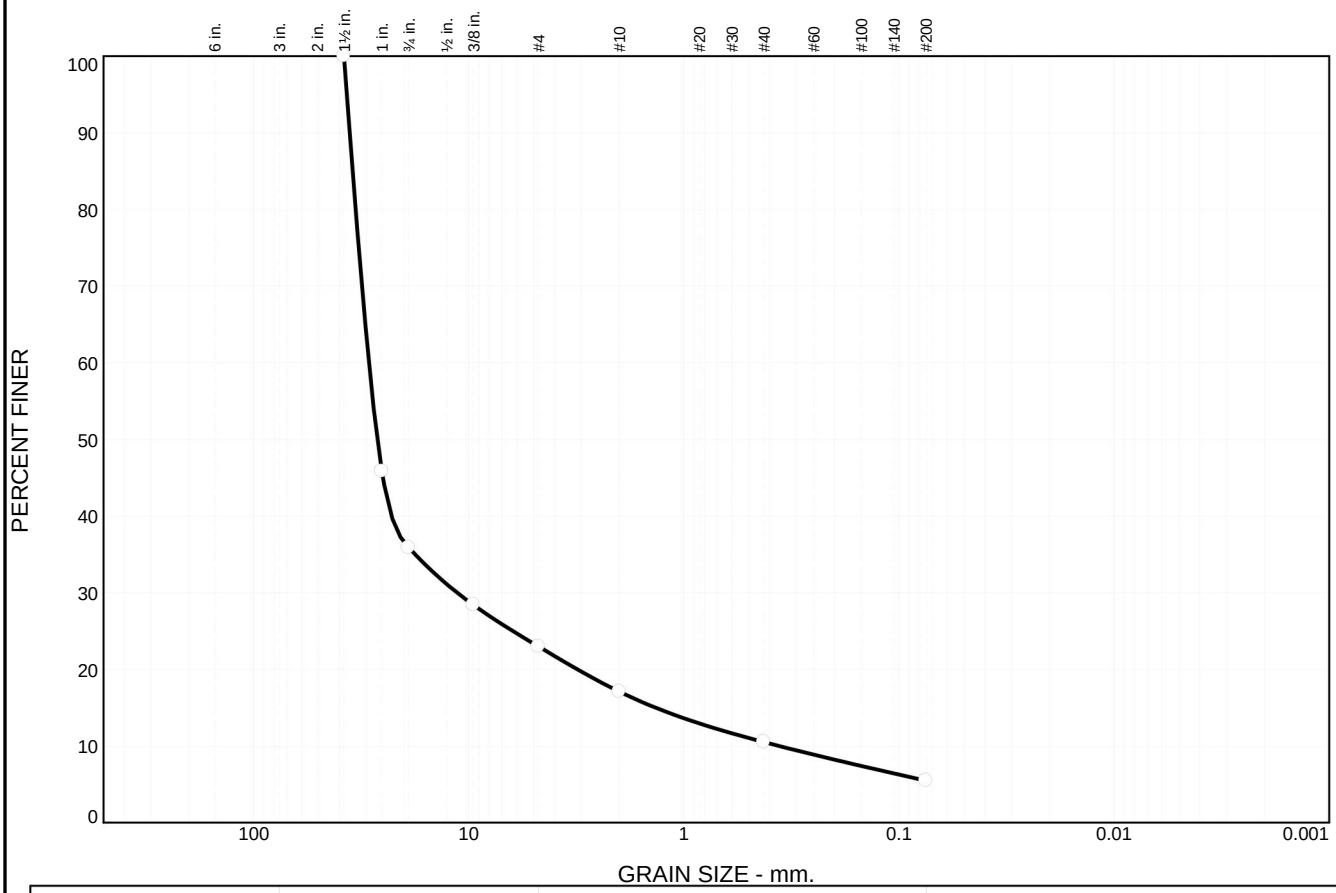
SUMMARY OF LABORATORY TEST DATA

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

SAMPLE IDENTIFICATION			Soil Group (USCS System)	GRAIN SIZE DISTRIBUTION				PLASTICITY				Specific Gravity	Moisture Content (%)	Unit Weight (pcf)	Compressive Strength (tsf)	Organic Content (%)
Boring #	Sample #	Depth (ft)		Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Liquidity Index)					
	S-5	8.0-10.0	-	-	-	-	-	-	-	-	-	-	20.7	88.6	-	-
	S-6	13.5-15.0	-	-	-	-	-	-	-	-	-	-	18.2	-	-	-
	S-7	18.5-20.0	-	-	-	-	-	-	-	-	-	-	21.4	-	-	-
B221.0-1	S-1	0.0-2.0	-	-	-	-	-	-	-	-	-	-	7.6	-	-	-
	S-3	4.0-6.0	GW	77.0	17.5	5.5		-	-	-	-	-	4.2	-	-	-
	S-4	6.0-8.0														
	S-5	8.0-10.0														
B221.14-1	S-1	0.0-2.0	-	-	-	-	-	-	-	-	-	-	21.3	-	-	-
	S-3	4.0-6.0	-	-	-	-	-	-	-	-	-	-	6.3	-	-	-
	S-4	6.0-8.0	GW-GM	58.7	31.3	10.0		-	-	-	-	-	6.4	-	-	-
	S-5	8.0-10.0														

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	64.1	12.9	5.9	6.6	5.0	5.5	

LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
		34.7080	29.1773	26.6607	11.3379	1.3566	0.3617	12.18	80.66

Material Description	USCS	AASHTO
DARK GRAY C/F GRAVEL, SM M/C/F SAND, TR SILT	GW	

Project No. 195651 **Client:** TRANSMISSION DEVELOPERS INC.

Project: TDI CHAMPLAIN HUDSON POWER EXPRESS - CSX

Sample Source: B221.0-1 **Depth:** 4.0-10.0 FT **Sample No.:** S-3, S-4, & S-5

Remarks:
SAMPLE DESCRIPTION BASED ON VISUAL IDENTIFICAITON AND LABORATORY ANALYSIS

TRC Engineers, Inc.

Mt. Laurel, NJ

Figure 117

Tested By: TBT 01/10/13 **Checked By:** JPB 03/12/13

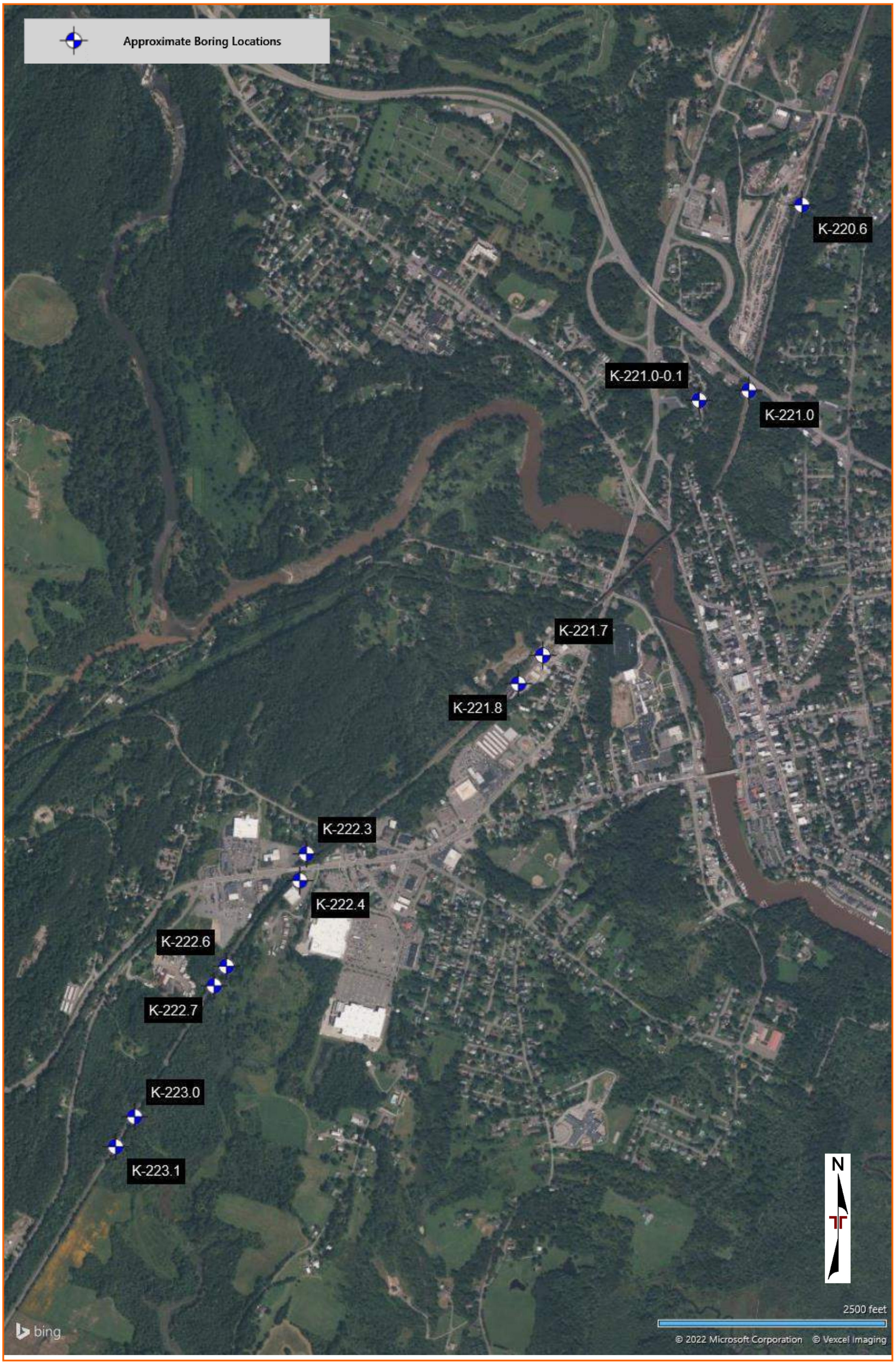


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

BORING LOG NO. K-221.0

PROJECT: Champlain-Hudson Power Express Package 7a

CLIENT: Kiewit Engineering (NY) Corp.

SITE: Champlain to Hudson HDD Crossings Catskill, NY

LOCATION See Exploration Plan

Latitude: 42.228733° Longitude: -73.866003°

Surface Elev.: 99.19 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		FILL - SAND AND GRAVEL, black, loose				3	2-2-3-6 N=5			
						2	2-2-3-3 N=5			
4.0	95	**SILT AND CLAY (CL-ML)**, brown, medium stiff to very stiff	5			4	2-2-4-5 N=6			
						13	5-7-9-8 N=16			
8.0	91	**FAT CLAY WITH SAND (CH)**, brown, stiff to very stiff				22	2-4-6-7 N=10	32.4	50-21-29	73
			10			12	5-8-10-12 N=18			
						22	2-5-6-9 N=11			
			15							
						24	2-4-5-6 N=9			
			20							
23.0	76	**LEAN CLAY (CL)**, brown, very soft				24	3-3-6-7 3" Split Spoon	30.9	41-23-18	90
			25							

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

Hammer Type: Automatic

Advancement Method:
4 1/4" HSA

Abandonment Method:
Boring backfilled with bentonite grout upon completion

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

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by Kiewit.

Notes:

Logged by LC
Hammer Efficiency Summary:
Energy Transfer Ratio: 89.1% +/- 4.4%
Hammer Efficiency Correction (CE): 1.49
WOH = Weight of Hammer

WATER LEVEL OBSERVATIONS

No measurable groundwater prior to grouting

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 03-15-2022 | Boring Completed: 03-15-2022

Drill Rig: Mobile B-57 | Driller: L. Spicher

Project No.: JB215256D

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL JB215256D CHAMPLAIN-HUDSON .GPJ TERRACON_DATATEMPLATE.GDT 5/20/22

BORING LOG NO. K-221.0

PROJECT: Champlain-Hudson Power Express Package 7a

CLIENT: Kiewit Engineering (NY) Corp.

SITE: Champlain to Hudson HDD Crossings Catskill, NY

LOCATION See Exploration Plan

Latitude: 42.228733° Longitude: -73.866003°

Surface Elev.: 99.19 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	LEAN CLAY (CL), brown, very soft *(continued)*						With Ring Sampler			
						24	WOH-WOH-WOH-2			
	30.0	69	30							
	LEAN CLAY (CL), gray, very soft									
						24	WOH-WOH-WOH-1	36.0		
			35							
						24	WOH-WOH-WOH-2			
	40.0	59	40							
	Boring Terminated at 40 Feet									

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

Hammer Type: Automatic

Advancement Method:
4 1/4" HSA

Abandonment Method:
Boring backfilled with bentonite grout upon completion

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

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by Kiewit.

Notes:

Logged by LC
Hammer Efficiency Summary:
Energy Transfer Ratio: 89.1% +/- 4.4%
Hammer Efficiency Correction (CE): 1.49
WOH = Weight of Hammer

WATER LEVEL OBSERVATIONS

No measurable groundwater prior to grouting

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 03-15-2022 | Boring Completed: 03-15-2022

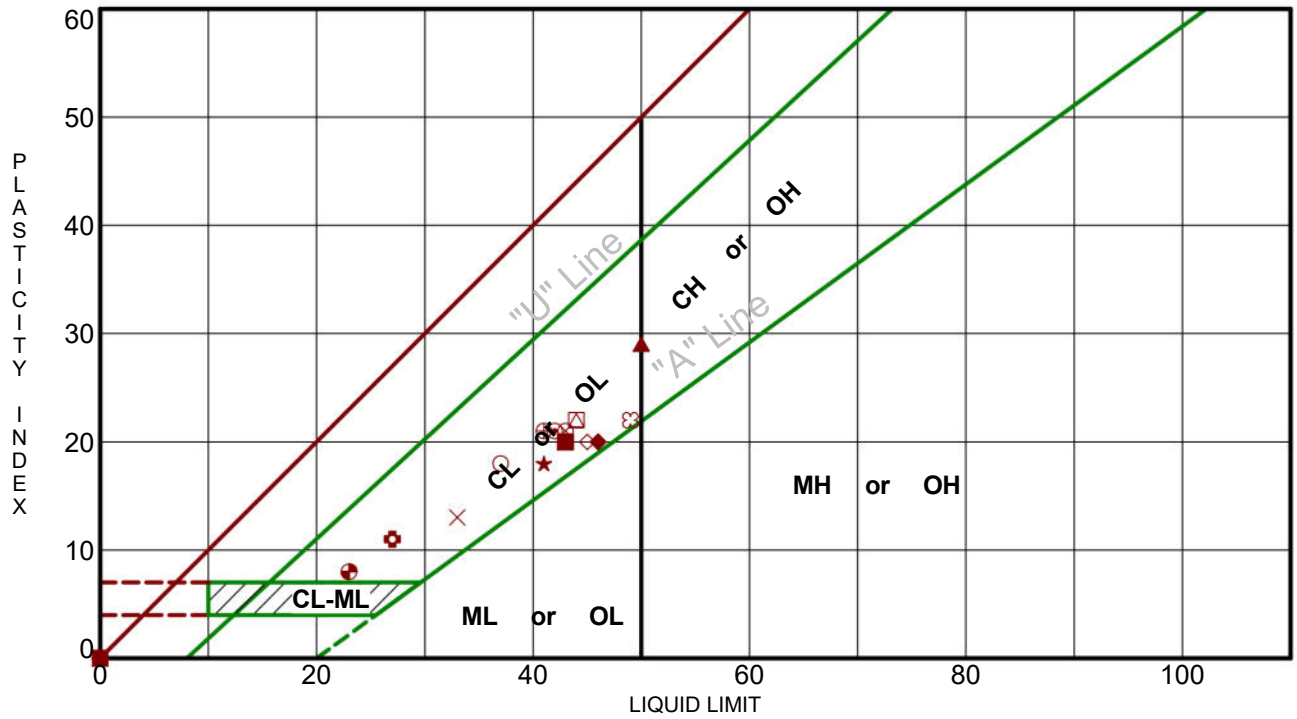
Drill Rig: Mobile B-57 | Driller: L. Spicher

Project No.: JB215256D

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL JB215256D CHAMPLAIN-HUDSON .GPJ TERRACON_DATATEMPLATE.GDT 5/20/22

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID		Depth (Ft)	LL	PL	PI	Fines	USCS	Description
●	K-220.6	6 - 8	NP	NP	NP	22.1	GM	SILTY GRAVEL with SAND
⊠	K-220.6	13 - 15	NP	NP	NP	11.9	SW-SM	WELL-GRADED SAND with SILT and GRAVEL
▲	K-221.0	8 - 10	50	21	29	73.4	CH	FAT CLAY with SAND
★	K-221.0	23 - 25	41	23	18	89.8	CL	LEAN CLAY
⊙	K-221.7	10 - 12	42	21	21	93.6	CL	LEAN CLAY
✿	K-221.7	33 - 35	27	16	11	58.8	CL	SANDY LEAN CLAY
○	K-221.8	8 - 10	37	19	18	91.3	CL	LEAN CLAY
△	K-221.8	35 - 37	44	22	22	79.7	CL	LEAN CLAY with SAND
⊗	K-222.3	6 - 8	43	22	21	59.8	CL	SANDY LEAN CLAY
⊕	K-222.3	10 - 12	41	20	21	69.6	CL	SANDY LEAN CLAY
□	K-222.4	10 - 12	44	22	22	87.3	CL	LEAN CLAY
◕	K-222.6	15 - 17	NP	NP	NP	6.5	GW-GM	WELL-GRADED GRAVEL with SILT and SAND
◕	K-222.6	35 - 37	23	15	8	86.7	CL	LEAN CLAY
☆	K-222.7	10 - 12	NP	NP	NP	25.3	GM	SILTY GRAVEL with SAND
✿	K-222.7	25 - 27	49	27	22	76.3	CL	LEAN CLAY with SAND
■	K-223.0	10 - 12	43	23	20	58.5	CL	SANDY LEAN CLAY
◆	K-223.0	25 - 27	46	26	20	84.9	CL	LEAN CLAY with SAND
◇	K-223.1	15 - 17	45	25	20	71.3	CL	LEAN CLAY with SAND
×	K-223.1	29 - 31	33	20	13	98.3	CL	LEAN CLAY

PROJECT: Champlain-Hudson Power Express Package 7a

SITE: Champlain to Hudson HDD Crossings Catskill, NY

Terracon
30 Corporate Cir Ste 201
Albany, NY

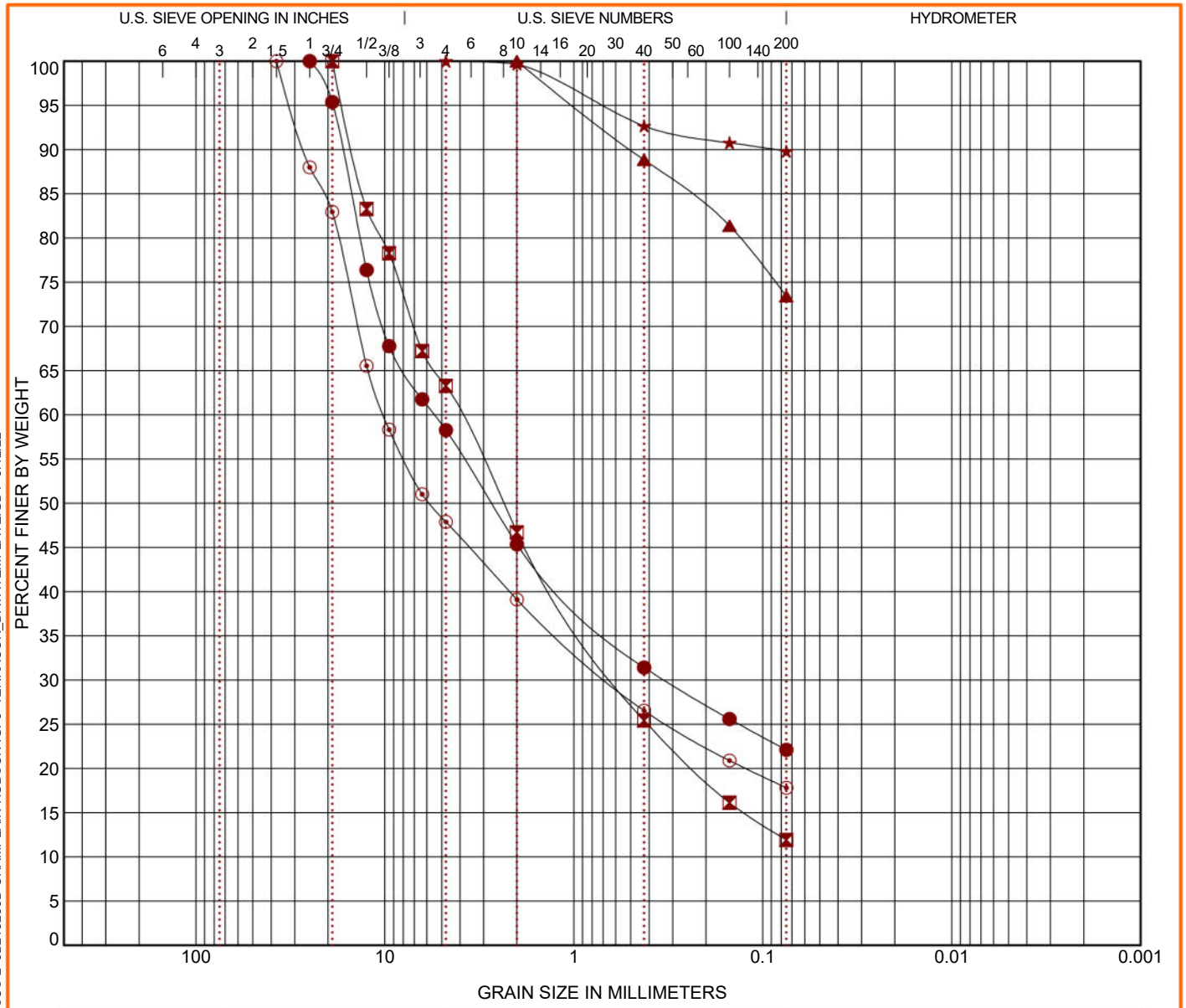
PROJECT NUMBER: JB215256D

CLIENT: Kiewit Engineering (NY) Corp.

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. ATTERBERG LIMITS JB215256D CHAMPLAIN-HUDSON .GPJ TERRACON_DATATEMPLATE.GDT 5/12/22

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth (Ft)	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	K-220.6	6 - 8	SILTY GRAVEL with SAND (GM)	9.9	NP	NP	NP		
⊠	K-220.6	13 - 15	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)	16.6	NP	NP	NP	1.60	73.20
▲	K-221.0	8 - 10	FAT CLAY with SAND (CH)	32.4	50	21	29		
★	K-221.0	23 - 25	LEAN CLAY (CL)	30.9	41	23	18		
⊙	K-221.0-0.1	8 - 10	SILTY GRAVEL with SAND (GM)	12.0	NP	NP	NP		

	Boring ID	Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
●	K-220.6	6 - 8	25	5.489	0.33		0.0	41.7	36.2		22.1	
⊠	K-220.6	13 - 15	19	4.006	0.593		0.0	36.7	51.4		11.9	
▲	K-221.0	8 - 10	2				0.0	0.0	26.6		73.4	
★	K-221.0	23 - 25	4.75				0.0	0.0	10.2		89.8	
⊙	K-221.0-0.1	8 - 10	37.5	10.125	0.651		0.0	52.1	30.1		17.8	

PROJECT: Champlain-Hudson Power Express Package 7a

SITE: Champlain to Hudson HDD Crossings Catskill, NY

Terracon
30 Corporate Cir Ste 201
Albany, NY

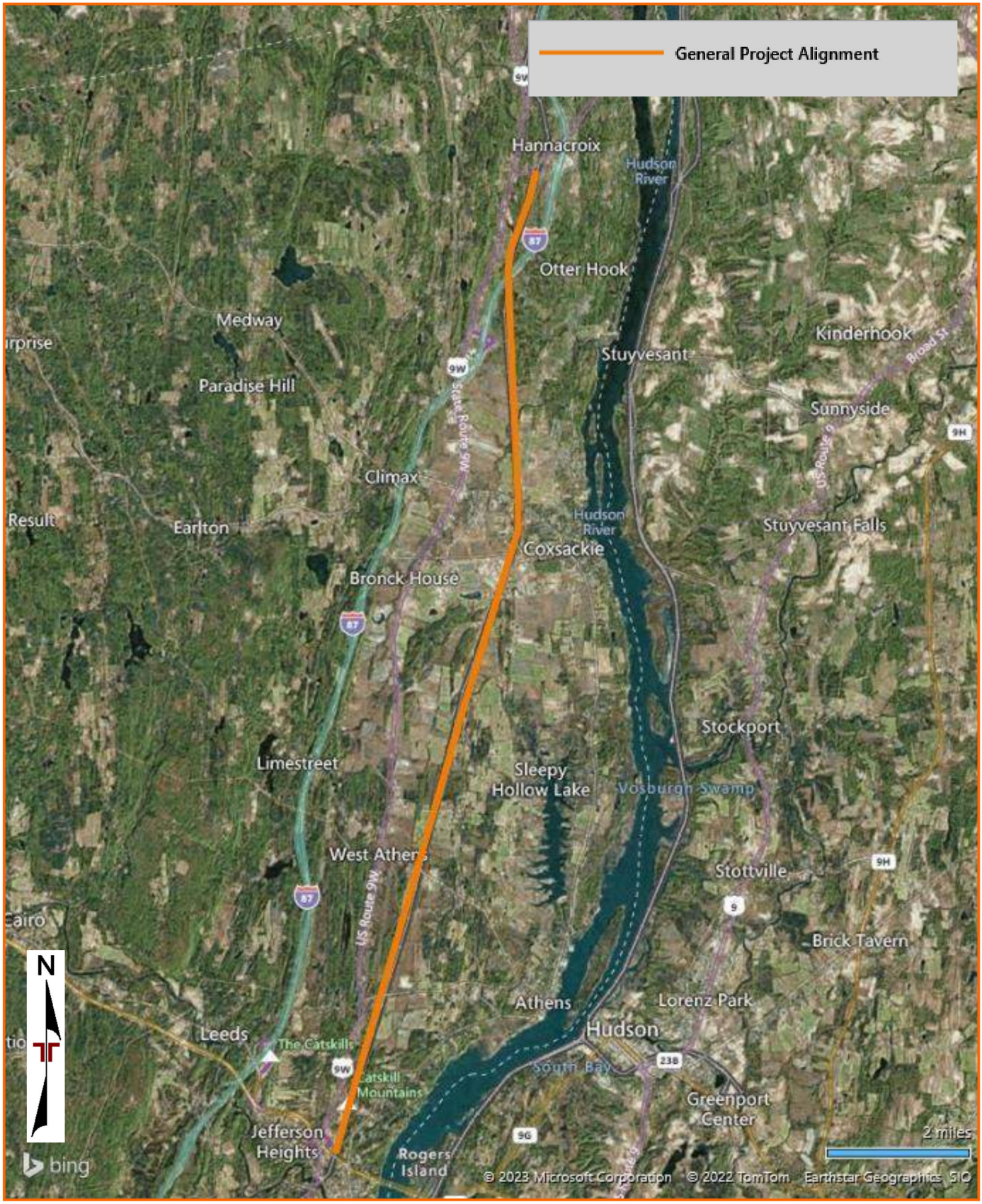
PROJECT NUMBER: JB215256D

CLIENT: Kiewit Engineering (NY) Corp.

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 JB215256D CHAMPLAIN-HUDSON .GPJ TERRACON_DATATEMPLATE.GDT 5/12/22

SITE LOCATION

Champlain-Hudson Power Express- Phase 4 HDD Borings Package 6 and 7A
Schenectady through Selkirk, NY
February 8, 2023 ■ Terracon Project No. JB215256J



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AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

Champlain-Hudson Power Express- Phase 4 HDD Borings Package 6 and 7A
Schenectady through Selkirk, NY
February 8, 2023 ■ Terracon Project No. JB215256J

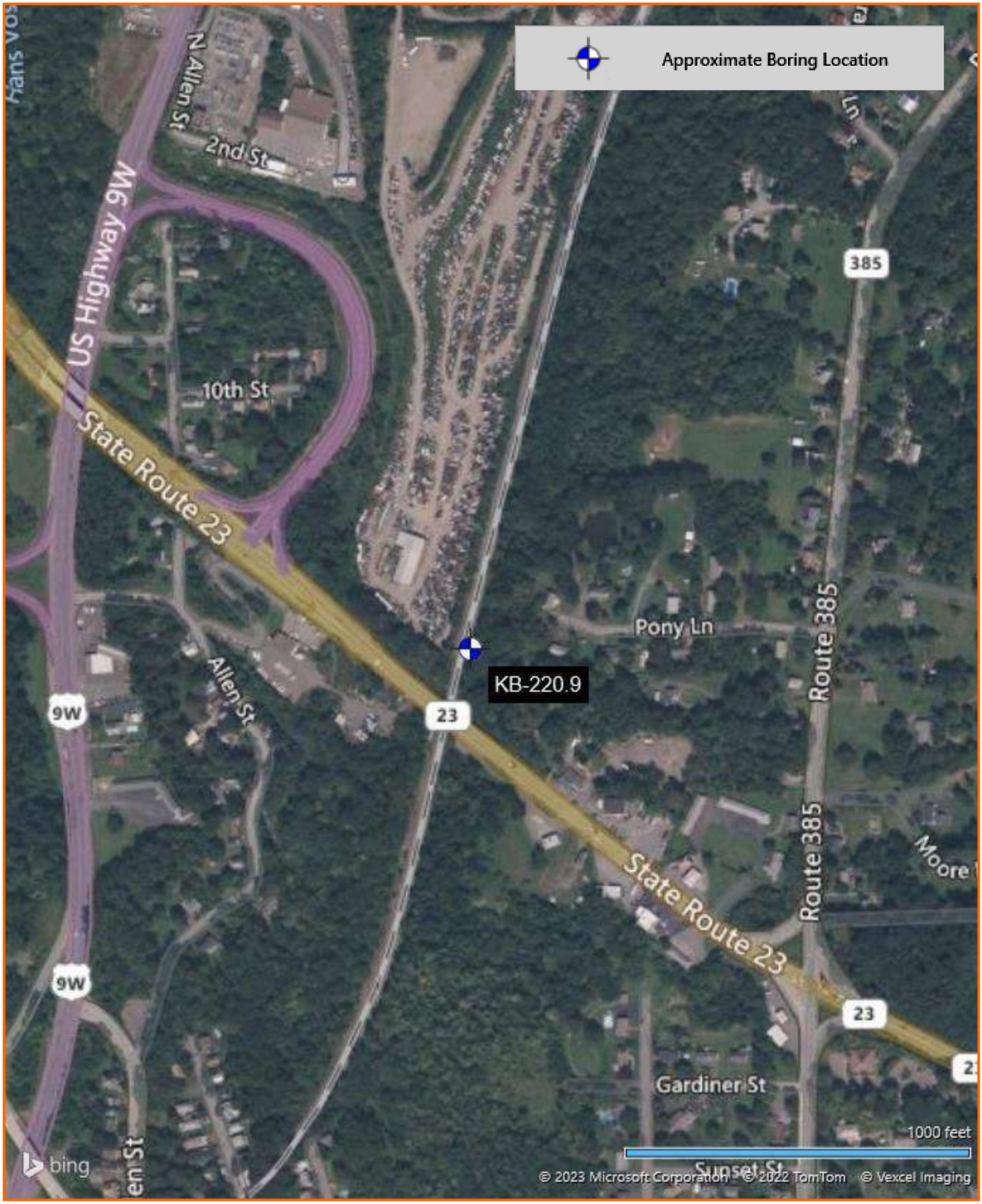

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

BORING LOG NO. KB-220.9

PROJECT: Phase 4 Borings

CLIENT: Kiewit Engineering (NY) Corp
Lone Tree, CO

SITE: Champlain to Hudson HDD Crossings

LOCATION See Exploration Plan

Latitude: 42.2296° Longitude: -73.8656°

Surface Elev.: 102.6 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
1.9	100.7	**FILL - SILTY SAND**, black
		FAT CLAY (CH), varved silt and clay, brown, medium stiff to very stiff
		grades with fine sand partings
20.0	82.6	**LEAN CLAY (CL)**, varved silt and clay, gray, very soft to soft

DEPTH (Ft.)	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	14	1-4-3-5 N=7			
	20	4-3-3-4 N=6			
5	18	3-3-6-7 N=9	31.0	50-27-23	98
	24	12-11-12-14 N=23			
	24	14-15-13-14 N=28			
10					
15	24	2-4-5-4 N=9			
20	24	WH-2-2-3 N=4	39.6	47-26-21	100
25					

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

Advancement Method:
0-10' 4" Casing
10'-57' Mud Rotary

Abandonment Method:
Boring backfilled with bentonite grout upon completion

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

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

Hammer Efficiency Summary:
Energy Transfer Ratio: 84.8% +/-3.7%
Hammer Efficiency Correction (CE): 1.41
Logged by AEB
WH = Weight of hammer
WR = Weight of rods

WATER LEVEL OBSERVATIONS

No free water encountered

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 12-15-2022 | Boring Completed: 12-20-2022
Drill Rig: Acker Renegade | Driller: L. Spicher
Project No.: JB215256J

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL JB215256J PHASE 4 BORINGS.GPJ TERRACON_DATATEMPLATE.GDT 2/8/23

BORING LOG NO. KB-220.9

PROJECT: Phase 4 Borings

CLIENT: Kiewit Engineering (NY) Corp
Lone Tree, CO

SITE: Champlain to Hudson HDD Crossings

LOCATION See Exploration Plan

Latitude: 42.2296° Longitude: -73.8656°

Surface Elev.: 102.6 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
LEAN CLAY (CL), varved silt and clay, gray, very soft to soft *(continued)*								
				24	WH/18"-2			
		30		24	WH/12"-1-3 N=1			
		35		24	WH/18"-5			
		40		24	WH/18"-6 3" Split Spoon With Ring Samplers			
45.0	57.6	45						
SILT (ML), varved silt and clay, gray, very soft				24	WR/12"-WH/12"	33.6	42-27-15	99
		50						

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

Advancement Method:
0-10' 4" Casing
10'-57' Mud Rotary

Abandonment Method:
Boring backfilled with bentonite grout upon completion

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

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Notes:

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Hammer Efficiency Correction (CE): 1.41
Logged by AEB
WH = Weight of hammer
WR = Weight of rods

WATER LEVEL OBSERVATIONS

No free water encountered

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 12-15-2022 | Boring Completed: 12-20-2022

Drill Rig: Acker Renegade | Driller: L. Spicher

Project No.: JB215256J

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL JB215256J PHASE 4 BORINGS.GPJ TERRACON_DATATEMPLATE.GDT 2/8/23

BORING LOG NO. KB-220.9

PROJECT: Phase 4 Borings

CLIENT: Kiewit Engineering (NY) Corp
Lone Tree, CO

SITE: Champlain to Hudson HDD Crossings

LOCATION See Exploration Plan

Latitude: 42.2296° Longitude: -73.8656°

Surface Elev.: 102.6 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILT (ML), varved silt and clay, gray, very soft *(continued)*					24	WR/18"-WH			
			55			24	WR/18"-3			
	57.0	45.6								
	Boring Terminated at 57 Feet									

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

Advancement Method:
0-10' 4" Casing
10'-57' Mud Rotary

Abandonment Method:
Boring backfilled with bentonite grout upon completion

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

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

Hammer Efficiency Summary:
Energy Transfer Ratio: 84.8% +/-3.7%
Hammer Efficiency Correction (CE): 1.41
Logged by AEB
WH = Weight of hammer
WR = Weight of rods

WATER LEVEL OBSERVATIONS

No free water encountered

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 12-15-2022 | Boring Completed: 12-20-2022

Drill Rig: Acker Renegade | Driller: L. Spicher

Project No.: JB215256J

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL JB215256J PHASE 4 BORINGS.GPJ TERRACON_DATATEMPLATE.GDT 2/8/23

Summary of Laboratory Results

BORING ID	Depth (Ft.)	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
KB-206.8	4-6	29.4	50	26	24
KB-206.8	15-17	32.9	40	23	17
KB-206.8	35-37	11.0	17	13	4
KB-207.0	4-6	23.7	42	30	12
KB-207.1	4-6	15.1			
KB-211.4B	4-6	32.8	58	32	26
KB-211.4B	15-17	48.0	55	31	24
KB-211.4B	40-42	36.7	63	32	31
KB-214.4	4-6	33.7	65	33	32
KB-214.4	15-17	37.6	57	29	28
KB-214.4	30-32	49.7	45	30	15
KB-220.9	4-6	31.0	50	27	23
KB-220.9	20-22	39.6	47	26	21
KB-220.9	45-47	33.6	42	27	15

PROJECT: Phase 4 Borings

SITE: Champlain to Hudson HDD Crossings

Terracon
30 Corporate Cir Ste 201
Albany, NY

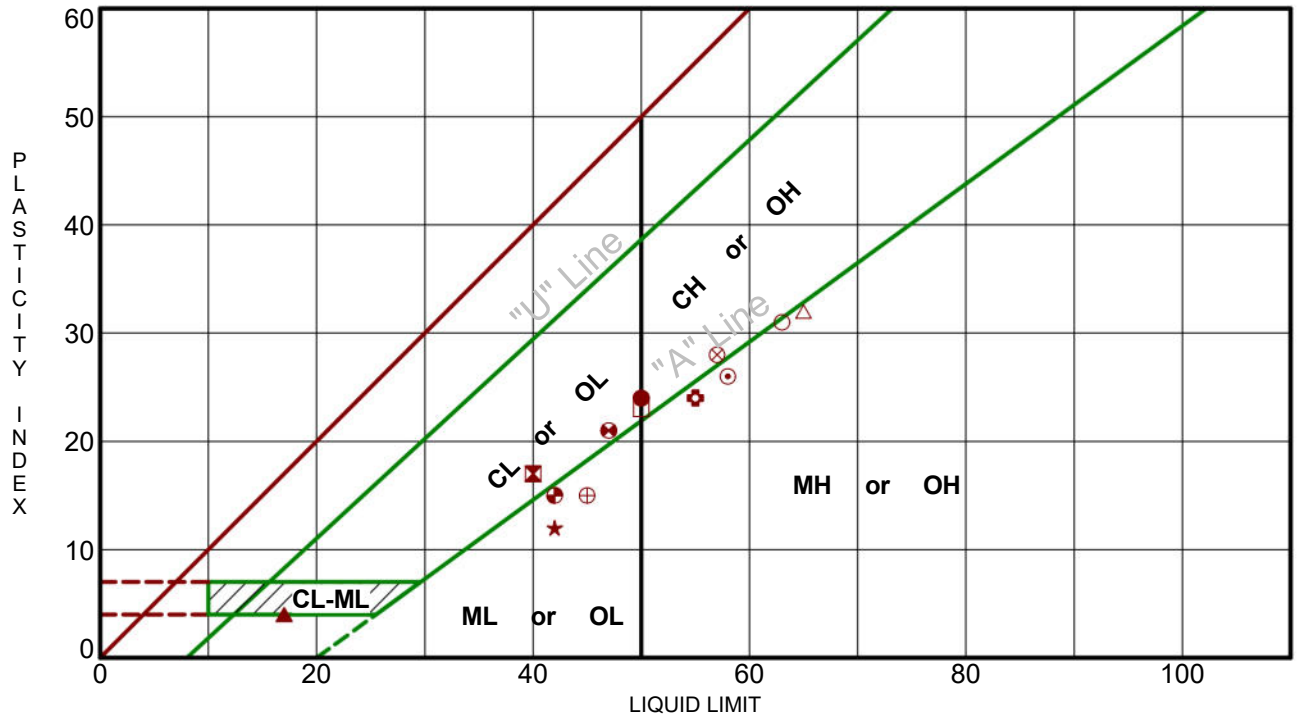
PROJECT NUMBER: JB215256J

CLIENT: Kiewit Engineering (NY) Corp
Lone Tree, CO

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. SMART LAB SUMMARY-PORTRAIT JB215256J PHASE 4 BORINGS.GPJ TERRACON_DATATEMPLATE.GDT 2/8/23

ATTERBERG LIMITS RESULTS

ASTM D4318



	Boring ID	Depth (Ft)	LL	PL	PI	Fines	USCS	Description
●	KB-206.8	4 - 6	50	26	24	87.8	CH	FAT CLAY
⊠	KB-206.8	15 - 17	40	23	17	99.4	CL	LEAN CLAY
▲	KB-206.8	35 - 37	17	13	4	37.5	SC-SM	SILTY, CLAYEY SAND with GRAVEL
★	KB-207.0	4 - 6	42	30	12	86.9	ML	SILT
⊙	KB-211.4B	4 - 6	58	32	26	53.8	MH	SANDY ELASTIC SILT
✿	KB-211.4B	15 - 17	55	31	24	82.0	MH	ELASTIC SILT with SAND
○	KB-211.4B	40 - 42	63	32	31	96.7	MH	ELASTIC SILT
△	KB-214.4	4 - 6	65	33	32	84.2	MH	ELASTIC SILT with SAND
⊗	KB-214.4	15 - 17	57	29	28	94.7	CH	FAT CLAY
⊕	KB-214.4	30 - 32	45	30	15	93.2	ML	SILT
□	KB-220.9	4 - 6	50	27	23	97.5	CH	FAT CLAY
⊞	KB-220.9	20 - 22	47	26	21	100.0	CL	LEAN CLAY
◕	KB-220.9	45 - 47	42	27	15	99.1	ML	SILT

PROJECT: Phase 4 Borings

SITE: Champlain to Hudson HDD Crossings

Terracon
30 Corporate Cir Ste 201
Albany, NY

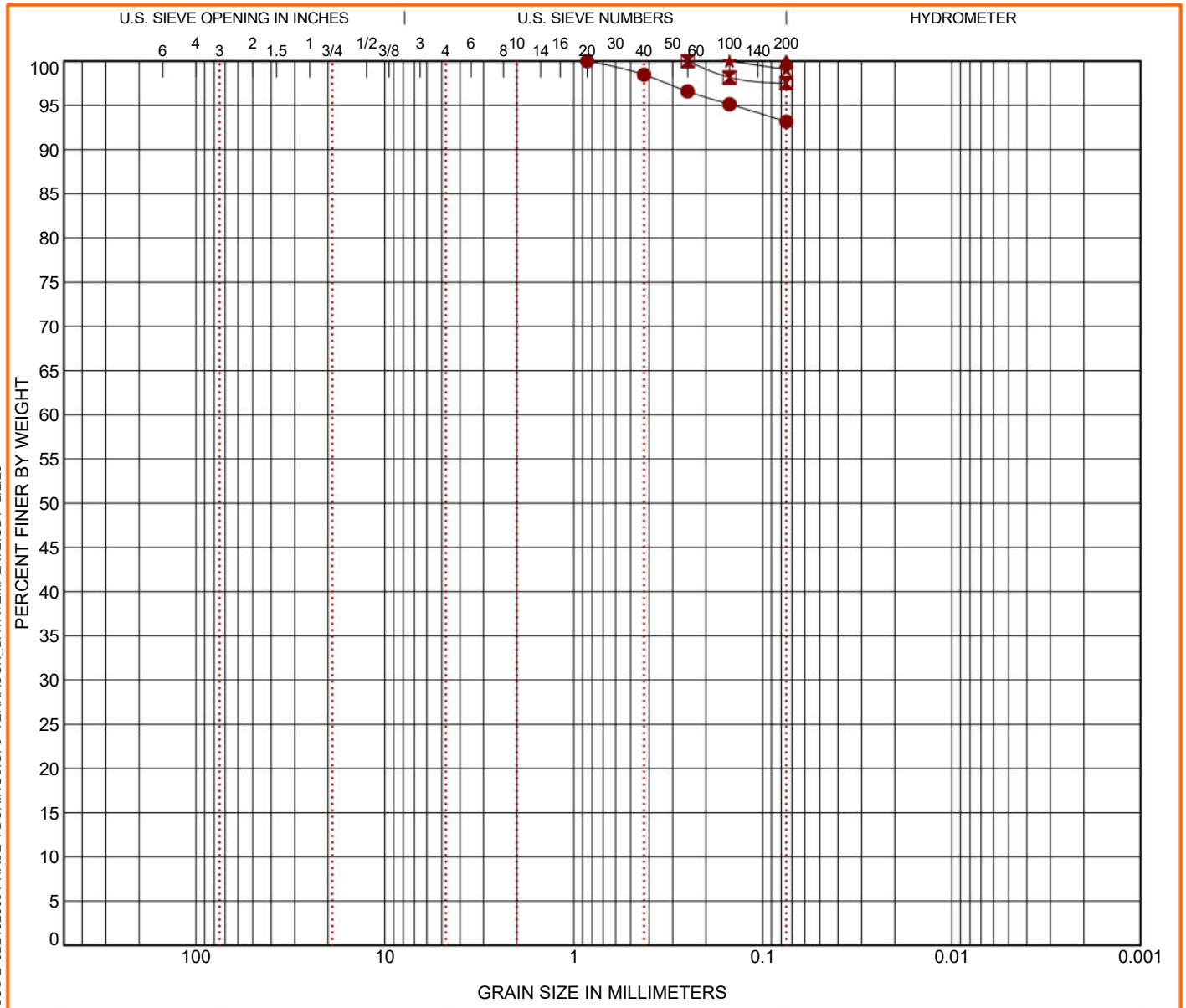
PROJECT NUMBER: JB215256J

CLIENT: Kiewit Engineering (NY) Corp
Lone Tree, CO

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. ATTERBERG LIMITS JB215256J PHASE 4 BORINGS.GPJ TERRACON_DATATEMPLATE.GDT 2/2/23

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth (Ft)	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	KB-214.4	30 - 32	SILT (ML)	49.7	45	30	15		
⊠	KB-220.9	4 - 6	FAT CLAY (CH)	31.0	50	27	23		
▲	KB-220.9	20 - 22	LEAN CLAY (CL)	39.6	47	26	21		
★	KB-220.9	45 - 47	SILT (ML)	33.6	42	27	15		

	Boring ID	Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
●	KB-214.4	30 - 32	0.85				0.0	0.0	6.8		93.2	
⊠	KB-220.9	4 - 6	0.25				0.0	0.0	2.5		97.5	
▲	KB-220.9	20 - 22	0.075				0.0	0.0	0.0		100.0	
★	KB-220.9	45 - 47	0.15				0.0	0.0	0.9		99.1	

PROJECT: Phase 4 Borings

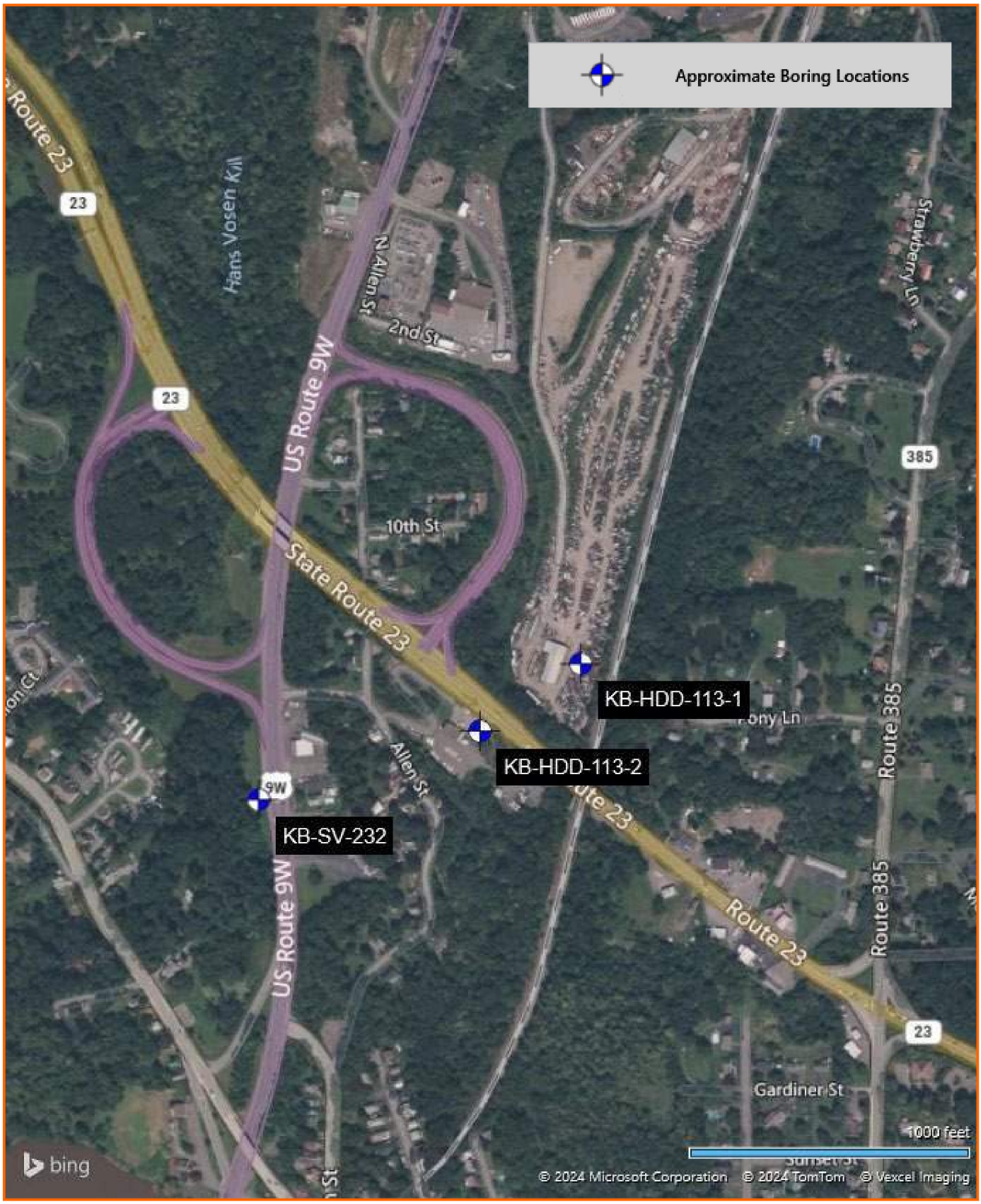
SITE: Champlain to Hudson HDD Crossings

Terracon
30 Corporate Cir Ste 201
Albany, NY

PROJECT NUMBER: JB215256J

CLIENT: Kiewit Engineering (NY) Corp
Lone Tree, CO

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 JB215256J PHASE 4 BORINGS.GPJ TERRACON_DATATEMPLATE.GDT 2/2/23


Approximate Boring Locations
Route 23
23
Hans Vosen Kill
N Allen St
2nd St
US Route 9W
10th St
State Route 23
385
Strawberry Ln
KB-HDD-113-1
KB-HDD-113-2
Allen St
9W
KB-SV-232
Route 385
Route 23
Gardiner St
1000 feet
bing
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BORING LOG NO. KB-HDD-113-1

PROJECT: Change Order 4 Borings

CLIENT: Kiewit Engineering (NY) Corp
Lone Tree, CO

SITE: Champlain to Hudson HDD Crossings
Catskill, NY

LOCATION See Exploration Plan

Latitude: 42.230309° Longitude: -73.865886°

Surface Elev.: 93.29 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
1.0	92.3	**CRUSHER RUN**
4.0	89.3	**FILL - LEAN CLAY WITH SAND**, brown
		LEAN CLAY (CL), trace silt, brown, very soft to hard
		Grades gray

DEPTH (Ft.)	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	18	7-20-20-19 N=40			
	12	54-54-24-19 N=78			
5	14	5-6-10-11 N=16			
	16	13-14-17-17 N=31			
	16	6-8-10-10 N=18	25.7	42-23-19	92
10	16	8-8-9-10 N=17	23.5	45-23-22	
15	16	6-8-9 N=17			
20	18	2-3-3 N=6			
25					

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

Hammer Type: Automatic

Advancement Method:
2 1/4" ID HSA

Abandonment Method:
Boring backfilled with bentonite grout upon completion

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

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 03-13-2024
Boring Completed: 03-14-2024
Drill Rig: CME 750X
Driller: Caleb Schindler
Project No.: JB215256L

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL JB215256L CHANGE ORDER 4 BO.GPJ TERRACON_DATATEMPLATE.GDT 6/5/24

BORING LOG NO. KB-HDD-113-1

PROJECT: Change Order 4 Borings

CLIENT: Kiewit Engineering (NY) Corp
Lone Tree, CO

SITE: Champlain to Hudson HDD Crossings
Catskill, NY

LOCATION See Exploration Plan

Latitude: 42.230309° Longitude: -73.865886°

Surface Elev.: 93.29 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	LEAN CLAY (CL), trace silt, brown, very soft to hard *(continued)*							
				18	WR-WR-WR			
		30		16	WR-WR-WR	32.7	33-22-11	94
		35		16	WR-WR-WR	26.8	30-21-9	
		40		16	WR-WH-WH			
45.0	48.3	45						
	SILTY SAND (SM), shale fragments noted, gray, very dense, (GLACIAL TILL)			16	12-17-24-54 3" Split Spoon			
				16	50-55-11 3" Split Spoon			
		50						

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

Hammer Type: Automatic

Advancement Method:
2 1/4" ID HSA

Abandonment Method:
Boring backfilled with bentonite grout upon completion

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

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:
WH = Weight of Hammer
WR = Weight of Rods

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 03-13-2024
Boring Completed: 03-14-2024
Drill Rig: CME 750X
Driller: Caleb Schindler
Project No.: JB215256L

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL JB215256L CHANGE ORDER 4 BO.GPJ TERRACON_DATATEMPLATE.GDT 6/5/24

BORING LOG NO. KB-HDD-113-1

PROJECT: Change Order 4 Borings

CLIENT: Kiewit Engineering (NY) Corp
Lone Tree, CO

SITE: Champlain to Hudson HDD Crossings
Catskill, NY

LOCATION See Exploration Plan

Latitude: 42.230309° Longitude: -73.865886°

Surface Elev.: 93.29 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), shale fragments noted, gray, very dense, (GLACIAL TILL) *(continued)*				2	50/2"			
		55		6	48-48-50/2"	12.5		44
				8	49-49-50 N=99			
60.0	33.3	60						
Boring Terminated at 60 Feet								

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

Hammer Type: Automatic

Advancement Method:
2 1/4" ID HSA

Abandonment Method:
Boring backfilled with bentonite grout upon completion

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

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 03-13-2024
Boring Completed: 03-14-2024
Drill Rig: CME 750X
Driller: Caleb Schindler
Project No.: JB215256L

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL JB215256L CHANGE ORDER 4 BO.GPJ TERRACON_DATATEMPLATE.GDT 6/5/24

BORING LOG NO. KB-HDD-113-2

PROJECT: Change Order 4 Borings

CLIENT: Kiewit Engineering (NY) Corp
Lone Tree, CO

SITE: Champlain to Hudson HDD Crossings
Catskill, NY

LOCATION See Exploration Plan

Latitude: 42.229650° Longitude: -73.867216°

Surface Elev.: 104.80 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		POORLY GRADED GRAVEL WITH SAND (GP), brown, medium dense			10	5-9-8-5 N=17			
5.0	99.8	**SILTY SAND (SM)**, brown, very loose to loose	5		10	1-2-1/12 N=3			
			10		10	1-2-1-2 N=3	16.7		23
15.0	89.8	**LEAN CLAY (CL)**, sand lenses noted, brown, medium stiff to very stiff	15		10	2-2-5-7 N=7			
			20		12	6-8-9 N=17	24.9	40-23-17	94
			25						

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

Hammer Type: Automatic

Advancement Method:
2 1/4" ID HSA

Abandonment Method:
Boring backfilled with bentonite grout upon completion

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

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 03-11-2024 | Boring Completed: 03-12-2024

Drill Rig: CME 750X | Driller: Caleb Schindler

Project No.: JB215256L

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL JB215256L CHANGE ORDER 4 BO.GPJ TERRACON_DATATEMPLATE.GDT 6/5/24

BORING LOG NO. KB-HDD-113-2

PROJECT: Change Order 4 Borings

CLIENT: Kiewit Engineering (NY) Corp
Lone Tree, CO

SITE: Champlain to Hudson HDD Crossings
Catskill, NY

LOCATION See Exploration Plan

Latitude: 42.229650° Longitude: -73.867216°

Surface Elev.: 104.80 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		LEAN CLAY (CL), sand lenses noted, brown, medium stiff to very stiff *(continued)*	10	5-8-10 N=18	22.2	34-21-13	
30			10	4-5-4 N=9			
35.0	69.8	**SILTY SAND WITH GRAVEL (SM)**, brown, very loose to very dense, (GLACIAL TILL)	16	1-2-2 N=4			
40			16	49-30-27 N=57	8.2		17
45			13	64-188-100/1" 3" Split Spoon			
			0	100/1" 3" Split Spoon			
50							

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

Hammer Type: Automatic

Advancement Method:
2 1/4" ID HSA

Abandonment Method:
Boring backfilled with bentonite grout upon completion

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

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
30 Corporate Cir Ste 201
Albany, NY

Boring Started: 03-11-2024
Boring Completed: 03-12-2024
Drill Rig: CME 750X
Driller: Caleb Schindler
Project No.: JB215256L

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL JB215256L CHANGE ORDER 4 BO.GPJ TERRACON_DATATEMPLATE.GDT 6/5/24

BORING LOG NO. KB-HDD-113-2

PROJECT: Change Order 4 Borings

CLIENT: Kiewit Engineering (NY) Corp
Lone Tree, CO

SITE: Champlain to Hudson HDD Crossings
Catskill, NY

LOCATION See Exploration Plan

Latitude: 42.229650° Longitude: -73.867216°

Surface Elev.: 104.80 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS
SILTY SAND WITH GRAVEL (SM), brown, very loose to very dense, (GLACIAL TILL) *(continued)* grades gray				3	50/2"
		55		2	50/2"
60.1	44.7	60		0	50/1"
Boring Terminated at 60.1 Feet					

GRAPHIC LOG | WATER LEVEL OBSERVATIONS | WATER CONTENT (%) | ATTERBERG LIMITS LL-PL-PI | PERCENT FINES

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

Hammer Type: Automatic

Advancement Method:
2 1/4" ID HSA

Abandonment Method:
Boring backfilled with bentonite grout upon completion

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

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
30 Corporate Cir Ste 201
Albany, NY

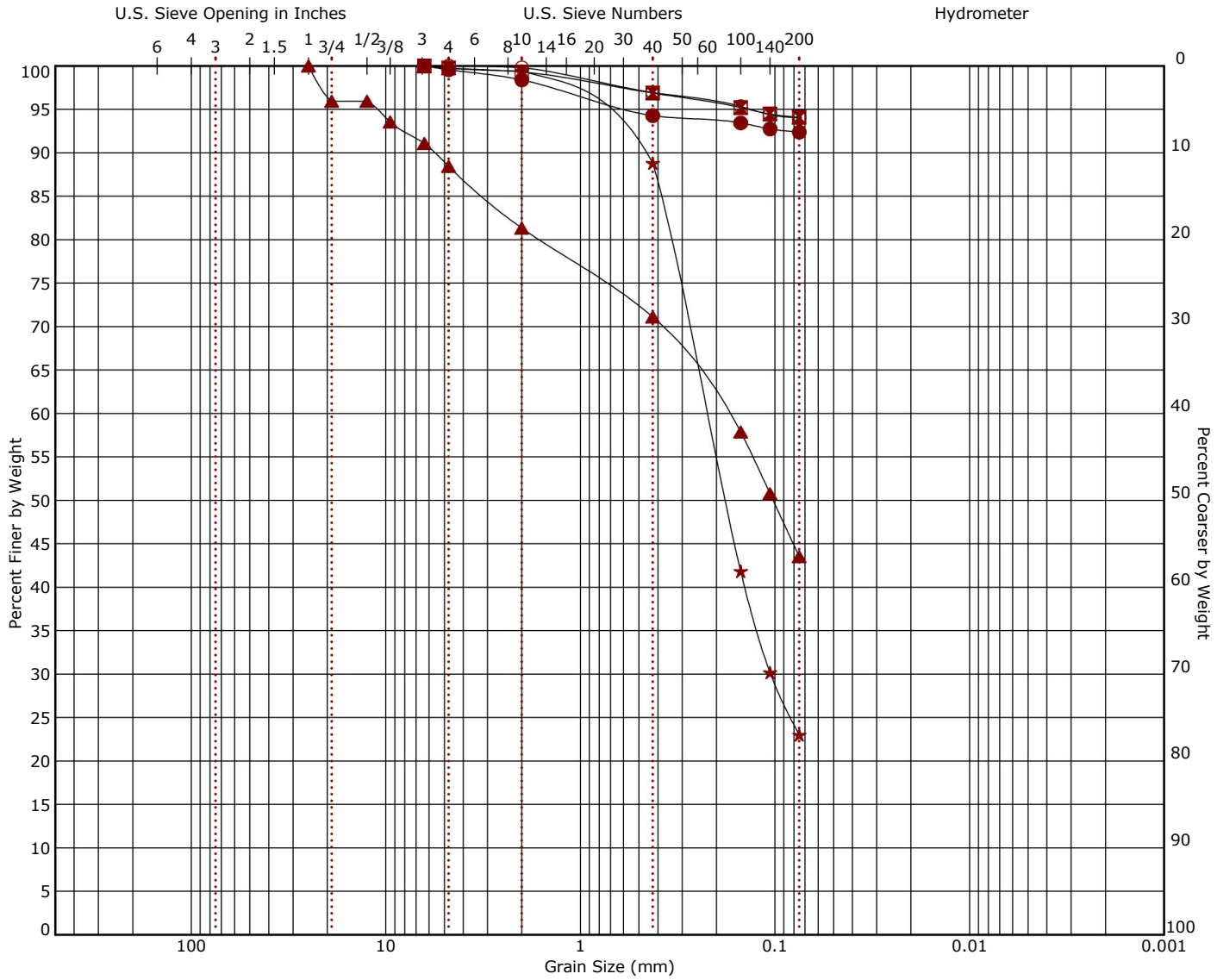
Boring Started: 03-11-2024
Boring Completed: 03-12-2024
Drill Rig: CME 750X
Driller: Caleb Schindler
Project No.: JB215256L

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL JB215256L CHANGE ORDER 4 BO.GPJ TERRACON_DATATEMPLATE.GDT 6/5/24

30 Corporate Cir Ste 201
Albany, NY

Grain Size Distribution

ASTM D422 / ASTM C136



Cobbles	Gravel		Sand			Silt or Clay
	coarse	fine	coarse	medium	fine	

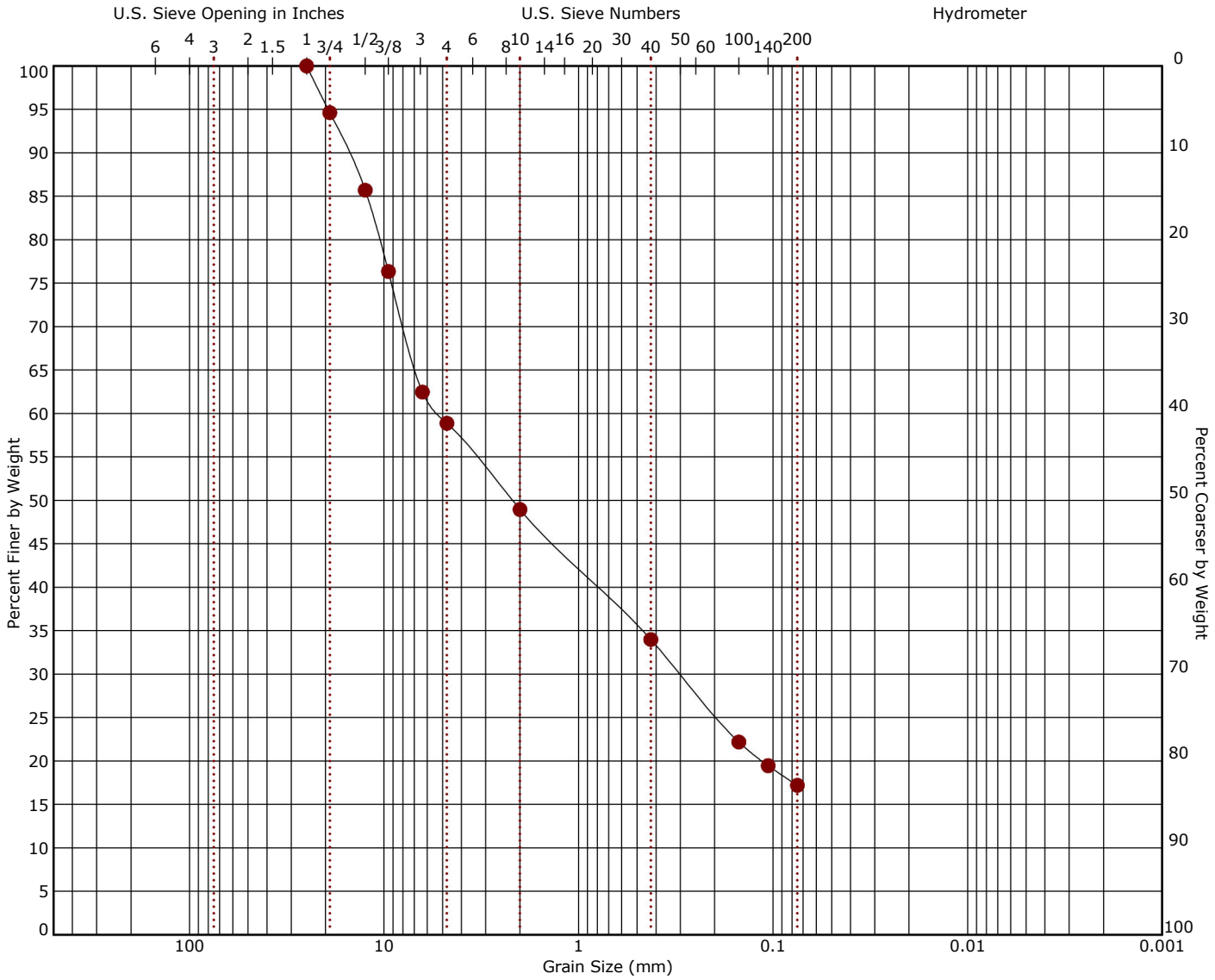
Boring ID	Depth (Ft)	Description	USCS	LL	PL	PI	Cc	Cu
KB-HDD-113-1	8 - 10	LEAN CLAY	CL	42	23	19		
KB-HDD-113-1	30 - 31.5	LEAN CLAY	CL	33	22	11		
KB-HDD-113-1	55 - 56.2	SILTY SAND	SM					
KB-HDD-113-2	10 - 12	SILTY SAND	SM					
KB-HDD-113-2	20 - 21.5	LEAN CLAY	CL	40	23	17		

Boring ID	Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay
KB-HDD-113-1	8 - 10	6.35				0.0	0.4	7.2	92.4		
KB-HDD-113-1	30 - 31.5	6.35				0.0	0.2	5.7	94.1		
KB-HDD-113-1	55 - 56.2	25	0.177			0.0	11.6	44.9	43.5		
KB-HDD-113-2	10 - 12	6.35	0.224	0.105		0.0	0.3	76.7	23.0		
KB-HDD-113-2	20 - 21.5	4.75				0.0	0.0	6.0	94.0		

30 Corporate Cir Ste 201
Albany, NY

Grain Size Distribution

ASTM D422 / ASTM C136



Cobbles	Gravel		Sand			Silt or Clay
	coarse	fine	coarse	medium	fine	

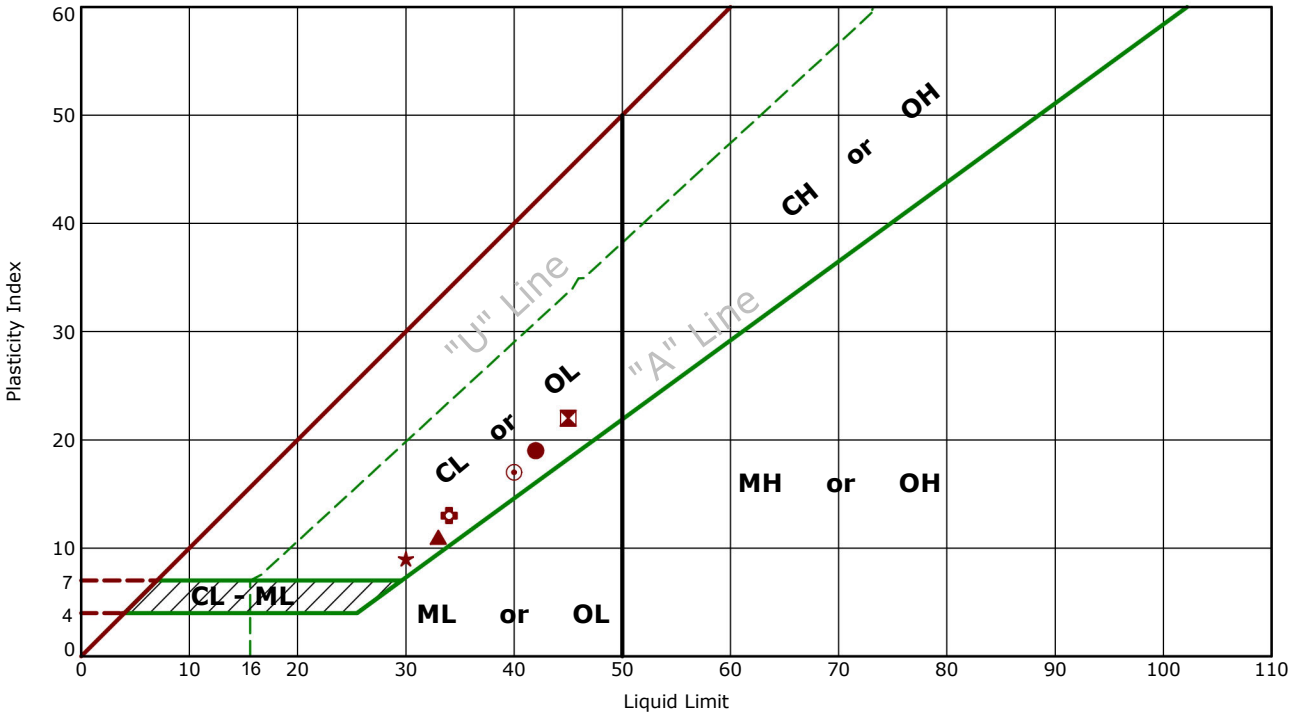
Boring ID	Depth (Ft)	Description	USCS	LL	PL	PI	Cc	Cu
KB-HDD-113-2	40 - 41.5	SILTY SAND with GRAVEL	SM					

Boring ID	Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay
KB-HDD-113-2	40 - 41.5	25	5.203	0.299		0.0	41.1	41.7	17.2		

30 Corporate Cir Ste 201
Albany, NY

Atterberg Limit Results

ASTM D4318



	Boring ID	Depth (Ft)	LL	PL	PI	Fines	USCS	Description
●	KB-HDD-113-1	8 - 10	42	23	19	92.4	CL	LEAN CLAY
⊠	KB-HDD-113-1	10 - 12	45	23	22			
▲	KB-HDD-113-1	30 - 31.5	33	22	11	94.1	CL	LEAN CLAY
★	KB-HDD-113-1	35 - 36.5	30	21	9			
⊙	KB-HDD-113-2	20 - 21.5	40	23	17	94.0	CL	LEAN CLAY
✿	KB-HDD-113-2	25 - 26.5	34	21	13			

Appendix C

BoreAid Calculations Revised

Appendix C

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:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-14-2024
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 1 HDD 113 DWG C-313

Powered by BoreAid

Input Summary

Start Coordinate	(0.00, 0.00, 82.00) ft
End Coordinate	(833.00, 0.00, 114.95) ft
Project Length	833.00 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

Powered by | BoreAid

Soil Summary

Number of Layers: 5

Soil Layer #1 USCS, Gravel (G), GP
From Assistant
Unit Weight: 15.9852 (dry), 17.9718 (sat) [lb/US (liquid) gallon]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Sand (S), SM
From Assistant
Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]
Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

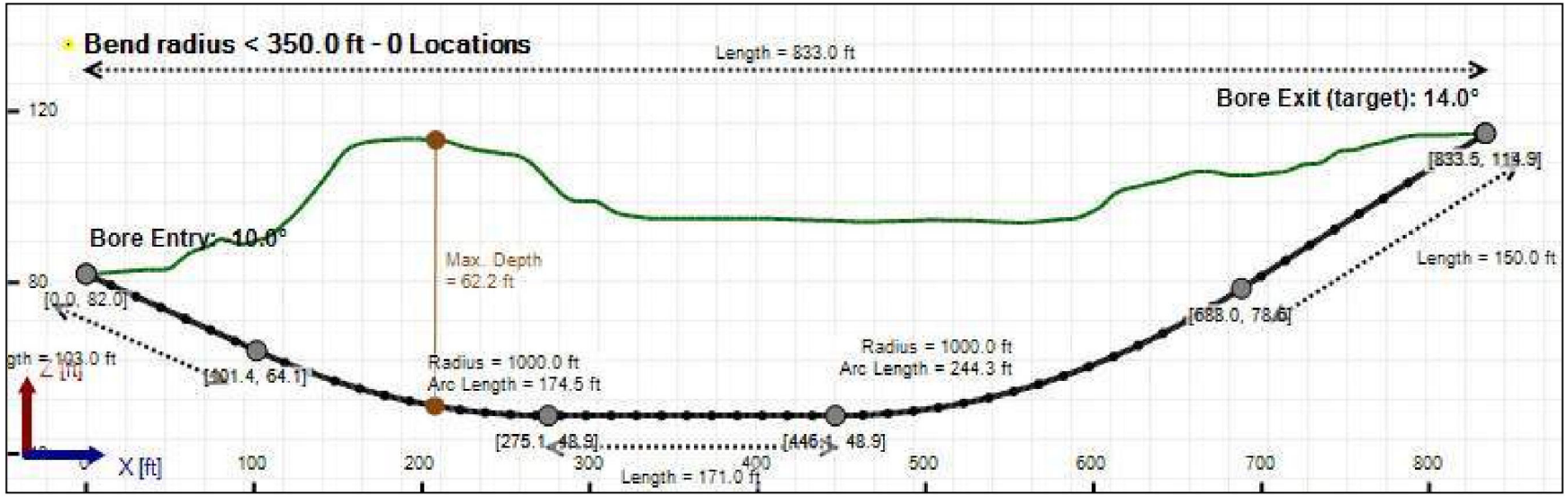
Soil Layer #3 USCS, Clay (C), CL
From Assistant
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Soil Layer #4 USCS, Clay (C), CL
From Assistant
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

Soil Layer #5 USCS, Sand (S), SM
From Assistant
Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]
Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

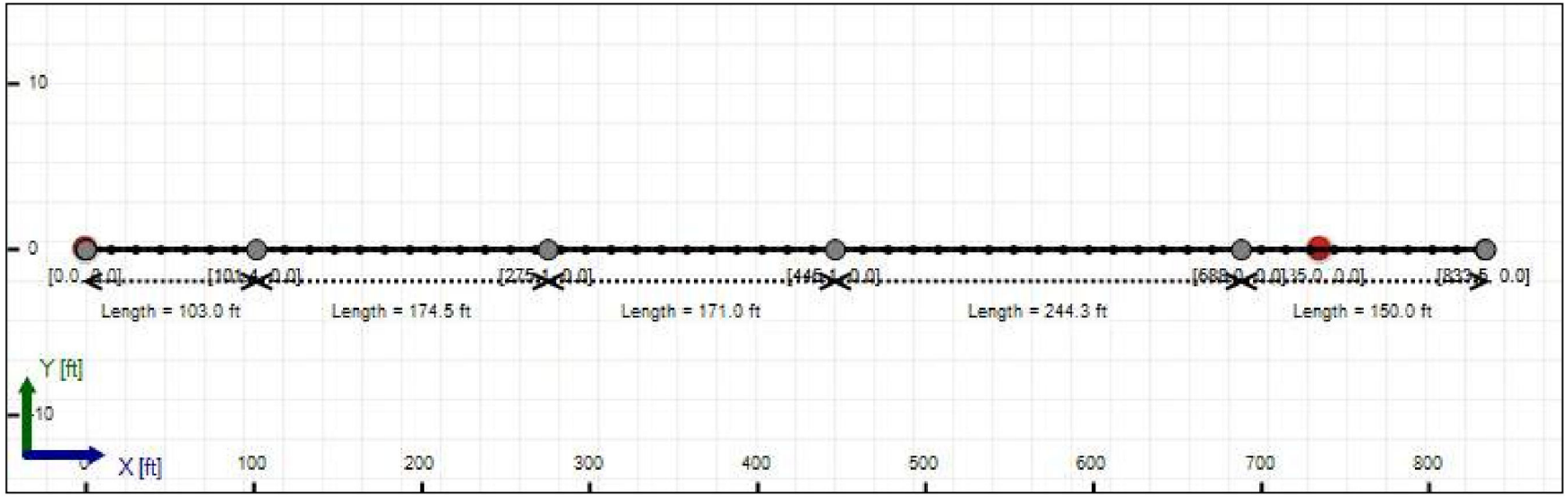
Powered by BoreAid

Bore Cross-Section View



Powered by BoreAid

Bore Plan View



Powered by | BoreAid

Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 10" (10.75")

Pipe DR: 9

Pipe Length: 855.00 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: 7.92790 lb/US (liquid) gallon

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: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

Powered by BoreAid

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	15.5	48.9
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	15.5	48.9
Deflection		
Earth Load Deflection	4.223	13.321
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	4.355	13.453
Compressive Stress [psi]		
Compressive Wall Stress	69.8	220.1

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	16651.7	16651.7
Pullback Stress [psi]	464.4	464.4
Pullback Strain	8.076E-3	8.076E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	464.4	489.3
Tensile Strain	8.076E-3	8.957E-3

Net External Pressure = 43.5 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

Powered by BoreAid

In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	4.355	7.5	1.7	OK
Unconstrained Collapse [psi]	41.1	93.6	2.3	OK
Compressive Wall Stress [psi]	69.8	1150.0	16.5	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	54.8	227.8	4.2	OK
Tensile Stress [psi]	489.3	1200.0	2.5	OK

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Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	135.163 psi	138.612 psi
1	8.75 in	12.00 in	135.134 psi	138.595 psi
2	12.00 in	16.13 in	135.085 psi	138.565 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): 70.00 US (liquid) gallon/min

Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 1000.2

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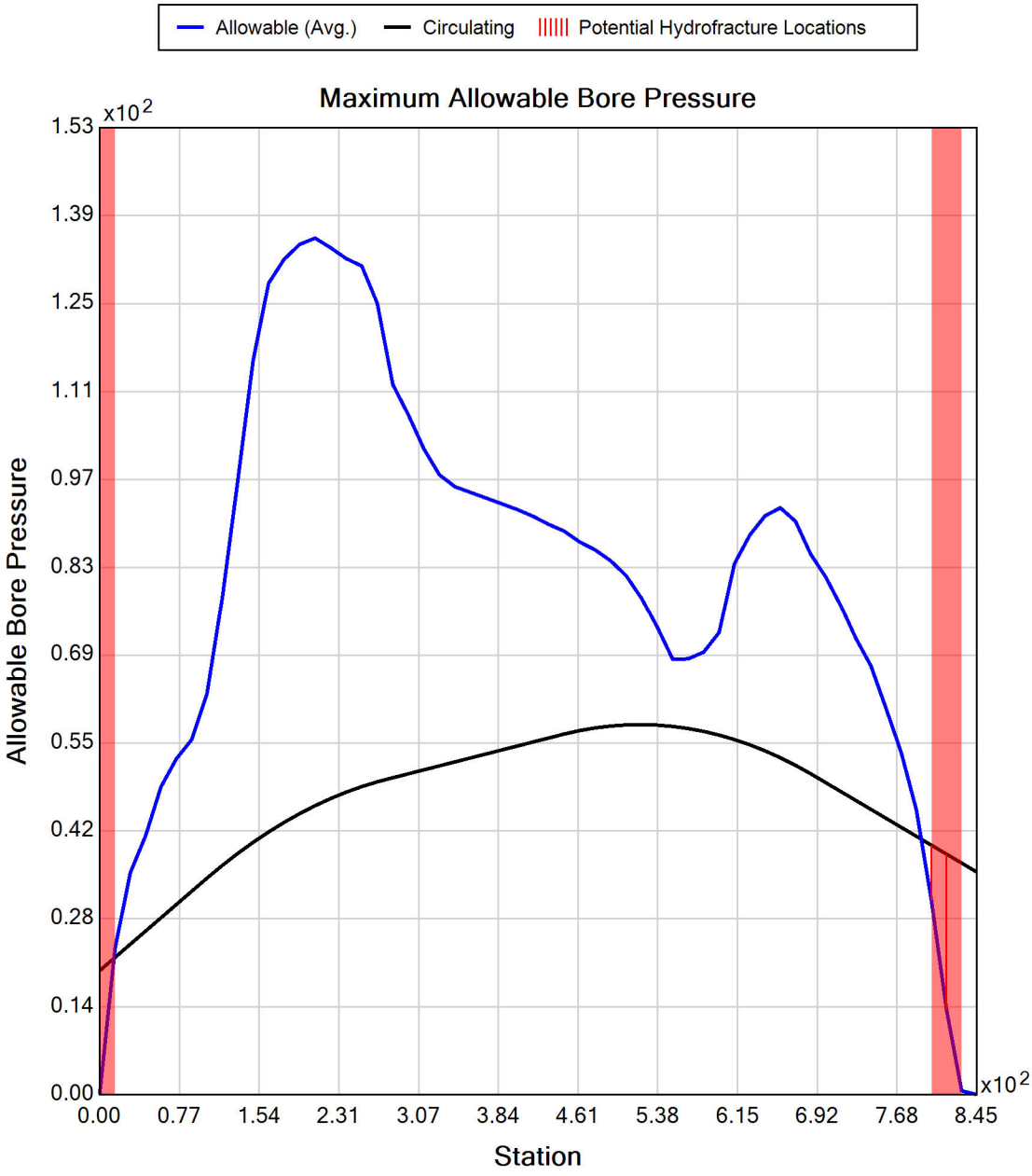

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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-14-2024
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 2 HDD 113 DWG C-313.2

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Input Summary

Start Coordinate	(0.00, 0.00, 82.41) ft
End Coordinate	(833.00, 0.00, 112.94) ft
Project Length	833.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

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Soil Summary

Number of Layers: 5

Soil Layer #1 USCS, Gravel (G), GP
From Assistant
Unit Weight: 15.9852 (dry), 17.9718 (sat) [lb/US (liquid) gallon]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Sand (S), SM
From Assistant
Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]
Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

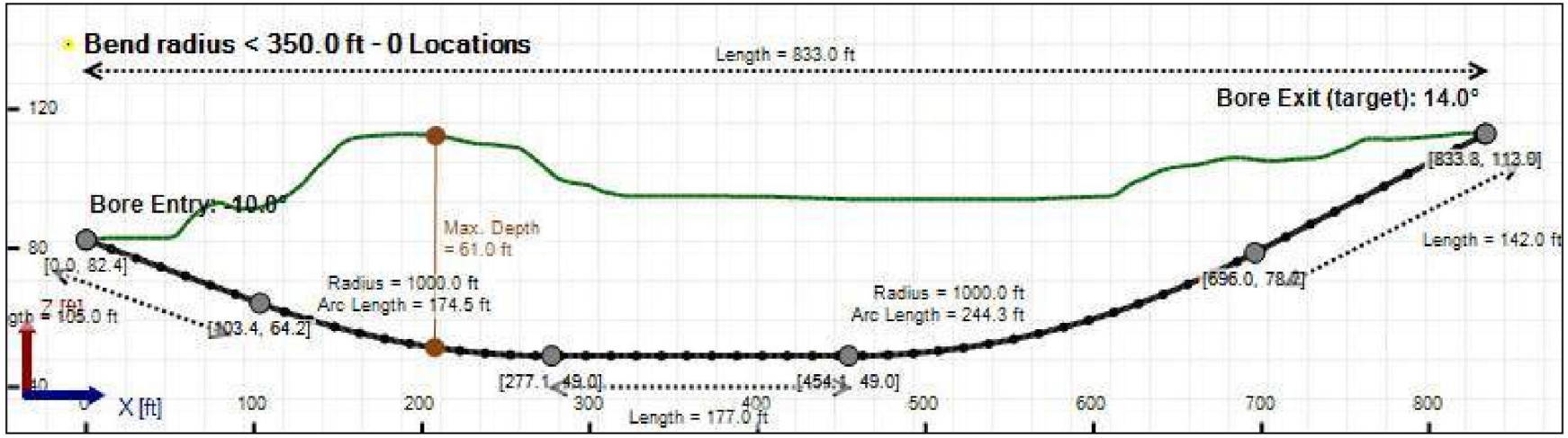
Soil Layer #3 USCS, Clay (C), CL
From Assistant
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Soil Layer #4 USCS, Clay (C), CL
From Assistant
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

Soil Layer #5 USCS, Sand (S), SM
From Assistant
Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]
Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

Powered by BoreAid

Bore Cross-Section View



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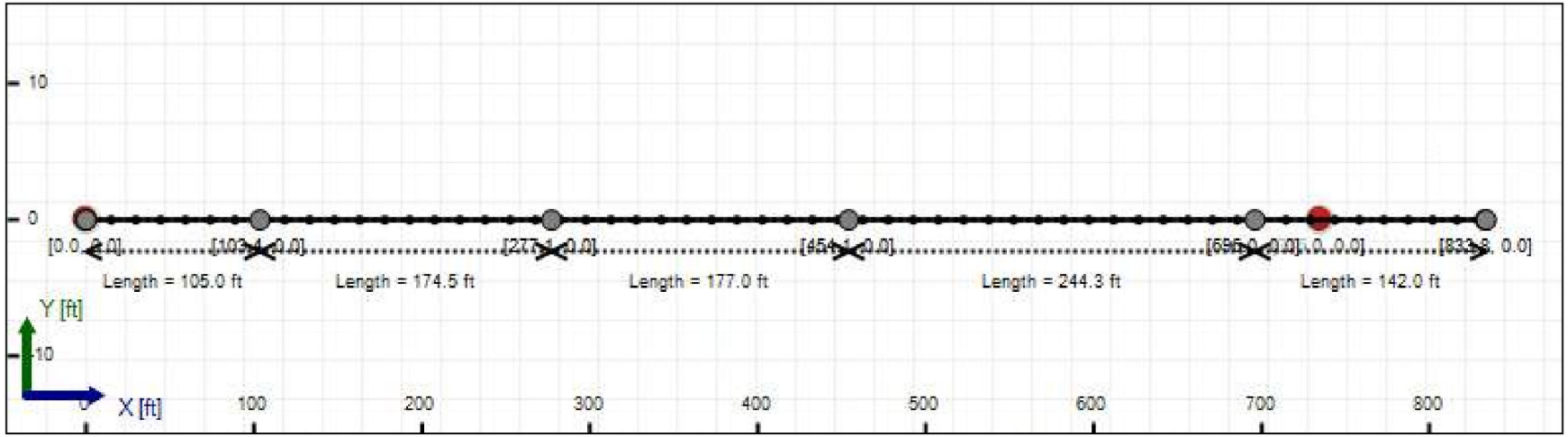
Bore Plan View



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Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 10" (10.75")

Pipe DR: 9

Pipe Length: 855.00 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: 7.92790 lb/US (liquid) gallon

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: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

Powered by BoreAid

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	15.0	48.0
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	15.0	48.0
Deflection		
Earth Load Deflection	4.080	13.062
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	4.212	13.194
Compressive Stress [psi]		
Compressive Wall Stress	67.4	215.8

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	16516.7	16516.7
Pullback Stress [psi]	460.6	460.6
Pullback Strain	8.011E-3	8.011E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	460.6	483.5
Tensile Strain	8.011E-3	8.857E-3

Net External Pressure = 42.0 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

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In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	4.212	7.5	1.8	OK
Unconstrained Collapse [psi]	40.4	95.3	2.4	OK
Compressive Wall Stress [psi]	67.4	1150.0	17.1	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	53.5	228.0	4.3	OK
Tensile Stress [psi]	483.5	1200.0	2.5	OK

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Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	133.065 psi	136.963 psi
1	8.75 in	12.00 in	133.035 psi	136.946 psi
2	12.00 in	16.13 in	132.984 psi	136.915 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): 70.00 US (liquid) gallon/min

Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 1000.2

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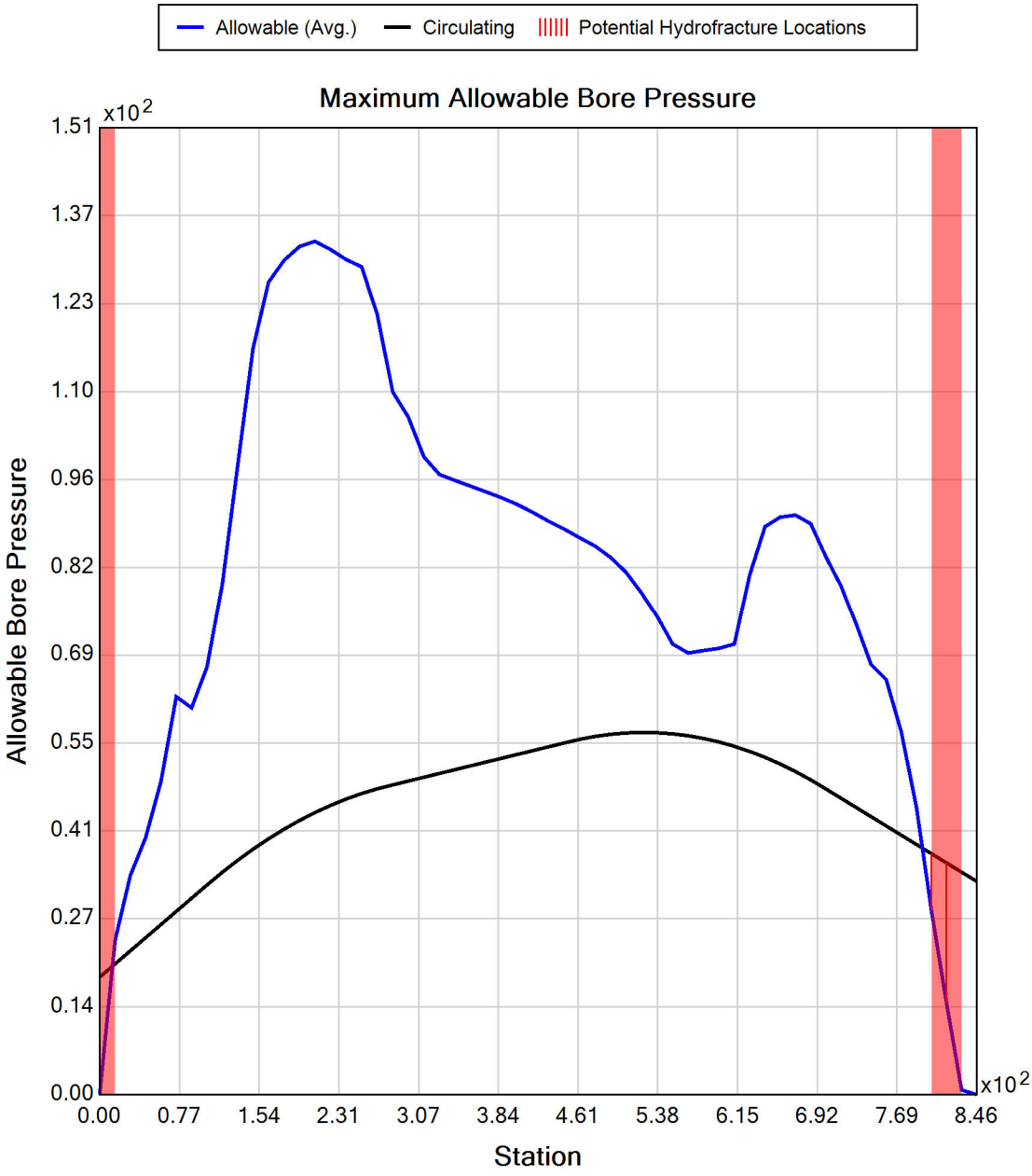

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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-14-2024
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 3 HDD 113 DWG C-313.2

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Input Summary

Start Coordinate	(0.00, 0.00, 82.41) ft
End Coordinate	(833.00, 0.00, 112.94) ft
Project Length	833.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	3.500 in
Pipe DR	9.0
Pipe Thickness	0.39 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

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Soil Summary

Number of Layers: 5

Soil Layer #1 USCS, Gravel (G), GP
From Assistant
Unit Weight: 15.9852 (dry), 17.9718 (sat) [lb/US (liquid) gallon]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Sand (S), SM
From Assistant
Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]
Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #3 USCS, Clay (C), CL
From Assistant
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Soil Layer #4 USCS, Clay (C), CL
From Assistant
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

Soil Layer #5 USCS, Sand (S), SM
From Assistant
Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]
Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

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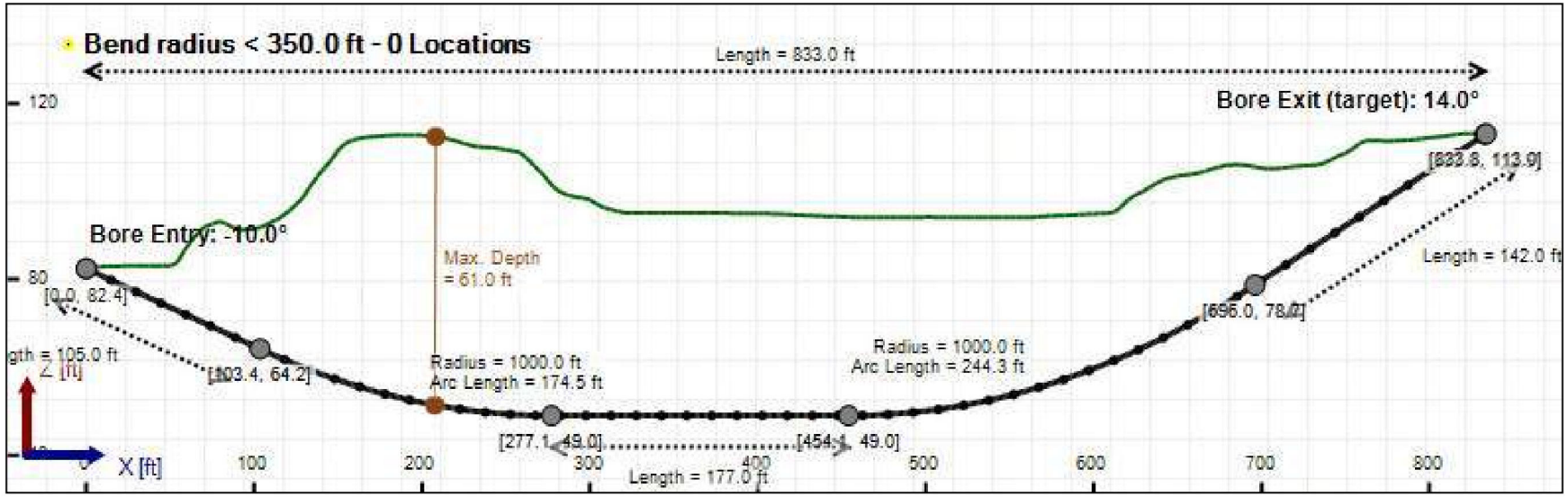
Bore Cross-Section View



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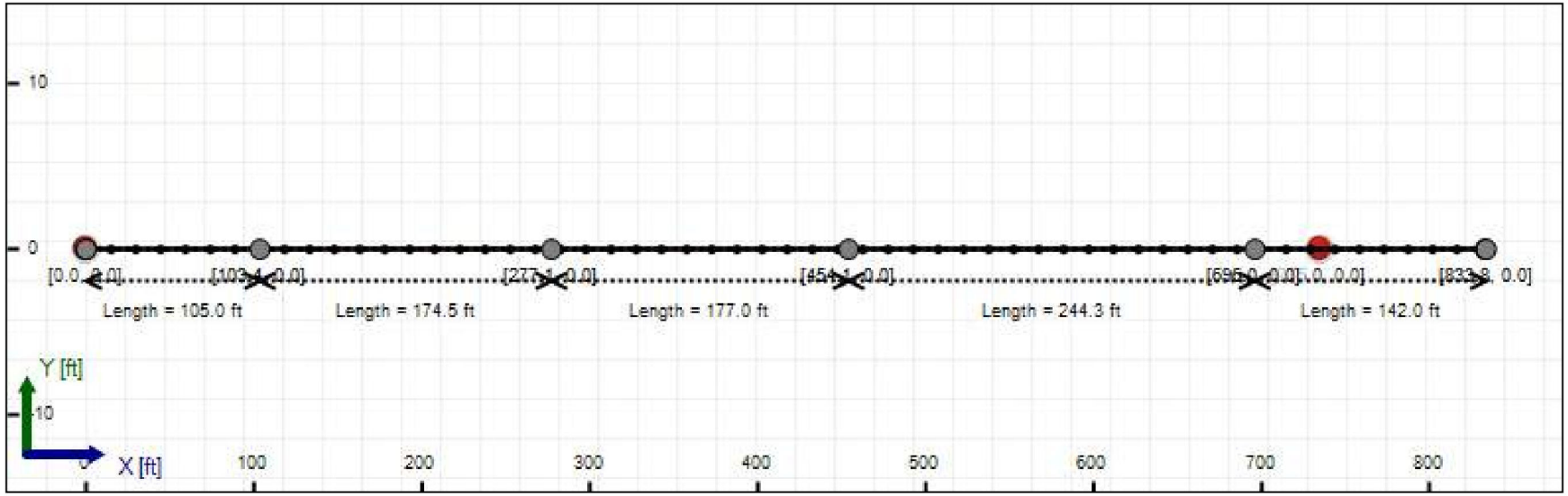
Bore Plan View



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Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 3" (3.5")

Pipe DR: 9

Pipe Length: 855.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 0.625 ft

Silo Width: 0.625 ft

Surface Surcharge: 0 psi

Short Term Modulus: 57500 psi

Long Term Modulus: 28200 psi

Short Term Poisson Ratio: 0.35

Long Term Poisson Ratio: 0.45

Pipe Unit Weight: 7.92790 lb/US (liquid) gallon

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: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

Powered by BoreAid

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	11.1	48.0
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	11.1	48.0
Deflection		
Earth Load Deflection	3.018	13.062
Buoyant Deflection	0.043	0.043
Reissner Effect	0	0
Net Deflection	3.061	13.105
Compressive Stress [psi]		
Compressive Wall Stress	49.9	215.8

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	1863.4	1863.4
Pullback Stress [psi]	490.3	490.3
Pullback Strain	8.526E-3	8.526E-3
Bending Stress [psi]	0.0	8.4
Bending Strain	0	1.458E-4
Tensile Stress [psi]	490.3	495.8
Tensile Strain	8.526E-3	8.768E-3

Net External Pressure = 42.0 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 172.8 lb

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In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	3.061	7.5	2.4	OK
Unconstrained Collapse [psi]	40.4	112.5	2.8	OK
Compressive Wall Stress [psi]	49.9	1150.0	23.1	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.021	7.5	355.7	OK
Unconstrained Collapse [psi]	53.5	228.1	4.3	OK
Tensile Stress [psi]	495.8	1200.0	2.4	OK

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Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	133.065 psi	136.963 psi
1	8.75 in	12.00 in	133.035 psi	136.946 psi
2	12.00 in	16.13 in	132.984 psi	136.915 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): 70.00 US (liquid) gallon/min

Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 1000.2

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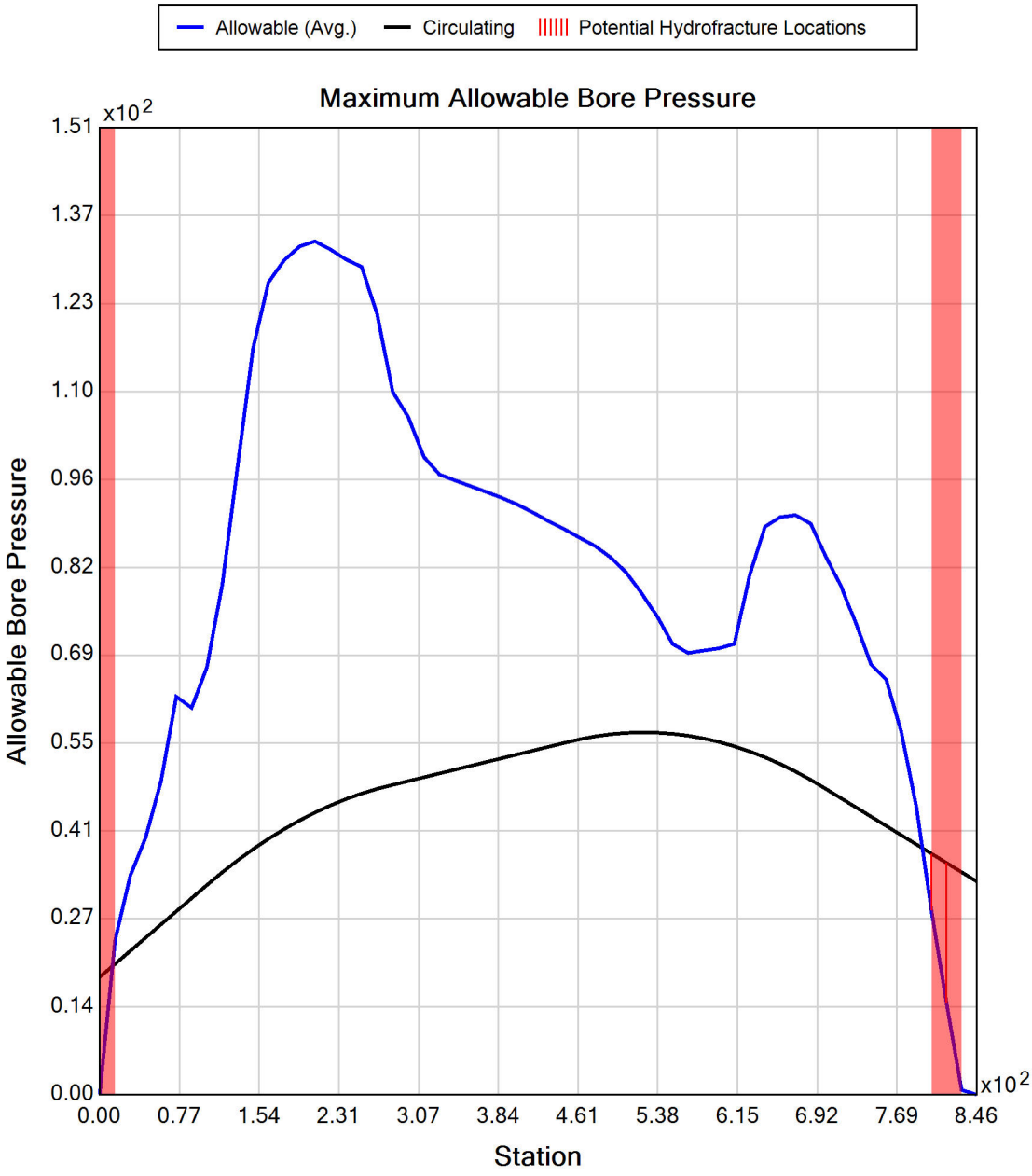

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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-14-2024
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 2 & 3 Equivalent Pipe Bundle HDD 113 DWG C-313.2

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Input Summary

Start Coordinate	(0.00, 0.00, 82.41) ft
End Coordinate	(833.00, 0.00, 112.94) ft
Project Length	833.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	11.305 in
Pipe DR	6.3
Pipe Thickness	1.79 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

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Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 11.305 in

Pipe DR: 6.3

Pipe Length: 855.00 ft

Internal Pressure: 0 psi

Borehole Diameter: 1.4129999478658 ft

Silo Width: 1.4129999478658 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: 7.92790 lb/US (liquid) gallon

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: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

Powered by BoreAid

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	12.5	41.6
Water Pressure	7.8	8.8
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	20.3	50.4
Deflection		
Earth Load Deflection	1.016	3.292
Buoyant Deflection	0.048	0.048
Reissner Effect	0	0
Net Deflection	1.063	3.340
Compressive Stress [psi]		
Compressive Wall Stress	63.8	158.7

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	16962.0	16962.0
Pullback Stress [psi]	316.4	316.4
Pullback Strain	5.502E-3	5.502E-3
Bending Stress [psi]	0.0	27.1
Bending Strain	0	4.710E-4
Tensile Stress [psi]	316.4	343.0
Tensile Strain	5.502E-3	6.437E-3

Net External Pressure = 43.7 [psi]

Buoyant Deflection = 0.0

Hydrokinetic Force = 627.2 lb

Powered by BoreAid

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.023	7.5	321.1	OK
Unconstrained Collapse [psi]	53.5	813.5	15.2	OK
Tensile Stress [psi]	343.0	1200.0	3.5	OK

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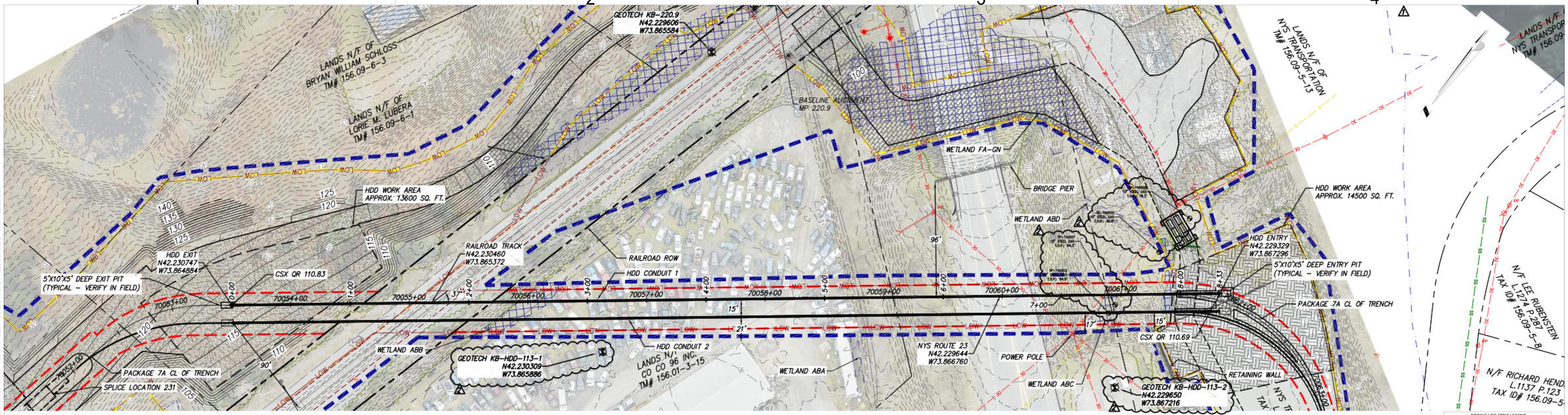
Appendix D

Sheets Revised

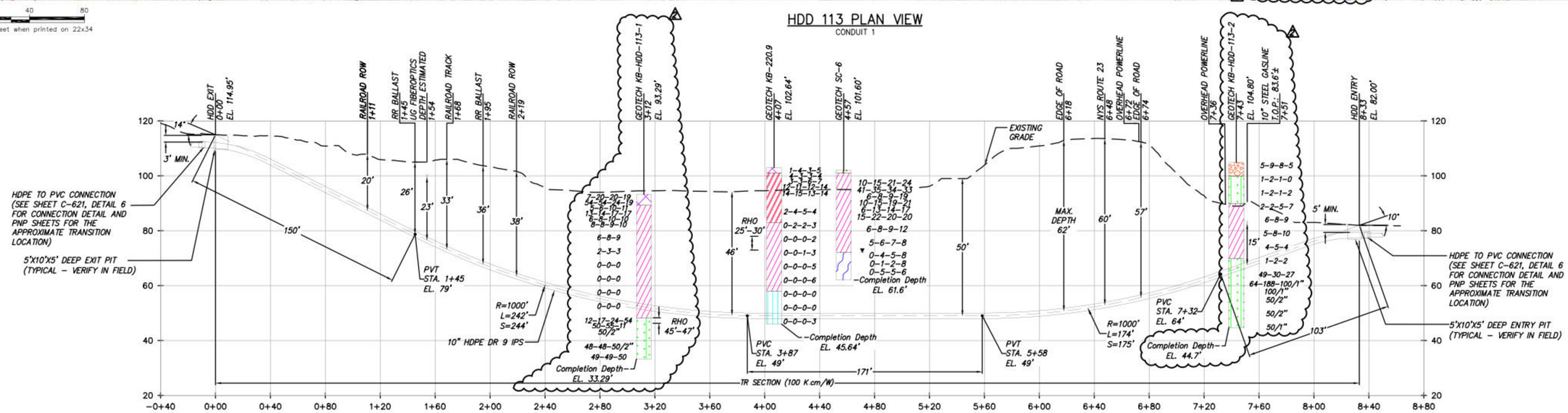
Appendix D

HDD Design Drawings



HDD 113 PLAN VIEW

CONDUIT 1



HDD 113 PROFILE VIEW

CONDUIT 1

DESIGN AND CONSTRUCTION NOTES:

1. INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL.
2. 10.750" HDPE MIN. W.T. 1.194" DR 9 IPS PIPE.
   3.500" HDPE MIN. W.T. 0.389" DR 9 IPS PIPE.
   HDD HORIZONTAL LENGTH (L): 833'
   HDD DESIGNED PIPE LENGTH (S): 843'
3. THE MINIMUM THREE JOINT (APPROX. 100 FT) COMBINED CURVE (VERTICAL + HORIZONTAL) RADIUS SHALL NOT BE LESS THAN 800 FT.
4. THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FT.
5. DRILL CONTRACTOR AND/OR GEOTECHNICAL ENGINEER TO DETERMINE LENGTH OF TEMPORARY SURFACE/CONDUCTOR CASING.
6. SPT N-VALUES SHOWN ON THIS DRAWING ARE NOT CORRECTED FOR SAMPLER SIZE OR HAMMER ENERGY. REFERENCE BORING LOGS AND GEOTECHNICAL REPORTS FOR ADDITIONAL SOIL INFORMATION.
7. BUOYANCY CONTROL MEASURES (INTERNAL WATER USED FOR BALLAST) SHALL BE UTILIZED DURING PULLBACK FOR ALL BUNDLED CASINGS AT DRILL CONTRACTOR'S DISCRETION.

GENERAL NOTES:

1. ALL BURIED LINE DEPTHS ARE APPROXIMATE. PRIOR TO ANY EXCAVATION OR EXPLORATORY BORING, CONTRACTOR MUST CONTACT 811 AND ABIDE BY ALL STATE EXCAVATION REQUIREMENTS. CONTRACTOR MUST CONTACT CSX WHENEVER ON RR ROW.
2. TETRA TECH ENGINEERING AND SURVEYING P.C. IS NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES IN THIS DRAWING. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF TETRA TECH ENGINEERING AND SURVEYING P.C. OR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
3. ALL COORDINATES ARE IN NEW YORK STATE PLANE, NAD83, EAST ZONE, US FOOT.

CHPE Champlain Hudson Power Express

PROJECT NO.: 21162 | PROJECT NO.: 204-3701 | ALTERED ON: | AFFIXED ON: 06/14/2024

Kiewit

TETRA TECH

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(A NEW YORK PROFESSIONAL CORPORATION)

STATE OF NEW YORK · EDWARD J. KELLY · 094981 · LICENSED PROFESSIONAL ENGINEER

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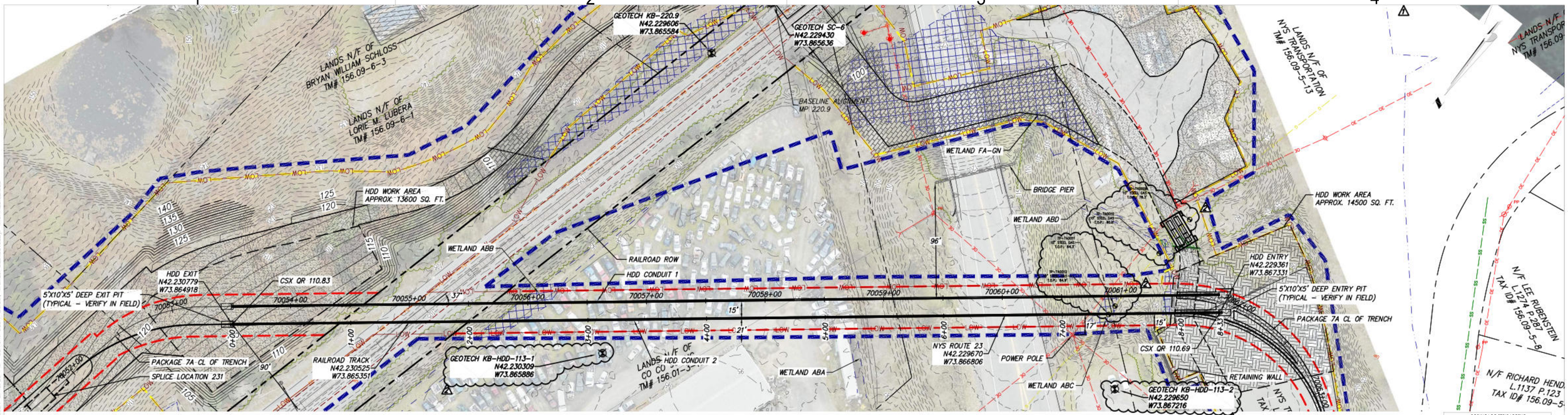
No.	DATE	SUBMITTAL / REVISION DESCRIPTION	DB	APP
2	06/14/2024	NDC-0122: HDD 113 GEOTECH DATA & QL-A UPDATE	MRS	EJK
1	03/18/2024	NDC-0043: HDD 113 ALIGNMENT CHANGE	MRS	EJK
0	06/19/2023	ISSUED FOR CONSTRUCTION SUBMISSION	MRS	EJK

CHAMPLAIN HUDSON POWER EXPRESS
SEGMENT 11 (PACKAGE 7A) - CSX: CATSKILL
PLAN AND PROFILE - HDD 113
RAILROAD AND HWY 23 CROSSING - CONDUIT 1
GREENE COUNTY, NY

DRAWN BY: MRS | DESIGNED BY: AMC | APPROVED BY: EJK | SCALE AS SHOWN | DATE: 06/19/2023

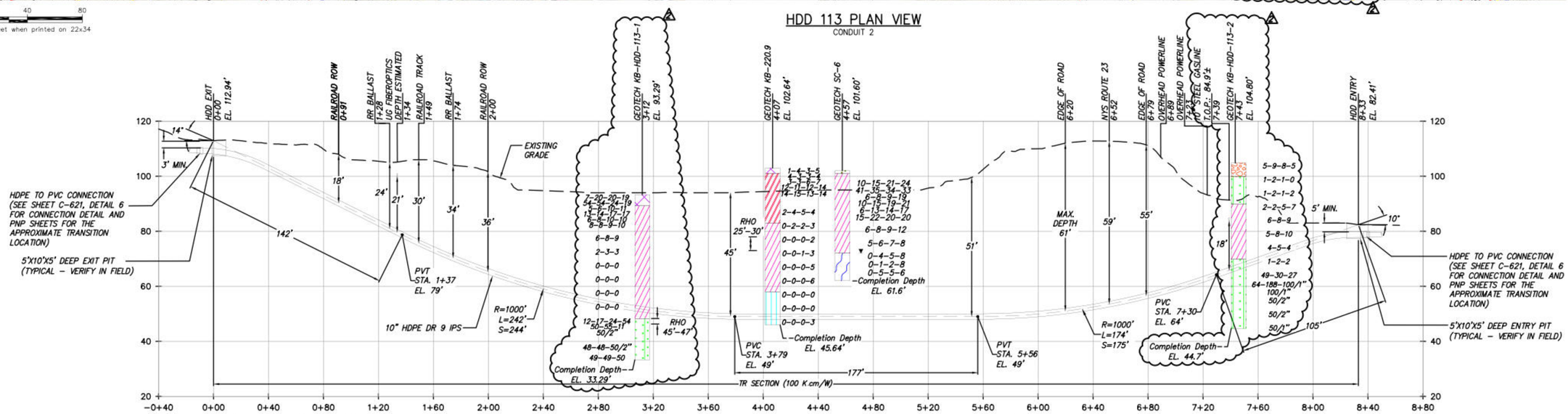
PERMIT DRAWING NO. **C-313-B**

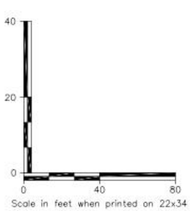
DRAWING NO. **C-313**



HDD 113 PLAN VIEW

CONDUIT 2





DESIGN AND CONSTRUCTION NOTES:

1. INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL.
2. 10.750" HDPE MIN. W.T. 1.194" DR 9 IPS PIPE.
   3.500" HDPE MIN. W.T. 0.389" DR 9 IPS PIPE.
   HDD HORIZONTAL LENGTH (L): 833'
   HDD DESIGNED PIPE LENGTH (S): 843'
3. THE MINIMUM THREE JOINT (APPROX. 100 FT) COMBINED CURVE (VERTICAL + HORIZONTAL) RADIUS SHALL NOT BE LESS THAN 800 FT.
4. THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FT.
5. DRILL CONTRACTOR AND/OR GEOTECHNICAL ENGINEER TO DETERMINE LENGTH OF TEMPORARY SURFACE/CONDUCTOR CASING.
6. SPT N-VALUES SHOWN ON THIS DRAWING ARE NOT CORRECTED FOR SAMPLER SIZE OR HAMMER ENERGY. REFERENCE BORING LOGS AND GEOTECHNICAL REPORTS FOR ADDITIONAL SOIL INFORMATION.
7. BUOYANCY CONTROL MEASURES (INTERNAL WATER USED FOR BALLAST) SHALL BE UTILIZED DURING PULLBACK FOR ALL BUNDLED CASINGS AT DRILL CONTRACTOR'S DISCRETION.

HDD 113 PROFILE VIEW

CONDUIT 2

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CHPE Champlain Hudson Power Express

PROJECT NO.: 21162 | PROJECT NO.: 204-3701 | ALTERED ON: | AFFIXED ON: 06/14/2024

Kiewit

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CHAMPLAIN HUDSON POWER EXPRESS
SEGMENT 11 (PACKAGE 7A) - CSX: CATSKILL
PLAN AND PROFILE - HDD 113
RAILROAD AND HWY 23 CROSSING - CONDUIT 2
GREENE COUNTY, NY

DRAWN BY: MRS | DESIGNED BY: AMC | APPROVED BY: EJK | SCALE AS SHOWN | DATE: 06/19/2023

PERMIT DRAWING NO. **C-313.2-B**

DRAWING NO. **C-313.2**

Champlain Hudson Power Express

UPDATES TO
Inadvertent Release Contingency Plan for Horizontal Directional Drilling in Segment 11 - Package 7A *FOR HDD 113*

For Design Rev. #2 || Design Rev. Date: 06/14/2024

Catskill to Germantown
Green County, New York

TTR Project Number 204-3701

STATE OF NEW YORK
EDWARD J. KELLY
094981

Prepared for:
Transmission Developers Inc.
600 Broadway Street
Albany, NY 12207

Prepared by:
Tetra Tech Engineering and Surveying, P.C.
(A New York Professional Corporation)
115 Inverness Drive East, Suite 300
Englewood, CO 80112
(303) 792-5911

June 2024

10.0 CROSSING SPECIFIC DISCUSSION

Text Revised

10.3 HDD CROSSING #113

10.3.2 Ground Conditions

Four Geotechnical bores (***KB-HDD-113-1***, KB-220.9, SC-6, ***and KB-HDD-113-2***) are located along the proposed HDD #113 alignment. The other borings listed in *Appendix B* of the DSR (K-221.0 and B221.0-1) are located outside the extents of the HDD alignment and are provided as reference only for the geology in the area. The full details of these Geotechnical borings, including bore log and lab testing data, can be found in *Appendix B* of the DSR for segment 11 package 7A. After reviewing and comparing these samples, geotechnical boring ***KB-HDD-113-2*** was selected to be used in the BoreAid analysis as it best represented the complete soil strata for the HDD alignment and covered the full depth of the HDD profile. Consideration was taken for the other Geotechnical borings in the design of the HDD. ***The Soils Assistant was used in BoreAid to build the complete soil strata for HDD #113 as borings KB-HDD-113-1 and KB-220.9 displayed similar soil layers as KB-HDD-113-2, but at differing depths.*** Geotechnical boring ***KB-HDD-113-2*** is located along the proposed HDD alignment at approximately station ***70060+95***. The surface elevation at the geotechnical bore was El. ***105*** feet and the total length of the bore was ***60*** feet. Based on the boring, the soil profile for the BoreAid analysis was divided into ***five (5)*** layers as listed out below in section 10.3.2.1. The soil profiles used for BoreAid analysis of the HDDs in this segment are shown in *Appendix A*.

10.3.2.1 Descriptions of the layers used for each HDD Crossing are summarized below:

- ***Layer 1 – Poorly Graded Gravel with Sand (GP): The gravel with sand layer extends from the ground surface at approximate El. 105 to 100 feet. This layer consists of brown, medium dense gravel with sand.***
- ***Layer 2 – Silty Sand (SM): Immediately below the above layer was a brown, loose to very loose sand from El. 100 to 90 feet.***
- ***Layer 3 – Clay (CL): A lean clay layer follows the silty sand layer from El. 90 to 68 feet. This layer consists of brown, medium stiff to very stiff clay.***
- ***Layer 4 – Clay (CL): From El. 68 to 48 feet the lean clay layer transitions from soft to very soft clay.***
- ***Layer 5 – Silty Sand (SM): The final layer that was present in this geotechnical sample was a silty sand layer that was present from El. 70 to 33 feet where the boring was***

terminated. This layer consists of gray, loose to predominantly very dense silty sand (Glacial Till).

10.3.3 Specific Design Considerations Include:

Preliminary analysis of the geotechnical bores, assuming typical drilling methods, indicates that the maximum allowable pressure capacity in the middle of the alignment is approximately ***135*** psi and the drill fluid pressure estimated to occur in the middle portion ranges from 30 to 55 psi. In the remaining section of the drill the maximum allowable pressure ranges from approximately ***135*** to ***1*** psi. The approximate minimum required drill fluid pressure needed to return cuttings ranges from 21 to 58 psi and the estimated operating drill fluid pressure can range from 27 to 73 psi. A sketch showing the maximum allowable pressure and the minimum required drill fluid pressure is provided in the BoreAid analyses in *Appendix A.*

The entry workspace is variable width and the exit workspace has a designed width of 100 feet by 150 feet long. There is also a pit 5 feet wide by 10 feet long and 5 feet deep at the entry and exit of the drill to help contain the drilling fluid when actively drilling. An approximate 843 feet-long by 20 feet-wide pipe assembly corridor will be required on the exit side of the drill within the acquired easement. Erosion and sediment control measure will be available on site as listed in section 3.7 as added precaution and preventative measures.

It appears that there is a potential for releases at the entry and exit of the HDD. These should be relatively easily controlled through the use of conductor casing, haybales, silt fences, erosion control measures and vacuum trucks.

In our opinion the conditions conducive to inadvertent releases that may exist at this site based on the ground conditions described in the borings at the site include:

- The silty sand ***layers*** that are expected to be present at the entry and exit side of the drill. The results of the BoreAid analysis indicate the risk for a release due to this layer is low. Utilizing a conductor/surface casing (installed along the entry/exit tangent), monitoring the drilling pressures, and minimizing the drill fluid pressures over the final 60-feet will limit the chance for an IR event occurring during the pilot and reaming phases of the drill. If these recommendations are followed it is our opinion that an uncontrollable release due to these layers are low.
- In the general area of the railroad the boring indicates that the drill will be in the predominantly lean clay layer. ***The results of the BoreAid analysis combined with the***

depth of the drill leads to our opinion that the risk for a release in this area is also low. It should be noted that the lean clay layer around the railroad ROW (HDD stationing 1+11 to 2+19) appears to transition from very soft to hard clay where the HDD will be steering to the ground surface. Due to the variable drill depth and soil strength under the railroad ROW, it is recommended to closely monitor the drill fluid and minimize the drill fluid pressures as much as possible. Doing so will limit the chance of an IR event occurring and minimize any potential ground settlement during the pilot and reaming phases of the drill in this sensitive area.

Additional design considerations and recommended IR preventative measures include:

- Drilling an 8in or larger diameter pilot hole is recommended to reduce the required drill fluid pressures *(Note: 8.75in diameter pilot hole was used in the BoreAid analysis)*
- Requiring monitoring and controlling drilling fluid pressures with downhole sensors during pilot hole and reaming operations.
- Requiring drilling fluid composition and drilling procedures that minimize drilling fluid pressures.
- Requiring drilling fluids that adequately address site-specific drilling concerns while posing the least threat to the environment.
- Increased monitoring and potential for reduced drill fluid pressures as the drill path approaches the Geotech bore locations. If a reduction in drill fluid pressures is noticed at a specific Geotech location that location can be proactively used as a strategic drill fluid containment relief well.
- If pressure is reaching the maximum allowable, the contractor can trip back as needed to clean the hole, before advancing the HDD.
- The contractor may elect to minimize drill fluid pressures as they approach the exit and/or push the drill bit over the final 60-feet.

Appendix A

BoreAid Calculations Revised

Appendix A

BoreAid HDD Simulation Output

Generated Output

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Project Summary

General:	Kiewit - CHPE Ref: New York 204-3701 Start Date: 04-29-2022 End Date: 06-14-2024
Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 1 HDD 113 DWG C-313

Powered by BoreAid

Input Summary

Start Coordinate	(0.00, 0.00, 82.00) ft
End Coordinate	(833.00, 0.00, 114.95) ft
Project Length	833.00 ft
Pipe Type	HDPE
OD Classification	IPS
Pipe OD	10.750 in
Pipe DR	9.0
Pipe Thickness	1.19 in
Rod Length	15.00 ft
Rod Diameter	3.5 in
Drill Rig Location	(0.00, 0.00, 0.00) ft

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Soil Summary

Number of Layers: 5

Soil Layer #1 USCS, Gravel (G), GP
From Assistant
Unit Weight: 15.9852 (dry), 17.9718 (sat) [lb/US (liquid) gallon]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

Soil Layer #2 USCS, Sand (S), SM
From Assistant
Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]
Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

Soil Layer #3 USCS, Clay (C), CL
From Assistant
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 400.00, Coh: 8.30 [psi]

Soil Layer #4 USCS, Clay (C), CL
From Assistant
Unit Weight: 14.3220 (dry), 16.8861 (sat) [lb/US (liquid) gallon]
Phi: 0.00, S.M.: 200.00, Coh: 3.10 [psi]

Soil Layer #5 USCS, Sand (S), SM
From Assistant
Unit Weight: 15.6618 (dry), 17.7639 (sat) [lb/US (liquid) gallon]
Phi: 30.00, S.M.: 145.00, Coh: 4.40 [psi]

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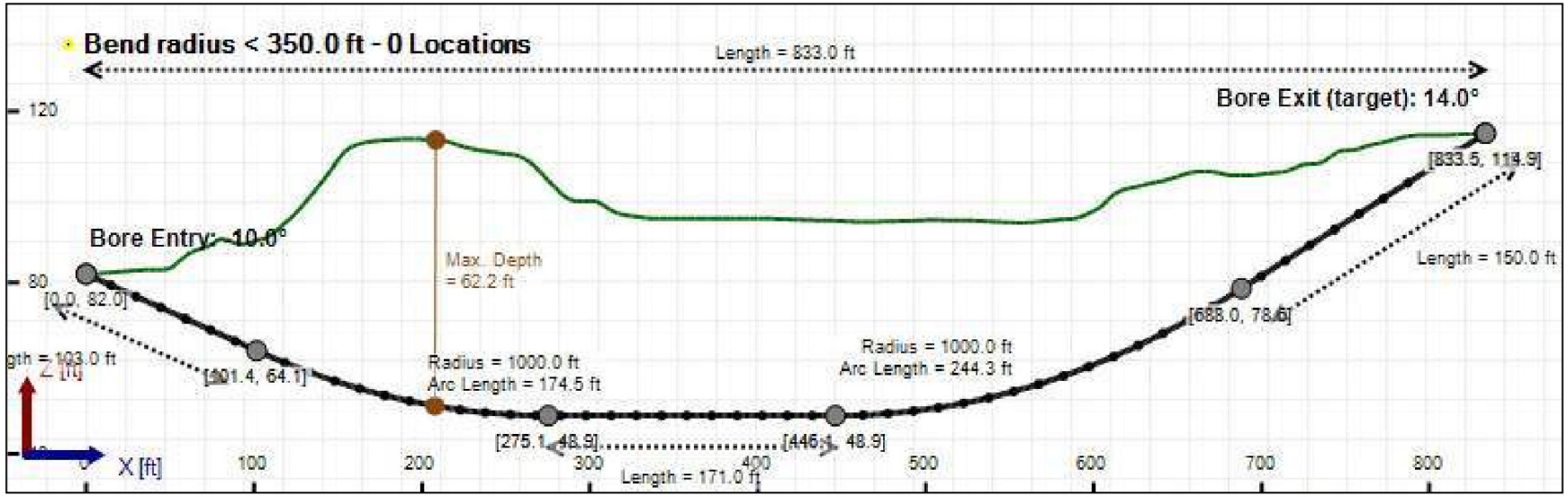
Bore Cross-Section View



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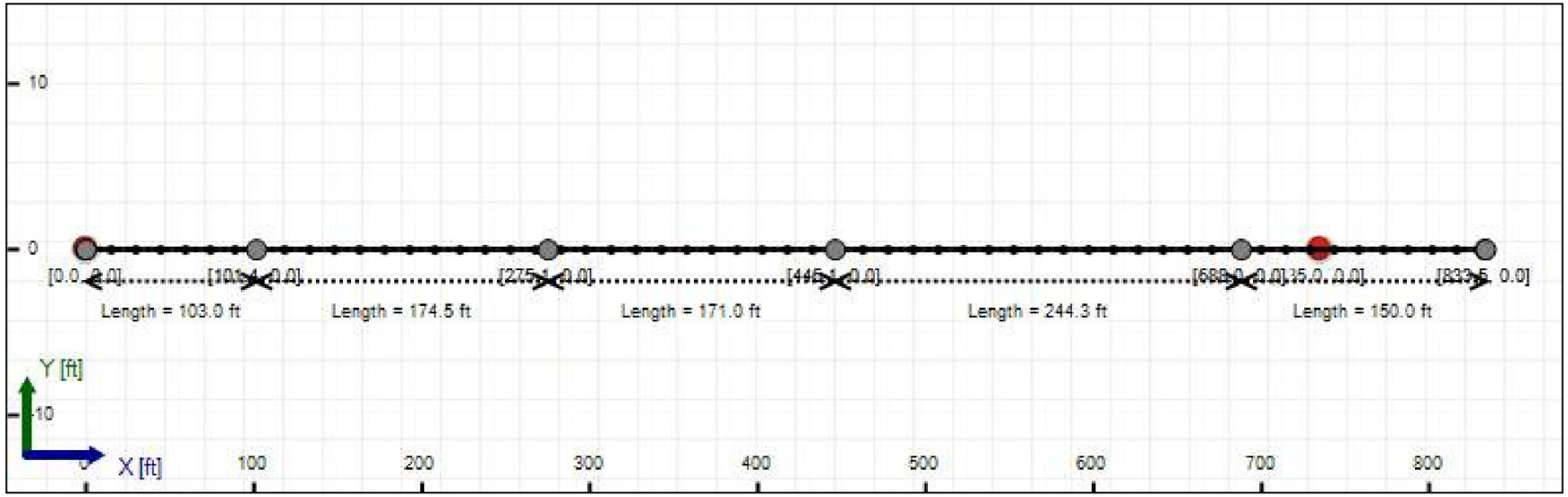
Bore Plan View



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Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 10" (10.75")

Pipe DR: 9

Pipe Length: 855.00 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: 7.92790 lb/US (liquid) gallon

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: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

Powered by BoreAid

In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	15.5	48.9
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	15.5	48.9
Deflection		
Earth Load Deflection	4.223	13.321
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	4.355	13.453
Compressive Stress [psi]		
Compressive Wall Stress	69.8	220.1

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	16651.7	16651.7
Pullback Stress [psi]	464.4	464.4
Pullback Strain	8.076E-3	8.076E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	464.4	489.3
Tensile Strain	8.076E-3	8.957E-3

Net External Pressure = 43.5 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

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In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	4.355	7.5	1.7	OK
Unconstrained Collapse [psi]	41.1	93.6	2.3	OK
Compressive Wall Stress [psi]	69.8	1150.0	16.5	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	54.8	227.8	4.2	OK
Tensile Stress [psi]	489.3	1200.0	2.5	OK

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Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	135.163 psi	138.612 psi
1	8.75 in	12.00 in	135.134 psi	138.595 psi
2	12.00 in	16.13 in	135.085 psi	138.565 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): 70.00 US (liquid) gallon/min

Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 1000.2

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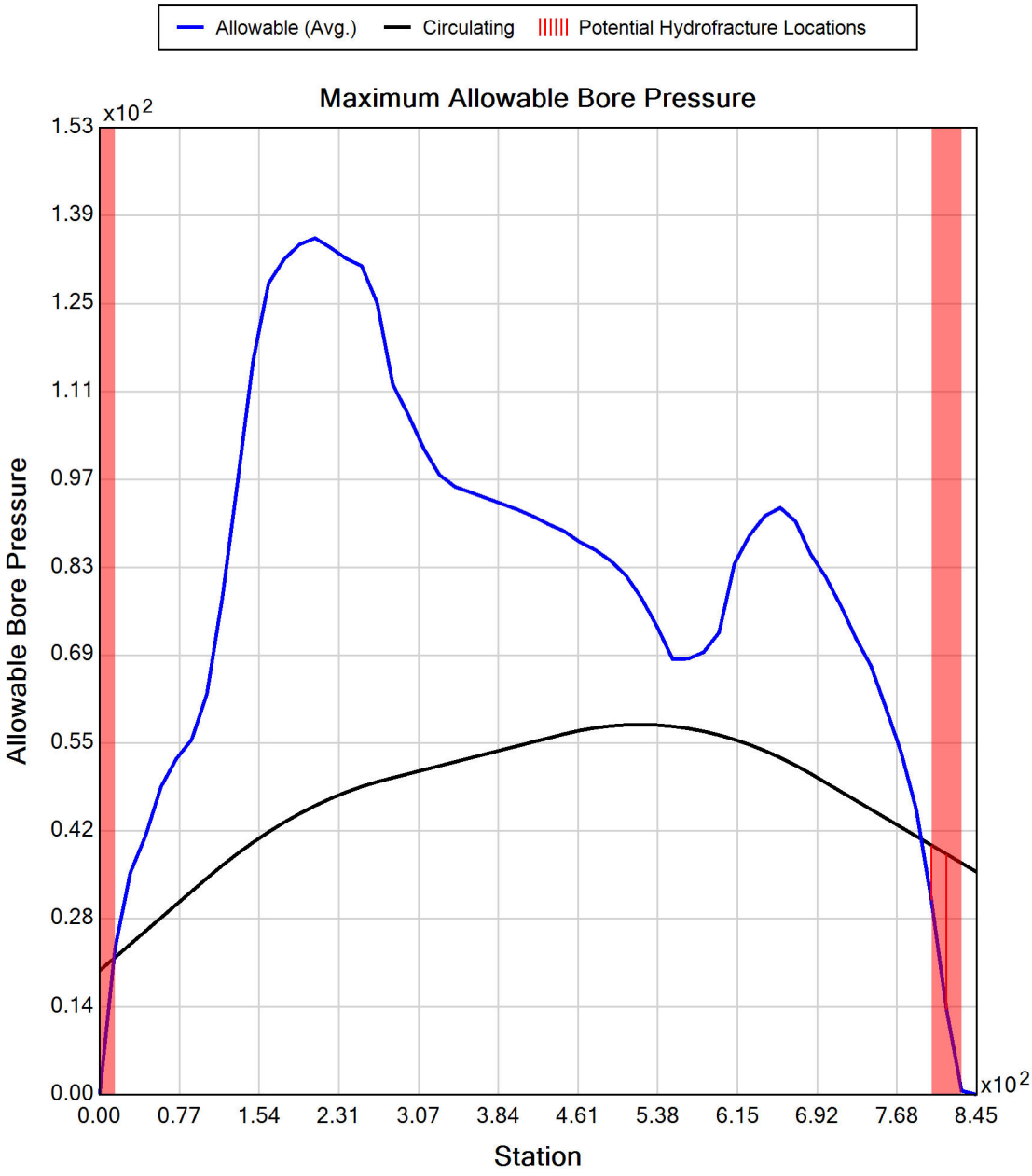

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Generated Output

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Designer:	Aaron Coady Tetra Tech Rooney 115 Inverness Drive East, Suite 300 Englewood, Colorado United States 80112 aaron.coady@tetratech.com
Description:	Segment 11 (Package 7A) Conduit 2 HDD 113 DWG C-313.2

Powered by BoreAid

Input Summary

Start Coordinate	(0.00, 0.00, 82.41) ft
End Coordinate	(833.00, 0.00, 112.94) ft
Project Length	833.00 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

Powered by BoreAid

Soil Summary

Number of Layers: 5

Soil Layer #1 USCS, Gravel (G), GP
From Assistant
Unit Weight: 15.9852 (dry), 17.9718 (sat) [lb/US (liquid) gallon]
Phi: 34.00, S.M.: 145.00, Coh: 0.00 [psi]

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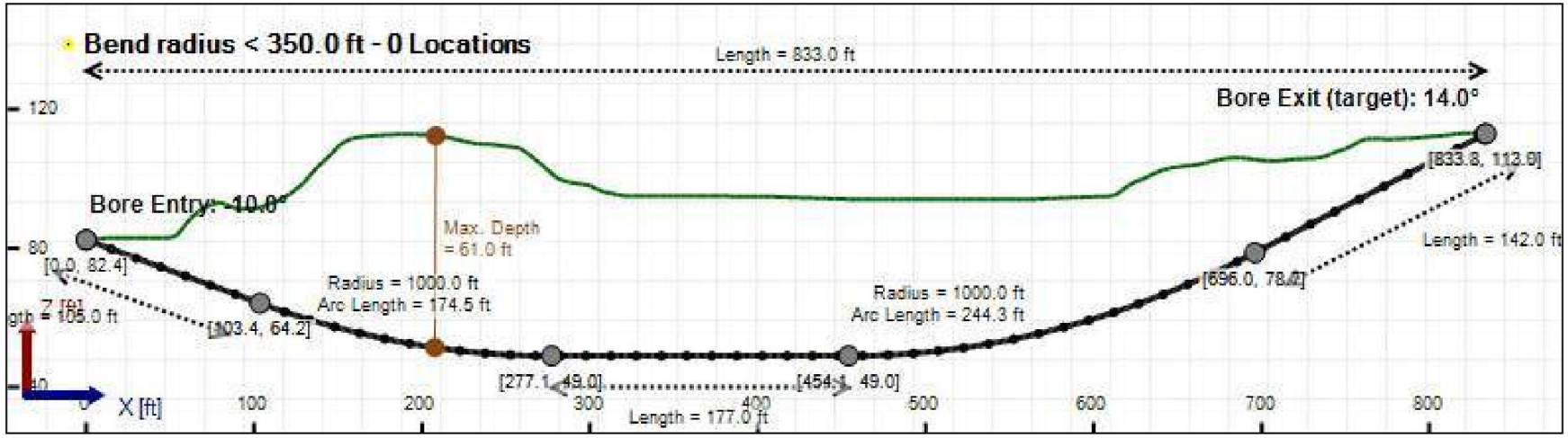
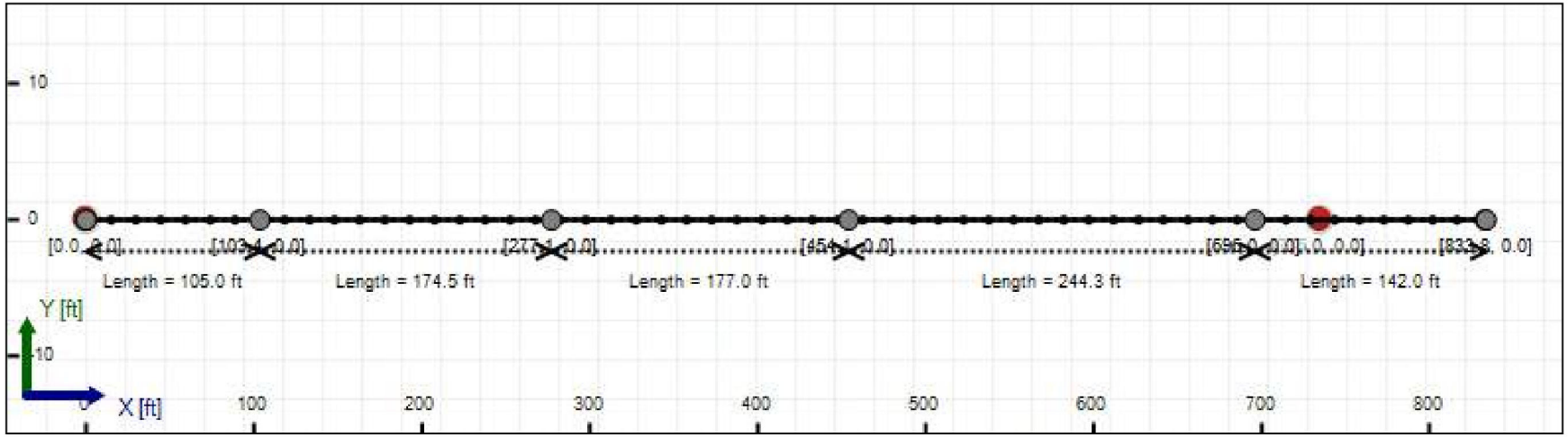
Bore Cross-Section View



Powered by BoreAid

Bore Plan View



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Load Verifier Input Summary:

Pipe Application: Electrical Cable

Pipe Type: HDPE

Classification: IPS

Pipe OD: 10" (10.75")

Pipe DR: 9

Pipe Length: 855.00 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: 7.92790 lb/US (liquid) gallon

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: 12.51801 lb/US (liquid) gallon

Hydrokinetic Pressure: 10 psi

Ballast Unit Weight: 8.34534 lb/US (liquid) gallon

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In-service Load Summary:

Pressure [psi]	Deformed	Collapsed
Earth Pressure	15.0	48.0
Water Pressure	0.0	0.0
Surface Surcharge	0.0	0.0
Internal Pressure	0.0	0.0
Net Pressure	15.0	48.0
Deflection		
Earth Load Deflection	4.080	13.062
Buoyant Deflection	0.132	0.132
Reissner Effect	0	0
Net Deflection	4.212	13.194
Compressive Stress [psi]		
Compressive Wall Stress	67.4	215.8

Installation Load Summary:

Forces/Stresses	@Maximum Force	Absolute Maximum
Pullback Force [lb]	16516.7	16516.7
Pullback Stress [psi]	460.6	460.6
Pullback Strain	8.011E-3	8.011E-3
Bending Stress [psi]	0.0	25.8
Bending Strain	0	4.479E-4
Tensile Stress [psi]	460.6	483.5
Tensile Strain	8.011E-3	8.857E-3

Net External Pressure = 42.0 [psi]

Buoyant Deflection = 0.1

Hydrokinetic Force = 567.6 lb

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In-service Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	4.212	7.5	1.8	OK
Unconstrained Collapse [psi]	40.4	95.3	2.4	OK
Compressive Wall Stress [psi]	67.4	1150.0	17.1	OK

Installation Analysis

	Calculated	Allowable	Factor of Safety	Check
Deflection [%]	0.065	7.5	115.8	OK
Unconstrained Collapse [psi]	53.5	228.0	4.3	OK
Tensile Stress [psi]	483.5	1200.0	2.5	OK

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Maximum Allowable Bore Pressure Summary

Ream Number	Initial Diameter	Final Diameter	Estimated Maximum Pressure (Avg.)	Estimated Maximum Pressure (Local)
Pilot Bore	0.00 in	8.75 in	133.065 psi	136.963 psi
1	8.75 in	12.00 in	133.035 psi	136.946 psi
2	12.00 in	16.13 in	132.984 psi	136.915 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): 70.00 US (liquid) gallon/min

Drill Fluid Density: 10.500 lb/US (liquid) gallon

Rheological model: Bingham-Plastic

Plastic Viscosity (PV): 25.53

Yield Point (YP): 16.49

Effective Viscosity (cP): 1000.2

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