Attachment A
HDD Table
Dauphin County

Drawing Name	Drill Name	County	Township	Drill Location	Risk Assessment Level (Low / Medium / High)
PA-DA-0005.0000-RD.pdf	White House Lane	Dauphin	Lower Swatara	N: 40.201728 W: 76.771911	low
PA-DA-0019.0000-RD.pdf	Interstate 76	Dauphin	Lower Swatara	N: 40.211018 W: 76.760300	low
PA-DA-0020.0000-RD.pdf	Highway 3032	Dauphin	Lower Swatara	N: 40.212200 W: 76.754698	low
PA-DA-0030.0000-RR.pdf	MIDH Railroad	Dauphin	Lower Swatara & Londonderry	N: 40.247679 W: 76.726404	low
PA-DA-0039.0000-RD.pdf	Highway 283	Dauphin	Londonderry	N: 40.221686 W: 76.716128	low
PA-DA-0056.0000-RDa.pdf	Waltonville Road	Dauphin	Derry	N: 40.231478 W: 76.681004	low
PA-DA-0056.0000-RDb.pdf	Waltonville Road	Dauphin	Derry	N: 40.231478 W: 76.681004	low
PA-DA-0063.0000-RD.pdf	Woodbine Drive	Dauphin	Derry	N: 40.237893 W: 76.658305	low

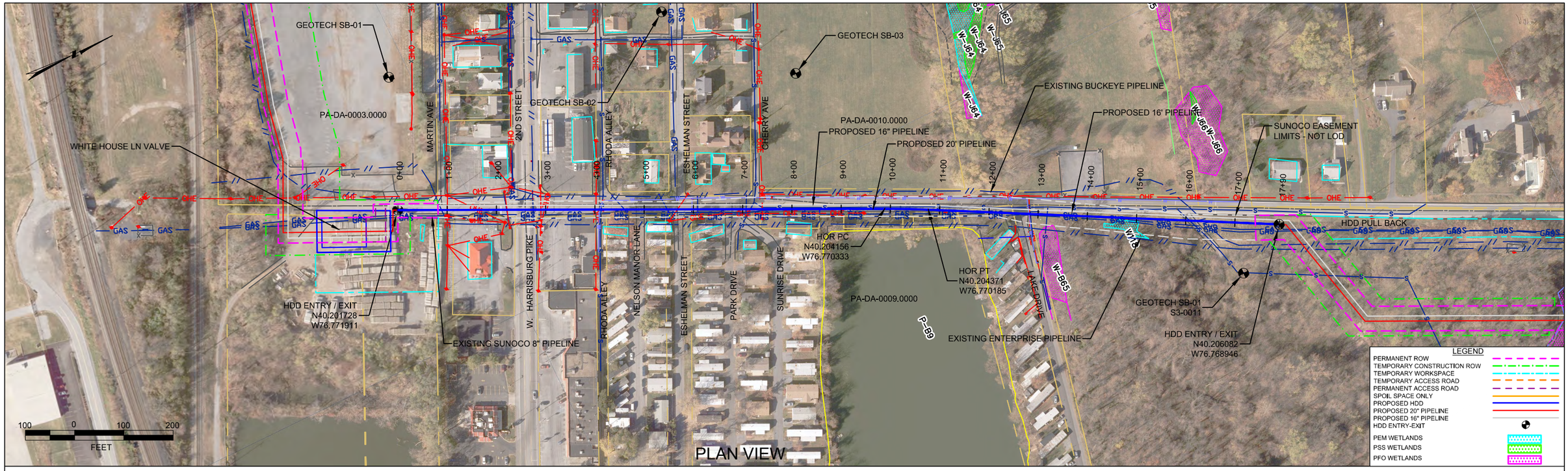
Prepared By:
Tetra Tech Rooney

10/14/2016

HDD PA-DA-0005.0000-RD (PuB-B9)

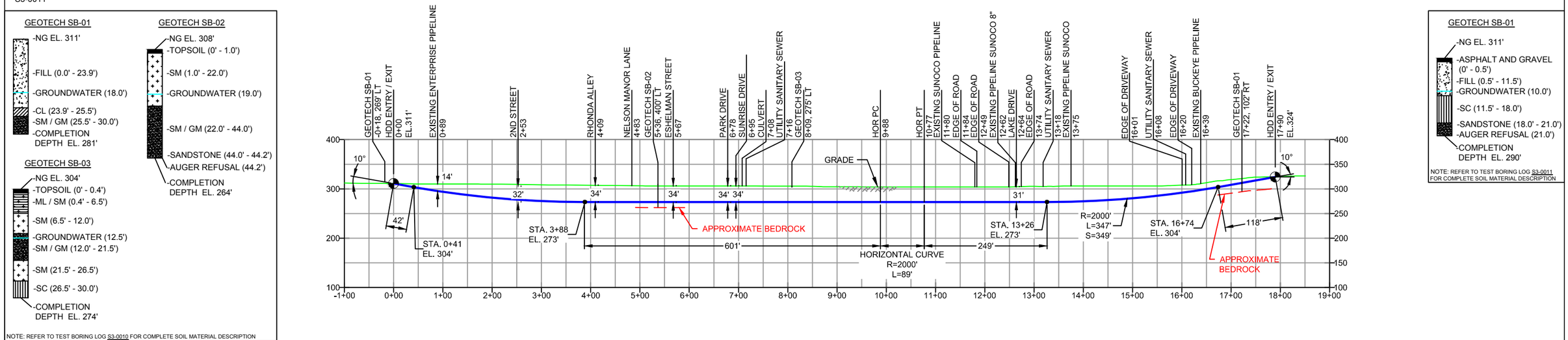
Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable and in this case that threat is considered to be low. Implementing this design, along with adherence to the Pennsylvania Pipeline Project Inadvertent Return Contingency Plan will ensure inadvertent impacts,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

The White House Lane drill does not directly cross any water bodies or wetlands. It does run adjacent to Lisa Lake (PuB-B9) for approximately 310 feet beginning 880 feet from the drill's western entrance/exit and 630 feet from the drill's eastern entrance/exit. The drill is more than 30 feet below the lake surface. The geotechnical results indicate the drill is within sandstone with layers of sand and silt with the spoon being wet at 22 feet depth. 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). Based on the geotechnical report and the drill profile minimal inadvertent returns are expected but additional inspection around the pond is recommended.



DAUPHIN COUNTY, PENNSYLVANIA - LOWER SWATARA TOWNSHIP
S3-0011

PROFILE VIEW



GEOTECH SB-01
-NG EL. 311'
-ASPHALT AND GRAVEL (0' - 0.5')
-FILL (0.5' - 11.5')
-GROUNDWATER (10.0')
-SC (11.5' - 18.0')
-SANDSTONE (18.0' - 21.0')
-AUGER REFUSAL (21.0')
-COMPLETION DEPTH EL. 290'
NOTE: REFER TO TEST BORING LOG S3-0011 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=):1790'
   HDD PIPE LENGTH (S=):1796'
   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-4.06	TO	ES-4.07	EROSION & SEDIMENT PLAN
SHEET 4	TO	SHEET 4	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	09/30/16	RMB	09/30/16	AAW	09/30/16
EP1	REVISED PER PADEP COMMENTS	DLM	05/07/16	RMB	05/07/16	AAW	05/07/16
EP		DLM	02/26/16	RMB	02/26/16	AAW	02/26/16
C	ADDED GEOTECH INFO	MRS	09/18/15	RMB	09/18/15	AAW	09/18/15
B	ISSUED FOR BID	MRS	07/31/15	RMB	07/31/15	AAW	07/31/15
A	ISSUED FOR REVIEW	RTT	02/20/15	RMB	02/20/15	AAW	02/20/15

Sunoco Logistics Partners L.P.

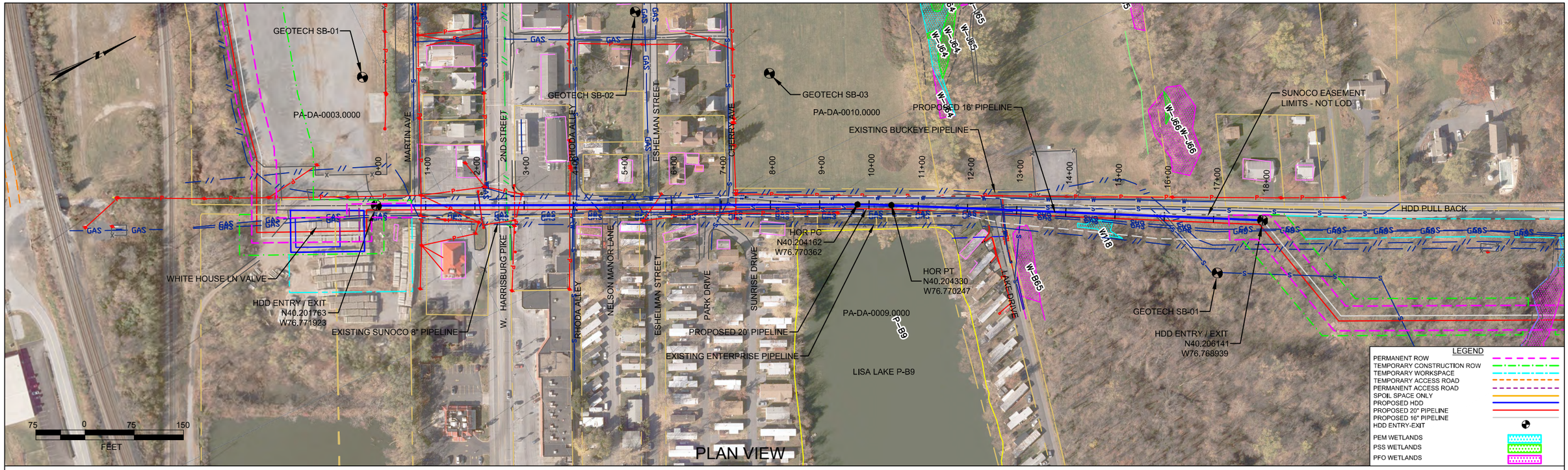
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

20-INCH HORIZONTAL DIRECTIONAL DRILL
WHITE HOUSE LANE
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=200'

DWG. NO: PA-DA-0005.0000-RD



PLAN VIEW

PROFILE VIEW

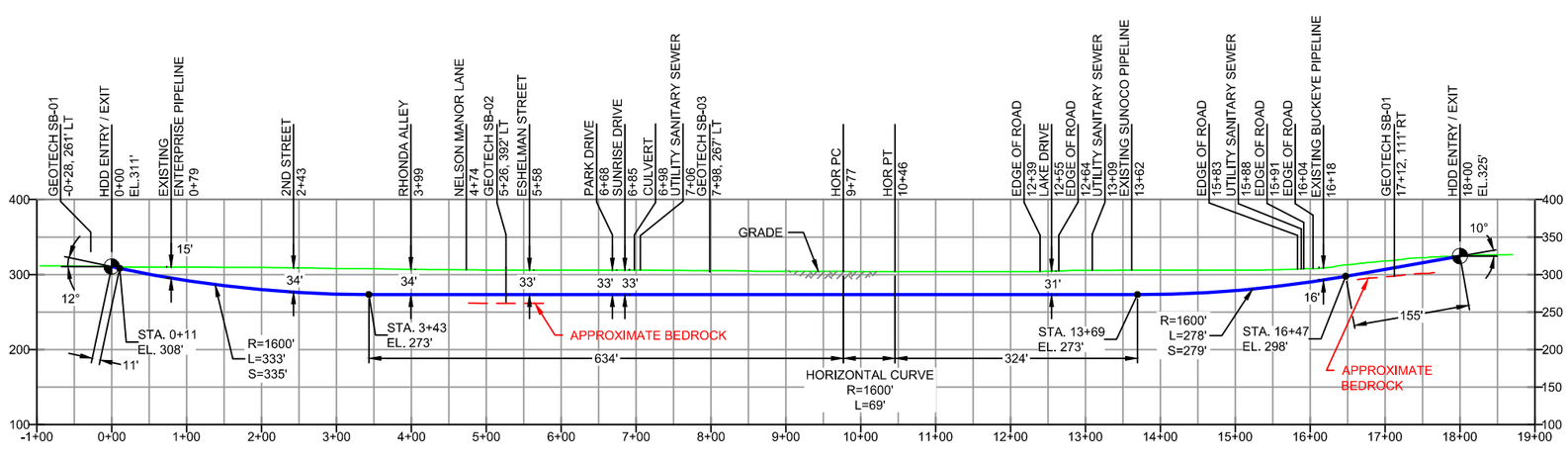
DAUPHIN COUNTY, PENNSYLVANIA - LOWER SWATARA TOWNSHIP
S3-0011-16

GEOTECH SB-01
- -NG EL. 311'
- -FILL (0.0' - 23.9')
- -GROUNDWATER (18.0')
- -CL (23.9' - 25.5')
- -SM / GM (25.5' - 30.0')
- -COMPLETION DEPTH EL. 281'

GEOTECH SB-02
- -NG EL. 308'
- -TOPSOIL (0' - 1.0')
- -SM (1.0' - 22.0')
- -GROUNDWATER (19.0')
- -SM / GM (22.0' - 44.0')
- -SANDSTONE (44.0' - 44.2')
- -AUGER REFUSAL (44.2')
- -COMPLETION DEPTH EL. 264'

GEOTECH SB-03
- -NG EL. 304'
- -TOPSOIL (0' - 0.4')
- -ML / SM (0.4' - 6.5')
- -SM (6.5' - 12.0')
- -GROUNDWATER (12.5')
- -SM / GM (12.0' - 21.5')
- -SM (21.5' - 26.5')
- -SC (26.5' - 30.0')
- -COMPLETION DEPTH EL. 274'

NOTE: REFER TO TEST BORING LOG S3-0010 FOR COMPLETE SOIL MATERIAL DESCRIPTION



GEOTECH SB-01
- -NG EL. 311'
- -ASPHALT AND GRAVEL (0' - 0.5')
- -FILL (0.5' - 11.5')
- -GROUNDWATER (10.0')
- -SC (11.5' - 18.0')
- -SANDSTONE (18.0' - 21.0')
- -AUGER REFUSAL (21.0')
- -COMPLETION DEPTH EL. 290'

NOTE: REFER TO TEST BORING LOG S3-0011 FOR COMPLETE SOIL MATERIAL DESCRIPTION

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3. DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
4. CROSSING PIPE SPECIFICATION:
   HDD HORZ. LENGTH (L=):1800'
   HDD PIPE LENGTH (S=):1806'
   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.
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5. SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING

DWG NO		DWG NO	DESCRIPTION
ES-4.06	TO	ES-4.07	EROSION & SEDIMENT PLAN
SHEET 4	TO	SHEET 4	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	DLM	05/09/16	RMB	05/09/16	AAW	05/09/16
EP		DLM	02/26/16	RMB	02/26/16	AAW	02/26/16
B	ADDED GEOTECH INFO	MRS	09/18/15	RMB	09/18/15	AAW	09/18/15
A	ISSUED FOR BID	MRS	08/31/15	RMB	08/31/15	AAW	08/31/15

Sunoco Logistics Partners L.P.

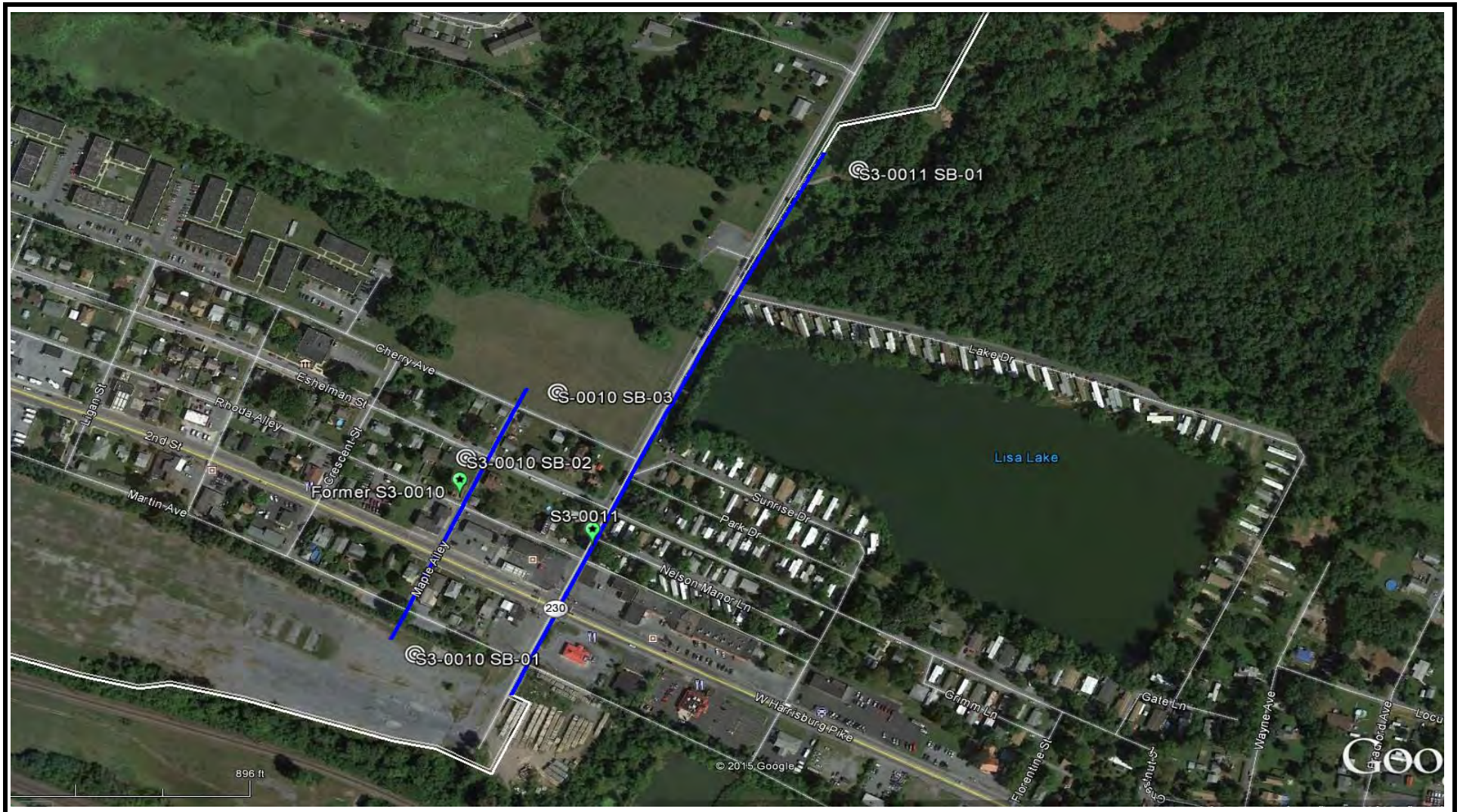
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

16-INCH HORIZONTAL DIRECTIONAL DRILL
WHITE HOUSE LANE
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=150'

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



LEGEND:

Geotechnical Soil Boring (SB) Locations

TETRA TECH

GEOTECHNICAL BORING LOCATIONS
HDD S3-0011 AND FORMER S3-0010
DAUPHIN COUNTY, HIGHSPIRE TOWHSHIP, 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:	WHITE HOUSE LANE, HIGHSPIRE, PA (HARRISBURG AIRPORT PROPERTY)		Page 1 of 1
HDD No.:	S3-0010	Dates(s) Drilled: 10-29-14	Inspector: E. WATT
Boring No.:	SB-01	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 18.0	Total Depth (ft): 30.0
Boring Location Coordinates:		40°12'7.25"N	76°46'22.09"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
							NO DISCERABLE TOPSOIL PRESENT.					
1	3.0	5.0	0.0		18	HISTORIC FILL, ML?	FILL MATERIAL (ASH/COAL SPOILS?): DARK GRAY TO BLACK FINE	2	3	4	7	**7**
							SAND, LITTLE SILT.					
2	8.0	10.0			10		FILL MATERIAL (ASH/COAL SPOILS?): DARK GRAY TO BLACK SILT	1	1	1	2	**2**
							WITH SOME FINE SAND, TRACE PIECES OF (COAL?)					
3	13.0	15.0			19		FILL MATERIAL (ASH/COAL SPOILS?): DARK GRAY TO BLACK SILT	1	1	1	1	**2**
							AND FINE SAND, TRACE PIECES OF (COAL?) USCS: ML?					
4	18.0	20.0			24		FILL MATERIAL (ASH/COAL SPOILS?): DARK GRAY TO BLACK SILT	1	1	1	2	**2**
				23.9			AND FINE SAND.					
5	23.0	25.0	23.9		24	CL	REDDISH BROWN TO DARK GRAY CLAY (VERY SOFT), SATURATED,	1	1	1	5	**2**
				25.5			(USCS: CL).					
6	28.0	30.0	25.5		24	SM/SP/GM	BROWN TO ORANGE BROWN FINE TO COARSE SAND AND F-C	3	8	18	35	**26**
				30.0			GRAVEL, WITH A LITTLE SILT.					
							WET ON SPOON AT 18'.					
							CAVED AT 22.5', WATER LEVEL ON CAVE AT 22.5'.					

Notes/Comments:

Pocket Pentrometer Testing

NOT TESTABLE, DOES NOT BEHAVE LIKE SILT/CLAY.

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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fax: 302.454.5988

TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	ESHELMAN STREET AND MAPLE ALLEY, HIGHSPIRE, PA		Page 1 of 1
HDD No.:	S3-0010	Dates(s) Drilled: 11-06-14	Inspector: E. WATT
Boring No.:	SB-02	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 19.0	Total Depth (ft): 44.2
Boring Location Coordinates:		40°12'12.73"N	76°46'20.41"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	1.0			TOPSOIL (12")					
1	3.0	5.0	1.0		10		BROWN FINE TO MEDIUM SAND WITH A LITTLE SILT, AND A TRACE	2	6	4	5	**10**
							FINE TO COARSE GRAVEL.					
2	8.0	10.0			10		BROWN FINE TO MEDIUM SAND WITH A LITTLE SILT, WITH A LITTLE	10	16	16	15	**32**
						SM	FINE TO COARSE GRAVEL.					
3	13.0	15.0			7		BROWN AND REDDISH BROWN FINE TO MEDIUM SAND WITH A LITTLE	27	23	20	18	**43**
							SILT, AND A LITTLE FINE TO COARSE GRAVEL.					
4	18.0	20.0			12		VARYING SHADES OF BROWN MEDIUM TO COARSE SAND WITH A	1	22	40	47	**62**
				22.0			LITTLE SILT AND SOME FINE TO COARSE GRAVEL.					
5	23.0	25.0	22.0		19	SM/ GM	BROWN, ORANGE BROWN, GREENISH BROWN AND MAROON FINE	7	24	33	38	**57**
				26.0			TO COARSE GRAVEL AND FINE TO COARSE SAND, TRACE SILT.					
6	28.0	28.2			4		REDDISH BROWN TO MAROON FINETO COARSE SANDSTONE	50/2"				**>50**
							GRAVEL AND FINE TOMEDIUM SAND, SOME SILT.					
7	33.0	33.4			5	SM/ GM	MAROON FINE SAND AND UNWEATHERED SANDSTONE	50/5"				**>50**
							GRAVEL, SOME SILT.					
8	38.0	38.6			7		MAROON SILTY FINE SAND AND UNWEATHERED SANDSTONE	40	50/1"			**>50**
							GRAVEL.					
9	43.0	43.4		44.2	3		MARRON TO LIGHT GRAY PARTIALLY WEATHERED SANDSTONE.	50/5"				**>50**
							AUGER REFUSAL AT 44.2'.					
							WET ON SPOON AT 22'.					
							WATER LEVEL THROUGH AUGERS AT 19'.					
							CAVED AT 27', WATER LEVEL ON CAVE AT 16'.					

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.

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TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	CHERRY AVENUE, HIGHSPIRE, PA		Page 1 of 1
HDD No.:	S3-0010	Dates(s) Drilled: 11-07-14	Inspector: E. WATT
Boring No.:	SB-03	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 12.5	Total Depth (ft): 30.0
Boring Location Coordinates:		40°12'14.58"N	76°46'17.40"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	0.4			TOPSOIL (5")					
1	3.0	5.0	0.4		5	ML/ SM	BROWN SILT AND FINE TO MEDIUM SAND WITH SOME FINE TO COARSE	10	22	18	12	**40**
				6.5			GRAVEL.					
2	8.0	10.0	6.5		17	SM	BROWN TO GRAYISH BROWN FINE TO COARSE SAND WITH A LITTLE	7	9	10	12	**19**
				12.0			FINE TO COARSE GRAVEL, AND SOME SILT.					
3	13.0	15.0	12.0		16	SM/ GM	BROWN TO GRAYISH BROWN FINE TO COARSE SAND AND FINE	1	21	24	21	**45**
							TO COARSE GRAVEL, LITTLE SILT.					
4*	18.0	20.0		21.5	6		*MULTI-COLORED FINE TO COARSE GRAVEL.	1	1	1	2	**2**
5	23.0	25.0	21.5		12	SM	REDDISH BROWN FINE TO MEDIUM WITH A LITTLE SILT, AND A LITTLE	20	50/6"			**>50**
				26.5			FINE TO COARSE SANDSTONE GRAVEL.					
6	28.0	28.2			4	SC	REDDISH BROWN FINE TO MEDIUM SAND AND SILTY CLAY, WITH A	25	50/5"			**>50**
				30.0			LITTLE FINE TO COARSE SANDSTONE GRAVEL (USCS: SC).					
							WET ON SPOON AT 13'.					
							WATER LEVEL THROUGH AUGERS AT 12.5'.					
							CAVED AT 14', WATER LEVEL ON CAVE AT 11'.					
							*TWO FEET OF HEAVE AT SAMPLE 4, HEAVE WASHED OUT. SAMPLE					
							AND BLOW COUNTS MAY NOT BE REPRESENTATIVE.					

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.

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TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	256 WHITE HOUSE LAND, HIGHSPIRE, PA		Page 1 of 1
HDD No.:	S3-0011	Dates(s) Drilled: 12-14-15	Inspector: J. COSTELLO
Boring No.:	SB-01	Drilling Method: SPT - ASTM D1586	Driller: E. OGDEN
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 10.0	Total Depth (ft): 21.0
Boring Location Coordinates:		40°12'20.82"N	76°46'7.48"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			OLD DRIVEWAY - ASPHALT AND GRAVEL.					
1	3.0	5.0	0.5		10	GM (HISTORICAL FILL)	GRAY AND BROWN F-C GRAVEL AND F-M SAND,LITTLE SILT.	5	15	11	10	**26**
							(HISTORIC FILL)					
2	8.0	10.0			13		GRAY AND BROWN F-C GRAVEL AND F-C SAND, WITH A LITTLE SILT	16	13	12	12	**25**
				11.5			(HISTORIC FILL)					
3	13.0	14.4	11.5		10	SC	REDDISH BROWN WEATHERED SANDSTONE, WEALTHERED TO A	10	50	3/5"		**>50**
				18.0			F-C SAND AND SILTY CLAY. (USCS: SC)					
4	18.0	18.6	18.0	21.0	14		REDDISH BROWN PARTIALLY WEATHERED SHALE OR SANDSTONE.	25	50/1"			**>50**
							AUGER REFUSAL AT 21'.					
							WATER LEVEL THROUGH AUGERS AT 10'.					
							CAVED AND WET AT 9.5'.					

Notes/Comments:

Pocket Pentrometer Testing

S4: > 4 TSF

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

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

GEOTECHNICAL LABORATORY TESTING SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0010 (Former) and S3-0011

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)
S3-0010	SB-01	1	3.0	5.0	9.9	16.0	-	-	-	-
		2	8.0	10.0	44.2	77.7	-	-	-	-
		3	13.0	15.0	45.7	58.9	NV	NP	NP	ML
		4	18.0	20.0	65.5	62.5	-	-	-	-
		5	23.0	25.0	47.9	98.7	47	26	21	CL
		6	28.0	30.0	11.7	13.4	-	-	-	-
	SB-02	2	8.0	10.0	5.2	12.0	-	-	-	-
		4	18.0	20.0	9.0	11.9	-	-	-	-
		6	28.0	28.2	12.4	21.6	-	-	-	-
		7	33.0	33.4	12.4	28.9	-	-	-	-
		8	38.0	38.6	9.7	33.2	-	-	-	-
	SB-03	2	8.0	10.0	13.3	27.5	-	-	-	-
		3	13.0	15.0	10.3	11.8	-	-	-	-
		5	23.0	25.0	12.9	16.3	-	-	-	-
		6	28.0	28.2	13.1	46.7	30	20	10	SC
S3-0011	SB-01	1	3.0	5.0	5.4	16.7	-	-	-	-
		2	8.0	10.0	9.0	12.0	-	-	-	-
		3	13.0	14.4	10.0	47.1	26	22	14	SC

Notes:

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

REGIONAL GEOLOGY SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0010 (Former) and S3-0011

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
S3-0010	Maple Alley	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.	Level low area (adj. to airport)	Gettysburg Fm	Silty mudstone-shale-sandstone w/ some impure limestone	16,000	25-30	
		SB-02							
		SB-03							
S3-011	White House Lane	SB-01		Level area near edge of treeline					

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).

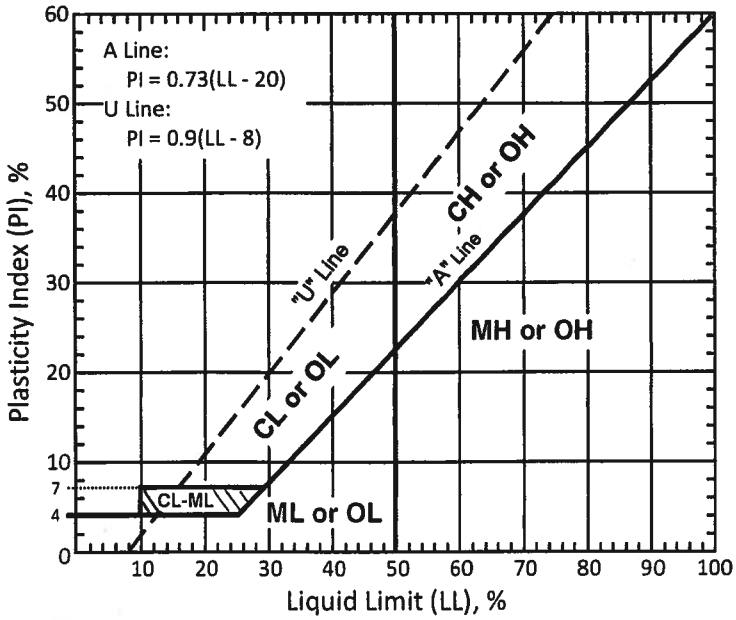
Groundwater observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

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.

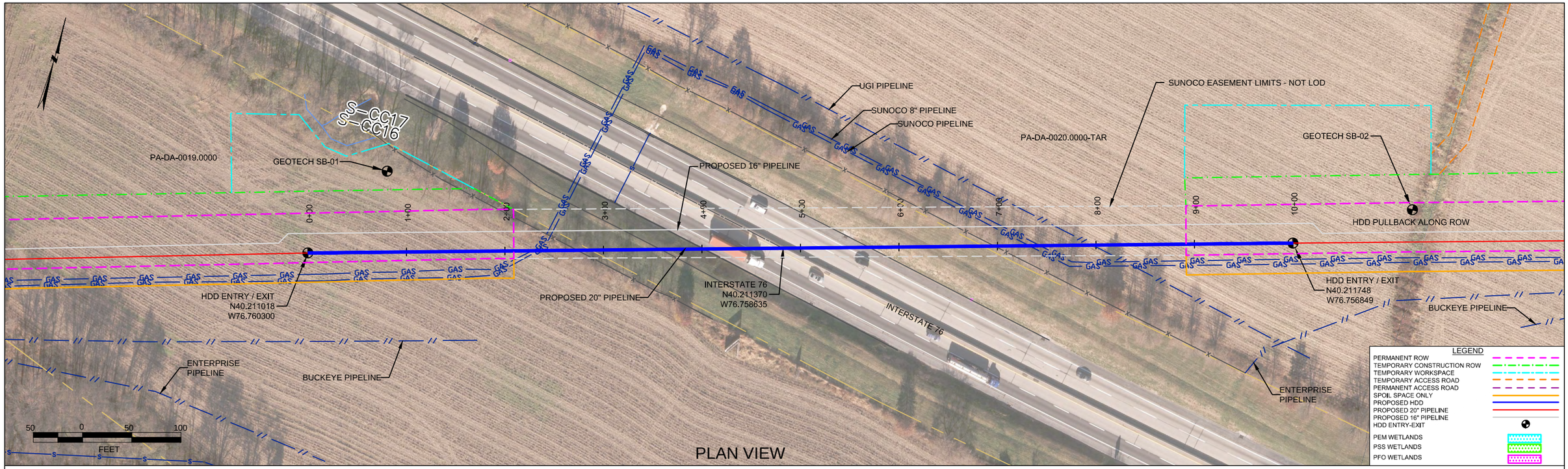


(1) Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC. well-graded gravel-sand mixture with clay binder.

HDD PA-DA-0019.0000-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.

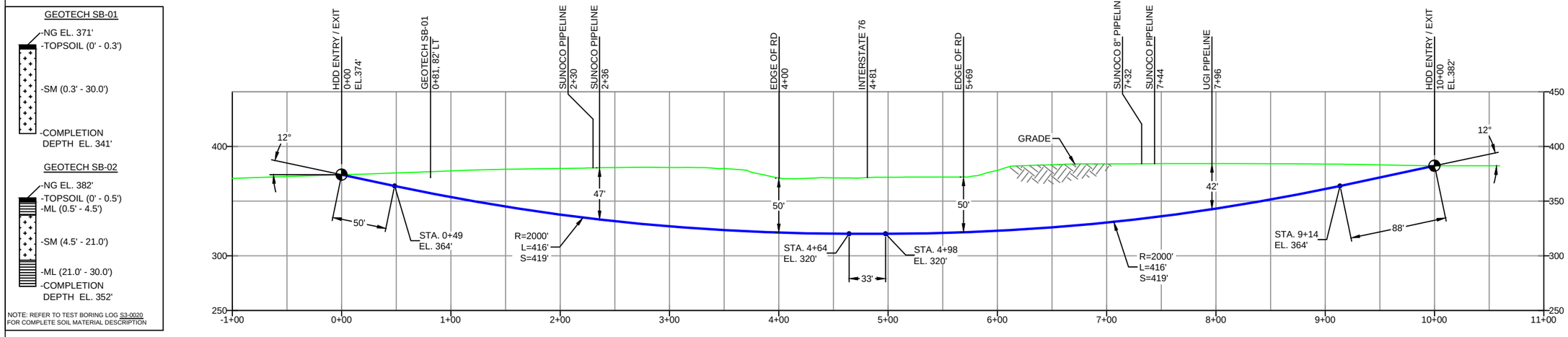
The drill will enter/exit 430 feet from the western edge of Interstate 76 (I-76) and enter/exit 450 feet from the eastern edge. There are not active water bodies or wetlands in the area of this drill. The drill will pass 50 below the interstate. The geotechnical results, as well as other data points, 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 silts and sands. Based on the geotechnical report and the drill profile minimal inadvertent returns are expected.



PLAN VIEW

PROFILE VIEW

DAUPHIN COUNTY, PENNSYLVANIA - LOWER SWATARA TOWNSHIP
S3-0020



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=):1000'
   HDD PIPE LENGTH (S=):1009'
   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-4.09	TO	ES-1.10	EROSION & SEDIMENT PLAN	
SHEET 6	TO	SHEET 6	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	09/30/16	RMB	09/30/16	AAW	09/30/16
EP1	REVISED PER PADEP COMMENTS	DLM	05/07/16	RMB	05/07/16	AAW	05/07/16
EP		DLM	11/13/15	RMB	11/13/15	AAW	11/13/15
C	ADDED GEOTECH INFO	MRS	09/18/15	RMB	09/18/15	AAW	09/18/15
B	ISSUED FOR BID	DLM	07/31/15	RMB	07/31/15	AAW	07/31/15
A	ISSUED FOR REVIEW	KB	03/09/15	RMB	03/09/15	AAW	03/09/15

Sunoco Logistics Partners L.P.

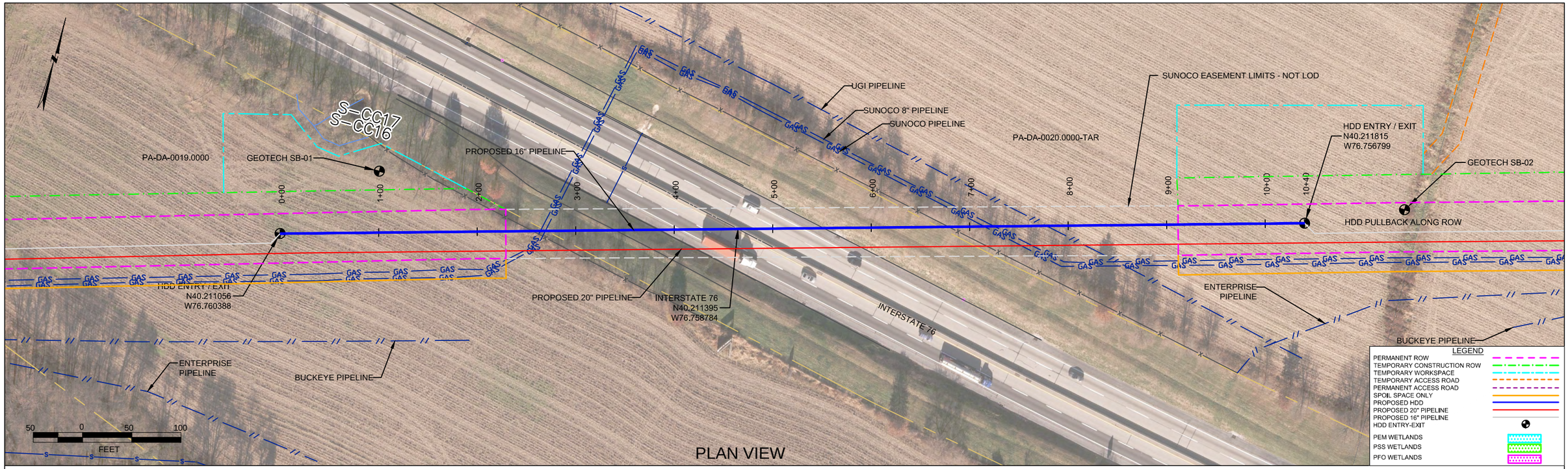
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

20-INCH HORIZONTAL DIRECTIONAL DRILL
INTERSTATE 76
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=100'

DWG. NO: PA-DA-0019.0000-RD



PLAN VIEW

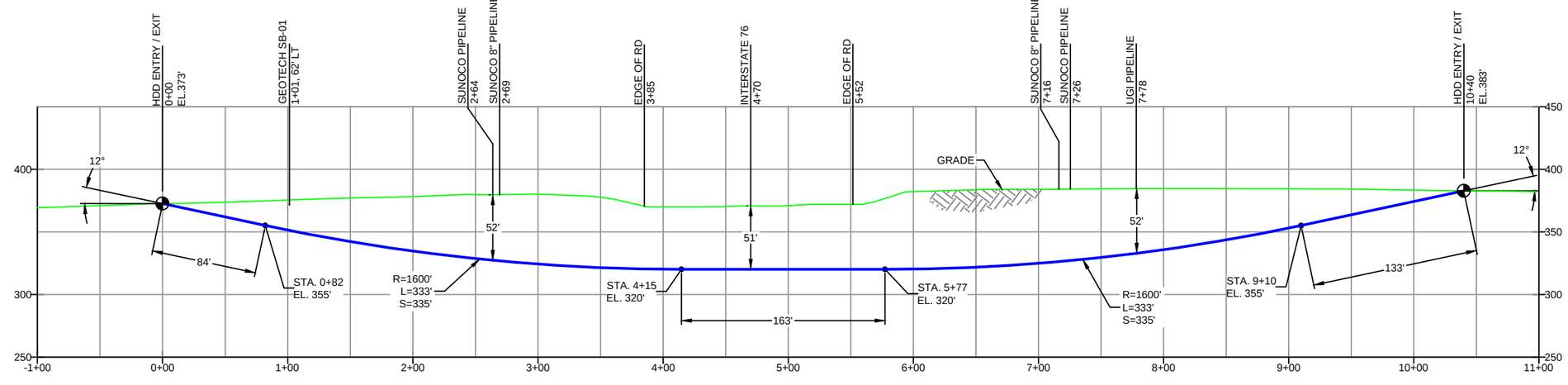
PROFILE VIEW

DAUPHIN COUNTY, PENNSYLVANIA - LOWER SWATARA TOWNSHIP
S3-0020-16

GEOTECH SB-01
-NG EL. 371'
-TOPSOIL (0' - 0.3')
-SM (0.3' - 30.0')
-COMPLETION DEPTH EL. 341'

GEOTECH SB-02
-NG EL. 382'
-TOPSOIL (0' - 0.5')
-ML (0.5' - 4.5')
-SM (4.5' - 21.0')
-ML (21.0' - 30.0')
-COMPLETION DEPTH EL. 352'

NOTE: REFER TO TEST BORING LOG S3-0020 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=):1040'
   HDD PIPE LENGTH (S=):1050'
   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

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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

ES-4.09	TO	ES-4.10	EROSION & SEDIMENT PLAN	
SHEET 6	TO	SHEET 6	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	DLM	05/07/16	RMB	05/07/16	AAW	05/07/16
EP		DLM	11/13/15	RMB	11/13/15	AAW	11/13/15
B	ADDED GEOTECH INFO	MRS	09/18/15	RMB	09/18/15	AAW	09/18/15
A	ISSUED FOR BID	MRS	08/31/15	RMB	08/31/15	AAW	08/31/15

Sunoco Logistics Partners L.P.

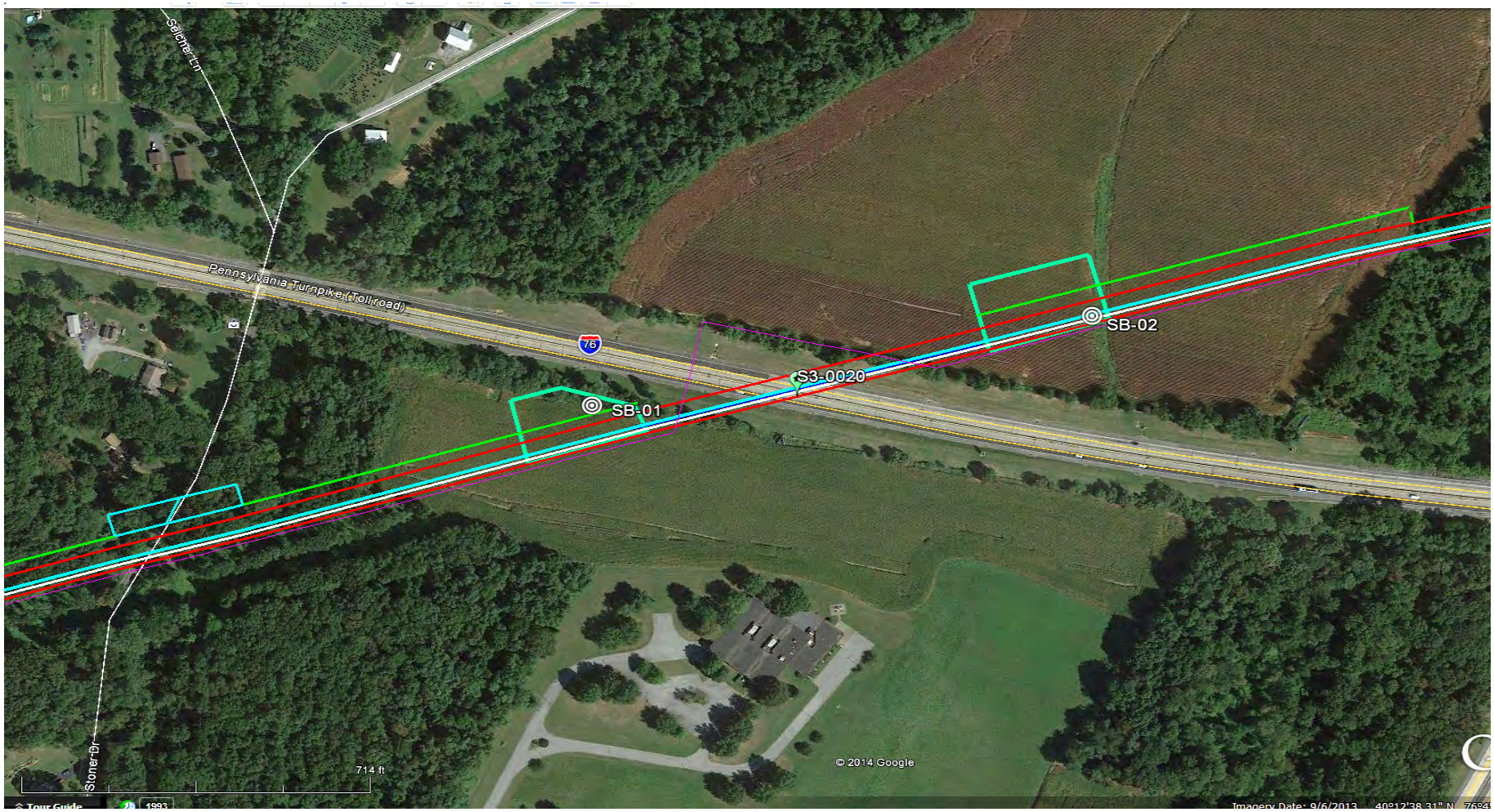
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

16-INCH HORIZONTAL DIRECTIONAL DRILL
INTERSTATE 76
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=100'

DWG. NO: PA-DA-0019.0000-RD-16



LEGEND:

◎ Geotechnical Soil Boring (SB) Locations

TETRA TECH

GEOTECHNICAL BORING LOCATIONS
HDD S3-0020
DAUPHIN COUNTY, LOWER SWATARA TOWHSHIP, 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:	NORTHSIDE OF CORNFIELD OFF ROSEDALE AVENUE, MIDDLETOWN, PA		Page 1 of 1
HDD No.:	S3-0020	Dates(s) Drilled: 11-07-14	Inspector: E. WATT
Boring No.:	SB-01	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 21.0	Total Depth (ft): 30.0

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	4.0	0.3		7		LIGHT REDDISH BROWN FINE TO COARSE SAND, LITTLE SILT, AND A	7	50/6"			**>50**
							LITTLE FINE TO COARSE GRAVEL.					
2	8.0	9.0			10		REDDISH BROWN FINE TO MEDIUM SAND WITH SOME SILT, AND SOME	40	50/6"			**>50**
							UNWEATHERED FINE TO COARSE SANDSTONE GRAVEL.					
3	13.0	15.0			24		REDDISH BROWN FINE TO MEDIUM SAND WITH A LITTLE SILT. SAND	4	10	18	36	**28**
							HAS APPROXIMATELY 50% CONGLOMERATE MATRIX.					
4	18.0	20.0			24	SM	REDDISH BROWN FINE TO MEDIUM SAND AND SILT. USCS: SM).	3	15	27	44	**42**
5	23.0	23.9			12		MAROON FINE TO MEDIUM SAND WITH SOME SILT.	27	50/5"			**>50**
6	28.0	28.6			5		MAROON FINE TO MEDIUM SAND AND SILT, WITH A LITTLE	50	50/1"			**>50**
				30.0			UNWEATHERED FINE TO COARSE SANDSTONE GRAVEL.					
							WET ON SPOON AT 21'.					
							NO WATER LEVEL THROUGH AUGERS					
							CAVED AT 28', WATER LEVEL ON CAVE AT 22'.					

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:	STONER DRIVE, MIDDLETOWN, PA		Page 1 of 1
HDD No.:	S3-0020	Dates(s) Drilled: 11-07-14	Inspector: E. WATT
Boring No.:	SB-02	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 27.0	Total Depth (ft): 30.0

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		11	ML	MOTTLED REDDISH BROWN TO ORANGE BROWN SILT AND FINE	10	10	15	10	**25**
				4.5			SAND, WITH A LITTLE FINE GRAVEL (USCS: ML).					
2	8.0	8.0	4.5		12	SM	REDDISH BROWN FINE SAND WITH A LITTLE SILT, TRACE MICA.	9	50/6"			**>50**
3	13.0	14.0			12		REDDISH BROWN FINE SAND WITH A LITTLE SILT, TRACE FINE	11	50/6"			**>50**
							SANDSTONE GRAVEL.					
4	18.0	19.3			13		REDDISH BROWN FINE TO MEDIUM SAND WITH A LITTLE SILT, TRACE	4	24	50/4"		**>74**
				21.0			CONGLOMERTE MATRIX.					
5	23.0	24.5	21.0		18	ML	MAROON MICACEOUS SILT WITH SOME FINE SAND, TRACE	18	27	50		**77**
							FINE GRAVEL. (USCS: ML)					
6	28.0	28.9			9		MAROON MICACEOUS SILT WITH SOME FINE SAND, WITH A LITTLE	7	50/5"			**>50**
				30.0			CONGLOMERTE MATRIX.					
							WATER LEVEL NOT ENCOUNTERED DURING DRILLING.					
							CAVED AT 29', WATER LEVEL ON CAVE AT 27'.					

Notes/Comments:

Pocket Pentrometer Testing
S5: >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 S3-0020

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)
S3-0020	SB-01	1	3.0	4.0	4.5	17.7	-	-	-	-
		2	8.0	9.0	4.7	29.5	-	-	-	-
		4	18.0	20.0	10.7	41.3	31	25	6	SM
		5	23.0	23.9	5.3	34.3	-	-	-	-
		6	28.0	28.6	8.2	47.2	-	-	-	-
	SB-02	1	3.0	5.0	13.2	66.1	33	25	8	ML
		2	8.0	8.0	6.6	16.5	-	-	-	-
		4	18.0	19.3	11.3	14.9	-	-	-	-
		5	23.0	24.5	9.3	74.7	34	26	8	ML
		6	28.0	28.9	8.7	76.3	-	-	-	-

Notes:

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

REGIONAL GEOLOGY SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0020

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
S3-0020	MP 209 @ I-76	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.	Upland (farm field)	Gettysburg Fm	Silty mudstone-shale-sandstone w/ some impure limestone	16,000	21-36	
		SB-02							

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

FIELD DESCRIPTION AND LOGGING SYSTEM FOR SOIL EXPLORATION

GRANULAR SOILS

(Sand, Gravel & Combinations)

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).

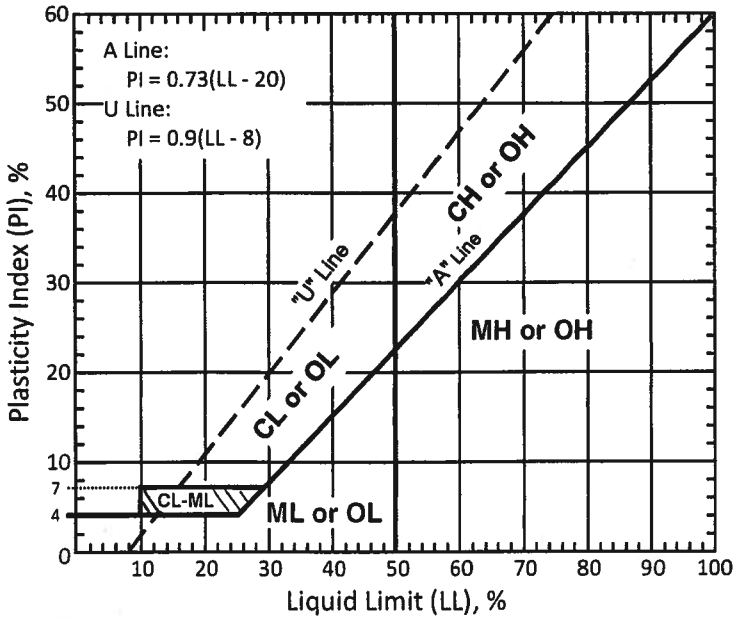
Groundwater observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

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.

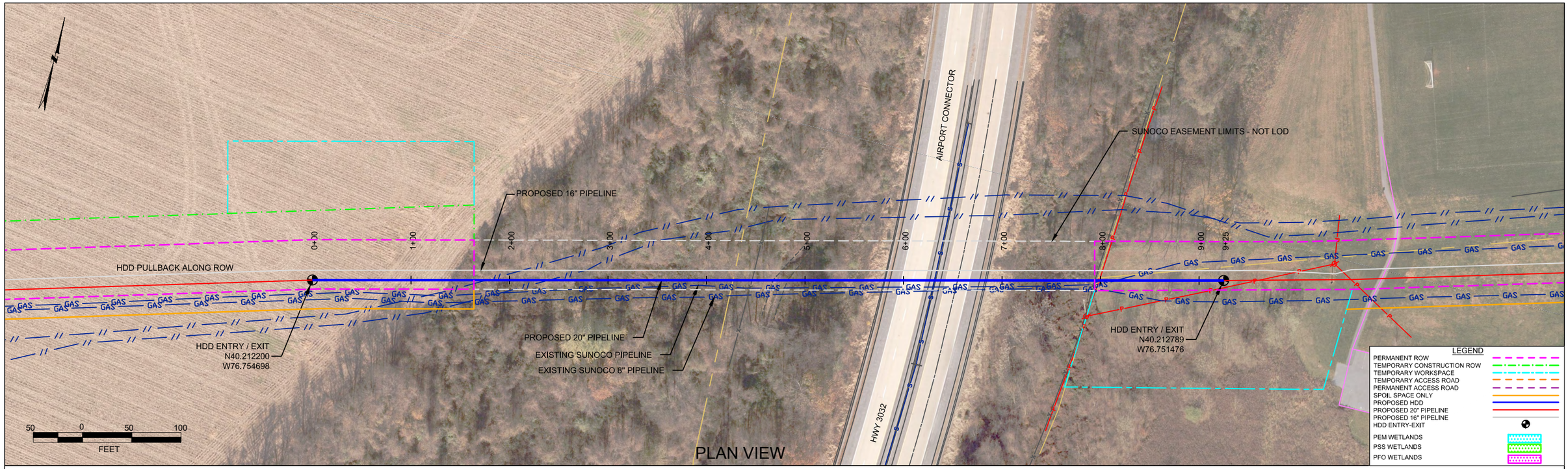


(1) Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC. well-graded gravel-sand mixture with clay binder.

HDD PA-DA-0020.0000-RD

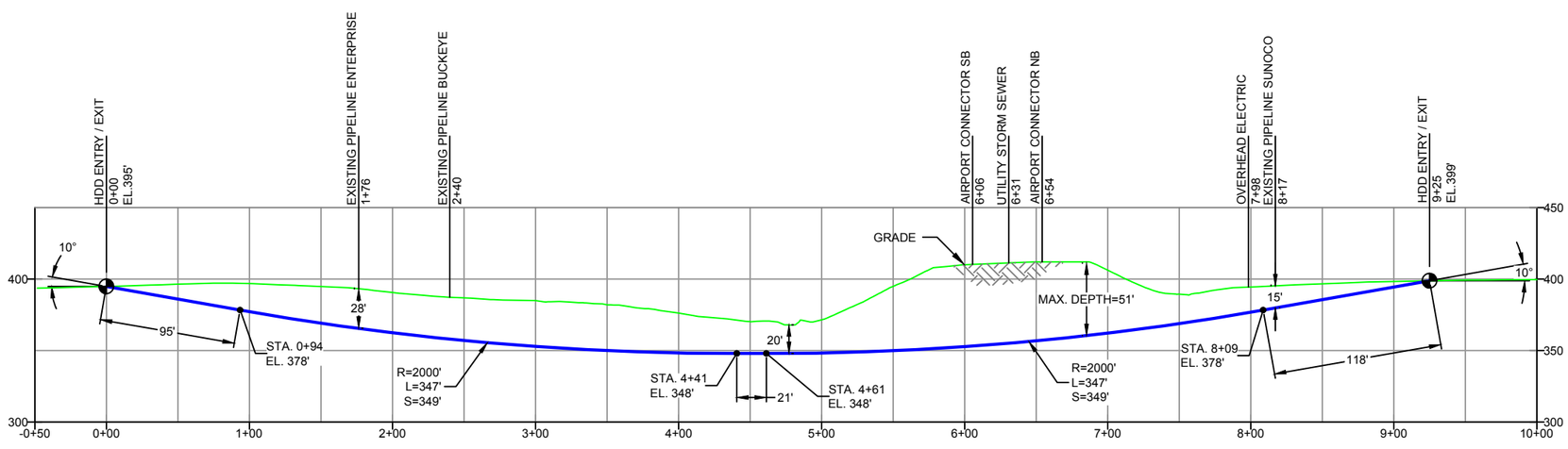
Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable and in this case that threat is considered to be low. Implementing this design, along with adherence to the Pennsylvania Pipeline Project Inadvertent Return Contingency Plan will ensure inadvertent impacts,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

The drill will enter/exit 600 feet from the western edge of Airport Connector (Hwy 3032) and enter/exit 240 feet from the eastern edge. There are no active water bodies or wetlands in the area of this drill. The drill will pass 50 below the highway. 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 fine sands and silts. Based on the geotechnical report and the drill profile minimal inadvertent returns are expected.



PLAN VIEW

PROFILE VIEW



DAUGPHIN COUNTY, PENNSYLVANIA - LOWER SATARA TOWNSHIP
S3-0030

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=):925'
   HDD PIPE LENGTH (S=):932'
   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-4.10	TO	ES-4.10	EROSION & SEDIMENT PLAN
SHEET 6	TO	SHEET 7	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	05/07/16	RMB	05/07/16	AAW	05/07/16
EP		DLM	11/23/15	RMB	11/23/15	AAW	11/23/15
C	ISSUED FOR BID / DESIGN CHANGE	MRS	08/14/15	RMB	08/14/15	AAW	08/14/15
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.

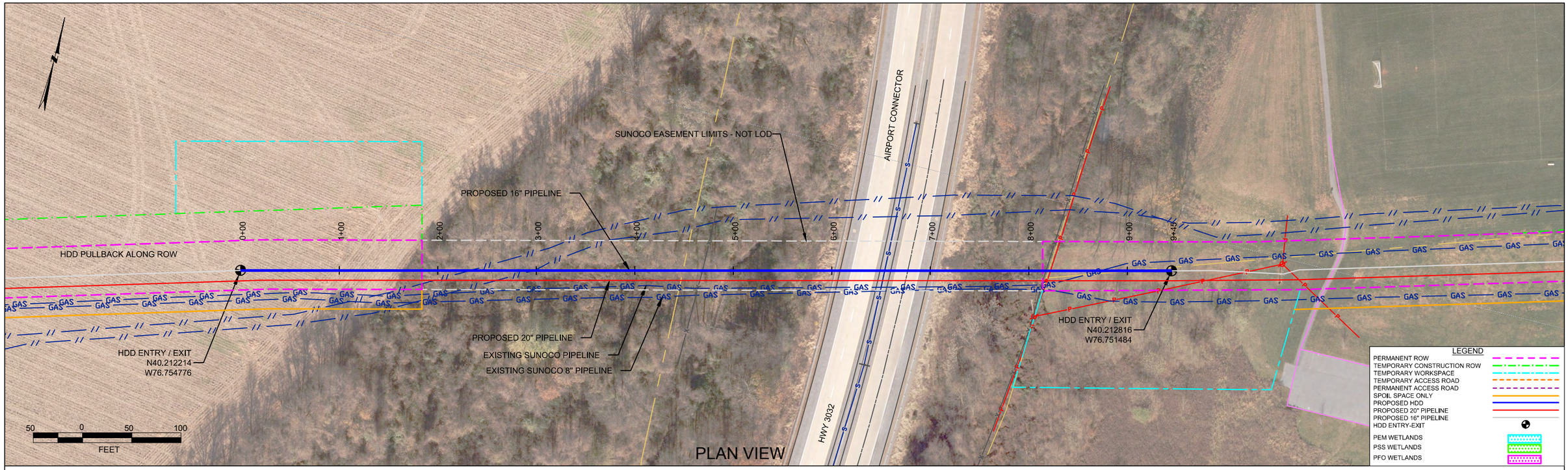
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

20-INCH HORIZONTAL DIRECTIONAL DRILL
HIGHWAY 3032
PENNSYLVANIA PIPELINE PROJECT

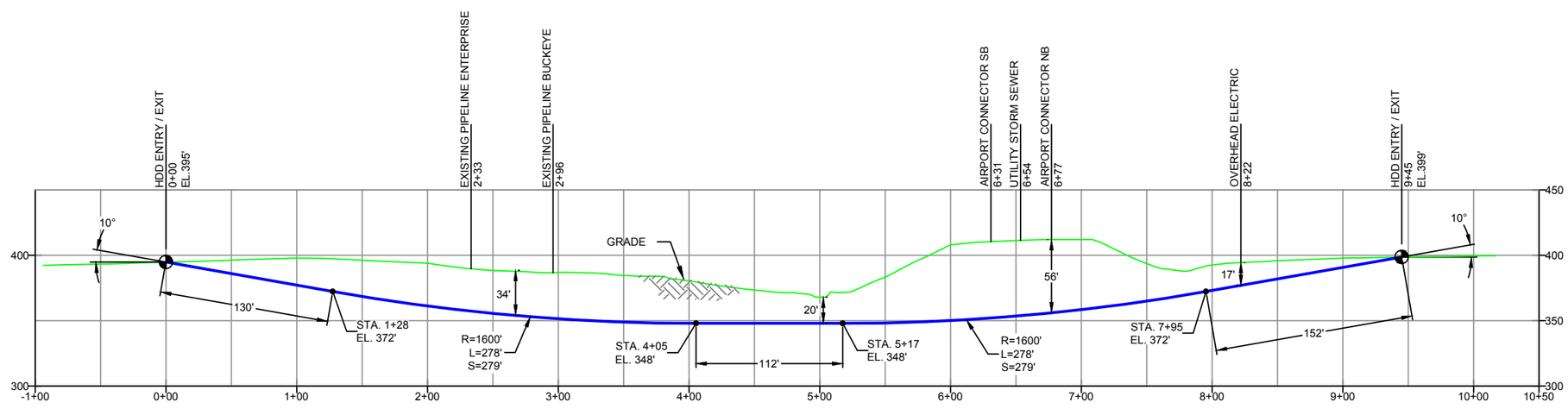
SCALE: 1"=100'

DWG. NO: PA-DA-0020.0000-RD



PLAN VIEW

PROFILE VIEW



DAUGHPHIN COUNTY, PENNSYLVANIA - LOWER SATARA TOWNSHIP
S3-0030-16

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=):945'
   HDD PIPE LENGTH (S=):952'
   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-4.10	TO ES-4.10	EROSION & SEDIMENT PLAN	
SHEET 6	TO SHEET 7	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	DLM	05/07/16	RMB	05/07/16	AAW	05/07/16
EP		MRS	11/23/15	RMB	11/23/15	AAW	11/23/15
A	ISSUED FOR BID	MRS	08/31/15	RMB	08/31/15	AAW	08/14/15

Sunoco Logistics Partners L.P.

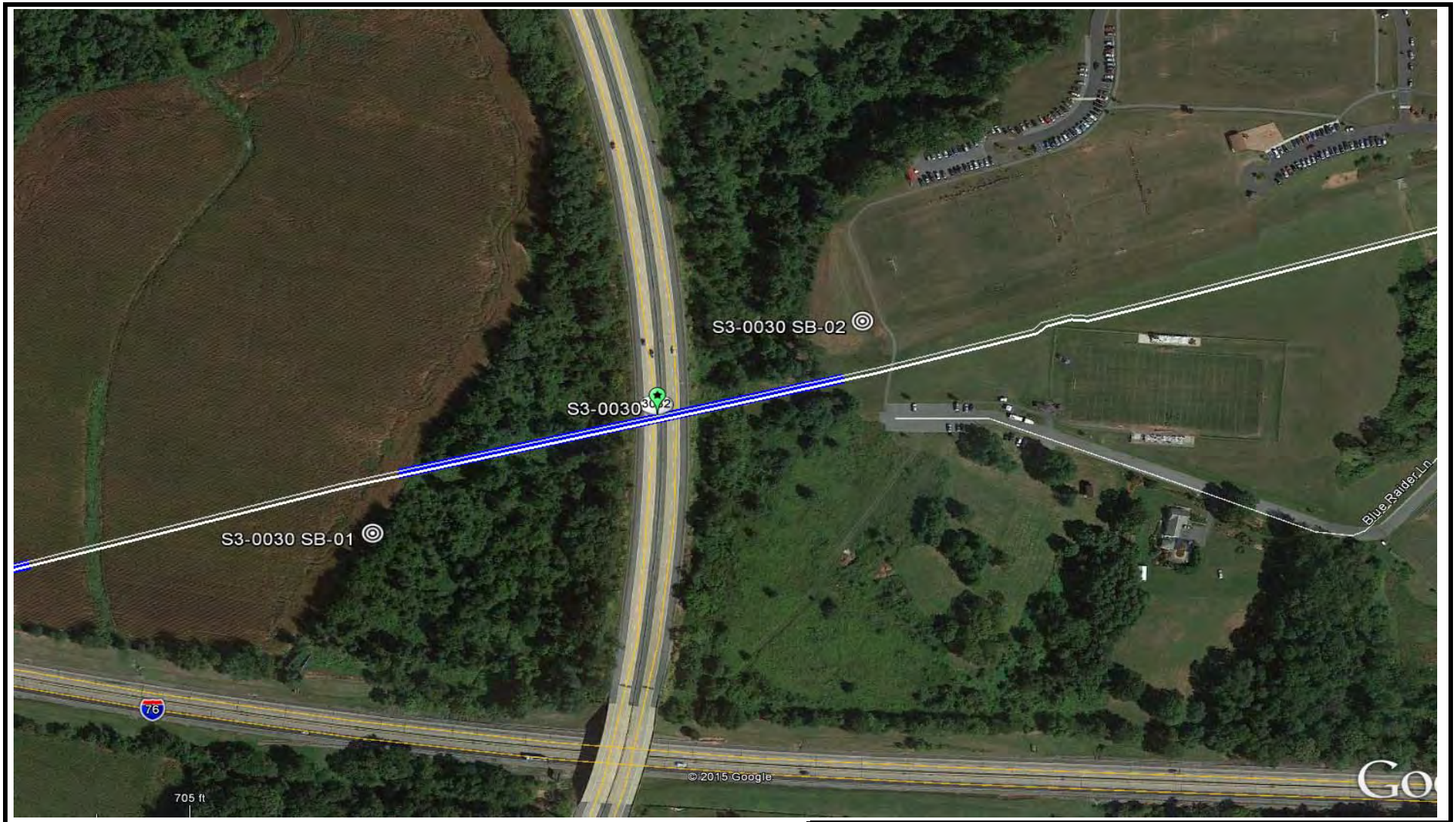
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

16-INCH HORIZONTAL DIRECTIONAL DRILL
HIGHWAY 3032
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=100'

DWG. NO: PA-DA-0020.0000-RD-16



LEGEND:

◎ Geotechnical Soil Boring (SB) Locations

TETRA TECH

GEOTECHNICAL BORING LOCATIONS
HDD S3-0030
DAUPHIN COUNTY, LOWER SWATARA TOWHSHIP, 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:	FIELD WEST OF pa 3032, NORTH OF i-76, MIDDLETOWN, PA		Page 1 of 1
HDD No.:	S3-0030	Dates(s) Drilled: 11-08-14	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°12'42.98"N	76°45'16.08"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		17	ML	BROWN SILT WITH TRACE FINE SAND, YELLOWISH BROWN NEAR	3	12	12	14	**24**
							BOTTOM OF SPOON (USCS: ML)					
2	8.0	10.0			16		YELLOWISH BROWN SILT AND FINE SAND, TRACE FINE	8	10	21	15	**31**
				11.5			GRAVEL.					
3	13.0	15.0			24	ML	DR WEATHERRED TO A VARI-COLORED (REDDISH BRWN, OR. BRWN,	4	11	16	25	**27**
							BLACK) SILT, TRACE FINE SAND, LITTLE CONGLOMERATE (USCS:ML)					
4	18.0	20.0			16	SM	REDDISH BROWN TO MAROON FINE SAND AND SILT. CONTAINS	5	40	50/4"		**>90**
							CONGLOMERATE MATRIX.					
5	23.0	23.9			21		MAROON FINE TO MEDIUM SAND WITH SOME SILT.	2	9	17	34	**26**
6	28.0	28.6			18		MAROON FINE TO MEDIUM SAND WITH SOME SILT, WITH	2	17	9	4	**26**
				30.0			CONGLOMERTE MATRIX.					
							CAVED AND DRY AT 28'.					

Notes/Comments:

Pocket Pentrometer Testing
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
Newark, Delaware 19713
302.738.7551
fax: 302.454.5988

TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	GREENFIELD PARK, MIDDLETOWN, PA (DA-0023)		Page 1 of 1
HDD No.:	S3-0030	Dates(s) Drilled: 10-27-15	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): 30.0
Boring Location Coordinates:		40°12'47.42"N	76°45'4.01"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		18	SM	DR, DARK REDDISH BROWN TO MAROON FINE SAND AND SILT.	1	3	3	4	**6**
2	8.0	10.0			16		DR, DARK REDDISH BROWN TO MAROON FINE SAND AND SILT.	1	1	3	5	**4**
				13.0								
3	13.0	15.0	13.0		24	SM	DR, DARK REDDISH BROWN TO MAROON FINE SAND WITH SOME	4	12	28	41	**40**
							SILT.					
4	18.0	20.0			20		DR, DARK REDDISH BROWN TO MAROON FINE SAND AND SILT.	2	15	38	50	**53**
				21.0								
5	23.0	24.4	21.0		15	PARTIALLY WEATHERED SHALE	DARK REDDISH BROWN TO MAROON PARTIALLY WEATHERED	3	28	50/5"		**>50**
							SHALE.					
6	28.0	29.3			14		DARK REDDISH BROWN TO MAROON PARTIALLY WEATHERED	3	24	50/4"		**>50**
				30.0			SHALE.					
							AUGURED TO 30'.					
							CAVED AND DRY AT 24'.					

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 S3-0030

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)
S3-0030	SB-01	1	3.0	5.0	11.0	94.1	38	26	12	ML
		2	8.0	10.0	9.1	65.9	-	-	-	-
		3	13.0	15.0	16.6	97.6	35	25	10	ML
		4	18.0	20.0	7.8	46.8	-	-	-	-
		5	23.0	23.9	10.2	21.7	-	-	-	-
	SB-02	1	3.0	5.0	15.2	44.0	-	-	-	-
		2	8.0	10.0	15.1	47.2	23	17	6	SM
		3	13.0	15.0	11.5	34.3	-	-	-	-
		4	18.0	20.0	10.2	43.2	25	19	6	SM
		6	28.0	29.3	9.7	88.1	-	-	-	-

Notes:

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

REGIONAL GEOLOGY SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0030

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
S3-0030	HW 3032 - Airport Connector	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.	Upland (farm field)	Gettysburg Fm	Silty mudstone-shale-sandstone w/ some impure limestone	16,000	21-36	
		SB-02							

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

FIELD DESCRIPTION AND LOGGING SYSTEM FOR SOIL EXPLORATION

GRANULAR SOILS

(Sand, Gravel & Combinations)

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).

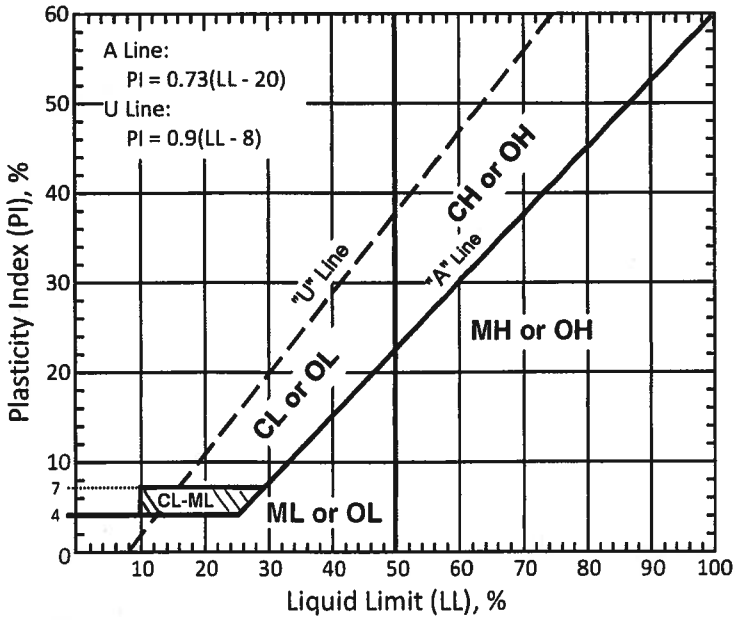
Groundwater observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

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.

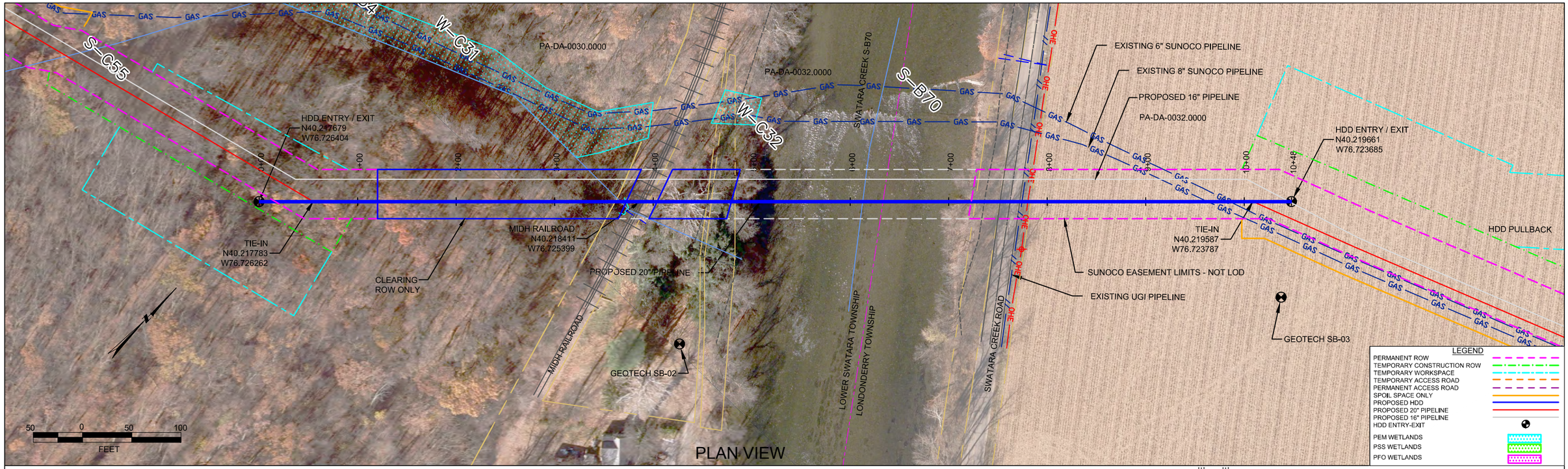


(1) Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC. well-graded gravel-sand mixture with clay binder.

HDD PA-DA-0030.0000-RR (S-C54, S-B70)

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.

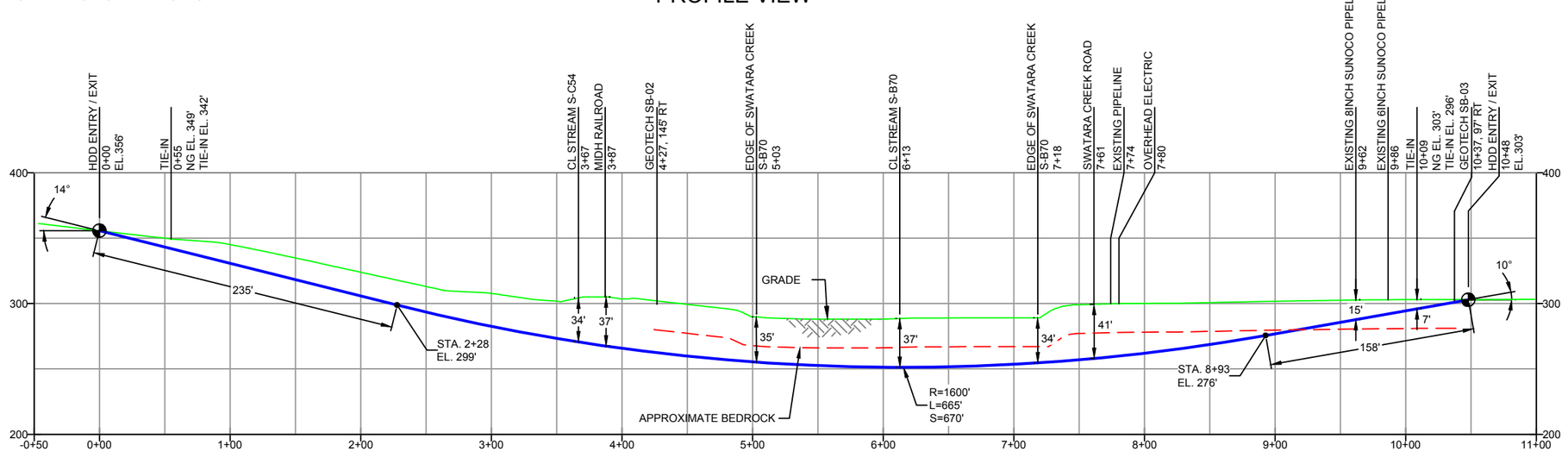
The drill will enter/exit 310 feet from the western edge of Stream C54 (S-C54) and enter/exit 640 feet from the eastern edge. The horizontal directional drill will enter/exit 420 feet from the western edge of Swatara Creek (S-B70) and enter/exit 280 feet from the eastern edge. The drill will pass 35 feet below each of the water bodies. 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 sandstone, fine sand and silt. Based on the geotechnical report and the drill profile minimal inadvertent returns are expected.



PLAN VIEW

PROFILE VIEW

DAUPHIN COUNTY, PENNSYLVANIA - LOWER SWATARA/LONDONDERRY TOWNSHIP
S3-0050



GEOTECH SB-02
- NG EL. 299'
- -TOPSOIL (<1")
- -ML (0.0' - 4.0')
- -SM (4.0' - 11.5')
- -GROUNDWATER (13.0')
- -SM / GM (11.5' - 19.0')
- -SANDSTONE (19.0' - 20.4')
- -COMPLETION DEPTH EL. 279'

GEOTECH SB-03
- NG EL. 299'
- -TOPSOIL (0.0' -0.7')
- -SM (0.7' - 8.5')
- -GROUNDWATER (13.5')
- -SANDSTONE (8.5' - 23.1')
- -COMPLETION DEPTH EL. 276'

NOTE: REFER TO TEST BORING LOG S3-0050 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=): 1048'
   HDD PIPE LENGTH (S=): 1063'
   20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 40 MILS MIN. ARO (POWERCRETE R95)
5. INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50 (HOOP STRESS)).
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. PIPELINE AND CROSSING TO BE INSTALLED AND MAINTAINED IN ACCORDANCE WITH LAST APPROVED AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION SPECIFICATIONS FOR PIPELINES CONVEYING FLAMMABLE AND NON-FLAMMABLE SUBSTANCES.
12. BLASTING NOT PERMITTED.
13. SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.

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-4.15	TO	ES-4.15	EROSION & SEDIMENT PLAN	
SHEET 9	TO	SHEET 10	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	09/30/16	RMB	09/30/16	AAW	09/30/16
EP1	REVISED PER PADEP COMMENTS	DLM	05/17/16	RMB	05/17/16	AAW	05/17/16
EP		JTW	02/26/16	RMB	02/26/16	AAW	02/26/16
C	ADDED GEOTECH INFO	MRS	09/18/15	RMB	09/18/15	AAW	09/18/15
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.

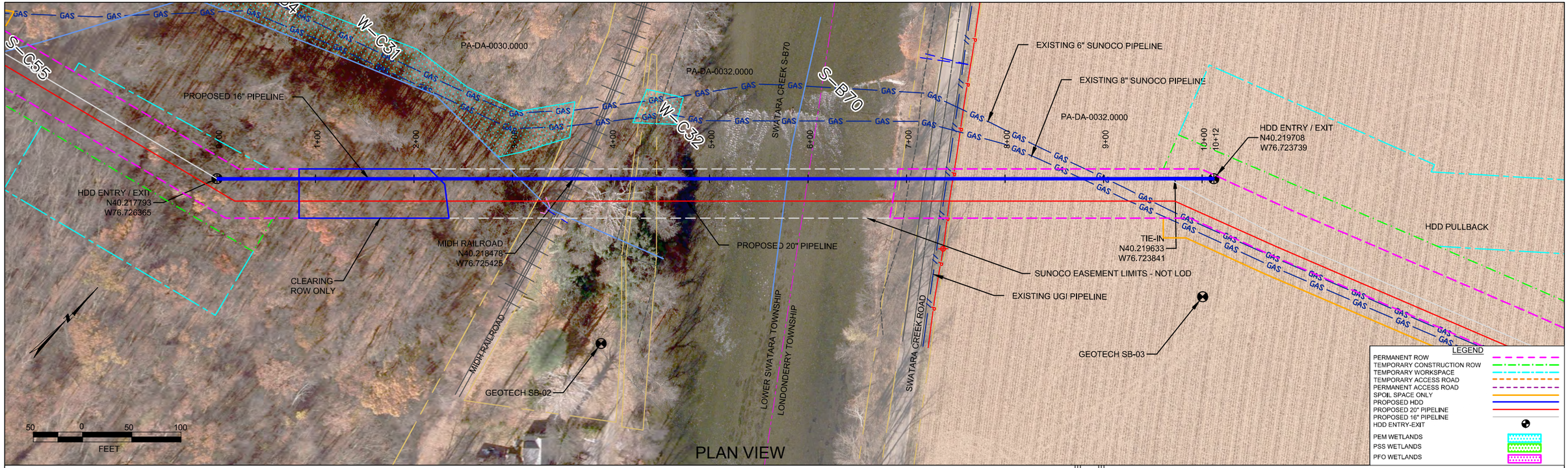
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

20-INCH HORIZONTAL DIRECTIONAL DRILL
MIDH RAILROAD
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=100'

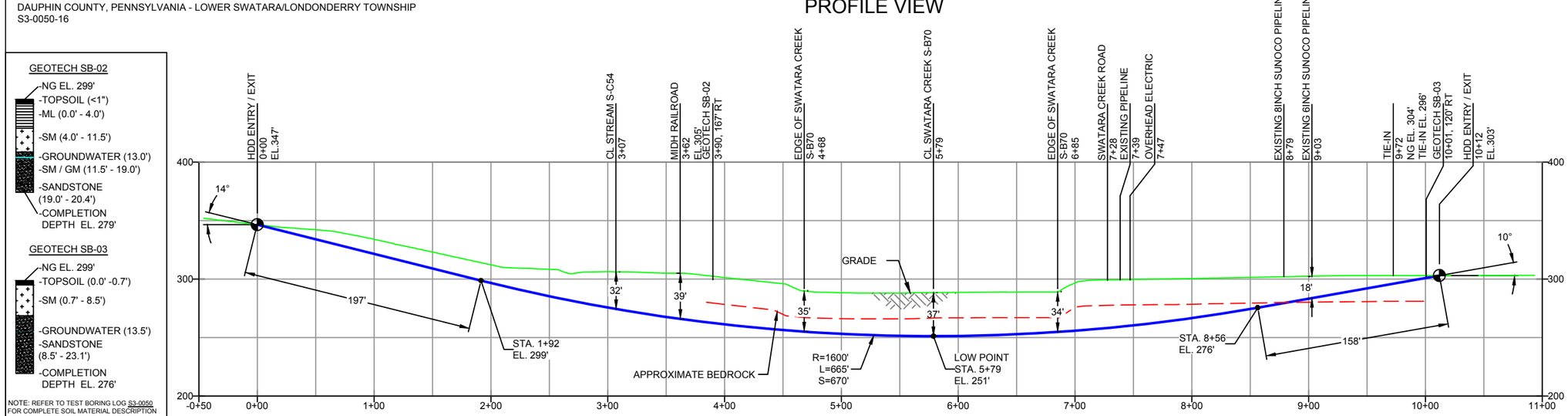
DWG. NO: PA-DA-0030.0000-RR



PLAN VIEW

DAUPHIN COUNTY, PENNSYLVANIA - LOWER SWATARA/LONDONDERRY TOWNSHIP
S3-0050-16

PROFILE VIEW



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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=):1012'
   HDD PIPE LENGTH (S=):1025'
   16" x 0.438" W.T., X-70, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 40 MILS MIN. ARO (POWERCRETE R95)
5. INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50 (HOOP STRESS)).
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. PIPELINE AND CROSSING TO BE INSTALLED AND MAINTAINED IN ACCORDANCE WITH LAST APPROVED AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION SPECIFICATIONS FOR PIPELINES CONVEYING FLAMMABLE AND NON-FLAMMABLE SUBSTANCES.
12. BLASTING NOT PERMITTED.
13. SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.

NOTES

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REF. DRAWING

ES-4.15	TO	ES-4.15	EROSION & SEDIMENT PLAN
SHEET 9	TO	SHEET 10	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
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EP		JTW	02/26/16	RMB	02/26/16	AAW	02/26/16
B	ADDED GEOTECH INFO	MRS	09/21/15	RMB	09/21/15	AAW	09/21/15
MB	ISSUED FOR REVIEW	MRS	08/14/15	RMB	08/14/15	AAW	08/14/15

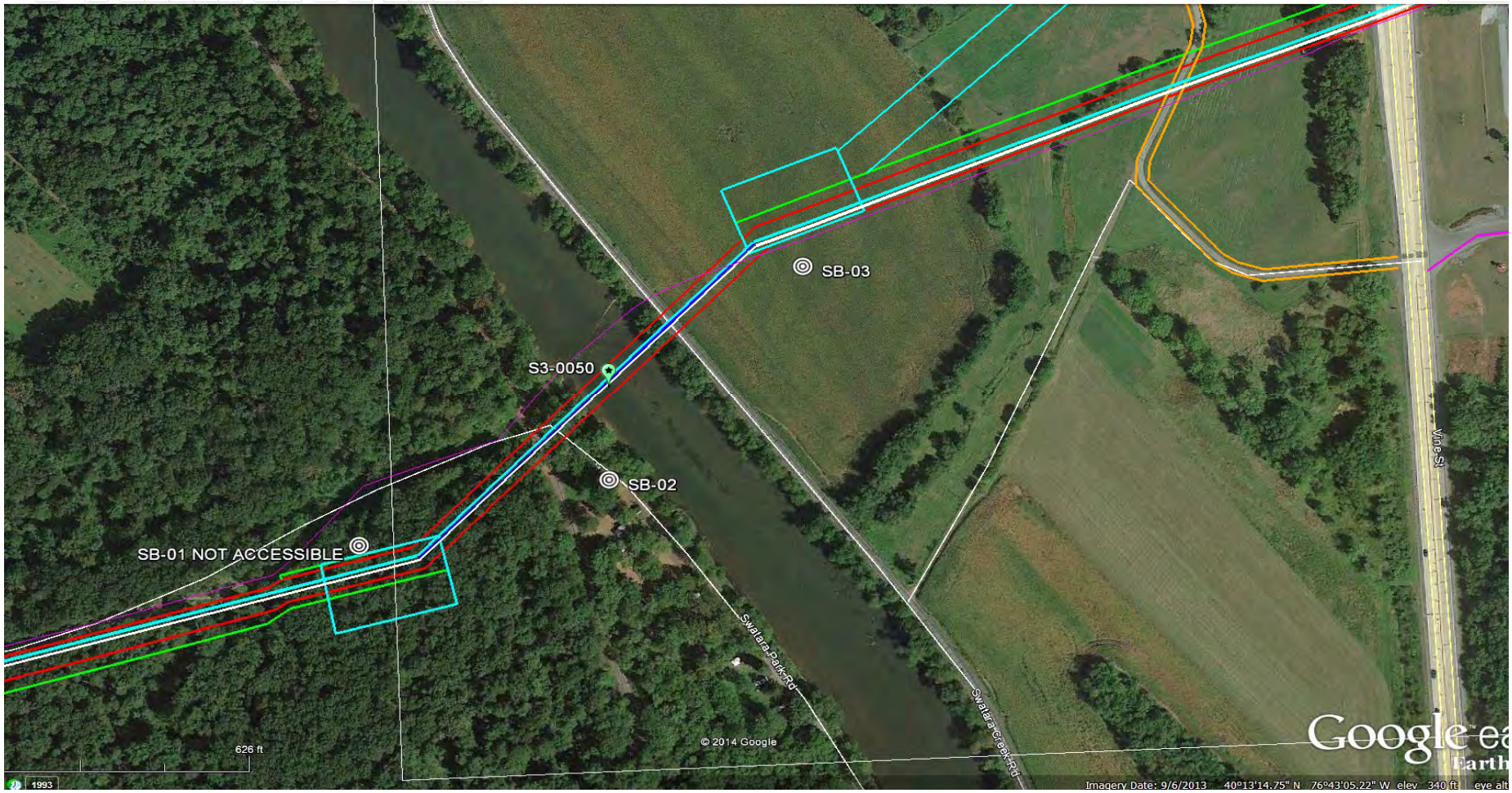
Sunoco Logistics Partners L.P.
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

16-INCH HORIZONTAL DIRECTIONAL DRILL
MIDH RAILROAD
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=100'

DWG. NO: PA-DA-0030.0000-RR-16



LEGEND:

◎ Geotechnical Soil Boring (SB) Locations

TETRA TECH

GEOTECHNICAL BORING LOCATIONS
HDD S3-0050
DAUPHIN COUNTY, LOWER SWATARA AND
LONDONDERRY TOWNSHIPS, 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:	SWARTA PARK ROAD, MIDDLETOWN, PA		Page 1 of 1
HDD No.:	S3-0050	Dates(s) Drilled: 11-09-14	Inspector: E. WATT
Boring No.:	SB-01	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft):	Total Depth (ft):
Boring Location Coordinates:		40°13'4.33"N	76°43'36.19"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
							SOIL BORING NOT PERFORMED. COULD NOT ACCESS BORING		
							DUE TO NO AVAILABLE CROSSING OF RAIL ROAD TRACKS.		
							BASED ON CONSISTANCY OF BORING LOCATIONS SB-02 AND		
							SB-03, AND AVAILABLE REGIONAL GEOLOGICAL INFORMATION,		
							SUBSURFACE CONDITIONS AT SB-01 ARE LIKELY SIMILAR TO SB-01		
							AND SB-02.		

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:	SWARTA PARK ROAD, MIDDLETOWN, PA		Page 1 of 1
HDD No.:	S3-0050	Dates(s) Drilled: 11-09-14	Inspector: E. WATT
Boring No.:	SB-02	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 13.0	Total Depth (ft): 20.4
Boring Location Coordinates:		40° 13' 5.520" N	76° 43' 29.725" 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	0.0			TOPSOIL (<1")					
1	3.0	5.0	0.0		17	ML	BROWN SILT AND FINE SAND (USCS: ML).	6	11	11	12	**22**
				4.0								
2	8.0	10.0	4.0		19	SM	VARIEGATED REDDISH BROWN, GREENISH BROWN, YELLOWISH BRN,	3	9	9	6	**18**
				11.5			FINE TO MEDIUM SAND WITH A LITTLE SILT, LITTLE F-C GRAVEL.					
3	13.0	13.9	11.5		6	SM/ GM	MAROON MICACEOUS FINE SAND AND SILT, AND	2	50/5"			**>50**
							UNWEATHERED F-C SANDSTONE GRAVEL.					
4	18.0	18.6			6		MAROON FINE SAND AND FINE TO COARSE GRAVEL, WITH SOME	18	50/2"			**>50**
				19.0			SILT.					
5	20.0	20.4	19.0		4		PARTIALLY WEATHERED MAROON SANDSTONE AND	50/5"				**>50**
				20.4			CONGLOMERATE.					
							AUGER REFUSAL AT 20'. OFFSET BORING 10' AND CONTINUOUSLY					
							AUGERED TO REFUSAL AT 19.1'.					
							WET ON SPOON AT 13'.					
							WATER LEVEL THROUGH AUGERS AT 14'.					
							CAVED AT 17', WATER LEVEL ON CAVE AT 11'.					

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:	SWARTA CREEK ROAD, MIDDLETOWN, PA		Page 1 of 1
HDD No.:	S3-0050	Dates(s) Drilled: 11-08-14	Inspector: E. WATT
Boring No.:	SB-03	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 13.5	Total Depth (ft): 23.1
Boring Location Coordinates:		40° 13' 10.019" N	76° 43' 24.443" 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")					
			0.7	3.5			MOTTLED ORANGE BROWN AND LIGHT GRAY FINE SAND AND SILT.					
1	3.0	5.0	0.7		18		GRAYISH BROWN FINE TO MEDIUM SAND WITH A LITTLE SILT,	2	7	8	8	**15**
						SM	TRACE FINE GRAVEL.					
2	8.0	9.3			12		MAROON (TRACE OF MOTTLING OF YELLOWISH BROWN), CONTAINS	4	50	50/3"		**>100**
				8.5			CONGLOMERATE MATRIX.					
3	13.0	13.3	8.5		4		MAROON WEATHERED CONGLOMERATE.	50/4"				
4	18.0	18.1			1		MAROON WEATHERED CONGLOMERATE.	50/1"				
5	23.0	23.1		23.1	1		PATIALLY WEATERED COARSE GRAINED SANDSTONE.	50/0"				
							AUGER REFUSAL AT 23'.					
							DIFFICULT DRILLING BETWEEN 9 TO 10', GRINDING BETWEEN					
							11 TO 12'.					
							WATER LEVEL THROUGH AUGERS AT 13.5'.					
							CAVED AT 20'.					

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 S3-0050

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)
S3-0050	SB-02	1	3.0	5.0	12.9	64.3	34	25	9	ML
		2	8.0	10.0	10.3	16.7	-	-	-	-
		3	13.0	13.9	13.7	42.2	-	-	-	-
		4	18.0	18.6	6.6	24.5	-	-	-	-
	SB-03	1	3.0	5.0	5.1	11.1	-	-	-	-
		2	8.0	9.3	8.3	44.0	-	-	-	-

Notes:

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

REGIONAL GEOLOGY SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0050

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
S3-0050	Swatara Creek	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.	Stream valley	Gettysburg Fm	Silty mudstone-shale-sandstone w/ some impure limestone	16,000	21-62	
		SB-02		W.side of creek					
		SB-03		E. side of creek					

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).

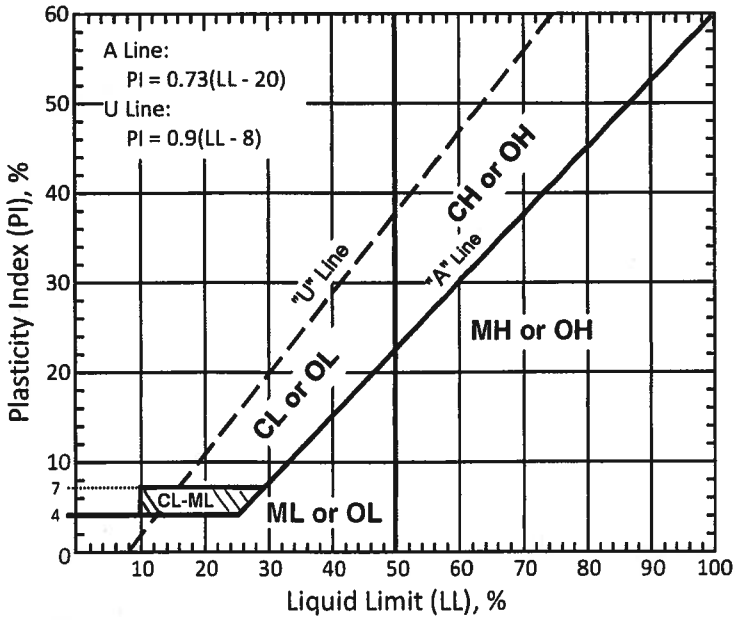
Groundwater observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

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.

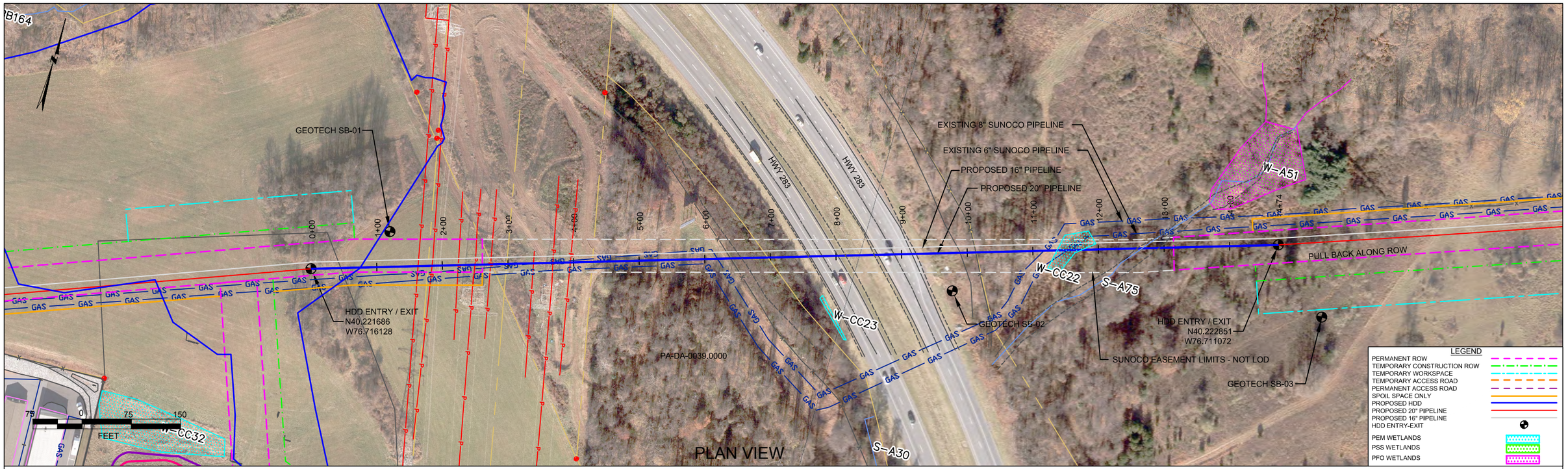


(1) Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC. well-graded gravel-sand mixture with clay binder.

HDD PA-DA-0039.0000-RD (PEM-CC22, S-A75)

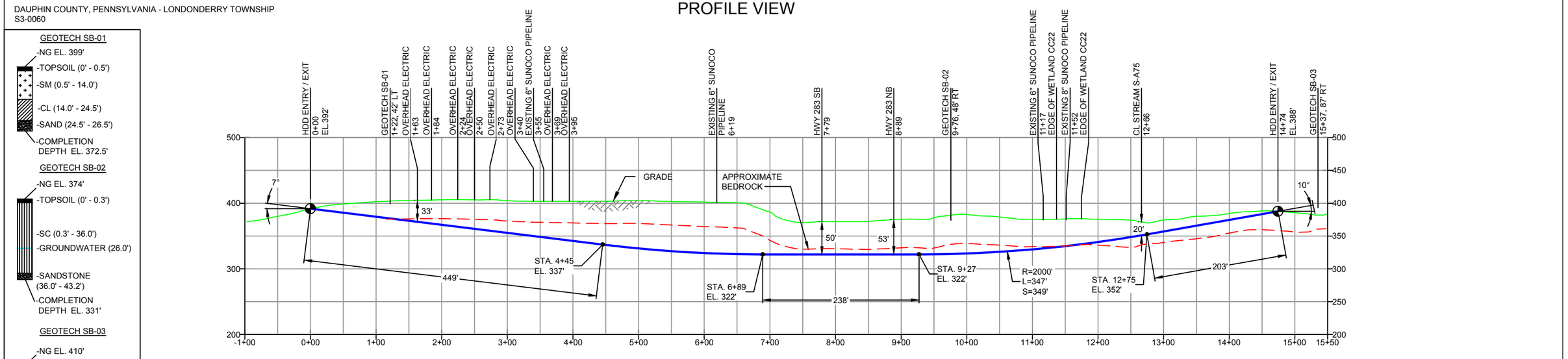
Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable and in this case that threat is considered to be low. Implementing this design, along with adherence to the Pennsylvania Pipeline Project Inadvertent Return Contingency Plan will ensure inadvertent impacts,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

The drill will enter/exit 750 feet from the western edge of Highway 283 and enter/exit 520 feet from the eastern edge. The horizontal directional drill will enter/exit 1,140 feet from the western edge of Grassy Wetland CC22 (PEM-CC22) and enter/exit 290 feet from the eastern edge. The drill will enter/exit 1,270 feet from the western edge of Stream A75 (S-A75) and enter/exit 190 feet from the eastern edge. The drill will pass 50 feet below the highway, 40 feet below PEM-CC22, and 20 feet below S-A75. 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 sandstone beneath layers of sands and silty clays. Based on the geotechnical report and the drill profile minimal inadvertent returns are expected.



DAUPHIN COUNTY, PENNSYLVANIA - LONDONDERRY TOWNSHIP
S3-0060

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=):1446'
   HDD PIPE LENGTH (S=):1455'
   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-4.17	TO	ES-4.18	EROSION & SEDIMENT PLAN	
SHEET 10	TO	SHEET 11	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	09/30/16	RMB	09/30/16	AAW	09/30/16
EP1	REVISED PER PADEP COMMENTS	DLM	05/07/16	RMB	05/07/16	AAW	05/07/16
EP		JTW	11/13/15	RMB	11/13/15	AAW	11/13/15
E	ISSUED FOR BID / DESIGN CHANGE	MRS	10/16/15	RMB	10/16/15	AAW	10/16/15
D	ADDED GEOTECH INFO	MRS	09/21/15	RMB	09/21/15	AAW	09/21/15
C	ISSUED FOR BID	MRS	08/28/16	RMB	08/28/16	AAW	08/28/16

Sunoco Logistics Partners L.P.

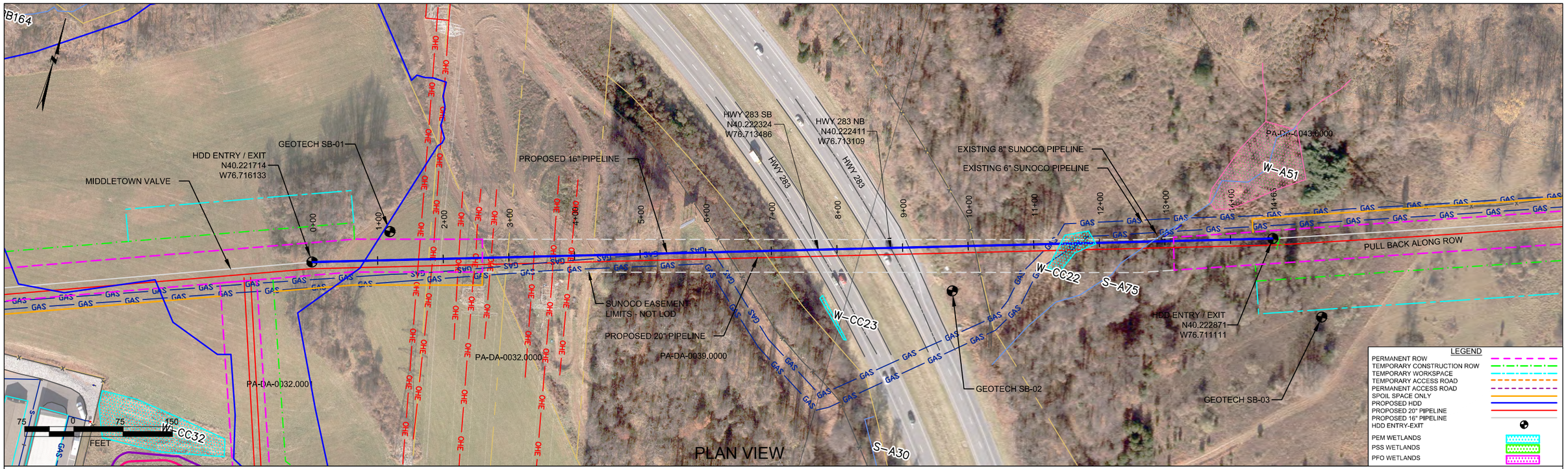
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

20-INCH HORIZONTAL DIRECTIONAL DRILL
HWY 283
PENNSYLVANIA PIPELINE PROJECT

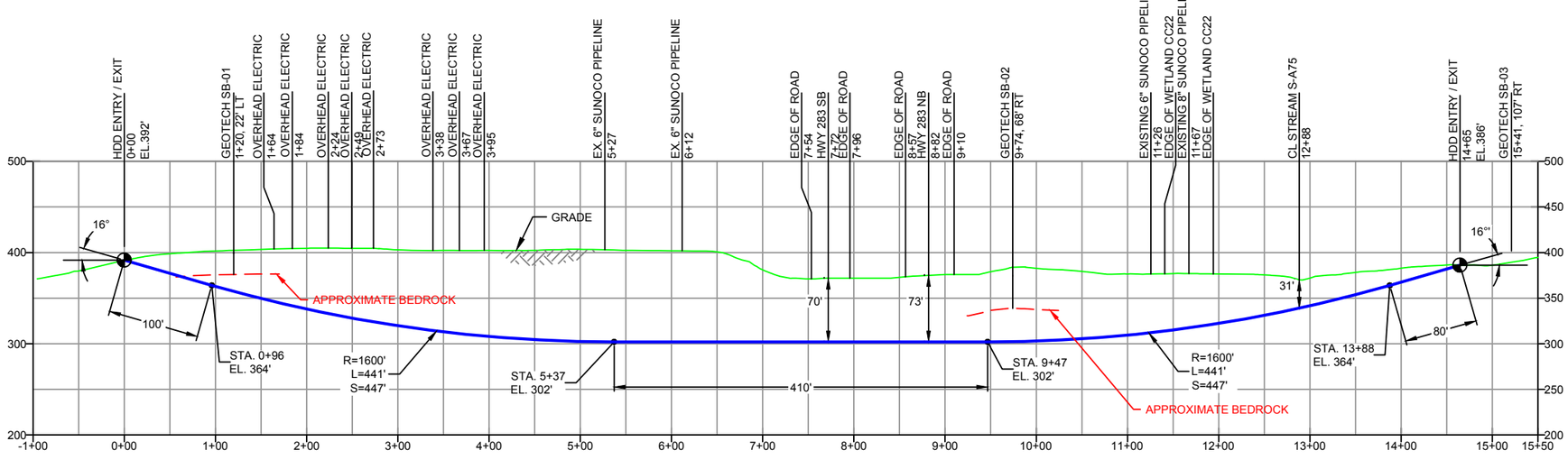
SCALE: 1"=150'

DWG. NO: PA-DA-0039.0000-RD



DAUPHIN COUNTY, PENNSYLVANIA - LONDONDERRY TOWNSHIP
S3-0060-16

PROFILE VIEW



GEOTECH SB-01
-NG EL. 399'
-TOPSOIL (0' - 0.5')
-SM (0.5' - 14.0')
-CL (14.0' - 24.5')
-SAND (24.5' - 26.5')
-AUGER REFUSAL (26.0')
-COMPLETION DEPTH EL. 372.5'

GEOTECH SB-02
-NG EL. 374'
-TOPSOIL (0' - 0.3')
-SC (0.3' - 36.0')
-GROUNDWATER (26.0')
-SANDSTONE (36.0' - 43.2')
-AUGER REFUSAL (43.0')
-COMPLETION DEPTH EL. 331'

GEOTECH SB-03
-NG EL. 410'
-TOPSOIL (0' - 0.7')
-SC (0.7' - 11.5')
-SC (11.5' - 29.4')
-COMPLETION DEPTH EL. 381'

NOTE: REFER TO TEST BORING LOG S3-0060 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=):1465'
   HDD PIPE LENGTH (S=):1484'
   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.
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NOTES
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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-4.17	TO	ES-4.18	EROSION & SEDIMENT PLAN
SHEET 10	TO	SHEET 11	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	DLM	05/07/16	RMB	05/07/16	AAW	05/07/16
EP		JTW	11/13/15	RMB	11/13/15	AAW	11/13/15
C	ISSUED FOR BID / DESIGN CHANGE	MRS	10/16/15	RMB	10/16/15	AAW	10/16/15
B	ADDED GEOTECH INFO	MRS	09/21/15	RMB	09/21/15	AAW	09/21/15
A	ISSUED FOR BID	MRS	08/31/15	RMB	08/31/15	AAW	08/31/15

Sunoco Logistics Partners L.P.

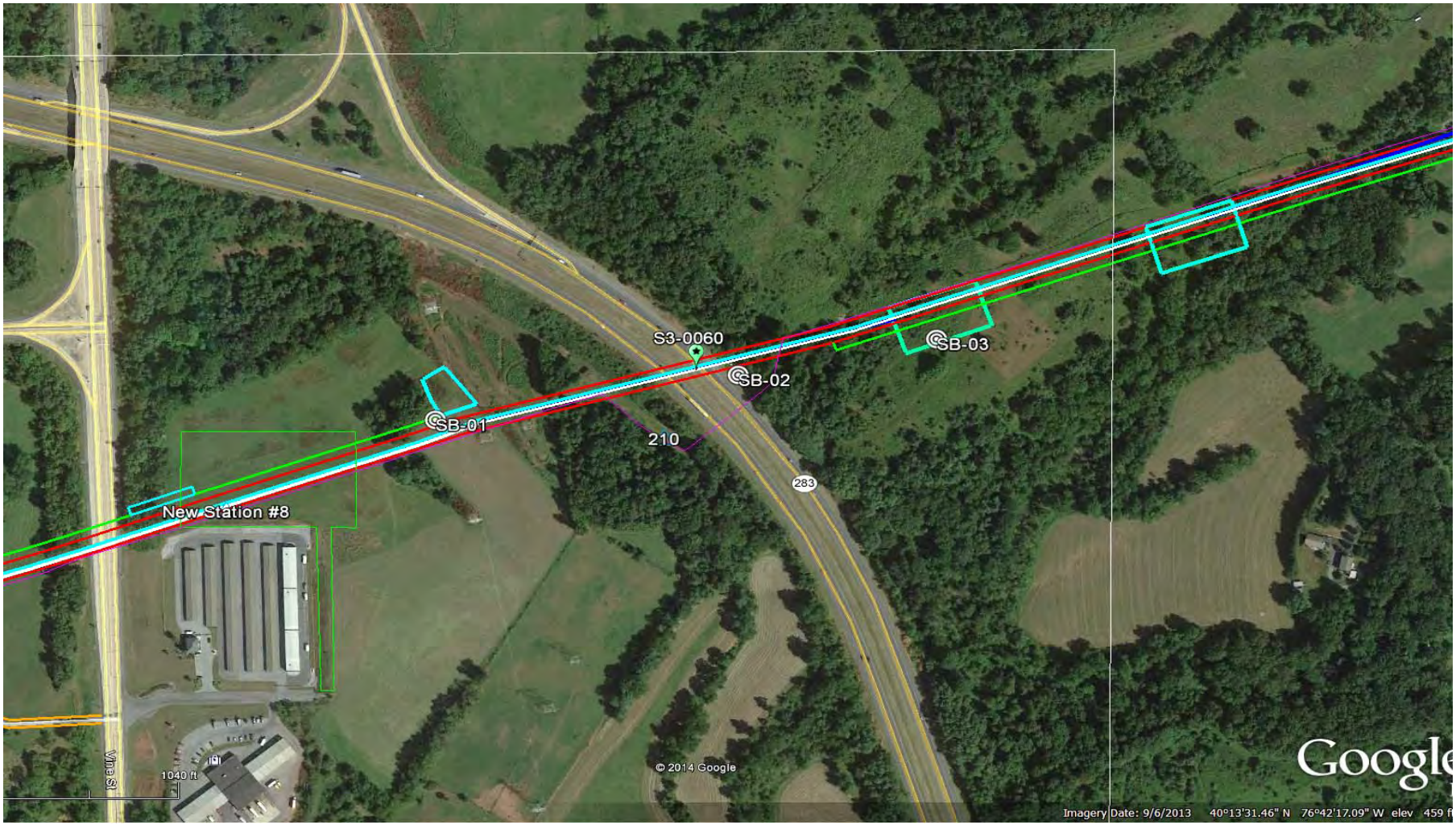
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

16-INCH HORIZONTAL DIRECTIONAL DRILL
HWY 283
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=150'

DWG. NO: PA-DA-0039.0000-RD-16



LEGEND:

Geotechnical Soil Boring (SB) Locations

TETRA TECH

GEOTECHNICAL BORING LOCATIONS
HDD S3-0060
DAUPHIN COUNTY, LODONDERRY 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:	VINE STREET, MIDDLETOWN, PA		Page 1 of 1
HDD No.:	S3-0060	Dates(s) Drilled: 11-09-14	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): 26.5
Boring Location Coordinates:		40° 13' 18.927" N	76° 42' 56.702" 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		18	SM	MAROON FINE TO MEDIUM SAND WITH A LITTLE SILT, TRACE FINE	1	6	8	12	**14**
							QUARTZ GRAVEL.					
2	8.0	10.0			17		MARRON FINE SAND WITH SOME SILT, TRACE FINE	3	7	6	17	**13**
				14.0			GRAVEL.					
3	13.0	15.0	14.0		24	CL	MAROON SILTY CLAY AND FINE SAND WITH CONGLOMERATE MATRIX	4	15	22	28	**>50**
							LENSES.					
4	18.0	20.0			22		MAROON SILTY CLAY, TRACE FINE SAND, TRACE F-GRAVEL	3	15	12	25	**>50**
							(USCS: CL).					
5	23.0	23.9			11		MAROON SILTY CLAY WITH SOME FINE SAND, TRACE FINE	3	50/5"			**>50**
				24.5			GRAVEL.					
6	26.0	26.5	24.5	26.5	5		MAROON FINE TO MEDIUM SAND AN CONGLOMERTE MATRIX.	50/6"				**>50**
							DIFFICULT DRILLING STARTING AT 14'.					
							AUGER REFUSAL AT 26'.					
							CAVED AND DRY AT 17'.					

Notes/Comments:

Pocket Pentrometer Testing

S4: > 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
Newark, Delaware 19713
302.738.7551
fax: 302.454.5988

TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	SHOULDER OF PA 283 WEST, MIDDLETOWN, PA		Page 1 of 1
HDD No.:	S3-0060	Dates(s) Drilled: 11-10-14	Inspector: E. WATT
Boring No.:	SB-02	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 26.0	Total Depth (ft): 43.2
Boring Location Coordinates:		40° 13' 20.305" N	76° 42' 45.741" 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		20		MAROON FINE TO MEDIUM MICACEOUS SAND AND SILTY CLAY,	3	12	14	18	**26**
							TRACE FINE GRAVEL.					
2	8.0	8.9			6		MAROON FINE TO MEDIUM SAND WITH SOME SILTY CLAY, TRACE	4	50/5"			**>50**
							FINE GRAVEL. (USCS: SC)					
3	13.0	13.6			9		MAROON FINE TO MEDIUM SAND WITH SOME SILTY CLAY, TRACE	20	50/2"			**>50**
							FINE GRAVEL WITH CONGLOMERATE MATRIX.					
4	18.0	19.0			8		MAROON FINE TO MEDIUM SAND WITH SOME SILTY CLAY, TRACE	18	50/6"			**>50**
						SC	FINE GRAVEL WITH CONGLOMERATE MATRIX.					
5	23.0	25.0			18		MAROON FINE TO MEDIUM SAND WITH SOME SILTY CLAY AND A	2	17	13	18	**30**
							LITTLE FINE GRAVEL.					
6	28.0	28.7			7		MAROON FINE TO MEDIUM SAND WITH A LITTLE SILTY CLAY AND A	8	50/3"			**>50**
							LITTLE FINE GRAVEL.					
7	33.0	35.0			22		MAROON MEDIUM TO COARSE SAND WITH A LITTLE SILTY CLAY,	4	38	30	40	**68**
				36.0			WITH CONGLOMERATE MATRIX.					
8	38.0	38.4	36.0		4		MAROON PARTIALLY WEATHERED SANDSTONE	50/5"				
9	43.0	43.2		43.2	2		MAROON PARTIALLY WEATHERED SANDSTONE	50/2"				
							AUGER REFUSAL AT 43'.					
							WET ON SPOON AT 26'.					
							WATER LEVEL NOT DETECTED THROUGH AUGERS.					
							CAVED AT 37', WATER LEVEL ON CAVE AT 13'.					

Notes/Comments:
Pocket Pentrometer Testing

DR: DECOMPOSED ROCK

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

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

TETRA TECH
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Newark, Delaware 19713
302.738.7551
fax: 302.454.5988

TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	FIELD SOUTH OF SUNOCO ROW, EAST OF PA 283 WEST, MIDDLETOWN, PA		Page 1 of 1
HDD No.:	S3-0060	Dates(s) Drilled: 11-10-14	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): 29.4
Boring Location Coordinates:		40° 13' 21.396" N	76° 42' 38.605" 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		12	SC	REDDISH BROWN FINE TO MEDIUM SAND WITH A LITTLE SILTY	2	8	10	13	**18**
							CLAY.					
2	8.0	10.0			21		REDDISH BROWN FINE TO MEDIUM SAND WITH SOME LITTLE SILTY	1	5	6	6	**11**
				11.5			CLAY.					
3	13.0	15.0	11.5		24	SC	DR WEATHERED TO A MAROON (WITH WHITE SPECS) FINE TO MEDIUM	3	20	30	50	**50**
							SAND WITH SOME SILTY CLAY, WITH CONGLOMERTE MATRIX.					
4	18.0	20.0			18		DR WEATHERED TO A MAROON (WITH WHITE SPECS) FINE TO MEDIUM	5	18	28	45	**46**
							SAND WITH A LITTLE SILTY CLAY, LITTLE F-C GRAVEL					
5	23.0	24.2			11		DR WEATHERED TO A MAROON F-MSAND, SOME SILTY CLAY, TRACE	1	20	50/2"		**>70**
							UNWEATHERED GRAVEL, WITH CONGLOMERATE MATRIX.					
6	28.0	29.4			13		DR WEATHERED TO A MAROON F-MSAND, SOME SILTY CLAY, TRACE	3	27	50/5"		**>77**
				29.4			UNWEATHERED GRAVEL, WITH CONGLOMERATE MATRIX.					
							CAVED AND DRY AT 27'.					

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 S3-0060

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)
S3-0060	SB-01	2	8.0	10.0	10.2	23.9	-	-	-	-
		3	13.0	15.0	10.5	53.3	-	-	-	-
		4	18.0	20.0	14.0	93.9	41	23	18	CL
		5	23.0	23.9	9.1	74.7	-	-	-	-
	SB-02	2	8.0	8.9	8.3	36.6	37	23	14	SC
		4	18.0	19.0	8.1	21.0	-	-	-	-
		6	28.0	28.7	10.9	17.1	-	-	-	-
	SB-03	2	8.0	10.0	13.0	33.7	-	-	-	-
		3	13.0	15.0	8.3	36.4	-	-	-	-
		4	18.0	20.0	7.2	16.8	-	-	-	-
		5	23.0	24.2	11.6	30.4	-	-	-	-
		6	28.0	29.4	9.0	33.8	-	-	-	-

Notes:

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

REGIONAL GEOLOGY SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0060

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
S3-0060	HW 283	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.	Upland along PA Route 283	Gettysburg Fm	Silty mudstone-shale-sandstone w/ some impure limestone	16,000	36-135 (average ~ 60)	
		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).

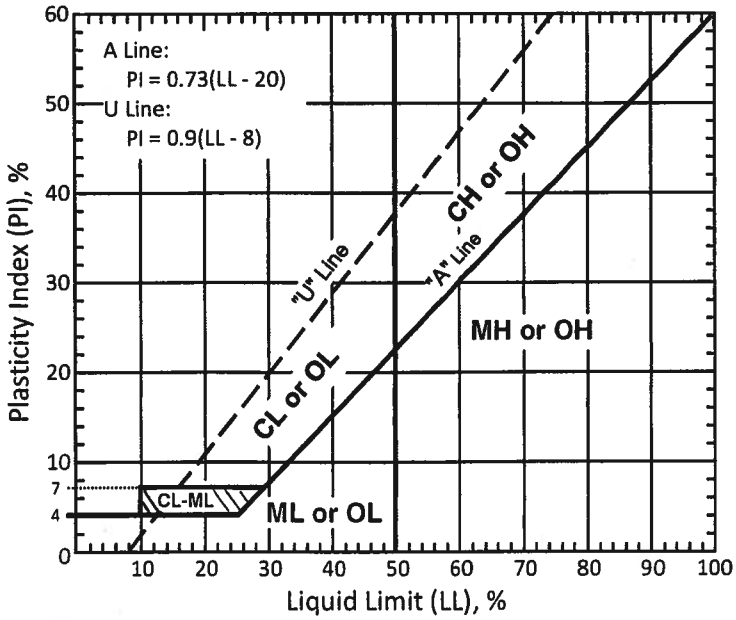
Groundwater observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

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.



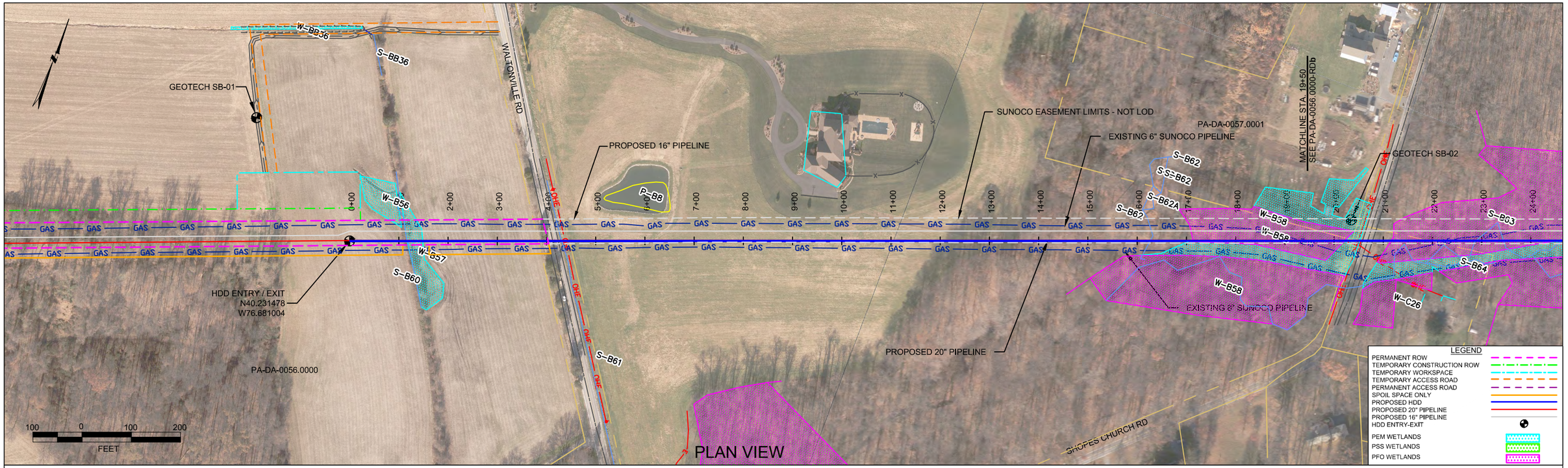
(1) Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC. well-graded gravel-sand mixture with clay binder.

HDD PA-DA-0056.0000-RD (S-B60, PEM-B57, S-B61, S-B62, W-B58, W-C26, S-B63)

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 120 feet from the western edge of Stream B60 (S-B60) and enter exit 3,750 feet from the eastern edge. The drill will enter/exit 120 feet from the edge of Grassy Wetland B57 (PEM-B57) and enter/exit 3,720 feet from the eastern edge. The western entrance/exit of the drill will be 430 feet from the western edge of Stream B61 (S-B61) while the eastern entrance/exit is 3,440 feet from the eastern edge. The western edge of Stream B62 (S-B62) is 1,630 feet from the drill's western entrance/exit and the eastern edge is 2,240 feet from the eastern entrance/exit. The drill will enter/exit 1,710 feet from the western edge of wetland B58 (W-B58) and will enter/exit 1,820 feet from the eastern edge. The drill will enter/exit 2,120 feet from the western edge of Wetland C26 (W-C26) and enter/exit 100 feet from the eastern edge. The Iron Run (S-B63) crosses the drill in multiple locations. The westernmost crossing is 2,290 feet from the drill's western entrance/exit while the easternmost crossing is 1,306 feet from the eastern entrance/exit. The drill will pass under each of these formations at different depths: 15 feet below S-B60 and PEM-B57; 32 feet beneath S-B61; 20 feet beneath S-B62; 25 feet beneath W-B58; 25 feet beneath S-B63; and between 25 feet on the western side and 5 feet on the eastern edge beneath W-C26.

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 sandstone beneath layers of sands with some silts. Based on the geotechnical report and the drill profile minimal inadvertent returns are expected. Additional inspection is recommended on the eastern portion of the drill due to the lower depth of the drill and the size of W-C26.

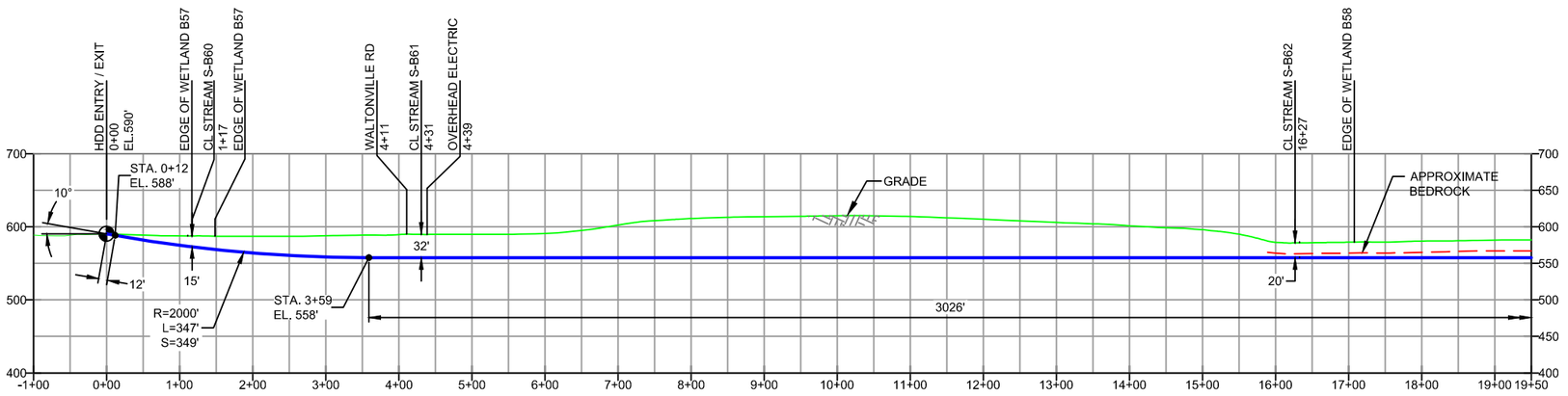


PROFILE VIEW

DAUPHIN COUNTY, PENNSYLVANIA - DERRY TOWNSHIP
S3-0080A

GEOTECH SB-01
-NG EL. 599'
-TOPSOIL (0' - 1.0')
-GROUNDWATER (6.0')
-SM (1.0' - 30.0')
-COMPLETION DEPTH EL. 569'

NOTE: REFER TO TEST BORING LOG S3-0080 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=):3,850'
   HDD PIPE LENGTH (S=):3,855'
   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-4.23	TO	ES-4.25	EROSION & SEDIMENT PLAN
SHEET 14	TO	SHEET 15	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	05/08/16	RMB	05/08/16	AAW	05/08/16
EP		JTW	03/15/16	RMB	03/15/16	AAW	03/15/16
C	ADDED GEOTECH INFO	MRS	09/21/15	RMB	09/21/15	AAW	09/21/15
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

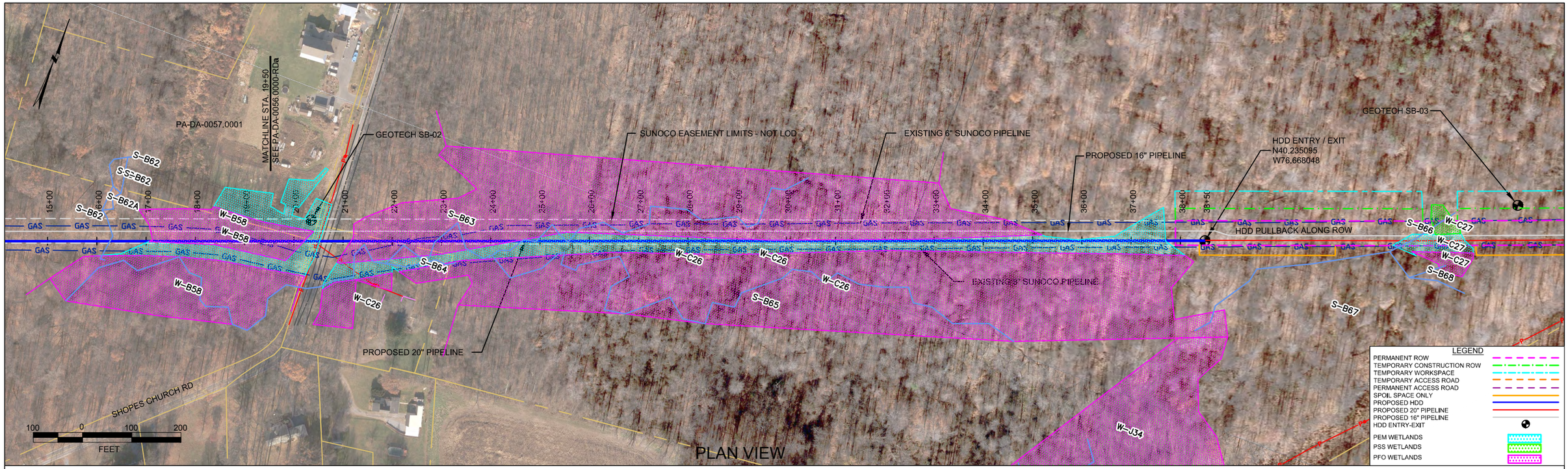
Sunoco Logistics Partners L.P.

TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

20-INCH HORIZONTAL DIRECTIONAL DRILL
WALTONVILLE ROAD
PENNSYLVANIA PIPELINE PROJECT

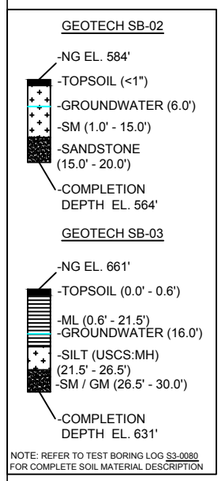
SCALE: 1"=200' | DWG. NO: PA-DA-0056.0000-RDa



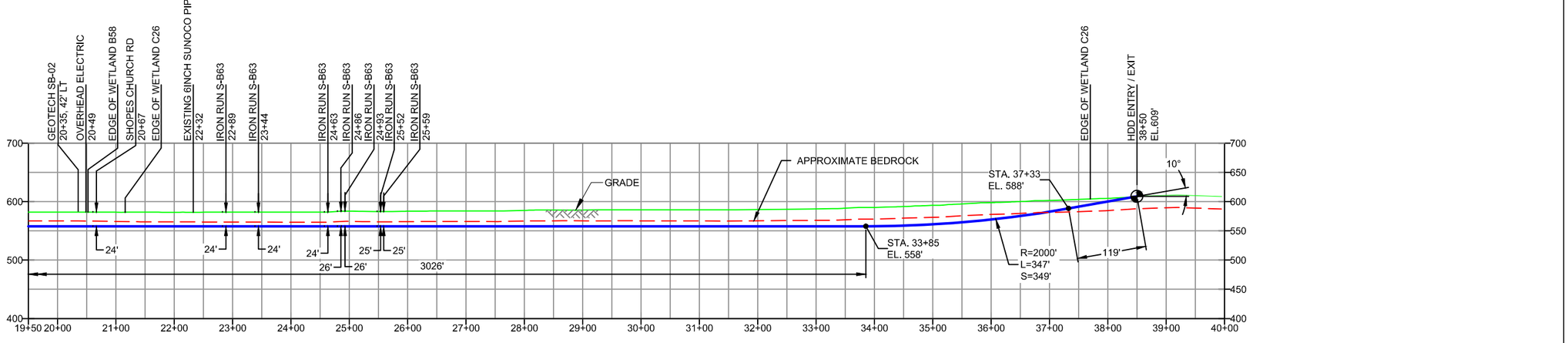
PLAN VIEW

PROFILE VIEW

DAUPHIN COUNTY, PENNSYLVANIA - DERRY TOWNSHIP
S3-0080B



NOTE: REFER TO TEST BORING LOG S3-0080 FOR COMPLETE SOIL MATERIAL DESCRIPTION



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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=):3850'
   HDD PIPE LENGTH (S=):3855'
   20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
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REF. DRAWING

ES-4.23	TO	ES-4.25	EROSION & SEDIMENT PLAN	
SHEET 14	TO	SHEET 15	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	09/30/16	RMB	09/30/16	AAW	09/30/16
EP1	REVISED PER PADEP COMMENTS	DLM	05/17/16	RMB	05/17/16	AAW	05/17/16
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A	ISSUED FOR REVIEW	JVA	04/15/15	RMB	04/15/15	AAW	04/15/15

Sunoco Logistics Partners L.P.

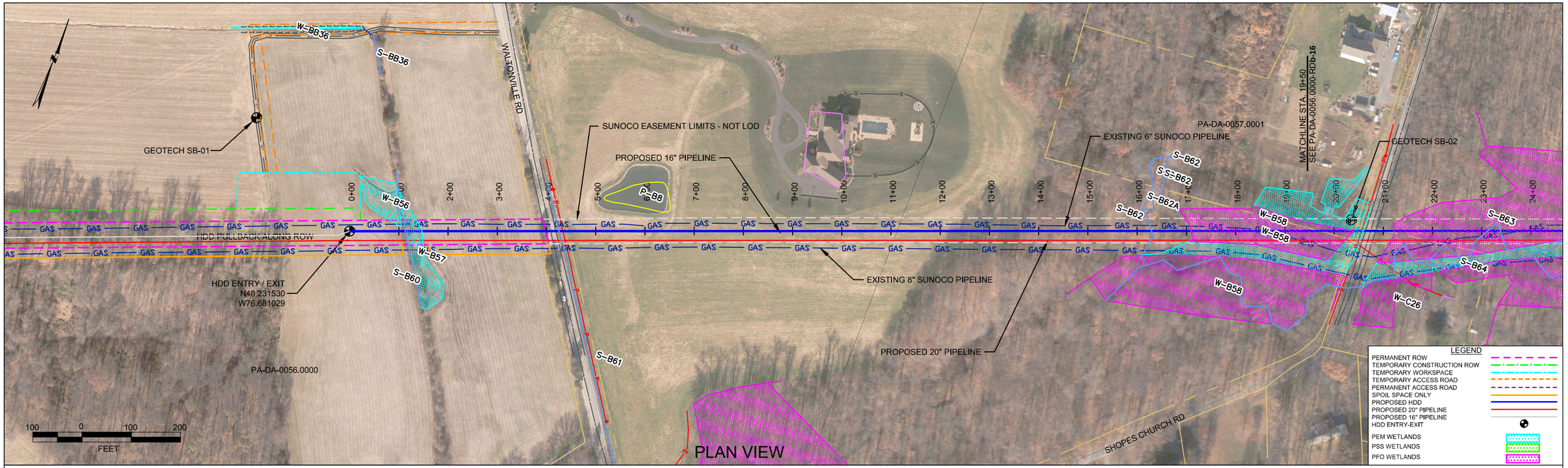
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

20-INCH HORIZONTAL DIRECTIONAL DRILL
WALTONVILLE ROAD
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=200'

DWG. NO: PA-DA-0056.0000-RDb



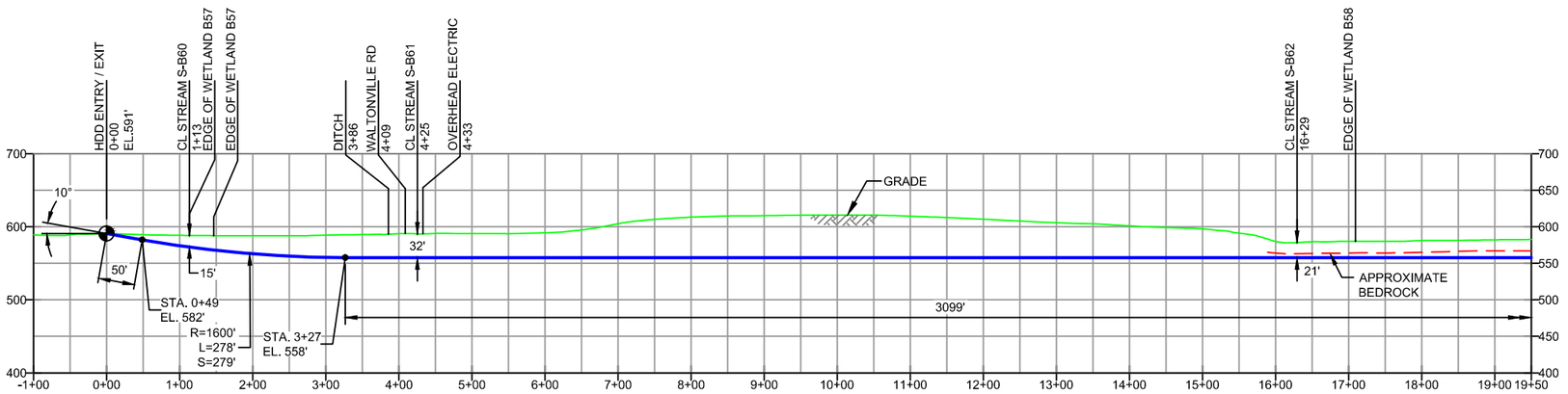
PROFILE VIEW

DAUPHIN COUNTY, PENNSYLVANIA - DERRY TOWNSHIP
S3-0080A-16

GEOTECH SB-01

-NG EL. 599'
-TOPSOIL (0' - 1.0')
-GROUNDWATER (6.0')
-SM (1.0' - 30.0')
-COMPLETION DEPTH EL. 569'

NOTE: REFER TO TEST BORING LOG S3-0080 FOR COMPLETE SOIL MATERIAL DESCRIPTION



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3. DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
4. CROSSING PIPE SPECIFICATION:
   HDD HORZ. LENGTH (L=):3850'
   HDD PIPE LENGTH (S=):3875'
   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-4.23	TO	ES-4.25	EROSION & SEDIMENT PLAN
SHEET 14	TO	SHEET 15	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	DLM	05/09/16	RMB	05/09/16	AAW	05/09/16
EP		JTW	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

Sunoco Logistics Partners L.P.

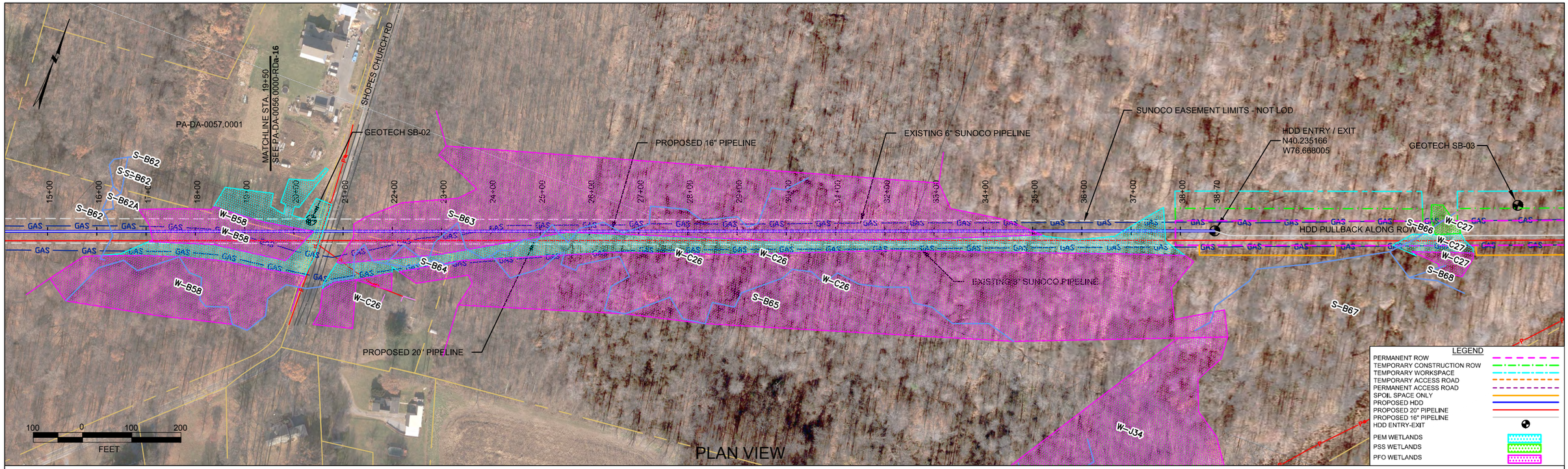
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

16-INCH HORIZONTAL DIRECTIONAL DRILL
WALTONVILLE ROAD
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=200'

DWG. NO: PA-DA-0056.0000-RDa-16



PLAN VIEW

PROFILE VIEW

DAUPHIN COUNTY, PENNSYLVANIA - DERRY TOWNSHIP
S3-0080B-16

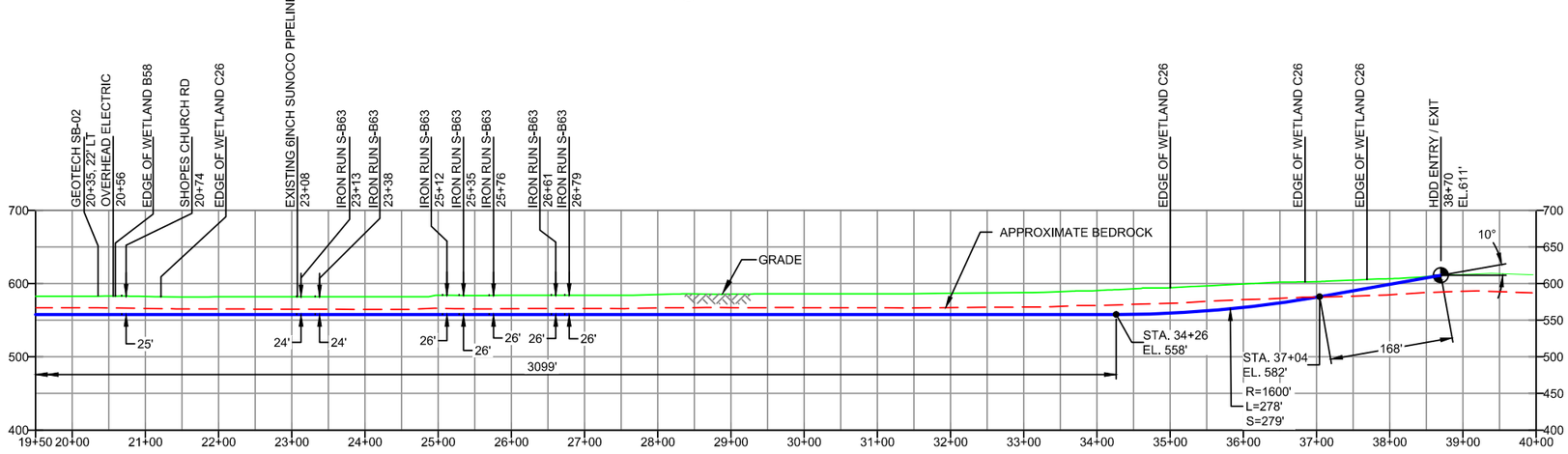
GEOTECH SB-02

-NG EL. 584'
-TOPSOIL (<1")
-GROUNDWATER (6.0')
-SM (1.0' - 15.0')
-SANDSTONE (15.0' - 20.0')
-COMPLETION DEPTH EL. 564'

GEOTECH SB-03

-NG EL. 661'
-TOPSOIL (0.0' - 0.6')
-ML (0.6' - 21.5')
-GROUNDWATER (16.0')
-SILT (USCS:MH) (21.5' - 26.5')
-SM / GM (26.5' - 30.0')
-COMPLETION DEPTH EL. 631'

NOTE: REFER TO TEST BORING LOG S3-0080 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=):3850'
   HDD PIPE LENGTH (S=):3875'
   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.
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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

ES-4.23	TO	ES-4.25	EROSION & SEDIMENT PLAN	
SHEET 14	TO	SHEET 15	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	DLM	05/17/16	RMB	05/17/16	AAW	05/17/16
EP		JTW	03/15/16	RMB	03/15/16	AAW	03/15/16
B	ISSUED FOR BID	MRS	09/22/15	RMB	09/22/15	AAW	09/22/15
A	ISSUED FOR REVIEW	JVA	08/31/15	RMB	08/31/15	AAW	08/31/15

Sunoco Logistics Partners L.P.

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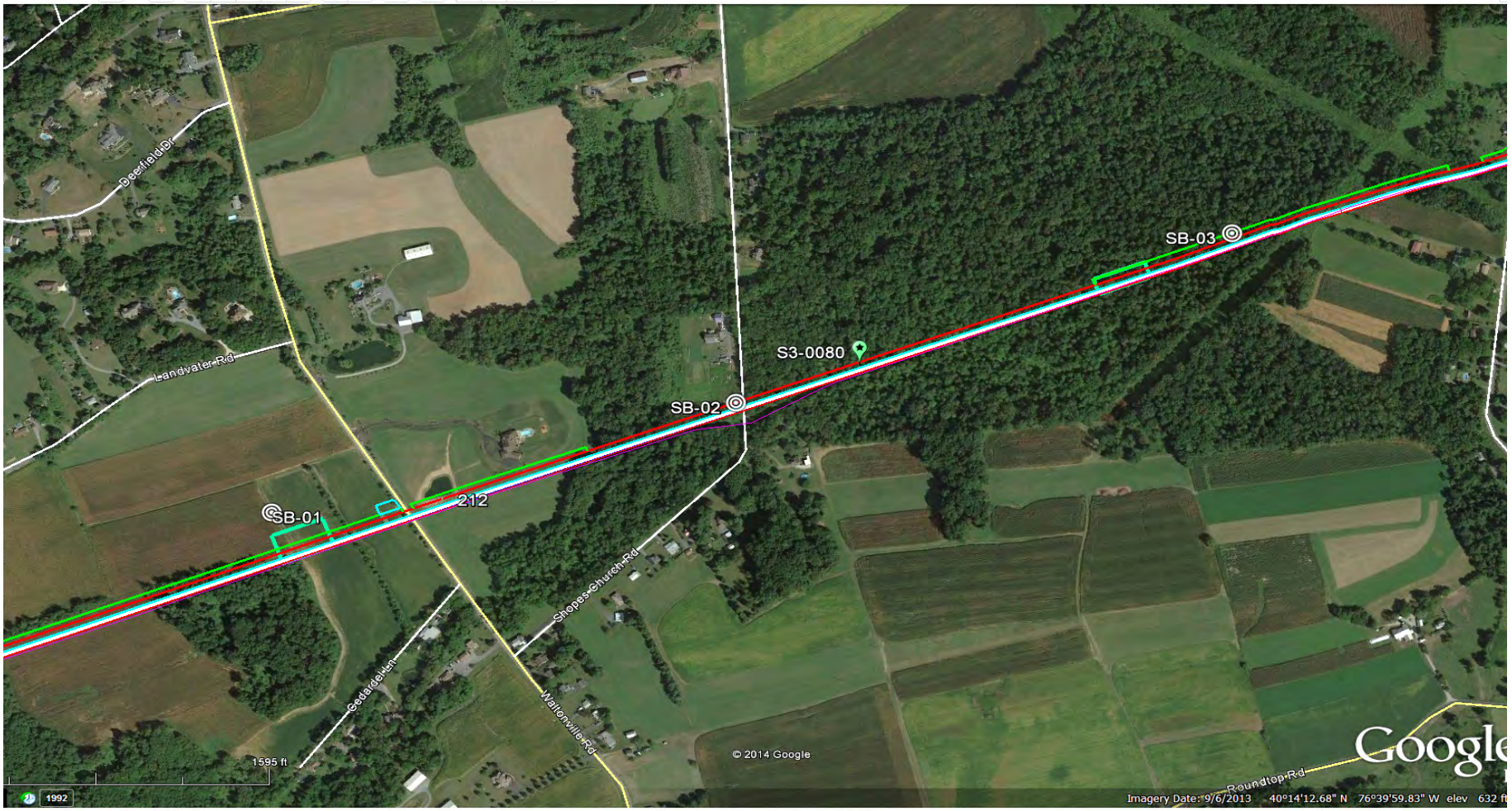
SUNOCO PIPELINE, L.P.

16-INCH HORIZONTAL DIRECTIONAL DRILL
WALTONVILLE ROAD
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=200'

DWG. NO: PA-DA-0056.0000-RDb-16



LEGEND:

◎ Geotechnical Soil Boring (SB) Locations

TETRA TECH

GEOTECHNICAL BORING LOCATIONS
HDD S3-0080
DAUPHIN COUNTY, DERRY 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:	WALTONVILLE ROAD, HUMMELSTOWN, PA		Page 1 of 1
HDD No.:	S3-0080	Dates(s) Drilled: 11-11-14	Inspector: E. WATT
Boring No.:	SB-01	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 6.0	Total Depth (ft): 30.0
Boring Location Coordinates:		40° 13' 55.015" N	76° 40' 54.952" 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	1.0			TOPSOIL (12")					
1	3.0	5.0	1.0		16	SM	BROWN TO ORANGE BROWN MEDIUM TO COARSE SAND WITH	2	8	10	11	**18**
							SOME SILT AND A LITTLE FINE TO COARSE GRAVEL.					
2	8.0	10.0			20		GRAY FINE TO MEIDUM SAND WITH SOME SILT.	2	6	6	6	**12**
3	13.0	15.0			24		GRAY FINE SAND WITH SOME SILT, TRACE FINE GRAVEL.	1	3	6	12	**9**
4	18.0	20.0			8		GRAY FINE TO MEDIUM SAND WITH SOME SILT, AND WITH SOME	3	14	15	15	**29**
							FINE TO COARSE GRAVEL.					
5	23.0	25.0			22		GRAY AND BROWN FINE TO MEDIUM SAND WITH A LITTLE SILT, AND	6	22	19	50	**41**
							A LITTLE FINE GRAVEL.					
6	28.0	29.2			10		BROWN TO ORANGE BROWN MEDIUM TO COARSE SAND WITH A	2	15	50/2"		**>65**
				30.0			LITTLE SILT.					
							WET ON SPOON AT 6'.					
							WATER LEVEL THROUGH AUGERS AT 8'.					
							CAVED AT 21', WATER LEVEL ON CAVE AT 5'.					

Notes/Comments:
Pocket Pentrometer Testing

DR: DECOMPOSED ROCK

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

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

TETRA TECH
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Newark, Delaware 19713
302.738.7551
fax: 302.454.5988

TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	SHOPS CHURCH ROAD, HUMMELSTOWN, PA		Page 1 of 1
HDD No.:	S3-0080	Dates(s) Drilled: 11-11-14	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): 20.0
Boring Location Coordinates:		40° 14' 0.606" N	76° 40' 27.087" 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	0.0			TOPSOIL (<1")					
1	3.0	5.0	0.0		18		BROWN, YELLOWISH BROWN TO ORANGE BROWN FINE TO COARSE	1	6	11	11	**17**
							SAND WITH A LITTLE SILT, AND LITTLE F-C GRAVEL.					
2	8.0	9.9			24		SAME, WITH PIECES OF UNWEATHERED SANDSTONE.	2	9	26	50/5"	**35**
							AUGER REFUSAL AT 12', OFF-SET 10' SOUTH, AND CONTINUOULSY					
						SM	AUGERED TO 10'.					
3	10.0	12.0					DR WEATHERED TO A YELLOWISH BROWN TO GRAY FINE TO	8	29	17	50/6"	**46**
							COARSE SAND AND SILT, WITH SOME F-C UNWEATHERED SANDSTONE					
				15.0			GRAVEL.					
							AUGERS STICKING UP TOO HIGH TO ROCK CORE. OFF-SET BORING					
							AND CONTINUOUSLY AUGERED TO REFUSAL AT 15"					
							<u>ROCK CORING</u>					
RUN 1	15.0	20.0	15.0	20.0	24		HIGHLY FRACTURED AND HEAVILY WEATHERED GRAY SAND STONE.	TCR: 40%, SCR: 0%, RQD: 0%				
							COULD NOT PERFORM AN ADDITIONAL ROCK CORE RUN. BORING					
							CAVED DUE TO HEAVILY FRACTURED/WEATHERED ROCK.					
							WET ON SPOON AT 10'					
							WATER LEVEL THROUGH AUGERS AT 6'.					
							CAVED AT 4', WATER AT SURFACE.					

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

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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302.738.7551
fax: 302.454.5988

TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	SAND HILL ROAD, NUMMELSTOWN, PA		Page 1 of 1
HDD No.:	S3-0080	Dates(s) Drilled: 11-12-14	Inspector: E. WATT
Boring No.:	SB-03	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 16.0	Total Depth (ft): 30.0
Boring Location Coordinates:		40° 14' 9.164" N	76° 39' 57.534" 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		17		BROWN SILT AND FINE SAND WITH A TRACE FINE	2	7	8	9	**15**
				6.5			GRAEL.					
2	8.0	10.0	6.5		24		ORANGE BROWN CLAYEY SILT AND FINE SAND, TRACE FINE	4	9	7	12	**16**
				11.5		ML	GRAVEL (USCS: ML).					
3	13.0	15.0	11.5		24		ORANGE BROWN TO REDDISH BROWN CLAYEY SILT WITH A LITTLE	1	2	4	5	**6**
							FINE SAND, TRACE FINE GRAVEL.					
4	18.0	20.0			24		ORANGE BROWN TO REDDISH BROWN CLAYEY SILT AND FINE	1	1	7	22	**8**
				21.5			SAND, TRACE FINE GRAVEL.					
5	23.0	25.0	21.5		15	MH	MOTTLED (GRAY, YELLOWISH BRWN,BLACK) CLAYEY SILT WITH	8	12	3	11	**15**
				26.5			SOME FINE SAND, TRACE FINE GRAVEL. (USCS: MH)					
6	28.0	30.0	26.5		13	SM/ GM	VARI-COLORED FINE TO COARSE SAND AND FINE TO COARSE	3	21	34	43	**55**
				30.0			SANDSTONE GRAVEL.					
							SOME GRINDING AT 9'.					
							WET ON SPOON AT 16'.					
							WATER LEVEL NOT DETECTED THORUGH AUGERS.					
							CAVED AT 26', WATER LEVEL ON CAVE AT 20'.					

Notes/Comments:

Pocket Pentrometer Testing
S1: > 4 TSF S4: 1.25 TSF
S2: 3 TSF
S3: 1.5 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 S3-0080

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)
S3-0080	SB-01	2	8.0	10.0	19.1	30.4	-	-	-	-
		3	13.0	15.0	17.5	27.2	-	-	-	-
		5	23.0	25.0	16.3	21.0	-	-	-	-
		6	28.0	29.2	16.7	16.2	-	-	-	-
	SB-02	1	3.0	5.0	13.8	18.9	-	-	-	-
		2	8.0	9.9	9.6	14.5	-	-	-	-
		3	10.0	12.0	29.8	46.2	-	-	-	-
	SB-03	1	3.0	5.0	15.1	55.7	-	-	-	-
		2	8.0	10.0	39.4	54.0	49	34	15	ML
		3	13.0	15.0	50.0	81.0	-	-	-	-
		4	18.0	20.0	49.5	66.3	-	-	-	-
		5	23.0	25.0	45.5	73.7	53	38	15	MH

Notes:

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

REGIONAL GEOLOGY SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0080

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
S3-0080	Wetland C26 - Shopes Church Rd.	SB-01 SB-02 SB-03	**Diabase** - occurs primarily as dikes and sheets and forms a complex igneous network that extensively intrudes sedimentary rocks in the Gettysburg and Newark basins.	Moderately sloping rolling hills	Diabase	Ophitic texture , an important variety of basalt texture where pyroxene (or occasionally olivine) forms larger crystals and typically contains numerous crystals of plagioclase (right).	N/A	10-62	Diabase - Medium- to coarse-grained, quartz-normative tholeiite; composed of labradorite and various pyroxenes; occurs as dikes, sheets, and a few small flows. Includes the dark-gray York Haven Diabase (high titanium oxide) and the slightly younger Rossville Diabase (low titanium oxide). In chilled margins, the Rossville is distinguished from the York Haven by its lighter gray color and distinctive, sparse, centimeter-sized calcic-plagioclase phenocrysts.

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

ROCK CORE DESCRIPTION SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0080

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					
S3-0080	SB-2	1	15	20	40	0	0	15	20	Heavily	Sandstone	Massive	Gray	Heavily fractured, ranging from 0° to 90°

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).

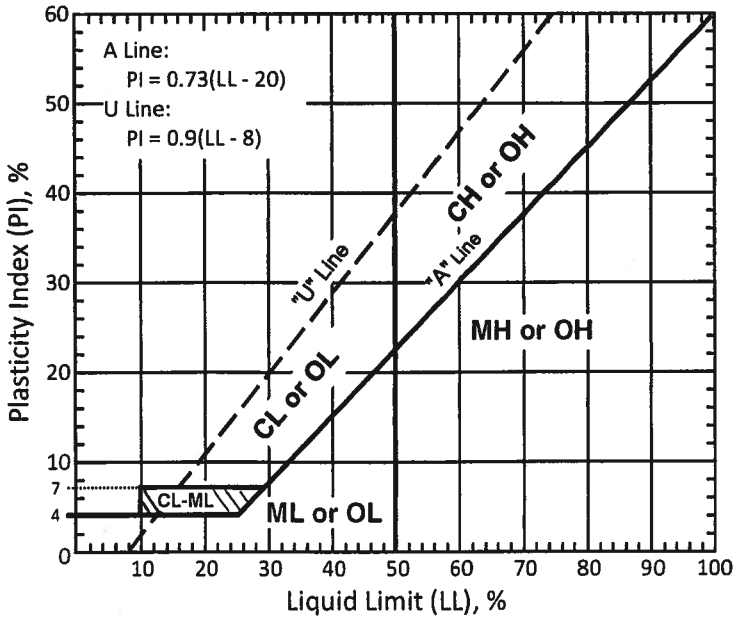
Groundwater observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

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.

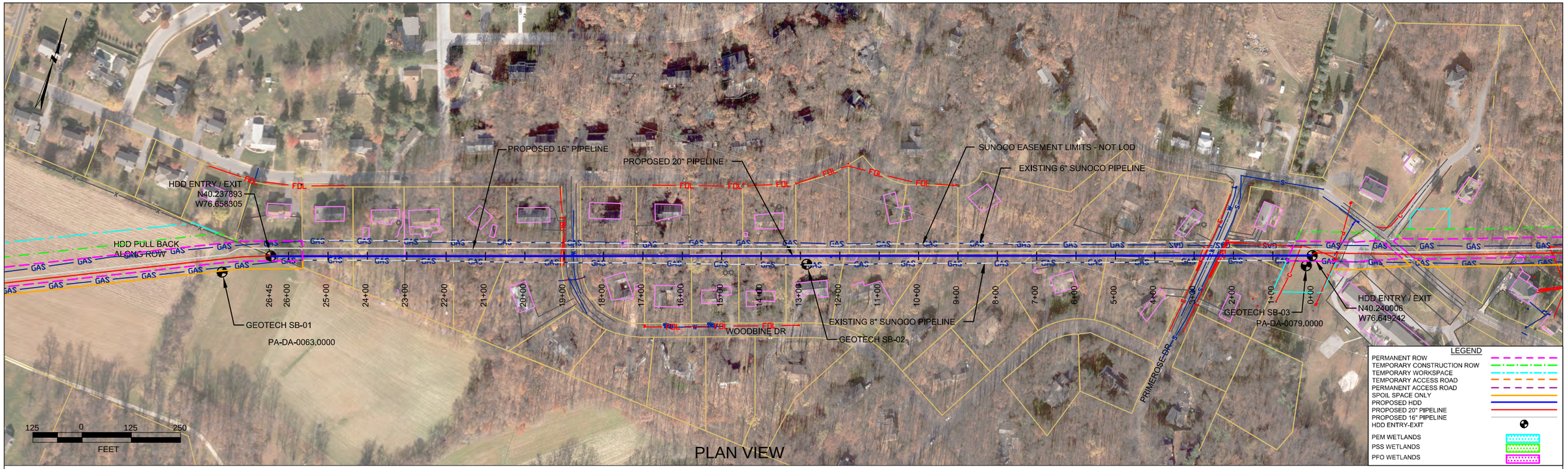


(1) Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC. well-graded gravel-sand mixture with clay binder.

HDD PA-DA-0063.0000-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.

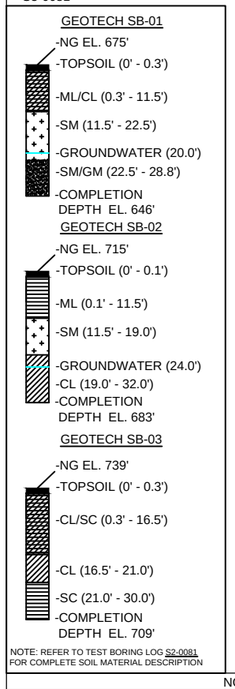
The drill will enter/exit 780 feet from the western edge of Woodbine Drive and enter/exit 1,850 feet from the eastern edge. The drill will enter/exit 2,370 feet from the western edge of Primrose Drive and enter/exit 240 feet from the eastern edge. There are no active water bodies or wetlands in the area of this drill. The drill will pass 115 feet below Woodbine Drive and 36 feet below Primrose Drive. 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 sandstone below layers of clayey silt and sands. Based on the geotechnical report and the drill profile minimal inadvertent returns are expected.



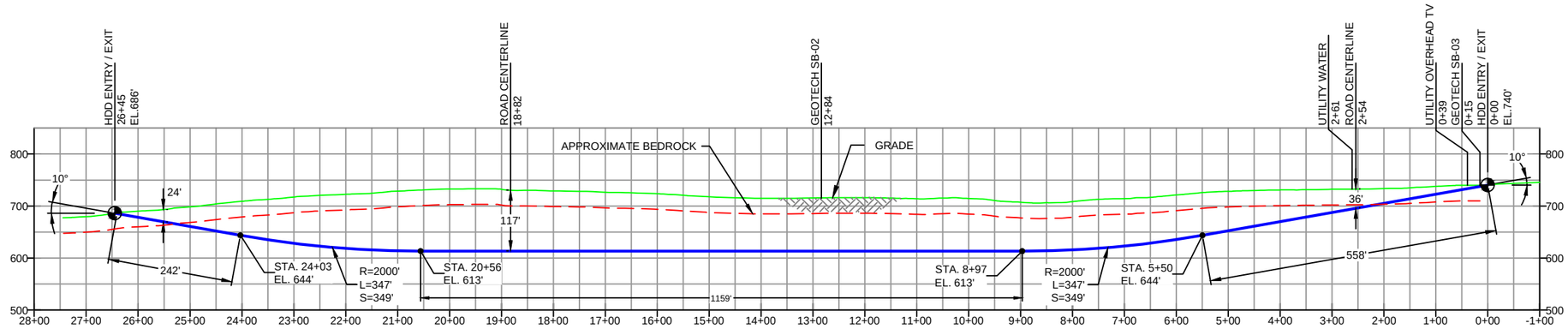
PLAN VIEW

PROFILE VIEW

DAUPHIN COUNTY, PENNSYLVANIA - DERRY TOWNSHIP
S3-0081



NOTE: REFER TO TEST BORING LOG S2-0081 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=):2645'
   HDD PIPE LENGTH (S=):2657'
   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-4.27	TO	ES-4.29	EROSION & SEDIMENT PLAN	EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	MRS	09/30/16	RMB	09/30/16	AAW	09/30/16
SHEET 17	TO	SHEET 17	AERIAL SITE PLAN	EP1	REVISED PER PADEP COMMENTS	DLM	05/09/16	RMB	05/09/16	AAW	05/09/16
				EP		DLM	11/13/15	RMB	11/13/15	AAW	11/13/15
				C	ADDED GEOTECH INFO/DESIGN ADJUSTMENT	MRS	10/27/15	RMB	10/27/15	AAW	10/27/15
				B	ISSUED FOR BID	MRS	07/31/15	RMB	07/31/15	AAW	07/31/15
				A	ISSUED FOR FOR REVIEW	KB	04/15/15	RMB	04/15/15	AAW	04/15/15
DWG NO		DWG NO	DESCRIPTION	NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE

Sunoco Logistics Partners L.P.

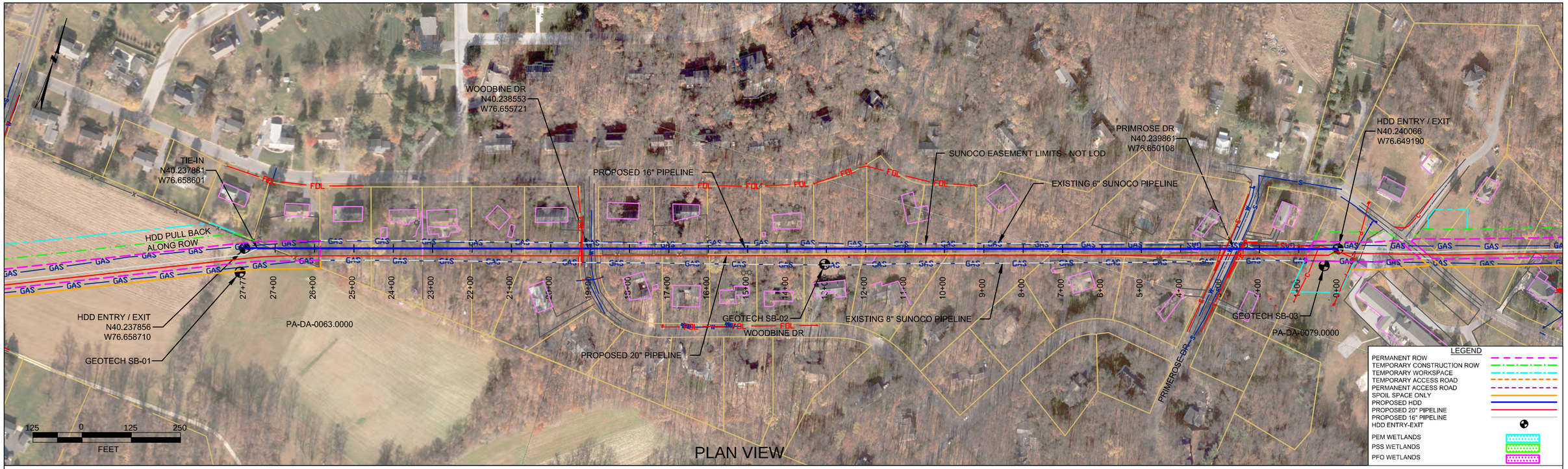
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

20-INCH HORIZONTAL DIRECTIONAL DRILL
WOODBINE DRIVE
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=250'

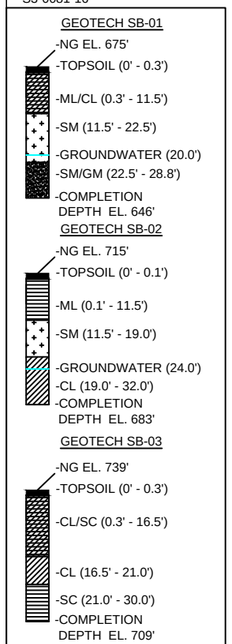
DWG. NO: PA-DA-0063.0000-RD



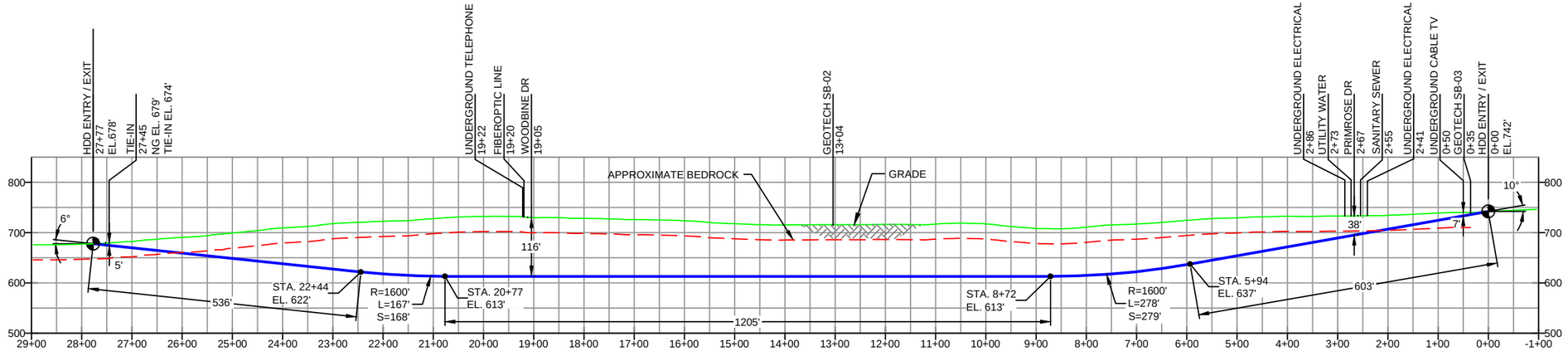
PLAN VIEW

PROFILE VIEW

DAUPHIN COUNTY, PENNSYLVANIA - DERRY TOWNSHIP
S3-0081-16



NOTE: REFER TO TEST BORING LOG S2-0081 FOR COMPLETE SOIL MATERIAL DESCRIPTION



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3. DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
4. CROSSING PIPE SPECIFICATION:
   HDD HORZ. LENGTH (L=):2777'
   HDD PIPE LENGTH (S=):2791'
   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.
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NOTES

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

REF. DRAWING

DWG NO		DWG NO	DESCRIPTION
ES-4.27	TO	ES-4.29	EROSION & SEDIMENT PLAN
SHEET 17	TO	SHEET 17	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	DLM	05/09/16	RMB	05/09/16	AAW	05/09/16
EP		DLM	11/13/15	RMB	11/13/15	AAW	11/13/15
B	ADDED GEOTECH INFO/DESIGN ADJUSTMENT	MRS	10/27/15	RMB	10/27/15	AAW	10/27/15
A	ISSUED FOR BID	MRS	08/31/15	RMB	08/31/15	AAW	08/31/15

Sunoco Logistics Partners L.P.

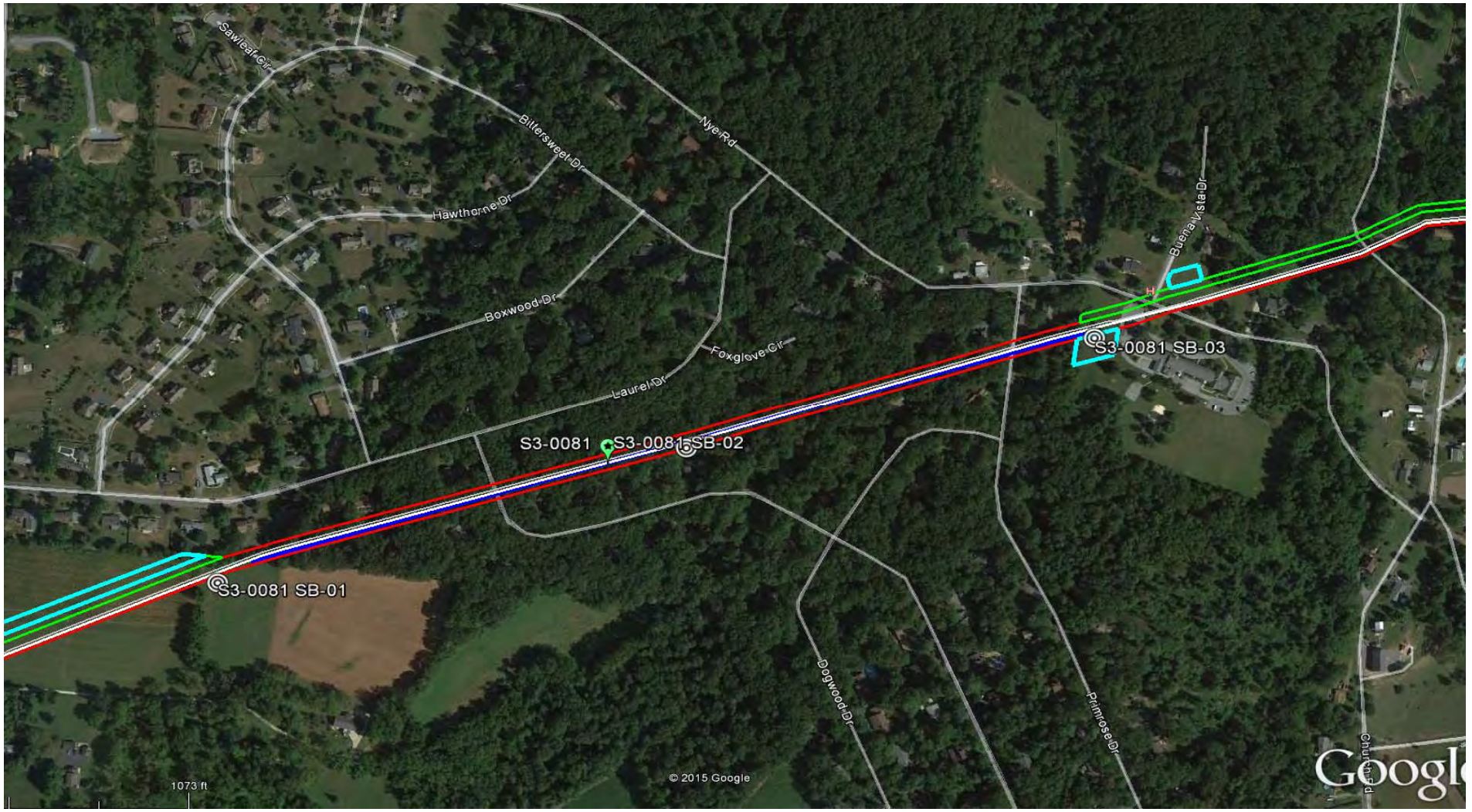
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

16-INCH HORIZONTAL DIRECTIONAL DRILL
WOODBINE DRIVE
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=250'

DWG. NO: PA-DA-0063.0000-RD-16



LEGEND:

◎ Geotechnical Soil Boring (SB) Locations

TETRA TECH

GEOTECHNICAL BORING LOCATIONS
HDD S3-0081 WOODBINE ROAD
DAUPHIN 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:	SAND HILL ROAD, HERSHEY, PA		Page 1 of 1
HDD No.:	S3-0081	Dates(s) Drilled: 05-05-15	Inspector: E. WATT
Boring No.:	SB-01	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 20.0	Total Depth (ft): 28.8
Boring Location Coordinates:		40° 14' 15.678" N	76° 39' 31.214" 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 (4")					
1	3.0	5.0	0.3		9	ML/ CL	MOTTLED GRAY AND BROWN CLAYEY SILT, WITH SOME FINE SAND.	1	3	6	8	**9**
2	8.0	10.0			21		MOTTLED GRAY AND BROWN CLAYEY SILT WITH SOME FINE SAND	3	6	7	9	**13**
				11.5			(USCS: ML/CL).					
3	13.0	15.0	11.5		24	SM	GRAY FINE TO MEDIUM SAND WITH A LITTLE SILT, AND SOME FINE	14	40	18	18	**58**
							GRAVEL.					
4	18.0	19.5			12		LIGHT GRAY AND LIGHT BROWN FINE TO MEDIUM SAND WITH SOME	3	23	50		**73**
				22.5			SILT, TRACE FINE GRAVEL. (USCS: SM).					
5	23.0	24.0	22.5		7	GM/ SM	WET, GRAY AND BROWN FINE TO COARSE GRAVEL AND FINE TO	20	50/6"			**>50**
							COARSE SAND, SOME SILT.					
6	28.0	28.8			9		WET, GRAY AND BROWN FINE TO COARSE GRAVEL AND FINE TO	4	50/3"			**>50**
				28.8			COARSE SAND, SOME SILT.					
							WET ON SPOON AT 25'.					
							WATER LEVEL THROUGH AUGERS AT 20'.					
							CAVED AT 25', WATER LEVEL ON CAVE AT 20'.					
							STARTED GRINDING BETWEEN 22' AND 23'.					

Notes/Comments:

Pocket Pentrometer Testing
8': 3.0 TSF
10': 1.5 TSF

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

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

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:	WOODBINE AND LAUREL DRIVE, HERSHEY, PA		Page 1 of 1
HDD No.:	S3-0081	Dates(s) Drilled: 10-09-15	Inspector: J. COSTELLO
Boring No.:	SB-02	Drilling Method: SPT - ASTM D1586	Driller: E. ODGEN
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 24.0	Total Depth (ft): 32.0
Boring Location Coordinates:		40°14'20.13"N	76°39'12.97"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		20	ML	PURPLISH BROWN CLAYEY SILT WITH SOME FINE SAND, TRACE	3	7	12	19	**19**
							FINE ROCK FRAGS.					
2	8.0	10.0			22		PURPLISH BROWN CLAYEY SILT, TRACE FINE SAND.	2	4	4	5	**8**
				11.5			(USCS: ML)					
3	13.0	15.0	11.5		24	SM	PURPLISH BROWN FINE TO MEDIUM SAND WITH SOME SILT, WITH	3	7	12	13	**19**
							A LITTLE FINE TO COARSE GRAVEL.					
4	18.0	20.0			24		PURPLISH BROWN FINE TO MEDIUM SAND WITH SOME SILT, WITH	5	31	30	21	**61**
				19.0			A TRACE FINE TO COARSE GRAVEL.					
5	23.0	25.0	19.0		24	CL	PURPLISH BROWN SILTY CLAY WITH SOME FINE SAND.	2	5	6	7	**11**
							(USCS: CL).					
6	28.0	29.3		32.0	12		PURPLISH BROWN SILTY CLAY AND FINE SAND.	5	21	50/3"		**>50**
							AUGER REFUSAL AT 32'.					
							WET ON SPOON AT 24'.					
							WATER LEVEL THROUGH AUGERS AT 24'.					
							CAVED AT 30'.					

Notes/Comments:

Pocket Pentrometer Testing
S2: 2.75 TSF
S5: 3 TSF
S6: > 4 TSF

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

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

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

TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	SAND HILL ROAD, HERSHEY, PA		Page 1 of 1
HDD No.:	S3-0081	Dates(s) Drilled: 05-05-15	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): 28.8
Boring Location Coordinates:		40° 14' 23.739" N	76° 38' 57.302" 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		23		REDDISH BROWN SILTY CLAY AND FINE SAND	6	8	6	9	**14**
2	8.0	10.0			24	CL/ SC	REDDISH BROWN SILTY CLAY AND FINE SAND	1	4	7	10	**11**
3	13.0	15.0			22		REDDISH BROWN SILTY CLAY AND FINE SAND	2	6	8	2	**14**
				16.5			(USCS: CL/SC).					
4	18.0	19.5	16.5		18	CL	REDDISH BROWN AND PURPLISH BROWN SILTY CLAY WITH SOME	11	24	50		**74**
				21.0			FINE SAND, TRACE FINE GRAVEL. (USCS: CL).					
5	23.0	24.0	21.0		9	SC	REDDISH BROWN FINE TO MEDIUM SAND, TRACE FINE GRAVEL,	9	50/6"			**>50**
							WITH SOME SILTY CLAY.					
6	28.0	28.8			8		REDDISH BROWN FINE TO MEDIUM SAND, TRACE FINE GRAVEL,	22	50/3"			**>50**
				30.0			WITH SOME SILTY CLAY.					
							AUGERED TO 30'.					
							DRY AND CAVED AT 27'.					

Notes/Comments:

Pocket Pentrometer Testing

10': 2.5 TSF

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

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

GEOTECHNICAL LABORATORY TESTING SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0081

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)
S3-0081	SB-01	2	8.0	10.0	26.3	71.3	37	25	12	ML/CL
		3	13.0	15.0	11.9	18.8	-	-	-	-
		4	18.0	19.5	15.5	29.1	29	34	5	SM
		6	28.0	28.8	18.2	25.8	-	-	-	-
	SB-02	2	8.0	10.0	32.0	95.0	41	32	9	ML
		3	13.0	15.0	13.4	32.6	-	-	-	-
		4	18.0	20.0	9.1	24.2	-	-	-	-
		5	23.0	25.0	28.3	70.7	48	26	22	CL
		6	28.0	29.3	19.4	61.9	-	-	-	-
	SB-03	2	8.0	10.0	16.4	51.7	-	-	-	-
		3	13.0	15.0	17.4	51.5	30	21	9	CL/SC
		4	18.0	19.5	16.8	85.4	38	23	15	CL
		5	23.0	24.0	9.4	34.2	-	-	-	-
		6	28.0	28.8	7.9	31.9	-	-	-	-

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

REGIONAL GEOLOGY SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0081

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
S3-0081	Woodbine Drive	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.	Moderately sloping rolling hills	Gettysburg Fm	Silty mudstone-shale-sandstone w/ some impure limestone	16,000		
		SB-02						30-65	Well yields generally 5-30 gpm
		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).

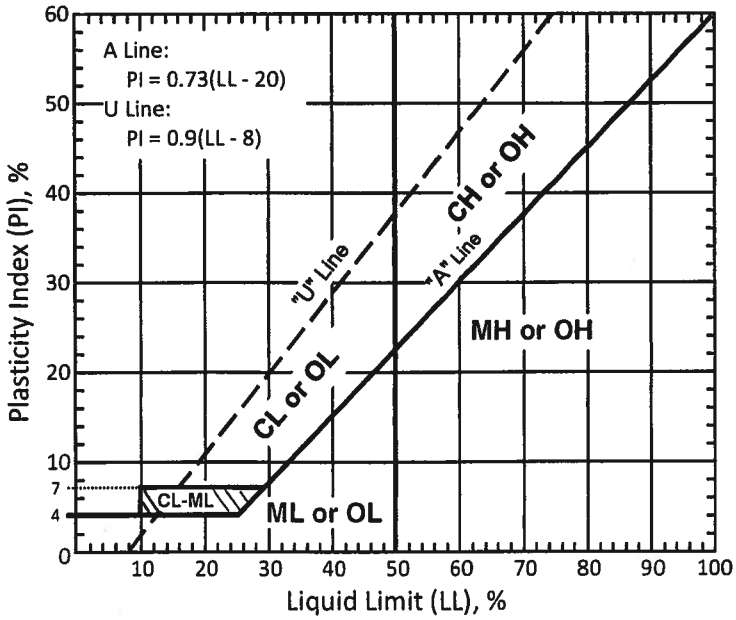
Groundwater observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

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.