

May 23, 2019

Via Electronic Mail

Mr. Scott R. Williamson
Program Manager, Waterways & Wetlands Program
Pennsylvania Department of Environmental Protection
Southcentral Regional Office
909 Elmerton Avenue
Harrisburg, PA 17110-8200

**Re: DEP HDD Re-Evaluation Report – Request for Additional Information
Joanna Road Crossing 16" Horizontal Directional Drill Location (S3-0250-16)
Permit No. E06-701
Caernarvon Township, Berks County**

Dear Mr. Williamson:

In compliance with the Corrected Stipulated Order dated August 10, 2017, a Re-Evaluation Report of the above-referenced horizontal directional drill (HDD) was submitted to the Pennsylvania Department of Environmental Protection (Department) on March 7, 2019. In a letter dated April 1, 2019, the Department requested additional information. Please accept this letter as a response. Your requests are bolded below followed by Sunoco Pipeline, LP (SPLP) responses.

- 1. As required by Paragraph 4 and 5 of the Environmental Hearing Board's August 10, 2017 Corrected Stipulated Order, SPLP failed to fully utilize information gathered during the HDD of the 20-inch bore as part of the HDD Re-evaluation for the 16-inch pipeline. Please utilize the geologic and drilling logs of the 20-inch pipeline bore in conjunction with the boring data on the alignment to demonstrate and support how the proposed drill pathway will assuredly travel in the bedrock for a significant distance beyond the previous eastern exit hole. Plot this information on the proposed drill path profile.**

This information should then be used to describe why the chosen bore path for the 16-inch pipeline was determined and how such information has been used to minimize the potential for IR's to occur and as part of the discussion of construction alternatives, including why HDD activity is still the preferred and chosen methodology for pipeline construction at this location.

The attached figure presents the top of bedrock profile overlain onto the proposed 16-inch HDD plan and profile. As shown on this figure, the asdrilled profile for the 20-inch pipeline is above bedrock where the subsidence occurred. The redesigned 16-inch pipeline will be entirely within the bedrock until passing through the unconsolidated overburden immediately prior to the HDD entry/exit points.

The Inadvertent Return (IR) information presented graphically on Figure 1 in Attachment 2, presents the plan and cross section views of IR events that occurred during the 2017 and 2018 pilot hole drilling, reaming, and completion of this HDD. This figure presents the events occurring during this HDD in relation to the depth of profile and allowed for correlation to monitoring data collected by the monitoring professional geologists during active drilling. SPLP utilized all the foregoing information obtained during drilling of the 20-inch HDD in our internal assessment and evaluation of the proposed 16-inch HDD profile, and as required by paragraph 5 of the Corrected Stipulated Order, described and presented the results of this study in the HDD Hydrogeologic Re-Evaluation Report. Nevertheless, the Department has requested that SPLP provide additional details concerning the conditions associated with this HDD location and the conclusion to proceed with an HDD for the proposed 16-inch line at this location along a revised profile. In the interest of working cooperatively with the Department, the following information is provided in response to the Department's request.

SPLP reviewed the daily drilling reports, the geotechnical investigations, IR Restart Reports and the HDD Inspection Daily Reports. Specifically, the depth of the bit was compared to the geotechnical investigations to determine if the pilot bit and/or reamer was advancing through an interval of bedrock that could be either highly fractured or weathered. Further, the annular and mud pressures were reviewed to identify any sudden changes in pressure while the pilot bit or reamer was being advanced, which could be utilized to approximate the competency of the bedrock.

The root cause analysis for the two IRs determined the cause to be the repeated tripping in and out of the reamer, which mechanically loosened the unconsolidated diabase boulder/soil matrix located above the HDD annulus. This led to subsiding material falling into the annulus, thereby blocking the returns of drilling fluids and resulting in the vertical movement of drilling fluids to the ground surface where the IRs resulted.

To reduce the potential for IRs during completion of the proposed 16-inch HDD, the profile was redesigned and the entry and exit angles and overall length of the 16-inch HDD profile were increased. By increasing the entry and exit angles, the redesigned 16-inch HDD will be advanced through the unconsolidated soils and weathered bedrock more quickly and closer to the respective entry and exit points. By lengthening the 16-inch profile, the revised bore path will be completed in more competent bedrock nearer the land surface. The modifications to the 16-inch profile will also allow the HDD boring to avoid the area of large diabase boulder/soil matrix encountered during completion of the 20-inch HDD. Further, the overall depth of the profile has been increased from a maximum depth of 100 feet below ground surface (bgs) on the permitted 16-inch profile, to 140 feet bgs on the redesigned 16-inch profile to have more of the boring advanced through the bedrock containing higher rock quality designation (RQD) values. The RQD values for the 20-inch profile were generally considered good; however, to further reduce the potential of IRs during the installation of the 16-inch HDD, the profile was redesigned to intersect more competent bedrock and to avoid intervals of bedrock which contained multiple fractures as identified in the 2017 geotechnical investigation. These design changes, along with best management drilling practices, will be used to reduce the risk of IRs from occurring during completion of the 16-inch HDD.

As mentioned in the Alternative Analysis section of the Hydrogeologic Re-Evaluation Report, the HDD methodology was confirmed to be the preferred installation method because it will result in the least amount of direct impact to the environment. Berks County prohibits Joanna Road from being an open-cut and as a result, a conventional road bore would need to be completed under the road. One of the "receiving pits" for the auger machine would have to be excavated through the stream that runs perpendicular to Joanna Road. This would also result in impacts to the adjacent and parallel stream located in the southern edge of the easement. As discussed in the Re-Evaluation Report, converting this location to open-cut construction methods would result in a direct increase in the physical disturbances to exceptional value wetlands and the stream. Specifically, open-cut installation would result in 0.10 acres of stream, 0.52 acres of emergent wetland and 1.32 acres of forested wetlands being directly impacted. Further, any dewatering required to maintain the open-cut trench could result in the potential discharge of cloudy water downstream, regardless of the utilization of filtration bags and erosion and sedimentation control structures. Re-routing the pipeline is not a viable option, the same waterways and roadways would be crossed, and the bedrock that would be encountered would be the same, and therefore, an alternative crossing location will not reduce the potential for the occurrence of IRs. Re-routing to the north or south would result in the development of a new "greenfield" corridor through existing woodlands.

The only other possible construction methods not discussed in the Hydrogeologic Re-Evaluation Report include Direct Pipe Bore and FlexBor.

SPLP contractors attempted three (3) FlexBors and partially completed two of these to replace HDDs on the Mariner Project. One FlexBor failed in the pilot phase and was replaced with both a conventional bore under a highway and open-cut construction. The two partially successful FlexBors were completed during the pilot phases, but both had difficulties being completed during the reaming phase. SPLP's analysis is that this technology is not perfected for larger diameter bore attempts. Therefore, SPLP did not include this method in the Alternatives Analysis section of the Re-Evaluation Report.

The Direct Pipe Bore method is also known as "microtunneling". This method of pipeline installation is a remote-controlled, continuously supported pipe jacking method. During the direct pipe installation, operations are managed by an operator in an above-ground control room alongside of the installation pit. Rock and soil cutting and removal occurs by drilling fluid injection through the cutting tool during rotation at the face of the bore, and the cuttings are forced into inlet holes in the crushing cone at the tool face for circulation to a recycling plant through a closed system. The entire operating system for this method of pipeline installation, including the cutting tool drive hydraulics, fluid injection, fluid return, and operating controls are enclosed inside the outside diameter bore pipe (or casing pipe) being installed. At the launching point/entry pit, the bore pipe is attached to a "jacking block" that hammers the bore pipe while the tool is cutting through the substrate or geology. The cutting tool face is marginally larger in diameter than the pipe it is attached to. As a result, there is minimal annulus space, which minimizes the potential for drilling fluid returns or the production of groundwater returning back to the point of entry.

SPLP's construction contractors have successfully completed one (1) Direct Pipe Bore approximately 925 ft in extent on the Mariner Pipeline project. However, the length that would be required to cross under Joanna Road, the stream, and wetlands is 2,000 ft, which exceeds the limits of Direct Pipe bore technology. Moreover, there are no feasible entry-exit points subset (spaced) within the length of this HDD to employ this technology.

Based on the analysis of all alternatives, the HDD method remains the preferred option for this location.

2. Relating to the Analysis of well production zones and use of information obtained during construction of the 20-inch pipeline:

The re-evaluation report fails to include evaluation of the information and any data collected for the two private water supplies within 450 feet of the HDD, the other nearby water supplies identified in the report (>450 feet from the HDD), or the water supply complaint that was investigated during the construction of the 20-inch pipeline.

Any private or public water supply data obtained within 450 feet or otherwise obtained in the vicinity of the 20-inch or proposed 16-inch HDD should be used and discussed as part of this HDD re-evaluation. This data should include but not be limited to any applicable water supply sampling data and any water supply complaints that SPLP may have obtained and received for water supplies within 450 of the HDD or within the general vicinity during construction of the 20-inch pipeline. The results of the SPLP's water supply sampling program, investigation, disposition of the complaint, and any correlation or non-correlation to SPLP's construction activities should be evaluated and discussed in the HDD re-evaluation report and used to demonstrate that the proposed 16-inch HDD activity will minimize the potential for IR's and impacts to water supplies. Please revise the re-evaluation report to include this information.

Per the Order, SPLP conducted a search for any water supply wells located within 450 feet of the Joanna Road HDD. A total of two water wells were identified and are represented on Attachment 3 of the Hydrogeologic Re-Evaluation Report. Water quality samples were collected from the identified locations prior to the initiation of HDD activities, during the completion of the 20-inch HDD and following the completion of the 20-inch HDD.

One well complaint was received (Anspach, 8/17/17) relative to the completion of the Joanna 20-inch HDD. After further review it was determined that there was no relationship to pipeline construction operations. The Department agreed with these findings and sent correspondence to the landowner confirming this. A letter reaffirming our position was sent to the landowner on 12/18/17. Initially, the landowner refused all offers from SPLP for temporary water supply, including a water buffalo (vessel), but eventually requested a temporary water supply. Notwithstanding the absence of a connection between pipeline construction operations and the landowner complaints, SPLP installed a water vessel

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on March 16, 2018. The water buffalo will remain until the 16-inch pipeline is completed. Ongoing communications continue to take place between SPLP and the landowner to settle the complaint.

SPLP submits that we have been, and are, in complete compliance with the agreed terms and analysis requirements of the Order, as agreed to by the Department, and that no further analysis is required for the Department to consent to the start of this HDD. SPLP requests that the Department approve the Re-Evaluation Report for the Joanna Road Crossing Horizontal Directional Drill (S3-0250) as soon as possible.

Sincerely,



Larry J. Gremminger, CWB
Vice-President – Environmental, Health & Safety
Energy Transfer Partners
Mariner East 2 Pipeline Project

Pertaining to the practice of geology

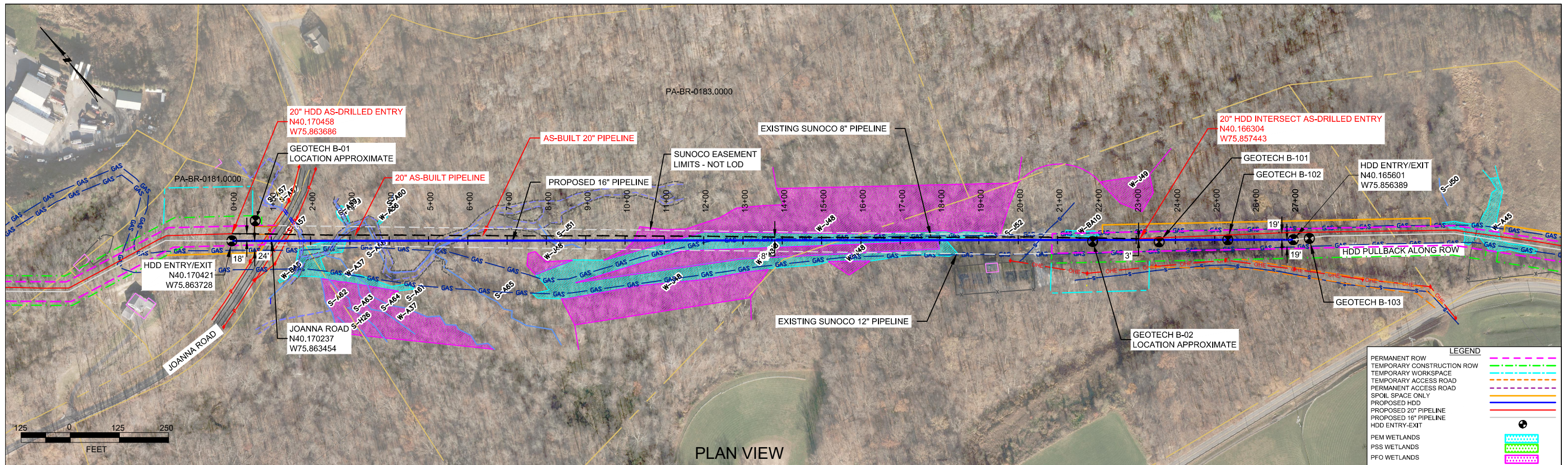


Douglas J. Hess, P.G.
License No. PG-000186-G
Skelly and Loy, Inc.
Director of Groundwater
and Site Characterization
Geo-Environmental Services

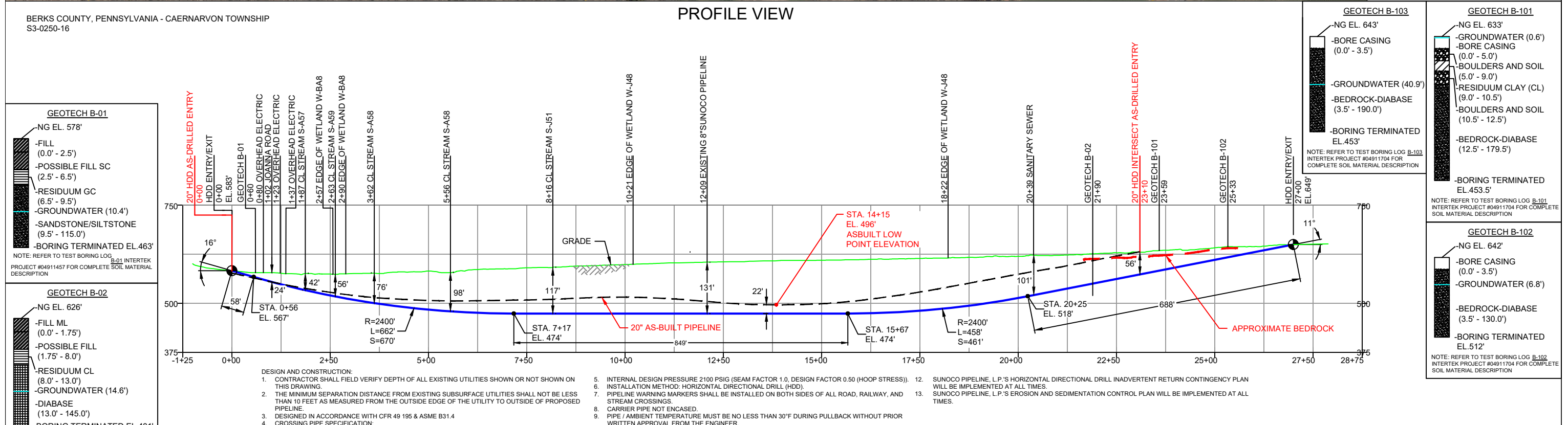
5/23/2019

Date

Attachment as stated



PLAN VIEW



PROFILE VIEW

BERKS COUNTY, PENNSYLVANIA - CAERNARVON TOWNSHIP
S3-0250-16

GEOTECH B-01
-NG EL. 578'
-FILL (0.0' - 2.5')
-POSSIBLE FILL SC (2.5' - 6.5')
-RESIDUUM GC (6.5' - 9.5')
-GROUNDWATER (10.4')
-SANDSTONE/SILTSTONE (9.5' - 115.0')
-BORING TERMINATED EL.463'

GEOTECH B-02
-NG EL. 626'
-FILL ML (0.0' - 1.75')
-POSSIBLE FILL (1.75' - 8.0')
-RESIDUUM CL (8.0' - 13.0')
-GROUNDWATER (14.6')
-DIABASE (13.0' - 145.0')
-BORING TERMINATED EL.481'

NOTE: REFER TO TEST BORING LOG B-01 INTERTEK PROJECT #04911457 FOR COMPLETE SOIL MATERIAL DESCRIPTION

- DESIGN AND CONSTRUCTION:**
- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
 - THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
 - DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
 - CROSSING PIPE SPECIFICATION:
HDD HORIZ. LENGTH (L=): 2700'
HDD PIPE LENGTH (S=): 2726'
16" x 0.438" W.T., X-70, API5L PSL2, ERW, BFW
COATING: 14-16 MILS FBE WITH 40 MILS MIN. ARO (POWERCRETE R95)
 - INTERNAL DESIGN PRESSURE 2100 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50 (HOOP STRESS)).
 - INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
 - PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
 - CARRIER PIPE NOT ENCASED.
 - PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
 - CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 2625 PSIG.
 - SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
 - SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
 - SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

Illustration of Bedrock Level at Subsidence Location and Compared to Redesigned 16-Inch HDD

NOTES			REF. DRAWING			REVISIONS					
1. ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83	EP-5.68	TO ES-5.69	EROSION & SEDIMENT PLAN	EP5	DESIGN CHANGE - EXTENDED DRILL & ADDED GEOTECH	MRS	01/17/19	RMB	01/17/19	AMC	01/17/19
2. STATIONING IS BASED ON HORIZONTAL DISTANCES.	SHEET 40	TO SHEET 41	AERIAL SITE PLAN	EP4	ADDED 20" AS-BUILT INFORMATION AND ADDITIONAL GEOTECH	MRS	11/28/18	RMB	11/28/18	AMC	11/28/18
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.				EP3	UPDATED TO MATCH 16" IFC DESIGN AND NOTE 5 AND 10 PER INCREASED 16" MOP	MRS	05/10/18	RMB	05/10/18	AMC	05/10/18
4. CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.				EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	MRS	10/21/16	RMB	10/21/16	AAW	10/21/16
5. SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.				EP1	REVISED PER PADEP COMMENTS	JTW	05/18/16	RMB	05/18/16	AAW	05/18/16
	DWG NO	DWG NO	DESCRIPTION	EP		MRS	03/15/16	RMB	03/15/16	AAW	03/15/16

Sunoco Logistics Partners L.P.

TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

HORIZONTAL DIRECTIONAL DRILL
JOANNA ROAD
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=250'
DWG. NO. PA-BR-0181.0000-RD-16

Hartman Spring Sample Analytical Results Summary

Parcel ID: 35-5320-02-69-2466 (11 Hartman Lane)
Well Location Map ID: SP-05182017-604-02

Parameter	Units	Sample Date: 05/18/2017	PA DEP Drinking Water MCL/SMCL
		Sample I.D.: 05182017-604-02	
Coliform, fecal	col/100ml	NA	-
E. Coli	MPN/100ml	NA	-
Coliform, total	MPN/100ml	NA	-
Dissolved Solids	mg/l	75.0	500
Suspended Solids	mg/l	ND	-
Hardness (colorimetric) as CaCO3	mg/l	32.8	-
Turbidity	NTU	1.52	-
Alkalinity	mg/l	ND	-
pH	SU	5.97	-
Specific Conductance	umhos/cm	113	-
Bromide	mg/l	ND	-
Chloride	mg/l	10.1	250
Sulfate	mg/l	8.57	250
Barium	mg/l	0.0333	2
Calcium	mg/l	6.18	-
Iron	mg/l	0.450	0.3
Magnesium	mg/l	4.20	-
Manganese	mg/l	ND	0.05
Potassium	mg/l	1.64	-
Sodium	mg/l	6.62	-
Methane	mg/l	ND	-
Ethane	mg/l	ND	-
Ethene	mg/l	ND	-
Propane	mg/l	ND	-
Benzene	mg/l	ND	0.005
Toluene	mg/l	ND	1
Ethylbenzene	mg/l	ND	0.7
Total Xylenes	mg/l	ND	10
Residual Bentonite	-	NA	-

20-inch HDD construction dates: July 16, 2017 through November 18, 2018

16-inch HDD construction dates: Awaiting PA DEP authorization to start

Notes:

1. MCL - Maximum Primary Contaminant Level
 2. SMCL - Maximum Secondary Contaminant Level
 3. NA - Not Analyzed
 4. ND - Not Detected
 5. col/100ml - colonies per 100 milliliters
 6. MPN/100ml - most probable number per 100 milliliters
 7. mg/l - milligrams per liter
 8. NTU - nephelometric turbidity units
 9. SU - standard units
 10. umhos/cm - micro ohms per centimeter
- Concentrations that are bolded exceed or are equivalent to their respective PA DEP MCL/SMCL

Hartman Water Sample Analytical Results Summary

Parcel ID: 35-5320-02-69-7928 (512 Joanna Road)
 Well Location Map ID: WL-05182017-604-03

Parameter	Units	Sample Date: 05/18/2017	Sample Date: 03/28/2018	PA DEP Drinking Water MCL/SMCL
		Sample I.D.: 05182017-604-03	Sample I.D.: 03282018-628-01	
Coliform, fecal	col/100ml	NA	<1	-
E. Coli	MPN/100ml	NA	<1	-
Coliform, total	MPN/100ml	NA	2.00	-
Dissolved Solids	mg/l	104	93.0	500
Suspended Solids	mg/l	59.4	5.66	-
Hardness (colorimetric) as CaCO3	mg/l	31.8	ND	-
Turbidity	NTU	5.91	12.1	-
Alkalinity	mg/l	58.3	49.3	-
pH	SU	8.70	8.70	-
Specific Conductance	umhos/cm	166	139	-
Bromide	mg/l	ND	ND	-
Chloride	mg/l	2.88	2.49	250
Sulfate	mg/l	20.4	17.3	250
Barium	mg/l	ND	ND	2
Calcium	mg/l	10.0	8.33	-
Iron	mg/l	13.4	0.748	0.3
Magnesium	mg/l	ND	ND	-
Manganese	mg/l	0.0619	ND	0.05
Potassium	mg/l	ND	ND	-
Sodium	mg/l	25.4	25.0	-
Methane	mg/l	0.0570	0.0139	-
Ethane	mg/l	ND	ND	-
Ethene	mg/l	ND	ND	-
Propane	mg/l	ND	ND	-
Benzene	mg/l	ND	ND	0.005
Toluene	mg/l	ND	ND	1
Ethylbenzene	mg/l	ND	ND	0.7
Total Xylenes	mg/l	ND	ND	10
Residual Bentonite	-	NA	NA	-

20-inch HDD construction dates: July 16, 2017 through November 18, 2018
 16-inch HDD construction dates: Awaiting PA DEP authorization to start

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Anspach Water Sample Analytical Results Summary

Parcel ID: 35-5321-04-60-8597 (609 Joanna Road)
Well Location Map ID: WL-08142017-604-03

Parameter	Units	Sample Date: 08/14/2017	Sample Date: 10/19/2017	Sample Date: 03/28/2018	PA DEP Drinking Water MCL/SMCL
		Sample I.D.: 08142017-604-03	Sample I.D.: 10192017-634-01	Sample I.D.: 03282018-629-02	
Coliform, fecal	col/100ml	726	5.00	3.00	-
E. Coli	MPN/100ml	727	1.00	3.10	-
Coliform, total	MPN/100ml	2420	35.9	12.1	-
Dissolved Solids	mg/l	654	894	647	500
Suspended Solids	mg/l	40.7	5.78	4.40	-
Hardness (colorimetric) as CaCO3	mg/l	550	897	560	-
Turbidity	NTU	12.9	21.6	17.0	-
Alkalinity	mg/l	148	140	162	-
pH	SU	7.25	7.12	7.31	-
Specific Conductance	umhos/cm	964	1110	811	-
Bromide	mg/l	ND	ND	ND	-
Chloride	mg/l	3.16	3.82	5.54	250
Sulfate	mg/l	380	494	300	250
Barium	mg/l	0.211	0.0489	0.0567	2
Calcium	mg/l	205	241	198	-
Iron	mg/l	3.51	1.90	1.32	0.3
Magnesium	mg/l	7.72	8.33	7.13	-
Manganese	mg/l	1.08	0.174	0.0451	0.05
Potassium	mg/l	ND	ND	ND	-
Sodium	mg/l	9.93	11.4	8.75	-
Methane	mg/l	ND	ND	ND	-
Ethane	mg/l	ND	ND	ND	-
Ethene	mg/l	ND	ND	ND	-
Propane	mg/l	ND	ND	ND	-
Benzene	mg/l	ND	ND	ND	0.005
Toluene	mg/l	ND	ND	ND	1
Ethylbenzene	mg/l	ND	ND	ND	0.7
Total Xylenes	mg/l	ND	ND	ND	10
Residual Bentonite	-	NA	ND	NA	-

20-inch HDD construction dates: July 16, 2017 through November 18, 2018

16-inch HDD construction dates: Awaiting PA DEP authorization to start

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9. SU - standard units
10. umhos/cm - micro ohms per centimeter

Concentrations that are bolded exceed or are equivalent to their respective PA DEP MCL/SMCL

Anspach Water Sample Analytical Results Summary

Parcel ID: 532104605587 (605 Joanna Road)
Well Location Map ID: WL-02192018-629-01

Parameter	Units	Sample Date: 02/19/2018	Sample Date: 03/28/2018	PA DEP Drinking Water MCL/SMCL
		Sample I.D.: 02192018-629-02	Sample I.D.: 03282018-639-01	
Coliform, fecal	col/100ml	<1	<1	-
E. Coli	MPN/100ml	<1	<1	-
Coliform, total	MPN/100ml	<1	<1	-
Dissolved Solids	mg/l	188	186	500
Suspended Solids	mg/l	ND	3.80	-
Hardness (colorimetric) as CaCO3	mg/l	135	135	-
Turbidity	NTU	2.54	0.553	-
Alkalinity	mg/l	58.1	58.8	-
pH	SU	6.73	6.94	-
Specific Conductance	umhos/cm	286	263	-
Bromide	mg/l	ND	ND	-
Chloride	mg/l	2.86	2.60	250
Sulfate	mg/l	65.2	67.0	250
Barium	mg/l	0.0537	0.0536	2
Calcium	mg/l	42.0	44.5	-
Iron	mg/l	0.688	ND	0.3
Magnesium	mg/l	4.81	4.83	-
Manganese	mg/l	0.0627	0.0255	0.05
Potassium	mg/l	ND	ND	-
Sodium	mg/l	6.82	6.78	-
Methane	mg/l	ND	ND	-
Ethane	mg/l	ND	ND	-
Ethene	mg/l	ND	ND	-
Propane	mg/l	ND	ND	-
Benzene	mg/l	ND	ND	0.005
Toluene	mg/l	ND	ND	1
Ethylbenzene	mg/l	ND	ND	0.7
Total Xylenes	mg/l	ND	ND	10
Residual Bentonite	-	NA	NA	-

20-inch HDD construction dates: July 16, 2017 through November 18, 2018

16-inch HDD construction dates: Awaiting PA DEP authorization to start

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- Concentrations that are bolded exceed or are equivalent to their respective PA DEP MCL/SMCL

Twin Valley Joint School System Authority Water Sample Analytical Results Summary

Parcel ID: 35532002883496 (4851 North Twin Valley Road)
 Well Location Map ID: WL-03052018-611-01

Parameter	Units	Sample Date: 03/05/2018	Sample Date: 03/28/2018	Sample Date: 07/02/2018	Sample Date: 07/02/2018	Sample Date: 10/15/2018	Sample Date: 10/15/2018	PA DEP Drinking Water MCL/SMCL
		High School Well	High School Well	High School Well	Middle School Well	High School Well	Middle School Well	
		Sample I.D.: 03052018-611-01	Sample I.D.: 03282018-617-02	Sample I.D.: 07022018-611-01	Sample I.D.: 07022018-611-02	Sample I.D.: 10152018-639-01	Sample I.D.: 10152018-639-02	
Coliform, fecal	col/100ml	<1	<1	NA	NA	<1	<1	-
E. Coli	MPN/100ml	<1	<1	<1	<1	<1	<1	-
Coliform, total	MPN/100ml	1.00	<1	<1	<1	13.4	<1	-
Dissolved Solids	mg/l	426	402	452	131	423	127	500
Suspended Solids	mg/l	ND	ND	ND	ND	ND	2.90	-
Hardness (colorimetric) as CaCO3	mg/l	174	178	183	68.4	191	63.8	-
Turbidity	NTU	ND	0.429	0.534	2.63	ND	3.87	-
Alkalinity	mg/l	28.8	37.4	31.6	59.5	31.6	59.9	-
pH	SU	6.44	6.62	6.41	7.62	6.35	7.64	-
Specific Conductance	umhos/cm	658	535	663	159	642	158	-
Bromide	mg/l	ND	ND	ND	ND	ND	ND	-
Chloride	mg/l	165	120	158	ND	155	1.12	250
Sulfate	mg/l	18.8	21.6	18.6	17.6	17.4	17.3	250
Barium	mg/l	0.0937	0.0723	0.0776	0.0138	0.0929	0.0150	2
Calcium	mg/l	34.7	32.3	31.2	12.7	37.1	13.5	-
Iron	mg/l	ND	ND	ND	0.367	ND	1.29	0.3
Magnesium	mg/l	27.1	25.5	30.5	6.54	24.8	6.56	-
Manganese	mg/l	ND	ND	ND	0.184	ND	0.170	0.05
Potassium	mg/l	2.92	2.28	2.36	ND	2.59	ND	-
Sodium	mg/l	40.1	32.4	31.7	8.14	37.7	8.05	-
Methane	mg/l	ND	ND	ND	ND	ND	ND	-
Ethane	mg/l	ND	ND	ND	ND	ND	ND	-
Ethene	mg/l	ND	ND	ND	ND	ND	ND	-
Propane	mg/l	ND	ND	ND	ND	ND	ND	-
Benzene	mg/l	ND	ND	ND	ND	ND	ND	0.005
Toluene	mg/l	ND	ND	ND	ND	ND	ND	1
Ethylbenzene	mg/l	ND	ND	ND	ND	ND	ND	0.7
Total Xylenes	mg/l	ND	ND	ND	ND	ND	ND	10
Residual Bentonite	-	NA	NA	NA	NA	NA	NA	-

20-inch HDD construction dates: July 16, 2017 through November 18, 2018
 16-inch HDD construction dates: Awaiting PA DEP authorization to start

Notes:

1. MCL - Maximum Primary Contaminant Level
 2. SMCL - Maximum Secondary Contaminant Level
 3. NA - Not Analyzed
 4. ND - Not Detected
 5. col/100ml - colonies per 100 milliliters
 6. MPN/100ml - most probable number per 100 milliliters
 7. mg/l - milligrams per liter
 8. NTU - nephelometric turbidity units
 9. SU - standard units
 10. umhos/cm - micro ohms per centimeter
- Concentrations that are bolded exceed or are equivalent to their respective PA DEP MCL/SMCL