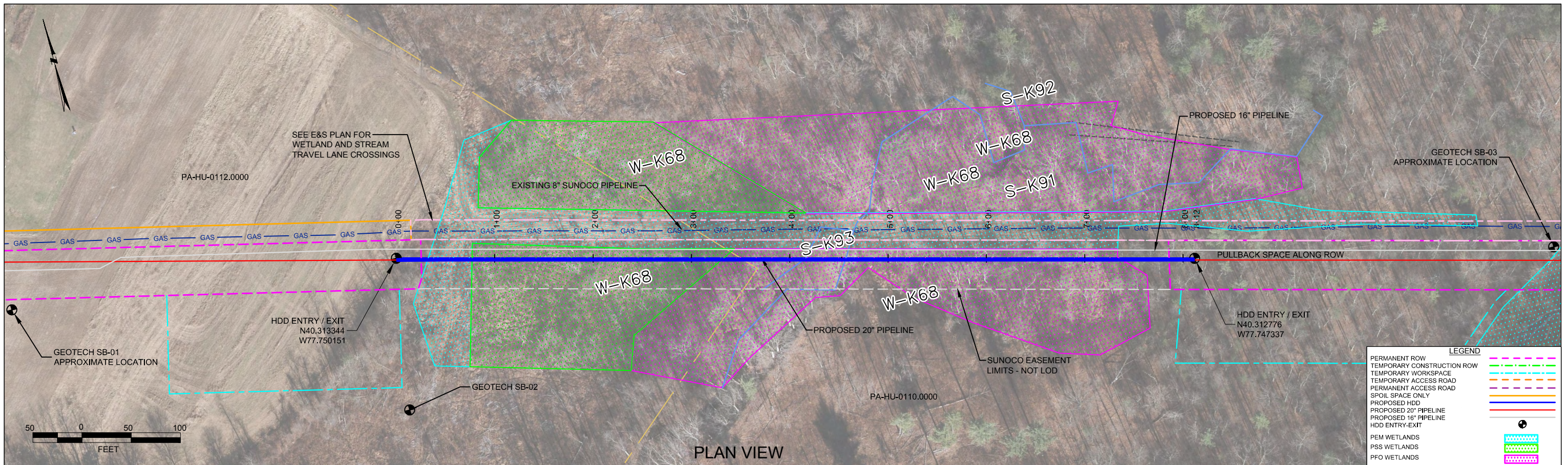


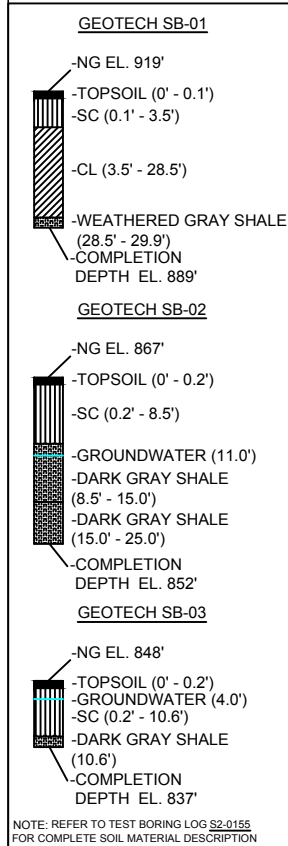
HDD PA-HU-0110.0000-SR (W-K68, S-K93, S-K91)

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.

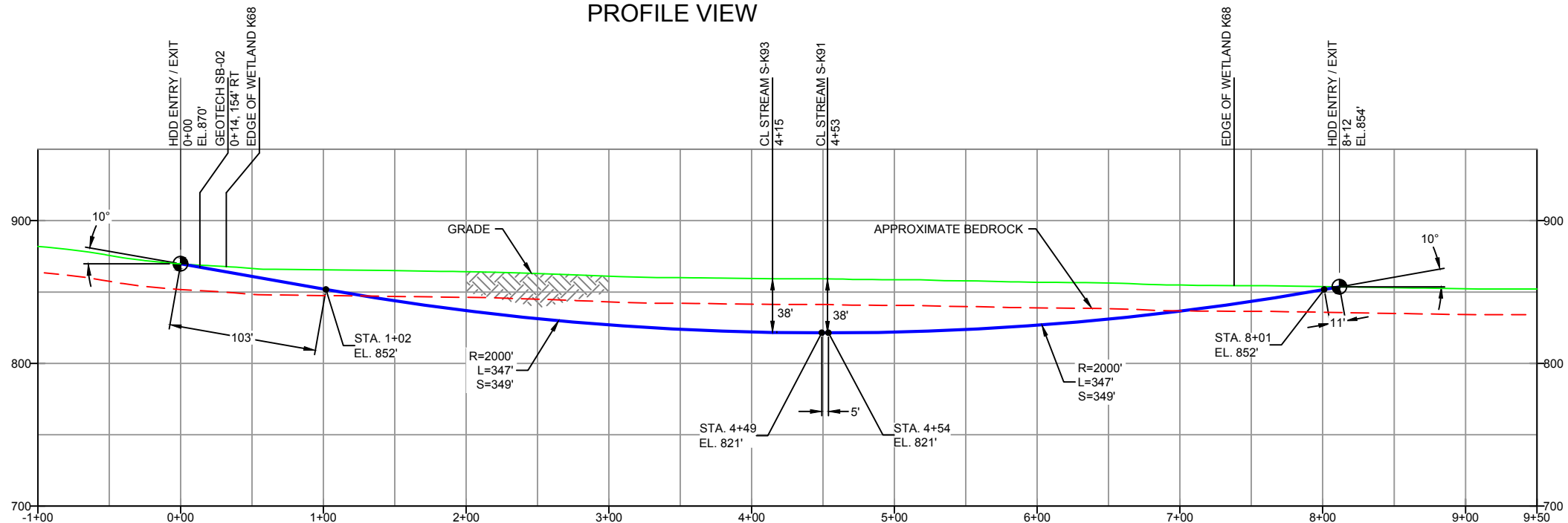


HUNTINGDON COUNTY PENNSYLVANIA, TELL TOWNSHIP
S2-0155



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

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	DESCRIPTION	NO.

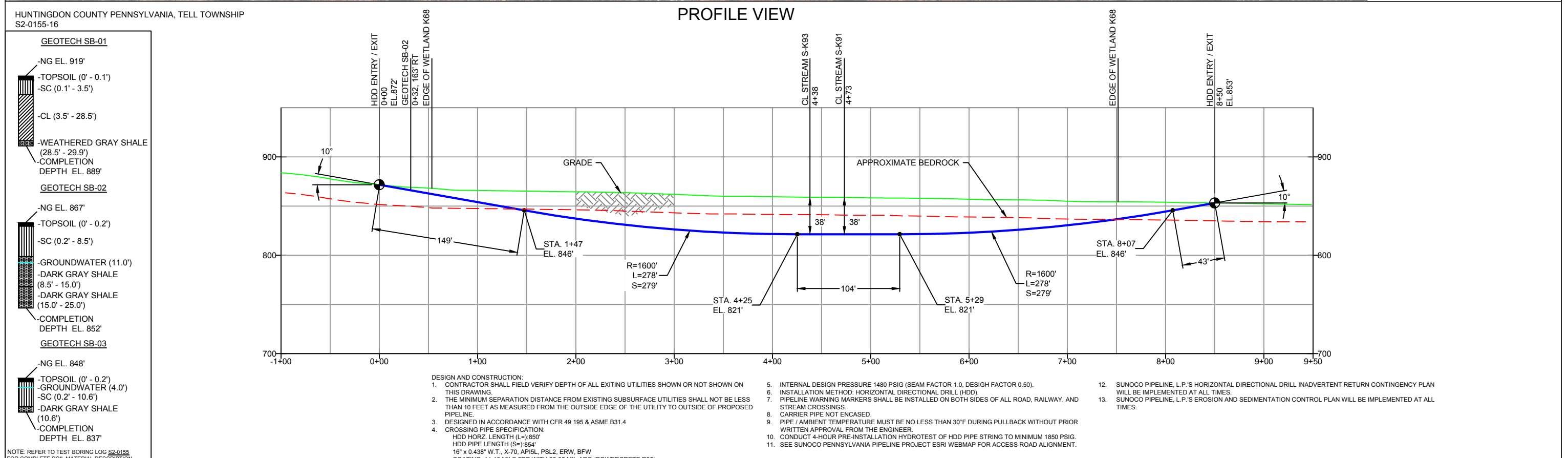
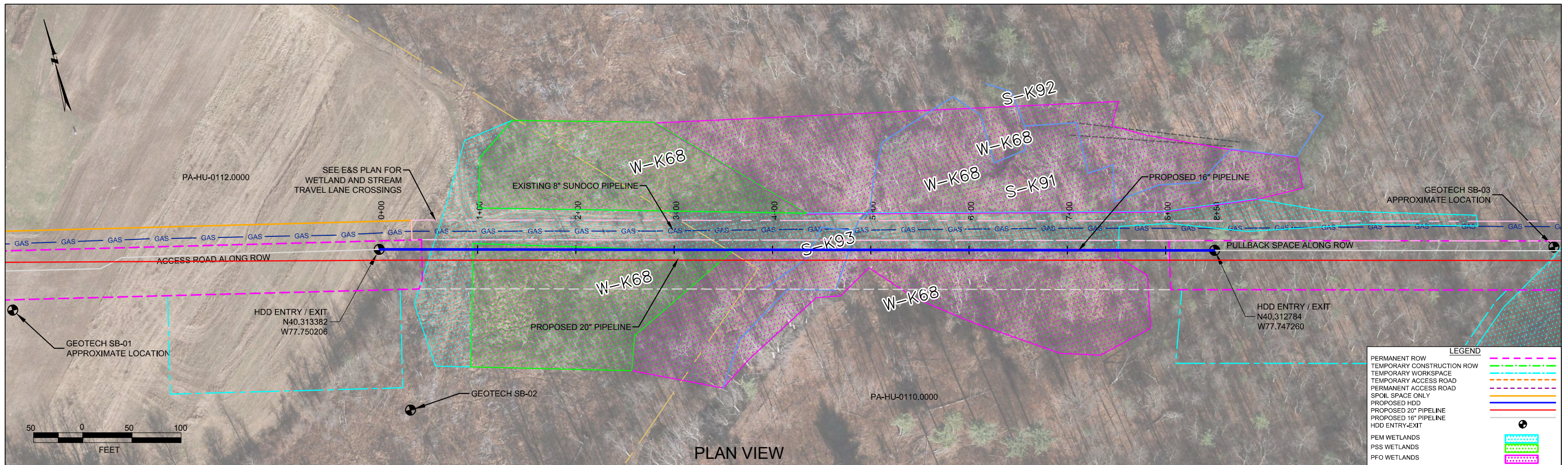
**Sunoco Logistics
Partners L.P.**

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



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							 (303) 792-5911	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				AAW	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



TETRA TECH

GEOTECHNICAL BORING LOCATIONS
 HDD S2-0155
 HUNTINGDON COUNTY, TELL 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:	16410 SHADE VALLEY ROAD, BLAIRS MILLS, PA	Page 1 of 1	
HDD No.:	S2-0155	Dates(s) Drilled:	10-13-14
Boring No.:	SB-02	Inspector:	E. WATT
Drilling Contractor:	HAD DRILLING	Drilling Method:	SPT - ASTM D1586
		Driller:	S. HOFFER
		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		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'.						
							ROCK CORING						
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	Onondaga Formation - 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	Mahantango Fm - 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
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S2-0155**

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 ⁽¹⁾	$C_u = \frac{D_{60}}{D_{10}}$ 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 ± 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.