ADVANCED TERRA TESTING

Splitting Tensile
ASTM D3967

CLIENT	Atlantic Testing Labs LTD	BORING NO.	
JOB NO.	2161-016	DEPTH	21
PROJECT	Champlain Hudson Power Express	SAMPLE NO.	K-158.3-RC2
PROJECT NO.	CD10279	DATE SAMPLED	
LOCATION	--	DATE TESTED	05/03/22
		TECHNICIAN	DL
		ROCK TYPE	

Before Picture

NOTES

Picture File: 5.JPG
File name: 2161016__Brazilian ASTM D3967_0.xlsm

ADVANCED TERRA TESTING

Splitting Tensile
ASTM D3967

CLIENT	Atlantic Testing Labs LTD	BORING NO.	
JOB NO.	2161-016	DEPTH	21
PROJECT	Champlain Hudson Power Express	SAMPLE NO.	K-158.3-RC2
PROJECT NO.	CD10279	DATE SAMPLED	
LOCATION	--	DATE TESTED	05/03/22
		TECHNICIAN	DL
		ROCK TYPE	

After Picture

NOTES

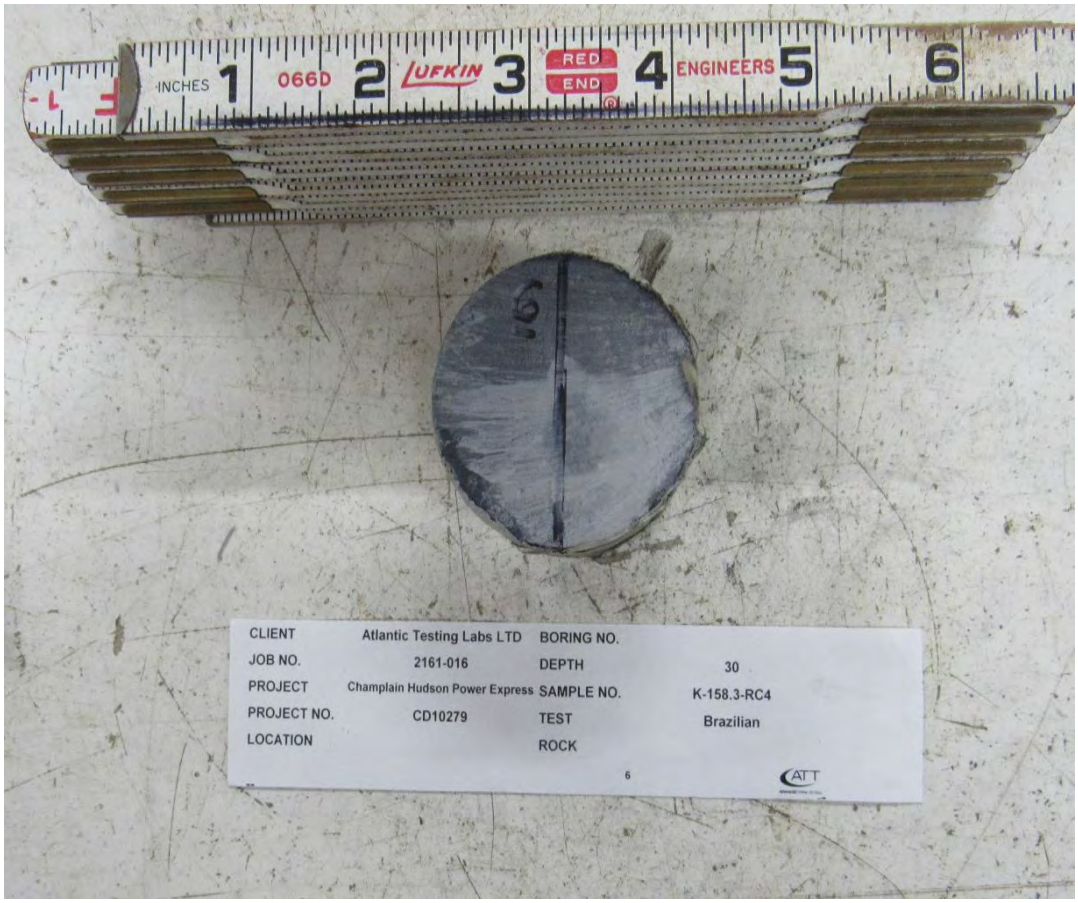
Picture File: 5a.JPG
File name: 2161016__Brazilian ASTM D3967_0.xlsm

ADVANCED TERRA TESTING

Splitting Tensile
ASTM D3967

CLIENT	Atlantic Testing Labs LTD	BORING NO.	
JOB NO.	2161-016	DEPTH	30
PROJECT	Champlain Hudson Power Express	SAMPLE NO.	K-158.3-RC4
PROJECT NO.	CD10279	DATE SAMPLED	
LOCATION	--	DATE TESTED	05/03/22
		TECHNICIAN	DL
		ROCK TYPE	

Before Picture



NOTES

Picture File: 6.JPG
File name: 2161016__Brazilian ASTM D3967_0.xlsm

ADVANCED TERRA TESTING

Splitting Tensile
ASTM D3967

CLIENT	Atlantic Testing Labs LTD	BORING NO.	
JOB NO.	2161-016	DEPTH	30
PROJECT	Champlain Hudson Power Express	SAMPLE NO.	K-158.3-RC4
PROJECT NO.	CD10279	DATE SAMPLED	
LOCATION	--	DATE TESTED	05/03/22
		TECHNICIAN	DL
		ROCK TYPE	

After Picture

NOTES

Picture File: 6a.JPG
File name: 2161016__Brazilian ASTM D3967_0.xlsm

ADVANCED TERRA TESTING

CERCHAR Abrasiveness
ASTM D7625

CLIENT	Atlantic Testing Labs LTD	JOB NO.	2161-016
PROJECT	Champlain Hudson Power Express	LOCATION	--
PROJECT NO.	CD10279		

BORING NO.				
DEPTH	77.0	65	28.0-29.0	34.0
SAMPLE NO.	K-140.0-RC1	K-140.1-RC1	K-158.1-RC1	K-158.2-RC1
DATE SAMPLED				
DATE TESTED	05/05/22	05/05/22	05/05/22	05/06/22
TECHNICIAN	HN	HN	HN	HN
ROCK TYPE				
Surface Type:	Saw Cut	Saw Cut	Saw Cut	Saw Cut
Moisture Condition	As Received	As Received	As Received	As Received
Reading A.1 (in):	0.00344	0.00344	0.00828	0.00375
Reading A.2 (in):	0.00547	0.00523	0.00188	0.00164
Reading A.3 (in):	0.00539	0.00461	0.00102	0.00438
Reading A.4 (in):	0.00570	0.00359	0.00359	0.00297
Reading A.5 (in):	0.00219	0.00344	0.00484	0.00273
Reading B.1 (in):	0.00550	0.00352	0.00570	0.00336
Reading B.2 (in):	0.00539	0.00430	0.00336	0.00213
Reading B.3 (in):	0.00469	0.00555	0.00203	0.00266
Reading B.4 (in):	0.00625	0.00297	0.00227	0.00281
Reading B.5 (in):	0.00422	0.00352	0.00602	0.00320
Average Reading (in):	0.00482	0.00402	0.00390	0.00296
Average Reading (mm):	0.1225	0.1020	0.0990	0.0753
Uncorrected CAI or CAI_S:	**1.23**	**1.02**	**0.99**	**0.75**
Corrected CAI:	**1.69**	**1.49**	**1.46**	**1.23**

NOTES

CAI_s is the CAI calculated on saw cut specimens.
Corrected CAI for saw cut specimens based on R. Plinger and H. Kasling
Suggested formula CAI = 0.99*CAIs + 0.48.
Applied pins had a Rockwell Hardness of 54-56.

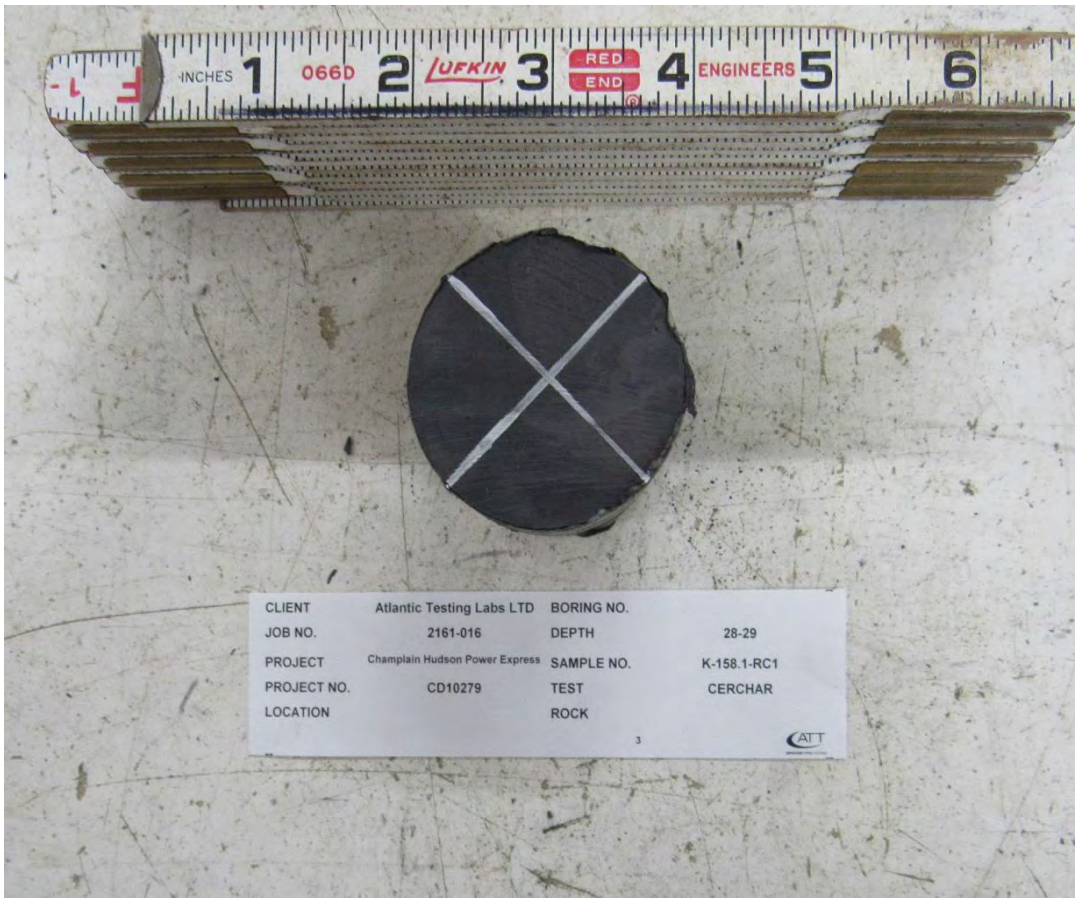
Data entry by:	HN	Date:	05/06/22
Checked by:	DL	Date:	05/06/22
File name:	2161016__CHERCHAR ASTM D7625_0.xlsm		

ADVANCED TERRA TESTING

CHERCHAR Abrasiveness
ASTM D7625

CLIENT	Atlantic Testing Labs LTD	BORING NO.	--
JOB NO.	2161-016	DEPTH	28.0-29.0
PROJECT	Champlain Hudson Power Express	SAMPLE NO.	K-158.1-RC1
PROJECT NO.	CD10279	DATE SAMPLED	--
LOCATION	--	DATE TESTED	05/05/22
		TECHNICIAN	HN
		ROCK TYPE	--

Before Picture



NOTES

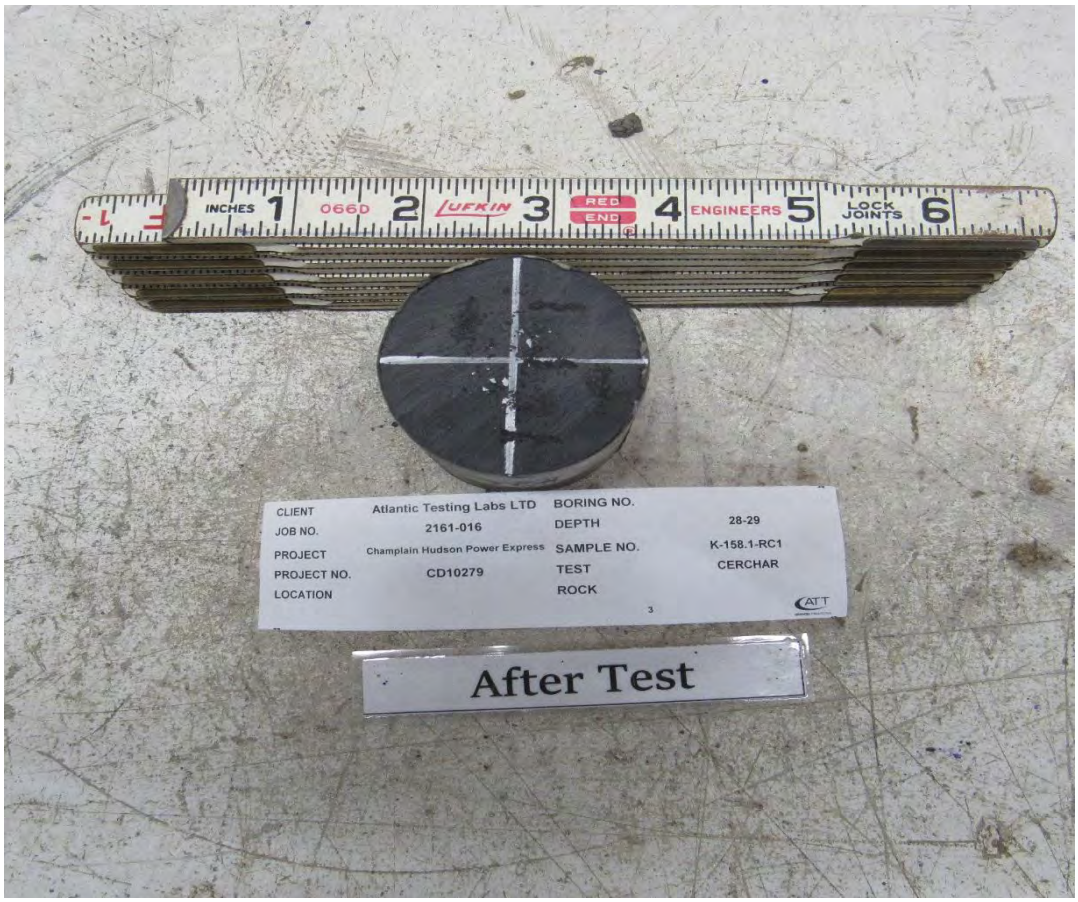
Picture File: 3.JPG
File name: 2161016__CHERCHAR ASTM D7625_0.xlsm

ADVANCED TERRA TESTING

CHERCHAR Abrasiveness
ASTM D7625

CLIENT	Atlantic Testing Labs LTD	BORING NO.	--
JOB NO.	2161-016	DEPTH	28.0-29.0
PROJECT	Champlain Hudson Power Express	SAMPLE NO.	K-158.1-RC1
PROJECT NO.	CD10279	DATE SAMPLED	--
LOCATION	--	DATE TESTED	05/05/22
		TECHNICIAN	HN
		ROCK TYPE	--

After Picture



NOTES

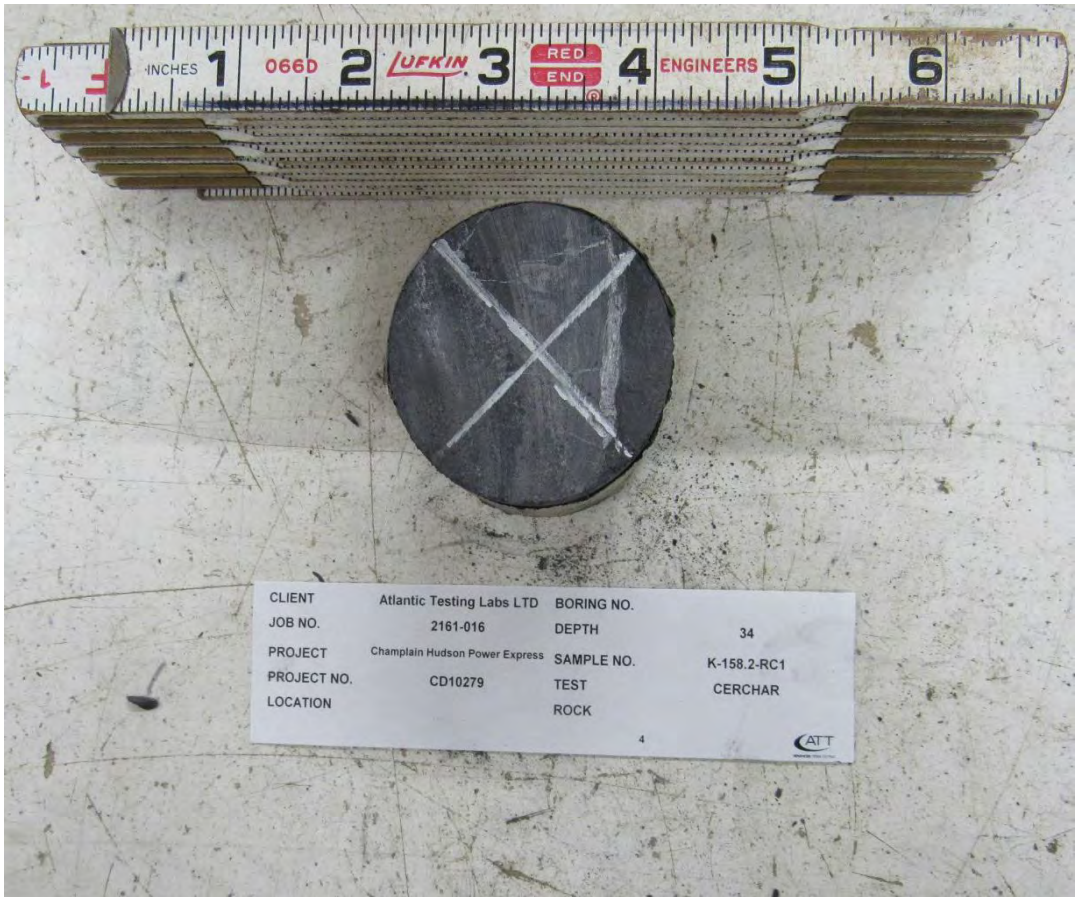
Picture File: 3a.JPG
File name: 2161016__CHERCHAR ASTM D7625_0.xlsm

ADVANCED TERRA TESTING

CHERCHAR Abrasiveness
ASTM D7625

CLIENT	Atlantic Testing Labs LTD	BORING NO.	--
JOB NO.	2161-016	DEPTH	34.0
PROJECT	Champlain Hudson Power Express	SAMPLE NO.	K-158.2-RC1
PROJECT NO.	CD10279	DATE SAMPLED	--
LOCATION	--	DATE TESTED	05/06/22
		TECHNICIAN	HN
		ROCK TYPE	--

Before Picture



NOTES

Picture File: 4.JPG
File name: 2161016__CHERCHAR ASTM D7625_0.xlsm

ADVANCED TERRA TESTING

CHERCHAR Abrasiveness
ASTM D7625

CLIENT	Atlantic Testing Labs LTD	BORING NO.	--
JOB NO.	2161-016	DEPTH	34.0
PROJECT	Champlain Hudson Power Express	SAMPLE NO.	K-158.2-RC1
PROJECT NO.	CD10279	DATE SAMPLED	--
LOCATION	--	DATE TESTED	05/06/22
		TECHNICIAN	HN
		ROCK TYPE	--

After Picture

NOTES

Picture File: 4a.JPG
File name: 2161016__CHERCHAR ASTM D7625_0.xlsm

ADVANCED TERRA TESTING

CERCHAR Abrasiveness
ASTM D7625

CLIENT	Atlantic Testing Labs LTD	JOB NO.	2161-016
PROJECT	Champlain Hudson Power Express	LOCATION	--
PROJECT NO.	CD10279		

BORING NO.		
DEPTH	21.0	30.0
SAMPLE NO.	K-158.3-RC2	K-158.3-RC4
DATE SAMPLED		
DATE TESTED	05/06/22	05/06/22
TECHNICIAN	HN	HN
ROCK TYPE		
Surface Type:	Saw Cut	Saw Cut
Moisture Condition	As Received	As Received
Reading A.1 (in):	0.00276	0.00272
Reading A.2 (in):	0.00181	0.00207
Reading A.3 (in):	0.00228	0.00260
Reading A.4 (in):	0.00344	0.00299
Reading A.5 (in):	0.00375	0.00205
Reading B.1 (in):	0.00236	0.00197
Reading B.2 (in):	0.00126	0.00157
Reading B.3 (in):	0.00197	0.00346
Reading B.4 (in):	0.00307	0.00299
Reading B.5 (in):	0.00313	0.00252
Average Reading (in):	0.00258	0.00249
Average Reading (mm):	0.0656	0.0633
Uncorrected CAI or CAI_s:	**0.66**	**0.63**
Corrected CAI:	**1.13**	**1.11**

NOTES

CAI_s is the CAI calculated on saw cut specimens.
Corrected CAI for saw cut specimens based on R. Plinger and H. Kasling
Suggested formula CAI = 0.99*CAIs + 0.48.
Applied pins had a Rockwell Hardness of 54-56.
* Test surface area was broken.

Data entry by:	HN	Date:	05/06/22
Checked by:	DL	Date:	05/06/22
File name:	2161016__CHERCHAR ASTM D7625_1.xlsm		

ADVANCED TERRA TESTING

CHERCHAR Abrasiveness
ASTM D7625

CLIENT	Atlantic Testing Labs LTD	BORING NO.	--
JOB NO.	2161-016	DEPTH	21.0
PROJECT	Champlain Hudson Power Express	SAMPLE NO.	K-158.3-RC2
PROJECT NO.	CD10279	DATE SAMPLED	--
LOCATION	--	DATE TESTED	05/06/22
		TECHNICIAN	HN
		ROCK TYPE	--

Before Picture

NOTES	* Test surface area was broken.

Picture File: 5.JPG
File name: 2161016__CHERCHAR ASTM D7625_1.xlsm

ADVANCED TERRA TESTING

CHERCHAR Abrasiveness
ASTM D7625

CLIENT	Atlantic Testing Labs LTD	BORING NO.	--
JOB NO.	2161-016	DEPTH	21.0
PROJECT	Champlain Hudson Power Express	SAMPLE NO.	K-158.3-RC2
PROJECT NO.	CD10279	DATE SAMPLED	--
LOCATION	--	DATE TESTED	05/06/22
		TECHNICIAN	HN
		ROCK TYPE	--

After Picture

NOTES	* Test surface area was broken.

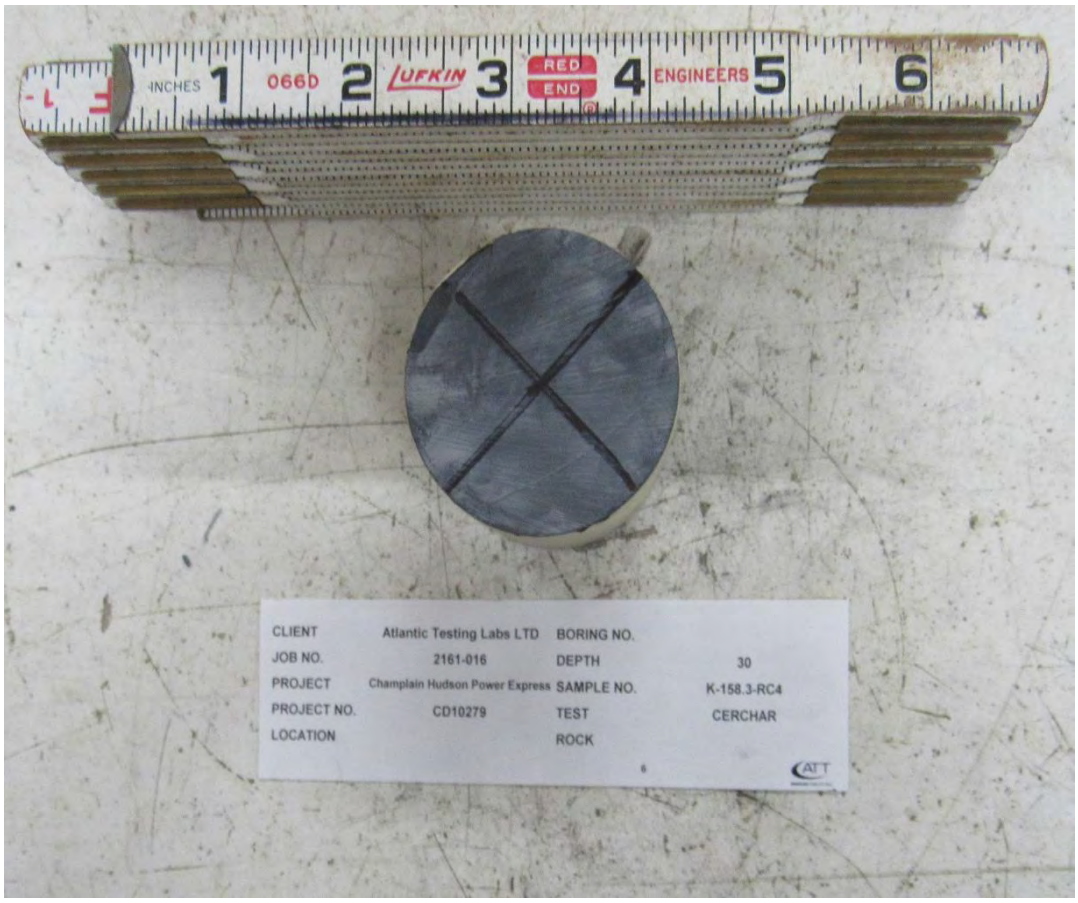
Picture File: 5a.JPG
File name: 2161016__CHERCHAR ASTM D7625_1.xlsm

ADVANCED TERRA TESTING

CHERCHAR Abrasiveness
ASTM D7625

CLIENT	Atlantic Testing Labs LTD	BORING NO.	--
JOB NO.	2161-016	DEPTH	30.0
PROJECT	Champlain Hudson Power Express	SAMPLE NO.	K-158.3-RC4
PROJECT NO.	CD10279	DATE SAMPLED	--
LOCATION	--	DATE TESTED	05/06/22
		TECHNICIAN	HN
		ROCK TYPE	--

Before Picture



NOTES	* Test surface area was broken.

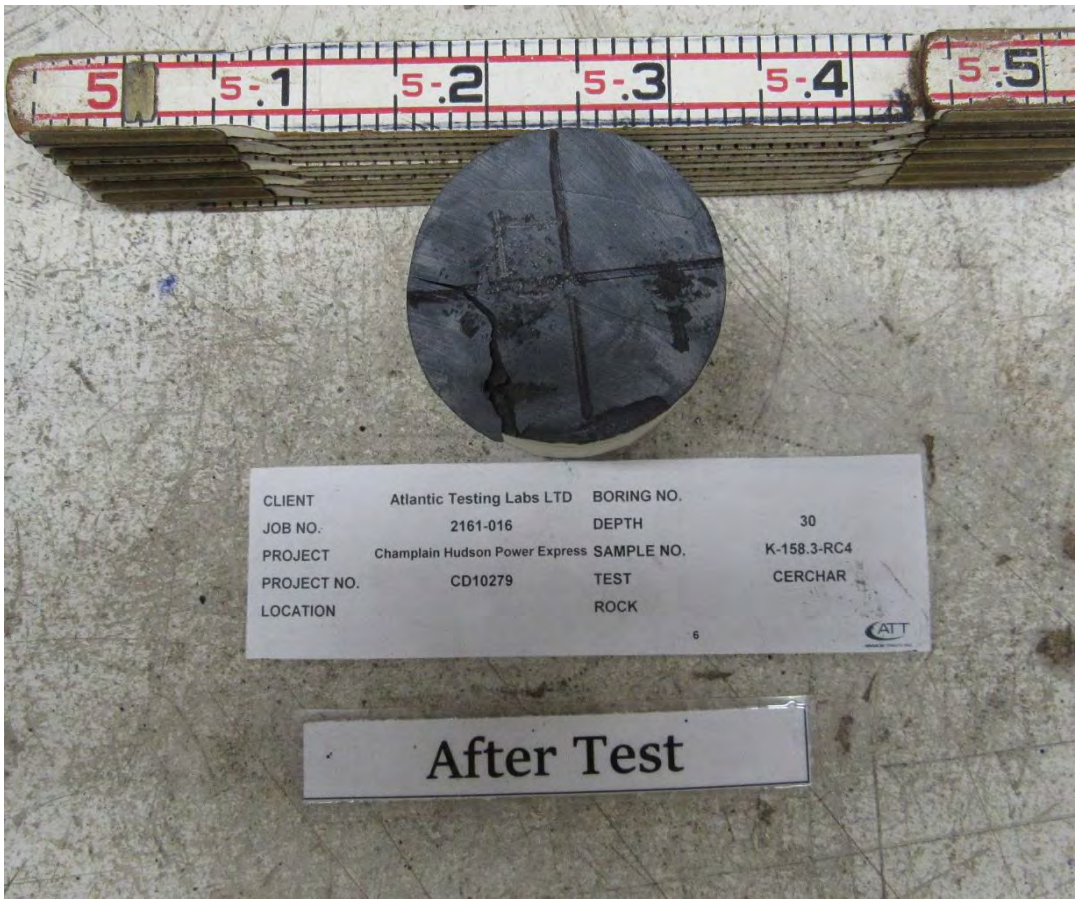
Picture File: 6.JPG
File name: 2161016__CHERCHAR ASTM D7625_1.xlsm

ADVANCED TERRA TESTING

CHERCHAR Abrasiveness
ASTM D7625

CLIENT	Atlantic Testing Labs LTD	BORING NO.	--
JOB NO.	2161-016	DEPTH	30.0
PROJECT	Champlain Hudson Power Express	SAMPLE NO.	K-158.3-RC4
PROJECT NO.	CD10279	DATE SAMPLED	--
LOCATION	--	DATE TESTED	05/06/22
		TECHNICIAN	HN
		ROCK TYPE	--

After Picture

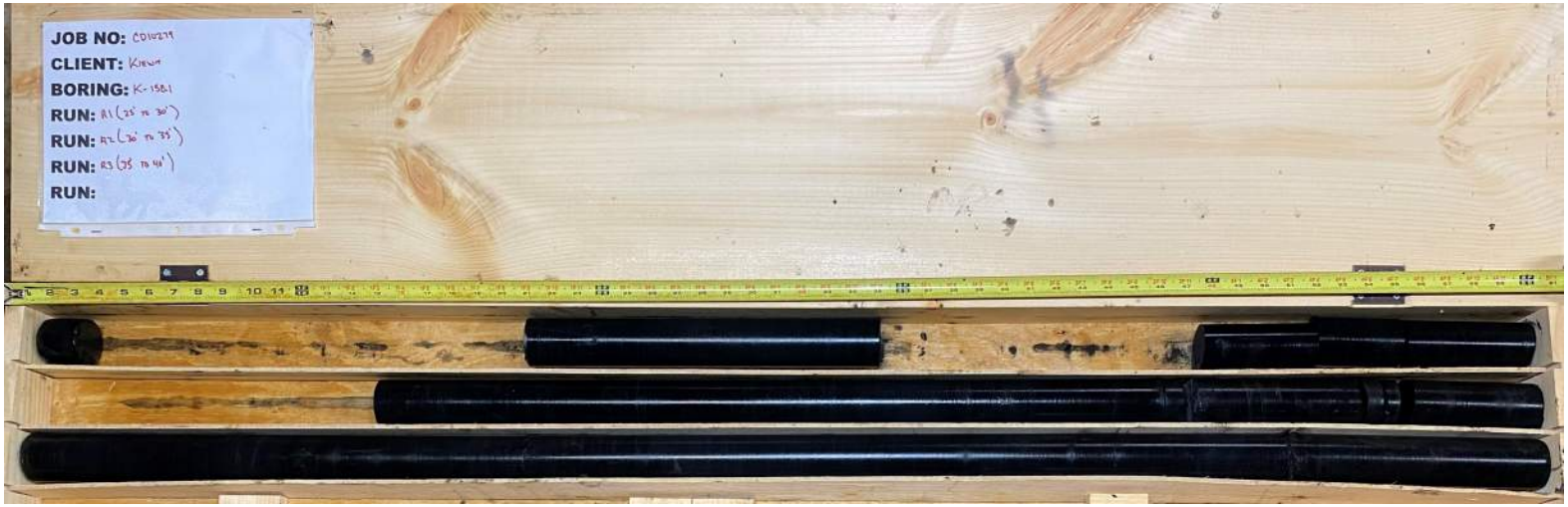


NOTES	* Test surface area was broken.

Picture File: 6a.JPG
File name: 2161016__CHERCHAR ASTM D7625_1.xlsm

Champlain Hudson Power Express
Kiewit Engineering (NY) Corp.

K-158.1 - Runs 1 through 3



K-158.2 - Runs 1 and 2

Champlain Hudson Power Express
Kiewit Engineering (NY) Corp.

K-158.3 - Runs 1 through 4

K-158.3 - Run 5

Kiewit

MEMORANDUM

DATE: December 7, 2022

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 5 - Package 3 - HDD Crossing 50 – Revision 1
Champlain Hudson Power Express Project
Ballston Spa, 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 east of Ballston Spa, New York. The approximate station for the start of HDD crossing Number 50 is STA 31368+00 (43.0075°N, 73.8381°W).

The geotechnical data at this HDD crossing is attached. The available data is from the previous investigation by AECOM and data from a recent investigation by Atlantic Testing Laboratories (ATL), referenced below.

- AECOM, Geotechnical Data Report, Upland Segments: Putnam Station, Washington County, to Cementon, Green County, NY, Champlain Hudson Power Express, dated May 28, 2021.
- Atlantic Testing Laboratories, Subsurface Investigation Services, Champlain Hudson Power Express, Design Package 3, Glens Falls to Ballston Spa, New York, dated June 15, 2022.

Contact us if you have questions or require additional information.

HDD 50
Borings BM-1A, K-158.5
Segment 5 - Design Package 3

CHPE Segment 4&5 - Package 3
HDD Soil Boring Coordinates and Elevations

Firm	Boring	Northing (feet)	Easting (feet)	Ground Surface Elevation (feet)
TRC*	A136.0-1	1611762.7	732951.9	146.6
	A137.9-1	1602848.9	729488.6	157.2
	B134.6-1	1617614.3	737160.7	140.2
	B135.1-1	1615942.5	735298.2	130.7
	B135.35-1	1615043.9	734326.1	147.7
	B140.0-1	1594313.7	721767.2	205.0
	B144.2-1	1577578.6	707868.0	307.5
	B144.3-1	1577307.0	707733.5	307.4
	B144.5-1	1576380.0	707249.6	308.5
	B144.8-1	1574825.2	706447.7	310.8
	B145.0-1	1574014.3	706034.4	312.7
	B145.48	1571450.2	704693.3	320.4
	B146.1-1	1568896.3	703364.4	321.4
	B146.5-1	1566773.3	702083.1	323.6
	B148.4-1	1561976.4	694067.5	326.0
	B148.4-5	1561817.7	693531.9	327.4
	B149.87-1	1559610.1	686723.2	325.2
	B151.58-1	1551257.2	677175.4	336.4
	B152.6-0	1550004.2	676432.6	329.3
	B153.1-1	1547302.8	676031.8	322.5
	B154.3-1	1541375.5	674232.0	321.5
	B155.2-1	1536685.4	674403.7	313.7
	B155.7-1	1534202.1	674175.1	340.0
	B157.9-1	1524284.2	668932.6	246.0
	B158.1-1	1523474.2	668924.1	243.0
	B158.22-1	1522640.9	669168.4	279.1
AECOM**	BM-1A	1521184.8	669107.0	292.4
	FES-3	1616410.4	736040.4	143.9
	FES-3A	1616311.4	735904.6	139.3
	FES-3B	1611359.3	732784.5	142.5
	FES-4	1608699.4	732017.0	142.6
	FES-5	1605493.6	731399.7	147.1
	FES-6	1598212.9	725299.3	174.4
	FES-9	1583302.9	711497.9	271.6
	FES-10A	1563547.6	698025.3	321.4
	FES-12	1560130.5	687972.2	322.5
	SB-1A	1547803.7	676160.2	321.0
	SB-1B	1551257.2	677175.4	327.5
	SB-2	1540348.5	674275.0	316.3
	SB-3	1540348.5	670744.8	322.4

Notes:

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

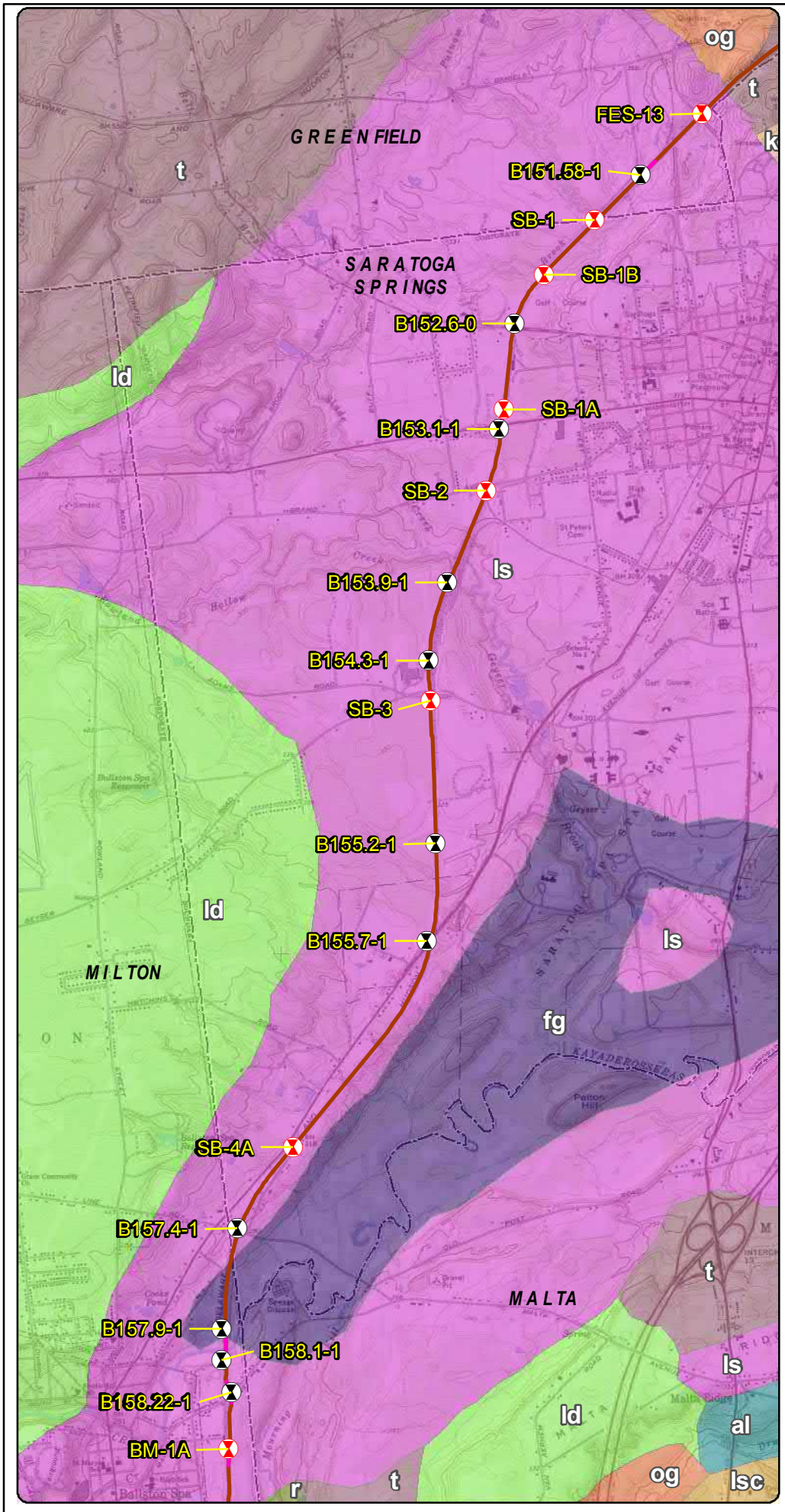
* TRC boring coordinates as shown in Table 1-6 in AECOM report (reference below). Boring elevations estimated from November 2021 topographic survey by Williams Aerial.

** 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

0.35 0.175 0 0.35 Miles

Transmission Developers Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Surficial Geology and Geotechnical Borings Saratoga to Ballston Figure 3-5

Prepared on 4/28/2021

by: AECOM

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

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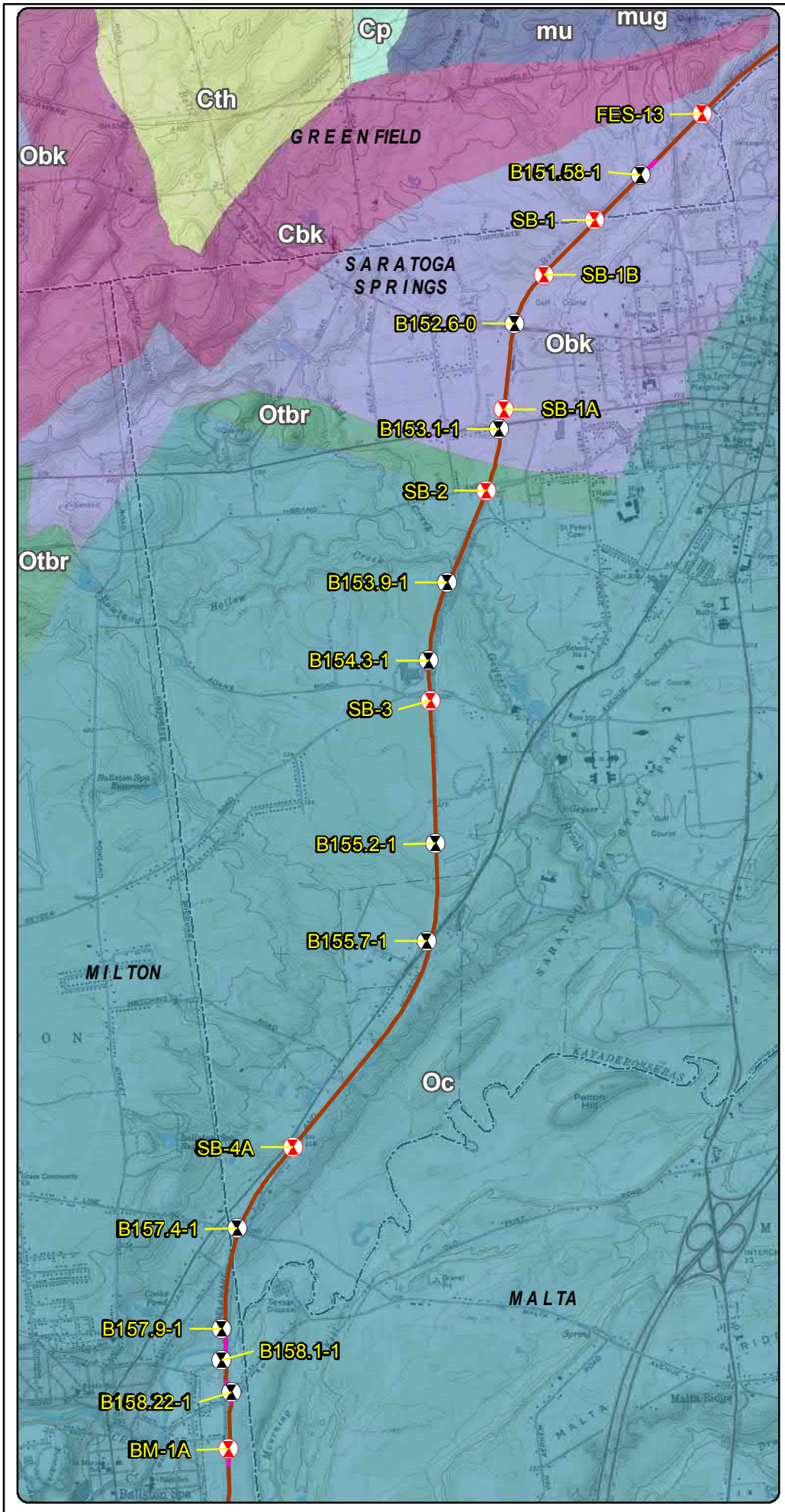

LEGEND

- 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

- Cbk - Beekmantown Group
- Cp - Potsdam Sandstone
- Cth - Theresa (Galway) Formation
- Obk - Beekmantown Group
- Oc - Canajoharie Shale
- Otbr - Dolgeville Formation
- mu - Undivided metasedimentary rock
- mug - Interlayered metasedimentary rock

N

0.35 0.175 0 0.35 Miles

Transmission Developments Inc.

Champlain Hudson Power Express Project

Champlain Hudson Power Express Inc.

Bedrockl Geology and Geotechnical Borings Saratoga to Ballston Figure 4-5

Prepared on 4/29/2021

by: AECOM

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

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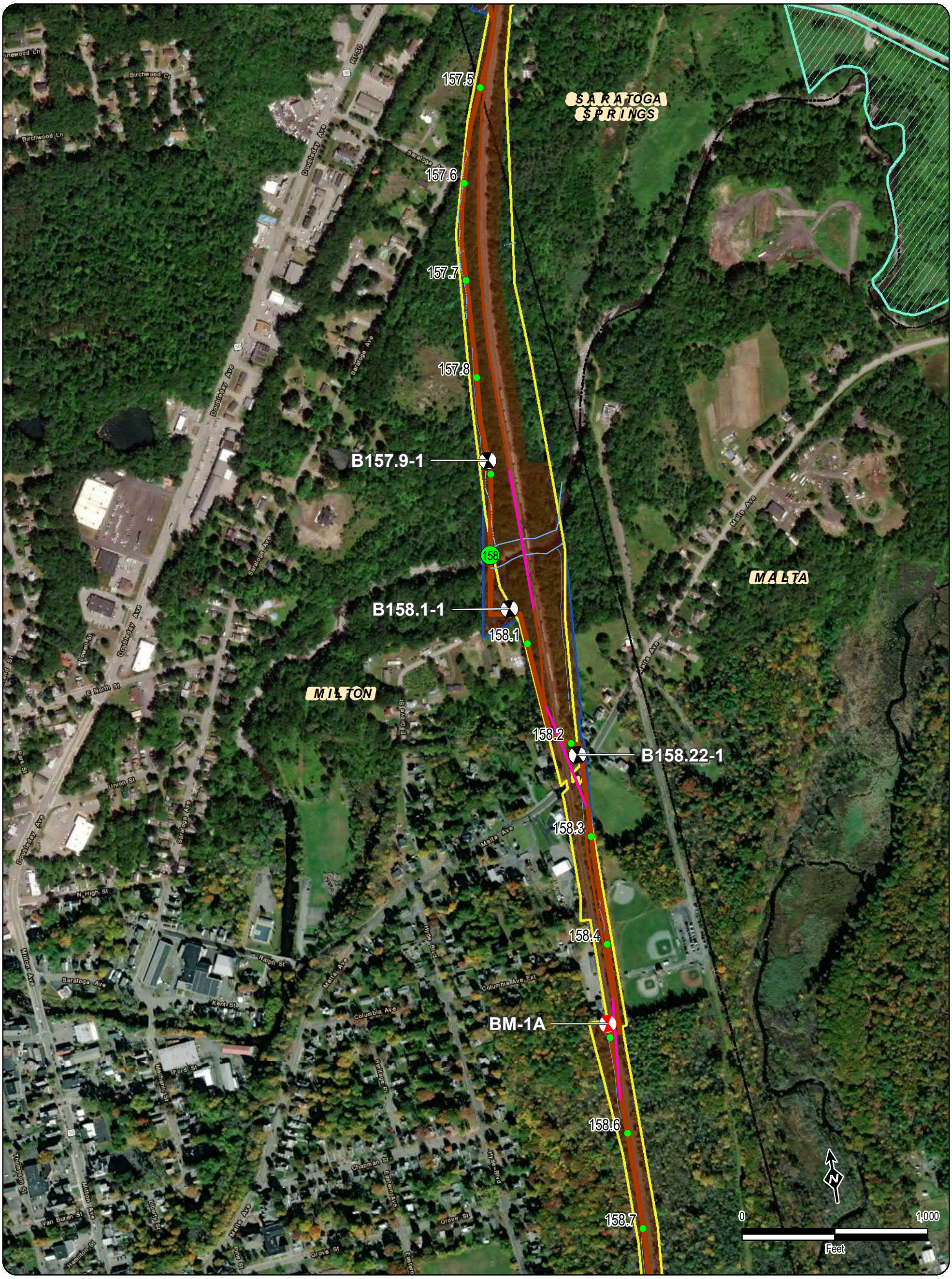
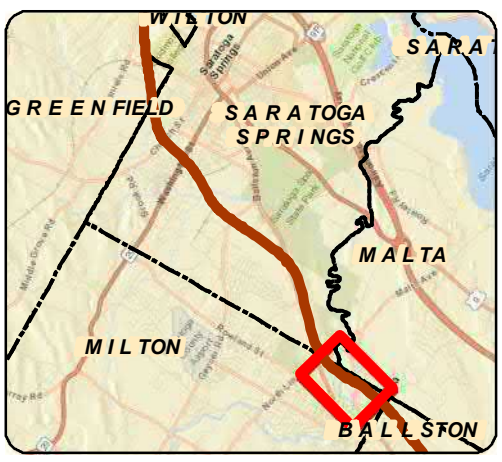




LEGEND

- 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

Saratoga to Ballston

Figure A-5

Sheet 6 of 6

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\Saratoga_to_Ballston_Boring_Locations_Mapset_May_2021_Report.mxd

BORING CONTRACTOR: ADT

DRILLER: Francisco Martinez

SOILS ENGINEER/GEOLOGIST: Alexandra Golden

LOCATION: Ballston, NY MP 158.51

AECOM

BORING LOG

SHEET 1 OF 2

PROJECT NAME: CHPE -

PROJECT NO.: 60323056

HOLE NO.: **BM-1A**

START DATE: 3/1/21

FINISH DATE: 3/2/21

OFFSET: N/A

DRILL RIG: Geoprobe 7822 DT

BORING TYPE: SPT/Core

BORING O.D.: 4.5"/3"

SURFACE ELEV.:

LONGITUDE:

LATITUDE:

GROUND WATER OBSERVATIONS		CASING	SAMPLER	DRILL BIT	CORE BARREL
No water observed	TYPE	Flush Joint Steel	California Modified	Tricone Roller Bit	NQ
	SIZE I.D.	4"	2.5"	- -	1 7/8"
	SIZE O.D.	4.5"	3"	3 7/8"	3"
	HAMMER WT.	140 lbs	140 lbs		
	HAMMER FALL	30"	30"		

DEPTH	CORING RATE MIN/FT	SAMPLE DEPTHS FROM - TO (FEET)	SAMPLE TYPE AND NO.	PEN. in	REC. in	BLOWS PER 6 in ON SAMPLER (ROCK QUALITY DESIGNATION)				N Corr.(2)	USCS CLASS.	STRAT. CHNG. DEPTH	FIELD IDENTIFICATION OF SOILS
		0'-5'		60	60	Hand Cleared					SP/GP	Gravelly SAND	0.0': Brown medium-coarse SAND, subangular medium-coarse gravel, trace organics
1.0													
2.0													
3.0													
		3'-5'	S-1										TR-1; (3.0'-5.0')
4.0													
5.0													
		5'-7'	S-2	24	24	7	22	30	35	34	SP/GP		5.0': Brown fine-medium SAND and angular gray shale coarse gravel, trace Silt, moist
6.0													6.0': Shale cobble fragment, angular
7.0													
		7'-9'	S-3	9	9	49	50/3"	-	-	-	GP/SP	GRAVEL	7.0': Brown-gray fine-coarse GRAVEL, trace fine-medium sand; subangular/angular, moist, loose
8.0													7.5'; Shale cobble fragment
9.0													
10.0													Drill to 11' bgs
11.0													
	10 min	11'-'16'	R-1	60	60	RQD: 0" = 0%						SHALE	11.0': Gray shale, thinly laminated, moderately-intensely fractured, 70 pieces
12.0													TR-2; (11.7'-12.1')
13.0													
14.0													
15.0													
16.0													
	10.0	16'-21'	R-2	60	50	RQD: 4" = 7%							16.0':SAA, 50 pieces
17.0													
	11.0												
18.0													
	12.0												
19.0													
	10.0												
20.0													

NOTES:

(1) Thick-wall ring lined drive sampler (California sampler) used for SPT samples. Rings dimensions = 2-1/2" O.D. by 2-7/16" I.D. by 6" length.

(2) Correction factor: $N_{corr}=N*(2.0^2-1.375^2)in./(3.0^2-2.4^2)in. = N*0.65$.

Soil description represents a field identification after D.M. Burmister unless otherwise noted.

SAMPLE TYPE: S= SPLIT SPOON U=SHELBY TUBE R=ROCK CORE

PROPORTIONS: TRACE=1-10% LITTLE=10-20% SOME=20-35% AND=35-50%

BORING CONTRACTOR: ADT

DRILLER: Francisco Martinez

SOILS ENGINEER: Alexandra Golden

LOCATION: Ballston, NY MP 158.51

AECOM

BORING LOG

SHEET 2 OF 2

PROJECT NAME: CHPE -

PROJECT NO.: 60323056

HOLE NO.: **BM-1A**

START DATE: 3/1/21

FINISH DATE: 3/2/21

OFFSET: N/A

DEPTH	CORING RATE MIN/FT	DEPTHS FROM - TO (FEET)	TYPE AND NO.	PEN. in	REC. in	BLOWS PER 6 in ON SAMPLER (ROCK QUALITY DESIGNATION)	N Corr.	USCS CLASS.	STRAT. CHNG. DEPTH	FIELD IDENTIFICATION OF SOILS
	10.0									
21.0										
	10.0	21'-26'	R-3	60	60	RQD: 20" = 34%				SAA- fractured-intensely fractured, 34 pieces
22.0										TR-3; (24.0'-24.5')
	11.0									
23.0										
	9.0									
24.0										
	13.0									
25.0										
	10.0									
26.0										
	13.0	26.0-31.0	R-4	60"	55"	RQD: 49" = 82%			SHALE	SAA, slightly/moderately fractured, 11 pieces
27.0										TR-4; (29.8'-30.5')
	8.0									
28.0										
	10.0									
29.0										
	6.0									
30.0										
	5.0									
31.0										
		31.0'-33.0'	R-5	24"	24"	RQD: 10.5" = 44%				SAA, 20 pieces
32.0										
33.0										
										BM-1A terminated at 33' bgs, grouted to surface
34.0										
35.0										
36.0										
37.0										
38.0										
39.0										
40.0										
41.0										
42.0										
43.0										
44.0										
45.0										

NOTES:

Soil description represents a field identification after D.M. Burmister unless otherwise noted.

The information contained on this log is not warranted to show the actual subsurface condition. The contractor agrees that he will make no claims against AECOM if he finds that the actual conditions do not conform to those indicated by this log.

SAMPLE TYPE: S= SPLIT SPOON U=SHELBY TUBE R=ROCK CORE

PROPORTIONS: TRACE=1-10% LITTLE=10-20% SOME=20-35% AND=35-50%

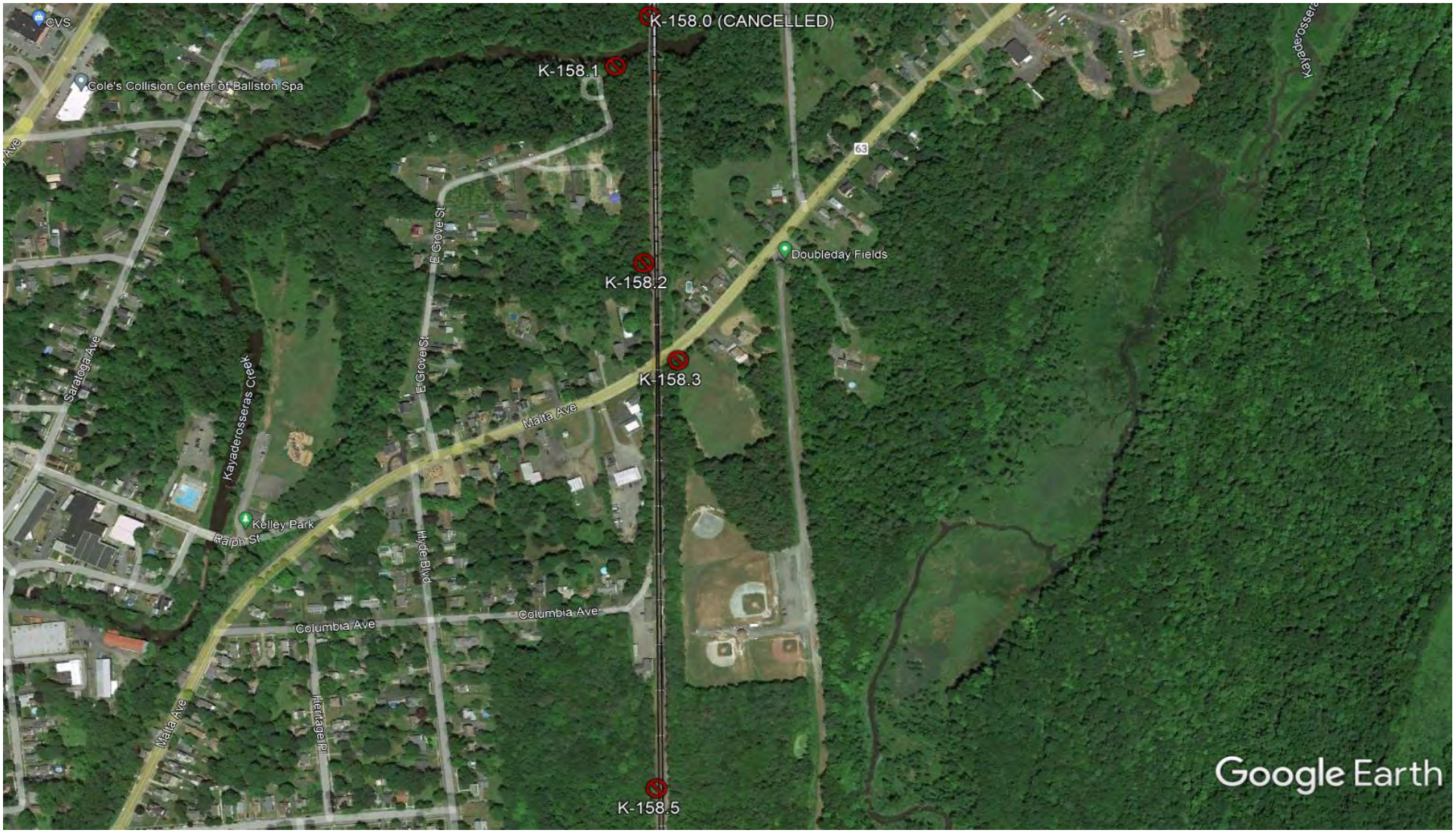
ROCK CORE PHOTOGRAPHIC LOG

AECOM Project No: **60323056**
Project Name: **CHPE – Upstate New York Upland Geotechnical Investigation**
Location: **Ballston - Mohawk Segment**

Boring No.	Depth (ft.)
BM-1A	11.0 – 31.0

Boring No.	Depth (ft.)
BM-1A	31.0-33.0
BM-1C	10.0 – 15.0

Note: Black foam inserts represent core pieces that were removed for geotechnical and/or thermal resistivity laboratory testing



Boring Location Plans Page 18 of 18	Drawn by: ADW	Scale: Not to scale	Project No.: CD10279	Date: April 2022

Champlain Hudson Power Express
Design Package 3
Glens Falls to Ballston Spa, New York

***ATLANTIC TESTING LABORATORIES*, Limited**

Albany, NY	Binghamton, NY	Canton, NY	Elmira, NY	Plattsburgh, NY
Poughkeepsie, NY	Syracuse, NY	Rochester, NY	Utica, NY	Watertown, NY

ATLANTIC TESTING LABORATORIES, Limited

Subsurface Investigation

Report No.: **CD10279D-01-04-22**

Client: **Kiewit Engineering (NY) Corp.**

Boring Location: **See Boring Location Plan**

Project: **Subsurface Investigation**
Champlain Hudson Power Express, Design Package 3
Various Locations, New York

Start Date: **3/24/2022** Finish Date: **3/24/2022**

Boring No.: **K-158.5** Sheet **1** of **2**

Groundwater Observations

Date	Time	Depth	Casing
3/24/2022	PM	*7.8'	10.0'

Coordinates
Northing **1520773**
Easting **669116.9**

Sampler Hammer
Weight: **140** lbs.
Fall: **30** in.
Hammer Type: **Automatic**

Ground Elev.: **288.4**

Boring Advance By: **HW (4") Casing/3 7/8" Wet Rotary/NX Core**

***May be affected by water utilized to advance the borehole.**

DEPTH	METHOD OF ADVANCE	SAMPLE NO.	DEPTH OF SAMPLE From	DEPTH OF SAMPLE To	SAMPLE TYPE	BLOWS ON SAMPLER PER 6" 2" O.D. SAMPLER	DEPTH OF CHANGE	CLASSIFICATION OF MATERIAL (f - fine; m - medium; c - coarse; and - 35-50%; some - 20-35%; little - 10-20%; trace - 0-10%)	Recovery (Inches)
1	CASING	1	0.0	2.0	SS	WH/24"	2.0	Grey cmf SAND; and mf GRAVEL; trace SILT (moist, non-plastic) SW	1
2	CASING	2	2.0	4.0	SS	1 1 1 1		Brown cmf SAND; and SILT; little mf GRAVEL (moist, non-plastic) w = 17.6%, % Fines = 36.0% SM	14
4		3	4.0	6.0	SS	1 1 3 5	6.0	Grey mf SAND; some SILT; some mf GRAVEL (moist, non-plastic) SM	16
6		4	6.0	8.0	SS	6 6 4 4		Grey cmf SAND; little mf GRAVEL; trace SILT (moist, non-plastic) possible WEATHERED ROCK Fragments SW	10
8		5	8.0	10.0	SS	14 15 18 20		Grey cmf SAND; little SILT; trace CLAY (moist, very slightly plastic) possible WEATHERED ROCK Fragments w = 8.8%, LL = 25, PL = 17, PI = 8, % Fines = 18.5% SM	24
10	WET ROTARY								
12								Advanced casing to 10.0 feet. Advanced 3 7/8" tri-cone roller bit wet rotary open hole to 14.0 feet and began coring.	
14	NX CORE (WET)	6	14.0 ~~14.2~~	14.1 ~~19.0~~	SS NX	50/1" RUN 1	14.1	WEATHERED ROCK Fragments	1 ~~58~~
15								Greyish-Black SHALE 58" or 97% Recovery 29 Pieces (36") - 38% Chips and Fragments 0 Pieces longer than 4" (0") - RQD = 0%	
19			19.0	23.0	NX	RUN 2	19.0	Greyish-Black SHALE 44" or 92% Recovery 20 Pieces (22") - 50% Chips and Fragments 0 Pieces longer than 4" (0") - RQD = 0%	44
23		TR-1	23.0	25.0	NX	TR-1	23.0	Greyish-Black SHALE NX Rock Core sample collected from 23.0 to 25.0 feet for TR	
25							25.0		

SS Split Spoon Sample
NX Rock Core
SH Undisturbed Sample (Shelby Tube)
Estimated Groundwater

Drillers: **Jeffrey Donovan; Chase Bertrand**

Inspector: **Camren Campeau (ATL)**

ATL-LOG1 NE CD10279 KIEWIT INFRASTRUCTURE CO - VARIOUS LOCATIONS (PACKAGE 3).GPJ ATL4-08.GDT 6/9/22

ATLANTIC TESTING LABORATORIES, Limited

Subsurface Investigation

Boring No.: **K-158.5** Report No.: **CD10279D-01-04-22** Sheet **2** of **2**

DEPTH	METHOD OF ADVANCE	SAMPLE NO.	DEPTH OF SAMPLE From	DEPTH OF SAMPLE To	SAMPLE TYPE	BLOWS ON SAMPLER PER 6" 2" O.D. SAMPLER	DEPTH OF CHANGE	CLASSIFICATION OF MATERIAL	RECOVERY (inches)
								f - fine; m - medium; c - course; and - 35-50%; some - 20-35%; little - 10-20%; trace - 0-10%	
			25.0	29.0	NX	RUN 3		testing.	48
26								Greyish-Black SHALE	
27								48" or 100% Recovery	
28								6 Pieces (10") - 79% Chips and Fragments	
29							29.0	0 Pieces longer than 4" (0") - RQD = 0%	
			29.0	34.0	NX	RUN 4		Greyish-Black SHALE	60
30								60" or 100% Recovery	
31								13 Pieces (44") - 27% Chips and Fragments	
32								3 Pieces longer than 4" (19") - RQD = 32%	
33									
34							34.0		
			34.0	35.0	NX	RUN 5	35.0	Greyish-Black SHALE	12
35								12" or 100% Recovery	
36								5 Pieces (9") - 25% Chips and Fragments	
37								0 Pieces longer than 4" (0") - RQD = 0%	
38									
39								Boring terminated at 35.0 feet.	
40									
41								Notes:	
42								1. Borehole backfilled with cement-bentonite grout.	
43								2. Soil classifications based on ATL Field Engineer's field classification.	
44								3. Borehole was advanced with ATL's Geoprobe 7822D7 (Rig Unit No. CDGV706) drill rig.	
45									
46									
47									
48									
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50									
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55									
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60									
61									
62									

ATLANTIC TESTING LABORATORIES

LABORATORY TEST SUMMARY TABLE

ATL No. CD10279: Kiewit Infrastructure Co. - Champlain Hudson Power Express - Design Package 3

Boring ID	Sample No.	Sample Depth (ft.)	Soil/Rock Description	Percent Finer No. 200 Sieve	Moisture Content (%)	Atterburg Limits			Organic Content (%)	Water-Soluble Sulfate (ppm)	Water-Soluble Chloride (ppm)	pH	Resistivity (ohm-cm)	Rock Unconfined Compressive Strength (psi)	Rock Splitting Tensile Strength (psi)	Rock CERCHAR Abrasiveness Corrected CAI
						LL	PL	PI								
K-155.7	S-2	2.0-4.0	Brown cmf SAND; and m+f GRAVEL; little SILT	11.0	8.7	--	--	--	--	--	--	--	--	--	--	--
	S-5	8.0-9.5	DEBRIS; and c SAND; trace SILT	--	18.0	--	--	--	--	--	--	--	--	--	--	--
	TR-1A	30.0-32.0	Brown c-mf+ SAND; trace mf GRAVEL; trace SILT; trace DEBRIS	4.0	23.9	--	--	--	--	--	--	--	--	--	--	--
	TR-2A	40.0-42.0	Brown cmf SAND; little mf GRAVEL; trace SILT; trace DEBRIS	--	7.8	--	--	--	--	--	--	--	--	--	--	--
K-158.1	S-4	6.0-8.0	Grey cm+f SAND; little mf+ GRAVEL; little SILT	16.0	16.4	--	--	--	--	--	--	--	--	--	--	--
	S-6	14.0-16.0	Grey cmf SAND; some SILT	27.8	8.2	NP	NP	NP	--	--	--	--	--	--	--	--
	RC-1	25.0-30.0	Greyish-Black SHALE	--	--	--	--	--	--	--	--	--	--	21,840	1716	1.46
K-158.2	S-2/3	2.0-6.0	Brown cmf SAND; some mf GRAVEL; trace SILT	--	--	--	--	--	--	1,800	30	6.26	19,350	--	--	--
	S-5	8.0-10.0	Light Brown SILT; little f SAND	84.0	25.7	--	--	--	--	--	--	--	--	--	--	--
	S-7	19.0-20.5	Grey cmf SAND; some SILT; little mf GRAVEL; little CLAY	42.0	10.4	--	--	--	--	--	--	--	--	--	--	--
	RC-1	25.0-30.0	Greyish-Black SHALE	--	--	--	--	--	--	--	--	--	--	6,070	640	1.23
K-158.3	S-3	4.0-6.0	Brownish-Grey cmf SAND; some SILT; little mf+ GRAVEL	30.0	9.5	--	--	--	--	--	--	--	--	--	--	--
	RC-2	19.0-24.0	Greyish-Black SHALE	--	--	--	--	--	--	--	--	--	--	12,960	1560	1.13
	RC-4	29.0-34.0	Greyish-Black SHALE	--	--	--	--	--	--	--	--	--	--	3,920	1746	1.11
K-158.5	S-2	2.0-4.0	Brown cmf SAND; and SILT; little mf GRAVEL	36.0	17.6	--	--	--	--	--	--	--	--	--	--	--
	S-5	8.0-10.0	Brown cmf SAND; little mf GRAVEL; trace SILT	18.5	8.8	25	17	8	--	--	--	--	--	--	--	--

ATLANTIC TESTING LABORATORIES

WBE certified company

LABORATORY DETERMINATION OF MOISTURE CONTENT OF SOILS

ASTM D 2216

PROJECT INFORMATION

Client: Kiewit Intrastructure Co.
Project: Champlain Hudson Power Express
United Cable Installation
Various Locations, New York

ATL Report No.: CD10279E-11-04-22
Report Date: April 11, 2022
Date Received: March 30, 2022

TEST DATA

Boring No.	Sample No.	Depth (ft)	Moisture Content (%)
K-140.2	S-2 [1]	2-4	25.6
	S-5	8-10	9.4
	S-8	24-26	39.4
	TR-1	46-48	40.7
K-153.1	S-2	2-4	14.1
	S-5	8-10	23.4
	TR-1	23-25	22.1
	S-9	34-36	21.4
K-155.7	S-2 [1]	2-4	8.7
	S-5	8-9.5	18.0
	TR-1 [1]	30-32	23.9
	TR-2 [1]	40-42	7.8
K-158.5	S-2 [1]	2-4	17.6
	S-5 [1]	8-10	8.8
[redacted]			

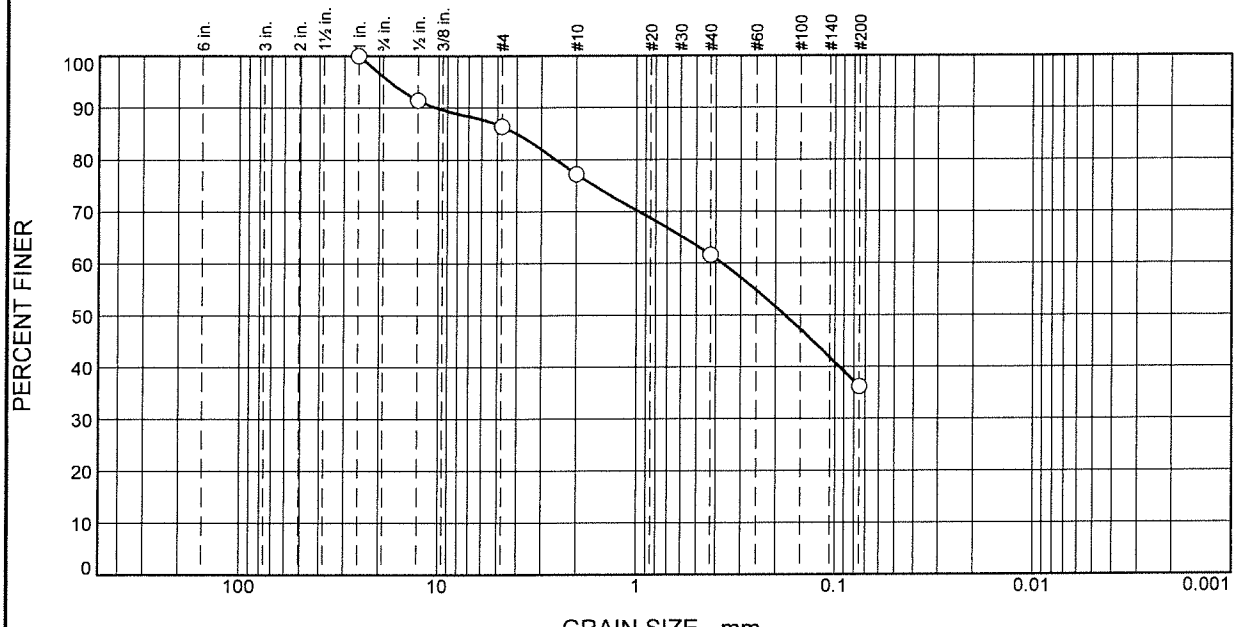
ATLANTIC TESTING LABORATORIES

Particle Size Distribution Report

Project: Champlain Hudson Power Express United Cable Install **Report No.:** CD10279E-11-04-22

Client: Kiewit Intrastructure Co. **Date:** 04/11/22

Sample No: K-158.5, S-2 **Source of Sample:** Boring Sample
Location: In-place **Elev./Depth:** 2-4'



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	4	10	9	15	26	36	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	OUT OF SPEC. (X)
1"	100		
1/2"	91		
#4	86		
#10	77		
#40	62		
#200	36		

Soil Description

Brown cmf SAND; and SILT; little mf GRAVEL

Atterberg Limits

PL= -- LL= -- PI= --

Coefficients

D_{85}= 4.0049 D_{60}= 0.3713 D_{50}= 0.1796
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Moisture Content= 17.6%

* (no specification provided)

Figure

ATLANTIC TESTING LABORATORIES, LIMITED

Reviewed by: _____ Date: 04/11/22

ATLANTIC TESTING LABORATORIES

WBE certified company

AMOUNT OF MATERIAL IN SOILS FINER THAN THE NO. 200 SIEVE
ASTM D 1140

PROJECT INFORMATION

Client:	Kiewit Intrastructure Co.	**ATL Report No.:**	CD10279E-11-04-22
Project:	Champlain Hudson Power Express	**Report Date:**	April 11, 2022
	United Cable Installation	**Test Date:**	April 7, 2022
	Various Locations, New York	**Performed By:**	H. Brownell

TEST DATA

Boring No.	Sample No.	Depth (ft)	Method (A or B)	Soak Time (min)	Initial Dry Weight (g)	% Finer than #200
K-140.2	S-2	2-4	A	10	67.21	52.3
K-140.2	S-8	24-26	A	10	65.84	57.1
K-140.2	TR-1	46-48	A	10	97.87	84.5
K-158.5	S-5	8-10	A	10	126.91	18.5

Reviewed By: _____ Date: 04/11/22

ATLANTIC TESTING LABORATORIES

WBE certified company

LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOIL
ASTM D 4318

PROJECT INFORMATION

Client:	Kiewit Instrastructure Co.	**ATL Report No.:**	CD10279E-11-04-22
Project:	Champlain Hudson Power Express	**Report Date:**	April 11, 2022
	United Cable Installation	**Date Received:**	March 30, 2022
	Various Locations, New York		

TEST DATA

Boring No.	Sample No.	LL	PL	PI
K-140.2	S-2	38	16	22
K-140.2	S-8	47	17	30
K-140.2	TR-1	52	20	32
K-158.5	S-5	25	17	8

SAMPLE INFORMATION

Boring No.	Sample No.	Maximum Grain Size (mm)	Estimated Amount of Sample Retained on No. 40 Sieve (%)	As Received Moisture Content (%)
K-140.2	S-2	9.51	14	25.6
K-140.2	S-8	0.25	0	39.4
K-140.2	TR-1	0.149	0	40.7
K-158.5	S-5	12.7	60	8.8

PREPARATION INFORMATION

Boring No.	Sample No.	Preparation	Method of Removing Oversized Material
K-140.2	S-2	Air Dry	Pulverizing and Screening
K-140.2	S-8	Air Dry	Not Necessary
K-140.2	TR-1	Air Dry	Not Necessary
K-158.5	S-5	Air Dry	Pulverizing and Screening

Champlain Hudson Power Express
Kiewit Engineering (NY) Corp.

K-158.5 - Runs 1 through 5

Appendix D

BoreAid HDD Simulation Output

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 21B Conduit 1
	P3
	Start Date: 12-10-2021
	End Date: 12-10-2021
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	AJB
	CHA
Description:	HDD 21B 10-inch DR 9 Conduit 1

Input Summary

Start Coordinate	(0.00, 0.00, 142.70) ft
End Coordinate	(903.00, 0.00, 136.00) ft
Project Length	903.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 5

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

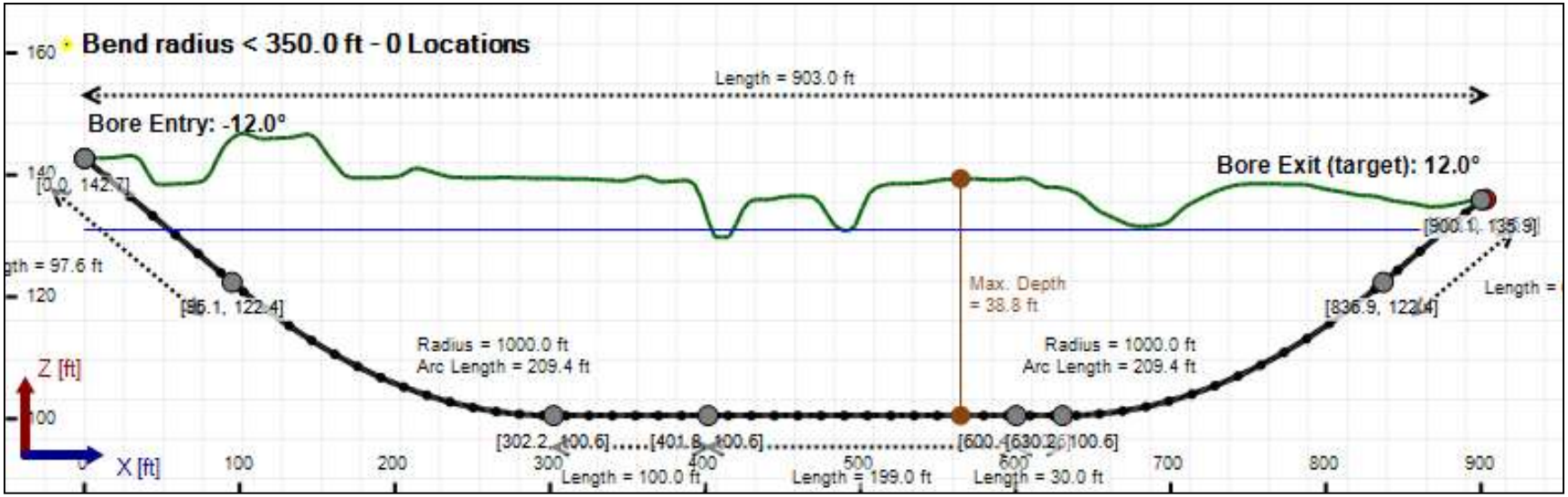
Soil Layer #2 USCS, Sand (S), SP
From Assistant
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #3 USCS, Clay (C), CL
From Assistant
Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 5.56 [psi]

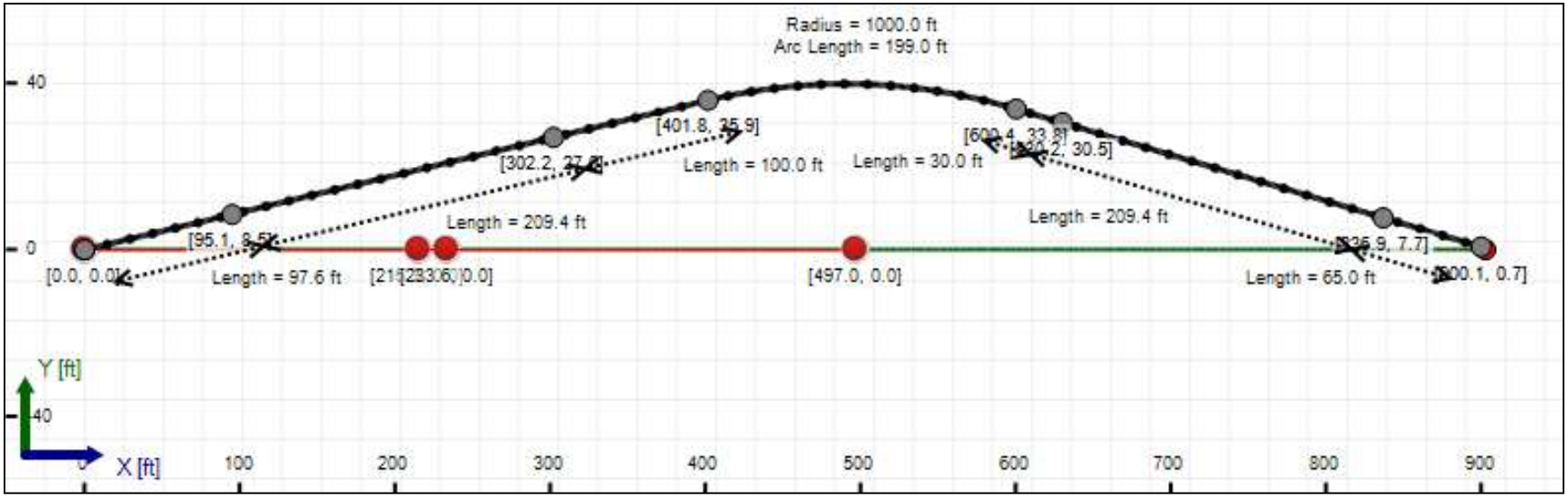
Soil Layer #4 USCS, Sand (S), SW
From Assistant
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #5 USCS, Clay (C), CL
From Assistant
Unit Weight: 70.0000 (dry), 100.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 3.13 [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: 914.99 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.34400002161662 ft
Silo Width: 1.34400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 59.30500 lb/ft3
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 93.64118 lb/ft3
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	3.7	19.0
Water Pressure	13.2	13.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	16.9	32.2
Deflection		
Earth Load Deflection	1.255	5.277
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.387	5.409
Compressive Stress [psi]		
Compressive Wall Stress	75.9	145.0

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	16153.8	16153.8
Pullback Stress [psi]	450.5	450.5
Pullback Strain	7.835E-3	7.835E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	450.5	475.3
Tensile Strain	7.835E-3	8.713E-3

Net External Pressure = 22.2 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.387	7.5	5.4	OK
Unconstrained Collapse [psi]	27.4	124.8	4.6	OK
Compressive Wall Stress [psi]	75.9	1150.0	15.2	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	37.4	228.8	6.1	OK
Tensile Stress [psi]	475.3	1200.0	2.5	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	86.709 psi	84.374 psi
1	8.00 in	12.00 in	86.625 psi	84.273 psi
2	12.00 in	16.13 in	86.503 psi	84.127 psi

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

Estimated Circulating Pressure Summary

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

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

Drill Fluid Density: 68.670 lb/ft3

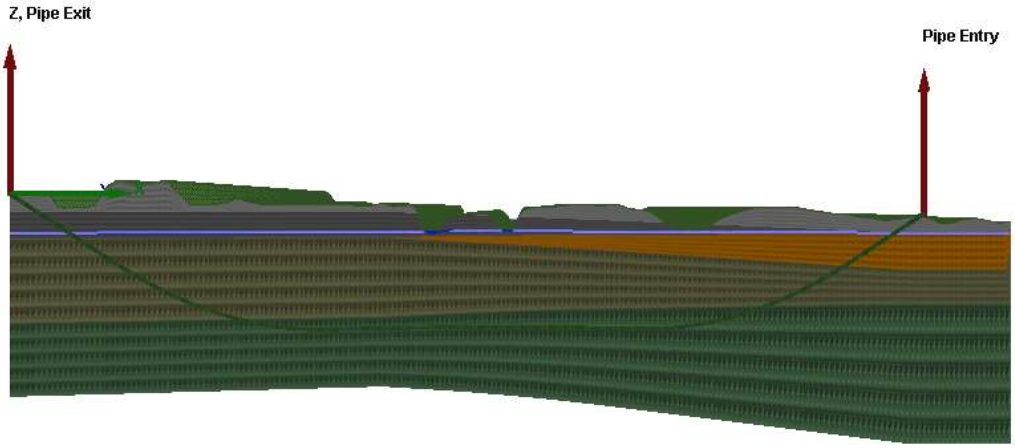
Rheological model: Bingham-Plastic

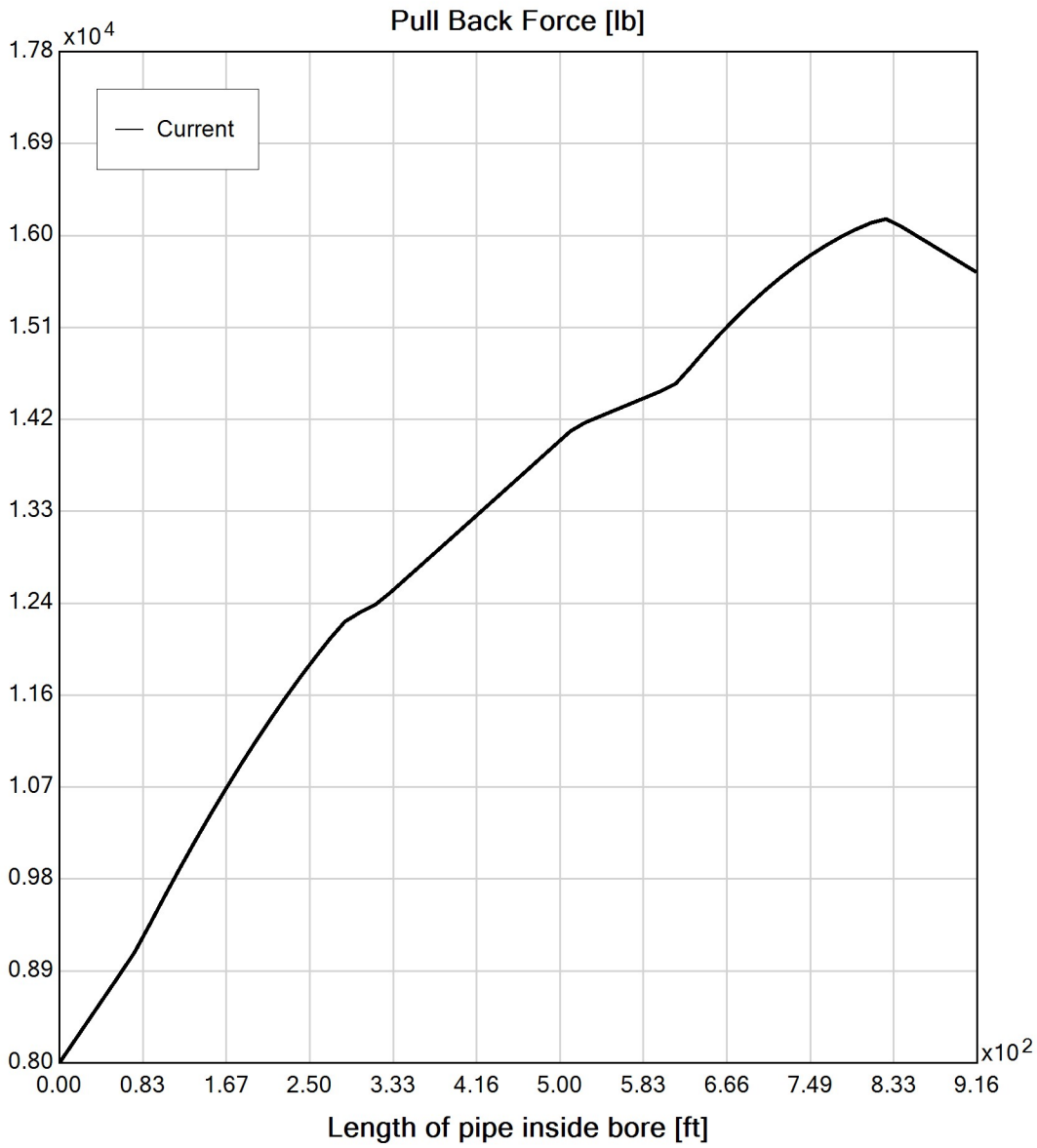
Plastic Viscosity (PV): 25.53

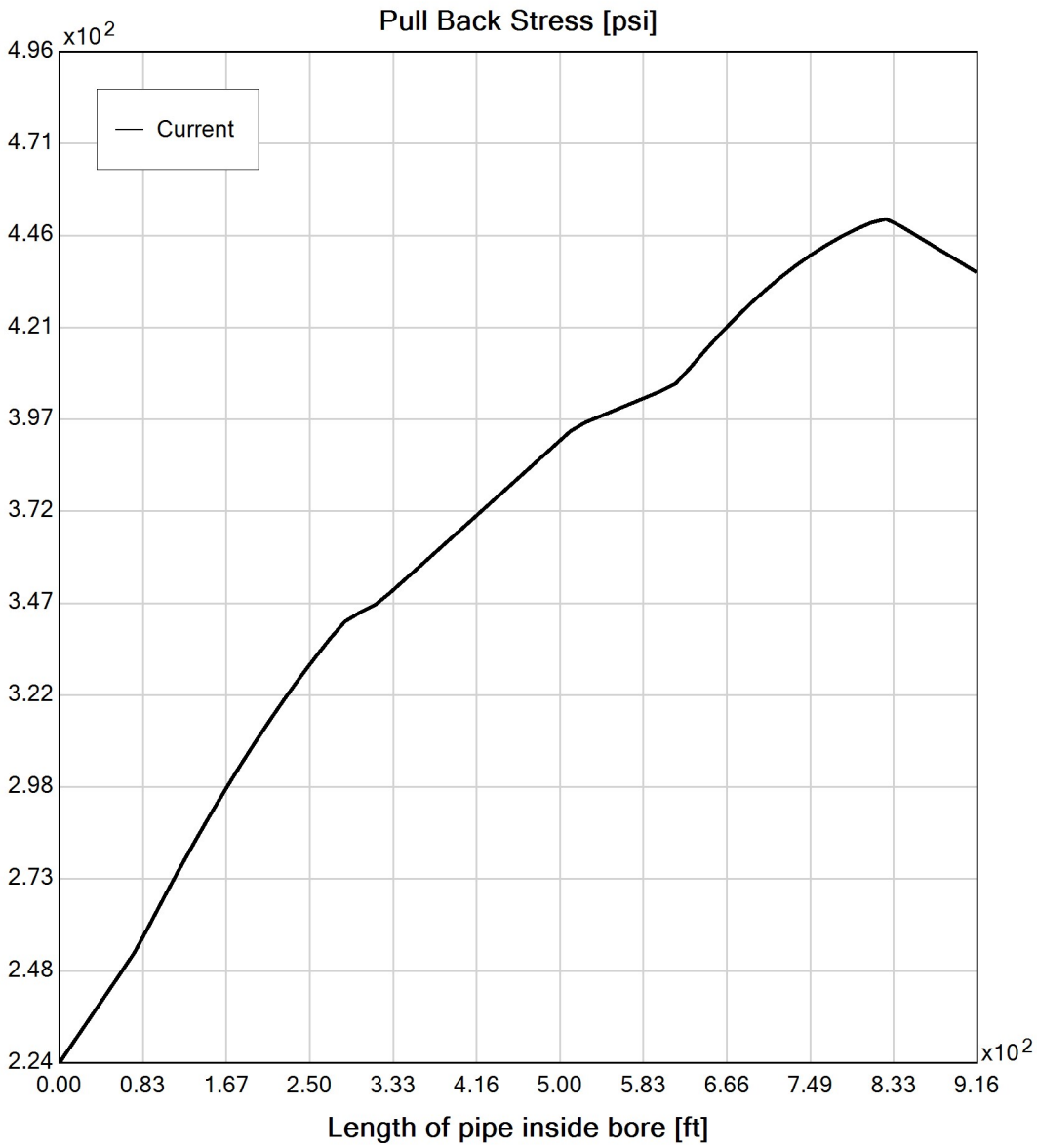
Yield Point (YP): 16.49

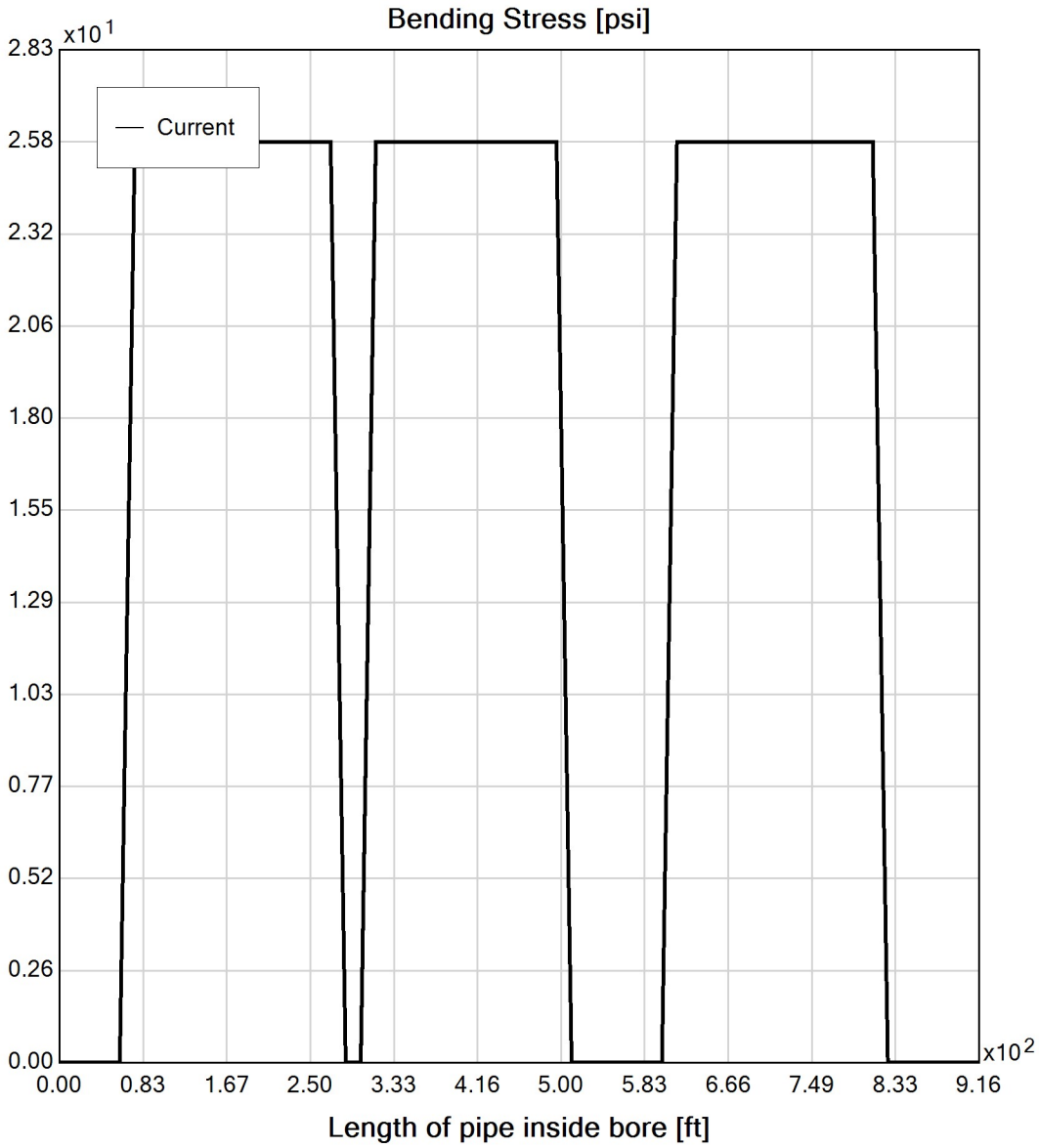
Effective Viscosity (cP): 1202.0

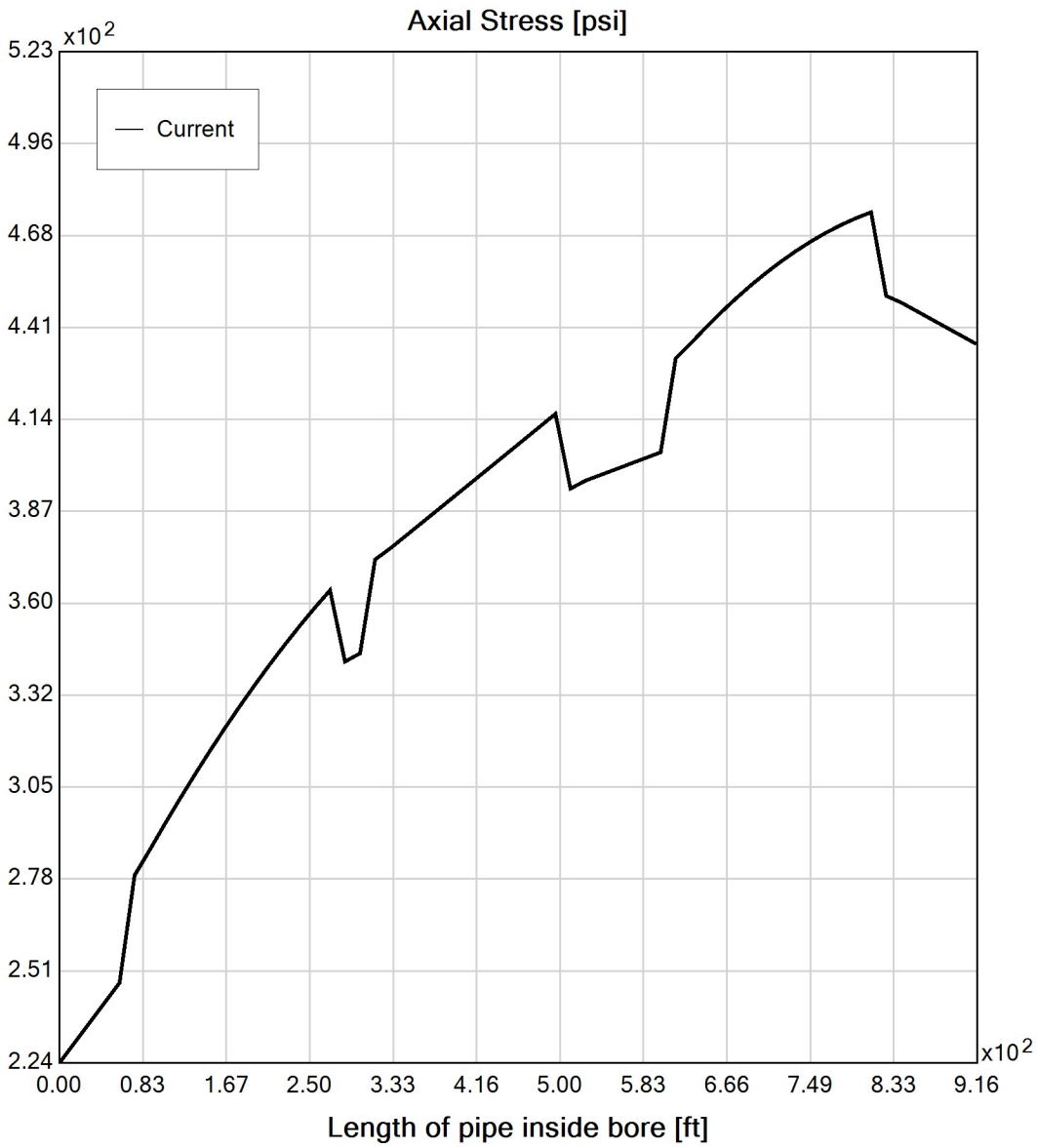
Virtual Site

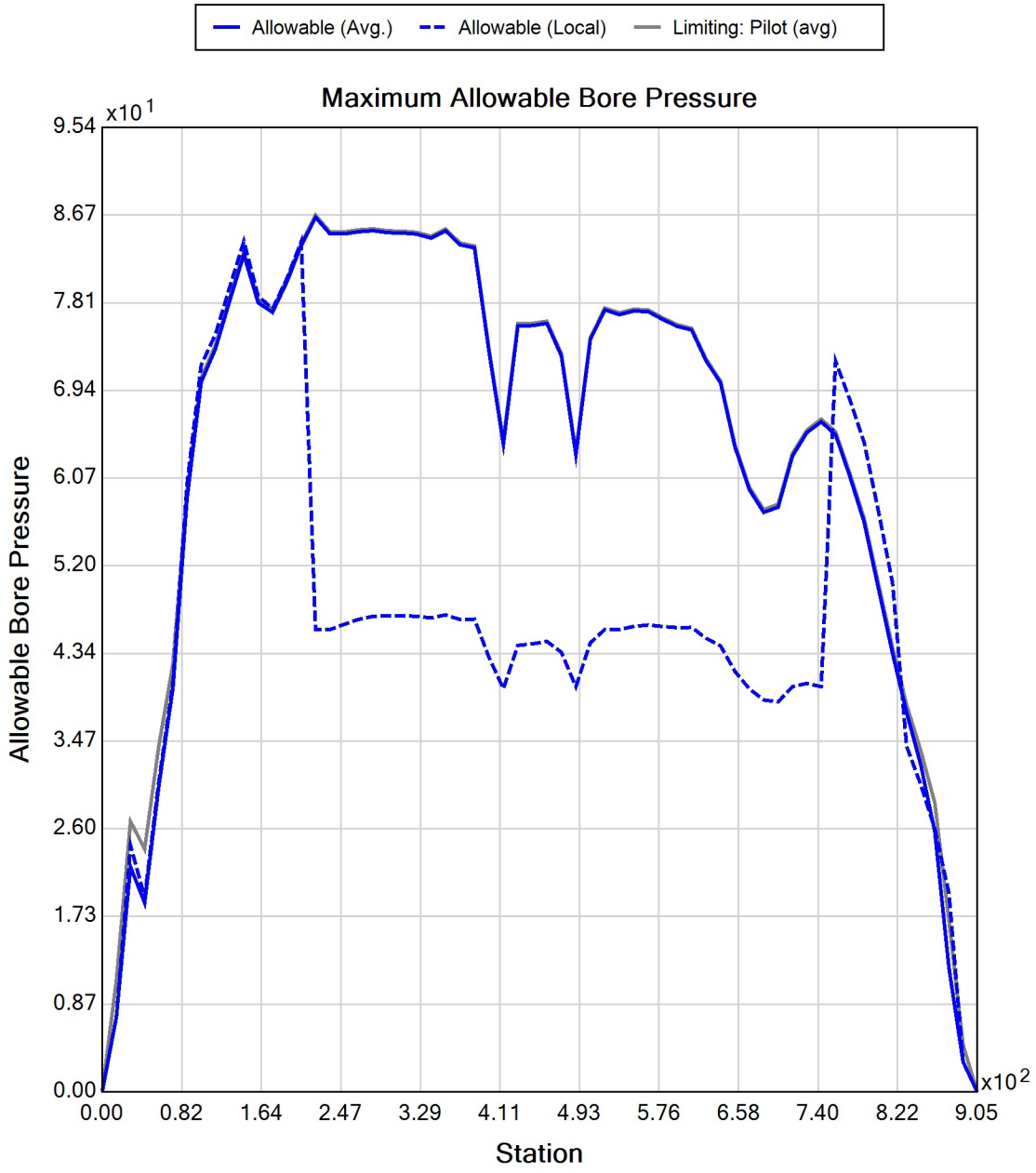


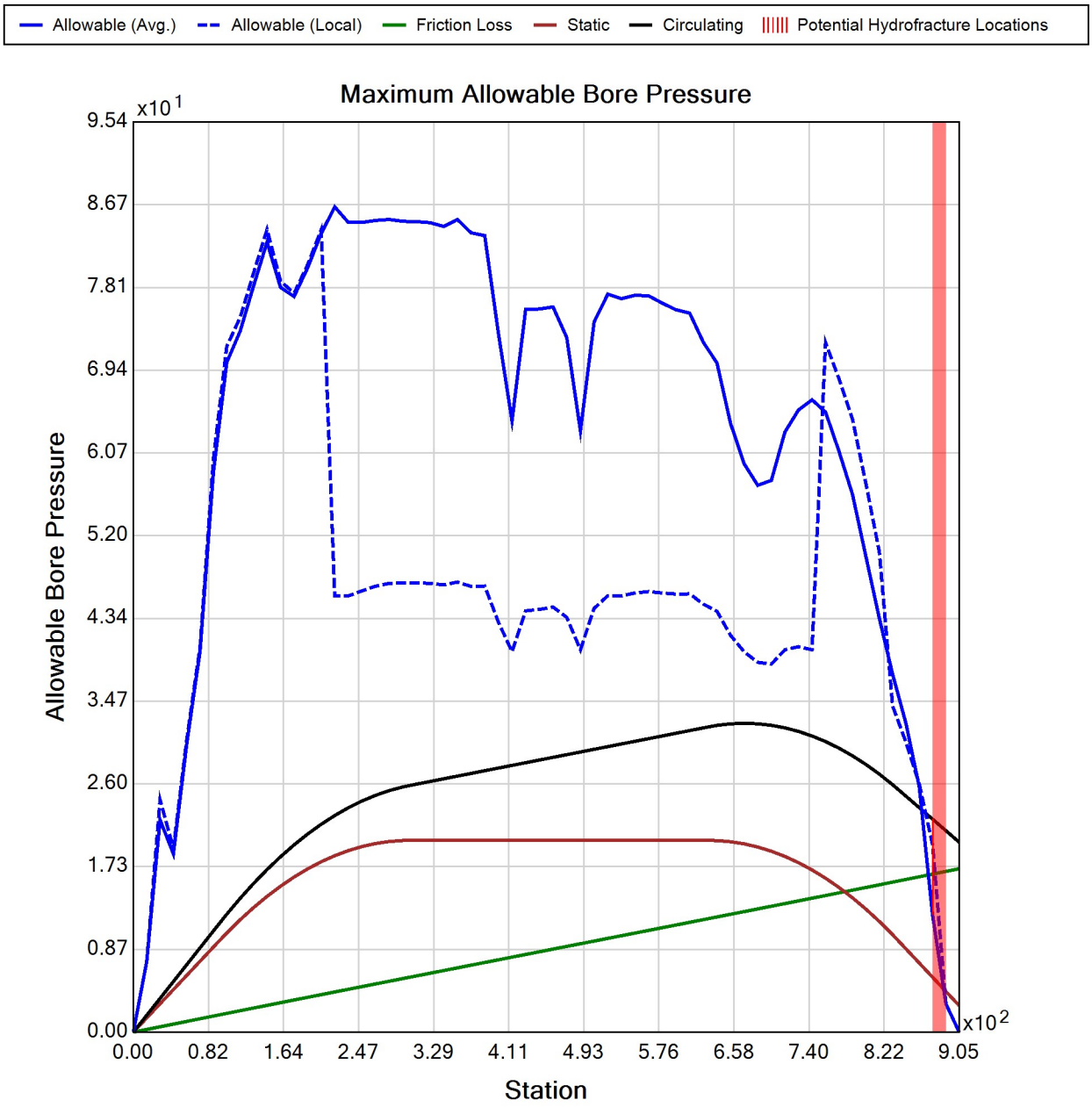












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Input Summary

Start Coordinate	(0.00, 0.00, 142.70) ft
End Coordinate	(903.00, 0.00, 136.00) ft
Project Length	903.00 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: 914.99 ft
Internal Pressure: 0 psi
Borehole Diameter: 0.531000018119812 ft
Silo Width: 0.531000018119812 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 59.30500 lb/ft3
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 93.64118 lb/ft3
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	1.5	19.0
Water Pressure	13.2	13.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	14.7	32.2
Deflection		
Earth Load Deflection	0.565	5.277
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.594	5.306
Compressive Stress [psi]		
Compressive Wall Stress	65.9	145.0

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	898.1	898.1
Pullback Stress [psi]	513.1	513.1
Pullback Strain	8.924E-3	8.924E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	513.1	517.8
Tensile Strain	8.924E-3	9.104E-3

Net External Pressure = 22.2 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.594	7.5	12.6	OK
Unconstrained Collapse [psi]	27.4	132.9	4.9	OK
Compressive Wall Stress [psi]	65.9	1150.0	17.4	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	37.4	227.0	6.1	OK
Tensile Stress [psi]	517.8	1200.0	2.3	OK

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Project Summary

General:	CHPE HDD 21B Conduit 2 P3 Start Date: 12-10-2021 End Date: 12-10-2021
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	AJB CHA
Description:	HDD 21B 10-inch DR9 Conduit 2

Input Summary

Start Coordinate	(0.00, 0.00, 144.00) ft
End Coordinate	(947.20, 0.00, 135.50) ft
Project Length	947.20 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: 5

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

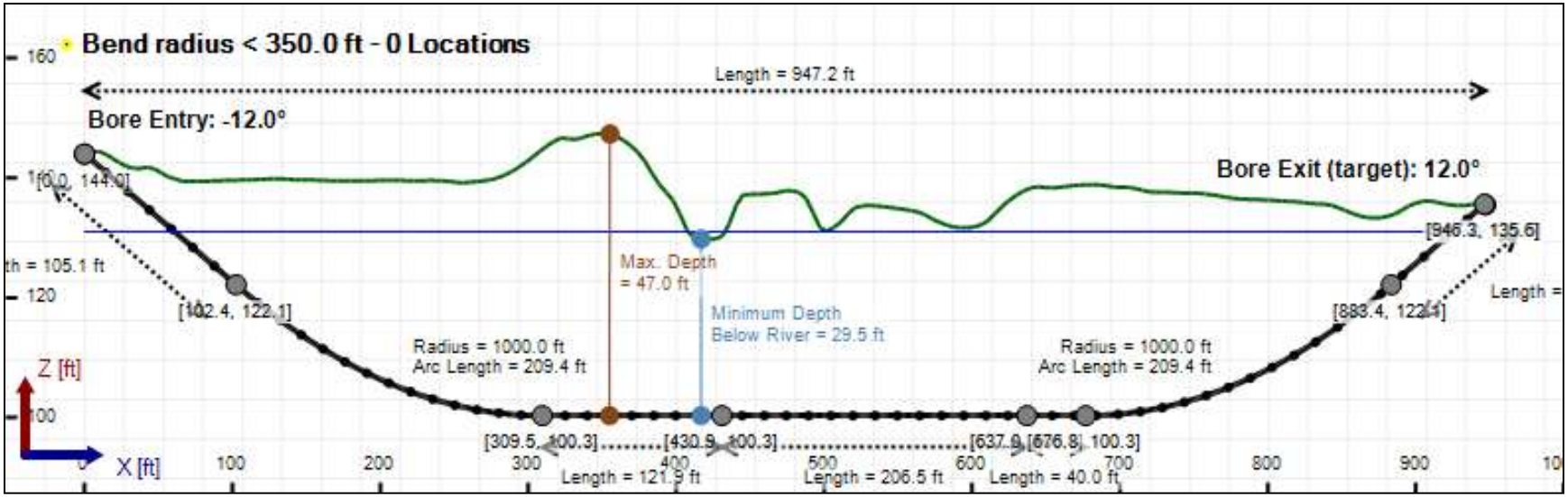
Soil Layer #2 USCS, Sand (S), SP
From Assistant
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #3 USCS, Clay (C), CL
From Assistant
Unit Weight: 80.0000 (dry), 110.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 5.56 [psi]

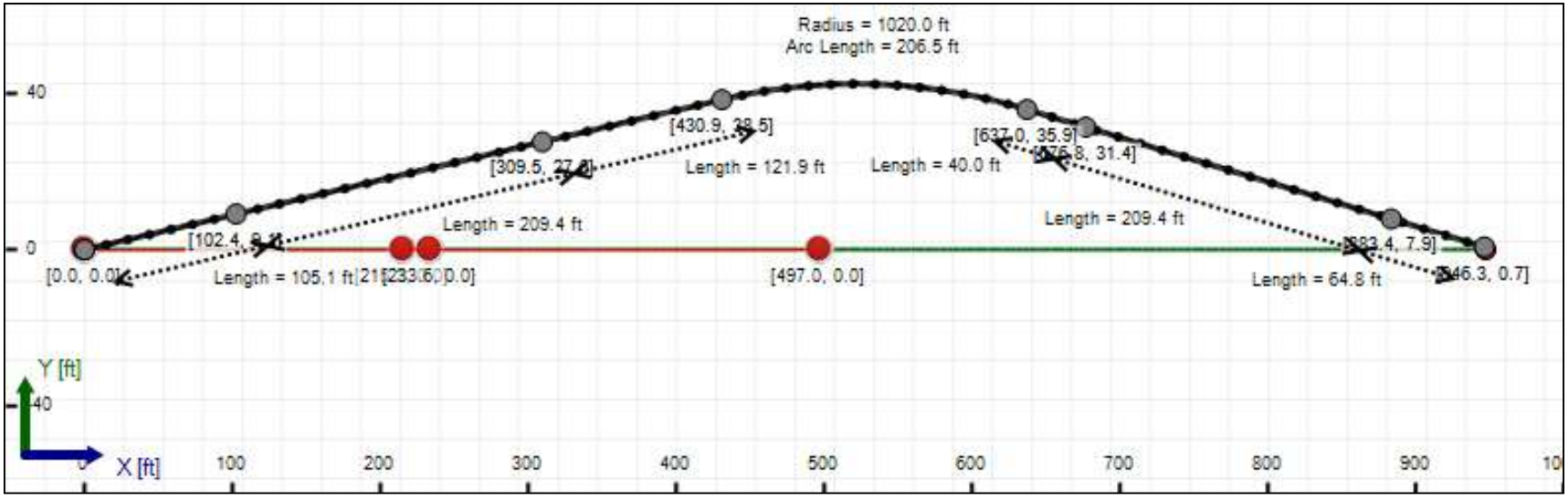
Soil Layer #4 USCS, Sand (S), SW
From Assistant
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #5 USCS, Clay (C), CL
From Assistant
Unit Weight: 70.0000 (dry), 100.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 3.13 [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: 960.09 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.34400002161662 ft
Silo Width: 1.34400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 59.30500 lb/ft3
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 93.64118 lb/ft3
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	4.0	24.8
Water Pressure	13.3	13.3
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	17.3	38.1
Deflection		
Earth Load Deflection	1.117	6.756
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.249	6.888
Compressive Stress [psi]		
Compressive Wall Stress	77.7	171.5

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	16821.9	16821.9
Pullback Stress [psi]	469.1	469.1
Pullback Strain	8.159E-3	8.159E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	469.1	493.0
Tensile Strain	8.159E-3	9.018E-3

Net External Pressure = 24.2 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.249	7.5	6.0	OK
Unconstrained Collapse [psi]	28.4	123.9	4.4	OK
Compressive Wall Stress [psi]	77.7	1150.0	14.8	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	38.4	227.6	5.9	OK
Tensile Stress [psi]	493.0	1200.0	2.4	OK

Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.00 in	98.726 psi	84.643 psi
1	8.00 in	12.00 in	98.680 psi	84.548 psi
2	12.00 in	16.13 in	98.613 psi	84.412 psi

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

Estimated Circulating Pressure Summary

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

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

Drill Fluid Density: 68.670 lb/ft3

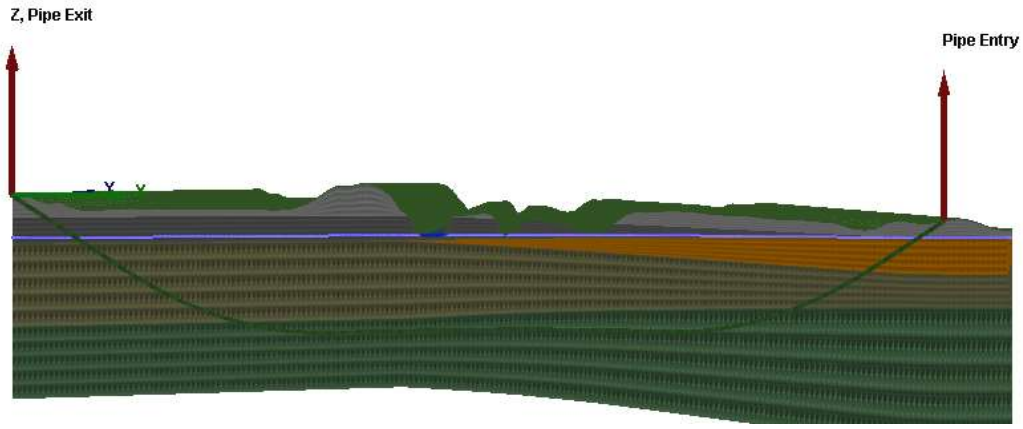
Rheological model: Bingham-Plastic

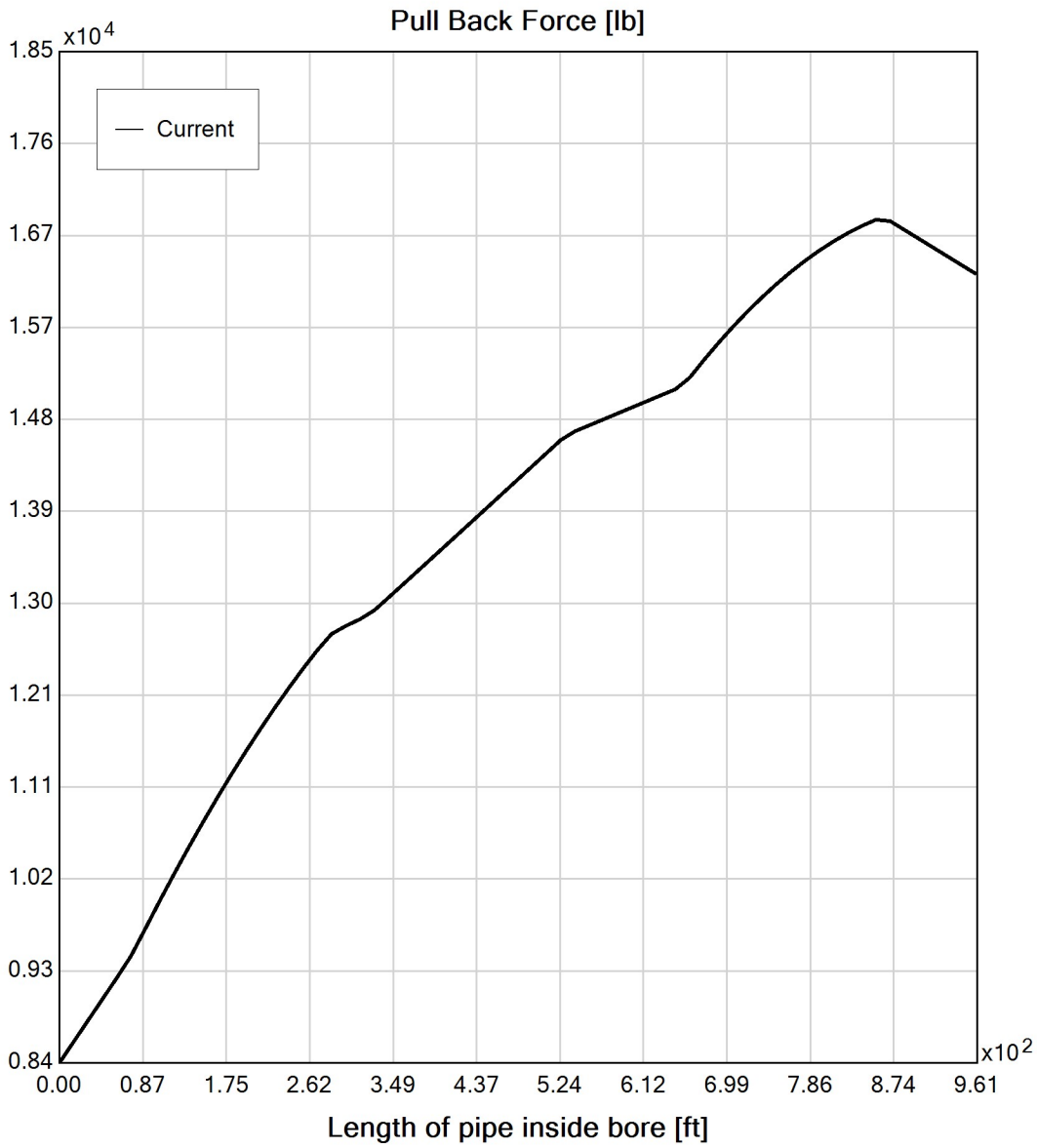
Plastic Viscosity (PV): 25.53

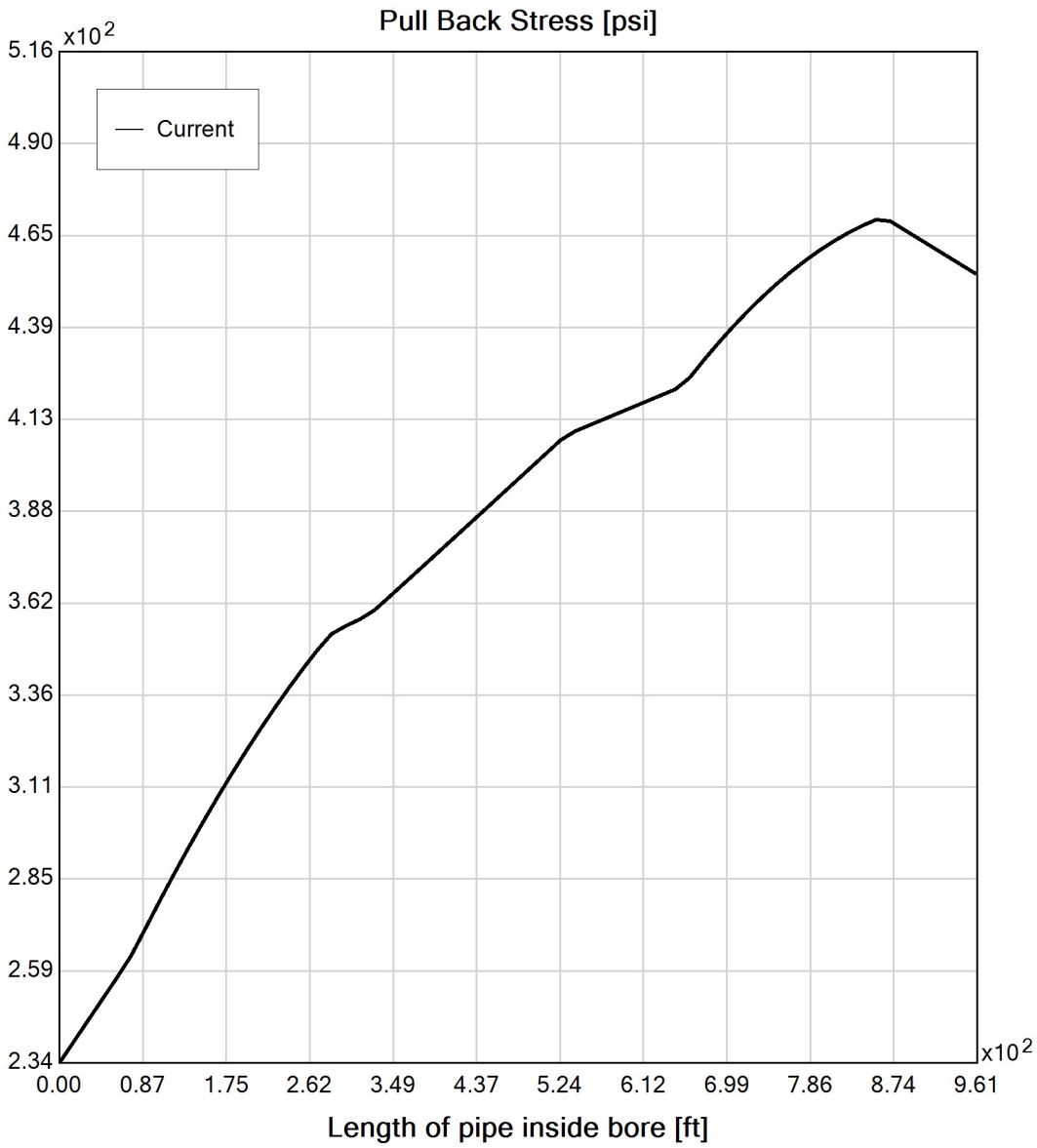
Yield Point (YP): 16.49

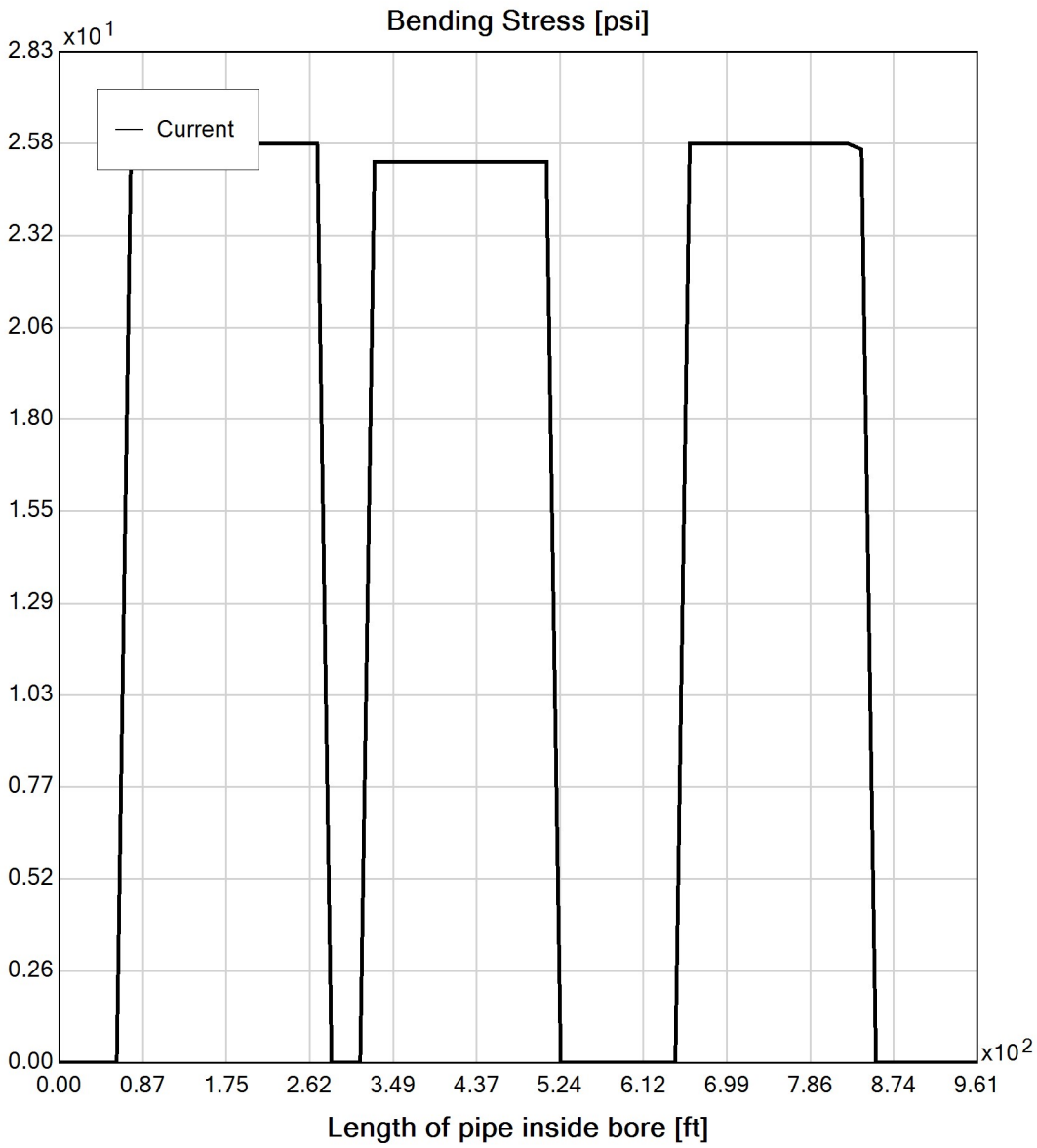
Effective Viscosity (cP): 1202.0

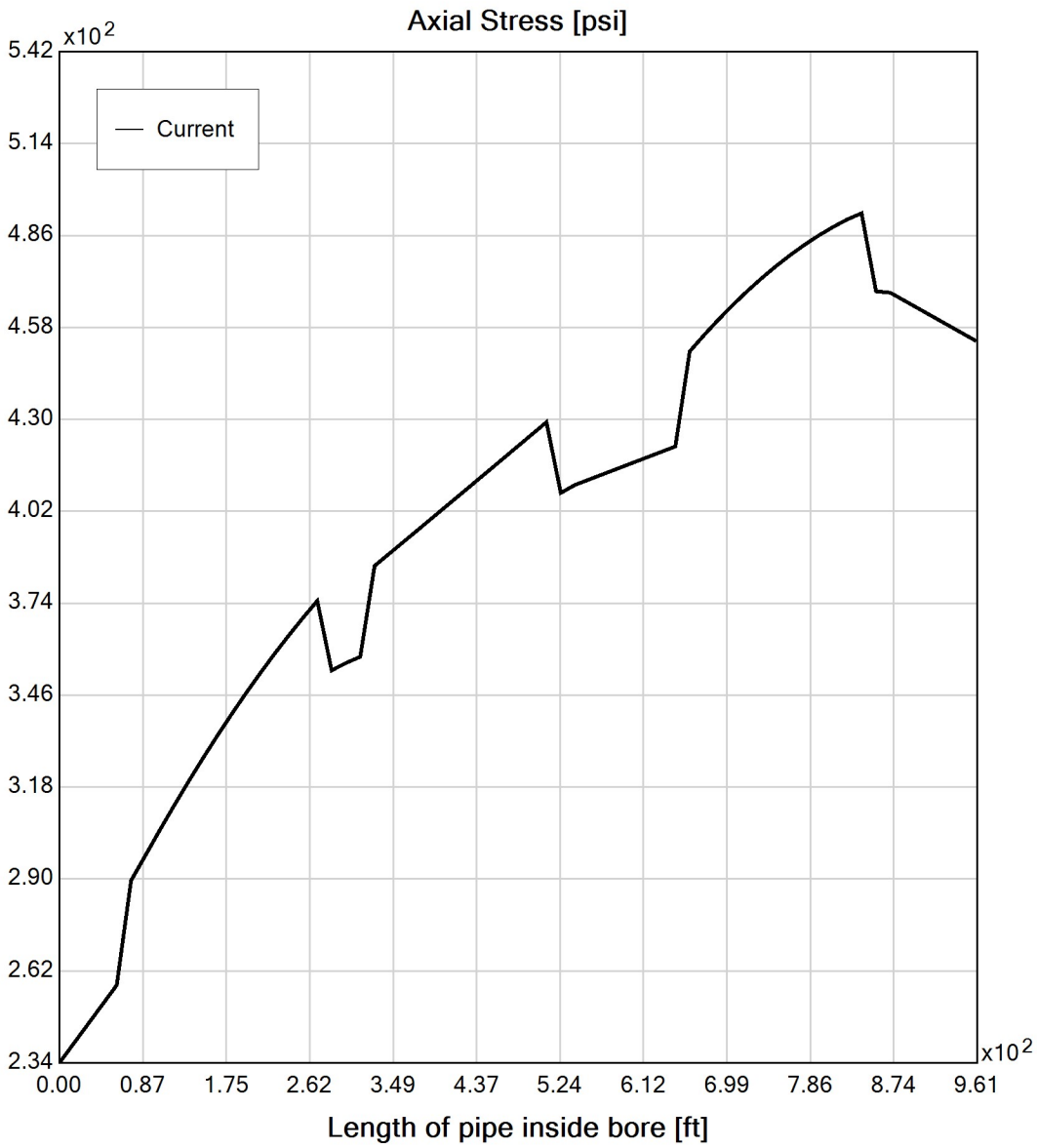
Virtual Site

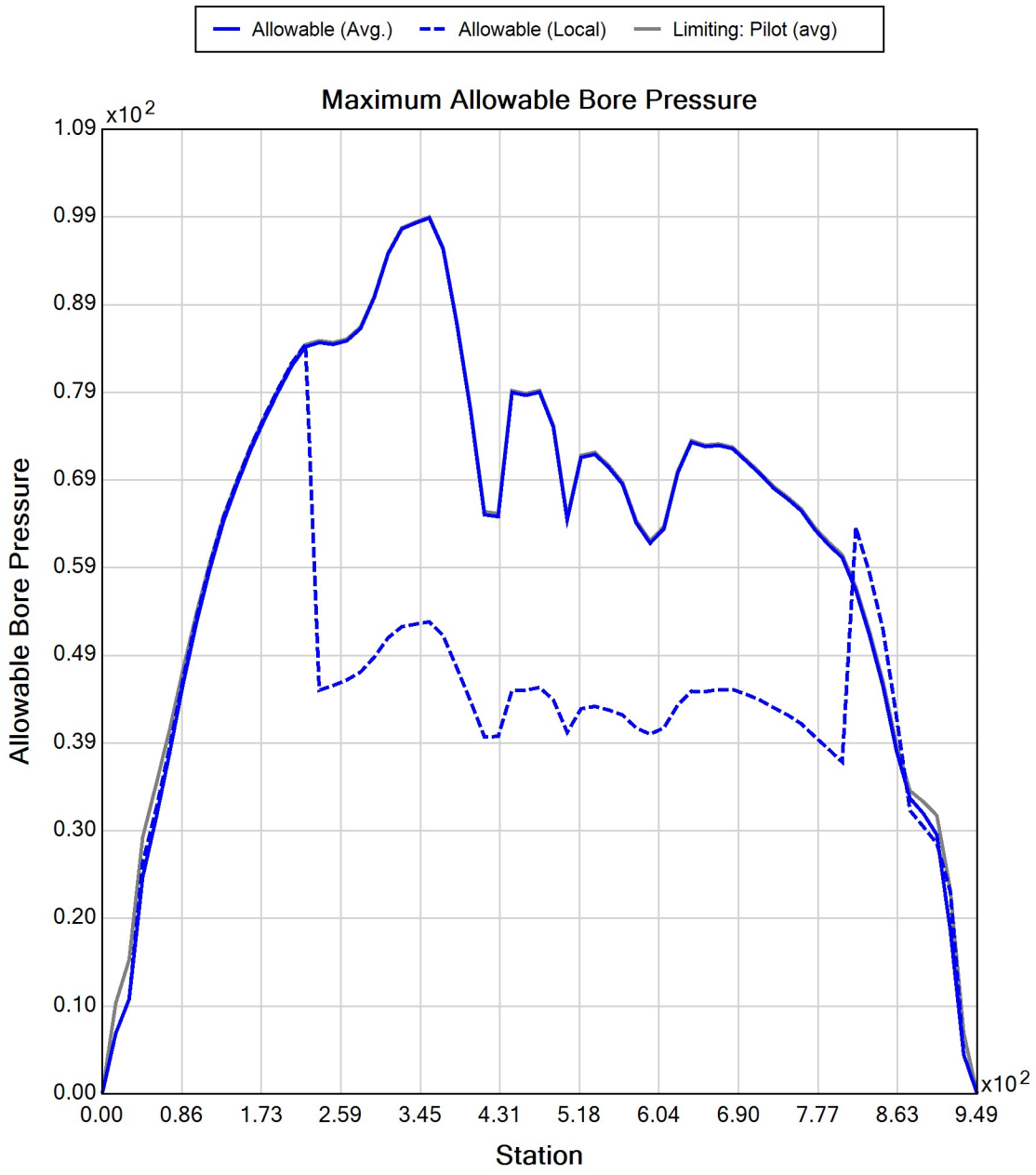


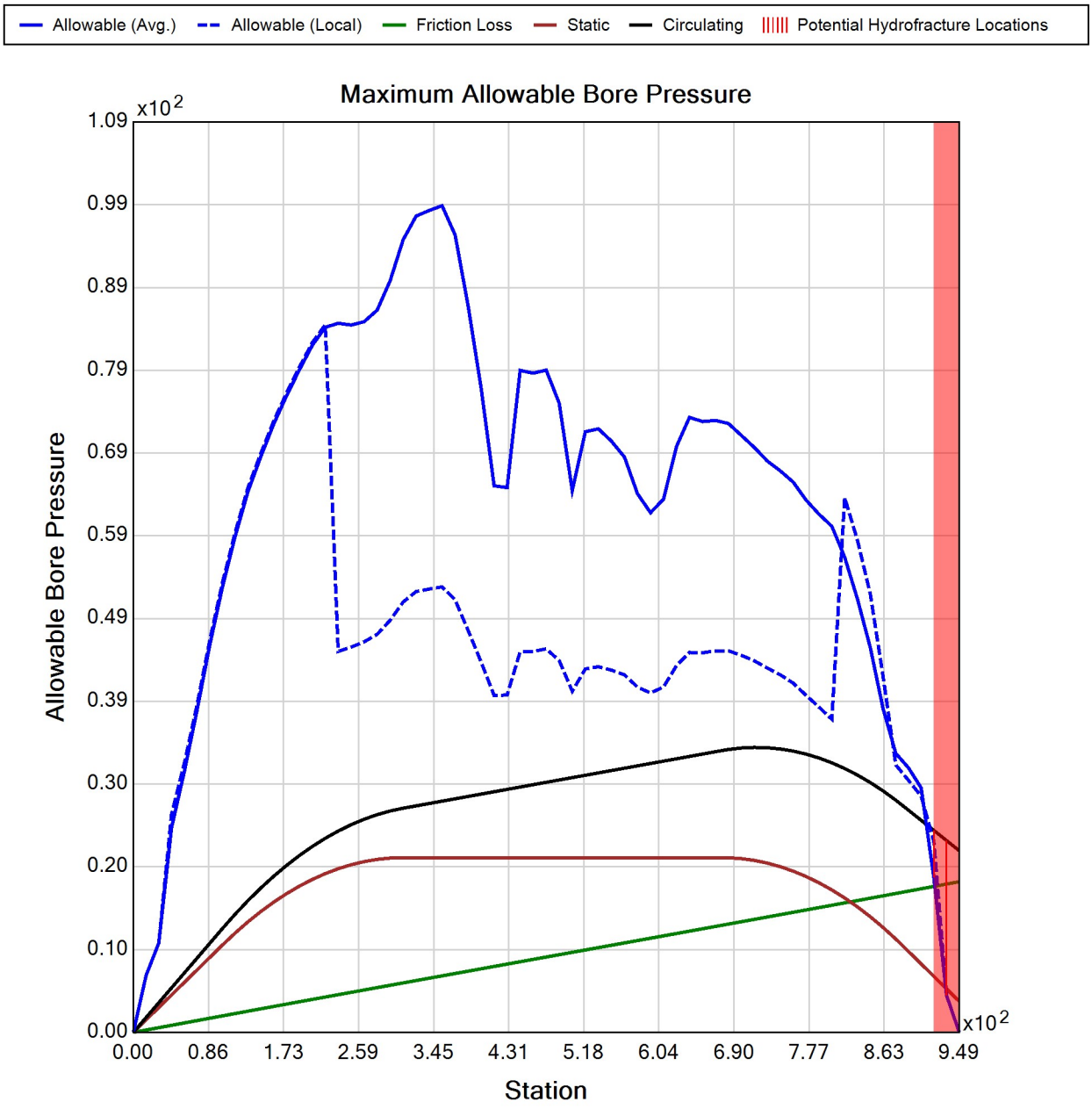












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Input Summary

Start Coordinate	(0.00, 0.00, 144.00) ft
End Coordinate	(947.20, 0.00, 135.50) ft
Project Length	947.20 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: 960.09 ft
Internal Pressure: 0 psi
Borehole Diameter: 0.531000018119812 ft
Silo Width: 0.531000018119812 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 59.30500 lb/ft3
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 93.64118 lb/ft3
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	1.6	24.8
Water Pressure	13.3	13.3
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	14.9	38.1
Deflection		
Earth Load Deflection	0.601	6.756
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.631	6.785
Compressive Stress [psi]		
Compressive Wall Stress	67.0	171.5

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	930.7	930.7
Pullback Stress [psi]	531.8	531.8
Pullback Strain	9.248E-3	9.248E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	531.8	535.6
Tensile Strain	9.248E-3	9.414E-3

Net External Pressure = 24.2 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.631	7.5	11.9	OK
Unconstrained Collapse [psi]	28.4	132.6	4.7	OK
Compressive Wall Stress [psi]	67.0	1150.0	17.2	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	38.4	225.6	5.9	OK
Tensile Stress [psi]	535.6	1200.0	2.2	OK

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Project Summary

General:	CHPE HDD 22 Conduit 1
	P3
	Start Date: 12-10-2021
	End Date: 12-10-2021
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	AJB
	CHA
Description:	HDD 22 10-inch DR 9 Conduit 1

Input Summary

Start Coordinate	(0.00, 0.00, 140.50) ft
End Coordinate	(1280.00, 0.00, 141.50) ft
Project Length	1280.00 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: 8

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

Soil Layer #2 USCS, Sand (S), SW
From Assistant
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #3 USCS, Gravel (G), GW
From Assistant
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

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

Soil Layer #5 USCS, Gravel (G), GW
From Assistant
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #6 USCS, Sand (S), SP
From Assistant
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

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

From Assistant

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

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

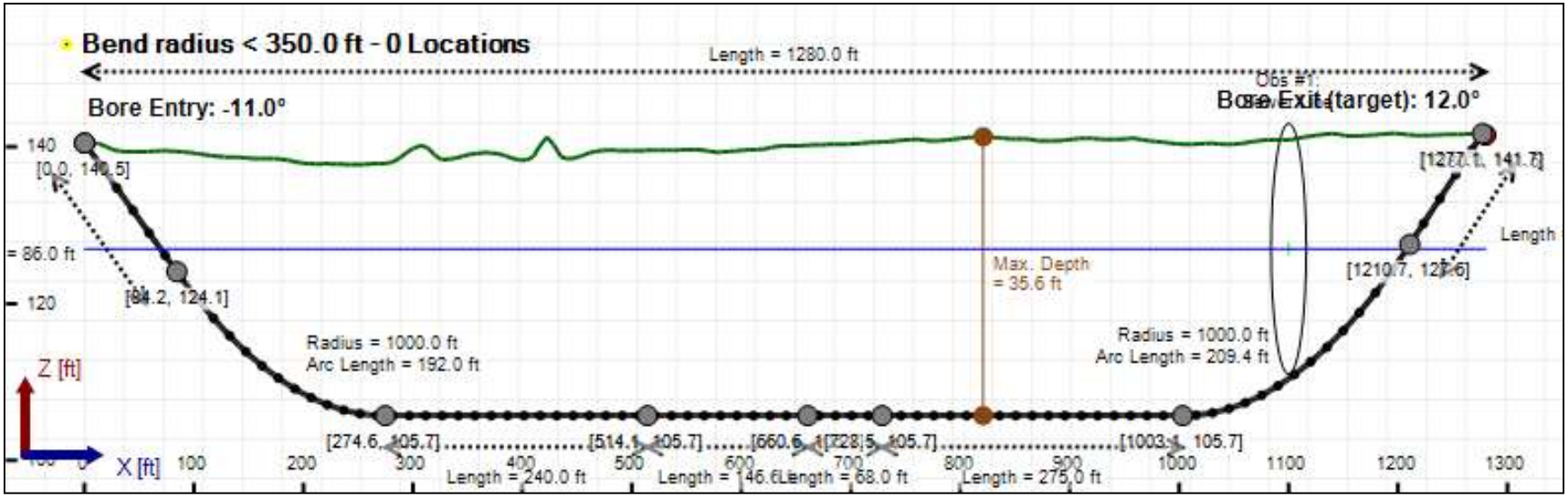
Soil Layer #8 USCS, Clay (C), CH

From Assistant

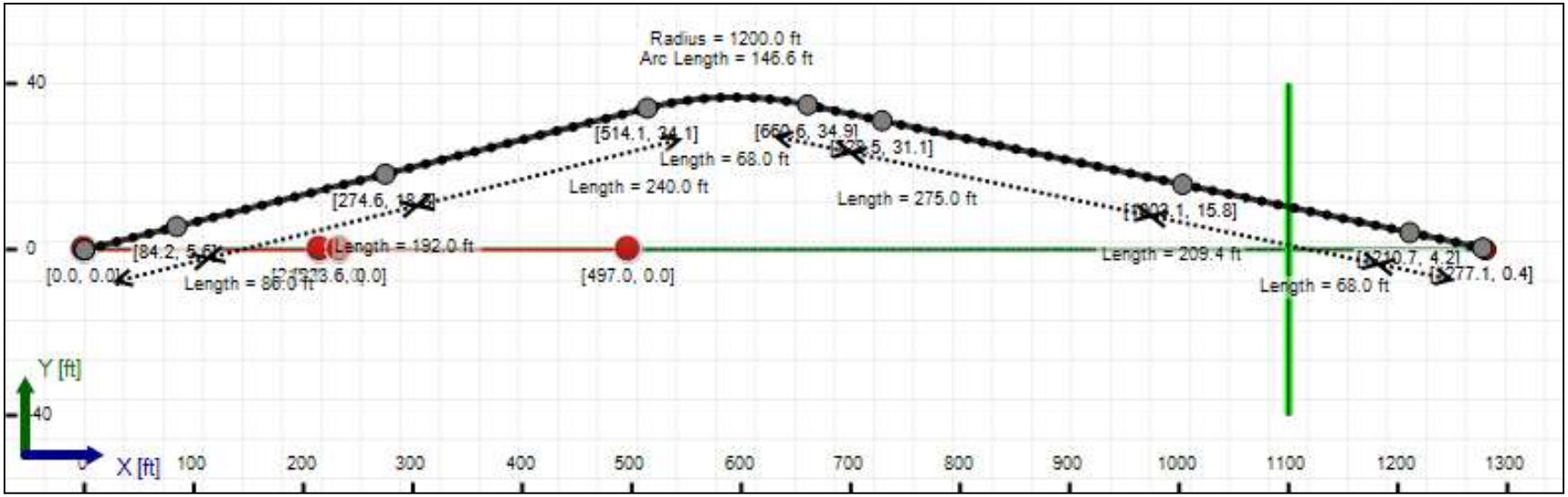
Unit Weight: 70.0000 (dry), 100.0000 (sat) [lb/ft3]

Phi: 0.00, S.M.: 145.00, Coh: 3.13 [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: 1290.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.34400002161662 ft
Silo Width: 1.34400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 59.30500 lb/ft3
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 93.64118 lb/ft3
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	3.8	18.2
Water Pressure	9.2	9.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	13.0	27.4
Deflection		
Earth Load Deflection	1.274	4.957
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.406	5.089
Compressive Stress [psi]		
Compressive Wall Stress	58.7	123.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	22019.9	22019.9
Pullback Stress [psi]	614.1	614.1
Pullback Strain	1.068E-2	1.068E-2
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	614.1	637.9
Tensile Strain	1.068E-2	1.154E-2

Net External Pressure = 20.8 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.406	7.5	5.3	OK
Unconstrained Collapse [psi]	24.1	124.3	5.2	OK
Compressive Wall Stress [psi]	58.7	1150.0	19.6	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	34.1	218.6	6.4	OK
Tensile Stress [psi]	637.9	1200.0	1.9	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	77.852 psi	77.852 psi
1	8.00 in	12.00 in	77.762 psi	77.762 psi
2	12.00 in	16.13 in	77.633 psi	77.633 psi

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

Estimated Circulating Pressure Summary

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

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

Drill Fluid Density: 68.670 lb/ft3

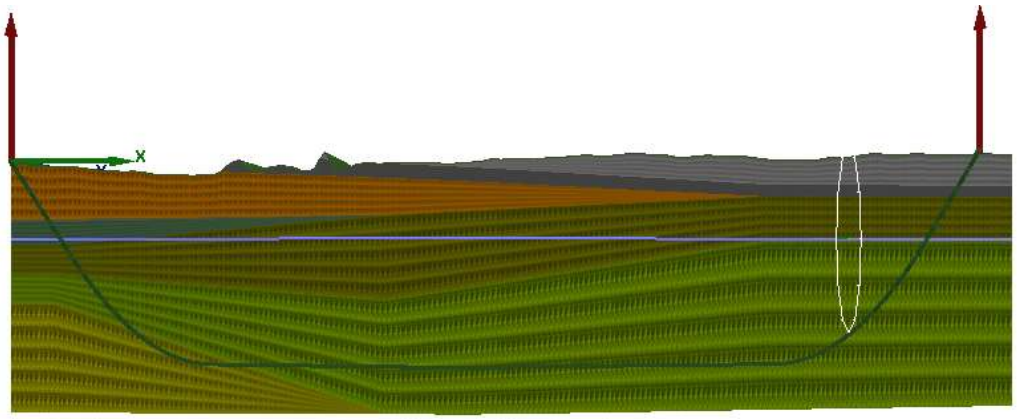
Rheological model: Bingham-Plastic

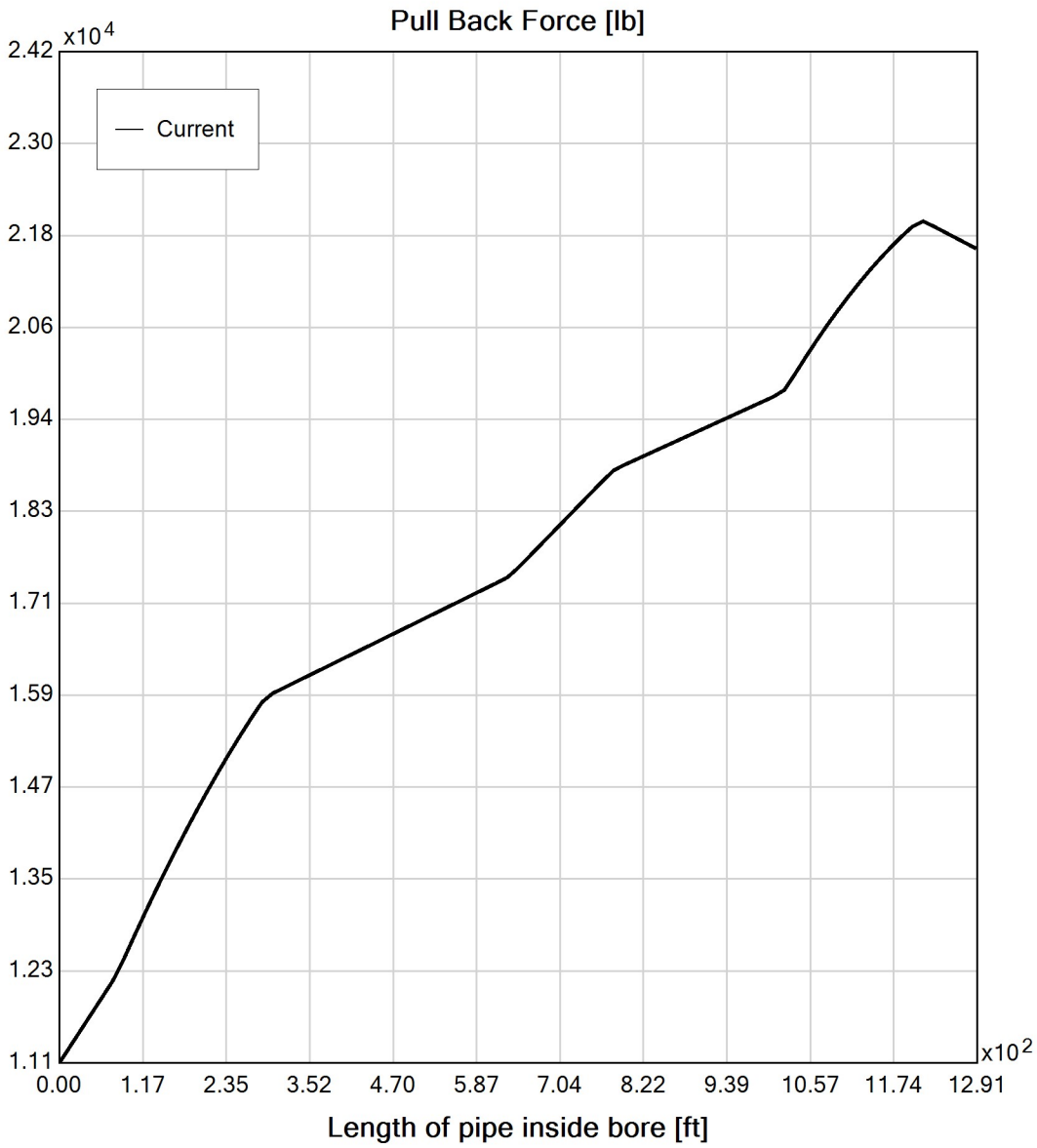
Plastic Viscosity (PV): 25.53

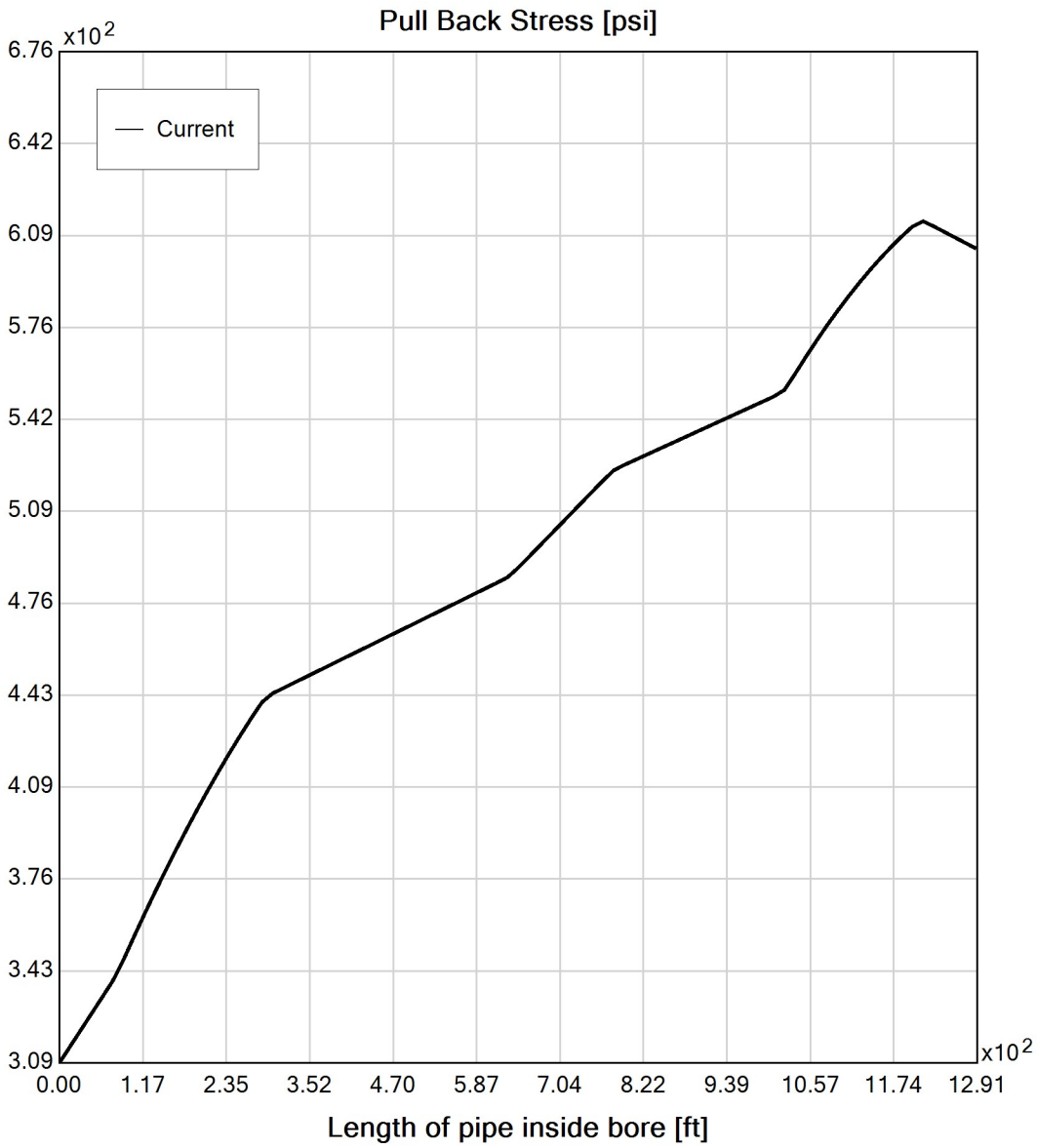
Yield Point (YP): 16.49

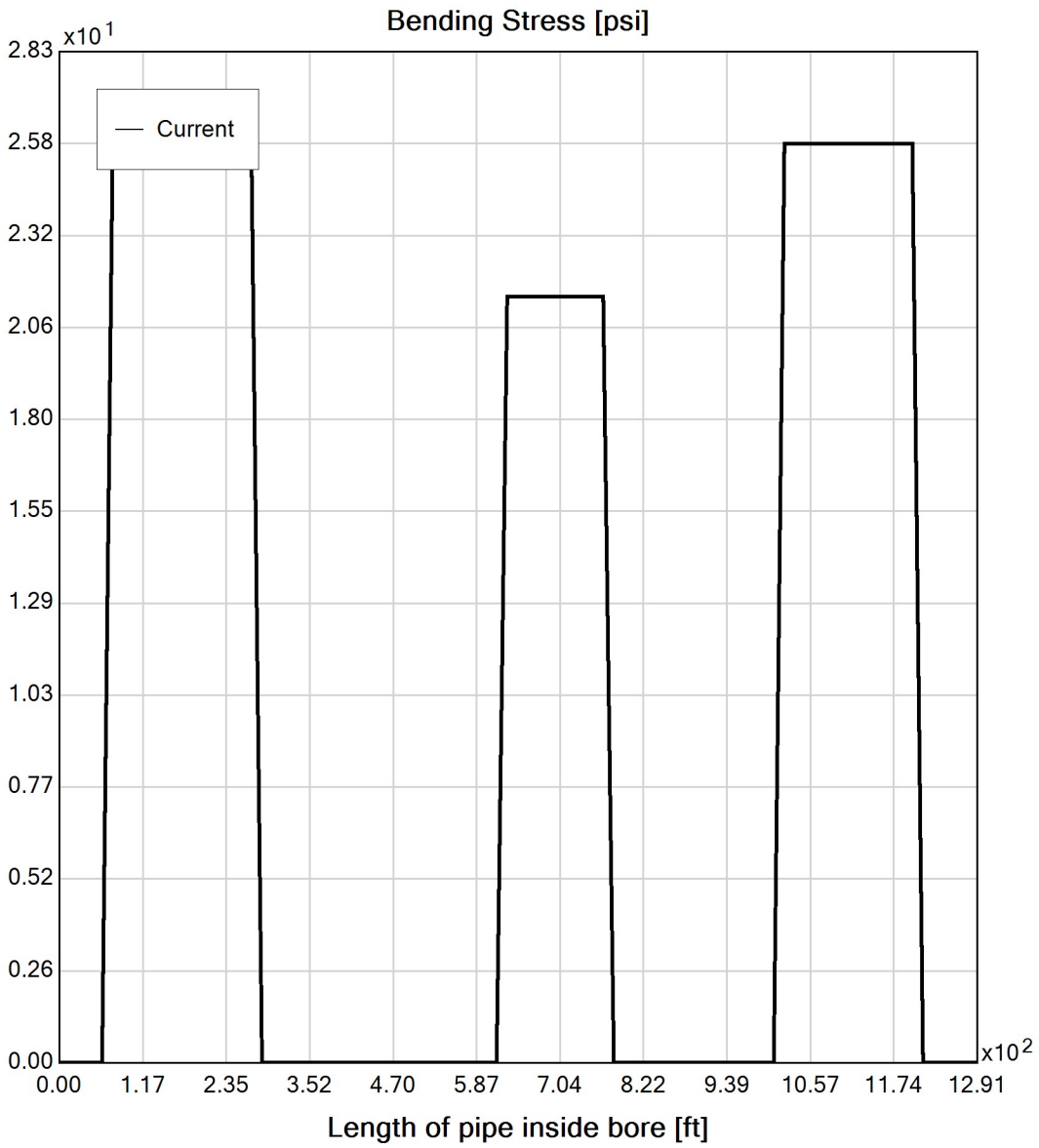
Effective Viscosity (cP): 1202.0

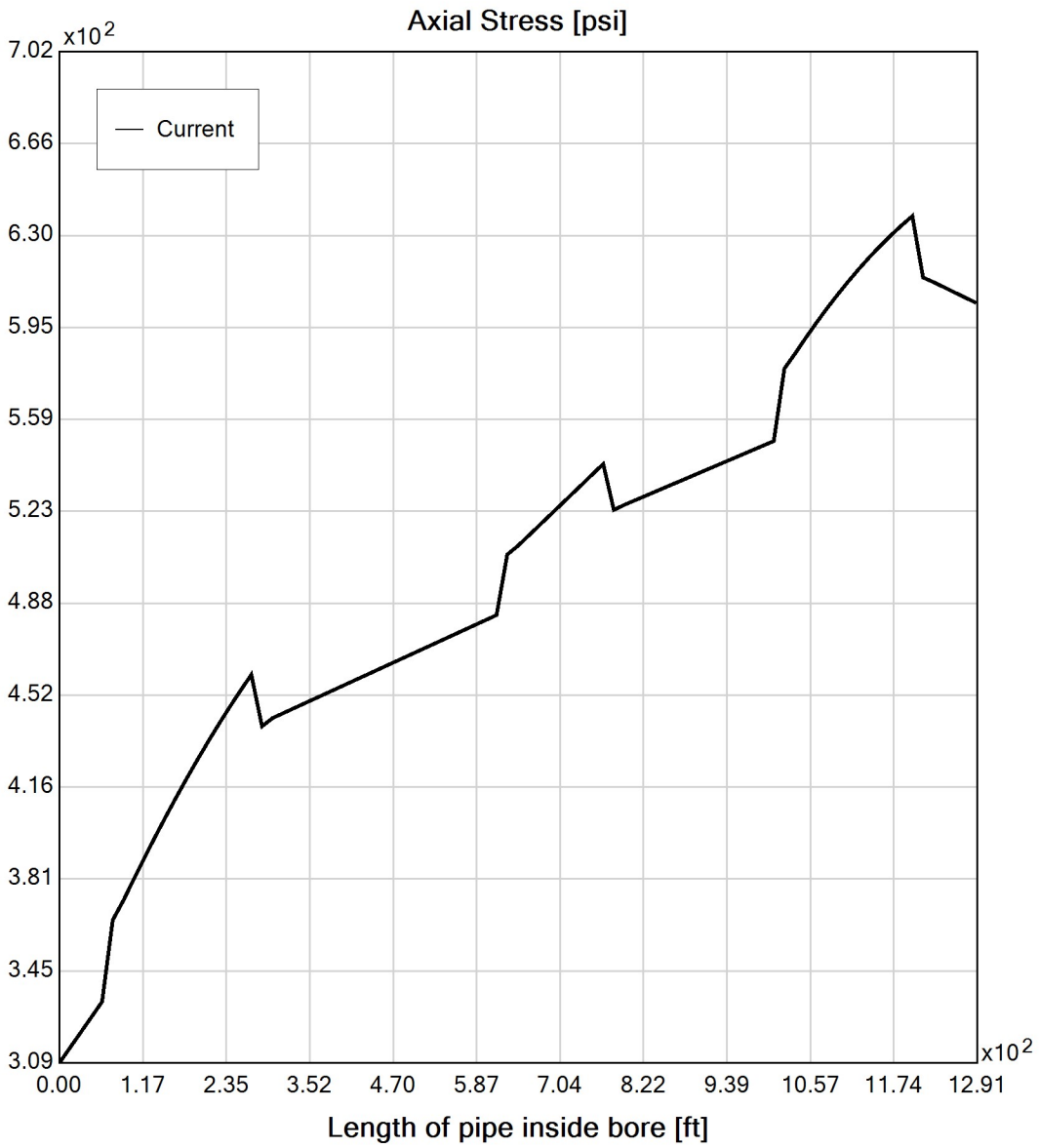
Virtual Site

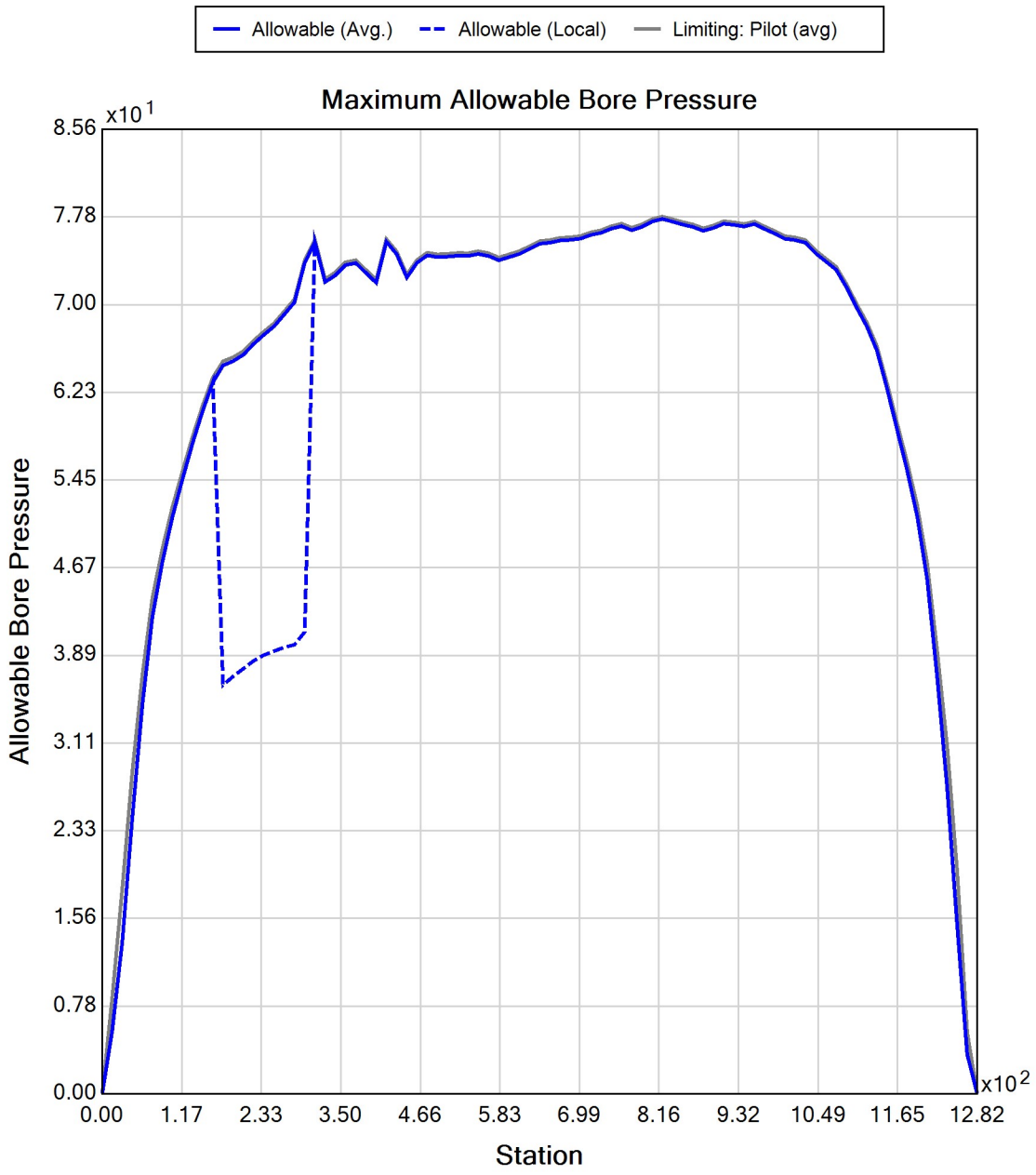


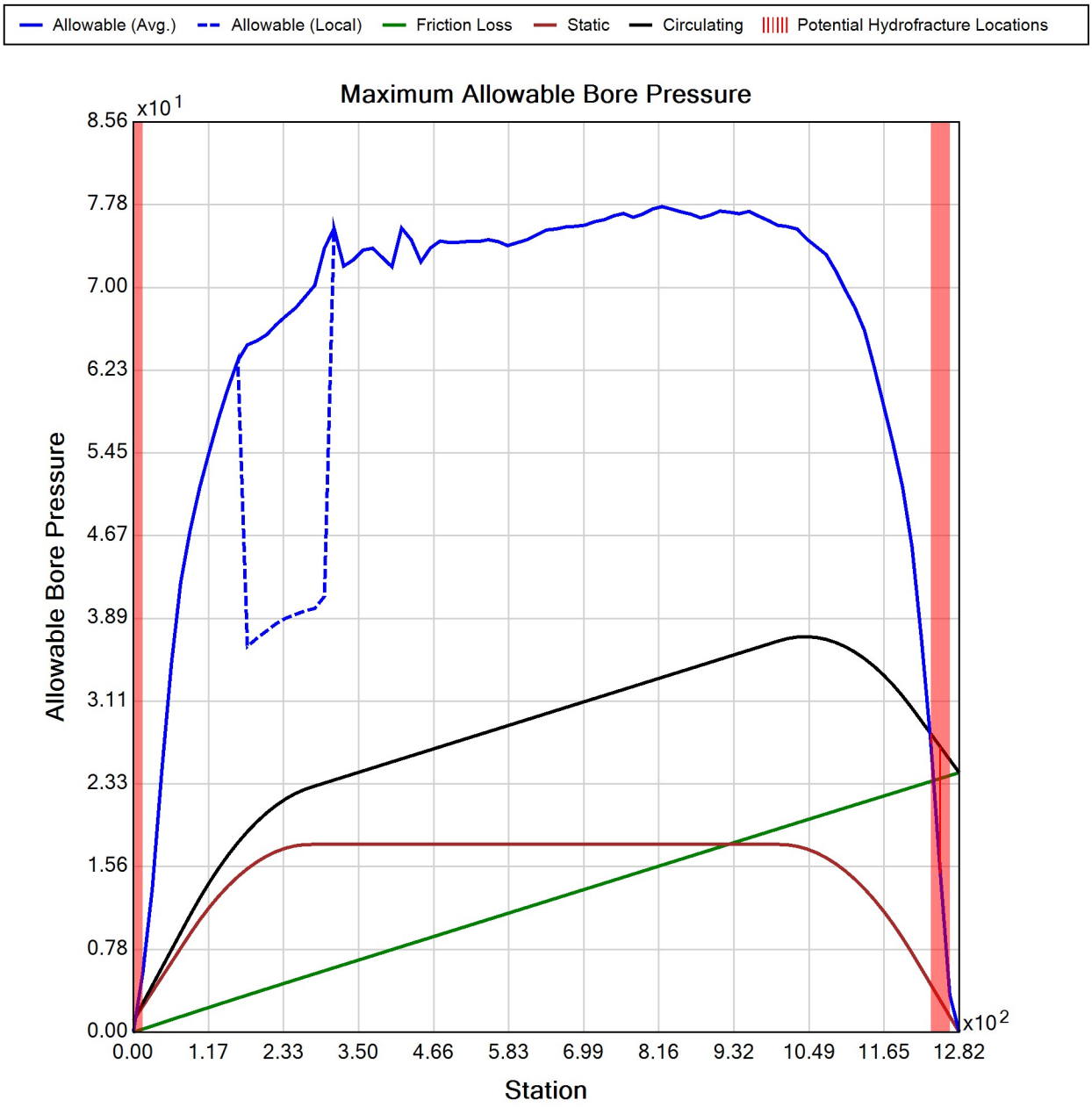












Generated Output

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Input Summary

Start Coordinate	(0.00, 0.00, 140.50) ft
End Coordinate	(1280.00, 0.00, 141.50) ft
Project Length	1280.00 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: 1290.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 0.531000018119812 ft
Silo Width: 0.531000018119812 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 59.30500 lb/ft3
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 93.64118 lb/ft3
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	1.5	18.2
Water Pressure	9.2	9.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	10.7	27.4
Deflection		
Earth Load Deflection	0.586	4.957
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.615	4.986
Compressive Stress [psi]		
Compressive Wall Stress	48.4	123.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1184.4	1184.4
Pullback Stress [psi]	676.7	676.7
Pullback Strain	1.177E-2	1.177E-2
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	676.7	680.5
Tensile Strain	1.177E-2	1.193E-2

Net External Pressure = 20.8 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.615	7.5	12.2	OK
Unconstrained Collapse [psi]	24.1	132.7	5.5	OK
Compressive Wall Stress [psi]	48.4	1150.0	23.8	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	34.1	216.4	6.4	OK
Tensile Stress [psi]	680.5	1200.0	1.8	OK

Generated Output

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Project Summary

General:	CHPE HDD 22 Conduit 2
	P3
	Start Date: 12-10-2021
	End Date: 12-10-2021
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA/BCE
Designer:	AJB
	CHA
Description:	HDD 22 10-inch DR 9 Conduit 2

Input Summary

Start Coordinate	(0.00, 0.00, 140.50) ft
End Coordinate	(1280.00, 0.00, 141.50) ft
Project Length	1280.00 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: 8

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

Soil Layer #2 USCS, Sand (S), SW
From Assistant
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #3 USCS, Gravel (G), GW
From Assistant
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

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

Soil Layer #5 USCS, Gravel (G), GW
From Assistant
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #6 USCS, Sand (S), SP
From Assistant
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

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

From Assistant

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

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

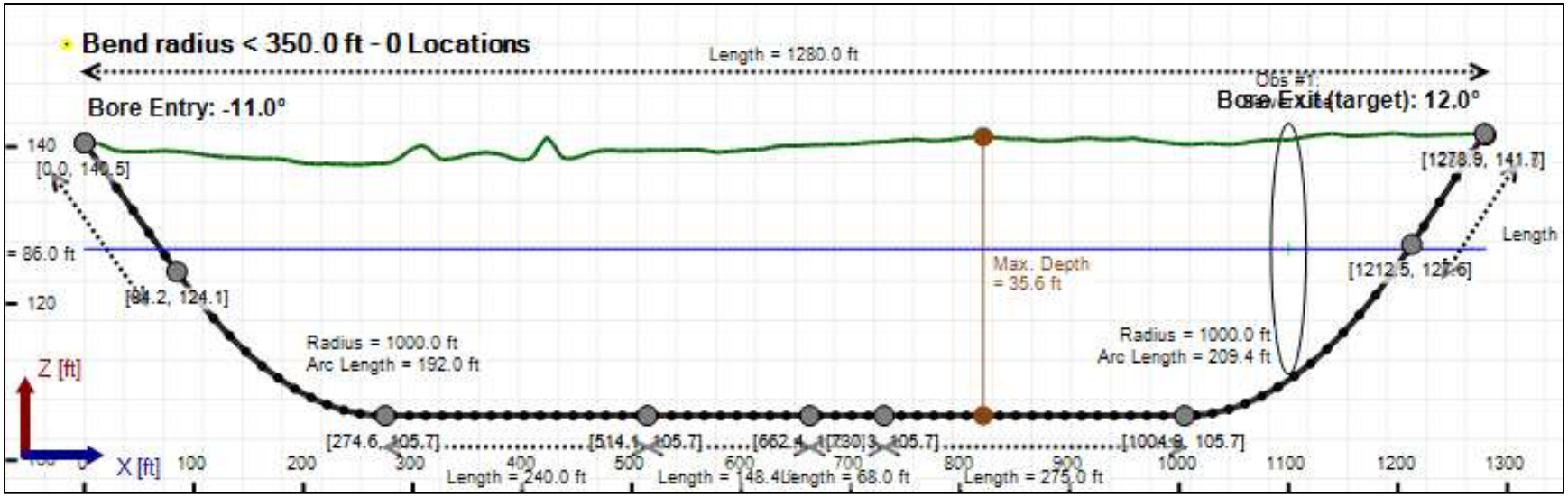
Soil Layer #8 USCS, Clay (C), CH

From Assistant

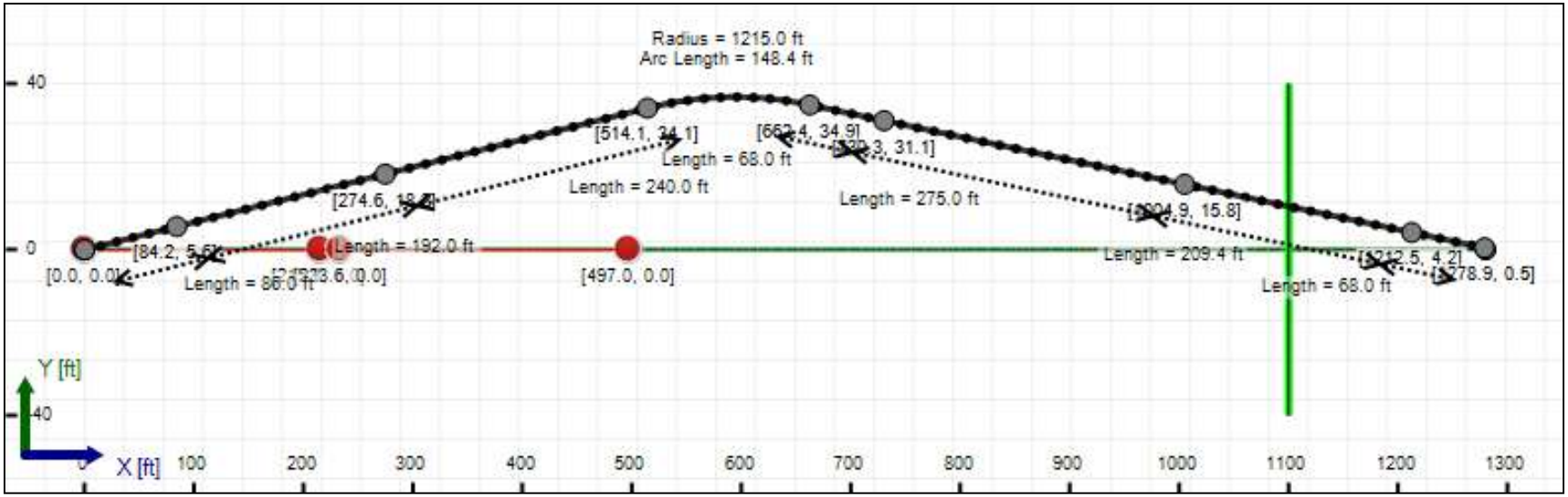
Unit Weight: 70.0000 (dry), 100.0000 (sat) [lb/ft3]

Phi: 0.00, S.M.: 145.00, Coh: 3.13 [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: 1290.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.34400002161662 ft
Silo Width: 1.34400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 59.30500 lb/ft3
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 93.64118 lb/ft3
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	3.8	18.2
Water Pressure	9.2	9.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	13.0	27.4
Deflection		
Earth Load Deflection	1.275	4.957
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	1.407	5.089
Compressive Stress [psi]		
Compressive Wall Stress	58.7	123.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	21993.8	21993.8
Pullback Stress [psi]	613.4	613.4
Pullback Strain	1.067E-2	1.067E-2
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	613.4	637.2
Tensile Strain	1.067E-2	1.153E-2

Net External Pressure = 20.5 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.407	7.5	5.3	OK
Unconstrained Collapse [psi]	23.8	124.3	5.2	OK
Compressive Wall Stress [psi]	58.7	1150.0	19.6	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	33.8	218.6	6.5	OK
Tensile Stress [psi]	637.2	1200.0	1.9	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	77.852 psi	77.852 psi
1	8.00 in	12.00 in	77.762 psi	77.762 psi
2	12.00 in	16.13 in	77.633 psi	77.633 psi

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

Estimated Circulating Pressure Summary

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

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

Drill Fluid Density: 68.700 lb/ft3

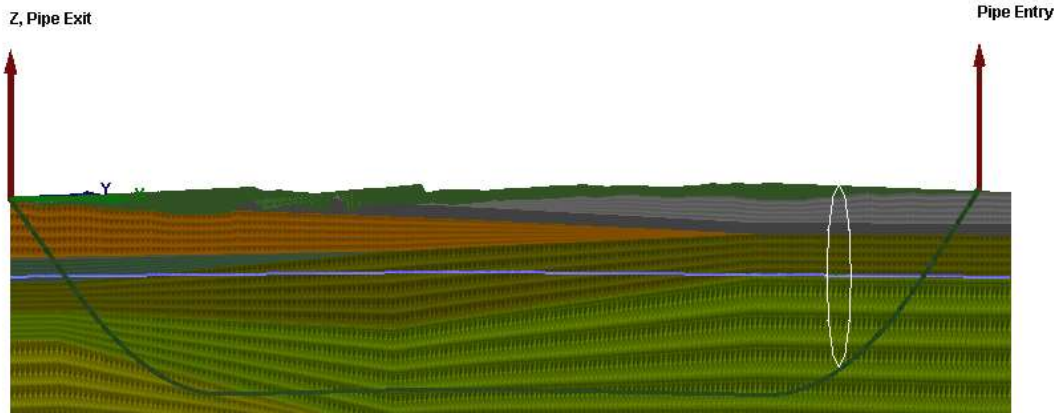
Rheological model: Bingham-Plastic

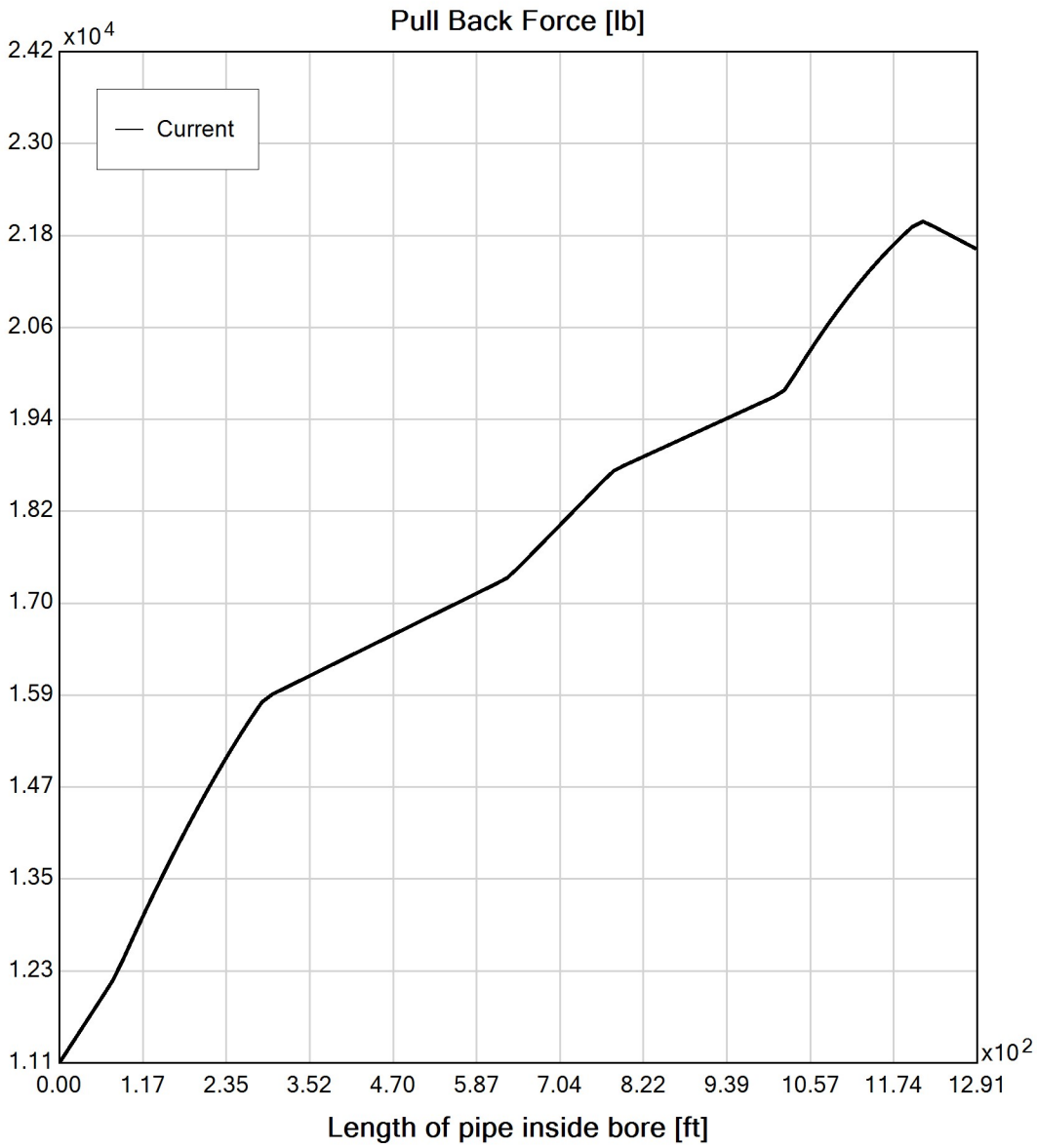
Plastic Viscosity (PV): 25.53

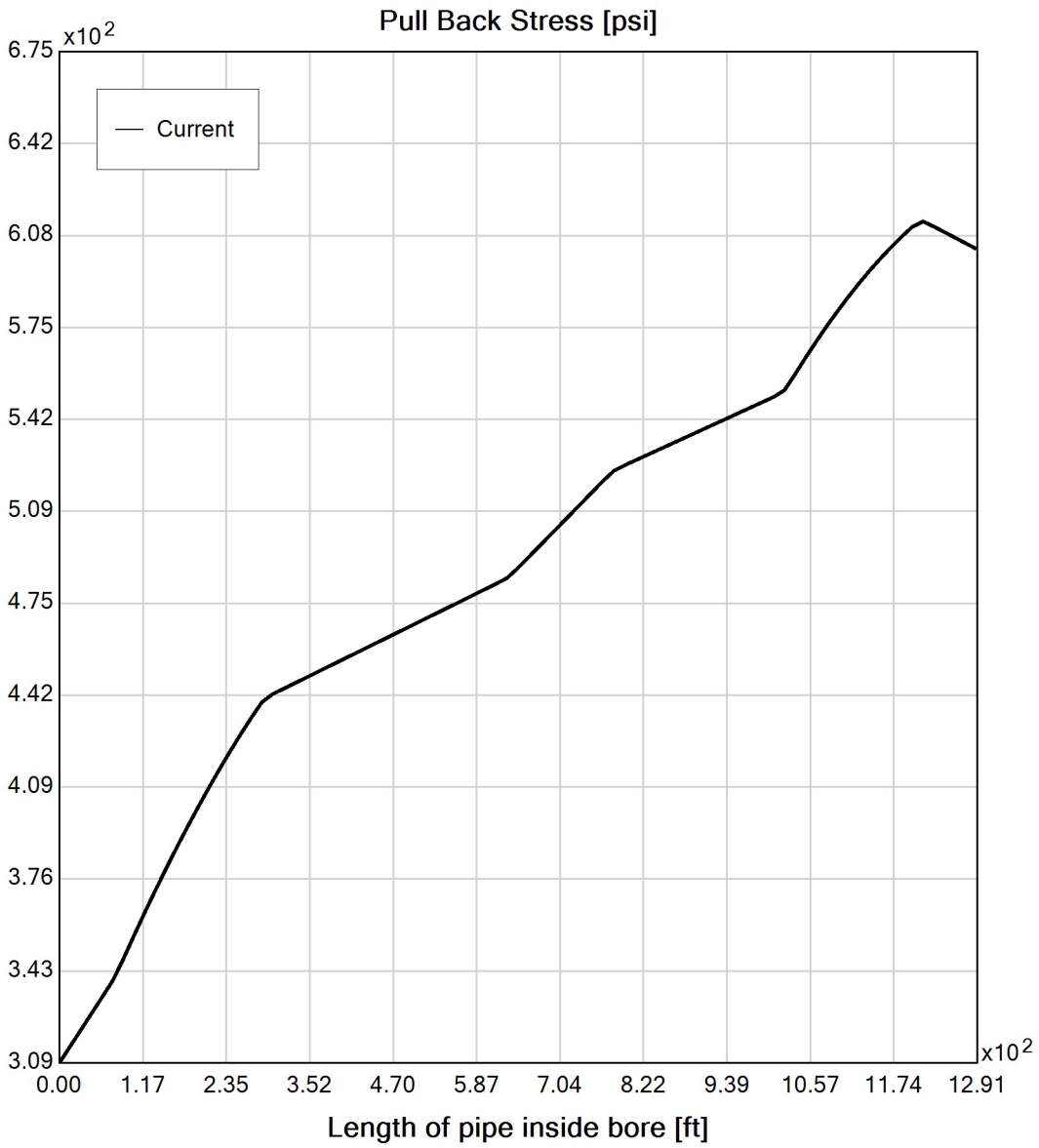
Yield Point (YP): 16.49

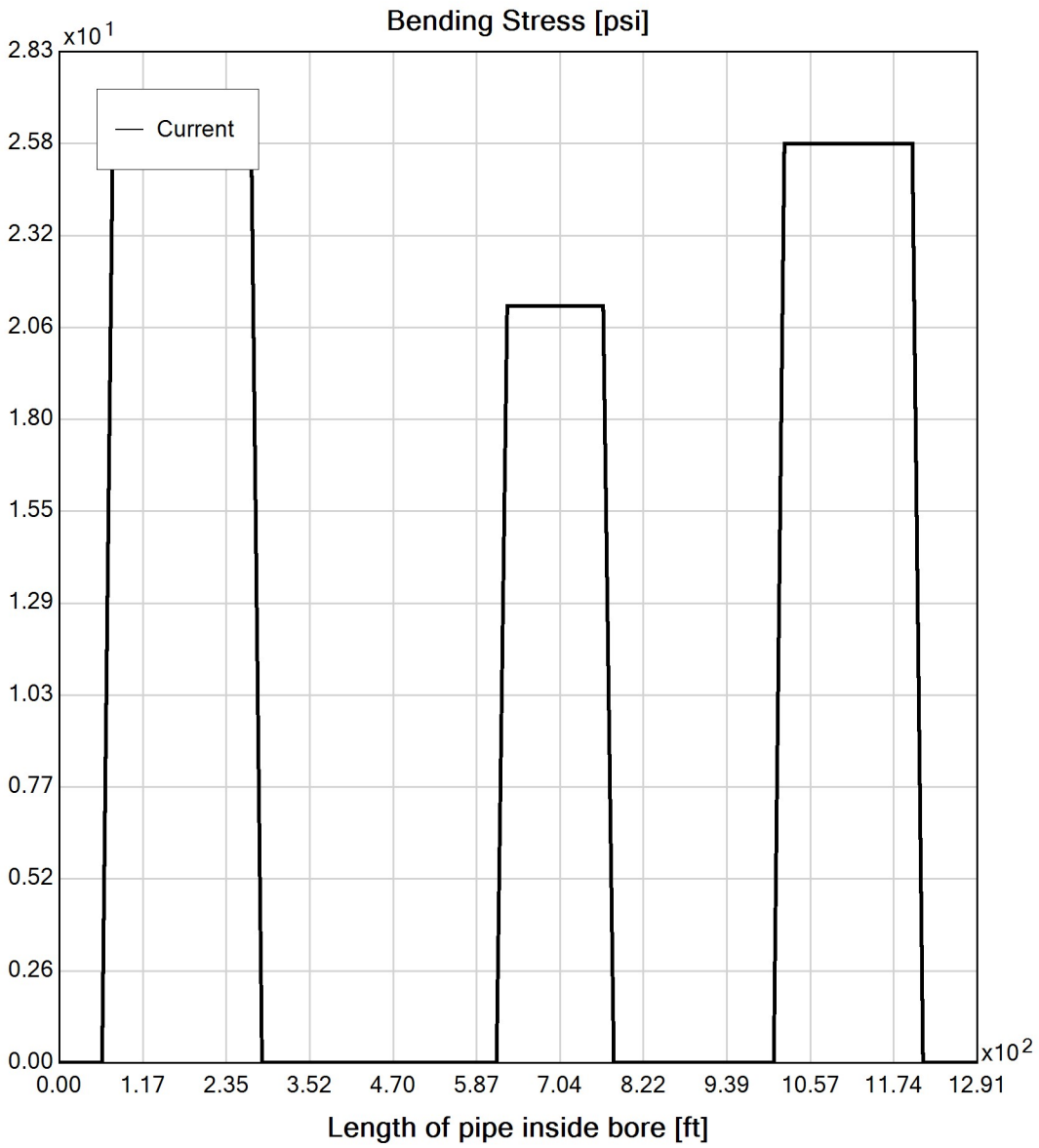
Effective Viscosity (cP): 1202.0

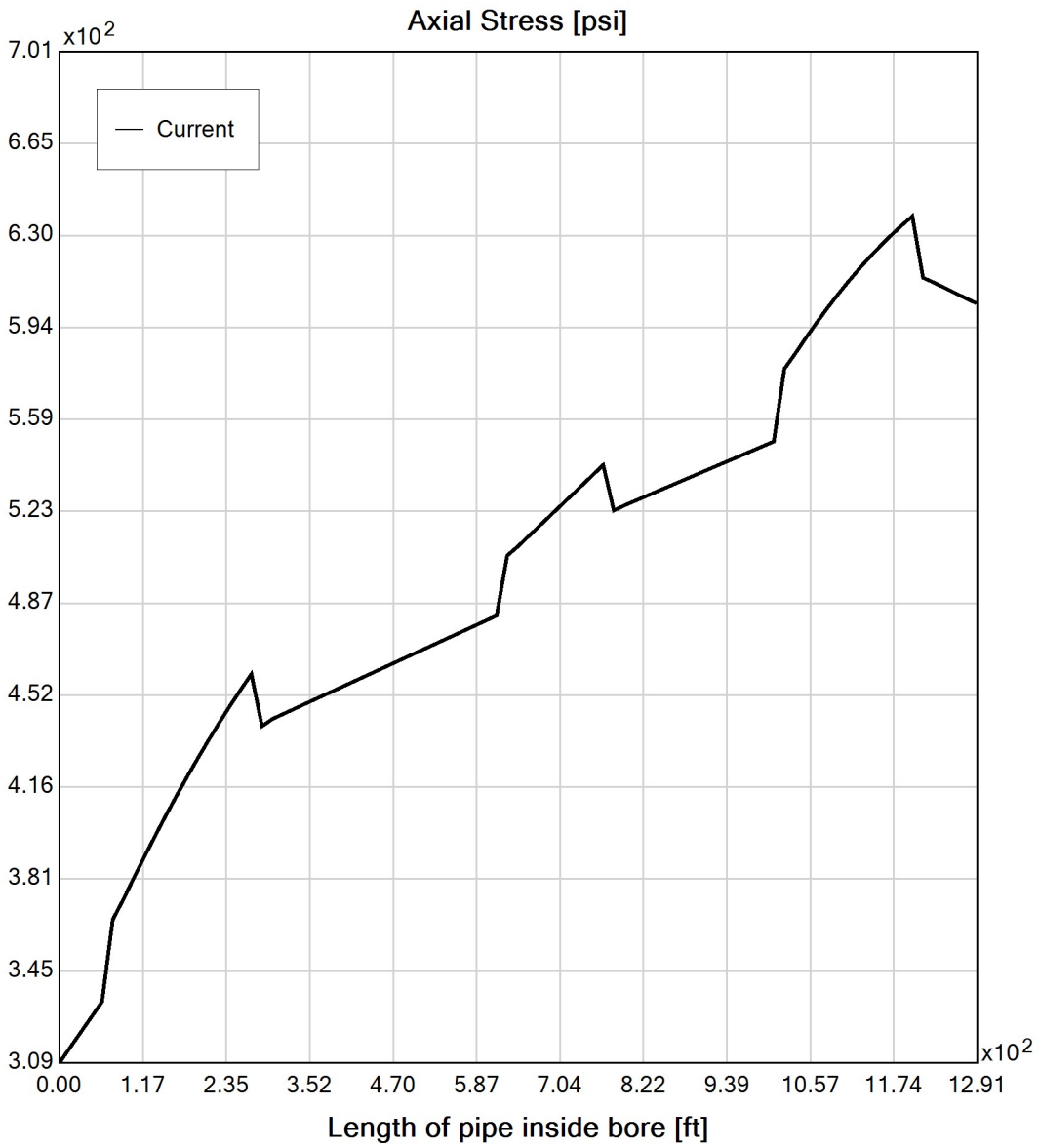
Virtual Site

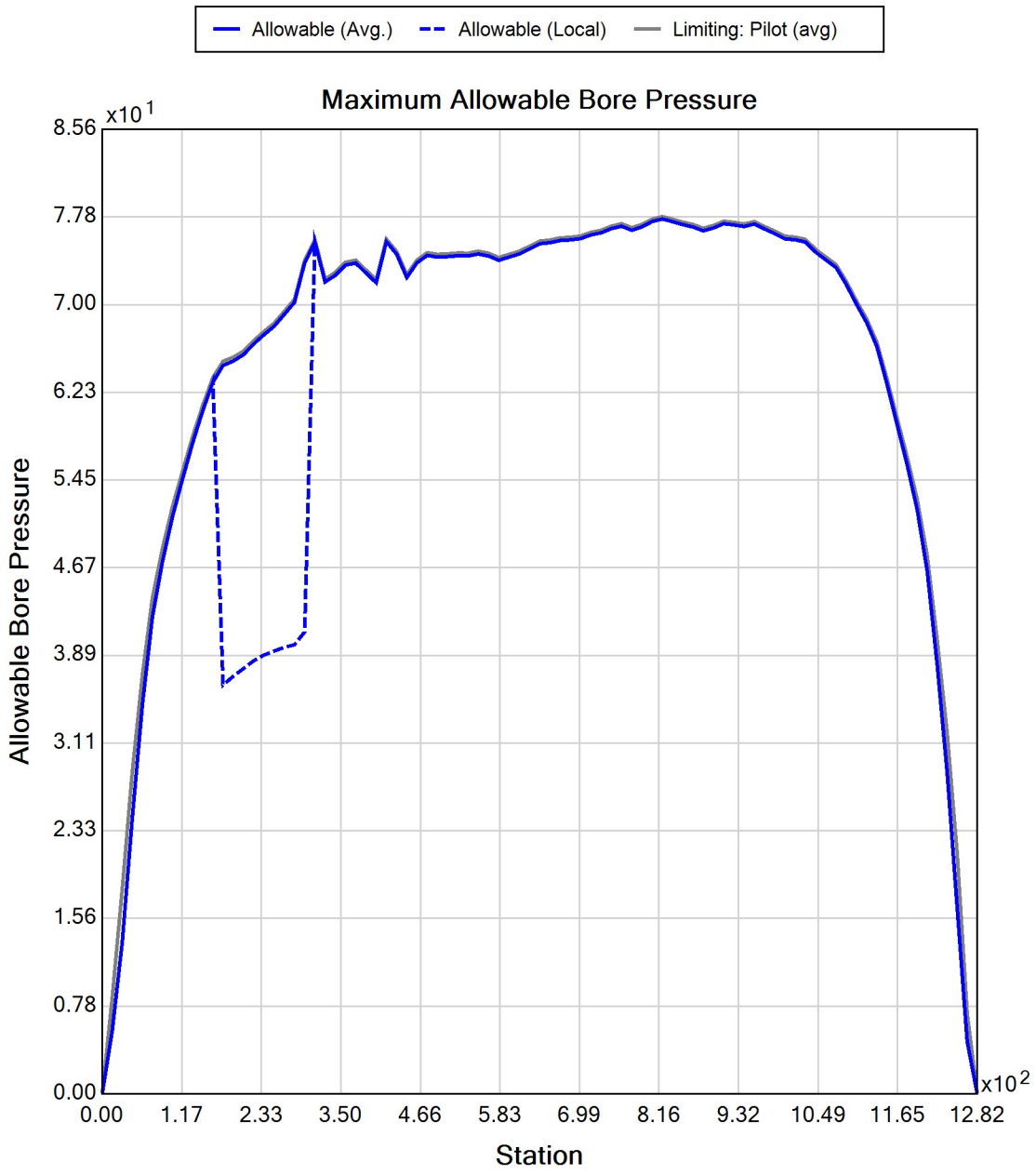


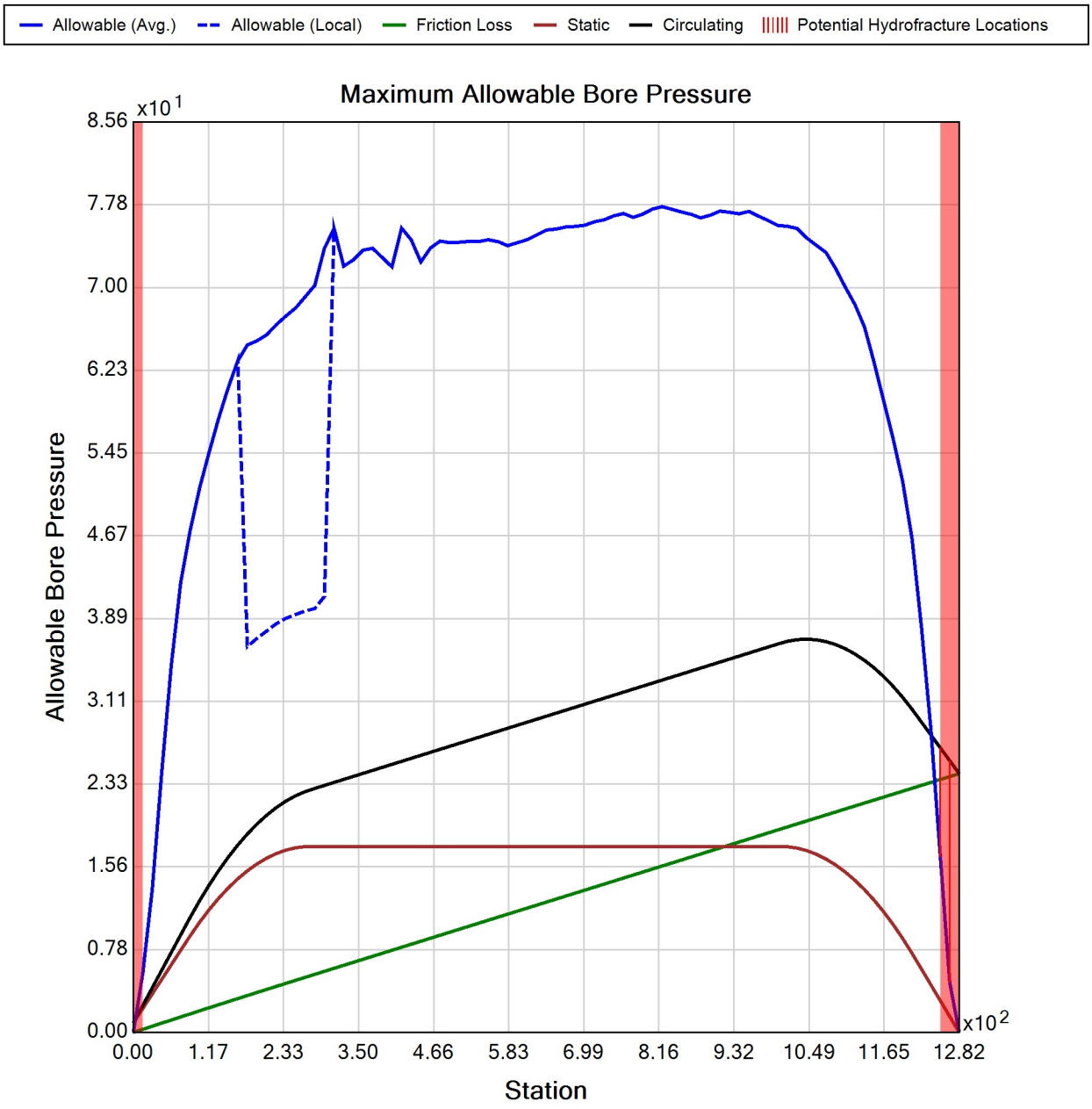












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Input Summary

Start Coordinate	(0.00, 0.00, 140.50) ft
End Coordinate	(1280.00, 0.00, 141.50) ft
Project Length	1280.00 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: 1290.00 ft
Internal Pressure: 0 psi
Borehole Diameter: 0.531000018119812 ft
Silo Width: 0.531000018119812 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 59.30500 lb/ft3
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 93.64118 lb/ft3
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	1.5	18.2
Water Pressure	9.2	9.2
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	10.7	27.4
Deflection		
Earth Load Deflection	0.582	4.957
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	0.611	4.986
Compressive Stress [psi]		
Compressive Wall Stress	48.4	123.4

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1183.1	1183.1
Pullback Stress [psi]	676.0	676.0
Pullback Strain	1.176E-2	1.176E-2
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	676.0	679.8
Tensile Strain	1.176E-2	1.192E-2

Net External Pressure = 20.5 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.611	7.5	12.3	OK
Unconstrained Collapse [psi]	23.8	132.7	5.6	OK
Compressive Wall Stress [psi]	48.4	1150.0	23.8	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	33.8	216.5	6.4	OK
Tensile Stress [psi]	679.8	1200.0	1.8	OK

Generated Output

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Project Summary

General:	CHPE Package 2 HDD 24 Draft
	J2105
	Start Date: 10-03-2022
	End Date: 10-03-2022
Project Owner:	TDI
Project Contractor:	Kiewit
Project Consultant:	CHA-BCE
Designer:	MDB
	BCE
	Amherst, MA
Description:	North to South 12" DR7 curved alignment

Input Summary

Start Coordinate	(0.00, 0.00, 135.00) ft
End Coordinate	(3320.00, 0.00, 162.00) ft
Project Length	3320.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	12.750 in
Pipe DR	7.0
Pipe Thickness	1.82 in
Rod Length	20.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 4

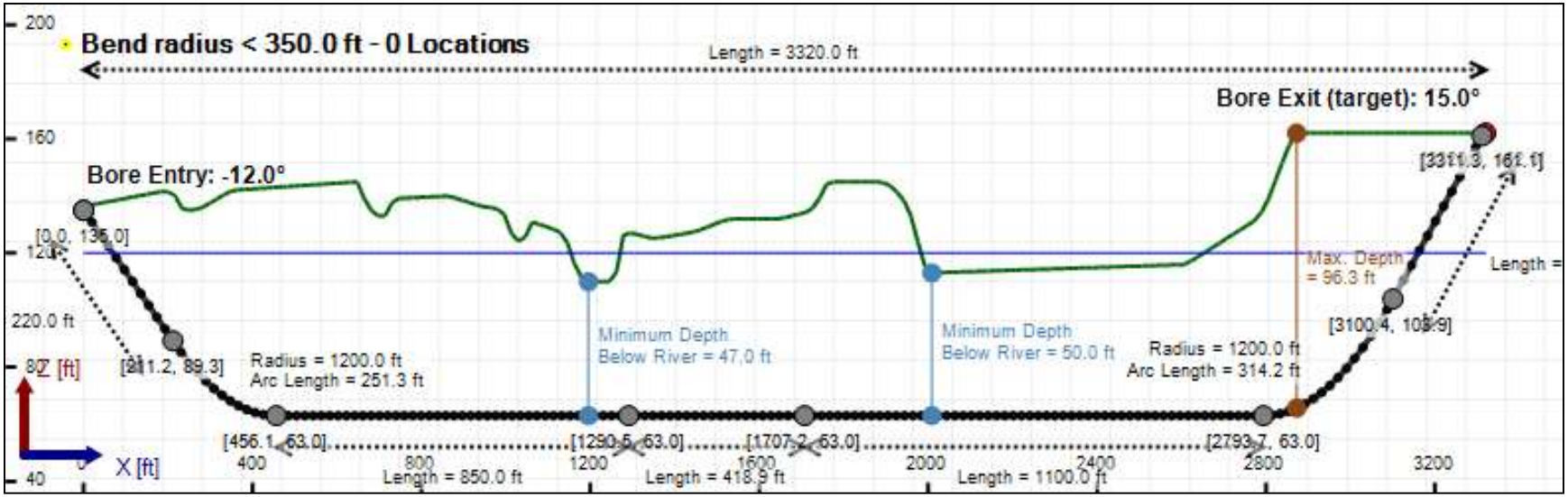
Soil Layer #1 USCS, Sand (S), SM
From Assistant
Unit Weight: 117.1584 (dry), 132.8832 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Clay (C), CL
From Assistant
Unit Weight: 70.0000 (dry), 100.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 300.00, Coh: 5.00 [psi]

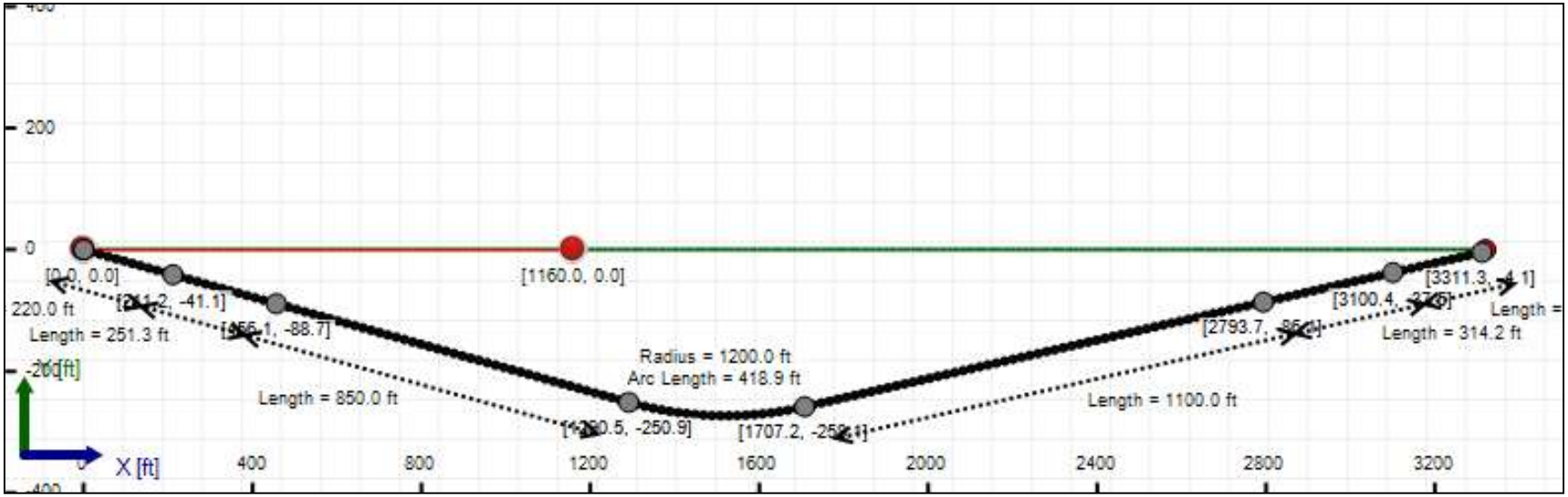
Soil Layer #3 USCS, Sand (S), SP
From Assistant
Unit Weight: 110.0000 (dry), 125.0000 (sat) [lb/ft3]
Phi: 32.00, S.M.: 250.00, Coh: 0.00 [psi]

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

Bore Cross-Section View



Bore Plan View



Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 12" (12.75")
Pipe DR: 7
Pipe Length: 3379.99 ft
Internal Pressure: 0 psi
Borehole Diameter: 1.59400002161662 ft
Silo Width: 1.59400002161662 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 59.30500 lb/ft3
Allowable Tensile Stress (Short Term): 1200 psi
Allowable Tensile Stress (Long Term): 1100 psi
Allowable Compressive Stress (Short Term): 1150 psi
Allowable Compressive Stress (Long Term): 1150 psi
Surface-pipe friction coefficient at entrance: 0.5
Surface-pipe friction coefficient in borehole: 0.3
Pipe-soil friction angle: 30
Slurry Unit Weight: 93.64118 lb/ft3
Hydrokinetic Pressure: 10 psi
Ballast Unit Weight: 62.42746 lb/ft3

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	7.4	63.5
Water Pressure	24.7	24.7
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	32.1	88.2
Deflection		
Earth Load Deflection	0.845	7.294
Buoyant Deflection	0.074	0.074
Reissner Effect	0	0
Net Deflection	0.919	7.368
Compressive Stress [psi]		
Compressive Wall Stress	112.2	308.6

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	57985.6	57985.6
Pullback Stress [psi]	927.2	927.2
Pullback Strain	1.613E-2	1.613E-2
Bending Stress [psi]	0.0	25.5
Bending Strain	0	4.427E-4
Tensile Stress [psi]	927.2	943.6
Tensile Strain	1.613E-2	1.685E-2

Net External Pressure = 31.5 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 798.4 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.919	7.5	8.2	OK
Unconstrained Collapse [psi]	64.6	301.5	4.7	OK
Compressive Wall Stress [psi]	112.2	1150.0	10.3	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.036	7.5	207.6	OK
Unconstrained Collapse [psi]	31.5	451.0	14.3	OK
Tensile Stress [psi]	943.6	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	8.00 in	1303.855 psi	1380.179 psi
1	8.00 in	12.00 in	1303.692 psi	1380.123 psi
2	12.00 in	16.13 in	1303.455 psi	1380.041 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): 0.00 US (liquid) gallon/min

Drill Fluid Density: 68.700 lb/ft3

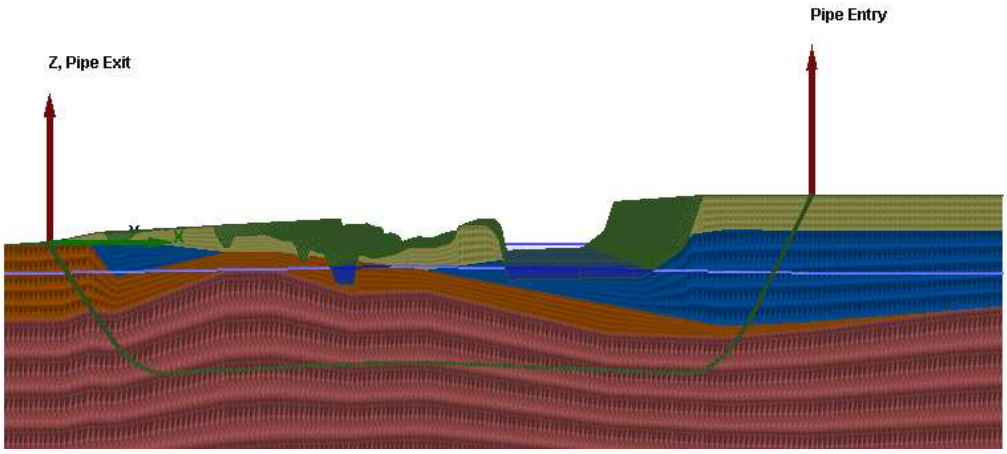
Rheological model: Bingham-Plastic

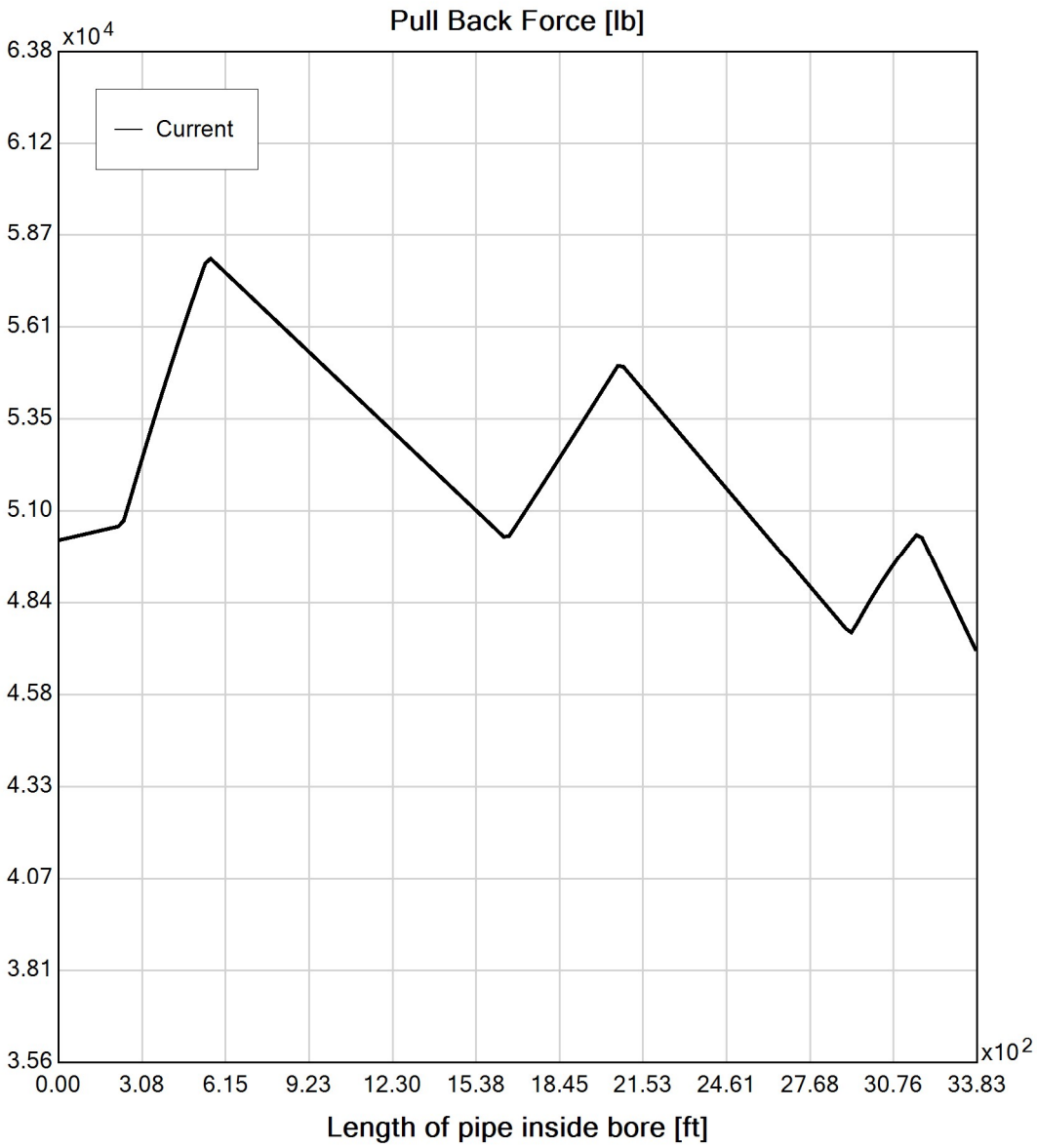
Plastic Viscosity (PV): 25.53

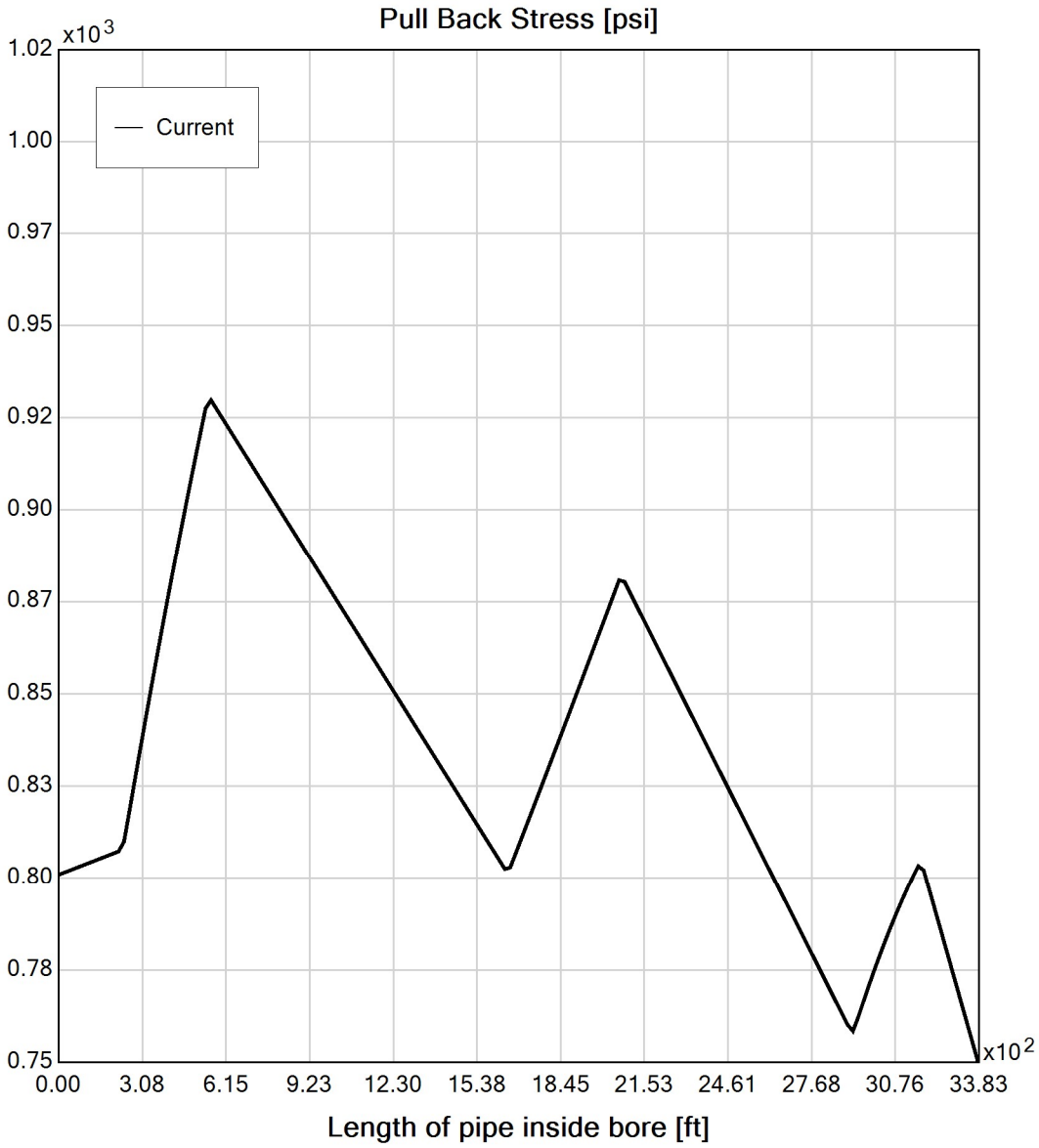
Yield Point (YP): 16.49

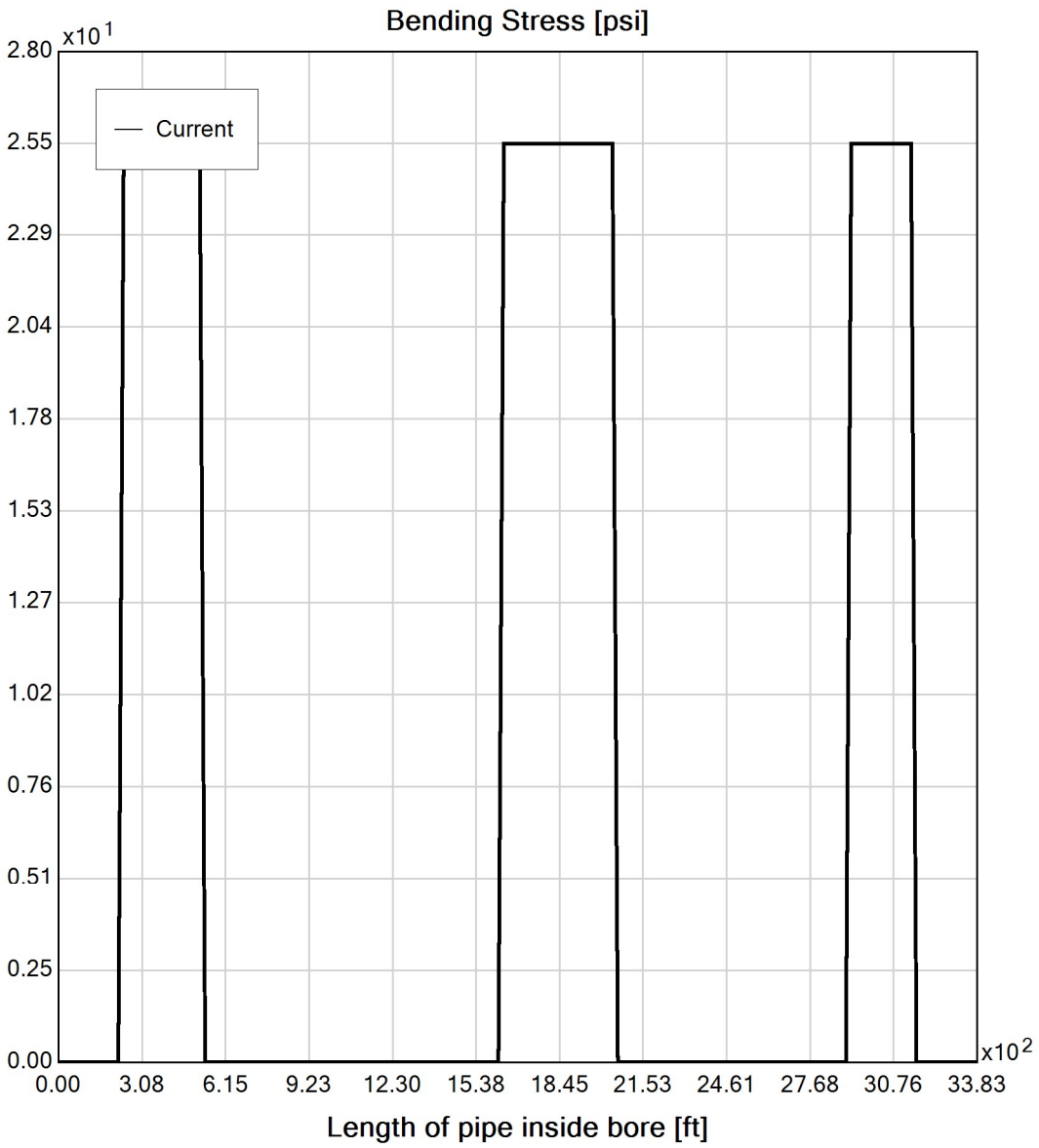
Effective Viscosity (cP): Infinity

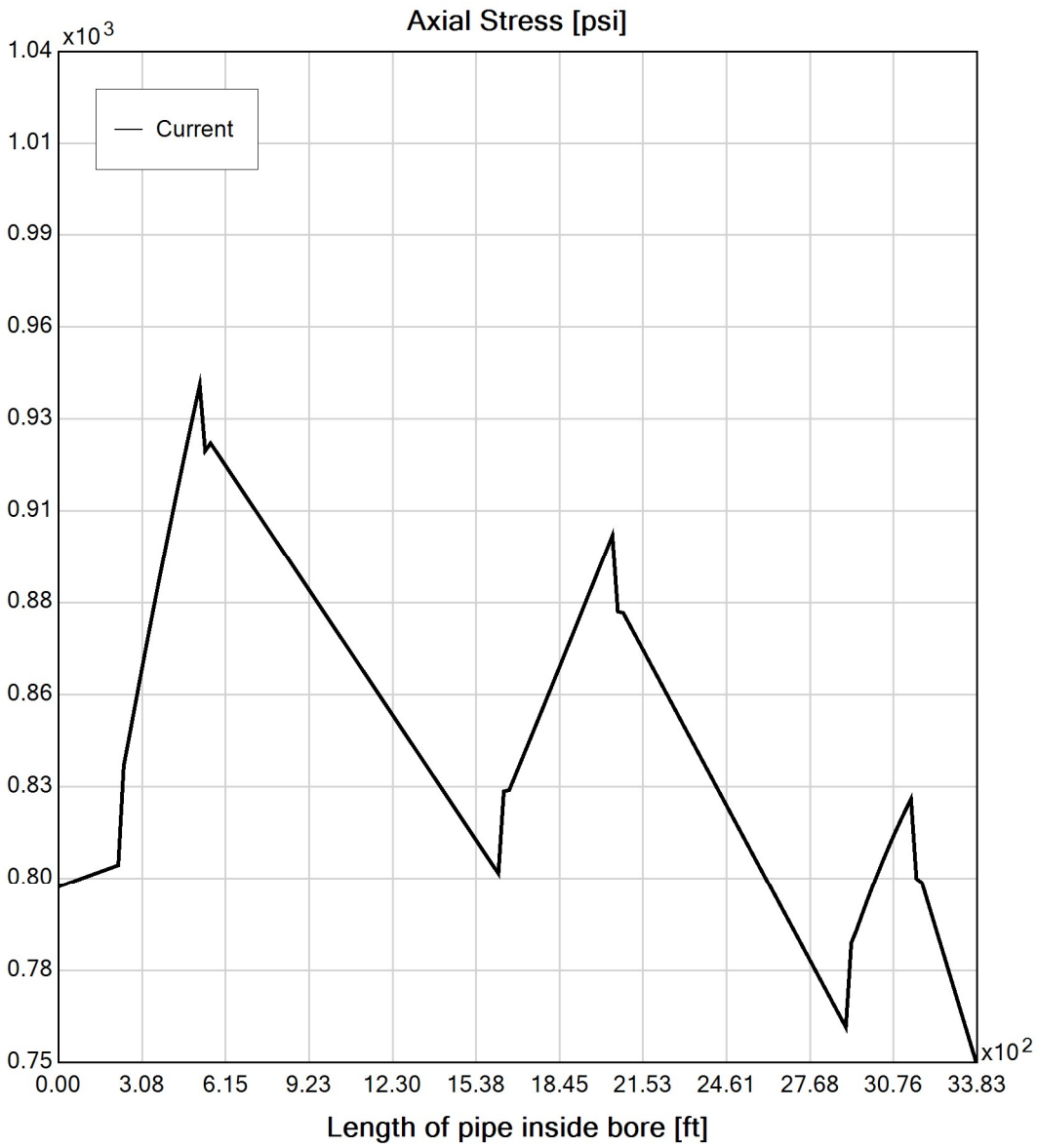
Virtual Site

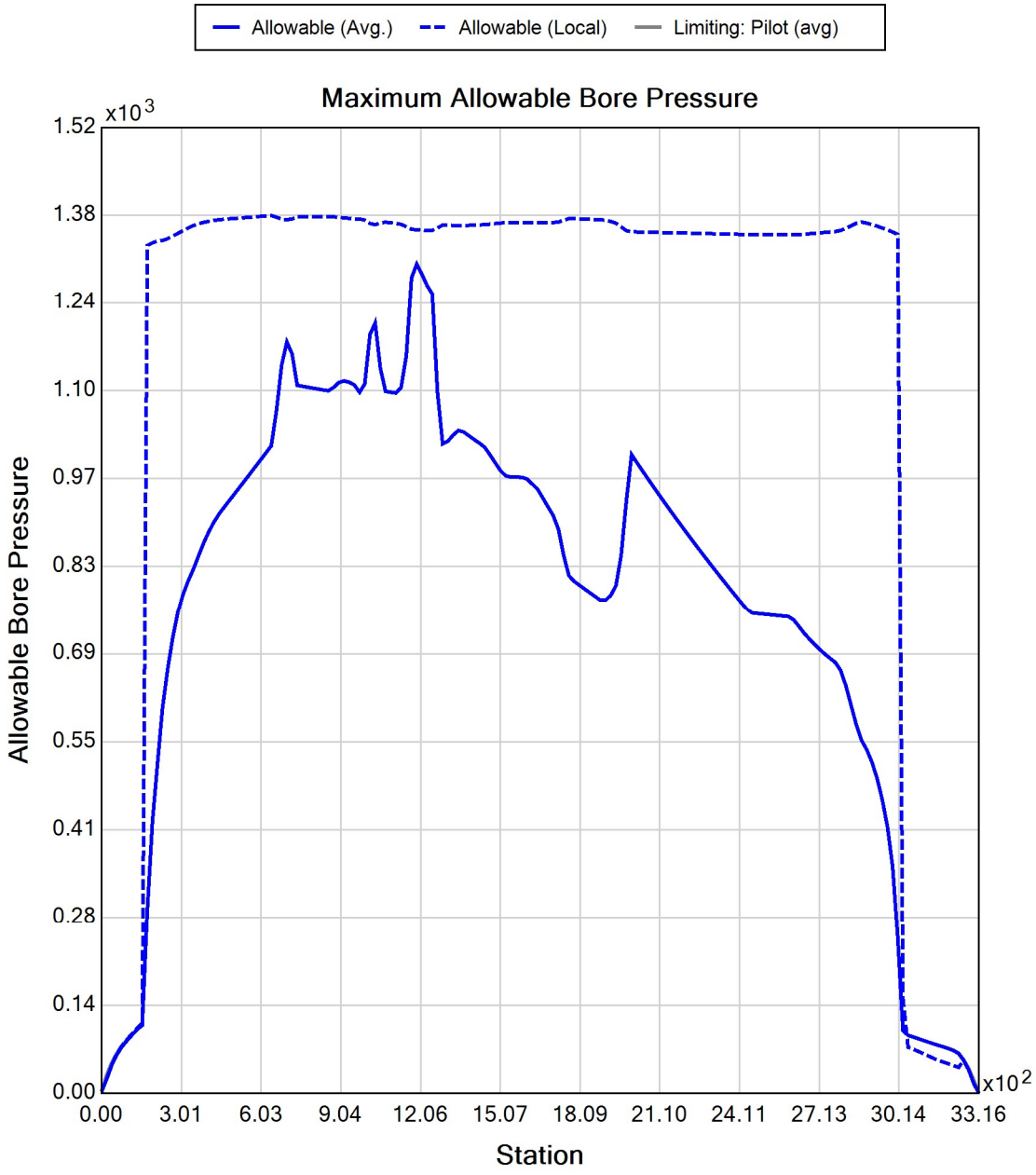


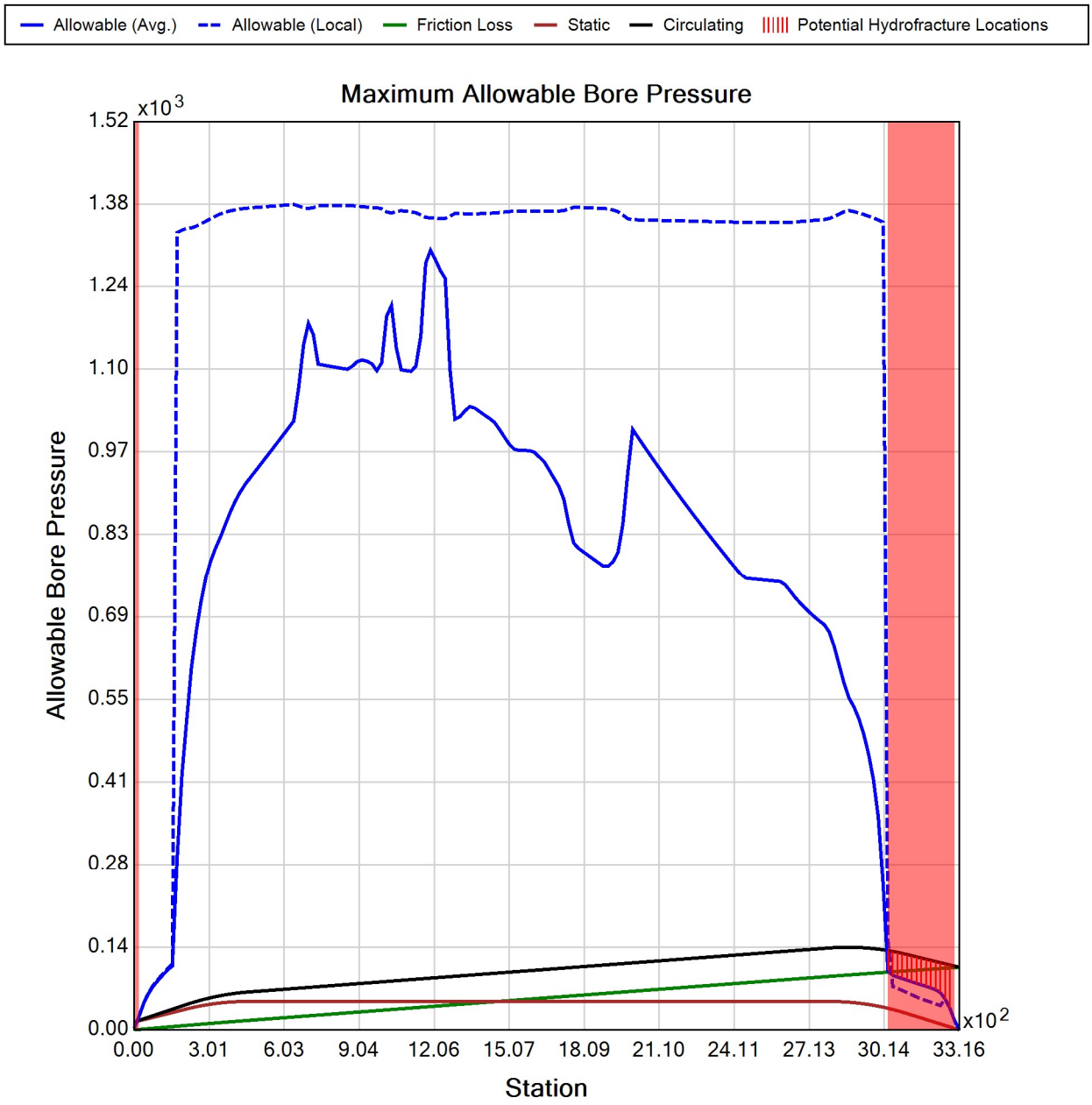












Generated Output

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Input Summary

Start Coordinate	(0.00, 0.00, 135.00) ft
End Coordinate	(3320.00, 0.00, 162.00) ft
Project Length	3320.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	3.500 in
Pipe DR	7.0
Pipe Thickness	0.50 in
Rod Length	20.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

Pipe Application: Electrical Cable
Pipe Type: HDPE
Classification: IPS
Pipe OD: 3" (3.5")
Pipe DR: 7
Pipe Length: 3379.99 ft
Internal Pressure: 0 psi
Borehole Diameter: 0.625 ft
Silo Width: 0.625 ft
Surface Surcharge: 0 psi
Short Term Modulus: 57500 psi
Long Term Modulus: 28200 psi
Short Term Poisson Ratio: 0.35
Long Term Poisson Ratio: 0.45
Pipe Unit Weight: 59.30500 lb/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	2.9	63.5
Water Pressure	24.7	24.7
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	27.6	88.2
Deflection		
Earth Load Deflection	0.332	7.294
Buoyant Deflection	0.020	0.020
Reissner Effect	0	0
Net Deflection	0.352	7.315
Compressive Stress [psi]		
Compressive Wall Stress	96.5	308.6

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	4482.2	4482.2
Pullback Stress [psi]	951.1	951.1
Pullback Strain	1.654E-2	1.654E-2
Bending Stress [psi]	0.0	7.0
Bending Strain	0	1.215E-4
Tensile Stress [psi]	951.1	951.1
Tensile Strain	1.654E-2	1.663E-2

Net External Pressure = 31.5 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 172.8 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.352	7.5	21.3	OK
Unconstrained Collapse [psi]	64.6	317.2	4.9	OK
Compressive Wall Stress [psi]	96.5	1150.0	11.9	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.010	7.5	756.1	OK
Unconstrained Collapse [psi]	31.5	450.6	14.3	OK
Tensile Stress [psi]	951.1	1200.0	1.3	OK

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Project Summary

General:	CHPE HDD 24A Conduit 1 P3 Start Date: 12-10-2021 End Date: 12-10-2021
Project Owner:	TDI
Project Contractor:	Kiewit
Designer:	AJB CHA
Description:	HDD 25 10-inch DR 9 Conduit 1

Input Summary

Start Coordinate	(130.00, 0.00, 157.20) ft
End Coordinate	(1014.10, 0.00, 158.20) ft
Project Length	884.10 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 6

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

Soil Layer #2 USCS, Gravel (G), GC
From Assistant
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

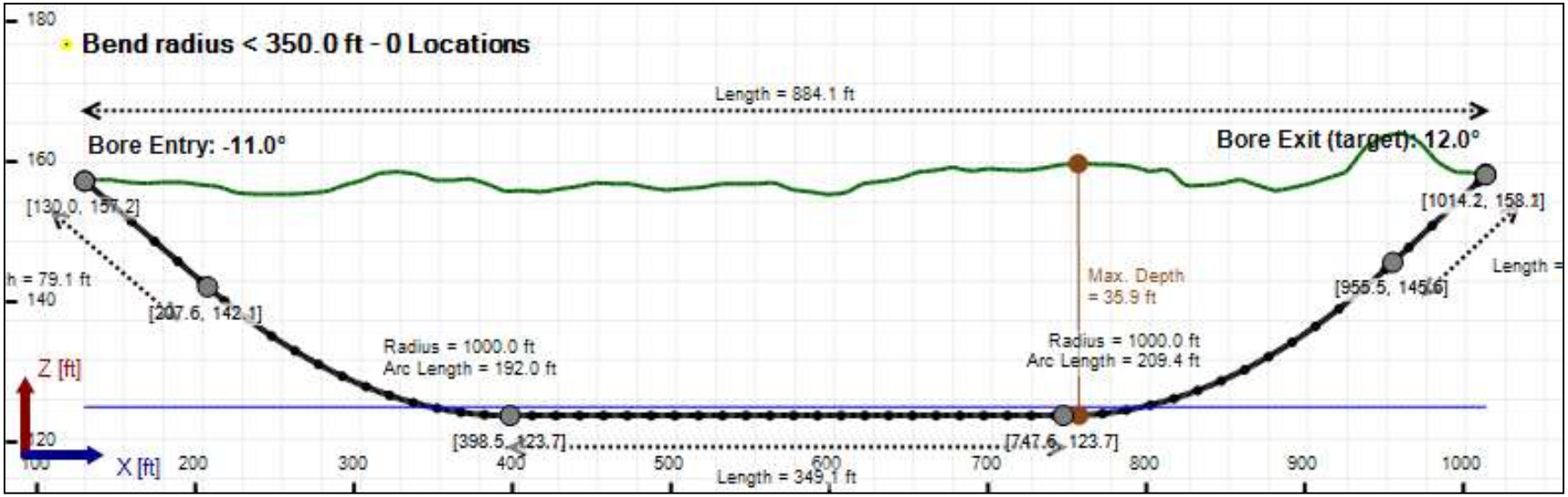
Soil Layer #3 USCS, Sand (S), SP
From Assistant
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #4 USCS, Clay (C), CL
From Assistant
Unit Weight: 70.0000 (dry), 100.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 3.13 [psi]

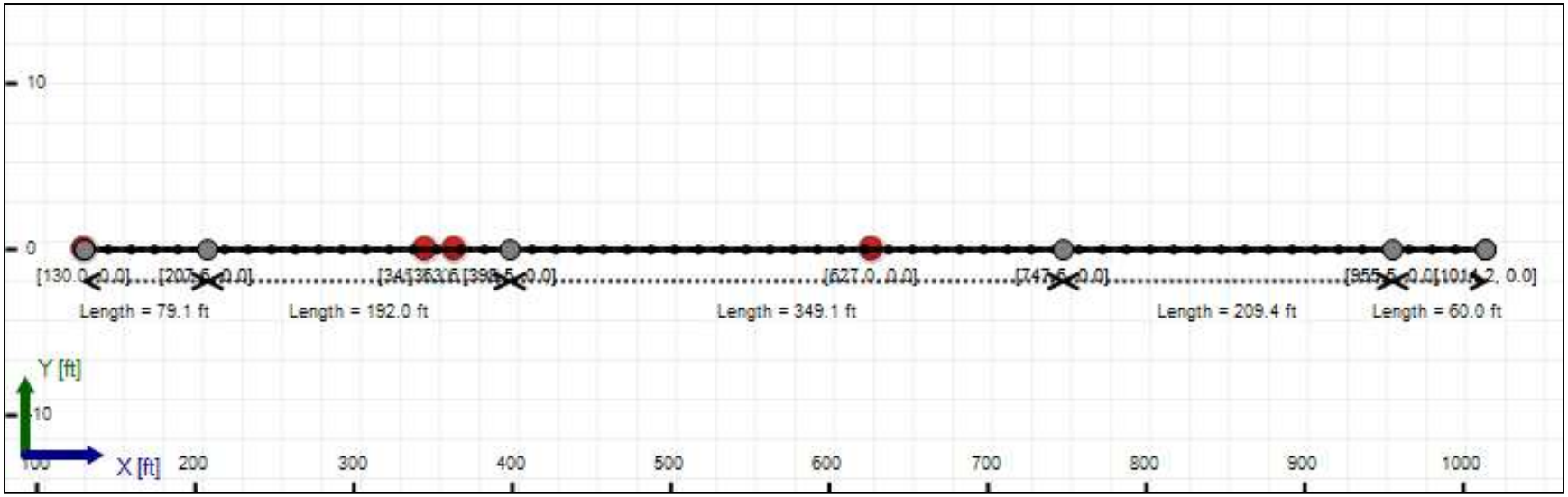
Soil Layer #5 USCS, Gravel (G), GW
From Assistant
Unit Weight: 120.0000 (dry), 140.0000 (sat) [lb/ft3]
Phi: 37.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #6 Rock, Geological Classification, Sedimentary Rocks
From Assistant
Unit Weight: 160.0000 (dry), 170.0000 (sat) [lb/ft3]
Phi: 37.00, S.M.: 1450.40, 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: 900.00 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	7.7	20.5
Water Pressure	0.5	0.5
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	8.2	21.1
Deflection		
Earth Load Deflection	2.092	5.590
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	2.224	5.722
Compressive Stress [psi]		
Compressive Wall Stress	37.0	94.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	15318.0	15318.0
Pullback Stress [psi]	427.2	427.2
Pullback Strain	7.430E-3	7.430E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	427.2	451.2
Tensile Strain	7.430E-3	8.295E-3

Net External Pressure = 21.3 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.224	7.5	3.4	OK
Unconstrained Collapse [psi]	23.7	113.1	4.8	OK
Compressive Wall Stress [psi]	37.0	1150.0	31.0	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	33.7	230.4	6.8	OK
Tensile Stress [psi]	451.2	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	56.951 psi	56.951 psi
1	8.00 in	12.00 in	56.614 psi	56.614 psi
2	12.00 in	16.13 in	56.140 psi	56.140 psi

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

Estimated Circulating Pressure Summary

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

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

Drill Fluid Density: 68.700 lb/ft3

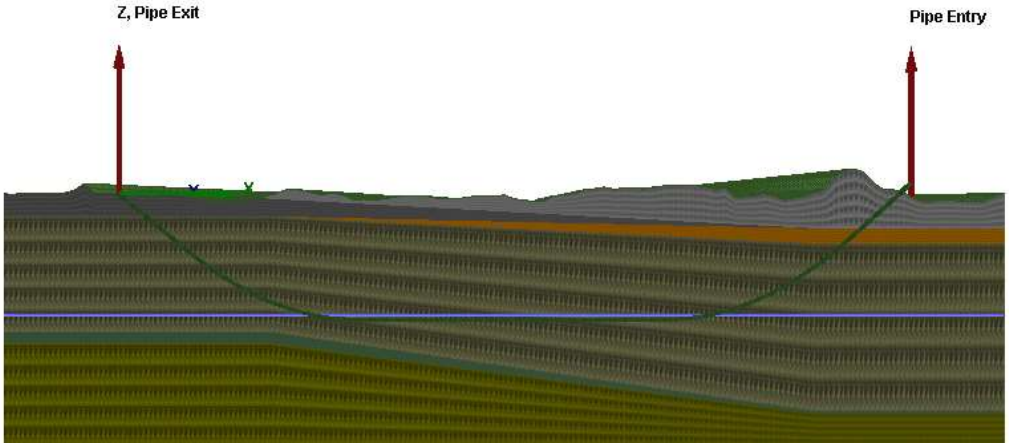
Rheological model: Bingham-Plastic

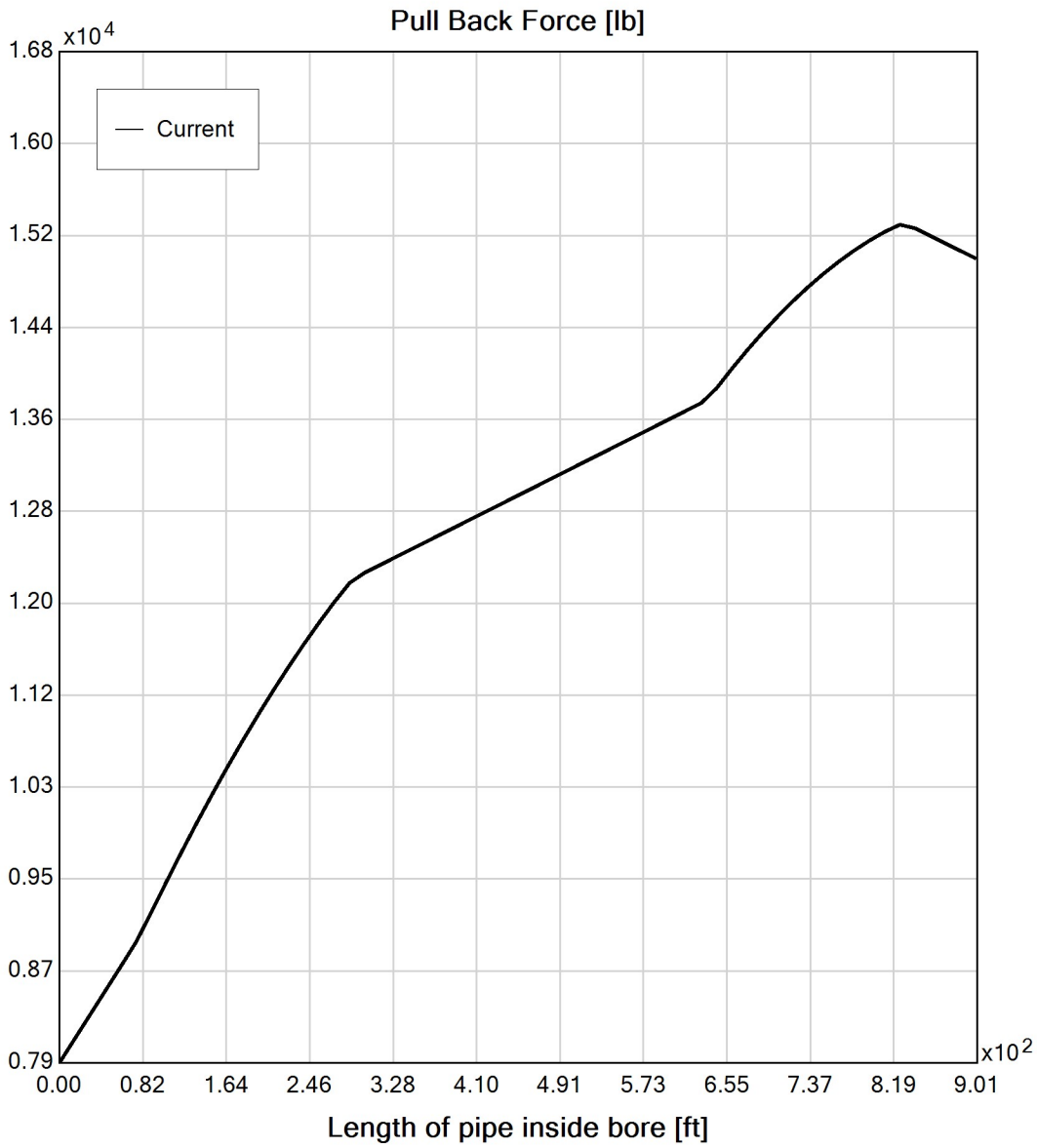
Plastic Viscosity (PV): 25.53

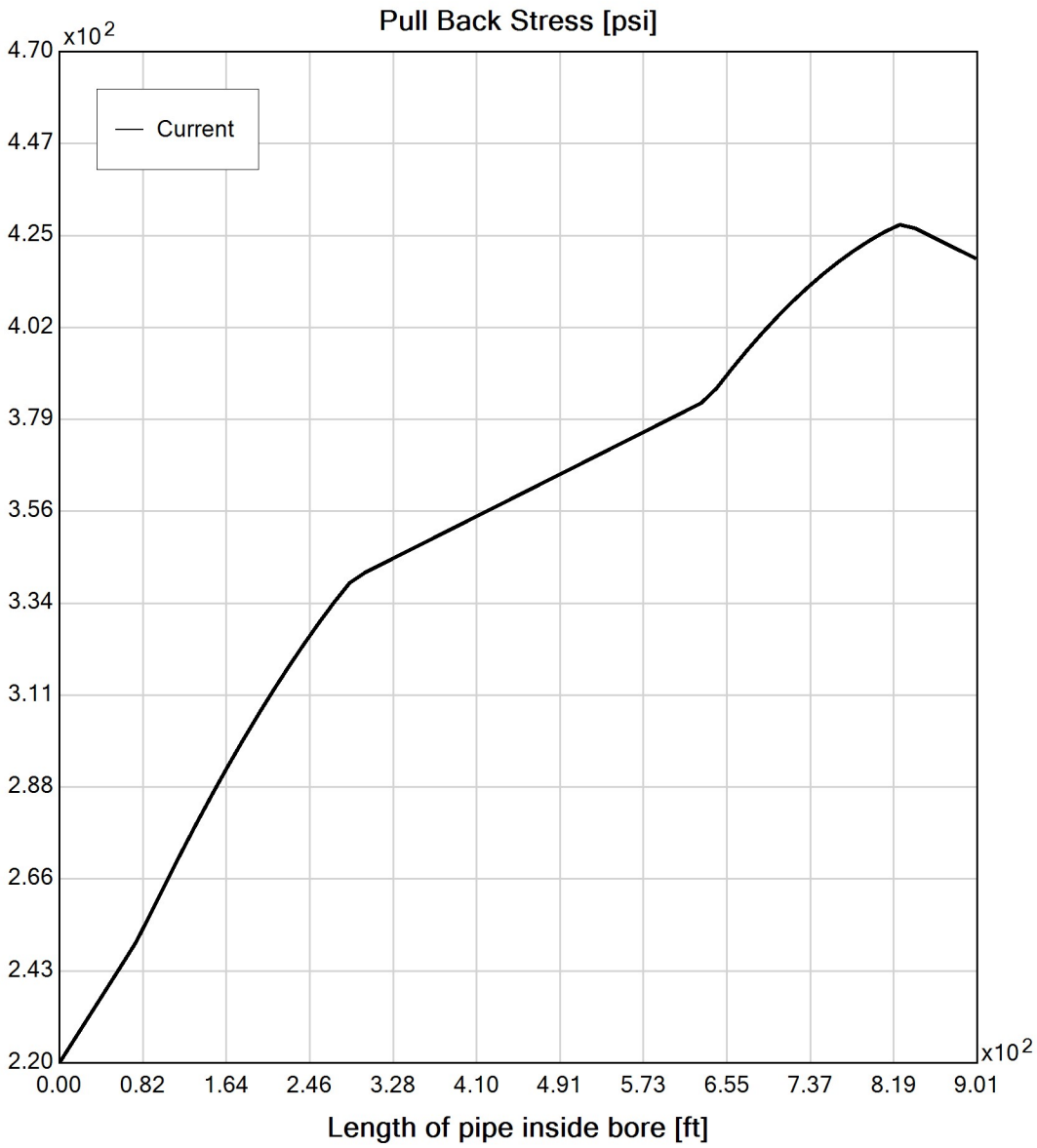
Yield Point (YP): 16.49

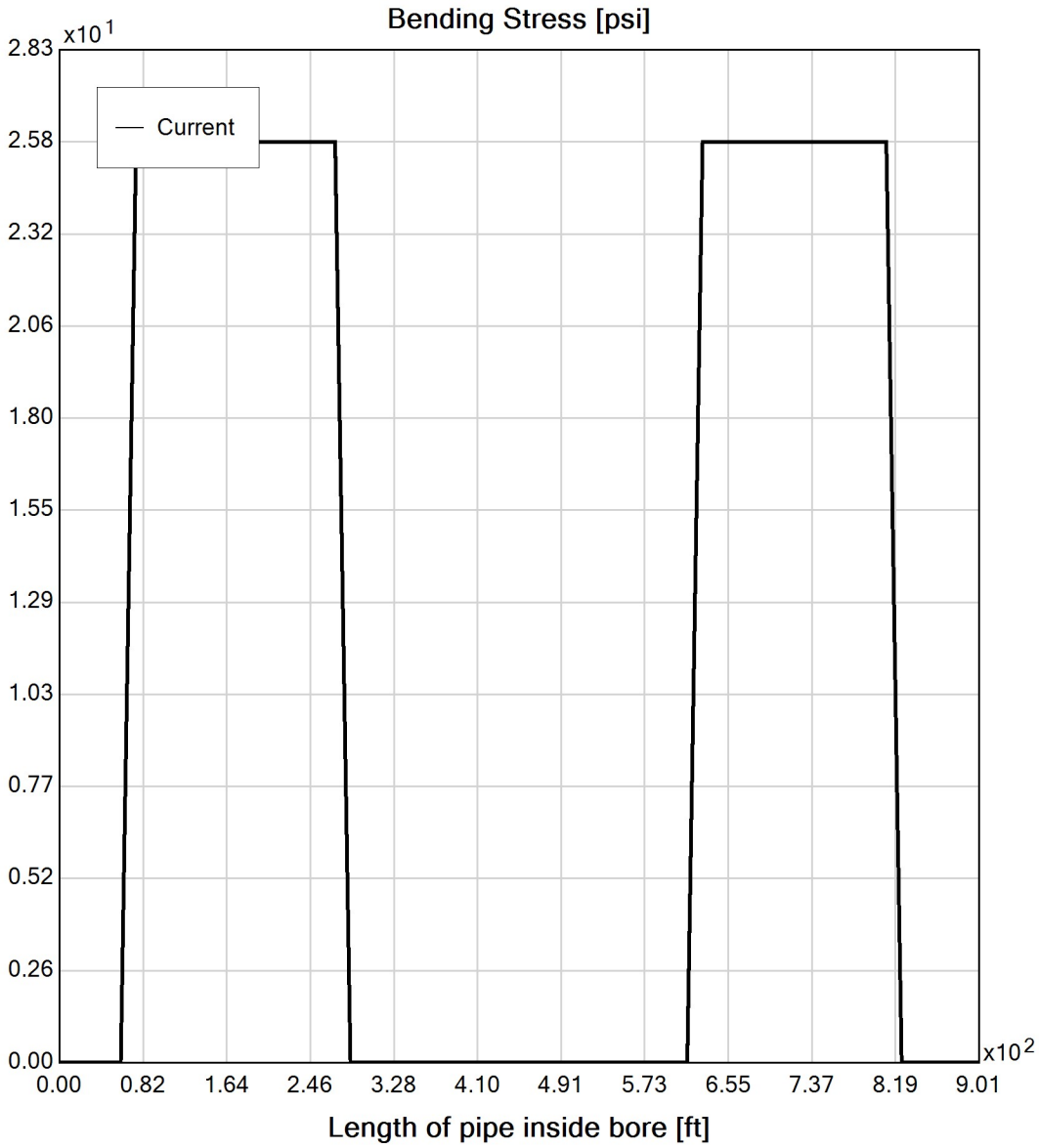
Effective Viscosity (cP): 1202.0

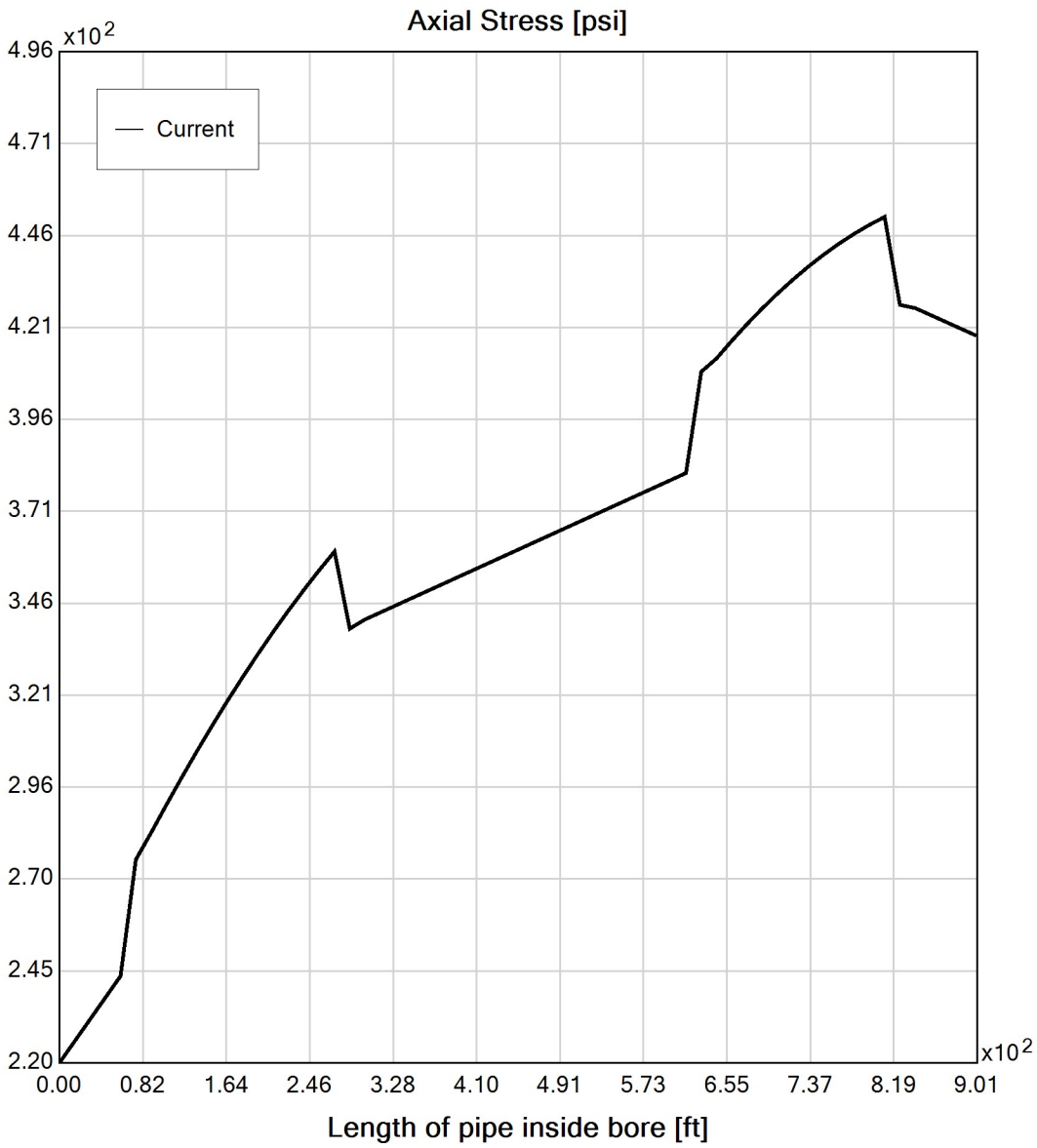
Virtual Site

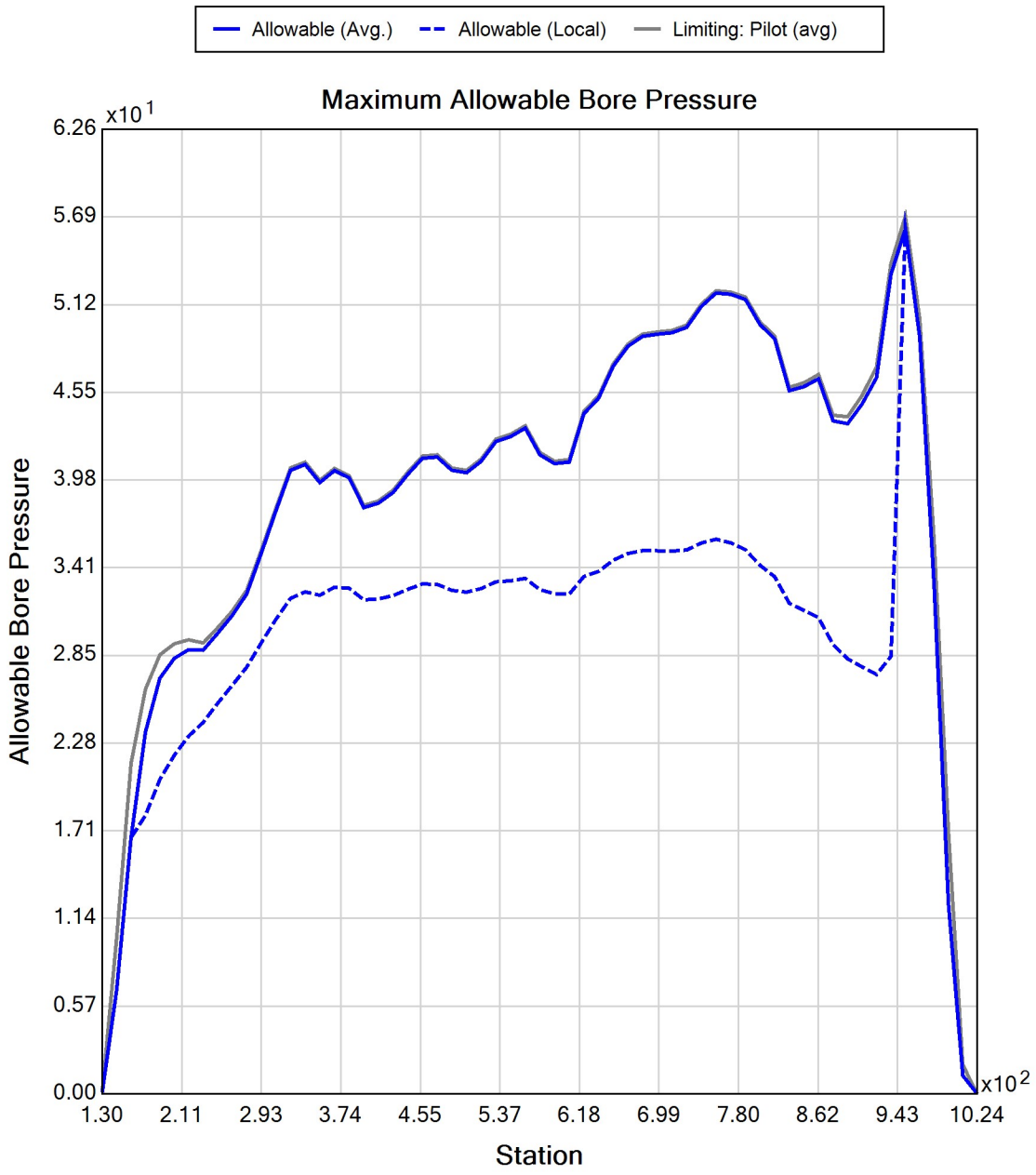


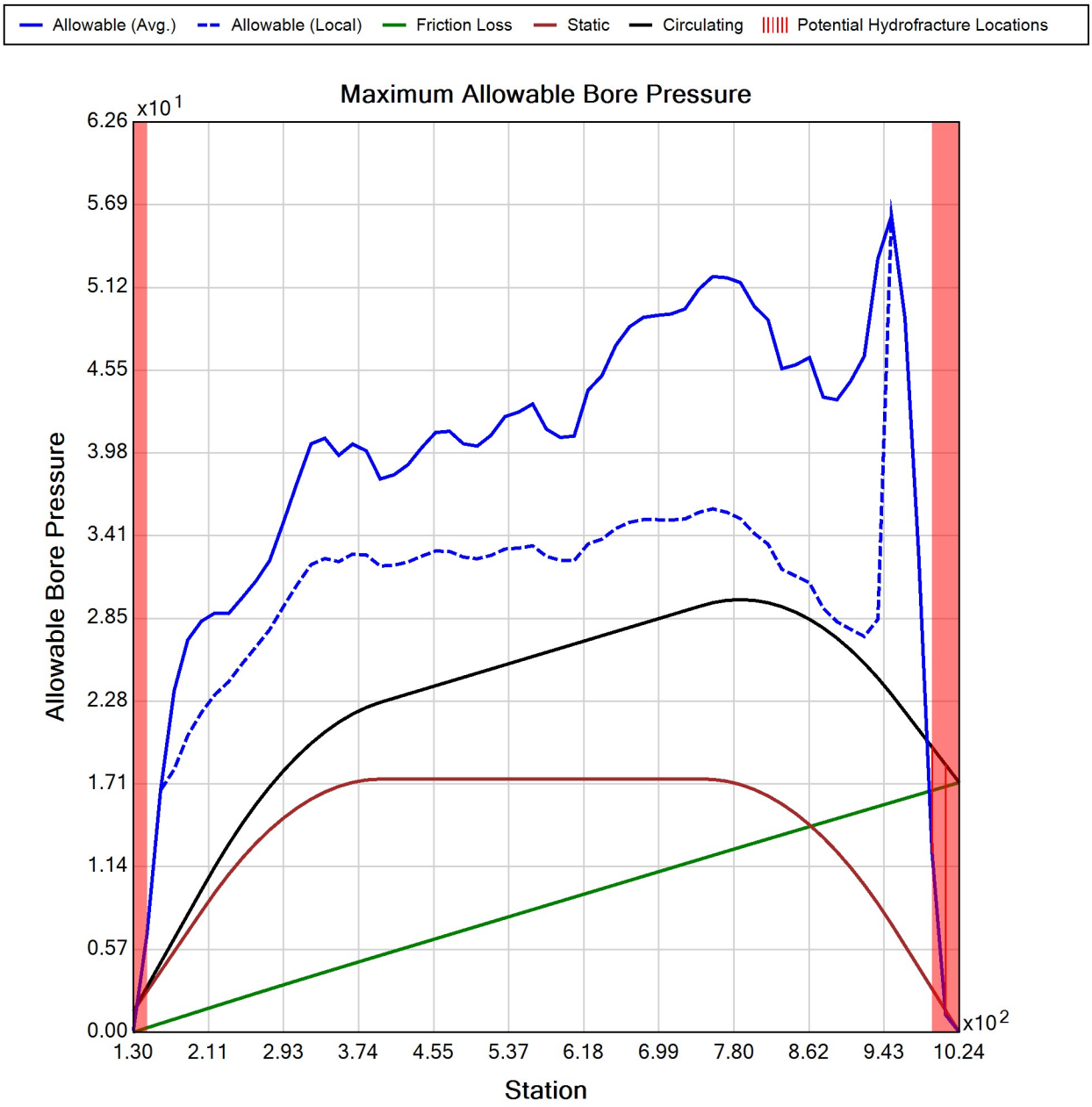












Generated Output

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Input Summary

Start Coordinate	(130.00, 0.00, 157.20) ft
End Coordinate	(1014.10, 0.00, 158.20) ft
Project Length	884.10 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	2.375 in
Pipe DR	9.0
Pipe Thickness	0.26 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Load Verifier Input Summary:

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

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	3.6	20.5
Water Pressure	0.5	0.5
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	4.1	21.1
Deflection		
Earth Load Deflection	0.978	5.590
Buoyant Deflection	0.029	0.029
Reissner Effect	0	0
Net Deflection	1.008	5.619
Compressive Stress [psi]		
Compressive Wall Stress	18.6	94.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	857.3	857.3
Pullback Stress [psi]	489.8	489.8
Pullback Strain	8.518E-3	8.518E-3
Bending Stress [psi]	0.0	5.7
Bending Strain	0	9.896E-5
Tensile Stress [psi]	489.8	493.7
Tensile Strain	8.518E-3	8.686E-3

Net External Pressure = 21.3 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 137.3 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	1.008	7.5	7.4	OK
Unconstrained Collapse [psi]	23.7	126.2	5.3	OK
Compressive Wall Stress [psi]	18.6	1150.0	61.7	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.014	7.5	524.3	OK
Unconstrained Collapse [psi]	33.7	228.5	6.8	OK
Tensile Stress [psi]	493.7	1200.0	2.4	OK

Generated Output

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Project Summary

General:	CHPE HDD 24A Conduit 2 P3 Start Date: 12-10-2021 End Date: 12-10-2021
Project Owner:	TDI
Project Contractor:	Kiewit
Designer:	AJB CHA
Description:	HDD 25 10-inch DR 9 Conduit 2

Input Summary

Start Coordinate	(130.00, 0.00, 157.20) ft
End Coordinate	(1014.10, 0.00, 158.50) ft
Project Length	884.10 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

Soil Summary

Number of Layers: 6

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

Soil Layer #2 USCS, Gravel (G), GC
From Assistant
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

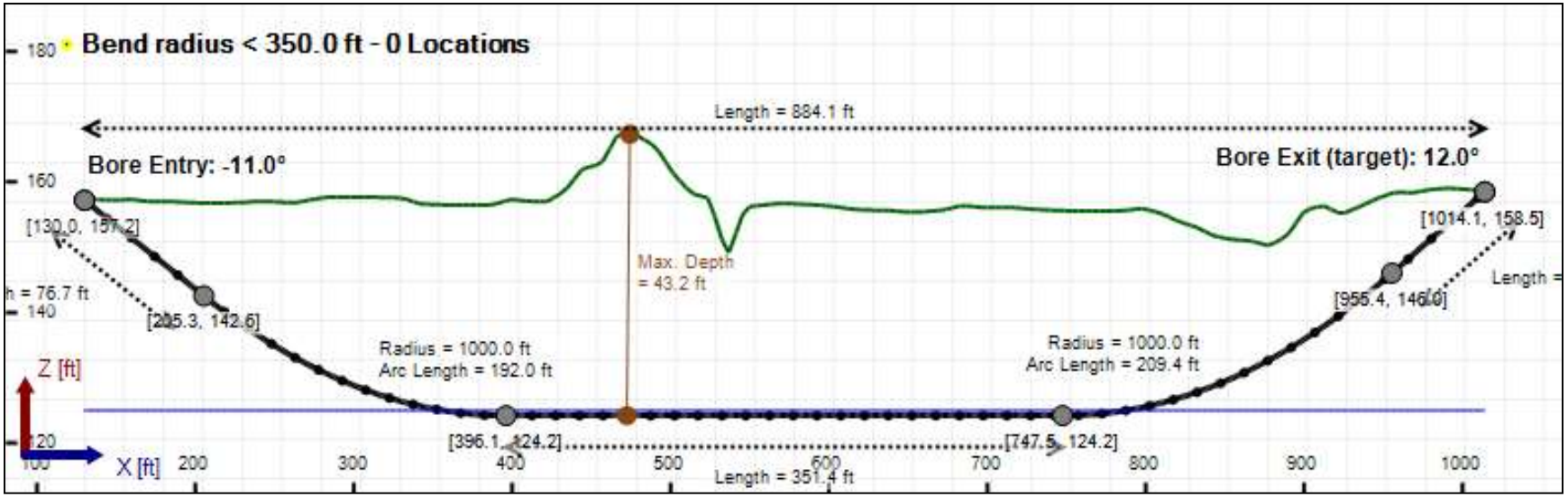
Soil Layer #3 USCS, Sand (S), SP
From Assistant
Unit Weight: 105.0000 (dry), 115.0000 (sat) [lb/ft3]
Phi: 30.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #4 USCS, Clay (C), CL
From Assistant
Unit Weight: 70.0000 (dry), 100.0000 (sat) [lb/ft3]
Phi: 0.00, S.M.: 145.00, Coh: 3.13 [psi]

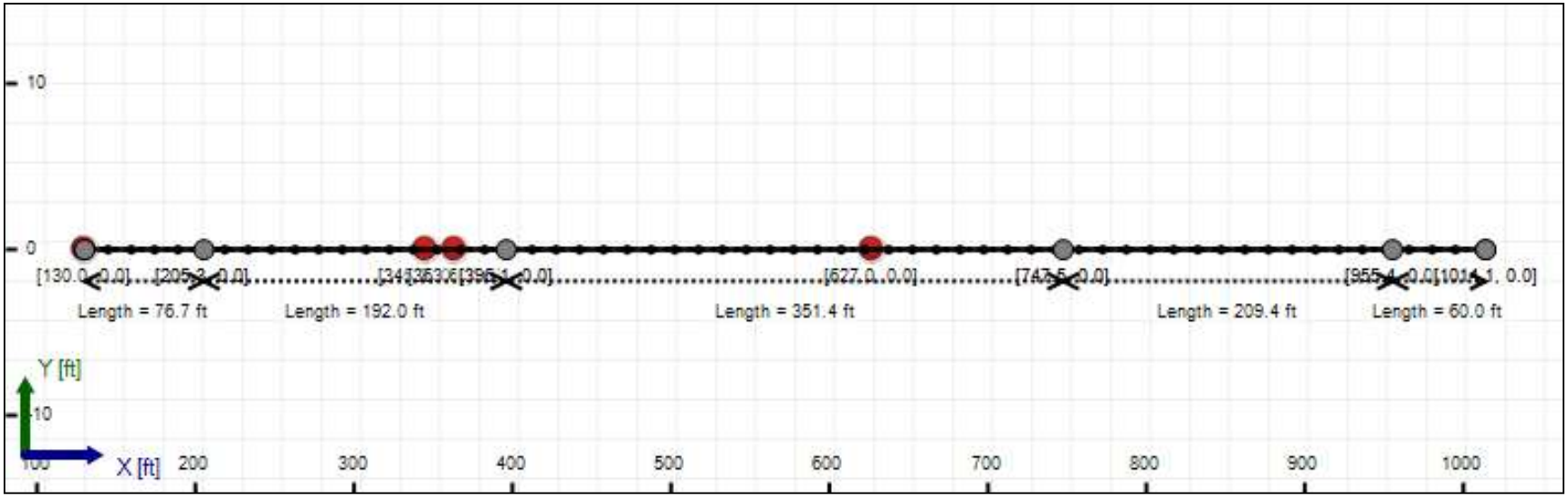
Soil Layer #5 USCS, Gravel (G), GW
From Assistant
Unit Weight: 120.0000 (dry), 140.0000 (sat) [lb/ft3]
Phi: 37.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #6 Rock, Geological Classification, Sedimentary Rocks
From Assistant
Unit Weight: 160.0000 (dry), 170.0000 (sat) [lb/ft3]
Phi: 37.00, S.M.: 1450.40, 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: 900.00 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	8.9	25.2
Water Pressure	0.4	0.4
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	9.2	25.6
Deflection		
Earth Load Deflection	2.417	6.870
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	2.549	7.002
Compressive Stress [psi]		
Compressive Wall Stress	41.5	115.1

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	15325.5	15325.5
Pullback Stress [psi]	427.4	427.4
Pullback Strain	7.433E-3	7.433E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	427.4	451.2
Tensile Strain	7.433E-3	8.296E-3

Net External Pressure = 21.6 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	2.549	7.5	2.9	OK
Unconstrained Collapse [psi]	23.7	109.9	4.6	OK
Compressive Wall Stress [psi]	41.5	1150.0	27.7	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	33.7	230.2	6.8	OK
Tensile Stress [psi]	451.2	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	61.579 psi	43.322 psi
1	8.00 in	12.00 in	61.538 psi	42.534 psi
2	12.00 in	16.13 in	61.478 psi	41.484 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