

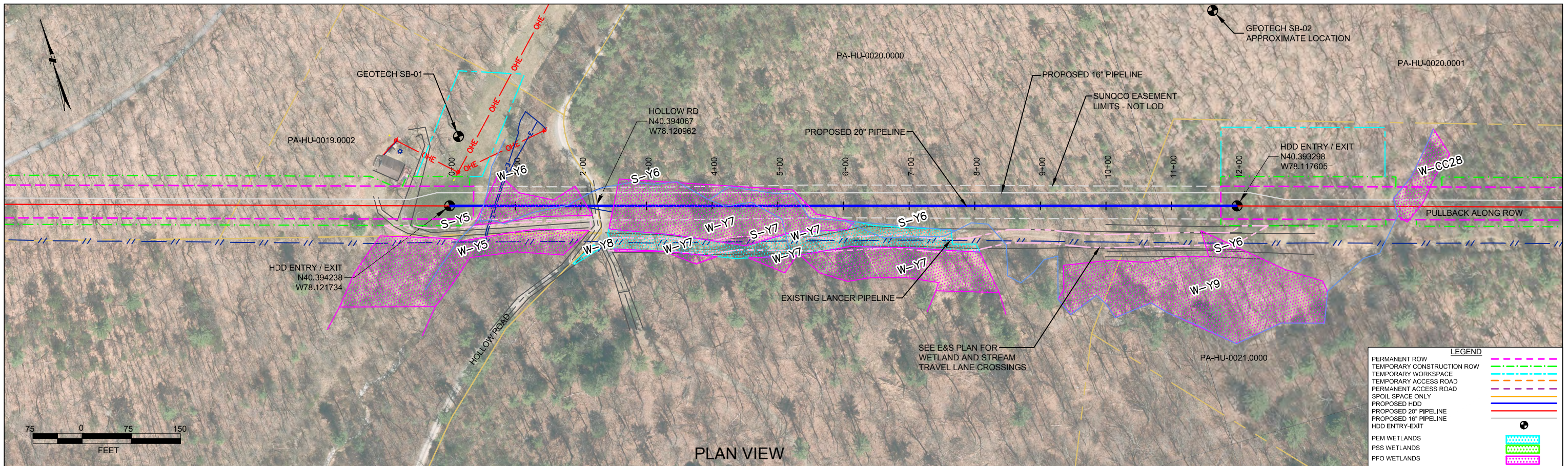
**Attachment A  
HDD Table  
Huntingdon County**

<b>Drawing Name</b>	<b>Drill Name</b>	<b>County</b>	<b>Township</b>	<b>Drill Location</b>	<b>Risk Assessment Level (Low / Medium / High)</b>
PA-HU-0020.0008-SS2.pdf	Hollow Rd	Huntingdon	Penn	N: 40.394228 W: 78.121734	low
PA-HU-0019.0002-RD.pdf	West Raystown Lake	Huntingdon	Penn	N: 40.397197 W: 78.134537	low
PA-HU-0020.0007-RD.pdf	Ridge Camp Loop Road	Huntingdon	Penn	N: 40.384726 W: 78.083103	low
PA-HU-0020.0008-WXa.pdf	Raystown Lake	Huntingdon	Penn	N: 40.373000 W: 78.074245	low
PA-HU-0020.0008-WXb.pdf	Raystown Lake	Huntingdon	Penn	N: 40.373000 W: 78.074245	low
PA-HU-0025.0000-RD3	Seven Point Loop Road	Huntingdon	Penn	N: 40.374381 W: 78.076973	low
PA-HU-0047.0000-RD.pdf	Trough Creek Valley Pike	Huntingdon	Union	N: 40.358132 W: 78.013858	low
PA-HU-0078.0000-WX.pdf	Aughwick Creek	Huntingdon	Shirley	N: 40.343452 W: 77.855639	low
PA-HU-0106.0000-RD.pdf	Backlog Creek	Huntingdon	Shirley	N: 40.321742 W: 77.790422	low
PA-HU-0110.0000-SR.pdf	Campbell Creek	Huntingdon	Tell	N: 40.313344 W: 77.750151	low

***HDD PA-HU-0019.0002-RD (S-Y5) (W-Y6) (S-Y6) (W-Y7) (S-Y7)***

Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable and in this case that threat is considered to be *low*. Implementing this design, along with adherence to the Pennsylvania Pipeline Project Inadvertent Return Contingency Plan will ensure inadvertent impacts, if they were to occur, are also minimized to the maximum extent.

The drill will enter/exit 65 feet from the edge of the western most boundary of the stream S-Y5 and wetland W-Y6. The drill will travel beneath stream S-Y5 for 8 feet and wetland for 155 feet. The drill will also travel beneath stream S-Y7 and stream S-Y6 at 120 feet and 125 feet east of the western most edge of wetland W-Y6 and will pass under stream S-Y7 for 3 feet and S-Y6 for 7 feet. Using the results of the geotechnical investigation, as well as several other data points, the entry/exit, angles, and depths have been configured to pass through the best substrates while maintaining pipe integrity (e.g., no large bends). The majority of the substrate that will be passed through is estimated to be weathered shale. The drill will continue beneath wetland W-Y6 and will exit 670 feet from the eastern most boundary of wetland W-Y6.

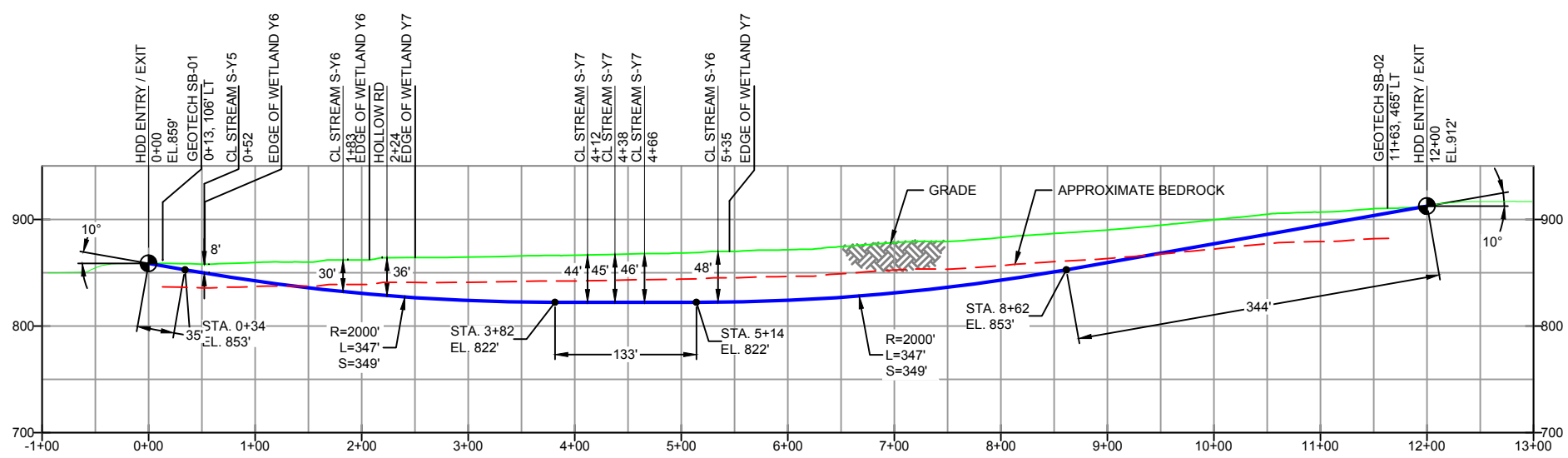


PLAN VIEW  
PROFILE VIEW

HUNTINGDON COUNTY PENNSYLVANIA, PENN TOWNSHIP  
S2-0148

GEOTECH SB-01	
NG EL. 862'	
-TOPSOIL (0' - 0.2')	
-SM (0.2' - 7.0')	
-SHALE/LIMESTONE (7.0' - 21.8')	
-GROUNDWATER (18.0')	
-COMPLETION DEPTH EL. 840'	
GEOTECH SB-02	
NG EL. 992'	
-SM (0.0' - 3.5')	
-WEATHERED SHALE (3.5' - 28.2')	
-COMPLETION DEPTH EL. 964'	

NOTE: REFER TO TEST BORING LOG S2-0148 FOR COMPLETE SOIL MATERIAL DESCRIPTION



DESIGN AND CONSTRUCTION:

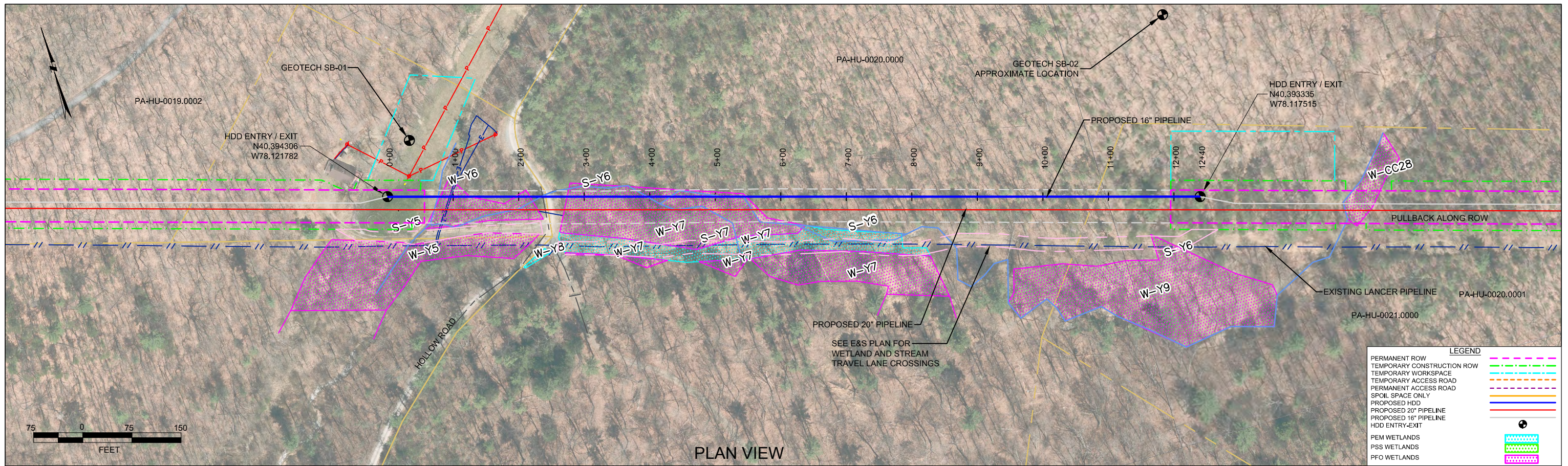
- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
- THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
- DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
- CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L=): 1200'  
HDD PIPE LENGTH (S=): 1210'  
20" x 0.456" W.T., X-65, API5L, PSL2, ERW, 8FW  
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
- INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
- INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
- PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
- CARRIER PIPE NOT ENCASED.
- PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
- CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
- SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
- SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
- SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

NOTES

- ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
- STATIONING IS BASED ON HORIZONTAL DISTANCES.
- ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP. FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
- CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
- SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING		REVISIONS		
ES-3.11	TO ES-3.12	EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	
SHEET 7	TO SHEET 8	EP1	REVISED PER PADEP COMMENTS	
		EP		
		C	ADDED GEOTECH INFO	
		B	ISSUED FOR BID	
		A	ISSUED FOR REVIEW	
DWG NO	DWG NO	DESCRIPTION	NO.	DESCRIPTION

			<b>SUNOCO PIPELINE, L.P.</b>	
	(303) 792-5911		20-INCH HORIZONTAL DIRECTIONAL DRILL HOLLOW RD PENNSYLVANIA PIPELINE PROJECT	
SCALE: 1"=150'		DWG. NO: PA-HU-0019.0002-RD		

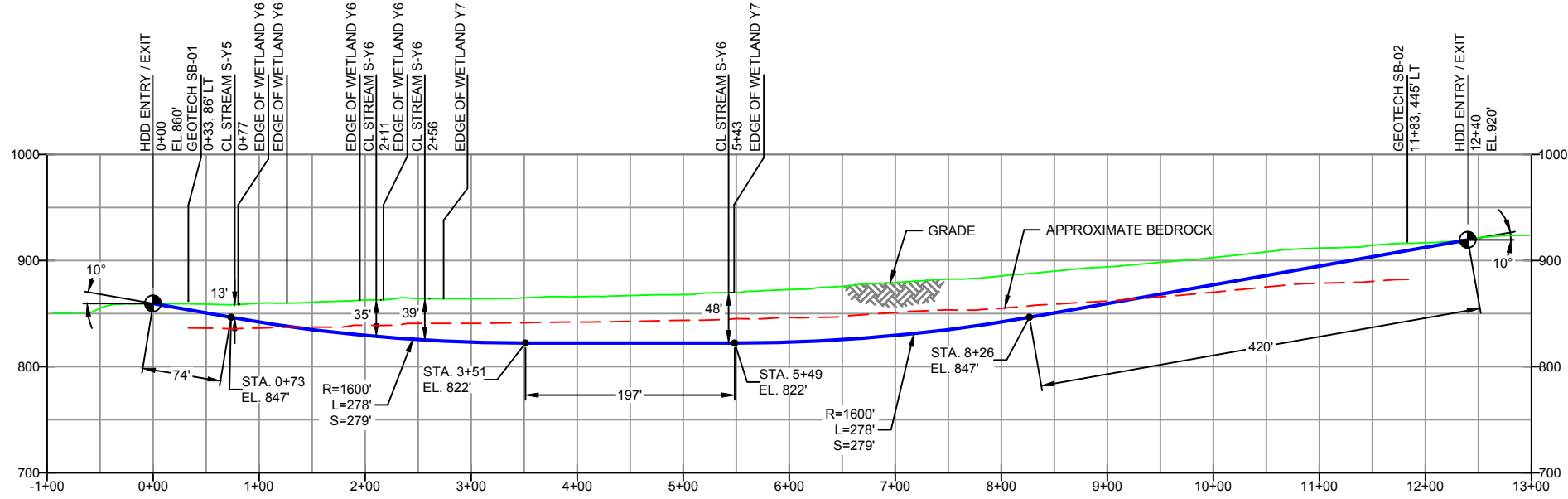


**PROFILE VIEW**

HUNTINGDON COUNTY PENNSYLVANIA, PENN TOWNSHIP  
S2-0148-16

GEOTECH SB-01	
NG EL. 862'	
-TOPSOIL (0' - 0.2')	
-SM (0.2' - 7.0')	
-SHALE/LIMESTONE (7.0' - 21.8')	
-GROUNDWATER (18.0')	
-COMPLETION DEPTH EL. 840'	
GEOTECH SB-02	
NG EL. 992'	
-SM (0.0' - 3.5')	
-WEATHERED SHALE (3.5' - 28.2')	
-COMPLETION DEPTH EL. 964'	

NOTE: REFER TO TEST BORING LOG S2-0148 FOR COMPLETE SOIL MATERIAL DESCRIPTION



- DESIGN AND CONSTRUCTION:**
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  - THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
  - DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
  - CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L-): 1240'  
HDD PIPE LENGTH (S-): 1249'  
16" x 0.438" W.T., X-70, APISL, PSL2, ERW, BFW  
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
  - INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
  - INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
  - PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
  - CARRIER PIPE NOT ENCASED
  - PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER
  - CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
  - SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
  - SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
  - SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

**NOTES**

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- SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING	NO.	DESCRIPTION	NO.	DESCRIPTION
ES-3.11	TO	ES-3.12	EROSION & SEDIMENT PLAN	
SHEET 7	TO	SHEET 8	AERIAL SITE PLAN	EP2
				EP1
				B
				A

**REVISIONS**

BY	DATE	CHK	DATE	APP	DATE
DLM	10/07/16	RMB	10/07/16	AAW	10/07/16
DLM	05/09/16	RMB	05/09/16	AAW	05/09/16
MRS	03/15/16	RMB	03/15/16	AAW	03/15/16
MRS	09/10/15	RMB	09/10/15	AAW	09/10/15
MRS	08/31/15	RMB	08/31/15	AAW	08/31/15

**Sunoco Logistics Partners L.P.**

**SUNOCO PIPELINE, L.P.**

16-INCH HORIZONTAL DIRECTIONAL DRILL  
HOLLOW RD  
PENNSYLVANIA PIPELINE PROJECT

**TETRA TECH ROONEY**  
(303) 792-5911

SCALE: 1"=150'

DWG. NO: PA-HU-0019.0002-RD-16



**LEGEND:**

⊙ Geotechnical Soil Boring (SB) Locations



**TETRA TECH**

GEOTECHNICAL BORING LOCATIONS  
 HDD S2-0148  
 HUNTINGDON COUNTY, PENN TOWNSHIP, PA  
 SUNOCO PENNSYLVANIA PIPELINE PROJECT





**TETRA TECH**  
 240 Continental Drive, Suite 200  
 Newark, Delaware 19713  
 302.738.7551  
 fax: 302.454.5988

# TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT	Project No.:	103IP3406
Project Location:	BUNKER HILL ROAD, HESSTON, PA	Page 1 of 1	
HDD No.:	S2-0148	Dates(s) Drilled:	01-20-15
Boring No.:	SB-02	Inspector:	E. WATT
Drilling Contractor:	HAD DRILLING	Drilling Method:	SPT - ASTM D1586
		Driller:	S. HOFFER
		Groundwater Depth (ft):	NOT ENCOUNTERED
		Total Depth (ft):	28.2

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *			N
	From	To	From	To							
							NO TOPSOIL				
			0.0				MOTTLED (GRAY, ORANGE BROWN, YELLOW BROWN) SILTY FINE SAND, WITH A LITTLE FINE GRAVEL.				
				3.5		SM					
1	3.0	4.3	3.5		10	WEATHERED SHALE	LIGHT BROWN AND LIGHT GRAY WEATHERED FISSILE SHALE.	1	30	50/4"	>50
2	8.0	8.9			7		LIGHT BROWN AND LIGHT GRAY WEATHERED FISSILE SHALE.	10	50/5"		>50
3	13.0	13.6			7		LIGHT BROWN AND LIGHT GRAY WEATHERED FISSILE SHALE.	30	50/1"		>50
4	18.0	18.5			5		DARK GRAY WEATHERED FISSILE SHALE	50/6"			>50
5	23.0	23.7			6		DARK GRAY WEATHERED FISSILE SHALE	2	50/2"		>50
6	28.0	28.1		28.2	2		DARK GRAY WEATHERED FISSILE SHALE	50/2"			>50
							AUGER REFUSAL AT 28'.				

Notes/Comments:  
Pocket Pentrometer Testing DR: DECOMPOSED ROCK

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

\* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.  
 N: Number of blows to drive spoon from 6" to 18" interval.

**GEOTECHNICAL LABORATORY TESTING SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0148**

HDD No.	Boring No.	Sample No.	Depth of Sample (ft.)		Water	Percent	Atterburg Limits (ASTM D4318)			USCS
			From	To	Content, % (ASTM D2216)	Silts/Clays, % (ASTM D1140)	Liquid Limit, %	Plastic Limit, %	Plasticity Index, %	Classif. (ASTM D2487)
S2-0148	SB-01	1	3.0	5.0	12.8	44.1	-	-	-	-
		2	8.0	8.4	2.4	15.3	-	-	-	-
		3	13.0	13.4	2.9	16.4	-	-	-	-
		4	18.0	18.4	4.1	12.7	-	-	-	-
		5	21.0	21.8	9.4	25.5	-	-	-	-
	SB-02	1	3.0	4.3	8.4	33.5	-	-	-	-
		3	13.0	13.6	5.4	24.2	-	-	-	-
		4	18.0	18.5	4.5	12.6	-	-	-	-
		6	28.0	28.1	2.1	14.7	-	-	-	-

Notes:

- 1) Sample depths based on feet below grade at time of exploration.

**REGIONAL GEOLOGY SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0148**

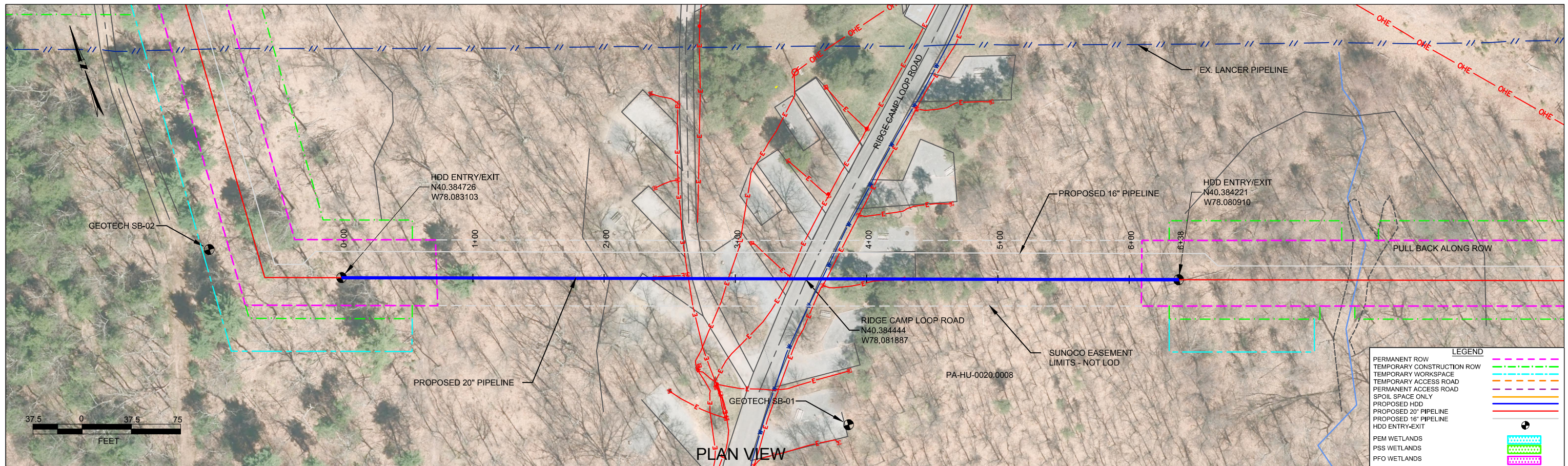
HDD No.	NAME	BORING NO.	REGIONAL GEOLOGY DESCRIPTION	GENERAL TOPOGRAPHIC SETTING	BEDROCK FORMATION	GENERAL ROCK TYPE	APPROX MAX FM THICKNESS (FT)	DEPTH TO ROCK (Ft bgs) based on nearby well drilling logs	NOTES / COMMENTS
S2-0148	Hollow Road	SB-01	<b>Brallier and Harrell Formations</b> (undivided) - composed of interbedded light-gray, graded, siliceous siltstone beds and light-gray, hard, silty shales, sparsely fossiliferous.	Ridge & Valley (Steep relief changes)	Brallier-Harrell	Interbedded subfissile shales, f-c. thinly bedded siltstone and sandstones	1,800	14-50	Depth to bedrock varies considerably with topography
		SB-02							

*Note : Source of well log data - <http://www.dcnr.state.pa.us/topogeo/groundwater/pagwis/records/index.htm>. All other sources as referenced in comments section.*

***HDD PA-HU-0020.0007-RD***

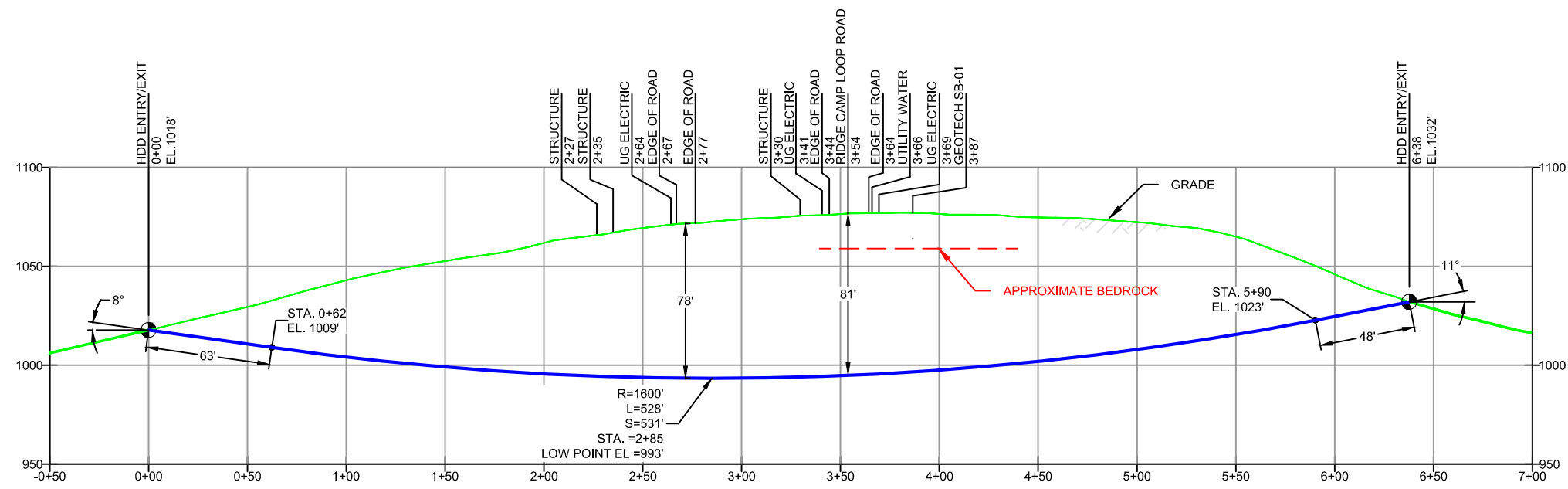
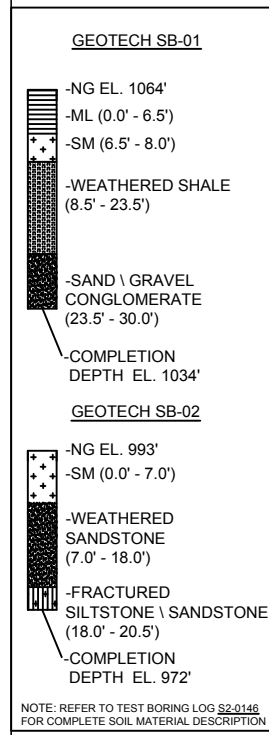
Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable and in this case that threat is considered to be low. Implementing this design, along with adherence to the Pennsylvania Pipeline Project Inadvertent Return Contingency Plan will ensure inadvertent impacts, if they were to occur, are also minimized to the maximum extent.

The drill will enter/exit 360 feet from the western edge of Ridge Camp Loop Road and enter/exit 290 feet from the eastern edge. The drill is going through a hill, therefore the average depth of the drill is greater than 50 feet. The geotechnical results, as well as other data points, were used to determine the entry/exit angles, and depths to pass through the best substrates while maintaining the pipe integrity (e.g., no large bends). According to the geotechnical report substrates being drilled through are silts with fine sands, shale, and sandstone. Based on the geotechnical report and drill profile minimal inadvertent returns are expected.



HUNTINGDON COUNTY, PENNSYLVANIA - PENN TOWNSHIP  
S2-0146

PROFILE VIEW



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  - DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
  - CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L)=638'  
HDD PIPE LENGTH (S)=843'  
20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW  
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
  - INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
  - INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
  - PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
  - CARRIER PIPE NOT ENCASED.
  - PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
  - CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
  - SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
  - SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
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NOTES

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- SUNOCO EMERGENCY HOTLINE NUMBER IS 1-800-786-7440.

REF. DRAWING

TO WEST	TO EAST	DESCRIPTION	NO.
ES-3.18	ES-3.18	EROSION & SEDIMENT PLAN	
		AERIAL SITE PLAN	
		EP	
		REVISED PER ENGINEERING COMMENTS	2
		ADDED GEOTECH INFO	1
		ISSUED FOR CONSTRUCTION	0

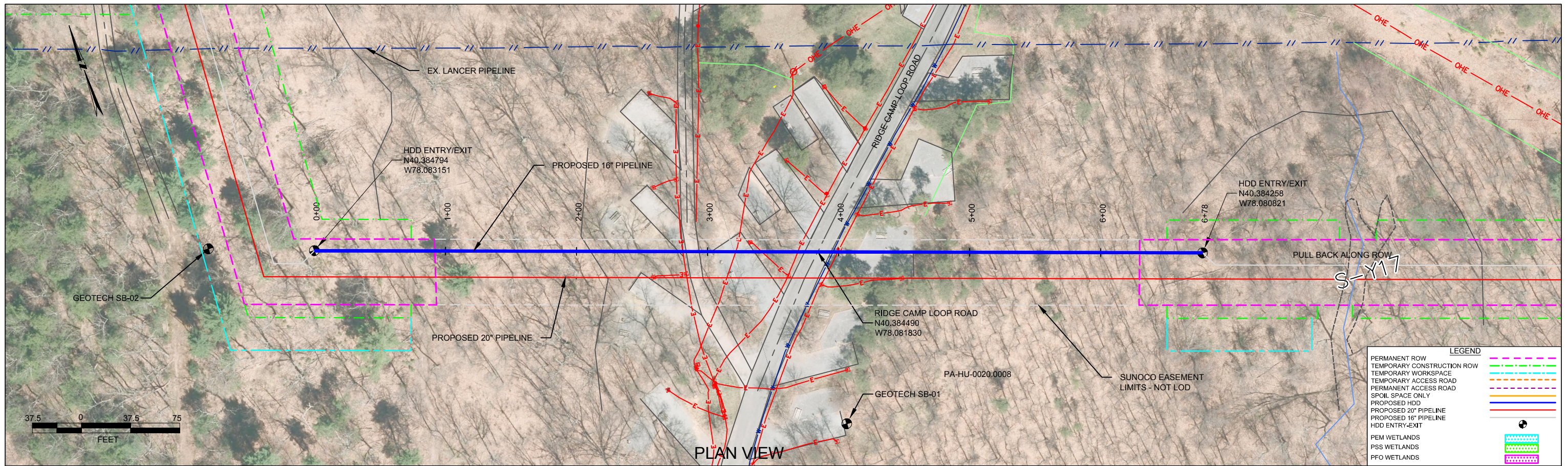
REVISIONS

BY	DATE	CHK	DATE	APP	DATE
DLM	09/30/16	RMB	09/30/16	AAW	09/30/16
DLM	08/26/16	RMB	08/26/16	AAW	08/26/16
MRS	07/19/16	RMB	07/19/16	AAW	07/19/16
DLM	04/18/16	RMB	04/18/16	AAW	04/18/16

SUNOCO PIPELINE, L.P.

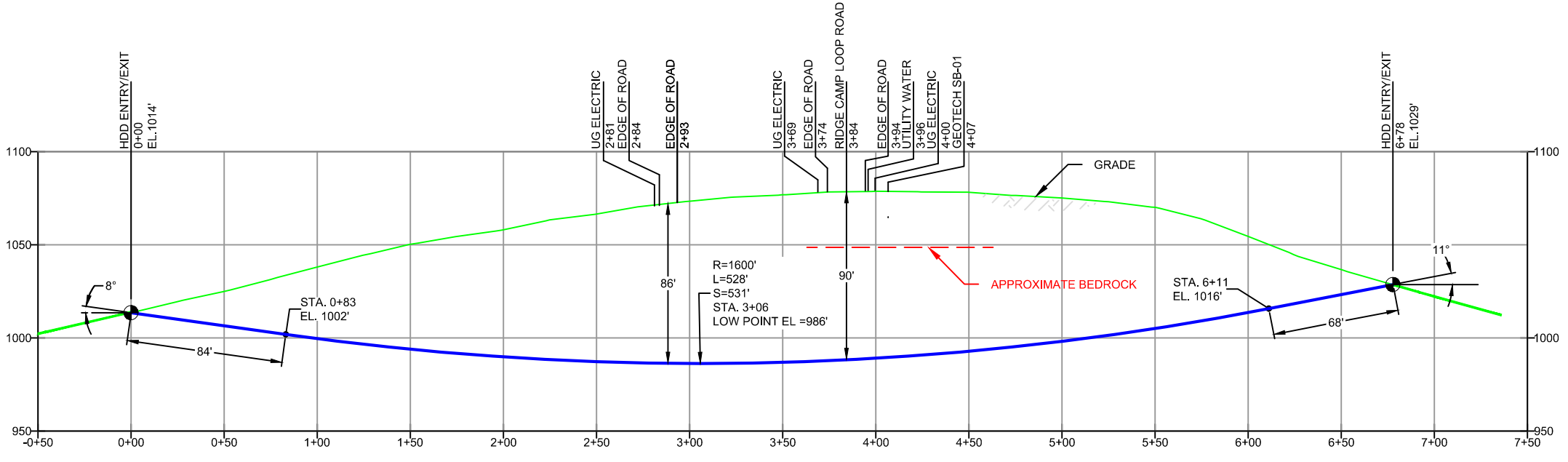
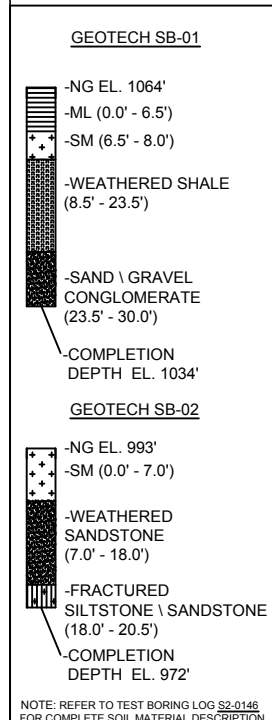
DIANCH HORIZONTAL DIRECTIONAL DRILL  
RIDGE CAMP LOOP ROAD  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=75' DWG. NO: PA-HU-0020.0007-RD



PLAN VIEW

HUNTINGDON COUNTY, PENNSYLVANIA - PENN TOWNSHIP  
S2-0146-16



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  - CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L)=678'  
HDD PIPE LENGTH (S)=683'  
16" x 0.438" W.T., X-70, API5L, PSL2, ERW, BFW  
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
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REF. DRAWING	TO	DESCRIPTION
ES-3.18	TO ES-3.18	EROSION & SEDIMENT PLAN
SHEET 11	TO SHEET 12	AERIAL SITE PLAN
		2 REVISED PER ENGINEERING COMMENTS
		1 ADDED GEOTECH INFO
		0 ISSUED FOR CONSTRUCTION

REVISIONS

BY	DATE	CHK	DATE	APP	DATE
DLM	10/07/16	RMB	10/07/16	AAW	10/07/16
DLM	08/26/16	RMB	08/26/16	AAW	08/26/16
MRS	07/19/16	RMB	07/19/16	AAW	07/19/16
DLM	04/18/16	RMB	04/18/16	AAW	04/18/16

(303) 792-5911

SUNOCO PIPELINE, L.P.

16-INCH HORIZONTAL DIRECTIONAL DRILL  
RIDGE CAMP LOOP ROAD  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=75'    DWG. NO: PA-HU-0020.0007-RD-16



**LEGEND:**

⊙ Geotechnical Soil Boring (SB) Locations



GEOTECHNICAL BORING LOCATIONS  
HDD S2-0146 RIDGE CAMP LOOP, RAYSTOWN LAKE  
HUNTINGDON COUNTY, PENN TOWNSHIP, PA  
SUNOCO PENNSYLVANIA PIPELINE PROJECT





**TETRA TECH**

240 Continental Drive, Suite 200  
 Newark, Delaware 19713  
 302.738.7551  
 fax: 302.454.5988

**TEST BORING LOG**

Project Name: SUNOCO PENNSYLVANIA PIPELINE PROJECT			Project No.: 103IP3406		
Project Location: RAYSTOWN LAKE, CAMP SERVICE ROAD, PA			Page 1 of 1		
HDD No.: S2-0146		Dates(s) Drilled: 04-20-16		Inspector: E. WATT	
Boring No.: SB-02		Drilling Method: SPT - ASTM D1586		Driller: S. HOFFER	
Drilling Contractor: HAD DRILLING		Groundwater Depth (ft): NOT ENCOUNTERED		Total Depth (ft): 20.5	
Boring Location Coordinates:			40°23'5.50"N		78° 5'0.34"W

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N	
	From	To	From	To									
			0.0	0.0			NO TOPSOIL						
1	3.0	5.0	0.0		8	SM	BROWN, DARK BROWN, AND GRAY SHALE WEATHERED TO A F-M	6	50/5				>50
				7.0			SAND, WITH A LITTLE SILT, SOME UNWEATHERED SHALE FRAGS.						
2	8.0	9.5	7.0		4	PARTIALLY WEATHERED SANDSTONE	GRAY PARTIALLY WEATHERED SANDSTONE.	10	50/3"				>50
3	13.0	13.3			3		GRAY PARTIALLY WEATHERED SANDSTONE.	50/4"					>50
4	18.0	18.1		18.0	<1		GRAY PARTIALLY WEATHERED SANDSTONE.	50/1					>50
							AUGER REFUSAL AT 18'.						
							<u>ROCK CORING</u>						
RUN 1	18.0	20.5	18.0		24		VERY INTENSELY FRACTURED, BROWN, REDDISH BROWN, GRAY	TCR: 80%, SCR: 17%, RQD: 0%					
				20.5			INTERBEDDED SANDSTONE AND SILTSTONE. CALCAREOUS.						
							ROCK CORE SEGMENTS TOO SMALL FOR TESTING OF						
							COMPRESSIVE STRENGTH.						
							AUGER GRINDING COMMENCED AT 7'.						
							HARD GRINDING COMMENCED AT 15'.						
							CAVED AND DRY AT 17'.						

Notes/Comments:  
Pocket Pentrometer Testing  
 S1: > 4 TSF

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

\* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.  
 N: Number of blows to drive spoon from 6" to 18" interval.

**ROCK CORE DESCRIPTION SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
S2-0146 RIDGE CAMP LOOP**

Location	Boring No.	Core Run	Core Depth (ft)		TCR (%)	SCR (%)	RQD (%)	Depth (ft)		Weathering	Classification	Bedding Thickness (ft)	Color	Discontinuity Data
			From	To				From	To					
S2-0146	SB-02	1	18	20.5	80	17	0	18	20.5	Moderate	Calcareous Siltstone	Massive	Gray with red staining in fractures	Fractures ranging from 8° to 78°, average 24°

Notes:

**RQD:** Rock Quality Designation

**TCR:** Total Core Recovery

**SCR:** Solid Core Recovery

**GEOTECHNICAL LABORATORY TESTING SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0146 RIDGE CAMP LOOP**

HDD No.	Test Boring No.	Sample No.	Depth of Sample (ft.)		Water Content, % (ASTM D2216)	Percent Silts/Clays, % (ASTM D1140)	Atterburg Limits (ASTM D4318)			USCS Classif. (ASTM D2487)
			From	To			Liquid Limit, %	Plastic Limit, %	Plasticity Index, %	
S2-0146	SB-01	1	3.0	5.0	14.2	59.7	33	25	8	ML
		2	8.0	9.5	7.7	33.5	NV	NP	NP	SM
		3	13.0	13.3	3.6	18.7	-	-	-	-
		4	18.0	18.4	3.7	21.5	-	-	-	-
		5	23.0	23.8	3.8	27.3	-	-	-	-
		6	28.0	28.1	4.0	15.2	-	-	-	-
	SB-02	1	3.0	5.0	8.7	18.5	NV	NP	NP	SM
		2	8.0	9.5	3.6	24.9	-	-	-	-
		3	13.0	13.3	3.9	27.6	-	-	-	-

**Notes:**

- 1) Sample depths based on feet below grade at time of exploration.

**REGIONAL GEOLOGY SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
S2-0146 RIDGE CAMP LOOP**

NAME	BORING NO.	REGIONAL GEOLOGY DESCRIPTION	GENERAL TOPOGRAPHIC SETTING	BEDROCK FORMATION	GENERAL ROCK TYPE	APPROX MAX FM THICKNESS (FT)	DEPTH TO ROCK (Ft bgs) based on nearby well drilling logs	NOTES / COMMENTS
S2-0146	SB-01	<b>Foreknobs Fm</b> - consists of brownish-gray sandstone, siltstone, and shale; some conglomerate contacting the Catskill Formation consists of a succession of grayish-red sandstone, siltstone, shale, and some conglomerate and mudstone	Steep hilly, NE side of lake	Foreknobs Fm	Brownish-gray sandstone, siltstone, and shale; some conglomerate	1,200	Data not available for Raystown Lake area; however, based on other borings performed in Raystown Lake area, depth to bedrock is shallow.	
	SB-02							

*Note : Source of well log data - <http://www.dcnr.state.pa.us/topogeo/groundwater/pagwis/records/index.htm>. All other sources as referenced in comments section.*

# FIELD DESCRIPTION AND LOGGING SYSTEM FOR SOIL EXPLORATION

## GRANULAR SOILS

(Sand, Gravel & Combinations)

<u>Density</u>	<u>N (blows)*</u>
Very Loose	5 or less
Loose	6 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	51 or more

### Particle Size Identification

Boulders	8 in. diameter or more
Cobbles	3 to 8 in. diameter
Gravel	Coarse (C) 3 in. to ¾ in. sieve Fine (F) ¾ in. to No. 4 sieve
Sand	Coarse (C) No. 4 to No. 10 sieve (4.75mm-2.00mm) Medium (M) No. 10 to No. 40 sieve (2.00mm – 0.425mm) Fine (F) No. 40 to No. 200 sieve (0.425 – 0.074mm)
Silt/Clay	Less Than a No. 200 sieve (<0.074mm)

### Relative Proportions

<u>Description Term</u>	<u>Percent</u>
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

## COHESIVE SOILS

(Silt, Clay & Combinations)

<u>Consistency</u>	<u>N (blows)*</u>
Very Soft	3 or less
Soft	4 to 5
Medium Stiff	6 to 10
Stiff	11 to 15
Very Stiff	16 to 30
Hard	31 or more

### Plasticity

<u>Degree of Plasticity</u>	<u>Plasticity Index</u>
None to Slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	> 22

## ROCK

(Rock Cores)

<u>Rock Quality Designation (RQD), %</u>	<u>Rock Quality Description</u>
0-25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
90-100	Excellent

**RQD:** Rock Quality Designation

**TCR:** Total Core Recovery

**SCR:** Solid Core Recovery

**\*N - Standard Penetration Resistance.** Driving a 2.0" O.D., 1-3/8" I.D. sampler a distance of 18 inches into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. The number of hammer blows to drive the sampler through each 6 inch interval is recorded; the number of blows required to drive the sampler through the final 12 inch interval is termed the Standard Penetration Resistance (SPR) N-value. For example, blow counts of 6/8/9 (through three 6-inch intervals) results in an SPR N-value of 17 (8+9).

**Groundwater** observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

**UNIFIED SOIL CLASSIFICATION SYSTEM [Casagrande (1948)]**

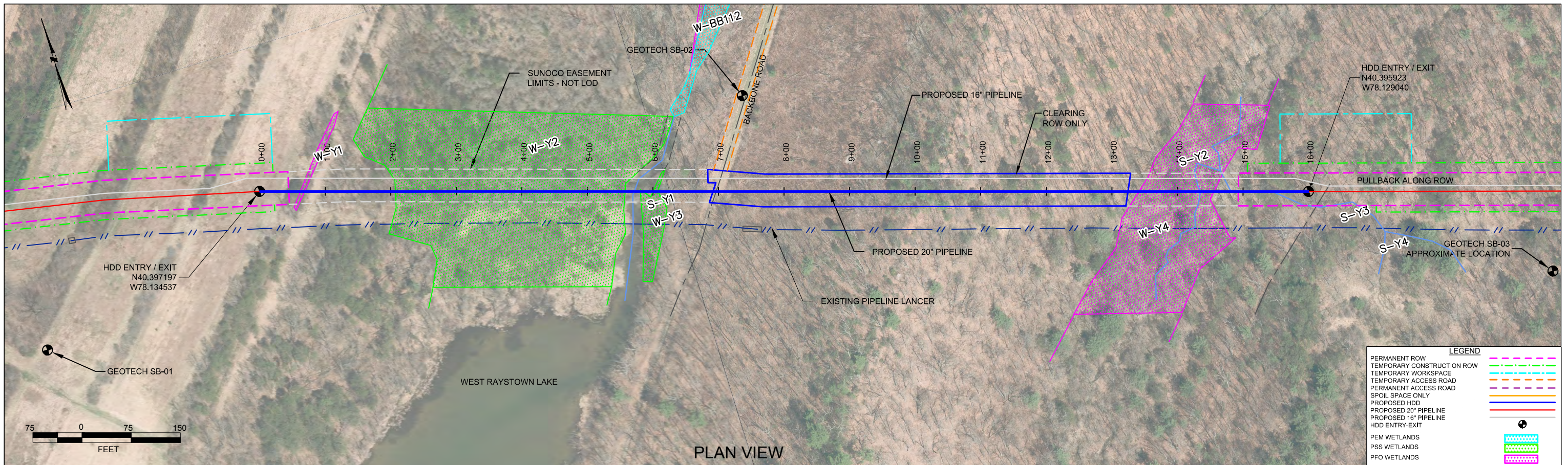
Major Divisions		Group Symbols	Typical Descriptions	Laboratory Classifications			
Coarse Grained Soils (More than half of material is larger than No. 200 sieve)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravel (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4: $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3  Not meeting $C_u$ or $C_c$ requirements for GW		
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines			
		Gravel with fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below A Line or $I_p$ less than 4	Limits plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols	
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits above A line with $I_p$ greater than 7		
	Sands (More than half of coarse fraction is smaller than No. 4 Sieve)	Clean sands (Little or no fines)	SW	Well graded sands, gravelly sands, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6: $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3  Not meeting $C_u$ or $C_c$ requirements for SW		
			SP	Poorly graded sands, gravelly sands, little or no fines			
		Sands with fines (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures	Atterberg limits below A Line or $I_p$ less than 4	Limits Plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols	
			SC	Clayey sands, sand-clay mixtures	Atterberg limits above A line with $I_p$ greater than 7		
		Determine Percentage of sand and gravel from grain size curve. Depending on Percentage of fines (fraction smaller than No. 200 sieve), coarse-grained soils are classified as follows:  Less than 5 percent GW, GP, SW, SP More than 12 percent GM, GC, SM, SC 5 to 12 percent Borderline cases requiring dual symbols <sup>(1)</sup>					
		Major Divisions		Group Symbols	Typical Descriptions	For soils plotting nearly on A line use dual symbols i.e., $I_p = 29.5$ , $w_L = 60$ gives CH-MH. When $w_L$ is near 50 use CL-CH or ML-MH. Take near as $\pm 2$ percent.	
Fine-grained soils (More than half of material is smaller than No. 200 sieve)	Silt and clays (Liquid limit less than 50)	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity				
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays				
		OL	Organic silts and organic silty clays of low plasticity				
	Silt and Clays (Liquid limit greater than 50)	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts				
		CH	Inorganic clays of high plasticity, fat clays				
		OH	Organic clays of medium to high plasticity, organic silts				
	Highly organic soils	Pt	Peat and other highly organic soils				

(1) Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC. well-graded gravel-sand mixture with clay binder.

***HDD PA-HU-0020.0008-SS2 (W-Y1) (W-Y2) (S-Y1) (W-Y4) (S-Y2) (S-Y3)***

Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable and in this case that threat is considered to be *low*. Implementing this design, along with adherence to the Pennsylvania Pipeline Project Inadvertent Return Contingency Plan will ensure inadvertent impacts, if they were to occur, are also minimized to the maximum extent.

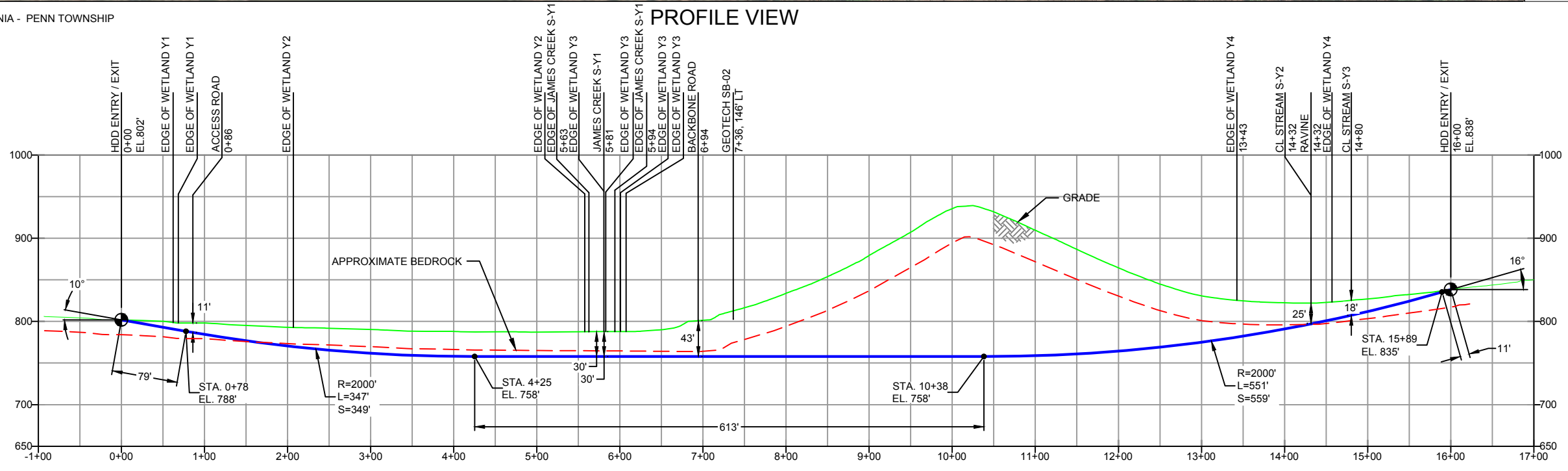
The drill will enter/exit 75 feet from the edge of the western most boundary of the wetland W-Y1. The drill will travel beneath wetland W-Y1 for 15 feet. Using the results of the geotechnical investigation, as well as several other data points, the entry/exit, angles, and depths have been configured to pass through the best substrates while maintaining pipe integrity (e.g., no large bends). The majority of the substrate that will be passed through is estimated to be fine sand or silt. The drill will continue beneath the eastern most boundary of the wetland W-Y1 and will travel 130 feet from the eastern most edge of wetland W-Y1 to the western most edge of wetland W-Y2. The drill will pass 400 feet under the wetland W-Y2 starting at the western most boundary. The drill will also reach stream S-Y1 350 feet from the western edge of W-Y2 and will pass under stream S-Y1 for 10 feet. The majority of the substrate that will be passed through is estimated to be weathered siltstone. The drill will continue beneath the eastern most boundary of the wetland W-Y2 and will travel 725 feet from the eastern most edge of wetland W-Y2 to the western most edge of wetland W-Y4. The drill will pass 115 feet under the wetland W-Y4 starting at the western most boundary. The drill will also reach stream S-Y2 80 feet from the western edge of wetland W-Y4 and will pass under stream S-Y2 for 5 feet. The majority of the substrate that will be passed through is estimated to be weathered siltstone. The drill will continue beneath the eastern most boundary of the wetland W-Y4 and will travel 25 feet from the eastern most edge of wetland W-Y2 to the western most edge of stream S-Y3 and will pass under stream S-Y3 for 10 feet. The majority of the substrate that will be passed through is estimated to be weathered and fractured siltstone. The drill will continue beneath stream S-Y3 and will enter/exit 80 feet from the eastern most edge of stream S-Y3.



HUNTINGDON COUNTY, PENNSYLVANIA - PENN TOWNSHIP  
S2-0147

GEOTECH SB-01	
-NG EL. 810'	-TOPSOIL (0' - 0.3')
-SM (0.3' - 9.6')	
-GROUNDWATER (11.0')	-SILTSTONE (9.6' - 17.2')
-COMPLETION DEPTH EL. 793'	
GEOTECH SB-02	
-NG EL. 803'	-SM/SC (0.0' - 23.5')
-GROUNDWATER (18.0')	
-WEATHERED SILTSTONE (23.5' - 29.0')	-FRACTURED SILTSTONE (29.0' - 37.0')
-COMPLETION DEPTH EL. 866'	
GEOTECH SB-03	
-NG EL. 1121'	-TOPSOIL (0' - 0.2')
-SM (0.2' - 6.0')	
-WEATHERED SILTSTONE (6.0' - 10.1')	-COMPLETION DEPTH EL. 793'

NOTE: REFER TO TEST BORING LOG S2-0147 FOR COMPLETE SOIL MATERIAL DESCRIPTION



DESIGN AND CONSTRUCTION:

- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
- THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
- DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
- CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L=): 1600'  
HDD PIPE LENGTH (S=): 1611'  
20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW  
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
- INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
- INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
- PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
- CARRIER PIPE NOT ENCASED.
- PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
- CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
- SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
- SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
- SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

NOTES

- ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
- STATIONING IS BASED ON HORIZONTAL DISTANCES.
- ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP. FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
- CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
- SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING		REVISIONS		
ES-3.09	TO ES-3.10	EROSION & SEDIMENT PLAN	EP2 REVISED PER PADEP COMMENTS RECEIVED 09-06-16	
SHEET 6	TO SHEET 7	AERIAL SITE PLAN	EP1 REVISED PER PADEP COMMENTS	
			EP	
			C ADDED GEOTECH INFO	
			B ISSUED FOR BID	
			A ISSUED FOR REVIEW	
DWG NO	DWG NO	DESCRIPTION	NO.	DESCRIPTION

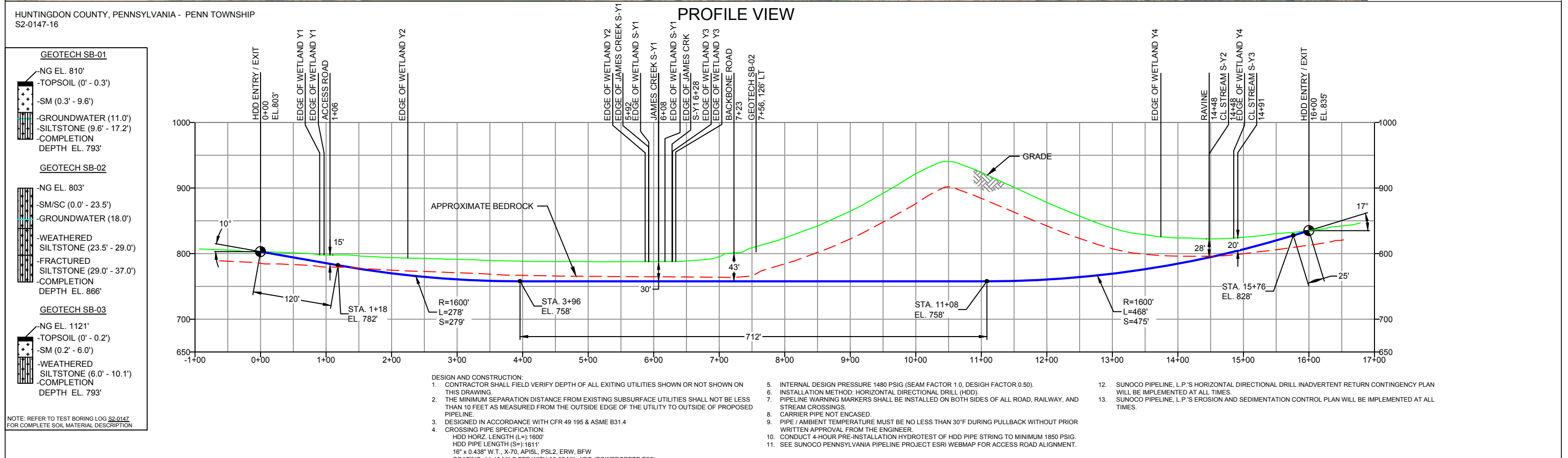
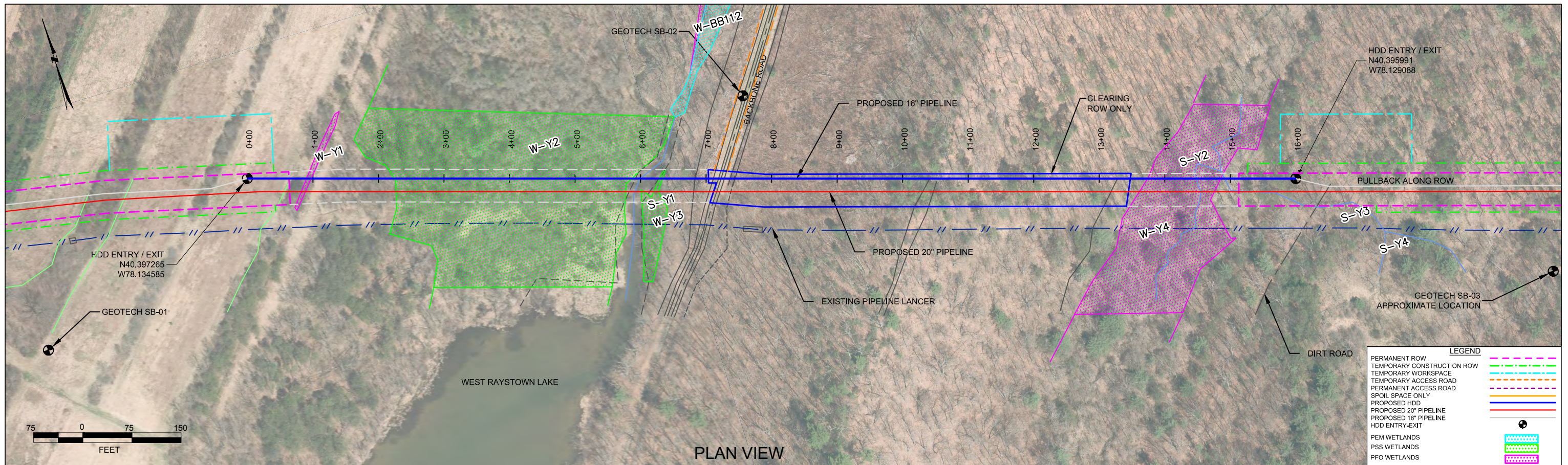
**Sunoco Logistics  
Partners L.P.**

**TETRA TECH ROONEY**  
(303) 792-5911

**SUNOCO PIPELINE, L.P.**

20-INCH HORIZONTAL DIRECTIONAL DRILL  
WEST RAYSTOWN LAKE  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=150'    DWG. NO: PA-HU-0020.0008-SS2



HUNTINGDON COUNTY, PENNSYLVANIA - PENN TOWNSHIP  
S2-0147-16

**GEOTECH SB-01**

- NG EL. 810'
- TOPSOIL (0' - 0.3')
- SM (0.3' - 9.6')
- GROUNDWATER (11.0')
- SILTSTONE (9.6' - 17.2')
- COMPLETION DEPTH EL. 793'

**GEOTECH SB-02**

- NG EL. 803'
- SM/SC (0.0' - 23.5')
- GROUNDWATER (18.0')
- WEATHERED SILTSTONE (23.5' - 29.0')
- FRACTURED SILTSTONE (29.0' - 37.0')
- COMPLETION DEPTH EL. 866'

**GEOTECH SB-03**

- NG EL. 1121'
- TOPSOIL (0' - 0.2')
- SM (0.2' - 6.0')
- WEATHERED SILTSTONE (6.0' - 10.1')
- COMPLETION DEPTH EL. 793'

NOTE: REFER TO TEST BORING LOG S2-0147 FOR COMPLETE SOIL MATERIAL DESCRIPTION

**NOTES**

- ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
- STATIONING IS BASED ON HORIZONTAL DISTANCES
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REF. DRAWING	NO.	DESCRIPTION
ES-3.09 TO ES-3.10	EROSION & SEDIMENT PLAN	
SHEET 6 TO SHEET 7	AERIAL SITE PLAN	
	EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16
	EP1	REVISED PER PADEP COMMENTS
	EP	
	B	ADDED GEOTECH INFO
	A	ISSUED FOR BID

**REVISIONS**

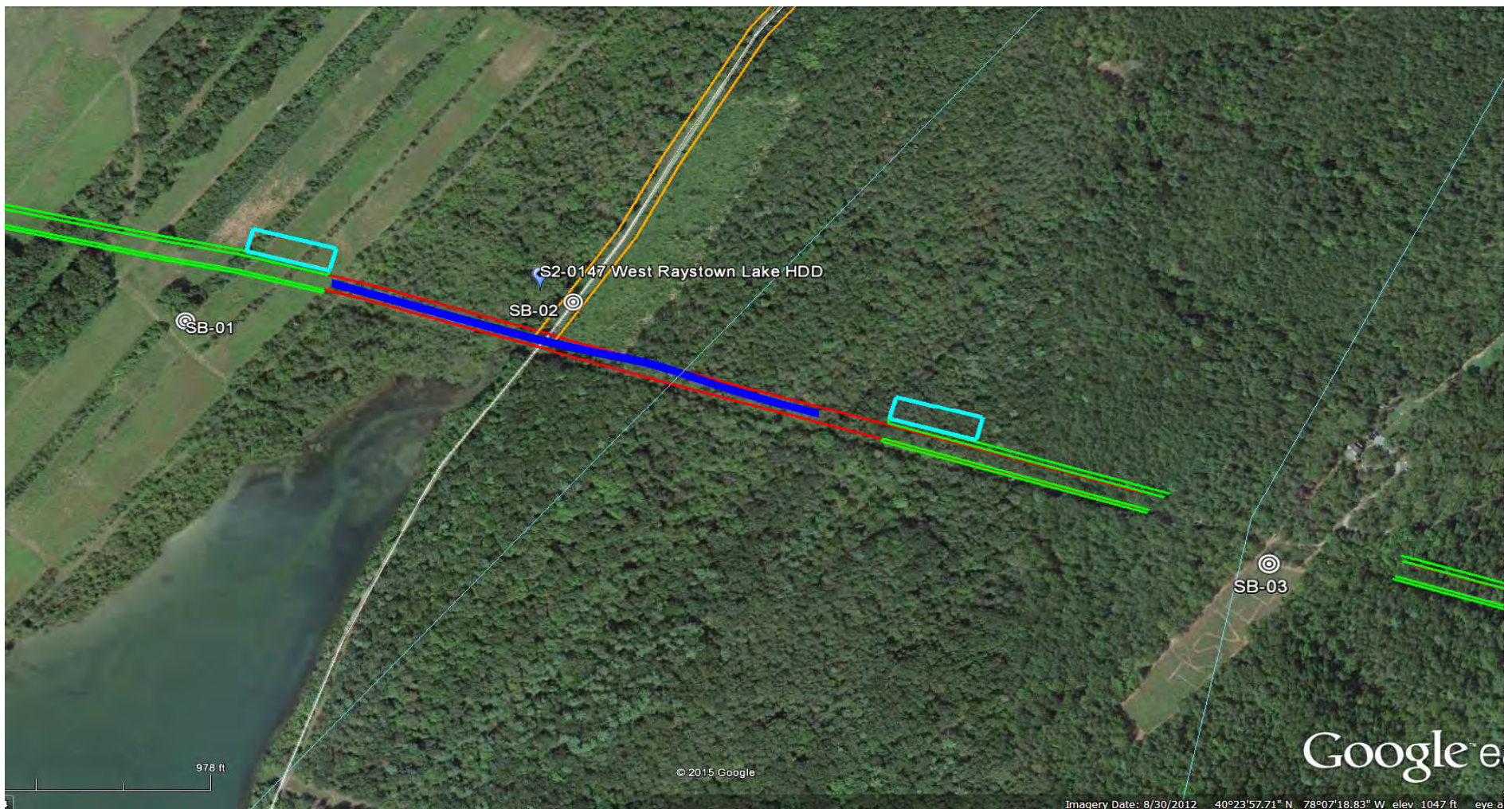
BY	DATE	CHK	DATE	APP	DATE
DLM	10/07/16	RMB	10/07/16	AAW	10/07/16
DLM	05/18/16	RMB	05/18/16	AAW	05/18/16
MRS	03/23/16	RMB	03/23/16	AAW	03/23/16
MRS	09/10/15	RMB	09/10/15	AAW	09/10/15
MRS	08/31/15	RMB	08/31/15	AAW	08/31/15



**SUNOCO PIPELINE, L.P.**

16-INCH HORIZONTAL DIRECTIONAL DRILL  
WEST RAYSTOWN LAKE  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=150'    DWG. NO: PA-HU-0020.0008-SS2-16



**LEGEND:**

☉ Geotechnical Soil Boring (SB) Locations



**TETRA TECH**

GEOTECHNICAL BORING LOCATIONS  
 HDD S2-0147  
 HUNTINGDON COUNTY, PENN TOWNSHIP, PA  
 SUNOCO PENNSYLVANIA PIPELINE PROJECT



**TETRA TECH**

240 Continental Drive, Suite 200  
 Newark, Delaware 19713  
 302.738.7551  
 fax: 302.454.5988

**TEST BORING LOG**

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT	Project No.:	103IP3406
Project Location:	VALLEY VIEW CEMETARY ROAD, HESSTON, PA	Page 1 of 1	
HDD No.:	S2-0147	Dates(s) Drilled:	01-13-15
Boring No.:	SB-01	Inspector:	E. WATT
Drilling Contractor:	HAD DRILLING	Drilling Method:	SPT - ASTM D1586
		Driller:	S. HOFFER
		Groundwater Depth (ft):	11
		Total Depth (ft):	17.2

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N	
	From	To	From	To									
			0.0	0.3			TOPSOIL (4").						
1	3.0	5.0	0.3		14	SM	MOTTLED LIGHT BROWN AND LIGHT GRAY FINE SAND AND SILT, TRACE FINE GRAVEL.	1	5	8	10	13	
2	8.0	10.0			24		MOTTLED LIGHT BROWN AND LIGHT GRAY FINE SAND AND SILT, TRACE FINE GRAVEL.	2	14	20	13	34	
				9.6		WEATHERED SILTSTONE	DARK GRAY WEATHERED SILTSTONE.	2	50/2"			>50	
3	13.0	13.7	9.6		11		DARK GRAY WEATHERED SILTSTONE.						
4	16.5	16.9			6		DARK GRAY WEATHERED SILTSTONE	50/5"				>50	
							DARK GRAY WEATHERED SILTSTONE.	50/2"				>50	
5	17.0	17.2		17.2	<2		DARK GRAY WEATHERED SILTSTONE.	50/2"				>50	
							AUGER REFUSAL AT 16.5'. AFTER SAMPLE 4 COLLECTED, OFF-SET BORING 15' NE AND CONTINUOUSLY AUGERED TO REFUSAL AT 17'. COLLECTED SAMPLE AT 17'.						
							BORING LOCATION ADJUSTED DUE TO GAS LINES.						
							WET ON SPOON AT 13'.						
							WATER LEVEL THROUGH AUGERS AT 11'.						
							CAVED AT 13.5', WATER LEVEL ON CAVE AT 6'.						

Notes/Comments:  
Pocket Pentrometer Testing DR: DECOMPOSED ROCK

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

\* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.  
 N: Number of blows to drive spoon from 6" to 18" interval.



**TETRA TECH**

240 Continental Drive, Suite 200  
 Newark, Delaware 19713  
 302.738.7551  
 fax: 302.454.5988

**TEST BORING LOG**

Project Name: SUNOCO PENNSYLVANIA PIPELINE PROJECT			Project No.: 103IP3406		
Project Location: BACKBONE ROAD, HESSTON, PA			Page 1 of 1		
HDD No.: S2-0147		Dates(s) Drilled: 01-21-15		Inspector: E. WATT	
Boring No.: SB-02		Drilling Method: SPT - ASTM D1586		Driller: S. HOFFER	
Drilling Contractor: HAD DRILLING		Groundwater Depth (ft): 18.0		Total Depth (ft): 37.0	

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
	From	To	From	To								
1	3.0	5.0	0.0		14	SC/SM	BROWN FINE SAND AND AND SILT/CLAY, TRACE FINE GRAVEL.	2	9	9	11	18
2	8.0	10.0			24		MOTTLED ORANGE BROWN AND GRAY FINE SAND AND SILT/CLAY, WITH A TRACE FINE GRAVEL. (USCS: SC/SM)	4	8	14	20	22
3	13.0	15.0			16		MOTTLED ORANGE BROWN AND GRAY FINE SAND AND SILT/CLAY, WITH TRACE OF FINE UNWEATHERED ROCK GRAVEL.	2	5	5	5	10
4	18.0	20.0			24		BROWN AND ORANGE FINE SAND WITH SOME SILT AN D CLAY, AND A LITTLE FINE GRAVEL SILTSTONE GRAVEL).	1	9	10	9	19
				23.5								
5	23.0	23.9	23.5			WEATHERED SILTSTONE	GRAY TO DARK GRAY WEATHERED SILTSTONE.	3	50/5"			>50
6	28.0	28.4		29.0	4	WEATHERED SILTSTONE	GRAY TO DARK GRAY WEATHERED SILTSTONE.	50/5"				
							AUGER REFUSAL AT 29'.					
							<u>ROCK CORING</u>					
RUN 1	29.0	32.5	29.00	29.74	42	WEATHERED AND FRACTURED SILTSTONE	DARK GRAY INTENSELY FRACTURED SILTSTONE.	TCR: 100%, SCR: 43%, RQD: 19%				
			29.74	30.05			DARK GRAY SILT AND CLAY.					
			30.05	31.48			DARK GRAY INTENSELY FRACTURED SILTSTONE.					
			31.48	31.80			DARK GRAY, VERY INTENSELY FRATURED SILTSTONE.					
			31.80	31.99			DARK GRAY INTENSELY FRACTURED SILTSTONE.					
RUN 2	32.5	37.0	31.99	32.77	54		DARK GRAY, VERY INTENSELY FRATURED SILTSTONE.	TCR: 100%, SCR: 54%, RQD: 41%				
			32.77	33.14			DARK GRAY INTENSELY FRACTURED SILTSTONE.					
			33.14	33.40			DARK GRAY, VERY INTENSELY FRATURED SILTSTONE.					
			33.40	34.21			DARK GRAY INTENSELY FRACTURED SILTSTONE.					
			34.21	34.70			DARK GRAY MODERATELY FRACTURED SILTSTONE.					
			34.70	35.88		DARK GRAY, VERY INTENSELY FRATURED SILTSTONE.						
			35.88	36.70		DARK GRAY MODERATELY FRACTURED SILTSTONE.						
			36.70	37.00		DARK GRAY INTENSELY FRACTURED SILTSTONE.						
							<u>CORE TESTING RESULTS (RUN 1 CORE):</u>					
							COMPRESSIVE STRENGTH: 4,200 PSI					
							UNIT WEIGHT: 176.7 PCF					
							<u>CORE TESTING RESULTS (RUN 2 CORE):</u>					
							COMPRESSIVE STRENGTH: 2,950 PSI					
							UNIT WEIGHT: 170.9 PCF					

Notes/Comments:  
Pocket Pentrometer Testing  
 S1: 3.5 TSF      S3: 2.75 TSF  
 S2: > 4 TSF  
 WET ON SPOON AT 18'.  
 WATER LEVEL THROUGH AUGERS AT 25'.  
 CAVED AT 27'.  
 Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.  
 \* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.  
 N: Number of blows to drive spoon from 6" to 18" interval.



**GEOTECHNICAL LABORATORY TESTING SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0147**

HDD No.	Boring No.	Sample No.	Depth of Sample (ft.)		Water Content, %	Percent Silts/Clays, %	Atterburg Limits (ASTM D4318)			USCS Classif.
			From	To	(ASTM D2216)	(ASTM D1140)	Liquid Limit, %	Plastic Limit, %	Plasticity Index, %	(ASTM D2487)
S2-0147	SB-01	1	3.0	5.0	19.0	44.1	36	26	10	SM
		2	8.0	10.0	11.2	36.3	-	-	-	-
		3	13.0	13.7	30.4	67.5	-	-	-	-
		5	17.0	17.2	7.2	16.3	-	-	-	-
	SB-02	1	3.0	5.0	11.6	43.0	-	-	-	-
		2	8.0	10.0	11.0	44.4	33	23	10	SC/SM
		3	13.0	15.0	12.7	48.1	-	-	-	-
		4	18.0	20.0	14.1	21.6	-	-	-	-
		5	23.0	23.9	7.8	24.9	-	-	-	-
	SB-03	2	8.0	9.3	7.5	30.2	-	-	-	-

Rock Core Testing Results				
Boring No.	Core Run	Approximate Depth (ft)	Compressive Strength (psi)	Unit Weight (pcf)
SB-02	1		4,200	176.7
SB-02	2		2,950	170.9

**Notes:**

- 1) Sample depths based on feet below grade at time of exploration.

**REGIONAL GEOLOGY SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0147**

HDD No.	NAME	BORING NO.	REGIONAL GEOLOGY DESCRIPTION	GENERAL TOPOGRAPHIC SETTING	BEDROCK FORMATION	GENERAL ROCK TYPE	APPROX MAX FM THICKNESS (FT)	DEPTH TO ROCK (Ft bgs) based on nearby well drilling logs	NOTES / COMMENTS
S2-0147	West Raystown Lake	SB-01	<b>Hamilton Group</b> - The Mahantango Formation and the underlying Marcellus Formation make up the Hamilton Group. Devonian-age shale.	Ridge & Valley (Steep relief changes)	Mahantango/Marcellus	Black shale that may contain limestone beds and concentrations of iron pyrite and siderite, Its sedimentary structure, or bedding, is moderately well developed and fissile.	9,000	2-16	Lighter colored shales in the upper portion of the formation tend to split into small thin-edged fragments after exposure. These fragments may have rust stains from exposure of pyrite to air, and tiny gypsum crystals from the reaction between pyrite and limestone particles. Fresh exposures of the pyriteiferous shale may develop the secondary mineralization of orange limonite, and the pale yellow efflorescence or bloom of sulfur, associated with acid rock drainage. Well yields 6-15 gpm. Depth to bedrock varies considerably with topography
		SB-02							
		SB-03	<b>Brallier and Harrell Formations</b> (undivided) - composed of interbedded light-gray, graded, siliceous siltstone beds and light-gray, hard, silty shales, sparsely fossiliferous.		Brallier-Harrell	Interbedded subfissile shales, f-c. thinly bedded siltstone and sandstones	1,800		

*Note : Source of well log data - <http://www.dcnr.state.pa.us/topogeo/groundwater/pagwis/records/index.htm>. All other sources as referenced in comments section.*

**ROCK CORE DESCRIPTION SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0147**

Location	Boring No.	Core Run	Core Depth (ft)		TCR (%)	SCR (%)	RQD (%)	Depth (ft)		Weathering	Classification	Bedding Thickness (ft)	Color	Discontinuity Data
			From	To				From	To					
S2-0147	SB-2	1	29	32.5	100	43	19	29	29.5	Moderate	Siltstone	Massive	Gray	Single mechanical fracture seen in section
								29.5	30	Heavily	Clay	Massive	Dark Gray	Highly chemically eroded siltstone and infilling with clay
								30	32.5	Moderate	Siltstone	Massive	Gray	Moderately fractured, ranging from 15° to 75°, Avg. 31°
		2	32.5	37	100	54	41	32.5	37	Moderate	Siltstone	Massive	Dark Gray	Moderately fractured, ranging from 0° to 80°, Avg. 26°

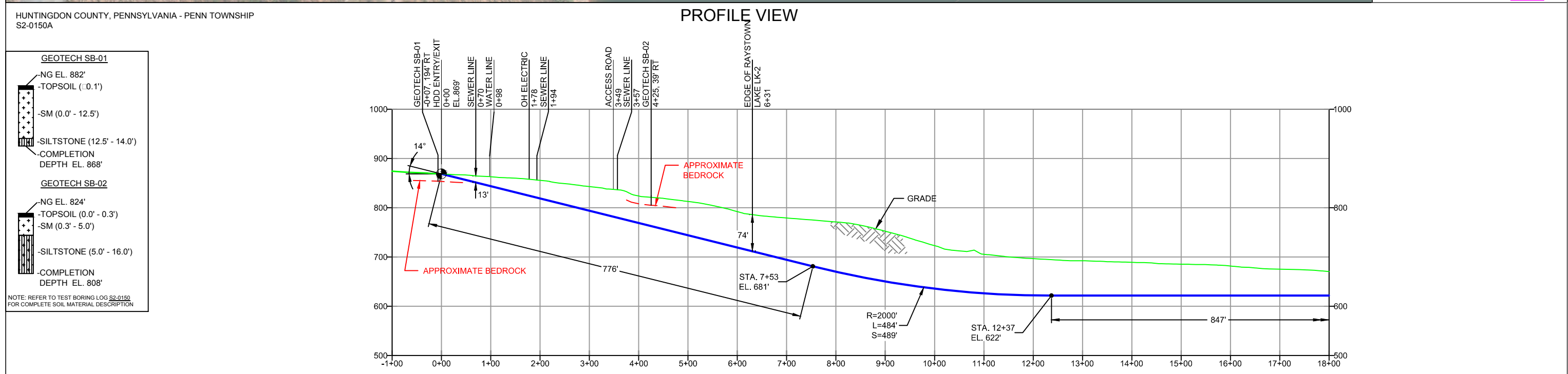
***HDD PA-HU-0020.0008-WX (MP-140)***

Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable and in this case that threat is considered to be *low*. Implementing this design, along with adherence to the Pennsylvania Pipeline Project Inadvertent Return Contingency Plan will ensure inadvertent impacts, if they were to occur, are also minimized to the maximum extent.

The drill will enter/exit 630 feet from the edge of the western most boundary of the lake crossing MP-140. The drill will travel beneath MP-140 for 2100 feet. Using the results of the geotechnical investigation, as well as several other data points, the entry/exit, angles, and depths have been configured to pass through the best substrates while maintaining pipe integrity (e.g., no large bends). The majority of the substrate that will be passed through is estimated to be siltstone to partially weathered siltstone. The drill will continue beneath MP-140 and will enter/exit 920 feet from the eastern most edge of MP-140.



PLAN VIEW



PROFILE VIEW

HUNTINGDON COUNTY, PENNSYLVANIA - PENN TOWNSHIP  
S2-0150A

GEOTECH SB-01	
NG EL. 882'	-TOPSOIL (0.0' - 0.1')
-SM (0.0' - 12.5')	
-SILTSTONE (12.5' - 14.0')	
COMPLETION DEPTH EL. 868'	
GEOTECH SB-02	
NG EL. 824'	-TOPSOIL (0.0' - 0.3')
-SM (0.3' - 5.0')	
-SILTSTONE (5.0' - 16.0')	
COMPLETION DEPTH EL. 808'	

NOTE: REFER TO TEST BORING LOG S2-0150 FOR COMPLETE SOIL MATERIAL DESCRIPTION

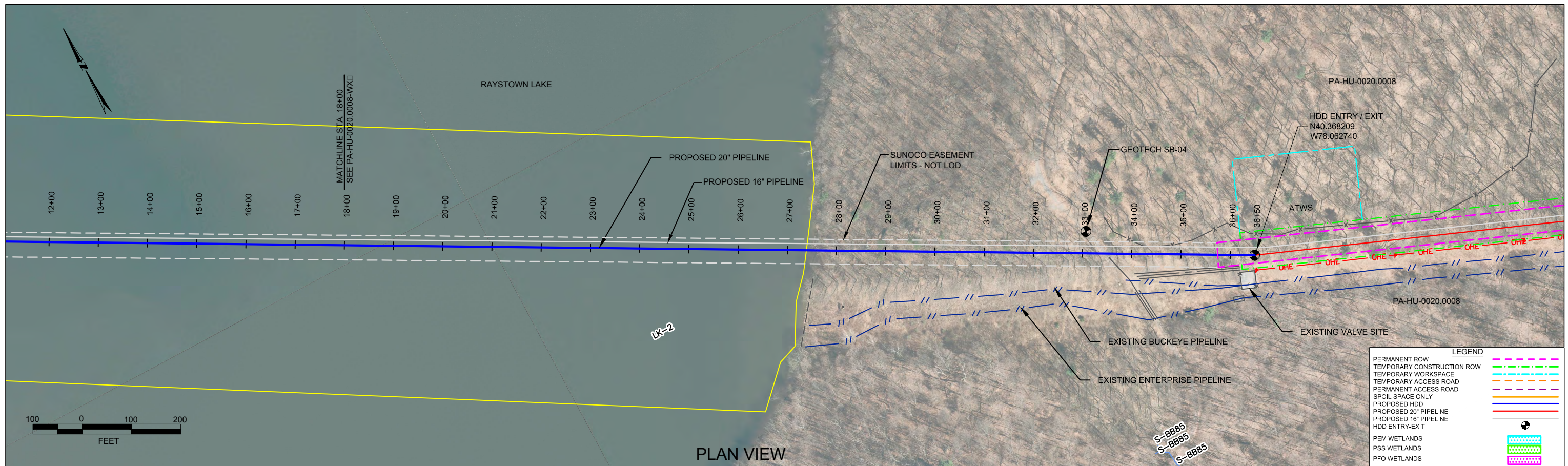
- DESIGN AND CONSTRUCTION:
- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
  - THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
  - DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
  - CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L)=3650'  
HDD PIPE LENGTH (S)=3780'  
20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW  
COATINGS: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
  - INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
  - INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
  - PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
  - CARRIER PIPE NOT ENCASED.
  - PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
  - CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
  - SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
  - SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
  - SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

NOTES

- ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
- STATIONING IS BASED ON HORIZONTAL DISTANCES.
- ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP. FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
- CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
- SUNOCO EMERGENCY HOTLINE NUMBER IS 1-800-786-7440.

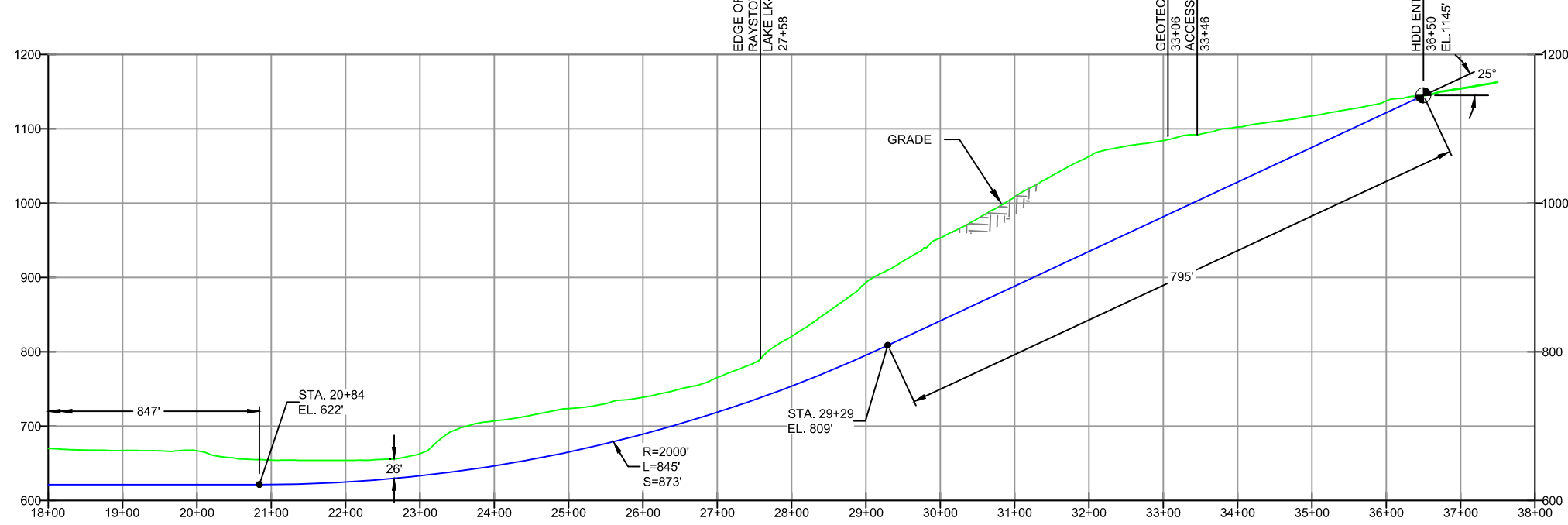
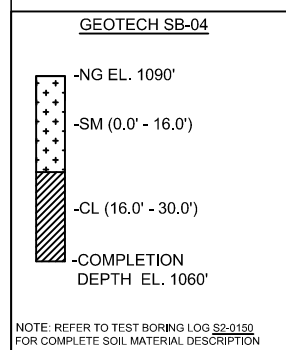
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ES-3.21	TO ES-3.24	NO.	DESCRIPTION
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SHEET 14	TO SHEET 15	EP1	REVISED PER PADEP COMMENTS
		EP	
		C	ADDED GEOTECH INFO
		B	ISSUED FOR BID
		A	ISSUED FOR REVIEW
DWG NO	DWG NO	NO.	DESCRIPTION

		<b>SUNOCO PIPELINE, L.P.</b>	
		20-INCH HORIZONTAL DIRECTIONAL DRILL RAYSTOWN LAKE PENNSYLVANIA PIPELINE PROJECT	
SCALE: 1"=200'		DWG. NO: PA-HU-0020.0008-WX	



HUNTINGDON COUNTY, PENNSYLVANIA - PENN TOWNSHIP S2-0150B

**PLAN VIEW**  
**PROFILE VIEW**



- DESIGN AND CONSTRUCTION:**
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  - DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
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HDD HORZ. LENGTH (L=): 3650'  
HDD PIPE LENGTH (S=): 3780'  
20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW  
COATINGS: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
  - INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
  - INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
  - PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
  - CARRIER PIPE NOT ENCASED.
  - PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
  - CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
  - SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
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- SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING			REVISIONS		
ES-3.21	TO	ES-3.24	EROSION & SEDIMENT PLAN	EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16
SHEET 14	TO	SHEET 15	AERIAL SITE PLAN	EP1	REVISED PER PADEP COMMENTS
				EP	
				C	ADDED GEOTECH INFO
				B	ISSUED FOR BID
				A	ISSUED FOR REVIEW
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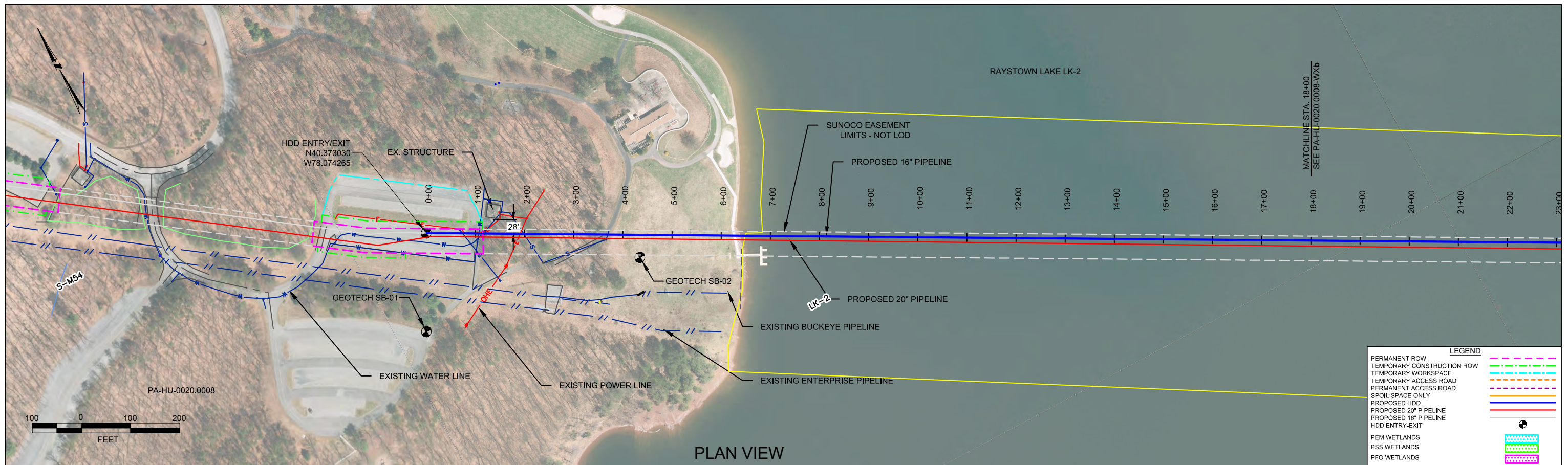
**Sunoco Logistics  
Partners L.P.**

**TETRA TECH ROONEY**  
(303) 792-5911

**SUNOCO PIPELINE, L.P.**

20-INCH HORIZONTAL DIRECTIONAL DRILL  
RAYSTOWN LAKE  
PENNSYLVANIA PIPELINE PROJECT

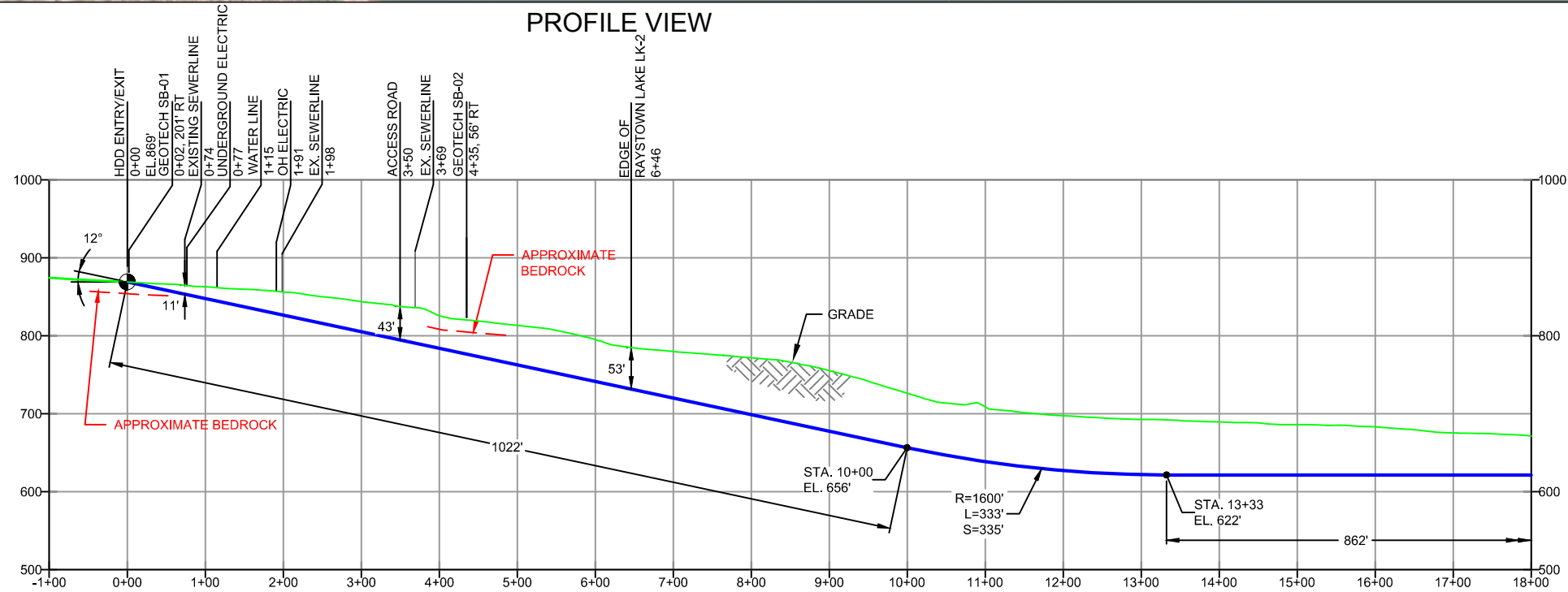
SCALE: 1"=200'    DWG. NO: PA-HU-0020.0008-WX



LEGEND	
PERMANENT ROW	
TEMPORARY CONSTRUCTION ROW	
TEMPORARY WORKSPACE	
TEMPORARY ACCESS ROAD	
PERMANENT ACCESS ROAD	
SPOIL SPACE ONLY	
PROPOSED HDD	
PROPOSED 20\"/>	

HUNTINGDON COUNTY, PENNSYLVANIA - PENN TOWNSHIP  
S2-0150A-16

PROFILE VIEW



GEOTECH SB-01	
-NG EL. 882'	
-TOPSOIL (0.1')	
-SM (0.0' - 12.5')	
-SILTSTONE (12.5' - 14.0')	
-COMPLETION DEPTH EL. 868'	
GEOTECH SB-02	
-NG EL. 824'	
-TOPSOIL (0.0' - 0.3')	
-SM (0.3' - 5.0')	
-SILTSTONE (5.0' - 16.0')	
-COMPLETION DEPTH EL. 808'	

NOTE: REFER TO TEST BORING LOG S2-0150 FOR COMPLETE SOIL MATERIAL DESCRIPTION

- DESIGN AND CONSTRUCTION:
- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
  - THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
  - DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
  - CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L-): 3680'  
HDD PIPE LENGTH (S-): 3808'  
16" x 0.438" W.T., X-70, API5L, PSL2, ERW, BFW  
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
  - INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
  - INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
  - PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
  - CARRIER PIPE NOT ENCASED.
  - PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
  - CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
  - SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
  - SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
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NOTES	
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2. STATIONING IS BASED ON HORIZONTAL DISTANCES	
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5. SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.	

REF. DRAWING	REVISIONS
ES-3.21 TO ES-3.24	EROSION & SEDIMENT PLAN
SHEET 14 TO SHEET 15	AERIAL SITE PLAN
	EP2 REVISED PER PADEP COMMENTS RECEIVED 09-06-16
	EP1 REVISED PER PADEP COMMENTS
	EP ADDED GEOTECH INFO
	B ISSUED FOR CONSTRUCTION
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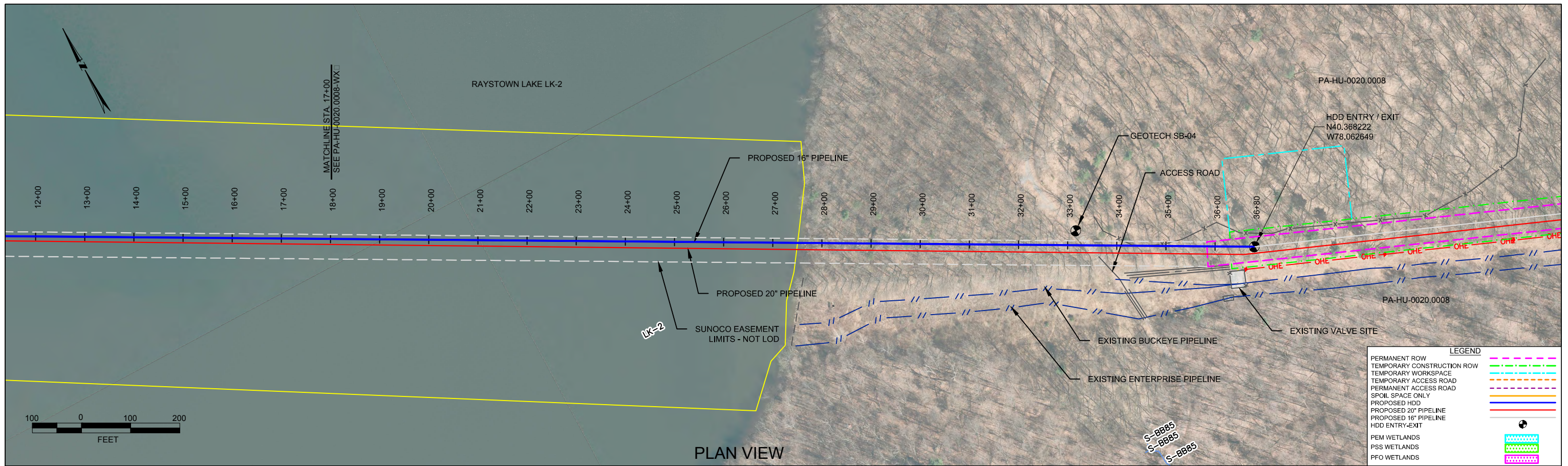
**Sunoco Logistics Partners L.P.**

**TETRA TECH ROONEY**  
(303) 792-5911

**SUNOCO PIPELINE, L.P.**

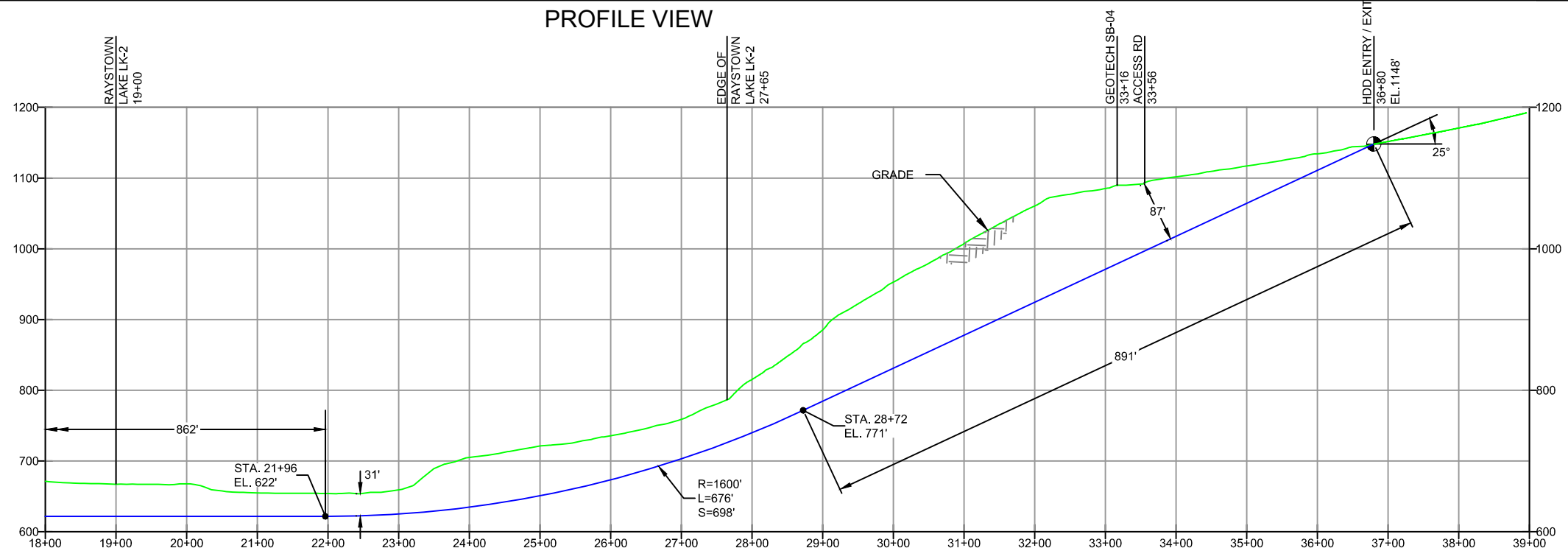
16-INCH HORIZONTAL DIRECTIONAL DRILL  
RAYSTOWN LAKE  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=200' DWG. NO: PA-HU-0020.0008-WX-16



HUNTINGDON COUNTY, PENNSYLVANIA - PENN TOWNSHIP  
S2-0150B-16

**PROFILE VIEW**



**GEOTECH SB-04**

- NG EL. 1090'
- SM (0.0' - 16.0')
- CL (16.0' - 30.0')
- COMPLETION DEPTH EL. 1060'

NOTE: REFER TO TEST BORING LOG S2-0150 FOR COMPLETE SOIL MATERIAL DESCRIPTION

- DESIGN AND CONSTRUCTION:
- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
  - THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
  - DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
  - CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L)=3680'  
HDD PIPE LENGTH (S)=3808'  
16" x 0.438" W.T., X-70, API5L, PSL2, ERW, BFW  
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
  - INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
  - INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
  - PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
  - CARRIER PIPE NOT ENCASED.
  - PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
  - CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
  - SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
  - SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
  - SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

**NOTES**

- ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
- STATIONING IS BASED ON HORIZONTAL DISTANCES
- ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP. FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
- CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
- SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING		REVISIONS	
ES-3.21	TO ES-3.24	NO.	DESCRIPTION
SHEET 14	TO SHEET 15	EP2	REVISED PAR PADEP COMMENTS RECEIVED 09-06-16
		EP1	REVISED PER PADEP COMMENTS
		EP	
		B	ISSUED FOR BID
		A	ISSUED FOR BID
DWG NO	DWG NO	NO.	DESCRIPTION

**Sunoco Logistics Partners L.P.**

**TETRA TECH ROONEY**  
(303) 792-5911

**SUNOCO PIPELINE, L.P.**

16-INCH HORIZONTAL DIRECTIONAL DRILL  
RAYSTOWN LAKE  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=200' DWG. NO: PA-HU-0020.0008-WX-16



**LEGEND:**

⊙ Geotechnical Soil Boring (SB) Locations



GEOTECHNICAL BORING LOCATIONS  
 HDD S2-0150  
 HUNTINGDON COUNTY, PENN TOWNSHIP, PA  
 SUNOCO PENNSYLVANIA PIPELINE PROJECT



**TETRA TECH**

240 Continental Drive, Suite 200  
 Newark, Delaware 19713  
 302.738.7551  
 fax: 302.454.5988

**TEST BORING LOG**

Project Name: SUNOCO PENNSYLVANIA PIPELINE PROJECT			Project No.: 103IP3406		
Project Location: WEST SIDE OF RAYSTOWN LAKE, PA			Page 1 of 1		
HDD No.: S2-0150		Dates(s) Drilled: 09-16-14		Inspector: E. WATT	
Boring No.: SB-01		Drilling Method: SPT - ASTM D1586		Driller: S. HOFFER	
Drilling Contractor: HAD DRILLING			Groundwater Depth (ft): NOT ENCOUNTERED		Total Depth (ft): 14.0

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (ft)	Strata (USCS)	Description of Materials	6" Increment Blows *				N		
	From	To	From	To										
							TOPSOIL (<1")							
1	3.0	5.0	0.0		12		DR WEATHERED TO A REDDISH BROWN SILTY SAND, TRACE	2	5	6	6		11	
							UNWEATHERED SILTSTONE FRAGMENTS.							
2	8.0	8.9			9	SM	DR WEATHERED TO A REDDISH BROWN FINE SAND WITH SOME SILT,	2	50/4"				>50	
				8.5			TRACE UNWEATHERED SILTSTONE F-GRAVEL.							
			8.5				DR WEATHERED TO A REDDISH BROWN FINE SAND WITH SOME							
				12.5			UNWEATHERED SILTSTONE F-C GRAVEL.							
3	13.0	13.3	12.5	14.0	4		PARTIALLY WEATHERED SILTSTONE.	50/4"					>50	
							GRINDING AT 12.5'.							
							AUGER REFUSAL AT 14.0'. OFF-SET BORING 24' TO THE NW AND							
							CONTINUOUSLY AUGERED TO AUGER REFUSAL AT 12.0.							
							CAVED AT 12.0'.							

Notes/Comments: Pocket Pentrometer Testing DR: DECOMPOSED ROCK

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

\* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.  
 N: Number of blows to drive spoon from 6" to 18" interval.



**TETRA TECH**

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**TEST BORING LOG**

Project Name:		SUNOCO PENNSYLVANIA PIPELINE PROJECT			Project No.: 103IP3406	
Project Location:		WEST SIDE OF RAYSTOWN LAKE, PA			Page 1 of 1	
HDD No.:	S2-0150	Dates(s) Drilled: 09-16-14		Inspector: E. WATT		
Boring No.:	SB-02	Drilling Method: SPT - ASTM D1586		Driller: S. HOFFER		
Drilling Contractor: HAD DRILLING		Groundwater Depth (ft): NOT ENCOUNTERED		Total Depth (ft): 16.0		

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (ft)	Strata (USCS)	Description of Materials	6" Increment Blows *				N	
	From	To	From	To									
			0.0	0.3			TOPSOIL (3")						
1	3.0	3.9	0.3			SM	DR WEATHERED TO A REDDISH BROWN FINE SAND WITH A LITTLE SILT, WITH SOME UNWEATHERED F-C SILTSTONE GRAVEL.	5	50/5"				>50
				5.0	6		AUGER REFUSAL AT 5.0'.						
							<u>ROCK CORING</u>						
RUN 1	5.0	7.0	5.0		24	ROCK	HIGHLY FRACTURED REDDISH BROWN SILTSTONE, TRACE MICA.	TCR: 100%, SCR: 54%, RQD: 17%					
							FRACTURE ZONES: 5.0 TO 5.27', 6.44', AND INDIVIDUAL FRACTURES EVERY .1 TO .2' BETWEEN 5.27 TO 6.2'.						
RUN 2			7.0		60		HIGHLY FRACTURED REDDISH BROWN SILTSTONE, TRACE MICA.	TCR: 100%, SCR: 31%, RQD: 0%					
				12.0			FRACTURED THROUGHOUT, SOLID RECOVERY RANGES FROM 1" TO 3". MOST CORE SECTIONS <1".						
RUN 3	12.0	16.0	12.0		45		HIGHLY FRACTURED REDDISH BROWN SILTSTONE, TRACE MICA.	TCR: 94%, SCR: 54%, RQD: 29%					
				16.0			FRACTURE ZONES: 12.0 TO 13.2' AND 13.9 TO 14.3'; INDIVIDUAL FRACTURES AT 13.56', 14.5', 14.95', 15.14', 15.24' AND 15.45'.						
							CAVED AND DRY AT 5'.						
							<u>CORE TESTING RESULTS (DEPTH 15.7'):</u>						
							COMPRESSIVE STRENGTH: 6,280 PSI						
							UNIT WEIGHT: 167.0 PCF						

Notes/Comments:

Pocket Pentrometer Testing  
 S1: >4 TSF

DR: DECOMPOSED ROCK

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

\* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.

N: Number of blows to drive spoon from 6" to 18" interval.



**TETRA TECH**

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**TEST BORING LOG**

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT	Project No.:	103IP3406
Project Location:	WEST SIDE OF RAYSTOWN LAKE, PA	Page 1 of 1	
HDD No.:	S2-0150	Dates(s) Drilled:	09-17-14
Boring No.:	SB-04	Inspector:	E. WATT
Drilling Contractor:	HAD DRILLING	Drilling Method:	SPT - ASTM D1586
		Driller:	S. HOFFER
		Groundwater Depth (ft):	NOT ENCOUNTERED
		Total Depth (ft):	30.0

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (ft)	Strata (USCS)	Description of Materials	6" Increment Blows *				N	
	From	To	From	To									
							NO TOPSOIL.						
1	3.0	5.0	0.0		18	SM	DR WEATHERED TO A TAN TO BROWN FINE SAND, TRACE FINE GRAVEL.	2	14	15	13	29	
2	8.0	10.0			11		DR WEATHERED TO A TAN TO BROWN FINE SAND, WITH SOME FINE TO COARSE SILTSTONE GRAVEL.	14	18	15	16	33	
3	13.0	13.9			11	CL	DR WEATHERED TO A LIGHT BROWN TO ORANGE BROWN FINE SAND, WITH SOME F-C SANDSTONE? GRAVEL.	6	50/5"			>50	
4	18.0	18.8	16.0		10		DR WEATHERED TO A REDDISH BROWN CLAY AND FINE SAND, TRACE TO A LITTLE FINE SILTSTONE GRAVEL. (USCS: CL)	16	50/4"			>50	
5	23.0	23.9			11	CL	DR WEATHERED TO A REDDISH BROWN CLAY AND FINE SAND, TRACE TO A LITTLE FINE SILTSTONE GRAVEL.	3	50/5"			>50	
6	28.0	28.4			6		DR WEATHERED TO A REDDISH BROWN CLAY AND FINE SAND, TRACE TO A LITTLE FINE SILTSTONE GRAVEL.	50/5"				>50	
				30.0									
							AUGERED TO 30'.						
							CAVED AND DRY AT 27'.						
							CONCRETE PLUG PLACED FROM 1' TO 4' BGS.						

Notes/Comments:  
Pocket Pentrometer Testing DR: DECOMPOSED ROCK  
 S4-S6: >3 TSF

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

\* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.  
 N: Number of blows to drive spoon from 6" to 18" interval.

**LABORATORY TESTING SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0150 SOIL BORINGS**

HDD No.	Test Boring No.	Sample No.	Depth of Sample (ft.)		Water Content, % (ASTM D2216)	Percent Silts/Clays, % (ASTM D1140)	Atterburg Limits (ASTM D4318)			USCS Classif. (ASTM D2487)
			From	To			Liquid Limit, %	Plastic Limit, %	Plasticity Index, %	
S2-0150	SB-01	1	3.0	5.0	13.6	46.3	-	-	-	-
		2	8.0	8.9	6.4	22.2	-	-	-	-
		3	13.0	13.3	1.6	8.2	-	-	-	-
	SB-02	1	3.0	3.9	2.2	19.7	-	-	-	-
		2	8.0	10.0	2.3	8.2	-	-	-	-
	SB-04	4	18.0	18.8	5.6	67.0	28	17	11	CL
		6	28.0	28.4	4.6	55.8	-	-	-	-

Notes:

- 1) Sample depths based on feet below grade at time of exploration.

**Sunoco Pennsylvania Pipeline Project  
Regional Geological Description  
HDD S2-0150 Raystown Lake**

HDD No.	Name	Boring No.	Geology Description	GENERAL TOPOGRAPHIC SETTING	BEDROCK FORMATION	GENERAL ROCK TYPE	APPROX MAX FM THICKNESS (FT)	DEPTH TO ROCK (Ft bgs) based on nearby well drilling logs	NOTES / COMMENTS
S2-0150	Raystown Lake	SB-01	Catskill Fm - succession of greenish-gray-red sandstone, siltstone, shale, and mudstone, generally in fining-upward cycles.	Lake	Catskill Fm	Sandstone-siltstone-shale-conglomerate	900-3,900	39-46	Bedding ranges in thickness from <1ft to 16 ft.
		SB-02							
		SB-03							
		SB-04							

**SUNOCO PENNSYLVANIA PIPELINE  
ROCK CORE DESCRIPTION SUMMARY TABLE**

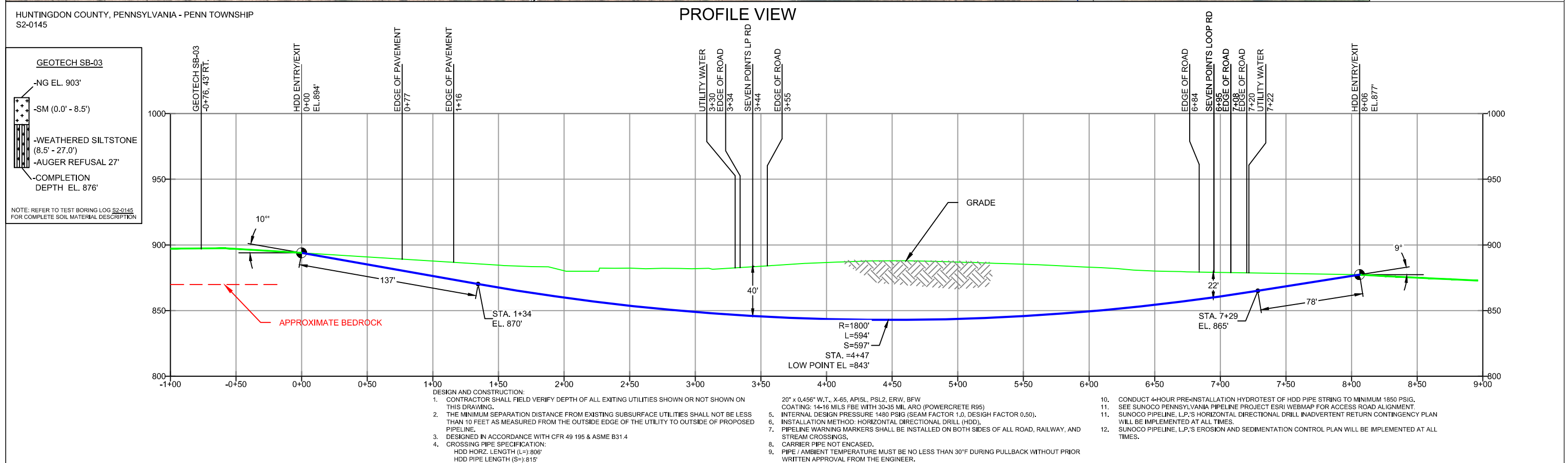
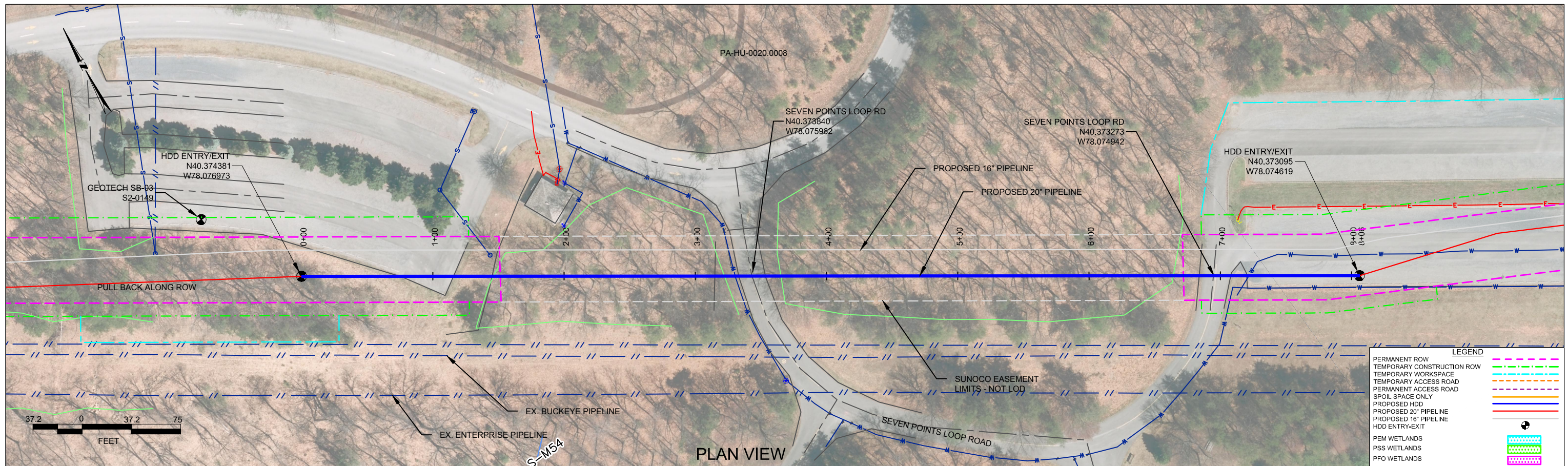
Page 1 of 1

Location	Boring No.	Core Run	Core Depth (ft)		TCR (%)	SCR (%)	RQD (%)	Depth (ft)		Weathering	Classification	Bedding Thickness (ft)	Color	Discontinuity Data
			From	To				From	To					
S2-0150	SB-2	1	5	7	100	54	13							
S2-0150	SB-2	2	7	12	100	31	0	5	16	Moderate	Siltstone	11+	Red	Heavily fractured throughout boring; dip angles range from 0° to 70°; slight laminations visible; fractures do not orient to lamination
S2-0150	SB-2	3	12	16	94	54	29							

***HDD PA-HU-0025.0000-RD3***

Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable and in this case that threat is considered to be low. Implementing this design, along with adherence to the Pennsylvania Pipeline Project Inadvertent Return Contingency Plan will ensure inadvertent impacts, if they were to occur, are also minimized to the maximum extent.

The drill will enter/exit 360 feet from the western edge of the first Seven Point Loop Road crossing and enter/exit 450 feet from the eastern edge. The drill will enter/exit 710 feet from the western edge of the second Seven Point Loop Road crossing and enter/exit 100 feet from the eastern edge. The drill will pass below each road crossing at depths greater than 20 feet with a maximum depth of about 45 feet. The geotechnical results, as well as other data points, were used to determine the entry/exit angles, and depths to pass through the best substrates while maintaining the pipe integrity (e.g., no large bends). According to the geotechnical report substrates being drilled through are silts with fine sands, and siltstone. Based on the geotechnical report and drill profile minimal inadvertent returns are expected.



**NOTES**

1. ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE, ALL MSL ELEVATIONS ARE NAD83
2. STATIONING IS BASED ON HORIZONTAL DISTANCES.
3. ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE, THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP. FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
4. CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
5. SUNOCO EMERGENCY HOTLINE NUMBER IS 1-800-786-7440.

REF. DRAWING		EROSION & SEDIMENT PLAN	
DWG NO	DWG NO	DESCRIPTION	NO.
ES-3.21	TO ES-3.21	EROSION & SEDIMENT PLAN	
SHEET 14	TO SHEET 14	AERIAL SITE PLAN	
		EP	
		2	REVISED PER ENGINEERING COMMENTS
		1	ADDED GEOTECH INFO
		0	ISSUED FOR CONSTRUCTION

REVISIONS					
BY	DATE	CHK	DATE	APP	DATE
MRS	11/08/16	RMB	11/08/16	AAW	11/08/16
DLM	08/26/16	RMB	08/26/16	AAW	08/26/16
MRS	07/19/16	RMB	07/19/16	AAW	07/19/16
DLM	04/18/16	RMB	04/18/16	AAW	04/18/16

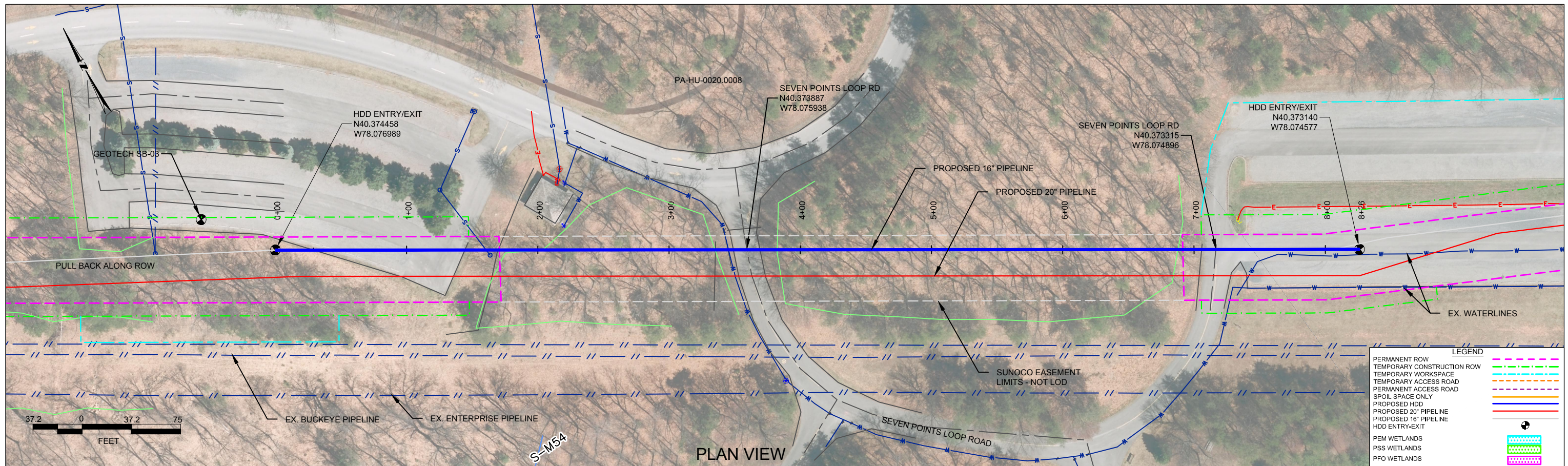
**Sunoco Logistics Partners L.P.**

**Tetra Tech Rooney**  
(303) 792-5911

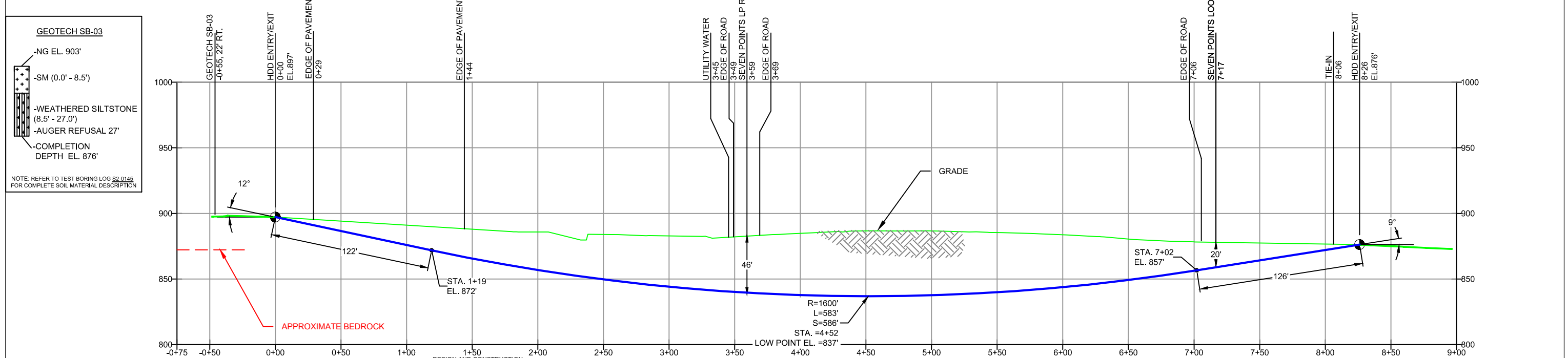
**SUNOCO PIPELINE, L.P.**

DIANCH HORIZONTAL DIRECTIONAL DRILL  
SEVEN POINT LOOP ROAD  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=200' DWG. NO: PA-HU-0025.0000-RD3



HUNTINGDON COUNTY, PENNSYLVANIA - PENN TOWNSHIP  
S2-145-16



- DESIGN AND CONSTRUCTION:**
- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
  - THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
  - DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
  - CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L)=826'  
HDD PIPE LENGTH (S)=835'
  - 16" x 0.438" W.T., X-70, API5L, PSL2, ERW, BFW  
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)  
INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
  - INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
  - PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
  - CARRIER PIPE NOT ENCASED.
  - PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
  - CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
  - SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
  - SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
  - SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

**NOTES**

- ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
- STATIONING IS BASED ON HORIZONTAL DISTANCES.
- ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP. FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
- CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
- SUNOCO EMERGENCY HOTLINE NUMBER IS 811-800-786-7440.

**REF. DRAWING**

ES-3.21	TO	ES-3.21	EROSION & SEDIMENT PLAN
SHEET 14	TO	SHEET 14	AERIAL SITE PLAN

**REVISIONS**

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
2	REVISED PER ENGINEERING COMMENTS	MRS	11/08/16	RMB	11/08/16	AAW	11/08/16
1	ADDED GEOTECH INFO	DLM	08/26/16	RMB	08/26/16	AAW	08/26/16
0	ISSUED FOR CONSTRUCTION	MRS	07/19/16	RMB	07/19/16	AAW	07/19/16
		DLM	04/18/16	RMB	04/18/16	AAW	04/18/16

**Sunoco Logistics Partners L.P.**

**Tetra Tech Rooney**  
(303) 792-5911

**SUNOCO PIPELINE, L.P.**

DIANCH HORIZONTAL DIRECTIONAL DRILL  
SEVEN POINT LOOP ROAD  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=200'  
DWG. NO: PA-HU-0025.0000-RD3-16



**LEGEND:**

⊙ Geotechnical Soil Boring (SB) Locations



GEOTECHNICAL BORING LOCATIONS  
S2-0145 RAYSTOWN LAKE MUSHROOM PARKING AREA  
HUNTINGDON COUNTY, PENN TOWNSHIP, PA  
SUNOCO PENNSYLVANIA PIPELINE PROJECT



**TETRA TECH**

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 Newark, Delaware 19713  
 302.738.7551  
 fax: 302.454.5988

**TEST BORING LOG**

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT	Project No.:	103IP3406
Project Location:	RAYSTOWN LAKE, SEVEN POINTS LOOP, MUSHROOM PARKING AREA, PA	Page 1 of 1	
HDD No.:	S2-0145	Dates(s) Drilled:	04-21-16
Boring No.:	SB-03	Inspector:	E. WATT
Drilling Contractor:	HAD DRILLING	Drilling Method:	SPT - ASTM D1586
Boring Location Coordinates:	40°22'28.56"N	Driller:	S. HOFFER
		Groundwater Depth (ft):	NOT ENCOUNTERED
		Total Depth (ft):	27.0
			78° 4'37.58"W

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N	
	From	To	From	To									
			0.0	0.0			NO TOPSOIL						
1	3.0	5.0	0.0		16	SM	REDDISH BROWN FINE SAND WITH SOME SILT, WITH A LITTLE UNWEATHERED FINE ROCK FRAGMENTS.	3	5	6	8	11	
2	8.0	9.5			17		SAME	7	35	50/4"		>50	
				8.5									
3	13.0	13.3	8.5		1	PARTIALLY WEATHERED SILTSTONE	REDDISH BROWN PARTIALLY WEATHERED SILTSTONE.	50/2"				>50	
4	18.0	18.4			5		GRAY PARTIALLY WEATHERED SILTSTONE.	50/5"				>50	
5	23.0	23.8			3		REDDISH BROWN PARTIALLY WEATHERED SILTSTONE.	50/5"				>50	
6	27.0	27.0		27.0	0		NO RECOVERY	50/0"					
							AUGER REFUSAL AT 27'.						
							A LITTLE AUGER GRINDING COMMENCED AT 11'.						
							HARD GRINDING COMMENCED AT 23'.						
							CAVED AND DRY AT 22'.						

Notes/Comments:  
Pocket Pentrometer Testing  
 S1: 3.5 TSF

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

\* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.  
 N: Number of blows to drive spoon from 6" to 18" interval.

**GEOTECHNICAL LABORATORY TESTING SUMMARY  
 SUNOCO PENNSYLVANIA PIPELINE PROJECT  
 S2-0145 RAYSTOWN LAKE MUSHROOM PARKING AREA**

Location	Test Boring No.	Sample No.	Depth of Sample (ft.)		Water Content, % (ASTM D2216)	Percent Silts/Clays, % (ASTM D1140)	Atterburg Limits (ASTM D4318)			USCS Classif. (ASTM D2487)
			From	To			Liquid Limit, %	Plastic Limit, %	Plasticity Index, %	
S2-0145	SB-03	1	3.0	5.0	11.9	32.7	-	-	-	-
		2	8.0	9.5	6.5	29.2	NV	NP	NP	SM
		4	18.0	18.4	4.7	23.4	-	-	-	-

**Notes:**

- 1) Sample depths based on feet below grade at time of exploration.

**REGIONAL GEOLOGY SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
S2-0145 RAYSTOWN LAKE MUSHROOM PARKING AREA**

NAME	BORING NO.	REGIONAL GEOLOGY DESCRIPTION	GENERAL TOPOGRAPHIC SETTING	BEDROCK FORMATION	GENERAL ROCK TYPE	APPROX MAX FM THICKNESS (FT)	DEPTH TO ROCK (Ft bgs) based on nearby well drilling logs	NOTES / COMMENTS
S2-0145	SB-01	<b>Catskill Fm</b> - succession of greenish-gray-red sandstone, siltstone, shale, and mudstone, generally in fining-upward cycles.	Hilly small peninsula	Catskill Fm	Greenish-gray-red sandstone, siltstone, shale, and mudstone	900-3,900	Data not available for Raystown Lake area; however, based on other borings performed in Raystown Lake area, depth to bedrock is shallow.	

*Note : Source of well log data - <http://www.dcnr.state.pa.us/topogeo/groundwater/pagwis/records/index.htm>. All other sources as referenced in comments section.*

# FIELD DESCRIPTION AND LOGGING SYSTEM FOR SOIL EXPLORATION

## GRANULAR SOILS

(Sand, Gravel & Combinations)

<u>Density</u>	<u>N (blows)*</u>
Very Loose	5 or less
Loose	6 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	51 or more

### Particle Size Identification

Boulders	8 in. diameter or more
Cobbles	3 to 8 in. diameter
Gravel	Coarse (C) 3 in. to ¾ in. sieve Fine (F) ¾ in. to No. 4 sieve
Sand	Coarse (C) No. 4 to No. 10 sieve (4.75mm-2.00mm) Medium No. 10 to No. 40 sieve (M) (2.00mm – 0.425mm) Fine (F) No. 40 to No. 200 sieve (0.425 – 0.074mm)
Silt/Clay	Less Than a No. 200 sieve (<0.074mm)

### Relative Proportions

<u>Description Term</u>	<u>Percent</u>
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

## COHESIVE SOILS

(Silt, Clay & Combinations)

<u>Consistency</u>	<u>N (blows)*</u>
Very Soft	3 or less
Soft	4 to 5
Medium Stiff	6 to 10
Stiff	11 to 15
Very Stiff	16 to 30
Hard	31 or more

### Plasticity

<u>Degree of Plasticity</u>	<u>Plasticity Index</u>
None to Slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	> 22

## ROCK

(Rock Cores)

<u>Rock Quality Designation (RQD), %</u>	<u>Rock Quality Description</u>
0-25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
90-100	Excellent

**RQD:** Rock Quality Designation

**TCR:** Total Core Recovery

**SCR:** Solid Core Recovery

**\*N - Standard Penetration Resistance.** Driving a 2.0" O.D., 1-3/8" I.D. sampler a distance of 18 inches into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. The number of hammer blows to drive the sampler through each 6 inch interval is recorded; the number of blows required to drive the sampler through the final 12 inch interval is termed the Standard Penetration Resistance (SPR) N-value. For example, blow counts of 6/8/9 (through three 6-inch intervals) results in an SPR N-value of 17 (8+9).

**Groundwater** observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

**UNIFIED SOIL CLASSIFICATION SYSTEM [Casagrande (1948)]**

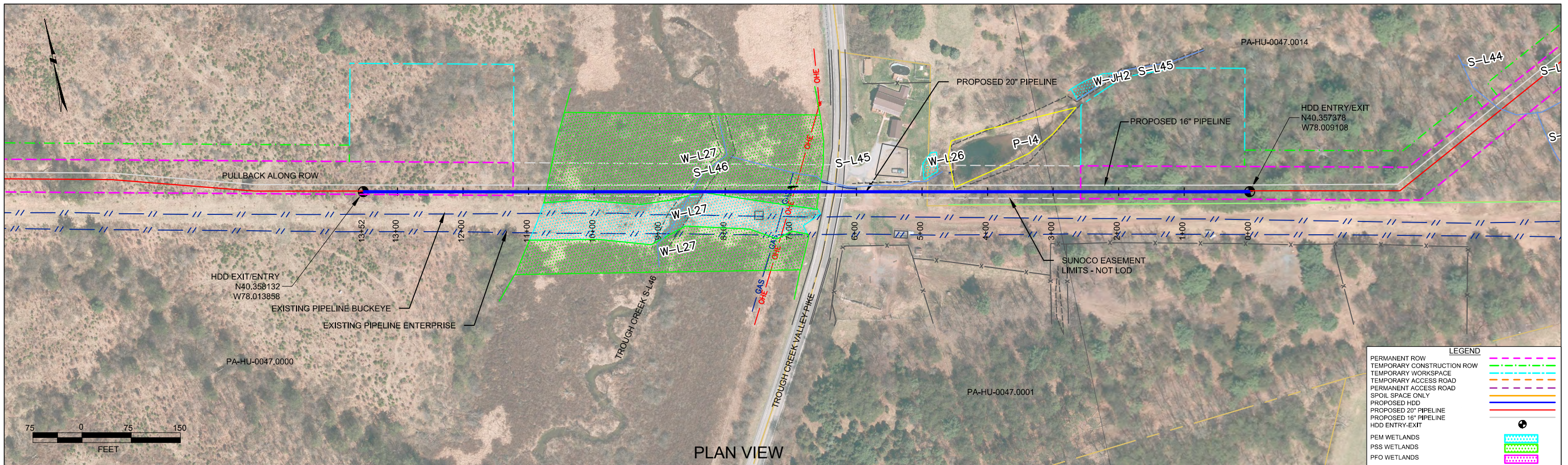
Major Divisions		Group Symbols	Typical Descriptions	Laboratory Classifications				
Coarse Grained Soils (More than half of material is larger than No. 200 sieve)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravel (Little or no fines)	GW Well-graded gravels, gravel-sand mixtures, little or no fines	Determine Percentage of sand and gravel from grain size curve. Depending on Percentage of fines (fraction smaller than No. 200 sieve), coarse-grained soils are classified as follows:  Less than 5 percent GW, GP, SW, SP More than 12 percent GM, GC, SM, SC 5 to 12 percent Borderline cases requiring dual symbols <sup>(1)</sup>	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4: $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3			
		GP Poorly graded gravels, gravel-sand mixtures, little or no fines	Not meeting $C_u$ or $C_c$ requirements for GW					
		Gravel with fines (Appreciable amount of fines)	GM Silty gravels, gravel-sand-silt mixtures		Atterberg limits below A Line or $I_p$ less than 4	Limits plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols		
			GC Clayey gravels, gravel-sand-clay mixtures		Atterberg limits above A line with $I_p$ greater than 7			
	Sands (More than half of coarse fraction is smaller than No. 4 Sieve)	Clean sands (Little or no fines)	SW Well graded sands, gravelly sands, little or no fines		$C_u = \frac{D_{60}}{D_{10}}$ greater than 6: $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3			
			SP Poorly graded sands, gravelly sands, little or no fines		Not meeting $C_u$ or $C_c$ requirements for SW			
		Sands with fines (Appreciable amount of fines)	SM Silty sands, sand-silt mixtures		Atterberg limits below A Line or $I_p$ less than 4	Limits Plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols		
			SC Clayey sands, sand-clay mixtures		Atterberg limits above A line with $I_p$ greater than 7			
						For soils plotting nearly on A line use dual symbols i.e., $I_p = 29.5$ , $w_L = 60$ gives CH-MH. When $w_L$ is near 50 use CL-CH or ML-MH. Take near as $\pm 2$ percent.		
		Fine-grained soils (More than half of material is smaller than No. 200 sieve)	Silt and clays (Liquid limit less than 50)		ML Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity			
CL Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays								
OL Organic silts and organic silty clays of low plasticity								
Silt and Clays (Liquid limit greater than 50)	MH Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts							
	CH Inorganic clays of high plasticity, fat clays							
	OH Organic clays of medium to high plasticity, organic silts							
Highly organic soils	Pt Peat and other highly organic soils							

(1) Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC. well-graded gravel-sand mixture with clay binder.

***HDD PA-HL-0047.0000-RD (W-L27) (S-L46)***

Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable and in this case that threat is considered to be *low*. Implementing this design, along with adherence to the Pennsylvania Pipeline Project Inadvertent Return Contingency Plan will ensure inadvertent impacts, if they were to occur, are also minimized to the maximum extent.

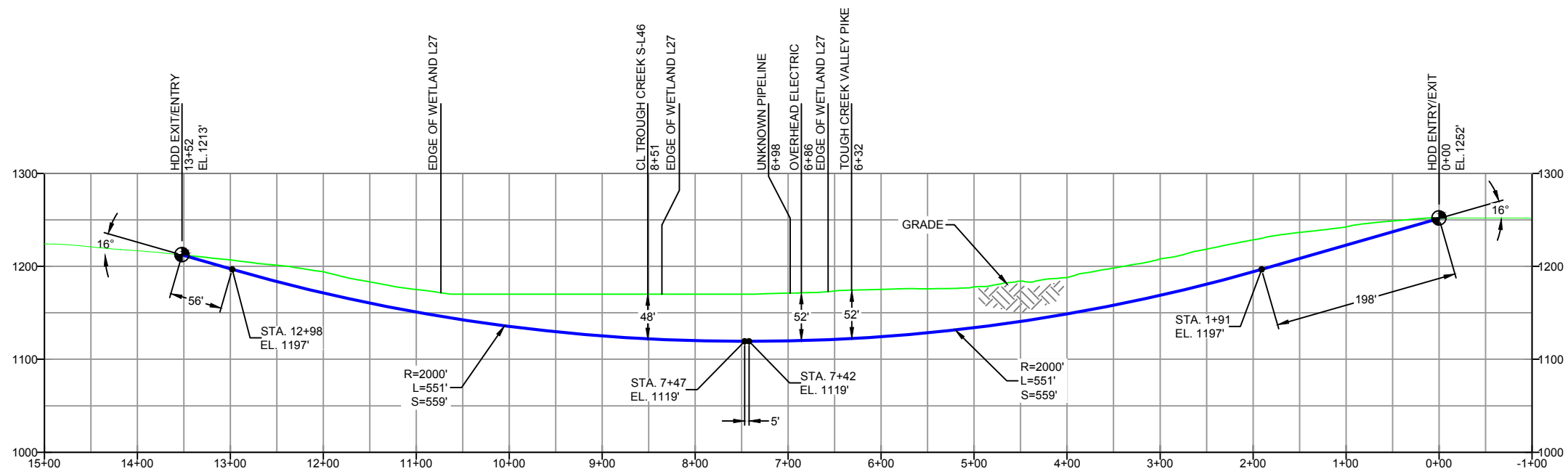
The drill will enter/exit 275 feet from the edge of the western most boundary of the wetland W-L27. The drill will travel beneath wetland W-L47 for 420 feet. The drill will also travel 220 feet to the western most boundary of stream S-L46 and will pass beneath stream S-L46 for 15 feet. Using the results of the geotechnical investigation, as well as several other data points, the entry/exit, angles, and depths have been configured to pass through the best substrates while maintaining pipe integrity (e.g., no large bends). The majority of the substrate that will be passed through is estimated to be reddish brown weathered fissile shale. The drill will continue beneath the eastern most boundary of the wetland W-L47 and will travel 650 feet from the eastern most edge of wetland W-L47 and will enter/exit.



PLAN VIEW

HUNTINGDON COUNTY, PENNSYLVANIA - UNION TOWNSHIP  
S2-0152

PROFILE VIEW



DESIGN AND CONSTRUCTION:

- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
- THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
- DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
- CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L=): 1352'  
HDD PIPE LENGTH (S=): 1376'  
20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW  
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
- INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
- INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
- PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
- CARRIER PIPE NOT ENCASED.
- PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
- CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
- SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
- SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
- SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

NOTES	
1.	ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
2.	STATIONING IS BASED ON HORIZONTAL DISTANCES.
3.	ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP. FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
4.	CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
5.	SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING	
ES-3.32	TO ES-3.33 EROSION & SEDIMENT PLAN
SHEET 20	TO SHEET 21 AERIAL SITE PLAN

REVISIONS	
EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16
EP1	REVISED PER PADEP COMMENTS
EP	
B	ISSUED FOR BID
A	ISSUED FOR REVIEW

BY	DATE	CHK	DATE	APP	DATE
DLM	09/30/16	RMB	09/30/16	AAW	09/30/16
DLM	05/18/16	RMB	05/18/16	AAW	05/18/16
MRS	02/26/16	RMB	02/26/16	AAW	02/26/16
DLM	07/31/15	RMB	07/31/15	AAW	07/31/15
JAM	03/24/15	RMB	03/24/15	AAW	03/24/15

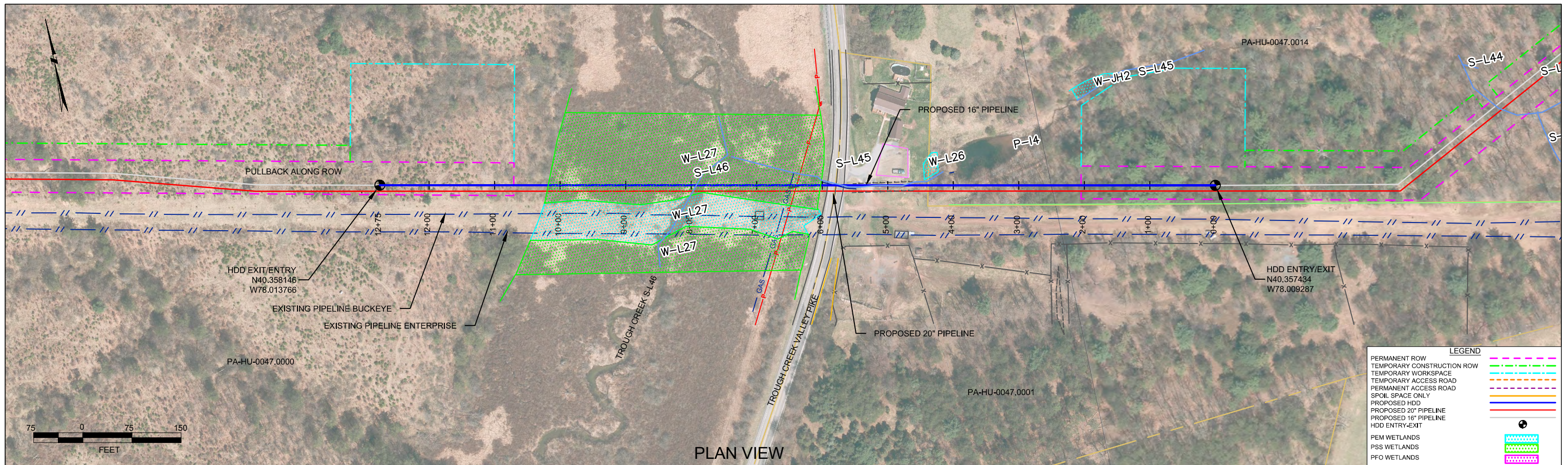
**Sunoco Logistics Partners L.P.**

**TETRA TECH ROONEY**  
(303) 792-5911

**SUNOCO PIPELINE, L.P.**

20-INCH HORIZONTAL DIRECTIONAL DRILL  
TROUGH CREEK VALLEY PIKE  
PENNSYLVANIA PIPELINE PROJECT

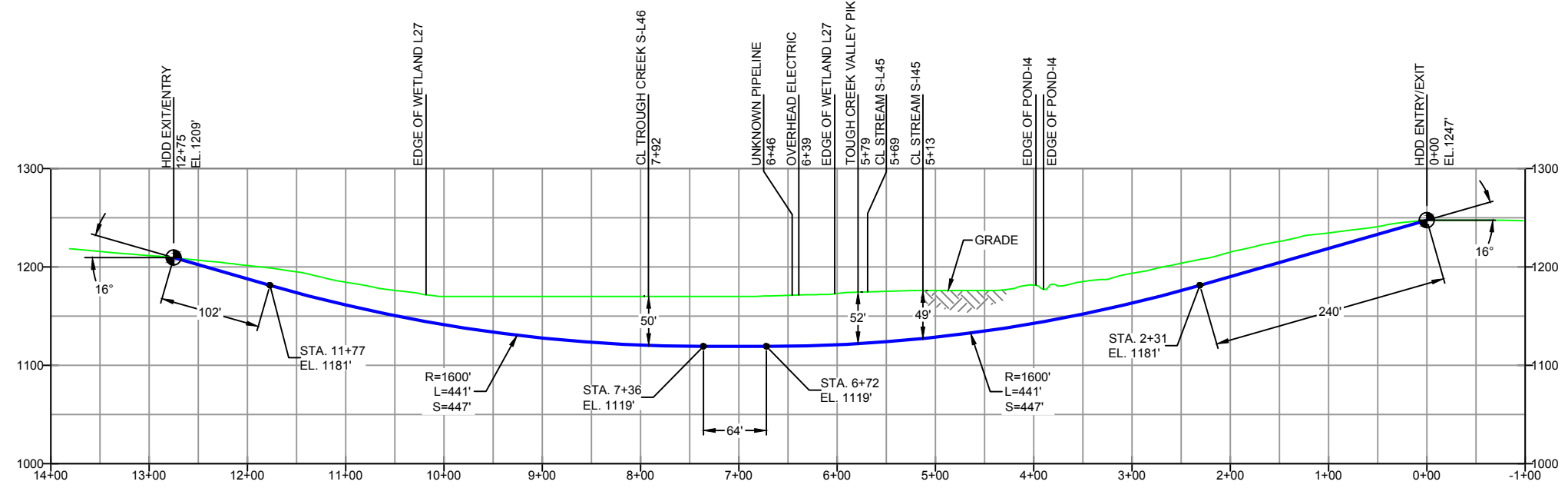
SCALE: 1"=150'  
DWG. NO: PA-HU-0047.0000-RD



PLAN VIEW

PROFILE VIEW

HUNTINGDON COUNTY, PENNSYLVANIA - UNION TOWNSHIP  
S2-0152-16



- DESIGN AND CONSTRUCTION:
- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
  - THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
  - DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
  - CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L-): 1275'  
HDD PIPE LENGTH (S-): 1300'  
16" x 0.438" W.T., X-70, APISL, PSL2, ERW, BFW  
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
  - INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
  - INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
  - PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
  - CARRIER PIPE NOT ENCASED.
  - PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
  - CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
  - SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
  - SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
  - SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

NOTES

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- STATIONING IS BASED ON HORIZONTAL DISTANCES
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- CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
- SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING		REVISIONS	
ES-3.32	TO ES-3.33	NO.	DESCRIPTION
SHEET 20	TO SHEET 21	EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16
		EP1	REVISED PER PADEP COMMENTS
		EP	
		A	ISSUED FOR BID
DWG NO	DWG NO	NO.	DESCRIPTION

**Sunoco Logistics Partners L.P.**

**TETRA TECH ROONEY**  
(303) 792-5911

**SUNOCO PIPELINE, L.P.**

16-INCH HORIZONTAL DIRECTIONAL DRILL  
TROUGH CREEK VALLEY PIKE  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=150'    DWG. NO: PA-HU-0047.0000-RD-16



**LEGEND:**

⊙ Geotechnical Soil Boring (SB) Locations



**TETRA TECH**

GEOTECHNICAL BORING LOCATIONS

HDD S2-0152

HUNTINGDON COUNTY, UNION TOWNSHIP, PA

SUNOCO PENNSYLVANIA PIPELINE PROJECT





**GEOTECHNICAL LABORATORY TESTING SUMMARY**  
**SUNOCO PENNSYLVANIA PIPELINE PROJECT**  
**HDD S2-0152**

HDD No.	Test Boring No.	Sample No.	Depth of Sample (ft.)		Water Content, % (ASTM D2216)	Percent Silts/Clays, % (ASTM D1140)	Atterburg Limits (ASTM D4318)			USCS Classif. (ASTM D2487)
			From	To			Liquid Limit, %	Plastic Limit, %	Plasticity Index, %	
S2-0152	SB-01	1	3.0	5.0	22.4	81.4	37	24	13	CL/ML
		2	8.0	9.4	8.1	56.0	-	-	-	-
		3	13.0	13.4	13.7	37.7	-	-	-	-
	SB-02	1	3.0	3.9	4.9	55.6	35	24	11	CL/ML
		2	8.0	9.0	5.0	27.4	-	-	-	-
		3	13.0	13.7	5.2	23.9	-	-	-	-

Notes:

- 1) Sample depths based on feet below grade at time of exploration.

**REGIONAL GEOLOGY SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0152**

HDD No.	NAME	BORING NO.	REGIONAL GEOLOGY DESCRIPTION	GENERAL TOPOGRAPHIC SETTING	BEDROCK FORMATION	GENERAL ROCK TYPE	APPROX MAX FM THICKNESS (FT)	DEPTH TO ROCK (Ft bgs) based on nearby well drilling logs	NOTES / COMMENTS
S2-0152	Tough Creek	SB-01	<b>Mauch Chunk Formation</b> - consists of grayish-red shale and siltstone, brown, gray, and white sandstone, and some conglomerate.	Rolling hills/ridges of med relief (<100 ft)	Mauch Chunk	Shale-mudstone-sandstone	500-800	6-30	Yields range: 3-30 gpm, average ~20 gpm
		SB-02							Mauch Chunk Formation - Red and green shale, reddish-purple mudstone, and red, green, brown, and gray thin-bedded and cross-bedded sandstones; thickness 500 feet in west, increases to about 800 feet in east

*Note : Source of well log data - <http://www.dcnr.state.pa.us/topogeo/groundwater/pagwis/records/index.htm>. All other sources as referenced in comments section.*

# FIELD DESCRIPTION AND LOGGING SYSTEM FOR SOIL EXPLORATION

## GRANULAR SOILS

(Sand, Gravel & Combinations)

<u>Density</u>	<u>N (blows)*</u>
Very Loose	5 or less
Loose	6 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	51 or more

### Particle Size Identification

Boulders	8 in. diameter or more
Cobbles	3 to 8 in. diameter
Gravel	Coarse (C) 3 in. to ¾ in. sieve
	Fine (F) ¾ in. to No. 4 sieve
Sand	Coarse (C) No. 4 to No. 10 sieve (4.75mm-2.00mm)
	Medium (M) No. 10 to No. 40 sieve (2.00mm – 0.425mm)
	Fine (F) No. 40 to No. 200 sieve (0.425 – 0.074mm)
Silt/Clay	Less Than a No. 200 sieve (<0.074mm)

### Relative Proportions

<u>Description Term</u>	<u>Percent</u>
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

## COHESIVE SOILS

(Silt, Clay & Combinations)

<u>Consistency</u>	<u>N (blows)*</u>
Very Soft	3 or less
Soft	4 to 5
Medium Stiff	6 to 10
Stiff	11 to 15
Very Stiff	16 to 30
Hard	31 or more

### Plasticity

<u>Degree of Plasticity</u>	<u>Plasticity Index</u>
None to Slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	> 22

## ROCK

(Rock Cores)

<u>Rock Quality Designation (RQD), %</u>	<u>Rock Quality Description</u>
0-25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
90-100	Excellent

**\*N - Standard Penetration Resistance.** Driving a 2.0" O.D., 1-3/8" I.D. sampler a distance of 18 inches into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. The number of hammer blows to drive the sampler through each 6 inch interval is recorded; the number of blows required to drive the sampler through the final 12 inch interval is termed the Standard Penetration Resistance (SPR) N-value. For example, blow counts of 6/8/9 (through three 6-inch intervals) results in an SPR N-value of 17 (8+9).

**Groundwater** observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

**UNIFIED SOIL CLASSIFICATION SYSTEM [Casagrande (1948)]**

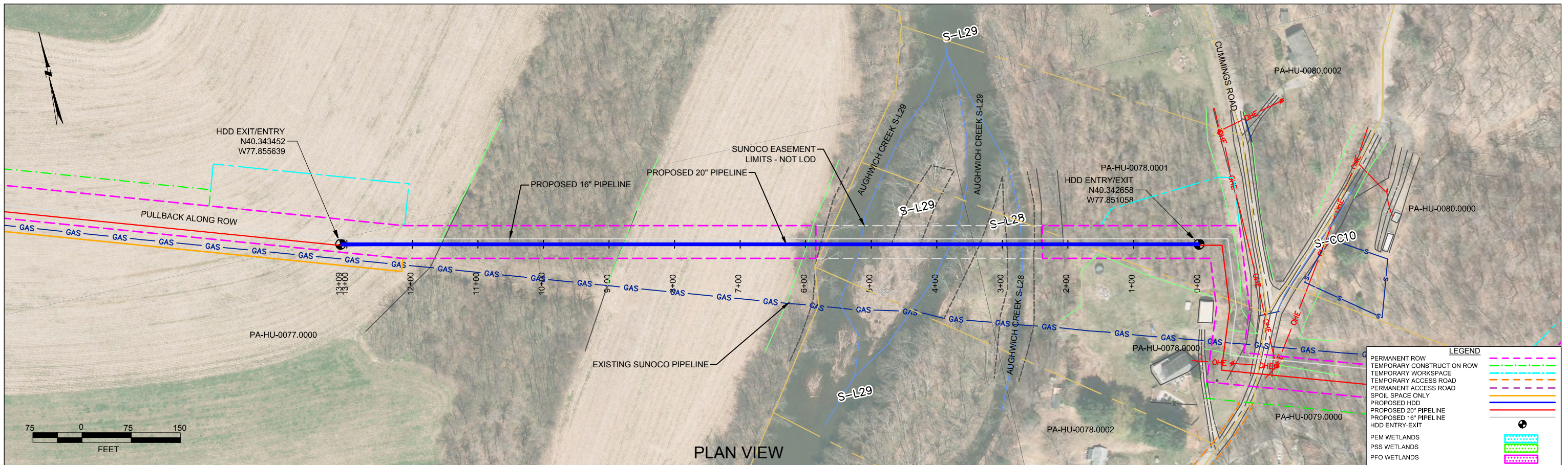
Major Divisions		Group Symbols	Typical Descriptions	Laboratory Classifications			
Coarse Grained Soils (More than half of material is larger than No. 200 sieve)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravel (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4: $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3  Not meeting $C_u$ or $C_c$ requirements for GW		
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines			
		Gravel with fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below A Line or $I_p$ less than 4	Limits plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols	
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits above A line with $I_p$ greater than 7		
	Sands (More than half of coarse fraction is smaller than No. 4 Sieve)	Clean sands (Little or no fines)	SW	Well graded sands, gravelly sands, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6: $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3  Not meeting $C_u$ or $C_c$ requirements for SW		
			SP	Poorly graded sands, gravelly sands, little or no fines			
		Sands with fines (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures	Atterberg limits below A Line or $I_p$ less than 4	Limits Plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols	
			SC	Clayey sands, sand-clay mixtures	Atterberg limits above A line with $I_p$ greater than 7		
		Determine Percentage of sand and gravel from grain size curve. Depending on Percentage of fines (fraction smaller than No. 200 sieve), coarse-grained soils are classified as follows:  Less than 5 percent GW, GP, SW, SP More than 12 percent GM, GC, SM, SC 5 to 12 percent Borderline cases requiring dual symbols <sup>(1)</sup>					
		Major Divisions		Group Symbols	Typical Descriptions	For soils plotting nearly on A line use dual symbols i.e., $I_p = 29.5$ , $w_L = 60$ gives CH-MH. When $w_L$ is near 50 use CL-CH or ML-MH. Take near as $\pm 2$ percent.	
Fine-grained soils (More than half of material is smaller than No. 200 sieve)	Silt and clays (Liquid limit less than 50)	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity				
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays				
		OL	Organic silts and organic silty clays of low plasticity				
	Silt and Clays (Liquid limit greater than 50)	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts				
		CH	Inorganic clays of high plasticity, fat clays				
		OH	Organic clays of medium to high plasticity, organic silts				
	Highly organic soils	Pt	Peat and other highly organic soils				

(1) Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC. well-graded gravel-sand mixture with clay binder.

***HDD PA-HU-0078.0000-WX (S-L29) (W-W46B) (S-L28)***

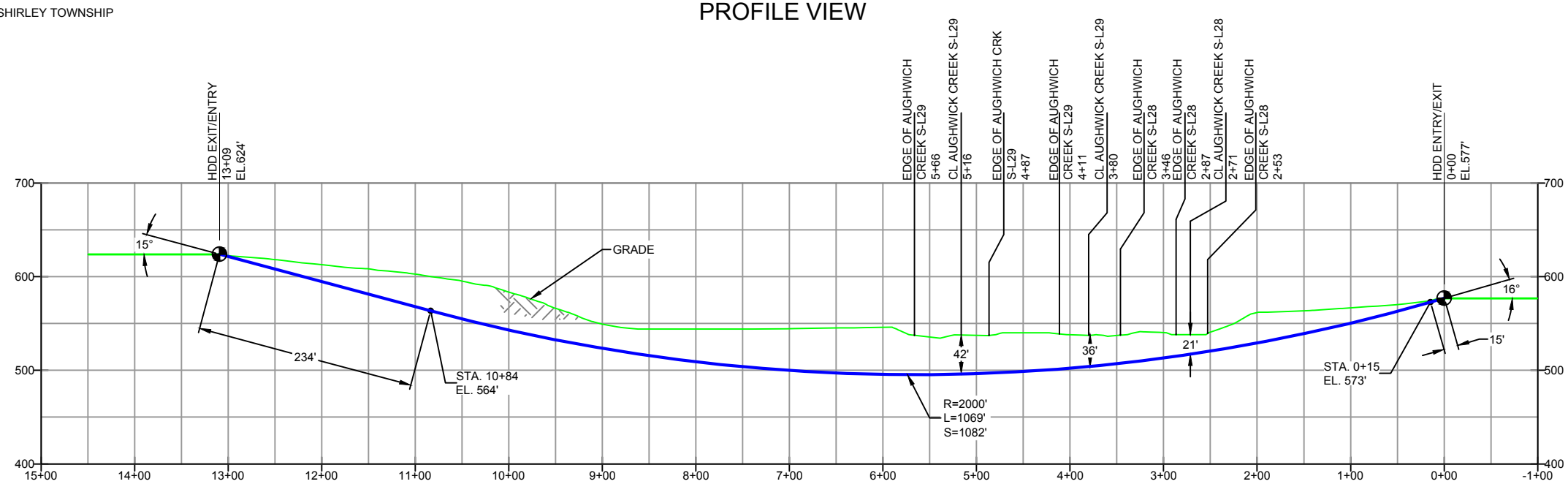
Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable and in this case that threat is considered to be *low*. Implementing this design, along with adherence to the Pennsylvania Pipeline Project Inadvertent Return Contingency Plan will ensure inadvertent impacts, if they were to occur, are also minimized to the maximum extent.

The drill will enter/exit 750 feet from the edge of the western most boundary of the stream S-L29. The drill will travel beneath stream S-L29 for 60 feet. The drill will then travel under wetland W-W46B for 90 feet and then travel under stream S-L29 for another 60 feet. The drill will pass beneath the western most boundary of stream S-L28 and travel under stream S-L28 for 50 feet. Using the results of the geotechnical investigation, as well as several other data points, the entry/exit, angles, and depths have been configured to pass through the best substrates while maintaining pipe integrity (e.g., no large bends). The majority of the substrate that will be passed through is estimated to be grey weathered limestone. The drill will continue beneath stream S-L28 and will enter/exit 250 feet from the eastern most edge of stream S-L28.



PLAN VIEW

HUNTINGDON COUNTY, PENNSYLVANIA - SHIRLEY TOWNSHIP  
S2-0153



PROFILE VIEW

DESIGN AND CONSTRUCTION:

- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
- THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
- DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
- CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L=): 1359'  
HDD PIPE LENGTH (S=): 1383'  
20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW  
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
- INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
- INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
- PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
- CARRIER PIPE NOT ENCASED.
- PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
- CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
- SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
- SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
- SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

**NOTES**

- ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
- STATIONING IS BASED ON HORIZONTAL DISTANCES.
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- CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
- SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING		EROSION & SEDIMENT PLAN	
ES-3.60	TO	ES-3.61	EROSION & SEDIMENT PLAN
SHEET 37	TO	SHEET 38	AERIAL SITE PLAN

REVISIONS					
EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	DLM	09/30/16	RMB	09/30/16
EP1	REVISED PER PADEP COMMENTS	DLM	05/25/16	RMB	05/25/16
EP		MRS	03/15/16	RMB	03/15/16
B	ISSUED FOR BID	DLM	07/31/15	RMB	07/31/15
A	ISSUED FOR REVIEW	JAM	03/24/15	RMB	03/24/15

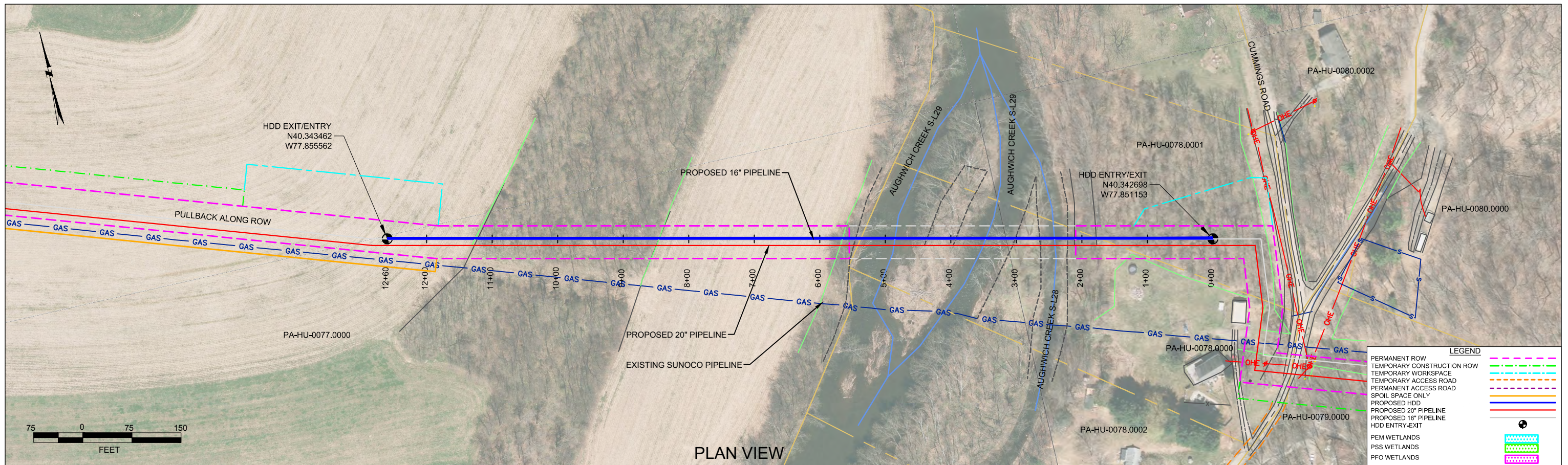
**Sunoco Logistics Partners L.P.**

**TETRA TECH ROONEY**  
(303) 792-5911

**SUNOCO PIPELINE, L.P.**

20-INCH HORIZONTAL DIRECTIONAL DRILL  
AUGHWICK CREEK  
PENNSYLVANIA PIPELINE PROJECT

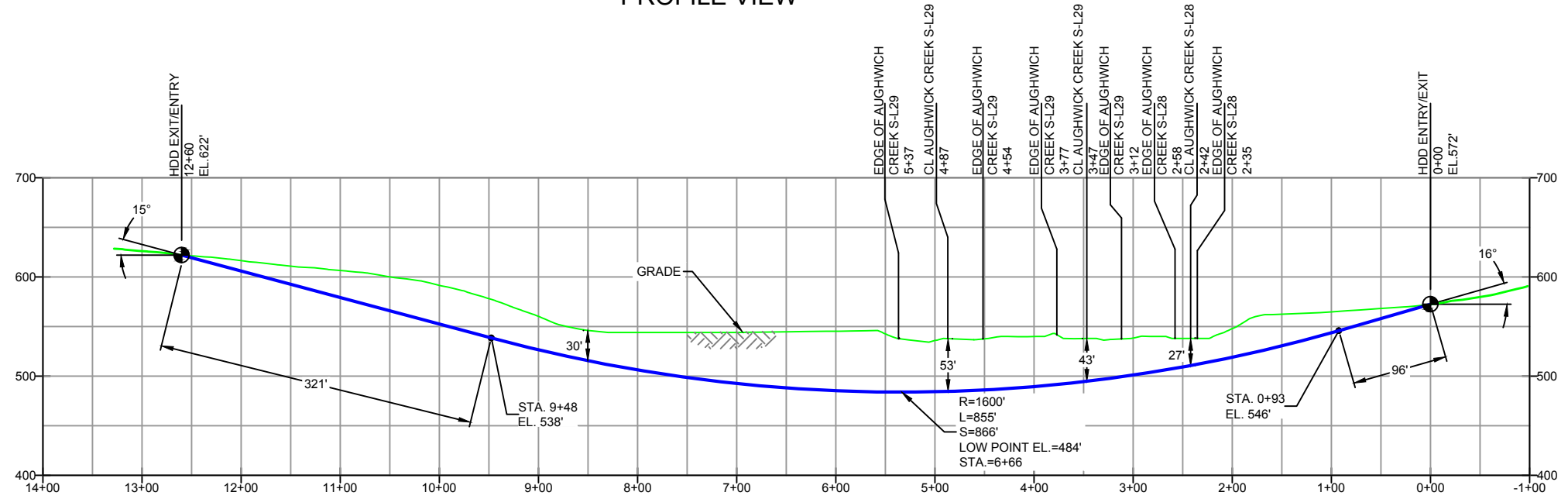
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DWG. NO: PA-HU-0078.0000-WX



PLAN VIEW

HUNTINGDON COUNTY, PENNSYLVANIA - SHIRLEY TOWNSHIP  
S2-0153-16

PROFILE VIEW



- DESIGN AND CONSTRUCTION:**
- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
  - THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
  - DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
  - CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L-): 1310'  
HDD PIPE LENGTH (S-): 1337'  
16" x 0.438" W.T., X-70, API5L, PSL2, ERW, BFW  
COATING: 14-16 MILS FBW WITH 30-35 MIL ARO (POWERCRETE R95)
  - INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
  - INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
  - PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
  - CARRIER PIPE NOT ENCASED
  - PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER
  - CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
  - SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
  - SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
  - SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

NOTES	
1.	ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
2.	STATIONING IS BASED ON HORIZONTAL DISTANCES
3.	ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, L.P. ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, L.P. FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
4.	CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
5.	SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING		REVISIONS	
ES-3.60	TO ES-3.61	EROSION & SEDIMENT PLAN	
SHEET 37	TO SHEET 38	AERIAL SITE PLAN	
		EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16
		EP1	REVISED PER PADEP COMMENTS
		EP	
		A	ISSUED FOR BID
DWG NO	DWG NO	DESCRIPTION	NO.

**Sunoco Logistics Partners L.P.**

**TETRA TECH ROONEY**  
(303) 792-5911

**SUNOCO PIPELINE, L.P.**

16-INCH HORIZONTAL DIRECTIONAL DRILL  
AUGHWICK CREEK  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=150'    DWG. NO: PA-HU-0078.0000-WX-16



**LEGEND:**

⊙ Geotechnical Soil Boring (SB) Locations



**TETRA TECH**

GEOTECHNICAL BORING LOCATIONS

HDD S2-0153

HUNTINGDON COUNTY, SHIRLEY TOWNSHIP, PA

SUNOCO PENNSYLVANIA PIPELINE PROJECT



**TETRA TECH**

240 Continental Drive, Suite 200  
 Newark, Delaware 19713  
 302.738.7551  
 fax: 302.454.5988

**TEST BORING LOG**

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT	Project No.:	103IP3406
Project Location:	US 522, SHIRLEYSBURG, PA	Page 1 of 1	
HDD No.:	S2-0153	Dates(s) Drilled:	01-22-15
Boring No.:	SB-01	Inspector:	E. WATT
Drilling Contractor:	HAD DRILLING	Drilling Method:	SPT - ASTM D1586
		Driller:	S. HOFFER
		Groundwater Depth (ft):	NOT ENCOUNTERED
		Total Depth (ft):	6.7
Boring Location Coordinates:	40°20'34.37"N	77°51'20.29"W	

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N	
	From	To	From	To									
			0.0	0.4			TOPSOIL (5").						
1	3.0	5.0	0.4		24	CL	MOTTLED BROWN, ORANGE BROWN, RED BROWN AND YELLOW BRWN	5	12	10	15	22	
							SILTY CLAY WITH SOME F-SAND, A LITTLE F-GRAVEL. (USCS: CL).						
2	6.5	6.7			1.5		ORANGE BROWN SILTY CLAY WITH SOME FINE SAND, AND	50/2"					>50
				6.7			SOME SANDSTONE GRAVEL.						
							AUGER REFUSAL AT 6.5'. OFF-SET 23' EAST AND CONTINUOUSLY						
							AUGERED TO REFUSAL AT 6.5'. OFF-SET CLOSER TO ORIGINAL						
							LOCATION AND CONTINUOUSLY AUGERED TO 6.2'.						
							CAVED AT 5'.						
							REFUSAL MATERIAL MAY BE DUE TO BOULDERY SUBSURFACE,						
							COULD NOT PENETRATE DEEPER.						
							SANDSTONE OUTCROPS OBSERVED AT SURFACE IN VICINITY OF						
							BORING.						

Notes/Comments:  
Pocket Penetrometer Testing DR: DECOMPOSED ROCK  
 S1: >4 TSF

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

\* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.  
 N: Number of blows to drive spoon from 6" to 18" interval.



**TETRA TECH**

240 Continental Drive, Suite 200  
 Newark, Delaware 19713  
 302.738.7551  
 fax: 302.454.5988

**TEST BORING LOG**

Project Name: SUNOCO PENNSYLVANIA PIPELINE PROJECT			Project No.: 103IP3406		
Project Location: US 522, WEST SIDE OF AUGHWIZK CREEK, MOUNT UNION, PA			Page 1 of 1		
HDD No.: S2-0153		Dates(s) Drilled: 01-23-15		Inspector: E. WATT	
Boring No.: SB-02		Drilling Method: SPT - ASTM D1586		Driller: S. HOFFER	
Drilling Contractor: HAD DRILLING		Groundwater Depth (ft): NOT ENCOUNTERED		Total Depth (ft): 36.9	
Boring Location Coordinates:			40°20'32.84"N		77°51'13.34"W

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N	
	From	To	From	To									
			0.0	0.3			TOPSOIL (4")						
1	3.0	5.0	0.3		20	CL	ORANGE BROWN SILTY CLAY WITH A LITTLE FINE SAND.	3	6	7	8	13	
2	8.0	10.0			20		MOTTLED (BROWN AND DARK BROWN) SILTY CLAY WITH SOME FINE SAND. (USCS: CL).	3	10	12	22	22	
3	13.0	15.0	9.9		24	SC/CL	YELLOWISH BROWN FINE TO MEDIUM SAND AND SILTY CLAY, WITH SOME UNWEATHERED SHALE GRAVEL.	5	11	12	18	23	
4	18.0	18.9			12		YELLOWISH BROWN FINE TO MEDIUM SAND AND SILTY CLAY, WITH SOME UNWEATHERED SHALE GRAVEL. (USCS: SC/CL).	7	50/5"				>50
5	23.0	23.9	21.0		13	WEATHERED ROCK	GRAY AND GREENISH GRAY WEATHERED SHALE.	13	50/5"				>50
6	27.0	27.3		27.7	4		GRAY WEATHERED LIMESTONE.	50/4"					>50
							AUGER REFUSAL AT 27.7'.						
							<u>ROCK CORING</u>						
RUN 1	27.7	31.9	27.70		42	FRACTURED LIMESTONE ROCK	GRAY MODERATELY FRACTURED LIMESTONE. FRACTURES AT 28.24, 29.14, 29.5. OXIDATION LENSES THROUGHOUT.	TCR: 83%, SCR: 48%, RQD: 44%					
			29.50				GRAY INTENSELY FRACTURED LIMESTONE.						
			30.10	30.70			GRAY MODERATELY FRACTURED LIMESTONE.						
			30.70	31.90			GRAY VERY INTENSELY FRACTURED LIMESTONE.						
RUN 2	31.9	36.9	31.90	33.88	54		GRAY MODERATELY FRACTURED LIMESTONE.	TCR: 55%, SCR: 27%, RQD: 27%					
			33.88			GRAY VERY INTENSELY FRACTURED AND WEATHERED LIMESTONE.							
			36.90			FRACTURE BREAK AT 33.88 APPEARS TO BE VERTICAL.							
							<u>CORE TESTING RESULTS (RUN 1, DEPTH 30.2):</u>						
							COMPRESSIVE STRENGTH: 2,110 PSI						
							UNIT WEIGHT: 161.6 PCF						
							<u>CORE TESTING RESULTS (RUN 2, DEPTH 32.5):</u>						
							COMPRESSIVE STRENGTH: 840 PSI						
							UNIT WEIGHT: 160.2 PCF						

Notes/Comments:  
Pocket Pentrometer Testing CAVED AT 27".  
 S1: > 4 TSF  
 S2: > 4 TSF

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

\* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.  
 N: Number of blows to drive spoon from 6" to 18" interval.

**GEOTECHNICAL LABORATORY TESTING SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0153**

HDD No.	Test Boring No.	Sample No.	Depth of Sample (ft.)		Water Content, % (ASTM D2216)	Percent Silts/Clays, % (ASTM D1140)	Atterburg Limits (ASTM D4318)			USCS Classif. (ASTM D2487)
			From	To			Liquid Limit, %	Plastic Limit, %	Plasticity Index, %	
SB-0153	SB-01	1	3.0	5.0	16.8	71.1	32	20	12	CL
		2	6.5	6.7	16.0	72.4	-	-	-	-
	SB-02	1	3.0	5.0	19.9	86.8	-	-	-	-
		2	8.0	10.0	20.4	75.1	35	21	14	CL
		3	13.0	15.0	16.8	42.5	-	-	-	-
		4	18.0	18.9	12.5	48.9	31	20	11	SC/CL
		5	23.0	23.9	13.5	42.6	-	-	-	-

Rock Core Testing Results				
Boring No.	Core Run	Approximate Depth (ft)	Compressive Strength (psi)	Unit Weight (pcf)
SB-02	1	30.2	2,110	161.6
SB-02	2	32.5	840	160.2

**Notes:**

- 1) Sample depths based on feet below grade at time of exploration.

**REGIONAL GEOLOGY SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0153**

HDD No.	NAME	BORING NO.	REGIONAL GEOLOGY DESCRIPTION	GENERAL TOPOGRAPHIC SETTING	BEDROCK FORMATION	GENERAL ROCK TYPE	APPROX MAX FM THICKNESS (FT)	DEPTH TO ROCK (Ft bgs) based on nearby well drilling logs	NOTES / COMMENTS
S2-0153	Aughwick Creek	SB-01	<b>Onondaga and Old Port Formation</b> - (undivided) consists of two members - the upper Selinsgrove Limestone and the lower calcereous Needmore Shale.	Rolling hills/ridges of med relief (<100 ft)	Onondaga	Limestone and calcareous shale with occasional chert	200 (Onondaga)	3-67 (average DTB range 5-30 ftbg)	Yields range from 20-75 gpm
		Old Port			100-200 (Old Port)				

*Note : Source of well log data - <http://www.dcnr.state.pa.us/topogeo/groundwater/pagwis/records/index.htm>. All other sources as referenced in comments section.*

**ROCK CORE DESCRIPTION SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0153**

Location	Boring No.	Core Run	Core Depth (ft)		TCR (%)	SCR (%)	RQD (%)	Depth (ft)		Weathering	Classification	Bedding Thickness (ft)	Color	Discontinuity Data
			From	To				From	To					
S2-0153	SB-2	1	27.7	31.9	83	48	44	27.7	31.9	Slight to moderate	Limestone	Massive	Light to Dark	Moderately fractured, ranging from 0° to 75°, Avg. 48°
		2	31.9	36.9	55	27	27	31.9	33.9	Slight	Limestone	Massive	Dark Gray	Slightly fractured, ranging from 30° to 60°, Avg. 45°
								33.9	36.9	Heavily	Limestone	Massive	Light Gray	Heavily fractured and weathered, rubble

# FIELD DESCRIPTION AND LOGGING SYSTEM FOR SOIL EXPLORATION

## GRANULAR SOILS

(Sand, Gravel & Combinations)

<u>Density</u>	<u>N (blows)*</u>
Very Loose	5 or less
Loose	6 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	51 or more

### Particle Size Identification

Boulders	8 in. diameter or more
Cobbles	3 to 8 in. diameter
Gravel	Coarse (C) 3 in. to ¾ in. sieve Fine (F) ¾ in. to No. 4 sieve
Sand	Coarse (C) No. 4 to No. 10 sieve (4.75mm-2.00mm) Medium (M) No. 10 to No. 40 sieve (2.00mm – 0.425mm) Fine (F) No. 40 to No. 200 sieve (0.425 – 0.074mm)
Silt/Clay	Less Than a No. 200 sieve (<0.074mm)

### Relative Proportions

<u>Description Term</u>	<u>Percent</u>
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

## COHESIVE SOILS

(Silt, Clay & Combinations)

<u>Consistency</u>	<u>N (blows)*</u>
Very Soft	3 or less
Soft	4 to 5
Medium Stiff	6 to 10
Stiff	11 to 15
Very Stiff	16 to 30
Hard	31 or more

### Plasticity

<u>Degree of Plasticity</u>	<u>Plasticity Index</u>
None to Slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	> 22

## ROCK

(Rock Cores)

<u>Rock Quality Designation (RQD), %</u>	<u>Rock Quality Description</u>
0-25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
90-100	Excellent

**\*N - Standard Penetration Resistance.** Driving a 2.0" O.D., 1-3/8" I.D. sampler a distance of 18 inches into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. The number of hammer blows to drive the sampler through each 6 inch interval is recorded; the number of blows required to drive the sampler through the final 12 inch interval is termed the Standard Penetration Resistance (SPR) N-value. For example, blow counts of 6/8/9 (through three 6-inch intervals) results in an SPR N-value of 17 (8+9).

**Groundwater** observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

**UNIFIED SOIL CLASSIFICATION SYSTEM [Casagrande (1948)]**

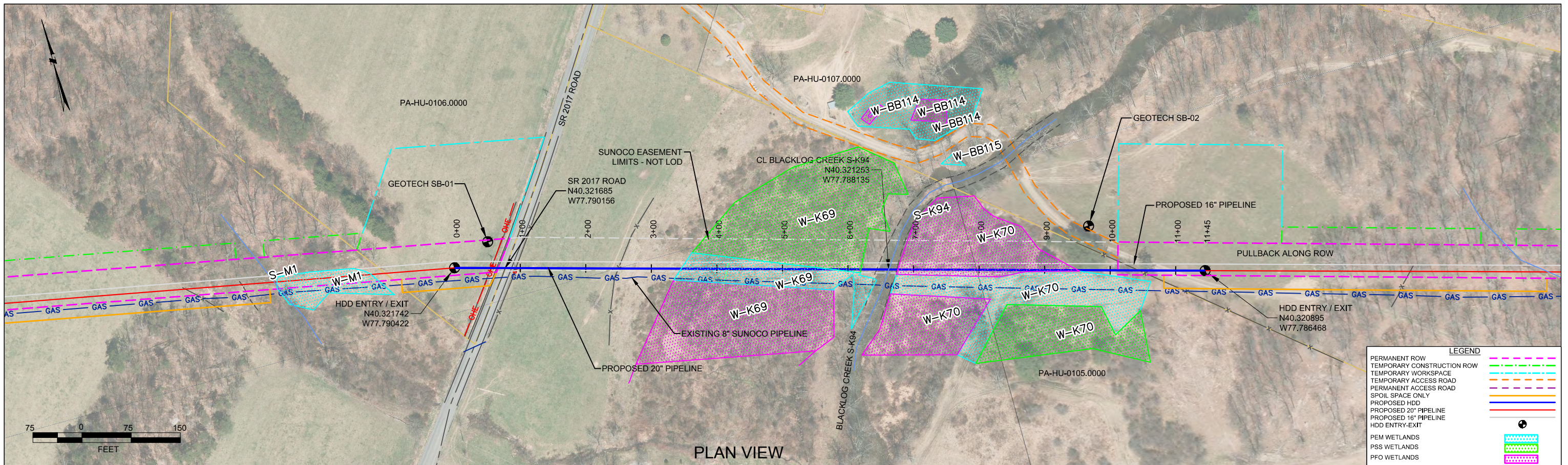
Major Divisions		Group Symbols	Typical Descriptions	Laboratory Classifications			
Coarse Grained Soils (More than half of material is larger than No. 200 sieve)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravel (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3  Not meeting $C_u$ or $C_c$ requirements for GW		
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines			
		Gravel with fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below A Line or $I_p$ less than 4	Limits plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols	
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits above A line with $I_p$ greater than 7		
	Sands (More than half of coarse fraction is smaller than No. 4 Sieve)	Clean sands (Little or no fines)	SW	Well graded sands, gravelly sands, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3  Not meeting $C_u$ or $C_c$ requirements for SW		
			SP	Poorly graded sands, gravelly sands, little or no fines			
		Sands with fines (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures	Atterberg limits below A Line or $I_p$ less than 4	Limits Plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols	
			SC	Clayey sands, sand-clay mixtures	Atterberg limits above A line with $I_p$ greater than 7		
		Determine Percentage of sand and gravel from grain size curve. Depending on Percentage of fines (fraction smaller than No. 200 sieve), coarse-grained soils are classified as follows:  Less than 5 percent GW, GP, SW, SP More than 12 percent GM, GC, SM, SC 5 to 12 percent Borderline cases requiring dual symbols <sup>(1)</sup>					
		Major Divisions		Group Symbols	Typical Descriptions	For soils plotting nearly on A line use dual symbols i.e., $I_p = 29.5$ , $w_L = 60$ gives CH-MH. When $w_L$ is near 50 use CL-CH or ML-MH. Take near as $\pm 2$ percent.	
Fine-grained soils (More than half of material is smaller than No. 200 sieve)	Silt and clays (Liquid limit less than 50)	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity				
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays				
		OL	Organic silts and organic silty clays of low plasticity				
	Silt and Clays (Liquid limit greater than 50)	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts				
		CH	Inorganic clays of high plasticity, fat clays				
		OH	Organic clays of medium to high plasticity, organic silts				
	Highly organic soils	Pt	Peat and other highly organic soils				

(1) Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC. well-graded gravel-sand mixture with clay binder.

***HDD PA-HU-0106.0000-RD (W-K69) (S-K94)***

Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable and in this case that threat is considered to be *low*. Implementing this design, along with adherence to the Pennsylvania Pipeline Project Inadvertent Return Contingency Plan will ensure inadvertent impacts, if they were to occur, are also minimized to the maximum extent.

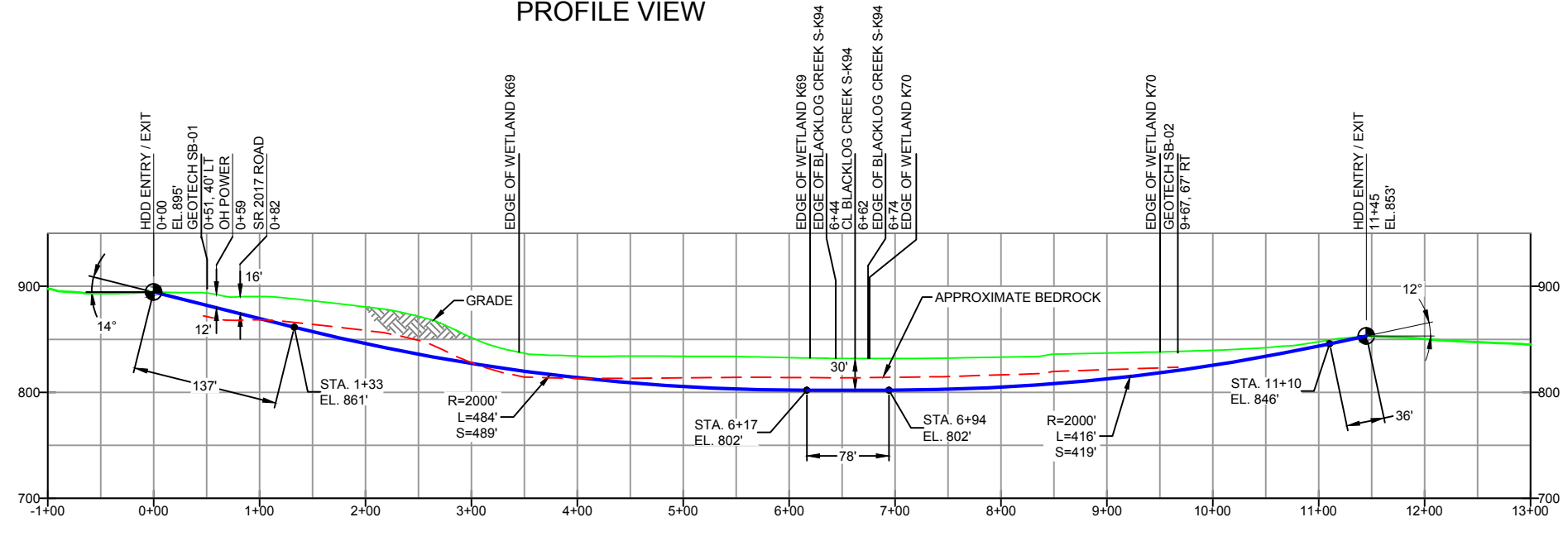
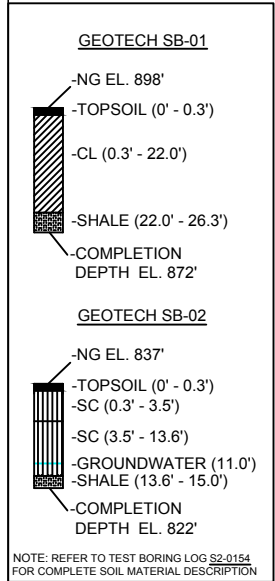
The drill will enter/exit 360 feet from the edge of the western most boundary of the wetland W-K69. The drill will travel beneath wetland W-K69 for 630 feet. The drill will also cross under the western most boundary of stream S-K94 within the wetland and travel beneath stream S-K94 for 50 feet. Using the results of the geotechnical investigation, as well as several other data points, the entry/exit, angles, and depths have been configured to pass through the best substrates while maintaining pipe integrity (e.g., no large bends). The majority of the substrate that will be passed through is estimated to be weathered grey shale. The drill will continue beneath wetland W-K69 and will enter/exit 215 feet from the eastern most edge of wetland W-K69.



PLAN VIEW

HUNTINGDON COUNTY PENNSYLVANIA, SHIRLEY TOWNSHIP  
S2-0154

PROFILE VIEW



- DESIGN AND CONSTRUCTION:
- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
  - THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
  - DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
  - CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L)=1145'  
HDD PIPE LENGTH (S)=1158'  
20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW  
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
  - INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
  - INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
  - PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
  - CARRIER PIPE NOT ENCASED.
  - PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
  - CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
  - SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
  - SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
  - SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

**NOTES**

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- CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
- SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING		REVISIONS	
ES-3.73	TO ES-3.73	EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16
SHEET 44	TO SHEET 44	EP1	REVISED PER PADEP COMMENTS
		EP	
		C	ADDED GEOTECH INFO
		B	ISSUED FOR BID
		A	ISSUED FOR REVIEW
DWG NO	DWG NO	DESCRIPTION	NO.

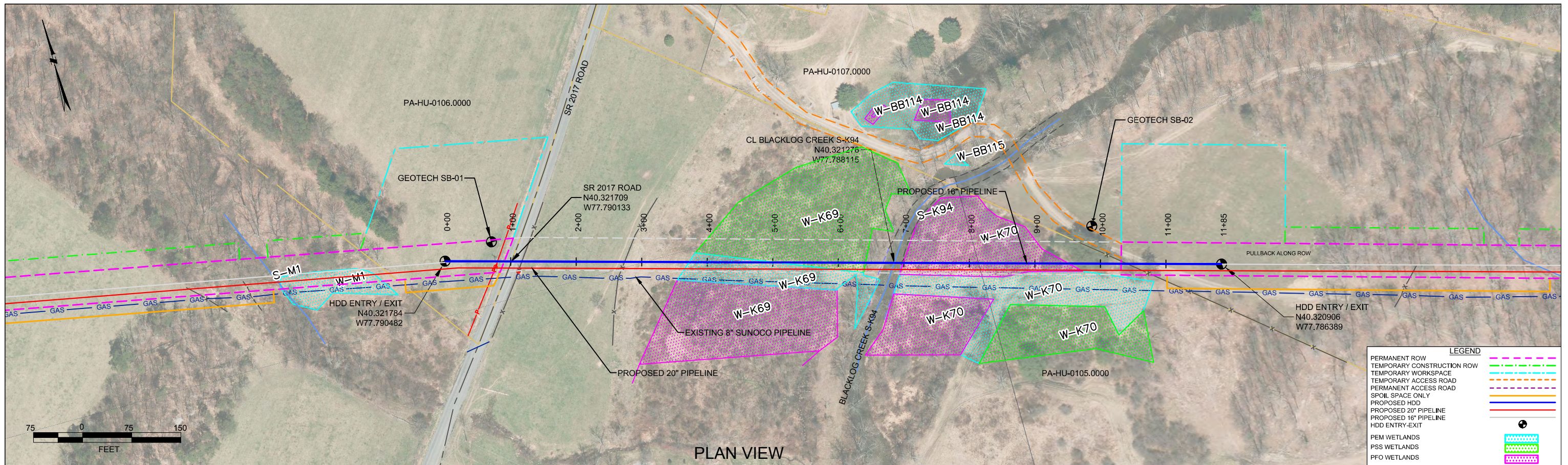
**Sunoco Logistics Partners L.P.**

**TETRA TECH ROONEY**  
(303) 792-5911

**SUNOCO PIPELINE, L.P.**

20-INCH HORIZONTAL DIRECTIONAL DRILL  
BLACKLOG CREEK  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=150'  
DWG. NO: PA-HU-0106.0000-RD

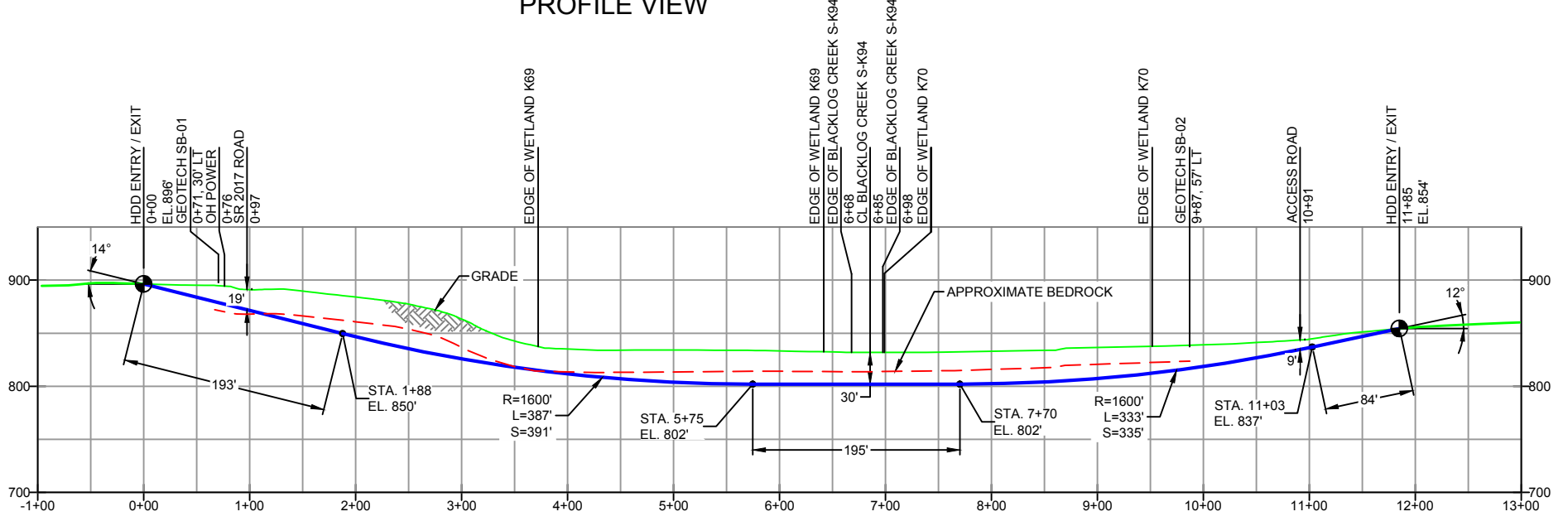


PLAN VIEW

LEGEND	
PERMANENT ROW	
TEMPORARY CONSTRUCTION ROW	
TEMPORARY WORKSPACE	
TEMPORARY ACCESS ROAD	
PERMANENT ACCESS ROAD	
SPOIL SPACE ONLY	
PROPOSED HDD	
PROPOSED 20" PIPELINE	
PROPOSED 16" PIPELINE	
HDD ENTRY-EXIT	
PEM WETLANDS	
PSS WETLANDS	
PFO WETLANDS	

HUNTINGDON COUNTY PENNSYLVANIA, SHIRLEY TOWNSHIP  
S2-0154-16

PROFILE VIEW



GEOTECH SB-01	
-NG EL. 898'	
-TOPSOIL (0' - 0.3')	
-CL (0.3' - 22.0')	
-SHALE (22.0' - 26.3')	
-COMPLETION DEPTH EL. 872'	
GEOTECH SB-02	
-NG EL. 837'	
-TOPSOIL (0' - 0.3')	
-SC (0.3' - 3.5')	
-SC (3.5' - 13.6')	
-GROUNDWATER (11.0')	
-SHALE (13.6' - 15.0')	
-COMPLETION DEPTH EL. 822'	

NOTE: REFER TO TEST BORING LOG S2-0154 FOR COMPLETE SOIL MATERIAL DESCRIPTION

- DESIGN AND CONSTRUCTION:
- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
  - THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
  - DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
  - CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L-): 1185'  
HDD PIPE LENGTH (S-): 1198'  
16" x 0.438" W.T., X-70, API5L, PSL2, ERW, BFW  
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
  - INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
  - INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
  - PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
  - CARRIER PIPE NOT ENCASED.
  - PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
  - CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
  - SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
  - SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
  - SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

NOTES	
1. ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83	
2. STATIONING IS BASED ON HORIZONTAL DISTANCES	
3. ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP, FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.	
4. CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.	
5. SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.	

REF. DRAWING	NO.	DESCRIPTION	NO.	DESCRIPTION
ES-3.73	TO	ES-3.73	EROSION & SEDIMENT PLAN	
SHEET 44	TO	SHEET 44	AERIAL SITE PLAN	EP2
				EP1
				EP
				B
				A

REVISIONS					
DLM	10/07/16	RMB	10/07/16	AAW	10/07/16
DLM	05/18/16	RMB	05/18/16	AAW	05/18/16
MRS	03/15/16	RMB	03/15/16	AAW	03/15/16
MRS	09/14/15	RMB	09/14/15	AAW	09/14/15
MRS	08/31/15	RMB	08/31/15	AAW	08/31/15
BY	DATE	CHK	DATE	APP	DATE

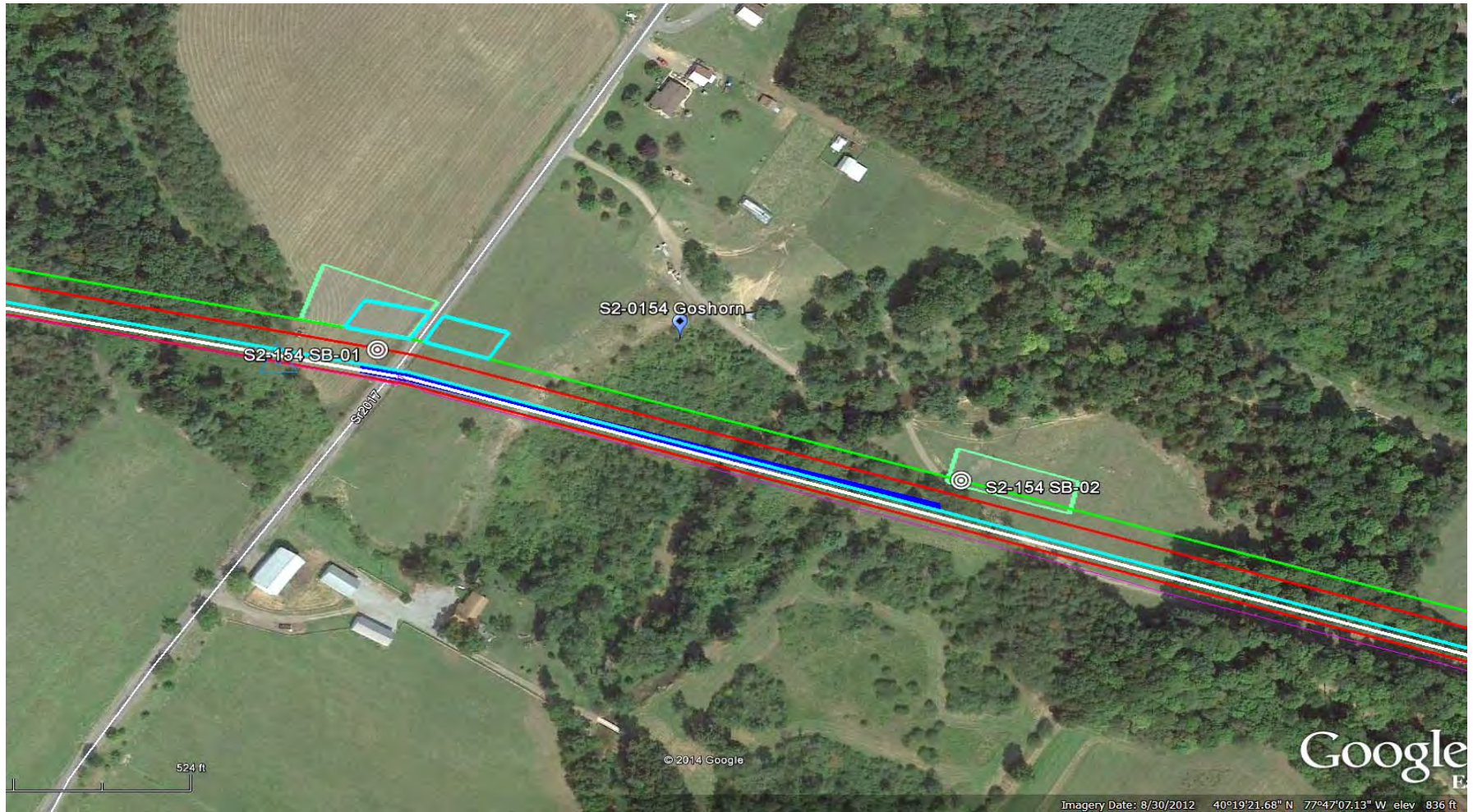
**Sunoco Logistics Partners L.P.**

**TETRA TECH ROONEY**  
(303) 792-5911

**SUNOCO PIPELINE, L.P.**

16-INCH HORIZONTAL DIRECTIONAL DRILL  
BLACKLOG CREEK  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=150'    DWG. NO: PA-HU-0106.0000-RD-16



**LEGEND:**

⊙ Geotechnical Soil Boring (SB) Locations



GEOTECHNICAL BORING LOCATIONS  
HDD S2-0154  
HUNTINGDON COUNTY, SHIRLEY TOWNSHIP, PA  
SUNOCO PENNSYLVANIA PIPELINE PROJECT





**TETRA TECH**

240 Continental Drive, Suite 200  
 Newark, Delaware 19713  
 302.738.7551  
 fax: 302.454.5988

**TEST BORING LOG**

Project Name: SUNOCO PENNSYLVANIA PIPELINE PROJECT			Project No.: 103IP3406		
Project Location: 16443 BLACKLOG VALLEY ROAD, ORBISONIA, PA			Page 1 of 1		
HDD No.: S2-0154		Dates(s) Drilled: 10-12-14		Inspector: E. WATT	
Boring No.: SB-02		Drilling Method: SPT - ASTM D1586		Driller: S. HOFFER	
Drilling Contractor: HAD DRILLING		Groundwater Depth (ft): 11.0		Total Depth (ft): 25.0	

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (ft)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
	From	To	From	To								
			0.0	0.3			TOPSOIL (4").					
1	3.0	5.0	0.3	3.5	21	SC	BROWN AND GRAY CLAYEY FINE TO MEDIUM SAND (USCS: SC).	5	10	14	16	24
2	8.0	10.0	3.5		17	SC	DR WEATHERED TO A VARI-COLORED FINE TO MEDIUM SAND, WITH	4	21	30	28	51
				13.6			SOME SILTY CLAY, AND A LITTLE FINE SANDSTONE GRAVEL.					
3	13.0	13.9	13.6	15.0	9		PARTIALLY WEATHERED GRAY TO GREENISH GRAY SHALE.	5	50/5"			>50
							AUGER REFUSAL AT 15.0'.					
							<u>ROCK CORING</u>					
RUN 1	15.0	20.0			42	ROCK	HIGHLY FRACTURED DARK GRAY SHALE WITH PYRITE DEPOSITS.	TCR: 70%, SCR: 2%, RQD: 0%				
RUN 2	20.0	25.0			48		HIGHLY FRACTURED DARK GRAY SHALE WITH PYRITE DEPOSITS,	TCR: 80%, SCR: 8%, RQD: 0%				
							WITH CALCITE DEPOSITS AT 24.4', 24.5', AND 24.7'.					
							WET TON SPOON AT 11'					
							WATER LEVELS THROUGH AUGERS AT 13.5'					
							CAVED AT 15'.					

Notes/Comments:  
Pocket Pentrometer Testing DR: DECOMPOSED ROCK  
 S1: .4 TSF

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

\* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.  
 N: Number of blows to drive spoon from 6" to 18" interval.

**GEOTECHNICAL LABORATORY TESTING SUMMARY**  
**SUNOCO PENNSYLVANIA PIPELINE PROJECT**  
**HDD S2-0154**

HDD No.	Test Boring No.	Sample No.	Depth of Sample (ft.)		Water Content, % (ASTM D2216)	Percent Silts/Clays, % (ASTM D1140)	Atterburg Limits (ASTM D4318)			USCS Classif. (ASTM D2487)
			From	To			Liquid Limit, %	Plastic Limit, %	Plasticity Index, %	
S2-0154	SB-01	1	3.0	5.0	20.2	63.2	-	-	-	-
		2	8.0	10.0	14.3	74.0	31	20	11	CL
		3	13.0	14.5	13.4	72.8	32	21	10	CL
		6	26.0	26.3	3.8	23.6	-	-	-	-
	SB-02	1	3.0	5.0	11.2	41.9	28	18	10	SC
		2	8.0	10.0	14.4	28.6	-	-	-	-
		3	13.0	13.9	9.0	23.2	-	-	-	-

Notes:

- 1) Sample depths based on feet below grade at time of exploration.

**REGIONAL GEOLOGY SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0154**

HDD No.	NAME	BORING NO.	REGIONAL GEOLOGY DESCRIPTION	GENERAL TOPOGRAPHIC SETTING	BEDROCK FORMATION	GENERAL ROCK TYPE	APPROX MAX FM THICKNESS (FT)	DEPTH TO ROCK (Ft bgs) based on nearby well drilling logs	NOTES / COMMENTS
S2-0154	Goshorn	SB-01	<b>Reedsville Formation</b> - consists of dark-gray shale containing thin sandy to silty shale and siltstone interbeds, and it has an upper fossiliferous sandstone.	Rolling hills (ridge & valley)	Reedsville Fm.	Shale-siltstone		18-59	
		SB-02							

*Note* : Source of well log data - <http://www.dcnr.state.pa.us/topogeo/groundwater/pagwis/records/index.htm>. All other sources as referenced in comments section.

**ROCK CORE DESCRIPTION SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0154**

Location	Boring No.	Core Run	Core Depth (ft)		TCR (%)	SCR (%)	RQD (%)	Depth (ft)		Weathering	Classification	Bedding Thickness (ft)	Color	Discontinuity Data
			From	To				From	To					
S2-0154	SB-2	1	15	20	70	1.6	0	15	20	Slight	Limestone	Massive	Gray to Dark Gray	Heavily fractured, significant mechanical fracturing, wildly varying dip angles in range of 0° to 60°
S2-0154	SB-2	2	20	25	80	8	0	20	25	Slight	Limestone	Massive	Gray to Dark Gray	Heavily fractured, significant mechanical fracturing, Avg. Dip 45°, calcite filling of some thin fractures

# FIELD DESCRIPTION AND LOGGING SYSTEM FOR SOIL EXPLORATION

## GRANULAR SOILS

(Sand, Gravel & Combinations)

<u>Density</u>	<u>N (blows)*</u>
Very Loose	5 or less
Loose	6 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	51 or more

### Particle Size Identification

Boulders	8 in. diameter or more
Cobbles	3 to 8 in. diameter
Gravel	Coarse (C) 3 in. to ¾ in. sieve
	Fine (F) ¾ in. to No. 4 sieve
Sand	Coarse (C) No. 4 to No. 10 sieve (4.75mm-2.00mm)
	Medium (M) No. 10 to No. 40 sieve (2.00mm – 0.425mm)
	Fine (F) No. 40 to No. 200 sieve (0.425 – 0.074mm)
Silt/Clay	Less Than a No. 200 sieve (<0.074mm)

### Relative Proportions

<u>Description Term</u>	<u>Percent</u>
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

## COHESIVE SOILS

(Silt, Clay & Combinations)

<u>Consistency</u>	<u>N (blows)*</u>
Very Soft	3 or less
Soft	4 to 5
Medium Stiff	6 to 10
Stiff	11 to 15
Very Stiff	16 to 30
Hard	31 or more

### Plasticity

<u>Degree of Plasticity</u>	<u>Plasticity Index</u>
None to Slight	0 - 4
Slight	5 - 7
Medium	8- 22
High to Very High	> 22

## ROCK

(Rock Cores)

<u>Rock Quality Designation (RQD), %</u>	<u>Rock Quality Description</u>
0-25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
90-100	Excellent

**\*N - Standard Penetration Resistance.** Driving a 2.0" O.D., 1-3/8" I.D. sampler a distance of 18 inches into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. The number of hammer blows to drive the sampler through each 6 inch interval is recorded; the number of blows required to drive the sampler through the final 12 inch interval is termed the Standard Penetration Resistance (SPR) N-value. For example, blow counts of 6/8/9 (through three 6-inch intervals) results in an SPR N-value of 17 (8+9).

**Groundwater** observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

**UNIFIED SOIL CLASSIFICATION SYSTEM [Casagrande (1948)]**

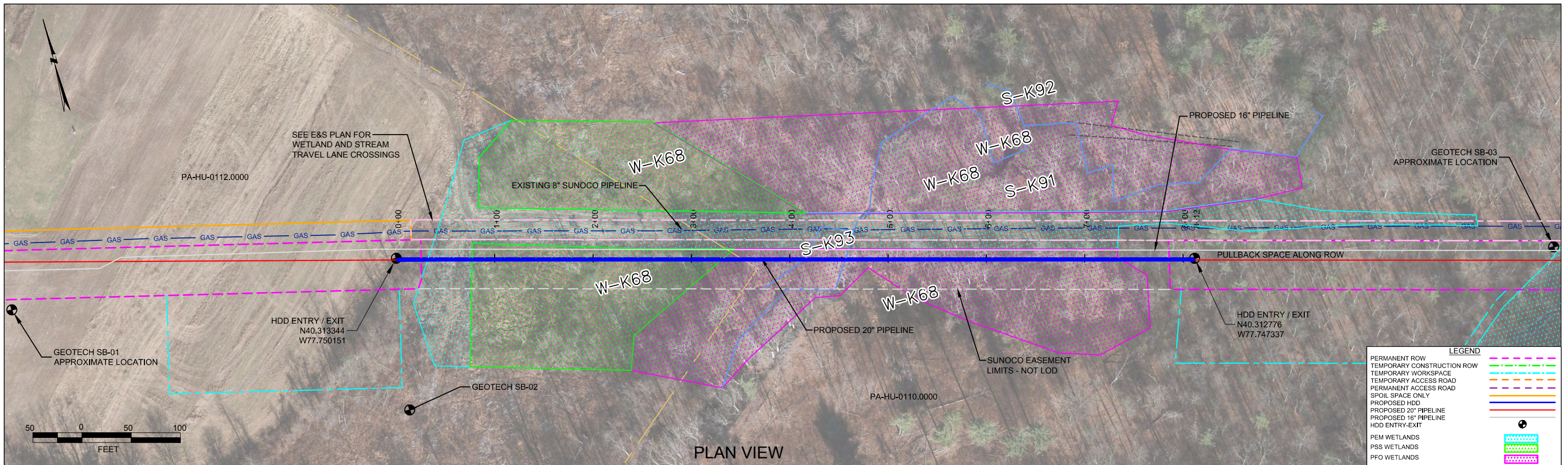
Major Divisions		Group Symbols	Typical Descriptions	Laboratory Classifications				
Coarse Grained Soils (More than half of material is larger than No. 200 sieve)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravel (Little or no fines)	GW Well-graded gravels, gravel-sand mixtures, little or no fines	Determine Percentage of sand and gravel from grain size curve. Depending on Percentage of fines (fraction smaller than No. 200 sieve), coarse-grained soils are classified as follows:  Less than 5 percent GW, GP, SW, SP More than 12 percent GM, GC, SM, SC 5 to 12 percent Borderline cases requiring dual symbols <sup>(1)</sup>	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4: $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3			
		GP Poorly graded gravels, gravel-sand mixtures, little or no fines	Not meeting $C_u$ or $C_c$ requirements for GW					
		Gravel with fines (Appreciable amount of fines)	GM Silty gravels, gravel-sand-silt mixtures		Atterberg limits below A Line or $I_p$ less than 4	Limits plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols		
			GC Clayey gravels, gravel-sand-clay mixtures		Atterberg limits above A line with $I_p$ greater than 7			
	Sands (More than half of coarse fraction is smaller than No. 4 Sieve)	Clean sands (Little or no fines)	SW Well graded sands, gravelly sands, little or no fines		$C_u = \frac{D_{60}}{D_{10}}$ greater than 6: $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3			
			SP Poorly graded sands, gravelly sands, little or no fines		Not meeting $C_u$ or $C_c$ requirements for SW			
		Sands with fines (Appreciable amount of fines)	SM Silty sands, sand-silt mixtures		Atterberg limits below A Line or $I_p$ less than 4	Limits Plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols		
			SC Clayey sands, sand-clay mixtures		Atterberg limits above A line with $I_p$ greater than 7			
						For soils plotting nearly on A line use dual symbols i.e., $I_p = 29.5$ , $w_L = 60$ gives CH-MH. When $w_L$ is near 50 use CL-CH or ML-MH. Take near as $\pm 2$ percent.		
		Fine-grained soils (More than half of material is smaller than No. 200 sieve)	Silt and clays (Liquid limit less than 50)		ML Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity			
CL Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays								
OL Organic silts and organic silty clays of low plasticity								
Silt and Clays (Liquid limit greater than 50)	MH Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts							
	CH Inorganic clays of high plasticity, fat clays							
	OH Organic clays of medium to high plasticity, organic silts							
Highly organic soils	Pt Peat and other highly organic soils							

(1) Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC. well-graded gravel-sand mixture with clay binder.

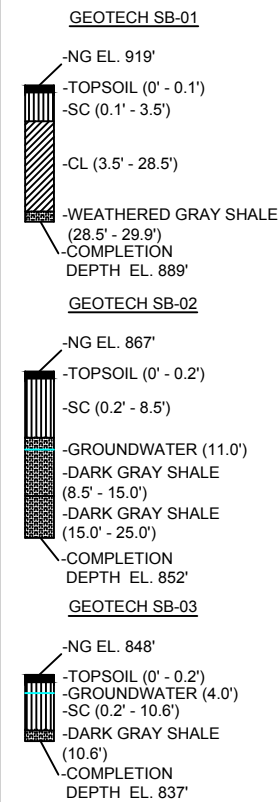
***HDD PA-HU-0110.0000-SR (W-K68, S-K93, S-K91)***

Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable and in this case that threat is considered to be *low*. Implementing this design, along with adherence to the Pennsylvania Pipeline Project Inadvertent Return Contingency Plan will ensure inadvertent impacts, if they were to occur, are also minimized to the maximum extent.

The drill will enter/exit 50 feet from the edge of the western most boundary of the Wetland K68 (W-K68) and enter/exit 100 feet from the eastern most boundary. The drill will travel beneath stream W-K68 for 700 feet with a minimum depth of 10 feet at the boundary and 38 feet in the middle. Using the results of the geotechnical investigation, as well as several other data points, the entry/exit, angles, and depths have been configured to pass through the best substrates while maintaining pipe integrity (e.g., no large bends). The majority of the substrate that will be passed through is estimated to be dark gray fractured shale. The drill will enter/exit 430 feet from the western edge of Stream K93 (S-K93) and enter/exit 420 feet from the eastern edge. The drill will pass 38 feet under the stream. Using the results of the geotechnical investigation, as well as several other data points, the entry/exit, angles, and depths have been configured to pass through the best substrates while maintaining pipe integrity (e.g., no large bends). The majority of the substrate that will be passed through is estimated to be dark gray factured shale. The drill will continue beneath Stream K91 (S-K91) and will enter/exit 470 feet from the western edge and enter/exit 380 feet from the eastern edge. Based on the geotechnical report and the drill profile minimal inadvertent returns are expected.

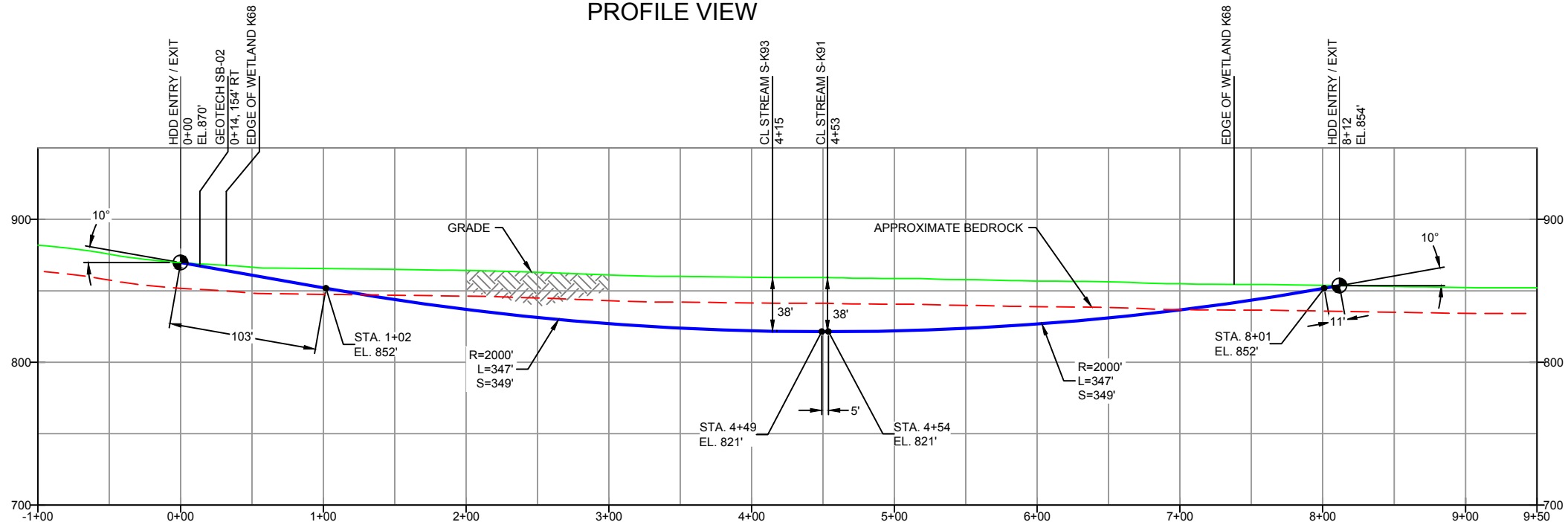


HUNTINGDON COUNTY PENNSYLVANIA, TELL TOWNSHIP  
S2-0155



NOTE: REFER TO TEST BORING LOG S2-0155 FOR COMPLETE SOIL MATERIAL DESCRIPTION

PLAN VIEW  
PROFILE VIEW



DESIGN AND CONSTRUCTION:

- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
- THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
- DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
- CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L)=812'  
HDD PIPE LENGTH (S)=817'  
20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW  
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
- INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
- INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
- PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
- CARRIER PIPE NOT ENCASED.
- PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
- CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
- SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
- SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
- SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

NOTES

- ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
- STATIONING IS BASED ON HORIZONTAL DISTANCES.
- ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP. FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
- CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
- SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING		REVISIONS	
ES-3.80	TO ES-3.80	EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16
SHEET 48	TO SHEET 49	EP1	REVISED PER PADEP COMMENTS
		EP	
		C	ADDED GEOTECH INFO
		B	ISSUED FOR BID
		A	ISSUED FOR REVIEW
DWG NO	DWG NO	NO.	DESCRIPTION

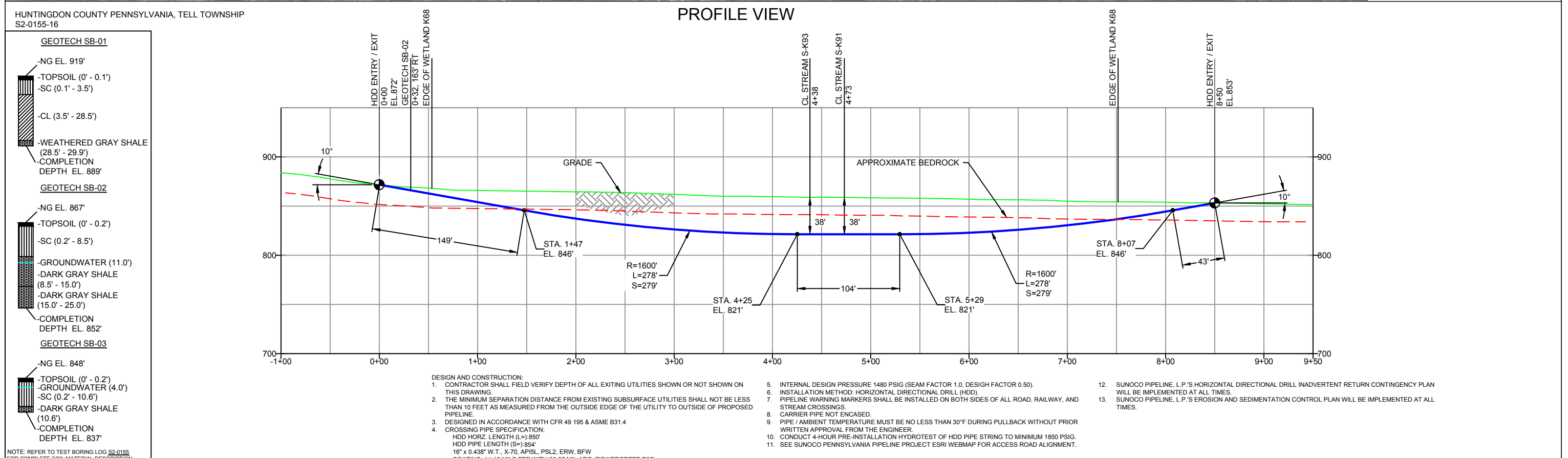
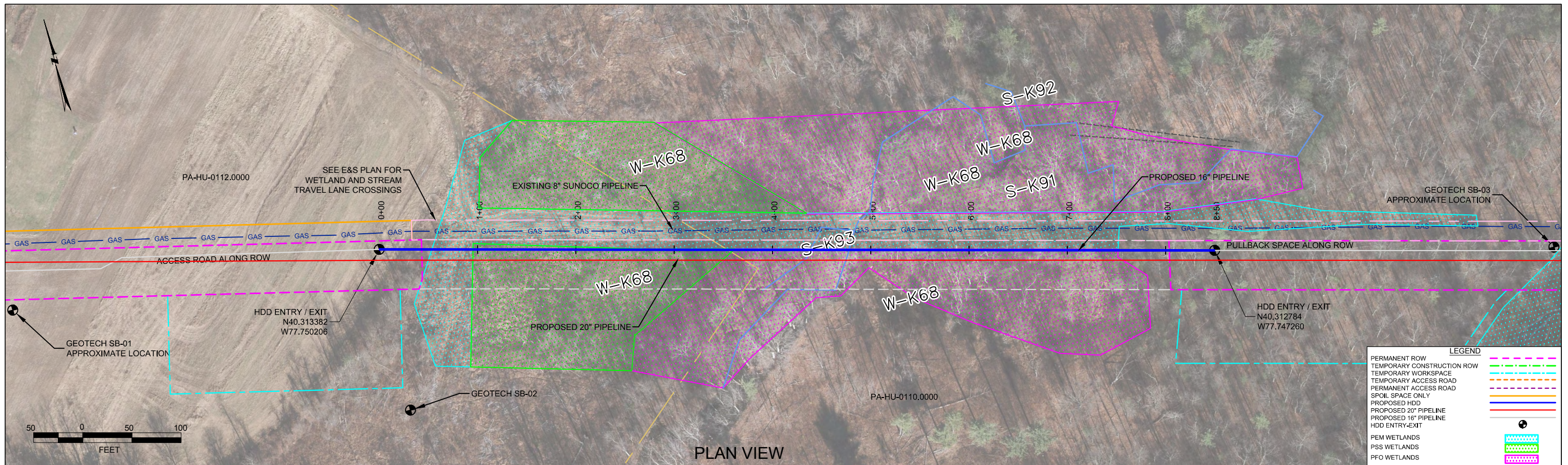
**Sunoco Logistics Partners L.P.**

**TETRA TECH ROONEY**  
(303) 792-5911

SUNOCO PIPELINE, L.P.

20-INCH HORIZONTAL DIRECTIONAL DRILL  
CAMPBELL CREEK  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=100' DWG. NO: PA-HU-0110.0000-SR



**GEOTECH SB-01**

- NG EL. 919'
- TOPSOIL (0' - 0.1')
- SC (0.1' - 3.5')
- CL (3.5' - 28.5')
- WEATHERED GRAY SHALE (28.5' - 29.9')
- COMPLETION DEPTH EL. 889'

**GEOTECH SB-02**

- NG EL. 867'
- TOPSOIL (0' - 0.2')
- SC (0.2' - 8.5')
- GROUNDWATER (11.0')
- DARK GRAY SHALE (8.5' - 15.0')
- DARK GRAY SHALE (15.0' - 25.0')
- COMPLETION DEPTH EL. 852'

**GEOTECH SB-03**

- NG EL. 848'
- TOPSOIL (0' - 0.2')
- GROUNDWATER (4.0')
- SC (0.2' - 10.6')
- DARK GRAY SHALE (10.6')
- COMPLETION DEPTH EL. 837'

NOTE: REFER TO TEST BORING LOG S2-0155 FOR COMPLETE SOIL MATERIAL DESCRIPTION

NOTES		REF. DRAWING		REVISIONS		SUNOCO PIPELINE, L.P.						
1. ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83		ES-3.80	TO ES-3.80	EROSION & SEDIMENT PLAN							Sunoco Logistics Partners L.P.	16-INCH HORIZONTAL DIRECTIONAL DRILL CAMPBELL CREEK PENNSYLVANIA PIPELINE PROJECT
2. STATIONING IS BASED ON HORIZONTAL DISTANCES		SHEET 48	TO SHEET 49	AERIAL SITE PLAN	EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	DLM	10/07/16	RMB	10/07/16		
3. ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP. FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.					EP1	REVISED PER PADEP COMMENTS	DLM	05/20/16	RMB	05/20/16	AAW	05/20/16
4. CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.					EP		MRS	03/15/16	RMB	03/15/16	AAW	03/15/16
5. SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.					B	ADDED GEOTECH INFO	MRS	09/14/15	RMB	09/14/15	AAW	09/14/15
					A	ISSUED FOR BID	MRS	08/31/15	RMB	08/31/15	AAW	08/31/15
DWG NO	DWG NO	DESCRIPTION	NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE	SCALE: 1"=100' DWG. NO: PA-HU-0110.0000-SR-16	





**LEGEND:**

⊙ Geotechnical Soil Boring (SB) Locations



GEOTECHNICAL BORING LOCATIONS  
 HDD S2-0155  
 HUNTINGDON COUNTY, TELL TOWNSHIP, PA  
 SUNOCO PENNSYLVANIA PIPELINE PROJECT





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**TEST BORING LOG**

Project Name: SUNOCO PENNSYLVANIA PIPELINE PROJECT			Project No.: 103IP3406		
Project Location: 16410 SHADE VALLEY ROAD, BLAIRS MILLS, PA			Page 1 of 1		
HDD No.: S2-0155		Dates(s) Drilled: 10-13-14		Inspector: E. WATT	
Boring No.: SB-02		Drilling Method: SPT - ASTM D1586		Driller: S. HOFFER	
Drilling Contractor: HAD DRILLING		Groundwater Depth (ft): 11.0		Total Depth (ft): 25.0	

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (ft)	Strata (USCS)	Description of Materials	6" Increment Blows *				N	
	From	To	From	To									
			0.0	0.2			TOPSOIL (2").						
1	3.0	5.0	0.2		12	SC	DR WEATHERED TO A VARIAGATED BROWN, GRAY, OR.BROWN FINE SAND AND SILTY CLAY, TRACE FINE GRAVEL.	3	10	11	10	21	
2	8.0	10.0	8.5		17		DARK GRAY WEATHERED FISSILE SHALE.	4	12	20	38	32	
3	13.0	13.9			10	ROCK	DARK GRAY WEATHERED FISSILE SHALE.	2	50/5"			>50	
4	14.4	15.0		15.0	4		DARK GRAY FISSILE SHALE.	12	50/1"			>50	
							AUGER REFUSAL AT 14.4'.						
							<u>ROCK CORING</u>						
RUN 1	15.0	20.0	15.0		31	ROCK	HIGHLY FRACTURED DARK GRAY SHALE, TRACE CALCITE DEPOSITS>	TCR: 52%, SCR: 0%, RQD: 0%					
RUN 2	20.0	25.0		25.0	40		HIGHLY FRACTURED DARK GRAY SHALE, TRACE CALCITE DEPOSITS>	TCR: 67%, SCR: 0%, RQD: 0%					
							WET TON SPOON AT 11'						
							WATER LEVELS THROUGH AUGERS AT 12.5'						
							CAVED AT 14'.						

Notes/Comments: Pocket Pentrometer Testing DR: DECOMPOSED ROCK

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

\* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.

N: Number of blows to drive spoon from 6" to 18" interval.



**GEOTECHNICAL LABORATORY TESTING SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0155**

HDD No.	Test Boring No.	Sample No.	Depth of Sample (ft.)		Water Content, % (ASTM D2216)	Percent Silts/Clays, % (ASTM D1140)	Atterburg Limits (ASTM D4318)			USCS Classif. (ASTM D2487)
			From	To			Liquid Limit, %	Plastic Limit, %	Plasticity Index, %	
S2-0155	SB-01	1	3.0	5.0	14.4	92.7	-	-	-	-
		2	8.0	10.0	14.7	90.5	38	21	17	CL
		4	18.0	20.0	14.5	69.2	-	-	-	-
		5	23.0	25.0	12.2	63.4	33	20	13	CL
		6	28.0	29.9	13.6	83.7	-	-	-	-
	SB-02	1	3.0	5.0	19.3	43.9	-	-	-	-
		2	8.0	10.0	7.2	14.4	-	-	-	-
		4	14.4	15.0	8.9	29.3	-	-	-	-
	SB-03	1	3.0	5.0	8.1	36.0	-	-	-	-
		2	8.0	8.9	11.1	23.2	-	-	-	-
		3	10.0	10.6	5.5	16.1	-	-	-	-

**Notes:**

- 1) Sample depths based on feet below grade at time of exploration.

**REGIONAL GEOLOGY SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0155**

HDD No.	NAME	BORING NO.	REGIONAL GEOLOGY DESCRIPTION	GENERAL TOPOGRAPHIC SETTING	BEDROCK FORMATION	GENERAL ROCK TYPE	APPROX MAX FM THICKNESS (FT)	DEPTH TO ROCK (Ft bgs) based on nearby well drilling logs	NOTES / COMMENTS
S2-0155	Campbell	SB-01	<b>Onondaga Formation</b> - Medium-gray calcareous shale; marine fossils; medium-gray argillaceous limestone of Selinsgrove Member at top	Rolling hills (ridge & valley)	Onondaga Formation	Shale-limestone		35-70	The Onondaga Formation consists of two members - the upper Selinsgrove Limestone and the lower calcerous Needmore Shale.
		SB-02	<b>Mahantango Fm</b> - gray, dark gray, brown, and olive laminated shale; siltstone; and very fine-grained sandstone or claystone containing marine fossils		Mahatango (aka Hamilton Group)	Shale-siltstone, laminated, fossiliferous			
		SB-03							

*Note : Source of well log data - <http://www.dcnr.state.pa.us/topogeo/groundwater/pagwis/records/index.htm>. All other sources as referenced in comments section.*

**ROCK CORE DESCRIPTION SUMMARY  
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Location	Boring No.	Core Run	Core Depth (ft)		TCR (%)	SCR (%)	RQD (%)	Depth (ft)		Weathering	Classification	Bedding Thickness (ft)	Color	Discontinuity Data
			From	To				From	To					
S2-0155	SB-2	1	15	20	52	0	0	15	20	Moderate	Dolostone	Massive	Gray	Heavily fractured, steeply dipping bedding, approximately 45°
S2-0155	SB-2	2	20	25	67	0	0	20	25	Moderate	Dolostone	Massive	Gray to dark gray	Same as above, some slight calcite filling of fractures

# FIELD DESCRIPTION AND LOGGING SYSTEM FOR SOIL EXPLORATION

## GRANULAR SOILS

(Sand, Gravel & Combinations)

<u>Density</u>	<u>N (blows)*</u>
Very Loose	5 or less
Loose	6 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	51 or more

### Particle Size Identification

Boulders	8 in. diameter or more
Cobbles	3 to 8 in. diameter
Gravel	Coarse (C) 3 in. to ¾ in. sieve Fine (F) ¾ in. to No. 4 sieve
Sand	Coarse (C) No. 4 to No. 10 sieve (4.75mm-2.00mm) Medium (M) No. 10 to No. 40 sieve (2.00mm – 0.425mm) Fine (F) No. 40 to No. 200 sieve (0.425 – 0.074mm)
Silt/Clay	Less Than a No. 200 sieve (<0.074mm)

### Relative Proportions

<u>Description Term</u>	<u>Percent</u>
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

## COHESIVE SOILS

(Silt, Clay & Combinations)

<u>Consistency</u>	<u>N (blows)*</u>
Very Soft	3 or less
Soft	4 to 5
Medium Stiff	6 to 10
Stiff	11 to 15
Very Stiff	16 to 30
Hard	31 or more

### Plasticity

<u>Degree of Plasticity</u>	<u>Plasticity Index</u>
None to Slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	> 22

## ROCK

(Rock Cores)

<u>Rock Quality Designation (RQD), %</u>	<u>Rock Quality Description</u>
0-25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
90-100	Excellent

**\*N - Standard Penetration Resistance.** Driving a 2.0" O.D., 1-3/8" I.D. sampler a distance of 18 inches into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. The number of hammer blows to drive the sampler through each 6 inch interval is recorded; the number of blows required to drive the sampler through the final 12 inch interval is termed the Standard Penetration Resistance (SPR) N-value. For example, blow counts of 6/8/9 (through three 6-inch intervals) results in an SPR N-value of 17 (8+9).

**Groundwater** observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

**UNIFIED SOIL CLASSIFICATION SYSTEM [Casagrande (1948)]**

Major Divisions		Group Symbols	Typical Descriptions	Laboratory Classifications				
Coarse Grained Soils (More than half of material is larger than No. 200 sieve)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravel (Little or no fines)	GW Well-graded gravels, gravel-sand mixtures, little or no fines	Determine Percentage of sand and gravel from grain size curve. Depending on Percentage of fines (fraction smaller than No. 200 sieve), coarse-grained soils are classified as follows:  Less than 5 percent GW, GP, SW, SP More than 12 percent GM, GC, SM, SC 5 to 12 percent Borderline cases requiring dual symbols <sup>(1)</sup>	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4: $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3			
		GP Poorly graded gravels, gravel-sand mixtures, little or no fines	Not meeting $C_u$ or $C_c$ requirements for GW					
		Gravel with fines (Appreciable amount of fines)	GM Silty gravels, gravel-sand-silt mixtures		Atterberg limits below A Line or $I_p$ less than 4	Limits plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols		
			GC Clayey gravels, gravel-sand-clay mixtures					
	Sands (More than half of coarse fraction is smaller than No. 4 Sieve)	Clean sands (Little or no fines)	SW Well graded sands, gravelly sands, little or no fines		$C_u = \frac{D_{60}}{D_{10}}$ greater than 6: $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3			
			SP Poorly graded sands, gravelly sands, little or no fines		Not meeting $C_u$ or $C_c$ requirements for SW			
		Sands with fines (Appreciable amount of fines)	SM Silty sands, sand-silt mixtures		Atterberg limits below A Line or $I_p$ less than 4	Limits Plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols		
			SC Clayey sands, sand-clay mixtures		Atterberg limits above A line with $I_p$ greater than 7			
						For soils plotting nearly on A line use dual symbols i.e., $I_p = 29.5$ , $w_L = 60$ gives CH-MH. When $w_L$ is near 50 use CL-CH or ML-MH. Take near as $\pm 2$ percent.		
		Fine-grained soils (More than half of material is smaller than No. 200 sieve)	Silt and clays (Liquid limit less than 50)		ML Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity			
CL Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays								
OL Organic silts and organic silty clays of low plasticity								
Silt and Clays (Liquid limit greater than 50)	MH Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts							
	CH Inorganic clays of high plasticity, fat clays							
	OH Organic clays of medium to high plasticity, organic silts							
Highly organic soils	Pt Peat and other highly organic soils							

(1) Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC. well-graded gravel-sand mixture with clay binder.