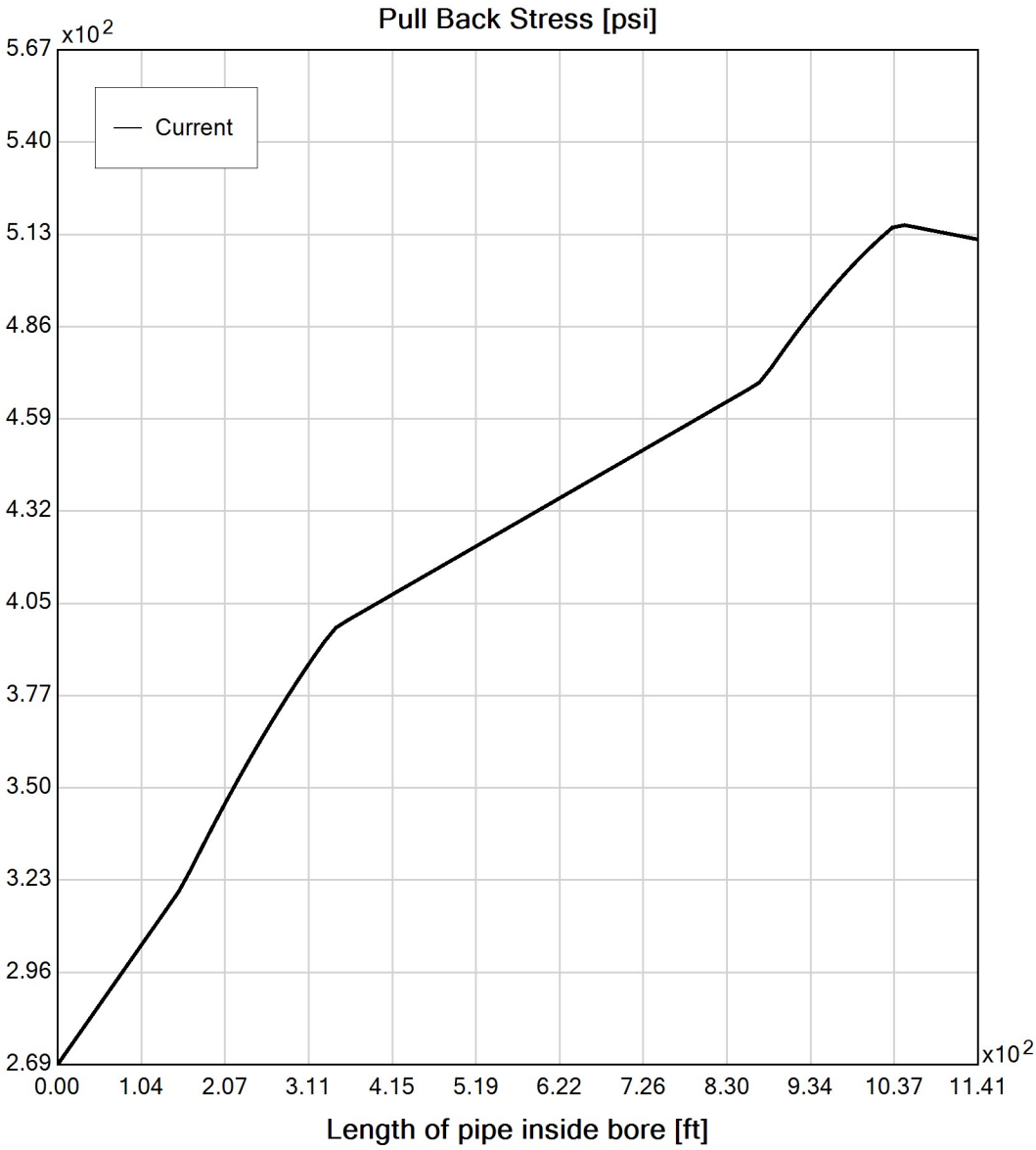
Yield Point (YP): 16.49

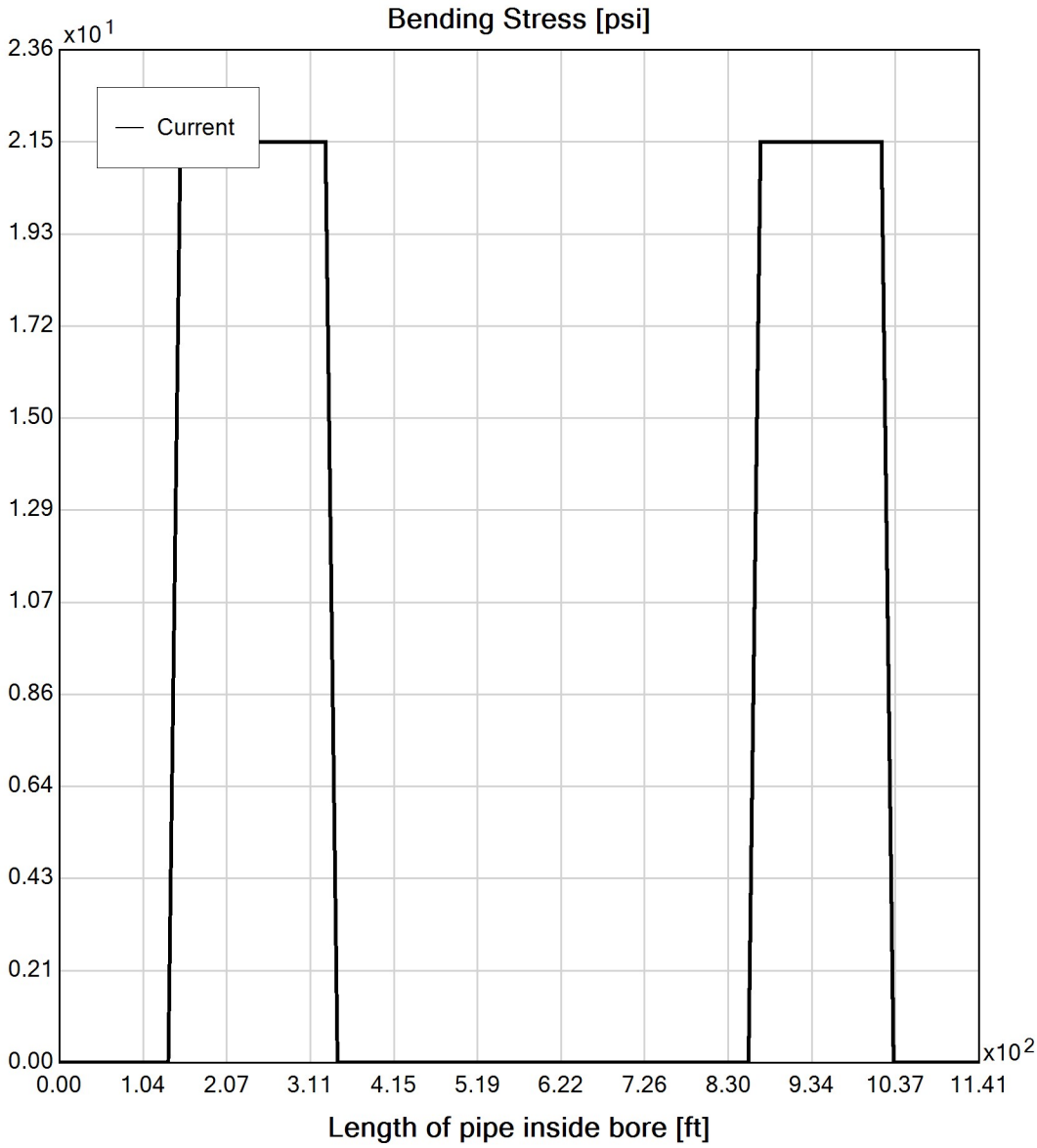
Effective Viscosity (cP): 417.7

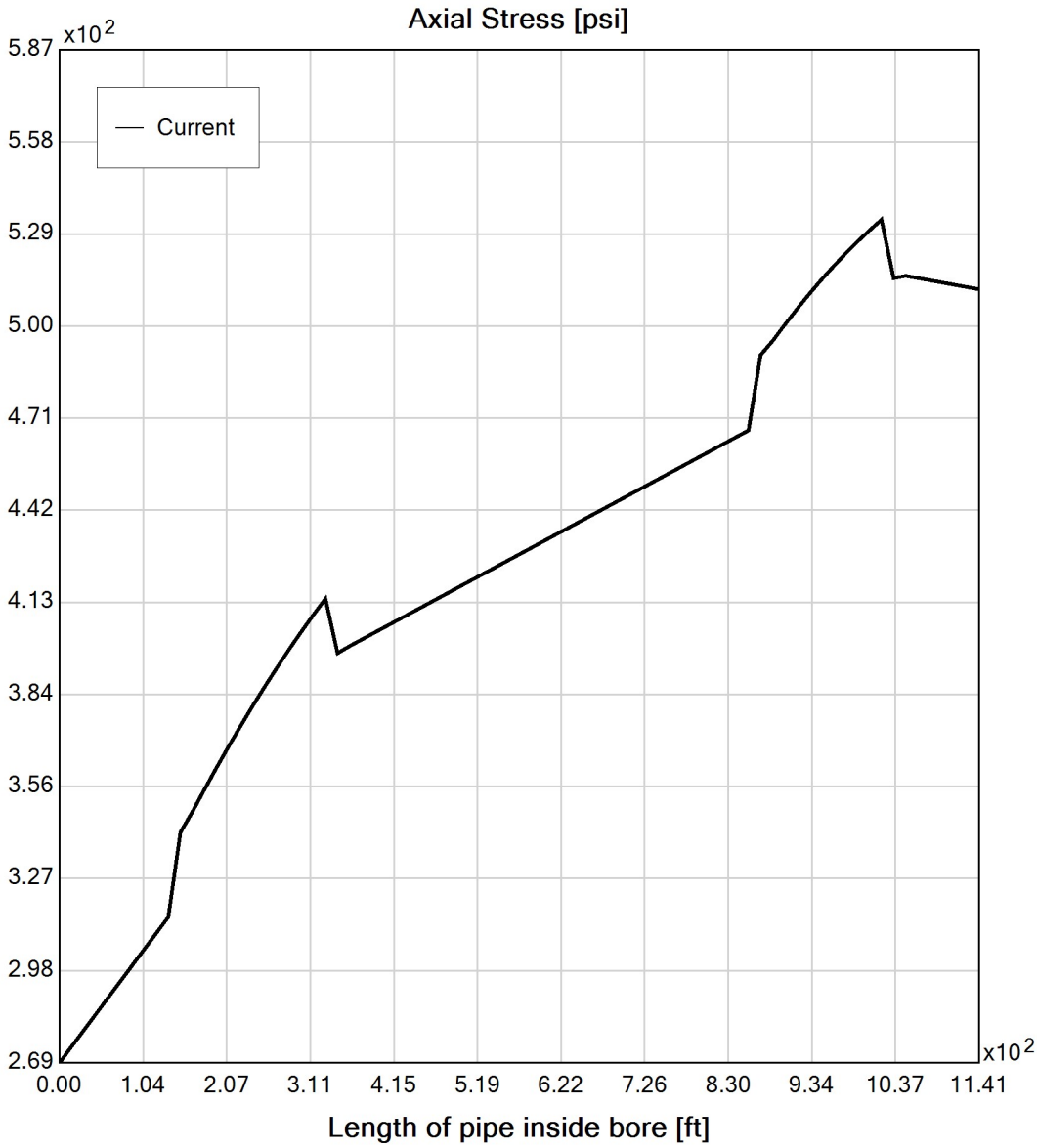
Virtual Site

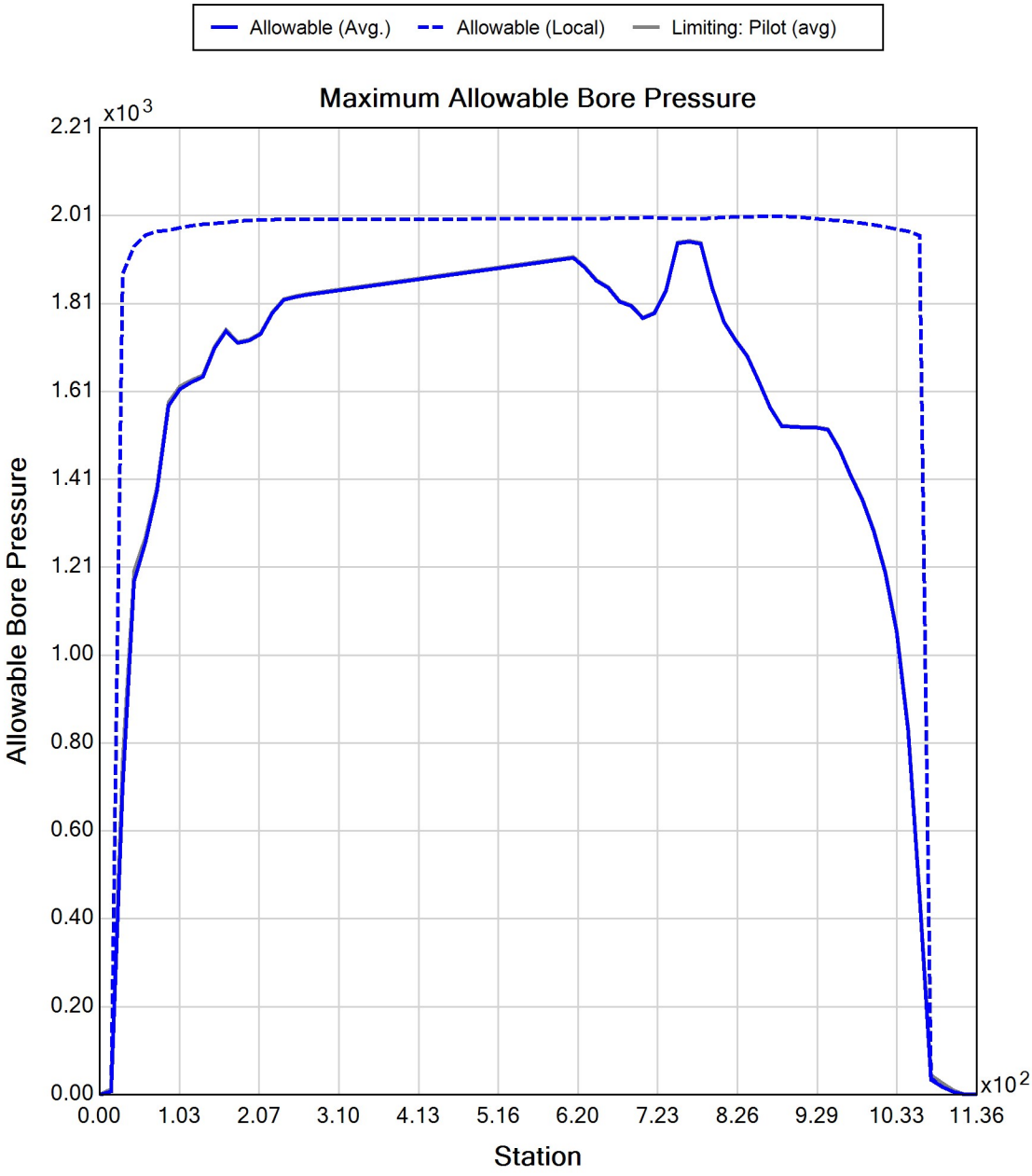


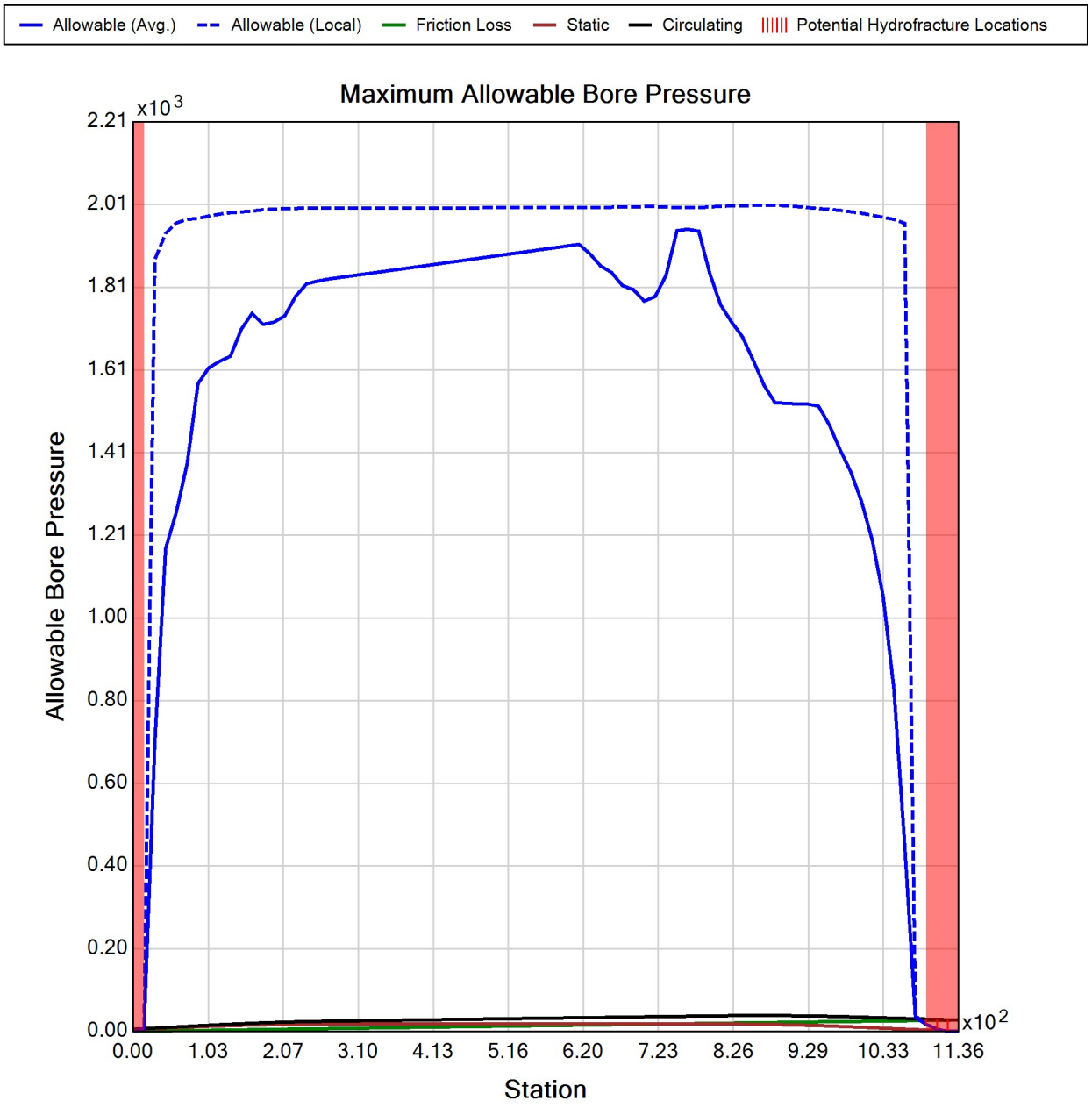












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Project Summary

General:	CHPE HDD 59
	P4A
	Start Date: 06-07-2023
	End Date: 06-07-2023
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA
Designer:	MDB
	BCE
	Amherst, MA
Description:	HDD 59 Reversed Conduit 1 2-inch DR-9

Input Summary

Start Coordinate	(0.00, 0.00, 260.00) ft
End Coordinate	(1124.00, 0.00, 269.00) ft
Project Length	1124.00 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: 1140.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 0.531000018119812 ft

Silo Width: 0.531000018119812 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 59.30500 lb/ft3

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 93.64118 lb/ft3

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	2.3	24.0
Water Pressure	10.7	9.9
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	13.0	33.9
Deflection		
Earth Load Deflection	0.640	6.619
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.669	6.648
Compressive Stress [psi]		
Compressive Wall Stress	58.4	152.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1012.4	1012.4
Pullback Stress [psi]	578.5	578.5
Pullback Strain	1.006E-2	1.006E-2
Bending Stress [psi]	0.0	4.7
Bending Strain	0	8.247E-5
Tensile Stress [psi]	578.5	579.4
Tensile Strain	1.006E-2	1.016E-2

Net External Pressure = 25.4 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.669	7.5	11.2	OK
Unconstrained Collapse [psi]	24.6	130.1	5.3	OK
Compressive Wall Stress [psi]	58.4	1150.0	19.7	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	34.6	222.6	6.4	OK
Tensile Stress [psi]	579.4	1200.0	2.1	OK

Generated Output

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

CALL YOUR ONE-CALL SYSTEM FIRST

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

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

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

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

Project Summary

General:	CHPE HDD 59
	P4A
	Start Date: 06-07-2023
	End Date: 06-07-2023
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA
Designer:	MDB
	BCE
	Amherst, MA
Description:	HDD 59 Reversed Conduit 2 10-inch DR9

Input Summary

Start Coordinate	(0.00, 0.00, 260.00) ft
End Coordinate	(1159.00, 0.00, 268.00) ft
Project Length	1159.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 4

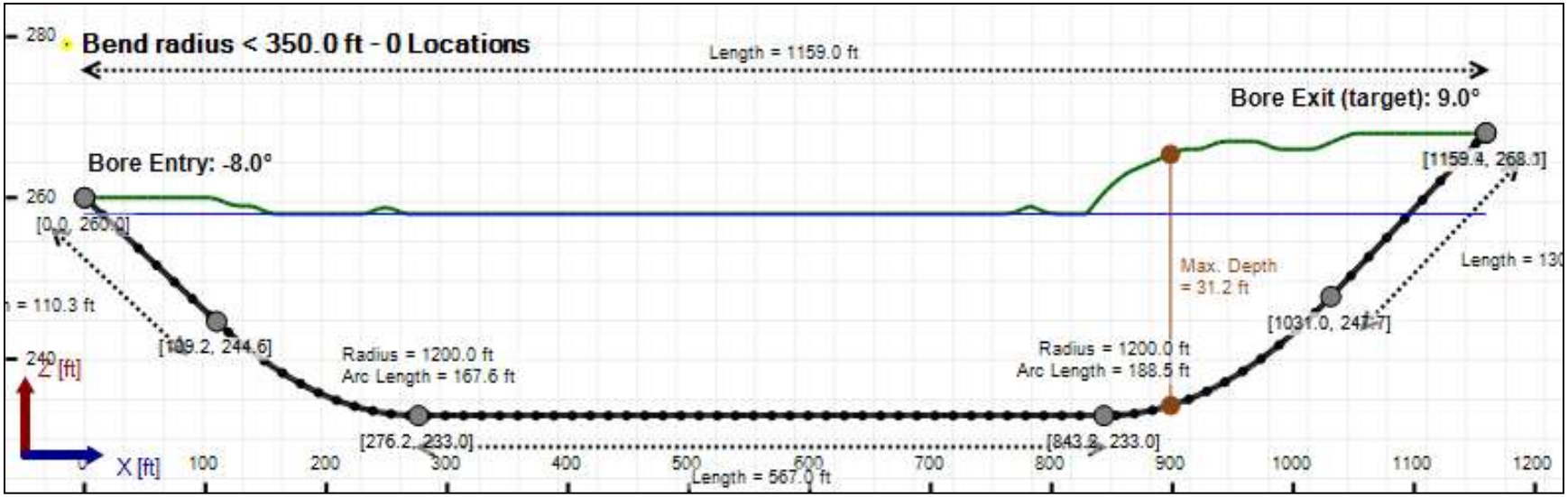
Soil Layer #1 USCS, Sand (S), SP
From Assistant
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 500.00, Coh: 0.00 [psi]

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

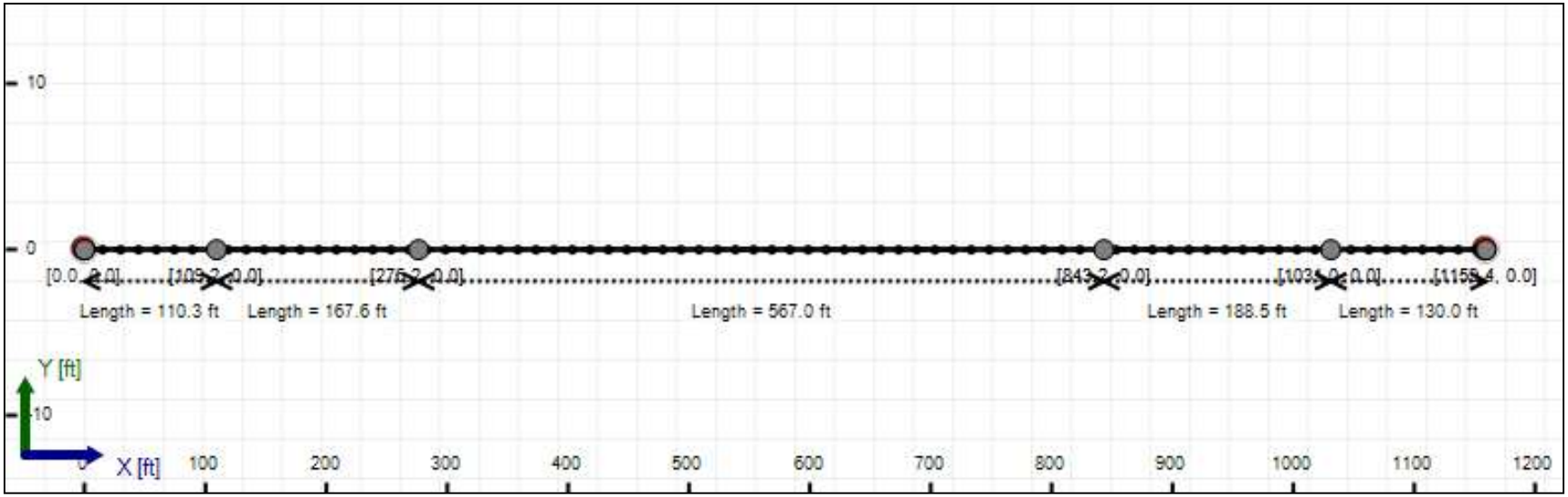
Soil Layer #3 USCS, Gravel (G), GP
From Assistant
Unit Weight: 120.0000 (dry), 140.0000 (sat) [lb/ft3]
Phi: 37.00, S.M.: 1000.00, Coh: 0.00 [psi]

Soil Layer #4 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: 1170.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.34400002161662 ft

Silo Width: 1.34400002161662 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 59.30500 lb/ft3

Allowable Tensile Stress (Short Term): 1200 psi

Allowable Tensile Stress (Long Term): 1100 psi

Allowable Compressive Stress (Short Term): 1150 psi

Allowable Compressive Stress (Long Term): 1150 psi

Surface-pipe friction coefficient at entrance: 0.5

Surface-pipe friction coefficient in borehole: 0.3

Pipe-soil friction angle: 30

Slurry Unit Weight: 93.64118 lb/ft3

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	5.7	23.2
Water Pressure	10.9	10.3
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	16.5	33.5
Deflection		
Earth Load Deflection	1.551	6.308
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.683	6.440
Compressive Stress [psi]		
Compressive Wall Stress	74.3	150.6

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	18825.8	18825.8
Pullback Stress [psi]	525.0	525.0
Pullback Strain	9.131E-3	9.131E-3
Bending Stress [psi]	0.0	21.5
Bending Strain	0	3.733E-4
Tensile Stress [psi]	525.0	543.4
Tensile Strain	9.131E-3	9.824E-3

Net External Pressure = 24.1 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.683	7.5	4.5	OK
Unconstrained Collapse [psi]	23.5	118.8	5.1	OK
Compressive Wall Stress [psi]	74.3	1150.0	15.5	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	33.5	224.1	6.7	OK
Tensile Stress [psi]	543.4	1200.0	2.2	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	1959.396 psi	2008.966 psi
1	8.00 in	12.00 in	1958.483 psi	2008.366 psi
2	12.00 in	16.13 in	1957.158 psi	2007.496 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

Virtual Site