

***HDD PA-WM1-0012.0000-RR (S122, S222)***

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.

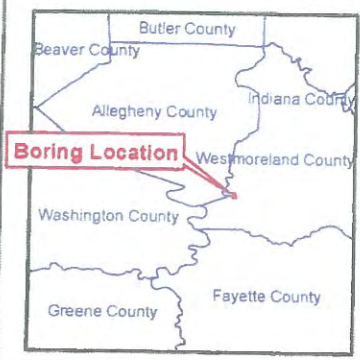
The drill will enter/exit 260 feet from the western edge of the Youghioghney River (S122) and enter/exit 2,380 feet from the eastern edge. The horizontal directional drill will enter/exit 2,200 feet from the western edge of Stream 222 (S222) and enter/exit 810 feet from the eastern edge. The drill will cross below the Youghioghney River at 45 feet and S222 at 125 feet. The 20" drill will parallel the existing ME1 12" pipeline drill. The geotechnical results from the previous drill, as well as other data points, were used to determine the entry/exit angles, and depths to pass through the best substrates while maintaining the pipe integrity (e.g., no large bends). According to the geotechnical report the primary substrate at both crossings (S122 and S222) is estimated to be siltstone or sandstone. Based on the geotechnical report, the drill profile, and the previous drill data minimal inadvertent returns are expected.



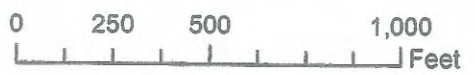


Source: Topo data from USGS OLG; Roads from DelDOT

S:\03-Projects\In\com\p\TTL - Rooney (RE)\GIS\Boring Map HDD-12A\B.mxd



**Figure**  
**Boring Locations HDD-12A/12B**  
**Sunoco Mariner East Project**  
**Westmoreland County, PA**



1 inch = 500 feet

**Tt** Tetra Tech, Inc.  
 Phone: (302) 738-7551  
 Toll Free: (800) 462-0910  
 www.tetrattech.com

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**TETRA TECH**  
 240 Continental Drive, Suite 200  
 Newark, Delaware 19713  
 302.733.7551  
 fax 302.454.5988

# TEST BORING LOG

Project Name: SUNOCO MARINER EAST  
 Project Location: WESTMORELAND COUNTY, PA  
 Project No.: 103IP2762  
 Test Boring No.: HDD-12A  
 Dates(s) Drilled: 06/26/13  
 Inspector: E. WATT  
 Drilling Contractor: CONNELLY  
 Drilling Method: SPT - ASTM D1586  
 Driller: K. KERSH  
 Surface Elevation (ft):  
 Groundwater Depth (ft): 15.5'  
 Total Depth (ft): VARIOUS, SEE BELOW.

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *			N
	From	To	From	To							
1	3.5	5.0	0.0		15	CL/SC	DARK BROWN SILTY CLAY AND FINE SAND	13	4	2	6
2	8.5	10.0		12.0	14	CL/SC	DARK BROWN SILTY CLAY AND FINE SAND. USCS: CL/SC	2	3	4	7
3	13.5	15.0	12.0		10	SM/SC	MEDIUM GRAY FINE SAND WITH SOME SILTY CLAY, TRACE DECAYED WOOD, MOIST.	3	2	2	4
4	18.5	20.0			10	SM/SC	BROWN FINE TO MEDIUM SAND WITH SOME SILT, AND TRACE FINE TO COARSE GRAVEL.	4	6	8	14
5	23.5	25.0		28.0	17	SM/SC	BROWN FINE TO MEDIUM SAND WITH SOME SILT.	3	3	5	8
6	28.5	29.5	28.0		0		NO RECOVERY	18	50/5"		>50
7	33.5	33.9			4		LIGHT GRAY PARTIALLY WEATHERED SILTSTONE.	50/4"			
8	38.5	39.4		42.0	11		LIGHT GRAY PARTIALLY WEATHERED SILTSTONE.	23	50/5"		>50
							AUGER REFUSAL ENCOUNTERED AT 42'. OFF-SITE BORING 51 FEET SOUTH AND CONTINUOUSLY DRILLED TO AUGER REFUSAL AT 43.5'. WEATHERED SILTSTONE STARTING BETWEEN 32' TO 33'.  WET ON SPOON AT 23.5. WATER LEVEL THROUGH AUGERS AT 15.5'. CAVED AT 28', WATER LEVEL ON CAVE AT 16'.				

Notes/Comments:  
Pocket Penetrometer Testing  
 S1: 2.5 TSF  
 S2: 1.25 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.



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# TEST BORING LOG

Project Name: SUNOCO MARINER EAST  
 Project Location: WESTMORELAND COUNTY, PA  
 Project No.: 103IP2762  
 Test Boring No.: HDD-12B  
 Dates(s) Drilled: 06/26/13  
 Inspector: E. WATT  
 Drilling Contractor: CONNELLY  
 Drilling Method: SPT - ASTM D1586  
 Driller: K. KERSH  
 Surface Elevation (ft):  
 Groundwater Depth (ft): Not Encountered  
 Total Depth (ft): VARIOUS, SEE BELOW.

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *			N
	From	To	From	To							
1	3.5	5.0	0.0		9	CL	LIGHT GRAY TO BROWN SILTY CLAY WITH A LITTLE FINE SAND.	26	26	26	52
2	7.2	7.2		7.2	<1"		PIECES OF FISSILE SHALE/SANDSTONE. USCS: CL SANDSTONE FRAGMENTS.			50/0"	
							AUGER REFUSAL AT 7.2'. CAVED AT 7.2'. OFF-SET BORING 9' TO THE NORTHEAST AND CONTINUOUSLY DRILLED TO AUGER RESUSAL AT 7.8'.  OFF-SET BORING AGAIN 48' TO THE NORTHEAST AND DRILLED TO 8.5' FOR DEEPER SAMPLE.				
3	8.5	9.4			9		PARTIALLY WEATHERED BROWN SANDSTONE.	28	50/4"		>50
							AUGER REFUSAL AT 10.3'.				

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.

# FIELD DESCRIPTION AND LOGGING SYSTEM FOR SOIL EXPLORATION

## GRANULAR SOILS

(Sand, Gravel & Combinations)

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

### Relative Proportions

<u>Description Term</u>	<u>Percent</u>
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 No. 10 to No. 40 sieve (M) (2.00mm – 0.425mm) Fine (F) No. 40 to No. 200 sieve (0.425 – 0.074mm)
Silt/Clay	Less Than a No. 200 sieve (<0.074mm)

## COHESIVE SOILS

(Silt, Clay & Combinations)

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

### Plasticity

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

## ROCK

(Rock Cores)

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

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

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

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

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

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