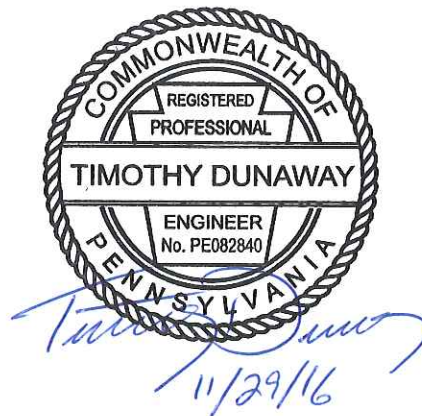


# Site Restoration and Post-Construction Stormwater Management Plan

## Pennsylvania Pipeline Project Delmont Pump Station

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## LIST OF ACRONYMS

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<b>ACRONYM</b>	<b>MEANING</b>
ABACT	Antidegradation Best Available Combination of Technologies
BMP	Best Management Practice
CWF	Cold water fishes
E&SC	Erosion and Sediment Control
ft.	Feet
HDPE	High-density polyethylene
HQ	High quality
NGL	Natural gas liquids
PA	Pennsylvania
PADEP	Pennsylvania Department of Environmental Protection
PASDA	Pennsylvania Spatial Data Access
PCSM	Post-Construction Stormwater Management
PPP	Pennsylvania Pipeline Project

ROW	Right of way
SPLP	Sunoco Pipeline, L.P.
SR	Sight Restoration
TSF	Trout stock fisheries
Tt	Tetra Tech, Inc.
UNT	Unnamed tributary
USGS	United States Geological Survey
WWF	Warm water fisheries

## **1.0 INTRODUCTION**

Tetra Tech, Inc. (Tt) has prepared this Site Restoration and Post-Construction Stormwater Management Plan for Sunoco Pipeline, L.P. (SPLP) – Pennsylvania Pipeline Project (PPP) – Delmont Pump Station. The Plan addresses restoration and post-construction stormwater management following installation of the Delmont Pump Station (Project). The Project is located in Salem Township, Westmoreland County, Pennsylvania. A USGS site location map is provided in Appendix A.

## 2.0 SITE DESCRIPTION

SPLP is proposing to construct the Project in Salem Township, Westmoreland County, Pennsylvania (PA). The pump station will be located on State Route 66 at latitude 40.430°, longitude -79.578°, in Delmont, PA. The Project will include the construction of a PDC enclosure, enclosed vapor combustion unit, knockout tank, pump with motor, cable tray, light pole, pipe rack, and pipe supports. The proposed Delmont Pump Station will be constructed within an LOD of 12.40 acres.

The current land use within the project area is industrial and commercial with some woodland and meadow areas. Future land use will be maintained gravel pads, access roads, and restored areas being returned to meadow in good condition. The project area drains to Tributary 43017 to Beaver Run and Turtle Creek. Site soils information was taken from the USDA NRCS Web Soil Survey. A soil map and list of existing soil types is located in Appendix B. Relevant topographic features including streams, streets, pipelines, structures, utility lines, fences, paving and other significant items along the pump station LOD are indicated on the plans, where applicable. The PCSM BMPs at the site include infiltration basins, underground storage pipes, and vegetated channels. PCSM BMPs are discussed in detail in section 4.3.

### 2.1 TOPOGRAPHY

The work zone is located on ground of varying elevations. Site elevations vary from approximately 1200 feet (eastern corner of pad) to 1270 feet (western corner of pad) above mean sea level based on the Pennsylvania Spatial Data Access (PASDA). The construction plans show the topography of the site and the surrounding area.

### 2.2 GEOLOGY AND SOILS

Soil and geologic formations figures are provided in Appendix B. Appendix B also provides soil descriptions and properties of the soils found at the site. The site consists of Culleoka channery silt loam (CuC), 8 to 15 percent slopes, Ernest silt loam (ErB), 3 to 8 percent slopes, Fairpoint very channery silt loam (FaC), 8 to 15 percent slopes, Gilpin channery silt loam (GcC), 8 to 15 percent slopes, Guernsey silt loam (GyC), 8 to 15 percent slopes, Holly silt loam (Ho), 0 to 2 percent slopes, Urban land (UdB), 3 to 8 percent slopes, Urban land-Culleoka complex (UeB), 0 to 8 percent slopes, Urban land-Guernsey complex (UhB), 0 to 8 percent slopes, and Wharton silt loam (WrC), 8 to 15 percent slopes, which are described below.

**CuC - Culleoka channery silt loam, 8 to 15 percent slopes.** This well-draining soil is located on elevations ranging from 720 to 1,610 feet above mean sea-level. It is formed from fine-loamy residuum weathered from sandstone and shale. The typical soil profile is: 0 to 10 inches: channery silt loam; 10 to 19 inches: channery silt loam; 19 to 26 inches: very channery silt loam, 26 to 31 inches: very channery silt loam, and 31 to 41 inches: bedrock. The depth to water table is more than 80 inches. The restrictive feature

is encountered 24 to 40 inches below the surface. There is no flooding. Limiting soil characteristics of the Culleoka channery silt loam include caving cutbanks, corrosivity, erodibility, low strength, slow percolation, piping, lack of organic content for topsoil use, and susceptible to frost action.

**ErB - Ernest silt loam, 3 to 8 percent slopes.** This moderately well-draining soil is located on elevations ranging from 900 to 1,800 feet above mean sea-level. It is formed from acid fine-loamy colluvium derived from shale and siltstone. The typical soil profile is: 0 to 8 inches: silt loam; 8 to 24 inches: silty clay loam; 24 to 50 inches: channery silt loam, and 50 to 74 inches: channery silt loam. The depth to water table is about 17 to 22 inches. The restrictive feature is encountered 20 to 36 inches below the surface. There is no flooding. Limiting soil characteristics of the Ernest silt loam include caving cutbanks, corrosivity, erodibility, seasonal high water table, hydric soils, low strength, slow percolation, piping, lack of organic content for topsoil use, susceptible to frost action, susceptible to shrink-swell, and wetness.

**FaC - Fairpoint very channery silt loam, 8 to 15 percent slopes.** This well-draining soil is located on elevations ranging from 800 to 2,800 feet above mean sea-level. It is formed from moderately acid to neutral loamy coal extraction mine spoil derived from limestone, sandstone, and shale. The typical soil profile is: 0 to 9 inches: very channery silt loam and 9 to 75 inches: very channery clay loam. The depth to water table is more than 80 inches. The restrictive feature is encountered more than 80 inches below the surface. There is no flooding. Limiting soil characteristics of the Fairpoint very channery silt loam include caving cutbanks, corrosivity, droughty, hydric soils, low strength, slow percolation, lack of organic content for topsoil use, susceptible to frost action, susceptible to shrink-swell, and potential to sinkhole.

**GcC - Gilpin channery silt loam, 8 to 15 percent slopes.** This well-draining soil is located on elevations ranging from 800 to 3,090 feet above mean sea-level. It is formed from acid fine-loamy residuum weathered from shale and siltstone. The typical soil profile is: 0 to 8 inches: channery silt loam, 8 to 24 inches: channery silt loam, 24 to 30 inches: extremely channery loam, and 30 to 40 inches: bedrock. The depth to water table is more than 80 inches. The restrictive feature is encountered 30 to 36 inches below the surface. There is no flooding. Limiting soil characteristics of the Gilpin channery silt loam include caving cutbanks, corrosivity, droughty, erodibility, hydric soils, low strength, slow percolation, piping, lack of organic content for topsoil use, and susceptible to frost action.

**GyC - Guernsey silt loam, 8 to 15 percent slopes.** This moderately well-draining soil is located on elevations ranging from 600 to 1,880 feet above mean sea-level. It is formed from colluvium derived from limestone and shale over residuum weathered from limestone and shale. The typical soil profile is: 0 to 8 inches: silt loam, 8 to 15 inches: silt loam, 15 to 22 inches: silty clay loam, 22 to 37 inches: silty clay, 37 to 54 inches: silty clay loam, 54 to 60 inches: channery silt loam, and 60 to 70 inches: bedrock. The depth to water table is about 16 to 23 inches. The restrictive feature is encountered 59 to 62 inches below the surface. There is no flooding. Limiting soil characteristics of the Guernsey silt loam include caving cutbanks, corrosivity, erodibility, seasonal high water table, hydric soils, low strength, slow percolation, lack of organic

content for topsoil use, susceptible to frost action, susceptible to shrink-swell, potential to sinkhole, and wetness.

**Ho - Holly silt loam, 0 to 2 percent slopes.** This poorly-draining soil is located on elevations ranging from 480 to 3,000 feet above mean sea-level. It is formed from colluvium derived from recent loamy alluvium derived from sandstone and shale. The typical soil profile is: 0 to 9 inches: silt loam, 9 to 13 inches: silt loam, 13 to 35 inches: loam, 35 to 42 inches: clay loam, and 42 to 65 inches: gravelly loam. The depth to water table is about 0 to 12 inches. The restrictive feature is encountered more than 80 inches below the surface. There is frequent flooding. Limiting soil characteristics of the Holly silt loam include caving cutbanks, corrosivity, flooding, seasonal high water table, hydric soils, low strength, slow percolation, piping, lack of organic content for topsoil use, susceptible to frost action, ponding, and wetness.

**UdB - Urban land, 3 to 8 percent slopes.** This non-draining soil is located only on the surface of the ground. It is formed from pavement, buildings and other artificially covered areas human transported material. The typical soil profile is: surface of ground: impervious materials. The depth to water table is dependent on the depth of the water table at a given location. The restrictive feature is encountered at the normal depth of the restrictive feature. There is frequent flooding. Limiting soil characteristics of the Urban land include seasonal high water table, slow percolation, lack of organic content for topsoil use, susceptible to frost action, and susceptible to shrink-swell.

**UeB - Urban land-Culleoka complex, 0 to 8 percent slopes.** See Urban land (UdB) and Culleoka channery silt loam (CuC) descriptions above.

**UhB - Urban land-Guernsey complex, 0 to 8 percent slopes.** See Urban land (UdB) and Guernsey silt loam (GyC) descriptions above.

**WrC - Wharton silt loam, 8 to 15 percent slopes.** This moderately well-draining soil is located on elevations ranging from 760 to 2,860 feet above mean sea-level. It is formed from fine-loamy residuum weathered from shale and siltstone. The typical soil profile is: 0 to 9 inches: silt loam, 9 to 16 inches: silt loam, 16 to 22 inches: silt loam, 22 to 31 inches: silt loam, 31 to 46 inches: silty clay loam, 46 to 69 inches: channery silty clay loam, and 69 to 79 inches: bedrock. The depth to water table is about 16 to 28 inches. The restrictive feature is encountered 40 to 71 inches below the surface. There is no flooding. Limiting soil characteristics of the Wharton silt loam include caving cutbanks, corrosivity, erodibility, seasonal high water table, hydric soils, low strength, slow percolation, piping, lack of organic content for topsoil use, susceptible to frost action, susceptible to shrink-swell, and wetness.

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## **2.3 SURFACE WATER HYDROLOGY**

The pump station and substation project area surface water runoff drains to UNT to Beaver Run which is designated as high quality cold water fishes (HQ-CWF) under PA Code 25 Chapter 93. These waters are designated as having impaired aquatic life due to: Agriculture – Siltation; Grazing Related Agriculture – Nutrients; Grazing Related Agriculture – Siltation.

The metering station project area surface water runoff drains to Turtle Creek which is designated as trout stock fishes (TSF) under PA Code 25 Chapter 93. These waters are designated as having impaired aquatic life due to: Abandoned Mine Drainage - Metals.

The locations of the receiving waters relative to the Project area can be seen on Appendix A, the USGS Project Location figure.

Offsite primary receiving waters include: UNT to Beaver Run and Turtle Creek. The Project area surface water runoff drains to the east towards UNT to Beaver Run (HQ-CWF) and to the northwest to Turtle Creek (TSF).

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### **3.0 SITE RESTORATION PRACTICES**

Grounds disturbed by any of the operations necessary to complete the work for this project are to be permanently seeded, or if specified, sodded, unless occupied by structures, paved, graveled, or designated as a permanent access road. Disturbed areas will be seeded and mulched within 24 hours once final grades are achieved. If seeding cannot be completed within a four (4) day period due to weather conditions, the disturbed area will be mulched with straw at the rate of three (3) tons per acre. This straw will be anchored using a method described in Section 3.4. Two infiltration basins, an infiltration filter, an underground stormwater storage system, and seven vegetated channels will be installed as post construction stormwater BMPs to mitigate the permanent stormwater impacts of construction.

#### **3.1 CONSTRUCTION SEQUENCE**

A generalized construction sequence is provided below for installing post construction stormwater BMPs. The construction sequence is intended to provide a general course of action to conform to the applicable regulatory agency requirements for restoration and post-construction stormwater management of the site. Necessary steps for proper and complete execution of work pertaining to this plan, whether specifically mentioned or not, are to be performed by the contractor. The contractor will comply with all requirements listed in this section and the Pennsylvania Stormwater Best Management Practices Manual. The contractor may be required to alter controls based on the effectiveness of controls or differing conditions encountered in the field. If the contractor plans on deviating from the methods and controls in this PCSM Plan, they must get approval from the county conservation district and DEP before any actions commence.

A pre-construction meeting is required prior to the start of any construction activity. The Pennsylvania Department of Environmental Protection (PADEP) or applicable county conservation district, contractors, the landowner, appropriate municipal officials, and the plan preparer must be invited to this meeting at least seven (7) days prior to construction commencement. All construction activities shall be discussed in this meeting including, but not limited to, the PCSM features and any deviations the contractor has planned.

Install post construction BMPs after completion and stabilization of the Project to prevent sediment accumulation in the BMPs. The critical stages that a licensed professional shall oversee are all installation and testing procedures for the infiltration basins, underground storage pipes, infiltration filters, diversion berms, and vegetated channels.

#### **Infiltration Basins Installation**

1. Protect Infiltration Basin areas from compaction prior to installation.
2. If possible, install the Infiltration Basin during later phases of site construction to prevent sedimentation and/or damage from construction activity. After installation, prevent sediment laden water from entering inlets and pipes. If the Infiltration Basin is used for sediment control during construction, the basin

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bottom shall be protected from sediment clogging by an engineered cover material or removal of the upper soil layer after construction.

3. Install and maintain proper Erosion and Sediment Control Measures during construction.
4. Excavate Infiltration Basin bottom to an uncompacted subgrade free from rocks and debris. Do NOT compact subgrade.
5. Install outlet control structures.
6. Seed and stabilize topsoil. (Vegetate if appropriate with native plantings.)
7. Do not remove Inlet Protection or other Erosion and Sediment Control measures until site is fully stabilized.

### **Underground Storage Pipe Installation**

1. Structures such as inlet boxes, reinforced concrete boxes, etc. should be installed in accordance with the manufacturers' or design engineers guidance.
2. Structures may be set on a layer of clean, lightly compacted gravel (such as AASHTO #57).
3. The underground storage system should be underlain by a layer of permeable non-woven-geotextile.
4. Place underlying gravel/stone in minimum 6 inch lifts and lightly compact. Place pipes in gravel during placement.
5. Wrap and secure nonwoven geotextile to prevent gravel/stone from clogging with sediments.
6. Gravel should be free of fine sands, silts and clays within and above the underground storage system to the ground surface to allow infiltration into the pipes.

### **Infiltration Filter Installation**

1. Permanent Filters should not be installed until the site is stabilized. Excessive sediment generated during construction can clog the Filter and prevent or reduce the anticipated post-construction water quality benefits. Stabilize all contributing drainage areas before runoff enters the filter.
2. Structures such as inlet boxes, reinforced concrete boxes, etc. should be installed in accordance with the manufacturer's or design engineer's guidance.
3. Excavate in such a manner as to avoid compaction of the subbase. Structures may be set on a layer of clean, lightly compacted gravel (such as AASHTO #57).
4. Infiltration filters should be underlain by a layer of permeable nonwoven geotextile.
5. Place underlying gravel/stone in minimum 6 inch lifts. Place underdrain pipes in gravel during placement.

6. Wrap and secure nonwoven geotextile to prevent gravel/stone from clogging with sediments.
7. Lay filtering material. Do not compact.
8. Saturate filter media and allow media to drain to properly settle and distribute.

### **Diversion Berm Installation**

1. Lightly scarify the soil in the area of the proposed diversion berm before delivering soil to site.
2. Bring in fill material to make up the majority of the diversion berm. Soil shall be added and compacted according to design specifications. The slope and shape of the diversion berm shall be graded out as soil is added.
3. Complete final grading of diversion berm after the top layer of soil is added. Tamp soil down lightly and smooths sides of the diversion berm. The crest and base of the diversion berm shall be at level grade.
4. Plant diversion berm with permanent grass seed mix.
5. Mulch planted and disturbed areas with compost mulch to prevent erosion while plants become established.

### **Vegetated Channel Installation**

1. Begin vegetated swale construction only when the upgradient temporary erosion and sediment control measures are in place. Vegetated swales should be constructed and stabilized early in the construction schedule, preferably before mass earthwork and paving increase the rate and volume of runoff.
2. Rough grade the vegetated swale. Equipment shall avoid excessive compaction and/or land disturbance. Excavating equipment should operate from the side of the swale and never on the bottom. If excavation leads to substantial compaction of the subgrade (where an infiltration trench is not proposed), 18 inches shall be removed and replaced with a blend of topsoil and sand to promote infiltration and biological growth. At the very least, topsoil shall be thoroughly deep plowed into the subgrade in order to penetrate the compacted zone and promote aeration and the formation of macropores. Following this, the area should be disked prior to final grading of topsoil.
3. Fine grade the vegetated swale. Accurate grading is crucial for swales. Even the smallest nonconformities may compromise flow conditions.
4. Seed, vegetate and install geo-synthetic clay lining as per approved plans and according to final planting list. The geo-synthetic clay liner acts as a water barrier to prevent slope saturation and potential slope failure. Plant the swale at a time of the year when successful establishment without irrigation is most likely. However, temporary irrigation may be needed in periods of little rain or drought. Vegetation should be established as soon as possible to prevent erosion and scour.
5. Once all tributary areas are sufficiently stabilized, remove temporary erosion and sediment controls. It is very important that the swale be stabilized before receiving upland stormwater flow.

**Level Spreader**

1. The uphill development shall be stabilized before diverting runoff to any dispersing flow techniques.
2. All contributing stormwater elements (diversion berms, inlets, outlet control structures, pipes, etc.) shall be installed prior to installation of the level spreader.
3. HDPE pipe shall be installed along a contour uphill of the level spreader, with care taken to construct a slightly sloped bottom.
4. If necessary, install erosion control matting along the length of the level spreader and to a distance downhill, as specified by the manufacturer/supplier.

**3.2 PERMANENT SEEDING**

Site preparation and establishment of permanent cover will be conducted according to the following guidelines:

1. Install needed surface water control measures.
2. Hydroseed or follow Steps 3 through 6 below.
3. Perform all cultural operations at right angles to the slope.
4. Determine agricultural time application rates by field pH testing at a rate of 1 test per acre (minimum). In the absence of testing, apply at 6 tons per acre.
5. Apply dry 10-20-20 formulation of fertilizer at the rate of 678 lb. per acre or at a rate determined by field testing.
6. Work in lime and fertilizer to a depth of 4 inches using suitable equipment.
7. Seed Mixture – The seed mixture will be:

SCIENTIFIC NAME	COMMON NAME	REQUIRED VARIETIES	% BY WEIGHT	MINIMUM % PURITY	MINIMUM % GERMINATION	MAX % WEED	SEEDING RATE (LBS/1000 SF)
Festuca Arundinacea	Tall Fesuce	Festuca arundinacea var. Kentucky 31	70	98	85	0.15	7.5

Lotus Corniculatus	Birdsfoot Trefoil Mixture	A combination of varieties (Viking, Empire, Norcen, Dawn, Leo, Bull, Maitland) with no one variety exceeding 50% of the total Trefoil component.	20	98	80 <sup>(1)</sup>	0.1	2
Agrostis Alba	Redtop	Agrostis alba	10	92	80	0.15	1

<sup>(1)</sup> Recommended 10% hardseed and 70% normal sprouts.

8. If not hydroseeding, apply mulch.

Notes:

1. Spread seeds where indicated and at the rates specified in Table 1, or as otherwise indicated.
2. Spread seeds within April 1 to June 15 or August 16 to September 15.
3. Extend seeding dates where project conditions warrant. Apply full treatment or apply only 50% of the permanent seeding and soil supplements and apply the remaining 50% within the next seeding dates, as directed in writing.
4. Use tillage and soil supplements before permanent seeding on topsoiled areas, where temporary seeding or mulching has been applied.
  - a. On topsoiled areas, 1:3 (3:1) and flatter, loosen the surface to a depth of at least 50 mm (2 inches) by disking, harrowing, or other acceptable methods until the tillage is satisfactory. On untilled areas, 1:3 (3:1) and flatter, till only as directed. Also, till or scarify areas if the surface is glazed or crusted.
  - b. Correct surface irregularities by filling depressions and leveling rough or uneven areas. Remove metal objects, stones larger than 50 mm (2 inches) in any dimension, and other debris or objects deemed detrimental to maintenance operations.
5. Inoculate leguminous seed, such as Crownvetch and Birdsfoot Trefoil, with proper cultures, according to the manufacturer's directions.
6. At the rates specified in Table 1, sow seeds uniformly on the prepared areas by the helicopter, hydraulic placement, broadcasting, drilling, or hand seeding methods. Inspect seeding equipment and adjust the equipment, if required, to ensure the specified application rates. Periodically perform a check on the rate and uniformity of application, as directed. Prior to seed application of each designated seed formula, thoroughly clean-out seed tank by rinsing with clean water to prevent contamination from one seed formula to the next. Repeat rinsing cycle until tank is clean. Collect all non-applied seed derived from each clean-out event and remove as waste from the project.

7. *After seeding, roll topsoiled areas that are to be mowed. Use a roller with a mass (weight) not more than 100 kg/m (65 pounds per foot). If soil is wet or frozen, roll only when directed.*
8. *Apply herbicides as directed, to areas that are to be mowed and where weed growth is prominent. The Representative will designate existing plants or groups of plants to be saved within these areas before herbicide application. If directed, more than one application may be required to control undesirable growth. Apply material with application personnel certified by the Department of Agriculture and with equipment specified in Section 108.05(c).*
9. *Final acceptance of seeding and soil supplement materials and installation are subject to the results of official sampling and testing as specified before use and installation and the resultant establishment of the specified vegetation. Remove non-approved materials from the project.*
  - a. *Reseed rejected areas with additional applications of the specified seed and soil supplement materials. Redress soil surfaces when directed. Perform reapplication of seed and soil supplements within the next applicable seeding date if necessary or as directed. When directed, reseed areas damaged by herbicide applications and mowing operations. NOTE: Reseeded areas will also require the application of appropriate mulch as specified in Section 805.*
  - b. *Seeded areas may be rejected based on the lack of actual grass seedling establishment exhibited in the area for the specified seed formula.*
    - i. *Table 1 formula seeded areas that exhibit less than 70% surface area coverage with the specified germinated grass seedlings after 90 days of growth may be rejected upon visual inspection. The seed germination and growth period is determined from the date of the seeding operation for the area when these operations are performed within the specified seeding dates.*
    - ii. *Special seed formula planted areas (seed mixtures not indicated in Table 1) may be rejected based on the lack of the specified seed germination and growth of less than 11 seedlings/m<sup>2</sup> (9 seedlings/square yard) after 120 days of growth determined by visual inspection. The seed germination and growth period is determined from the date of the seeding operation of the area when these operations are performed within the specified seeding dates.*
    - iii. *Seeded areas exhibiting soil surface erosion rills or gullies deeper than 250 mm (1-inch) may be rejected upon visual inspection. Redress and reseed designated eroded areas with specified materials and application rates as directed.*

### **Liming Rates**

Minimum 6 tons per acre at 100% effective neutralizing value (% ENV), unless the soil test determines that a lesser amount is needed. To determine the actual amount of regular lime to apply, divide the amount called for by the soil test by the % ENV for the product used. For example, if 6 tons per acre is needed and the % ENV for the lime used is 88%, divide 6 by 0.88 resulting in 6.8 tons needing to be applied. For dolomitic lime, which has a significant amount of magnesium in it, divide the amount called for by the soil test by the % calcium carbonate equivalent (% CCE) listed for the product instead of the % ENV. The % CCE may be above 100% which accounts for the fact that magnesium has a greater effect per pound than the calcium in regular lime. Note: When a soil test requires more than 8,000 pounds of lime per acre, the lime must be mixed into the top 6 inches of soil.

**Fertilization Rates**

Prepare areas for seeding by uniformly applying supplements. Document bulk delivery. Blend the initial soil supplements into the soil at least 50 mm (2 inches), on topsoiled areas, by raking, disking, harrowing, or other acceptable methods. Blend the supplements into the soil during tillage operations. Apply slow-release nitrogen fertilizer to the surface of Formula W seeded areas before project completion. Apply soil supplements as shown in the following table, unless otherwise indicated:

<b>Permanent Seeding Application Rate</b>				
<b>Soil Amendment</b>	<b>Per Acre</b>	<b>Per 1,000 sq. ft.</b>	<b>Per 1,000 sq. yds.</b>	<b>Notes</b>
Agricultural Lime	3872 LBS.	89 LBS.	800 LBS.	or as per soil test; may not be required in agricultural fields
10-20-20 Fertilizer	678 LBS.	16 LBS.	140 LBS.	
38-0-0 Ureaform Fertilizer, OR	242 LBS.	6 LBS.	50 LBS.	
32-0-0 to 38-0-0 Sulfur Coated Urea Fertilizer, OR	286 LBS.	7 LBS.	59 LBS.	
31-0-0 IBDU Fertilizer	295 LBS.	7 LBS.	61 LBS.	

**3.3 TEMPORARY SEEDING**

Temporary grass cover will be established in the following areas:

- Where vegetative filters must be established below filter bags, a minimum distance of 10 feet will be seeded down slope of the trap outlet. Seed mixture for temporary cover will consist of 100-percent annual ryegrass. Seed will be applied at the rate of 40 lb. per acre or as recommended by a local recognized seed supplier and approved by the owner's representative. Prior to seeding, apply 1 ton of agricultural grade limestone per acre plus 10-10-10 fertilizer at the rate of 500 lb. per acre and work into soil.
- Where soil stockpiles are to be exposed for a period greater than four (4) days, the stockpile shall be seeded.

<b>Temporary Seeding Application Rate</b>				
<b>Soil Amendment</b>	<b>Per Acre</b>	<b>Per 1,000 sq. ft.</b>	<b>Per 1,000 sq. yd.</b>	<b>Notes</b>
Agricultural Lime	1 ton	40lb.	410 lb.	Typically not required for topsoil stockpiles
10-10-10 Fertilizer	500lb.	12.5 lb.	100lb.	Typically not required for topsoil stockpiles

### 3.4 MULCHING

The purpose of mulch is to reduce runoff and erosion, prevent surface compaction or crusting, conserve moisture, aid in establishing plant cover, and control weeds. Mulch will be applied on any area subject to erosion, or which has unfavorable conditions for plant establishment and growth. The practice will be used alone or in conjunction with other structural and vegetative conservation practices, such as waterways, ponds, sedimentation traps or critical area planting. On sediment producing areas where the period of exposure is less than 2 months, mulch materials will be applied according to the following guidelines:

- Apply straw mulch at the rate of 3 tons per acre. Chemically treated or salted straw is not acceptable as mulch.
- Anchor straw mulch immediately after application by at least one of the following methods.
  - A. “Crimp” straw mulch into the soil using tractor drawn equipment (straight bladed coulter or similar). This method is limited to slopes no steeper than 3:1. Operate machinery on the contour. Crimping of hay or straw by running it over with tracked machinery is not recommended.
  - B. Uniformly apply asphalt, either emulsified or cut-back, containing no solvents or other diluting agents toxic to plant or animal life, at the rate of 31 gallons per 1,000 square feet.
  - C. Use synthetic binders (chemical binders) as recommended by the manufacturer to anchor mulch provided sufficient documentation is provided to show that it is non-toxic to native plant and animal species.
  - D. Staple lightweight plastic, fiber, or paper nets over the mulch according to the manufacturer’s recommendations.

Mulched areas will be checked periodically and after each runoff event (e.g. rain, snowmelt, etc.) for damage until the desired purpose of the mulching is achieved. Damaged portions of the mulch or tie-down material will be repaired upon discovery.

### 3.5 MATERIAL RECYCLING AND DISPOSAL

The operator will remove from the site, recycle, or dispose of all building materials and wastes in accordance with PADEP’s solid waste management regulations at 25 PA Code 260.1 et seq., 271.1 et seq., and 287.1 et seq. The contractor will not illegally bury, dump, or discharge building material or wastes at the site. Excess material brought into the site areas to facilitate construction access will be completely removed prior to rough grading and final surface stabilization. Expected construction wastes will consist of packaging material and sediment cleaned from BMPs. Packaging from the materials brought on-site will be disposed of by a licensed hauler. Sediment removed from BMPs will either be spread in a protected area, within the

LOD, to dry and then recycled as fill material or disposed of off-site. In cases where disposal is necessary, waste materials are to be disposed of at an approved, permitted PADEP waste disposal facility. Off-site spoil and/or borrow sites greater than one acre must be operated under an E&SC Plan approved by the County Conservation District.

### **3.6 THERMAL IMPACTS**

Potential pollution to surface waters from thermal impacts will be minimized by minimizing clearing and retaining existing vegetation where possible during construction. Following construction, permanent seeding will occur within 24 hours to facilitate vegetative growth.

### **3.7 RIPARIAN FOREST BUFFERS**

Existing riparian forest buffers do not exist within the Project area.

### **3.8 INSPECTION AND MAINTENANCE PROCEDURES**

Seeded areas will be inspected weekly and after each runoff event for bare spots, washouts, and healthy growth. Necessary repairs will be made immediately. Mulched areas will be checked periodically and after severe storms for damage until the desired purpose of the mulching is achieved. Damaged portions of the mulch or tie-down material will be repaired upon discovery.

If BMPs are found to be inoperative or ineffective during an inspection, PADEP shall be contacted within 24 hours, followed by submission of a written noncompliance report to PADEP within 5 days of the initial contact. A written report is required for each inspection and maintenance procedure, and shall be kept on site at all times. A licensed professional shall oversee all installation and testing procedures for the infiltration basins, underground storage pipes, infiltration filters, diversion berms and vegetated channels.

#### **Long-Term Maintenance**

The owner will maintain the stormwater management facilities for this site. Maintenance of the stormwater management facilities includes, but is not limited to, the following:

1. The proposed stormwater detention system, private storm systems, and stormwater BMP's will be inspected and maintained by the property owner in accordance with the approved operation and maintenance program.
2. The stormwater BMPs are fixtures that can be altered or removed only after approval by PADEP.
3. Infiltration Basins:
  - Inspect Infiltration Basin and associated inlets and piping at least four times per year and within 48 hours after every major storm event (> 1 inch rainfall depth).

- The vegetation along the surface of the infiltration basin should be maintained in good condition, and any bare spots revegetated as soon as possible.
- Vehicles should not be parked or driven on an infiltration basin, and care should be taken to avoid excessive compaction by mowers.
- Inspect the basin after large runoff events (> 1 inch) and make sure that runoff drains down within 72 hours. Mosquitoes should not be a problem if the water drains in 72 hours. Mosquitoes require a Pennsylvania Stormwater Best Management Practices Manual Chapter 6 considerably long breeding period with relatively static water levels.
- Also inspect for accumulation of sediment, damage to outlet control structures, erosion control measures, signs of water contamination/spills, and slope stability in the diversion berms. Remove trash and debris as necessary.
- Mow only as appropriate for vegetative cover species.
- Remove accumulated sediment from basin as required. Restore original cross section and infiltration rate. Properly dispose of sediment.

#### 4. Underground Storage Pipes:

- Inspect Underground Storage Pipes at least four times per year and within 48 hours after every major storm event (> 1 inch rainfall depth).
- The gravel surrounding underground pipes should be free of fine sands, silts and clays to provide proper storage and drainage.
- Catch Basins and Inlets should be cleaned of sediment when accumulation is more than 6 inches.
- Remove trash and debris as necessary from collection inlets, pipes and from the surface above the storage area. Rake or vacuum fine materials as necessary from the gravel.
- Replace gravel if raking/vacuumping has reduced depth of gravel.

#### 5. Infiltration Filter:

- Inspect Infiltration Filters and associated inlets and piping at least four times per year and within 48 hours after every major storm event (> 1 inch rainfall depth). Inspection considerations include:
  - Inspect cleanouts – any water left in a surface filter after the design drain down time indicates the filter is not optimally functioning.
  - Film or discoloration of any surface filter material – this indicates organics or debris have clogged the filter surface.
- Remove trash and debris as necessary.

- Scrape silt with rakes.
- Till and aerate filter area.
- Replace filtering medium if scraping/removal has reduced the depth of the filtering media.
- Dispose of filter media in accordance with all state and federal regulations.

#### 6. Level Spreader:

- Inspections to be done annually and within 48 hours after every major storm event (> 1 inch rainfall depth)
- The receiving land are shall be immediately restored to design conditions after any disturbance. Vegetated areas shall be seeded and blanketed.
- It is critical that even sheet flow conditions are sustained throughout the life of the level spreader, as their effectiveness can deteriorate due to lack of maintenance, inadequate design/location, and poor vegetation cover.
  - Inspection – The area below the level spreader shall be inspected for clogging, density of vegetation, damage by foot or vehicular traffic, excessive accumulations, and channelization. Inspections shall be made on a quarterly basis for the first two years following installation, and then on a semiannual basis thereafter. Inspections shall also be made after every storm event greater than 1-inch.
  - Removal – Sediment and debris shall be routinely removed (but never less than semiannually), or upon observation, when buildup occurs in the clean outs. Regrading and reseeded may be necessary in the areas below the level spreader. Regrading may also be required when pools of standing water are observed along the slope. (In no case should standing water be allowed for longer than 72 hours.)
  - Vegetation – Maintaining a vigorous vegetative cover on the areas below the level spreader is critical for maximizing pollutant removal efficiency and erosion prevention. If vegetative cover is not fully established within the designated time, it may need to be replaced with an alternative species. (It is standard practice to contractually require the contractor to replace dead vegetation.) Unwanted or invasive growth shall be removed on an annual basis. Biweekly inspections are recommended for at least the first growing season, or until the vegetation is permanently established. Once the vegetation is established, inspections of health, diversity, and density shall be performed at least twice a year, during both the growing and non-growing season. Vegetative cover shall be sustained at 85% and replaced if damage greater than 50% is observed.

#### 7. Diversion Berm

- 
- Inspections to be done annually and within 48 hours after every major storm event (> 1 inch rainfall depth)
  - Maintain turf grass and other vegetation by mowing and re-mulching
  - The crest of the diversion berm may be used as access for heavy equipment when necessary to limit disturbance.
  - Routinely remove accumulated trash and debris.
  - Remove invasive plants as needed.
  - Inspect for signs of flow channelization; restore level gradient immediately after deficiencies are observed.

#### 8. Vegetated Channel

- Inspections to be done annually and within 48 hours after every major storm event (> 1 inch rainfall depth)
  - Inspect and correct erosions problems, damage to vegetation, and sediment and debris accumulation (address when > 3 inches at any spot or covering vegetation)
  - Inspect vegetation on side slopes for erosion and formation of rills or gullies, correct as needed
  - Inspect for pools of standing water, dewater and discharge to an approved location and restore to design grade
  - Mow and trim vegetation to ensure safety, aesthetics, proper swale operation, or to suppress weeds and invasive vegetation; dispose of cuttings in a local composting facility; mow only when swale is dry to avoid rutting
  - Inspect for litter; remove prior to mowing
  - Inspect for uniformity in cross-section and longitudinal slope, correct as needed
  - Inspect swale inlet (curb cuts, pipes, etc.) and outlet for signs of erosion or blockage, correct as needed
- Maintenance to be done as needed
  - Plant alternative grass species in the event of unsuccessful establishment

- Reseed bare areas; install appropriate erosion control measures when native soil is exposed or erosion channels are forming
- Rototill and replant swale if draw down time is more than 48 hours
- Inspect and correct check dams when signs of altered water flow (channelization, obstructions, erosion, etc.) are identified
- Water during dry periods, fertilize, and apply pesticide only when absolutely necessary
- Additional maintenance necessitated by winter conditions
  - Inspect swale immediately after spring melt, remove residuals (e.g. sand) and replace damaged vegetation without disturbing remaining vegetation
  - If roadside road side or parking lot runoff is directed to the swale, mulching and/or soil aeration/manipulation may be required in the spring to restore structure and moisture capacity and to reduce the impacts of deicing agents
  - Use nontoxic, organic deicing agents, applied either as blended, magnesium chloride-based liquid products or as pretreated salt
  - Use salt-tolerant vegetation in swales

### Long-Term Operation and Maintenance Schedule

PCSM BMP	Inspection	Repairs	Reconstruction	BMP Life Expectancy
Infiltration Basin	1 hr Quarterly @ \$70/hr	Repair erosion: 1 day / \$1,200	1-2 weeks Cost: \$100,000	20-30 years
Infiltration Filter	1 hr Quarterly @ \$70/hr	Replace 10% of filter media: 1 day / \$2,200	1-2 weeks Cost: \$100,000	20-30 years
Underground Storage Pipes	1 hr Quarterly @ \$70/hr	Replace 10% of gravel: 1 day / \$2,200	4-5 days Cost: \$50,000	20-30 years
Level Spreader	1 hr Quarterly @ \$70/hr	Repair erosion: 1 day / \$700	1-2 days Cost: \$2,100	20-30 years
Vegetated Channel	1 hr Annually @ \$70/hr	Repair erosion: 1 day / \$1,200	1-2 days Cost: \$5,900	20-30 years

Diversion Berm	1 hr Annually @ \$70/hr	Repair erosion: 1 day / \$800	1-2 days Cost: \$2,800	20-30 years
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1. Sunoco Pipeline L.P. is the owner/operator of the Houston Injection Station and is responsible for the long term maintenance of the site PCSM BMPs. SPLP can be contacted at: 610-670-3200

### 3.9 ANTIDEGRADATION REQUIREMENTS

PCSM BMPs associated with the Pennsylvania Pipeline Project will be located within a siltation-impaired watershed. A combination of non-discharge alternatives and the use of Antidegradation Best Available Combination of Technologies (ABACT) BMPs on site will protect the water quality of the receiving waters.

Non-discharge alternatives were evaluated to minimize accelerated erosion and sedimentation and achieve zero net change in runoff between the pre- and post-construction conditions. The extent of the disturbed area will be minimized, and the duration of disturbance will be minimized by stabilizing disturbed areas as soon as practicable. ABACT BMPs will be used on site to protect and maintain the existing water quality of receiving waters.

ABACT site restoration BMPs will include the following:

- Keeping the pre-construction drainage pattern intact
- Minimizing the disturbed area
- No direct discharge to surface waters
- Prompt site restoration
- Proper vegetative cover techniques

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## **4.0 POST-CONSTRUCTION STORMWATER MANAGEMENT ANALYSIS**

### **4.1 DESIGN BASIS**

This plan has been prepared to comply with the Township of Salem Subdivision and Land Development Ordinance, and the Westmoreland County Act 167 County-Wide Stormwater Management Plan.

The site's pre-development and post-development drainage characteristics were modeled in accordance with local and state requirements. The hydrology calculations were performed utilizing the U.S. Soil Conservation Service (SCS) TR-55 Urban Hydrology for Small Watersheds. The 1, 2, 5, 10, 25, 50, and 100-year storm events have been analyzed for pre- and post-developed conditions. The rainfall depths for each storm event are 2.3, 2.7, 3.4, 4.0, 4.6, 5.0, and 5.4 inches respectively, and follow the SCS 24-hour Type II rainfall distribution. Bentley PondPack V8i was used to perform the hydrology analysis. The pre-development watershed maps are located in Appendix C. The post-development watershed maps are located in Appendix D. The PondPack report is located in Appendix E.

Stormwater BMPs have been designed for the pump station to comply with the stormwater quality and quantity management requirements. The watershed network and detention facility routing calculations were performed using Bentley PondPack V8i. The BMPs also have been designed meet state stormwater quality and quantity management requirements. Calculation worksheets from Chapter 8 of the Pennsylvania Stormwater Best Management Practices Manual were used to ensure compliance with state requirements. The completed worksheets are located in Appendix F.

Ditches and stormwater pipes will be provided to convey runoff on the site. Ditches and stormwater pipes are designed to convey the 10-year storm event peak flow. Bentley FlowMaster V8i is used to perform flow calculations for ditches and culverts.

### **4.2 HYDROLOGY**

Pre-development and post-development runoff results were calculated using the previously described design basis. The project has been separated into three separate pre-development watersheds (A, B and C). Each pre-development watershed has a single point of interest that encompasses both developed and undeveloped areas.

The point of interest for watershed A is located southeast of the development within a tributary to Beaver Run. Within watershed A, there are two separate post-development sub-watersheds that are controlled by two different BMPs. The point of interest for watershed B is located southwest of the development at a drainage inlet on Route 66. Within watershed B, there is a single post-development sub-watershed that is controlled one BMP. The point of interest for watershed C is located northwest of the development at a drainage inlet on Route 66. Within watershed C, there is a single post-development sub-watershed that is controlled one BMP. Because of a proposed drainage ditch, this controlled watershed extends partially into watershed B, making the post-developed areas for watershed B and C different than the pre-developed

areas. Table 1 provides a summary of all of the pre-development and post-development watersheds and associated peak flow discharge rates without stormwater controls.

**Table 1: Pre-Development and Post-Development Hydrology**

DA	Drainage Area (ac.)	Tc (hr.)	CN	Peak Flow (cfs)						
				1-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Pre-Development A	34.02	0.399	82.42	27.83	37.80	56.29	72.79	89.78	101.35	113.00
Post-Development A Controlled 1	2.575	0.083	89.91	5.25	6.63	9.07	11.17	13.27	14.67	16.06
Post-Development A Controlled 2	3.058	0.083	82.32	3.99	5.37	7.92	10.30	12.73	14.37	16.02
Post-Development A Uncontrolled	28.374	0.399	82.64	23.48	31.81	47.25	61.00	75.24	84.89	94.59
Pre-Development B	3.238	0.104	77.02	2.80	4.08	6.53	8.78	11.12	12.72	14.34
Post-Development B Controlled	1.103	0.083	85.90	1.79	2.33	3.34	4.23	5.12	5.72	6.32
Post-Development B Uncontrolled	1.785	0.109	76.77	1.50	2.19	3.53	4.77	6.05	6.93	7.82
Pre-Development C	1.324	0.083	78.87	1.36	1.91	2.95	3.89	4.89	5.58	6.28
Post-Development C Controlled	0.776	0.083	81.58	0.97	1.31	1.95	2.54	3.15	3.57	3.98
Post-Development C Uncontrolled	0.900	0.083	81.27	1.10	1.49	2.23	2.91	3.62	4.10	4.58

Maps for the pre-development and post-development watersheds are located in Appendix C and Appendix D respectively.

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### 4.3 BMP DESIGN

Two BMPs are used to control runoff volume and peak flow rates in watershed A. BMP-1 consists of underground storage pipes that are bedded in gravel and wrapped with geomembrane. The underground storage pipes do not provide infiltration. BMP-1 is associated with the post-development A controlled 1 drainage area. BMP-2 is an infiltration basin. The basin provides volume control by filtering water through the basin floor and it also provides rate control by detaining water in the basin. An emergency spillway is provided for the infiltration basin that will pass the 100-year storm. BMP-2 is associated with the post-development A controlled 2 drainage area.

One BMP is used to control runoff volume and peak flow rates in watershed B. BMP-3 is an infiltration filter that consists of underground storage pipes that are bedded in gravel and wrapped with filter fabric. Soil amendment is proposed underneath of BMP-3 to promote infiltration. BMP-3 is associated with the post-development B controlled drainage area.

One BMP is used to control runoff volume and peak flow rates in watershed C. BMP-4 is an infiltration basin. The basin provides volume control by filtering water through the basin floor and it also provides rate control by detaining water in the basin. An emergency spillway is provided for the infiltration basin that will pass the 100-year storm. BMP-4 is associated with the post-development C controlled drainage area.

Two BMPs, diversion berms and vegetated channels, are used to divert stormwater on site. The diversion berms and vegetated channels on site provide minimal infiltration and are only intended to direct stormwater to structural BMPs that will control the runoff volume and peak flow rates.

One BMP, a level spreader, is used to reduce the erosive energy of concentrated flows by distributing runoff as sheet flow to stabilized vegetated areas. The level spreaders on site provide minimal infiltration and are only intended to disperse the erosive energy of stormwater runoff.

The BMP design details are shown in Appendix G. The PondPack report of the storm routing for all BMPs is provided in Appendix E. The cumulative storage volume of each BMP is shown in Table 2 through Table 5. The routing summary for each BMP is summarized in Table 6 through Table 9.

**Table 2: BMP-1 Cumulative Storage Volume**

<b>Depth of Water in System</b>	<b>Cumulative Pipe Storage</b>	<b>Cumulative Pipe + Gravel Storage</b>	<b>Total System Cumulative Storage</b>	<b>Total System Cumulative Storage</b>
<b>(Feet)</b>	<b>(Cubic Feet)</b>	<b>(Cubic Feet)</b>	<b>(Cubic Feet)</b>	<b>(Acre Feet)</b>
4.0	3.14	9.88	5930.94	0.136
3.5	3.14	8.88	5330.94	0.122
3.0	3.14	7.88	4730.94	0.109
2.5	3.14	6.88	4130.94	0.095
2.0	3.14	5.88	3530.94	0.081
1.5	1.57	3.94	2365.47	0.054
1.0	0.61	2.37	1421.21	0.033
0.5	0.00	1.00	600.00	0.014
0.0	0.00	0.00	0.00	0.000

Note: The volume has been reduced to account for 40% void space in the gravel filter media

**Table 3: BMP-2 Cumulative Storage Volume**

<b>Elevation</b>	<b>Cumulative Volume</b>	<b>Cumulative Volume</b>
<b>(Feet)</b>	<b>(Acre Feet)</b>	<b>(Cubic Feet)</b>
1204.00	0.00	0.00
1206.00	0.333	14,505
1208.00	0.773	33,672
1210.00	1.336	58,196

**Table 4: BMP-3 Cumulative Storage Volume**

Depth of Water in System	Cumulative Pipe Storage	Cumulative Pipe + Gravel Storage	Total System Cumulative Storage	Total System Cumulative Storage
(Feet)	(Cubic Feet)	(Cubic Feet)	(Cubic Feet)	(Acre Feet)
4.0	3.14	9.88	7907.92	0.182
3.5	3.14	8.88	7107.92	0.163
3.0	3.14	7.88	6307.92	0.145
2.5	3.14	6.88	5507.92	0.126
2.0	3.14	5.88	4707.92	0.108
1.5	1.57	3.94	3153.96	0.072
1.0	0.61	2.37	1894.95	0.044
0.5	0.00	1.00	800.00	0.018
0.0	0.00	0.00	0.00	0.000

Note: The volume has been reduced to account for 40% void space in the gravel filter media

**Table 5: BMP-4 Cumulative Storage Volume**

Elevation	Cumulative Volume	Cumulative Volume
(Feet)	(Acre Feet)	(Cubic Feet)
1232.00	0.000	0.00
1233.00	0.022	958
1234.00	0.055	2,396
1235.00	0.101	4,400
1236.00	0.163	7,100
1237.00	0.242	10,542

**Table 6: BMP-1 Routing Summary**

<b>Storm Event (years)</b>	<b>Peak BMP Inflow (cfs)</b>	<b>Routed Peak BMP Outflow (cfs)</b>	<b>Maximum Storage Volume (ac-ft.)</b>	<b>Water Surface Elevation (feet)</b>
1	5.25	4.38	0.041	1217.19
2	6.63	5.55	0.050	1217.40
5	9.07	6.98	0.068	1217.76
10	11.17	8.34	0.087	1218.22
25	13.27	9.89	0.104	1218.84
50	14.67	10.88	0.117	1219.30
100	16.06	11.77	0.129	1219.74

**Table 7: BMP-2 Routing Summary**

<b>Storm Event (years)</b>	<b>Peak BMP Inflow (cfs)</b>	<b>Routed Peak BMP Outflow (cfs)</b>	<b>Maximum Storage Volume (ac-ft.)</b>	<b>Water Surface Elevation (feet)</b>
1	3.99	0.00	0.221	1205.40
2	5.37	0.00	0.296	1205.81
5	7.92	0.03	0.483	1206.53
10	10.30	0.18	0.464	1206.65
25	12.73	0.35	0.496	1206.80
50	14.37	0.51	0.526	1206.94
100	16.02	0.73	0.560	1207.10

**Table 8: BMP-3 Routing Summary**

<b>Storm Event (years)</b>	<b>Peak BMP Inflow (cfs)</b>	<b>Routed Peak BMP Outflow (cfs)</b>	<b>Maximum Storage Volume (ac-ft.)</b>	<b>Water Surface Elevation (feet)</b>
1	1.79	0.05	0.074	1234.53
2	2.33	0.13	0.079	1234.59
5	3.34	0.45	0.096	1234.83
10	4.23	1.22	0.115	1235.20
25	5.12	2.18	0.131	1235.62
50	5.72	2.62	0.142	1235.92
100	6.32	3.01	0.153	1236.23

**Table 9: BMP-4 Routing Summary**

<b>Storm Event (years)</b>	<b>Peak BMP Inflow (cfs)</b>	<b>Routed Peak BMP Outflow (cfs)</b>	<b>Maximum Storage Volume (ac-ft.)</b>	<b>Water Surface Elevation (feet)</b>
1	0.97	0.00	0.054	1233.97
2	1.31	0.03	0.057	1234.06
5	1.95	0.10	0.063	1234.21
10	2.54	0.23	0.075	1234.47
25	3.15	0.33	0.091	1234.80
50	3.57	0.53	0.102	1235.01
100	3.98	1.55	0.106	1235.09

#### **4.4 INFILTRATION AREAS**

BMP-2, BMP-3 and BMP-4 are designed to provide infiltration for volume control. Infiltration rates must be adequate to drain the water quality volume within 72 hours. PondPack allows for infiltration information to be included in the BMP design and it can be used to calculate the volumes removed by the BMPs through infiltration. Infiltration testing was performed according to the Pennsylvania Stormwater Best Management

Practices Manual to determine the infiltration rates to use in the calculations. Infiltration test results are located in Appendix B.

BMP-2 is located at infiltration test points IT-3 and IT-4. The infiltration rate at IT-3 was measured to be 0.0 in/hr. The infiltration rate at IT-4 was measured to be 28.4 in/hr. The average of IT-1 and IT-2 is 14.2 in/hr. (1.18 ft./hr.). From Table 7, the maximum ponding depth for the 2-year storm is 2.5 feet. Therefore, the water quality volume is drained adequately:

$$\text{Drain time} = 2.5 \text{ ft.} / 1.18 \text{ ft./hr.} = 2.12 \text{ hours}$$

BMP-3 is located at infiltration test points IT-8. The infiltration rate at IT-8 was measured to be 0.00 in/hr. Soil amendments will be provided underneath this BMP to achieve infiltration. From Table 8, the maximum storage volume for the 2-year storm is 0.079 ac-ft. The surface area of BMP-3 is 4,000 sf (0.092 acres).

$$\text{Soil amendment depth required} = 0.079 \text{ ac-ft.} / (0.4 * 0.092 \text{ ac}) = 2.15 \text{ ft.}$$

Therefore, soil amendments will be provided to a depth of 2.15 feet below the BMP.

BMP-4 is located at infiltration test points IT-9. The infiltration rate at IT-9 was measured to be 0.12 in/hr. (0.01 ft./hr.). Soil amendments will be provided underneath this BMP to achieve infiltration. From Table 9, the maximum ponding depth for the 2-year storm is 2.0 feet.

$$\text{Amount of infiltration in 72 hours} = 72 \text{ hours} * 0.01 \text{ ft./hr.} = 0.72 \text{ ft.}$$

$$\text{Soil amendment depth required} = [(2.0 \text{ ft.} - 0.72 \text{ ft.}) * \text{pond area}] / [\text{pond area} * 0.4] = 3.2 \text{ ft.}$$

Therefore, soil amendments will be provided to a depth of 3.2 feet below the BMP.

#### **4.5 STORMWATER MANAGEMENT**

Stormwater quality management for the project will comply with Township ordinances and state regulations through the implementation of erosion and sediment controls during construction and implementation and maintenance of Post Construction Stormwater Management (PCSM) controls after construction. Erosion and sediment control details are included in the land development plans for the project and are designed to be in compliance with state regulations. Stormwater quality is achieved with the proposed BMP design, which is in accordance with the Pennsylvania Stormwater Best Management Practices Manual. The BMPs will capture suspended solids through settling and filtration and will improve water quality. Table 10 through Table 12 show how the design criteria for peak discharge rate and volume reduction is achieved for this project. The post development peak flow is less than 100% of the pre-development peak flow for each design storm event. For the 2-year storm, the post development hydrograph volume is less than the pre-development hydrograph volume.

**Table 10: Watershed A Peak Discharge Rate Reduction Summary**

Storm Event (years)	Total Pre-Development Peak Flow (cfs)	Total Post-Development Peak Flow (cfs)	Total Peak Flow Rate Difference (cfs)	Total Pre-Development Hydrograph Volume (ac-ft)	Total Post-Development Hydrograph Volume (ac-ft)	Total Hydrograph Volume Difference (ac-ft)
1	27.83	26.29	-1.54	2.484	2.387	-0.097
2	37.80	35.52	-2.28	<b>3.326</b>	<b>3.170</b>	<b>-0.156</b>
5	56.29	53.15	-3.14	4.910	4.640	-0.270
10	72.79	68.18	-4.61	6.346	6.091	-0.255
25	89.78	83.57	-6.21	7.832	7.590	-0.242
50	101.35	94.16	-7.19	8.844	8.609	-0.235
100	113.00	105.00	-8.00	9.870	9.641	-0.229

2. The total post development peak flow and hydrograph volume is the routed flow of all post-development watersheds to the point of interest.

**Table 11: Watershed B Peak Discharge Rate Reduction Summary**

Storm Event (years)	Total Pre-Development Peak Flow (cfs)	Total Post-Development Peak Flow (cfs)	Total Peak Flow Rate Difference (cfs)	Total Pre-Development Hydrograph Volume (ac-ft)	Total Post-Development Hydrograph Volume (ac-ft)	Total Hydrograph Volume Difference (ac-ft)
1	2.80	1.50	-1.30	0.167	0.117	-0.050
2	4.08	2.19	-1.89	<b>0.235</b>	<b>0.184</b>	<b>-0.051</b>
5	6.53	2.53	-4.00	0.366	0.312	-0.054
10	8.78	5.09	-3.69	0.489	0.428	-0.061
25	11.12	7.44	-3.68	0.619	0.550	-0.069
50	12.72	8.75	-3.97	0.708	0.633	-0.075
100	14.34	10.14	-4.20	0.799	0.718	-0.081

1. The total post development peak flow and hydrograph volume is the routed flow of all post-development watersheds to the point of interest.

**Table 12: Watershed C Peak Discharge Rate Reduction Summary**

Storm Event (years)	Total Pre-Development Peak Flow (cfs)	Total Post-Development Peak Flow (cfs)	Total Peak Flow Rate Difference (cfs)	Total Pre-Development Hydrograph Volume (ac-ft)	Total Post-Development Hydrograph Volume (ac-ft)	Total Hydrograph Volume Difference (ac-ft)
1	1.36	1.10	-0.26	0.077	0.061	-0.016
2	1.91	1.49	-0.42	<b>0.107</b>	<b>0.100</b>	<b>-0.007</b>
5	2.95	2.23	-0.72	0.163	0.177	0.014
10	3.89	2.91	-0.98	0.216	0.246	0.030
25	4.89	3.65	-1.24	0.270	0.318	0.048
50	5.58	4.22	-1.36	0.308	0.367	0.059
100	6.28	4.75	-1.53	0.346	0.417	0.071

1. The total post development peak flow and hydrograph volume is the routed flow of all post-development watersheds to the point of interest.

## **5.0 REFERENCES**

*Erosion and Sediment Pollution Control Program Manual, Commonwealth of Pennsylvania*, Department of Environmental Protection, Office of Water Management, March 2012.

*Pennsylvania Stormwater Best Management Practices Manual Draft*, Pennsylvania Department of Environmental Protection, Bureau of Watershed Management, October, 2009.

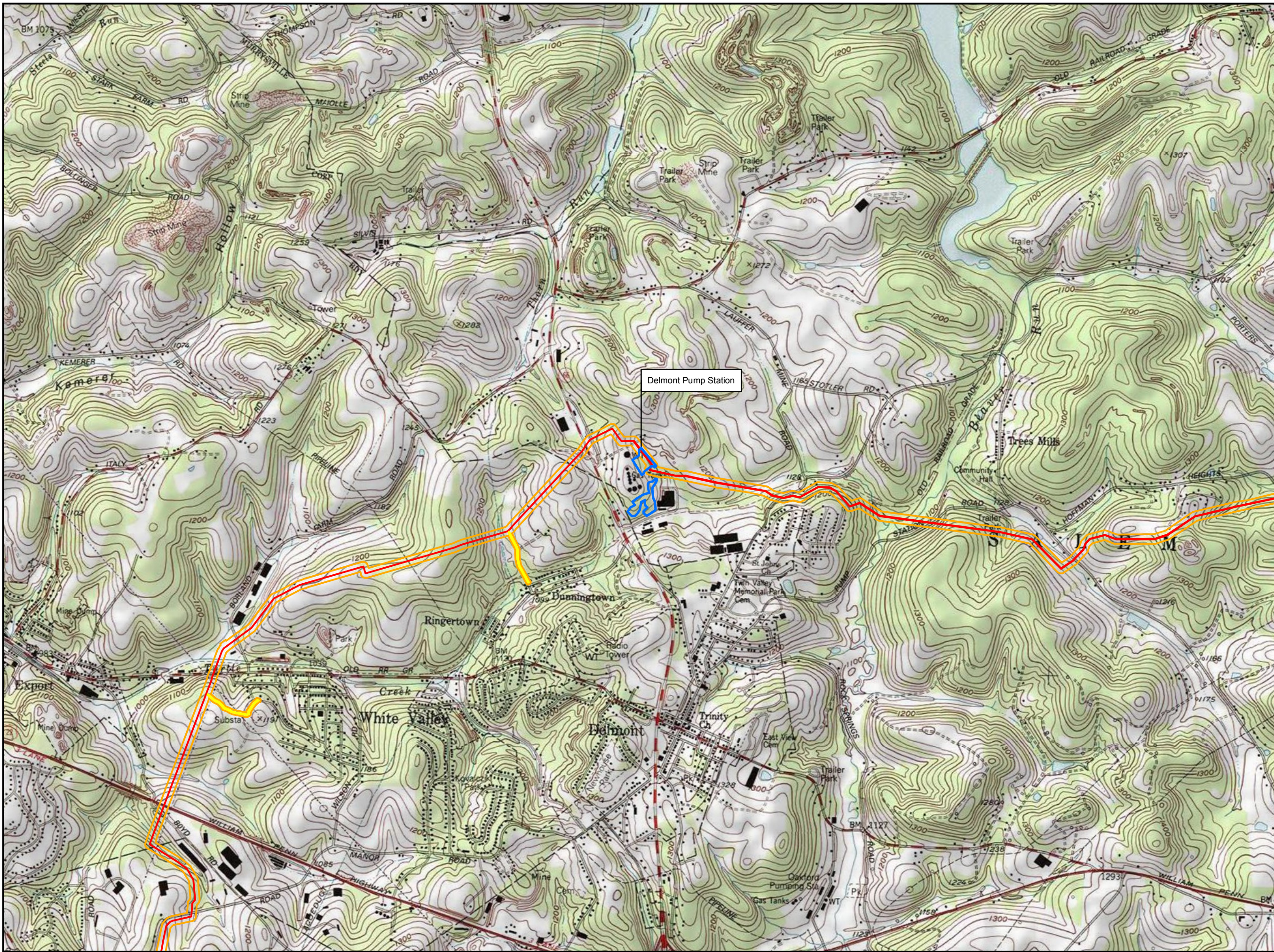
*Murrysville Quadrangle, Pennsylvania* – Westmoreland County, Geological Survey, United States Department of Interior.

*Slickville Quadrangle, Pennsylvania* – Westmoreland County, Geological Survey, United States Department of Interior.

*Web Soil Survey of Westmoreland County, Pennsylvania*, United States Department of Agriculture, Soil Conservation Service.

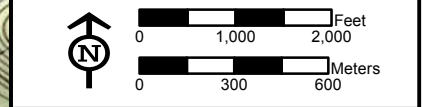
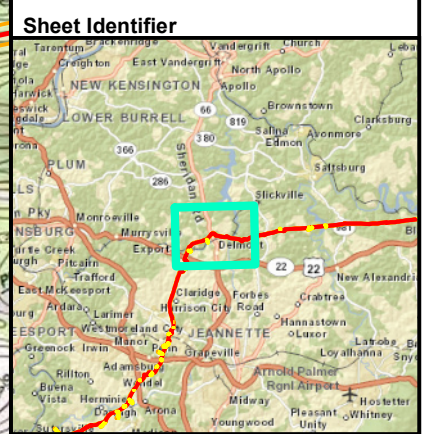
*Westmoreland County Act 167 Plan*.

## **APPENDIX A – SITE LOCATION MAP**



**Legend**

- Access Road
- Alignment Centerline
- Limit of Disturbance
- Pump Station



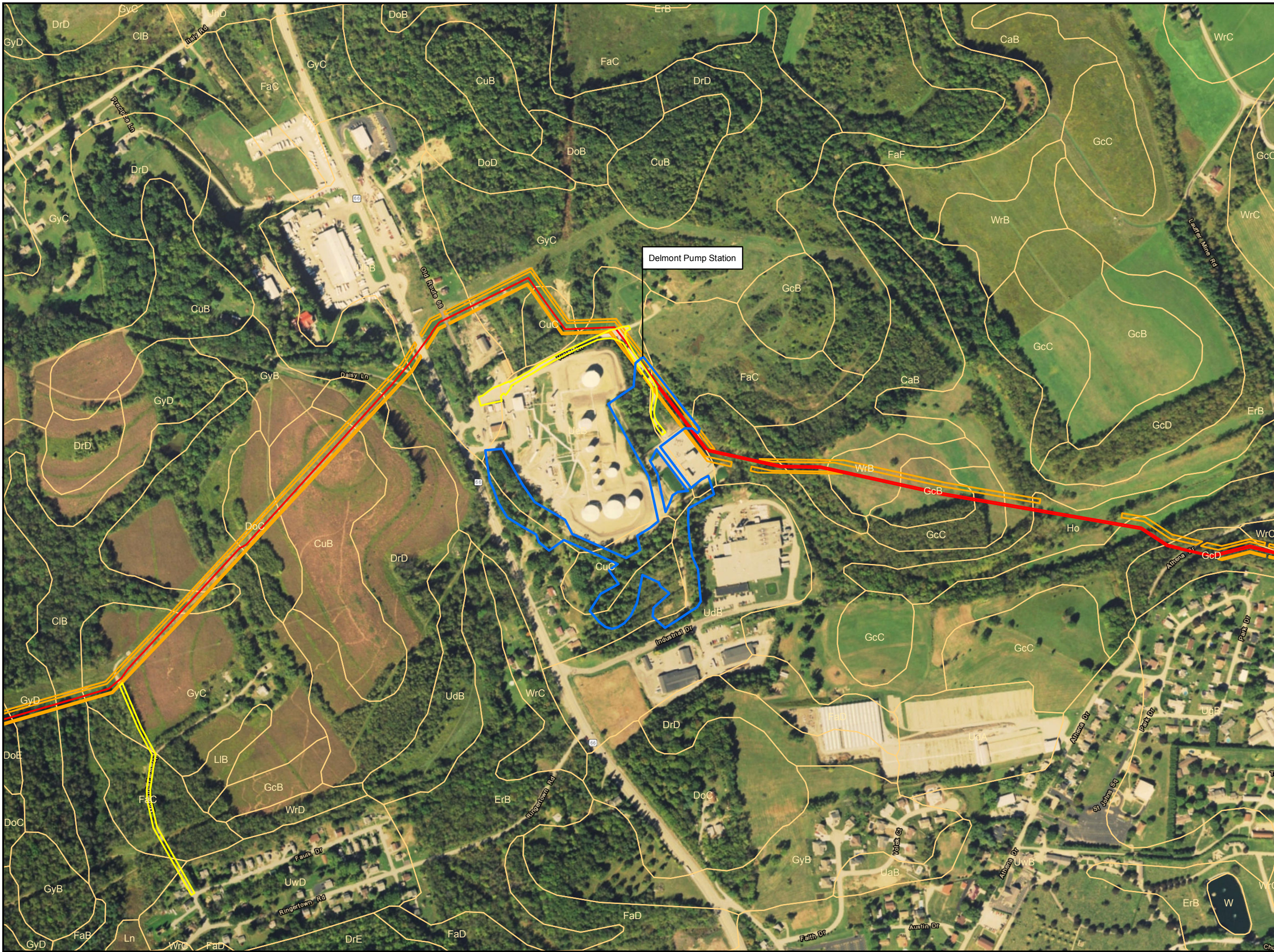
**PROJECT LOCATION MAP  
ATTACHMENT 1  
PENNSYLVANIA PIPELINE PROJECT  
AUGUST 2, 2015 ALIGNMENT  
SUNOCO LOGISTICS, L.P.  
WESTMORELAND COUNTY, PA**



Notes:  
 1) Topographic map provided by ESRI's ArcGIS Online USA Topo Maps map service (© 2013 National Geographic Society, I-cubed).  
 2) Quadrangles being displayed are Murrysville, Slickville

PGH-P\GIS\SUNOCO\MARINER\_EAST\_2M\XDP\PPP\_ESGCR\PIPELINE\_STATIONS\PIPELINE\_PUMPSTATIONS\_USGS\_ESGCR\_MXD\_11030115\_1N

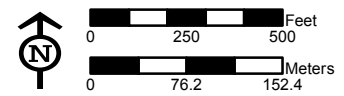
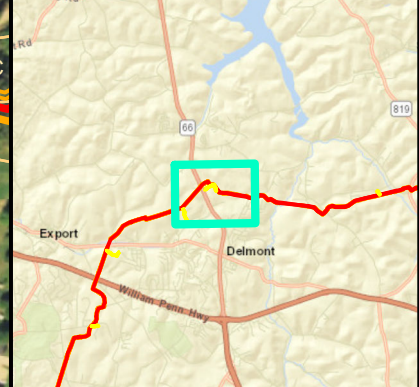
## **APPENDIX B – SOILS LOCATION MAPS AND INFILTRATION TEST RESULTS**



- Legend**
- Access Road
  - Alignment Centerline
  - Limit of Disturbance
  - NRCS Soils and Codes
  - Pump Station

Delmont Pump Station

**Sheet Identifier**



**NRCS SOILS MAP  
ATTACHMENT 2  
PENNSYLVANIA PIPELINE PROJECT  
OCTOBER 3, 2016 ALIGNMENT  
SUNOCO LOGISTICS, L.P.  
WESTMORELAND COUNTY, PA**



**Notes:**  
Aerial photograph provided by ESRI's  
ArcGIS Online World Imagery map service  
(© 2015 ESRI and its data suppliers)

FGH-P\GIS\SUNOCO\MARINER EAST 2\MDX\PPP-ESG\PIPELINE\_PUMPSTATIONS\_SOILS\_ESG\PP-ESG\PP-MXD 10/14/16.SP

Hydrologic Soil Group—Westmoreland County, Pennsylvania



Map Scale: 1:6,560 if printed on A landscape (11" x 8.5") sheet.




Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84



## MAP LEGEND

### Area of Interest (AOI)









 Area of Interest (AOI)

### Soils

#### Soil Rating Polygons





 A  
 A/D  
 B  
 B/D  
 C  
 C/D  
 D  
 Not rated or not available

#### Soil Rating Lines


 A  
 A/D  
 B  
 B/D  
 C  
 C/D  
 D  
 Not rated or not available

#### Soil Rating Points






 A  
 A/D  
 B  
 B/D

 C  
 C/D  
 D  
 Not rated or not available


### 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 1:24,000.

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: Westmoreland County, Pennsylvania  
 Survey Area Data: Version 7, Sep 22, 2014

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

Date(s) aerial images were photographed: Data not available.

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.

## Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Westmoreland County, Pennsylvania (PA129)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
CuC	Culleoka channery silt loam, 8 to 15 percent slopes	B	5.4	6.3%
ErB	Ernest silt loam, 3 to 8 percent slopes	C/D	10.2	12.0%
FaC	Fairpoint very channery silt loam, 8 to 15 percent slopes	C	7.2	8.4%
GcC	Gilpin channery silt loam, 8 to 15 percent slopes	C	2.0	2.4%
GyC	Guernsey silt loam, 8 to 15 percent slopes	C/D	14.6	17.1%
Ho	Holly silt loam, 0 to 2 percent slopes	B/D	2.3	2.7%
UdB	Urban land, 3 to 8 percent slopes		14.8	17.3%
UeB	Urban land-Culleoka complex, 0 to 8 percent slopes		23.8	27.8%
UhB	Urban land-Guernsey complex, 0 to 8 percent slopes		4.5	5.2%
WrC	Wharton silt loam, 8 to 15 percent slopes	C/D	0.7	0.8%
<b>Totals for Area of Interest</b>			<b>85.4</b>	<b>100.0%</b>

## Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher

## TRIP REPORT

**Date:** October 26, 2015

**To:** Megan Carson

**From:** Tim Evans, PG

**Subject:** Summary of Soil Infiltration Tests  
Delmont Station  
Sunoco PPP  
Salem and Murrysville Townships, Westmorland County, Pennsylvania

This trip report provides results of soil infiltration tests that were completed as part of the Pennsylvania Pipeline Project (PPP) for Sunoco Pipeline, LP, in Salem and Murrysville Townships, Westmoreland County, Pennsylvania.

### 1.0 PURPOSE

This report presents the field data and results of single and double-ring soil infiltration tests conducted to support the design of stormwater management systems at several locations in Salem and Murrysville Townships, Westmoreland County, Pennsylvania. Five shallow tests (IT-1, IT-3, IT-5, IT-6, and IT-7) and two deep tests (IT-2 and 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 Mark Mengel, Scott Anderson, Jim Coffman, and Shannon Hill of Tetra Tech, Inc., from October 7 to 9, 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 of the test locations. IT-1 and IT-2 were both located near a gas line; IT-1 was in an open, mowed area maintained for the gas line with a gently sloping surface, and IT-2 was located between gas lines in a wooded area on a gently sloping surface. IT-3 and IT-4 were located in a cleared area that was gently sloping. IT-5 was located near the footprint of a former home, and IT-6 and IT-7 were located in an undeveloped cleared area surrounded by trees. IT-5, IT-6, and IT-7 were located on gently sloping surfaces. 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. Based on test depths either a double ring test or single ring test was performed. Infiltration test depths are provided on Table 1. The double-ring test locations were prepared for shallow test locations with the assistance of a mini-excavator, with care taken to minimize disturbance of the soil surface to be

tested. The double-ring infiltrometers that were used for testing consisted of 10-inch and 6-inch diameter sections of 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.

The single-ring tests were performed at locations where the excavation depth was too deep to install double-ring infiltrometers without significant disturbance. The single-ring test locations were prepared using a hollow-stem auger rig. The single ring infiltrometers that was used for testing consisted of a 6-inch diameter PVC casing. After augering to the desired depth, the PVC casing was driven approximately 2 inches. Loose soil that fell into the casing during installation was removed, if possible, and approximately 2 inches of sand was placed at the bottom of the casing to avoid wash out during the infiltration testing. Bentonite was used to seal the annulus space between outside of the ring and the soil boring and was hydrated for 30 minutes prior to beginning the presoak.

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 overcast and cool and approximately 60 to 70 degrees Fahrenheit. Light precipitation was observed during the IT-2 and IT-4 tests on October 9, 2015, with less than 0.1 foot total precipitation<sup>1</sup>. A summary of the precipitation is attached.

In addition, test pits were machine-excavated at each shallow testing locations (IT-1, -3, -5, -6, and -7), and split-spoon samples were collected continuously at the deeper testing locations (IT-2 and IT-4) to characterize the soil, determine the depth to bedrock, if encountered, and inspect for evidence of the seasonal high water table. The test pits/split-spoon samples were identified with the corresponding infiltration test name. The test pits/split-spoon samples were completed to two feet below the target infiltration test depth or refusal, whichever was encountered first.

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 up to 8 inches dark brown topsoil/surface soil layer, underlain by silty and clayey soils (generally silty clay to clay or silt) with rock fragments. Rock

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<sup>1</sup> <http://www.wunderground.com/personal-weather-station/dashboard?ID=KPAMURRY2#history/s20151009/e20151009/mdaily>. Accessed September 30, 2015

fragments became more abundant with depth, and weathered shale was observed at 54 inches in IT-5. Thin grass roots were encountered in the topsoil/surface soils with few roots being observed in the underlying soil horizons. Table 1 summarizes the depths of the infiltration tests (test pits or split spoon sampling completed approximately 2 feet deeper than infiltration test depths).

The soils were noted to be dry to damp during the excavation activities. Mottling of soils was recorded in the field as being observed from 0 to 20 inches at IT-1 in a gray/brown/orange silty clay; from 48 to 60 inches at IT-3 in the orange/brown/clay; and, from 50 to 60 inches at IT-6/7 in the brown/black/light gray/red clay. Mottling may be an indication of a seasonal high water table, however, no groundwater was observed in the test pits or split spoon samples. At location IT-4 oxidation and orange coloration was observed in the rock fragments in the soil; however, this area appeared to have been reworked so the orange coloration is not considered attributable to a seasonal high water table.

According to United States Department of Agriculture Natural Resources Conservation Service Web Soil Survey<sup>2</sup> data, the soil types for the test locations are mapped as follows:

- IT-1 and IT-2 – Fairpoint very channery silt loam (FaC soil symbol) with 8 to 15 percent slopes
- IT-3 – Urban land (UdB soil symbol) with 3 to 8 percent slopes
- IT-4, -5, -6 and -7 – Guernsey silt loam (GyC soil symbol) with 8 to 15 percent slopes.

### **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.

One location (IT-3) exhibited no infiltration. The four locations (IT-1, -2, -6, and -7) exhibited slow rates of infiltration, requiring a 30-minute test cycle. Moderate infiltration rates occurred at two locations (IT-4 and IT-5), requiring 10-minute test cycles.

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<sup>2</sup> <http://websoilsurvey.nrcs.usda.gov/>. Accessed October 13, 2015.

**Table 1**  
**Summary of Infiltration Test Results**  
**Delmont Station**  
**Salem and Murrysville Townships, Westmoreland County, PA**  
**Sunoco**

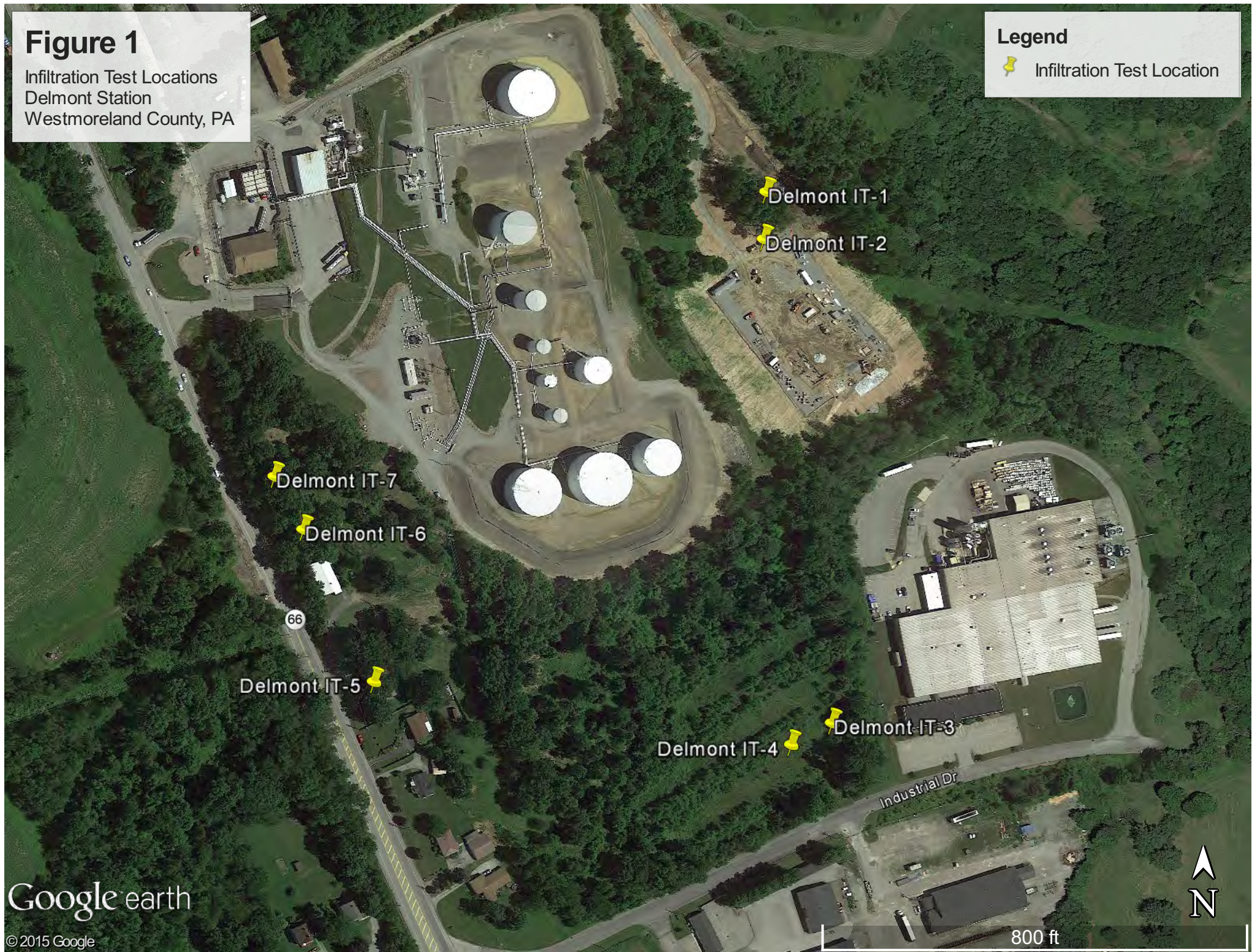
Test Location (IT-)	Location Data		Test Depth (inches)	Infiltration Test Result (inches/hour)
	LATITUDE	LONGITUDE		
IT-1	40.429142	-79.5735	12	1.6
IT-2	40.4289	-79.573517	120	0.30
IT-3	40.426419	-79.573058	60	0.0
IT-4	40.426308	-79.573333	72	28.4
IT-5	40.426631	-79.576142	48	6.8
IT-6	40.427411	-79.576617	36	0.13
IT-7	40.427683	-79.576811	36	0.19

# Figure 1

Infiltration Test Locations  
Delmont Station  
Westmoreland County, PA

## Legend

 Infiltration Test Location



## **ATTACHMENTS**

## SOIL LOGS

**Soil Log**

Tested By: J. Coffman

Project: Marinet PPP

Project No.: 112IC07754

Test Pit: IT-1 (Delmont)

Date: 10/7/15

Elevation: \_\_\_\_\_

Equipment Used: min: ex/shovel

Geology: Soil

Soil Type: silty clay

Land Use: mowed grass Row

Weather: Overcast

**Additional Comments**

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
A	0	20"	Silty clay little v.f. sand		Gry-Bur (orangish)	mixed/mottles	few roots	—	—	# moist
B	20"	36"	silty clay 10cm	medium sand + small gravel	Org-Bur	Solid no mottling		—	—	dry

Horizon:	USDA Definition	Soil Textural Class	Boundary	Notes:
O	Organic debris	Use ternary diagram from US Department of Agriculture Soil Conservation Service	Use depth and classification	
A	Dark colored, mixed mineral organic matter		Classification as Follows: Abrupt	
B	Maximum accumulation of silicate clay minerals		Clear	
C	Weathered parent material		Gradual	
R	Layer of consolidated rock beneath the soil		Diffuse	





**Soil Log**

Tested By: J. Coffman  
 Test Pit: IT-3 (Delmont) Date: 10/8/15  
 Geology: soil Soil Type: clay

Project: Mariner 2 PPP Project No.: 112IC07754  
 Elevation: \_\_\_\_\_ Equipment Used mini-ex  
 Land Use: tall grass/undeveloped Weather: Mostly Sunny 60°

**Additional Comments**

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
A	0	8"	loam	black shale fragments	Dk Brun	solid	grass roots & small tree roots	—	—	dry
B	8"	48"	clay loam	black shale fragments mainly cobble size	Org - Brun	transitional	few small tree roots	—	—	dry
B	48"	60"	clay	weathered	"	mixed, mottles		—	—	lightly moist

Horizon:	USDA Definition	Soil Textural Class	Boundary	Notes:
O	Organic debris	Use ternary diagram from US Department of Agriculture Soil Conservation Service	Use depth and classification	Exploration pit for rock/seasonal high water table varied in lithology from test hole described in log above. Exploration pit - little <del>clay</del> top 2' & some weathered (mottled) fine gr/red sandstone (cobble/small boulder size). Exploration pit loamy (clay loam) below. A layer of lightly moist. Sidewalls caved in exploration pit below 4'. Reddish Brun soil in exploration hole.
A	Dark colored, mixed mineral organic matter		Classification as Follows: Abrupt	
B	Maximum accumulation of silicate clay minerals		Clear	
C	Weathered parent material		Gradual	
R	Layer of consolidated rock beneath the soil		Diffuse	

Table based on: Sample soil log located on page 12 of the Pennsylvania Stormwater Best Management Practices Manual  
 USDA Definitions located from: [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2\\_054308](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2_054308)





**Soil Log**

Tested By: J. Coffman  
 Test Pit: IT-5 (Delmont) Date: 10/7/15  
 Geology: soil/rock Soil Type: silt loam

Project: Mariner 2 PPP Project No.: 112IC07754  
 Elevation: \_\_\_\_\_ Equipment Used minicex  
 Land Use: former house in area Weather: Poly sunny 70°

**Additional Comments**

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
A	0	4"	clay loam	little gravel	Dk Bwr	Solid	Few roots	—	—	dry
B	4"	54"	silt loam <del>clay loam</del>	some gravel some cobble size frags	Borg-Bwr	"	few roots	—	—	inter layer red shale
C	54"	72"	shale	weathered	Org/Org-Bwr	"	Sub-horizontal	54"	—	

Horizon:	USDA Definition	Soil Textural Class	Boundary	Notes:
O	Organic debris	Use ternary diagram from US Department of Agriculture Soil Conservation Service	Use depth and classification	
A	Dark colored, mixed mineral organic matter		Classification as Follows:	
B	Maximum accumulation of silicate clay minerals		Abrupt	
C	Weathered parent material		Clear	
R	Layer of consolidated rock beneath the soil		Gradual	
			Diffuse	

Table based on: Sample soil log located on page 12 of the Pennsylvania Stormwater Best Management Practices Manual  
 USDA Definitions located from: [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2\\_054308](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2_054308)

**Soil Log**

Tested By: J. Coffman  
 Test Pit: IT6/7 (Delmont) Date: 10/7/15  
 Geology: soil Soil Type: clay

Project: Mariner 2 PPP Project No.: 112CIC07754  
 Elevation: \_\_\_\_\_ Equipment Used: min. ex  
 Land Use: undeveloped Weather: ptly Sunny 70°  
cleared (surrounded by trees)

**Additional Comments**

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
A	0	6"	clay loam		Dk Bwn	solid	few roots (~50")	—	—	dry
B	6"	60"	clay little silty		Lt Bwn / little black / grey / red	solid mixed mottled	few roots (~50")	—	—	weathered

Horizon:	USDA Definition	Soil Textural Class	Boundary	Notes:
O	Organic debris	Use ternary diagram from US Department of Agriculture Soil Conservation Service	Use depth and classification	Test pit ~ 1/2 way between IT-7 & IT-6 test locs.
A	Dark colored, mixed mineral organic matter		Classification as Follows:	
B	Maximum accumulation of silicate clay minerals		Abrupt	
C	Weathered parent material		Clear	
R	Layer of consolidated rock beneath the soil		Gradual	
			Diffuse	

**INFILTRATION TEST DATA SHEETS**



# INFILTRATION TEST DATA SHEET

Tetra Tech, Inc.

PROJECT NAME: Mariner PPD TEST AREA ID: IT-1 (Delmont)  
 PROJECT NUMBER: 112IC07754 PERSONNEL: J. Coffman

TEST METHOD: Double Ring Infiltrometer Percolation  
 Single Ring Infiltrometer

INNER RING INSIDE DIAMETER/HEIGHT: 6"/10"  
 OUTER RING INSIDE DIAMETER/HEIGHT: 10"/10"

Location Coordinates or Description:  
Slight slope to ground (mowed grass Row)

PERCOLATION HOLE DIAMETER: \_\_\_\_\_ (If performing an open hole perc test)

DATE(s): 10/7/15

Distance from the bottom of the inner ring/hole to measuring point (minimum water column of 6-8 inches): 8"

MEASURING POINT: Ring Rim Indicator Mark DEPTH OF TEST: 12" by 5

TIME	ELAPSED TIME SINCE START OF TEST (minutes)	WATER LEVEL DROP, INNER RING OR PERCOLATION HOLE (inches)	VOLUME OF WATER ADDED AT EACH CYCLE, INNER RING (liters)	REMARKS
------	--	---	--	---------

**PRESOAK DATA**

10:58	0	-----		10L to fill both rings
11:28	30	3 0/16	1.7	
11:58	60	1 12/16	1.0	never water drop in inner/outer, outer drop slightly more

**TEST DATA**

<del>12:28</del>	<del>0</del>	-----		
12:28	30	1 7/16	0.9	
12:58	60	1 5/16	0.8	
13:28	90	0 15/16	0.5	outer drop > inner drop
13:58	120	0 12/16	0.4	
14:28	150	0 12/16	0.4	
14:58	180	0 11/16	—	end of test



# INFILTRATION TEST DATA SHEET

Tetra Tech, Inc.

PROJECT NAME: Sunoco Delmont TEST AREA ID: Delmont IT-2  
 PROJECT NUMBER: 1121C07754 PERSONNEL: S. Hill & S. Anderson

TEST METHOD: Double Ring Infiltrometer Percolation  
Single Ring Infiltrometer

INNER RING INSIDE  
 DIAMETER/HEIGHT: 6" x 10'  
 OUTER RING INSIDE  
 DIAMETER/HEIGHT: N/A

Location Coordinates or Description:  
40.4289  
-79.573517

PERCOLATION HOLE DIAMETER: N/A (If performing an open hole perc test)

DATE(s): 10/9/15

Distance from the bottom of the inner ring/hole to measuring point (minimum water column of 6-8 inches): ~8'

MEASURING POINT: Ring Rim Indicator Mark DEPTH OF TEST: 10'

TIME	ELAPSED TIME SINCE START OF TEST (minutes)	WATER LEVEL DROP, INNER RING OR PERCOLATION HOLE (inches)	VOLUME OF WATER ADDED AT EACH CYCLE, INNER RING (liters)	REMARKS
------	--	---	--	---------

### PRESOAK DATA

1605	0	—	9L	
1625	30	0	—	
1605	60	0	—	

### TEST DATA

1705	0	—	—	
1735	30	0	—	
1705	60	0.01	—	
1835	90	0.02	—	
1905	120	0.02	—	No water added during test since very little draw down occurred



# INFILTRATION TEST DATA SHEET

Tetra Tech, Inc.

PROJECT NAME: <u>PPP</u>		TEST AREA ID: <u>DELMONT IT-3</u>		
PROJECT NUMBER: <u>112IC07754</u>		PERSONNEL: <u>MM JL</u>		
TEST METHOD: <u>Double Ring Infiltrometer</u> Percolation Single Ring Infiltrometer		Location Coordinates or Description: <u>N 40.426419</u> <u>W -79.573058</u>		
INNER RING INSIDE DIAMETER/HEIGHT: <u>6"/10"</u>				
OUTER RING INSIDE DIAMETER/HEIGHT: <u>10"/10"</u>				
PERCOLATION HOLE DIAMETER: <u>NA</u>		(If performing an open hole perc test)		
DATE(s): <u>10-8-15</u>				
Distance from the bottom of the inner ring/hole to measuring point (minimum water column of 6-8 inches):		<u>8"</u>		
MEASURING POINT: <u>Ring Rim</u> Indicator Mark		DEPTH OF TEST: <u>5'</u>		
TIME	ELAPSED TIME SINCE START OF TEST (minutes)	WATER LEVEL DROP, INNER RING OR PERCOLATION HOLE (inches)	VOLUME OF WATER ADDED AT EACH CYCLE, INNER RING (liters)	REMARKS
<b>PRESOAK DATA</b>				
0912	0	-----	9.4	
0942	30	1/16	0.1	
1012	60	0/16	0.1	
<b>TEST DATA</b>				
1012	0	-----		
1042	30	0/16	0.1	
1112	60	0/16	0	
1142	90	0/16	0	
1212	120	0/16	-	END OF TEST



# INFILTRATION TEST DATA SHEET

Tetra Tech, Inc.

PROJECT NAME: Sennoco Delmont TEST AREA ID: Delmont IT-4  
 PROJECT NUMBER: 1121007751 PERSONNEL: S. Hill & S. Anderson

TEST METHOD: Double Ring Infiltrometer Percolation  
Single Ring Infiltrometer

Location Coordinates or Description:

INNER RING INSIDE DIAMETER/HEIGHT: 6" / 10'  
 OUTER RING INSIDE DIAMETER/HEIGHT: N/A

40.426308  
-79.573333

PERCOLATION HOLE DIAMETER: N/A (If performing an open hole perc test)

DATE(s): 10/9/15

Distance from the bottom of the inner ring/hole to measuring point (minimum water column of 6-8 inches): ~4'

MEASURING POINT: Ring Rim Indicator Mark

DEPTH OF TEST: 6'

TIME	ELAPSED TIME SINCE START OF TEST (minutes)	WATER LEVEL DROP, INNER RING OR PERCOLATION HOLE (inches)	VOLUME OF WATER ADDED AT EACH CYCLE, INNER RING (liters)	REMARKS
<b>PRESOAK DATA</b>				
1139	0	—	7L	Start of test presoak
1154	15	0.67	3L	Storming. Con- ed casing ↓
1209	30	0.7	4L	
1214	45	0.5	3L	
1239	60	0.52	3L	
<b>TEST DATA</b>				
1239	0	<u>0.52</u>	3L	↓ Start of 10 min test
1249	10	0.38	2.5L	
1259	20	0.39	2.5L	Rain stops
1309	30	0.41	2.5L	
1319	40	0.40	N/A	water in annulus stays at same level throughout test
		Stable		



# INFILTRATION TEST DATA SHEET

Tetra Tech, Inc.

PROJECT NAME: Mariner 2 PPP TEST AREA ID: IT-5 (Pelmont)  
 PROJECT NUMBER: 112TC07754 PERSONNEL: J. Coffman

TEST METHOD:  Double Ring Infiltrometer  Percolation  
 Single Ring Infiltrometer

INNER RING INSIDE DIAMETER/HEIGHT: 6" / 10"  
 OUTER RING INSIDE DIAMETER/HEIGHT: 10" / 10"

Location Coordinates or Description:  
Moderate slope (grassy)  
next to former foundation

PERCOLATION HOLE DIAMETER: \_\_\_\_\_ (If performing an open hole perc test)

DATE(S): 10/7/15

Distance from the bottom of the inner ring/hole to measuring point (minimum water column of 6-8 inches): 7"

MEASURING POINT:  Ring Rim  Indicator Mark DEPTH OF TEST: 4'

TIME	ELAPSED TIME SINCE START OF TEST (minutes)	WATER LEVEL DROP, INNER RING OR PERCOLATION HOLE (inches)	VOLUME OF WATER ADDED AT EACH CYCLE, INNER RING (liters)	REMARKS
------	--	---	--	---------

**PRESOAK DATA**

<u>1453</u>	<u>0</u>	<u>-----</u>		<u>10L to start test</u>
<u>1605</u>	<u>30</u>	<u>5 2/16</u>	<u>2.8</u>	
<u>1635</u>	<u>60</u>	<u>4 1/16</u>	<u>2.1</u>	

**TEST DATA**

		<u>-----</u>		
<u>1645</u>	<u>10</u>	<u>1 2/16</u>	<u>0.6</u>	
<u>1655</u>	<u>20</u>	<u>1 2/16</u>	<u>0.6</u>	
<u>1705</u>	<u>30</u>	<u>1 2/16</u>	<u>0.6</u>	
<u>1715</u>	<u>40</u>	<u>1 2/16</u>	<u>---</u>	<u>end of test</u>



# INFILTRATION TEST DATA SHEET

Tetra Tech, Inc.

PROJECT NAME: PPP TEST AREA ID: DELMONT IT-6  
 PROJECT NUMBER: 112 ICC 07754 PERSONNEL: Mengel

TEST METHOD: Double Ring Infiltrometer Percolation  
 Single Ring Infiltrometer

INNER RING INSIDE DIAMETER/HEIGHT: 6"/10"  
 OUTER RING INSIDE DIAMETER/HEIGHT: 10"/10"

Location Coordinates or Description:  
 N 40.427411  
 W -79.576617

PERCOLATION HOLE DIAMETER: NA (If performing an open hole perc test)  
 DATE(s): 10/7/15

Distance from the bottom of the inner ring/hole to measuring point (minimum water column of 6-8 inches): 8"

MEASURING POINT: Ring Rim Indicator Mark DEPTH OF TEST: 3'

TIME	ELAPSED TIME SINCE START OF TEST (minutes)	WATER LEVEL DROP, INNER RING OR PERCOLATION HOLE (inches)	VOLUME OF WATER ADDED AT EACH CYCLE, INNER RING (liters)	REMARKS
<b>PRESOAK DATA</b>				
1400	0	-----		
1430	30	1/16	0.5 L	
1500	60	1/16	0.1 L	
<b>TEST DATA</b>				
1500	0	-----		
1530	30	1/16	0.1 L	
1600	60	1/16	0.1	
1630	90	1/16	0.1	
1700	120	1/16	-	END OF TEST
				Photo 1



# INFILTRATION TEST DATA SHEET

Tetra Tech, Inc.

PROJECT NAME: PPP TEST AREA ID: DILLMONT IT-7  
 PROJECT NUMBER: 1125C07754 PERSONNEL: MM

TEST METHOD: Double Ring Infiltrometer Percolation  
Single Ring Infiltrometer

Location Coordinates or Description:  
 N 40.427683  
 W -79.576811

INNER RING INSIDE DIAMETER/HEIGHT: 6" / 10"  
 OUTER RING INSIDE DIAMETER/HEIGHT: 10" / 10"

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

DATE(s): 10/7/15


Distance from the bottom of the inner ring/hole to measuring point (minimum water column of 6-8 inches): 8"


MEASURING POINT: Ring Rim Indicator Mark DEPTH OF TEST: 3'


TIME	ELAPSED TIME SINCE START OF TEST (minutes)	WATER LEVEL DROP, INNER RING OR PERCOLATION HOLE (inches)	VOLUME OF WATER ADDED AT EACH CYCLE, INNER RING (liters)	REMARKS
<b>PRESOAK DATA</b>				
1335	0	-----	9.4	
1405	30	3 0/16	1.7	
1435	60	7/16	0.3 L	
<b>TEST DATA</b>				
1435	0	-----		
1505	30	2/16	0.1 L	
1535	60	2/16	0.1 L	
1605	90	1/16	0.1 L	
1635	120	1/16	-	END OF TEST
				PHOTO 2


## PHOTOGRAPHS

## SITE PHOTOGRAPHIC LOG

		
<b>Date:</b> 10/7/15	<b>View:</b>	<b>Photographer:</b> J. Coffman
IT-1 Infiltration Test.		

		
<b>Date:</b> 10/8/15	<b>View:</b>	<b>Photographer:</b> J. Coffman
IT-1 Excavation to determine high water table and bedrock.		

		
<b>Date:</b> 10/7/15	<b>View:</b>	<b>Photographer:</b> J. Coffman
IT-3 Infiltration Test. Lithology visible in excavation.		

		
<b>Date:</b> 10/7/15	<b>View:</b>	<b>Photographer:</b> J. Coffman
IT-5 Infiltration Test. Lithology visible in excavation.		

## SITE PHOTOGRAPHIC LOG



**Date:**  
10/7/15

**View:**

**Photographer:**  
J. Coffman

IT-6/7 Excavation to determine high water table and bedrock.



**Date:**  
10/9/15

**View:**

**Photographer:**  
J. Coffman

IT-2 Infiltration Test.

**WEATHER HISTORY  
FOR  
MURRYSVILLE, PA  
OCTOBER 9, 2015**

# Weather History for Murrysville, PA [KPAMURRY2]



Previous

Daily Mode



October



9



2015



## Summary October 9, 2015

	High	Low	Average
Temperature	75.6 °F	54.7 °F	63 °F
Dew Point	56.2 °F	40.6 °F	47.7 °F
Humidity	61%	51%	57%
Precipitation	0.07 in	--	--

	High	Low	Average
Wind Speed	6 mph	--	1 mph
Wind Gust	13 mph	--	--
Wind Direction	--	--	ESE
Pressure	29.03 in	28.8 in	--



## TRIP REPORT

**Date:** March 15, 2016

**To:** Megan Carson, Tim Dunaway

**From:** Tim Evans, PG

**Subject:** Summary of Soil Infiltration Tests  
Delmont Station  
Sunoco PPP  
Salem Township, Westmorland County, Pennsylvania

This trip report provides results of soil infiltration tests that were completed as part of the Pennsylvania Pipeline Project (PPP) for Sunoco Pipeline, LP, in Salem Township, Westmoreland County, Pennsylvania.

### 1.0 PURPOSE

This report presents the field data and results of single soil infiltration tests conducted to support the design of stormwater management systems at two locations in Salem Township, Westmoreland County, Pennsylvania. Two deep tests (IT-8 and IT-9) were performed at the property. Test locations are listed by coordinates (latitude and longitude) in Table 1 and shown on the attached Figure 1.

### 2.0 FIELD ACTIVITIES

The infiltration tests were conducted by Shannon Hill of Tetra Tech, Inc., on March 9, 2016. The test locations were positioned in the field using a handheld, WAAS-enabled GPS unit. Table 1 provides the coordinates of the infiltration test locations. IT-8 and IT-9 were located in a wooded area between Route 66 and the Sunoco Logistics Station. The area is flat to gently sloping with steep slopes to the east and west of the locations. 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. Based on test depths, single ring tests were performed. The single-ring test locations were prepared using a hollow-stem auger rig. The single ring infiltrometers that were used for testing consisted of a 6-inch diameter PVC casing. After augering to the desired depth, the PVC casing was driven approximately 2 inches. Bentonite was used to seal the annulus space between outside of the ring and the soil boring and was hydrated for 30 minutes prior to beginning the presoak. Infiltration test depths are provided on Table 1.

Test locations were pre-soaked for 1 hour. The tests were then conducted with measurements at 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 sunny and warm, approximately 60 to 70 degrees Fahrenheit, and no precipitation was observed during the tests.

In addition, split-spoon samples were collected continuously at the test locations to characterize the soil, determine the depth to bedrock, if encountered, and inspect for evidence of the seasonal high water table. The split-spoon samples were identified with the corresponding infiltration test name. The split-spoon samples were completed to 2 feet (IT-9) to 4 feet (IT-8) below the target infiltration test depths.

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 up to 2 inches of dark brown topsoil/surface soil layer, underlain by silty and clayey soils (generally silty clay to silt). Thin grass roots were encountered in the topsoil/surface soils with no roots being observed in the underlying soil horizons.

The soils were noted to be dry to damp during the drilling activities. Mottling of soils was recorded in the field as being observed from 0 to 12 feet at IT-8 in a gray/light brown/orange silty clay to silt and from 0 to 7.3 feet at IT-9 in the gray/orange/light brown silty clay to silt. Mottling may be an indication of a seasonal high water table, however, no groundwater was observed in the split spoon samples. At location IT-9 weathered siltstone was observed at approximately 7.3 feet bgs.

According to United States Department of Agriculture Natural Resources Conservation Service Web Soil Survey<sup>1</sup> data, the soil types for the test locations are mapped as follows:

- IT-8 is located along a contact line between UeB – Urban land – Culleoka complex, 0-8 percent slopes; and GyC - Guernsey silt loam, 8 to 15 percent slopes.
- IT-9 is located within the area mapped as UeB – Urban land – Culleoka complex, 0-8 percent slopes.

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<sup>1</sup> <http://websoilsurvey.nrcs.usda.gov/>. Accessed March 10, 2016.

### **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 from the top of the PVC riser.

IT-8 exhibited no infiltration. IT-9 exhibited a slow rate of infiltration requiring a 30-minute test cycle.

**Table 1**  
**Summary of Infiltration Test Results**  
**Delmont Station**  
**Salem Township, Westmoreland County, PA**  
**Sunoco**

Test Location (IT-)	Location Data		Test Depth (feet)	Infiltration Test Result (inches/hour)
	LATITUDE	LONGITUDE		
IT-8	40.4274583	-79.5762139	8	0.00
IT-9	40.42815	-79.5770222	7	0.12

## **ATTACHMENTS**

## SOIL LOGS



# BORING LOG

PROJECT NAME: PPP Surface  
 PROJECT NUMBER: 12IC07771  
 DRILLING COMPANY: Terra Estima  
 DRILLING RIG: HSA

BORING No.: IT-8  
 DATE: 3/9/16  
 GEOLOGIST: S. Hill  
 DRILLER: D. Novotny

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION			U S C S *	Remarks	PID/FID Reading (ppm)			
					Soil Density/ Consistency or Rock Hardness	Color	Material Classification			Sample	Sampler BZ	Borehole**	Driller BZ**
	0	1	1.5/2		Soft	H yellow top soil (5m) Brn	CLAY w/ SILT & little sand/gravel, moist		CLAY mottling (likely fill, unconsolidated)				
		3							Surface house next to hole (20' west)				
		2	1.5/2			gray/orange BR			Small coal seam? Spent? (Black)				
		6											
		4	2/2										
	5	7											
		4	1.5/2						Small coal seam Spent? (Black)				
		8											
		4	2/2										
		10											
	10	8	2/2						SILT w/ little clay ML Dry, possible weathered BR				
		11							some mottling				
		13											
					E08E 12'								

\* When rock coring, enter rock brokenness.

\*\* Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

Remarks: Install IT @ 8' bgs

Drilling Area Background (ppm):

Converted to Well: Yes  No  Well I.D. #:



# BORING LOG

PROJECT NAME: PPP Source  
 PROJECT NUMBER: 1121C0771  
 DRILLING COMPANY: Terra Testing  
 DRILLING RIG: HSA

BORING No.: JT 9  
 DATE: 3/9/16  
 GEOLOGIST: S Hill  
 DRILLER: D. Novotny

Sample No. and Type or RQD	Depth (Ft) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft) or Screened Interval	MATERIAL DESCRIPTION			U S C S *	Remarks	PID/FID Reading (ppm)								
					Soil Density/ Consistency or Rock Hardness	Color	Material Classification			Sample	Sampler BZ	Borehole**	Driller BZ**					
		1/2	15/2	[Hatched Box]														
		2/3																
		3/3	15/2															
		5/5																
		5/6	2/2															
		7/6																
		11/6	15/5															
		17/26	15/5															
					EDGE													
					9' bgs													

\* When rock coring, enter rock brokeness.

\*\* Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: Install IT @ 7' bgs

Drilling Area Background (ppm):     

Converted to Well: Yes      No X Well I.D. #:

**INFILTRATION TEST DATA SHEETS**



Tetra Tech, Inc.

# INFILTRATION TEST DATA SHEET CASED HOLE INFILTRATION TEST

PROJECT NAME: PPP Sunoco

TEST AREA ID: IT-8

PROJECT NUMBER: \_\_\_\_\_

DATE: 3/9/16

PERSONNEL: S Hill

Sunny warm N 70°F

CASING INSIDE DIAMETER: 6" sch 40  
BOREHOLE DIAMETER: 8"

Location Coordinates or Description:  
offset slightly from original coordinate  
top of hill, wooded area

TESTING DEPTH: 8'

Distance from the top of casing to bottom of the hole: 10'

TIME	ELAPSED TIME SINCE START OF TEST (minutes)	WATER LEVEL READING (inches) <u>TOP (ft)</u>	WATER LEVEL DROP (inches) <u>(feet)</u>	VOLUME OF WATER ADDED AT EACH CYCLE, INNER RING (liters)	REMARKS
------	--	--	---	--	---------

### PRESOAK DATA

<u>1108</u>		<u>8.0'</u>	<u>-----</u>		<u>Start with 10L of H<sub>2</sub>O</u>
<u>1158</u>	<u>30</u>	<u>8.0'</u>	<u>0.01</u>	<u>~25ML</u>	
<u>1208</u>	<u>60</u>	<u>8.0'</u>	<u>—</u>	<u>—</u>	<u>No change in WL</u>

### TEST DATA

<u>1208</u>	<u>0</u>	<u>8.0'</u>	<u>-----</u>	<u>—</u>	<u>No change in WL</u>
<u>1238</u>	<u>30</u>	<u>8.0'</u>	<u>—</u>	<u>—</u>	<u>" "</u>
<u>1308</u>	<u>60</u>	<u>8.0'</u>	<u>—</u>	<u>—</u>	<u>No change in WL</u>
<u>1338</u>	<u>90</u>	<u>8.0'</u>	<u>—</u>	<u>—</u>	<u>" "</u>
<u>1408</u>	<u>120</u>	<u>8.0'</u>	<u>—</u>	<u>—</u>	<u>" "</u>

Test complete



## PHOTOGRAPHS

## SITE PHOTOGRAPHIC LOG



<b>Date:</b> 3/9/16	<b>View:</b> N	<b>Photographer:</b> S. Hill
------------------------	-------------------	---------------------------------

IT-8 Infiltration Test



<b>Date:</b> 3/9/16	<b>View:</b> N	<b>Photographer:</b> S. Hill
------------------------	-------------------	---------------------------------

IT-9 Infiltration Test



<b>Date:</b> 3/9/16	<b>View:</b> --	<b>Photographer:</b> S. Hill
------------------------	--------------------	---------------------------------

IT-8 soil core from 10 to 12 feet

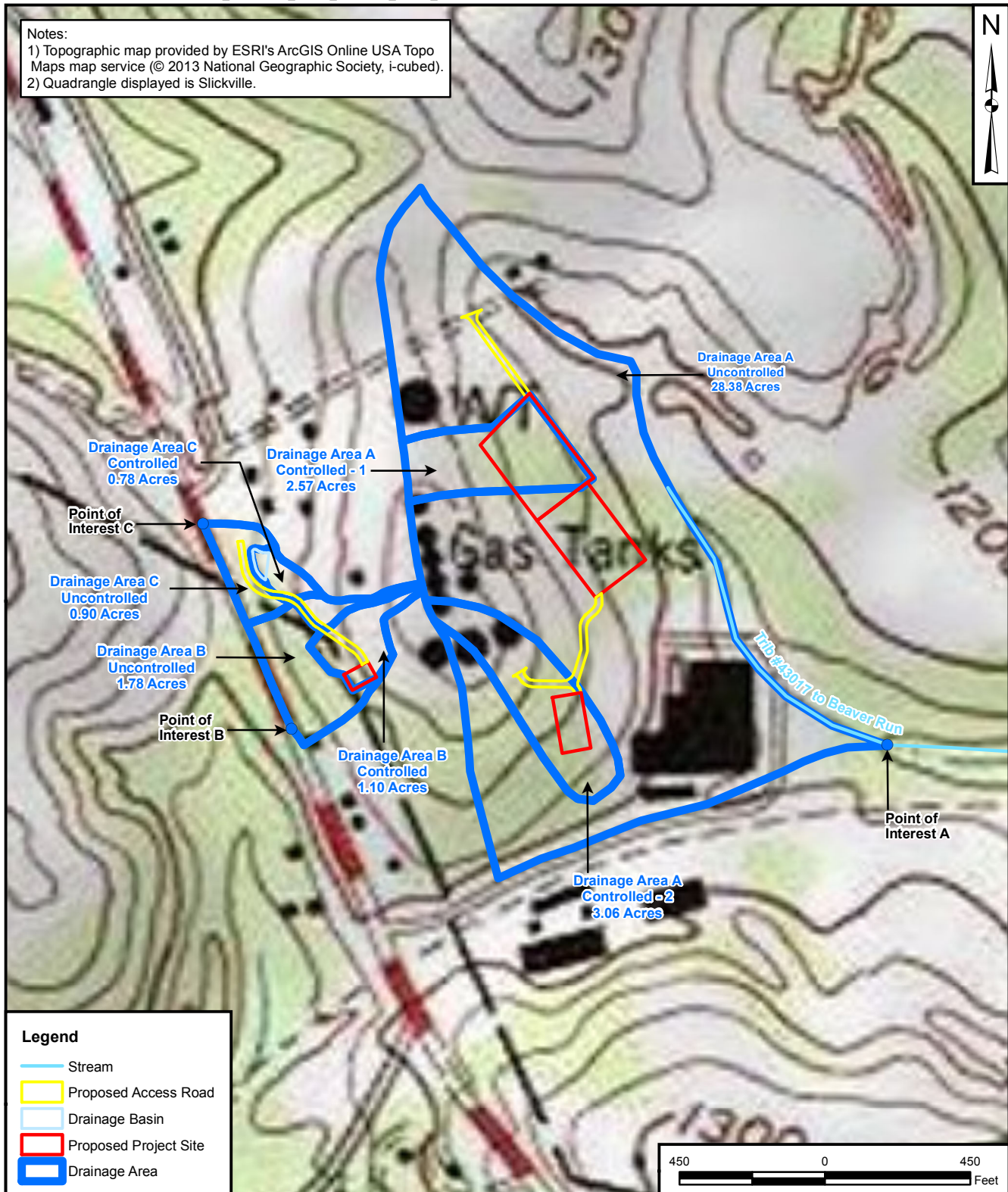


<b>Date:</b> 3/9/16	<b>View:</b> --	<b>Photographer:</b> S. Hill
------------------------	--------------------	---------------------------------

IT-9 soil core from 7 to 9 feet

## **APPENDIX C – PRE-DEVELOPED RUNOFF MAPS**

Notes:  
 1) Topographic map provided by ESRI's ArcGIS Online USA Topo Maps map service (© 2013 National Geographic Society, i-cubed).  
 2) Quadrangle displayed is Slickville.



**Legend**

- Stream
- Proposed Access Road
- Drainage Basin
- Proposed Project Site
- Drainage Area



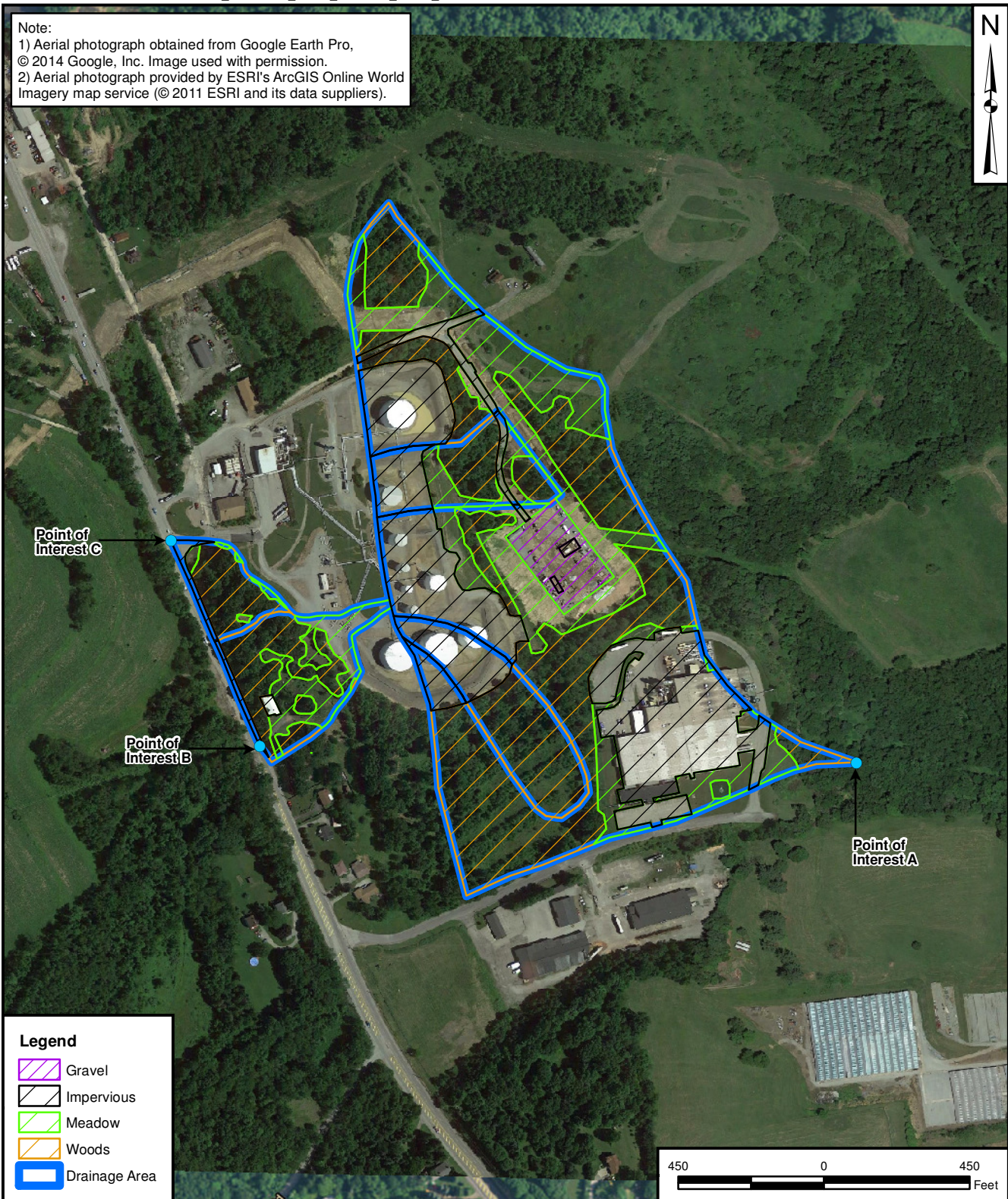
**DRAINAGE AREA MAP**  
**DELMONT PUMP STATION**  
**MARINER EAST**  
**SUNOCO LOGISTICS, L.P.**  
**WESTMORELAND COUNTY, PENNSYLVANIA**

DRAWN BY: J. HERNING 9/28/2015  
 CHECKED BY: T. DUNAWAY 09/26/16  
 APPROVED BY:  
 CONTRACT NUMBER: 212IC-PB-00136

FIGURE NUMBER	1	REV	0
---------------	---	-----	---

**Note:**

- 1) Aerial photograph obtained from Google Earth Pro, © 2014 Google, Inc. Image used with permission.
- 2) Aerial photograph provided by ESRI's ArcGIS Online World Imagery map service (© 2011 ESRI and its data suppliers).



**Legend**

-  Gravel
-  Impervious
-  Meadow
-  Woods
-  Drainage Area



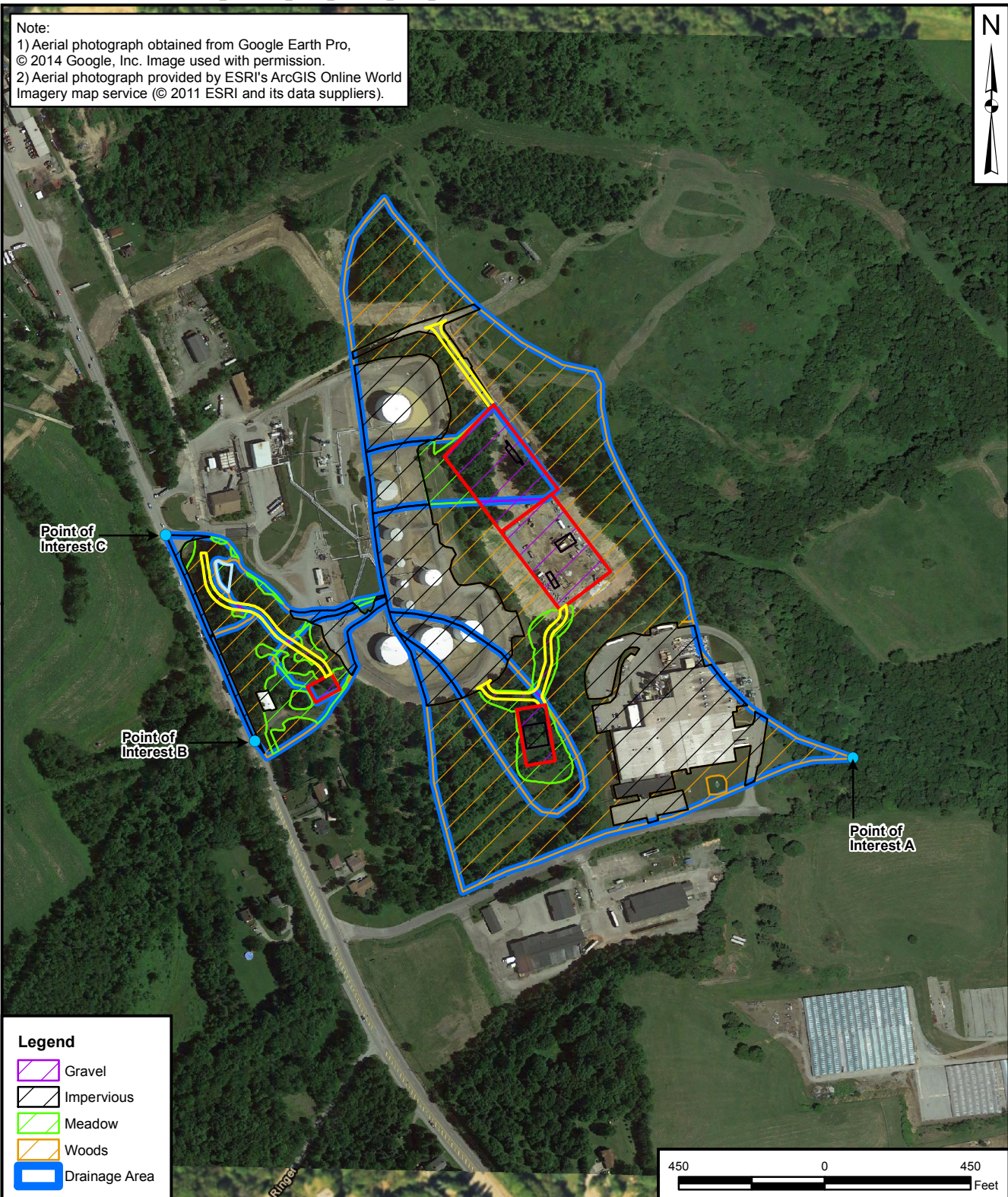
**PRE-CONSTRUCTION DRAINAGE AREA MAP**  
**DELMONT PUMP STATION**  
**MARINER EAST**  
**SUNOCO LOGISTICS, L.P.**  
**WESTMORELAND COUNTY, PENNSYLVANIA**

DRAWN BY: J. HERNING 9/30/15  
 CHECKED BY: T. DUNAWAY 02/24/16  
 APPROVED BY:  
 CONTRACT NUMBER: 112IC05370

FIGURE NUMBER	1	REV	0
---------------	---	-----	---

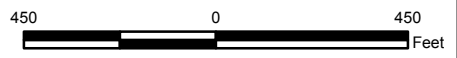
## **APPENDIX D – POST-DEVELOPED RUNOFF MAP**

Note:  
 1) Aerial photograph obtained from Google Earth Pro,  
 © 2014 Google, Inc. Image used with permission.  
 2) Aerial photograph provided by ESRI's ArcGIS Online World  
 Imagery map service (© 2011 ESRI and its data suppliers).



**Legend**

-  Gravel
-  Impervious
-  Meadow
-  Woods
-  Drainage Area



POST-CONSTRUCTION DRAINAGE AREA MAP  
 DELMONT PUMP STATION  
 MARINER EAST  
 SUNOCO LOGISTICS, L.P.  
 WESTMORELAND COUNTY, PENNSYLVANIA

DRAWN BY: J. HERNING 9/30/15  
 CHECKED BY: T. DUNAWAY 09/26/16  
 APPROVED BY:

CONTRACT NUMBER: 212IC-PB-00136

FIGURE NUMBER	1
---------------	---

REV	0
-----	---

## **APPENDIX E – PONDPACK CALCULATIONS**

## Table of Contents

	Master Network Summary	1
Post Uncontrolled B		
	Time of Concentration Calculations, 1 years	6
Post-Controlled A1		
	Time of Concentration Calculations, 1 years	8
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Pre Developed B		
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BMP-3		
	Elevation vs. Volume Curve, 1 years	18
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	Outlet Input Data, 1 years	20
BMP-2		
	Outlet Input Data, 1 years	24
BMP-3		
	Outlet Input Data, 1 years	28
BMP-4		
	Outlet Input Data, 1 years	32

Subsection: Master Network Summary

**Catchments Summary**

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft <sup>3</sup> /s)
Post-Controlled A1	1-year	1	0.289	11.900	5.25
Post-Controlled A1	2-year	2	0.365	11.900	6.63
Post-Controlled A1	5-year	5	0.503	11.900	9.07
Post-Controlled A1	10-year	10	0.624	11.900	11.17
Post-Controlled A1	25-year	25	0.747	11.900	13.27
Post-Controlled A1	50-year	50	0.830	11.900	14.67
Post-Controlled A1	100-year	100	0.913	11.900	16.06
Pre-Developed A	1-year	1	2.484	12.150	27.83
Pre-Developed A	2-year	2	3.326	12.150	37.80
Pre-Developed A	5-year	5	4.910	12.150	56.29
Pre-Developed A	10-year	10	6.346	12.150	72.79
Pre-Developed A	25-year	25	7.832	12.100	89.78
Pre-Developed A	50-year	50	8.844	12.100	101.35
Pre-Developed A	100-year	100	9.870	12.100	113.00
Post-Controlled A2	1-year	1	0.222	11.950	3.99
Post-Controlled A2	2-year	2	0.297	11.950	5.37
Post-Controlled A2	5-year	5	0.439	11.900	7.92
Post-Controlled A2	10-year	10	0.568	11.900	10.30
Post-Controlled A2	25-year	25	0.701	11.900	12.73
Post-Controlled A2	50-year	50	0.792	11.900	14.37
Post-Controlled A2	100-year	100	0.884	11.900	16.02
Post-Uncontrolled A	1-year	1	2.098	12.150	23.48
Post-Uncontrolled A	2-year	2	2.804	12.150	31.81
Post-Uncontrolled A	5-year	5	4.130	12.150	47.25
Post-Uncontrolled A	10-year	10	5.331	12.150	61.00
Post-Uncontrolled A	25-year	25	6.573	12.100	75.24
Post-Uncontrolled A	50-year	50	7.419	12.100	84.89
Post-Uncontrolled A	100-year	100	8.276	12.100	94.59
Post Controlled B	1-year	1	0.099	11.950	1.79
Post Controlled B	2-year	2	0.129	11.900	2.33
Post Controlled B	5-year	5	0.184	11.900	3.34
Post Controlled B	10-year	10	0.233	11.900	4.23
Post Controlled B	25-year	25	0.284	11.900	5.12
Post Controlled B	50-year	50	0.318	11.900	5.72
Post Controlled B	100-year	100	0.352	11.900	6.32
Post Uncontrolled B	1-year	1	0.090	11.950	1.50
Post Uncontrolled B	2-year	2	0.127	11.950	2.19
Post Uncontrolled B	5-year	5	0.200	11.950	3.53
Post Uncontrolled B	10-year	10	0.267	11.950	4.77
Post Uncontrolled B	25-year	25	0.338	11.950	6.05
Post Uncontrolled B	50-year	50	0.387	11.950	6.93
Post Uncontrolled B	100-year	100	0.437	11.950	7.82
Pre Developed B	1-year	1	0.167	11.950	2.80
Pre Developed B	2-year	2	0.235	11.950	4.08
Pre Developed B	5-year	5	0.366	11.950	6.53

Subsection: Master Network Summary

**Catchments Summary**

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft <sup>3</sup> /s)
Pre Developed B	10-year	10	0.489	11.950	8.78
Pre Developed B	25-year	25	0.619	11.950	11.12
Pre Developed B	50-year	50	0.708	11.950	12.72
Pre Developed B	100-year	100	0.799	11.950	14.34
Post Controlled C	1-year	1	0.054	11.950	0.97
Post Controlled C	2-year	2	0.073	11.950	1.31
Post Controlled C	5-year	5	0.108	11.950	1.95
Post Controlled C	10-year	10	0.140	11.900	2.54
Post Controlled C	25-year	25	0.174	11.900	3.15
Post Controlled C	50-year	50	0.197	11.900	3.57
Post Controlled C	100-year	100	0.220	11.900	3.98
Post Uncontrolled C	1-year	1	0.061	11.950	1.10
Post Uncontrolled C	2-year	2	0.083	11.950	1.49
Post Uncontrolled C	5-year	5	0.124	11.950	2.23
Post Uncontrolled C	10-year	10	0.161	11.900	2.91
Post Uncontrolled C	25-year	25	0.199	11.900	3.62
Post Uncontrolled C	50-year	50	0.226	11.900	4.10
Post Uncontrolled C	100-year	100	0.253	11.900	4.58
Pre-Developed C	1-year	1	0.077	11.950	1.36
Pre-Developed C	2-year	2	0.107	11.950	1.91
Pre-Developed C	5-year	5	0.163	11.950	2.95
Pre-Developed C	10-year	10	0.216	11.950	3.89
Pre-Developed C	25-year	25	0.270	11.900	4.89
Pre-Developed C	50-year	50	0.308	11.900	5.58
Pre-Developed C	100-year	100	0.346	11.900	6.28

**Node Summary**

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft <sup>3</sup> /s)
Pre Out A	1-year	1	2.484	12.150	27.83
Pre Out A	2-year	2	3.326	12.150	37.80
Pre Out A	5-year	5	4.910	12.150	56.29
Pre Out A	10-year	10	6.346	12.150	72.79
Pre Out A	25-year	25	7.832	12.100	89.78
Pre Out A	50-year	50	8.844	12.100	101.35
Pre Out A	100-year	100	9.870	12.100	113.00
Post Out A	1-year	1	2.387	12.100	26.29
Post Out A	2-year	2	3.170	12.100	35.52
Post Out A	5-year	5	4.640	12.100	53.15
Post Out A	10-year	10	6.091	12.100	68.18
Post Out A	25-year	25	7.590	12.100	83.57
Post Out A	50-year	50	8.609	12.100	94.16
Post Out A	100-year	100	9.641	12.100	105.00

Subsection: Master Network Summary

**Node Summary**

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft <sup>3</sup> /s)
Pre Out B	1-year	1	0.167	11.950	2.80
Pre Out B	2-year	2	0.235	11.950	4.08
Pre Out B	5-year	5	0.366	11.950	6.53
Pre Out B	10-year	10	0.489	11.950	8.78
Pre Out B	25-year	25	0.619	11.950	11.12
Pre Out B	50-year	50	0.708	11.950	12.72
Pre Out B	100-year	100	0.799	11.950	14.34
Post Out B	1-year	1	0.117	11.950	1.50
Post Out B	2-year	2	0.184	11.950	2.19
Post Out B	5-year	5	0.312	11.950	3.53
Post Out B	10-year	10	0.428	11.950	5.09
Post Out B	25-year	25	0.550	12.000	7.44
Post Out B	50-year	50	0.633	12.000	8.75
Post Out B	100-year	100	0.718	11.950	10.14
Pre Out C	1-year	1	0.077	11.950	1.36
Pre Out C	2-year	2	0.107	11.950	1.91
Pre Out C	5-year	5	0.163	11.950	2.95
Pre Out C	10-year	10	0.216	11.950	3.89
Pre Out C	25-year	25	0.270	11.900	4.89
Pre Out C	50-year	50	0.308	11.900	5.58
Pre Out C	100-year	100	0.346	11.900	6.28
Post Out C	1-year	1	0.061	11.950	1.10
Post Out C	2-year	2	0.100	11.950	1.49
Post Out C	5-year	5	0.177	11.950	2.23
Post Out C	10-year	10	0.246	11.900	2.91
Post Out C	25-year	25	0.318	11.950	3.65
Post Out C	50-year	50	0.367	11.950	4.21
Post Out C	100-year	100	0.417	11.950	4.75

**Pond Summary**

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft <sup>3</sup> /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
BMP-1 (IN)	1-year	1	0.289	11.900	5.25	(N/A)	(N/A)
BMP-1 (OUT)	1-year	1	0.289	12.000	4.38	1,217.19	0.041
BMP-1 (IN)	2-year	2	0.365	11.900	6.63	(N/A)	(N/A)
BMP-1 (OUT)	2-year	2	0.365	12.000	5.55	1,217.40	0.050
BMP-1 (IN)	5-year	5	0.503	11.900	9.07	(N/A)	(N/A)
BMP-1 (OUT)	5-year	5	0.503	12.000	6.98	1,217.76	0.068
BMP-1 (IN)	10-year	10	0.624	11.900	11.17	(N/A)	(N/A)

Subsection: Master Network Summary

**Pond Summary**

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft <sup>3</sup> /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
BMP-1 (OUT)	10-year	10	0.624	12.000	8.34	1,218.22	0.087
BMP-1 (IN)	25-year	25	0.747	11.900	13.27	(N/A)	(N/A)
BMP-1 (OUT)	25-year	25	0.747	12.000	9.89	1,218.84	0.104
BMP-1 (IN)	50-year	50	0.830	11.900	14.67	(N/A)	(N/A)
BMP-1 (OUT)	50-year	50	0.830	12.000	10.88	1,219.30	0.117
BMP-1 (IN)	100-year	100	0.913	11.900	16.06	(N/A)	(N/A)
BMP-1 (OUT)	100-year	100	0.913	12.000	11.77	1,219.74	0.129
BMP-2 (IN)	1-year	1	0.222	11.950	3.99	(N/A)	(N/A)
BMP-2 (OUT)	1-year	1	0.000	0.000	0.00	1,205.40	0.221
BMP-2 (IN)	2-year	2	0.297	11.950	5.37	(N/A)	(N/A)
BMP-2 (OUT)	2-year	2	0.000	0.000	0.00	1,205.81	0.296
BMP-2 (IN)	5-year	5	0.439	11.900	7.92	(N/A)	(N/A)
BMP-2 (OUT)	5-year	5	0.007	24.100	0.03	1,206.53	0.438
BMP-2 (IN)	10-year	10	0.568	11.900	10.30	(N/A)	(N/A)
BMP-2 (OUT)	10-year	10	0.136	18.450	0.18	1,206.65	0.464
BMP-2 (IN)	25-year	25	0.701	11.900	12.73	(N/A)	(N/A)
BMP-2 (OUT)	25-year	25	0.269	15.200	0.35	1,206.80	0.496
BMP-2 (IN)	50-year	50	0.792	11.900	14.37	(N/A)	(N/A)
BMP-2 (OUT)	50-year	50	0.360	14.000	0.51	1,206.94	0.526
BMP-2 (IN)	100-year	100	0.884	11.900	16.02	(N/A)	(N/A)
BMP-2 (OUT)	100-year	100	0.452	13.450	0.73	1,207.10	0.560
BMP-3 (IN)	1-year	1	0.099	11.950	1.79	(N/A)	(N/A)
BMP-3 (OUT)	1-year	1	0.027	15.900	0.05	1,234.53	0.074
BMP-3 (IN)	2-year	2	0.129	11.900	2.33	(N/A)	(N/A)
BMP-3 (OUT)	2-year	2	0.057	13.300	0.13	1,234.59	0.079
BMP-3 (IN)	5-year	5	0.184	11.900	3.34	(N/A)	(N/A)
BMP-3 (OUT)	5-year	5	0.112	12.300	0.45	1,234.83	0.096
BMP-3 (IN)	10-year	10	0.233	11.900	4.23	(N/A)	(N/A)
BMP-3 (OUT)	10-year	10	0.161	12.100	1.22	1,235.20	0.115
BMP-3 (IN)	25-year	25	0.284	11.900	5.12	(N/A)	(N/A)

Subsection: Master Network Summary

**Pond Summary**

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft <sup>3</sup> /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
BMP-3 (OUT)	25-year	25	0.212	12.050	2.18	1,235.62	0.131
BMP-3 (IN)	50-year	50	0.318	11.900	5.72	(N/A)	(N/A)
BMP-3 (OUT)	50-year	50	0.246	12.050	2.62	1,235.92	0.142
BMP-3 (IN)	100-year	100	0.352	11.900	6.32	(N/A)	(N/A)
BMP-3 (OUT)	100-year	100	0.280	12.050	3.01	1,236.23	0.153
BMP-4 (IN)	1-year	1	0.054	11.950	0.97	(N/A)	(N/A)
BMP-4 (OUT)	1-year	1	0.000	0.000	0.00	1,233.97	0.054
BMP-4 (IN)	2-year	2	0.073	11.950	1.31	(N/A)	(N/A)
BMP-4 (OUT)	2-year	2	0.018	17.850	0.03	1,234.06	0.057
BMP-4 (IN)	5-year	5	0.108	11.950	1.95	(N/A)	(N/A)
BMP-4 (OUT)	5-year	5	0.053	13.400	0.10	1,234.21	0.064
BMP-4 (IN)	10-year	10	0.140	11.900	2.54	(N/A)	(N/A)
BMP-4 (OUT)	10-year	10	0.085	12.550	0.23	1,234.47	0.075
BMP-4 (IN)	25-year	25	0.174	11.900	3.15	(N/A)	(N/A)
BMP-4 (OUT)	25-year	25	0.119	12.450	0.33	1,234.81	0.091
BMP-4 (IN)	50-year	50	0.197	11.900	3.57	(N/A)	(N/A)
BMP-4 (OUT)	50-year	50	0.142	12.250	0.53	1,235.01	0.102
BMP-4 (IN)	100-year	100	0.220	11.900	3.98	(N/A)	(N/A)
BMP-4 (OUT)	100-year	100	0.165	12.100	1.55	1,235.09	0.106

Subsection: Time of Concentration Calculations  
 Label: Post Uncontrolled B

Return Event: 1 years  
 Storm Event: 1-year

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.130 ft/ft
2 Year 24 Hour Depth	2.7 in
Average Velocity	0.33 ft/s
Segment Time of Concentration	0.084 hours
Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	190.00 ft
Is Paved?	True
Slope	0.095 ft/ft
Average Velocity	6.27 ft/s
Segment Time of Concentration	0.008 hours
Segment #3: TR-55 Shallow Concentrated Flow	
Hydraulic Length	218.00 ft
Is Paved?	False
Slope	0.174 ft/ft
Average Velocity	6.73 ft/s
Segment Time of Concentration	0.009 hours
Segment #4: TR-55 Channel Flow	
Flow Area	4.0 ft <sup>2</sup>
Hydraulic Length	290.00 ft
Manning's n	0.030
Slope	0.080 ft/ft
Wetted Perimeter	6.00 ft
Average Velocity	10.72 ft/s
Segment Time of Concentration	0.008 hours
Time of Concentration (Composite)	
Time of Concentration (Composite)	0.109 hours

Subsection: Time of Concentration Calculations  
Label: Post Uncontrolled B

Return Event: 1 years  
Storm Event: 1-year

#### ==== SCS Channel Flow

$T_c = \frac{R = Q_a / W_p}{V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n}$   
 $(L_f / V) / 3600$   
R= Hydraulic radius  
Aq= Flow area, square feet  
Wp= Wetted perimeter, feet  
V= Velocity, ft/sec  
Where: Sf= Slope, ft/ft  
n= Manning's n  
Tc= Time of concentration, hours  
Lf= Flow length, feet

#### ==== SCS TR-55 Shallow Concentration Flow

Unpaved surface:  
 $V = 16.1345 * (S_f^{0.5})$   
Tc = Paved Surface:  
 $V = 20.3282 * (S_f^{0.5})$   
 $(L_f / V) / 3600$   
V= Velocity, ft/sec  
Where: Sf= Slope, ft/ft  
Tc= Time of concentration, hours  
Lf= Flow length, feet

#### ==== SCS TR-55 Sheet Flow

$T_c = \frac{(0.007 * ((n * L_f)^{0.8}) / ((P^{0.5}) * (S_f^{0.4}))}{T_c = \text{Time of concentration, hours}}$   
n= Manning's n  
Where: Lf= Flow length, feet  
P= 2yr, 24hr Rain depth, inches  
Sf= Slope, %

Subsection: Time of Concentration Calculations  
 Label: Post-Controlled A1

Return Event: 1 years  
 Storm Event: 1-year

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	150.00 ft
Manning's n	0.011
Slope	0.050 ft/ft
2 Year 24 Hour Depth	2.7 in
Average Velocity	1.98 ft/s
Segment Time of Concentration	0.021 hours
Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	150.00 ft
Is Paved?	False
Slope	0.200 ft/ft
Average Velocity	7.22 ft/s
Segment Time of Concentration	0.006 hours
Segment #3: TR-55 Shallow Concentrated Flow	
Hydraulic Length	350.00 ft
Is Paved?	True
Slope	0.020 ft/ft
Average Velocity	2.87 ft/s
Segment Time of Concentration	0.034 hours
Time of Concentration (Composite)	
Time of Concentration (Composite)	0.083 hours

Subsection: Time of Concentration Calculations  
Label: Post-Controlled A1

Return Event: 1 years  
Storm Event: 1-year

**==== SCS Channel Flow**

$T_c = \frac{R = Q_a / W_p}{V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n}$   
 $(L_f / V) / 3600$   
R= Hydraulic radius  
Aq= Flow area, square feet  
Wp= Wetted perimeter, feet  
V= Velocity, ft/sec  
Where: Sf= Slope, ft/ft  
n= Manning's n  
Tc= Time of concentration, hours  
Lf= Flow length, feet

**==== SCS TR-55 Shallow Concentration Flow**

Unpaved surface:  
 $V = 16.1345 * (S_f^{0.5})$   
Tc = Paved Surface:  
 $V = 20.3282 * (S_f^{0.5})$   
 $(L_f / V) / 3600$   
V= Velocity, ft/sec  
Where: Sf= Slope, ft/ft  
Tc= Time of concentration, hours  
Lf= Flow length, feet

Subsection: Time of Concentration Calculations  
Label: Post-Controlled A2

Return Event: 1 years  
Storm Event: 1-year

Time of Concentration Results

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Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.011
Slope	0.050 ft/ft
2 Year 24 Hour Depth	2.7 in
Average Velocity	1.82 ft/s
Segment Time of Concentration	0.015 hours

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Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	500.00 ft
Is Paved?	True
Slope	0.050 ft/ft
Average Velocity	4.55 ft/s
Segment Time of Concentration	0.031 hours

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Segment #3: TR-55 Shallow Concentrated Flow	
Hydraulic Length	150.00 ft
Is Paved?	False
Slope	0.080 ft/ft
Average Velocity	4.56 ft/s
Segment Time of Concentration	0.009 hours

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Segment #4: TR-55 Channel Flow	
Flow Area	8.0 ft <sup>2</sup>
Hydraulic Length	350.00 ft
Manning's n	0.030
Slope	0.110 ft/ft
Wetted Perimeter	11.00 ft
Average Velocity	13.32 ft/s
Segment Time of Concentration	0.007 hours

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Time of Concentration (Composite)	
Time of Concentration (Composite)	0.083 hours

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Subsection: Time of Concentration Calculations  
Label: Post-Controlled A2

Return Event: 1 years  
Storm Event: 1-year

#### ==== SCS Channel Flow

$$T_c = \frac{R = Q_a / W_p}{V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n}$$

$(L_f / V) / 3600$   
R= Hydraulic radius  
Aq= Flow area, square feet  
Wp= Wetted perimeter, feet  
Where: V= Velocity, ft/sec  
Sf= Slope, ft/ft  
n= Manning's n  
Tc= Time of concentration, hours  
Lf= Flow length, feet

#### ==== SCS TR-55 Shallow Concentration Flow

$$T_c = \frac{\text{Unpaved surface:}}{V = 16.1345 * (S_f^{0.5})}$$

$$\text{Paved Surface:}$$
$$V = 20.3282 * (S_f^{0.5})$$

$(L_f / V) / 3600$   
V= Velocity, ft/sec  
Where: Sf= Slope, ft/ft  
Tc= Time of concentration, hours  
Lf= Flow length, feet

#### ==== SCS TR-55 Sheet Flow

$$T_c = \frac{(0.007 * ((n * L_f)^{0.8}) / ((P^{0.5}) * (S_f^{0.4}))}{T_c = \text{Time of concentration, hours}}$$

n= Manning's n  
Where: Lf= Flow length, feet  
P= 2yr, 24hr Rain depth, inches  
Sf= Slope, %

Subsection: Time of Concentration Calculations  
Label: Pre Developed B

Return Event: 1 years  
Storm Event: 1-year

Time of Concentration Results

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Segment #1: TR-55 Sheet Flow

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Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.130 ft/ft
2 Year 24 Hour Depth	2.7 in
Average Velocity	0.33 ft/s
Segment Time of Concentration	0.084 hours

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Segment #2: TR-55 Shallow Concentrated Flow

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Hydraulic Length	240.00 ft
Is Paved?	True
Slope	0.160 ft/ft
Average Velocity	8.13 ft/s
Segment Time of Concentration	0.008 hours

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Segment #3: TR-55 Channel Flow

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Flow Area	6.0 ft <sup>2</sup>
Hydraulic Length	420.00 ft
Manning's n	0.040
Slope	0.100 ft/ft
Wetted Perimeter	8.00 ft
Average Velocity	9.72 ft/s
Segment Time of Concentration	0.012 hours

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Time of Concentration (Composite)

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Time of Concentration (Composite)	0.104 hours
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Subsection: Time of Concentration Calculations  
Label: Pre Developed B

Return Event: 1 years  
Storm Event: 1-year

#### ==== SCS Channel Flow

$T_c = \frac{R = Q_a / W_p}{V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n}$   
 $(L_f / V) / 3600$   
R= Hydraulic radius  
Aq= Flow area, square feet  
Wp= Wetted perimeter, feet  
V= Velocity, ft/sec  
Sf= Slope, ft/ft  
n= Manning's n  
Tc= Time of concentration, hours  
Lf= Flow length, feet

#### ==== SCS TR-55 Shallow Concentration Flow

Unpaved surface:  
 $V = 16.1345 * (S_f^{0.5})$   
Paved Surface:  
 $V = 20.3282 * (S_f^{0.5})$   
 $(L_f / V) / 3600$   
V= Velocity, ft/sec  
Sf= Slope, ft/ft  
Tc= Time of concentration, hours  
Lf= Flow length, feet

#### ==== SCS TR-55 Sheet Flow

$T_c = \frac{(0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))}{T_c = \text{Time of concentration, hours}}$   
n= Manning's n  
Lf= Flow length, feet  
P= 2yr, 24hr Rain depth, inches  
Sf= Slope, %

Subsection: Time of Concentration Calculations  
Label: Pre-Developed A

Return Event: 1 years  
Storm Event: 1-year

Time of Concentration Results

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Segment #1: TR-55 Sheet Flow

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Hydraulic Length	100.00 ft
Manning's n	0.400
Slope	0.050 ft/ft
2 Year 24 Hour Depth	2.7 in
Average Velocity	0.10 ft/s
Segment Time of Concentration	0.270 hours

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Segment #2: TR-55 Shallow Concentrated Flow

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Hydraulic Length	750.00 ft
Is Paved?	False
Slope	0.066 ft/ft
Average Velocity	4.15 ft/s
Segment Time of Concentration	0.050 hours

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Segment #3: TR-55 Channel Flow

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Flow Area	10.0 ft <sup>2</sup>
Hydraulic Length	1,500.00 ft
Manning's n	0.040
Slope	0.020 ft/ft
Wetted Perimeter	10.00 ft
Average Velocity	5.27 ft/s
Segment Time of Concentration	0.079 hours

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Time of Concentration (Composite)

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Time of Concentration (Composite)	0.399 hours
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Subsection: Time of Concentration Calculations  
Label: Pre-Developed A

Return Event: 1 years  
Storm Event: 1-year

#### ==== SCS Channel Flow

$T_c = \frac{R = Q_a / W_p}{V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n}$   
 $(L_f / V) / 3600$   
R= Hydraulic radius  
Aq= Flow area, square feet  
Wp= Wetted perimeter, feet  
V= Velocity, ft/sec  
Where: Sf= Slope, ft/ft  
n= Manning's n  
Tc= Time of concentration, hours  
Lf= Flow length, feet

#### ==== SCS TR-55 Shallow Concentration Flow

Unpaved surface:  
 $V = 16.1345 * (S_f^{0.5})$   
Tc = Paved Surface:  
 $V = 20.3282 * (S_f^{0.5})$   
 $(L_f / V) / 3600$   
V= Velocity, ft/sec  
Where: Sf= Slope, ft/ft  
Tc= Time of concentration, hours  
Lf= Flow length, feet

#### ==== SCS TR-55 Sheet Flow

$T_c = \frac{(0.007 * ((n * L_f)^{0.8}) / ((P^{0.5}) * (S_f^{0.4}))}{T_c = \text{Time of concentration, hours}}$   
n= Manning's n  
Where: Lf= Flow length, feet  
P= 2yr, 24hr Rain depth, inches  
Sf= Slope, %

Subsection: Elevation vs. Volume Curve  
Label: BMP-1

Return Event: 1 years  
Storm Event: 1-year

### Elevation-Volume

Pond Elevation (ft)	Pond Volume (ac-ft)
1,216.00	0.000
1,216.50	0.014
1,217.00	0.033
1,217.50	0.054
1,218.00	0.081
1,218.50	0.095
1,219.00	0.109
1,219.50	0.122
1,220.00	0.136

Subsection: Elevation-Area Volume Curve  
 Label: BMP-2

Return Event: 1 years  
 Storm Event: 1-year

Elevation (ft)	Planimeter (ft <sup>2</sup> )	Area (acres)	$A1+A2+\frac{\text{sqr}(A1*A2)}{2}$ (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
1,204.00	0.0	0.141	0.000	0.000	0.000
1,206.00	0.0	0.193	0.499	0.333	0.333
1,208.00	0.0	0.249	0.661	0.441	0.773
1,210.00	0.0	0.315	0.844	0.563	1.336

Subsection: Elevation vs. Volume Curve  
Label: BMP-3

Return Event: 1 years  
Storm Event: 1-year

### Elevation-Volume

Pond Elevation (ft)	Pond Volume (ac-ft)
1,233.00	0.000
1,233.50	0.018
1,234.00	0.044
1,234.50	0.072
1,235.00	0.108
1,235.50	0.126
1,236.00	0.145
1,236.50	0.163
1,237.00	0.182

Subsection: Elevation-Area Volume Curve  
 Label: BMP-4

Return Event: 1 years  
 Storm Event: 1-year

Elevation (ft)	Planimeter (ft <sup>2</sup> )	Area (acres)	$A1+A2+\frac{\text{sqr}(A1*A2)}{2}$ (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
1,232.00	0.0	0.017	0.000	0.000	0.000
1,233.00	0.0	0.027	0.065	0.022	0.022
1,234.00	0.0	0.040	0.099	0.033	0.055
1,235.00	0.0	0.054	0.139	0.046	0.101
1,236.00	0.0	0.070	0.185	0.062	0.163
1,237.00	0.0	0.088	0.236	0.079	0.242

Subsection: Outlet Input Data  
 Label: BMP-1

Return Event: 1 years  
 Storm Event: 1-year

Requested Pond Water Surface Elevations	
Minimum (Headwater)	1,216.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	1,220.00 ft

**Outlet Connectivity**

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Stand Pipe	Riser - 1	Forward	Culvert - 1	1,220.00	1,220.00
Orifice-Circular	Orifice - 1	Forward	Culvert - 1	1,216.00	1,220.00
Culvert-Circular	Culvert - 1	Forward	TW	1,214.00	1,220.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Subsection: Outlet Input Data  
Label: BMP-1

Return Event: 1 years  
Storm Event: 1-year

---

Structure ID: Riser - 1	
Structure Type: Stand Pipe	
<hr/>	
Number of Openings	1
Elevation	1,220.00 ft
Diameter	30.0 in
Orifice Area	4.9 ft <sup>2</sup>
Orifice Coefficient	0.600
Weir Length	7.85 ft
Weir Coefficient	3.00 (ft <sup>0.5</sup> )/s
K Reverse	1.000
Manning's n	0.000
Kev, Charged Riser	0.000
Weir Submergence	False
Orifice H to crest	False

---

Subsection: Outlet Input Data  
 Label: BMP-1

Return Event: 1 years  
 Storm Event: 1-year

Structure ID: Culvert - 1	
Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	18.0 in
Length	50.00 ft
Length (Computed Barrel)	51.42 ft
Slope (Computed)	0.240 ft/ft
Outlet Control Data	
Manning's n	0.013
Ke	0.200
Kb	0.018
Kr	0.000
Convergence Tolerance	0.00 ft
Inlet Control Data	
Equation Form	Form 1
K	0.0045
M	2.0000
C	0.0317
Y	0.6900
T1 ratio (HW/D)	0.000
T2 ratio (HW/D)	1.077
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.

Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control, interpolate between flows at T1 & T2...

T1 Elevation	1,214.00 ft	T1 Flow	7.58 ft <sup>3</sup> /s
T2 Elevation	1,215.62 ft	T2 Flow	8.66 ft <sup>3</sup> /s

Subsection: Outlet Input Data  
Label: BMP-1

Return Event: 1 years  
Storm Event: 1-year

---

Structure ID: Orifice - 1	
Structure Type: Orifice-Circular	
<hr/>	
Number of Openings	1
Elevation	1,216.00 ft
Orifice Diameter	16.0 in
Orifice Coefficient	0.600
<hr/>	
Structure ID: TW	
Structure Type: TW Setup, DS Channel	
<hr/>	
Tailwater Type	Free Outfall
<hr/>	
Convergence Tolerances	
<hr/>	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft <sup>3</sup> /s
Flow Tolerance (Maximum)	10.000 ft <sup>3</sup> /s
<hr/>	

Subsection: Outlet Input Data  
 Label: BMP-2

Return Event: 1 years  
 Storm Event: 1-year

Requested Pond Water Surface Elevations	
Minimum (Headwater)	1,204.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	1,210.00 ft

**Outlet Connectivity**

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Stand Pipe	Riser - 2	Forward	Culvert - 2	1,208.00	1,210.00
Orifice-Circular	Orifice - 2	Forward	Culvert - 2	1,206.50	1,210.00
Culvert-Circular	Culvert - 2	Forward	TW	1,203.00	1,210.00
Rectangular Weir	Weir - 1	Forward	TW	1,208.50	1,210.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Subsection: Outlet Input Data  
Label: BMP-2

Return Event: 1 years  
Storm Event: 1-year

---

Structure ID: Riser - 2	
Structure Type: Stand Pipe	
<hr/>	
Number of Openings	1
Elevation	1,208.00 ft
Diameter	24.0 in
Orifice Area	3.1 ft <sup>2</sup>
Orifice Coefficient	0.600
Weir Length	6.28 ft
Weir Coefficient	3.00 (ft <sup>0.5</sup> )/s
K Reverse	1.000
Manning's n	0.000
Kev, Charged Riser	0.000
Weir Submergence	False
Orifice H to crest	False

---

Subsection: Outlet Input Data  
 Label: BMP-2

Return Event: 1 years  
 Storm Event: 1-year

Structure ID: Culvert - 2	
Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	12.0 in
Length	40.00 ft
Length (Computed Barrel)	40.01 ft
Slope (Computed)	0.025 ft/ft
Outlet Control Data	
Manning's n	0.013
Ke	0.200
Kb	0.031
Kr	0.000
Convergence Tolerance	0.00 ft
Inlet Control Data	
Equation Form	Form 1
K	0.0045
M	2.0000
C	0.0317
Y	0.6900
T1 ratio (HW/D)	1.083
T2 ratio (HW/D)	1.185
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.

Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control, interpolate between flows at T1 & T2...

T1 Elevation	1,204.08 ft	T1 Flow	2.75 ft <sup>3</sup> /s
T2 Elevation	1,204.18 ft	T2 Flow	3.14 ft <sup>3</sup> /s

Subsection: Outlet Input Data  
 Label: BMP-2

Return Event: 1 years  
 Storm Event: 1-year

---

Structure ID: Orifice - 2	
Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	1,206.50 ft
Orifice Diameter	8.0 in
Orifice Coefficient	0.600

---



---

Structure ID: Weir - 1	
Structure Type: Rectangular Weir	
Number of Openings	1
Elevation	1,208.50 ft
Weir Length	8.00 ft
Weir Coefficient	3.00 (ft <sup>0.5</sup> )/s

---



---

Structure ID: TW	
Structure Type: TW Setup, DS Channel	
Tailwater Type	Free Outfall

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Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft <sup>3</sup> /s
Flow Tolerance (Maximum)	10.000 ft <sup>3</sup> /s

---

Subsection: Outlet Input Data  
 Label: BMP-3

Return Event: 1 years  
 Storm Event: 1-year

Requested Pond Water Surface Elevations	
Minimum (Headwater)	1,233.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	1,237.00 ft

**Outlet Connectivity**

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Rectangular Weir	Weir - 1	Forward	Culvert - 1	1,236.25	1,237.00
Stand Pipe	Riser - 1	Forward	Culvert - 1	1,237.00	1,237.00
Orifice-Circular	Orifice - 1	Forward	Culvert - 1	1,234.50	1,237.00
Culvert-Circular	Culvert - 1	Forward	TW	1,232.00	1,237.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Subsection: Outlet Input Data  
 Label: BMP-3

Return Event: 1 years  
 Storm Event: 1-year

Structure ID: Culvert - 1	
Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	18.0 in
Length	20.00 ft
Length (Computed Barrel)	20.00 ft
Slope (Computed)	0.012 ft/ft
Outlet Control Data	
Manning's n	0.013
Ke	0.200
Kb	0.018
Kr	0.000
Convergence Tolerance	0.00 ft
Inlet Control Data	
Equation Form	Form 1
K	0.0045
M	2.0000
C	0.0317
Y	0.6900
T1 ratio (HW/D)	1.089
T2 ratio (HW/D)	1.191
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.

Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control, interpolate between flows at T1 & T2...

T1 Elevation	1,233.63 ft	T1 Flow	7.58 ft <sup>3</sup> /s
T2 Elevation	1,233.79 ft	T2 Flow	8.66 ft <sup>3</sup> /s

Subsection: Outlet Input Data  
 Label: BMP-3

Return Event: 1 years  
 Storm Event: 1-year

---

Structure ID: Riser - 1  
 Structure Type: Stand Pipe

---

Number of Openings	1
Elevation	1,237.00 ft
Diameter	30.0 in
Orifice Area	4.9 ft <sup>2</sup>
Orifice Coefficient	0.600
Weir Length	7.85 ft
Weir Coefficient	3.00 (ft <sup>0.5</sup> )/s
K Reverse	1.000
Manning's n	0.000
Kev, Charged Riser	0.000
Weir Submergence	False
Orifice H to crest	False

---



---

Structure ID: Orifice - 1  
 Structure Type: Orifice-Circular

---

Number of Openings	1
Elevation	1,234.50 ft
Orifice Diameter	10.0 in
Orifice Coefficient	0.600

---



---

Structure ID: Weir - 1  
 Structure Type: Rectangular Weir

---

Number of Openings	1
Elevation	1,236.25 ft
Weir Length	2.50 ft
Weir Coefficient	3.00 (ft <sup>0.5</sup> )/s

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Structure ID: TW  
 Structure Type: TW Setup, DS Channel

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Tailwater Type	Free Outfall
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Convergence Tolerances

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Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft <sup>3</sup> /s
Flow Tolerance (Maximum)	10.000 ft <sup>3</sup> /s

Subsection: Outlet Input Data  
Label: BMP-3

Return Event: 1 years  
Storm Event: 1-year

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Convergence Tolerances

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Subsection: Outlet Input Data  
 Label: BMP-4

Return Event: 1 years  
 Storm Event: 1-year

Requested Pond Water Surface Elevations	
Minimum (Headwater)	1,232.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	1,237.00 ft

**Outlet Connectivity**

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Stand Pipe	Riser - 1	Forward	Culvert - 1	1,235.00	1,237.00
Orifice-Circular	Orifice - 1	Forward	Culvert - 1	1,234.00	1,237.00
Culvert-Circular	Culvert - 1	Forward	TW	1,230.50	1,237.00
Rectangular Weir	Weir - 1	Forward	TW	1,235.50	1,237.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Subsection: Outlet Input Data  
 Label: BMP-4

Return Event: 1 years  
 Storm Event: 1-year

Structure ID: Culvert - 1	
Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	12.0 in
Length	90.00 ft
Length (Computed Barrel)	90.61 ft
Slope (Computed)	0.117 ft/ft
Outlet Control Data	
Manning's n	0.013
Ke	0.200
Kb	0.031
Kr	0.000
Convergence Tolerance	0.00 ft
Inlet Control Data	
Equation Form	Form 1
K	0.0045
M	2.0000
C	0.0317
Y	0.6900
T1 ratio (HW/D)	1.037
T2 ratio (HW/D)	1.139
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.

Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control, interpolate between flows at T1 & T2...

T1 Elevation	1,231.54 ft	T1 Flow	2.75 ft <sup>3</sup> /s
T2 Elevation	1,231.64 ft	T2 Flow	3.14 ft <sup>3</sup> /s

Subsection: Outlet Input Data  
 Label: BMP-4

Return Event: 1 years  
 Storm Event: 1-year

---

Structure ID: Riser - 1  
 Structure Type: Stand Pipe

---

Number of Openings	1
Elevation	1,235.00 ft
Diameter	24.0 in
Orifice Area	3.1 ft <sup>2</sup>
Orifice Coefficient	0.600
Weir Length	6.28 ft
Weir Coefficient	3.00 (ft <sup>0.5</sup> )/s
K Reverse	1.000
Manning's n	0.000
Kev, Charged Riser	0.000
Weir Submergence	False
Orifice H to crest	False

---



---

Structure ID: Orifice - 1  
 Structure Type: Orifice-Circular

---

Number of Openings	1
Elevation	1,234.00 ft
Orifice Diameter	4.0 in
Orifice Coefficient	0.600

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---

Structure ID: Weir - 1  
 Structure Type: Rectangular Weir

---

Number of Openings	1
Elevation	1,235.50 ft
Weir Length	8.00 ft
Weir Coefficient	3.00 (ft <sup>0.5</sup> )/s

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Structure ID: TW  
 Structure Type: TW Setup, DS Channel

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Tailwater Type	Free Outfall
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Convergence Tolerances

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Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft <sup>3</sup> /s
Flow Tolerance (Maximum)	10.000 ft <sup>3</sup> /s

Subsection: Outlet Input Data  
Label: BMP-4

Return Event: 1 years  
Storm Event: 1-year

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Convergence Tolerances

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## CN Area Collection - Pre-Developed A (Catchment)

Description	CN	Area (acres)	Percent Connected Impervious Area (%)	Percent Unconnected Impervious Area (%)
Impervious Areas - Gravel (w/ right-of-way) - Soil C	89.000	0.944	0.0	0.0
Impervious Areas - Gravel (w/ right-of-way) - Soil C/D	90.000	0.003	0.0	0.0
Impervious Areas - Gravel (w/ right-of-way) - Soil D	91.000	0.333	0.0	0.0
Impervious Areas - Paved parking lots, roofs, driveways, Streets and roads - Soil D	98.000	11.202	0.0	0.0
Meadow - cont. grass (non grazed) - ---- - Soil B	58.000	0.139	0.0	0.0
Meadow - cont. grass (non grazed) - ---- - Soil C	71.000	2.393	0.0	0.0
Meadow - cont. grass (non grazed) - ---- - Soil C/D	75.000	0.868	0.0	0.0
Meadow - cont. grass (non grazed) - ---- - Soil D	78.000	4.561	0.0	0.0
Woods - good - Soil B	55.000	1.392	0.0	0.0
Woods - good - Soil B/D	66.000	0.008	0.0	0.0
Woods - good - Soil C	70.000	1.083	0.0	0.0
Woods - good - Soil C/D	74.000	4.832	0.0	0.0
Woods - good - Soil D	77.000	6.262	0.0	0.0

## CN Area Collection - Post-Controlled A1 (Catchment)

Description	CN	Area (acres)	Percent Connected Impervious Area (%)	Percent Unconnected Impervious Area (%)
Impervious Areas - Gravel (w/ right-of-way) - Soil C	89.000	0.683	0.0	0.0
Impervious Areas - Gravel (w/ right-of-way) - Soil D	91.000	0.607	0.0	0.0
Impervious Areas - Paved parking lots, roofs, driveways, Streets and roads - Soil D	98.000	0.765	0.0	0.0
Meadow - cont. grass (non grazed) - ---- - Soil D	78.000	0.480	0.0	0.0
Woods - good - Soil D	77.000	0.040	0.0	0.0

## CN Area Collection - Post-Controlled A2 (Catchment)

Description	CN	Area (acres)	Percent Connected Impervious Area (%)	Percent Unconnected Impervious Area (%)
Impervious Areas - Gravel (w/ right-of- way) - Soil B	85.000	0.081	0.0	0.0
Impervious Areas - Gravel (w/ right-of- way) - Soil C/D	90.000	0.155	0.0	0.0
Impervious Areas - Gravel (w/ right-of- way) - Soil D	91.000	0.114	0.0	0.0
Impervious Areas - Paved parking lots, roofs, driveways, Streets and roads - Soil D	98.000	1.146	0.0	0.0
Meadow - cont. grass (non grazed) - ---- - Soil B	58.000	0.109	0.0	0.0
Meadow - cont. grass (non grazed) - ---- - Soil C/D	75.000	0.178	0.0	0.0
Meadow - cont. grass (non grazed) - ---- - Soil D	78.000	0.206	0.0	0.0
Woods - good - Soil B	55.000	0.388	0.0	0.0
Woods - good - Soil C/D	74.000	0.434	0.0	0.0
Woods - good - Soil D	77.000	0.247	0.0	0.0

## CN Area Collection - Post-Uncontrolled A (Catchment)

Description	CN	Area (acres)	Percent Connected Impervious Area (%)	Percent Unconnected Impervious Area (%)
Impervious Areas - Gravel (w/ right-of-way) - Soil B	85.000	0.000	0.0	0.0
Impervious Areas - Gravel (w/ right-of-way) - Soil C	89.000	1.043	0.0	0.0
Impervious Areas - Gravel (w/ right-of-way) - Soil C/D	90.000	0.003	0.0	0.0
Impervious Areas - Gravel (w/ right-of-way) - Soil D	91.000	0.595	0.0	0.0
Impervious Areas - Paved parking lots, roofs, driveways, Streets and roads - Soil D	98.000	9.253	0.0	0.0
Meadow - cont. grass (non grazed) - ---- - Soil B	58.000	0.017	0.0	0.0
Meadow - cont. grass (non grazed) - ---- - Soil C	71.000	0.010	0.0	0.0
Meadow - cont. grass (non grazed) - ---- - Soil C/D	75.000	0.000	0.0	0.0
Meadow - cont. grass (non grazed) - ---- - Soil D	78.000	0.320	0.0	0.0
Woods - good - Soil B	55.000	0.942	0.0	0.0
Woods - good - Soil B/D	66.000	0.008	0.0	0.0
Woods - good - Soil C	70.000	2.809	0.0	0.0
Woods - good - Soil C/D	74.000	4.855	0.0	0.0
Woods - good - Soil D	77.000	8.519	0.0	0.0

## CN Area Collection - Pre Developed B (Catchment)

Description	CN	Area (acres)	Percent Connected Impervious Area (%)	Percent Unconnected Impervious Area (%)
Impervious Areas - Paved parking lots, roofs, driveways, Streets and roads - Soil C	98.000	0.159	0.0	0.0
Impervious Areas - Gravel (w/ right-of- way) - Soil D	91.000	0.000	0.0	0.0
Meadow - cont. grass (non grazed) - ---- - Soil C/D	75.000	0.576	0.0	0.0
Meadow - cont. grass (non grazed) - ---- - Soil D	78.000	0.782	0.0	0.0
Woods - good - Soil C/D	74.000	0.973	0.0	0.0
Woods - good - Soil D	77.000	0.748	0.0	0.0

## CN Area Collection - Post Controlled B (Catchment)

Description	CN	Area (acres)	Percent Connected Impervious Area (%)	Percent Unconnected Impervious Area (%)
Impervious Areas - Gravel (w/ right-of-way) - Soil C/D	90.000	0.043	0.0	0.0
Impervious Areas - Gravel (w/ right-of-way) - Soil D	91.000	0.140	0.0	0.0
Meadow - cont. grass (non grazed) - ---- - Soil C/D	75.000	0.061	0.0	0.0
Meadow - cont. grass (non grazed) - ---- - Soil D	78.000	0.215	0.0	0.0
Impervious Areas - Paved parking lots, roofs, driveways, Streets and roads - Soil B	98.000	0.346	0.0	0.0
Woods - good - Soil C/D	74.000	0.019	0.0	0.0
Woods - good - Soil D	77.000	0.279	0.0	0.0

## CN Area Collection - Post Uncontrolled B (Catchment)

Description	CN	Area (acres)	Percent Connected Impervious Area (%)	Percent Unconnected Impervious Area (%)
Impervious Areas - Paved parking lots, roofs, driveways, Streets and roads - Soil C	98.000	0.160	0.0	0.0
Impervious Areas - Gravel (w/ right-of- way) - Soil D	91.000	0.000	0.0	0.0
Meadow - cont. grass (non grazed) - ---- - Soil C/D	75.000	0.473	0.0	0.0
Meadow - cont. grass (non grazed) - ---- - Soil D	78.000	0.032	0.0	0.0
Woods - good - Soil C/D	74.000	0.954	0.0	0.0
Woods - good - Soil D	77.000	0.166	0.0	0.0

## CN Area Collection - Pre-Developed C (Catchment)

Description	CN	Area (acres)	Percent Connected Impervious Area (%)	Percent Unconnected Impervious Area (%)
Impervious Areas - Paved parking lots, roofs, driveways, Streets and roads - Soil C	98.000	0.157	0.0	0.0
Meadow - cont. grass (non grazed) - ---- - Soil C/D	75.000	0.024	0.0	0.0
Meadow - cont. grass (non grazed) - ---- - Soil D	78.000	0.106	0.0	0.0
Woods - good - Soil C/D	74.000	0.292	0.0	0.0
Woods - good - Soil D	77.000	0.745	0.0	0.0

## CN Area Collection - Post Controlled C (Catchment)

Description	CN	Area (acres)	Percent Connected Impervious Area (%)	Percent Unconnected Impervious Area (%)
Impervious Areas - Gravel (w/ right-of-way) - Soil D	91.000	0.088	0.0	0.0
Impervious Areas - Paved parking lots, roofs, driveways, Streets and roads - Soil C	98.000	0.104	0.0	0.0
Meadow - cont. grass (non grazed) - ---- - Soil D	78.000	0.134	0.0	0.0
Woods - good - Soil D	77.000	0.450	0.0	0.0

## CN Area Collection - Post Uncontrolled C (Catchment)

Description	CN	Area (acres)	Percent Connected Impervious Area (%)	Percent Unconnected Impervious Area (%)
Impervious Areas - Gravel (w/ right-of-way) - Soil C/D	90.000	0.020	0.0	0.0
Impervious Areas - Gravel (w/ right-of-way) - Soil D	91.000	0.077	0.0	0.0
Impervious Areas - Paved parking lots, roofs, driveways, Streets and roads - Soil C	98.000	0.157	0.0	0.0
Meadow - cont. grass (non grazed) - ---- - Soil C/D	75.000	0.024	0.0	0.0
Meadow - cont. grass (non grazed) - ---- - Soil D	78.000	0.072	0.0	0.0
Woods - good - Soil C/D	74.000	0.272	0.0	0.0
Woods - good - Soil D	77.000	0.278	0.0	0.0

## Underdrain Dewatering Rate Calculation

Project: Delmont

BMP: BMP-3

Filter Media				
Layer	Media	Thickness - T (ft)	Min. Infiltration Rate - K (ft/min) <sup>1</sup>	Flow Rate (cfs) <sup>2</sup>
1	Clean Gravel	1	2	666.67
2	Coarse Sand	N/A	0.02	N/A
3	Fine Sand	N/A	0.002	N/A
4	Other <sup>3</sup>	N/A	N/A	N/A
<b>Minimum Flow Rate (cfs)</b>				<b>666.67</b>

1. From Principles of Geotechnical Engineering Third Edition, Braja Das, 1994

2.  $Q = KA(Hm + T/T)$

A = Area (square feet) = 4,000

Hm = Head above media (feet) = 4

3. Infiltration rate measured in field or laboratory

Perforated Pipe				
Pipe	Perforation Area (square inch) <sup>4</sup>	# Perforations per Foot - N	Pipe Length - L (ft)	Flow Rate (cfs) <sup>5</sup>
1	0.046	100	35	51.07
2	0	0	0	0.00
<b>Total Flow Rate (cfs)</b>				<b>51.07</b>

4. Reference: [PVC: certainteed.com](http://PVC.certainteed.com) [HDPE: ads-pipe.com](http://HDPE.ads-pipe.com)

5.  $Q = N * L * c * A_o * \sqrt{2GH}$

c = Orifice Coefficient = 0.6

A<sub>o</sub> = Perforation Area (sq. ft.)

G = Grav. Accel. (ft/sec<sup>2</sup>) = 32.2

H = Average Head (ft) = 2.5

Pipe Discharge				
Pipe	Pipe Diameter - D (in)	Pipe Roughness Coefficient - n	Pipe Slope - S <sup>6</sup>	Flow Rate (cfs) <sup>7</sup>
1	2	0.012	0.004761905	0.02
2	0	0	0	0.00
<b>Total Flow Rate (cfs)</b>				<b>0.02</b>

6. For flat pipe, use hydraulic grade (pipe diameter/pipe length) for the pipe slope

7. From Manning's equation (attach separate calculation worksheet)

Limiting flow rate from combined underdrain system - Q <sub>l</sub> (cfs) =	0.02
Dewatering Volume (cu-ft) =	2,400.00
Dewatering Time (sec) = 2HA/Q <sub>l</sub> =	120,000
Dewatering Time (hrs) =	33.33

---

## Worksheet for BMP-3 Underdrain

---

### Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

### Input Data

Roughness Coefficient	0.012	
Channel Slope	0.00476	ft/ft
Normal Depth	0.17	ft
Diameter	0.17	ft
Discharge	0.02	ft <sup>3</sup> /s

### Results

Discharge	0.02	ft <sup>3</sup> /s
Normal Depth	0.17	ft
Flow Area	0.02	ft <sup>2</sup>
Wetted Perimeter	0.53	ft
Hydraulic Radius	0.04	ft
Top Width	0.00	ft
Critical Depth	0.10	ft
Percent Full	100.0	%
Critical Slope	0.01055	ft/ft
Velocity	1.04	ft/s
Velocity Head	0.02	ft
Specific Energy	0.19	ft
Froude Number	0.00	
Maximum Discharge	0.03	ft <sup>3</sup> /s
Discharge Full	0.02	ft <sup>3</sup> /s
Slope Full	0.00476	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

---

## Worksheet for BMP-3 Underdrain

---

### GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.17	ft
Critical Depth	0.10	ft
Channel Slope	0.00476	ft/ft
Critical Slope	0.01055	ft/ft

## Underdrain Dewatering Rate Calculation

Project: Delmont

BMP: BMP-4

Filter Media				
Layer	Media	Thickness - T (ft)	Min. Infiltration Rate - K (ft/min) <sup>1</sup>	Flow Rate (cfs) <sup>2</sup>
1	Clean Gravel	1	2	74.00
2	Coarse Sand	N/A	0.02	N/A
3	Fine Sand	N/A	0.002	N/A
4	Other <sup>3</sup>	N/A	N/A	N/A
<b>Minimum Flow Rate (cfs)</b>				<b>74.00</b>

1. From Principles of Geotechnical Engineering Third Edition, Braja Das, 1994

2.  $Q = KA(H_m + T)/T$

A = Area (square feet) = 740

H<sub>m</sub> = Head above media (feet) = 2

3. Infiltration rate measured in field or laboratory

Perforated Pipe				
Pipe	Perforation Area (square inch) <sup>4</sup>	# Perforations per Foot - N	Pipe Length - L (ft)	Flow Rate (cfs) <sup>5</sup>
1	0.046	100	40	45.21
2	0	0	0	0.00
<b>Total Flow Rate (cfs)</b>				<b>45.21</b>

4. Reference: [PVC: certainteed.com](http://PVC.certainteed.com) [HDPE: ads-pipe.com](http://HDPE.ads-pipe.com)

5.  $Q = N * L * c * A_o \sqrt{2GH}$

c = Orifice Coefficient = 0.6

A<sub>o</sub> = Perforation Area (sq. ft.)

G = Grav. Accel. (ft/sec<sup>2</sup>) = 32.2

H = Average Head (ft) = 1.5

Pipe Discharge				
Pipe	Pipe Diameter - D (in)	Pipe Roughness Coefficient - n	Pipe Slope - S <sup>6</sup>	Flow Rate (cfs) <sup>7</sup>
1	2	0.012	0.004166667	0.02
2	0	0	0	0.00
<b>Total Flow Rate (cfs)</b>				<b>0.02</b>

6. For flat pipe, use hydraulic grade (pipe diameter/pipe length) for the pipe slope

7. From Manning's equation (attach separate calculation worksheet)

Limiting flow rate from combined underdrain system - Q <sub>l</sub> (cfs) =	0.02
Dewatering Volume (cu-ft) =	2,396.00
Dewatering Time (sec) = 2HA/Q <sub>l</sub> =	119,800
Dewatering Time (hrs) =	33.28

## Worksheet for BMP-4 Underdrain

### Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

### Input Data

Roughness Coefficient	0.012	
Channel Slope	0.00417	ft/ft
Normal Depth	0.17	ft
Diameter	0.17	ft
Discharge	0.02	ft <sup>3</sup> /s

### Results

Discharge	0.02	ft <sup>3</sup> /s
Normal Depth	0.17	ft
Flow Area	0.02	ft <sup>2</sup>
Wetted Perimeter	0.52	ft
Hydraulic Radius	0.04	ft
Top Width	0.00	ft
Critical Depth	0.10	ft
Percent Full	100.0	%
Critical Slope	0.01033	ft/ft
Velocity	0.96	ft/s
Velocity Head	0.01	ft
Specific Energy	0.18	ft
Froude Number	0.00	
Maximum Discharge	0.02	ft <sup>3</sup> /s
Discharge Full	0.02	ft <sup>3</sup> /s
Slope Full	0.00417	ft/ft
Flow Type	SubCritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

---

## Worksheet for BMP-4 Underdrain

---

### GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.17	ft
Critical Depth	0.10	ft
Channel Slope	0.00417	ft/ft
Critical Slope	0.01033	ft/ft

## STANDARD E&S WORKSHEET # 20 Riprap Apron Outlet Protection

PROJECT NAME: Sunoco PPP - Delmont Station

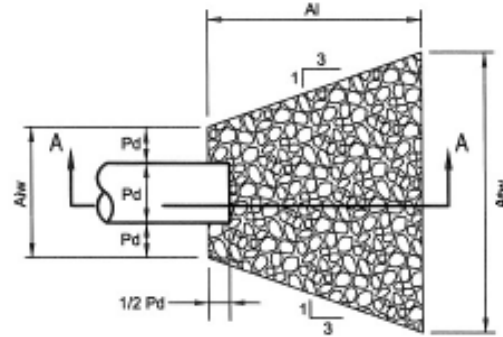
LOCATION: S.R. 66, Delmont, PA

PREPARED BY: Michael Smith

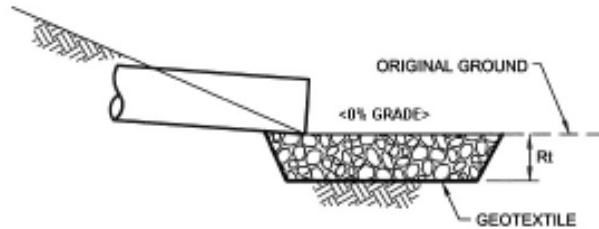
DATE: 10-11-16

CHECKED BY: Tim Dunaway

DATE: 10-24-16



PLAN VIEW



SECTION A - A

NO.	PIPE DIA. Do (in.)	TAIL WATER COND. (Max or Min)	MAN. "n" FOR PIPE	PIPE SLOPE (FT/FT)	Q (CFS)	V* (FPS)	RIPRAP SIZE	Rt (in)	Al (ft)	Aiw (ft)	Atw (ft)
RA-01	18	Min.	0.012	0.27	11.77	6.66	R-5	27	11	4.5	15.5
RA-02	18	Min.	0.012	0.02	18	10.19	R-5	27	16	4.5	20.5
RA-03	18	Min.	0.012	0.14	11.9	6.73	R-5	27	11	4.5	15.5
RA-04	Chan.	Min.	0.012	0.03	6.32	<11.5	R-5	27	35	2	10

\*:The anticipated velocity (V) should not exceed the maximum permissible shown in Table 6.6 for the proposed riprap protection. Adjust for less than full pipe flow. Use Manning's equation to calculate velocity for pipe slopes  $\geq 0.05$  ft/ft.

## **APPENDIX F – CALCULATION WORKSHEETS**

**WORKSHEET 1. GENERAL SITE INFORMATION**

**Date:** May 26, 2016

**Project Name:** Sunoco - Delmont PPP Station

**Municipality:** Salem Township

**County:** Westmoreland

**Total Area (acres):** 12.40

**Major River Basin:** \_\_\_\_\_

**Watershed:** Beaver Run

**Sub Basin:** UNT to Beaver Run

**Nearest Surface Water to Receive Runoff:** UNT to Beaver Run

**Chapter 93 - Designated Water Use:** HQ-CWF

**Impaired according to Chapter 303(d) list?** YES   
List Causes of Impairment: NO

***Is Project Subject to, or Part of:***

**Municipal Separate Storm Sewer System (MS4) Requirements** YES   
NO   
**Existing or Planned drinking water supply?** YES   
NO

**If yes, distance from proposed discharge (miles):** \_\_\_\_\_

**Approved Act 167 Plan?** YES   
NO   
**Existing River Conservation Plan?** YES   
NO

**Worksheet 2. Sensitive Natural Resources**

**INSTRUCTIONS:**

1. Provide Sensitive Resources Map according to non-structural BMP 5.4.1 in Chapter 5. This map should identify wetlands, woodlands, natural drainage ways, steep slopes, and other sensitive natural areas.

2. Summarize the existing extent of each sensitive resource in the Existing Sensitive Resources Table (below, using Acres). If none present, insert 0.

3. Summarize Total Protected Area as defined under BMPs in Chapter 5.

4. Do not count any area twice. For example, an area that is both a floodplain and a wetland may only be considered once.

<b>EXISTING NATURAL SENSITIVE RESOURCE</b>	<b>MAPPED? yes/no/n/a</b>	<b>TOTAL AREA (Ac.)</b>	<b>PROTECTED AREA (Ac.)</b>
Waterbodies	yes	0	0
Floodplains	yes	0	0
Riparian Areas	yes	0	0
Wetlands	yes	0	0
Woodlands	yes	0	0
Natural Drainage Ways	no	0	0
Steep Slopes, 15% - 25%	no	0	0
Steep Slopes, over 25%	no	0	0
Other:	n/a	0	0
Other:	n/a	0	0
<b>TOTAL EXISTING:</b>		0	0

Worksheet 3. Nonstructural BMP Credits																		
PROTECTED AREA																		
1.1 Area of Protected Sensitive/Special Value Features (see WS 2)	0	Ac.																
1.2 Area of Riparian Forest Buffer Protection	0	Ac.																
3.1 Area of Minimum Disturbance/Reduced Grading	0	Ac.																
<b>TOTAL</b>	<b>0</b>	<b>Ac.</b>																
<table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;">Site Area</td> <td style="padding: 5px;"><i>minus</i></td> <td style="padding: 5px;">Protected Area</td> <td style="padding: 5px;">=</td> <td style="padding: 5px;">Stormwater Management Area</td> </tr> <tr> <td style="text-align: center; padding: 5px;"><input style="width: 80px;" type="text" value="12.40"/></td> <td style="text-align: center; padding: 5px;">-</td> <td style="text-align: center; padding: 5px;"><input style="width: 80px;" type="text" value="0"/></td> <td style="text-align: center; padding: 5px;">=</td> <td style="text-align: center; padding: 5px;"><input style="width: 150px;" type="text" value="12.40"/></td> </tr> <tr> <td colspan="4"></td> <td style="padding: 5px;"><i>This is the area that requires stormwater management</i> </td> </tr> </table>				Site Area	<i>minus</i>	Protected Area	=	Stormwater Management Area	<input style="width: 80px;" type="text" value="12.40"/>	-	<input style="width: 80px;" type="text" value="0"/>	=	<input style="width: 150px;" type="text" value="12.40"/>					<i>This is the area that requires stormwater management</i>
Site Area	<i>minus</i>	Protected Area	=	Stormwater Management Area														
<input style="width: 80px;" type="text" value="12.40"/>	-	<input style="width: 80px;" type="text" value="0"/>	=	<input style="width: 150px;" type="text" value="12.40"/>														
				<i>This is the area that requires stormwater management</i>														
VOLUME CREDITS																		
<b>3.1 Minimum Soil Compaction</b>																		
Lawn	<input style="width: 80px;" type="text"/> ft <sup>2</sup>	x 1/4" x 1/12	= <input style="width: 80px;" type="text"/> ft <sup>3</sup>															
Meadow	<input style="width: 80px;" type="text"/> ft <sup>2</sup>	x 1/3" x 1/12	= <input style="width: 80px;" type="text"/> ft <sup>3</sup>															
<b>3.3 Protect Existing Trees</b>																		
<i>For Trees within 100 feet of impervious area:</i>																		
Tree Canopy	<input style="width: 80px;" type="text"/> ft <sup>2</sup>	x 1/2" x 1/12	= <input style="width: 80px;" type="text"/> ft <sup>3</sup>															
	<input style="width: 80px;" type="text"/>		<input style="width: 80px;" type="text"/>															
<b>5.1 Disconnect Roof Leaders to Vegetated Areas</b>																		
<i>For runoff directed to areas protected under 5.8.1 and 5.8.2</i>																		
Roof Area	<input style="width: 80px;" type="text"/> ft <sup>2</sup>	x 1/3" x 1/12	= <input style="width: 80px;" type="text"/> ft <sup>3</sup>															
<i>For all other disconnected roof areas</i>																		
Roof Area	<input style="width: 80px;" type="text"/> ft <sup>2</sup>	x 1/4" x 1/12	= <input style="width: 80px;" type="text"/> ft <sup>3</sup>															
<b>5.2 Disconnect Non-Roof impervious to Vegetated Areas</b>																		
<i>For Runoff directed to areas protected under 5.8.1 and 5.8.2</i>																		
Impervious Area	<input style="width: 80px;" type="text"/> ft <sup>2</sup>	x 1/3" x 1/12	= <input style="width: 80px;" type="text"/> ft <sup>3</sup>															
<i>For all other disconnected roof areas</i>																		
Impervious Area	<input style="width: 80px;" type="text"/> ft <sup>2</sup>	x 1/4" x 1/12	= <input style="width: 80px;" type="text"/> ft <sup>3</sup>															
<input style="width: 150px; background-color: #cccccc;" type="text"/>			<input style="width: 60px;" type="text" value="0"/>															
<small>* For use on Worksheet 5</small>																		

**WORKSHEET 4. CHANGE IN RUNOFF VOLUME FOR 2-YR STORM EVENT**

Project: Sunoco - Delmont PPP Station  
 Drainage Area: 34.01 acres (DA A)  
 2-Year Rainfall: 2.30 inches  
 Total Site Area (ac.): 12.40 acres  
 Protected Site Area: N/A acres  
 Managed Site Area: 12.40 acres

<b>Existing Conditions</b>								
Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia	Q	Runoff Volume (cf)
See PondPack Report								
<b>TOTAL:</b>								<b>144,881</b>
<b>Developed Conditions</b>								
Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia	Q	Runoff Volume (cf)
See PondPack Report								
<b>TOTAL:</b>		<b>0</b>						<b>150,979</b>
<b>2-Year Volume Increase (ft<sup>3</sup>):</b>			<b>6,098</b>					

**2-Year Volume Increase = Developed Conditions Runoff Volume - Existing Conditions Runoff Volume**

- Runoff (in) =  $Q = (P - 0.2S) / (P + 0.8S)$  where  
 P = 2-Year Rainfall (in)  
 S =  $(1000/CN) - 10$
- Runoff Volume (CF) =  $Q \times \text{Area} \times 1/12$   
 Q = Runoff (in)  
 Area = Land use area (sq. ft.)

**Note: Runoff Volume must be calculated for EACH land use type/condition and HSGI.  
 The use of a weighted CN value for volume calculations is not acceptable.**

Worksheet 5. Structural BMP Volume Credits

**PROJECT:** Sunoco - Delmont PPP Station  
**SUB-BASIN:** UNT to Beaver Run

<b>Required Control Volume (ft<sup>3</sup>) - from Worksheet 4:</b>	<u>6,098</u>	(DA A)
<b>Non-structural Volume Credit (ft<sup>3</sup>) - from Worksheet 3:</b>	<u>N/A</u>	
<b>Structural Volume Reqmt (ft<sup>3</sup>) (Required Control Volume minus Non-structural Credit)</b>	<u>6,098</u>	

	Proposed BMP	Area (ft <sup>2</sup> )	Storage Volume (ft <sup>3</sup> )
6.4.1	Porous Pavement		
6.4.2	Infiltration Basin		12,937
6.4.3	Infiltration Bed		
6.4.4	Infiltration Trench		
6.4.5	Rain Garden/Bioretention		
6.4.6	Dry Well/Seepage Pit		
6.4.7	Constructed Filter		
6.4.8	Vegetated Swale		
6.4.9	Vegetated Filter Strip		
6.4.10	Berm		
6.5.1	Vegetated Roof		
6.5.2	Capture and Re-Use		
6.6.1	Constructed Wetlands		
6.6.2	Wet Pond/Retention Basin		
6.6.3	Dry Extended Detention Basin		
6.6.4	Water Quality Filters		
6.7.1	Riparian Buffer Restoration		
6.7.2	Landscape Restoration/Reforestation		
6.7.3	Soil Amendment		
6.8.1	Level Spreader		
6.8.2	Special Storage Areas		
<i>Other:</i>			

**Total Structural Volume Provided (ft<sup>3</sup>):** **12,937**

**Structural Volume Requirement (ft<sup>3</sup>):** **6,098**

**DIFFERENCE:** **-6,839**

**WORKSHEET 4. CHANGE IN RUNOFF VOLUME FOR 2-YR STORM EVENT**

Project: Sunoco - Delmont PPP Station  
 Drainage Area: 2.92 acres (DA B)  
 2-Year Rainfall: 2.30 inches  
 Total Site Area (ac.): 12.40 acres  
 Protected Site Area: 0.00 acres  
 Managed Site Area: 12.40 acres

Existing Conditions								
Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia	Q	Runoff Volume (cf)
See PondPack Report								
<b>TOTAL:</b>								<b>10,237</b>
Developed Conditions								
Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia	Q	Runoff Volume (cf)
See PondPack Report								
<b>TOTAL:</b>		<b>0</b>						<b>11,151</b>
<b>2-Year Volume Increase (ft<sup>3</sup>):</b>			<b>914</b>					

**2-Year Volume Increase = Developed Conditions Runoff Volume - Existing Conditions Runoff Volume**

- Runoff (in) =  $Q = (P - 0.2S) / (P + 0.8S)$  where  
 P = 2-Year Rainfall (in)  
 S =  $(1000/CN) - 10$
- Runoff Volume (CF) =  $Q \times \text{Area} \times 1/12$   
 Q = Runoff (in)  
 Area = Land use area (sq. ft.)

**Note: Runoff Volume must be calculated for EACH land use type/condition and HSGI.  
 The use of a weighted CN value for volume calculations is not acceptable.**

Worksheet 5. Structural BMP Volume Credits

**PROJECT:** Sunoco - Delmont PPP Station  
**SUB-BASIN:** UNT to Beaver Run

**Required Control Volume (ft<sup>3</sup>) - from Worksheet 4:** 914 (DA B)  
**Non-structural Volume Credit (ft<sup>3</sup>) - from Worksheet 3:** 0  
**Structural Volume Reqmt (ft<sup>3</sup>)** 914  
*(Required Control Volume minus Non-structural Credit)*

Proposed BMP	Area (ft <sup>2</sup> )	Storage Volume (ft <sup>3</sup> )
6.4.1 Porous Pavement		
6.4.2 Infiltration Basin		
6.4.3 Infiltration Bed		
6.4.4 Infiltration Trench		
6.4.5 Rain Garden/Bioretention		
6.4.6 Dry Well/Seepage Pit		
6.4.7 Constructed Filter		3,136
6.4.8 Vegetated Swale		
6.4.9 Vegetated Filter Strip		
6.4.10 Berm		
6.5.1 Vegetated Roof		
6.5.2 Capture and Re-Use		
6.6.1 Constructed Wetlands		
6.6.2 Wet Pond/Retention Basin		
6.6.3 Dry Extended Detention Basin		
6.6.4 Water Quality Filters		
6.7.1 Riparian Buffer Restoration		
6.7.2 Landscape Restoration/Reforestation		
6.7.3 Soil Amendment		
6.8.1 Level Spreader		
6.8.2 Special Storage Areas		
<i>Other:</i>		
<b>Total Structural Volume Provided (ft<sup>3</sup>):</b>		<b>3,136</b>
<b>Structural Volume Requirement (ft<sup>3</sup>):</b>		<b>914</b>
<b>DIFFERENCE:</b>		<b>-2,222</b>

**WORKSHEET 4. CHANGE IN RUNOFF VOLUME FOR 2-YR STORM EVENT**

Project: Sunoco - Delmont PPP Station  
 Drainage Area: 1.64 acres (DA C)  
 2-Year Rainfall: 2.30 inches  
 Total Site Area (ac.): 12.40 acres  
 Protected Site Area: 0.00 acres  
 Managed Site Area: 12.40 acres

Existing Conditions								
Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia	Q	Runoff Volume (cf)
See PondPack Report								
<b>TOTAL:</b>								<b>4,661</b>
Developed Conditions								
Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia	Q	Runoff Volume (cf)
See PondPack Report								
<b>TOTAL:</b>		<b>0</b>						<b>6,795</b>
<b>2-Year Volume Increase (ft<sup>3</sup>):</b>			<b>2,134</b>					

**2-Year Volume Increase = Developed Conditions Runoff Volume - Existing Conditions Runoff Volume**

- Runoff (in) =  $Q = (P - 0.2S) / (P + 0.8S)$  where  
 P = 2-Year Rainfall (in)  
 S =  $(1000/CN) - 10$
- Runoff Volume (CF) =  $Q \times \text{Area} \times 1/12$   
 Q = Runoff (in)  
 Area = Land use area (sq. ft.)

**Note: Runoff Volume must be calculated for EACH land use type/condition and HSGI.  
 The use of a weighted CN value for volume calculations is not acceptable.**

Worksheet 5. Structural BMP Volume Credits

**PROJECT:** Sunoco - Delmont PPP Station  
**SUB-BASIN:** UNT to Beaver Run

<b>Required Control Volume (ft<sup>3</sup>) - from Worksheet 4:</b>	2,134	(DA C)
<b>Non-structural Volume Credit (ft<sup>3</sup>) - from Worksheet 3:</b>	0	
<b>Structural Volume Reqmt (ft<sup>3</sup>)</b> <i>(Required Control Volume minus Non-structural Credit)</i>	2,134	

	Proposed BMP	Area (ft <sup>2</sup> )	Storage Volume (ft <sup>3</sup> )
6.4.1	Porous Pavement		
6.4.2	Infiltration Basin		2,396
6.4.3	Infiltration Bed		
6.4.4	Infiltration Trench		
6.4.5	Rain Garden/Bioretention		
6.4.6	Dry Well/Seepage Pit		
6.4.7	Constructed Filter		
6.4.8	Vegetated Swale		
6.4.9	Vegetated Filter Strip		
6.4.10	Berm		
6.5.1	Vegetated Roof		
6.5.2	Capture and Re-Use		
6.6.1	Constructed Wetlands		
6.6.2	Wet Pond/Retention Basin		
6.6.3	Dry Extended Detention Basin		
6.6.4	Water Quality Filters		
6.7.1	Riparian Buffer Restoration		
6.7.2	Landscape Restoration/Reforestation		
6.7.3	Soil Amendment		
6.8.1	Level Spreader		
6.8.2	Special Storage Areas		
<i>Other:</i>			

<b>Total Structural Volume Provided (ft<sup>3</sup>):</b>	<b>2,396</b>
<b>Structural Volume Requirement (ft<sup>3</sup>):</b>	<b>2,134</b>
<b>DIFFERENCE:</b>	<b>-262</b>

## WORKSHEET 10. WATER QUALITY COMPLIANCE FOR NITRATE

*Does the site design incorporate the following BMPs to address nitrate pollution? A summary "yes" rating is achieved if at least 2 Primary BMPs for nitrate are provided across the site or 4 secondary BMPs for nitrate are provided across the site (or the*

**PRIMARY BMPs FOR NITRATE:**

	YES	NO
NS BMP 5.4.2 - Protect / Conserve / Enhance Riparian Buffers	<input type="checkbox"/>	<input checked="" type="checkbox"/>
NS BMP 5.5.4 - Cluster Uses at Each Site	<input type="checkbox"/>	<input checked="" type="checkbox"/>
NS BMP 5.6.1 - Minimize Total Disturbed Area	<input checked="" type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.6.3 - Re-Vegetate / Re-Forest Disturbed Areas (Native Species)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
NS BMP 5.9.1 - Street Sweeping / Vacuuming	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Structural BMP 6.7.1 - Riparian Buffer Restoration	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Structural BMP 6.7.2 - Landscape Restoration	<input checked="" type="checkbox"/>	<input type="checkbox"/>

**SECONDARY BMPs FOR NITRATE:**

NS BMP 5.4.1 - Protect Sensitive / Special Value Features	<input type="checkbox"/>	<input checked="" type="checkbox"/>
NS BMP 5.4.3 - Protect / Utilize Natural Drainage Features	<input checked="" type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.6.2 - Minimize Soil Compaction	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Structural BMP 6.4.5 - Rain Garden / Bioretention	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Structural BMP 6.4.8 - Vegetated Swale	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Structural BMP 6.4.9 - Vegetated Filter Strip	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Structural BMP 6.6.1 - Constructed Wetland	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Structural BMP 6.7.1 - Riparian Buffer Restoration	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Structural BMP 6.7.2 - Landscape Restoration	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.7.3 - Soils Amendment/Restoration	<input type="checkbox"/>	<input checked="" type="checkbox"/>

**Stormwater BMP Information Chart 5.B revised March 15, 2016**

Proposed Infiltration BMP(s) (site specific)	Infiltration Information					Drainage Information						BMP Information					
	Measured Infiltration Rate <sup>9</sup>	Factor of Safety	Design Infiltration Rate	Dewatering Time <sup>1</sup>	Elevation of Limiting Zone - Water Table, Bedrock, etc. <sup>2</sup>	Total Drainage Area to BMP	Total Impervious Drainage Area to BMP	Infiltration BMP Surface Area	Total Drainage Area Loading Ratio <sup>6</sup>	Impervious Area Loading Ratio <sup>7</sup>	Volume of Runoff Tributary to BMP During the 2yr/24hr Design Storm <sup>5</sup>	Calculated Infiltration Volume (from storms up to and including 2yr/24hr)	Calculated Managed Volume (from storms up to and including 2yr/24hr) <sup>8</sup>	Maximum water surface elevation in BMP from 2yr storm <sup>3</sup>	Infiltration Elevation Bottom of Bed/ Basin <sup>3</sup>	Elevation of Infiltration Test <sup>4</sup>	Elevation of E&S Sediment Basin Bottom (if applies)
	<i>in./hr.</i>	<i>Min. of 2</i>	<i>in./hr.</i>	<i>hrs.</i>		<i>sq. ft.</i>	<i>sq. ft.</i>	<i>sq. ft.</i>			<i>cf</i>	<i>cf</i>	<i>cf</i>				
BMP 6.4.1 Pervious Pvmnt w. Infiltr. Bed																	
BMP 6.4.2 Infiltration Basin BMP-2 BMP-4	14.20 0.00	2 1*	14.2 0*	2.12 N/A*	none none	133,206 31,450	65,165 6,011	8407 1742	16* 18*	8* 3	12,937.0 2,831.0	12,937 2,396	0 0	1206.5* 1234.0	1,204.0 1,232.0	1,202 1,233	N/A N/A
BMP 6.4.3 Subsurface Infiltration Bed																	
BMP 6.4.4 Infiltration Trench																	
BMP 6.4.5 Rain Garden/Bioretenion																	
BMP 6.4.6 Dry Well / Seepage Pit																	
Other																	
BMP 6.4.7 Constructed Filter (BMP-3)	0.12	1*	0.12*	72	none	48,090	23,087	4000	12*	6*	5,619.0	3,136	0	1234.6	1,233.0	1,232	N/A
BMP 6.4.8 Vegetated Swale																	
BMP 6.4.9 Vegetated Filter Strip																	
BMP 6.4.10 Infiltr. Berm & Ret. Grading																	

All information to be based on the 2-year/24-hour storm  
Provide page numbers from the stormwater narrative identifying the location of the above information.

- <sup>1</sup> Can include active infiltration time - dewatering time should not exceed 72 hours after the 2-year/24-hour storm
- <sup>2</sup> Depth to limiting zone is recommended to be at least 2 ft below infiltration testing elevation/proposed infiltration elevation.
- <sup>3</sup> A maximum of 2 feet of Hydraulic head is recommended.
- <sup>4</sup> Provide supporting field notes/documentation from soil evaluation.
- <sup>5</sup> This value should be greater than or equal to the Volume to be Infiltrated or Managed by the BMP.
- <sup>6</sup> A maximum of 8:1 is recommended.
- <sup>7</sup> A maximum of 5:1 is recommended; however, in carbonate geology areas, a maximum of 3:1 is recommended.
- <sup>8</sup> Calculated runoff volume that is managed in ways other than infiltration to address 25 PA Code Ch 102.8(g)(2)
- <sup>9</sup> The infiltration testing information should be located on the plan view of the PCSM Plan and should include infiltration test elevation and rate.

**Any deviations from the recommendations above should be adequately justified by a qualified professional and included with the application.**

**NOTE: This chart is for summary purposes only and should be consistent with all design calculations and worksheets.**

**\* Notes:**  
 1. Earlier infiltration testing at IT-6 and IT-7, near BMP-3 and BMP-4, indicated poor infiltration. Only one test point was taken within each BMP that confirmed the poor rate. BMP-3 and BMP-4 were both designed to be over-excavated and filled in the bottom with porous soil amendments to improve infiltration.  
 2. The total area and impervious area loading ratios are slightly higher than recommended. A maintenance agreement will be established to ensure proper BMP repairs in the event of sedimentation.  
 3. The hydraulic head is 0.5 feet over the recommended value. This is not a significant deviation and is not expected to affect BMP performance.

## **APPENDIX G – STORMWATER MANAGEMENT PLANS**

**SEE FULL SIZE DRAWINGS**