Attachment A
HDD Table
Lebanon County

Drawing Name	Drill Name	County	Township	Drill Location	Risk Assessment Level (Low / Medium / High)
PA-LE-0001.0000-SR.pdf	Wetland	Lebanon	Conewago & South Londonderry	N: 40.253069 W: 76.594862	low
PA-LE-0005.0000-RD.pdf	School House Road	Lebanon	South Londonderry	N: 40.254448 W: 76.590059	low
PA-LE-0009.0000-RD.pdf	Lawn Road	Lebanon	South Londonderry	N: 40.258714 W: 76.573279	low
PA-LE-0055.0000-RD.pdf	N. Zinns Mill Road	Lebanon	West Cornwall	N: 40.290573 W: 76.431442	low
PA-LE-0117.0000-WX.pdf	Creek & T307	Lebanon	Heidelberg	N: 40.285371 W: 76.242903	low

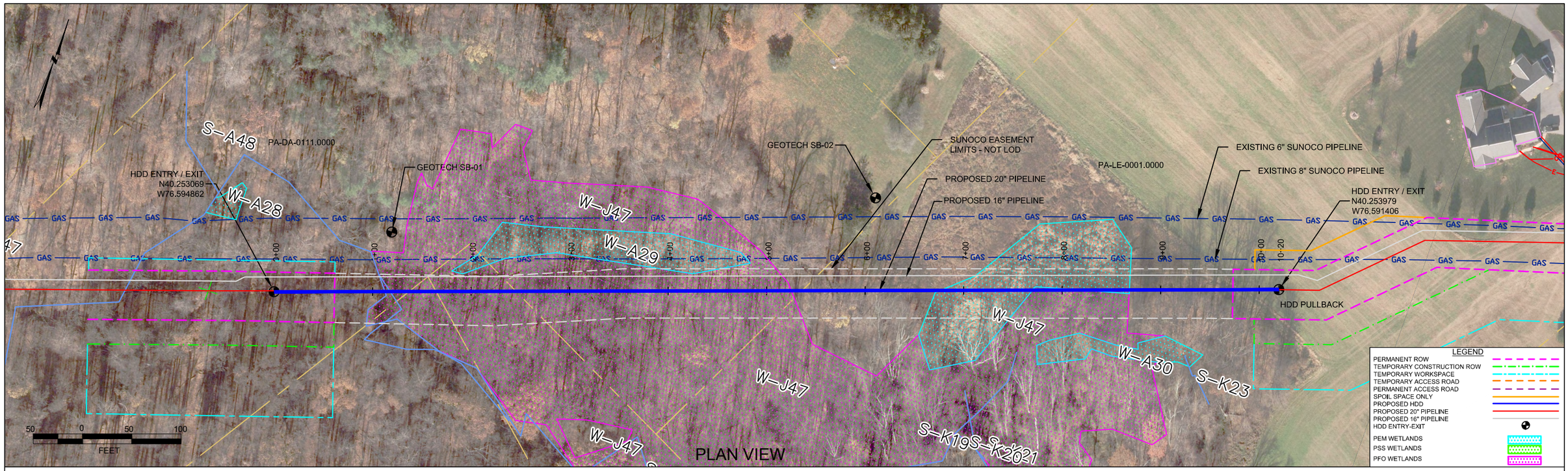
Prepared By:
Tetra Tech Rooney

10/14/2016

HDD PA-LE-0001.0000-SR (S-A47, S-K18, PFO-J47, PEM-J47)

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 140 feet from the western edge of Forested Wetland J47 (PFO-J47) and enter/exit 514 feet from the eastern edge. Two small streams (S-A47, S-K18) flow through the forested wetland. The horizontal directional drill will enter/exit 710 feet from the western edge of Grassy Wetland J47 (PEM-J47) and enter/exit 170 feet from the eastern edge. The drill will pass below PFO-J47 starting at 10 feet (western edge) with a maximum depth of 60 feet at the eastern edge. It will continue below PEM-J47 starting at 50 feet along the western edge and 20 feet below grade on the eastern edge. 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 primary substrates being drilled through are clays and silty sands. Based on the geotechnical report and the drill profile minimal inadvertent returns are expected.



PLAN VIEW

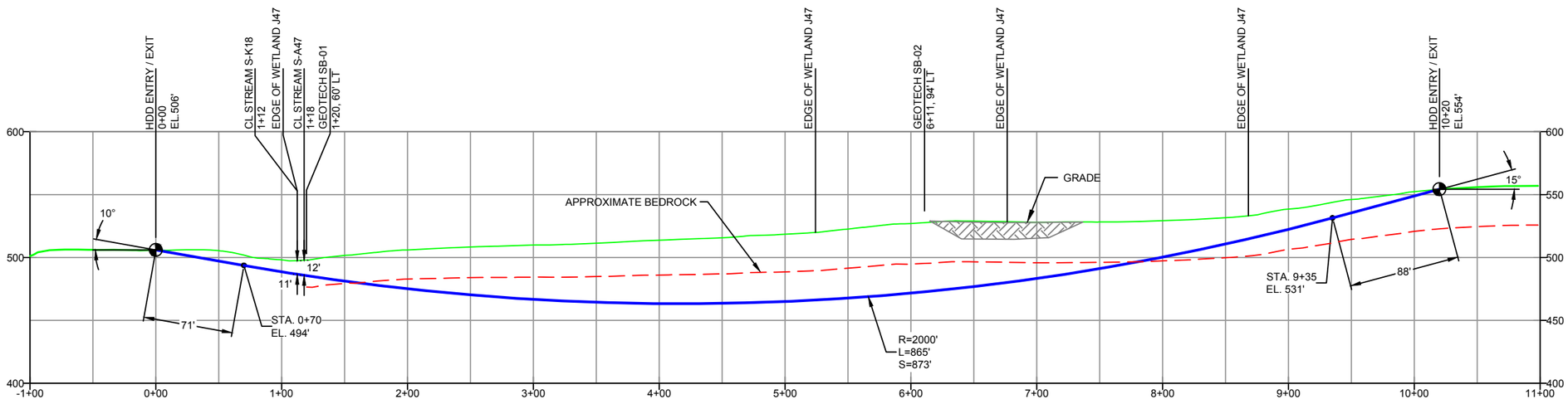
PROFILE VIEW

LEBANON COUNTY, PENNSYLVANIA - CONEWAGO TOWNSHIP
S3-0090

GEOTECH SB-01
-NG EL. 503'
-TOPSOIL (0.0' - 0.8')
-ML (0.8' - 3.5')
-SM (3.5' - 21.5')
-COMPLETION DEPTH EL. 482'

GEOTECH SB-02
-NG EL. 537'
-TOPSOIL (0.0' - 0.3')
-SM (0.3' - 6.5')
-CL (6.5' - 16.5')
-SC (16.5' - 21.5')
-GROUNDWATER (20.0')
-CL (21.5' - 27.0')
-SANDSTONE (27.0' - 32.5')
-COMPLETION DEPTH EL. 505'

NOTE: REFER TO TEST BORING LOG S3-0090 FOR COMPLETE SOIL MATERIAL DESCRIPTION



DESIGN AND CONSTRUCTION:

1. CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXITING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
2. 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.
3. DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
4. CROSSING PIPE SPECIFICATION:
   HDD HORZ. LENGTH (L=):1020'
   HDD PIPE LENGTH (S=):1032'
   20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
5. INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGH FACTOR 0.50).
6. INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
7. PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
8. CARRIER PIPE NOT ENCASED.
9. PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
10. CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
11. SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
12. SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
13. 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-4.39	TO	ES-5.02	EROSION & SEDIMENT PLAN	
SHEET 1	TO	SHEET 1	AERIAL SITE PLAN	
DWG NO		DWG NO	DESCRIPTION	

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	DLM	09/30/16	RMB	09/30/16	AAW	09/30/16
EP1	REVISED PER PADEP COMMENTS	DLM	05/10/16	RMB	05/10/16	AAW	05/10/16
EP		MRS	03/15/16	RMB	03/15/16	AAW	03/15/16
C	ADDED GEOTECH INFO/DESIGN ADJUSTMENT	MRS	09/22/15	RMB	09/22/15	AAW	09/22/15
B	ISSUED FOR BID	DLM	07/31/15	RMB	07/31/15	AAW	07/31/15
A	ISSUED FOR REVIEW	JVA	04/15/15	RMB	04/15/15	AAW	04/15/15

Sunoco Logistics Partners L.P.

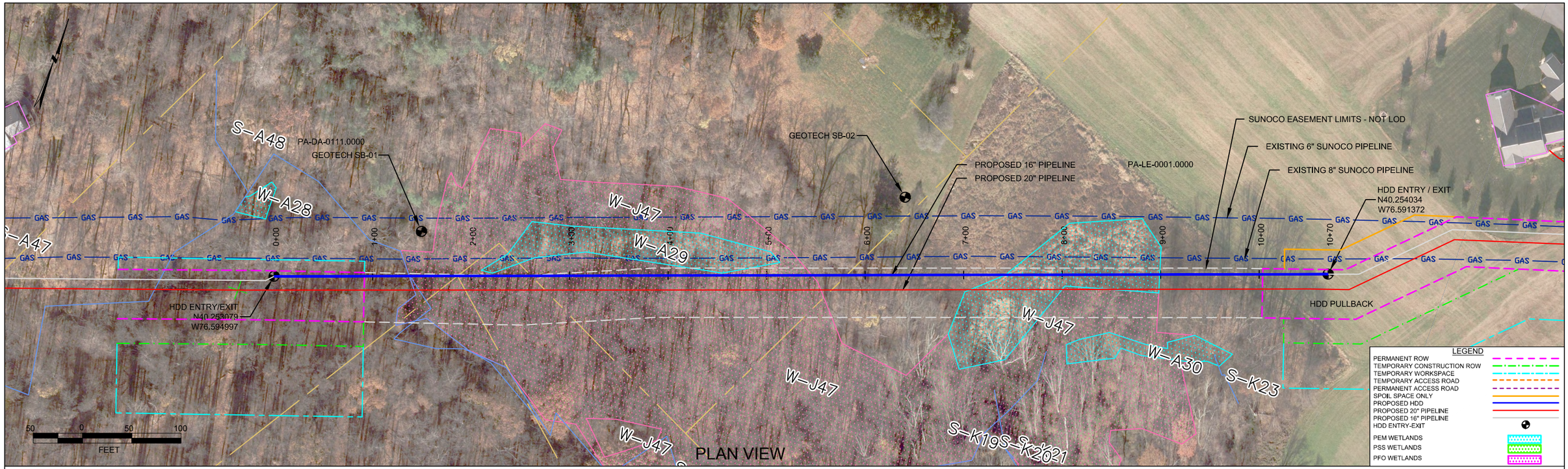
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

20-INCH HORIZONTAL DIRECTIONAL DRILL
WETLAND
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=100'

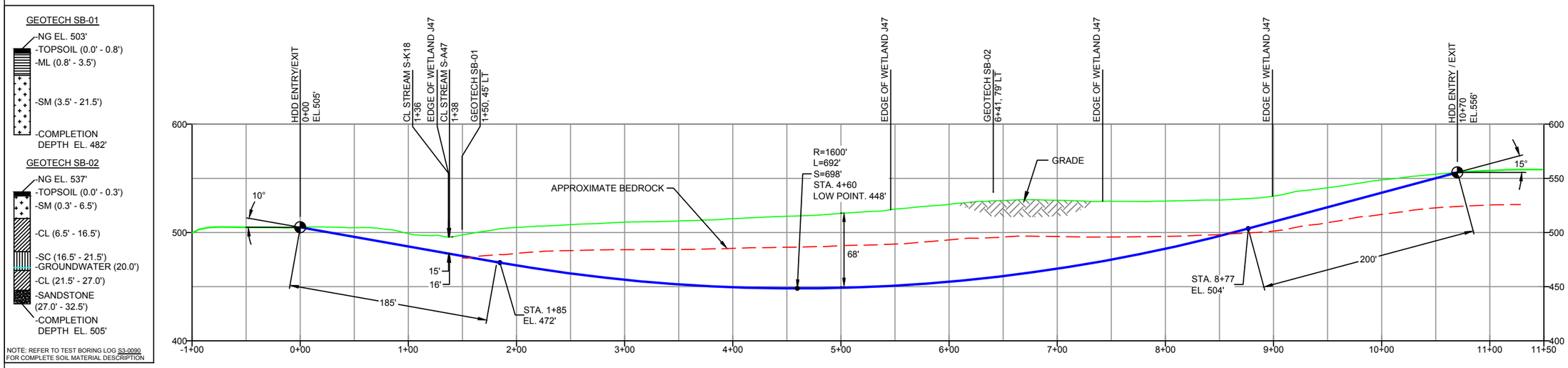
DWG. NO: PA-LE-0001.0000-SR



PLAN VIEW

PROFILE VIEW

LEBANON COUNTY, PENNSYLVANIA - CONEWAGO TOWNSHIP
S3-0090-16



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3. DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
4. CROSSING PIPE SPECIFICATION:
   HDD HORZ. LENGTH (L=):1070'
   HDD PIPE LENGTH (S=):1083'
   16" x 0.438" W.T., X-70, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
5. INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGH FACTOR 0.50).
6. INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
7. PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
8. CARRIER PIPE NOT ENCASED.
9. PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
10. CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
11. SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
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NOTES

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

REF. DRAWING				REVISIONS							
ES-4.39	TO	ES-5.02	EROSION & SEDIMENT PLAN								
SHEET 1	TO	SHEET 1	AERIAL SITE PLAN	EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	MRS	10/07/16	RMB	10/07/16	AAW	10/07/16
				EP1	REVISED PER PADEP COMMENTS	DLM	05/17/16	RMB	05/17/16	AAW	05/17/16
				EP		MRS	03/15/16	RMB	03/15/16	AAW	03/15/16
				B	ADDED GEOTECH INFO	MRS	09/22/15	RMB	09/22/15	AAW	09/22/15
				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

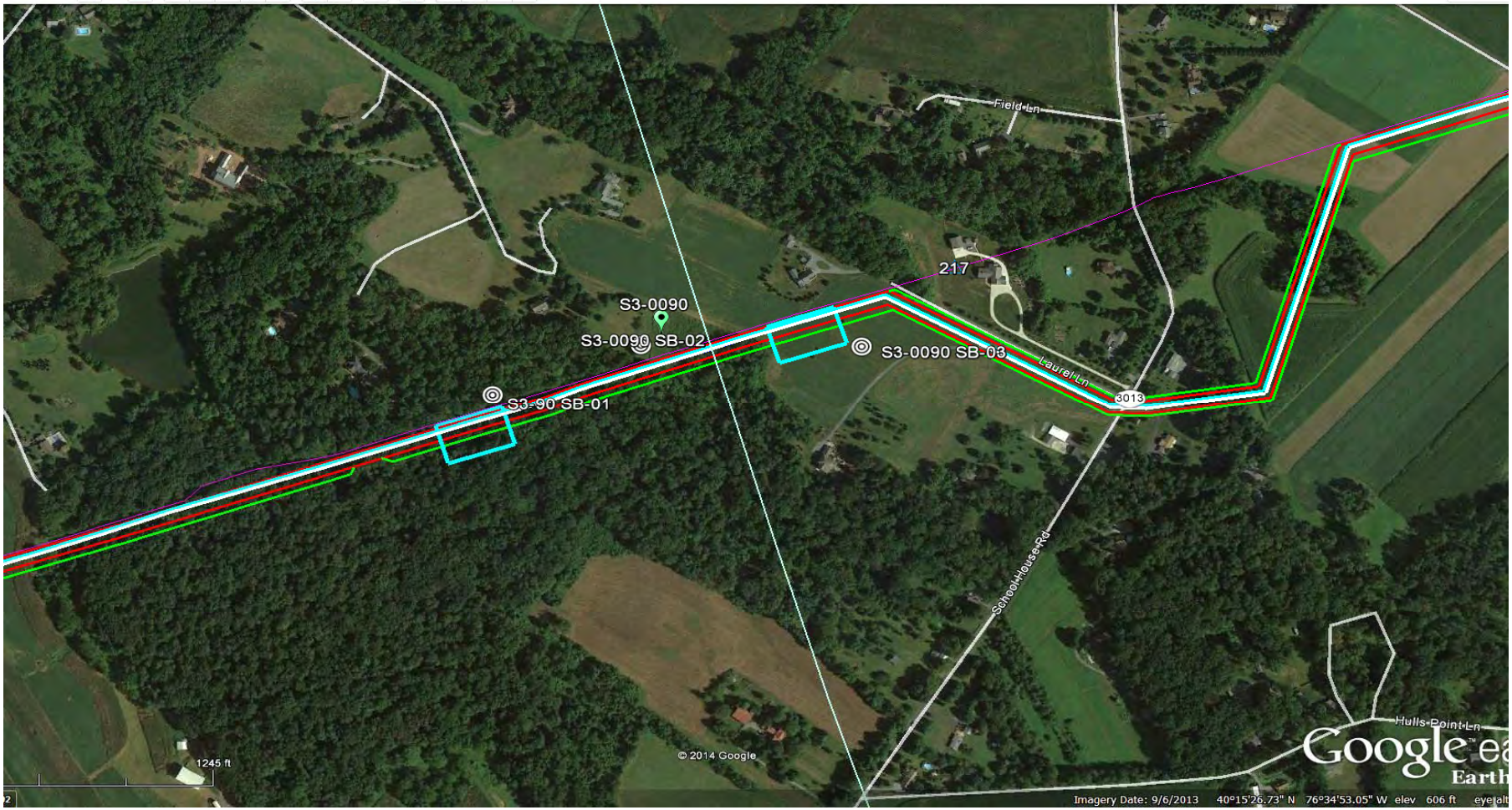
Sunoco Logistics Partners L.P.

TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

16-INCH HORIZONTAL DIRECTIONAL DRILL
WETLAND
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=100' | DWG. NO: PA-LE-0001.0000-SR-16



LEGEND:

Geotechnical Soil Boring (SB) Locations

TETRA TECH

GEOTECHNICAL BORING LOCATIONS
HDD S3-0090
LEBANON COUNTY, SOUTH LONDONDERRY TOWNSHIP &
DAUGHIN COUNTY, CONEWAGO 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:	95 LAUREL LANE, PALMYRA, PA		Page 1 of 1
HDD No.:	S3-0090	Dates(s) Drilled: 11-18-14	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): 21.5
Boring Location Coordinates:		40° 15' 11.995" N	76° 35' 40.296" W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.8			TOPSOIL (10")					
1	3.0	5.0	0.8	3.5	12	ML	REDDISH BROWN MICACEOUS SILT WITH A LITTLE FINE SAND.	4	11	18	45	**29**
			3.5				REDDISH BROWN FINE TO MEDIUM SAND AND SILT.					
2	8.0	8.7			9		REDDISH BROWN FINE SAND AND SILT WITH SOME UNWEATHERED	30	50/2"			**>50**
							SANDSTONE GRAVEL.					
3	13.0	13.8			7		REDDISH BROWN FINE SAND AND SILT WITH SOME UNWEATHERED	15	50/3"			**>50**
						SM	SANDSTONE GRAVEL.					
4	18.0	19.2			10		REDDISH BROWN FINE SAND AND SILT WITH SOME UNWEATHERED	17	50	50/2"		**>50**
							SANDSTONE GRAVEL.					
5	20.0	20.3			4		REDDISH BROWN FINE SAND AND SILT WITH SOME UNWEATHERED	50/4"				**>50**
				21.5			SANDSTONE GRAVEL.					
							AUGER GRINDING STARTING AT 12'.					
							AUGER REFUSAL AT 20'. OFFSET BORING AND CONTINUOUSLY					
							AUGERED TO REFUSAL AT 21.5'.					
							CAVED AND NO WATER AT 17', BOTTOM MUDDY.					
							PLACED CONCETE PLUG.					

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:	95 LAUREL LANE, PALMYRA, PA		Page 1 of 1
HDD No.:	S3-0090	Dates(s) Drilled: 11-18-14	Inspector: E. WATT
Boring No.:	SB-02	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 20.0	Total Depth (ft): 32.5
Boring Location Coordinates:		40° 15' 13.887" N	76° 35' 34.446" W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.3			TOPSOIL (3")					
1	3.0	5.0	0.3		16	SM	REDDISH BROWN FINE TO MEDIUM SAND WITH SOME SILT, WITH A	4	20	27	45	**47**
				6.5			LITTLE FINE TO COARSE SANDSTONE GRAVEL.					
2	8.0	10.0	6.5		22	CL	REDDISH BROWN MICACEOUS SILTY CLAY WITH A LITTLE FINE SAND, T	3	6	14	18	**20**
							TRACE FINE GRAVEL. (USCS: CL)					
3	13.0	15.0			24		MAROON MICACWOUS SILTY CLAYWITH SOME FINE SAND, TRACE	3	8	30	43	**38**
				16.5			FINE TO COARSE SANDSTONE GRAVEL.					
4	18.0	20.0	16.5		21	SC	MAROON FINE SAND (TRACE MICA) WITH A LITTLE SILTY CLAY,	5	11	23	40	**34**
				21.5			TRACE FINE SANDSTONE GRAVEL.					
5	23.0	24.4	21.5		15	CL	MARRON MICACEOUS SILTY CLAY WITH A LITTLE FINE SAND, WITH	3	7	50/5"		**>57**
				27.0			A LITTLE F-C SANDSTONE GRAVEL.					
6	28.0	28.5	27.0		5		PARTIALLY WEATHERED MAROON SANDSTONE.	50/6"				**>50**
7	31.0	31.6		32.5	6		PARTIALLY WEATHERED MAROON SANDSTONE.	12	50/2"			**>50**
							AUGER REFUSAL AT 31'. OFF-SET BORING AND CONTINUOUSLY					
							AUGERED TO REFUSAL AT 32.5'.					
							WET ON SPOON AT 20'.					
							WATER LEVEL THROUGH AUGERS AT 22'.					
							CAVED AT 27', WATER LEVEL ON CAVE AT 14'.					

Notes/Comments:

Pocket Pentrometer Testing
S2: > 4 TSF
S3: > 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
240 Continental Drive, Suite 200
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fax: 302.454.5988

TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	95 LAUREL LANE, PALMYRA, PA		Page 1 of 1
HDD No.:	S3-0090	Dates(s) Drilled: 11-18-14	Inspector: E. WATT
Boring No.:	SB-03	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): NOT ENCOUNTERED	Total Depth (ft): 30.0
Boring Location Coordinates:		40° 15' 13.813" N	76° 35' 24.341" W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.4			TOPSOIL (5")					
1	3.0	5.0	0.4		13	CL	REDDISH BROWN SILTY CLAY WITH A TRACE TO A LITTLE FINE SAND	1	6	9	10	**15**
				6.5			(USCS: CL).					
2	8.0	10.0	6.5		23	SC	MAROON FINE TO MEDIUM MICACEOUS SAND WITH SOME	2	18	26	20	**44**
							SILTY CLAY.					
3	13.0	15.0			18		MARRON FINE TO MEDIUM SAND WITH A LITTLE SILTY CLAY AND A	4	23	23	50/5"	**46**
							LITTLE FINE TO COARSE QUARTZ GRAVEL.					
4	18.0	20.0			24		MARRON FINE TO MEDIUM SAND WITH SOME SILTY CLAY AND A	4	21	35	50/6"	**56**
				21.5			LITTLE FINE TO COARSE SILT OR CLAYSTONE GRAVEL.					
5	23.0	24.4	21.5		11	CL	REDDISH BROWN WEATHERED CLAYSTONE (SILTY CLAY WITH SOME	10	27	50/5"		**>77**
				26.0			FINE SAND).					
6	28.0	28.3	26.0	30.0	4		REDDISH BROWN PARTIALLY WEATHERED SANDSTONE.	50/4"				**>50**
							CAVED AND DRY AT 28'.					

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.

GEOTECHNICAL LABORATORY TESTING SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0090

HDD No.	Test Boring No.	Sample No.	Depth of Sample (ft.) From	Depth of Sample (ft.) To	Water Content, % (ASTM D2216)	Percent Silts/Clays, % (ASTM D1140)	Atterburg Limits (ASTM D4318) Liquid Limit, %	Atterburg Limits (ASTM D4318) Plastic Limit, %	Atterburg Limits (ASTM D4318) Plasticity Index, %	USCS Classif. (ASTM D2487)
S3-0090	SB-01	1	3.0	5.0	6.4	41.2	-	-	-	-
		2	8.0	8.7	3.6	39.2	-	-	-	-
		4	18.0	19.2	5.7	39.8	-	-	-	-
		5	20.0	20.3	6.3	41.9	-	-	-	-
	SB-02	1	3.0	5.0	9.2	21.9	-	-	-	-
		2	8.0	10.0	10.4	80.8	30	19	11	CL
		3	13.0	15.0	12.5	75.1	-	-	-	-
		4	18.0	20.0	14.2	16.3	-	-	-	-
		5	23.0	24.4	10.5	90.7	-	-	-	-
		6	28.0	28.5	5.7	21.4	-	-	-	-
	SB-03	1	3.0	5.0	14.2	99.2	32	19	13	CL
		2	8.0	10.0	9.2	21.1	-	-	-	-
		4	18.0	20.0	13.7	38.8	-	-	-	-
		5	23.0	24.4	9.6	75.3	-	-	-	-

Notes:

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

REGIONAL GEOLOGY SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0090

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
S3-0090	Wetland J47	SB-01	**Gettysburg Fm** - reddish-brown to maroon silty mudstone and shale and soft, red-brown, medium- to fine-grained sandstone, with minor amounts of yellowish-brown shale and sandstone and thin beds of impure limestone.	Gently sloping lowland to forested wetlands	Gettysburg Fm	Silty mudstone-shale-sandstone w/ some impure limestone		12-22	
		SB-02							
		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.

FIELD DESCRIPTION AND LOGGING SYSTEM FOR SOIL EXPLORATION

GRANULAR SOILS

(Sand, Gravel & Combinations)

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

Relative Proportions

Description Term	*Percent*
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

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)	

COHESIVE SOILS

(Silt, Clay & Combinations)

Consistency	***N (blows)****
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

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

ROCK

(Rock Cores)

Rock Quality Designation (RQD), %	***Rock Quality Description***
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).

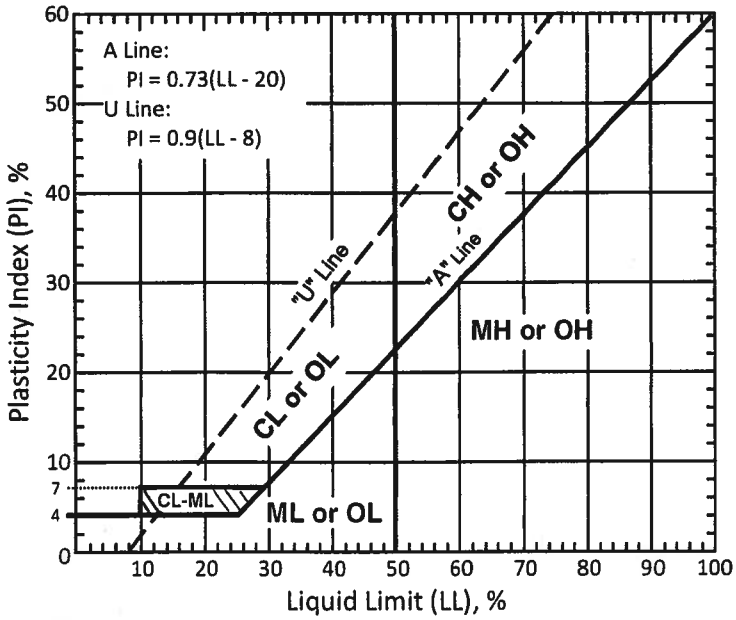
Groundwater observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

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	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, gravely 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	

Major Divisions		Group Symbols	Typical Descriptions
Fine-grained soils (More than half of material is smaller than No. 200 sieve)	Silts 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
	Silts 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

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.

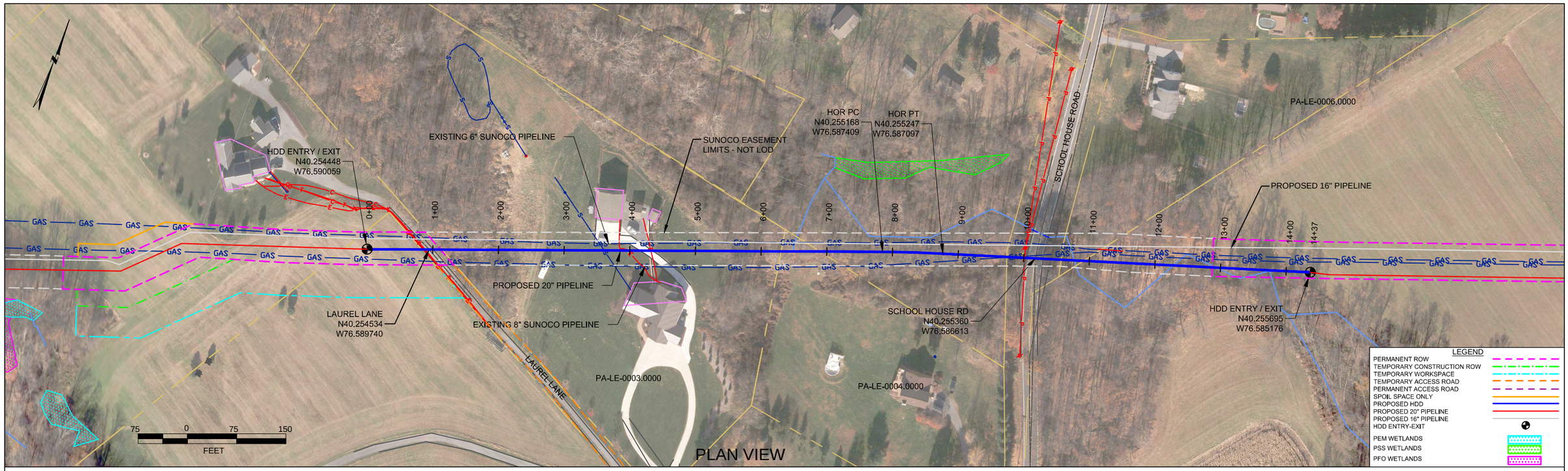


(1) Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC. well-graded gravel-sand mixture with clay binder.

HDD PA-LE-0005.0000-RD (S-A49)

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.

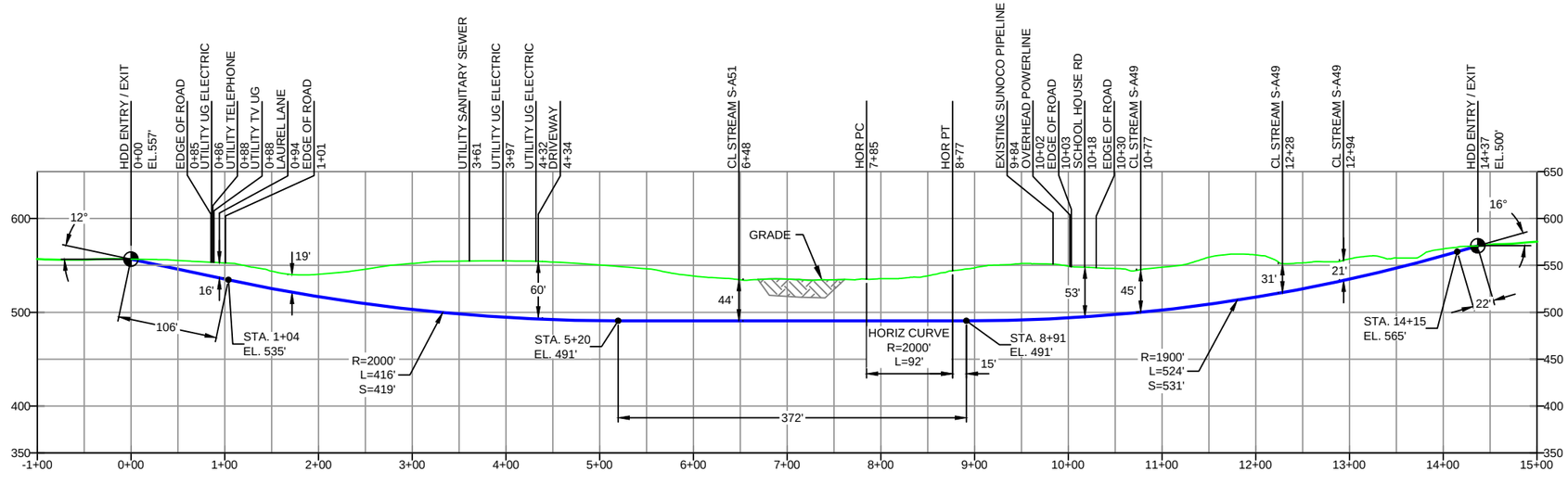
The drill crosses under Stream A49 (S-A49) three times between the entry and exit locations. Only the western and eastern edges of the stream crossing are considered here. The drill will enter/exit 1,100 feet from the western edge of S-A49 and enter/exit 50 feet from the eastern edge. The drill will pass 50 feet below the western edge and 20 feet below the eastern edge of S-A49. Due to a design change geotechnical bores were not completed for this horizontal directional drill. However, it is adjacent to PA-LE-0001.0000 and it can be assumed the soil layers are the same, clays and silty sands. Based on the drill profile and the adjacent geotechnical report minimal inadvertent returns are expected.



PLAN VIEW

LEBANON COUNTY, PENNSYLVANIA - SOUTH LONDONDERRY TOWNSHIP
S3-0091

PROFILE VIEW



DESIGN AND CONSTRUCTION:

1. CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXITING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
2. 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.
3. DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
4. CROSSING PIPE SPECIFICATION:
   HDD HORZ. LENGTH (L=):1437'
   HDD PIPE LENGTH (S=):1449'
   20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
5. INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGH FACTOR 0.50).
6. INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
7. PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
8. CARRIER PIPE NOT ENCASED.
9. PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
10. CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
11. SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
12. SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
13. 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

DWG NO		DWG NO	DESCRIPTION
ES-5.04	TO	ES-5.05	EROSION & SEDIMENT PLAN
SHEET 24	TO	SHEET 24	AERIAL SITE PLAN

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	MRS	09/30/16	RMB	09/30/16	AAW	09/30/16
EP1	REVISED PER PADEP COMMENTS	DLM	05/10/16	RMB	05/10/16	AAW	05/10/16
EP		MRS	03/15/16	RMB	03/15/16	AAW	03/15/16
1	DESIGN CHANGE	MRS	02/18/16	RMB	02/18/16	AAW	02/18/16
0	ISSUED FOR CONSTRUCTION	MRS	01/21/16	RMB	01/21/16	AAW	01/21/16

Sunoco Logistics Partners L.P.

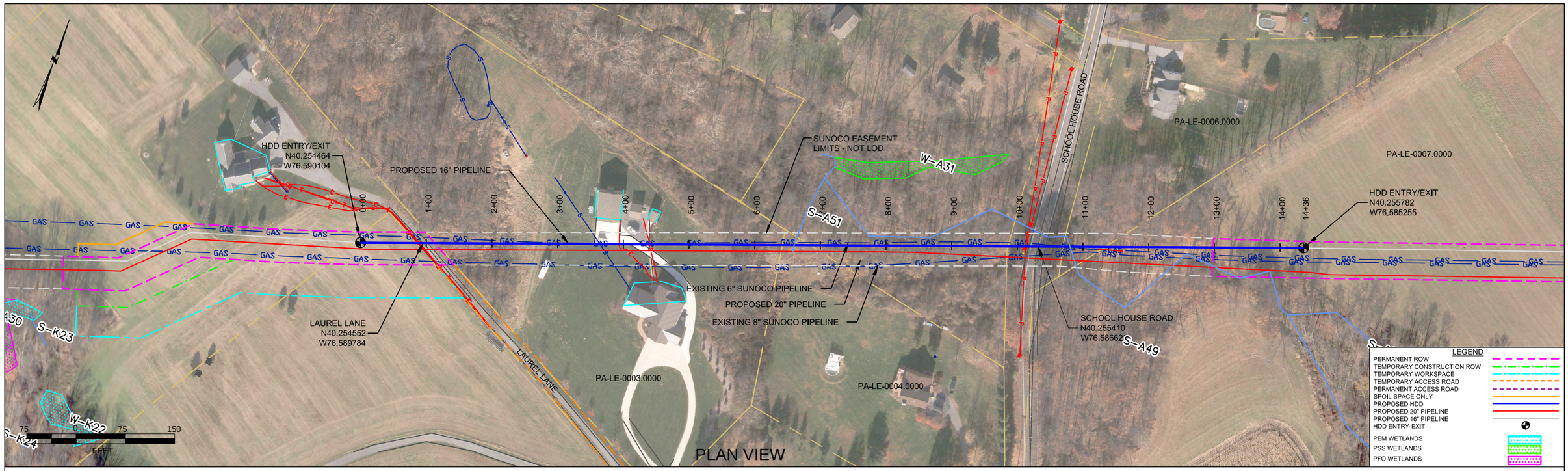
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

DIANCH HORIZONTAL DIRECTIONAL DRILL
SCHOOL HOUSE RD
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=150'

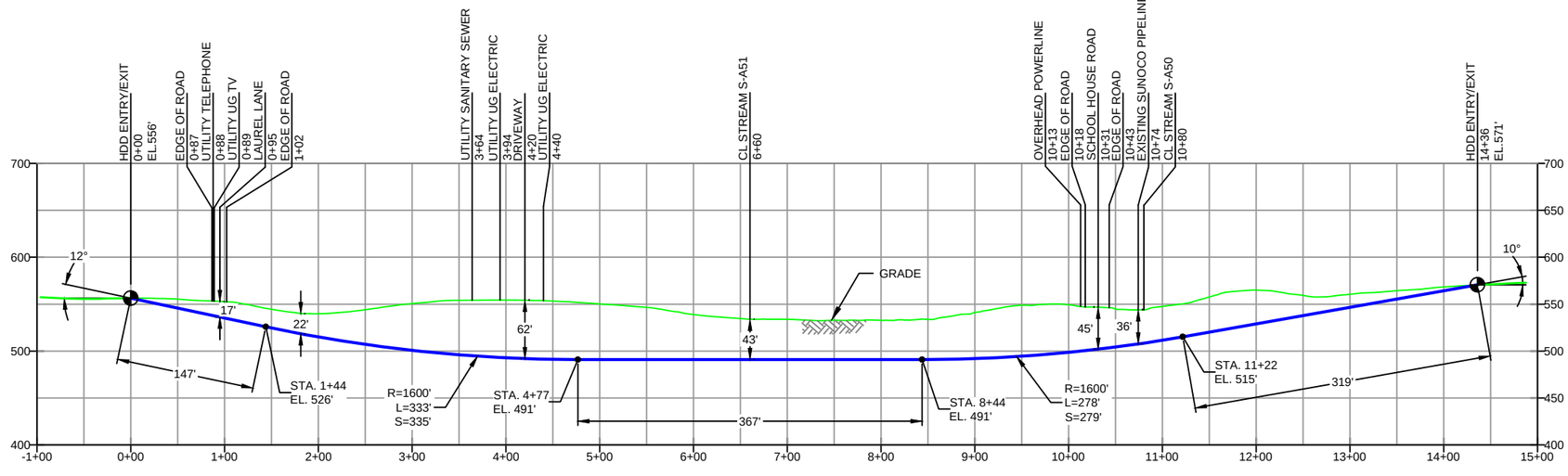
DWG. NO: PA-LE-0005.0000-RD



PLAN VIEW

LEBANON COUNTY, PENNSYLVANIA - SOUTH LONDONDERRY TOWNSHIP
S3-0091-16

PROFILE VIEW



DESIGN AND CONSTRUCTION:

1. CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXITING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
2. 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.
3. DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
4. CROSSING PIPE SPECIFICATION:
   HDD HORZ. LENGTH (L=):1436'
   HDD PIPE LENGTH (S=):1447'
   16" x 0.438" W.T., X-70, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
5. INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGH FACTOR 0.50).
6. INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
7. PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
8. CARRIER PIPE NOT ENCASED.
9. PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
10. CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
11. SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
12. SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
13. SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

PRELIMINARY DESIGN ONLY

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

DWG NO		DWG NO	DESCRIPTION
ES-5.04	TO	ES-5.05	EROSION & SEDIMENT PLAN
SHEET 24	TO	SHEET 24	AERIAL SITE PLAN

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	MRS	10/07/16	RMB	10/07/16	AAW	10/07/16
EP1	REVISED PER PADEP COMMENTS	JTW	05/10/16	RMB	05/10/16	AAW	05/10/16
EP		MRS	03/15/16	RMB	03/15/16	AAW	03/15/16
1	DESIGN CHANGE	MRS	02/18/16	RMB	02/18/16	AAW	02/18/16
0	ISSUED FOR CONSTRUCTION	MRS	01/21/16	RMB	01/21/16	AAW	01/21/16

Sunoco Logistics Partners L.P.

TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

16-INCH HORIZONTAL DIRECTIONAL DRILL
SCHOOL HOUSE RD
PENNSYLVANIA PIPELINE PROJECT

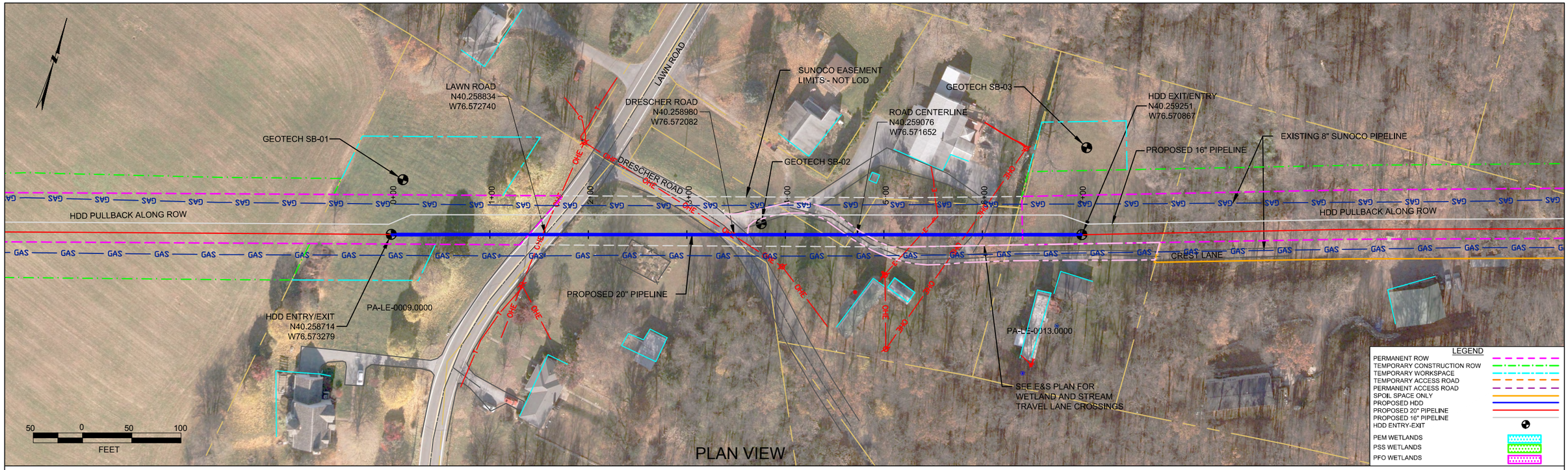
SCALE: 1"=150'

DWG. NO: PA-LE-0005.0000-RD-16

HDD PA-LE-0009.0000-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.

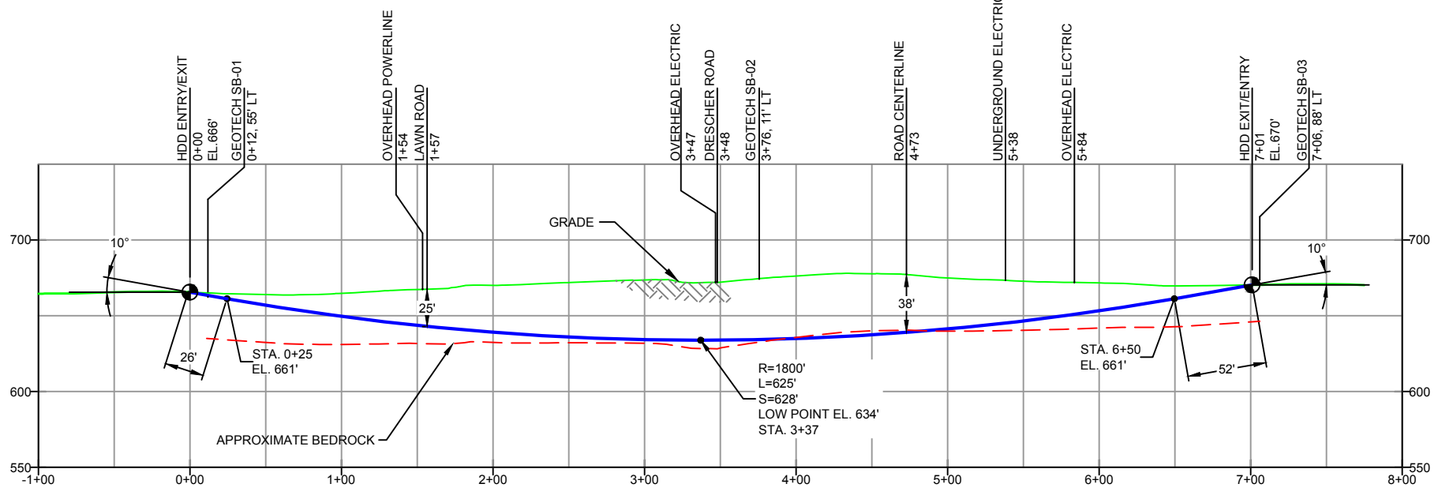
The drill does not cross any water bodies or wetlands but crosses two residential roads (Lawn Road and Crest Lane). The drill will enter/exit 140 feet from the western edge of Lawn Road and enter/exit 530 feet from the eastern edge. The drill will enter/exit 330 feet from the western edge of Crest Lane and enter/exit 210 feet from the western edge. The drill will pass 25 feet below Lawn Road and 40 feet below Crest Lane. 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 the primary substrates being drilled through are fine sands, silty clays, and sandstone gravels. Based on the geotechnical report and the drill profile minimal inadvertent returns are expected.



PLAN VIEW

PROFILE VIEW

LEBANON COUNTY, PENNSYLVANIA - SOUTH LONDONDERRY TOWNSHIP
S3-0100



GEOTECH SB-01
- NG EL. 662'
- -TOPSOIL (0.0' - 0.6')
- -ML (0.6' - 21.0')
- -SM / GM (21.0' - 30.0')
- -COMPLETION DEPTH EL. 632'

GEOTECH SB-02
- NG EL. 674'
- -TOPSOIL (0.0' - 0.8')
- -SM (0.8' - 26.0')
- -SM / GM (26.0' - 43.8')
- -COMPLETION DEPTH EL. 630'

GEOTECH SB-03
- NG EL. 660'
- -TOPSOIL (0.0' - 0.5')
- -SC / CL (0.5' - 11.5')
- -SC (11.5' - 17.0')
- -SANDSTONE (17.0' - 24.0')
- -COMPLETION DEPTH EL. 636'

NOTE: REFER TO TEST BORING LOG S3-0100 FOR COMPLETE SOIL MATERIAL DESCRIPTION

DESIGN AND CONSTRUCTION:
1. CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXITING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
2. 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.
3. DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
4. CROSSING PIPE SPECIFICATION:
   HDD HORZ. LENGTH (L=):701'
   HDD PIPE LENGTH (S=):706'
   20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
5. INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGH FACTOR 0.50).
6. INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
7. PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
8. CARRIER PIPE NOT ENCASED.
9. PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
10. CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
11. SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
12. SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
13. 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-5.04	TO	ES-5.05	EROSION & SEDIMENT PLAN
SHEET 3	TO	SHEET 3	AERIAL SITE PLAN
DWG NO		DWG NO	DESCRIPTION

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	DLM	09/30/16	RMB	09/30/16	AAW	09/30/16
EP1	REVISED PER PADEP COMMENTS	JTW	05/11/16	RMB	05/11/16	AAW	05/11/16
EP		MRS	02/26/16	RMB	02/26/16	AAW	02/26/16
C	ADDED GEOTECH INFO	MRS	09/22/15	RMB	09/22/15	AAW	09/22/15
B	ISSUED FOR BID	MRS	07/31/15	RMB	07/31/15	AAW	07/31/15
A	ISSUED FOR REVIEW	JVA	04/15/15	RMB	04/15/15	AAW	04/15/15

Sunoco Logistics Partners L.P.

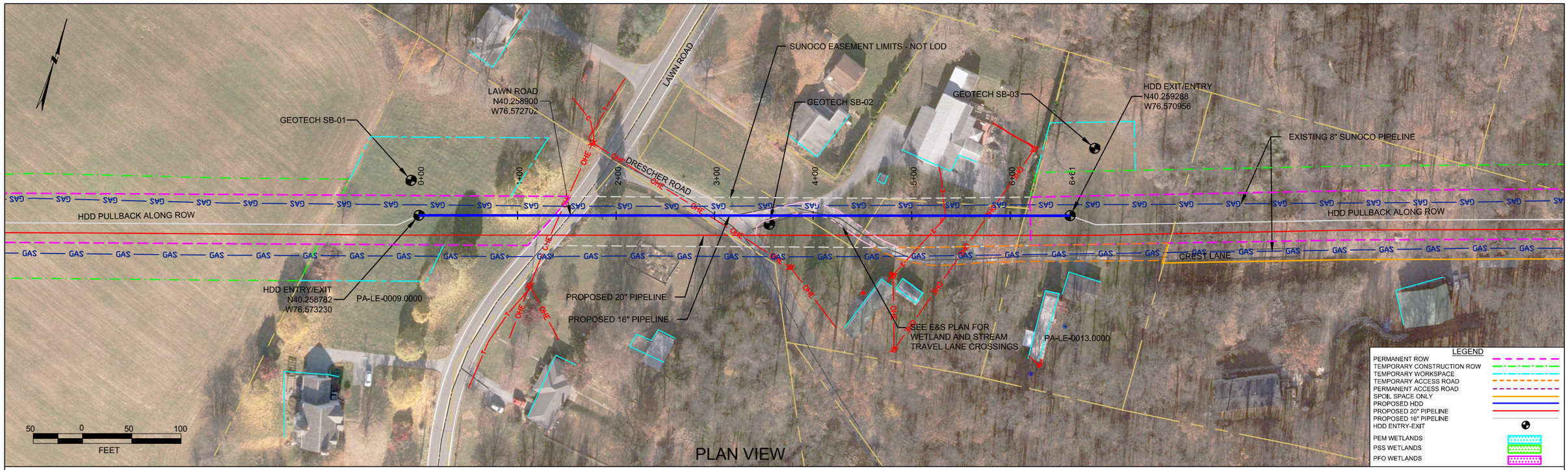
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

20-INCH HORIZONTAL DIRECTIONAL DRILL
LAWN ROAD
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=100'

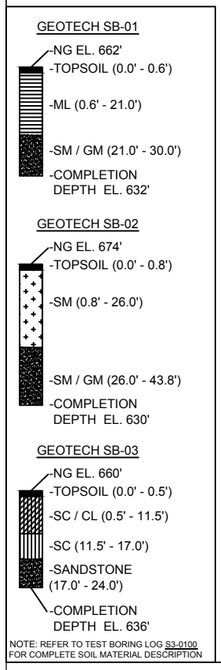
DWG. NO: PA-LE-0009.0000-RD



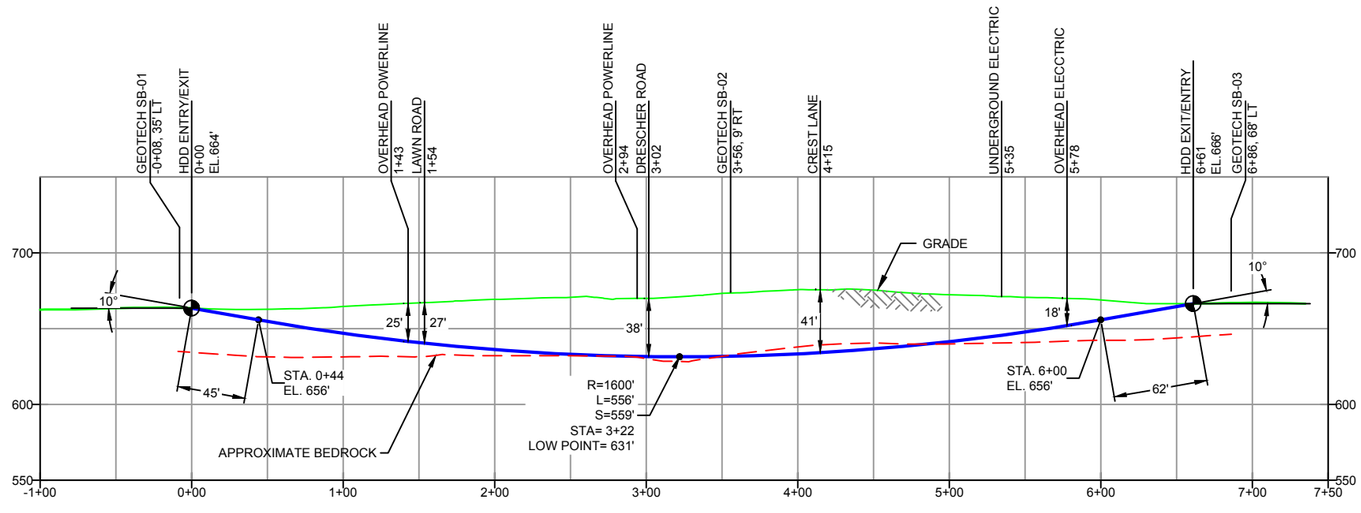
PLAN VIEW

PROFILE VIEW

LEBANON COUNTY, PENNSYLVANIA - SOUTH LONDONDERRY TOWNSHIP
S3-0100-16



NOTE: REFER TO TEST BORING LOG S3-0100 FOR COMPLETE SOIL MATERIAL DESCRIPTION



DESIGN AND CONSTRUCTION:

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2. 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.
3. DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
4. CROSSING PIPE SPECIFICATION:
   HDD HORZ. LENGTH (L=):661'
   HDD PIPE LENGTH (S=):666'
   16" x 0.438" W.T., X-70, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
5. INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGH FACTOR 0.50).
6. INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
7. PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
8. CARRIER PIPE NOT ENCASED.
9. PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
10. CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
11. SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
12. SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
13. 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-5.04	TO	ES-5.05	EROSION & SEDIMENT PLAN	
SHEET 3	TO	SHEET 3	AERIAL SITE PLAN	
DWG NO		DWG NO	DESCRIPTION	

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	MRS	10/07/16	RMB	10/07/16	AAW	10/07/16
EP1	REVISED PER PADEP COMMENTS	JTW	05/17/16	RMB	05/17/16	AAW	05/17/16
EP		MRS	02/26/16	RMB	02/26/16	AAW	02/26/16
B	ADDED GEOTECH INFO	MRS	09/22/16	RMB	09/22/16	AAW	09/22/16
A	ISSUED FOR BID	MRS	08/31/15	RMB	08/31/15	AAW	08/31/15

Sunoco Logistics Partners L.P.

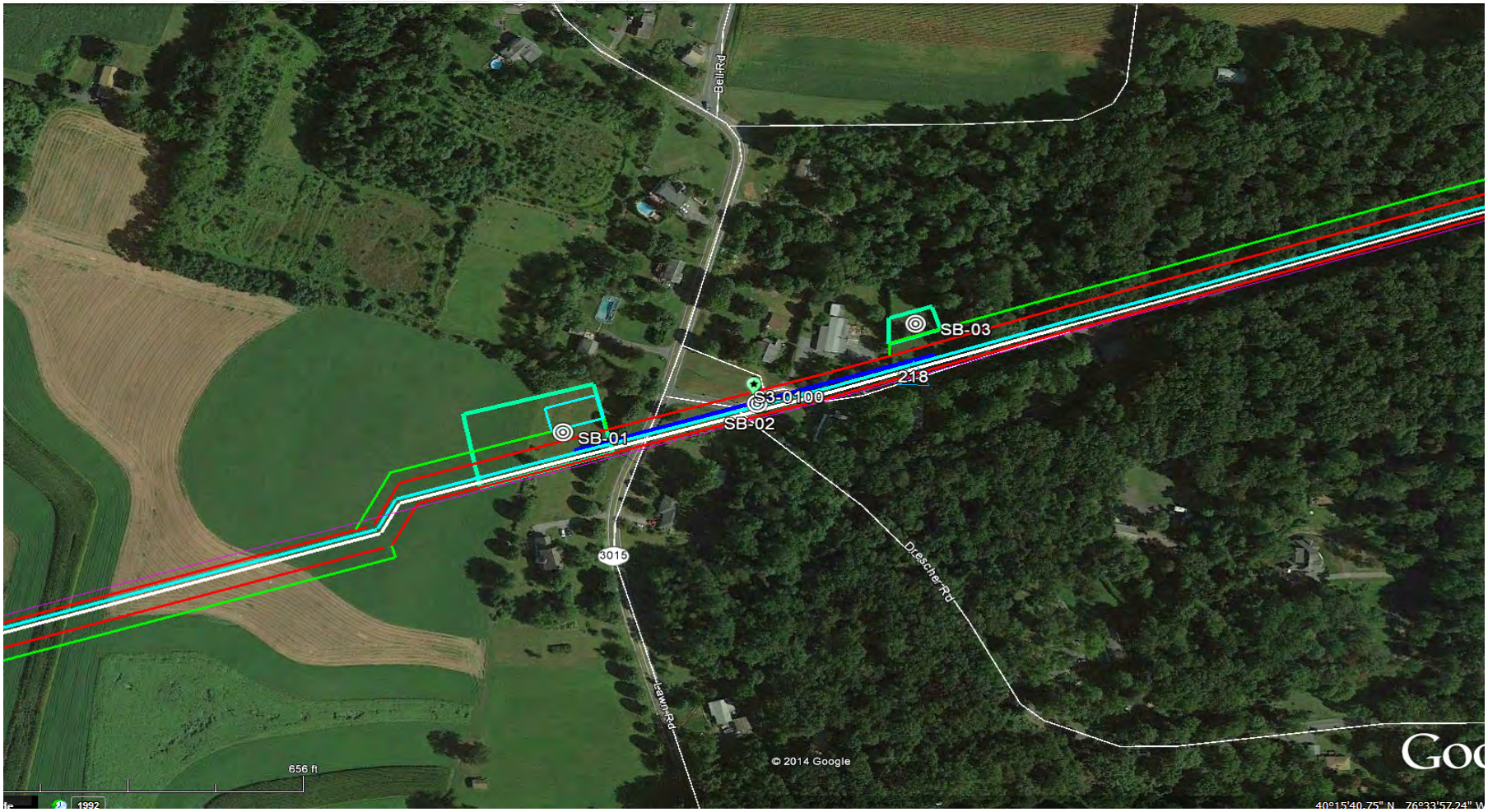
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

16-INCH HORIZONTAL DIRECTIONAL DRILL
LAWN ROAD
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=100'

DWG. NO: PA-LE-0009.0000-RD-16



LEGEND:

◎ Geotechnical Soil Boring (SB) Locations

TETRA TECH

GEOTECHNICAL BORING LOCATIONS
HDD S3-0100
LEBANON COUNTY, SOUTH LONDONDERRY 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:	220 LAWN ROAD (SR 3015), PALMYRA, PA		Page 1 of 1
HDD No.:	S3-0100	Dates(s) Drilled: 11-19-14	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): 30.0
Boring Location Coordinates:		40° 15' 31.935" N	76° 34' 23.797" W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.6			TOPSOIL (7")					
1	3.0	5.0	0.6		20	ML	MAROON CLAYEY SILT AND FINE SAND, TRACE FINE QUARTZ	2	10	12	15	**22**
							GRAVEL.					
2	8.0	10.0			16		MAROON CLAYEY SILT AND FINE SAND, TRACE CONGLOMERATE	2	10	10	11	**20**
							MATRIX. (USCS: ML).					
3	13.0	14.4			17		REDDISH BRWON (WITH WHITE SPECS) CLAYEY SILT WITH A LITTLE	4	22	50/5"		**>72**
							FINE SAND, WITH A LITTLE UNWEATHERED FINE GRAVEL.					
4	18.0	18.9			10		REDDISH BRWON (WITH WHITE SPECS) CLAYEY SILT WITH A LITTLE	5	50/5"			**>50**
				21.0			FINE SAND, WITH A LITTLE UNWEATHERED FINE GRAVEL.					
5	23.0	23.6	21.0		9	SM/ GM	REDDISH BROWN FINE SAND AND CLAYEY SILT, AND FINE TO COARSE	26	50/2"			**>50**
							SANDSTONE GRAVEL.					
6	28.0	28.8			8		REDDISH BROWN FINE SAND AND CLAYEY SILT, AND FINE TO COARSE	2	50/4"			**>50**
				30.0			SANDSTONE GRAVEL.					
							CAVED AND DRY AT 25'.					

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.

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TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	CREST LANE, PALMYRA, PA		Page 1 of 1
HDD No.:	S3-0100	Dates(s) Drilled: 11-19-14	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): 43.8
Boring Location Coordinates:		40° 15' 32.517" N	76° 34' 19.132" W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.8			TOPSOIL (10")					
1	3.0	5.0	0.8		15		MAROON FINE SAND WITH SOME SILT, TRACE MICA.	3	13	9	11	**22**
2	8.0	9.5			13		MAROON FINE SAND AND SILT, TRACE UNWEATHERED SANDSTONE	4	26	50/6"		**>76**
							GRAVEL.					
3	13.0	14.9			13	SM	REDDISH BROWN MICACEOUS FINE SAND AND SILT, TRACE	7	41	50/5"		**>91**
							UNWEATHERED F-C SANDSTONE GRAVEL.					
4	18.0	18.8			9		REDDISH BROWN FINE SAND AND SILT WITH A LITTLE UNWEATHERED	12	50/3"			**>50**
							F-C SANDSTONE GRAVEL.					
5	23.0	24.0			11		REDDISH BROWN FINE SAND AND SILT WITH A LITTLE UNWEATHERED	2	50/6"			**>50**
				26.0			F-C SANDSTONE GRAVEL.					
6	28.0	28.3	26.0		3		REDDISH BROWN FINE SAND AND F-C SANDSTONE GRAVEL, AND	50/3"				**>50**
							SILT. (USCS: SM)					
7	33.0	33.4			7		MAROON FINE MICACEOUS SAND AND F-C GRAVEL, AND SILT.	50/5"				**>50**
						SM/ GM						
8	38.0	38.3			6		MAROON FINE MICACEOUS SAND AND F-C GRAVEL, AND SILT.	50/3"				**>50**
9	43.0	43.8			9		REDDISH BROWN AND MAROON FINE SAND AND SANDSTONE	7	50/3"			**>50**
				43.8			GRAVEL AND SILT.					
							AUGER REFUSAL AT 43'.					
							STARTED AUGER GRINDING AT 37'.					
							CAVED AND DRY AT 41'					
							PLACED CONCRETE PLUG.					

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.

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TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	CREST LANE, PALMYRA, PA		Page 1 of 1
HDD No.:	S3-0100	Dates(s) Drilled: 11-19-14	Inspector: E. WATT
Boring No.:	SB-03	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): NOT ENCOUNTERED	Total Depth (ft): 24.0
Boring Location Coordinates:		40° 15' 34.161" N	76° 34' 15.319" W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.5			TOPSOIL (6")					
1	3.0	5.0	0.5		15	SC/ CL	MAROON FINE SAND AND SILTY CLAY, TRACE FINE UNWEATHERED	1	3	4	5	**7**
							SANDSTONE GRAVEL. (USCS: SC/CL)					
2	8.0	9.5			19		MAROON MICACEOUS FINE SAND AND SILTY CLAY, WITH SOME	6	24	50/6"		**74**
				11.5			UNWEATHERED SANDSTONE GRAVEL.					
3	13.0	13.9	11.5		9	SC	MAROON MICACEOUS FINE SAND AND SILTY CLAY, WITH SOME	3	50/5"			**>50**
				17.0			UNWEATHERED SANDSTONE GRAVEL.					
4	18.0	18.2	17.0		2		PARTIALLY WEATHERED REDDISH BROWN SANDSTONE.	50/2"				**>50**
5	23.0	23.2		24.0	2		PARTIALLY WEATHERED MAROON SANDSTONE.	50/2"				**>50**
							STATED AUGER GRINDING AT 17'					
							AUGER REFUSAL AT 24'.					
							CAVED AND DRY AT 21'.					

Notes/Comments:

Pocket Pentrometer Testing
S1: 2 TSF
S2: 3.5 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.

GEOTECHNICAL LABORATORY TESTING SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0100

HDD No.	Test Boring No.	Sample No.	Depth of Sample (ft.) From	Depth of Sample (ft.) To	Water Content, % (ASTM D2216)	Percent Silts/Clays, % (ASTM D1140)	Atterburg Limits (ASTM D4318) Liquid Limit, %	Atterburg Limits (ASTM D4318) Plastic Limit, %	Atterburg Limits (ASTM D4318) Plasticity Index, %	USCS Classif. (ASTM D2487)
S3-0100	SB-01	1	3.0	5.0	11.3	61.5	-	-	-	-
		2	8.0	10.0	9.5	62.1	21	21	NP	ML
		3	13.0	14.4	8.3	83.5	-	-	-	-
		5	23.0	23.6	5.6	44.2	-	-	-	-
		6	28.0	28.8	6.2	42.6	-	-	-	-
	SB-02	2	8.0	9.5	9.6	43.3	-	-	-	-
		4	18.0	18.8	6.0	47.1	-	-	-	-
		6	28.0	28.3	6.1	48.0	-	-	-	-
		8	38.0	38.3	4.8	46.9	-	-	-	-
		9	43.0	43.8	4.9	46.4	-	-	-	-
	SB-03	1	3.0	5.0	16.4	49.1	24	15	9	SC/CL
		2	8.0	9.5	11.0	49.8	-	-	-	-
		3	13.0	13.9	10.3	40.0	-	-	-	-

Notes:

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

REGIONAL GEOLOGY SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0100

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
S3-0100	Lawn Rd., Drescher Rd., & Crest Ln.	SB-01	**Hammer Creek Conglomerate** - very coarse quartz conglomerate having abundant pebbles and cobbles of gray quartzite.	Upland	Hammer Creek Conglomerate	quartz conglomerate; reddish brown cross-bedded sandstone	2,580	15-69 (average ~30)	
		SB-02							
		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.

FIELD DESCRIPTION AND LOGGING SYSTEM FOR SOIL EXPLORATION

GRANULAR SOILS

(Sand, Gravel & Combinations)

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

Relative Proportions

Description Term	*Percent*
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

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)	

COHESIVE SOILS

(Silt, Clay & Combinations)

Consistency	***N (blows)****
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

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

ROCK

(Rock Cores)

Rock Quality Designation (RQD), %	***Rock Quality Description***
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).

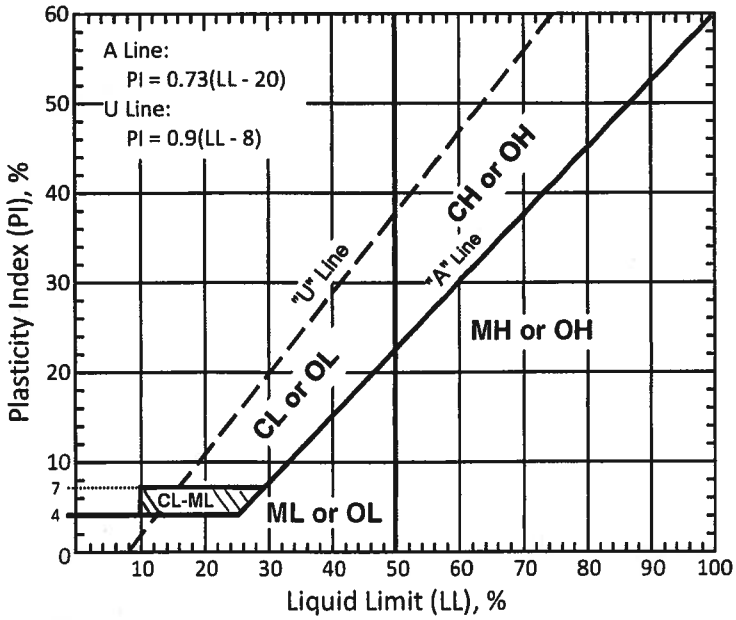
Groundwater observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

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	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, gravely 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	

Major Divisions		Group Symbols	Typical Descriptions
Fine-grained soils (More than half of material is smaller than No. 200 sieve)	Silts 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
	Silts 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

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.

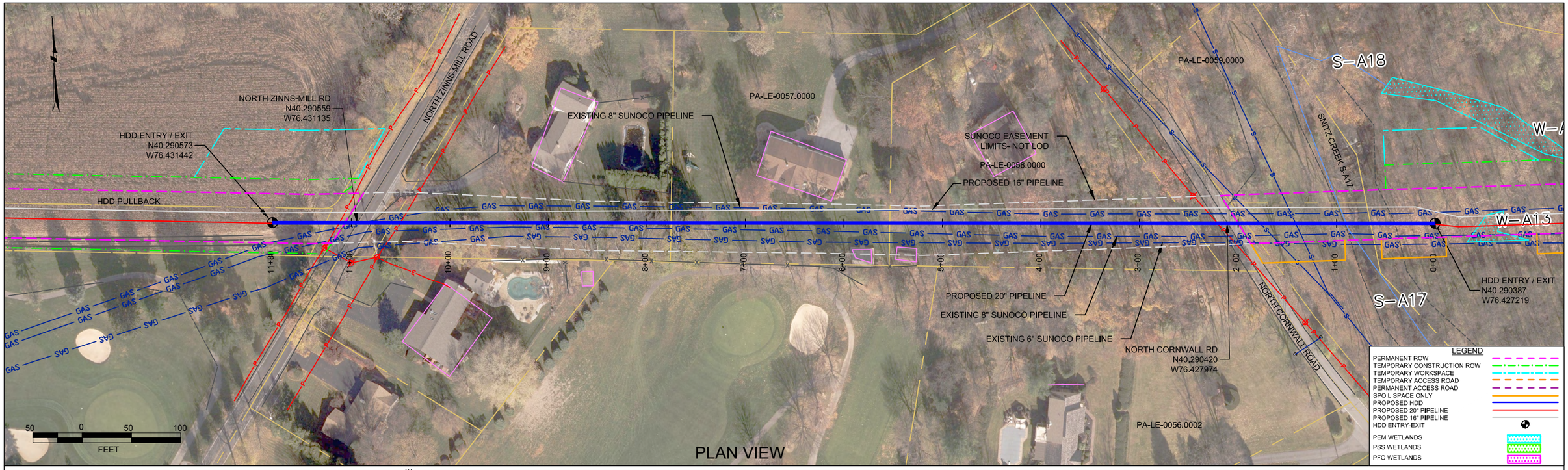


(1) Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC. well-graded gravel-sand mixture with clay binder.

HDD PA-LE-0055.0000-RD (S-A17)

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.

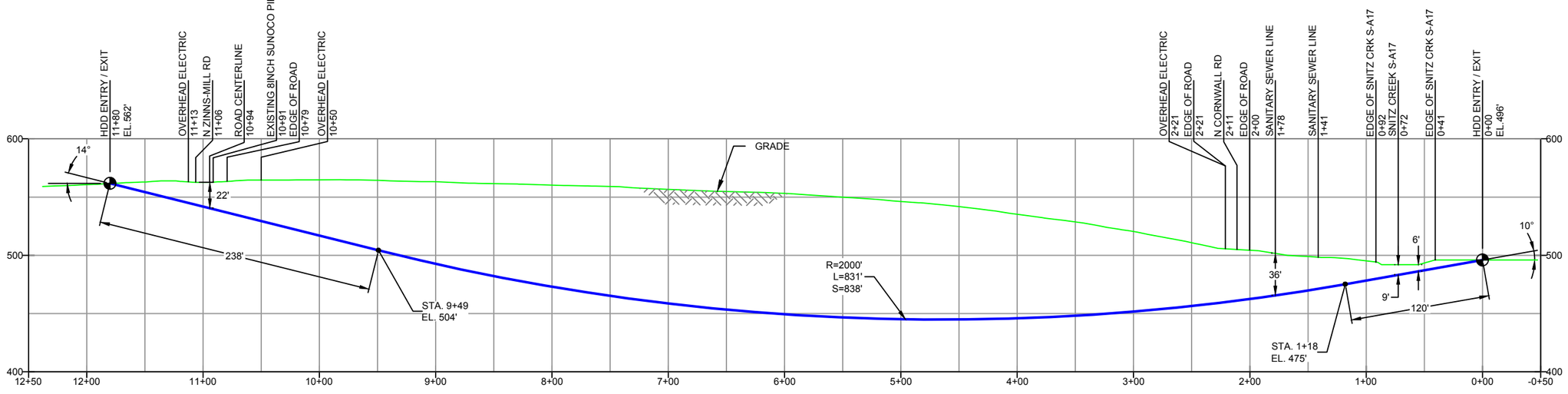
The drill will enter/exit 1,100 feet from the western edge of Stream A17 (S-A17) and enter/exit 90 feet from the eastern edge. The drill will pass 14 feet below S-A17. The geotechnical results, as well as other data points, were used to determine the entry/exit angles, and depths to pass through the best substrates while maintaining the pipe integrity (e.g., no large bends). According to the geotechnical report the primary substrates being drilled through are clays and silty sands with a limestone base below 10 feet. Based on the geotechnical report and the drill profile minimal inadvertent returns are expected.



PLAN VIEW

PROFILE VIEW

LEBANON COUNTY, PENNSYLVANIA - WEST CORNWALL TOWNSHIP
S3-0101



DESIGN AND CONSTRUCTION:

1. CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXITING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
2. 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.
3. DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
4. CROSSING PIPE SPECIFICATION:
   HDD HORZ. LENGTH (L=):1180'
   HDD PIPE LENGTH (S=):1196'
   20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
5. INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGH FACTOR 0.50).
6. INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
7. PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
8. CARRIER PIPE NOT ENCASED.
9. PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
10. CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
11. SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
12. SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
13. 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-5.32	TO	ES-5.32	EROSION & SEDIMENT PLAN	
SHEET 18	TO	SHEET 18	AERIAL SITE PLAN	
DWG NO		DWG NO	DESCRIPTION	

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	DLM	09/30/16	RMB	09/30/16	AAW	09/30/16
EP1	REVISED PER PADEP COMMENTS	JTW	05/20/16	RMB	05/20/16	AAW	05/20/16
EP		MRS	03/15/16	RMB	03/15/16	AAW	03/15/16
B	ISSUED FOR BID	MRS	07/31/15	RMB	07/31/15	AAW	07/31/15
A	ISSUED FOR REVIEW	JVA	04/20/15	RMB	04/20/15	AAW	04/20/15

Sunoco Logistics Partners L.P.

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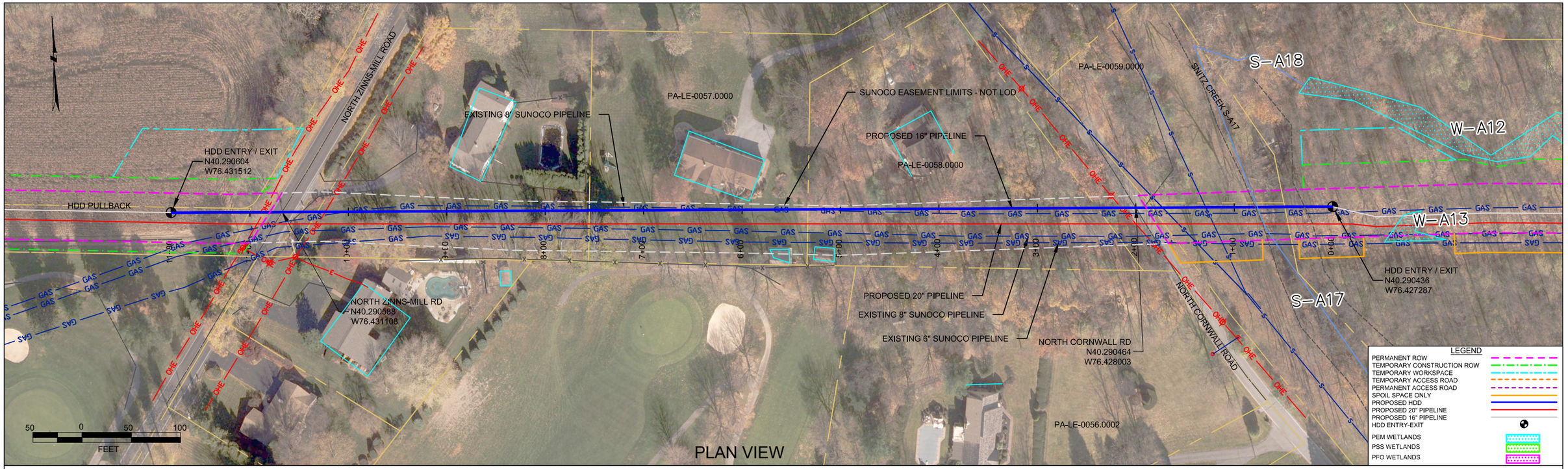
SUNOCO PIPELINE, L.P.

20-INCH HORIZONTAL DIRECTIONAL DRILL
N ZINNS MILL ROAD
PENNSYLVANIA PIPELINE PROJECT

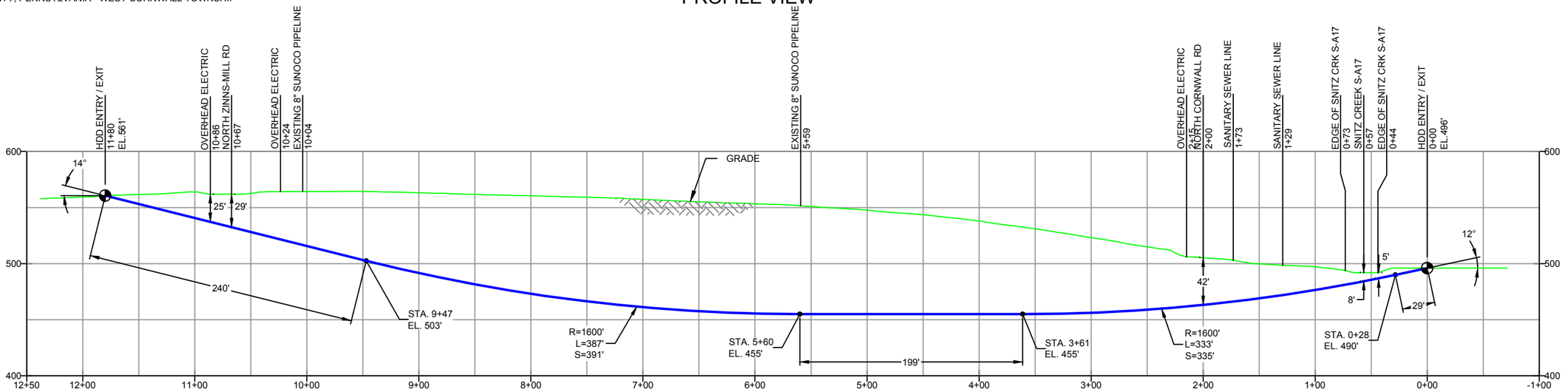
SCALE: 1"=100'

DWG. NO: PA-LE-0055.0000-RD



PLAN VIEW

PROFILE VIEW



DESIGN AND CONSTRUCTION:

1. CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXITING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
2. 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.
3. DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
4. CROSSING PIPE SPECIFICATION:
   HDD HORZ. LENGTH (L=):1180'
   HDD PIPE LENGTH (S=):1196'
   16" x 0.438" W.T., X-70, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
5. INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGH FACTOR 0.50).
6. INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
7. PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
8. CARRIER PIPE NOT ENCASED.
9. PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
10. CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
11. SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
12. SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
13. SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

LEBANON COUNTY, PENNSYLVANIA - WEST CORNWALL TOWNSHIP
S3-0101-16

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-5.32	TO	ES-5.32	EROSION & SEDIMENT PLAN	
SHEET 18	TO	SHEET 18	AERIAL SITE PLAN	
DWG NO		DWG NO	DESCRIPTION	

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	MRS	10/07/16	RMB	10/07/16	AAW	10/07/16
EP1	REVISED PER PADEP COMMENTS	JTW	05/18/16	RMB	05/18/16	AAW	05/18/16
EP		MRS	03/15/16	RMB	03/15/16	AAW	03/15/16
A	ISSUED FOR BID	MRS	08/31/15	RMB	08/31/15	AAW	08/31/15

Sunoco Logistics Partners L.P.

TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

16-INCH HORIZONTAL DIRECTIONAL DRILL
N ZINNS MILL ROAD
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=100'

DWG. NO: PA-LE-0055.0000-RD-16

LEGEND:

Geotechnical Soil Boring (SB) Locations

TETRA TECH

GEOTECHNICAL BORING LOCATIONS
HDD S3-0101
LEBANON COUNTY, WEST CORNWALL 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:	N. ZINNS MILL ROAD, LEBANON, PA		Page 1 of 1
HDD No.:	S3-0101	Dates(s) Drilled: 10-07-15	Inspector: J. COSTELLO
Boring No.:	SB-01	Drilling Method: SPT - ASTM D1586	Driller: E. ODGEN
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): NOT ENCOUNTERED	Total Depth (ft): 18.0
Boring Location Coordinates:		40°17'25.92"N	76°25'53.56"W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.1			TOPSOIL (<1"")					
1	3.0	5.0	0.1		6	ML	YELLOWISH BROWN SILT, SOME FINE SAND, TRACE FINE	1	2	1	2	**3**
				8.0			GRAVEL. (USCS: ML)					
2	7.5	8.0	8.0	8.1			PARTIALLY WEATHERED GRAY LIMESTONE	5	50/1"			**>50**
							AUGER REFUSAL. PERFORMED 3 OFF-SETS TO ATTEMPT TO GO					
							DEEPER, ALL OFF-SETS RESULTED IN AUGER REFUSAL AT 7.5'.					
							<u>ROCK CORING</u>					
RUN 1	8.0	13.0	8.0		60	ROCK	LIGHT GRAY FRACTURED LIMESTONE.	TCR: 100%, SCR: 97%, RQD: 66%				
RUN 2	13.0	18.0		18.0	60		LIGHT GRAY FRACTURED LIMESTONE.	TCR: 100%, SCR: 88, RQD: 68%				
							CAVED AND DRY AT 8'.					
							<u>CORE TESTING RESULTS (DEPTH 14-14.5'):</u>					
							COMPRESSIVE STRENGTH: 2,960 PSI					
							UNIT WEIGHT: 174.6 PCF					

Notes/Comments:
<u>Pocket Pentrometer Testing</u>

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:	44 N. CORNWALL ROAD, LEBANON, PA		Page 1 of 1
HDD No.:	S3-0101	Dates(s) Drilled: 11-13-15	Inspector: J. COSTELLO
Boring No.:	SB-02	Drilling Method: SPT - ASTM D1586	Driller: E. ODGEN
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): NOT ENCOUNTERED	Total Depth (ft): 6.0
Boring Location Coordinates:		40°17'25.79"N	76°25'46.42"W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.1			TOPSOIL (<1"")					
1	3.0	5.0	0.1	4.0	21	CL	BROWN CLAYEY SILT, TRACE F-C SAND, TRACE FINE GRAVEL.	2	12	31	50	**43**
			4.0				INTERLAYERED LIGHT GRAY PARIALY WEATHERED LIMESTONE AND					
				6.0			FINE TO MEDIUM SAND AND SILT.					
							AUGER REFUSAL AT 6'. OFF-SET BORING AND CONTINUOUSLY					
							AUGERED TO REFUSAL AT 6'.					

Notes/Comments:
Pocket Pentrometer Testing

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:	N. CORNWALL RD, LEBANON, PA		Page 1 of 1
HDD No.:	S3-0101	Dates(s) Drilled: 10-07-15	Inspector: J. COSTELLO
Boring No.:	SB-03	Drilling Method: SPT - ASTM D1586	Driller: E. ODGEN
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): NOT ENCOUNTERED	Total Depth (ft): 7.0
Boring Location Coordinates:		40°17'25.73"N	76°25'39.40"W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.3			TOPSOIL (3")					
1	3.0	5.0	0.3		6	ML	BROWN FINE SANDY SILT, INTERMIXED WITH LIMESTONE GRAVEL	2	5	11	7	**16**
				7.0			AND COBBLES. (USCS: ML).					
							AUGER REFUSAL AT 7'. OFF-SET BORING TWICE WITH SHALLOWER					
							AUGER REFUSAL.					
							AREA HAS LIMESTONE OUTCROPS, AND NEARBY CREEK BOTTOM					
							IS ROCKY.					

Notes/Comments:
Pocket Pentrometer Testing

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
HDD S3-0101

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					
S3-0101	SB-01	1	8	13	100	97	66	8	18	Slight	Limestone	Massive	Light gray	Fractures ranging from 2° to 62°, Avg. 21°
		2	13	18	100	88	68							

GEOTECHNICAL LABORATORY TESTING SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0101

HDD No.	Test Boring No.	Sample No.	Depth of Sample (ft.) From	Depth of Sample (ft.) To	Water Content, % (ASTM D2216)	Percent Silts/Clays, % (ASTM D1140)	Atterburg Limits (ASTM D4318) Liquid Limit, %	Atterburg Limits (ASTM D4318) Plastic Limit, %	Atterburg Limits (ASTM D4318) Plasticity Index, %	USCS Classif. (ASTM D2487)
S3-0101	SB-01	1	3.0	5.0	21.0	79.9	38	27	11	ML
	SB-02	1	3.0	5.0	5.5	24.1	-	-	-	-
	SB-03	1	3.0	5.0	12.5	63.1	35	25	10	ML

Rock Core Testing Results				
Boring No.	Core Run	Approximate Depth (ft)	Compressive Strength (psi)	Unit Weight (pcf)
SB-01	2	14-14.5	2,960	174.6

Notes:

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

REGIONAL GEOLOGY SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0101

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
S3-101	N. Zinns Mill Road	SB-01	**Snitz Creek Formation** - Thick-bedded, medium- to coarsely crystalline dolomite, in part oolitic, containing laminated limestone and sandstone interbeds	Gently rolling to level terrain	Snitz Creek	crystalline dolomite containing laminated limestone and sandstone interbeds	350		
		SB-02							
		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.

FIELD DESCRIPTION AND LOGGING SYSTEM FOR SOIL EXPLORATION

GRANULAR SOILS

(Sand, Gravel & Combinations)

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

Relative Proportions

Description Term	*Percent*
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

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)	

COHESIVE SOILS

(Silt, Clay & Combinations)

Consistency	***N (blows)****
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

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

ROCK

(Rock Cores)

Rock Quality Designation (RQD), %	***Rock Quality Description***
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).

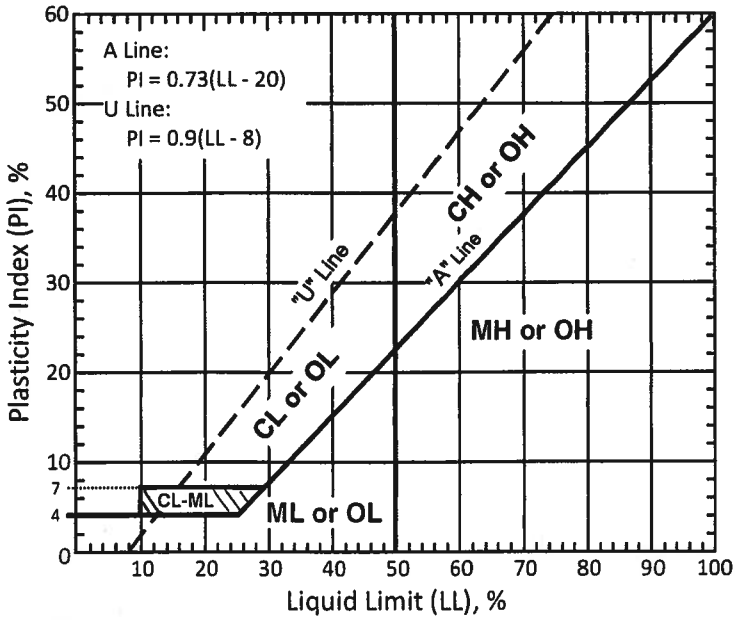
Groundwater observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

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	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, gravely 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	

Major Divisions		Group Symbols	Typical Descriptions
Fine-grained soils (More than half of material is smaller than No. 200 sieve)	Silts 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
	Silts 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

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.



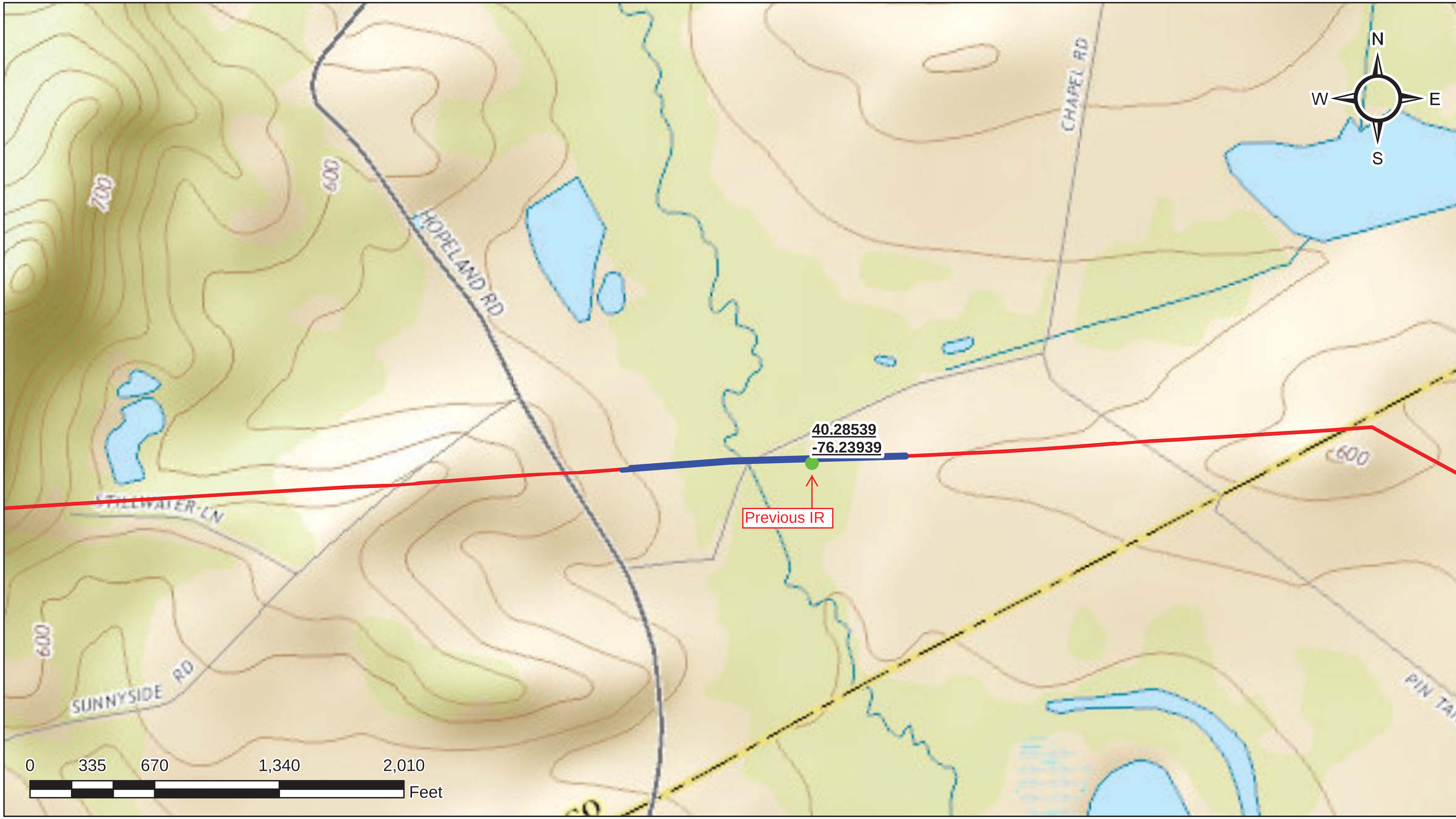
(1) Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC. well-graded gravel-sand mixture with clay binder.

HDD PA-LE-0117.0000-WX (PEM-H14, PEM-H13, S-C86)

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 medium. 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 230 feet from the western edge of Grassy Wetland H14 (PEM-H14) and enter/exit 870 feet from the eastern edge. The horizontal directional drill will enter/exit 750 feet from the western edge of Grassy Wetland H13 (PEM-H13) and enter/exit 130 feet from the eastern edge. The drill also enters/exits 720 feet from the western edge of Middle Creek (S-C86) and enters/exits 810 feet from the creek's eastern edge. The drill will pass between 30 and 70 feet below PEM-H14 and PEM-H13, and it will cross 70 feet below Middle Creek. 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 the primary substrates being drilled through are fine sands with silt.

The ME1 drill through this wetland resulted in 60 gallons of inadvertent returns into the wetland which were manually cleaned up on site without the need for silt fence or other containment requirements. Based on the geotechnical report, the drill profile, and the small returns from the previous drill minimal inadvertent returns are expected. It is recommended that additional inspection be present during the drill to observe the wetland areas for potential inadvertent returns in the large wetland areas surrounding the drill.



Legend

- HDD Path
- Proposed Centerline

AW	RB	RB	11/21/16	A	ISSUED FOR REVIEW
DRAWN	CHECKED	APPROVED	DATE	REV NO.	DESCRIPTION

PREPARED BY: TETRA TECH ROONEY (303) 792-5911

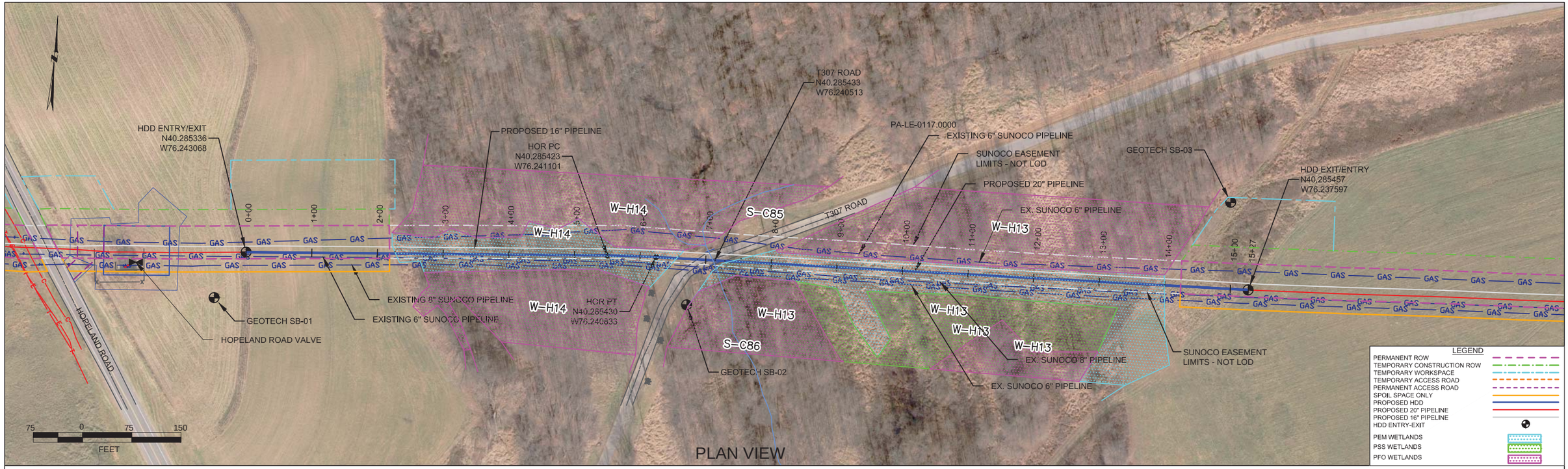
Sunoco Pipeline L.P.

PENNSYLVANIA PIPELINE PROJECT

INADVERTENT RETURN ASSESSMENTS

DRAWN:	AW	CHECKED:	RB
DATE:	11/21/16	SCALE:	AS SHOWN

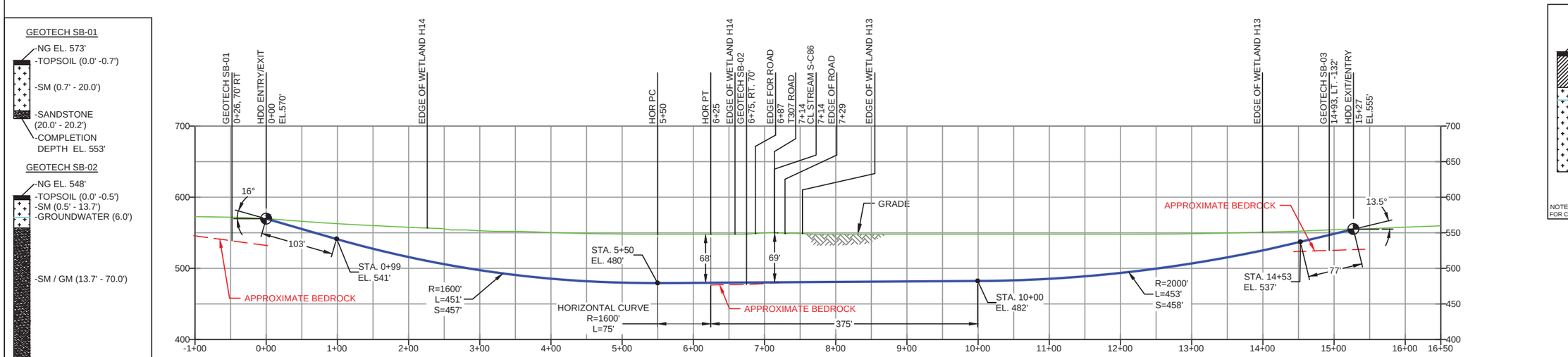
PA-LE-0117-WX-HDD



PLAN VIEW

LEBANON/LANCASTER COUNTY, PENNSYLVANIA - HEIDELBERG TOWNSHIP
S3-0110

PROFILE VIEW



GEOTECH SB-01
- NG EL. 573'
- -TOPSOIL (0.0' -0.7')
- -SM (0.7' - 20.0')
- -SANDSTONE (20.0' - 20.2')
- -COMPLETION DEPTH EL. 553'

GEOTECH SB-02
- NG EL. 548'
- -TOPSOIL (0.0' -0.5')
- -SM (0.5' - 13.7')
- -GROUNDWATER (6.0')
- -SM / GM (13.7' - 70.0')
- -SILT STONE (70.0' - 70.1')
- -COMPLETION DEPTH EL. 478'

NOTE: REFER TO TEST BORING LOG S3-0110 FOR COMPLETE SOIL MATERIAL DESCRIPTION

GEOTECH SB-03
- NG EL. 552'
- -TOPSOIL (0.0' -0.7')
- -CL (0.7' - 13.5')
- -GROUNDWATER (16.0')
- -SM (13.5' - 30.0')
- -COMPLETION DEPTH EL. 522'

NOTE: REFER TO TEST BORING LOG S3-0110 FOR COMPLETE SOIL MATERIAL DESCRIPTION

DESIGN AND CONSTRUCTION:
1. CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXITING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
2. 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.
3. DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
4. CROSSING PIPE SPECIFICATION:
   HDD HORZ. LENGTH (≈):1527'
   HDD PIPE LENGTH (S=):1545'
   20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
5. INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGH FACTOR 0.50).
6. INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
7. PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
8. CARRIER PIPE NOT ENCASED.
9. PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
10. CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
11. SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
12. SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
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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

DWG NO		DWG NO	DESCRIPTION
ES-5.66	TO	ES-5.67	EROSION & SEDIMENT PLAN
SHEET 38	TO	SHEET 38	AERIAL SITE PLAN

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	DLM	09/30/16	RMB	09/30/16	AAW	09/30/16
EP1	REVISED PER PADEP COMMENTS	JTW	05/18/16	RMB	05/18/16	AAW	05/18/16
EP		MRS	03/15/16	RMB	03/15/16	AAW	03/15/16
C	ADDED GEOTECH INFO	MRS	09/22/15	RMB	09/22/15	AAW	09/22/15
B	ISSUED FOR BID	DLM	07/31/15	RMB	07/31/15	AAW	07/31/15
A	ISSUED FOR REVIEW	JVA	04/15/15	RMB	04/15/15	AAW	04/15/15

Sunoco Logistics Partners L.P.

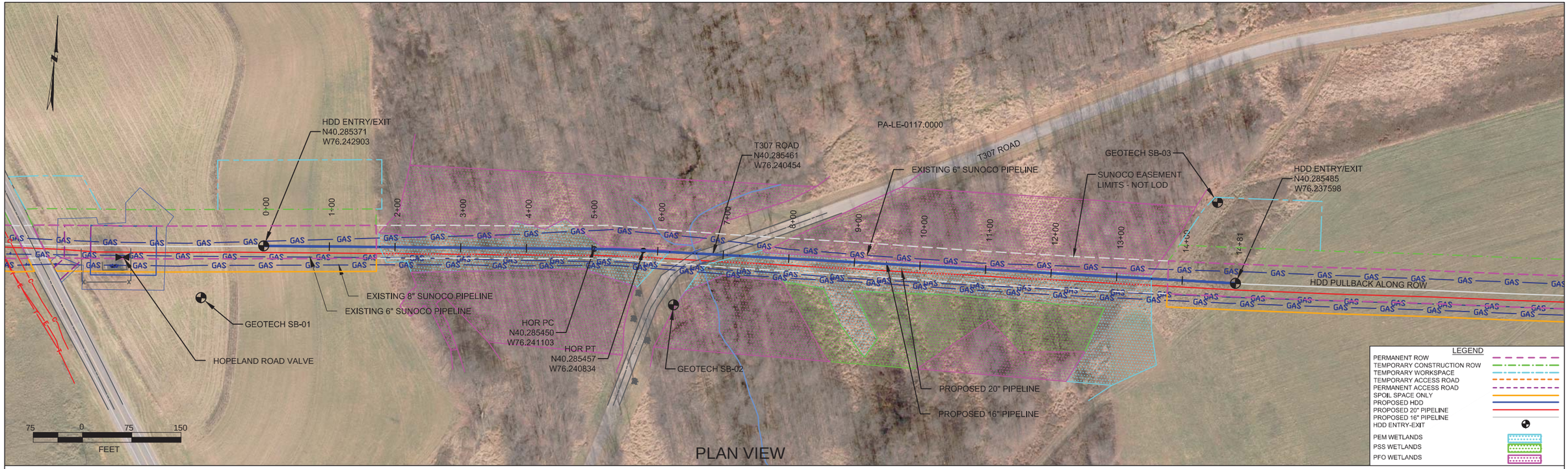
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

20-INCH HORIZONTAL DIRECTIONAL DRILL
CREEK & T307
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=150'

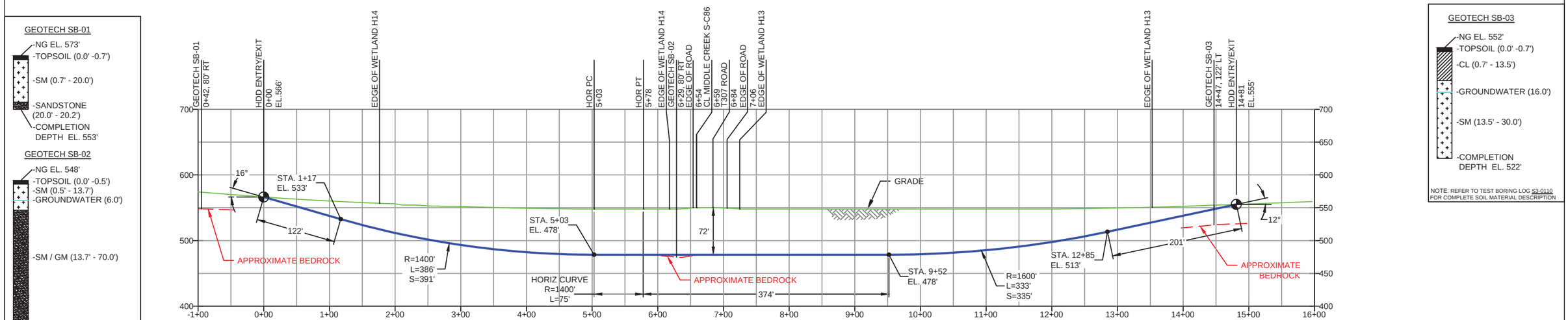
DWG. NO: PA-LE-0117.0000-WX



PLAN VIEW

LEBANON/LANCASTER COUNTY, PENNSYLVANIA - HEIDELBERG TOWNSHIP
S3-0110-16

PROFILE VIEW



GEOTECH SB-01

GEOTECH SB-02

NOTE: REFER TO TEST BORING LOG S3-0110 FOR COMPLETE SOIL MATERIAL DESCRIPTION

GEOTECH SB-03

NOTE: REFER TO TEST BORING LOG S3-0110 FOR COMPLETE SOIL MATERIAL DESCRIPTION

DESIGN AND CONSTRUCTION:

1. CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXITING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
2. 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.
3. DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
4. CROSSING PIPE SPECIFICATION:
   HDD HORZ. LENGTH (L=):1481'
   HDD PIPE LENGTH (S=):1498'
   16" x 0.438" W.T., X-70, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
5. INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGH FACTOR 0.50).
6. INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
7. PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
8. CARRIER PIPE NOT ENCASED.
9. PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
10. CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
11. SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
12. SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
13. 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

DWG NO		DWG NO	DESCRIPTION
ES-5.66	TO	ES-5.67	EROSION & SEDIMENT PLAN
SHEET 38	TO	SHEET 38	AERIAL SITE PLAN

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	MRS	10/07/16	RMB	10/07/16	AAW	10/07/16
EP1	REVISED PER PADEP COMMENTS	JTW	05/18/16	RMB	05/18/16	AAW	05/18/16
EP		MRS	03/15/16	RMB	03/15/16	AAW	03/15/16
B	ADDED GEOTECH INFO	MRS	09/23/15	RMB	09/23/15	AAW	09/23/15
A	ISSUED FOR BID	MRS	08/31/15	RMB	08/31/15	AAW	08/31/15

Sunoco Logistics Partners L.P.

TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

16-INCH HORIZONTAL DIRECTIONAL DRILL
CREEK & T307
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=150'

DWG. NO: PA-LE-0117.0000-WX-16

LEGEND:

Geotechnical Soil Boring (SB) Locations

TETRA TECH

GEOTECHNICAL BORING LOCATIONS
HDD S3-0110
LEBANON COUNTY, SOUTH HEIDELBERG 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:	HOPELAND ROAD, MIDDLECREEK WILDLIFE MANAGEMENT AREA, NEWMANSTOWN, PA		Page 1 of 1
HDD No.:	S3-0110	Dates(s) Drilled: 12-14-14	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): 20.2
Boring Location Coordinates:		40° 17' 6.502" N	76° 14' 35.550" W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.7			TOPSOIL (8")					
1	3.0	5.0	0.7		24	SM	REDDISH BROWN FINE TO MEDIUM SAND, TRACE CONGLOMERATE,	6	29	42	50	**71**
							WITH A LITTLE SILT.					
2	8.0	9.4			14		REDDISH BROWN FINE TO MEDIUM SAND, TRACE CONGLOMERATE,	6	45	50/5"		**>50**
							WITH SOME SILT.					
3	13.0	13.7			8		REDDISH BROWN FINE TO MEDIUM SAND, TRACE CONGLOMERATE,	8	50/2"			**>50**
							WITH SOME SILT, TRACE UNWEATHERED GRAVEL.					
4	18.0	18.6			6		REDDISH BROWN FINE TO MEDIUM SAND, TRACE CONGLOMERATE,	10	50/1"			**>50**
				20.0			WITH SOME SILT, TRACE UNWEATHERED GRAVEL.					
5	20.0	20.2	20.0	20.2	2		PARTIALLY WEATHERED SANDSTONE GRAVEL.	50/2"				
							AUGER REFUSAL AT 20.0'. OFFSET BORING AND AUGUERED TO					
							REFUSAL AT 19.1'.					
							CAVED AND DRY AT 18'.					

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.

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TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	MIDDLECREEK WILDLIFE MANAGEMENT AREA, NEWMANSTOWN, PA		Page 1 of 1
HDD No.:	S3-0110	Dates(s) Drilled: 11-21 & 12-15-14	Inspector: E. WATT
Boring No.:	SB-02	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 6.0	Total Depth (ft): 70.1
Boring Location Coordinates:		40° 17' 6.866" N	76° 14' 26.278" W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.5			TOPSOIL (6")					
1	3.0	5.0	0.5		16		MOTTLED (GRAY, GREENISH GRAY, LIGHT BROWN) FINE TO MEDIUM	2	7	11	11	**18**
						SM	SAND WITH A LITTLE SILT, A LITTLE F-C GRAVEL.					
2	8.0	10.0			13		BROWN, YELLOW BROWN AND REDDISH BROWN MEDIUM TO COARSE	1	6	14	22	**20**
				13.7			SAND WITH A LITTLE SILT, LITTLE F-C GRAVEL.					
3	13.0	15.0	13.7		22		MAROON FINE TO MEDIUM SAND WITH A LITTLE SILT, TRACE	6	17	25	28	**42**
							FINE QUARTZ GRAVEL.					
4	18.0	18.8			8		MAROON FINE TO MEDIUM SAND WITH SOME SILT WITH A	24	50/4"			**>50**
							LITTLE CONGLOMERATE MATRIX.					
5	23.0	23.6			6		MAROON FINE TO MEDIUM SAND WITH SOME SILT WITH A	20	50/1"			**>50**
							LITTLE CONGLOMERATE MATRIX.					
6	28.0	28.8			7		MAROON FINE TO MEDIUM SAND WITH SOME SILT WITH A	34	50/4"			**>50**
							LITTLE CONGLOMERATE MATRIX.					
7	33.0	33.7			7		MAROON FINE TO MEDIUM SAND WITH SOME SILT WITH A	27	50/2"			**>50**
						SM	LITTLE CONGLOMERATE MATRIX.					
8	38.0	38.7			7		MAROON FINE TO MEDIUM SAND WITH SOME SILT WITH A	7	50/2"			**>50**
							LITTLE CONGLOMERATE MATRIX.					
9	43.0	43.8			6		MAROON FINE TO MEDIUM SAND WITH SOME SILT WITH A	20	50/3"			**>50**
							LITTLE CONGLOMERATE MATRIX.					
10	48.0	48.7			6		MAROON FINE TO MEDIUM SAND WITH SOME SILT WITH A	33	50/2"			**>50**
							LITTLE CONGLOMERATE MATRIX.					
11	53.0	53.4			5		MAROON FINE TO MEDIUM SAND WITH SOME SILT, WITH A	50/5"				**>50**
							LITTLE FINE TO COARSE SANDSTONE GRAVEL.					
12	58.0	58.3			3		REDDISH BROWN MEDIUM TO COARSE SAND WITH SOME FINE TO	50/4"				
							COARSE GRAVEL, WITH A LITTLE SILT.					
13	63.0	63.4			5	SM/	REDDISH BROWN MEDIUM TO COARSE SAND, SOME FINE TO COARSE	50/5"				
						GM	GRAVEL, SOME SILT.					
14	68.0	68.4			5		LIGHT REDDISH BROWN FINE TO MEDIUM SAND, WITH A LITTLE	50/5"				
				70.0			CONGLOMERATE GRAVEL.					
15	70.0	70.1	70.0				PARTIALLY WEATHERED REDDISH BROWN CONGLOMERATE AND	50/1"				
				70.1			GRAY SILTSTONE.					
							AUGUR REFUSAL AT 70'.					
							WET ON SPOON AT 7'. WATER LEVEL THROUGH AUGERS AT 6'					
							CAVED AT 30'					

Notes/Comments:

Pocket Pentrometer Testing

DR: DECOMPOSED ROCK

DRILL RIG BROKED DOWN AT 55'. REMOBILIZED TO CONTINUE DRILLING ON 12/15/14.

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.

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TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	MIDDLECREEK WILDLIFE MANAGEMENT AREA, NEWMANSTOWN, PA		Page 1 of 1
HDD No.:	S3-0110	Dates(s) Drilled: 12-14-14	Inspector: E. WATT
Boring No.:	SB-03	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): SEE BELOW	Total Depth (ft): 30.0
Boring Location Coordinates:		40° 17' 8.951" N	76° 14' 15.746" W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.7			TOPSOIL (8")					
1	3.0	5.0	0.7		15	CL	REDDISH BROWN SILTY CLAY WITH SOME FINE SAND, TRACE	1	4	10	12	**14**
							FINE GRAVEL.					
2	8.0	10.0			14		REDDISH BROWN SILTY CLAY WITH A LITTLE FINE SAND, TRACE	3	11	13	16	**24**
				13.5			FINE GRAVEL (USCS: CL).					
3	13.0	13.9	13.5		9	SM	REDDISH BROWN MEDIUM TO COARSE SAND WITH A LITTLE SILT,	8	50/5"			**>50**
							WITH A LITTLE FINE TO COARSE GRAVEL.					
4	18.0	18.8			8		REDDISH BROWN MEDIUM TO COARSE SAND AND CLAYEY SILT,	3	50/4"			**>50**
							WITH A LITTLE FINE TO COARSE GRAVEL. (USCS: SM)					
5	23.0	24.4			16		REDDISH BROWN FINE TO COARSE SAND WITH A LITTLE SILT, TRACE	12	42	50/5"		**>50**
							FINE GRAVEL.					
6	28.0	28.8			7		REDDISH BROWN FINE TO MEDIUM SILTY SAND, TRACE FINE GRAVEL,	7	50/3"			**>50**
				30.0			(WEATHERED ROCK IN TIP).					
							AUGURED TO 30'.					
							MOIST RETURN AT 15' AND 18'.					
							WET ON SPOON AT 16".					
							WATER LEVEL THROUGH AUGERS AT 4'.					
							CAVED AT 26.5'. WATER LEVEL ON CAVE AT 4'.					

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 S3-0110

HDD No.	Test Boring No.	Sample No.	Depth of Sample (ft.) From	Depth of Sample (ft.) To	Water Content, % (ASTM D2216)	Percent Silts/Clays, % (ASTM D1140)	Atterburg Limits (ASTM D4318) Liquid Limit, %	Atterburg Limits (ASTM D4318) Plastic Limit, %	Atterburg Limits (ASTM D4318) Plasticity Index, %	USCS Classif. (ASTM D2487)
S3-0110	SB-01	1	3.0	5.0	6.9	16.4	-	-	-	-
		2	8.0	9.4	8.6	29.5	-	-	-	-
		3	13.0	13.7	7.9	28.3	-	-	-	-
		4	18.0	18.6	6.1	32.2	32	24	8	SM
		5	20.0	20.2	6.8	31.2	-	-	-	-
	SB-02	2	8.0	10.0	11.8	14.9	-	-	-	-
		4	18.0	18.8	12.4	21.0	-	-	-	-
		6	28.0	28.8	11.4	27.2	-	-	-	-
		8	38.0	38.7	12.8	20.7	-	-	-	-
		11	53.0	53.4	9.7	28.7	-	-	-	-
		13	63.0	63.4	14.4	29.2	-	-	-	-
		14	68.0	68.4	3.4	43.3	-	-	-	-
	SB-03	2	8.0	10.0	13.0	82.4	28	20	8	CL
		3	13.0	13.9	6.7	20.6	-	-	-	-
		4	18.0	18.8	11.0	47.5	33	25	8	SM
		5	23.0	24.4	17.2	12.1	-	-	-	-
		6	28.0	28.8	10.5	36.9	-	-	-	-

Notes:

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

REGIONAL GEOLOGY SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0110

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
S3-0110	Wetland H14 - T307	SB-01	**Hammer Creek Formation** - Gray and pale red, fine- to coarse-grained quartzose sandstone, siltstone, and mudstone	Lowland, wetlands area	Hammer Creek Fm	sandstone with quartz pebble conglomerate	9,360	32-71	
		SB-02	**Hammer Creek Conglomerate** - very coarse quartz conglomerate having abundant pebbles and cobbles of gray quartzite.		Hammer Creek Conglomerate	quartz conglomerate; reddish brown cross-bedded sandstone	2,580		
		SB-03	**Hammer Creek Formation** - Gray and pale red, fine- to coarse-grained quartzose sandstone, siltstone, and mudstone		Hammer Creek Fm	sandstone with quartz pebble conglomerate	9,360		

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)

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

Relative Proportions

Description Term	*Percent*
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

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)	

COHESIVE SOILS

(Silt, Clay & Combinations)

Consistency	***N (blows)****
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

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

ROCK

(Rock Cores)

Rock Quality Designation (RQD), %	***Rock Quality Description***
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).

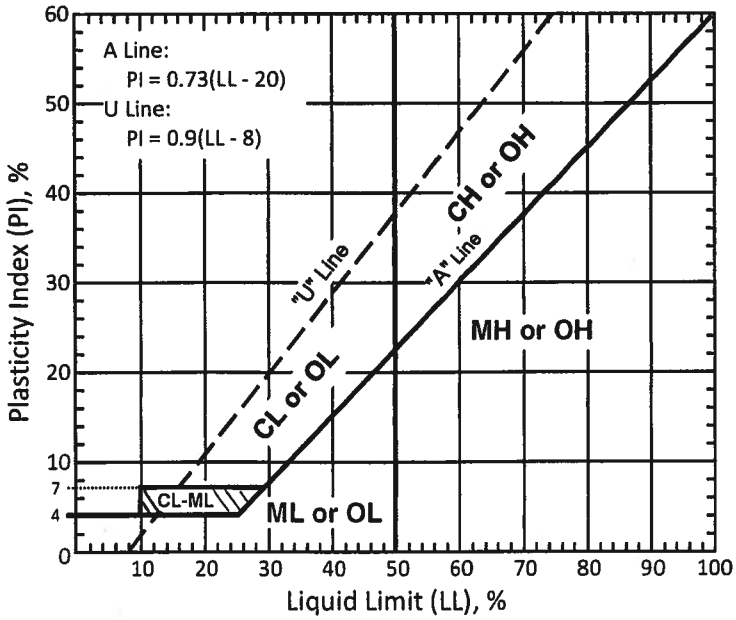
Groundwater observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

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	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, gravely 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	

Major Divisions		Group Symbols	Typical Descriptions
Fine-grained soils (More than half of material is smaller than No. 200 sieve)	Silts 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
	Silts 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

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.



(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.