

TRIP REPORT

Date: November 17, 2015

To: Rob Simcik

From: Scott R. Anderson, Hydrogeologist

Subject: Summary of Soil Infiltration Tests
Wolf Bridge Road
Sunoco Pipeline/Valve Stations
Middlesex Township, Cumberland County, Pennsylvania

This trip report provides results of soil infiltration tests that were completed as part of the Segment 2 Pipeline Project for Sunoco, in Middlesex Township, Cumberland County, Pennsylvania.

1.0 PURPOSE

This report presents the field data and results of double ring soil infiltration tests conducted to support the design of stormwater management systems at several locations in Middlesex Township, Cumberland County, Pennsylvania. Four shallow tests (IT-1 through IT-4) were performed at the property. Test locations are listed by coordinates (latitude and longitude) in Table 1 and shown on the attached figures.

2.0 FIELD ACTIVITIES

The infiltration tests were conducted by Scott Anderson and Keith Simpson of Tetra Tech, Inc., on September 18, 2015. The test locations were positioned in the field using a handheld, WAAS-enabled GPS unit and reference to google earth map. Table 1 provides the coordinates recorded in the field. IT-1 through IT-4 were located in an open farm field (soybean). Photographs of testing locations are attached to this report.

The infiltration tests were performed in accordance with the procedure specified in the 2006 Pennsylvania Stormwater Best Management Practices (BMP) Manual. Double ring tests were performed at this site. The double ring test locations were prepared for test locations with a mini-excavator for the deep tests and with a shovel for the shallow tests. The double-ring infiltrometers that were used for testing consisted of 10-inch and 6-inch diameter sections of 10-inch steel casing. After digging to the target depth, the test surface was leveled, and any loose soil or fallen vegetation was removed. The rings were driven a minimum of 2 inches into the soil. Infiltration test depths are provided on Table 1.

Test locations were pre-soaked for 1 hour. The tests were then conducted with measurements at 10 or 30-minute intervals, based on the observed water level drops during the pre-soak period.

Pre-soak and test information was recorded on infiltration test sheets; copies of the test sheets are attached to this report.

During the testing, the weather was warm and sunny, approximately 70 degrees Fahrenheit. No precipitation was observed during the tests.

In addition, three hand auguring locations were advanced to a maximum of 15 inches bgs near the testing locations to characterize the soil, determine the depth to bedrock, if encountered, and inspect for evidence of the seasonal high water table. The hand augers were completed to approximately 1 foot below the infiltration depth with refusal on rock (assumed weathered bedrock). One auger location was completed near IT-1 and two were completed at the midpoints of IT-1/IT-3 and IT-2/IT-4.

Descriptions of the soil were recorded on field logs, which were based on the form example in the BMP manual. Copies of the field soil logs are attached to this report.

3.0 RESULTS

3.1 SOILS DESCRIPTION

Soils encountered generally consisted of thin (approximately 9 inches) layer of topsoil/surface soil layer composed of brown-tan-orange silts and clays (silt loam to silty clay loam). Underlain is a thin layer of silty clay (silty clay loam). Broken rock fragments were observed throughout both layers. Thin roots were encountered in the topsoil/surface soils with trace roots being observed in the underlying soil horizons. Table 1 summarizes the depths of the infiltration tests (excavation completed to approximately one foot below infiltration test depth).

The soils were noted to be dry to moist during the excavation activities. The rock encountered at refusal depths was noted to show signs of oxidation. Based on the dark reddish staining of the oxidation and shallow depths where it was encountered, it is assumed that this oxidation is likely iron oxide (rust). No groundwater or mottled soils were recorded.

According to United States Department of Agriculture Natural Resources Conservation Service Web Soil Survey¹ data, the soil types for the test locations are mapped as follows:

- IT-1 and IT-3 – Berks shaly silt loam (BeC soil symbol), 8 to 15 percent slopes
- IT-2 and IT-4 – Berks channery silt loam (BeC soil symbol), 3 to 8 percent slopes

Based on the interactive website PaGEODE, the geology of the site is shale of the Martinsburg Formation (Ordovician age). The Martinsburg Formation consists of dark gray shale and slate with some siltstone and sandstones. A Geologic map is attached to this report.

¹ <http://websoilsurvey.nrcs.usda.gov/>. Accessed November 4, 2015.

3.2 INFILTRATION TEST RESULTS

Table 1 summarizes the infiltration rates (inches per hour) calculated from the test data. Infiltration rates presented in Table 1 were calculated from the average water level drop of the last four readings measured in the inner ring.

IT-2 through IT-4 tests exhibited slow rates of infiltration requiring a 30-minute test cycle. IT-1 exhibited moderate rates of infiltration requiring a 10-minute test cycle.

Table 1
Summary of Infiltration Test Results
Wolf Bridge Road
Middlesex Township, Cumberland County, PA
Sunoco Pipeline/Valve Stations

Test Location (IT-)	Location Data		Test Depth (inches)	Infiltration Test Result (inches/hour)
	LATITUDE	LONGITUDE		
IT-1	40° 14' 14.12"	77° 9' 55.11"	6	19.5
IT-2	40° 14' 14.10"	77° 9' 54.03"	6	0.1
IT-3	40° 14' 12.84"	77° 9' 54.90"	6	0.1
IT-4	40° 14' 12.98"	77° 9' 53.95"	6	0.0

ATTACHMENTS

SITE FIGURE

SOIL LOGS

Table 1
Summary of Infiltration Test Results
Wolf Bridge Road
Middlesex Township, Cumberland County, PA
Sunoco Pipeline/Valve Stations

Test Location (IT-)	Location Data		Test Depth (inches)	Infiltration Test Result (inches/hour)
	LATITUDE	LONGITUDE		
IT-1	40° 14' 14.12"	77° 9' 55.11"	6	19.5
IT-2	40° 14' 14.10"	77° 9' 54.03"	6	0.1
IT-3	40° 14' 12.84"	77° 9' 54.90"	6	0.1
IT-4	40° 14' 12.98"	77° 9' 53.95"	6	0.0

ATTACHMENTS

SITE FIGURE



© 2015 Google

Google earth

Google earth

feet
meters



SOIL LOGS

Soil Log

Tested By: SA

Project: SUNOCO

Project No.: 112IC07309

Test Pit: Wolf Bridge IT-2+4

Date: 9-18-15

Elevation: _____

Equipment Used: Hand Auger

Geology: Martinsburg Formation

Soil Type: Berks Shaly Silt
Loam (BeB, BeC)

Land Use: Open Agriculture Field

Weather: _____

Additional Comments

Hand Auger refusal at 14"

Horizon	Upper Boundary	Lower Boundary	Soil Textural Class	Type, Size, Coarse Fragments, etc.	Soil Color	Color Patterns	Pores, Roots, Rock Structure	Depth to Bedrock	Depth to Water	Comments
O/To/A	0"	9"	Top Soil/To/ Silty clay	Silts and clays	Tan/Brown/ orange	-	Top Soil ~2.0"	-	-	
B	9"	14"	Silty clay	Silts and clays			Weathered shale	-	-	
C		14"	-	Weathered Shale Breaks w/ Bar Blow			Compacted shale	≥ 14"	-	

INFILTRATION TEST DATA SHEETS

Wolf Bridge Road #1

Test Loc. 6" deep

Test Date 9/18/2015

Time	Elapsed Time (minutes)	Water Level Drop (in)	Volume of Water Added (L)
930	10	5.25	3.00
940	20	3.25	1.75
950	30	3.00	1.50
1000	40	3.25	1.75
1010	50	3.25	1.70
1020	60	3.25	1.77
1030	70	3.25	N/A

Infiltration Rate

Average Stabilized Rate (in/hr)

19.5

Wolf Bridge Road #2

Test Loc. 6" deep

Test Date 9/18/2015

Time	Elapsed Time (minutes)	Water Level Drop (in)	Volume of Water Added (L)
1230	30	0.06	0.09
1300	60	0.06	0.09
1330	90	0.06	0.07
1400	120	0.06	0.08
1430	150	0.06	0.08

0.08 Infiltration Rate

Average Stabilized Rate (in/hr)

0.1

Wolf Bridge Road #3

Test Loc. 6" deep

Test Date 9/18/2015

Time	Elapsed Time (minutes)	Water Level Drop (in)	Volume of Water Added (L)
905	30	0.06	0.08
935	60	0.06	0.08
1005	90	0.06	0.08
1035	120	0.06	0.08
1105	150	0.06	0.08

0.08 Infiltration Rate

Average Stabilized Rate (in/hr)

0.1

Wolf Bridge Road #4

Test Loc. 6" deep

Test Date 9/18/2015

Time	Elapsed Time (minutes)	Water Level Drop (in)	Volume of Water Added (L)
1050	30	0.00	0.00
1120	60	0.03	0.03
1150	90	0.00	0.00
1220	120	0.00	0.00
1250	150	0.00	0.00

0.00 Infiltration Rate

Average Stabilized Rate (in/hr)

0.0



TETRA TECH

INFILTRATION TEST DATA SHEET

PROJECT NAME: Sunoco Pipeline TEST AREA ID: Welf Bridge Road IT#1
 PROJECT NUMBER: 118IC07309 PERSONNEL: SA, TR

TEST METHOD: Double-Ring Infiltrometer Percolation
 Location Coordinates or Description:
N: 40° 14' 14.12"
W: 77° 09' 53.11"

INNER RING INSIDE DIAMETER: 6"

OUTER RING INSIDE DIAMETER: 16"

PERCOLATION HOLE DIAMETER: (If performing an open hole percolation test)

DATE(S): 9/18/15 7

Distance from the bottom of the inner ring/hole to measuring point
 (minimum water column of 4-6 inches):

MEASURING POINT: Ring Rim Indicator Mark DEPTH OF TEST:

TIME	ELAPSED TIME SINCE START OF TEST (minutes)	WATER LEVEL DROP, INNER RING OR PERCOLATION HOLE (inches)	VOLUME OF WATER ADDED AT EACH CYCLE* (units _____)	REMARKS
PRESOAK DATA				
830	<u>0</u>	<u>φ</u>	<u>NRL</u>	<u>Start Test</u>
900	<u>30</u>	<u>6 1/4" IN, 3/8" OUT</u>	<u>3050 ml IN 400 ml OUT</u>	<u>840 5 1/2" OUT IN, 1/2" OUT</u>
930	<u>60</u>	<u>5 1/4" IN, 1/4" OUT</u>	<u>2500 ml IN 500 ml OUT</u>	<u>915 5" IN, 1/4" OUT / 2500 IN 250 OUT</u>
TEST DATA				
930	<u>0</u> (<u>60</u>)	<u>5 1/4" IN, 1/4" OUT</u>	<u>3000 ml</u>	<u>st. f @ 10 min</u>
940	<u>10</u> (<u>70</u>)	<u>3 1/4" IN, 1/8" OUT</u>	<u>1750 ml IN 200 ml OUT</u>	
950	<u>20</u> (<u>80</u>)	<u>3" IN, 1/8" OUT</u>	<u>1500 ml IN 200 ml OUT</u>	
1000	<u>30</u> (<u>90</u>)	<u>3 1/4" IN, 1/8" OUT</u>	<u>1750 ml IN 200 ml OUT</u>	
1010	<u>40</u> (<u>100</u>)	<u>3 1/4" IN, 1/8" OUT</u>	<u>1700 ml IN 220</u>	
1020	<u>50</u> (<u>110</u>)	<u>3 1/4" IN, 1/8" OUT</u>	<u>1770 ml IN</u>	
1030	<u>60</u> (<u>120</u>)	<u>3 1/4" IN, 1/8" OUT</u>	<u>210</u>	
			<u>NA</u>	<u>END OF TEST</u>

*For double ring test, the volume of water added equals the sum for the inner and outer rings.



TETRA TECH

INFILTRATION TEST DATA SHEET

PROJECT NAME: Sunoco Ape line TEST AREA ID: WOLF BRIDG6 RUN 17#2
 PROJECT NUMBER: 181C07309 PERSONNEL: SA, TR

TEST METHOD: Double-Ring Infiltrometer Percolation

Location Coordinates or Description:

N: 40° 14' 14.10"
 W: 77° 09' 54.03"

INNER RING INSIDE DIAMETER: 6"

OUTER RING INSIDE DIAMETER: 10"

PERCOLATION HOLE DIAMETER: —

(If performing an open hole percolation test)

DATE(s): 9.18.15

7"

Distance from the bottom of the inner ring/hole to measuring point
 (minimum water column of 4-6 inches): —

MEASURING POINT: Ring Rim Indicator Mark

DEPTH OF TEST: N6"

TIME	ELAPSED TIME SINCE START OF TEST (minutes)	WATER LEVEL DROP, INNER RING OR PERCOLATION HOLE (inches)	VOLUME OF WATER ADDED AT EACH CYCLE* (units ML)	REMARKS
PRESOAK DATA				
1100	0	0	NEL	Start soak
1130	30	1/16 IN, 1 1/2 OUT	65 IN, 125 OUT	
1200	60	1/16 IN, 1 1/4 OUT	85 IN, 150 OUT	
TEST DATA				
1230	90	1/16 IN, 1 1/4 OUT	90 IN, 125 OUT	
1300	120	1/16 IN, 1 1/8 OUT	90 IN, 125 OUT	
1330	150	1/16 IN, 1 1/8 OUT	70 IN, 130 OUT	
1400	180	1/16 IN, 1 1/8 OUT	75 IN, 130 OUT	
1430	210	1/16 IN, 1 1/8 OUT	75 IN, 140 OUT	

*For double ring test, the volume of water added equals the sum for the inner and outer rings.



TETRA TECH

INFILTRATION TEST DATA SHEET

PROJECT NAME: Sunoco Pipeline
PROJECT NUMBER: 112 ITCO 7309

TEST AREA ID: Wolf Bridge Road IT#3
PERSONNEL: SA, TR

TEST METHOD: Double-Ring Infiltrometer Percolation

Location Coordinates or Description:

N: 40° 14' 12.84"
W: 77° 09' 54.90"

INNER RING INSIDE DIAMETER: ~~12~~ 6"

OUTER RING INSIDE DIAMETER: 16"

PERCOLATION HOLE DIAMETER: _____

(If performing an open hole percolation test)

DATE(S): 9/18/15

Distance from the bottom of the inner ring/hole to measuring point

7"

(minimum water column of 4-6 inches):

MEASURING POINT: Ring Rim Indicator Mark _____

DEPTH OF TEST: _____

TIME	ELAPSED TIME SINCE START OF TEST (minutes)	WATER LEVEL DROP, INNER RING OR PERCOLATION HOLE (inches)	VOLUME OF WATER ADDED AT EACH CYCLE* (units _____)	REMARKS
PRESOAK DATA				
805	<u>0</u>	<u>0</u>	<u>N 8L</u>	<u>start test</u>
835	<u>30</u>	<u>1/4" IN, 5/8" Out</u>	<u>200 ml IN, 600 ml Out</u>	
905	<u>60</u>	<u>1/2" IN, 3/5" Out</u>		
TEST DATA				
905	<u>0</u>	<u>1/6" IN, 3/8" Out</u>	<u>75 ml IN, 425 ml Out</u>	<u>start test</u>
935	<u>30</u>	<u>1/6" IN, 3/8" Out</u>	<u>75 ml IN, 425 ml Out</u>	
1005	<u>60</u>	<u>1/6" IN, 3/8" Out</u>	<u>75 ml IN, 410 ml Out</u>	
1035	<u>90</u>	<u>1/6" IN, 3/8" Out</u>	<u>75 ml IN, 425 ml Out</u>	
1105	<u>120</u>	<u>1/6" IN, 3/8" Out</u>	<u>NA</u>	<u>END TEST</u>

*For double ring test, the volume of water added equals the sum for the inner and outer rings.



TETRA TECH

INFILTRATION TEST DATA SHEET

PROJECT NAME: Sunoco Pipeline TEST AREA ID: Wolf Bldgs Road It #4
 PROJECT NUMBER: 18IC07309 PERSONNEL: SA, TR

TEST METHOD: Double-Ring Infiltrometer Percolation

Location Coordinates or Description:

N: 40° 14' 13.48"
 W: 77° 09' 53.45"

INNER RING INSIDE DIAMETER: 6"

OUTER RING INSIDE DIAMETER: 10"

PERCOLATION HOLE DIAMETER: —

(If performing an open hole percolation test)

DATE(s): 9/18/15

Distance from the bottom of the inner ring/hole to measuring point 7"
 (minimum water column of 4-6 inches):

MEASURING POINT: Ring Rim Indicator Mark

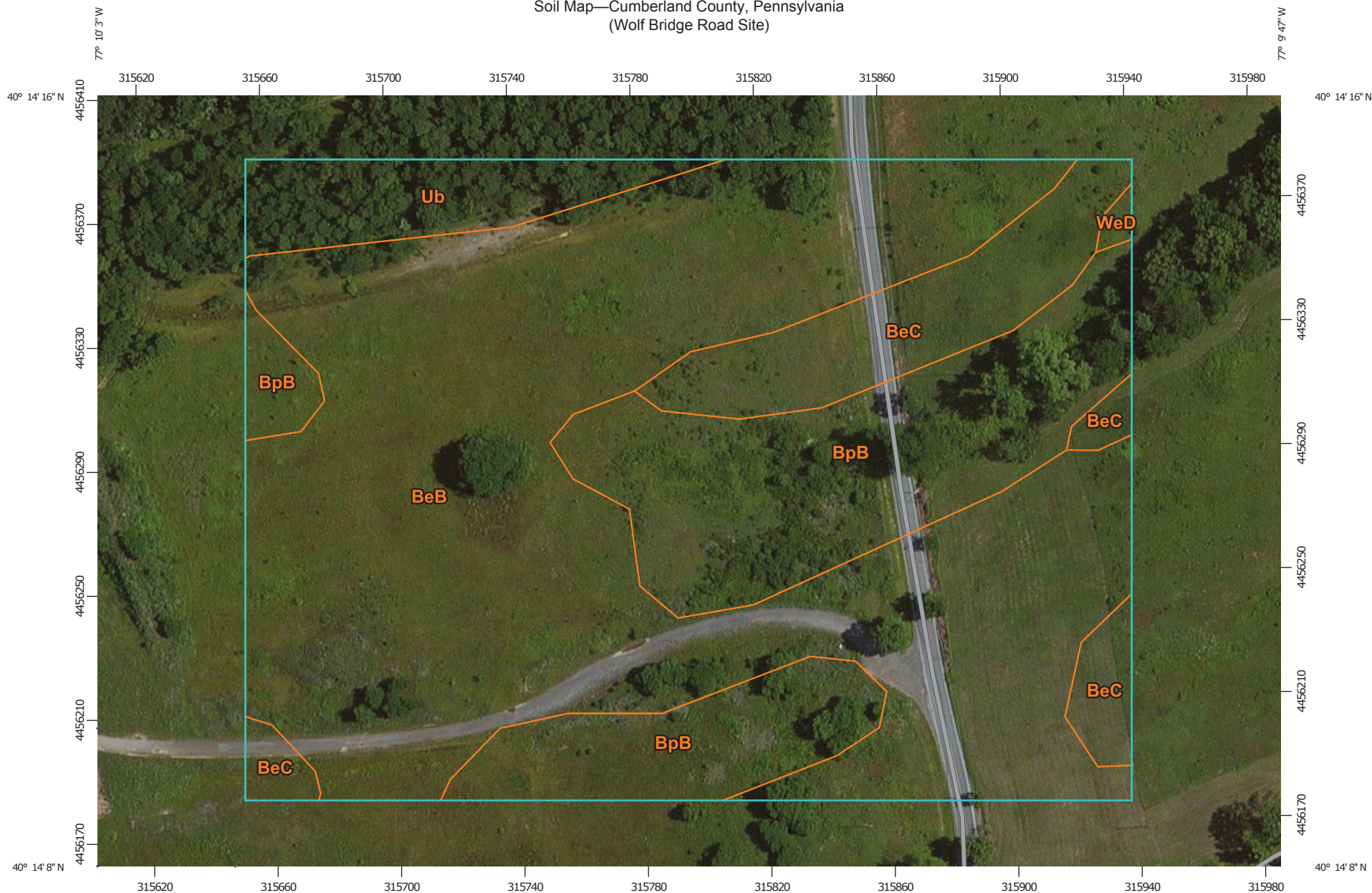
DEPTH OF TEST: —

TIME	ELAPSED TIME SINCE START OF TEST (minutes)	WATER LEVEL DROP, INNER RING OR PERCOLATION HOLE (inches)	VOLUME OF WATER ADDED AT EACH CYCLE* (units mL)	REMARKS
PRESOAK DATA				
920	0	0	N/L	Start Test
950	30	0 IN, 0 OUT	0	No movement
1020	60			
TEST DATA				
1050	90	0 IN, 0 OUT	0 mL	NO MOVEMENT
1120	120	+1/32" IN, +1/32" OUT	30 IN, 70 OUT	
1150	150	0 IN, 0 OUT	0	NO MOVEMENT
1220	180	0 IN, 0 OUT	0	u u
1250	210	0 IN, 0 OUT	0	END TEST

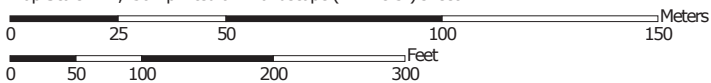
*For double ring test, the volume of water added equals the sum for the inner and outer rings.

SOIL MAP FIGURE AND SUPPORTING MATERIAL

Soil Map—Cumberland County, Pennsylvania
(Wolf Bridge Road Site)



Map Scale: 1:1,750 if printed on A landscape (11" x 8.5") sheet.




Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features



Blowout



Borrow Pit



Clay Spot



Closed Depression



Gravel Pit



Gravelly Spot



Landfill



Lava Flow



Marsh or swamp



Mine or Quarry



Miscellaneous Water



Perennial Water



Rock Outcrop



Saline Spot



Sandy Spot



Severely Eroded Spot



Sinkhole



Slide or Slip



Sodic Spot



Spoil Area



Stony Spot



Very Stony Spot



Wet Spot



Other



Special Line Features

Water Features



Streams and Canals

Transportation



Rails



Interstate Highways



US Routes



Major Roads



Local Roads

Background



Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Cumberland County, Pennsylvania
Survey Area Data: Version 6, Sep 18, 2015

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

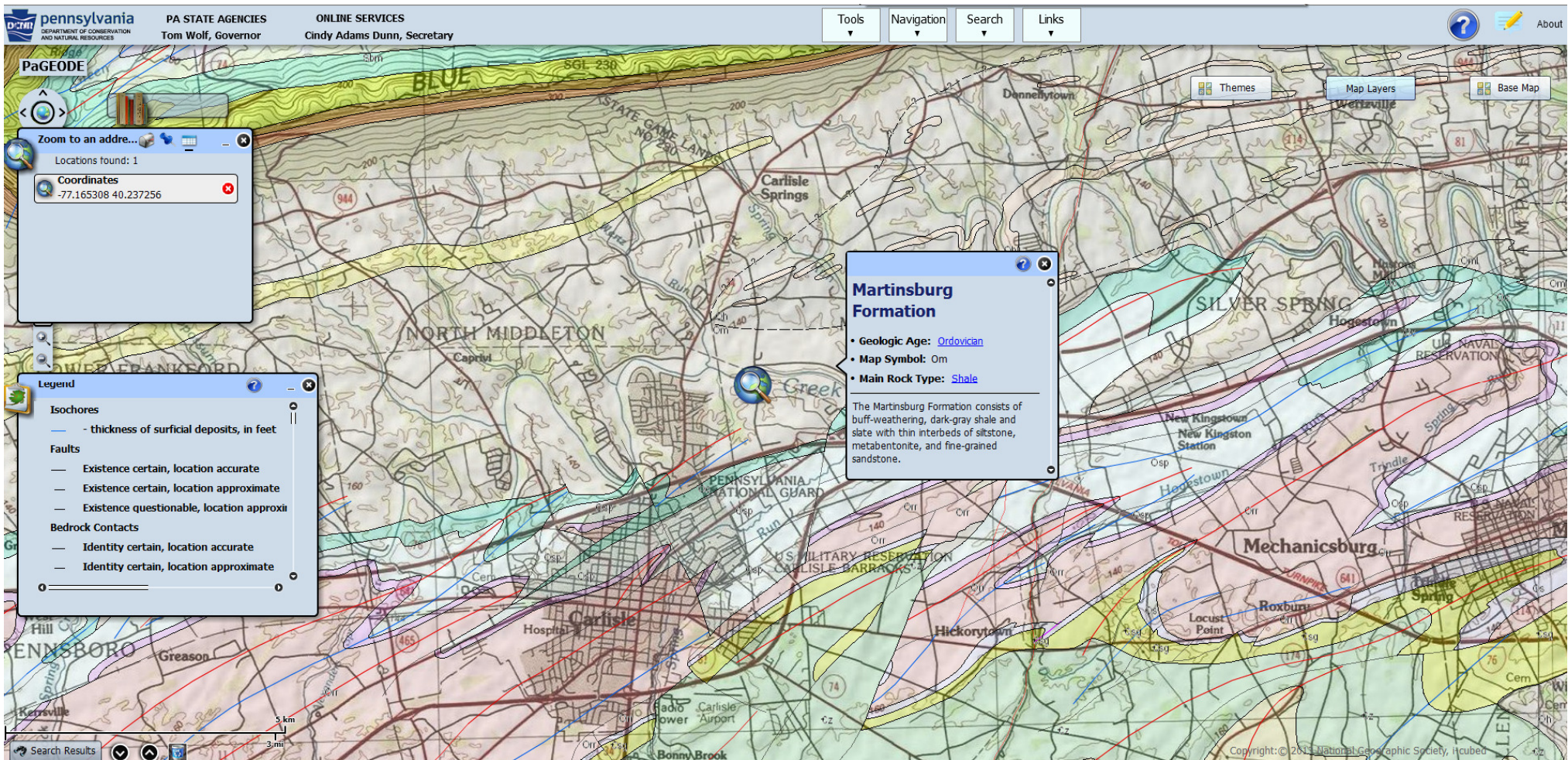
Date(s) aerial images were photographed: Jun 18, 2010—Sep 25, 2010

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Cumberland County, Pennsylvania (PA041)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BeB	Berks channery silt loam, 3 to 8 percent slopes	9.0	60.8%
BeC	Berks shaly silt loam, 8 to 15 percent slopes	1.5	10.0%
BpB	Blairton silt loam, 3 to 8 percent slopes	3.5	23.8%
Ub	Urban land and Udorthents	0.8	5.1%
WeD	Weikert very channery silt loam, 15 to 25 percent slopes	0.0	0.3%
Totals for Area of Interest		14.7	100.0%

SITE GEOLOGY MAP



Geologic Map of the Wolf Bridge Road Site

PHOTOGRAPHS

**PHOTOGRAPHS
INFILTRATION TESTING
SUNOCO PIPELINE
WOLF BRIDGE ROAD SITE
CUMBERLAND COUNTY, PA**



Description: Test at Wolf Bridge Rd. IT-1, approximately 6 inches deep.

Date: September 18, 2015



Description: Test at Wolf Bridge Rd. IT-2, approximately 6 inches deep.

Date: September 18, 2015

**PHOTOGRAPHS
INFILTRATION TESTING
SUNOCO PIPELINE
WOLF BRIDGE ROAD SITE
CUMBERLAND COUNTY, PA**



Description: Test at Wolf Bridge Rd. IT-3, approximately 6 inches deep.

Date: September 18, 2015



Description: Test at Wolf Bridge Rd. IT-4, approximately 6 inches deep.

Date: September 18, 2015

**PHOTOGRAPHS
INFILTRATION TESTING
SUNOCO PIPELINE
WOLF BRIDGE ROAD SITE
CUMBERLAND COUNTY, PA**



Description: Soil Boring at Wolf Bridge Rd. IT-1/3.

Date: September 18, 2015



Description: Soil Boring at Wolf Bridge Rd. IT-2/4.

Date: September 18, 2015