March 24, 2020

Christopher Smith, P.E.
Chief, Construction Permits Section
Waterways and Wetlands
PADEP Southeast Region
2 East Main Street
Norristown, PA 19401

RE: Technical Deficiency Letter
Erosion and Sediment Control General Permit (ESCGP)
Permit Application No. ESG 01 00 19 001
JMT Job No. 18-00672-001

Dear Mr. Smith:

Johnson, Mirmiran & Thompson (JMT) is pleased to submit the Comment Resolution Summary letter in response to the Technical Deficiency Letter – Erosion and Sediment Control General Permit (ESCGP) for Adelphia Gateway Project – Phase 1, dated February 25, 2020. Please note, due to the COVID-19 pandemic and the statewide restrictions on non-life sustaining businesses this submission is being issued electronically. Based on our coordination, each county conservation district and the DEP Regional office will receive electronic copies of the specific plan sheets and sections of the reports based on the comment response for the respective districts. Once the restrictions are lifted and normal business operations are resumed, JMT will issue the hard copies and CD-ROMs required as part of this submission to all the appropriate offices.

The resubmission includes the following revised documents:

- Notice of Intent for ESCGP-3 (2 copies, 1 copy with highlighted revisions)
- Adelphia Gateway Project, Erosion and Sediment Control Plan and Post Construction Stormwater Management Plan (2 copies, 1 copy with highlighted revisions)
- Erosion and Sediment Control Report (2 copies, 1 copy with highlighted revisions)
- Post Construction Stormwater Report (2 copies, 1 copy with highlighted revisions)
- CD of all Submission Documents (2 copies)

The following are our responses to comments:

**<u>Technical Deficiencies from BCCD:</u>**

1. **BCCD Comment (2/25/20):** Please include the placement of timber mats and protective fencing around wetland areas on the construction sequence and drawing plans. BCCD recommends all areas where the limit of disturbance line sits next to wetlands have protective fencing installed. [Section 102.11(a)(1)]

   **JMT Response (3/24/20):** *The construction sequence on ES-5 was updated to include the placement of timber mats and protective fence (refer to Note 4). Protective fencing was added at all areas in which the limit of disturbance sits next to the wetlands and can be shown on the E&S Plans.*

2. **BCCD Comment (2/25/20):** Please include only Antidegradation Best Available Combination of Technologies (ABACT) E&S BMPs to prevent additional sedimentation impairment to siltation impaired waters. [Section 102.11(a)(1)]

**JMT Response (3/24/20):** *ABACT E&S BMPs used as follows: rock construction entrance with wash rack, compost filter sock, erosion and control matting was added within 50 ft of the wetlands, a note was added to the construction sequence to immediately stabilize disturbed areas upon completion or temporary cessation of earth disturbance activity.*

**Technical Deficiencies from CCCD:**

1. **CCCD Comment (2/25/20):** Please utilize a minimum of 24" Filter Sock adjacent to streams and wetlands. [Section 102.4(C)]

   **JMT Response (3/24/20):** *Filter sock revised to 24" adjacent to streams and wetlands. This is applicable to Schuylkill River Blowdown, Paoli Pike Blowdown, Chester Creek Blowdown.*

2. **CCCD Comment (2/25/20):** Please provide a blow up of the stream/ wetland crossing to the Schuylkill River Blowdown on the plan mapping and illustrate the proposed E&S controls for bypassing the stream flow both on the regular mapping and within the blow-up insert. [Section 102.11(a)(1)]

   **JMT Response (3/24/20):** *There are 2 crossings along the Schuylkill River Blowdown, this is along the easement of the gas line. As requested, blow-up inserts for each crossing have been added to sheet ES-19. The temporary crossing details and notes are provided through details on ES-9.*

3. **CCCD Comment (2/25/20):** There are long runs of mat access roads that cross what appear to be steeper slopes. The LOD is shown as the width of the mats indicating that the mats and disturbance will be limited to that width. The designers should evaluate whether the contractor will be able to traverse the mats if they are placed at existing grades or if grading or other methods will be needed to place the mats to allow for construction equipment and material deliveries. [Section 102.11(a)(1)]

   **JMT Response (3/24/20):** *JMT has reviewed the intended travel path with HGA, mechanical designers, for constructability. The review focused on confirming the width and maximum slopes that the purposed construction equipment could traverse. HGA concurred that the pathways width and grades are appropriate, they also indicated that it would be beneficial to include turnaround locations along the French Creek Blowdown access path. The design plans reflect these revisions, see Sheet ES-16 and ES-17.*

4. **CCCD Comment (2/25/20):** The site restoration plans should address de-compaction of the work area especially in areas of the mat placement. [Section 102.11(a)(2)]

   **JMT Response (3/24/20):** *A note to decompact subgrade of disturbed areas to a depth of 12 inches was included in the construction sequence for all main line valve sites on ES-4 and ES-5. In addition, additional language was added to the Site Restoration Schedule found on ES-6.*

**Technical Deficiencies from DCCD:**
*All comments from DCCD refer to regulatory citation of Chapter 102.11(a)(1)*

**Marcus Hook Compressor Station:**

1. **DCCD Comment (2/25/20):** L.O.D. expanded to impact two existing drainage swales and storm sewer outfalls. No erosion control provided, no swale designs and calculations for reinstallation and stabilization.

   **JMT Response (3/24/20):** *The limit of disturbance (LOD) and construction activities were re-evaluated and earth disturbance will not take place within the two existing swales and storm sewer outfalls. The LOD was revised to exclude this area.*

2. **DCCD Comment (2/25/20):** An 18" F.S. placed across one stormwater outfall, and also to a disturbed area which is unacceptable for erosion and sediment control. Swales and disturbed area along New Castle County, DE, border no sediment control provided.

   **JMT Response (3/24/20):** *The limit of disturbance (LOD) and construction activities were re-evaluated, and earth disturbance will not take place within the two existing swales and storm sewer outfalls. The 18" filter sock was revised to protect the perimeter of the LOD.*

3. **DCCD Comment (2/25/20):** Sequence of Construction Item 5 - install the MRC during final stages of site construction, but the only step before this item is the installation of compost filter sock.

   **JMT Response (3/24/20):** *The construction sequence was revised to include further details on the construction detailing, see ES-4.*

4. **DCCD Comment (2/25/20):** No erosion and sediment control provided for the construction of the MRC to prevent disturbed areas from draining to the facility or to temporary protect the outlet structure top of grate until facility is stabilized. This is an upslope diversion, so why two different linings?

   **JMT Response (3/24/20):** *The erosion and sediment control plans have been revised to include a compost filter sock sediment trap at the southern end of the site prior to construction of the MRC basin. In addition, perimeter measures have been included to limit sediment laden runoff from reaching surface waters. Please note that erosion and sediment control blanketing in proposed for the basin embankments, the basin also has a vegetated hatch to represent the final condition, there is only one lining proposed.*

5. **DCCD Comment (2/25/20):** The plan does not label this endwall at the MRC, and it could not be determined whether or not a design detail and calculations have been prepared for the rock rip apron illustrated.

   **JMT Response (3/24/20):** *The endwall at this location is identified as M-1, calculations have been prepared for the rock apron (M-1) and can found in the PCSM report Appendix D.2 and E&S Report, Appendix C. Revisions were made to the design plans and calculations to ensure that rock apron M-1 is consistently labeled throughout.*

**Transco Meter Station:**

1. **DCCD Comment (2/25/20):** Compost Filter Sock No. 4 is not placed on the contour.

   **JMT Response (3/24/20):** *Compost filter sock segments was revised to run parallel to the contours.*

2. **DCCD Comment (2/25/20):** Rock lined Channel No. 2 and riprap apron from storm-tank infiltration system does not discharge to a surface water. Please provide a discharge analysis that meets the standard Item 15 on page 161 and Items 1—3 of page 439 of the E&SPC Manual.

   **JMT Response (3/24/20):** *The PCSM and E&S Narratives were updated to include an off-site discharge analysis for the existing swales at Marcus Hook and Transco, see PCSM Appendix D.3.*

3. **DCCD Comment (2/25/20):** ES-9 list CH-2 design detail as temporary, then temporary lining of SC150, and then permanent lining as R-3. Also, the table points to detail and stating temporary geotextile lining — it should read just geotextile lining. Finally, it has a column T (FT) 0.25. If it is a representative of t or rock lining placement thickness, it should be 9 inches. It would also be preferred if the table would also list location. Freeboard must be a minimum of 0.5 feet calculations state 0.25 feet.

   **JMT Response (3/24/20):** *The stormwater diversion channel table on ES-9 was revised to note the*

*geotextile lining and rock linings. Column T was revised to 9 inches and a location column was added to the table. Within the calculations in Appendix D.2, a minimum freeboard of 0.5 ft is noted.*

4. **DCCD Comment (2/25/20):** Detail for rock filter/check dam are all listed as used in Quakertown. Where is the detail for rock filters used at Marcus Hook?

   **JMT Response (3/24/20):** *The rock filter/check dam detail on ES-9 was revised to include two rock filters at Marcus Hook.*

**ABACT Controls:**

1. **DCCD Comment (2/25/20):** The two smaller sites, Chester Creek Blow-Down and Mainline Valve 1, are impaired for Siltation. They both use Compost Filter Sock. But they would both be deficient because they do not call for the use of an ABACT for Construction Access.

   **JMT Response (3/24/20):** *Rock construction entrances with wash rack are now proposed at Chester Creek Blowdown and Mainline Valve 1 sites. Refer to ES-12 and ES-13.*

**<u>Technical Deficiencies from MCCD:</u>**

**Existing topographic features of the project site and the immediate surrounding area. [Section 102.4(b)(5)(i)]**

1. **MCCD Comment (2/25/20):** The 100-year floodway boundary should be shown on the plan drawings. Please note that in the absence of a FEMA delineated floodway, the floodway is assumed to be 50' from the top of each bank. Any disturbance within the floodway would be a water encroachment and would require permitting as it is considered part of the stream. Please verify for the stream crossing area located on sheet ES-21.

   **JMT Response (3/24/20):** *The stream crossing was removed from the design plan ES-21 as it is not a verified waterway, but a pipe that drains to the wetlands. No other streams are located within the vicinity of the project sites for East Perkiomen Blowdown, Skippack Pike Valve Tap and Perkiomen Creek Blowdown.*

2. **MCCD Comment (2/25/20):** Please verify the existing contours for the project areas. For example, sheet ES-21 does not appear to be consistent with the current site conditions.

   **JMT Response (3/24/20):** *Revised survey is provided for Perkiomen Creek Blowdown, Skippack Pike Valve Tap and East Perkiomen Blowdown sites.*

3. **MCCD Comment (2/25/20):** Sufficient surrounding areas should be shown on the plan map(s) to identify tributary drainage areas and receiving watercourses. Where these features are beyond the coverage of the plan maps, they may be identified on the location map(s) (page 398 of the E&S Manual). [Section 102.11(a)(1)] Please provide for ES-22.

   **JMT Response (3/24/20):** *The Location Maps have been revised to identify the tributary drainage area and the receiving watercourses since these features extend beyond the plan viewport.*

4. **MCCD Comment (2/25/20):** A location map that conforms to the standards on page 397 of the E&S Manual should be provided. Please verify the location callouts on the location map. The site area appears to be inconsistent with the plan drawing areas.

   **JMT Response (3/24/20):** *The location maps have been updated to conform to the standards on page 397 of the E&S Manual. The location map shows major highways and the USGS quadrangle is noted. The site locations have been confirmed and adjusted accordingly.*

**Location of all surface waters and their classification under Chapter 93. [Section 102.4(b)(5)(v)]**

1. **MCCD Comment (2/25/20):** All existing surface waters (streams, wetlands, ponds, etc.) should be shown on the plan map(s) as described in Item 5 of pages 3 and 4 and on page 398 of the E&S Manual. [Section 102.11(a)(1)] Please verify for sheet ES-21.

   **JMT Response (3/24/20):** *Based on survey revisions, it was verified that at the stream crossing originally presented on ES-21 is not a stream. A pipe culvert is proposed to convey the drainage from the outlet pipe/riprap apron under the rock construction entrance. Detailing this pipe culvert can be shown on the rock construction entrance detail on ES-8.*

**Sequence of BMP installation and removal. [Section 102.4(b)(5)(vii)]**

1. **MCCD Comment (2/25/20):** Please verify when the stream crossing gets installed for the Perkiomen Creek blowdown area.

   **JMT Response (3/24/20):** *A note for the temporary stream crossing has been added to the Construction Sequence for Perkiomen Creek Blowdown on ES-5.*

2. **MCCD Comment (2/25/20):** The rock construction entrance should be installed prior to the wood matting installation. Please revise.

   **JMT Response (3/24/20):** *The construction sequence was revised to note the rock construction entrance was installed prior to the wood matting. This is applicable for Perkiomen Creek Blowdown and Skippack Pike Valve Tap sites.*

**Plan Drawings. [Section 102.4(b)(5)(ix)]**

1. **MCCD Comment (2/25/20):** Please verify if ABACT BMPs are required for this project. On narrative page 17, it mentions the need for ABACT controls, but the plan drawings did not show all ABACT BMPs.

   **JMT Response (3/24/20):** *Rock construction entrances with wash rack are now proposed as an ABACT control for construction access.*

**Inlets/Inlet Protection**

1. **MCCD Comment (2/25/20):** Please provide the drainage areas to the proposed inlet protection on sheet ES-22.

**JMT Response (3/24/20):** *As requested, inlet drainage area plans to the proposed inlet protection is provided in the E&S narrative, Appendix C*

**Silt Fence / Compost Socks**

1. **MCCD Comment (2/25/20):** The ends of the proposed compost socks should point sufficiently upslope to create adequate pooling of runoff for the settling of sediment and to prevent end-around flows. For example, 18" socks should be pointed upslope at least 18"—24" upslope in elevation difference to ensure that end- around flows are avoided. Per the E&S Manual, pages 61 and 62, “The ends of sediment barriers should be turned upslope at 45 degrees to the main barrier alignment Ion a distance sufficient to elevate the bottom of the barrier ends to the elevation of the top of the barrier at the lowest point. This is to prevent runoff from flowing around the barrier rather than through it. As with other sediment barriers, filter socks should be placed parallel to contour with both ends of the sock extended upslope at a 45-degree angle to the rest of the sock to prevent end-abounds.”

   **JMT Response (3/24/20):** *The ends of the proposed compost filter sock have been revised to point sufficiently upstream to allow for settling of sediment and to prevent end-around flows.*

2. **MCCD Comment (2/25/20):** It appears that the maximum slope length has been exceeded for several sections of silt fence. Was not able to verify slope lengths for compost sock located on sheet ES-22 due to insufficient upslope contours. Please revise.

   **JMT Response (3/24/20):**. *The calculations and sizing of compost filter sock have been revised to ensure that the maximum slope lengths does not exceed the compost filter sock sizing noted. The calculations have been provided in the Erosion and Sediment Control Narrative, Appendix C.*

3. **MCCD Comment (2/25/20):** Silt fence should be shown exactly parallel to existing contours. Maximum deviation from level grade should be 1 percent, and not extend for more than 25 ft.

   **JMT Response (3/24/20):** *Compost filter sock is shown parallel to the existing contours to the maximum extent possible given the small limit of disturbance and the requirement to stay within the project easement.*

4. **MCCD Comment (2/25/20):** Areas of compost sock on sheet ES-21 appeared to be located under the wood matting.

   **JMT Response (3/24/20):** *The compost filter sock on ES-21 has been adjusted so that it is not located under the timber matting.*

5. **MCCD Comment (2/25/20):** Multiple sections of compost sock appear to be discharging onto disturbed areas. Please revise.

   **JMT Response (3/24/20):** *The compost filter sock on ES-21 has been adjusted so that it is not located under the timber matting.*

6. **MCCD Comment (2/25/20):** Compost sock/silt fence should not be shown within areas of proposed grading/disturbance.

**JMT Response (3/24/20):** *Compost filter sock has been revised to the outer edge of the limit of disturbance boundary, however in some cases, could not be shown fully beyond the limit of disturbance in efforts to stay within the project's easement boundary.*

**Stabilization / Erosion Control Blanket (ECB) / Turf Reinforcement Matting**

1. **MCCD Comment (2/25/20):** Was not able to locate temporary stabilization specifications. Please revise.

   **JMT Response (3/24/20):** *A temporary seeding schedule has been added to ES-6.*

2. **MCCD Comment (2/25/20):** Erosion control blanketing (ECB) should be placed on all disturbance within 50' of streams and wetlands. This, and other stabilization standards are located in pages 260-265 in the E&S Manual. Please show the extent of all ECB on the plan drawings as shading, cross-hatching, or by some other similar manner.

   **JMT Response (3/24/20):** *Erosion control blanketing has been added to all disturbed areas within 50' of all streams and wetlands.*

**Potential thermal impacts to surface waters. [Section 102.4(b)(5)(xiii)]**

1. **MCCD Comment (2/25/20):** How potential thermal impacts upon receiving waters have been avoided and/or minimized by the plan design should be described (page 6 of the E&S Manual). [Section 102.11(a)(1)] Please provide for the E&S stage of construction.

   **JMT Response (3/24/20):** *At the main line valve sites, thermal impacts will be minimized by site restoration activities. The disturbed areas will be restored and seeded as soon as practicable and /or directing runoff to vegetated areas to reduce the temperature of runoff prior to discharge into the streams. The site restoration construction sequence and site restoration schedule on ES-6 state how the disturbed areas are to be restored to existing conditions, which in turn, will minimize thermal impacts to surface waters.*

**Overall Miscellaneous**

1. **MCCD Comment (2/25/20):** Please note that a resubmission fee is necessary. Please refer to the MCCD E&S Plan Review Application for further information.

   **JMT Response (3/24/20):** *A resubmission fee of $227.50 (50% of original submission fee) is included.*

2. **MCCD Comment (2/25/20):** Please take note that MCCD will not accept "piecemeal" plan revisions. All revisions must be submitted as part of a complete application package unless specifically otherwise agreed and allowed by the reviewer. Additionally, "piecemeal" applications could lead to the project being withdrawn if the complete set is not submitted by the due date.

   **JMT Response (3/24/20):** *Noted.*

**Technical Deficiencies from DEP:**

1. **DEP Comment (2/25/20):** For each Managed Release Concept (MRC) Best Management Practices (BMP) proposed for the above-referenced project, the professional engineer should document and demonstrate that the specific MRC BMP design addresses each and all of the 13 MRC design standards listed in the MRC document dated May 15, 2019 (the design standards start on page 4 of the MRC document), in narrative form with cross references to the specific location in the Post Construction Stormwater Management (PCSM) report. We have attached a courtesy template for the applicant's use to address the 13 MRC design standards. For each number or justification used to demonstrate that the design addresses the 13 design standards, the engineer will need to provide a specific page number in their PCSM report that reflects that number or justification. We need this information to verify that the numbers or justification are correct as modeled or calculated. Also, all hydrographs need to include the supporting and input data for hydrology and hydraulics associated with the hydrograph. Please make sure to include or account for any basin bypass areas in the design standards. This documentation/ demonstration should be provided in the respective section or appendix of the PCSM Report for each MRC BMP. [25 Pa. Code § 102.11(b))]

   **JMT Response (3/24/20):** *A courtesy template has been submitted to document and demonstrate that the specific MRC BMP design addresses each and all of the 13 MRC design standards listed in the MRC document dated May 15, 2019 (the design standards start on page 4 of the MRC document), in narrative form with cross references to the specific location in the Post Construction Stormwater Management (PCSM) report. This is attached to this letter, and also included in Appendix D.2, Supporting Calculations, for Quakertown and Marcus Hook Compressor Stations.*

2. **DEP Comment (2/25/20):** Please demonstrate in the applicant's response letter, the PSCM Narrative, and the PCSM Plan Drawings how the permittee and/or co-permittee will address all of the components of Title 25 Pa. Code § 102.8(n) for the restoration activities of the proposed earth disturbance activities for the areas to be restored as part of this ESCGP-3 permit application. Please note that the Site Restoration Schedule, that is located in the E&S Plan drawing set (General Notes Sheet 6 of 7), should also be located in the PCSM Plan drawing set since it is a PCSM BMP with Long-Term Operation and Maintenance requirements. (25 Pa. Code § 102.8(n)]

   **JMT Response (3/24/20):** *To best demonstrate how the applicant is to meet Title 25 Pa. Code § 102.8(n) to describe the project scope. There are 13 sites included with this permit application, 3-meter stations and 10 valve sites. This is comprised of 3 new valve sites and replacement of 7 existing valve sites.*

   *The meter stations (Marcus Hook, Transco, and Quakertown) proposes new buildings and paved areas. These sites provide stormwater management practice on each site to manage the increased volume runoff due to the revised land cover. These sites have been designed in accordance with DEP requirements for water quality, volume control, and rate control. The PCSM narrative has the complete analysis, infiltration testing results, and hydrologic modeling data for review. In addition, the PCSM design plans provide design details for the construction of the proposed BMP's on each site. Both the plans and narrative identify the long-term operation and maintenance requirements associated with these facilities. Finally, the applicant is abundantly aware of their long-term responsibilities as the selection of the BMP was discussed in great detail to ensure that the long term commitment was acceptable to the applicant.*

   *The valve sites have no change in land cover from existing conditions and the applicant is to restore the disturbed areas to match the existing land cover and drainage patterns. The scope of work for each site is to access the valve site, replace the valve and segments of pipeline, backfill the excavated areas,*

*place fencing, regrade the disturbed areas to maintain the existing drainage patterns, and restore the land cover (gravel or vegetation). The land cover on these existing valve sites is gravel with is to be replaced (in kind) and new sites will be restored to vegetated conditions. These sites have no increase in impervious land cover and it is not anticipated to negatively impact the watersheds drainage area. This is further defined on the PCSM and E&S plan notes in the "Site Restoration Schedule", PCSM 3 and E&S 6.*

*The design has given consideration on how to (1) preserve the integrity of stream channels and maintain and protect the physical, biological and chemical qualities of the receiving stream, (2) prevent an increase in the rate of stormwater runoff, (3) minimize any increase in stormwater runoff volume, (4) minimize impervious areas, (5) maximize the protection of existing drainage features and existing vegetation, (6) minimize land clearing and grading (7) minimize soil compaction, and (8) utilize other structural or nonstructural BMPs that prevent or minimize changes in stormwater runoff. The E&S and PCSM narratives and plans provide for ABACT control measures in special watersheds, structural stormwater management facilities on site with increased impervious land cover, maintaining tight workspaces to limit disturbance, and limiting impervious cover where feasible. Additional language has been added to the PCSM Narrative, Section V, to describe how the site restoration activities will satisfy the requirement set forth in Chapter 102.*

3. **DEP Comment (2/25/20):** In Section VI of the PCSM Report, it is mentioned that a Phase 1 Environmental Assessment was performed at the Marcus Hook Compressor Station site and at the Quakertown Compressor Station site. There is no mention of a Phase 1 Environmental Assessment for any other sites in this section of the report. Please amend Section VI of the PCSM Report to include any and all environmental due diligence that was performed for the other sites of proposed earth disturbance activities to be covered under this ESCGP-3 permit.

   **JMT Response (3/24/20):** *Phase 1 Environmental Assessments were completed for sites that was acquired, all environmental due diligence for these sites are included in previous submissions. Phase 1 Environmental Assessments were completed only at the Marcus Hook Compressor Station site and at the Quakertown Compressor Station site, only.*

4. **DEP Comment (2/25/20):** Please provide a recommendation from the applicant's environmental consultant that any known remaining contaminated soils (soils exceeding the PADEP's Statewide health standard) found during the applicant's environmental due diligence will be adequately managed with Best Management Practices (BMPs) along with adequate justification for the areas of the proposed earth disturbance activities. The adequate justification should include the regulated substance(s) chemical name, location (vertical and horizontal), and concentration found during the applicant's environmental due diligence, and the mobility and leachability potential of the regulated substances when exposed from earth disturbance activities during rain and other precipitation events. Any and all Best Management Practices (BMPs) that are recommended by the applicant's environmental consultant should be added to the E&S Plan Drawings. [BMP Manual Chapter 17]

   **JMT Response (3/24/20):** *Based on Adelphia's due diligence, no known contaminated soils would be crossed by construction of the Project. Should contaminated soils (soils exceeding the PADEP's Statewide health standard) be identified, NV5, LLC (NV5), as Adelphia's environmental consultant, recommends that Adelphia manage the soils in accordance with the Project's Unanticipated Discovery of Contamination, which will be provided to the DEP prior to construction.*

5. **DEP Comment (2/25/20):** Please add the following notes to both the E&S Plan Drawing set and the PCSM Plan Drawing set in regards to Clean Fill and Site Contamination [25 Pa. Code § 93, 25 Pa. Code § 250, and 25 Pa. Code § 271]:
    a. With the exception of sites enrolled in DEP's Land Recycling and Environmental Remediation Standards (Act 2) program, all fill material excavated and used on-site, imported to the site, and exported from the site, must meet the definition of clean fill, as defined as "Uncontaminated, non- water soluble, nondecomposable inert solid materials. The term does not include materials placed in or on waters of the Commonwealth unless otherwise authorized." Regulated fill may only be used on Act 2 sites, in accordance with standards established by that program.
    b. The permittee shall conduct environmental due diligence to verify that fill excavated on-site that is used to establish final grade, fill imported to the project site, and fill exported from the project site is considered clean fill, as defined as "Uncontaminated, nonwater soluble, nondecomposable inert solid material. The term does not include materials placed in or on waters of the Commonwealth unless otherwise authorized." If due diligence results in evidence of a release, as defined in DEP's Management of Fill Policy (285- 2182-773), that has affected the fill material, the permittee shall test the material to determine whether the material qualifies as clean fill, and Form FP- 001 (Certification of Clean Fill) must be completed, retained by the permittee or the property owner on-site, and be made available to DEP/CCD upon request.
    c. In the event that fill excavated on-site that is used to establish final grade, fill imported to the project site, or fill exported from the project site is found to be regulated fill during the term of permit coverage, where the utilization of the regulated fill will require a permit from DEP's Waste Management program, earth disturbance activities shall cease until such time that the permittee obtains all necessary permits or approvals from DEP.
    d. If the permittee becomes aware during earth disturbance activities that soils in the area of earth disturbance contain concentrations of regulated substances exceeding the residential medium-specific concentrations for soil in 25 Pa. Code Chapter 250, the permittee shall notify DEP and cease earth disturbance activities in areas of known soil contamination until authorized to resume by DEP.
    e. If the permittee encounters groundwater during excavation that the permittee knows or has reason to believe is contaminated by one or more pollutants at concentrations exceeding water quality criteria contained in 25 Pa. Code Chapter 93, the permittee shall notify DEP. Contaminated groundwater may not be pumped or otherwise diverted to surface waters unless specifically authorized by DEP.

    **JMT Response (3/24/20):** *The above notes have been added to the design plans, ES-3 and PCSM-2.*

6. **DEP Comment (2/25/20):** For each and all antidegradation analyses (PCSM and E&S) in the ESCGP-3 application, please provide an explanation of why the nondischarge BMPs were or were not utilized. This request for explanation is a standard note in the application. [ESCGP-3 permit application)

    **JMT Response (3/24/20):** *Additional explanations for the non-discharge BMPs utilized under Section I, Part 1 (Page 14) has been added for each watershed.*

7. **DEP Comment (2/25/20):** Please amend the Long-term Operation and Maintenance (O&M) Plan in the PCSM Plan drawing set to include if each BMP is designed to function as an infiltration BMP for volume and water quality management, a Managed Release Concept BMP for volume and water quality management, peak rate management BMP, and/or a water quality management BMP. In addition, the O&M Plan should include a list of potential failures that could happen during operation and how the

failures should be addressed by the responsible entity with corrective action measures. One of the failures listed should be if the BMP fails to drain in a specified amount of time after a specified rainfall event. One option for corrective action measures should be the replacement of the PCSM BMP in the O&M Plan to ensure proper function and operation to address the PCSM requirements of this ESCGP-3 permit. [25 Pa. Code§ 102.8(f)]

**JMT Response (3/24/20):** *The O&M plan has been amended to note the function of each BMP. In addition, a table has been added to include a list of potential failures that could happen during operation and corrective action measures for these failures. Refer to PCSM-4 and PCSM-5.*

8. **DEP Comment (2/25/20):** Regarding the Existing Conditions section of the completed DEP Worksheet 4 for this application, there are comments related to the regulation at Title 25 Pa. Code Chapter 102.8(g)(2)(i) and (ii). Please address the following in the PCSM Report [ESCGP-3 permit application worksheet and 25 Pa. Code § 102.8(g)(2)]:
    a. For the Transco Meter Station site, please provide an explanation for the use of “woods” and “brush” cover and the associated CN values listed in the Existing Conditions section.
    b. For the Marcus Hook Compressor Station site, please provide an explanation for the use of “gravel” and “impervious” cover and the associated CN values listed in the Existing Conditions section.
    c. For the Quakertown Compressor Station site, please provide an explanation for the use of “impervious,” “gravel,” and “brush” cover and the associated CA values listed in the Existing Conditions section.

**JMT Response (3/24/20):** *Per Chapter 102.8(g)(2), the Existing Conditions 2-yr, 24-hr runoff volume was revised to ensure runoff calculations within Worksheet 4 are using 20% of impervious and gravel as meadow and all non-forested areas, which includes brush areas, were also considered meadow in existing conditions. This is noted in PCSM Report, Section VII, and calculations are in App D.1. Please note the Existing Conditions and Demolition Plans for the Transco, Marcus Hook and Quakertown sites notes the existing land covers. Furthermore, the drainage area maps detail the land covers as well.*

9. **DEP Comment (2/25/20):** At the Transco Meter Station site, it is recommended to apply an appropriate factor of safety to the field measured infiltration rates to determine a recommended design infiltration rate, following Appendix C of the PA BMP Manual. Please revise the PCSM computations accordingly to include an appropriate factor of safety, or please provide adequate justification. [PA BMP Manual Appendix C]

**JMT Response (3/24/20):** U*sing a factor of safety of 2, an infiltration testing rate of 0.13 in/hr was used in the design calculations. HydroCAD computations within Appendix D.2 reflect this revision.*

10. **DEP Comment (2/25/20):** What is the intent and function of the impervious liner proposed for the PCSM BMPs at the Marcus Hook and the Quakertown sites? The intent and function of these impervious liners should be better discussed in Section VI of the PCSM Report. [25 Pa. Code § 102.8(f1]

**JMT Response (3/24/20):** *On the day of the infiltration testing, seepage was measured at a depth of 50-53 inches Thus, the groundwater table appears to have been between 4 to 4.5 feet deep at the locations of the three test pits. It should be noted that the tests were conducted in late Summer; and there was no rain on the day of testing. As a result, the design for the MRC Basin at Marcus Hook Compressor station is proposed to include an impervious liner to provide a separation from the groundwater table. This is noted in Section VI of the PCSM Report.*

11. **DEP Comment (2/25/20):** In Section H of the ESCGP-3 permit application under Water Quality Compliance, please answer all questions based on the applicant's answer to "Does the PCSM/SR plan comply with requirements for volume control?" If a "yes" or "no" answer is not applicable for the subsequent questions, please provide adequate clarification next to the question. [ESCGP-3 permit application Section H]

    **JMT Response (3/24/20):** *Section H for each of the 10 main line valve sites were updated to note "yes" for "is at least 90% of the disturbed area controlled by a PCSM BMP?" since 100% disturbed areas will be controlled by Site Restoration activities. Further worksheets #10, #12 and #13 are not applicable for site restoration activities and noted on the plans accordingly. Section H for Transco, Marcus Hook and Quakertown was not revised since DEP confirmed it was presented appropriately for these sites.*

12. **DEP Comment (2/25/20):** Please provide a seal and signature by a Professional Engineer (P.E.) licensed in the state of Pennsylvania on the PCSM Report and the PCSM Plan drawings for the proposed PCSM BMPs. [49 Pa. Code § 37.59]

    **JMT Response (3/24/20):** *The submitted plans and reports are signed and sealed.*

13. **DEP Comment (2/25/20):** For the Off-site Discharge Analyses provided for this ESCGP-3 permit application, please follow the Frequently Asked Questions (FAQ) - Chapter 102 Off-Site Discharges of Stormwater to Non-Surface Waters dated January 2, 2019. In the applicant's response, please document the changes that were made to address the items listed in the FAQ document. The FAQ document can be found on DEP's website at:
    https://www.dep.pa.gov/Business/Water/CleanWater/StormwaterMgmt/Stormwater%20Construction/Pages/E-S%20Resources.aspx [ESCGP-3 permit application and 102.4(c)]

    **JMT Response (3/24/20):** *The PCSM and E&S Narratives were updated to include an off-site discharge analysis for the existing swales at Marcus Hook and Transco, see PCSM Appendix D.3. The analysis within the narrative notes the resulting reduction in rate and volume. The following revisions were completed as part of this submission in response to the FAQ guidance:*
    - *Per FAQ #3, the appendix includes a separate exhibit detailing the soil types, flow path, and adjacent property owners. The exhibits illustrate that the flow path meet an unnamed tributary of Naaman's Creek (per eMaps).*
    - *Per FAQ #5, JMT has provided additional calculations to demonstrate stable flow at the existing swales.*
    - *Per FAQ #6, the flow does enter a MS4 sewer system prior to reaching a surface water however there is no increase in rate or volume and does not require consent from the MS4 permittee.*

14. **DEP Comment (2/25/20):** If one of the County Conservation Districts' deficiencies also applies to an earth disturbance activity in another county, the applicant should revise the plans accordingly in each and all counties.

    **JMT Response (3/24/20):** *Noted.*

If you have any questions or need further information, please do not hesitate to contact me at 215-496-4780 or smathew@jmt.com.

Very truly yours,

JOHNSON, MIRMIRAN & THOMPSON, INC.

Shiny M. Mathew, P.E.
Senior Associate
Water Resources

AH/sm
Enclosures

Cc: Keith Edmonds, NJR
Andrew Westhoven, NJR
Willie Keterson, HGA
Gretchen Schatschneider, Bucks County Conservation District
Christian Strohmaier, Chester County Conservation District
Ed Magargee, Delaware County Conservation District
Jessica Buck, Montgomery County Conservation District

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
OFFICE OF WATER PROGRAMS
OFFICE OF OIL AND GAS MANAGEMENT

| OFFICIAL USE ONLY |
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| ID # |
| Date Received |
| AUTH |
| SITE |
| CLNT |
| APS |
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| Check No. |
| Check Date |

# NOTICE OF INTENT (NOI) FOR COVERAGE UNDER THE EROSION AND SEDIMENT CONTROL GENERAL PERMIT (ESCGP-3) FOR EARTH DISTURBANCE ASSOCIATED WITH OIL AND GAS EXPLORATION, PRODUCTION, PROCESSING, OR TREATMENT OPERATIONS OR TRANSMISSION FACILITIES

**READ THE INSTRUCTIONS PROVIDED IN THIS PERMIT APPLICATION PACKAGE BEFORE COMPLETING THIS FORM. PLEASE PRINT OR TYPE INFORMATION IN BLACK OR BLUE INK.**

## SECTION A. APPLICATION TYPE

**Check one:**

**NEW** ☒ **RENEWAL** ☐ **MAJOR MODIFICATIONS (Provide ESCGP number)** ☐

**PHASED** ☒ (check only if applicable; *note: Most projects are not submitted as phased projects*)

**Check one: EXPEDITED** ☐ **STANDARD** ☒

If an Expedited Review Process being requested, be advised that the Expedited Review is not available for all projects. Refer to Section D - Expedited Review Process of the ESCGP-3 NOI Instructions to determine if the project is eligible.

## SECTION B. CLIENT INFORMATION

| Applicant's Last Name (If applicable) | First Name | MI | Telephone No. 732-938-1169 |
|---|---|---|---|
| Valori | Mark | | |
| Organization Name or Registered Fictitious Name | | | Telephone No. |
| Adelphia Gateway, LLC | | | |
| DEP Client ID No. | | | |
| Headquarters Mailing Address | City | State | ZIP Code |
| 1415 Wyckoff Road | Wall | NJ | 07719 |
| Email Address mvalori@njresources.com | | | |
| Co-Applicant's Last Name (If applicable) | First Name | MI | Telephone No. |
| | | | |
| Organization Name or Registered Fictitious Name | | | Telephone No. |
| | | | |
| Address | City | State | ZIP Code |
| | | | |
| Email Address | | | |

| SECTION C. SITE INFORMATION | | | | | |
|---|---|---|---|---|---|
| Is there an existing ESCGP associated with this site? ☐ Yes ☒ No If yes, Permit No. _____ | | | | | |
| Has a well permit application been submitted for this site? ☐ Yes ☒ No If yes, Permit No. _____<br>Does this site have a 911 address? ☐ Yes ☒ No If yes, provide site location address. | | | | | |
| Site Name<br>see Attachment on next Page | | | | | |
| Site Location<br>see Attachment on next Page | Site No. (if another permit has been issued for the site) | | | | |
| Site Location – City<br>see Attachment on next Page | | State<br>see Attachment on next Page | ZIP Code | | |
| Detailed Written Directions to Site<br>see Attachment on next Page | | | | | |
| Primary Location<br>see Attachment on next Page | County | Municipality<br>see Attachment on next Page | City<br>☐ | Boro<br>☐ | Twp.<br>☐ |

| SECTION D. EXPEDITED REVIEW | |
|---|---|
| **I. Expedited Review Eligibility** | |
| 1. Is any part of the project in the watershed of a surface water with an existing or designated use of exceptional value or high quality pursuant to Chapter 93 (relating to water quality standards), in an exceptional value wetland in accordance with 25 Pa. Code § 105.17, or in the watershed of an impaired surface water where the cause of the impairment is identified as siltation? | ☒ Yes ☐ No |
| 2. Will the project in which the well pad will be constructed be in or on a floodplain? | ☐ Yes ☒ No |
| 3. Is any earth disturbance located or proposed to be located on land known to be contaminated by the release of regulated substances as defined in Section 103 of Act 2, 35 P.S. § 6026.103? | ☐ Yes ☒ No |
| 4. Will naturally occurring geologic formations or soil conditions provide hazards to the project or surrounding environment or have the potential to cause or contribute to pollution when disturbed? | ☐ Yes ☒ No |
| 5. Do any unresolved non-compliance issues exist with the applicant or the facility? | ☐ Yes ☒ No |
| 6. Is the project a transmission project? | ☐ Yes ☒ No |

| Site # | Site Name | Site Address | Latitude | Longitude | City | State | Zip Code | County | Municipality | Directions To Site |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Quakertown Compressor Station | Unknown | 40°24'15.39"N | 75°20'53.13"W | Quakertown | Pennsylvania | 18951 | Bucks | Richland Township & West Rockhill Township (split) | From Allentown Road & Camp Rock Hill Road<br>Head east on Camp Rock Hill Rd toward Schukraft Rd 1.2 mi<br>Continue onto Scholls School Rd approximately 1,125'<br>Turn right onto Rich Hill Rd approximately 525'<br>Turn left and travel approximately 1,250'<br>Destination will be on the right |
| 2 | East Perkiomen Blowdown | Unknown | 40°15'2.51"N | 75°26'30.06"W | Schwenksville | Pennsylvania | 19473 | Montgomery | Skippack Township | From West Skippack Pike & Cross Road<br>Head north onto Cross Rd<br>Travel approximately 1,100'<br>Turn left onto Grages Rd<br>Travel approximately 2,500'<br>Destination will be on the right |
| 3 | Skippack Pike Meter Station | Unknown | 40°14'32.70"N | 75°26'48.26"W | Schwenksville | Pennsylvania | 19473 | Montgomery | Skippack Township | From West Skippack Pike & Cross Road<br>Head northwest on PA-73 W/W Skippack Pike toward Cressman Rd 2.5 mi<br>Destination will be on the right |
| 4 | Perkiomen Creek Blowdown | Unknown | 40°12'58.57"N | 75°27'14.12"W | Collegeville | Pennsylvania | 19426 | Montgomery | Perkiomen Township | From Bridge Road & Gravel Pike<br>Head north on PA-29 N toward Ellis Rd approximately 2,500'<br>Destination will be on the left |
| 5 | Schuylkill River Blowdown | Unknown | 40° 9'38.76"N | 75°31'42.05"W | Spring City | Pennsylvania | 19475 | Chester | East Pikeland Township | From Cromby Road & Township Line Road<br>Head north approximately 400’ on Cromby Rd<br>Turn left into private drive at Cromby Station<br>Travel approximately 875’ along private drive<br>Turn left and travel approximately 600’ to west gravel parking lot of Cromby Station<br>Turn right onto schuylkill River Trail<br>Continue approximately 3,625’<br>Destination will be on the right |
| 6 | Cromby Blowdown | Unknown | 40° 9'7.01"N | 75°31'58.89"W | Phoenixville | Pennsylvania | 19460 | Chester | East Pikeland Township | From Cromby Road & Township Line Road<br>Head north approximately 400’ on Cromby Rd<br>Turn left into private drive at Cromby Station<br>Travel approximately 875’ along private drive<br>Turn left and travel approximately 600’ to west gravel parking lot of Cromby Station<br>Destination will be on the right |
| 7 | French Creek Blowdown | Unknown | 40° 8'0.21"N | 75°32'56.35"W | Phoenixville | Pennsylvania | 19460 | Chester | East Pikeland Township | From Kimberton Rd & Powder Mill Dr<br>Head east approximately 125’<br>Turn left and travel approximately 1,500’ through private property<br>Destination will be directly ahead |
| 8 | Mainline Valve 2 | Unknown | 40° 1'49.95"N | 75°35'1.78"W | Malvern | Pennsylvania | 19355 | Chester | East Whiteland Township | From Lincoln Highway & Phoenixville Pike<br>Head south on Phoenixville Pike toward Mystic Ln approximately 2,900'<br>Turn left into private drive<br>Travel approximately 515’<br>Destination will be on the left |

| Site # | Site Name | Site Address | Latitude | Longitude | City | State | Zip Code | County | Municipality | Directions To Site |
|---|---|---|---|---|---|---|---|---|---|---|
| 9 | Paoli Pike Blowdown | Unknown | 39°59'27.05"N | 75°32'58.69"W | West Chester | Pennsylvania | 19380 | Chester | East Goshen Township | From Boot Road & Paoli Pike<br>Head northeast on Paoli Pike toward Boot Rd approximately 750'<br>Destination will be on the left |
| 10 | Chester Creek Blowdown | Unknown | 39°55'54.06"N | 75°30'40.35"W | Glen Mills | Pennsylvania | 19342 | Delaware | Thornbury Township | From Creek Road & Locksley Road<br>Head south on Locksley Rd approximately 415’<br>Turn right onto private drive<br>Travel approximately 1,600’<br>Destination will be on the right |
| 11 | Mainline Valve 1 | Unknown | 39°53'52.18"N | 75°29'18.63"W | Glen Mills | Pennsylvania | 19342 | Delaware | Concord Township | From Stoney Bank Road & Baltimore Pike<br>Head west on Baltimore Pike approximately 500’<br>Turn right into private parking lot<br>Travel approximately 225’<br>Destination will be directly ahead |
| 12 | Transco Meter Station | Unknown | 39°49'7.46"N | 75°26'5.59"W | Marcus Hook | Pennsylvania | 19061 | Delaware | Lower Chichester Township | From Naamans Road and Ridge Road<br>Head northeast on Ridge Rd toward Virginia Ave approximately 3,700'<br>Turn left onto private drive (Fed Ex Drive)<br>Travel approximately 200’<br>Destination will be on the left |
| 13 | Marcus Hook Compressor Station | Unknown | 39°48'53.17"N | 75°26'19.12"W | Marcus Hook | Pennsylvania | 19061 | Delaware | Lower Chichester Township | From Naamans Road and Ridge Road<br>Head northeast on Ridge Rd toward Virginia Ave approximately 1,900'<br>Destination will be on the Right |

| | |
|---|---|
| **If yes to any of the above questions the project is not eligible for Expedited Review; If the project is eligible for Expedited Review, all the following items must be completed.** | |
| **II. Expedited Review Process** | |
| 1. Is the technically and administratively complete and accurate NOI package prepared and certified by a licensed professional? | ☐ Yes ☐ No |
| 2. Are E&S and PCSM/Site Restoration Plan drawings and narrative prepared and sealed by a licensed professional? *(Include interim restoration details when needed)* | ☐ Yes ☐ No |
| 3. Include a Resource Delineation Report and answer the following questions: (If the answer to question a. is "Yes" then skip to #4. If the answer to a. is "No" the applicant must answer "Yes" to at least one of the questions, b. through d. to be eligible for expedited review.) | |
| a. Were all wetland resources delineated during the growing season? | ☐ Yes ☐ No |
| b. If not during the growing season, was a follow-up visit conducted during the growing season to verify/adjust boundaries and look for potentially missed resources? | ☐ Yes ☐ No |
| c. Was a quality assurance field review conducted at a later date by an independent qualified wetland professional to verify boundaries and look for potentially missed resources? (If yes, attach Quality Assurance Field Review Report) | ☐ Yes ☐ No |
| d. Was a Jurisdictional Determination (JD) or Preliminary JD conducted by the US Army Corps of Engineers on the whole project? (If yes, attach Preliminary or Jurisdictional Determination Report) | ☐ Yes ☐ No |
| 4. If applicable, have you included PNDI clearance letters or other documentation from applicable resource agencies? | ☐ Yes ☐ No |
| 5. If the project site contains, is along, or within 100 feet of a river, stream, creek, lake, pond or reservoir, will you establish new or preserve existing riparian forest buffer at least 100 feet in width between the top of streambank or normal pool elevation of a lake, pond or reservoir and areas of earth disturbances.<br>If no, will a waiver be obtained? ☐ Yes ☐ No | ☐ Yes ☐ No |
| 6. Name of Licensed Professional<br>Company | |
| Address | |
| Phone | |

## SECTION E. PROJECT INFORMATION

| | | | |
|---|---|---|---|
| 1. Total Project Area/Project Site (Ac): | 23.44 | Total Disturbed Area (Ac): | 18.1 |
| Increased disturbed acreage *(for permit modification only)* | | | 10.00 |
| Fee: ***(For additional information regarding fees, refer to NOI Instructions #3 Permit NOI Filing Fees.)*** | | | $ 2,900 |

2. Project Name: Adelphia Gateway Project

3. Project Type (Check all that apply)

- ☐ Oil/Gas Well [1]
- ☐ Gathering Facility
- ☐ Treatment Facility
- ☒ Compressor Station
- ☒ Pipeline
- ☒ Storage Field Facility
- ☐ Other
- ☐ Transmission Facility
- ☐ Processing Facility
- ☐ Well Development Impoundment
- ☐ Non-FERC regulated Transmission Facility
- ☐ Ground/Surface Water Withdrawal Site

[1] If Oil/Gas Well; is the well conventional or unconventional? ☐ Conventional ☐ Unconventional

Project Description

The Adelphia Gateway Pipeline is an 84-mile pipeline that runs from Martins Creek to Marcus Hook. Facility upgrades will occur to thirteen (13) sites along the pipeline: Quakertown Compressor Station, East Perkiomen Blowdown, Skippack Pike Meter Station, Perkiomen Creek Blowdown, Schuylkill River Blowdown, Cromby Blowdown, French Creek Blowdown, Mainline Valve 2, Paoli Pike Blowdown, Chester Creek Blowdown, Mainline Valve 1, Transco Meter Station, and Marcus Hook Compressor Station.
The subsequent phase is the Tilghman and Parkway lateral pipeline installations. The Tilghman lateral pipeline consists of approximately 4.5 miles of a 16-inch O.D. pipeline through traditional pipeline installation and horizontal direction drill (HDD) installation methods. The project scope for the Parkway Lateral includes the installation of 500 linear feet of natural gas main, new meter pads, gravel paths, and a small compressor building.
This application is for Phase 1 only. The subsequent phase (Phase 2) will be submitted to DEP with more detailed information under a separate cover.
Provide the date of pre-application meeting (if conducted with the Department) 2/21/2019

4. Provide the latitude and longitude coordinates for the center of the project. The coordinates should be in Decimal degrees and North American Datum 1983. The coordinates must meet the current DEP policy regarding locational accuracy. For linear projects provide the project's termini.

Latitude (DD) 39.8147 Longitude (DD) - 75.4383

Latitude (DD) 40.7933 Longitude (DD) - 75.1313

Horizontal Collection Method: ☒ GPS ☐ Interpolated from U.S.G.S. Topographic Map ☐ DEP's eMAP

5. U.S.G.S. 7.5 min. topographic quadrangle Name Perkiomenville, Media, Malvern, West Chester, Quakertown, Phoenixville, Collegeville, Marcus Hook

(*Include a copy of the project area on the 7.5 min quad map)*

6. Will the project be conducted as a phased permit project? ☒ Yes ☐ No

If Yes, Include Master Site Plan Estimated Timetable for Phased Projects. ☐ Additional sheet(s) attached.

| Phase No. or Name | Description | Total Area | Disturbed Area | Start Date | End Date |
|---|---|---|---|---|---|
| 1 | Adelphia Gateway | 13.44 | 13.44 | 1/2/20 | 6/2/20 |
| 2 | Tilghman & Parkway Laterals | 10.00 | 10.00 | 1/2/20 | 6/2/20 |
| | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |

7. List existing and previous land use for a minimum of the previous 5 years.

The existing use for the Quakertown Compressor Station is a partially developed meter site with gravel and brush.

East Perkiomen Blowdown, Skippack Pike Meter Station, Perkiomen Creek Blowdown , Schuylkill River Blowdown, Cromby Blowdown, French Creek Blowdown, Mainline Valve 2, Paoli Pike Blowdown, Chester Creek Blowdown, Mainline Valve 1 are existing valve sites with gravel and grass.

The existing use for the Quakertown Compressor Station is a partially developed site with an adjacent meter site. The area to be distributed is primarily meadow.

Marcus Hook Compressor Station is a fully developed compressor site that is primarily gravel in existing conditions.

8. Other Pollutants: Will the stormwater discharge contain pollutional substances other than sediment? ☐ Yes ☒ No

   If yes, explain and provide any available quantitative data.

9. Will fuels, chemicals, solvents, other hazardous waste or materials be used or stored on site during earth disturbance activities or will Horizontal Directional Drilling (HDD) activities be conducted?

   Yes ☒ No ☐ ***(If yes, Preparedness, Prevention and Contingency (PPC) Plan must be maintained on site during earth disturbance. See NOI Instructions, E.9 PPC Plan Guidance for further information.)***

10. Is the project in the watershed of an impaired surface water where the cause of the impairment is identified as siltation?

    Yes ☒ No ☐ ***(If yes, show how the project will not result in a net change in volume, rate or water quality. See section I below, and E.10 of NOI instructions.)***

11. Are there potentially hazardous naturally occurring geological or soil conditions in any portion of the project or surrounding area? Yes ☐ No ☒

    If yes, do the potentially hazardous geologic or soil conditions have the potential to cause or contribute to pollution as a result of the proposed earth disturbance activities?

    If no, provide an explanation.

    If yes, Geologic Hazard Mitigation Plan must be attached and explain where in this application details are provided.

12. Has the Act 14 Municipal Notification and proof of receipt of notification been attached to the NOI?

    Yes ☒ No ☐ ***(If not, the NOI is not complete, see E.12 and #4 Municipal Notification in the NOI Instructions for additional guidance.)***

13. Has the PNDI receipt been attached to the NOI?

    Yes ☒ No ☐ ***(If not, the NOI is not complete, see E.13 and #5 PNHP in the NOI Instructions for additional guidance.)***

14. Have the E&S Plan and PCSM/SR Plan been planned and designed to be consistent?

    Yes ☒ No ☐

15. Have existing and/or proposed Riparian Forest Buffers been identified?

    Yes ☐ N/A ☒ ***(If yes, they must be shown on the E&S Plan as well as the PCSM/SR Plans.)***

16. Have antidegradation implementation requirements for special protection waters been addressed?

    Yes ☒ No ☐ N/A ☐ ***(If yes, antidegradation requirements must be included in the plan.)***

17. Has the seasonal high groundwater level been identified and 20-inch separation established at all excavation locations for pits for conventional operations and Well Development Impoundments for unconventional operations?

    Yes ☐ No ☐ N/A ☒

| 18. Receiving Waters | Chapter 93, Designated Use Stream Classification | Chapter 93, Existing Use Stream Classification |
|---|---|---|
| Tohickon Creek | ☐ HQ ☐ EV Other WWF, MF<br>☒ Siltation-impaired | ☐ HQ ☐ EV ☒ Other WWF, MF<br>☒ Siltation-impaired |
| Perkiomen Creek | ☐ HQ ☐ EV ☒ Other WWF, MF<br>☒ Siltation-impaired | ☐ HQ ☐ EV ☒ Other WWF, MF<br>☒ Siltation-impaired |
| Schuylkill River | ☐ HQ ☐ EV ☒ Other WWF, MF<br>☒ Siltation-impaired | ☐ HQ ☐ EV ☒ Other WWF, MF<br>☒ Siltation-impaired |
| Stony Run | ☒ HQ ☐ EV ☒ Other TSF, MF<br>☒ Siltation-impaired | ☒ HQ ☐ EV ☒ Other TSF, MF<br>☒ Siltation-impaired |
| Secondary Receiving Water | Secondary Chapter 93, Designated Use | Secondary Existing Use |
| Name of Municipal or Private Separate Storm Sewer Operator, if applicable. | | |
| Non-Surface Receiving Water: (include off-site discharges) | | |

| 18. Receiving Waters | Chapter 93, Designated Use Stream Classification | Chapter 93, Existing Use Stream Classification |
|---|---|---|
| French Creek | ☐ HQ ☐ EV ☒ Other TSF, MF<br>☐ Siltation-impaired | ☐ HQ ☐ EV ☒ Other TSF, MF<br>☐ Siltation-impaired |
| Valley Creek | ☐ HQ ☐ EV ☒ Other CWF, MF<br>☒ Siltation-impaired | ☐ HQ ☐ EV ☒ Other CWF, MF<br>☒ Siltation-impaired |
| Ridley Creek | ☒ HQ ☐ EV ☒ Other HQ-TSF, MF<br>☒ Siltation-impaired | ☒ HQ ☐ EV ☒ Other HQ-TSF, MF<br>☒ Siltation-impaired |
| Chester Creek | ☐ HQ ☐ EV ☒ Other TSF, MF<br>☒ Siltation-impaired | ☐ HQ ☐ EV ☒ Other TSF, MF<br>☒ Siltation-impaired |
| Secondary Receiving Water | Secondary Chapter 93, Designated Use | Secondary Existing Use |
| Name of Municipal or Private Separate Storm Sewer Operator, if applicable. | | |
| Non-Surface Receiving Water: (include off-site discharges) | | |

| 18. Receiving Waters | Chapter 93, Designated Use Stream Classification | Chapter 93, Existing Use Stream Classification |
|---|---|---|
| Naamans Creek | ☐ HQ ☐ EV ☒ Other WWF, MF<br>☐ Siltation-impaired | ☐ HQ ☐ EV ☒ Other WWF, MF<br>☐ Siltation-impaired |
| | ☐ HQ ☐ EV ☐ Other _____<br>☐ Siltation-impaired | ☐ HQ ☐ EV ☐ Other _____<br>☐ Siltation-impaired |
| | ☐ HQ ☐ EV ☐ Other _____<br>☐ Siltation-impaired | ☐ HQ ☐ EV ☐ Other _____<br>☐ Siltation-impaired |
| | ☐ HQ ☐ EV ☐ Other ____<br>☐ Siltation-impaired | ☐ HQ ☐ EV ☐ Other _____<br>☐ Siltation-impaired |
| Secondary Receiving Water | Secondary Chapter 93, Designated Use | Secondary Existing Use |
| Name of Municipal or Private Separate Storm Sewer Operator, if applicable. | | |
| Non-Surface Receiving Water: (include off-site discharges) | | |

## SECTION F. EROSION AND SEDIMENT CONTROL (E&S) PLAN

**See the attached Instructions for additional guidance with E&S Plans**

Erosion and Sediment Control Plan BMPs should be designed to minimize accelerated erosion and sedimentation through limiting the extent and duration of earth disturbance, protection of existing drainage and vegetation, limiting soil compaction and controlling the generation of increased runoff. The Department recommends the use of the *Pennsylvania Erosion & Sedimentation Pollution Control Program Manual (E&S Manual)* (363-2134-008) to achieve this goal. The E&S Plan must meet the requirements of Pa. Code § 102.4(b) and submitted with the NOI. Also, see section 2. of the NOI instruction for detailed information on completing the E&S plan and additional requirements.

**a. E&S Plan Summary**

Provide a summary of proposed E&S BMPs and their performance to manage E&S for the project.

The following measures are aimed at controlling accelerated erosion and sedimentation during construction. Temporary erosion and sediment control will be accomplished by utilizing Best Management Practices, such as Rock Construction Entrance, Compost Filter Sock, Inlet Protection, Compost Sock Washout Facility, Pumped Water Filter Bags, Erosion Control Blanket, Temporary Wetland Crossings and Rock Filters. The extent and duration of earth disturbance is to be minimized to limit impacts of erosion and sedimentation to neighboring and downstream properties.

For project site in HQ watersheds, the E&S Desgin includes ABACT measures to ensure limited erosion and sedimentation.

**b. E&S Plan BMP Design**

Check those that apply:

☒ E&S Plan is designed using BMPs in the *E&S Manual*.

☐ E&S Plan is designed using an alternative BMP or design standard approved by DEP.

*Note: NOI packages submitted with alternate BMPs not approved by the Department will be returned to the Applicant.*

**c.** Do you have any information regarding riparian buffer which differs from Section G, Riparian Buffer?

Yes ☐ No ☒

Explain:

**d. Thermal Impacts Analysis**

Explain how thermal impacts associated with this project were avoided, minimized, or mitigated.

Thermal impacts associated with the project will be minimized and/or mitigated through the incorporation of various BMPs, which include a subsurface and subsurface MRC basins and a subsurface infiltration bed. Runoff from the impervious areas will be directed to the BMPs where the travel time is increased to infiltrate and/or store runoff, reducing the quantity and temperature of the runoff.

The surface basin at Marcus Hook Compressor Station will be vegetated. Landscaping and vegetative cover will mimic natural ecosystems, resulting in a system that is resistant to climatic stresses. Additionally, the basin's outlet structure is designed to promote the slow release of outflow to the surface waters.

The subsurface basin at Transco Meter Station will temporarily store stormwater runoff beneath the surface, away from direct sunlight and will promote infiltration which will release water into the groundwater instead of discharging to the surface waters.

The subsurface basin at Quakertown Compressor Station will temporarily store stormwater runoff beneath the surface, away from direct sunlight and will promote the slow release of outflow to the surface waters.

At the main line valve sites, thermal impacts will be avoided by site restoration activities. The disturbed areas will be restored and seeded as soon as practicable and /or directing runoff to vegetated areas to reduce the temperature of runoff prior to discharge into the streams.

**e. Off-Site Discharge Analysis**

Does the activity propose any off-site discharges to areas other than surface waters? ☒ Yes ☐ No

If yes, it is the applicant's responsibility to ensure that they have legal authority for any off-site discharge to neighboring properties.

The applicant must provide a demonstration in both E&S and PCSM/SR plans that the discharge will not cause erosion, damage, or a nuisance to off-site properties.

## SECTION G. RIPARIAN BUFFER

1. Will you be protecting, converting or establishing a voluntary riparian forest buffer as part of this project? ☐ Yes ☒ No
   If yes, as part of the PCSM/SR Plan, provide a Buffer Management Plan.
2. Will proposed earth disturbance activities be conducted in an EV or HQ watershed AND within 150 feet of a perennial or intermittent river, stream, or creek, or lake, pond, or reservoir? ☒ Yes ☐ No

   If no, proceed to the next section/module.
3. Does this project qualify for an exception (see § 102.14(d)(1))? ☒ Yes ☐ No

   If yes, indicate below the type of project for which the exception applies by marking the appropriate box.

   ☐ Oil and gas activities for which site reclamation or restoration is part of the permit authorization in Chapter 78 and 78a.

   ☐ Road maintenance activities.

   ☒ The repair or maintenance of existing pipelines and utilities.

   ☐ Other (see §102.14(d)(1))

   If exceptions are checked, explain how existing riparian buffer will be undisturbed to the extent practicable. Provide a demonstration that the requirements of §102.14(b) are met, or provide the necessary information to request a riparian buffer waiver.
4. Are you requesting a riparian buffer waiver for this project (see § 102.14(d)(2))? ☒ Yes ☐ No

   If yes, indicate below the type of project for which you are requesting a waiver by marking the appropriate box.

   ☐ Linear project that may include pipelines, public roadways, rail lines, or utility lines.

   ☒ Project is of a temporary nature where the site will be fully restored to its preexisting conditions during the ESCGP permit term.

   ☐ Project where compliance with mandatory riparian buffers is not appropriate or feasible due to site characteristics or existing structures at the project site.

   ☐ Other (see §102.14(d)(2)):

   If waivers are checked, explain how existing riparian buffers will be undisturbed to the extent practicable.

   Note: If "Yes" to #2 **AND** "No" to #3 and #4, provide an attachment to demonstrate how the requirements of §102.14 are met.

   **See PCSM Narrative, Section XII**

## SECTION H. POST CONSTRUCTION STORMWATER MANAGEMENT (PCSM) AND/OR SITE RESTORATION(SR) PLAN

**See NOI Instructions for additional guidance with PCSM Plans**

PCSM/SR BMPs should be designed to use natural measures to eliminate pollution, infiltrate runoff, not require extensive construction/maintenance, promote pollutant reduction, and preserve the integrity of stream channels. All PCSM/SR BMPs proposed in the PCSM/SR Plan must be designed in accordance with Ch. 102, Ch. 78a for unconventional operations, Ch. 78 for conventional operations and the *Pennsylvania Stormwater Best Management Practices Manual (Stormwater BMP Manual)* (363-0300-002). If alternate design criteria are utilized for the proposed project, they must have prior approval by the Department, or the NOI Application will be returned to the Applicant.

After construction is completed, how much of the entire disturbed area will be restored to meadow in good condition or better, or existing conditions? ☒ All ☐ Partial ☐ None

Include PCSM narrative and drawings for remaining impervious area. Also include a map showing the proposed contours of the site restoration plan.

If there are additional stages of the project prior to permit termination or expiration, list the stages and provide the documents required by subsection 'a' to section 'g' for each stage (e.g. partial restoration or changes to the amount of compacted areas, gravel, and/or impervious areas). Upload a narrative for each additional stage in addition to the drawings.

**EXAMPLE**

| Stage No | Stage Name | PCSM Plan | SR Plan |
|---|---|---|---|
| Stage 1 | Adelphia Gateway | ☒ | ☒ |
| Stage 2 | Tilghman & Parkway Laterals | ☐ | ☒ |
| Stage 3 | | ☐ | ☐ |
| Stage 4 | | ☐ | ☐ |

**Act 167 Consistency**. Check those that apply.

Is there an Act 167 Plan? ☒ Yes ☐ No

**Sites:**
**Chester Creek Blowdown**
**Mainline Valve 1**

☒ The attached PCSM/SR Plan is consistent with an applicable approved Act 167 Plan.

Complete the following for all approved Act 167 Stormwater Management Plans. (Use additional sheets if necessary)

| Act 167 Plan Name | Date Adopted | Consistency Letter Included ☐ |
|---|---|---|
| **Chester Creek Watershed** | June 2002 | Verification Report Included ☒ |

*Note: A consistency letter is not required if a verification report is provided. See NOI Instructions. The PCSM/SR Plan must satisfy either sub paragraph 1, 2, or 3 below. Check those that apply.*

1. ☐ Act 167 Plan approvals on or after January 2005 – The attached PCSM/SR Plan, in its entirety, is consistent with all requirements pertaining to rate, volume, and water quality from an Act 167 Stormwater Management Plan approved by DEP on or after January 2005. Box 1 must be checked if a current, DEP approved Act 167 plan exists.

2. ☒ The PCSM/SR Plan meets the standard design criteria from sections 102.8(g)(2) and (3) and the *Stormwater BMP Manual*. For projects involving oil and gas activities authorized by a permit issued under Chapter 78 or Chapter 78a (well pads) or pipelines and other similar utility infrastructure, post construction stormwater management requirements are met for all areas that are restored to preconstruction conditions or to a condition of meadow in good condition or better. *[Note: PCSM plans must meet both the volume and rate requirements in the regulations, which are provided in the 2 sections mentioned in this paragraph].*

3. ☐ Alternative Design Standard – The attached PCSM/SR Plan was developed using approaches as provided in 102.8(g)(2)(iv) and 102.8(g)(3)(iii). Demonstrate/explain in the space provided below how this standard will be either more protective than what is required in 102.8(g)(2) and 102.8(g)(3) or will maintain and protect existing water quality and existing and designated uses.

**PCSM/SR BMP Alternative Standards**:

Has the alternative BMP or design standard been approved by the Department?

☐ Yes

☐ No – Do not submit the ESCGP-3 application and see Section (H) of the NOI Instructions concerning the alternative BMP approval process.

**Water Quality Compliance:**

Does the PCSM/SR plan comply with requirements for volume control? ☒ Yes ☐ No

If yes, is at least 90% of the disturbed area controlled by a PCSM BMP? ☒ Yes ☐ No

If yes, do you have the Standard PCSM Worksheet # 10 attached to show water quality compliance has achieved?
☐ Yes ☒ No → **SITE RESTORATION ONLY - MEET SECTION 102.8(g)(2) and (3), WORKSHEET #10, #12 & #13 ARE NOT APPLICABLE**

If no, attach Standard PCSM Worksheets # 12 and #13 to show water quality compliance has achieved.

If PCSM/SR plan is not complying with the requirements for volume control, attach Standard PCSM Worksheets # 11, # 12 and #13 to show water quality compliance has achieved.

**a. PCSM/SR Plan Summary**

Provide a summary of proposed BMPs and their performance to manage PCSM/SR for the project.

All sites will be restored to pre-existing conditions. By limiting the disturbed areas, limiting extent and duration of disturbance and performing site restoration, these practices will eliminate the net change in rate, volume and water quality after construction.

Check all that apply ☐ PCSM BMPs ☒ SR BMPs

**b.** Do you have any information regarding riparian buffer which differs from what was submitted in the Section G, Riparian Buffer?

☐ Yes ☒ No

Explain:

**c. Thermal Impacts Analysis**

Explain how thermal impacts associated with this project were avoided, minimized, or mitigated.

Thermal impacts have been minimized by limiting the disturbed area to the maximum extent practicable. By minimizing the extent of the disturbed area, vegetative clearing has been minimized. Thermal impacts will also be minimizing the duration of disturbance and reseeding and restoring vegetative growth as soon as possible.

**d. Off-Site Discharge Analysis.**

Does the activity propose any off-site discharges to areas other than surface waters? ☒ Yes ☐ No

If yes, it is the applicant's responsibility to ensure that they have legal authority for any off-site discharge to neighboring properties.

The Applicant must provide a demonstration in both the E&S and PCSM/SR Plans that the discharge will not cause erosion, damage, or a nuisance to off-site properties.

**See PCSM Narrative, Section XI, Page 15**

**e. Summary Table for Supporting Calculation and Measurement Data**
***(See NOI Instructions for additional guidance with this section)***

The remainder of this section (Summary Table for Calculation and Measurement Data) does not need to be completed for areas of projects involving oil and gas activities authorized by Chapter 78 or Chapter 78a (well pads) or pipelines and other similar utility infrastructure which will be restored to meadow in good condition or better or existing conditions.

**Watershed Name: Chester Creek**

| Volume Control design storm frequency N/A<br>Rainfall amount N/A inches | Pre-construction | Post Construction | Net Change |
|---|---|---|---|
| Impervious area (acres) | N/A | N/A | N/A |
| Volume of stormwater runoff (acre-feet) without planned stormwater BMPs | N/A | N/A | N/A |
| Volume of stormwater runoff (acre-feet) with planned stormwater BMPs | | N/A | N/A |
| Stormwater discharge rate for the design frequency storm | Pre-construction | Post Construction | Net Change |
| 1) 2-Year/24-Hour | N/A | N/A | N/A |
| 2) 10-Year/24-Hour | N/A | N/A | N/A |
| 3) 50-year/24-Hour | N/A | N/A | N/A |
| 4) 100-year/24-Hour | N/A | N/A | N/A |

**f. Summary Description of PCSM/SR BMPs** **SITE RESTORATION ONLY**

In the lists below, check the BMPs identified in the PCSM Plan. The primary function(s) of the BMP listed in the functions column (infiltration/recharge; detention/retention; water quality). Additional functions may be added if applicable to that BMP. List the stormwater volume and area of runoff to be treated by each BMP type when calculations are required. If any BMP in the PCSM/SR Plan is not listed below, describe it in the space provided after "Other". A summary table with infiltration testing information (Attachment E, included in the NOI Instructions) must be submitted for all Bio-infiltration BMPs included in PCSM/SR plan.

For Rate control provide the volume of stormwater treated and acres treated for the 100-year/24-hour storm event.

For volume control and water quality provide the volume of stormwater treated and acres treated for the 2-year/24-hour storm event.

Key for BMP purpose(s): VC = Volume Control; RC = Rate Control; and WQ = Water Quality

| BMP | Function(s) | Purpose(s) | Volume of stormwater treated | Acres treated |
|---|---|---|---|---|
| **Site Restoration ONLY**<br>☒ Restore Site to Meadow in Good Condition or Better, or Existing Conditions | Infiltration/Recharge<br>Detention/WQ Treatment | ☒ VC ☒ RC ☒ WQ | _____ | _____ |
| **Bio-infiltration areas** | Infiltration/Recharge | | | |
| ☐ Infiltration Trench | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Infiltration Bed | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Infiltration Basin | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Rain Garden/ Bioretention | | ☐ VC ☐ RC ☐ WQ | _____ | |
| ☐ Infiltration Berm | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |

| | | | | |
|---|---|---|---|---|
| **Natural Area Conservation** | Infiltration/Recharge | | | |
| ☐ Streamside Buffer Zone | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Wetland Buffer Zone | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Sensitive Area Buffer Zone | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Pre-Construction Drainage Pattern Intact | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| **Stormwater Retention** | Detention/Retention | | | |
| ☐ Constructed Wetlands | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Wet Ponds | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Retention Basin | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| **Sediment and Pollutant Removal** | Water Quality Treatment | | | |
| ☐ Vegetated Filter Strips | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Compost Filter Sock | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Detention Basins | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| **Access Road Design** | Infiltration/Recharge | | | |
| ☐ Road Crowning | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Ditches | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Turnouts | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Culverts | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Roadside Vegetated Filter Strips | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| **Stormwater Energy Dissipaters** | Infiltration/Recharge | | | |
| ☐ Level Spreaders | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Riprap Aprons | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Upslope Diversions | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Other_____ | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |

**g. Critical PCSM Plan stages**

Identify and list critical stages of implementation of the PCSM Plan for which a licensed professional or designee shall be present on site.

License professional to be present during the site restoration activities as noted the in Site Restoration Schedule.

## SECTION H. POST CONSTRUCTION STORMWATER MANAGEMENT (PCSM) AND/OR SITE RESTORATION(SR) PLAN

**See NOI Instructions for additional guidance with PCSM Plans**

PCSM/SR BMPs should be designed to use natural measures to eliminate pollution, infiltrate runoff, not require extensive construction/maintenance, promote pollutant reduction, and preserve the integrity of stream channels. All PCSM/SR BMPs proposed in the PCSM/SR Plan must be designed in accordance with Ch. 102, Ch. 78a for unconventional operations, Ch. 78 for conventional operations and the *Pennsylvania Stormwater Best Management Practices Manual (Stormwater BMP Manual)* (363-0300-002). If alternate design criteria are utilized for the proposed project, they must have prior approval by the Department, or the NOI Application will be returned to the Applicant.

After construction is completed, how much of the entire disturbed area will be restored to meadow in good condition or better, or existing conditions? ☒ All ☐ Partial ☐ None

Include PCSM narrative and drawings for remaining impervious area. Also include a map showing the proposed contours of the site restoration plan.

If there are additional stages of the project prior to permit termination or expiration, list the stages and provide the documents required by subsection 'a' to section 'g' for each stage (e.g. partial restoration or changes to the amount of compacted areas, gravel, and/or impervious areas). Upload a narrative for each additional stage in addition to the drawings.

**EXAMPLE**

| Stage No | Stage Name | PCSM Plan | SR Plan |
|---|---|---|---|
| Stage 1 | Adelphia Gateway | ☒ | ☒ |
| Stage 2 | Tilghman & Parkway Laterals | ☐ | ☒ |
| Stage 3 | | ☐ | ☐ |
| Stage 4 | | ☐ | ☐ |

**Act 167 Consistency**. Check those that apply.

Is there an Act 167 Plan? ☒ Yes ☐ No

☒ The attached PCSM/SR Plan is consistent with an applicable approved Act 167 Plan.

**Sites:**
**French Creek Blowdown**
**Cromby Blowdown**
**Schuylkill River Blowdown**
**Paoli Pike Blowdown**

Complete the following for all approved Act 167 Stormwater Management Plans. (Use additional sheets if necessary)

| Act 167 Plan Name | Date Adopted | Consistency Letter Included ☐ |
|---|---|---|
| **Chester County-wide** | March 27,2013 | Verification Report Included ☒ |

*Note: A consistency letter is not required if a verification report is provided. See NOI Instructions. The PCSM/SR Plan must satisfy either sub paragraph 1, 2, or 3 below. Check those that apply.*

1. ☒ Act 167 Plan approvals on or after January 2005 – The attached PCSM/SR Plan, in its entirety, is consistent with all requirements pertaining to rate, volume, and water quality from an Act 167 Stormwater Management Plan approved by DEP on or after January 2005. Box 1 must be checked if a current, DEP approved Act 167 plan exists.

2. ☒ The PCSM/SR Plan meets the standard design criteria from sections 102.8(g)(2) and (3) and the *Stormwater BMP Manual*. For projects involving oil and gas activities authorized by a permit issued under Chapter 78 or Chapter 78a (well pads) or pipelines and other similar utility infrastructure, post construction stormwater management requirements are met for all areas that are restored to preconstruction conditions or to a condition of meadow in good condition or better. *[Note: PCSM plans must meet both the volume and rate requirements in the regulations, which are provided in the 2 sections mentioned in this paragraph].*

3. ☐ Alternative Design Standard – The attached PCSM/SR Plan was developed using approaches as provided in 102.8(g)(2)(iv) and 102.8(g)(3)(iii). Demonstrate/explain in the space provided below how this standard will be either more protective than what is required in 102.8(g)(2) and 102.8(g)(3) or will maintain and protect existing water quality and existing and designated uses.

**PCSM/SR BMP Alternative Standards**:

Has the alternative BMP or design standard been approved by the Department?

☐ Yes

☐ No – Do not submit the ESCGP-3 application and see Section (H) of the NOI Instructions concerning the alternative BMP approval process.

**Water Quality Compliance:**

Does the PCSM/SR plan comply with requirements for volume control? ☒ Yes ☐ No

If yes, is at least 90% of the disturbed area controlled by a PCSM BMP? ☒ Yes ☐ No

If yes, do you have the Standard PCSM Worksheet # 10 attached to show water quality compliance has achieved?
☐ Yes ☒ No → **SITE RESTORATION ONLY - MEET SECTION 102.8(g)(2) and (3). Per 102.8(n), WORKSHEET #10, #12 & #13 ARE NOT APPLICABLE**

If no, attach Standard PCSM Worksheets # 12 and #13 to show water quality compliance has achieved.

If PCSM/SR plan is not complying with the requirements for volume control, attach Standard PCSM Worksheets # 11, # 12 and #13 to show water quality compliance has achieved.

**a. PCSM/SR Plan Summary**

Provide a summary of proposed BMPs and their performance to manage PCSM/SR for the project.

All sites will be restored to pre-existing conditions. By limiting the disturbed areas, limiting extent and duration of disturbance and performing site restoration, these practices will eliminate the net change in rate, volume and water quality after construction.

Check all that apply ☐ PCSM BMPs ☒ SR BMPs

**b.** Do you have any information regarding riparian buffer which differs from what was submitted in the Section G, Riparian Buffer?

☐ Yes ☒ No

Explain:

**c. Thermal Impacts Analysis**

Explain how thermal impacts associated with this project were avoided, minimized, or mitigated.

Thermal impacts have been minimized by limiting the disturbed area to the maximum extent practicable. By minimizing the extent of the disturbed area, vegetative clearing has been minimized. Thermal impacts will also be minimizing the duration of disturbance and reseeding and restoring vegetative growth as soon as possible.

**d. Off-Site Discharge Analysis.**

Does the activity propose any off-site discharges to areas other than surface waters? ☒ Yes ☐ No

If yes, it is the applicant's responsibility to ensure that they have legal authority for any off-site discharge to neighboring properties.

The Applicant must provide a demonstration in both the E&S and PCSM/SR Plans that the discharge will not cause erosion, damage, or a nuisance to off-site properties.

**See PCSM Narrative, Section XI, Page 15**

**e. Summary Table for Supporting Calculation and Measurement Data**
***(See NOI Instructions for additional guidance with this section)***

The remainder of this section (Summary Table for Calculation and Measurement Data) does not need to be completed for areas of projects involving oil and gas activities authorized by Chapter 78 or Chapter 78a (well pads) or pipelines and other similar utility infrastructure which will be restored to meadow in good condition or better or existing conditions.

**Watershed Name: French Creek**

| Volume Control design storm frequency N/A<br>Rainfall amount N/A inches | Pre-construction | Post Construction | Net Change |
|---|---|---|---|
| Impervious area (acres) | N/A | N/A | N/A |
| Volume of stormwater runoff (acre-feet) without planned stormwater BMPs | N/A | N/A | N/A |
| Volume of stormwater runoff (acre-feet) with planned stormwater BMPs | | N/A | N/A |
| Stormwater discharge rate for the design frequency storm | Pre-construction | Post Construction | Net Change |
| 1) 2-Year/24-Hour | N/A | N/A | N/A |
| 2) 10-Year/24-Hour | N/A | N/A | N/A |
| 3) 50-year/24-Hour | N/A | N/A | N/A |
| 4) 100-year/24-Hour | N/A | N/A | N/A |

**f. Summary Description of PCSM/SR BMPs** **SITE RESTORATION ONLY**

In the lists below, check the BMPs identified in the PCSM Plan. The primary function(s) of the BMP listed in the functions column (infiltration/recharge; detention/retention; water quality). Additional functions may be added if applicable to that BMP. List the stormwater volume and area of runoff to be treated by each BMP type when calculations are required. If any BMP in the PCSM/SR Plan is not listed below, describe it in the space provided after "Other". A summary table with infiltration testing information (Attachment E, included in the NOI Instructions) must be submitted for all Bio-infiltration BMPs included in PCSM/SR plan.

For Rate control provide the volume of stormwater treated and acres treated for the 100-year/24-hour storm event.

For volume control and water quality provide the volume of stormwater treated and acres treated for the 2-year/24-hour storm event.

Key for BMP purpose(s): VC = Volume Control; RC = Rate Control; and WQ = Water Quality

| BMP | Function(s) | Purpose(s) | Volume of stormwater treated | Acres treated |
|---|---|---|---|---|
| **Site Restoration ONLY**<br>☒ Restore Site to Meadow in Good Condition or Better, or Existing Conditions | Infiltration/Recharge<br>Detention/WQ Treatment | ☒ VC ☒ RC ☒ WQ | _____ | _____ |
| **Bio-infiltration areas** | Infiltration/Recharge | | | |
| ☐ Infiltration Trench | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Infiltration Bed | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Infiltration Basin | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Rain Garden/ Bioretention | | ☐ VC ☐ RC ☐ WQ | _____ | |
| ☐ Infiltration Berm | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |

| | | | | |
|---|---|---|---|---|
| **Natural Area Conservation** | Infiltration/Recharge | | | |
| ☐ Streamside Buffer Zone | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Wetland Buffer Zone | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Sensitive Area Buffer Zone | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Pre-Construction Drainage Pattern Intact | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| **Stormwater Retention** | Detention/Retention | | | |
| ☐ Constructed Wetlands | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Wet Ponds | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Retention Basin | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| **Sediment and Pollutant Removal** | Water Quality Treatment | | | |
| ☐ Vegetated Filter Strips | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Compost Filter Sock | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Detention Basins | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| **Access Road Design** | Infiltration/Recharge | | | |
| ☐ Road Crowning | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Ditches | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Turnouts | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Culverts | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Roadside Vegetated Filter Strips | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| **Stormwater Energy Dissipaters** | Infiltration/Recharge | | | |
| ☐ Level Spreaders | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Riprap Aprons | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Upslope Diversions | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Other_____ | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |

**g. Critical PCSM Plan stages**

Identify and list critical stages of implementation of the PCSM Plan for which a licensed professional or designee shall be present on site.

License professional to be present during the site restoration activities as noted the in Site Restoration Schedule.

**e. Summary Table for Supporting Calculation and Measurement Data**
***(See NOI Instructions for additional guidance with this section)***

The remainder of this section (Summary Table for Calculation and Measurement Data) does not need to be completed for areas of projects involving oil and gas activities authorized by Chapter 78 or Chapter 78a (well pads) or pipelines and other similar utility infrastructure which will be restored to meadow in good condition or better or existing conditions.

**Watershed Name: Schuylkill River**

| Volume Control design storm frequency N/A<br>Rainfall amount N/A inches | Pre-construction | Post Construction | Net Change |
|---|---|---|---|
| Impervious area (acres) | N/A | N/A | N/A |
| Volume of stormwater runoff (acre-feet) without planned stormwater BMPs | N/A | N/A | N/A |
| Volume of stormwater runoff (acre-feet) with planned stormwater BMPs | | N/A | N/A |
| Stormwater discharge rate for the design frequency storm | Pre-construction | Post Construction | Net Change |
| 1) 2-Year/24-Hour | N/A | N/A | N/A |
| 2) 10-Year/24-Hour | N/A | N/A | N/A |
| 3) 50-year/24-Hour | N/A | N/A | N/A |
| 4) 100-year/24-Hour | N/A | N/A | N/A |

**f. Summary Description of PCSM/SR BMPs** **SITE RESTORATION ONLY**

In the lists below, check the BMPs identified in the PCSM Plan. The primary function(s) of the BMP listed in the functions column (infiltration/recharge; detention/retention; water quality). Additional functions may be added if applicable to that BMP. List the stormwater volume and area of runoff to be treated by each BMP type when calculations are required. If any BMP in the PCSM/SR Plan is not listed below, describe it in the space provided after "Other". A summary table with infiltration testing information (Attachment E, included in the NOI Instructions) must be submitted for all Bio-infiltration BMPs included in PCSM/SR plan.

For Rate control provide the volume of stormwater treated and acres treated for the 100-year/24-hour storm event.

For volume control and water quality provide the volume of stormwater treated and acres treated for the 2-year/24-hour storm event.

Key for BMP purpose(s): VC = Volume Control; RC = Rate Control; and WQ = Water Quality

| BMP | Function(s) | Purpose(s) | Volume of stormwater treated | Acres treated |
|---|---|---|---|---|
| **Site Restoration ONLY**<br>☒ Restore Site to Meadow in Good Condition or Better, or Existing Conditions | Infiltration/Recharge<br>Detention/WQ Treatment | ☒ VC ☒ RC ☒ WQ | _____ | _____ |
| **Bio-infiltration areas**<br>☐ Infiltration Trench<br>☐ Infiltration Bed<br>☐ Infiltration Basin<br>☐ Rain Garden/ Bioretention<br>☐ Infiltration Berm | Infiltration/Recharge | <br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | <br>_____<br>_____<br>_____<br>_____<br>_____ | <br>_____<br>_____<br>_____<br><br>_____ |

| | | | | |
|---|---|---|---|---|
| **Natural Area Conservation**<br>☐ Streamside Buffer Zone<br>☐ Wetland Buffer Zone<br>☐ Sensitive Area Buffer Zone<br>☐ Pre-Construction Drainage Pattern Intact | Infiltration/Recharge | ☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | _____<br>_____<br>_____<br>_____ | _____<br>_____<br>_____<br>_____ |
| **Stormwater Retention**<br>☐ Constructed Wetlands<br>☐ Wet Ponds<br>☐ Retention Basin | Detention/Retention | ☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | _____<br>_____<br>_____ | _____<br>_____<br>_____ |
| **Sediment and Pollutant Removal**<br>☐ Vegetated Filter Strips<br>☐ Compost Filter Sock<br>☐ Detention Basins | Water Quality Treatment | ☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | _____<br>_____<br>_____ | _____<br>_____<br>_____ |
| **Access Road Design**<br>☐ Road Crowning<br>☐ Ditches<br>☐ Turnouts<br>☐ Culverts<br>☐ Roadside Vegetated Filter Strips | Infiltration/Recharge | ☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | _____<br>_____<br>_____<br>_____<br>_____ | _____<br>_____<br>_____<br>_____<br>_____ |
| **Stormwater Energy Dissipaters**<br>☐ Level Spreaders<br>☐ Riprap Aprons<br>☐ Upslope Diversions<br>☐ Other_____ | Infiltration/Recharge | ☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | _____<br>_____<br>_____<br>_____ | _____<br>_____<br>_____<br>_____ |

**g. Critical PCSM Plan stages**

Identify and list critical stages of implementation of the PCSM Plan for which a licensed professional or designee shall be present on site.

License professional to be present during the site restoration activities as noted the in Site Restoration Schedule.

**e. Summary Table for Supporting Calculation and Measurement Data**
***(See NOI Instructions for additional guidance with this section)***

The remainder of this section (Summary Table for Calculation and Measurement Data) does not need to be completed for areas of projects involving oil and gas activities authorized by Chapter 78 or Chapter 78a (well pads) or pipelines and other similar utility infrastructure which will be restored to meadow in good condition or better or existing conditions.

**Watershed Name: Stony Run**

| Volume Control design storm frequency N/A<br>Rainfall amount N/A inches | Pre-construction | Post Construction | Net Change |
|---|---|---|---|
| Impervious area (acres) | N/A | N/A | N/A |
| Volume of stormwater runoff (acre-feet) without planned stormwater BMPs | N/A | N/A | N/A |
| Volume of stormwater runoff (acre-feet) with planned stormwater BMPs | | N/A | N/A |
| Stormwater discharge rate for the design frequency storm | Pre-construction | Post Construction | Net Change |
| 1) 2-Year/24-Hour | N/A | N/A | N/A |
| 2) 10-Year/24-Hour | N/A | N/A | N/A |
| 3) 50-year/24-Hour | N/A | N/A | N/A |
| 4) 100-year/24-Hour | N/A | N/A | N/A |

**f. Summary Description of PCSM/SR BMPs** **SITE RESTORATION ONLY**

In the lists below, check the BMPs identified in the PCSM Plan. The primary function(s) of the BMP listed in the functions column (infiltration/recharge; detention/retention; water quality). Additional functions may be added if applicable to that BMP. List the stormwater volume and area of runoff to be treated by each BMP type when calculations are required. If any BMP in the PCSM/SR Plan is not listed below, describe it in the space provided after "Other". A summary table with infiltration testing information (Attachment E, included in the NOI Instructions) must be submitted for all Bio-infiltration BMPs included in PCSM/SR plan.

For Rate control provide the volume of stormwater treated and acres treated for the 100-year/24-hour storm event.

For volume control and water quality provide the volume of stormwater treated and acres treated for the 2-year/24-hour storm event.

Key for BMP purpose(s): VC = Volume Control; RC = Rate Control; and WQ = Water Quality

| BMP | Function(s) | Purpose(s) | Volume of stormwater treated | Acres treated |
|---|---|---|---|---|
| **Site Restoration ONLY**<br>☒ Restore Site to Meadow in Good Condition or Better, or Existing Conditions | Infiltration/Recharge<br>Detention/WQ Treatment | ☒ VC ☒ RC ☒ WQ | _____ | _____ |
| **Bio-infiltration areas** | Infiltration/Recharge | | | |
| ☐ Infiltration Trench | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Infiltration Bed | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Infiltration Basin | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Rain Garden/ Bioretention | | ☐ VC ☐ RC ☐ WQ | _____ | |
| ☐ Infiltration Berm | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |

| | | | | |
|---|---|---|---|---|
| **Natural Area Conservation**<br>☐ Streamside Buffer Zone<br>☐ Wetland Buffer Zone<br>☐ Sensitive Area Buffer Zone<br>☐ Pre-Construction Drainage Pattern Intact | Infiltration/Recharge | ☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | _____<br>_____<br>_____<br>_____ | _____<br>_____<br>_____<br>_____ |
| **Stormwater Retention**<br>☐ Constructed Wetlands<br>☐ Wet Ponds<br>☐ Retention Basin | Detention/Retention | ☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | _____<br>_____<br>_____ | _____<br>_____<br>_____ |
| **Sediment and Pollutant Removal**<br>☐ Vegetated Filter Strips<br>☐ Compost Filter Sock<br>☐ Detention Basins | Water Quality Treatment | ☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | _____<br>_____<br>_____ | _____<br>_____<br>_____ |
| **Access Road Design**<br>☐ Road Crowning<br>☐ Ditches<br>☐ Turnouts<br>☐ Culverts<br>☐ Roadside Vegetated Filter Strips | Infiltration/Recharge | ☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | _____<br>_____<br>_____<br>_____<br>_____ | _____<br>_____<br>_____<br>_____<br>_____ |
| **Stormwater Energy Dissipaters**<br>☐ Level Spreaders<br>☐ Riprap Aprons<br>☐ Upslope Diversions<br>☐ Other_____ | Infiltration/Recharge | ☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | _____<br>_____<br>_____<br>_____ | _____<br>_____<br>_____<br>_____ |

**g. Critical PCSM Plan stages**

Identify and list critical stages of implementation of the PCSM Plan for which a licensed professional or designee shall be present on site.

License professional to be present during the site restoration activities as noted the in Site Restoration Schedule.

**e. Summary Table for Supporting Calculation and Measurement Data**
***(See NOI Instructions for additional guidance with this section)***

The remainder of this section (Summary Table for Calculation and Measurement Data) does not need to be completed for areas of projects involving oil and gas activities authorized by Chapter 78 or Chapter 78a (well pads) or pipelines and other similar utility infrastructure which will be restored to meadow in good condition or better or existing conditions.

**Watershed Name: Ridley Creek**

| Volume Control design storm frequency N/A<br>Rainfall amount N/A inches | Pre-construction | Post Construction | Net Change |
|---|---|---|---|
| Impervious area (acres) | N/A | N/A | N/A |
| Volume of stormwater runoff (acre-feet) without planned stormwater BMPs | N/A | N/A | N/A |
| Volume of stormwater runoff (acre-feet) with planned stormwater BMPs | | N/A | N/A |
| Stormwater discharge rate for the design frequency storm | Pre-construction | Post Construction | Net Change |
| 1) 2-Year/24-Hour | N/A | N/A | N/A |
| 2) 10-Year/24-Hour | N/A | N/A | N/A |
| 3) 50-year/24-Hour | N/A | N/A | N/A |
| 4) 100-year/24-Hour | N/A | N/A | N/A |

**f. Summary Description of PCSM/SR BMPs** **SITE RESTORATION ONLY**

In the lists below, check the BMPs identified in the PCSM Plan. The primary function(s) of the BMP listed in the functions column (infiltration/recharge; detention/retention; water quality). Additional functions may be added if applicable to that BMP. List the stormwater volume and area of runoff to be treated by each BMP type when calculations are required. If any BMP in the PCSM/SR Plan is not listed below, describe it in the space provided after "Other". A summary table with infiltration testing information (Attachment E, included in the NOI Instructions) must be submitted for all Bio-infiltration BMPs included in PCSM/SR plan.

For Rate control provide the volume of stormwater treated and acres treated for the 100-year/24-hour storm event.

For volume control and water quality provide the volume of stormwater treated and acres treated for the 2-year/24-hour storm event.

Key for BMP purpose(s): VC = Volume Control; RC = Rate Control; and WQ = Water Quality

| BMP | Function(s) | Purpose(s) | Volume of stormwater treated | Acres treated |
|---|---|---|---|---|
| **Site Restoration ONLY**<br>☒ Restore Site to Meadow in Good Condition or Better, or Existing Conditions | Infiltration/Recharge<br>Detention/WQ Treatment | ☒ VC ☒ RC ☒ WQ | _____ | _____ |
| **Bio-infiltration areas** | Infiltration/Recharge | | | |
| ☐ Infiltration Trench | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Infiltration Bed | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Infiltration Basin | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Rain Garden/ Bioretention | | ☐ VC ☐ RC ☐ WQ | _____ | |
| ☐ Infiltration Berm | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |

| | | | | |
|---|---|---|---|---|
| **Natural Area Conservation**<br>☐ Streamside Buffer Zone<br>☐ Wetland Buffer Zone<br>☐ Sensitive Area Buffer Zone<br>☐ Pre-Construction Drainage Pattern Intact | Infiltration/Recharge | ☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | _____<br>_____<br>_____<br>_____ | _____<br>_____<br>_____<br>_____ |
| **Stormwater Retention**<br>☐ Constructed Wetlands<br>☐ Wet Ponds<br>☐ Retention Basin | Detention/Retention | ☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | _____<br>_____<br>_____ | _____<br>_____<br>_____ |
| **Sediment and Pollutant Removal**<br>☐ Vegetated Filter Strips<br>☐ Compost Filter Sock<br>☐ Detention Basins | Water Quality Treatment | ☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | _____<br>_____<br>_____ | _____<br>_____<br>_____ |
| **Access Road Design**<br>☐ Road Crowning<br>☐ Ditches<br>☐ Turnouts<br>☐ Culverts<br>☐ Roadside Vegetated Filter Strips | Infiltration/Recharge | ☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | _____<br>_____<br>_____<br>_____<br>_____ | _____<br>_____<br>_____<br>_____<br>_____ |
| **Stormwater Energy Dissipaters**<br>☐ Level Spreaders<br>☐ Riprap Aprons<br>☐ Upslope Diversions<br>☐ Other_____ | Infiltration/Recharge | ☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | _____<br>_____<br>_____<br>_____ | _____<br>_____<br>_____<br>_____ |

**g. Critical PCSM Plan stages**

Identify and list critical stages of implementation of the PCSM Plan for which a licensed professional or designee shall be present on site.

License professional to be present during the site restoration activities as noted the in Site Restoration Schedule.

## SECTION H. POST CONSTRUCTION STORMWATER MANAGEMENT (PCSM) AND/OR SITE RESTORATION(SR) PLAN

**See NOI Instructions for additional guidance with PCSM Plans**

PCSM/SR BMPs should be designed to use natural measures to eliminate pollution, infiltrate runoff, not require extensive construction/maintenance, promote pollutant reduction, and preserve the integrity of stream channels. All PCSM/SR BMPs proposed in the PCSM/SR Plan must be designed in accordance with Ch. 102, Ch. 78a for unconventional operations, Ch. 78 for conventional operations and the *Pennsylvania Stormwater Best Management Practices Manual (Stormwater BMP Manual)* (363-0300-002). If alternate design criteria are utilized for the proposed project, they must have prior approval by the Department, or the NOI Application will be returned to the Applicant.

After construction is completed, how much of the entire disturbed area will be restored to meadow in good condition or better, or existing conditions? ☐ All ☒ Partial ☐ None

Include PCSM narrative and drawings for remaining impervious area. Also include a map showing the proposed contours of the site restoration plan.

If there are additional stages of the project prior to permit termination or expiration, list the stages and provide the documents required by subsection 'a' to section 'g' for each stage (e.g. partial restoration or changes to the amount of compacted areas, gravel, and/or impervious areas). Upload a narrative for each additional stage in addition to the drawings.

**EXAMPLE**

| Stage No | Stage Name | PCSM Plan | SR Plan |
|---|---|---|---|
| Stage 1 | Adelphia Gateway | ☒ | ☒ |
| Stage 2 | Tilghman & Parkway Laterals | ☐ | ☒ |
| Stage 3 | | ☐ | ☐ |
| Stage 4 | | ☐ | ☐ |

**Act 167 Consistency**. Check those that apply.

Is there an Act 167 Plan? ☐ Yes ☒ No

**Sites:**
**Transco Meter Station**
**Marcus Hook Compressor Station**

☐ The attached PCSM/SR Plan is consistent with an applicable approved Act 167 Plan.

Complete the following for all approved Act 167 Stormwater Management Plans. (Use additional sheets if necessary)

| Act 167 Plan Name | Date Adopted | |
|---|---|---|
| **Naaman's Creek** | N/A | Consistency Letter Included ☐ |
| | | Verification Report Included ☐ |

*Note: A consistency letter is not required if a verification report is provided. See NOI Instructions. The PCSM/SR Plan must satisfy either sub paragraph 1, 2, or 3 below. Check those that apply.*

1. ☐ Act 167 Plan approvals on or after January 2005 – The attached PCSM/SR Plan, in its entirety, is consistent with all requirements pertaining to rate, volume, and water quality from an Act 167 Stormwater Management Plan approved by DEP on or after January 2005. Box 1 must be checked if a current, DEP approved Act 167 plan exists.

2. ☒ The PCSM/SR Plan meets the standard design criteria from sections 102.8(g)(2) and (3) and the *Stormwater BMP Manual*. For projects involving oil and gas activities authorized by a permit issued under Chapter 78 or Chapter 78a (well pads) or pipelines and other similar utility infrastructure, post construction stormwater management requirements are met for all areas that are restored to preconstruction conditions or to a condition of meadow in good condition or better. *[Note: PCSM plans must meet both the volume and rate requirements in the regulations, which are provided in the 2 sections mentioned in this paragraph].*

3. ☐ Alternative Design Standard – The attached PCSM/SR Plan was developed using approaches as provided in 102.8(g)(2)(iv) and 102.8(g)(3)(iii). Demonstrate/explain in the space provided below how this standard will be either more protective than what is required in 102.8(g)(2) and 102.8(g)(3) or will maintain and protect existing water quality and existing and designated uses.

**PCSM/SR BMP Alternative Standards**:

Has the alternative BMP or design standard been approved by the Department?

☐ Yes

☐ No – Do not submit the ESCGP-3 application and see Section (H) of the NOI Instructions concerning the alternative BMP approval process.

**Water Quality Compliance:**

Does the PCSM/SR plan comply with requirements for volume control? ☒ Yes ☐ No

If yes, is at least 90% of the disturbed area controlled by a PCSM BMP? ☐ Yes ☒ No

If yes, do you have the Standard PCSM Worksheet # 10 attached to show water quality compliance has achieved?
☐ Yes ☐ No

If no, attach Standard PCSM Worksheets # 12 and #13 to show water quality compliance has achieved.

If PCSM/SR plan is not complying with the requirements for volume control, attach Standard PCSM Worksheets # 11, # 12 and #13 to show water quality compliance has achieved.

**See PCSM Narrative, Section VII & App. D.1**

**a. PCSM/SR Plan Summary**

Provide a summary of proposed BMPs and their performance to manage PCSM/SR for the project.

The following Best Management Practices (BMP), in accordance with Pennsylvania Stormwater BMP Manual, dated December 2006, have been integrated into the design to reduce runoff volume, reduce peak rates and improve water quality. These structural BMPs will result in the prevention or minimization of increased stormwater runoff rate, volume and/or changes in stormwater runoff. Implementing these controls will preserve the integrity of stream channels and maintain and protect the physical, biological and chemical qualities of the receiving stream.

A vegetated MRC BMP will be constructed at Marcus Hook Compressor Station. This structural BMP serves the functions of volume reduction, runoff quality and peak rate reduction. A subsurface infiltration bed (BMP 6.4.3, StormTank) will be constructed at Transco Meter Station. This structural BMP serves the functions of volume reduction, runoff quality and peak rate reduction.

Check all that apply ☒ PCSM BMPs ☐ SR BMPs

**b.** Do you have any information regarding riparian buffer which differs from what was submitted in the Section G, Riparian Buffer?

☐ Yes ☒ No

Explain:

**c. Thermal Impacts Analysis**

Explain how thermal impacts associated with this project were avoided, minimized, or mitigated.

Thermal impacts associated with the project will be minimized and/or mitigated through the incorporation of a vegetated MRC BMP. Runoff from the impervious areas will be directed to the BMPs where the travel time is increased to infiltrate and/or store runoff, reducing the quantity and temperature of the runoff.

The subsurface basin at Transco Meter Station will temporarily store stormwater runoff beneath the surface, away from direct sunlight and will promote infiltration which will release water into the groundwater instead of discharging to the surface waters.The surface basin at Marcus Hook Compressor Station will be vegetated. Landscaping and vegetative cover will mimic natural ecosystems, resulting in a system that is resistant to climatic stresses. Additionally, the basin's outlet structure is designed to promote the slow release of outflow to the surface waters.

**d. Off-Site Discharge Analysis.**

Does the activity propose any off-site discharges to areas other than surface waters? ☒ Yes ☐ No

If yes, it is the applicant's responsibility to ensure that they have legal authority for any off-site discharge to neighboring properties.

The Applicant must provide a demonstration in both the E&S and PCSM/SR Plans that the discharge will not cause erosion, damage, or a nuisance to off-site properties.

**See PCSM Narrative, Section XI, Page 15**

**e. Summary Table for Supporting Calculation and Measurement Data**
***(See NOI Instructions for additional guidance with this section)***

The remainder of this section (Summary Table for Calculation and Measurement Data) does not need to be completed for areas of projects involving oil and gas activities authorized by Chapter 78 or Chapter 78a (well pads) or pipelines and other similar utility infrastructure which will be restored to meadow in good condition or better or existing conditions.

**Watershed Name: Naamans Creek (Site - Marcus Hook Compressor Site)**

| Volume Control design storm frequency 2-yr<br>Rainfall amount 3.4 inches | Pre-construction | Post Construction | Net Change |
|---|---|---|---|
| Impervious area (acres) | 0.56 | 1.39 | +0.83 |
| Volume of stormwater runoff (acre-feet) without planned stormwater BMPs | 1.418 | 1.416 | -0.002 |
| Volume of stormwater runoff (acre-feet) with planned stormwater BMPs | | 0.377 | +0.375 |
| Stormwater discharge rate for the design frequency storm | Pre-construction | Post Construction | Net Change |
| 1) 2-Year/24-Hour | 28.74 | 18.94 | -9.80 |
| 2) 10-Year/24-Hour | 44.85 | 29.23 | -15.62 |
| 3) 50-year/24-Hour | 67.52 | 43.18 | -19.54 |
| 4) 100-year/24-Hour | 80.43 | 25.70 | -23.15 |

**f. Summary Description of PCSM/SR BMPs**

In the lists below, check the BMPs identified in the PCSM Plan. The primary function(s) of the BMP listed in the functions column (infiltration/recharge; detention/retention; water quality). Additional functions may be added if applicable to that BMP. List the stormwater volume and area of runoff to be treated by each BMP type when calculations are required. If any BMP in the PCSM/SR Plan is not listed below, describe it in the space provided after "Other". A summary table with infiltration testing information (Attachment E, included in the NOI Instructions) must be submitted for all Bio-infiltration BMPs included in PCSM/SR plan.

For Rate control provide the volume of stormwater treated and acres treated for the 100-year/24-hour storm event.

For volume control and water quality provide the volume of stormwater treated and acres treated for the 2-year/24-hour storm event.

Key for BMP purpose(s): VC = Volume Control; RC = Rate Control; and WQ = Water Quality

| BMP | Function(s) | Purpose(s) | Volume of stormwater treated | Acres treated |
|---|---|---|---|---|
| **Site Restoration ONLY**<br>☐ Restore Site to Meadow in Good Condition or Better, or Existing Conditions | Infiltration/Recharge<br>Detention/WQ Treatment | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| **Bio-infiltration areas** | Infiltration/Recharge | | | |
| ☐ Infiltration Trench | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Infiltration Bed | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Infiltration Basin | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☒ Rain Garden/ Bioretention(MRC) | | ☒ VC ☒ RC ☒ WQ | 0.377 | 2.20 |
| ☐ Infiltration Berm | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |

| | | | | |
|---|---|---|---|---|
| **Natural Area Conservation**<br>☐ Streamside Buffer Zone<br>☐ Wetland Buffer Zone<br>☐ Sensitive Area Buffer Zone<br>☐ Pre-Construction Drainage Pattern Intact | Infiltration/Recharge | ☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | _____<br>_____<br>_____<br>_____ | _____<br>_____<br>_____<br>_____ |
| **Stormwater Retention**<br>☐ Constructed Wetlands<br>☐ Wet Ponds<br>☐ Retention Basin | Detention/Retention | ☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | _____<br>_____<br>_____ | _____<br>_____<br>_____ |
| **Sediment and Pollutant Removal**<br>☐ Vegetated Filter Strips<br>☐ Compost Filter Sock<br>☐ Detention Basins | Water Quality Treatment | ☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | _____<br>_____<br>_____ | _____<br>_____<br>_____ |
| **Access Road Design**<br>☐ Road Crowning<br>☐ Ditches<br>☐ Turnouts<br>☐ Culverts<br>☐ Roadside Vegetated Filter Strips | Infiltration/Recharge | ☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | _____<br>_____<br>_____<br>_____<br>_____ | _____<br>_____<br>_____<br>_____<br>_____ |
| **Stormwater Energy Dissipaters**<br>☐ Level Spreaders<br>☐ Riprap Aprons<br>☐ Upslope Diversions<br>☐ Other_____ | Infiltration/Recharge | ☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | _____<br>_____<br>_____<br>_____ | _____<br>_____<br>_____<br>_____ |

**g. Critical PCSM Plan stages**

Identify and list critical stages of implementation of the PCSM Plan for which a licensed professional or designee shall be present on site.

A licensed professional should be present and witness the following stages in construction:

Excavation and final grading of the BMP.

Placement of geotextile and aggregate within the BMP.

Construction of the outlet structure and discharging of piping from the BMP.

**e. Summary Table for Supporting Calculation and Measurement Data**
***(See NOI Instructions for additional guidance with this section)***

The remainder of this section (Summary Table for Calculation and Measurement Data) does not need to be completed for areas of projects involving oil and gas activities authorized by Chapter 78 or Chapter 78a (well pads) or pipelines and other similar utility infrastructure which will be restored to meadow in good condition or better or existing conditions.

**Watershed Name: Naamans Creek (Site - Transco Meter Station Site)**

| Volume Control design storm frequency 2-yr<br>Rainfall amount 3.4 inches | Pre-construction | Post Construction | Net Change |
|---|---|---|---|
| Impervious area (acres) | 0.00 | 0.10 | +0.10 |
| Volume of stormwater runoff (acre-feet) without planned stormwater BMPs | 0.073 | 0.172 | +0.099 |
| Volume of stormwater runoff (acre-feet) with planned stormwater BMPs | | 0.105 | +0.006 |
| Stormwater discharge rate for the design frequency storm | Pre-construction | Post Construction | Net Change |
| 1) 2-Year/24-Hour | 1.29 | 1.19 | -0.10 |
| 2) 10-Year/24-Hour | 2.79 | 1.89 | -0.90 |
| 3) 50-year/24-Hour | 5.20 | 3.93 | -1.27 |
| 4) 100-year/24-Hour | 6.65 | 5.78 | -0.87 |

**f. Summary Description of PCSM/SR BMPs**

In the lists below, check the BMPs identified in the PCSM Plan. The primary function(s) of the BMP listed in the functions column (infiltration/recharge; detention/retention; water quality). Additional functions may be added if applicable to that BMP. List the stormwater volume and area of runoff to be treated by each BMP type when calculations are required. If any BMP in the PCSM/SR Plan is not listed below, describe it in the space provided after "Other". A summary table with infiltration testing information (Attachment E, included in the NOI Instructions) must be submitted for all Bio-infiltration BMPs included in PCSM/SR plan.

For Rate control provide the volume of stormwater treated and acres treated for the 100-year/24-hour storm event.

For volume control and water quality provide the volume of stormwater treated and acres treated for the 2-year/24-hour storm event.

Key for BMP purpose(s): VC = Volume Control; RC = Rate Control; and WQ = Water Quality

| BMP | Function(s) | Purpose(s) | Volume of stormwater treated | Acres treated |
|---|---|---|---|---|
| **Site Restoration ONLY**<br>☐ Restore Site to Meadow in Good Condition or Better, or Existing Conditions | Infiltration/Recharge<br>Detention/WQ Treatment | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| **Bio-infiltration areas** | Infiltration/Recharge | | | |
| ☐ Infiltration Trench | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☒ Infiltration Bed | | ☒ VC ☒ RC ☒ WQ | 0.105 | 0.64 |
| ☐ Infiltration Basin | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Rain Garden/ Bioretention | | ☐ VC ☐ RC ☐ WQ | _____ | |
| ☐ Infiltration Berm | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |

| | | | | |
|---|---|---|---|---|
| **Natural Area Conservation**<br>☐ Streamside Buffer Zone<br>☐ Wetland Buffer Zone<br>☐ Sensitive Area Buffer Zone<br>☐ Pre-Construction Drainage Pattern Intact | Infiltration/Recharge | ☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | _____<br>_____<br>_____<br>_____ | _____<br>_____<br>_____<br>_____ |
| **Stormwater Retention**<br>☐ Constructed Wetlands<br>☐ Wet Ponds<br>☐ Retention Basin | Detention/Retention | ☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | _____<br>_____<br>_____ | _____<br>_____<br>_____ |
| **Sediment and Pollutant Removal**<br>☐ Vegetated Filter Strips<br>☐ Compost Filter Sock<br>☐ Detention Basins | Water Quality Treatment | ☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | _____<br>_____<br>_____ | _____<br>_____<br>_____ |
| **Access Road Design**<br>☐ Road Crowning<br>☐ Ditches<br>☐ Turnouts<br>☐ Culverts<br>☐ Roadside Vegetated Filter Strips | Infiltration/Recharge | ☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | _____<br>_____<br>_____<br>_____<br>_____ | _____<br>_____<br>_____<br>_____<br>_____ |
| **Stormwater Energy Dissipaters**<br>☐ Level Spreaders<br>☐ Riprap Aprons<br>☐ Upslope Diversions<br>☐ Other_____ | Infiltration/Recharge | ☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | _____<br>_____<br>_____<br>_____ | _____<br>_____<br>_____<br>_____ |

**g. Critical PCSM Plan stages**

Identify and list critical stages of implementation of the PCSM Plan for which a licensed professional or designee shall be present on site.

A licensed professional should be present and witness the following stages in construction:

Excavation and final grading of the BMP.

Placement of geotextile and aggregate within the BMP.

Construction of the outlet structure and discharging of piping from the BMP.

## SECTION H. POST CONSTRUCTION STORMWATER MANAGEMENT (PCSM) AND/OR SITE RESTORATION(SR) PLAN

**See NOI Instructions for additional guidance with PCSM Plans**

PCSM/SR BMPs should be designed to use natural measures to eliminate pollution, infiltrate runoff, not require extensive construction/maintenance, promote pollutant reduction, and preserve the integrity of stream channels. All PCSM/SR BMPs proposed in the PCSM/SR Plan must be designed in accordance with Ch. 102, Ch. 78a for unconventional operations, Ch. 78 for conventional operations and the *Pennsylvania Stormwater Best Management Practices Manual (Stormwater BMP Manual)* (363-0300-002). If alternate design criteria are utilized for the proposed project, they must have prior approval by the Department, or the NOI Application will be returned to the Applicant.

After construction is completed, how much of the entire disturbed area will be restored to meadow in good condition or better, or existing conditions? ☒ All ☐ Partial ☐ None

Include PCSM narrative and drawings for remaining impervious area. Also include a map showing the proposed contours of the site restoration plan.

If there are additional stages of the project prior to permit termination or expiration, list the stages and provide the documents required by subsection 'a' to section 'g' for each stage (e.g. partial restoration or changes to the amount of compacted areas, gravel, and/or impervious areas). Upload a narrative for each additional stage in addition to the drawings.

**EXAMPLE**

| Stage No | Stage Name | PCSM Plan | SR Plan |
|---|---|---|---|
| Stage 1 | Adelphia Gateway | ☒ | ☒ |
| Stage 2 | Tilghman & Parkway Laterals | ☐ | ☒ |
| Stage 3 | | ☐ | ☐ |
| Stage 4 | | ☐ | ☐ |

**Act 167 Consistency**. Check those that apply.

Is there an Act 167 Plan? ☒ Yes ☐ No

**Sites:**
**East Perkiomen Creek**
**Skippack Pike Meter Station**
**Perkiomen Creek Blowdown**

☒ The attached PCSM/SR Plan is consistent with an applicable approved Act 167 Plan.

Complete the following for all approved Act 167 Stormwater Management Plans. (Use additional sheets if necessary)

| Act 167 Plan Name | Date Adopted | Consistency Letter Included | ☐ |
|---|---|---|---|
| **East Branch of Perkiomen Creek** | May 5, 2004 | Verification Report Included | ☒ |

*Note: A consistency letter is not required if a verification report is provided. See NOI Instructions. The PCSM/SR Plan must satisfy either sub paragraph 1, 2, or 3 below. Check those that apply.*

1. ☒ Act 167 Plan approvals on or after January 2005 – The attached PCSM/SR Plan, in its entirety, is consistent with all requirements pertaining to rate, volume, and water quality from an Act 167 Stormwater Management Plan approved by DEP on or after January 2005. Box 1 must be checked if a current, DEP approved Act 167 plan exists.

2. ☒ The PCSM/SR Plan meets the standard design criteria from sections 102.8(g)(2) and (3) and the *Stormwater BMP Manual*. For projects involving oil and gas activities authorized by a permit issued under Chapter 78 or Chapter 78a (well pads) or pipelines and other similar utility infrastructure, post construction stormwater management requirements are met for all areas that are restored to preconstruction conditions or to a condition of meadow in good condition or better. *[Note: PCSM plans must meet both the volume and rate requirements in the regulations, which are provided in the 2 sections mentioned in this paragraph].*

3. ☐ Alternative Design Standard – The attached PCSM/SR Plan was developed using approaches as provided in 102.8(g)(2)(iv) and 102.8(g)(3)(iii). Demonstrate/explain in the space provided below how this standard will be either more protective than what is required in 102.8(g)(2) and 102.8(g)(3) or will maintain and protect existing water quality and existing and designated uses.

**PCSM/SR BMP Alternative Standards**:

Has the alternative BMP or design standard been approved by the Department?

☐ Yes

☐ No – Do not submit the ESCGP-3 application and see Section (H) of the NOI Instructions concerning the alternative BMP approval process.

**Water Quality Compliance:**

Does the PCSM/SR plan comply with requirements for volume control? ☒ Yes ☐ No

If yes, is at least 90% of the disturbed area controlled by a PCSM BMP? ☒ Yes ☐ No

If yes, do you have the Standard PCSM Worksheet # 10 attached to show water quality compliance has achieved?
☐ Yes ☒ No → **SITE RESTORATION ONLY - MEET SECTION 102.8(g)(2) and (3). Per 102.8(n), WORKSHEET #10, #12 & #13 ARE NOT APPLICABLE**

If no, attach Standard PCSM Worksheets # 12 and #13 to show water quality compliance has achieved.

If PCSM/SR plan is not complying with the requirements for volume control, attach Standard PCSM Worksheets # 11, # 12 and #13 to show water quality compliance has achieved.

**a. PCSM/SR Plan Summary**

Provide a summary of proposed BMPs and their performance to manage PCSM/SR for the project.

All sites will be restored to pre-existing conditions. By limiting the disturbed areas, limiting extent and duration of disturbance and performing site restoration, these practices will eliminate the net change in rate, volume and water quality after construction.

Check all that apply ☐ PCSM BMPs ☒ SR BMPs

**b.** Do you have any information regarding riparian buffer which differs from what was submitted in the Section G, Riparian Buffer?

☐ Yes ☒ No

Explain:

**c. Thermal Impacts Analysis**

Explain how thermal impacts associated with this project were avoided, minimized, or mitigated.

Thermal impacts have been minimized by limiting the disturbed area to the maximum extent practicable. By minimizing the extent of the disturbed area, vegetative clearing has been minimized. Thermal impacts will also be minimizing the duration of disturbance and reseeding and restoring vegetative growth as soon as possible.

**d. Off-Site Discharge Analysis.**

Does the activity propose any off-site discharges to areas other than surface waters? ☒ Yes ☐ No

If yes, it is the applicant's responsibility to ensure that they have legal authority for any off-site discharge to neighboring properties.

The Applicant must provide a demonstration in both the E&S and PCSM/SR Plans that the discharge will not cause erosion, damage, or a nuisance to off-site properties.

**See PCSM Narrative, Section XI, Page 15**

**e. Summary Table for Supporting Calculation and Measurement Data**
***(See NOI Instructions for additional guidance with this section)***

The remainder of this section (Summary Table for Calculation and Measurement Data) does not need to be completed for areas of projects involving oil and gas activities authorized by Chapter 78 or Chapter 78a (well pads) or pipelines and other similar utility infrastructure which will be restored to meadow in good condition or better or existing conditions.

**Watershed Name: Perkiomen Creek**

| Volume Control design storm frequency N/A<br>Rainfall amount N/A inches | Pre-construction | Post Construction | Net Change |
|---|---|---|---|
| Impervious area (acres) | N/A | N/A | N/A |
| Volume of stormwater runoff (acre-feet) without planned stormwater BMPs | N/A | N/A | N/A |
| Volume of stormwater runoff (acre-feet) with planned stormwater BMPs | | N/A | N/A |
| Stormwater discharge rate for the design frequency storm | Pre-construction | Post Construction | Net Change |
| 1) 2-Year/24-Hour | N/A | N/A | N/A |
| 2) 10-Year/24-Hour | N/A | N/A | N/A |
| 3) 50-year/24-Hour | N/A | N/A | N/A |
| 4) 100-year/24-Hour | N/A | N/A | N/A |

**f. Summary Description of PCSM/SR BMPs** **SITE RESTORATION ONLY**

In the lists below, check the BMPs identified in the PCSM Plan. The primary function(s) of the BMP listed in the functions column (infiltration/recharge; detention/retention; water quality). Additional functions may be added if applicable to that BMP. List the stormwater volume and area of runoff to be treated by each BMP type when calculations are required. If any BMP in the PCSM/SR Plan is not listed below, describe it in the space provided after "Other". A summary table with infiltration testing information (Attachment E, included in the NOI Instructions) must be submitted for all Bio-infiltration BMPs included in PCSM/SR plan.

For Rate control provide the volume of stormwater treated and acres treated for the 100-year/24-hour storm event.

For volume control and water quality provide the volume of stormwater treated and acres treated for the 2-year/24-hour storm event.

Key for BMP purpose(s): VC = Volume Control; RC = Rate Control; and WQ = Water Quality

| BMP | Function(s) | Purpose(s) | Volume of stormwater treated | Acres treated |
|---|---|---|---|---|
| **Site Restoration ONLY**<br>☐ Restore Site to Meadow in Good Condition or Better, or Existing Conditions | Infiltration/Recharge<br>Detention/WQ Treatment | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| **Bio-infiltration areas**<br>☐ Infiltration Trench<br>☐ Infiltration Bed<br>☐ Infiltration Basin<br>☐ Rain Garden/ Bioretention<br>☐ Infiltration Berm | Infiltration/Recharge | <br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | <br>_____<br>_____<br>_____<br>_____<br>_____ | <br>_____<br>_____<br>_____<br><br>_____ |

| | | | | |
|---|---|---|---|---|
| **Natural Area Conservation** | Infiltration/Recharge | | | |
| ☐ Streamside Buffer Zone | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Wetland Buffer Zone | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Sensitive Area Buffer Zone | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Pre-Construction Drainage Pattern Intact | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| **Stormwater Retention** | Detention/Retention | | | |
| ☐ Constructed Wetlands | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Wet Ponds | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Retention Basin | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| **Sediment and Pollutant Removal** | Water Quality Treatment | | | |
| ☐ Vegetated Filter Strips | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Compost Filter Sock | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Detention Basins | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| **Access Road Design** | Infiltration/Recharge | | | |
| ☐ Road Crowning | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Ditches | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Turnouts | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Culverts | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Roadside Vegetated Filter Strips | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| **Stormwater Energy Dissipaters** | Infiltration/Recharge | | | |
| ☐ Level Spreaders | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Riprap Aprons | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Upslope Diversions | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Other_____ | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |

**g. Critical PCSM Plan stages**

Identify and list critical stages of implementation of the PCSM Plan for which a licensed professional or designee shall be present on site.

License professional to be present during the site restoration activities as noted the in Site Restoration Schedule.

## SECTION H. POST CONSTRUCTION STORMWATER MANAGEMENT (PCSM) AND/OR SITE RESTORATION(SR) PLAN

**See NOI Instructions for additional guidance with PCSM Plans**

PCSM/SR BMPs should be designed to use natural measures to eliminate pollution, infiltrate runoff, not require extensive construction/maintenance, promote pollutant reduction, and preserve the integrity of stream channels. All PCSM/SR BMPs proposed in the PCSM/SR Plan must be designed in accordance with Ch. 102, Ch. 78a for unconventional operations, Ch. 78 for conventional operations and the *Pennsylvania Stormwater Best Management Practices Manual (Stormwater BMP Manual)* (363-0300-002). If alternate design criteria are utilized for the proposed project, they must have prior approval by the Department, or the NOI Application will be returned to the Applicant.

After construction is completed, how much of the entire disturbed area will be restored to meadow in good condition or better, or existing conditions? ☒ All ☐ Partial ☐ None

Include PCSM narrative and drawings for remaining impervious area. Also include a map showing the proposed contours of the site restoration plan.

If there are additional stages of the project prior to permit termination or expiration, list the stages and provide the documents required by subsection 'a' to section 'g' for each stage (e.g. partial restoration or changes to the amount of compacted areas, gravel, and/or impervious areas). Upload a narrative for each additional stage in addition to the drawings.

**EXAMPLE**

| Stage No | Stage Name | PCSM Plan | SR Plan |
|---|---|---|---|
| Stage 1 | Adelphia Gateway | ☒ | ☒ |
| Stage 2 | Tilghman & Parkway Laterals | ☐ | ☒ |
| Stage 3 | | ☐ | ☐ |
| Stage 4 | | ☐ | ☐ |

**Act 167 Consistency**. Check those that apply.

**Site:**
**Quakertown Compressor Station**

Is there an Act 167 Plan? ☒ Yes ☐ No

☒ The attached PCSM/SR Plan is consistent with an applicable approved Act 167 Plan.

Complete the following for all approved Act 167 Stormwater Management Plans. (Use additional sheets if necessary)

| Act 167 Plan Name | Date Adopted | Consistency Letter Included ☐ |
|---|---|---|
| **Tohickon Creek** | February 28, 2002 | Verification Report Included ☒ |

*Note: A consistency letter is not required if a verification report is provided. See NOI Instructions. The PCSM/SR Plan must satisfy either sub paragraph 1, 2, or 3 below. Check those that apply.*

1. ☐ Act 167 Plan approvals on or after January 2005 – The attached PCSM/SR Plan, in its entirety, is consistent with all requirements pertaining to rate, volume, and water quality from an Act 167 Stormwater Management Plan approved by DEP on or after January 2005. Box 1 must be checked if a current, DEP approved Act 167 plan exists.

2. ☒ The PCSM/SR Plan meets the standard design criteria from sections 102.8(g)(2) and (3) and the *Stormwater BMP Manual*. For projects involving oil and gas activities authorized by a permit issued under Chapter 78 or Chapter 78a (well pads) or pipelines and other similar utility infrastructure, post construction stormwater management requirements are met for all areas that are restored to preconstruction conditions or to a condition of meadow in good condition or better. *[Note: PCSM plans must meet both the volume and rate requirements in the regulations, which are provided in the 2 sections mentioned in this paragraph].*

3. ☐ Alternative Design Standard – The attached PCSM/SR Plan was developed using approaches as provided in 102.8(g)(2)(iv) and 102.8(g)(3)(iii). Demonstrate/explain in the space provided below how this standard will be either more protective than what is required in 102.8(g)(2) and 102.8(g)(3) or will maintain and protect existing water quality and existing and designated uses.

**PCSM/SR BMP Alternative Standards**:

Has the alternative BMP or design standard been approved by the Department?

☐ Yes

☐ No – Do not submit the ESCGP-3 application and see Section (H) of the NOI Instructions concerning the alternative BMP approval process.

**Water Quality Compliance:**

Does the PCSM/SR plan comply with requirements for volume control? ☒ Yes ☐ No

If yes, is at least 90% of the disturbed area controlled by a PCSM BMP? ☐ Yes ☒ No

If yes, do you have the Standard PCSM Worksheet # 10 attached to show water quality compliance has achieved?
☐ Yes ☐ No

If no, attach Standard PCSM Worksheets # 12 and #13 to show water quality compliance has achieved.

If PCSM/SR plan is not complying with the requirements for volume control, attach Standard PCSM Worksheets # 11, # 12 and #13 to show water quality compliance has achieved.

**See PCSM Narrative, Section VII & App. D.1**

**a. PCSM/SR Plan Summary**

Provide a summary of proposed BMPs and their performance to manage PCSM/SR for the project.

The following Best Management Practices (BMP), in accordance with Pennsylvania Stormwater BMP Manual, dated December 2006, have been integrated into the design to reduce runoff volume, reduce peak rates and improve water quality. These structural BMPs will result in the prevention or minimization of increased stormwater runoff rate, volume and/or changes in stormwater runoff. Implementing these controls will preserve the integrity of stream channels and maintain and protect the physical, biological and chemical qualities of the receiving stream.

A non-vegetated managed release concept (MRC) BMP will be installed at Quakertown Compressor Station. The MRC BMP will be non-vegetated with underground storage chambers (Storm-tank). A stormwater swale with check dams will be installed upstream of the MRC BMP. This combination of structural BMPs serves the functions of volume reduction, runoff quality and peak rate reduction.

Check all that apply ☒ PCSM BMPs ☐ SR BMPs

**b.** Do you have any information regarding riparian buffer which differs from what was submitted in the Section G, Riparian Buffer?

☐ Yes ☒ No

Explain:

**c. Thermal Impacts Analysis**

Explain how thermal impacts associated with this project were avoided, minimized, or mitigated.

Thermal impacts associated with the project will be minimized and/or mitigated through the incorporation a subsurface MRC basin and a stormwater swale with check dams. Runoff from the impervious areas will be directed to the BMPs where the travel time is increased to store runoff, reducing the quantity and temperature of the runoff.

The subsurface basin at Quakertown Compressor Station will temporarily store stormwater runoff beneath the surface, away from direct sunlight and will promote the slow release of outflow to the surface waters.

**d. Off-Site Discharge Analysis.**

Does the activity propose any off-site discharges to areas other than surface waters? ☒ Yes ☐ No

If yes, it is the applicant's responsibility to ensure that they have legal authority for any off-site discharge to neighboring properties.

The Applicant must provide a demonstration in both the E&S and PCSM/SR Plans that the discharge will not cause erosion, damage, or a nuisance to off-site properties.

**See PCSM Narrative, Section XI, Page 15**

**e. Summary Table for Supporting Calculation and Measurement Data**
***(See NOI Instructions for additional guidance with this section)***

The remainder of this section (Summary Table for Calculation and Measurement Data) does not need to be completed for areas of projects involving oil and gas activities authorized by Chapter 78 or Chapter 78a (well pads) or pipelines and other similar utility infrastructure which will be restored to meadow in good condition or better or existing conditions.

**Watershed Name: Tohickon Creek (Site - Quakertown Compressor Site)**

| Volume Control design storm frequency 2-yr<br>Rainfall amount 3.16 inches | Pre-construction | Post Construction | Net Change |
|---|---|---|---|
| Impervious area (acres) | 0.00 | 0.32 | +0.32 |
| Volume of stormwater runoff (acre-feet) without planned stormwater BMPs | 0.194 | 0.287 | +0.093 |
| Volume of stormwater runoff (acre-feet) with planned stormwater BMPs | | 0.192 | -0.098 |
| Stormwater discharge rate for the design frequency storm | Pre-construction | Post Construction | Net Change |
| 1) 2-Year/24-Hour | 2.94 | 2.21 | -0.73 |
| 2) 10-Year/24-Hour | 5.36 | 3.45 | -1.91 |
| 3) 50-year/24-Hour | 8.87 | 5.15 | -3.72 |
| 4) 100-year/24-Hour | 10.88 | 7.47 | -4.78 |

**f. Summary Description of PCSM/SR BMPs**

In the lists below, check the BMPs identified in the PCSM Plan. The primary function(s) of the BMP listed in the functions column (infiltration/recharge; detention/retention; water quality). Additional functions may be added if applicable to that BMP. List the stormwater volume and area of runoff to be treated by each BMP type when calculations are required. If any BMP in the PCSM/SR Plan is not listed below, describe it in the space provided after "Other". A summary table with infiltration testing information (Attachment E, included in the NOI Instructions) must be submitted for all Bio-infiltration BMPs included in PCSM/SR plan.

For Rate control provide the volume of stormwater treated and acres treated for the 100-year/24-hour storm event.

For volume control and water quality provide the volume of stormwater treated and acres treated for the 2-year/24-hour storm event.

Key for BMP purpose(s): VC = Volume Control; RC = Rate Control; and WQ = Water Quality

| BMP | Function(s) | Purpose(s) | Volume of stormwater treated | Acres treated |
|---|---|---|---|---|
| **Site Restoration ONLY**<br>☐ Restore Site to Meadow in Good Condition or Better, or Existing Conditions | Infiltration/Recharge<br>Detention/WQ Treatment | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| **Bio-infiltration areas**<br>☐ Infiltration Trench<br>☐ Infiltration Bed<br>☐ Infiltration Basin<br>☐ Rain Garden/ Bioretention<br>☐ Infiltration Berm | Infiltration/Recharge | <br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ<br>☐ VC ☐ RC ☐ WQ | <br>_____<br>____<br>_____<br>_____<br>_____ | <br>_____<br>_____<br>_____<br><br>_____ |

| | | | | |
|---|---|---|---|---|
| **Natural Area Conservation** | Infiltration/Recharge | | | |
| ☐ Streamside Buffer Zone | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Wetland Buffer Zone | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Sensitive Area Buffer Zone | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Pre-Construction Drainage Pattern Intact | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| **Stormwater Retention** | Detention/Retention | | | |
| ☐ Constructed Wetlands | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Wet Ponds | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☒ Retention Basin (MRC) | | ☒ VC ☒ RC ☒ WQ | 0.192 | 1.09 |
| **Sediment and Pollutant Removal** | Water Quality Treatment | | | |
| ☐ Vegetated Filter Strips | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Compost Filter Sock | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Detention Basins | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| **Access Road Design** | Infiltration/Recharge | | | |
| ☐ Road Crowning | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Ditches | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Turnouts | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Culverts | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Roadside Vegetated Filter Strips | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| **Stormwater Energy Dissipaters** | Infiltration/Recharge | | | |
| ☐ Level Spreaders | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Riprap Aprons | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Upslope Diversions | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Other_____ | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |

**g. Critical PCSM Plan stages**

Identify and list critical stages of implementation of the PCSM Plan for which a licensed professional or designee shall be present on site.

A licensed professional should be present and witness the following stages in construction:

Excavation and final grading of the BMP.

Placement of geotextile and aggregate within the BMP.

Construction of the outlet structure and discharging of piping from the BMP.

## SECTION H. POST CONSTRUCTION STORMWATER MANAGEMENT (PCSM) AND/OR SITE RESTORATION(SR) PLAN

**See NOI Instructions for additional guidance with PCSM Plans**

PCSM/SR BMPs should be designed to use natural measures to eliminate pollution, infiltrate runoff, not require extensive construction/maintenance, promote pollutant reduction, and preserve the integrity of stream channels. All PCSM/SR BMPs proposed in the PCSM/SR Plan must be designed in accordance with Ch. 102, Ch. 78a for unconventional operations, Ch. 78 for conventional operations and the *Pennsylvania Stormwater Best Management Practices Manual (Stormwater BMP Manual)* (363-0300-002). If alternate design criteria are utilized for the proposed project, they must have prior approval by the Department, or the NOI Application will be returned to the Applicant.

After construction is completed, how much of the entire disturbed area will be restored to meadow in good condition or better, or existing conditions? ☒ All ☐ Partial ☐ None

Include PCSM narrative and drawings for remaining impervious area. Also include a map showing the proposed contours of the site restoration plan.

If there are additional stages of the project prior to permit termination or expiration, list the stages and provide the documents required by subsection 'a' to section 'g' for each stage (e.g. partial restoration or changes to the amount of compacted areas, gravel, and/or impervious areas). Upload a narrative for each additional stage in addition to the drawings.

**EXAMPLE**

| Stage No | Stage Name | PCSM Plan | SR Plan |
|---|---|---|---|
| Stage 1 | Adelphia Gateway | ☒ | ☒ |
| Stage 2 | Tilghman & Parkway Laterals | ☐ | ☒ |
| Stage 3 | | ☐ | ☐ |
| Stage 4 | | ☐ | ☐ |

**Act 167 Consistency**. Check those that apply.

**Site:**
**Mainline Valve 1**

Is there an Act 167 Plan? ☒ Yes ☐ No

☒ The attached PCSM/SR Plan is consistent with an applicable approved Act 167 Plan.

Complete the following for all approved Act 167 Stormwater Management Plans. (Use additional sheets if necessary)

| Act 167 Plan Name | Date Adopted | Consistency Letter Included ☐ |
|---|---|---|
| **Valley Creek** | July 30, 2010 | Verification Report Included ☒ |

*Note: A consistency letter is not required if a verification report is provided. See NOI Instructions. The PCSM/SR Plan must satisfy either sub paragraph 1, 2, or 3 below. Check those that apply.*

1. ☒ Act 167 Plan approvals on or after January 2005 – The attached PCSM/SR Plan, in its entirety, is consistent with all requirements pertaining to rate, volume, and water quality from an Act 167 Stormwater Management Plan approved by DEP on or after January 2005. Box 1 must be checked if a current, DEP approved Act 167 plan exists.

2. ☒ The PCSM/SR Plan meets the standard design criteria from sections 102.8(g)(2) and (3) and the *Stormwater BMP Manual*. For projects involving oil and gas activities authorized by a permit issued under Chapter 78 or Chapter 78a (well pads) or pipelines and other similar utility infrastructure, post construction stormwater management requirements are met for all areas that are restored to preconstruction conditions or to a condition of meadow in good condition or better. *[Note: PCSM plans must meet both the volume and rate requirements in the regulations, which are provided in the 2 sections mentioned in this paragraph].*

3. ☐ Alternative Design Standard – The attached PCSM/SR Plan was developed using approaches as provided in 102.8(g)(2)(iv) and 102.8(g)(3)(iii). Demonstrate/explain in the space provided below how this standard will be either more protective than what is required in 102.8(g)(2) and 102.8(g)(3) or will maintain and protect existing water quality and existing and designated uses.

**PCSM/SR BMP Alternative Standards**:

Has the alternative BMP or design standard been approved by the Department?

☐ Yes

☐ No – Do not submit the ESCGP-3 application and see Section (H) of the NOI Instructions concerning the alternative BMP approval process.

**Water Quality Compliance:**

Does the PCSM/SR plan comply with requirements for volume control? ☒ Yes ☐ No

If yes, is at least 90% of the disturbed area controlled by a PCSM BMP? ☒ Yes ☐ No

If yes, do you have the Standard PCSM Worksheet # 10 attached to show water quality compliance has achieved?
☐ Yes ☒ No → **SITE RESTORATION ONLY - MEET SECTION 102.8(g)(2) and (3). Per 102.8(n), WORKSHEET #10, #12 & #13 ARE NOT APPLICABLE**

If no, attach Standard PCSM Worksheets # 12 and #13 to show water quality compliance has achieved.

If PCSM/SR plan is not complying with the requirements for volume control, attach Standard PCSM Worksheets # 11, # 12 and #13 to show water quality compliance has achieved.

**a. PCSM/SR Plan Summary**

Provide a summary of proposed BMPs and their performance to manage PCSM/SR for the project.

All sites will be restored to pre-existing conditions. By limiting the disturbed areas, limiting extent and duration of disturbance and performing site restoration, these practices will eliminate the net change in rate, volume and water quality after construction.

Check all that apply ☐ PCSM BMPs ☒ SR BMPs

**b.** Do you have any information regarding riparian buffer which differs from what was submitted in the Section G, Riparian Buffer?

☐ Yes ☒ No

Explain:

**c. Thermal Impacts Analysis**

Explain how thermal impacts associated with this project were avoided, minimized, or mitigated.

Thermal impacts have been minimized by limiting the disturbed area to the maximum extent practicable. By minimizing the extent of the disturbed area, vegetative clearing has been minimized. Thermal impacts will also be minimizing the duration of disturbance and reseeding and restoring vegetative growth as soon as possible.

**d. Off-Site Discharge Analysis.**

Does the activity propose any off-site discharges to areas other than surface waters? ☒ Yes ☐ No

If yes, it is the applicant's responsibility to ensure that they have legal authority for any off-site discharge to neighboring properties.

The Applicant must provide a demonstration in both the E&S and PCSM/SR Plans that the discharge will not cause erosion, damage, or a nuisance to off-site properties.

**See PCSM Narrative, Section XI, Page 15**

**e. Summary Table for Supporting Calculation and Measurement Data**
***(See NOI Instructions for additional guidance with this section)***

The remainder of this section (Summary Table for Calculation and Measurement Data) does not need to be completed for areas of projects involving oil and gas activities authorized by Chapter 78 or Chapter 78a (well pads) or pipelines and other similar utility infrastructure which will be restored to meadow in good condition or better or existing conditions.

**Watershed Name: Valley Creek**

| Volume Control design storm frequency N/A<br>Rainfall amount N/A inches | Pre-construction | Post Construction | Net Change |
|---|---|---|---|
| Impervious area (acres) | N/A | N/A | N/A |
| Volume of stormwater runoff (acre-feet) without planned stormwater BMPs | N/A | N/A | N/A |
| Volume of stormwater runoff (acre-feet) with planned stormwater BMPs | | N/A | N/A |
| Stormwater discharge rate for the design frequency storm | Pre-construction | Post Construction | Net Change |
| 1) 2-Year/24-Hour | N/A | N/A | N/A |
| 2) 10-Year/24-Hour | N/A | N/A | N/A |
| 3) 50-year/24-Hour | N/A | N/A | N/A |
| 4) 100-year/24-Hour | N/A | N/A | N/A |

**f. Summary Description of PCSM/SR BMPs** **SITE RESTORATION ONLY**

In the lists below, check the BMPs identified in the PCSM Plan. The primary function(s) of the BMP listed in the functions column (infiltration/recharge; detention/retention; water quality). Additional functions may be added if applicable to that BMP. List the stormwater volume and area of runoff to be treated by each BMP type when calculations are required. If any BMP in the PCSM/SR Plan is not listed below, describe it in the space provided after "Other". A summary table with infiltration testing information (Attachment E, included in the NOI Instructions) must be submitted for all Bio-infiltration BMPs included in PCSM/SR plan.

For Rate control provide the volume of stormwater treated and acres treated for the 100-year/24-hour storm event.

For volume control and water quality provide the volume of stormwater treated and acres treated for the 2-year/24-hour storm event.

Key for BMP purpose(s): VC = Volume Control; RC = Rate Control; and WQ = Water Quality

| BMP | Function(s) | Purpose(s) | Volume of stormwater treated | Acres treated |
|---|---|---|---|---|
| **Site Restoration ONLY**<br>☒ Restore Site to Meadow in Good Condition or Better, or Existing Conditions | Infiltration/Recharge<br>Detention/WQ Treatment | ☒ VC ☒ RC ☒ WQ | _____ | _____ |
| **Bio-infiltration areas** | Infiltration/Recharge | | | |
| ☐ Infiltration Trench | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Infiltration Bed | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Infiltration Basin | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Rain Garden/ Bioretention | | ☐ VC ☐ RC ☐ WQ | _____ | |
| ☐ Infiltration Berm | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |

| | | | | |
|---|---|---|---|---|
| **Natural Area Conservation** | Infiltration/Recharge | | | |
| ☐ Streamside Buffer Zone | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Wetland Buffer Zone | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Sensitive Area Buffer Zone | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Pre-Construction Drainage Pattern Intact | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| **Stormwater Retention** | Detention/Retention | | | |
| ☐ Constructed Wetlands | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Wet Ponds | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Retention Basin | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| **Sediment and Pollutant Removal** | Water Quality Treatment | | | |
| ☐ Vegetated Filter Strips | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Compost Filter Sock | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Detention Basins | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| **Access Road Design** | Infiltration/Recharge | | | |
| ☐ Road Crowning | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Ditches | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Turnouts | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Culverts | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Roadside Vegetated Filter Strips | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| **Stormwater Energy Dissipaters** | Infiltration/Recharge | | | |
| ☐ Level Spreaders | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Riprap Aprons | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Upslope Diversions | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |
| ☐ Other_____ | | ☐ VC ☐ RC ☐ WQ | _____ | _____ |

**g. Critical PCSM Plan stages**

Identify and list critical stages of implementation of the PCSM Plan for which a licensed professional or designee shall be present on site.

License professional to be present during the site restoration activities as noted the in Site Restoration Schedule.

# CHESTER CREEK

## SECTION I. ANTIDEGRADATION ANALYSIS

**This section must be completed where earth disturbance activities will be conducted in the watershed of a surface water with an existing or designated use of exceptional value or high quality pursuant to Chapter 93 (relating to water quality standards), projects where any part is located in an exceptional value wetland in accordance with 25 Pa. Code § 105.17, and projects where any part is located in the watershed of an impaired surface water where the cause of impairment is identified as siltation.**

### Part 1 - NONDISCHARGE ALTERNATIVES EVALUATION

The applicant must consider and describe any and all non-discharge alternatives for the entire project area which are environmentally sound and will**:**

- Minimize accelerated erosion and sedimentation during the earth disturbance activity
- Achieve no net change from pre-development to post-development volume, rate and concentration of pollutants in water quality

| E & S Plan | PCSM/SR Plan |
|---|---|
| Check off the environmentally sound nondischarge Best Management Practices (BMPs) listed below to be used prior to, during, and after earth disturbance activities that have been incorporated into your E & S Plan based on the site analysis. For non-discharge BMPs not checked, provide an explanation of why they were not utilized. Also for BMPs checked, provide an explanation of why they were utilized. (Provide the analysis and attach additional sheets if necessary)<br><br>An alternative location, configuration or location of discharge was not utilized since upgrades are required at these existing sites; however, LOD is minimized. Regulations do not require a riparian forest buffer due to proximity to site. | Check off the environmentally sound nondischarge Best Management Practices (BMPs) listed below to be used after construction that have been incorporated into the PCSM/SR Plan based on your site analysis. For non-discharge BMPs not checked, provide an explanation of why they were not utilized. Also for BMPs checked, provide an explanation of why they were utilized. (Provide the analysis and attach additional sheets if necessary)<br><br>An alternative location, configuration or location of discharge was not utilized since upgrades are required at these existing sites; however, LOD is minimized. Regulations do not require a riparian forest buffer due to proximity to site. No BMPS proposed, therefore no infiltration and water reuse is applicable . |
| **Nondischarge BMPs**<br>☐ Alternative Siting<br>☐ Alternative location<br>☐ Alternative configuration<br>☐ Alternative location of discharge<br>☒ Limited Disturbed Area<br>☒ Limiting Extent & Duration of Disturbance (Phasing, Sequencing)<br>☒ Riparian Buffers (150 ft. min.)<br>☐ Riparian Forest Buffer (150 ft. min.)<br>☐ Other _____ | **Nondischarge BMPs**<br>☐ Alternative Siting<br>☐ Alternative location<br>☐ Alternative configuration<br>☐ Alternative location of discharge<br>☐ Low Impact Development (LID / BSD)<br>☒ Riparian Buffers (150 ft. min.)<br>☐ Riparian Forest Buffer (150 ft. min.)<br>☐ Infiltration<br>☐ Water Reuse<br>☐ Other Site Restoration |
| Will the non-discharge alternative BMPs eliminate the net change in rate, volume and quality during construction?<br>☒ Yes ☐ No<br><br>If yes, antidegradation analysis is complete.<br>If no, proceed to Part 2. | Will the non-discharge alternative BMPs eliminate the net change in rate, volume and quality after construction?<br>☒ Yes ☐ No<br><br>If yes, antidegradation analysis is complete.<br>If no, proceed to Part 2. |

# PERKIOMEN CREEK

## SECTION I. ANTIDEGRADATION ANALYSIS

**This section must be completed where earth disturbance activities will be conducted in the watershed of a surface water with an existing or designated use of exceptional value or high quality pursuant to Chapter 93 (relating to water quality standards), projects where any part is located in an exceptional value wetland in accordance with 25 Pa. Code § 105.17, and projects where any part is located in the watershed of an impaired surface water where the cause of impairment is identified as siltation.**

### Part 1 - NONDISCHARGE ALTERNATIVES EVALUATION

The applicant must consider and describe any and all non-discharge alternatives for the entire project area which are environmentally sound and will**:**

- Minimize accelerated erosion and sedimentation during the earth disturbance activity
- Achieve no net change from pre-development to post-development volume, rate and concentration of pollutants in water quality

| E & S Plan | PCSM/SR Plan |
|---|---|
| Check off the environmentally sound nondischarge Best Management Practices (BMPs) listed below to be used prior to, during, and after earth disturbance activities that have been incorporated into your E & S Plan based on the site analysis. For non-discharge BMPs not checked, provide an explanation of why they were not utilized. Also for BMPs checked, provide an explanation of why they were utilized. (Provide the analysis and attach additional sheets if necessary)<br><br>An alternative location, configuration or location of discharge was not utilized since upgrades are required at these existing sites; however, LOD is minimized. Regulations do not require a riparian buffer or riparian forest buffer due to proximity to site. | Check off the environmentally sound nondischarge Best Management Practices (BMPs) listed below to be used after construction that have been incorporated into the PCSM/SR Plan based on your site analysis. For non-discharge BMPs not checked, provide an explanation of why they were not utilized. Also for BMPs checked, provide an explanation of why they were utilized. (Provide the analysis and attach additional sheets if necessary)<br><br>An alternative location, configuration or location of discharge was not utilized since upgrades are required at these existing sites; however, LOD is minimized. Regulations do not require a riparian buffer or riparian forest buffer due to proximity to site. No BMPS proposed, therefore no infiltration and water reuse is applicable . |
| **Nondischarge BMPs**<br>☐ Alternative Siting<br>☐ Alternative location<br>☐ Alternative configuration<br>☐ Alternative location of discharge<br>☒ Limited Disturbed Area<br>☒ Limiting Extent & Duration of Disturbance (Phasing, Sequencing)<br>☐ Riparian Buffers (150 ft. min.)<br>☐ Riparian Forest Buffer (150 ft. min.)<br>☐ Other _____ | **Nondischarge BMPs**<br>☐ Alternative Siting<br>☐ Alternative location<br>☐ Alternative configuration<br>☐ Alternative location of discharge<br>☐ Low Impact Development (LID / BSD)<br>☐ Riparian Buffers (150 ft. min.)<br>☐ Riparian Forest Buffer (150 ft. min.)<br>☐ Infiltration<br>☐ Water Reuse<br>☐ Other Site Restoration |
| Will the non-discharge alternative BMPs eliminate the net change in rate, volume and quality during construction?<br>☒ Yes ☐ No<br><br>If yes, antidegradation analysis is complete.<br>If no, proceed to Part 2. | Will the non-discharge alternative BMPs eliminate the net change in rate, volume and quality after construction?<br>☒ Yes ☐ No<br><br>If yes, antidegradation analysis is complete.<br>If no, proceed to Part 2. |

# RIDLEY CREEK

## SECTION I. ANTIDEGRADATION ANALYSIS

**This section must be completed where earth disturbance activities will be conducted in the watershed of a surface water with an existing or designated use of exceptional value or high quality pursuant to Chapter 93 (relating to water quality standards), projects where any part is located in an exceptional value wetland in accordance with 25 Pa. Code § 105.17, and projects where any part is located in the watershed of an impaired surface water where the cause of impairment is identified as siltation.**

### Part 1 - NONDISCHARGE ALTERNATIVES EVALUATION

The applicant must consider and describe any and all non-discharge alternatives for the entire project area which are environmentally sound and will**:**

- Minimize accelerated erosion and sedimentation during the earth disturbance activity
- Achieve no net change from pre-development to post-development volume, rate and concentration of pollutants in water quality

| E & S Plan | PCSM/SR Plan |
|---|---|
| Check off the environmentally sound nondischarge Best Management Practices (BMPs) listed below to be used prior to, during, and after earth disturbance activities that have been incorporated into your E & S Plan based on the site analysis. For non-discharge BMPs not checked, provide an explanation of why they were not utilized. Also for BMPs checked, provide an explanation of why they were utilized. (Provide the analysis and attach additional sheets if necessary)<br><br>An alternative location, configuration or location of discharge was not utilized since upgrades are required at these existing sites; however, LOD is minimized. Regulations do not require a riparian forest buffer due to proximity to site. | Check off the environmentally sound nondischarge Best Management Practices (BMPs) listed below to be used after construction that have been incorporated into the PCSM/SR Plan based on your site analysis. For non-discharge BMPs not checked, provide an explanation of why they were not utilized. Also for BMPs checked, provide an explanation of why they were utilized. (Provide the analysis and attach additional sheets if necessary)<br><br>An alternative location, configuration or location of discharge was not utilized since upgrades are required at these existing sites; however, LOD is minimized. Regulations do not require a riparian forest buffer due to proximity to site. No BMPS proposed, therefore no infiltration and water reuse is applicable . |
| **Nondischarge BMPs**<br>☐ Alternative Siting<br>☐ Alternative location<br>☐ Alternative configuration<br>☐ Alternative location of discharge<br>☒ Limited Disturbed Area<br>☒ Limiting Extent & Duration of Disturbance (Phasing, Sequencing)<br>☒ Riparian Buffers (150 ft. min.)<br>☐ Riparian Forest Buffer (150 ft. min.)<br>☐ Other _____ | **Nondischarge BMPs**<br>☐ Alternative Siting<br>☐ Alternative location<br>☐ Alternative configuration<br>☐ Alternative location of discharge<br>☐ Low Impact Development (LID / BSD)<br>☒ Riparian Buffers (150 ft. min.)<br>☐ Riparian Forest Buffer (150 ft. min.)<br>☐ Infiltration<br>☐ Water Reuse<br>☐ Other Site Restoration |
| Will the non-discharge alternative BMPs eliminate the net change in rate, volume and quality during construction?<br>☒ Yes ☐ No<br><br>If yes, antidegradation analysis is complete.<br>If no, proceed to Part 2. | Will the non-discharge alternative BMPs eliminate the net change in rate, volume and quality after construction?<br>☒ Yes ☐ No<br><br>If yes, antidegradation analysis is complete.<br>If no, proceed to Part 2. |

# SCHUYLKILL RIVER

## SECTION I. ANTIDEGRADATION ANALYSIS

**This section must be completed where earth disturbance activities will be conducted in the watershed of a surface water with an existing or designated use of exceptional value or high quality pursuant to Chapter 93 (relating to water quality standards), projects where any part is located in an exceptional value wetland in accordance with 25 Pa. Code § 105.17, and projects where any part is located in the watershed of an impaired surface water where the cause of impairment is identified as siltation.**

### Part 1 - NONDISCHARGE ALTERNATIVES EVALUATION

The applicant must consider and describe any and all non-discharge alternatives for the entire project area which are environmentally sound and will**:**

- Minimize accelerated erosion and sedimentation during the earth disturbance activity
- Achieve no net change from pre-development to post-development volume, rate and concentration of pollutants in water quality

| E & S Plan | PCSM/SR Plan |
|---|---|
| Check off the environmentally sound nondischarge Best Management Practices (BMPs) listed below to be used prior to, during, and after earth disturbance activities that have been incorporated into your E & S Plan based on the site analysis. For non-discharge BMPs not checked, provide an explanation of why they were not utilized. Also for BMPs checked, provide an explanation of why they were utilized. (Provide the analysis and attach additional sheets if necessary)<br><br>An alternative location, configuration or location of discharge was not utilized since upgrades are required at these existing sites; however, LOD is minimized. Regulations do not require a riparian buffer or riparian forest buffer due to proximity to site. | Check off the environmentally sound nondischarge Best Management Practices (BMPs) listed below to be used after construction that have been incorporated into the PCSM/SR Plan based on your site analysis. For non-discharge BMPs not checked, provide an explanation of why they were not utilized. Also for BMPs checked, provide an explanation of why they were utilized. (Provide the analysis and attach additional sheets if necessary)<br><br>An alternative location, configuration or location of discharge was not utilized since upgrades are required at these existing sites; however, LOD is minimized. Regulations do not require a riparian buffer or riparian forest buffer due to proximity to site. No BMPS proposed, therefore no infiltration and water reuse is applicable . |
| **Nondischarge BMPs**<br>☐ Alternative Siting<br>☐ Alternative location<br>☐ Alternative configuration<br>☐ Alternative location of discharge<br>☒ Limited Disturbed Area<br>☒ Limiting Extent & Duration of Disturbance (Phasing, Sequencing)<br>☐ Riparian Buffers (150 ft. min.)<br>☐ Riparian Forest Buffer (150 ft. min.)<br>☐ Other _____ | **Nondischarge BMPs**<br>☐ Alternative Siting<br>☐ Alternative location<br>☐ Alternative configuration<br>☐ Alternative location of discharge<br>☐ Low Impact Development (LID / BSD)<br>☐ Riparian Buffers (150 ft. min.)<br>☐ Riparian Forest Buffer (150 ft. min.)<br>☐ Infiltration<br>☐ Water Reuse<br>☐ Other Site Restoration |
| Will the non-discharge alternative BMPs eliminate the net change in rate, volume and quality during construction?<br>☒ Yes ☐ No<br><br>If yes, antidegradation analysis is complete.<br>If no, proceed to Part 2. | Will the non-discharge alternative BMPs eliminate the net change in rate, volume and quality after construction?<br>☒ Yes ☐ No<br><br>If yes, antidegradation analysis is complete.<br>If no, proceed to Part 2. |

# STONY RUN

## SECTION I. ANTIDEGRADATION ANALYSIS

**This section must be completed where earth disturbance activities will be conducted in the watershed of a surface water with an existing or designated use of exceptional value or high quality pursuant to Chapter 93 (relating to water quality standards), projects where any part is located in an exceptional value wetland in accordance with 25 Pa. Code § 105.17, and projects where any part is located in the watershed of an impaired surface water where the cause of impairment is identified as siltation.**

### Part 1 - NONDISCHARGE ALTERNATIVES EVALUATION

The applicant must consider and describe any and all non-discharge alternatives for the entire project area which are environmentally sound and will**:**

- Minimize accelerated erosion and sedimentation during the earth disturbance activity
- Achieve no net change from pre-development to post-development volume, rate and concentration of pollutants in water quality

| E & S Plan | PCSM/SR Plan |
|---|---|
| Check off the environmentally sound nondischarge Best Management Practices (BMPs) listed below to be used prior to, during, and after earth disturbance activities that have been incorporated into your E & S Plan based on the site analysis. For non-discharge BMPs not checked, provide an explanation of why they were not utilized. Also for BMPs checked, provide an explanation of why they were utilized. (Provide the analysis and attach additional sheets if necessary)<br><br>An alternative location, configuration or location of discharge was not utilized since upgrades are required at these existing sites; however, LOD is minimized. Regulations do not require a riparian buffer or riparian forest buffer due to proximity to site. | Check off the environmentally sound nondischarge Best Management Practices (BMPs) listed below to be used after construction that have been incorporated into the PCSM/SR Plan based on your site analysis. For non-discharge BMPs not checked, provide an explanation of why they were not utilized. Also for BMPs checked, provide an explanation of why they were utilized. (Provide the analysis and attach additional sheets if necessary)<br><br>An alternative location, configuration or location of discharge was not utilized since upgrades are required at these existing sites; however, LOD is minimized. Regulations do not require a riparian buffer or riparian forest buffer due to proximity to site. No BMPS proposed, therefore no infiltration and water reuse is applicable . |
| **Nondischarge BMPs**<br>☐ Alternative Siting<br>☐ Alternative location<br>☐ Alternative configuration<br>☐ Alternative location of discharge<br>☒ Limited Disturbed Area<br>☒ Limiting Extent & Duration of Disturbance (Phasing, Sequencing)<br>☐ Riparian Buffers (150 ft. min.)<br>☐ Riparian Forest Buffer (150 ft. min.)<br>☐ Other _____ | **Nondischarge BMPs**<br>☐ Alternative Siting<br>☐ Alternative location<br>☐ Alternative configuration<br>☐ Alternative location of discharge<br>☐ Low Impact Development (LID / BSD)<br>☐ Riparian Buffers (150 ft. min.)<br>☐ Riparian Forest Buffer (150 ft. min.)<br>☐ Infiltration<br>☐ Water Reuse<br>☐ Other Site Restoration |
| Will the non-discharge alternative BMPs eliminate the net change in rate, volume and quality during construction?<br>☒ Yes ☐ No<br><br>If yes, antidegradation analysis is complete.<br>If no, proceed to Part 2. | Will the non-discharge alternative BMPs eliminate the net change in rate, volume and quality after construction?<br>☒ Yes ☐ No<br><br>If yes, antidegradation analysis is complete.<br>If no, proceed to Part 2. |

# TOHICKON CREEK

## SECTION I. ANTIDEGRADATION ANALYSIS

**This section must be completed where earth disturbance activities will be conducted in the watershed of a surface water with an existing or designated use of exceptional value or high quality pursuant to Chapter 93 (relating to water quality standards), projects where any part is located in an exceptional value wetland in accordance with 25 Pa. Code § 105.17, and projects where any part is located in the watershed of an impaired surface water where the cause of impairment is identified as siltation.**

### Part 1 - NONDISCHARGE ALTERNATIVES EVALUATION

The applicant must consider and describe any and all non-discharge alternatives for the entire project area which are environmentally sound and will**:**

- Minimize accelerated erosion and sedimentation during the earth disturbance activity
- Achieve no net change from pre-development to post-development volume, rate and concentration of pollutants in water quality

| E & S Plan | PCSM/SR Plan |
|---|---|
| Check off the environmentally sound nondischarge Best Management Practices (BMPs) listed below to be used prior to, during, and after earth disturbance activities that have been incorporated into your E & S Plan based on the site analysis. For non-discharge BMPs not checked, provide an explanation of why they were not utilized. Also for BMPs checked, provide an explanation of why they were utilized. (Provide the analysis and attach additional sheets if necessary)<br><br>An alternative location, configuration or location of discharge was not utilized since upgrades are required at these existing sites; however, LOD is minimized. Regulations do not require a riparian buffer or riparian forest buffer due to proximity to site. | Check off the environmentally sound nondischarge Best Management Practices (BMPs) listed below to be used after construction that have been incorporated into the PCSM/SR Plan based on your site analysis. For non-discharge BMPs not checked, provide an explanation of why they were not utilized. Also for BMPs checked, provide an explanation of why they were utilized. (Provide the analysis and attach additional sheets if necessary)<br><br>An alternative location, configuration or location of discharge was not utilized since upgrades are required at these existing sites; however, LOD is minimized. Regulations do not require a riparian buffer or riparian forest buffer due to proximity to site. No BMPS proposed, therefore no infiltration and water reuse is applicable . |
| **Nondischarge BMPs**<br>☐ Alternative Siting<br>☐ Alternative location<br>☐ Alternative configuration<br>☐ Alternative location of discharge<br>☒ Limited Disturbed Area<br>☒ Limiting Extent & Duration of Disturbance (Phasing, Sequencing)<br>☐ Riparian Buffers (150 ft. min.)<br>☐ Riparian Forest Buffer (150 ft. min.)<br>☐ Other _____ | **Nondischarge BMPs**<br>☐ Alternative Siting<br>☐ Alternative location<br>☐ Alternative configuration<br>☐ Alternative location of discharge<br>☐ Low Impact Development (LID / BSD)<br>☐ Riparian Buffers (150 ft. min.)<br>☐ Riparian Forest Buffer (150 ft. min.)<br>☐ Infiltration<br>☐ Water Reuse<br>☐ Other Site Restoration |
| Will the non-discharge alternative BMPs eliminate the net change in rate, volume and quality during construction?<br>☐ Yes ☒ No<br><br>If yes, antidegradation analysis is complete.<br>If no, proceed to Part 2. | Will the non-discharge alternative BMPs eliminate the net change in rate, volume and quality after construction?<br>☐ Yes ☒ No<br><br>If yes, antidegradation analysis is complete.<br>If no, proceed to Part 2. |

# TOHICKON CREEK

## PART 2 - ANTIDEGRADATION BEST AVAILABLE COMBINATION OF TECHNOLOGIES (ABACT)

If the net change in stormwater discharge from or after construction is not fully managed by nondischarge BMPs, the applicant must utilize ABACT BMPs to manage the difference. The Applicant must specify whether the discharge will occur during construction, post-construction or both, and identify the technologies that will be used to ensure that the discharge will be a non-degrading discharge. ABACT BMPs include but are not limited to:

### E & S Plan

☒ **Treatment BMPs:**
- ☐ Sediment basin with skimmer
- ☐ Sediment basin ratio of 4:1 or greater (flow length to basin width)
- ☐ Sediment basin with 4-7 day detention
- ☐ Flocculants
- ☒ Compost Filter Socks
- ☐ Compost Filter Sock Sediment Basin
- ☒ RCE w/ Wash Rack

☐ **Land disposal:**
- ☐ Vegetated filters
- ☐ Riparian buffers <150ft.
- ☐ Riparian Forest Buffer <150ft.
- ☐ Immediate stabilization

☒ **Pollution prevention:**
- ☐ PPC Plans
- ☐ Street sweeping
- ☒ Channels, collectors and diversions lined with permanent vegetation, rock, geotextile or other non-erosive materials

☐ **Stormwater reuse technologies:**
- ☐ Sediment basin water for dust control
- ☐ Sediment basin water for irrigation

☐ **Other** _____

Are the ABACT BMPs selected sufficient to minimize E&S discharges to the extent that existing or designated surface water uses are protected?

☒ Yes ☐ No

If yes, Antidegradation analysis is complete.
If no, NOI Application will be returned to the Applicant.

### PCSM/SR Plan

☒ **Treatment BMPs:**
- ☐ Infiltration Practices
- ☐ Wet ponds
- ☐ Created wetland treatment systems
- ☐ Vegetated swales
- ☐ Manufactured devices
- ☒ Bio-retention/infiltration
- ☐ Green Roofs

☒ **Land disposal:**
- ☐ Vegetated filters
- ☐ Riparian Buffers <150ft.
- ☐ Riparian Forest Buffer <150ft.
- ☐ Disconnection of roof drainage
- ☒ Bio-retention/bio-infiltration

☒ **Pollution prevention:**
- ☐ Street sweeping
- ☐ Nutrient, pesticide, herbicide or other chemical application plan alternatives
- ☐ PPC Plans
- ☐ Non-structural Practices
- ☒ Restoration BMPs

☐ **Stormwater reuse technologies:**
- ☐ Divert rainwater into impoundment
- ☐ Underground storage

☐ Spray/Drip Irrigation

☐ **Other** _____

Are the ABACT BMPs selected sufficient to achieve no net change and assure that existing or designated surface water uses are protected?

☒ Yes ☐ No

If yes, Antidegradation analysis is complete.
If no, NOI Application will be returned to the Applicant.

# VALLEY CREEK

## SECTION I. ANTIDEGRADATION ANALYSIS

**This section must be completed where earth disturbance activities will be conducted in the watershed of a surface water with an existing or designated use of exceptional value or high quality pursuant to Chapter 93 (relating to water quality standards), projects where any part is located in an exceptional value wetland in accordance with 25 Pa. Code § 105.17, and projects where any part is located in the watershed of an impaired surface water where the cause of impairment is identified as siltation.**

### Part 1 - NONDISCHARGE ALTERNATIVES EVALUATION

The applicant must consider and describe any and all non-discharge alternatives for the entire project area which are environmentally sound and will**:**

- Minimize accelerated erosion and sedimentation during the earth disturbance activity
- Achieve no net change from pre-development to post-development volume, rate and concentration of pollutants in water quality

| E & S Plan | PCSM/SR Plan |
|---|---|
| Check off the environmentally sound nondischarge Best Management Practices (BMPs) listed below to be used prior to, during, and after earth disturbance activities that have been incorporated into your E & S Plan based on the site analysis. For non-discharge BMPs not checked, provide an explanation of why they were not utilized. Also for BMPs checked, provide an explanation of why they were utilized. (Provide the analysis and attach additional sheets if necessary)<br>An alternative location, configuration or location of discharge was not utilized since upgrades are required at these existing sites; however, LOD is minimized. Regulations do not require a riparian buffer or riparian forest buffer due to proximity to site. | Check off the environmentally sound nondischarge Best Management Practices (BMPs) listed below to be used after construction that have been incorporated into the PCSM/SR Plan based on your site analysis. For non-discharge BMPs not checked, provide an explanation of why they were not utilized. Also for BMPs checked, provide an explanation of why they were utilized. (Provide the analysis and attach additional sheets if necessary)<br>An alternative location, configuration or location of discharge was not utilized since upgrades are required at these existing sites; however, LOD is minimized. Regulations do not require a riparian buffer or riparian forest buffer due to proximity to site. No BMPS proposed, therefore no infiltration and water reuse is applicable . |
| **Nondischarge BMPs**<br>☐ Alternative Siting<br>☐ Alternative location<br>☐ Alternative configuration<br>☐ Alternative location of discharge<br>☒ Limited Disturbed Area<br>☒ Limiting Extent & Duration of Disturbance (Phasing, Sequencing)<br>☐ Riparian Buffers (150 ft. min.)<br>☐ Riparian Forest Buffer (150 ft. min.)<br>☐ Other _____ | **Nondischarge BMPs**<br>☐ Alternative Siting<br>☐ Alternative location<br>☐ Alternative configuration<br>☐ Alternative location of discharge<br>☐ Low Impact Development (LID / BSD)<br>☐ Riparian Buffers (150 ft. min.)<br>☐ Riparian Forest Buffer (150 ft. min.)<br>☐ Infiltration<br>☐ Water Reuse<br>☐ Other Site Restoration |
| Will the non-discharge alternative BMPs eliminate the net change in rate, volume and quality during construction?<br>☒ Yes ☐ No<br><br>If yes, antidegradation analysis is complete.<br>If no, proceed to Part 2. | Will the non-discharge alternative BMPs eliminate the net change in rate, volume and quality after construction?<br>☒ Yes ☐ No<br><br>If yes, antidegradation analysis is complete.<br>If no, proceed to Part 2. |

## SECTION J. COMPLIANCE HISTORY REVIEW

Is/was the applicant(s) in violation of any Department regulation, order, schedule of compliance or permit or in violation of any department regulated activities within the past five years?

☐ Yes ☒ No

If yes, provide the permit number or facility name, a brief description of the violation, the compliance schedule (including dates and steps to achieve compliance) and the current compliance status. (Attach additional information on a separate sheet, when necessary)

**Permit Program or Activity:** _____ **Permit Number (if applicable):** _____

**Brief Description of non-compliance:**

| Steps taken to achieve compliance | Date(s) compliance achieved |
|---|---|
| | |

Current Compliance Status: ☐ In-Compliance ☐ In Non-Compliance

If in non-compliance, attach schedule for achieving compliance.

## SECTION K. CERTIFICATION BY PERSON PREPARING E&S AND PCSM/SR PLANS

I do hereby certify to the best of my knowledge, information, and belief, that the Erosion and Sediment Control and PCSM/Site Restoration Plans are true and correct, represent actual field conditions, and are in accordance with the 25 Pa. Code Chapters 78/78a and 102 of the Department's rules and regulations. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

| | | |
|---|---|---|
| Print Name Shiny Mathew | Signature | Professional Seal |
| Company JMT | | |
| Address 1600 Market Street, Suite 520 | | |
| Phone 215-496-4780 | | |
| Most Recent DEP Training Attended: E&S - Permitting Workshop | Location: Montgomery County | Date: 5/2016 |
| e-Mail Address smathew@jmt.com | | |

**EXPEDITED REVIEW PROCESS**

In addition to the certification required above, applicants using the expedited permit review process must attach an E&S and PCSM/Site Restoration Plans developed and sealed by a licensed professional engineer, surveyor or professional geologist. The plans shall contain the following certification:

*I do hereby certify to the best of my knowledge, information, and belief, that the E & S Control and PCSM/SR BMPs are true and correct, represent actual field conditions and are in accordance with the 25 Pa. Code Chapters 78 / 78a and 102 of the Department's rules and regulations. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment***.**

## SECTION L. APPLICANT CERTIFICATION

Applicant Certification

I certify under penalty of law, as provided by 18 Pa. C.S.A. § 4904, that this application and all related attachments were prepared by me or under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my own knowledge and on inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. The responsible official's signature also verifies that the activity is eligible to participate in the ESCGP, and that the applicant agrees to abide by the terms and conditions of the permit. BMP's, E&S Plan, PPC Plan, PCSM Plan, and other controls are being or will be, implemented to ensure that water quality standards and effluent limits are attained.

I grant permission to the agencies responsible for the permitting of this work, or their duly authorized representative to enter the project site for inspection purposes. I will abide by the conditions of the permit if issued and will not begin work prior to permit issuance.

(For individuals no indication of title is necessary, choose the box below. All others proceed to the next paragraph)

☐ **Individual; proceed to signature portion.**

I hereby certify under penalty of law, as provided by 18 Pa. C.S.A. § 4904, that I am the person who is responsible for decision-making regarding environmental compliance functions for Adelphia Gateway, LLC, the manager of one or more manufacturing, production, or operating facilities of the applicant and am authorized to make management decisions which govern the operation of regulated facility including having explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure the applicant's long term environmental compliance with environmental laws and regulations; and I am responsible for ensuring that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements.

(choose one of the following; not applicable for individuals):

☒ The responsible corporate officer ☐ president ☒ vice president ☐ secretary
☐ treasure of _____ Corporation/Company
Entity name

☐ The ☐ member or ☐ manager of _____ LLC
Entity name

☐ The general partner of _____ partnership/LP/LLP
Entity name

☐ The principal executive officer or ranking elected official of _____ Municipality/State/Federal/other public agency
Entity name

☐ Power of Attorney/delegation of contractual authority (documentation supporting delegation of contracting authority must be provided) for _____
Entity name

Mark F. Valori, Vice President
Print Name and Title of Applicant

Print Name and Title of Co-Applicant (if applicable)

Signature of Applicant

Signature of Co-Applicant

03/11/2019
Date Application Signed

Date Application Signed

**Notarization**
Sworn to and subscribed to before me this
11th day of March, 2019

Commonwealth of Pennsylvania
County of _____

Lori S. Castello
Notary Public

My Commission expires _____

AFFIX SEAL

**LORI S. CASTELLO**
**ID# 2353137**
**NOTARY PUBLIC**
**STATE OF NEW JERSEY**
**MY COMMISSION EXPIRES 12-4-21**

| SECTION M. ADDITIONAL CONTACT INFORMATION | | | | |
|---|---|---|---|---|
| Contact's Last Name | First Name | MI | Phone | |
| | | | FAX | |
| Mailing Address | City | | State | ZIP + 4 |
| e-Mail Address | | | | |

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

| | | Infiltration Information | | | | | Drainage Information | | | | | | BMP Information | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Proposed Structural BMPs (site specific) | Measured Infiltration Rate[9] | Factor of Safety | Design Infiltration Rate | Dewatering Time[1] | Elevation of Limiting Zone - Water Table, Bedrock, etc.[2] | Total Drainage Area to BMP | Total Impervious Drainage Area to BMP | Infiltration BMP Surface Area | Total Drainage Area Loading Ratio[6] | Impervious Area Loading Ratio[7] | Volume of Runoff Tributary to BMP During the 2yr/24hr Design Storm[5] | Calculated Infiltration Volume (from storms up to and including 2yr/24hr) | Calculated Managed Volume (from storms up to and including 2yr/24hr)[8] | Maximum water surface elevation in BMP from 2yr storm[3] | Infiltration Elevation Bottom of Bed/ Basin[3] | Elevation of Infiltration Test[4] | Elevation of E&S Sediment Basin Bottom (if applies) |
| | | *in./hr.* | *Min. of 2* | *in./hr.* | *hrs.* | | *sq. ft* | *sq. ft.* | *sq. ft.* | | | *cf* | *cf* | *cf* | | | | |
| BMP 6.4.1 | **Pervious Pavement w/ Infiltration Bed** | | | | | | | | | | | | | | | | | |
| BMP 6.4.2 | **Infiltration Basin** | | | | | | | | | | | | | | | | | |
| BMP 6.4.3 | **Subsurface Infiltration Bed** | | | | | | | | | | | | | | | | | |
| | Transco | N/A | N/A | N/A | N/A | N/A | 27,793 | 4,668 | 2075 | 13 | 2 | 4880.0 | N/A | N/A | N/A | N/A | N/A | N/A |
| BMP 6.4.4 | **Infiltration Trench** | | | | | | | | | | | | | | | | | |
| BMP 6.4.5 | **Rain Garden/Bioretention** | | | | | | | | | | | | | | | | | |
| BMP 6.4.6 | **Dry Well / Seepage Pit** | | | | | | | | | | | | | | | | | |
| Other | **Vegetated MRC BMP** | | | | | | | | | | | | | | | | | |
| | Marcus Hook | N/A | N/A | N/A | N/A | N/A | 95,996 | 21,048 | 16833 | 6 | 1 | 18,619.0 | N/A | N/A | N/A | N/A | N/A | N/A |
| | **Non-vegetated MRC: Underground storage chambers** | | | | | | | | | | | | | | | | | |
| | Quakertown | N/A | N/A | N/A | N/A | N/A | 47,481 | 14,106 | 3886 | 12 | 4 | 6,674.0 | N/A | N/A | N/A | N/A | N/A | N/A |
| BMP 6.4.7 | **Constructed Filter** | | | | | | | | | | | | | | | | | |
| BMP 6.4.8 | **Vegetated Swale** | | | | | | | | | | | | | | | | | |
| BMP 6.4.9 | **Vegetated Filter Strip** | | | | | | | | | | | | | | | | | |
| BMP 6.4.10 | **Infilt. Berm & Ret. Grading** | | | | | | | | | | | | | | | | | |

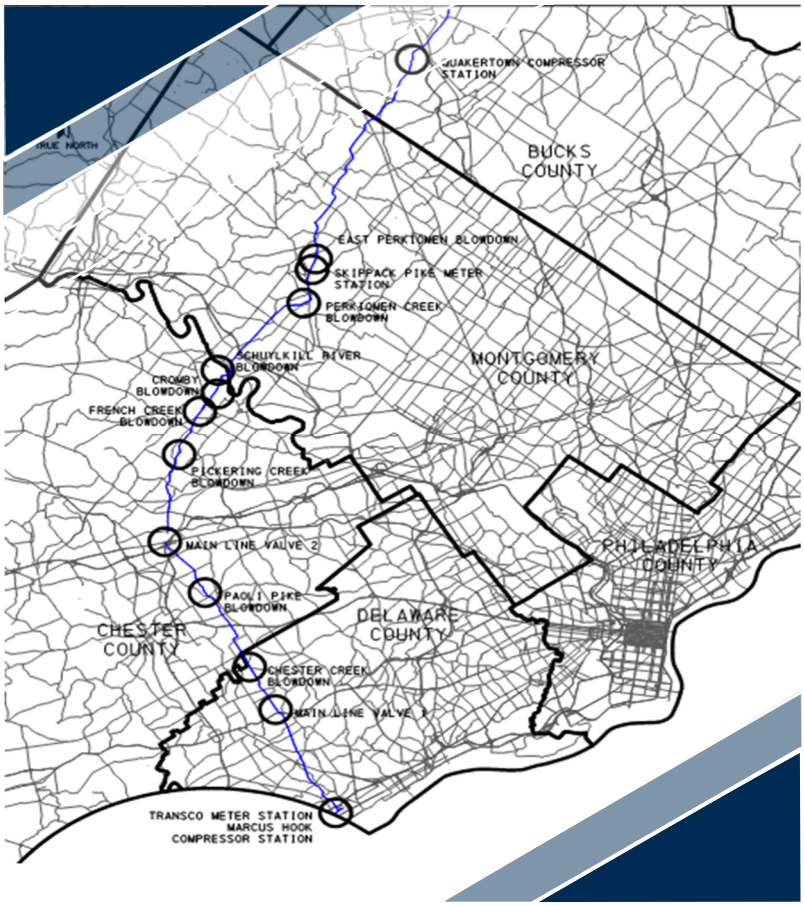
All information should be based on the 2-year/24-hour storm
Provide page numbers from the stormwater narrative identifying the location of the above information.

BMPs at Marcus Hook and Quakertown are MRC basins due to poor infiltration results.

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




# EROSION AND SEDIMENT POLLUTION CONTROL REPORT

**Adelphia Gateway Pipeline**

**Submitted to:**
Pennsylvania Department of Environmental Protection (PADEP)

March 2020

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B. SOIL DATA
C. EROSION AND SEDIMENT CONTROL STANDARD WORKSHEETS
D. OFF-SITE ANALYSIS

# I. PCSM PLANNING AND DESIGN

Johnson, Mirmiran & Thompson (JMT), on behalf of Adelphia Gateway, has prepared this Post Construction Stormwater Management (PCSM) Plan for the Adelphia Gateway Pipeline. The PCSM Plan has been designed in accordance with the criteria stated in the Pennsylvania Department of Environmental Protection (PADEP) Stormwater Best Management Practices Manual, dated December 2006; Pennsylvania Department of Environmental Protection (PADEP), Bureau of Waterways Engineering and Wetlands Erosion and Sediment Pollution Control Program Manual, dated March 2012, thus satisfying requirements for PADEP General Permit (ESCGP-3) for Earth Disturbance Associated with Oil and Gas Exploration, Production, Processing, or Treatment Operations or Transmission Facilities contained under Pa. Code Title 25 Chapter 102.

The Adelphia Gateway Pipeline is an 84-mile pipeline that runs from Martins Creek to Marcus Hook. Facility upgrades will occur to thirteen (13) sites along the pipeline: Quakertown Compressor Station, East Perkiomen Blowdown, Skippack Pike Valve Tap, Perkiomen Creek Blowdown, Schuylkill River Blowdown, Cromby Blowdown, French Creek Blowdown, Mainline Valve 2, Paoli Pike Blowdown, Chester Creek Blowdown, Mainline Valve 1, Transco Meter Station, and Marcus Hook Compressor Station. The total limit of disturbance is 18.1 acres.

Stormwater impacts will be minimal to all sites except for three: Quakertown Compressor Station, Transco Meter Station, and Marcus Hook Compressor Station. All other sites will be restored to existing conditions and per Pa. Code Title 25 Chapter 102, these sites do not require PCSM Plan and stormwater analysis. Therefore, the PCSM Plan focuses on these three (3) sites. This narrative describes the stormwater management controls for Quakertown Compressor Station, Transco Meter Station, and Marcus Hook Compressor Station of the Adelphia Gateway Pipeline and related site work.

A Site Restoration/E&S Plan is prepared, in lieu of a PCSM Plan, for the following ten (10) sites: East Perkiomen Blowdown, Skippack Pike Valve Tap, Perkiomen Creek Blowdown, Schuylkill River Blowdown, Cromby Blowdown, French Creek Blowdown, Mainline Valve 2, Paoli Pike Blowdown, Chester Creek Blowdown and Mainline Valve 1.

The existing use for the Quakertown Compressor Station is a partially developed meter site with gravel and brush. East Perkiomen Blowdown, Skippack Pike Valve Tap, Perkiomen Creek Blowdown, Schuylkill River Blowdown, Cromby Blowdown, French Creek Blowdown, Mainline Valve 2, Paoli Pike Blowdown, Chester Creek Blowdown, Mainline Valve 1 are existing valve sites with gravel and grass. The existing use for the Quakertown Compressor Station is a partially developed site with an adjacent meter site. The area to be distributed is primarily meadow. Marcus Hook Compressor Station is a fully developed compressor site that is primarily gravel in existing conditions.

A second part of this project consists of the proposed Laterals. The Tilghman Lateral begins at the Marcus Hook Compressor Station, Delaware County, PA and terminates at the Tilghman Meter Station, Delaware County, PA. The project scope includes the installation of 4.41 miles of natural gas main, new tap valve (Monroe Tap Valve), and facility upgrades at Tilghman Meter Station. The natural gas main installation will consist of approximately 0.64 miles of traditional pipeline installation and 3.86 miles of horizontal directional

The Parkway Lateral begins at the Marcus Hook Compressor Station, Chester County, PA and terminates at the Delmarva and TETCO Meter Station, New Castle, DE. The project scope includes the installation of 1,100 linear feet of natural gas main, new meter pads, gravel paths, and a small compressor building. This section will be submitted at a later date with the Phased ESCGP-3 Permit.

## II. EXISTING TOPOGRAPHIC FEATURES OF THE PROJECT SITE AND THE IMMEDIATE SURROUNDING AREA

USGS quadrangle location maps are provided in Appendix A, which shows the location of the project site and the surrounding area.

## III. SOIL CHARACTERISTICS

Tables II-1 through II-13 below detail the types of soils, as contained within the Stormwater Management areas, for each of the thirteen sites, as defined by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey.

| **Table II-1: Quakertown Compressor Station: Soil Types within LOD** | | |
|---|---|---|
| **Symbol** | **Map Unit Name** | **Brief Map Unit Description** |
| AmB | Amwell silt loam, 3 to 8 percent slopes | Soil Rating D, very slow infiltration rate when thoroughly wet. Mainly clays, high water table soils, claypan or clay layer at or near surface, and shallow soils over nearly impervious material. Very slow rate of water transmission. |
| UdB | Udorthents, shale and sandstone | Soil Rating A, high infiltration rate when thoroughly wet. Mainly deep, well drained sands or gravelly sands. High rate of water transmission. |

| **Table II-2: East Perkiomen Blowdown: Soil Types within LOD** | | |
|---|---|---|
| **Symbol** | **Map Unit Name** | **Brief Map Unit Description** |
| Rt | Rowland silt loam, terrace | Soil Rating C, slow infiltration rate when thoroughly wet. Mainly soils with layer that impedes downward movement of water or soils of fine texture. Slow rate of water transmission. |

| Table II-3: Skippack Pike Meter Station: Soil Types within LOD | | |
|---|---|---|
| **Symbol** | **Map Unit Name** | **Brief Map Unit Description** |
| PeB | Penn silt loam, 3 to 8 percent slopes | Soil Rating B, moderate infiltration rate when thoroughly wet. Mainly soils that are moderately deep or deep, moderately well drained or well drained and moderately fine texture to moderately coarse texture. Moderate rate of water transmission. |
| PeC | Penn silt loam, 8 to 15 percent slopes | Soil Rating B, moderate infiltration rate when thoroughly wet. Mainly soils that are moderately deep or deep, moderately well drained or well drained and moderately fine texture to moderately coarse texture. Moderate rate of water transmission. |

| Table II-4: Perkiomen Creek Blowdown: Soil Types within LOD | | |
|---|---|---|
| **Symbol** | **Map Unit Name** | **Brief Map Unit Description** |
| Bo | Bowmansville-Knauers silt loams | Soil Rating D, very slow infiltration rate when thoroughly wet. Mainly clays, high water table soils, claypan or clay layer at or near surface, and shallow soils over nearly impervious material. Very slow rate of water transmission. |
| ReA | Readington silt loam, 0 to 3 percent slopes | Soil Rating C, slow infiltration rate when thoroughly wet. Mainly soils with layer that impedes downward movement of water or soils of fine texture. Slow rate of water transmission. |

| Table II-5: Schuylkill River Blowdown: Soil Types within LOD | | |
|---|---|---|
| **Symbol** | **Map Unit Name** | **Brief Map Unit Description** |
| Gb | Gibraltar silt loam | Soil Rating B, moderate infiltration rate when thoroughly wet. Mainly soils that are moderately deep or deep, moderately well drained or well drained and moderately fine texture to moderately coarse texture. Moderate rate of water transmission. |
| PeB | Penn silt loam, 3 to 8 percent slopes | Soil Rating B, moderate infiltration rate when thoroughly wet. Mainly soils that are moderately deep or deep, moderately well drained or well drained and moderately fine texture to moderately coarse texture. Moderate rate of water transmission. |
| PeC | Penn silt loam, 8 to 15 percent slopes | Soil Rating B, moderate infiltration rate when thoroughly wet. Mainly soils that are moderately deep or deep, moderately well drained or well drained and moderately fine texture to moderately coarse texture. Moderate rate of water transmission. |
| ReA | Readington silt loam, 0 to 3 percent slopes | Soil Rating C, slow infiltration rate when thoroughly wet. Mainly soils with layer that impedes downward movement of water or soils of fine texture. Slow rate of water transmission. |
| UrB | Urban land, 0 to 8 percent slopes | No soil rating. |

| Table II-6: Cromby Blowdown: Soil Types within LOD | | |
|---|---|---|
| **Symbol** | **Map Unit Name** | **Brief Map Unit Description** |
| PeB | Penn silt loam, 3 to 8 percent slopes | Soil Rating B, moderate infiltration rate when thoroughly wet. Mainly soils that are moderately deep or deep, moderately well drained or well drained and moderately fine texture to moderately coarse texture. Moderate rate of water transmission. |

| Table II-7: French Creek Blowdown: Soil Types within LOD | | |
|---|---|---|
| **Symbol** | **Map Unit Name** | **Brief Map Unit Description** |
| PeB | Penn silt loam, 3 to 8 percent slopes | Soil Rating B, moderate infiltration rate when thoroughly wet. Mainly soils that are moderately deep or deep, moderately well drained or well drained and moderately fine texture to moderately coarse texture. Moderate rate of water transmission. |
| PeC | Penn silt loam, 8 to 15 percent slopes | Soil Rating B, moderate infiltration rate when thoroughly wet. Mainly soils that are moderately deep or deep, moderately well drained or well drained and moderately fine texture to moderately coarse texture. Moderate rate of water transmission. |
| PeD | Penn silt loam, 15 to 25 percent slopes | Soil Rating B, moderate infiltration rate when thoroughly wet. Mainly soils that are moderately deep or deep, moderately well drained or well drained and moderately fine texture to moderately coarse texture. Moderate rate of water transmission. |
| ReB | Readington silt loam, 3 to 8 percent slopes | Soil Rating C, slow infiltration rate when thoroughly wet. Mainly soils with layer that impedes downward movement of water or soils of fine texture. Slow rate of water transmission. |
| UrxB | Urban land-Penn complex, 0 to 8 percent slopes | No soil rating. |

| Table II-8: Mainline Valve 2: Soil Types within LOD | | |
|---|---|---|
| **Symbol** | **Map Unit Name** | **Brief Map Unit Description** |
| MaC | Manor loam, 8 to 15 percent slopes | Soil Rating B, moderate infiltration rate when thoroughly wet. Mainly soils that are moderately deep or deep, moderately well drained or well drained and moderately fine texture to moderately coarse texture. Moderate rate of water transmission. |

| Table II-9: Paoli Pike Blowdown: Soil Types within LOD | | |
|---|---|---|
| **Symbol** | **Map Unit Name** | **Brief Map Unit Description** |
| Ha | Hatboro silt loam | Soil Rating D, very slow infiltration rate when thoroughly wet. Mainly clays, high water table soils, claypan or clay layer at or near surface, and shallow soils over nearly impervious material. Very slow rate of water transmission. |

| Table II-10: Chester Creek Blowdown: Soil Types within LOD | | |
|---|---|---|
| **Symbol** | **Map Unit Name** | **Brief Map Unit Description** |
| We | Wehadkee silt loam | Soil Rating D, very slow infiltration rate when thoroughly wet. Mainly clays, high water table soils, claypan or clay layer at or near surface, and shallow soils over nearly impervious material. Very slow rate of water transmission. |

| Table II-11: Mainline Valve 1: Soil Types within LOD | | |
|---|---|---|
| **Symbol** | **Map Unit Name** | **Brief Map Unit Description** |
| GeB | Glenelg channery loam, 3 to 8 percent slopes | Soil Rating B, moderate infiltration rate when thoroughly wet. Mainly soils that are moderately deep or deep, moderately well drained or well drained and moderately fine texture to moderately coarse texture. Moderate rate of water transmission. |

| Table II-12: Transco Meter Station: Soil Types within LOD | | |
|---|---|---|
| **Symbol** | **Map Unit Name** | **Brief Map Unit Description** |
| ByB2 | Butlertown silt loam, 3 to 8 percent slopes, moderately eroded | Soil Rating C, slow infiltration rate when thoroughly wet. Mainly soils with layer that impedes downward movement of water or soils of fine texture. Slow rate of water transmission. |
| OtA | Othello silt loams, 0 to 2 percent slopes, northern coastal plain | Soil Rating D, very slow infiltration rate when thoroughly wet. Mainly clays, high water table soils, claypan or clay layer at or near surface, and shallow soils over nearly impervious material. Very slow rate of water transmission. |

| Table II-13: Marcus Hook Compressor Station: Soil Types within LOD | | |
|---|---|---|
| **Symbol** | **Map Unit Name** | **Brief Map Unit Description** |
| OtA | Othellow silt loams, 0 to 2 percent slopes, northern coastal plain | Soil Rating D, very slow infiltration rate when thoroughly wet. Mainly clays, high water table soils, claypan or clay layer at or near surface, and shallow soils over nearly impervious material. Very slow rate of water transmission. |
| Up | Urban land | No soil rating. |

The Hydrologic Soil Group Rating Report from USDA NRCS Web Soil Survey, which includes a soil map, the physical properties of the soils, and the soil use limitations and resolutions is provided for each site in Appendix B.

# IV. PROJECT SITE RUNOFF

Table IV-1 below details the watershed where each site is located, and if there is an applicable Act 167 Stormwater Management Plan for the watershed.

| Table IV-1: Act 167 Stormwater Management Plans | | | |
|---|---|---|---|
| **Site Location** | **Watershed** | **Act 167 Plan Title** | **Date** |
| Quakertown Compressor Station | Tohickon Creek | Tohickon Creek Watershed Act 167 Stormwater Management Plan | February 28, 2002 |
| East Perkiomen Blowdown | Perkiomen Creek | East Branch of Perkiomen Creek Watershed Act 167 Stormwater Management Plan | May 5, 2004 |
| Skippack Pike Valve Tap | Perkiomen Creek | | |
| Perkiomen Creek Blowdown | Perkiomen Creek | | |
| Schuylkill River Blowdown | Schuylkill River | County-wide Act 167 Stormwater Management Model Ordinance | March 27, 2013 |
| Cromby Blowdown | Stony Run | | |
| French Creek Blowdown | French Creek | | |
| Mainline Valve 2 | Valley Creek | Valley Creek Watershed Stormwater Management Plan | July 30, 2010 |
| Paoli Pike Blowdown | Ridley Creek | County-wide Act 167 Stormwater Management Model Ordinance | March 27, 2013 |

| | | | |
|---|---|---|---|
| Chester Creek Blowdown | Chester Creek | Act 167 Stormwater Management Plan Chester Creek Watershed | June 2002 |
| Mainline Valve 1 | Chester Creek | | |
| Transco Meter Station | Naamans Creek | No Act 167 Stormwater Management Plan | |
| Marcus Hook Compressor Station | Naamans Creek | | |

A verification of Act 167 regulations and calculations are included in the PCSM Report to demonstrate that all stormwater management criteria set forth within the Tohickon Creek Watershed Act 167 Stormwater Management Plan has been met for water quality, volume and flood control. PADEP criteria set forth by PADEP's Stormwater Best Management Practices Manual, dated December 2006, was more restrictive than the criteria that was set forth within the Tohickon Creek Watershed Act 167 Stormwater Management Plan.

There is not an applicable Act 167 Stormwater Management Plan for Naaman's Creek. All other watersheds within the project limits follow the standard design criteria from Sections 102.8(g)(2) and (3), which states that post construction management requirements are met for all areas that are restored to pre-construction conditions or to a condition of meadow in good condition or better.

Therefore, this project follows the criteria set forth by PADEP's Stormwater Best Management Practices Manual, dated December 2006. As per the requirements of CG-1 in the Pennsylvania Stormwater BMP Manual, "post-development total runoff volume for all storms equal or less than the two (2)-year 24-hour duration precipitation must not increase, while factoring in that twenty percent (20%) of the existing impervious area of a project site, when present, shall be considered meadow in the model for existing conditions." Through stormwater BMPs, the BMPs will statically store the 2-year volume increase to ensure that the runoff volume does not increase after construction is complete. The 2-year, 24-hour rainfall duration was determined using PennDOT Publication 584, Chapter 7, Appendix 7A.

In order to meet the requirements of the PADEP ESCGP-3 permit, standard BMP worksheets 4, 5 and 5b were completed to confirm that no negative impacts would occur for volume control. The spreadsheets indicated above are included in the PCSM Report.

Stormwater management calculations were performed using the SCS TR-55 method for volume and peak rate calculations. Stormwater BMPs were routed through HydroCAD, Version 10.0. Analysis for the project sites were performed for the 2-, 10-, 50-, and 100-year storm events for both the pre-developed condition and the post-developed conditions. All rainfall data was determined using PennDOT Publication 584, Chapter 7, Appendix 7A.

Below is a summary of pre- and post-construction runoff volumes to demonstrate that there will not be any increases at each respective project site.

**Table IV-2: Runoff Volume Summary**

| | Quakertown Compressor Station | Transco Meter Station | Marcus Hook Compressor Station |
|---|---|---|---|
| Existing Conditions 2-yr, 24-hr Runoff Volume (CF) | 8,460 | 2,295 | 52,844 |
| Proposed Conditions 2-yr, 24-hr Runoff Volume (CF) | 12,504 | 7,513 | 56,248 |
| 2-yr Volume Increase (CF) | 4,044 | 4873 | 3,405 |
| Storage Volume of Proposed BMPs (CF) | 6,674 | 4,880 | 18,619 |
| DIFFERENCE (CF) | 2,630 | 7 | 15,214 |

The stormwater management design achieves volume reduction criteria, but 90% of the disturbed area cannot be controlled by BMPs for any of the three (3) sites. However, the proposed design will maintain and protect existing water quality and existing and designated uses. To demonstrate how the proposed design will be more protective, Tables VI-3, VI-4 and VI-5 show the pre- and post-construction pollutant loads within the disturbed areas. In all cases, the increase of pollutant load runoff increased minimally, as calculated with PADEP Worksheet 12 and 13. Worksheets 12 and 13 are included within Appendix D.1. With the addition of a pollutant reducing BMP, the total pollutant load will not exceed pre-existing conditions.

For Quakertown Compressor Station, the land use consists of brush, meadow, impervious and gravel in pre-construction conditions. During construction, the brush will be converted to impervious with the addition of a new building and gravel will surround the building for truck access. All disturbed gravel areas will either be restored to existing covers or converted to vegetation. The new building and gravel swale will drain to the BMP which will remove an adequate pollutant load to mitigate the increase in post-construction pollutant loads.

Pre-treatment for the MRC Basin consists of using two (2) jellyfish membrane filtration system devices, which provides high flow pretreatment and membrane filtration in a compact stand-alone system. Jellyfish devices remove floatables, trash, oil, debris, TSS, fine silt-sized particles, and a high percentage of particulate-bound pollutants, including phosphorus, nitrogen, metals and hydrocarbons.

**Table VI-3: Quakertown Compressor Station Water Quality Summary**

| Pollutant Type | Pollutant Load within LOD | | | Pollutant Reduction Achieved through BMP | Pollutant Load after BMP installation |
|---|---|---|---|---|---|
| | Pre-construction | Post-construction | Increase | | |
| TSS (lbs) | 50.78 | 50.96 | 0.19 | 16.48 | 34.49 |
| TP (lbs) | 0.17 | 0.15 | -0.02 | 0.10 | 0.04 |
| $NO_3$ (lbs) | 0.33 | 0.38 | 0.05 | 0.05 | 0.34 |

For Transco Meter Station, the land use is a combination of woods and brush in pre-construction conditions. During construction, the land will be converted to gravel for the entire limit of disturbance. Through the addition of a subsurface detention basin, the BMP will remove an adequate pollutant load to mitigate the increase in pollutant loads caused by converting the site from woods and brush to gravel.

**Table VI-4: Transco Meter Station Water Quality Summary**

| Pollutant Type | Pollutant Load within LOD | | | Pollutant Reduction Achieved through BMP | Pollutant Load after BMP installation |
|---|---|---|---|---|---|
| | Pre-construction | Post-construction | Increase | | |
| TSS (lbs) | 27.97 | 39.68 | 11.71 | 24.14 | 15.54 |
| TP (lbs) | 0.11 | 0.10 | -0.01 | 0.06 | 0.04 |
| $NO_3$ (lbs) | 0.14 | 0.276 | 0.13 | 0.05 | 0.22 |

For Marcus Hook Compressor Station, the existing land uses is primarily gravel and impervious, with a small portion of meadow within an existing swale that will be restored to existing conditions after construction. A new impervious access road and building will be constructed within the existing gravel areas. The remaining disturbed gravel areas will either be restored to existing conditions or converted to vegetation. Through the addition of a surface detention basin, the BMP will remove an adequate pollutant load to mitigate the increase in pollutant loads.

Per MRC design guidelines, the use of a vegetated MRC BMP is a sufficient water quality demonstration and no additional water quality calculations are needed.

As stated on Page 9 of the E&S Narrative, PADEP criteria set forth by PADEP's Stormwater Best Management Practices Manual, dated December 2006, was more restrictive than the criteria set forth within the Tohickon Creek Watershed Act 167 Stormwater Management Plan. There is not an applicable Act 167 Stormwater Management Plan for Naaman's Creek. All other watersheds within the project limits follow the standard design criteria from Sections 102.8(g)(2) and 102.8(g)(3), which states that post construction management requirements are met for all areas that are restored to pre-construction conditions or to a condition of meadow in good condition or better.

A comparison between the analyzed conditions was made to assess the hydrological effects of the project and determine the best BMP to mitigate the volume and rate increases. The BMP facilities have been designed to manage the net change in peak rate for all storm events in a manner not to exceed pre-construction rates. Tables IV-6, IV-7 and IV-8 below outline the pre- and post-construction peak rates to show that there will not be any increases at any project site.

**Table IV-6: Quakertown Compressor Station Peak Rate Summary**

| Storm | Existing Peak Rate | Proposed Peak Rate | | | | Net Change |
|---|---|---|---|---|---|---|
| | | BMP Inflow | BMP Outflow | Bypass | Total | |
| | (cfs) | (cfs) | (cfs) | (cfs) | (cfs) | (cfs) |
| 2-yr | 2.94 | 2.60 | 0.01 | 2.29 | 2.21 | -0.73 |
| 10-yr | 5.36 | 4.15 | 0.36 | 3.45 | 3.45 | -1.91 |
| 50-yr | 8.87 | 6.28 | 2.78 | 5.15 | 5.15 | -3.72 |
| 100-yr | 10.88 | 7.47 | 3.70 | 6.10 | 6.10 | -4.78 |

**Table IV-7: Transco Meter Station Peak Rate Summary**

| Storm | Existing Peak Rate | Proposed Peak Rate | | | | Net Change |
|---|---|---|---|---|---|---|
| | | BMP Inflow | BMP Outflow | Bypass | Total | |
| | (cfs) | (cfs) | (cfs) | (cfs) | (cfs) | (cfs) |
| 2-yr | 1.24 | 2.19 | 0.03 | 1.04 | 1.04 | -0.20 |
| 10-yr | 2.75 | 3.55 | 0.47 | 1.80 | 1.80 | -0.95 |
| 50-yr | 5.19 | 5.49 | 2.72 | 2.90 | 4.00 | -1.19 |
| 100-yr | 6.66 | 6.59 | 3.47 | 3.53 | 5.88 | -0.78 |

**Table IV-8: Marcus Hook Compressor Station Peak Rate Summary**

| Storm | Existing Peak Rate | Proposed Peak Rate | | | | Net Change |
|---|---|---|---|---|---|---|
| | | BMP Inflow | BMP Outflow | Bypass | Total | |
| | (cfs) | (cfs) | (cfs) | (cfs) | (cfs) | (cfs) |
| 2-yr | 24.89 | 6.34 | 0.01 | 16.19 | 16.19 | -8.70 |
| 10-yr | 39.85 | 13.87 | 0.78 | 25.08 | 25.09 | -14.76 |
| 50-yr | 61.06 | 21.20 | 5.27 | 37.65 | 41.99 | -19.07 |
| 100-yr | 73.15 | 25.39 | 5.66 | 44.31 | 50.18 | -22.97 |

# V. OFF-SITE DISCHARGE ANALYSIS

In existing conditions, the entire Quakertown Compressor Station site drains to a delineated wetland to the North of the project site. The wetland drains to Tohickon Creek, which is located approximately 1,900 ft from the project site. In proposed conditions, the drainage pattern over the areas of earth disturbance will continue to drain to the delineated wetland. Site drainage to the surface water will travel via sheet flow from proposed gravel surfaces and from concentrated flow from the underground MRC basin.

At Transco Meter Station, there is an existing roadside swale that drains west to east along Ridge Road to a storm sewer under Fed Ex Drive. In existing conditions, the drainage at the project site drains off-site to this existing roadside swale, which eventually leads to Naaman's Creek approximately 2,790 feet Southwest of the project site.

There is a proposed bypass swale along the North property boundary that will shift the upstream drainage pattern that was previously draining through the site and discharging to the roadside swale along Ridge

Road. In proposed conditions, the upstream drainage from the bypass swale will flow directly to a delineated wetland to the west of the project site. All proposed earth disturbance south of the bypass swale will drain to the roadside swale along Ridge Road as originally intended. Site drainage will travel to the existing drainage swale via sheet flow from proposed gravel surfaces and from concentrated flow from the subsurface infiltration bed (BMP 6.4.3). As noted in Section IV, the overall peak rate is decreased in post construction conditions. In addition, a channel analysis of the existing channel was performed to confirm that the flow path downstream of the outlet point is stable flow. An analysis that shows table flow for the existing channel can be found in the PCSM Report. Since the flow is stable to the existing channel, it is concluded that the proposed conditions prevent erosion, damage, or nuisance to the downstream point of interest (POI).

At Marcus Hook Compressor station, there are two (2) existing swales that collects sheet flow from the project site in existing and proposed conditions. One swale drains Northwest-Southwest and another drains East to West. These two swales merge at the most Southern end of the project site and drains off-site towards Naaman's Creek. Naaman's Creek is located approximately 2,020 feet Southwest of the project site.

The drainage pattern from existing to proposed conditions is not altered. All post construction drains to the Southernmost swale to Naaman's Creek via sheet flow or concentrated outflow from a surface MRC basin. As noted in Section IV, the overall peak rate is decreased in post construction conditions. In addition, a channel analysis of the existing channel was performed to confirm that the flow path downstream of the outlet point is stable flow. An analysis that shows table flow for the existing channel can be found in the PCSM Report. Since the flow is stable to the existing channel, it is concluded that the proposed conditions prevent erosion, damage, or nuisance to the downstream point of interest (POI).

An exhibit is included on Appendix D to demonstrate the flow paths to Naaman's Creek. Also, included in Appendix D is the channel analysis of the existing channel which indicates stable flow at the discharge points at Transco Meter Station and Marcus Hook Compressor Station.

As mentioned in Section I of this report, the remaining ten (10) sites will be restored to existing conditions and will have no change to discharge quantity or quality. Therefore, any off-site discharge at all project sites will not cause erosion, damage, or a nuisance to off-site properties.

# VI. SURFACE WATER CLASSIFICATIONS

Table III-1 below details the watershed where each site is located, as well as the receiving surface waters classification, as defined by the Pennsylvania Department of Environmental Protection (PADEP) Title 25, Chapter 93: Water Quality Standards. Note the following acronyms: CWF (Cold Water Fishes), WWF (Warm Water Fishes), MF (Migratory Fishes), TSF (Trout Stocking), and HQ (High Quality Waters).

All sites with stormwater management impacts (Quakertown Compressor Station, Transco Meter Station and Marcus Hook Compressor Station) are not within HQ/EV watersheds.

| Table III-1: Receiving Surface Waters Classification | | |
|---|---|---|
| **Site Location** | **Watershed** | **Ch. 93 Classification** |
| Quakertown Compressor Station | Tohickon Creek | TSF |
| East Perkiomen Blowdown | Perkiomen Creek | WWF, MF, Siltation-Impaired |
| Skippack Pike Meter Station | Perkiomen Creek | WWF, MF, Siltation-Impaired |
| Perkiomen Creek Blowdown | Perkiomen Creek | WWF, MF, Siltation-Impaired |
| Schuylkill River Blowdown | Schuylkill River | WWF-MF, Siltation-Impaired |
| Cromby Blowdown | Stony Run | HQ-TSF, MF, Siltation-Impaired |
| French Creek Blowdown | French Creek | TSF, MF |
| Mainline Valve 2 | Valley Creek | CWF-MF, Siltation-Impaired |
| Paoli Pike Blowdown | Ridley Creek | HQ-TSF, MF, Siltation-Impaired |
| Chester Creek Blowdown | Chester Creek | TSF, MF, Siltation-Impaired |
| Mainline Valve 1 | Chester Creek | TST, MF, Siltation-Impaired |
| Transco Meter Station | Naamans Creek | WWF, MF |
| Marcus Hook Compressor Station | Naamans Creek | WWF, MF |

# VII. NARRATIVE DESCRIPTION OF THE LOCATION AND TYPE OF PERIMETER AND ON-SITE BMPS

**E&SPC Devices**

The following measures are aimed at controlling accelerated erosion and sedimentation during construction. Temporary erosion and sediment control will be accomplished by utilizing Best Management Practices, such as Rock Construction Entrance, Compost Filter Sock, Inlet Protection, Compost Sock Washout Facility, Pumped Water Filter Bags, Erosion Control Blanket, Temporary Wetland Crossings and Rock Filters. The extent and duration of earth disturbance is to be minimized to limit impacts of erosion and sedimentation to neighboring and downstream properties. For project site in HQ watersheds, the E&S Desgin includes ABACT measures to ensure limited erosion and sedimentation.

The following additional E&S plan details have been provided on the E&S sheets as required by PADEP:

1. Compost Filter Sock

   Compost filter sock will be placed on grade downslope from disturbed areas and around the temporary stockpile. The compost filter sock will be installed in accordance with the detail shown on the plan. This device is an ABACT for HQ and EV watersheds.

2. Inlet Protection

   Inlet protection will be placed in all existing and proposed inlets. Inlet protection is intended to filter sediment laden water and collect debris prior to entering the sewer system. Inlet protection will be installed in accordance with the detail shown on the plan. Filter bag inlet protect is ABACT for HQ, but not EV watersheds.

3. Rock Construction Entrance

   A Rock Construction Entrance will be placed where it is anticipated that construction traffic will exit the project site onto any roadway, public or private. Access to the site should be limited to the stabilized construction entrance. The rock Construction Entrance will be located as shown on the plans and installed in accordance with the detail shown in the plan. Rock construction entrances with wash racks are ABACT for HQ and EV watersheds.

4. Compost Sock Washout Facility

   A compost sock washout facility will be placed on-site in close vicinity of where the concrete will be mixed. The compost sock washout facility is required to be placed on a slope not exceeding 2%. It is recommended that it is not located close to vehicular traffic to minimize the potential for accidental spills. Concrete washout water will be directed into the filter ring to prevent untreated water from leaving the construction site and entering directly into existing and proposed inlets. The compost sock washout will be installed in accordance with the detail shown on the plan.

5. Pumped Water Filter Bags

   Pumped filter bags will be used on-site in disturbed areas to filter water prior to discharging to surface waters. The pumped water filter bags will be installed in accordance with the detail shown on the plan.

6. Erosion Control Blanket

   Erosion control blankets will be placed on-site in areas with slopes 3H:1V or steeper and in areas where sediment pollution is at risk for reaching receiving surface waters. Additionally, erosion control blankets will be placed in areas that are seeded and within 50 feet of a surface water, or within 100 feet of a special protection surface water, regardless of slope. The erosion control blanket will be installed in accordance with the detail shown on the plan.

7. Temporary Wetland Crossings

   Wetland crossings will be avoided wherever possible. When it is necessary to cross a wetland, temporary wetland crossings will be placed for the least possible impact on the wetland. Constructed materials for the temporary wetland crossings will be chosen for minimum disturbance to the soil surface and the crossings will be completely removed when they are no longer necessary. The temporary wetland crossings will be installed in accordance with the detail shown on the plan.

8. Rock Filters

Rock filters will be placed on-site to control runoff within constructed channels. They will be placed at the downstream end of the channel temporarily during the time of disturbance. The rock filters will be installed in accordance with the detail shown on the plan.

## VIII. GEOLOGIC FORMATIONS OR SOIL CONDITIONS

There are no known geologic formations or soil conditions identified at the site that have the potential to cause pollution during construction. Should the potential for pollution arise, measures have been provided to avoid, minimize, or mitigate erosion and sedimentation using erosion and sediment control devices, as shown in the plan.

## IX. POTENTIAL THERMAL IMPACTS TO SURFACE WATERS

Thermal impacts associated with the project will be minimized and/or mitigated through the incorporation of various BMPs, which include a subsurface and subsurface MRC basins and a subsurface infiltration bed. Runoff from the impervious areas will be directed to the BMPs where the travel time is increased to infiltrate and/or store runoff, reducing the quantity and temperature of the runoff.

The surface basin at Marcus Hook Compressor Station will be vegetated. Landscaping and vegetative cover will mimic natural ecosystems, resulting in a system that is resistant to climatic stresses. Additionally, the basin's outlet structure is designed to promote the slow release of outflow to the surface waters.

The subsurface basin at Transco Meter Station will temporarily store stormwater runoff beneath the surface, away from direct sunlight and will promote infiltration which will release water into the groundwater instead of discharging to the surface waters.

The subsurface basin at Quakertown Compressor Station will temporarily store stormwater runoff beneath the surface, away from direct sunlight and will promote the slow release of outflow to the surface waters.

## X. EXISTING/PROPOSED RIPARIAN FOREST BUFFERS

The proposed earth disturbance activities at Paoli Pike Blowdown are to be conducted within 150 feet of Ridley Creek, which is classified as an HQ watershed. Per PA Code 102.14(d)(1), oil and gas activities for which site restoration is part of the permit are not required to provide a mandatory riparian buffer so long as any existing riparian buffer is undisturbed to the extent practicable. The proposed earth disturbance is limited to a proposed valve replacement and associated site work. The disturbed area is limited to 3,445 SF, which will be restored to existing conditions after construction. Therefore, a riparian buffer waiver is being requested for this project since the project is a of a temporary nature where the site will be fully restored to it's pre-existing conditions during the ESCGP permit term.

## I. ANTIDEGRADATION REQUIREMENTS

Compliance with antidegradation implementation is required, including evaluation of non-discharge alternatives and ABACT for where activities will be conducted in special protection watersheds (HQ/EV) or siltation impaired waters. The following surface waters are HQ and siltation impaired waters:

- Tohickon Creek (siltation-impaired)

- Perkiomen Creek (siltation-impaired)
- Schuylkill River (siltation-impaired)
- Stony Run (HQ, siltation-impaired)
- Valley Creek (siltation-impaired)
- Ridley Creek (HQ, siltation-impaired)
- Chester Creek (siltation-impaired)

All sites within the watersheds listed above, with the exception of the Quakertown Compressor Station within the Tohickon Creek watershed, will be restored to pre-existing conditions. By limiting the disturbed areas, limiting extent and duration of disturbance and performing site restoration, these practices will eliminate the net change in rate, volume and water quality after construction.

At Quakertown Compressor Station within the Tohickon Creek watershed, non-discharge BMPs of limiting the disturbed areas, limiting extent and duration of disturbance and partially restoring the sites will aid in the protection of Tohickon Creek. A series of channels with rock filter check dams and stone storage will discharge to an MRC BMP. These proposed BMPs will eliminate the net change in rate, volume and water quality after construction.

## II. BMP INSTALLATION SEQUENCE

A sequence of construction was developed to minimize land clearing and grading, and to minimize soil compaction.

**Quakertown Compressor Station (Non-vegetated MRC: Underground Storage Chamber)**

1. Install stabilized rock construction entrances with wash rack where vehicles will enter construction areas from public roads at the direction of the environmental inspector (EI) based on site conditions and clearing access needs.
2. Install wood matting and protective fence to provide ingress/egress to the limit of disturbance. Whenever possible, work should be scheduled for low flow seasons.
3. Install compost filter sock, sediment barriers, or other county conservation district approved sediment barriers/BMPs prior to clearing an area. Contractor to utilize ABACT E&S BMP technologies to minimize sediment impairment to siltation impaired waters.
4. Install the MRC BMP during the final phases of site construction to prevent sedimentation and/or damage from construction activity. After installation, prevent sediment-laden water from entering via overland, inlets and pipes.
5. Install and maintain proper E&S BMPs during construction. Provide E&S proposed on the site so that the construction runoff is directed away from the StormTank system.
6. Complete site grading and stabilize the soil within the limit of the disturbance. Do no finalize the StormTank system's excavation and construction until the drainage area is fully stabilized.
7. Install the JellyFish Membrane Filtration system, as indicated on the Shop Drawings and Specifications from Contech.
8. Excavate to the proposed invert depths. Manually grade and scarify the existing soil surface. The bottom of the system shall be at level grade. Do not compact in-situ soils.

9. Place geotextile, impervious liner and aggregate immediately after approval of subgrade preparation to prevent accumulation of debris or sediment. Prevent runoff and sediment from entering the storage bed.
10. Install StormTank modules by hand, as indicated on Shop Drawings. Take care to avoid damage to geotextile.
11. Upon completion of module installation, wrap the module in geotextile fabric and impervious liner. Place stone aggregate on top of the geotextile. Inspect all geotextile, ensuring that no damage exists which will allow sediment into the system.
12. Complete surface grading above the StormTank system, using suitable equipment to avoid excess compaction.
13. Maintain E&S BMPs until the site is fully stabilized.

**Transco Meter Station (StormTank - Subsurface Infiltration Bed: BMP 6.4.3)**

1. Protect subsurface infiltration bed area from compaction prior to installation.
2. Areas for proposed StormTank system shall be clearly marked before any site work begins to avoid soil disturbance during construction.
3. Provide E&S proposed on the site so that the construction runoff is directed away from the StormTank system.
4. Complete site grading and stabilize the soil within the limit of the disturbance. Do no finalize the StormTank system's excavation and construction until the drainage area is fully stabilized.
5. Excavate to the proposed invert depths. Manually grade and scarify the existing soil surface. The bottom of the system shall be at level grade. Do not compact in-situ soils.
6. Place geotextile and aggregate immediately after approval of subgrade preparation to prevent accumulation of debris or sediment. Prevent runoff and sediment from entering the storage bed.
7. Install StormTank modules by hand, as indicated on Shop Drawings. Take care to avoid damage to geotextile.
8. Upon completion of module installation, wrap the module in geotextile fabric. Place stone aggregate on top of the geotextile. Inspect all geotextile, ensuring that no damage exists which will allow sediment into the system.
9. Complete surface grading above the StormTank system, using suitable equipment to avoid excess compaction.
10. Maintain E&S BMPs until the site is fully stabilized.

**Marcus Hook Compressor Station (Vegetated MRC BMP)**

1. Install stabilized rock construction entrances where vehicles will enter construction areas from public roads at the direction of the environmental inspector (EI) based on site conditions and clearing access needs.
2. Install compost filter sock, sediment barriers, or other county conservation district approved sediment barriers/BMPs prior to clearing an area.
3. Install and maintain proper E&S BMPs during construction.

4. Complete site grading, install proposed drainage and stabilize the soil within the limit of disturbance. Ensure compost filter sock trap is installed to protect the outlet structure top of grate.
5. Construct building, impervious access path and proposed site features outlined on the design plans.
6. Install the MRC BMP during the final phases of site construction to prevent sedimentation and/or damage from construction activity. After installation, prevent sediment-laden water from entering via overland, inlets and pipes. Do not finalize the BMP excavation and construction until the drainage area is fully stabilized.
7. Accumulated sediment shall be removed and disturbed areas shall be stabilized inside the basin before conversion to the MRC BMP. Excavate the MRC BMP bottom to an uncompacted subgrade free from rocks and debris. Do not compact the subgrade. Install outlet control structures, underdrain piping with aggregate envelope and cleanouts.
8. Place soil media gently. Do not compact soil media. The placement of soil media should be done from outside the BMP footprint to avoid compaction by construction equipment.
9. Place geotextile, impervious liner and aggregate immediately after approval of subgrade preparation to prevent accumulation of debris or sediment. Prevent runoff and sediment from entering the storage bed.
10. Equipment should never drive over placed soil media.
11. Presoak the planting soil prior to planting vegetation to aid in settlement.
12. Complete final grading to achieve proposed basin design elevations, leaving space for topsoil as needed.
13. Seed and stabilize disturbed area. Vegetate with native plantings.
14. Maintain E&S BMPs until the site is fully stabilized.

**Main Line Valve 1 (Site Restoration)**

1. Stake out the limit of disturbance. The area to be used for the installation of pipeline and valves shall be clearly marked before any site work begins to avoid soil disturbance and compaction during construction.
2. Install the rock construction entrances as shown on the plans and as necessary to provide ingress/egress to the limit of disturbance.
3. Install all E&S control devices such as: compost filter socks as shown on the plans and details.
4. Perform clearing and grubbing as needed for the project. Limit clearing and grubbing to the areas of the project that are being constructed.
5. Construct proposed mechanical piping and valves as shown on the plans.
6. Remove all erosion and sediment control devices upon completion and stabilization of work area.
7. Stabilize disturbed areas immediately. Contractor shall ensure that all grading is restored to existing conditions. Contractor shall match existing contours and maintain drainage features and topography per site conditions. Decompact subgrade of disturbed areas to a depth of 12 inches.

**Chester Creek Blowdown (Site Restoration)**

1. Stake out the limit of disturbance and clearly delineate sensitive areas including waterbodies and wetlands. The area to be used for the installation of pipeline and valves shall be clearly marked before any site work begins to avoid soil disturbance and compaction during construction.
2. Install the rock construction entrances as shown on the plans and as necessary to provide ingress/egress to the limit of disturbance.
3. Install all E&S control devices such as: compost filter socks as shown on the plans and details.
4. Perform clearing and grubbing as needed for the project. Limit clearing and grubbing to the areas of the project that are being constructed.
5. Construct proposed mechanical piping and valves as shown on the plans.
6. Remove all erosion and sediment control devices upon completion and stabilization of work area.
7. Stabilize disturbed areas immediately. Contractor shall ensure that all grading is restored to existing conditions. Contractor shall match existing contours and maintain drainage features and topography per site conditions. Decompact subgrade of disturbed areas to a depth of 12 inches.

**Paoli Pike Blowdown (Site Restoration)**

1. Stake out the limit of disturbance and clearly delineate sensitive areas including waterbodies, wetlands and riparian buffers. The area to be used for the installation of pipeline and valves shall be clearly marked before any site work begins to avoid soil disturbance and compaction during construction.
2. Install wood matting for wetlands to provide ingress/egress to the limit of disturbance. Whenever possible, work should be scheduled for low flow seasons.
3. Install the rock construction entrances as shown on the plans and as necessary to provide ingress/egress to the limit of disturbance.
4. Install all E&S control devices such as: compost filter socks and compost sock washout as shown on the plans and details.
5. Perform clearing and grubbing as needed for the project. Limit clearing and grubbing to the areas of the project that are being constructed.
6. Construct proposed mechanical piping and valves as shown on the plans.
7. Remove all erosion and sediment control devices upon completion and stabilization of work area.
8. Remove wood matting for wetlands. All disturbed areas within the wetlands must be stabilized and restored to existing conditions.
9. Stabilize disturbed areas immediately. Contractor shall ensure that all grading is restored to existing conditions. Contractor shall match existing contours and maintain drainage features and topography per site conditions. Decompact subgrade of disturbed areas to a depth of 12 inches.

**Main Line Valve 2 (Site Restoration)**

1. Stake out the limit of disturbance. The area to be used for the installation of pipeline and valves shall be clearly marked before any site work begins to avoid soil disturbance and compaction during construction.

2. Install the rock construction entrances as shown on the plans and as necessary to provide ingress/egress to the limit of disturbance.
3. Install all E&S control devices such as: compost filter socks as shown on the plans and details.
4. Perform clearing and grubbing as needed for the project. Limit clearing and grubbing to the areas of the project that are being constructed.
5. Construct proposed mechanical piping and valves as shown on the plans.
6. Remove all erosion and sediment control devices upon completion and stabilization of work area.
7. Stabilize disturbed areas immediately. Contractor shall ensure that all grading is restored to existing conditions. Contractor shall match existing contours and maintain drainage features and topography per site conditions. Decompact subgrade of disturbed areas to a depth of 12 inches.

**French Creek Blowdown (Site Restoration)**

1. Stake out the limit of disturbance and clearly delineate sensitive areas including waterbodies. The area to be used for the installation of pipeline and valves shall be clearly marked before any site work begins to avoid soil disturbance and compaction during construction.
2. Install wood matting to provide ingress/egress to the limit of disturbance. Whenever possible, work should be scheduled for low flow seasons.
3. Install the rock construction entrances as shown on the plans and as necessary to provide ingress/egress to the limit of disturbance.
4. Install all E&S control devices such as: compost filter socks as shown on the plans and details.
5. Perform clearing and grubbing as needed for the project. Limit clearing and grubbing to the areas of the project that are being constructed.
6. Construct proposed mechanical piping and valves as shown on the plans.
7. Remove all erosion and sediment control devices upon completion and stabilization of work area.
8. Remove wood matting. All disturbed areas within the wetlands must be stabilized and restored to existing conditions.
9. Stabilize disturbed areas immediately. Contractor shall ensure that all grading is restored to existing conditions. Contractor shall match existing contours and maintain drainage features and topography per site conditions. Decompact subgrade of disturbed areas to a depth of 12 inches.

**Cromby Blowdown (Site Restoration)**

1. Stake out the limit of disturbance. The area to be used for the installation of pipeline and valves shall be clearly marked before any site work begins to avoid soil disturbance and compaction during construction.
2. Install wood matting to provide ingress/egress to the limit of disturbance. Whenever possible, work should be scheduled for low flow seasons.
3. Install the rock construction entrances as shown on the plans and as necessary to provide ingress/egress to the limit of disturbance.

4. Install all E&S control devices such as: compost filter socks and compost sock washout as shown on the plans and details.
5. Perform clearing and grubbing as needed for the project. Limit clearing and grubbing to the areas of the project that are being constructed.
6. Construct proposed mechanical piping and valves as shown on the plans.
7. Remove all erosion and sediment control devices upon completion and stabilization of work area.
8. Remove wood matting. All disturbed areas within the wetlands must be stabilized and restored to existing conditions.
9. Stabilize disturbed areas immediately. Contractor shall ensure that all grading is restored to existing conditions. Contractor shall match existing contours and maintain drainage features and topography per site conditions. Decompact subgrade of disturbed areas to a depth of 12 inches.

**Schuylkill River Blowdown (Site Restoration)**

1. Stake out the limit of disturbance and clearly delineate sensitive areas including waterbodies and wetlands. The area to be used for the installation of pipeline and valves shall be clearly marked before any site work begins to avoid soil disturbance and compaction during construction.
2. Install wood matting and temporary crossings for wetlands to provide ingress/egress to the limit of disturbance. Whenever possible, work should be scheduled for low flow seasons.
3. Install the rock construction entrances as shown on the plans and as necessary to provide ingress/egress to the limit of disturbance.
4. Install all E&S control devices such as: compost filter socks as shown on the plans and details.
5. Perform clearing and grubbing as needed for the project. Limit clearing and grubbing to the areas of the project that are being constructed.
6. Construct proposed mechanical piping and valves as shown on the plans. Remove fence as shown on the plans.
7. Remove all erosion and sediment control devices upon completion and stabilization of work area.
8. Remove wood matting and temporary crossings for wetlands. All disturbed areas within the wetlands must be stabilized and restored to existing conditions.
9. Stabilize disturbed areas immediately. Contractor shall ensure that all grading is restored to existing conditions. Contractor shall match existing contours and maintain drainage features and topography per site conditions. Decompact subgrade of disturbed areas to a depth of 12 inches.

**Perkiomen Creek Blowdown (Site Restoration)**

1. Stake out the limit of disturbance and clearly delineate sensitive areas including wetlands. The area to be used for the installation of pipeline and valves shall be clearly marked before any site work begins to avoid soil disturbance and compaction during construction.
2. Install the rock construction entrances as shown on the plans and as necessary to provide ingress/egress to the limit of disturbance.
3. Install wood matting and temporary crossings for wetlands to provide ingress/egress to the limit of disturbance. Whenever possible, work should be scheduled for low flow seasons.

4. Install temporary stream crossing as shown on the plans.
5. Install all E&S control devices such as: compost filter socks as shown on the plans and details.
6. Perform clearing and grubbing as needed for the project. Limit clearing and grubbing to the areas of the project that are being constructed.
7. Construct proposed mechanical piping and valves as shown on the plans. Remove fence as shown on the plans.
8. Remove all erosion and sediment control devices upon completion and stabilization of work area.
9. Remove wood matting and temporary crossings for wetlands. All disturbed areas within the wetlands must be stabilized and restored to existing conditions.
10. Stabilize disturbed areas immediately. Contractor shall ensure that all grading is restored to existing conditions. Contractor shall match existing contours and maintain drainage features and topography per site conditions. Decompact subgrade of disturbed areas to a depth of 12 inches.

**Skippack Pike Valve Tap (Site Restoration)**

1. Stake out the limit of disturbance. The area to be used for the installation of pipeline and valves shall be clearly marked before any site work begins to avoid soil disturbance and compaction during construction.
2. Install the rock construction entrances as shown on the plans and as necessary to provide ingress/egress to the limit of disturbance.
3. Install wood matting to provide ingress/egress to the limit of disturbance. Whenever possible, work should be scheduled for low flow seasons.
4. Install all E&S control devices such as: compost filter socks and inlet protection on existing inlets as shown on the plans and details.
5. Perform clearing and grubbing as needed for the project. Limit clearing and grubbing to the areas of the project that are being constructed.
6. Construct proposed mechanical piping and valves as shown on the plans.
7. Remove all erosion and sediment control devices upon completion and stabilization of work area.
8. Remove wood matting. All disturbed areas within the wetlands must be stabilized and restored to existing conditions.
9. Stabilize disturbed areas immediately. Contractor shall ensure that all grading is restored to existing conditions. Contractor shall match existing contours and maintain drainage features and topography per site conditions. Decompact subgrade of disturbed areas to a depth of 12 inches.

**East Perkiomen Blowdown (Site Restoration)**

1. Stake out the limit of disturbance and clearly delineate sensitive areas including wetlands. The area to be used for the installation of pipeline and valves shall be clearly marked before any site work begins to avoid soil disturbance and compaction during construction.
2. Install the rock construction entrances as shown on the plans and as necessary to provide ingress/egress to the limit of disturbance.
3. Install all E&S control devices such as: compost filter socks as shown on the plans and details.

4. Preserve existing trees to remain. Install tree protection fence as shown on the plans and details.
5. Perform clearing and grubbing as needed for the project. Limit clearing and grubbing to the areas of the project that are being constructed.
6. Construct proposed mechanical piping and valves as shown on the plans. Remove fence as shown on the plans.
7. Remove all erosion and sediment control devices upon completion and stabilization of work area.
8. Stabilize disturbed areas immediately. Contractor shall ensure that all grading is restored to existing conditions. Contractor shall match existing contours and maintain drainage features and topography per site conditions. Decompact subgrade of disturbed areas to a depth of 12 inches.

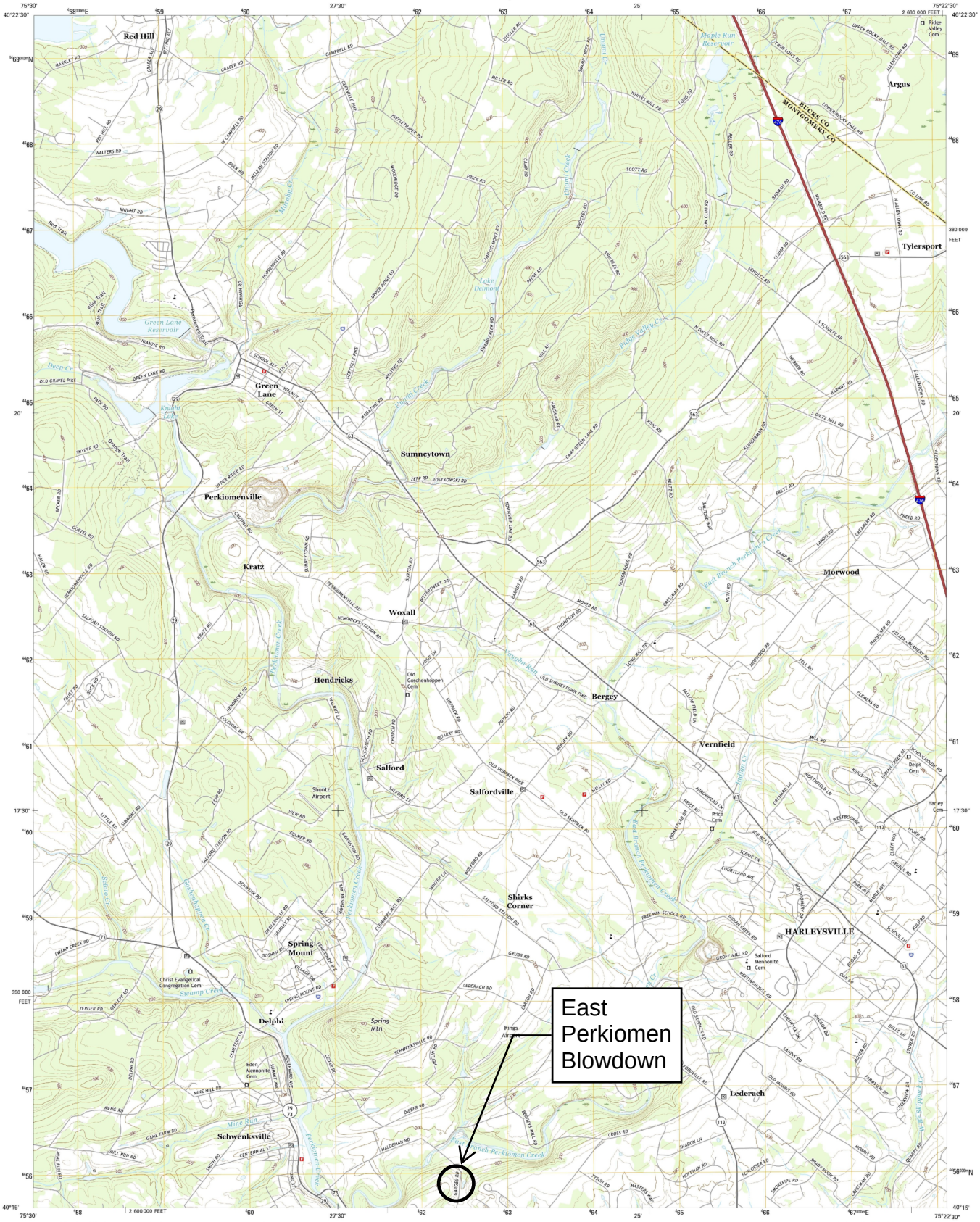
# Appendix A

Location Maps

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map US Topo

# PERKIOMENVILLE QUADRANGLE
PENNSYLVANIA
7.5-MINUTE SERIES




**Produced by the United States Geological Survey**
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and 1 000-meter grid: Universal Transverse Mercator, Zone 18T
10 000-foot ticks: Pennsylvania Coordinate System of 1983 (south zone)

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery.....NAIP, June 2013
Roads..... U.S. Census Bureau, 2015 - 2016
Names.....GNIS, 2016
Hydrography.....National Hydrography Dataset, 2013
Contours.....National Elevation Dataset, 2011
Boundaries.....Multiple sources; see metadata file 1972 - 2016

Wetlands.....FWS National Wetlands Inventory 1977 - 2014

12° 5'
215 MILS
6° 17'
5 MILS
MN
GN

UTM GRID AND 2016 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

| U.S. National Grid |
|---|
| 100,000-m Square ID |
| VK |
| Grid Zone Designation |
| 18T |

SCALE 1:24 000

KILOMETERS: 1 0.5 0 1 2
METERS: 1000 500 0 1000 2000
MILES: 1 0.5 0 1
FEET: 1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

CONTOUR INTERVAL 20 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.19

PENNSYLVANIA
QUADRANGLE LOCATION

| | | |
|---|---|---|
| 1 | 2 | 3 |
| 4 | | 5 |
| 6 | 7 | 8 |

ADJOINING QUADRANGLES

1 East Greenville
2 Milford Square
3 Quakertown
4 Sassamansville
5 Telford
6 Phoenixville
7 Collegeville
8 Lansdale

ROAD CLASSIFICATION
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

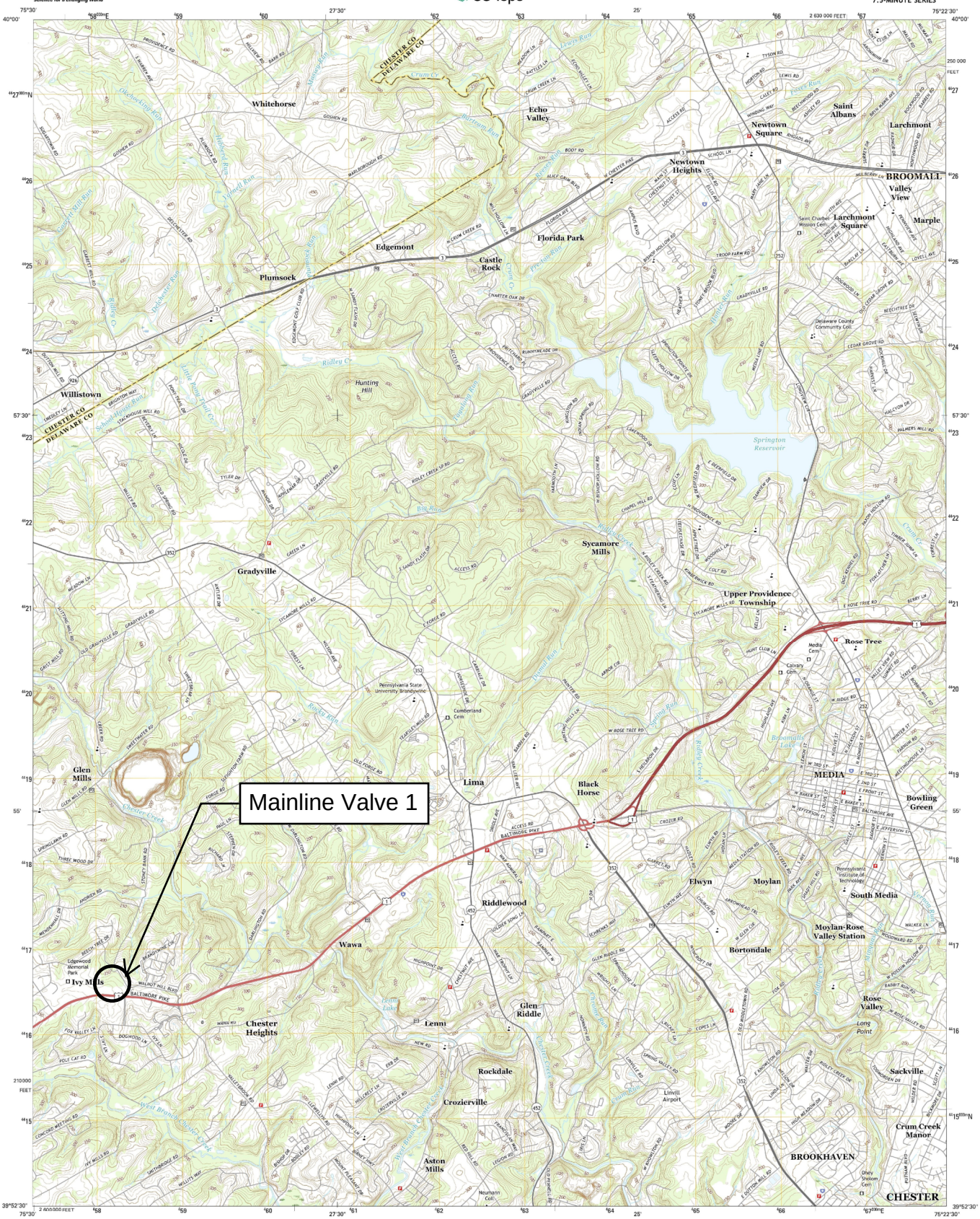
PERKIOMENVILLE, PA
2016

NSN 7643013934795
NGA REF NO. USGS24K34795

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map
US Topo

MEDIA QUADRANGLE
PENNSYLVANIA
7.5-MINUTE SERIES




**Produced by the United States Geological Survey**
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and 1 000-meter grid: Universal Transverse Mercator, Zone 18S
10 000-foot ticks: Pennsylvania Coordinate System of 1983 (south zone)

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery.....NAIP, June 2013
Roads..... U.S. Census Bureau, 2015 - 2016
Names.....GNIS, 2016
Hydrography.....National Hydrography Dataset, 2013
Contours.....National Elevation Dataset, 2000
Boundaries.....Multiple sources; see metadata file 1972 - 2016

Wetlands.....FWS National Wetlands Inventory 1977 - 2014

UTM GRID AND 2016 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

| U.S. National Grid |
|---|
| 100,000-m Square ID |
| VK |
| Grid Zone Designation |
| 18S |

SCALE 1:24 000

KILOMETERS
METERS
MILES
FEET

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.19

PENNSYLVANIA
QUADRANGLE LOCATION

| 1 | 2 | 3 |
|---|---|---|
| 4 | | 5 |
| 6 | 7 | 8 |

ADJOINING QUADRANGLES

1 Malvern
2 Valley Forge
3 Norristown
4 West Chester
5 Lansdowne
6 Wilmington North
7 Marcus Hook
8 Bridgeport

ROAD CLASSIFICATION
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

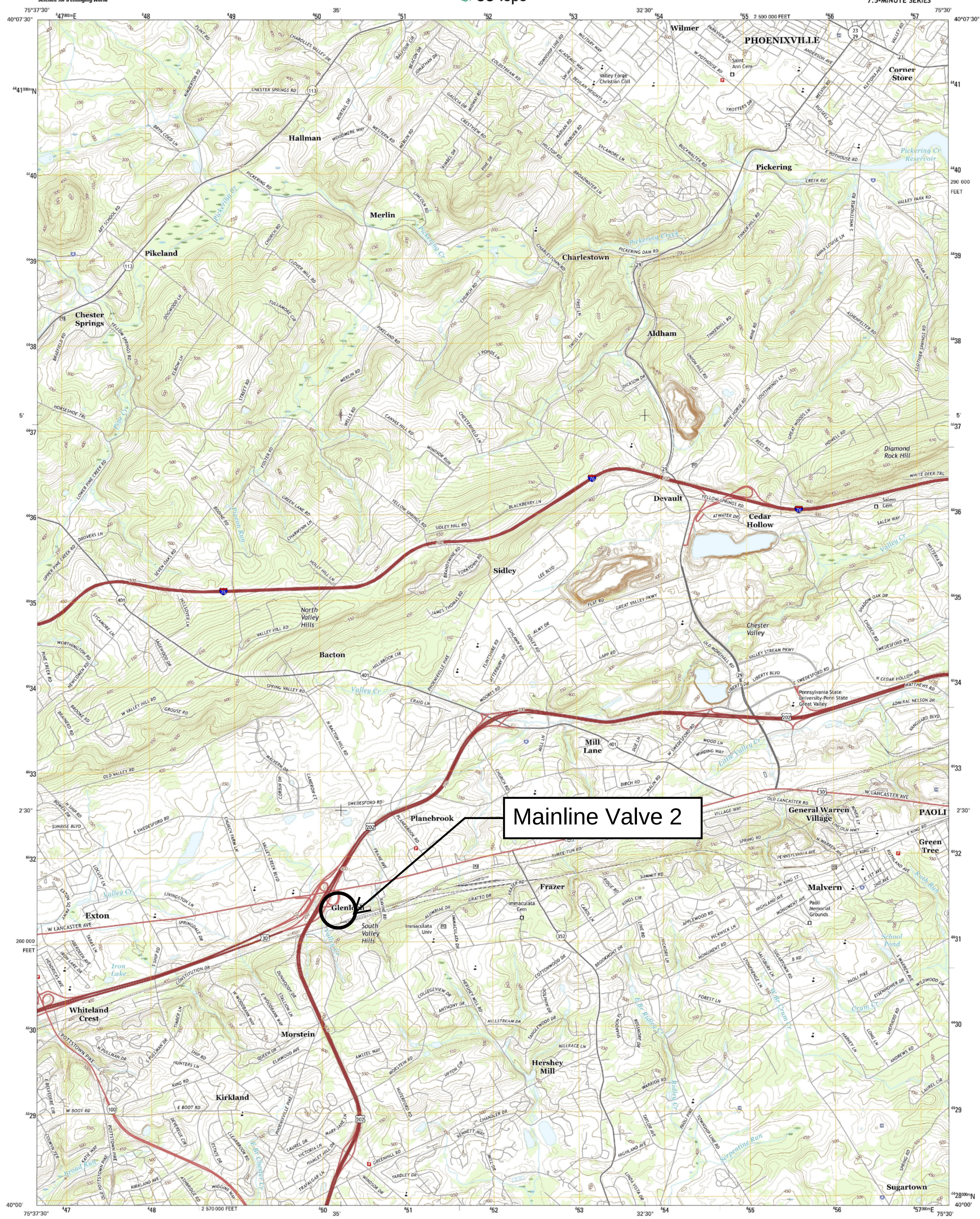
MEDIA, PA
2016

NSN 7643013918612
NGA REF NO. USGSX24K28647

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map
US Topo

MALVERN QUADRANGLE
PENNSYLVANIA-CHESTER CO.
7.5-MINUTE SERIES




Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and 1 000-meter grid: Universal Transverse Mercator, Zone 18T
10 000-foot ticks: Pennsylvania Coordinate System of 1983 (south zone)

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery....................NAIP, June 2013
Roads..........U.S. Census Bureau, 2015 - 2016
Names..............................GNIS, 2016
Hydrography........National Hydrography Dataset, 2013
Contours............National Elevation Dataset, 2011
Boundaries.........Multiple sources; see metadata file 1972 - 2016
Wetlands........FWS National Wetlands Inventory 1977 - 2014

UTM GRID AND 2016 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.19

ROAD CLASSIFICATION
Expressway — Local Connector
Secondary Hwy — Local Road
Ramp — 4WD
Interstate Route — US Route — State Route

QUADRANGLE LOCATION

1 Pottstown
2 Phoenixville
3 Collegeville
4 Downingtown
5 Valley Forge
6 Unionville
7 West Chester
8 Media

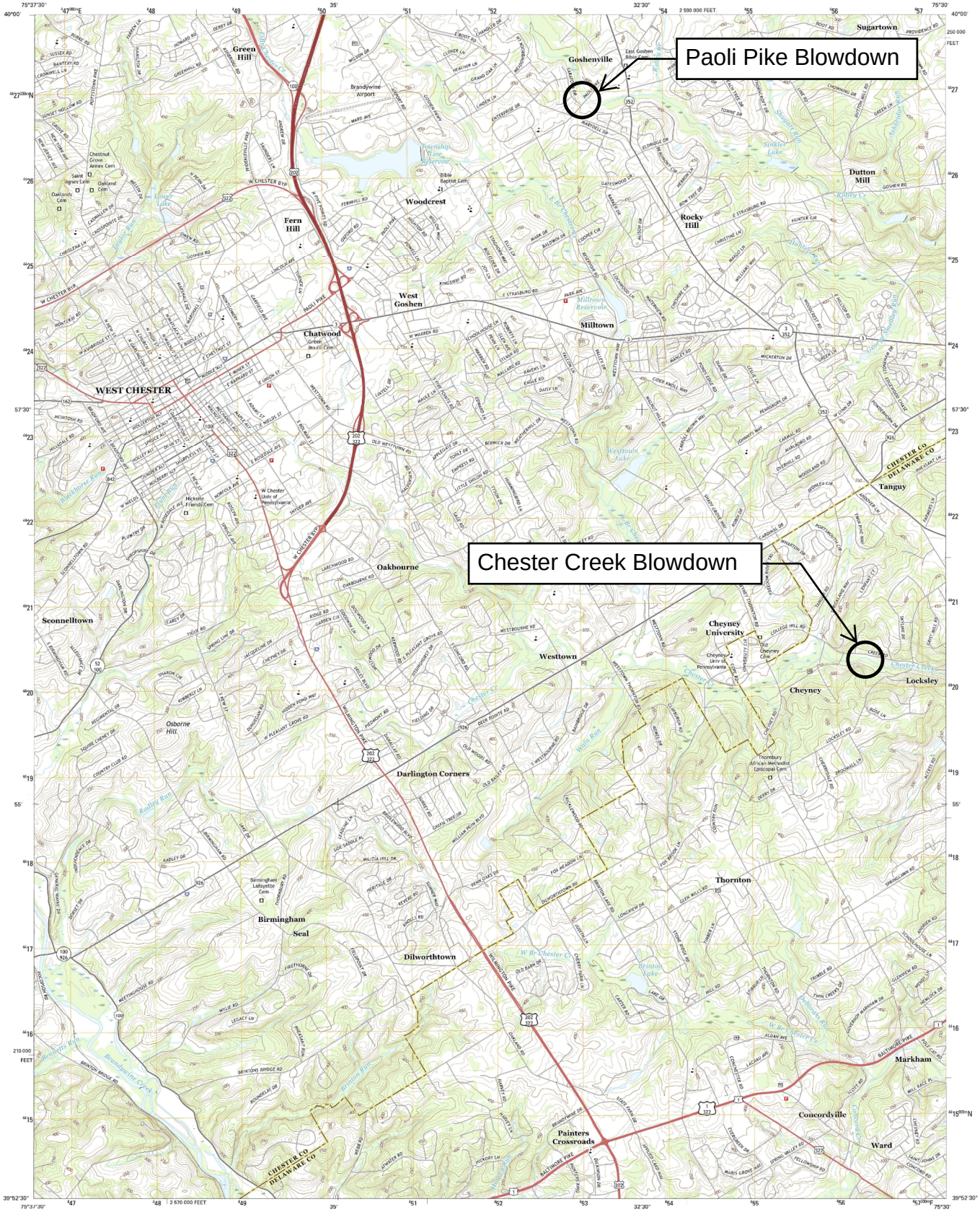
ADJOINING QUADRANGLES

MALVERN, PA
2016

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map US Topo

WEST CHESTER QUADRANGLE
PENNSYLVANIA
7.5-MINUTE SERIES




**Produced by the United States Geological Survey**
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and 1 000-meter grid: Universal Transverse Mercator, Zone 18S
10 000-foot ticks: Pennsylvania Coordinate System of 1983 (south zone)

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery.....NAIP, June 2013
Roads.....U.S. Census Bureau, 2015 - 2016
Names.....GNIS, 2016
Hydrography.....National Hydrography Dataset, 2013
Contours.....National Elevation Dataset, 2000
Boundaries.....Multiple sources; see metadata file 1972 - 2016

Wetlands.....FWS National Wetlands Inventory 1977 - 2014

UTM GRID AND 2016 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

MN
11° 55'
212 MILS
GN
0° 22'
6 MILS

U.S. National Grid
100,000-m Square ID
VK
Grid Zone Designation
18S

SCALE 1:24 000

KILOMETERS 1 0.5 0 1 2
METERS 1000 500 0 1000 2000
MILES 1 0.5 0 1
FEET 1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.19

PENNSYLVANIA
QUADRANGLE LOCATION

| | | |
|---|---|---|
| 1 | 2 | 3 |
| 4 | | 5 |
| 6 | 7 | 8 |

1 Downingtown
2 Malvern
3 Valley Forge
4 Unionville
5 Media
6 Kennett Square
7 Wilmington North
8 Marcus Hook

ADJOINING QUADRANGLES

ROAD CLASSIFICATION

Expressway — Local Connector
Secondary Hwy — Local Road
Ramp — 4WD
Interstate Route — US Route — State Route

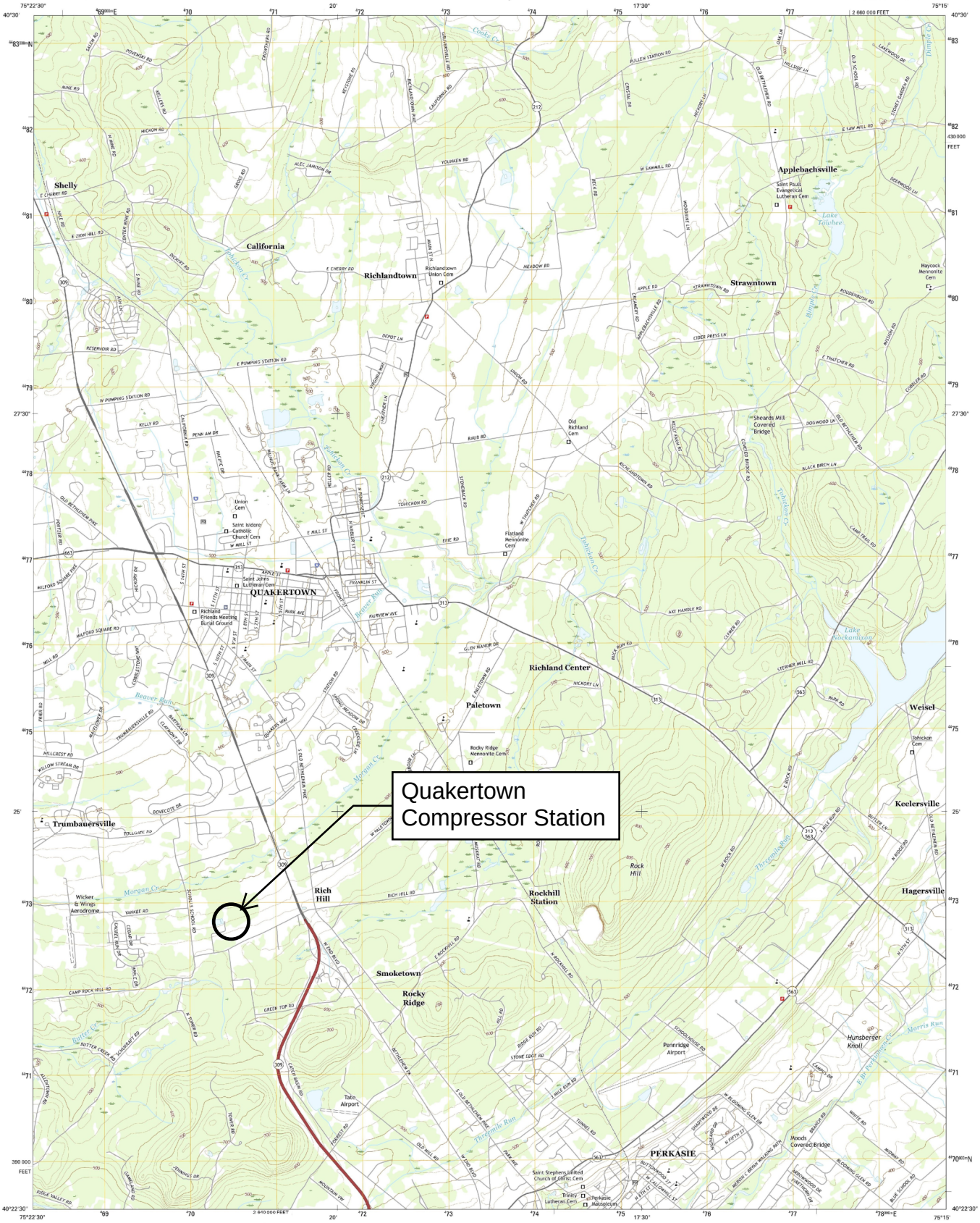
WEST CHESTER, PA
2016

NSN. 7643013919832
NGA REF NO. USGSX24K8159

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map US Topo

# QUAKERTOWN QUADRANGLE
PENNSYLVANIA-BUCKS CO.
7.5-MINUTE SERIES




Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid: Universal Transverse Mercator, Zone 18T
10 000-foot ticks: Pennsylvania Coordinate System of 1983
(south zone)

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery.....NAIP, June 2013
Roads..... U.S. Census Bureau, 2015 - 2016
Names.....GNIS, 2016
Hydrography.....National Hydrography Dataset, 2013
Contours.....National Elevation Dataset, 2011
Boundaries.....Multiple sources; see metadata file 1972 - 2016

Wetlands.....FWS National Wetlands Inventory 1977 - 2014

UTM GRID AND 2016 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

| U.S. National Grid |
|---|
| 100,000-m Square ID |
| VK |
| Grid Zone Designation |
| 18T |

SCALE 1:24 000

KILOMETERS 0 0.5 1 2
METERS 1000 500 0 1000 2000
MILES 1 0.5 0 1
FEET 1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

CONTOUR INTERVAL 20 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011. A metadata file associated with this product is draft version 0.6.19

PENNSYLVANIA
QUADRANGLE LOCATION

| 1 | 2 | 3 |
|---|---|---|
| 4 | | 5 |
| 6 | 7 | 8 |

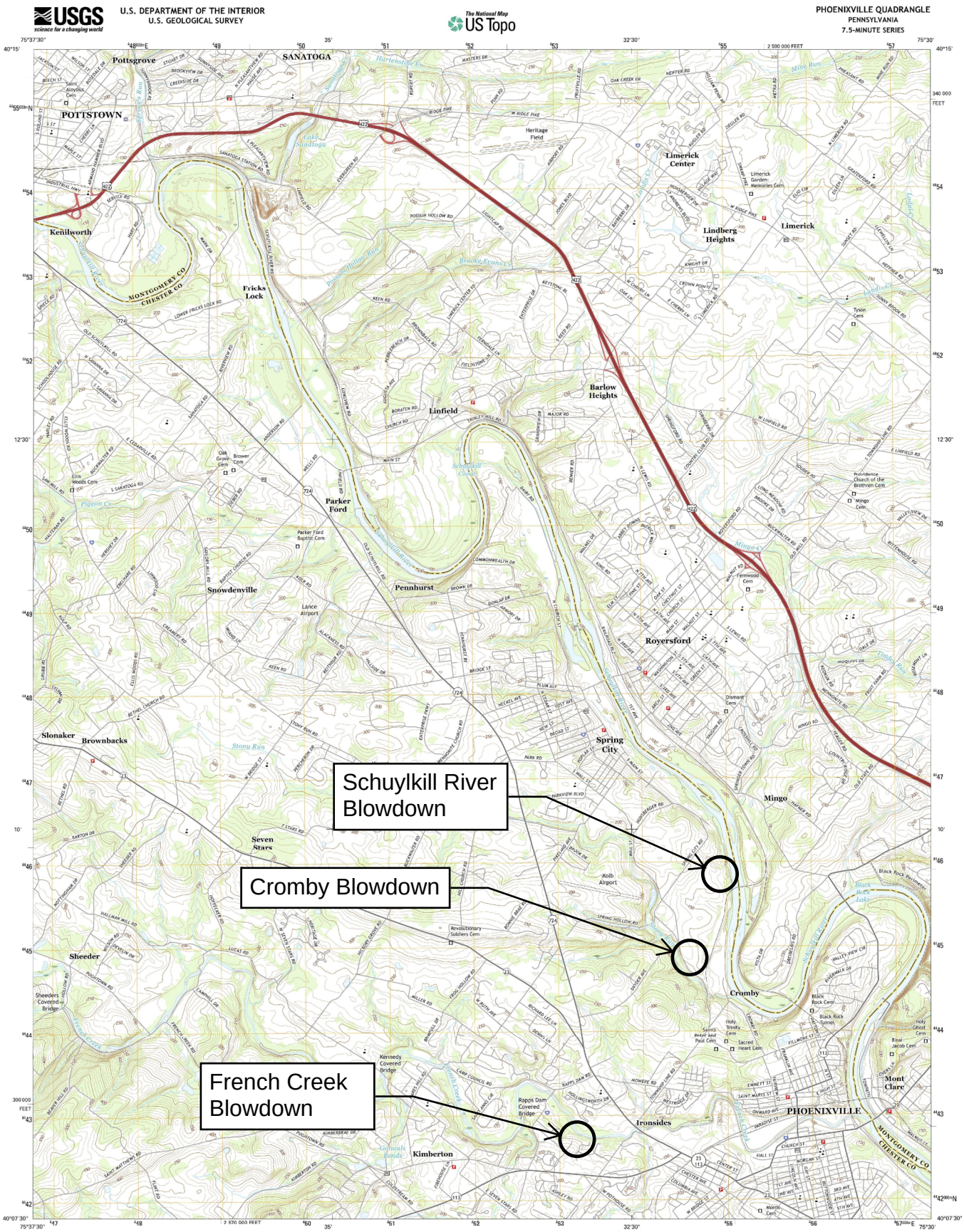
1 Allentown East
2 Hellertown
3 Riegelsville
4 Milford Square
5 Bedminster
6 Perkiomenville
7 Telford
8 Doylestown

ADJOINING QUADRANGLES

ROAD CLASSIFICATION
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

QUAKERTOWN, PA
2016

NSN 7643016374740
NGA REF NO. USGX243674


USGS
science for a changing world
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
The National Map
US Topo
PHOENIXVILLE QUADRANGLE
PENNSYLVANIA
7.5-MINUTE SERIES
Schuylkill River Blowdown
Cromby Blowdown
French Creek Blowdown
Pottsgrove
SANATOGA
POTTSTOWN
Kenilworth
Fricks Lock
Limerick Center
Limerick
Lindberg Heights
Barlow Heights
Linfield
Parker Ford
Snowdenville
Pennhurst
Royersford
Spring City
Slonaker
Brownbacks
Seven Stars
Mingo
Sheeder
Cromby
Mont Clare
PHOENIXVILLE
Ironsides
Kimberton
MONTGOMERY CO
CHESTER CO
Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid: Universal Transverse Mercator, Zone 18T
10 000-foot ticks: Pennsylvania Coordinate System of 1983
(south zone)
This map is not a legal document. Boundaries may be
generalized for this map scale. Private lands within government
reservations may not be shown. Obtain permission before
entering private lands.
Imagery....NAIP, June 2013
Roads.... U.S. Census Bureau, 2015 - 2016
Names....GNIS, 2016
Hydrography....National Hydrography Dataset, 2013
Contours....National Elevation Dataset, 2011
Boundaries....Multiple sources; see metadata file 1972 - 2016
Wetlands....FWS National Wetlands Inventory 1977 - 2014
UTM GRID AND 2016 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET
U.S. National Grid
100,000-m Square ID
VK
Grid Zone Designation
18T
SCALE 1:24 000
KILOMETERS
METERS
MILES
FEET
CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988
This map was produced to conform with the
National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.19
PENNSYLVANIA
QUADRANGLE LOCATION
ADJOINING QUADRANGLES
1 Boyertown
2 Sassamansville
3 Perkiomenville
4 Pottstown
5 Collegeville
6 Downingtown
7 Malvern
8 Valley Forge
ROAD CLASSIFICATION
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route
PHOENIXVILLE, PA
2016
NGA REF NO. USGS24K34982

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map US Topo

COLLEGEVILLE QUADRANGLE
PENNSYLVANIA
7.5-MINUTE SERIES

Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and 1 000 meter grid: Universal Transverse Mercator, Zone 18T
10 000-foot ticks: Pennsylvania Coordinate System of 1983 (south zone)

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery.....NAIP, June 2013
Roads..... U.S. Census Bureau, 2015 - 2016
Names.....GNIS, 2016
Hydrography.....National Hydrography Dataset, 2013
Contours.....National Elevation Dataset, 2011
Boundaries.....Multiple sources; see metadata file 1972 - 2016

Wetlands.....FWS National Wetlands Inventory 1977 - 2014

UTM GRID AND 2016 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

U.S. National Grid
100,000-m Square ID
VK
Grid Zone Designation
18T

SCALE 1:24 000

KILOMETERS
METERS
MILES
FEET

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.19

QUADRANGLE LOCATION

ADJOINING QUADRANGLES
1 Sassamansville
2 Perkiomenville
3 Telford
4 Phoenixville
5 Lansdale
6 Malvern
7 Valley Forge
8 Norristown

ROAD CLASSIFICATION
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

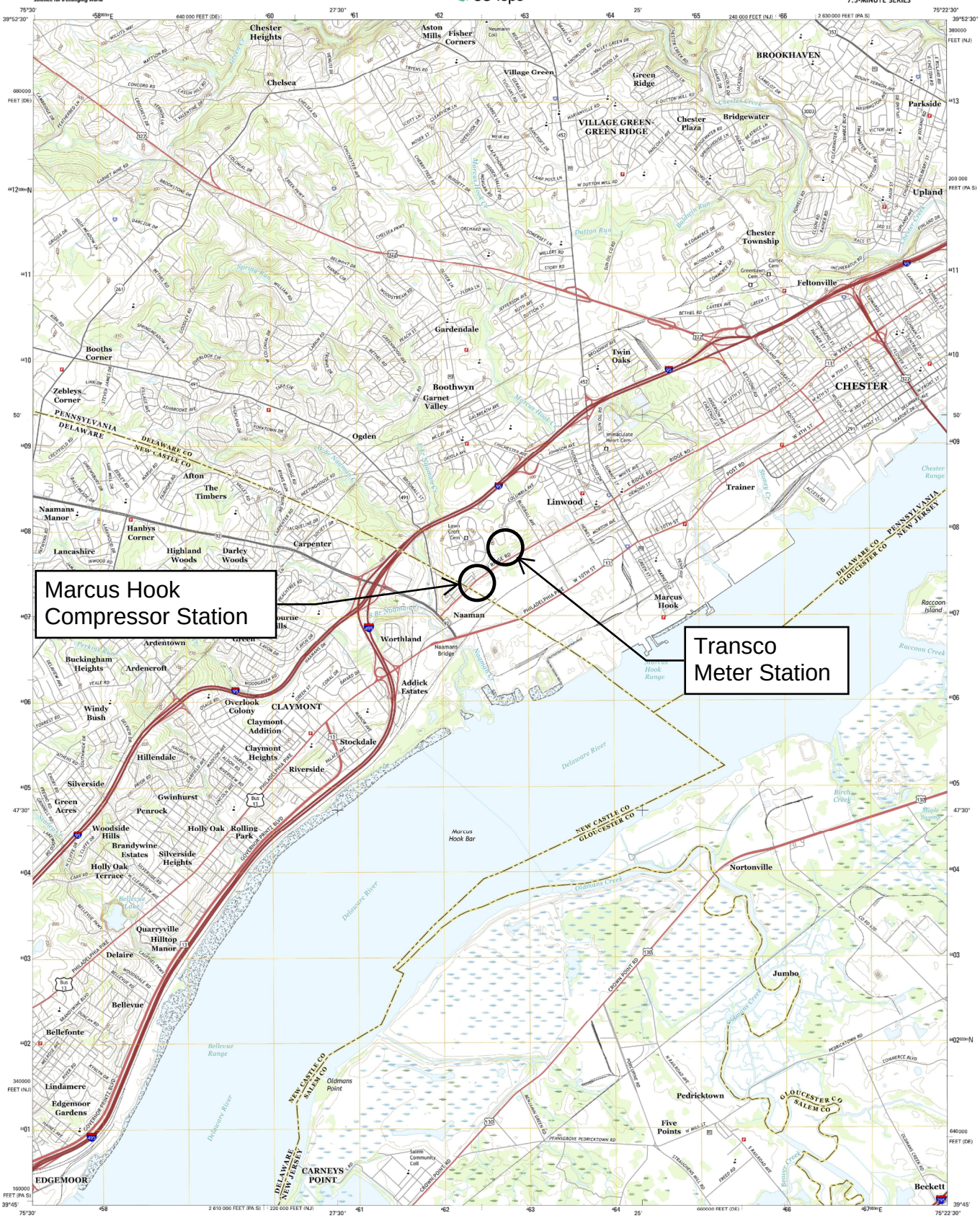
COLLEGEVILLE, PA
2016

NSN 7643013934257
NGA REF NO. USGSX24K9707

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map US Topo

# MARCUS HOOK QUADRANGLE
PENNSYLVANIA-DELAWARE-NEW JERSEY
7.5-MINUTE SERIES




**Produced by the United States Geological Survey**
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid: Universal Transverse Mercator, Zone 18S
10 000-foot ticks: Pennsylvania Coordinate System of 1983
(south zone), Delaware Coordinate System of 1983, New Jersey
Coordinate System of 1983

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering.

Imagery.....NAIP, September 2013
Roads.....U.S. Census Bureau, 2015 - 2016
Names.....GNIS, 2016
Hydrography.....National Hydrography Dataset, 2013
Contours.....National Elevation Dataset, 2000
Boundaries.....Multiple sources; see metadata file 1972 - 2016

Wetlands.....FWS National Wetlands Inventory 1977 - 2014

MN
11° 57'
213 MILS
GN
0° 17'
5 MILS
UTM GRID AND 2016 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

| U.S. National Grid |
|---|
| 100,000-m Square ID |
| VK |
| Grid Zone Designation 18S |

SCALE 1:24 000

KILOMETERS 1 0.5 0 1 2
METERS 1000 500 0 1000 2000
MILES 1 0.5 0 1
FEET 1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011. A metadata file associated with this product is draft version 0.6.19

PENNSYLVANIA
QUADRANGLE LOCATION

| | | |
|---|---|---|
| 1 | 2 | 3 |
| 4 | | 5 |
| 6 | 7 | 8 |

1 West Chester
2 Media
3 Lansdowne
4 Wilmington North
5 Bridgeport
6 Wilmington South
7 Penns Grove
8 Woodstown

ADJOINING QUADRANGLES

ROAD CLASSIFICATION
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

MARCUS HOOK, PA-DE-NJ
2016

NGA REF NO. USGSX24K27853

# Appendix B

Soil Data

# Hydrologic Soil Group—Delaware County, Pennsylvania

Map Scale: 1:269 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 3 7 14 21

Feet: 0 10 20 40 60

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil 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 1:20,000.

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:
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: Delaware County, Pennsylvania
Survey Area Data: Version 16, Sep 19, 2018

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

Date(s) aerial images were photographed: Aug 18, 2014—Sep 22, 2014

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| We | Wehadkee silt loam | B/D | 0.1 | 100.0% |
| **Totals for Area of Interest** | | | **0.1** | **100.0%** |

## 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

Map Scale: 1:470 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 5 10 20 30

Feet: 0 20 40 80 120

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil 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:
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: Chester County, Pennsylvania
Survey Area Data: Version 11, Sep 18, 2018

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

Date(s) aerial images were photographed: Jul 25, 2014—Aug 11, 2014

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| PeB | Penn silt loam, 3 to 8 percent slopes | B | 0.2 | 100.0% |
| **Totals for Area of Interest** | | | **0.2** | **100.0%** |

## 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.

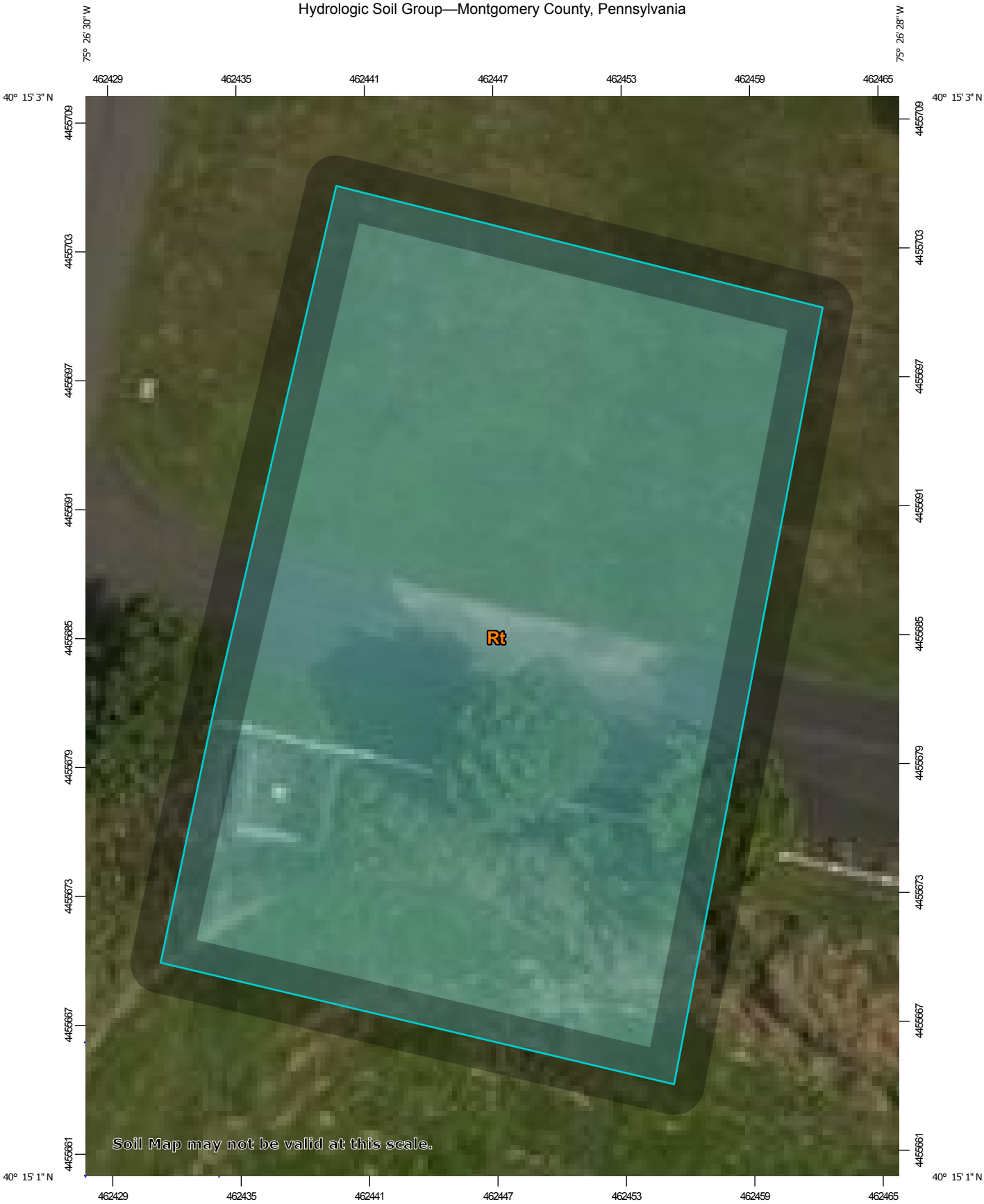
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher




Map Scale: 1:245 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 3 7 14 21

Feet: 0 10 20 40 60

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil 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 1:12,000.

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:
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: Montgomery County, Pennsylvania
Survey Area Data: Version 13, Sep 19, 2018

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

Date(s) aerial images were photographed: Jul 25, 2014—Aug 11, 2014

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| Rt | Rowland silt loam, terrace | C | 0.2 | 100.0% |
| **Totals for Area of Interest** | | | **0.2** | **100.0%** |

## 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

Map Scale: 1:2,440 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 35 70 140 210

Feet: 0 100 200 400 600

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil 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:
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: Chester County, Pennsylvania
Survey Area Data: Version 11, Sep 18, 2018

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

Date(s) aerial images were photographed: Jul 25, 2014—Aug 11, 2014

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| PeB | Penn silt loam, 3 to 8 percent slopes | B | 1.9 | 61.8% |
| PeC | Penn silt loam, 8 to 15 percent slopes | B | 0.2 | 7.0% |
| PeD | Penn silt loam, 15 to 25 percent slopes | B | 0.6 | 18.4% |
| ReB | Readington silt loam, 3 to 8 percent slopes | C | 0.4 | 12.2% |
| UrxB | Urban land-Penn complex, 0 to 8 percent slopes | | 0.0 | 0.6% |
| **Totals for Area of Interest** | | | **3.0** | **100.0%** |

## 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.

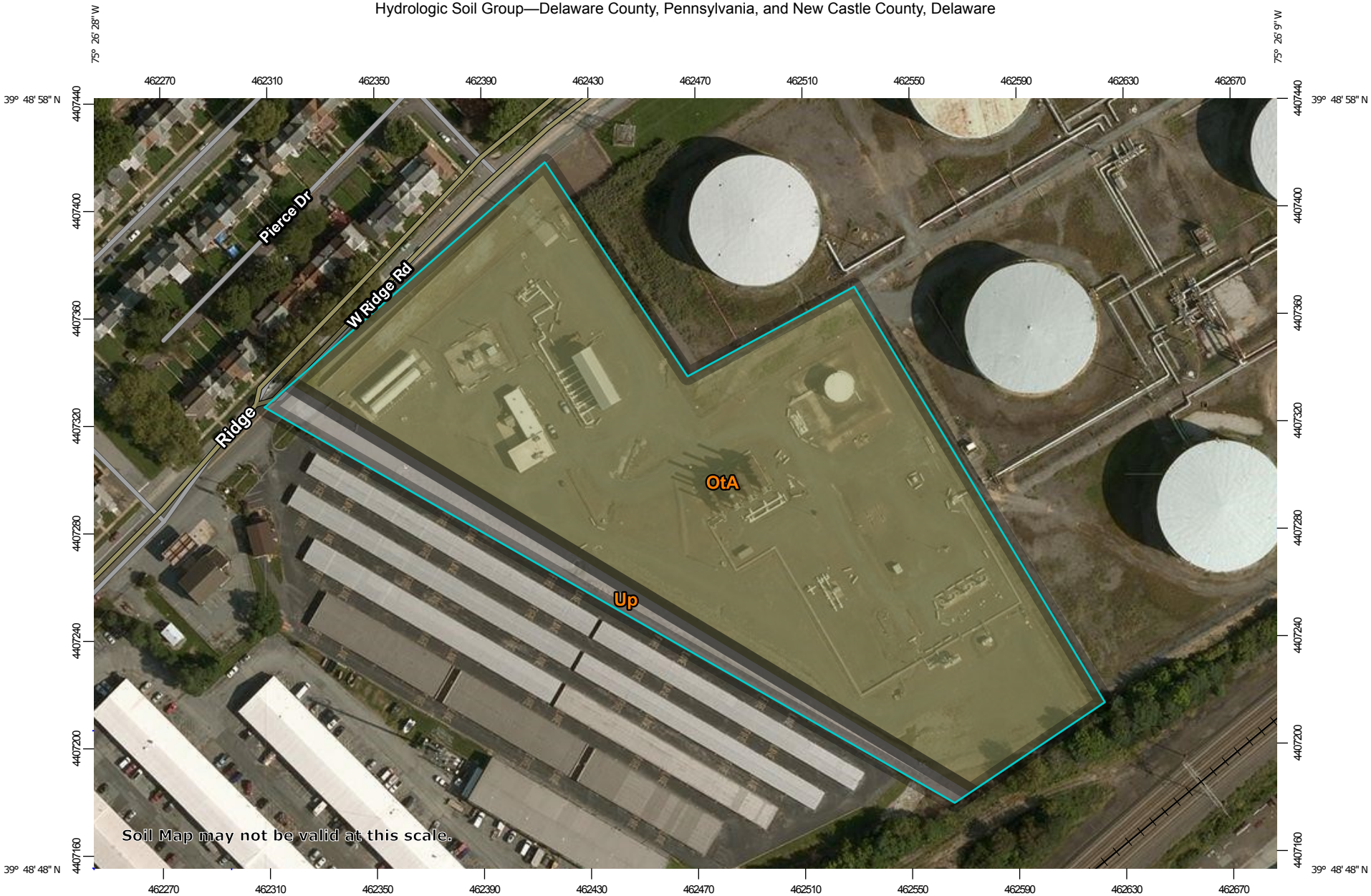
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher




Map Scale: 1:2,020 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil 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 scales ranging from 1:20,000 to 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:
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: Delaware County, Pennsylvania
Survey Area Data: Version 16, Sep 19, 2018

Soil Survey Area: New Castle County, Delaware
Survey Area Data: Version 13, Sep 14, 2018

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Aug 18, 2014—Sep 22, 2014

## MAP LEGEND

## MAP INFORMATION

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| OtA | Othello silt loams, 0 to 2 percent slopes, northern coastal plain | C/D | 7.4 | 91.5% |
| **Subtotals for Soil Survey Area** | | | **7.4** | **91.5%** |
| **Totals for Area of Interest** | | | **8.0** | **100.0%** |

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| Up | Urban land | | 0.7 | 8.5% |
| **Subtotals for Soil Survey Area** | | | **0.7** | **8.5%** |
| **Totals for Area of Interest** | | | **8.0** | **100.0%** |

## 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

Map Scale: 1:415 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 5 10 20 30

Feet: 0 20 40 80 120

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil 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 1:20,000.

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:
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: Delaware County, Pennsylvania
Survey Area Data: Version 16, Sep 19, 2018

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

Date(s) aerial images were photographed: Aug 18, 2014—Sep 22, 2014

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| GeB | Glenelg channery loam, 3 to 8 percent slopes | B | 0.1 | 100.0% |
| **Totals for Area of Interest** | | | **0.1** | **100.0%** |

## 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

Map Scale: 1:266 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 3 7 14 21

Feet: 0 10 20 40 60

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil 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:
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: Chester County, Pennsylvania
Survey Area Data: Version 11, Sep 18, 2018

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

Date(s) aerial images were photographed: Jul 25, 2014—Aug 11, 2014

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| MaC | Manor loam, 8 to 15 percent slopes | B | 0.1 | 100.0% |
| **Totals for Area of Interest** | | | **0.1** | **100.0%** |

## 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

# Hydrologic Soil Group—Chester County, Pennsylvania

Map Scale: 1:301 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 4 8 16 24

Feet: 0 10 20 40 60

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil 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:
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: Chester County, Pennsylvania
Survey Area Data: Version 11, Sep 18, 2018

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

Date(s) aerial images were photographed: Jul 25, 2014—Aug 11, 2014

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| Ha | Hatboro silt loam | B/D | 0.2 | 100.0% |
| **Totals for Area of Interest** | | | **0.2** | **100.0%** |

## 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

# Hydrologic Soil Group—Montgomery County, Pennsylvania

Map Scale: 1:508 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 5 10 20 30

Feet: 0 20 40 80 120

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil 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 1:12,000.

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:
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: Montgomery County, Pennsylvania
Survey Area Data: Version 13, Sep 19, 2018

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

Date(s) aerial images were photographed: Jul 25, 2014—Aug 11, 2014

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| Bo | Bowmansville-Knauers silt loams | C/D | 0.2 | 85.5% |
| ReA | Readington silt loam, 0 to 3 percent slopes | C | 0.0 | 14.5% |
| **Totals for Area of Interest** | | | **0.3** | **100.0%** |

## 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

# Hydrologic Soil Group—Bucks County, Pennsylvania

## 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:
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: Bucks County, Pennsylvania
Survey Area Data: Version 15, Sep 18, 2018

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

Date(s) aerial images were photographed: Jul 18, 2011—Mar 16, 2017

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| AmB | Amwell silt loam, 3 to 8 percent slopes | D | 1.4 | 98.6% |
| UdB | Udorthents, shale and sandstone | A | 0.0 | 1.4% |
| **Totals for Area of Interest** | | | **1.5** | **100.0%** |

## 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.

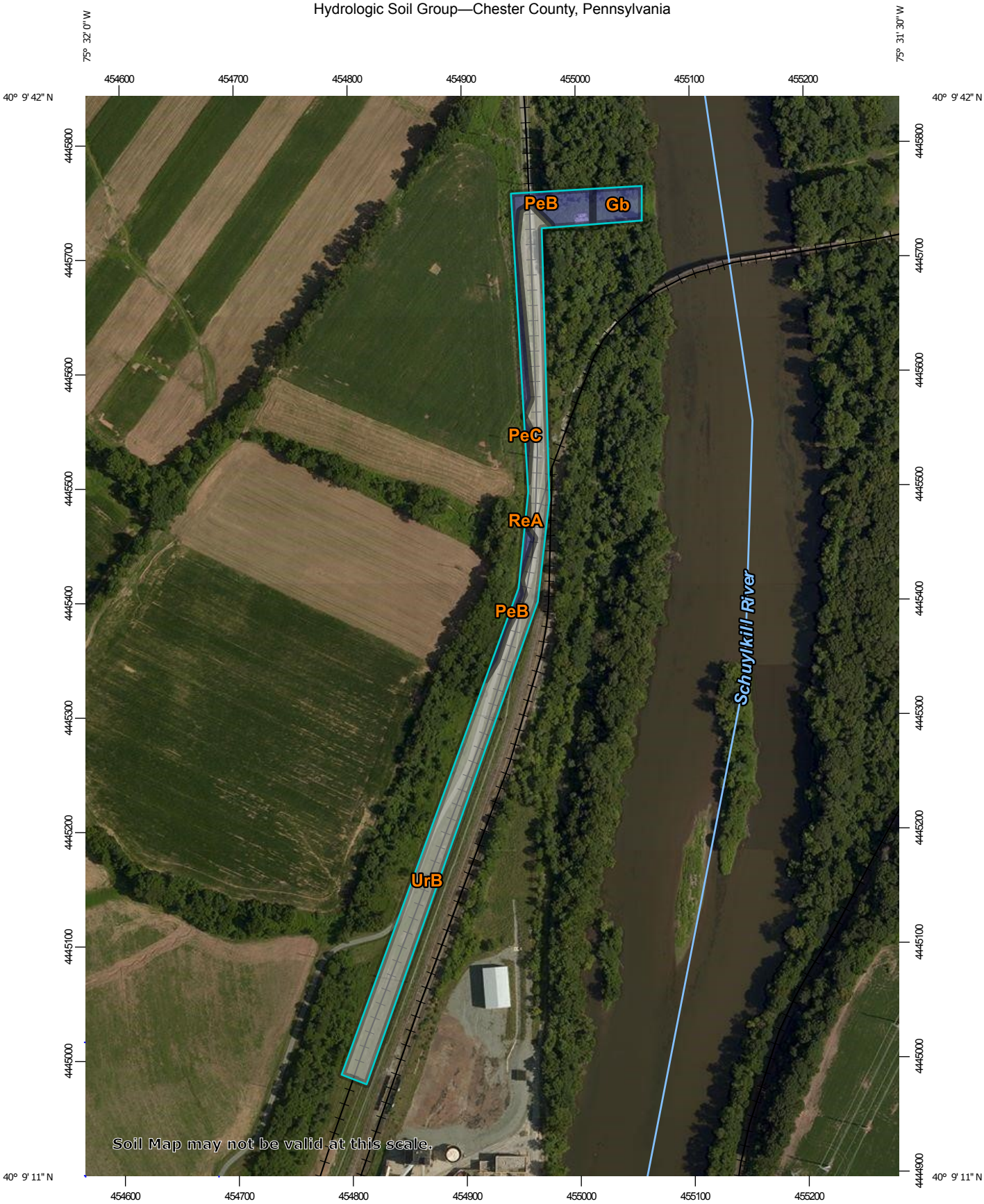
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher




Map Scale: 1:4,600 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil 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:
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: Chester County, Pennsylvania
Survey Area Data: Version 11, Sep 18, 2018

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

Date(s) aerial images were photographed: Jul 25, 2014—Aug 11, 2014

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| Gb | Gibraltar silt loam | B | 0.3 | 6.6% |
| PeB | Penn silt loam, 3 to 8 percent slopes | B | 0.8 | 15.8% |
| PeC | Penn silt loam, 8 to 15 percent slopes | B | 0.0 | 0.8% |
| ReA | Readington silt loam, 0 to 3 percent slopes | C | 0.0 | 0.2% |
| UrB | Urban land, 0 to 8 percent slopes | | 3.8 | 76.6% |
| **Totals for Area of Interest** | | | **5.0** | **100.0%** |

## 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

# Hydrologic Soil Group—Montgomery County, Pennsylvania

Map Scale: 1:362 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 5 10 20 30

Feet: 0 15 30 60 90

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil 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 1:12,000.

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:
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: Montgomery County, Pennsylvania
Survey Area Data: Version 13, Sep 19, 2018

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

Date(s) aerial images were photographed: Jul 25, 2014—Aug 11, 2014

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| PeB | Penn silt loam, 3 to 8 percent slopes | B | 0.1 | 36.3% |
| PeC | Penn silt loam, 8 to 15 percent slopes | B | 0.1 | 63.7% |
| **Totals for Area of Interest** | | | **0.2** | **100.0%** |

## 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.

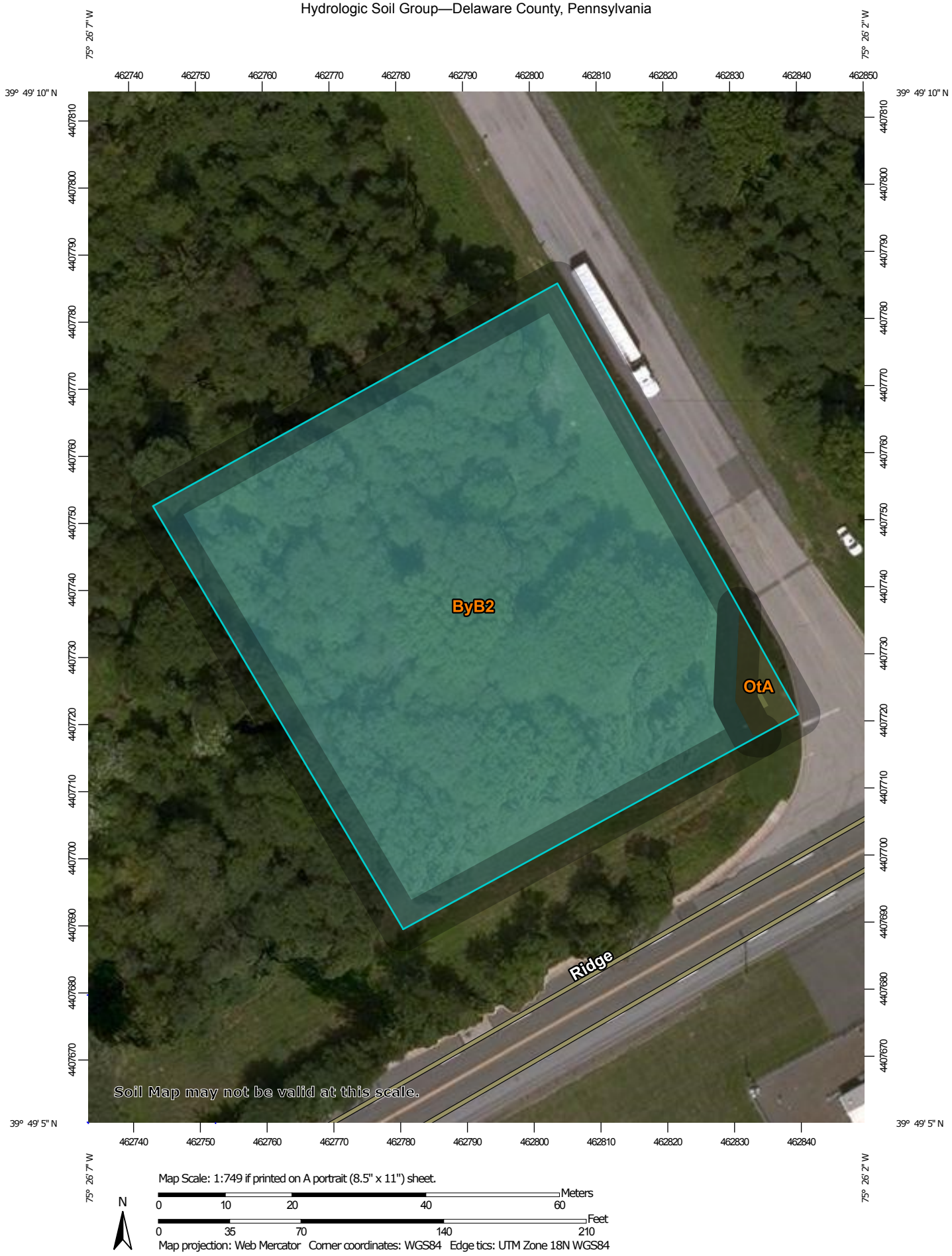
## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher

# Hydrologic Soil Group—Delaware County, Pennsylvania




Map Scale: 1:749 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 10 20 40 60

Feet: 0 35 70 140 210

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil 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 1:20,000.

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:
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: Delaware County, Pennsylvania
Survey Area Data: Version 16, Sep 19, 2018

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

Date(s) aerial images were photographed: Aug 18, 2014—Sep 22, 2014

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| ByB2 | Butlertown silt loam, 3 to 8 percent slopes, moderately eroded | C | 1.2 | 98.2% |
| OtA | Othello silt loams, 0 to 2 percent slopes, northern coastal plain | C/D | 0.0 | 1.8% |
| **Totals for Area of Interest** | | | **1.2** | **100.0%** |

## 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*

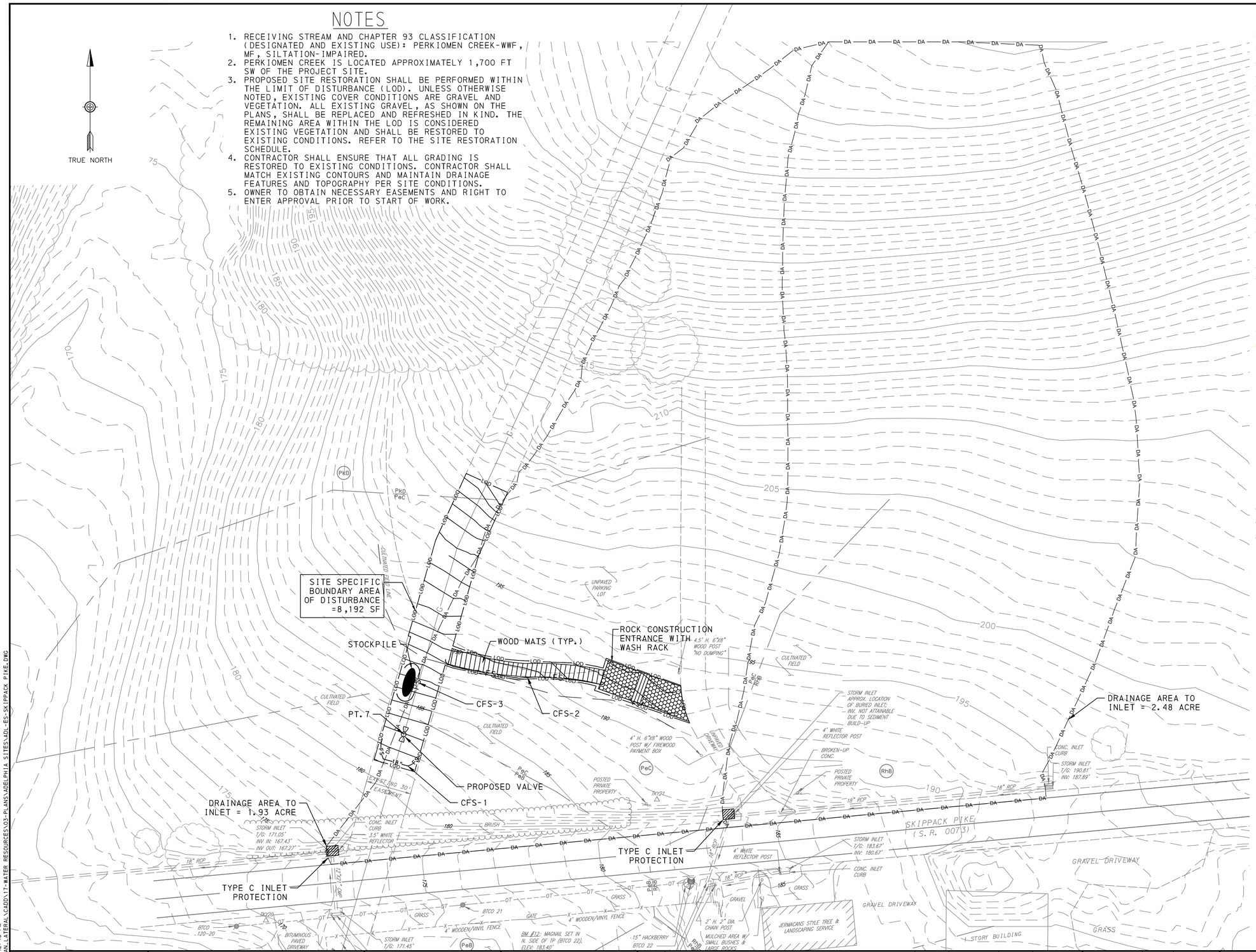
*Tie-break Rule:* Higher

# Appendix C

## Erosion and Sediment Control Worksheets

# NOTES

1. RECEIVING STREAM AND CHAPTER 93 CLASSIFICATION (DESIGNATED AND EXISTING USE): PERKIOMEN CREEK-WWF, MF, SILTATION-IMPAIRED.
2. PERKIOMEN CREEK IS LOCATED APPROXIMATELY 1,700 FT SW OF THE PROJECT SITE.
3. PROPOSED SITE RESTORATION SHALL BE PERFORMED WITHIN THE LIMIT OF DISTURBANCE (LOD). UNLESS OTHERWISE NOTED, EXISTING COVER CONDITIONS ARE GRAVEL AND VEGETATION. ALL EXISTING GRAVEL, AS SHOWN ON THE PLANS, SHALL BE REPLACED AND REFRESHED IN KIND. THE REMAINING AREA WITHIN THE LOD IS CONSIDERED EXISTING VEGETATION AND SHALL BE RESTORED TO EXISTING CONDITIONS. REFER TO THE SITE RESTORATION SCHEDULE.
4. CONTRACTOR SHALL ENSURE THAT ALL GRADING IS RESTORED TO EXISTING CONDITIONS. CONTRACTOR SHALL MATCH EXISTING CONTOURS AND MAINTAIN DRAINAGE FEATURES AND TOPOGRAPHY PER SITE CONDITIONS.
5. OWNER TO OBTAIN NECESSARY EASEMENTS AND RIGHT TO ENTER APPROVAL PRIOR TO START OF WORK.

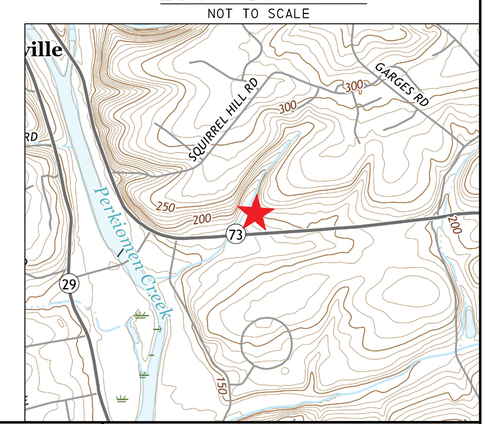



# LEGEND

| | |
|---|---|
| 324 | EXISTING 1' CONTOUR |
| 325 | EXISTING 5' CONTOUR |
| 324 | PROPOSED 1' CONTOUR |
| 325 | PROPOSED 5' CONTOUR |
| | EXISTING TREE LINE |
| X X | EXISTING FENCE LINE |
| X X | PROPOSED FENCE LINE |
| E | EXISTING OVERHEAD ELECTRIC |
| | EXISTING UTILITY POLE |
| W | EXISTING WATER LINE |
| G | EXISTING GAS LINE |
| S | EXISTING SEWER LINE |
| | EXISTING GAS EASEMENT |
| | UTILITY EASEMENT |
| PL | EXISTING PROPERTY LINE |
| WL | EXISTING WETLAND BOUNDARY |
| | EXISTING WETLAND AREA |
| | 100-YEAR FLOOD PLAIN |
| FLW FLW | 100-YEAR FLOOD WAY |
| | SOIL BOUNDARY |
| We | SOIL TYPE |
| LOD LOD LOD | LIMIT OF DISTURBANCE/ PERMIT BOUNDARY |
| DA DA DA DA | DRAINAGE AREA |
| | CHAPTER 105 REGULATED LOCATION (PERMITTED BY OTHERS) |
| | PROPOSED TEST PIT LOCATION |
| | PROPOSED VALVE LOCATION |
| | WOOD MATS |
| | ROCK CONSTRUCTION ENTRANCE |
| | EROSION CONTROL BLANKET |
| | EXISTING GRAVEL TO BE REPLACED AND REFRESHED ( IN KIND) |
| | INLET PROTECTION |
| | TREE PROTECTION |
| FS | COMPOST FILTER SOCK ( 12" DIA.) |
| FS 18" | COMPOST FILTER SOCK ( 18" DIA.) |
| FS 24" | COMPOST FILTER SOCK ( 24" DIA.) |

# LOCATION MAP

NOT TO SCALE




ADELPHIA GATEWAY

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
SHINY M. MATHEW
ENGINEER
NO. PE082407

10 0 20 40
SCALE: 1"=20'

DATE: _____

| REV | DESCRIPTION | CHK | DATE | APP | DATE |
|---|---|---|---|---|---|
| 2 | REVISED TO ADDRESS DEP COMMENTS | ATH | 03/24/20 | SMM | 03/24/20 |
| 1 | REVISED TO ADDRESS DEP COMMENTS | ATH | 11/15/19 | SMM | 11/15/19 |

REVISION

| | | |
|---|---|---|
| DRAWN BY | INTL | DATE |
| DESIGNED BY | RY | 03/24/20 |
| CHECKED BY | AH | 03/24/20 |
| APPROVED BY | SMM | 03/24/20 |
| JOB NO. | 18-00672-006 | |
| PLOT SCALE | 1"=20' | |
| MODEL ID | | |


JMT
Johnson, Mirmiran & Thompson
1600 Market Street, Suite 520
Philadelphia, PA 19103
T: 267-256-0300


# INLET PROTECTION DA EXHIBIT
# SKIPPACK PIKE VALVE TAP

MONTGOMERY COUNTY

| SCALE | DRAWING NUMBER | REV |
|---|---|---|
| 1"=20' | EXHIBIT 1 | |


DATE PRINTED: 3/24/2020 7:42:43 PM
Q:\2018\180672.005_TILGHMAN_LATERAL\CADD\17-WATER RESOURCES\03-PLANS\ADELPHIA SITES\ADL-ES-SKIPPACK PIKE.DWG

**STANDARD E&S WORKSHEET #10**
**Rational Method**

| | | | |
|---|---|---|---|
| **PROJECT NAME** | Adelphia | | |
| **LOCATION:** | Quakertown | | |
| **PREPARED BY:** | RY | **DATE:** | 3/1/2019 |
| **CHECKED BY:** | ATH | **DATE:** | 3/19/2019 |

**DETERMINE WATERSHED "C" VALUE**

| Channel Number | Drainage Area Number | Type of Cover | C VALUE | AREA (acres) | (C X A) | $C_w$ |
|---|---|---|---|---|---|---|
| CH-1 | - | Gravel | 0.6 | 0.98 | 0.59 | 0.49 |
| | - | Brush | 0.3 | 0.56 | 0.17 | |
| | - | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

**DETERMINE INTENSITY:**

| Channel Number | Tc | R2 | R10 | I2 | I10 |
|---|---|---|---|---|---|
| CH-1 | 15.00 | - | - | - | 4.16 |
| | | | | | |

**DETERMINE PEAK RUNOFF RATES (Q = C I A)**

| Channel Number | C VALUE | I (in./hr.) | A (acres) | Q2 (cfs) | Q10 (cfs) |
|---|---|---|---|---|---|
| CH-1 | 0.49 | 4.16 | 1.54 | - | 3.14 |
| | | | | | |

**STANDARD E&S WORKSHEET #10**
**Rational Method**

**PROJECT NAME** Adelphia
**LOCATION:** Transco
**PREPARED BY:** AT **DATE:** 3/2/2020
**CHECKED BY:** ATH **DATE:** 3/2/2020

**DETERMINE WATERSHED "C" VALUE**

| Channel Number | Drainage Area Number | Type of Cover | C VALUE | AREA (acres) | (C X A) | $C_w$ |
|---|---|---|---|---|---|---|
| CH-2 | - | Woods | 0.2 | 0.31 | 0.06 | 0.26 |
| | - | Grass | 0.3 | 0.10 | 0.03 | |
| | - | Gravel | 0.6 | 0.04 | 0.02 | |
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**DETERMINE INTENSITY:**

| Channel Number | Tc | R2 | R10 | I2 | I10 |
|---|---|---|---|---|---|
| CH-2 | 5.00 | - | - | - | 6.49 |
| | | | | | |
| | | | | | |

**DETERMINE PEAK RUNOFF RATES (Q = C I A)**

| Channel Number | C VALUE | I (in./hr.) | A (acres) | Q2 (cfs) | Q10 (cfs) |
|---|---|---|---|---|---|
| CH-3 | 0.26 | 6.49 | 0.46 | - | 0.76 |
| | | | | | |
| | | | | | |

**STANDARD E&S WORKSHEET #11**
**Channel Design Data**

| | | | |
|---|---|---|---|
| **PROJECT NAME:** | Adelphia | | |
| **LOCATION:** | Quakertown | | |
| **PREPARED BY:** | RY | **DATE:** | 3/1/2019 |
| **CHECKED BY:** | ATH | **DATE:** | 3/19/2019 |

| | | | | | |
|---|---|---|---|---|---|
| **CHANNEL OR CHANNEL SECTION** | CH-1 | | | | |
| **TEMPORARY OR PERMANENT (T or P)** | PERM | | | | |
| **DESIGN STORM (2, 5, or 10 YR)** | 10 YR | | | | |
| **ACRES (AC)** | CH-1 | | | | |
| **MULTIPLIER (1.6, 2.25, or 2.75)[1]** | N/A | | | | |
| **Qr (REQUIRED CAPACITY) (CFS)** | 4.16 | | | | |
| **Q (CALCULATED AT FLOW DEPTH d) (CFS)** | 4.16 | | | | |
| **PROTECTIVE LINING [2]** | R-3 | | | | |
| **n (MANNING'S COEFFICIENT) [2]** | 0.042 | | | | |
| **Va (ALLOWABLE VELOCITY) (FPS)** | 6.50 | | | | |
| **V (CALCULATED AT FLOW DEPTH d) (FPS)** | 1.89 | | | | |
| **$t_a$ (MAX. ALLOWABLE SHEAR STRESS) (LB/FT$^2$)** | 1.00 | | | | |
| **td (SHEAR STRESS AT FLOW DEPTH d) (LB/FT2)** | 0.37 | | | | |
| **CHANNEL BOTTOM WIDTH (FT)** | 2 | | | | |
| **CHANNEL SIDE SLOPES (H:V)** | 3 | | | | |
| **D (TOTAL DEPTH) (FT)** | 1.09 | | | | |
| **CHANNEL TOP WIDTH @ D (FT)** | 8.51 | | | | |
| **d (CALCULATED FLOW DEPTH) (FT)** | 0.59 | | | | |
| **CHANNEL TOP WIDTH @ FLOW DEPTH d (FT)** | 5.51 | | | | |
| **BOTTOM WIDTH:DEPTH RATIO (12:1 MAX)** | 3.4 | | | | |
| **$d_{50}$ STONE SIZE (IN)** | 0.25 | | | | |
| **A (CROSS-SECTIONAL AREA) (SQ.FT.)** | 2.20 | | | | |
| **R (HYDRAULIC RADIUS)** | 0.39 | | | | |
| **S (BED SLOPE) [3] (FT/FT)** | 0.0100 | | | | |
| **$S_c$ (CRITICAL SLOPE) (FT/FT)** | 0.0358 | | | | |
| **0.7 $S_c$ (FT/FT)** | 0.0251 | | | | |
| **1.3 $S_c$ (FT/FT)** | 0.0466 | | | | |
| **STABLE FLOW (Y/N)** | Y | | | | |
| **FREEBOARD BASED ON UNSTABLE FLOW (FT)** | N/A | | | | |
| **FREEBOARD BASED ON STABLE FLOW (FT)** | 0.15 | | | | |
| **MINIMUM REQUIRED FREEBOARD [4] (FT)** | 0.5 | | | | |
| **DESIGN METHOD FOR PROTECTIVE LINING[5]** | V | | | | |

1. Use 1.6 for Temporary Channels; 2.25 for Temporary Channels in Special Protection (HQ or EV) Watersheds; 2.75 for Permanent Channels. For Rational Method, enter "N/A" and attach Worksheets 9 and 10. For TR-55, enter N/A" and attach appropriate Worksheets.
2. Adjust "n" value for changes in channel liner and flow depth. For vegetated channels, provide data for manufactured linings without vegetation and with vegetation in separate columns.
3. Slopes may not be averaged
4. Minumum Freeboard is 0.5 ft. OR 1/4 Total Channel Depth, whichever is greater
5. Permissible velocity lining design method is not acceptable for channels with a bed slope of 10% or greater. Shear stress lining design method is required for channels with a bed slope of 10% or greater. Shear stress lining design method may be used for any channel bed slope.

**STANDARD E&S WORKSHEET #11**
**Channel Design Data**

| | | | |
|---|---|---|---|
| **PROJECT NAME:** | Adelphia | | |
| **LOCATION:** | Transco | | |
| **PREPARED BY:** | RY | **DATE:** | 3/1/2019 |
| **CHECKED BY:** | ATH | **DATE:** | 3/19/2019 |

| | | | | | |
|---|---|---|---|---|---|
| **CHANNEL OR CHANNEL SECTION** | CH-2 | | | | |
| **TEMPORARY OR PERMANENT (T or P)** | PERM | | | | |
| **DESIGN STORM (2, 5, or 10 YR)** | 10 YR | | | | |
| **ACRES (AC)** | 0.53 | | | | |
| **MULTIPLIER (1.6, 2.25, or 2.75)[1]** | N/A | | | | |
| **Qr (REQUIRED CAPACITY) (CFS)** | 0.76 | | | | |
| **Q (CALCULATED AT FLOW DEPTH d) (CFS)** | 0.76 | | | | |
| **PROTECTIVE LINING [2]** | R-3 | | | | |
| **n (MANNING'S COEFFICIENT) [2]** | 0.065 | | | | |
| **Va (ALLOWABLE VELOCITY) (FPS)** | 6.50 | | | | |
| **V (CALCULATED AT FLOW DEPTH d) (FPS)** | 1.49 | | | | |
| **$t_a$ (MAX. ALLOWABLE SHEAR STRESS) (LB/FT$^2$)** | 1.00 | | | | |
| **td (SHEAR STRESS AT FLOW DEPTH d) (LB/FT2)** | 0.61 | | | | |
| **CHANNEL BOTTOM WIDTH (FT)** | 2 | | | | |
| **CHANNEL SIDE SLOPES (H:V)** | 3 | | | | |
| **D (TOTAL DEPTH) (FT)** | 0.70 | | | | |
| **CHANNEL TOP WIDTH @ D (FT)** | 6.18 | | | | |
| **d (CALCULATED FLOW DEPTH) (FT)** | 0.20 | | | | |
| **CHANNEL TOP WIDTH @ FLOW DEPTH d (FT)** | 3.18 | | | | |
| **BOTTOM WIDTH:DEPTH RATIO (12:1 MAX)** | 10.2 | | | | |
| **$d_{50}$ STONE SIZE (IN)** | 0.25 | | | | |
| **A (CROSS-SECTIONAL AREA) (SQ.FT.)** | 0.51 | | | | |
| **R (HYDRAULIC RADIUS)** | 0.16 | | | | |
| **S (BED SLOPE) [3] (FT/FT)** | 0.0500 | | | | |
| **$S_c$ (CRITICAL SLOPE) (FT/FT)** | 0.1158 | | | | |
| **0.7 $S_c$ (FT/FT)** | 0.0811 | | | | |
| **1.3 $S_c$ (FT/FT)** | 0.1506 | | | | |
| **STABLE FLOW (Y/N)** | Y | | | | |
| **FREEBOARD BASED ON UNSTABLE FLOW (FT)** | N/A | | | | |
| **FREEBOARD BASED ON STABLE FLOW (FT)** | 0.05 | | | | |
| **MINIMUM REQUIRED FREEBOARD [4] (FT)** | 0.5 | | | | |
| **DESIGN METHOD FOR PROTECTIVE LINING[5]** | V | | | | |

1. Use 1.6 for Temporary Channels; 2.25 for Temporary Channels in Special Protection (HQ or EV) Watersheds; 2.75 for Permanent Channels. For Rational Method, enter "N/A" and attach Worksheets 9 and 10. For TR-55, enter N/A" and attach appropriate Worksheets.
2. Adjust "n" value for changes in channel liner and flow depth. For vegetated channels, provide data for manufactured linings without vegetation and with vegetation in separate columns.
3. Slopes may not be averaged
4. Minumum Freeboard is 0.5 ft. OR 1/4 Total Channel Depth, whichever is greater
5. Permissible velocity lining design method is not acceptable for channels with a bed slope of 10% or greater. Shear stress lining design method is required for channels with a bed slope of 10% or greater. Shear stress lining design method may be used for any channel bed slope.

## Compost Sock Sediment Trap Calcs

**DESIGN DATA: CSST-1** LOCATION :MARCUS HOOK

DRAINAGE AREA 2.19 ACRES

MIN.VOLUME REQUIRED (2000 CU.FT./ACRE) 4,380 CU.FT.

| Elevation Feet | Area Sq. Ft. | Average Area Sq. Ft. | Difference in Elev. Feet | Storage Volume Incremental Cu. Ft. | Storage Volume Total Cu. Ft. | Elevation Markers |
|---|---|---|---|---|---|---|
| 27.25 | 2,300.00 | - | - | - | - | |
| 27.91 | 2,300.00 | 2,300.00 | 0.66 | 1,518.00 | 1,518.00 | Sediment Cleanout |
| 28.00 | 2,300.00 | 2,300.00 | 0.09 | 207.00 | 1,725.00 | |
| 29.00 | 2,300.00 | 2,300.00 | 1.00 | 2,300.00 | 4,025.00 | |
| 29.25 | 2,300.00 | 2,300.00 | 0.25 | 575.00 | 4,600.00 | Top of Trap |
| | | | | | | |
| | | | | | | |
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| | | |
|---|---|---|
| **Required Total Storage** | 4,380 | cu. ft |
| **Provided Total Storage** | 4,600 | cu. ft |

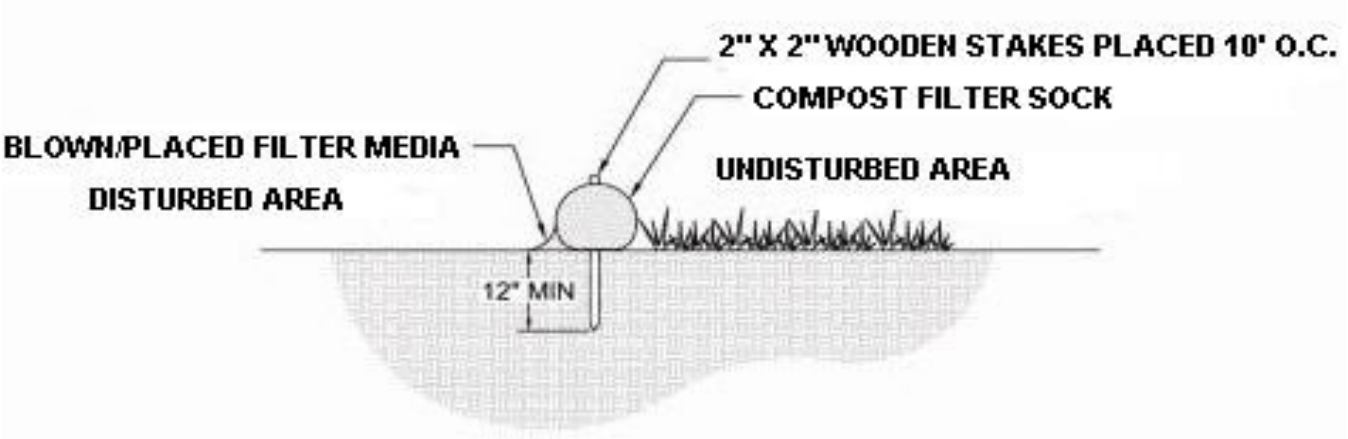
| | | |
|---|---|---|
| **Freeboard** | 1 | ft |
| **Sediment Cleanout Elevation** | 27.91 | ft |

| **Sock Pyramid Design** | | |
|---|---|---|
| **Row** | **Size of Sock (inches)** | **Number of Socks** |
| **Top** | - | - |
| **Middle** | - | - |
| **Bottom** | 24 | 1 |

Notes:
1. Designed according to PADEP E&S Manual; Technical Guidance Number 363-2134-008: March 2012
2. Sediment must be cleaned out once it reaches 1/3 the height of the trap
3. Trap must have 1ft of freeboard above the above the 2000 cu.ft storage elevation

**STANDARD E&S**
**WORKSHEET #1**
**Compost Filter Sock**

PROJECT NAME: ADELPHIA
LOCATION: Chester Creek Blowdown
PREPARED BY: RRY DATE: 3/11/2019
CHECKED BY: ATH DATE: 3/24/2020




| SOCK NO. | Dia. In. | LOCATION | SLOPE PERCENT | SLOPE LENGTH ABOVE BARRIER (FT) |
|---|---|---|---|---|
| CFS-1 | 24 | Chester Creek Blowdown | 10.2 | 46.5 |
| CFS-2 | 24 | Chester Creek Blowdown | 3.2 | 46.4 |
| CFS-3 | 12 | Chester Creek Blowdown | 8.4 | 11.9 |
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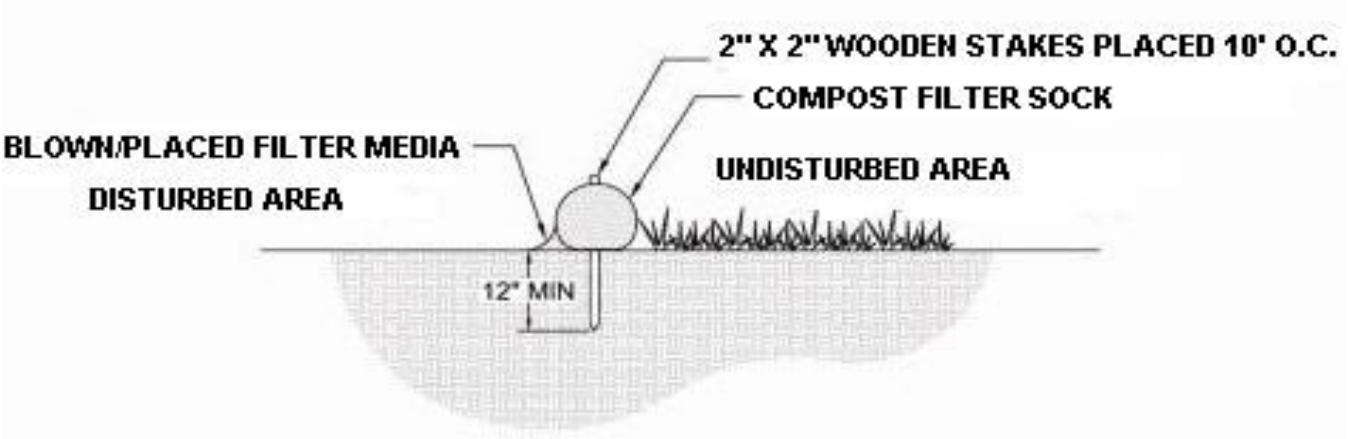
**STANDARD E&S**
**WORKSHEET #1**
**Compost Filter Sock**

PROJECT NAME: ADELPHIA
LOCATION: Cromby Blowdown
PREPARED BY: RRY DATE: 3/4/2019
CHECKED BY: ATH DATE: 3/24/2020




| SOCK NO. | Dia. In. | LOCATION | SLOPE PERCENT | SLOPE LENGTH ABOVE BARRIER (FT) |
|---|---|---|---|---|
| CFS-1 | 12 | Cromby Blowdown | 5.3 | 50.6 |
| CFS-2 | 12 | Cromby Blowdown | 2.5 | 81.1 |
| CFS-3 | 12 | Cromby Blowdown | 2.9 | 14.0 |
| CFS-4 | 12 | Cromby Blowdown | 5.8 | 12.9 |
| CFS-5 | 12 | Cromby Blowdown | 5.1 | 24.7 |
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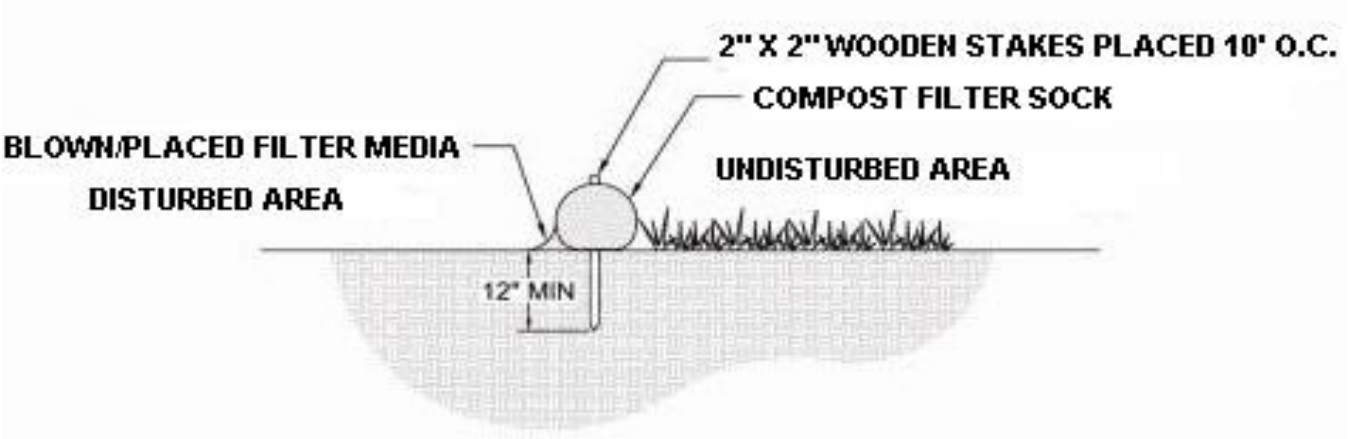
**STANDARD E&S**
**WORKSHEET #1**
**Compost Filter Sock**

PROJECT NAME: ADELPHIA
LOCATION: East Perkiomen Blowndown
PREPARED BY: RRY DATE: 3/11/2019
CHECKED BY: ATH DATE: 3/24/2020




| SOCK NO. | Dia. In. | LOCATION | SLOPE PERCENT | SLOPE LENGTH ABOVE BARRIER (FT) |
|---|---|---|---|---|
| CFS-1 | 12 | East Perkiomen Blowdown | 6.0 | 16.6 |
| CFS-2 | 12 | East Perkiomen Blowdown | 6.7 | 29.9 |
| CFS-3 | 12 | East Perkiomen Blowdown | 7.6 | 26.2 |
| CFS-4 | 12 | East Perkiomen Blowdown | 4.3 | 11.7 |
| CFS-5 | 12 | East Perkiomen Blowdown | 4.7 | 32.2 |
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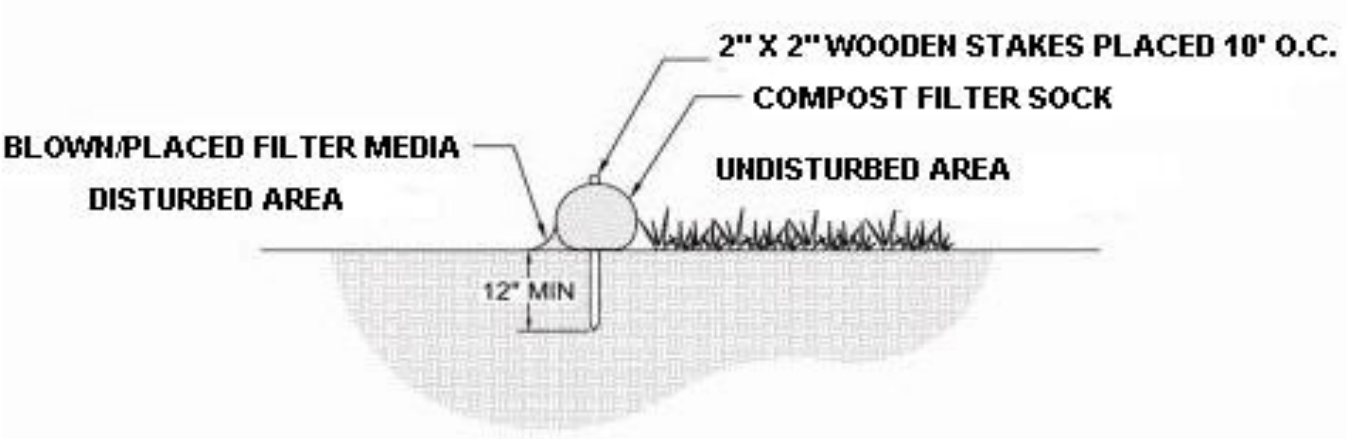
**STANDARD E&S**
**WORKSHEET #1**
**Compost Filter Sock**

PROJECT NAME: ADELPHIA
LOCATION: French Creek Blowdown
PREPARED BY: RRY DATE: 3/12/2019
CHECKED BY: ATH DATE: 3/24/2020




| SOCK NO. | Dia. In. | LOCATION | SLOPE PERCENT | SLOPE LENGTH ABOVE BARRIER (FT) |
|---|---|---|---|---|
| CFS-1 | 12 | French Creek Blowdown | 14.7 | 47.5 |
| CFS-2 | 12 | French Creek Blowdown | 9.4 | 26.5 |
| CFS-3 | 12 | French Creek Blowdown | 12.7 | 13.8 |
| CFS-4 | 12 | French Creek Blowdown | 13.0 | 11.5 |
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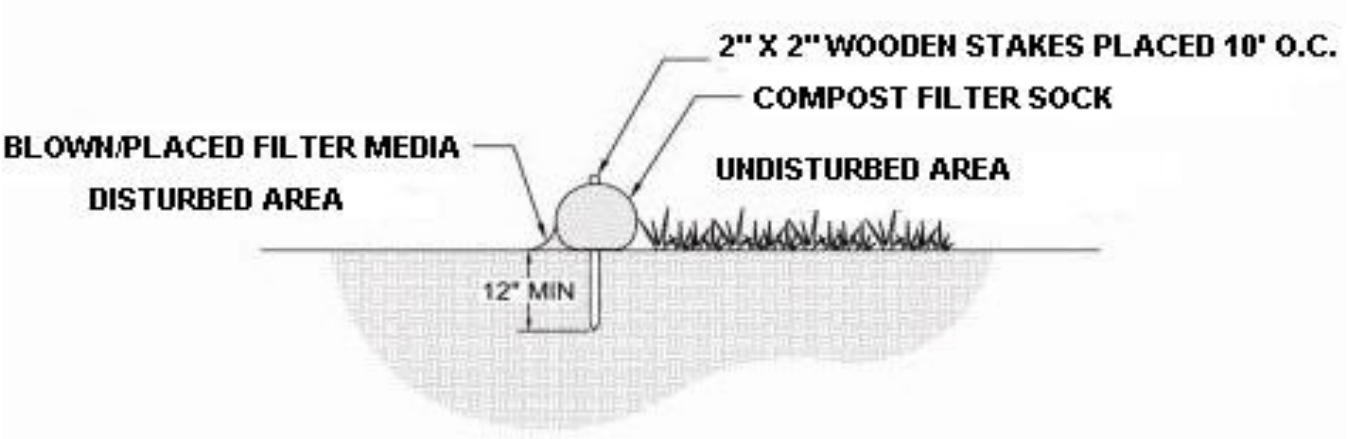
**STANDARD E&S**
**WORKSHEET #1**
**Compost Filter Sock**

PROJECT NAME: ADELPHIA
LOCATION: Main Line Valve 1
PREPARED BY: RRY DATE: 3/12/2019
CHECKED BY: ATH DATE: 3/24/2020




| SOCK NO. | Dia. In. | LOCATION | SLOPE PERCENT | SLOPE LENGTH ABOVE BARRIER (FT) |
|---|---|---|---|---|
| CFS-1 | 12 | Main Line Valve 1 | 3.0 | 33.0 |
| CFS-2 | 12 | Main Line Valve 1 | 5.7 | 17.5 |
| CFS-3 | 12 | Main Line Valve 1 | 3.8 | 53.0 |
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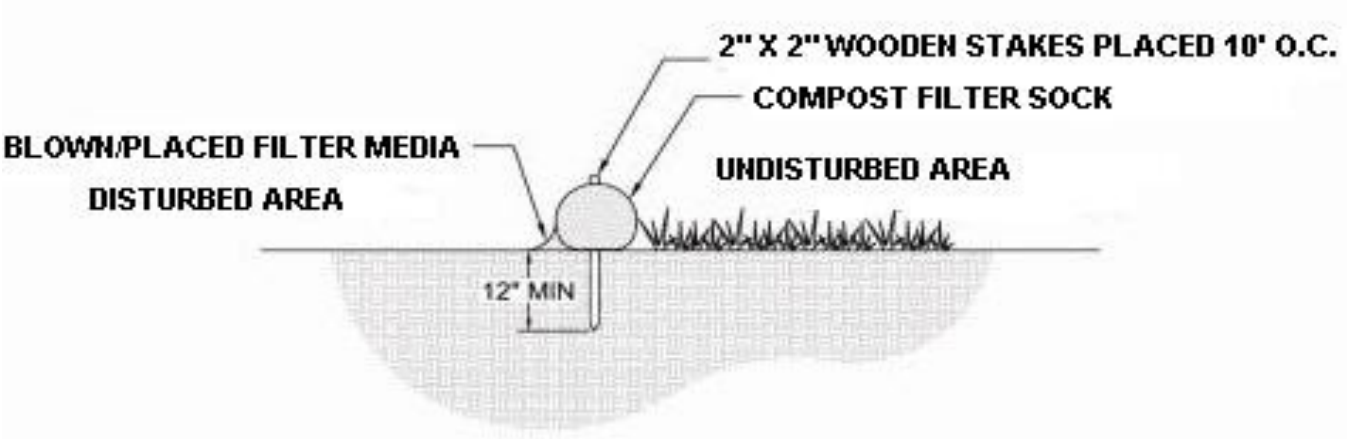
**STANDARD E&S**
**WORKSHEET #1**
**Compost Filter Sock**

PROJECT NAME: ADELPHIA
LOCATION: Main Line Valve 2
PREPARED BY: RRY DATE: 3/12/2019
CHECKED BY: ATH DATE: 3/24/2020




| SOCK NO. | Dia. In. | LOCATION | SLOPE PERCENT | SLOPE LENGTH ABOVE BARRIER (FT) |
|---|---|---|---|---|
| CFS-1 | 12 | Main Line Valve 2 | 8.1 | 64.7 |
| CFS-2 | 12 | Main Line Valve 2 | 22.2 | 36.0 |
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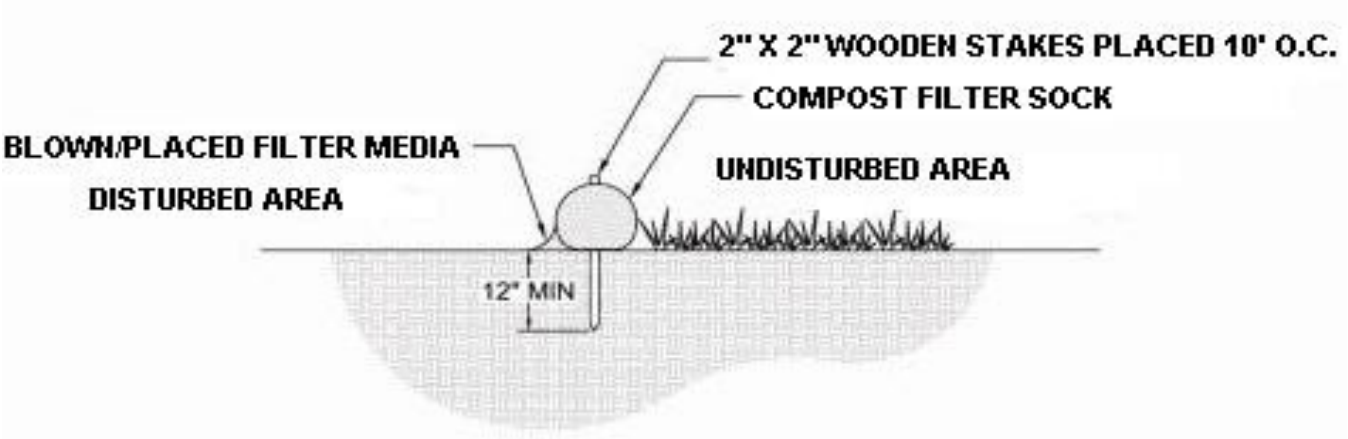
**STANDARD E&S**
**WORKSHEET #1**
**Compost Filter Sock**

PROJECT NAME: ADELPHIA
LOCATION: Marcus Hook Compressor Station
PREPARED BY: RRY DATE: 3/4/2019
CHECKED BY: ATH DATE: 3/24/2020




| SOCK NO. | Dia. In. | LOCATION | SLOPE PERCENT | SLOPE LENGTH ABOVE BARRIER (FT) |
|---|---|---|---|---|
| CFS-1 | 18 | Marcus Hook Compressor Station | 2.6 | 307.1 |
| CFS-2 | 24 | Marcus Hook Compressor Station | 2.8 | 396.8 |
| CFS-3 | 12 | Marcus Hook Compressor Station | 4.1 | 170.1 |
| CFS-4 | 12 | Marcus Hook Compressor Station | 3.2 | 31.5 |
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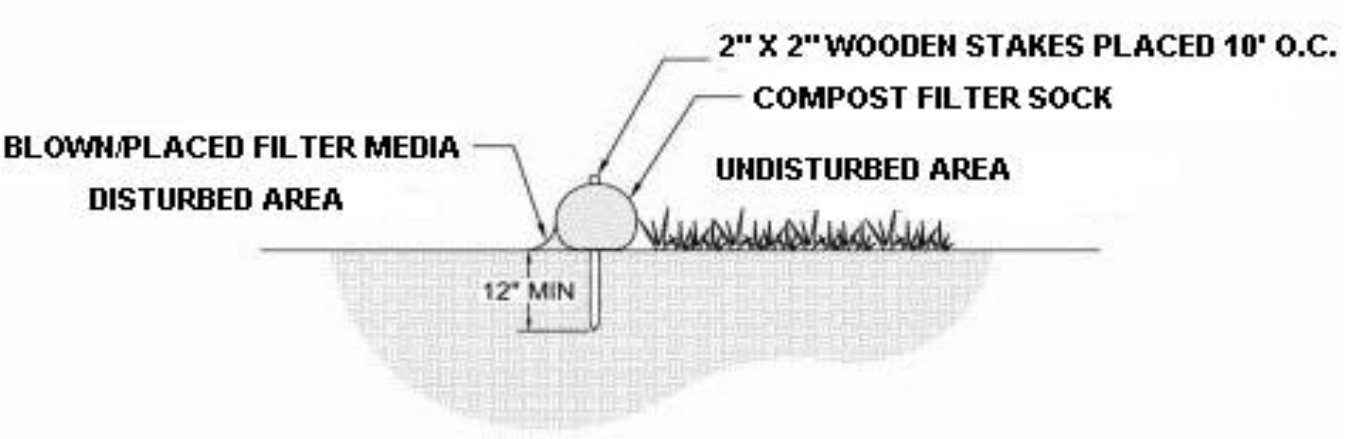
**STANDARD E&S**
**WORKSHEET #1**
**Compost Filter Sock**

PROJECT NAME: ADELPHIA
LOCATION: Paoli Pike Blowdown
PREPARED BY: RRY DATE: 3/12/2019
CHECKED BY: ATH DATE: 3/24/2020




| SOCK NO. | Dia. In. | LOCATION | SLOPE PERCENT | SLOPE LENGTH ABOVE BARRIER (FT) |
|---|---|---|---|---|
| CFS-1 | 24 | Paoli Pike Blowdown | 3.5 | 42.2 |
| CFS-2 | 12 | Paoli Pike Blowdown | 3.8 | 13.3 |
| CFS-3 | 12 | Paoli Pike Blowdown | 7.7 | 23.4 |
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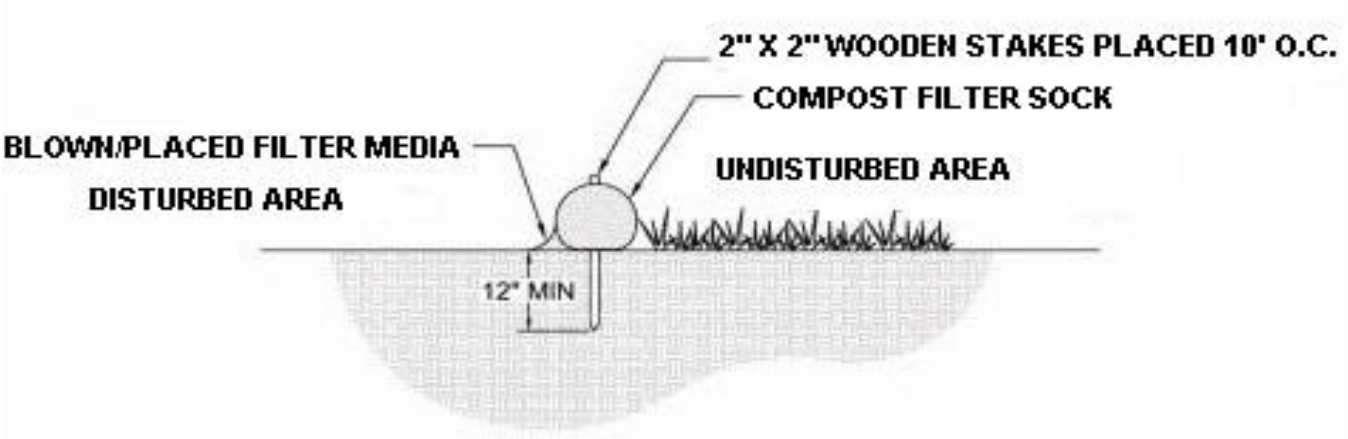
**STANDARD E&S**
**WORKSHEET #1**
**Compost Filter Sock**

PROJECT NAME: ADELPHIA
LOCATION: Perkiomen Creek Blowdown
PREPARED BY: RRY DATE: 3/11/2019
CHECKED BY: ATH DATE: 3/24/2020




| SOCK NO. | Dia. In. | LOCATION | SLOPE PERCENT | SLOPE LENGTH ABOVE BARRIER (FT) |
|---|---|---|---|---|
| CFS-1 | 12 | Perkiomen Creek Blowdown | 4.5 | 56.1 |
| CFS-2 | 12 | Perkiomen Creek Blowdown | 3.7 | 16.4 |
| CFS-3 | 12 | Perkiomen Creek Blowdown | 2.1 | 14.0 |
| CFS-4 | 12 | Perkiomen Creek Blowdown | 3.3 | 60.8 |
| CFS-5 | 12 | Perkiomen Creek Blowdown | 3.8 | 40.0 |
| CFS-6 | 12 | Perkiomen Creek Blowdown | 3.2 | 26.0 |
| CFS-7 | 12 | Perkiomen Creek Blowdown | 3.3 | 38.0 |
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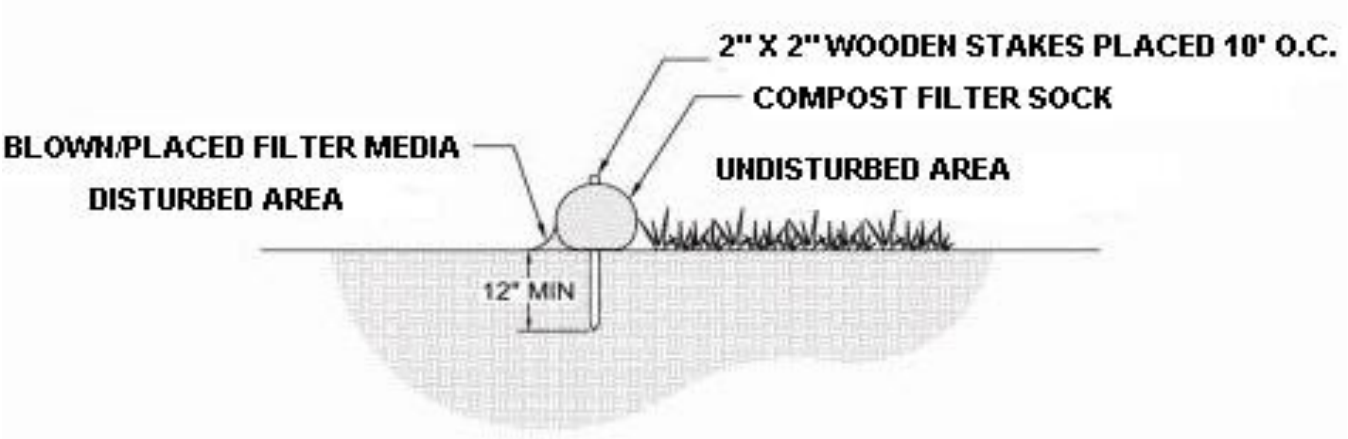
**STANDARD E&S**
**WORKSHEET #1**
**Compost Filter Sock**

PROJECT NAME: ADELPHIA
LOCATION: Quakertown Compressor Station
PREPARED BY: RRY DATE: 3/4/2019
CHECKED BY: ATH DATE: 3/24/2020




| SOCK NO. | Dia. In. | LOCATION | SLOPE PERCENT | SLOPE LENGTH ABOVE BARRIER (FT) |
|---|---|---|---|---|
| CFS-1 | 18 | Quakertown Compressor Station | 5.1 | 243.4 |
| CFS-2 | 18 | Quakertown Compressor Station | 4.9 | 272.1 |
| CFS-3 | 24 | Quakertown Compressor Station | 6.6 | 45.1 |
| CFS-4 | 24 | Quakertown Compressor Station | 5.8 | 258.7 |
| CFS-5 | 18 | Quakertown Compressor Station | 4.0 | 74.5 |
| CFS-6 | 24 | Quakertown Compressor Station | 5.1 | 59.3 |
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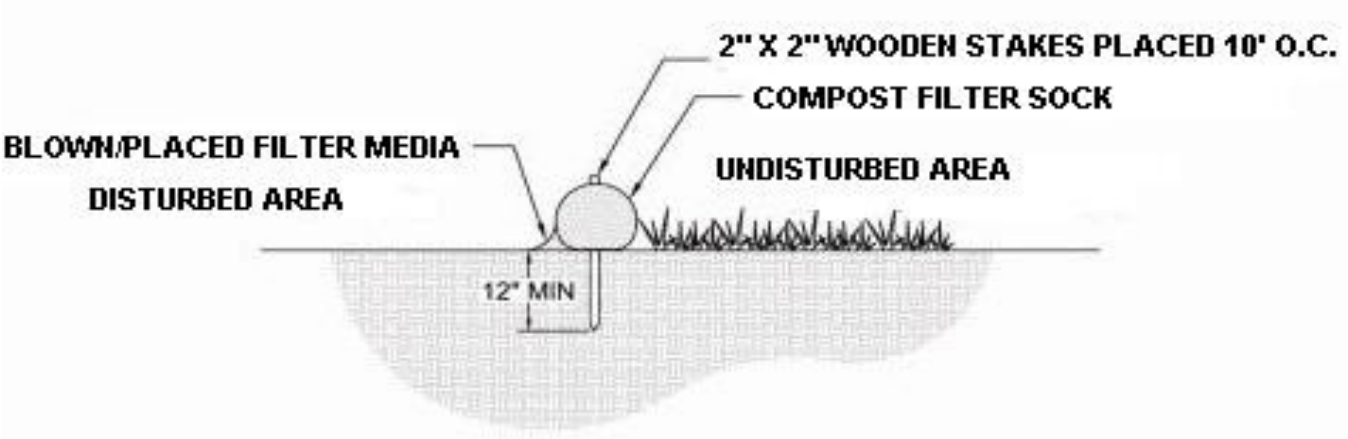
**STANDARD E&S**
**WORKSHEET #1**
**Compost Filter Sock**

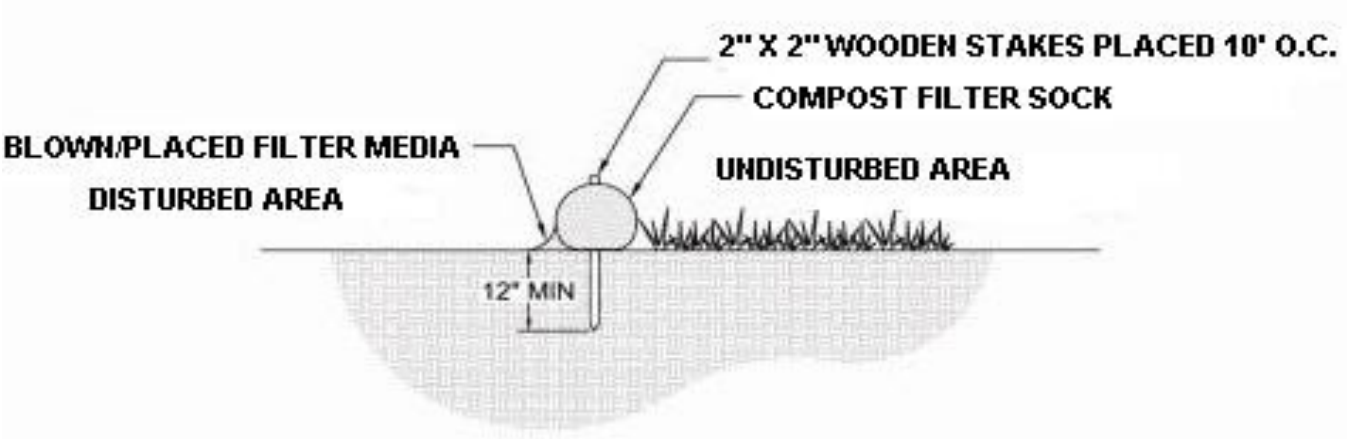
PROJECT NAME: ADELPHIA
LOCATION: Schuylkill River Blowdown
PREPARED BY: RRY DATE: 3/11/2019
CHECKED BY: ATH DATE: 3/24/2020




| SOCK NO. | Dia. In. | LOCATION | SLOPE PERCENT | SLOPE LENGTH ABOVE BARRIER (FT) |
|---|---|---|---|---|
| CFS-1 | 12 | Schuylkill River Blowdown | 7.6 | 115.2 |
| CFS-2 | 24 | Schuylkill River Blowdown | 14.8 | 16.9 |
| CFS-3 | 12 | Schuylkill River Blowdown | 13.1 | 13.4 |
| CFS-4 | 12 | Schuylkill River Blowdown | 6.2 | 36.5 |
| CFS-5 | 12 | Schuylkill River Blowdown | 3.0 | 16.9 |

**STANDARD E&S**
**WORKSHEET #1**
**Compost Filter Sock**

PROJECT NAME: ADELPHIA
LOCATION: Skippack Pike Meter Station
PREPARED BY: RRY DATE: 3/11/2019
CHECKED BY: ATH DATE: 3/24/2020




| SOCK NO. | Dia. In. | LOCATION | SLOPE PERCENT | SLOPE LENGTH ABOVE BARRIER (FT) |
|---|---|---|---|---|
| CFS-1 | 18 | Skippack Pike Meter Station | 10.6 | 84.5 |
| CFS-2 | 12 | Skippack Pike Meter Station | 8.5 | 59.0 |
| CFS-3 | 12 | Skippack Pike Meter Station | 11.7 | 47.0 |
| CFS-4 | 12 | Skippack Pike Meter Station | 7.8 | 31.0 |
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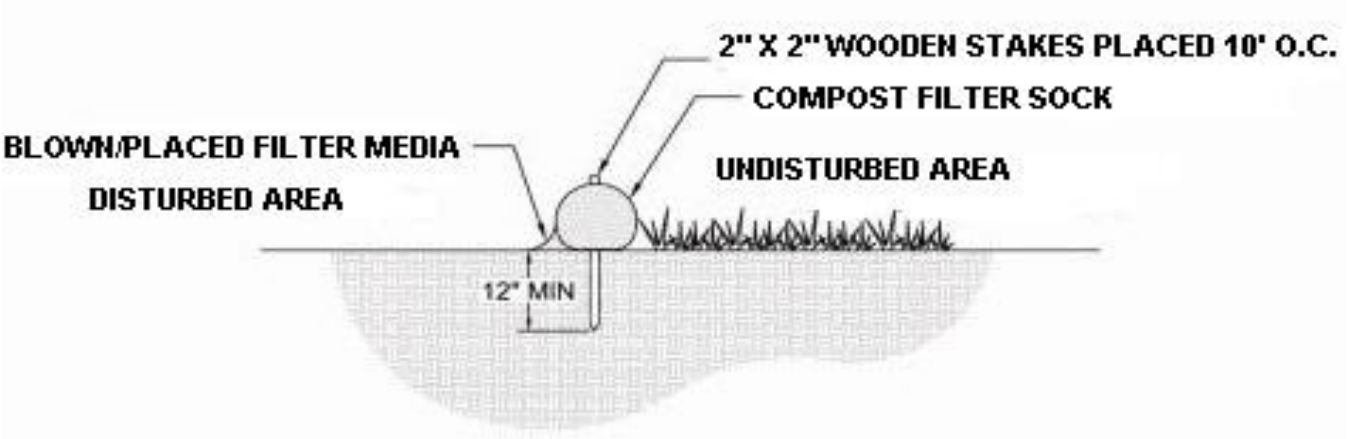
**STANDARD E&S**
**WORKSHEET #1**
**Compost Filter Sock**

PROJECT NAME: ADELPHIA
LOCATION: Transco Meter Station
PREPARED BY: RRY DATE: 3/4/2019
CHECKED BY: ATH DATE: 3/24/2020




| SOCK NO. | Dia. In. | LOCATION | SLOPE PERCENT | SLOPE LENGTH ABOVE BARRIER (FT) |
|---|---|---|---|---|
| CFS-1 | 12 | Transco Meter Station | 15.9 | 47.8 |
| CFS-2 | 12 | Transco Meter Station | 10.0 | 32.5 |
| CFS-3 | 18 | Transco Meter Station | 8.2 | 186.9 |
| CFS-4 | 12 | Transco Meter Station | 10.9 | 34.0 |
| CFS-5 | 12 | Transco Meter Station | 9.1 | 21.9 |
| CFS-6 | 12 | Transco Meter Station | 6.5 | 15.4 |
| CFS-7 | 12 | Transco Meter Station | 5.7 | 17.4 |
| CFS-8 | 12 | Transco Meter Station | 5.3 | 18.8 |
| CFS-9 | 12 | Transco Meter Station | 4.9 | 20.5 |
| CFS-10 | 12 | Transco Meter Station | 3.9 | 50.6 |
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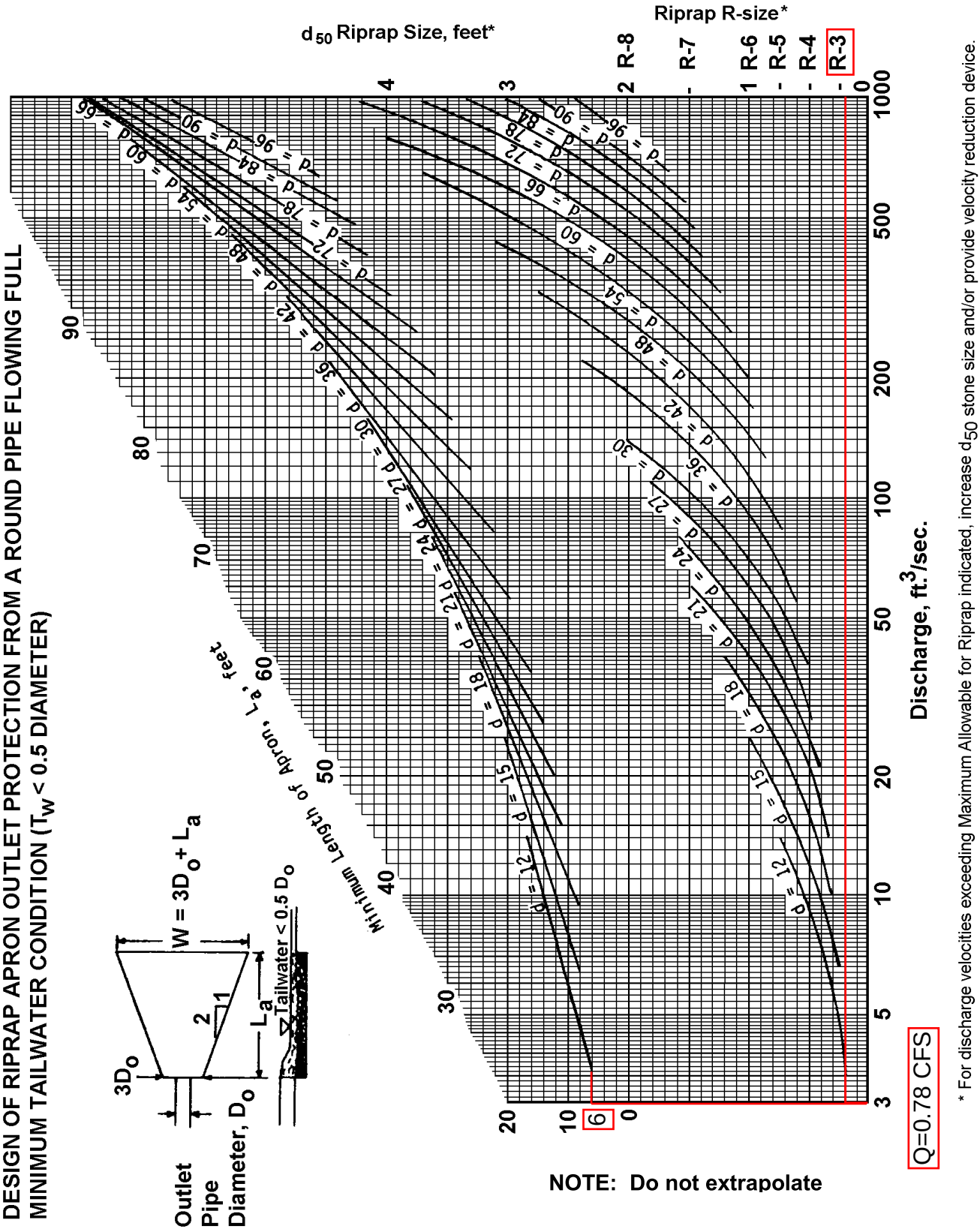
# FIGURE 9.3
## Riprap Apron Design, Minimum Tailwater Condition

Marcus Hook Compressor Station

**DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL**
**MINIMUM TAILWATER CONDITION ($T_W$ < 0.5 DIAMETER)**




* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase $d_{50}$ stone size and/or provide velocity reduction device.

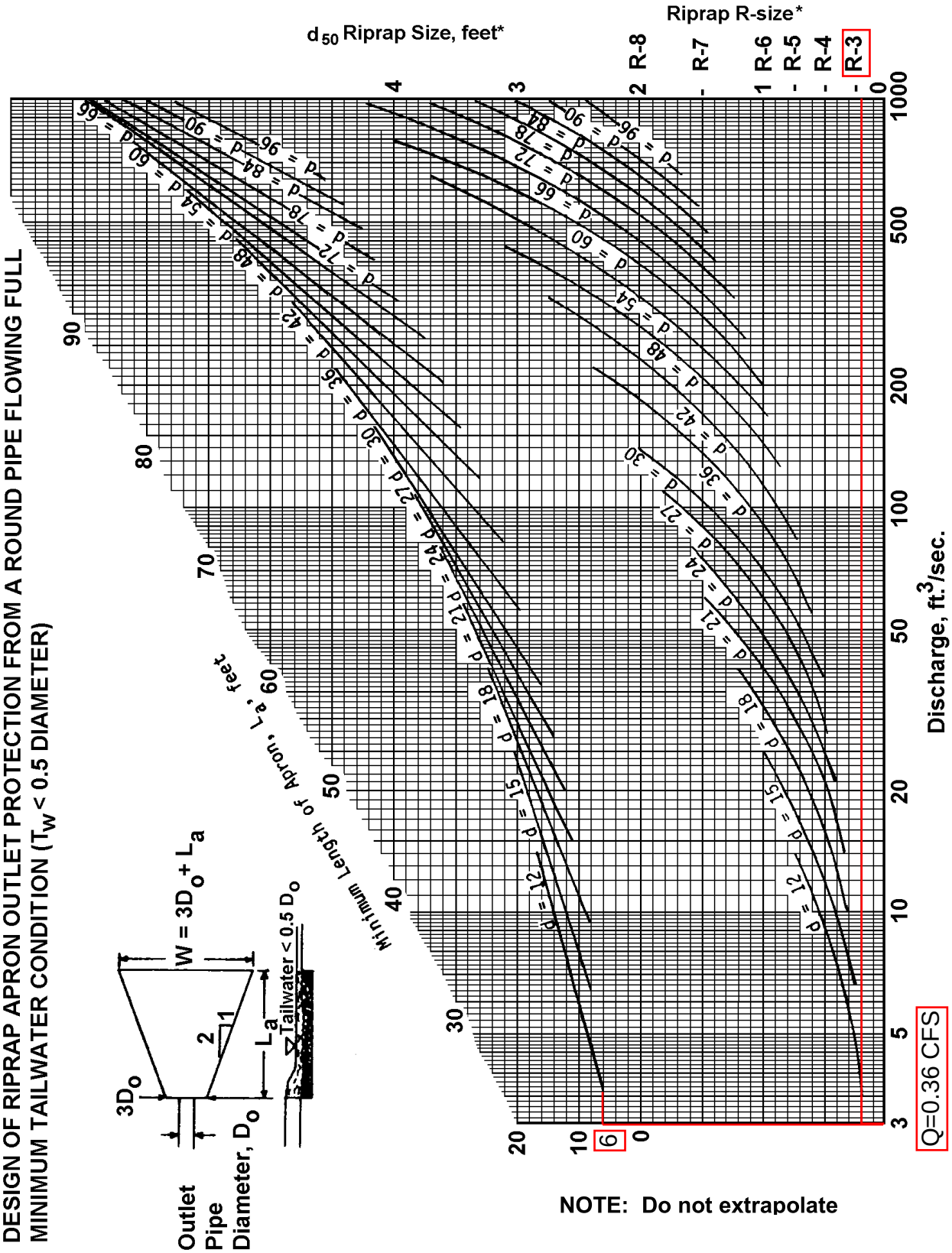
Adapted from USDA - NRCS

**Not to be used for Box Culverts**

# FIGURE 9.3
## Riprap Apron Design, Minimum Tailwater Condition

Quakertown Compressor Station

**DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL**
**MINIMUM TAILWATER CONDITION ($T_W$ < 0.5 DIAMETER)**




* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase $d_{50}$ stone size and/or provide velocity reduction device.

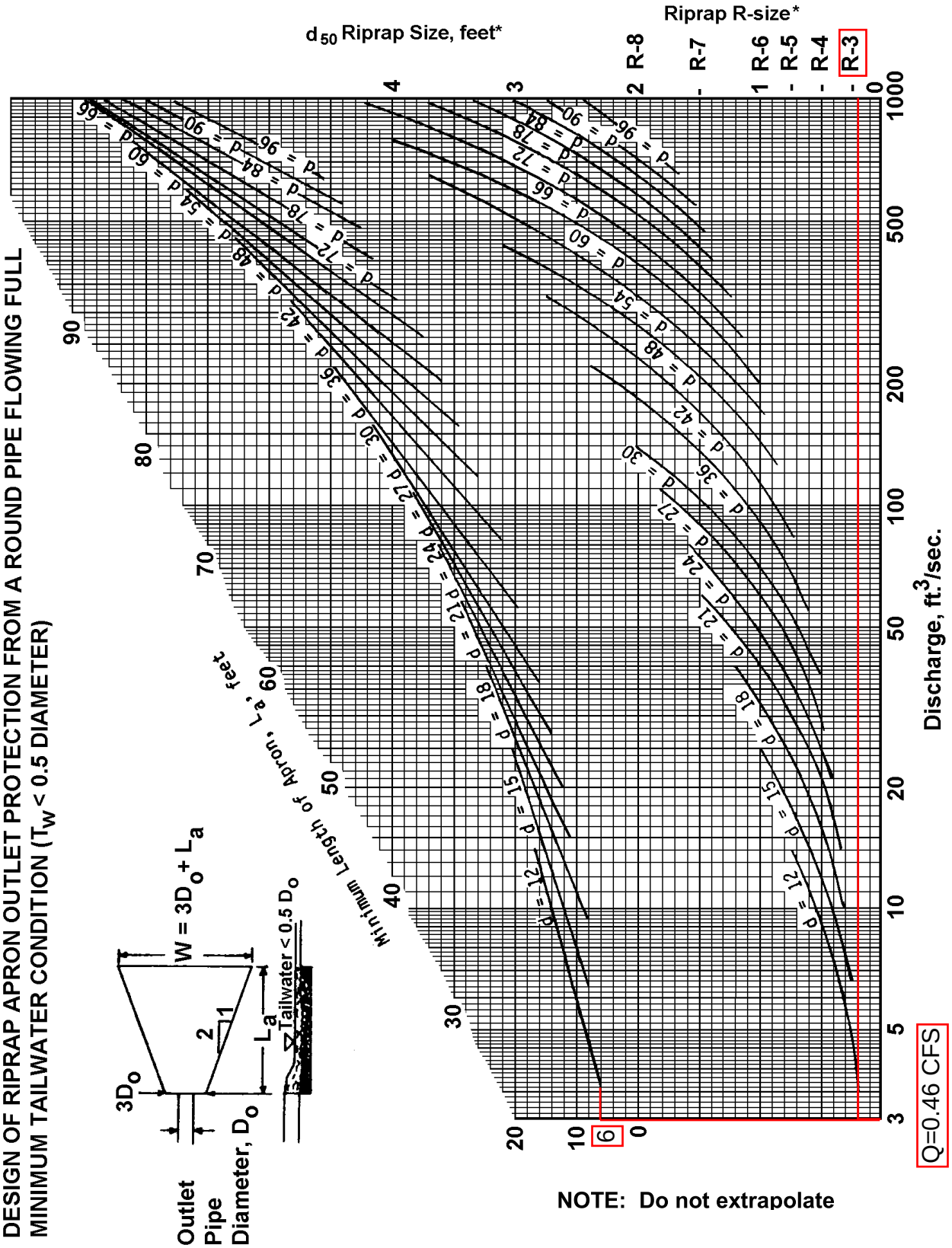
Adapted from USDA - NRCS

**Not to be used for Box Culverts**

# FIGURE 9.3
## Riprap Apron Design, Minimum Tailwater Condition

Transco Meter Station

**DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL**
**MINIMUM TAILWATER CONDITION ($T_W$ < 0.5 DIAMETER)**



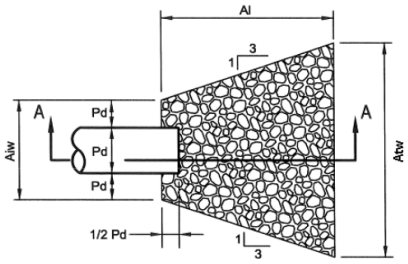

Adapted from USDA - NRCS

* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase $d_{50}$ stone size and/or provide velocity reduction device.

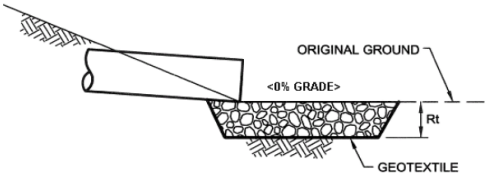
**Not to be used for Box Culverts**

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

PROJECT NAME: Adelphia Gateway
LOCATION: Marcus Hook Compressor Station
PREPARED BY: RRY DATE: 04/19/19
CHECKED BY: ATH DATE: 05/16/19




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) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| M-1 | 12 | MAX | 0.012 | 0.005 | 0.78 | 0.9936 | R-3 | 12 | 6 | 3 | 5.4 |
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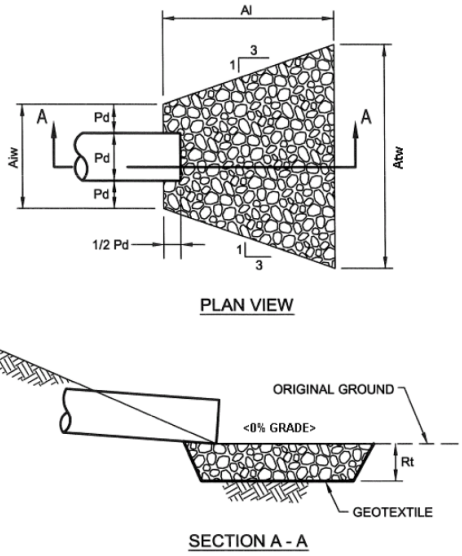
***:The anticipated velocity (V) should not exceed the maximum permissible shown in Table 6.6 for the proposed riprap protection. Adjust for less than full pipe flow. Use Manning's equation to calculate velocity for pipe slopes > 0.05 ft/ft.**

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

PROJECT NAME: Adelphia Gateway
LOCATION: Quakertown Compressor Station
PREPARED BY: RRY DATE: 04/19/19
CHECKED BY: ATH DATE: 05/16/19




| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Q-1 | 12 | MIN | 0.011 | 0.01 | 0.36 | 0.4586 | R-3 | 12 | 6 | 3 | 9 |
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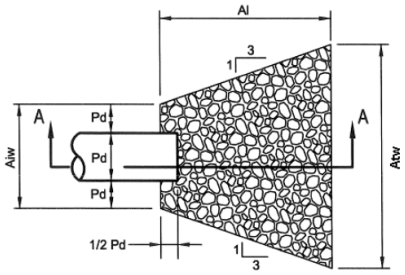
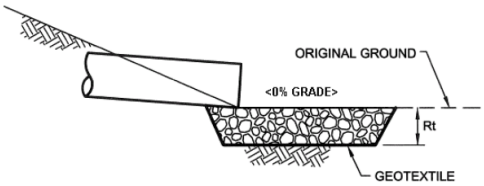
***:The anticipated velocity (V) should not exceed the maximum permissible shown in Table 6.6 for the proposed riprap protection. Adjust for less than full pipe flow. Use Manning's equation to calculate velocity for pipe slopes > 0.05 ft/ft.**

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

PROJECT NAME: Adelphia Gateway
LOCATION: Transco Meter Station
PREPARED BY: RRY DATE: 04/19/19
CHECKED BY: ATH DATE: 05/16/19




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) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| T-1 | 12 | MAX | 0.012 | 0.005 | 0.46 | 0.586 | R-3 | 12 | 6 | 3 | 5.4 |
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| | | | | | | | | | | | |

***: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 > 0.05 ft/ft.**

# Appendix D

## Off-site Analysis

**STANDARD E&S WORKSHEET #10**
**Rational Method**

| | | | |
|---|---|---|---|
| **PROJECT NAME:** | Adelphia | | |
| **LOCATION:** | Transco and Marcus Hook Stations | | |
| **PREPARED BY:** | RY | **DATE:** | 5/1/2019 |
| **CHECKED BY:** | ATH | **DATE:** | 5/19/2019 |

**DETERMINE WATERSHED "C" VALUE**

| Channel Number | Drainage Area Number | Type of Cover | C VALUE | AREA (acres) | (C X A) | $C_w$ |
|---|---|---|---|---|---|---|
| Off-site (Transco) | - | Impervious | 0.9 | 0.11 | 0.10 | 0.61 |
| | - | Gravel | 0.6 | 0.77 | 0.46 | |
| | - | Brush | 0.3 | 0.07 | 0.02 | |
| Off-site (Marcus Hook) | - | Impervious | 0.9 | 1.39 | 1.25 | 0.62 |
| | - | Gravel | 0.6 | 4.60 | 2.76 | |
| | - | Grass | 0.3 | 0.86 | 0.26 | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

**DETERMINE INTENSITY:**

| Channel Number | Tc | R2 | R10 | I2 | I10 |
|---|---|---|---|---|---|
| Off-site (Transco) | 5.00 | - | - | - | 6.50 |
| Off-site (Marcus Hook) | 5.00 | - | - | - | 6.50 |
| | | | | | |

**DETERMINE PEAK RUNOFF RATES (Q = C I A)**

| Channel Number | C VALUE | I (in./hr.) | A (acres) | Q2 (cfs) | Q10 (cfs) |
|---|---|---|---|---|---|
| Off-site (Transco) | 0.61 | 6.50 | 0.94 | - | 3.74 |
| Off-site (Marcus Hook) | 0.62 | 6.50 | 5.98 | - | 24.23 |
| | | | | | |

**STANDARD E&S WORKSHEET #11**
**Channel Design Data**

| | | | |
|---|---|---|---|
| **PROJECT NAME:** | Adelphia | | |
| **LOCATION:** | Transco and Marcus Hook Stations | | |
| **PREPARED BY:** | RY | **DATE:** | 5/1/2019 |
| **CHECKED BY:** | ATH | **DATE:** | 5/19/2019 |

| | | | | | |
|---|---|---|---|---|---|
| **CHANNEL OR CHANNEL SECTION** | Off-site (Transco) | Off-site (MH) | | | |
| **TEMPORARY OR PERMANENT (T or P)** | PERM | PERM | | | |
| **DESIGN STORM (2, 5, or 10 YR)** | 10 YR | 10 YR | | | |
| **ACRES (AC)** | 0.94 | 5.98 | | | |
| **MULTIPLIER (1.6, 2.25, or 2.75)[1]** | N/A | N/A | | | |
| **Qr (REQUIRED CAPACITY) (CFS)** | 3.74 | 24.23 | | | |
| **Q (CALCULATED AT FLOW DEPTH d) (CFS)** | 3.74 | 24.23 | | | |
| **PROTECTIVE LINING [2]** | Veg | R-4 | | | |
| **n (MANNING'S COEFFICIENT) [2]** | 0.080 | 0.038 | | | |
| **Va (ALLOWABLE VELOCITY) (FPS)** | 3.00 | 9.00 | | | |
| **V (CALCULATED AT FLOW DEPTH d) (FPS)** | 0.98 | 2.89 | | | |
| **$t_a$ (MAX. ALLOWABLE SHEAR STRESS) (LB/FT$^2$)** | 1.00 | 2.00 | | | |
| **td (SHEAR STRESS AT FLOW DEPTH d) (LB/FT2)** | 0.30 | 0.55 | | | |
| **CHANNEL BOTTOM WIDTH (FT)** | 6 | 6 | | | |
| **CHANNEL SIDE SLOPES (H:V)** | 4 | 4 | | | |
| **D (TOTAL DEPTH) (FT)** | 0.98 | 1.13 | | | |
| **CHANNEL TOP WIDTH @ D (FT)** | 13.85 | 15.05 | | | |
| **d (CALCULATED FLOW DEPTH) (FT)** | 0.48 | 0.88 | | | |
| **CHANNEL TOP WIDTH @ FLOW DEPTH d (FT)** | 9.85 | 13.05 | | | |
| **BOTTOM WIDTH:DEPTH RATIO (12:1 MAX)** | 12.5 | 6.8 | | | |
| **$d_{50}$ STONE SIZE (IN)** | 0.25 | 0.25 | | | |
| **A (CROSS-SECTIONAL AREA) (SQ.FT.)** | 3.82 | 8.39 | | | |
| **R (HYDRAULIC RADIUS)** | 0.38 | 0.63 | | | |
| **S (BED SLOPE) [3] (FT/FT)** | 0.0100 | 0.0100 | | | |
| **$S_c$ (CRITICAL SLOPE) (FT/FT)** | 0.1299 | 0.0248 | | | |
| **0.7 $S_c$ (FT/FT)** | 0.0909 | 0.0174 | | | |
| **1.3 $S_c$ (FT/FT)** | 0.1688 | 0.0322 | | | |
| **STABLE FLOW (Y/N)** | Y | Y | | | |
| **FREEBOARD BASED ON UNSTABLE FLOW (FT)** | N/A | N/A | | | |
| **FREEBOARD BASED ON STABLE FLOW (FT)** | 0.12 | 0.22 | | | |
| **MINIMUM REQUIRED FREEBOARD [4] (FT)** | 0.5 | 0.25 | | | |
| **DESIGN METHOD FOR PROTECTIVE LINING[5]** | V | V | | | |

1. Use 1.6 for Temporary Channels; 2.25 for Temporary Channels in Special Protection (HQ or EV) Watersheds; 2.75 for Permanent Channels. For Rational Method, enter "N/A" and attach Worksheets 9 and 10. For TR-55, enter N/A" and attach appropriate Worksheets.
2. Adjust "n" value for changes in channel liner and flow depth. For vegetated channels, provide data for manufactured linings without vegetation and with vegetation in separate columns.
3. Slopes may not be averaged
4. Minumum Freeboard is 0.5 ft. OR 1/4 Total Channel Depth, whichever is greater
5. Permissible velocity lining design method is not acceptable for channels with a bed slope of 10% or greater. Shear stress lining design method is required for channels with a bed slope of 10% or greater. Shear stress lining design method may be used for any channel bed slope.

United States Department of Agriculture

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

# Custom Soil Resource Report for Delaware County, Pennsylvania, and New Castle County, Delaware

March 24, 2020

# Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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# How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

# Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

# Custom Soil Resource Report
## Soil Map

Map Scale: 1:8,080 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 350 700 1400 2100

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

## MAP LEGEND

**Area of Interest (AOI)**

- Area of Interest (AOI)

**Soils**

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

**Special Point Features**

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

**Water Features**

- Streams and Canals

**Transportation**

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

**Background**

- Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at scales ranging from 1:20,000 to 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:
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: Delaware County, Pennsylvania
Survey Area Data: Version 17, Sep 17, 2019

Soil Survey Area: New Castle County, Delaware
Survey Area Data: Version 14, Sep 13, 2019

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

## MAP LEGEND

## MAP INFORMATION

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

Date(s) aerial images were photographed: May 26, 2019—Jul 10, 2019

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

# Map Unit Legend

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| BeB2 | Beltsville silt loam, 3 to 8 percent slopes, moderately eroded | 2.9 | 2.0% |
| ByA | Butlertown silt loam, 0 to 3 percent slopes | 2.3 | 1.6% |
| ByB2 | Butlertown silt loam, 3 to 8 percent slopes, moderately eroded | 25.3 | 17.4% |
| Ma | Made land, gravelly materials | 30.1 | 20.7% |
| OtA | Othello silt loams, 0 to 2 percent slopes, northern coastal plain | 70.5 | 48.5% |
| **Subtotals for Soil Survey Area** | | **131.0** | **90.3%** |
| **Totals for Area of Interest** | | **145.1** | **100.0%** |

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| Up | Urban land | 14.1 | 9.7% |
| **Subtotals for Soil Survey Area** | | **14.1** | **9.7%** |
| **Totals for Area of Interest** | | **145.1** | **100.0%** |

# Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different

management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

# Delaware County, Pennsylvania

## BeB2—Beltsville silt loam, 3 to 8 percent slopes, moderately eroded

### Map Unit Setting

*National map unit symbol:* 121d4
*Elevation:* 0 to 650 feet
*Mean annual precipitation:* 35 to 55 inches
*Mean annual air temperature:* 45 to 61 degrees F
*Frost-free period:* 160 to 250 days
*Farmland classification:* Farmland of statewide importance

### Map Unit Composition

*Beltsville and similar soils:* 85 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Beltsville

#### Setting

*Landform:* Flats
*Landform position (two-dimensional):* Summit, shoulder, backslope
*Landform position (three-dimensional):* Interfluve, side slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Concave, linear
*Parent material:* Silty eolian deposits over fluviomarine deposits

#### Typical profile

*H1 - 0 to 7 inches:* silt loam
*H2 - 7 to 48 inches:* silt loam
*H3 - 48 to 60 inches:* silt loam
*H4 - 60 to 64 inches:* gravelly sandy clay loam

#### Properties and qualities

*Slope:* 3 to 8 percent
*Depth to restrictive feature:* 20 to 48 inches to fragipan; 60 to 80 inches to lithic bedrock
*Natural drainage class:* Moderately well drained
*Runoff class:* Medium
*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately high (0.00 to 0.20 in/hr)
*Depth to water table:* About 18 to 30 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water storage in profile:* High (about 9.6 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 2e
*Hydrologic Soil Group:* C
*Hydric soil rating:* No

### Minor Components

#### Othello

*Percent of map unit:* 5 percent

*Landform:* Terraces
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Tread
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* Yes

**Sassafras**

*Percent of map unit:* 5 percent
*Landform:* Hillslopes
*Landform position (two-dimensional):* Summit
*Landform position (three-dimensional):* Side slope, interfluve
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* No

**Butlertown**

*Percent of map unit:* 5 percent
*Landform:* Coastal plains
*Landform position (two-dimensional):* Footslope, toeslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear, concave
*Hydric soil rating:* No

## ByA—Butlertown silt loam, 0 to 3 percent slopes

### Map Unit Setting

*National map unit symbol:* 121dk
*Elevation:* 0 to 800 feet
*Mean annual precipitation:* 35 to 55 inches
*Mean annual air temperature:* 48 to 61 degrees F
*Frost-free period:* 160 to 240 days
*Farmland classification:* All areas are prime farmland

### Map Unit Composition

*Butlertown and similar soils:* 85 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Butlertown

#### Setting

*Landform:* Coastal plains
*Landform position (two-dimensional):* Footslope, toeslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear, concave
*Parent material:* Thick deposits silty over sandy fluvial coastal plain sediments

**Typical profile**

*H1 - 0 to 8 inches:* silt loam
*H2 - 8 to 34 inches:* silt loam
*H3 - 34 to 50 inches:* silt loam
*H4 - 50 to 60 inches:* silt loam

**Properties and qualities**

*Slope:* 0 to 3 percent
*Depth to restrictive feature:* 25 to 40 inches to fragipan
*Natural drainage class:* Well drained
*Runoff class:* Medium
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)
*Depth to water table:* About 24 to 48 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water storage in profile:* Moderate (about 6.5 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 2w
*Hydrologic Soil Group:* C
*Hydric soil rating:* No

## Minor Components

**Beltsville**

*Percent of map unit:* 6 percent
*Landform:* Flats
*Landform position (two-dimensional):* Summit, shoulder, backslope
*Landform position (three-dimensional):* Interfluve, side slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Concave, linear
*Hydric soil rating:* No

**Othello**

*Percent of map unit:* 5 percent
*Landform:* Terraces
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Tread
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* Yes

**Woodstown**

*Percent of map unit:* 4 percent
*Landform:* Terraces
*Landform position (two-dimensional):* Footslope
*Landform position (three-dimensional):* Tread
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* No

## ByB2—Butlertown silt loam, 3 to 8 percent slopes, moderately eroded

### Map Unit Setting

*National map unit symbol:* 121dl
*Elevation:* 0 to 800 feet
*Mean annual precipitation:* 35 to 55 inches
*Mean annual air temperature:* 48 to 61 degrees F
*Frost-free period:* 160 to 240 days
*Farmland classification:* All areas are prime farmland

### Map Unit Composition

*Butlertown and similar soils:* 85 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Butlertown

#### Setting

*Landform:* Coastal plains
*Landform position (two-dimensional):* Toeslope, footslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear, concave
*Parent material:* Thick deposits silty over sandy fluvial coastal plain sediments

#### Typical profile

*H1 - 0 to 8 inches:* silt loam
*H2 - 8 to 34 inches:* silt loam
*H3 - 34 to 50 inches:* silt loam
*H4 - 50 to 60 inches:* silt loam

#### Properties and qualities

*Slope:* 3 to 8 percent
*Depth to restrictive feature:* 25 to 40 inches to fragipan
*Natural drainage class:* Well drained
*Runoff class:* High
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)
*Depth to water table:* About 24 to 48 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water storage in profile:* Moderate (about 6.5 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 3e
*Hydrologic Soil Group:* C
*Hydric soil rating:* No

### Minor Components

#### Beltsville

*Percent of map unit:* 6 percent
*Landform:* Flats
*Landform position (two-dimensional):* Summit, shoulder, backslope
*Landform position (three-dimensional):* Interfluve, side slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Concave, linear
*Hydric soil rating:* No

#### Othello

*Percent of map unit:* 5 percent
*Landform:* Terraces
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Tread
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* Yes

#### Woodstown

*Percent of map unit:* 4 percent
*Landform:* Terraces
*Landform position (two-dimensional):* Footslope
*Landform position (three-dimensional):* Tread
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* No

## Ma—Made land, gravelly materials

### Map Unit Setting

*National map unit symbol:* 121fv
*Elevation:* 200 to 1,500 feet
*Mean annual precipitation:* 36 to 55 inches
*Mean annual air temperature:* 45 to 57 degrees F
*Frost-free period:* 160 to 214 days
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Udorthents, shale and sandstone, and similar soils:* 85 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Udorthents, Shale And Sandstone

#### Setting

*Landform:* Ridges
*Landform position (two-dimensional):* Summit, shoulder, backslope
*Landform position (three-dimensional):* Nose slope, interfluve, side slope

*Down-slope shape:* Convex, linear
*Across-slope shape:* Convex, linear
*Parent material:* Graded areas of sandstone and shale

**Typical profile**

*Ap - 0 to 6 inches:* silt loam
*C - 6 to 60 inches:* silt loam

**Properties and qualities**

*Slope:* 0 to 8 percent
*Depth to restrictive feature:* 20 to 99 inches to lithic bedrock
*Natural drainage class:* Well drained
*Runoff class:* Very high
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to high (0.06 to 6.00 in/hr)
*Depth to water table:* About 60 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water storage in profile:* Very low (about 2.9 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 7s
*Hydrologic Soil Group:* A
*Hydric soil rating:* No

## Minor Components

**Penn**

*Percent of map unit:* 5 percent
*Landform:* Hillslopes
*Landform position (two-dimensional):* Shoulder, backslope
*Landform position (three-dimensional):* Side slope, nose slope
*Down-slope shape:* Linear, convex
*Across-slope shape:* Convex, linear
*Hydric soil rating:* No

**Abbottstown**

*Percent of map unit:* 2 percent
*Landform:* Hillslopes
*Landform position (two-dimensional):* Footslope, toeslope
*Landform position (three-dimensional):* Base slope, head slope
*Down-slope shape:* Concave, linear
*Across-slope shape:* Concave, linear
*Hydric soil rating:* No

**Readington**

*Percent of map unit:* 2 percent
*Landform:* Hillslopes
*Landform position (two-dimensional):* Footslope, backslope
*Landform position (three-dimensional):* Base slope, head slope, side slope
*Down-slope shape:* Concave, linear
*Across-slope shape:* Concave, linear
*Hydric soil rating:* No

**Reaville**

*Percent of map unit:* 2 percent
*Landform:* Hillslopes

*Landform position (two-dimensional):* Footslope, summit
*Landform position (three-dimensional):* Interfluve, base slope
*Down-slope shape:* Concave, linear
*Across-slope shape:* Concave, linear
*Hydric soil rating:* No

**Bowmansville**

*Percent of map unit:* 2 percent
*Landform:* Flood plains
*Landform position (two-dimensional):* Footslope, toeslope
*Landform position (three-dimensional):* Head slope
*Down-slope shape:* Concave, linear
*Across-slope shape:* Linear, concave
*Hydric soil rating:* No

**Berks**

*Percent of map unit:* 1 percent
*Landform:* Valleys, ridges
*Landform position (two-dimensional):* Backslope
*Landform position (three-dimensional):* Side slope
*Down-slope shape:* Convex, linear
*Across-slope shape:* Convex, linear
*Hydric soil rating:* No

**Croton**

*Percent of map unit:* 1 percent
*Landform:* Depressions
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Concave, linear
*Across-slope shape:* Linear, concave
*Hydric soil rating:* Yes

## OtA—Othello silt loams, 0 to 2 percent slopes, northern coastal plain

### Map Unit Setting

*National map unit symbol:* 2thwm
*Elevation:* 0 to 300 feet
*Mean annual precipitation:* 40 to 50 inches
*Mean annual air temperature:* 46 to 64 degrees F
*Frost-free period:* 190 to 250 days
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Othello, drained, and similar soils:* 50 percent
*Othello, undrained, and similar soils:* 30 percent
*Minor components:* 20 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Othello, Drained

#### Setting

*Landform:* Flats, depressions, swales
*Landform position (two-dimensional):* Footslope
*Landform position (three-dimensional):* Talf, dip
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear, concave
*Parent material:* Silty eolian deposits over fluviomarine deposits

#### Typical profile

*Ap - 0 to 9 inches:* silt loam
*Btg - 9 to 29 inches:* silt loam
*2BCg - 29 to 34 inches:* sandy loam
*2Cg - 34 to 80 inches:* loamy sand

#### Properties and qualities

*Slope:* 0 to 2 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Poorly drained
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.57 in/hr)
*Depth to water table:* About 10 to 20 inches
*Frequency of flooding:* None
*Frequency of ponding:* Rare
*Salinity, maximum in profile:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
*Available water storage in profile:* Moderate (about 8.8 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 3w
*Hydrologic Soil Group:* C/D
*Hydric soil rating:* Yes

### Description of Othello, Undrained

#### Setting

*Landform:* Depressions, swales, flats, drainageways
*Landform position (two-dimensional):* Footslope
*Landform position (three-dimensional):* Dip, talf
*Down-slope shape:* Concave, linear
*Across-slope shape:* Concave, linear
*Parent material:* Silty eolian deposits over fluviomarine deposits

#### Typical profile

*Oe - 0 to 2 inches:* peat
*A - 2 to 4 inches:* silt loam
*Eg - 4 to 10 inches:* silt loam
*Btg - 10 to 29 inches:* silt loam
*2BCg - 29 to 35 inches:* sandy loam
*2Cg - 35 to 80 inches:* loamy sand

#### Properties and qualities

*Slope:* 0 to 2 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Poorly drained

*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.57 in/hr)
*Depth to water table:* About 0 to 10 inches
*Frequency of flooding:* None
*Frequency of ponding:* Occasional
*Salinity, maximum in profile:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
*Available water storage in profile:* High (about 9.6 inches)

**Interpretive groups**
*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 5w
*Hydrologic Soil Group:* C/D
*Hydric soil rating:* Yes

**Minor Components**

**Fallsington, undrained**
*Percent of map unit:* 8 percent
*Landform:* Swales, flats, drainageways, depressions
*Landform position (two-dimensional):* Footslope
*Landform position (three-dimensional):* Dip, talf
*Down-slope shape:* Concave, linear
*Across-slope shape:* Linear, concave
*Hydric soil rating:* Yes

**Kentuck, undrained**
*Percent of map unit:* 7 percent
*Landform:* Flats, depressions, swales
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Talf, dip
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear, concave
*Hydric soil rating:* Yes

**Mattapex**
*Percent of map unit:* 5 percent
*Landform:* Flats, depressions, broad interstream divides, swales
*Landform position (two-dimensional):* Summit, footslope
*Landform position (three-dimensional):* Talf, dip
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear, concave
*Hydric soil rating:* No

# New Castle County, Delaware

## Up—Urban land

### Map Unit Setting

*National map unit symbol:* 2p7dx
*Elevation:* 0 to 300 feet
*Mean annual precipitation:* 42 to 48 inches
*Mean annual air temperature:* 52 to 58 degrees F
*Frost-free period:* 180 to 220 days
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Urban land:* 90 percent
*Minor components:* 10 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Urban Land

#### Setting

*Landform:* Flats
*Down-slope shape:* Linear
*Across-slope shape:* Linear

### Minor Components

#### Udorthents, loamy

*Percent of map unit:* 10 percent
*Landform:* Broad interstream divides
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* No

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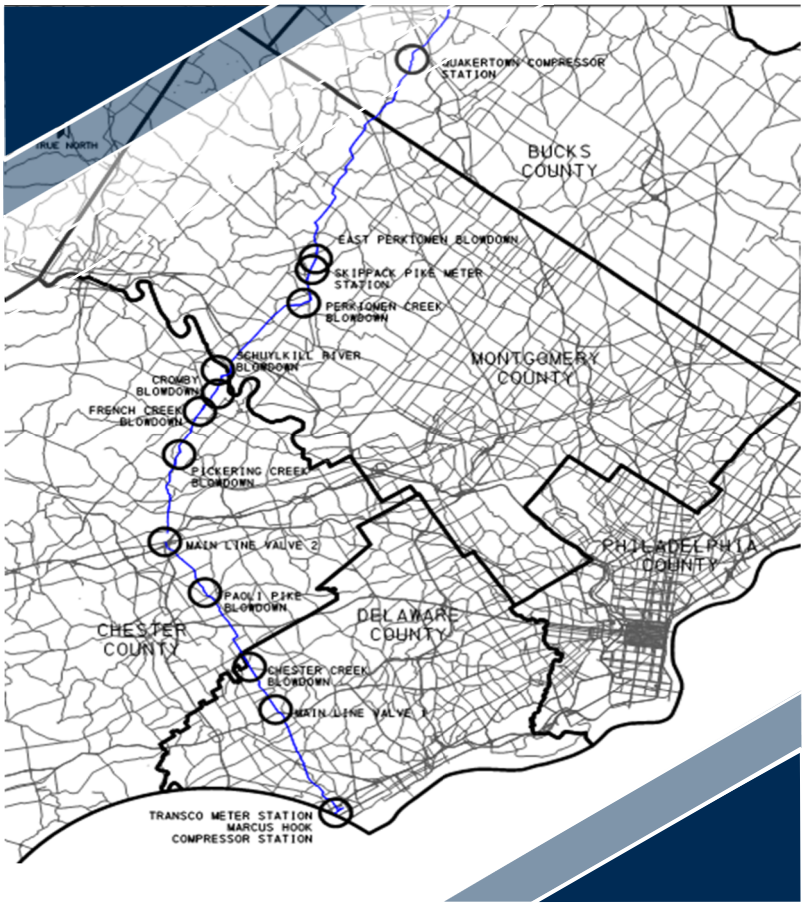


# POST CONSTRUCTION STORMWATER MANAGEMENT REPORT

## Adelphia Gateway Pipeline

**Submitted to:**
Pennsylvania Department of Environmental Protection (PADEP)

March 2020

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# I. PCSM PLANNING AND DESIGN

Johnson, Mirmiran & Thompson (JMT), on behalf of Adelphia Gateway, has prepared this Post Construction Stormwater Management (PCSM) Plan for the Adelphia Gateway Pipeline. The PCSM Plan has been designed in accordance with the criteria stated in the Pennsylvania Department of Environmental Protection (PADEP) Stormwater Best Management Practices Manual, dated December 2006; Pennsylvania Department of Environmental Protection (PADEP), Bureau of Waterways Engineering and Wetlands Erosion and Sediment Pollution Control Program Manual, dated March 2012, thus satisfying requirements for PADEP General Permit (ESCGP-3) for Earth Disturbance Associated with Oil and Gas Exploration, Production, Processing, or Treatment Operations or Transmission Facilities contained under Pa. Code Title 25 Chapter 102.

The Adelphia Gateway Pipeline is an 84-mile pipeline that runs from Martins Creek to Marcus Hook. Facility upgrades will occur to thirteen (13) sites along the pipeline: Quakertown Compressor Station, East Perkiomen Blowdown, Skippack Pike Valve Tap, Perkiomen Creek Blowdown, Schuylkill River Blowdown, Cromby Blowdown, French Creek Blowdown, Mainline Valve 2, Paoli Pike Blowdown, Chester Creek Blowdown, Mainline Valve 1, Transco Meter Station, and Marcus Hook Compressor Station. The total limit of disturbance is 18.1 acres.

Stormwater impacts will be minimal to all sites except for three: Quakertown Compressor Station, Transco Meter Station, and Marcus Hook Compressor Station. All other sites will be restored to existing conditions and per Pa. Code Title 25 Chapter 102, these sites do not require PCSM Plan and stormwater analysis. Therefore, the PCSM Plan focuses on these three (3) sites. This narrative describes the stormwater management controls for Quakertown Compressor Station, Transco Meter Station, and Marcus Hook Compressor Station of the Adelphia Gateway Pipeline and related site work.

A Site Restoration/E&S Plan is prepared, in lieu of a PCSM Plan, for the following ten (10) sites: East Perkiomen Blowdown, Skippack Pike Valve Tap, Perkiomen Creek Blowdown, Schuylkill River Blowdown, Cromby Blowdown, French Creek Blowdown, Mainline Valve 2, Paoli Pike Blowdown, Chester Creek Blowdown and Mainline Valve 1.

The existing use for the Quakertown Compressor Station is a partially developed meter site with gravel and brush. East Perkiomen Blowdown, Skippack Pike Valve Tap, Perkiomen Creek Blowdown, Schuylkill River Blowdown, Cromby Blowdown, French Creek Blowdown, Mainline Valve 2, Paoli Pike Blowdown, Chester Creek Blowdown, Mainline Valve 1 are existing valve sites with gravel and grass. The existing use for the Quakertown Compressor Station is a partially developed site with an adjacent meter site. The area to be distributed is primarily meadow. Marcus Hook Compressor Station is a fully developed compressor site that is primarily gravel in existing conditions.

A second part of this project consists of the proposed Laterals. The Tilghman Lateral begins at the Marcus Hook Compressor Station, Delaware County, PA and terminates at the Tilghman Meter Station, Delaware County, PA. The project scope includes the installation of 4.41 miles of natural gas main, new tap valve (Monroe Tap Valve), and facility upgrades at Tilghman Meter Station. The natural gas main installation will consist of approximately 0.64 miles of traditional pipeline installation and 3.86 miles of horizontal directional

drilling (HDD) installation. The total limit of disturbance is 10.0 acres. The entire limit of disturbance within the Tilghman Lateral will be restored to existing conditions. A Site Restoration/E&S Plan is prepared, in lieu of a PCSM Plan, for the Tilghman Lateral project.

The Parkway Lateral begins at the Marcus Hook Compressor Station, Chester County, PA and terminates at the Delmarva and TETCO Meter Station, New Castle, DE. The project scope includes the installation of 1,100 linear feet of natural gas main, new meter pads, gravel paths, and a small compressor building. This section will be submitted at a later date with the Phased ESCGP-3 Permit.

## II. SOIL CHARACTERISTICS

Tables II-1 through II-13 below detail the types of soils, as contained within the Stormwater Management areas, for each of the thirteen sites, as defined by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey.

**Table II-1: Quakertown Compressor Station: Soil Types within LOD**

| Symbol | Map Unit Name | Brief Map Unit Description |
|---|---|---|
| AmB | Amwell silt loam, 3 to 8 percent slopes | Soil Rating D, very slow infiltration rate when thoroughly wet. Mainly clays, high water table soils, claypan or clay layer at or near surface, and shallow soils over nearly impervious material. Very slow rate of water transmission. |
| UdB | Udorthents, shale and sandstone | Soil Rating A, high infiltration rate when thoroughly wet. Mainly deep, well drained sands or gravelly sands. High rate of water transmission. |

**Table II-2: East Perkiomen Blowdown: Soil Types within LOD**

| Symbol | Map Unit Name | Brief Map Unit Description |
|---|---|---|
| Rt | Rowland silt loam, terrace | Soil Rating C, slow infiltration rate when thoroughly wet. Mainly soils with layer that impedes downward movement of water or soils of fine texture. Slow rate of water transmission. |

| Table II-3: Skippack Pike Meter Station: Soil Types within LOD | | |
|---|---|---|
| **Symbol** | **Map Unit Name** | **Brief Map Unit Description** |
| PeB | Penn silt loam, 3 to 8 percent slopes | Soil Rating B, moderate infiltration rate when thoroughly wet. Mainly soils that are moderately deep or deep, moderately well drained or well drained and moderately fine texture to moderately coarse texture. Moderate rate of water transmission. |
| PeC | Penn silt loam, 8 to 15 percent slopes | Soil Rating B, moderate infiltration rate when thoroughly wet. Mainly soils that are moderately deep or deep, moderately well drained or well drained and moderately fine texture to moderately coarse texture. Moderate rate of water transmission. |

| Table II-4: Perkiomen Creek Blowdown: Soil Types within LOD | | |
|---|---|---|
| **Symbol** | **Map Unit Name** | **Brief Map Unit Description** |
| Bo | Bowmansville-Knauers silt loams | Soil Rating D, very slow infiltration rate when thoroughly wet. Mainly clays, high water table soils, claypan or clay layer at or near surface, and shallow soils over nearly impervious material. Very slow rate of water transmission. |
| ReA | Readington silt loam, 0 to 3 percent slopes | Soil Rating C, slow infiltration rate when thoroughly wet. Mainly soils with layer that impedes downward movement of water or soils of fine texture. Slow rate of water transmission. |

| Table II-5: Schuylkill River Blowdown: Soil Types within LOD | | |
|---|---|---|
| **Symbol** | **Map Unit Name** | **Brief Map Unit Description** |
| Gb | Gibraltar silt loam | Soil Rating B, moderate infiltration rate when thoroughly wet. Mainly soils that are moderately deep or deep, moderately well drained or well drained and moderately fine texture to moderately coarse texture. Moderate rate of water transmission. |
| PeB | Penn silt loam, 3 to 8 percent slopes | Soil Rating B, moderate infiltration rate when thoroughly wet. Mainly soils that are moderately deep or deep, moderately well drained or well drained and moderately fine texture to moderately coarse texture. Moderate rate of water transmission. |

| | | |
|---|---|---|
| PeC | Penn silt loam, 8 to 15 percent slopes | Soil Rating B, moderate infiltration rate when thoroughly wet. Mainly soils that are moderately deep or deep, moderately well drained or well drained and moderately fine texture to moderately coarse texture. Moderate rate of water transmission. |
| ReA | Readington silt loam, 0 to 3 percent slopes | Soil Rating C, slow infiltration rate when thoroughly wet. Mainly soils with layer that impedes downward movement of water or soils of fine texture. Slow rate of water transmission. |
| UrB | Urban land, 0 to 8 percent slopes | No soil rating. |

**Table II-6: Cromby Blowdown: Soil Types within LOD**

| Symbol | Map Unit Name | Brief Map Unit Description |
|---|---|---|
| PeB | Penn silt loam, 3 to 8 percent slopes | Soil Rating B, moderate infiltration rate when thoroughly wet. Mainly soils that are moderately deep or deep, moderately well drained or well drained and moderately fine texture to moderately coarse texture. Moderate rate of water transmission. |

**Table II-7: French Creek Blowdown: Soil Types within LOD**

| Symbol | Map Unit Name | Brief Map Unit Description |
|---|---|---|
| PeB | Penn silt loam, 3 to 8 percent slopes | Soil Rating B, moderate infiltration rate when thoroughly wet. Mainly soils that are moderately deep or deep, moderately well drained or well drained and moderately fine texture to moderately coarse texture. Moderate rate of water transmission. |
| PeC | Penn silt loam, 8 to 15 percent slopes | Soil Rating B, moderate infiltration rate when thoroughly wet. Mainly soils that are moderately deep or deep, moderately well drained or well drained and moderately fine texture to moderately coarse texture. Moderate rate of water transmission. |

| | | |
|---|---|---|
| PeD | Penn silt loam, 15 to 25 percent slopes | Soil Rating B, moderate infiltration rate when thoroughly wet. Mainly soils that are moderately deep or deep, moderately well drained or well drained and moderately fine texture to moderately coarse texture. Moderate rate of water transmission. |
| ReB | Readington silt loam, 3 to 8 percent slopes | Soil Rating C, slow infiltration rate when thoroughly wet. Mainly soils with layer that impedes downward movement of water or soils of fine texture. Slow rate of water transmission. |
| UrxB | Urban land-Penn complex, 0 to 8 percent slopes | No soil rating. |

**Table II-8: Mainline Valve 2: Soil Types within LOD**

| Symbol | Map Unit Name | Brief Map Unit Description |
|---|---|---|
| MaC | Manor loam, 8 to 15 percent slopes | Soil Rating B, moderate infiltration rate when thoroughly wet. Mainly soils that are moderately deep or deep, moderately well drained or well drained and moderately fine texture to moderately coarse texture. Moderate rate of water transmission. |

**Table II-9: Paoli Pike Blowdown: Soil Types within LOD**

| Symbol | Map Unit Name | Brief Map Unit Description |
|---|---|---|
| Ha | Hatboro silt loam | Soil Rating D, very slow infiltration rate when thoroughly wet. Mainly clays, high water table soils, claypan or clay layer at or near surface, and shallow soils over nearly impervious material. Very slow rate of water transmission. |

**Table II-10: Chester Creek Blowdown: Soil Types within LOD**

| Symbol | Map Unit Name | Brief Map Unit Description |
|---|---|---|
| We | Wehadkee silt loam | Soil Rating D, very slow infiltration rate when thoroughly wet. Mainly clays, high water table soils, claypan or clay layer at or near surface, and shallow soils over nearly impervious material. Very slow rate of water transmission. |

| Table II-11: Mainline Valve 1: Soil Types within LOD | | |
|---|---|---|
| **Symbol** | **Map Unit Name** | **Brief Map Unit Description** |
| GeB | Glenelg channery loam, 3 to 8 percent slopes | Soil Rating B, moderate infiltration rate when thoroughly wet. Mainly soils that are moderately deep or deep, moderately well drained or well drained and moderately fine texture to moderately coarse texture. Moderate rate of water transmission. |

| Table II-12: Transco Meter Station: Soil Types within LOD | | |
|---|---|---|
| **Symbol** | **Map Unit Name** | **Brief Map Unit Description** |
| ByB2 | Butlertown silt loam, 3 to 8 percent slopes, moderately eroded | Soil Rating C, slow infiltration rate when thoroughly wet. Mainly soils with layer that impedes downward movement of water or soils of fine texture. Slow rate of water transmission. |
| OtA | Othello silt loams, 0 to 2 percent slopes, northern coastal plain | Soil Rating D, very slow infiltration rate when thoroughly wet. Mainly clays, high water table soils, claypan or clay layer at or near surface, and shallow soils over nearly impervious material. Very slow rate of water transmission. |

| Table II-13: Marcus Hook Compressor Station: Soil Types within LOD | | |
|---|---|---|
| **Symbol** | **Map Unit Name** | **Brief Map Unit Description** |
| OtA | Othellow silt loams, 0 to 2 percent slopes, northern coastal plain | Soil Rating D, very slow infiltration rate when thoroughly wet. Mainly clays, high water table soils, claypan or clay layer at or near surface, and shallow soils over nearly impervious material. Very slow rate of water transmission. |
| Up | Urban land | No soil rating. |

The Hydrologic Soil Group Rating Report from USDA NRCS Web Soil Survey, which includes a soil map, the physical properties of the soils, and the soil use limitations and resolutions is provided for each site in Appendix B.

## III. EXISTING TOPOGRAPHIC FEATURES OF THE PROJECT SITE AND THE IMMEDIATE SURROUNDING AREA

USGS quadrangle location maps are provided in Appendix A, which shows the location of the project site and the surrounding area.

## IV. SURFACE WATER CLASSIFICATIONS

Table III-1 below details the watershed where each site is located, as well as the receiving surface waters classification, as defined by the Pennsylvania Department of Environmental Protection (PADEP) Title 25, Chapter 93: Water Quality Standards. Note the following acronyms: CWF (Cold Water Fishes), WWF (Warm Water Fishes), MF (Migratory Fishes), TSF (Trout Stocking), and HQ (High Quality Waters).

All sites with stormwater management impacts (Quakertown Compressor Station, Transco Meter Station and Marcus Hook Compressor Station) are not within HQ/EV watersheds.

**Table III-1: Receiving Surface Waters Classification**

| Site Location | Watershed | Ch. 93 Classification |
|---|---|---|
| Quakertown Compressor Station | Tohickon Creek | TSF, Siltation-impaired |
| East Perkiomen Blowdown | Perkiomen Creek | WWF, MF, Siltation-impaired |
| Skippack Pike Meter Station | Perkiomen Creek | WWF, MF, Siltation-impaired |
| Perkiomen Creek Blowdown | Perkiomen Creek | WWF, MF, Siltation-impaired |
| Schuylkill River Blowdown | Schuylkill River | WWF-MF, Siltation-impaired |
| Cromby Blowdown | Stony Run | HQ-TSF, MF, Siltation-impaired |
| French Creek Blowdown | French Creek | TSF, MF |
| Mainline Valve 2 | Valley Creek | CWF-MF, Siltation-impaired |
| Paoli Pike Blowdown | Ridley Creek | HQ-TSF, MF, Siltation-impaired |
| Chester Creek Blowdown | Chester Creek | TSF, MF, Siltation-impaired |
| Mainline Valve 1 | Chester Creek | TST, MF, Siltation-impaired |
| Transco Meter Station | Naamans Creek | WWF, MF |
| Marcus Hook Compressor Station | Naamans Creek | WWF, MF |

## V. NARRATIVE DESCRIPTION OF THE LOCATION AND TYPE OF ON-SITE BMPS

The following Best Management Practices (BMP), in accordance with Pennsylvania Stormwater BMP Manual, dated December 2006, have been integrated into the design to reduce runoff volume, reduce peak rates and improve water quality. These structural BMPs will result in the prevention or minimization of increased stormwater runoff rate, volume and/or changes in stormwater runoff. Implementing these controls will preserve the integrity of stream channels and maintain and protect the physical, biological and chemical qualities of the receiving stream.

The ten (10) main line valves will be restored to existing conditions. Following completion of the site work, the site shall be returned to existing grades maintain preconstruction drainage patterns. Any disturbed areas will be permanently seeded if previously vegetated and all gravel will be replaced and refreshed. By restoring the sites, the management of post construction stormwater will be conducted as follows:

- Preserve the integrity of stream channels and maintain and protect the physical, biological and chemical qualities of the receiving stream
- Prevent an increase in the rate of stormwater runoff.
- Minimize any increase in stormwater runoff volume.
- Minimize impervious areas.
- Maximize the protection of existing drainage features and existing vegetation.
- Minimize land clearing and grading.

Per Chapter 102.8(n), a restoration plan that identifies the site restoration activities to manage stormwater for oil and gas activities is adequate to demonstrate compliance with the stormwater management regulations outlined in Chapter 102.8.

A non-vegetated managed release concept (MRC) BMP will be installed at Quakertown Compressor Station. The MRC BMP will be non-vegetated with underground storage chambers (Storm-tank). This structural BMP serves the functions of volume reduction, runoff quality and peak rate reduction. Pre-treatment for the MRC Basin consists of using two (2) jellyfish membrane filtration system devices, which provides high flow pretreatment and membrane filtration in a compact stand-alone system.

A subsurface infiltration bed (BMP 6.4.3, StormTank) will be constructed at Transco Meter Station. This structural BMP serves the functions of volume reduction, runoff quality and peak rate reduction.

A vegetated MRC BMP will be constructed at Marcus Hook Compressor Station. This structural BMP serves the functions of volume reduction, runoff quality and peak rate reduction.

A sequence of construction was developed to minimize land clearing and grading, and to minimize soil compaction. See Section IX.

# VI. SITE CHARACTERIZATION AND ASSESSMENT

A Phase I Environmental Site Assessment at Quakertown Compressor Station prepared by NV5, dated August 2017. No Historical Recognized Environmental Condition (HREC), RECs (RECs) or controlled RECs (CRECs) were identified at the Site during this assessment.

A Geotechnical Engineering Report for Quakertown Compressor Station was prepared by Johnson, Mirmiran & Thompson, Inc, on June 29th, 2018. The subsurface conditions at the site were evaluated by using the data from seven (7) soil test boring locations. The subsurface investigation was performed by our sub-consultant American Geotech Incorporated (AGI) on April 17 and 24, 2018. A Geotechnical Design Memorandum was prepared on May 9, 2019, which contains includes the infiltration testing for two (2) test pits within the limits of the BMP. This memorandum can be further reviewed in Appendix F.

Groundwater was measured during drilling and after pulling the augers. Specifically, groundwater was encountered in three (3) borings along the highest portion of the south side of the property. Groundwater was encountered at depths ranging from 4 feet to 7 feet; however, these locations are within the vicinity of the proposed compressor building.

Soil infiltration testing at Quakertown Compressor Station was performed on May 7, 2019 using the Double Ring Infiltration Test method. Two (2) test infiltration tests were performed at the basin bottom elevation. The infiltration testing resulted in infiltration rates of 0.12 and 0.08 in/hr, respectively. Both infiltration test pits demonstrated silty clay loam at the testing depth. Based on the findings of a shallow limiting zone, decomposing rock, clay soils and poor infiltration rates, infiltration was not recommended at this site.

On the day of the infiltration testing, the test pit was first extended to 4 feet deep. After about two hours there was some seepage and the bottom of the test pit showed signs of groundwater. The decomposed rock stratum was encountered in the test pit at about 3 feet deep. The groundwater table on May 7 appears to have been between 3 to 4 feet deep at the location of the test pit (elevations 548.5 to 547.5 feet). It should be noted that the test was conducted in springtime in which there has been a normal amount of rainfall including some light rain on the day before and no rain on the day of the testing. As a result, the design for the MRC Basin at Quakertown Compressor station is proposed to include an impervious liner.

Soil infiltration testing at Transco Meter Station was performed on May 9, 2019 using the Double Ring Infiltration Test method. Two (2) test infiltration tests were performed at the basin bottom elevation. The infiltration testing resulted in infiltration rates of 0.24 and 0.28 in/hr, respectively. Using a factor of safety of 2, an infiltration testing rate of 0.13 in/hr was used in the design calculations. An infiltration report can be found in Appendix F.

A Phase I Environmental Site Assessment at Marcus Hook Compressor Station prepared by NV5, dated October 2017. Five (5) Historical Recognized Environmental Condition (HREC) were identified at the Site during this assessment. These conditions occurred between February 6, 1992 and May 28, 2015 and are all located within the limit of disturbance.

A Final Report was submitted to DEP under the Land Recycling and Environmental Remediation Standards Act ("Act 2") for the former Marcus Hook Pump Station site (October 10, 2018), the Department's December 21, 2018 letter approving the Final Report, and additional correspondence, dated January 31, 2019, documenting the lack of any evidence of groundwater contamination on the former site.

As part of the remedial activities under Act 2 at the former Marcus Hook Pump Station site, over 1,350 tons of impacted soils were removed and properly disposed of off-site. The Final Report includes the results from 120 post-excavation soil samples. These post-excavation soil sample results are presented in Tables 4 through 18 of the Final Report, and the locations of the soil samples are shown on Figures 3 through 7 of the Final Report. The analytical testing data for these samples are provided in Attachment C of the Final Report.

In September 2019, infiltration testing was completed on the southern portion of the site. This work was completed by JMT and AGI to determine the soil conditions and feasibility of infiltration. Testing was completed in three (3) test pits at varying depths between 3'-6' based on the proposed BMP elevations. The testing results varied from 0.04-0.08 in/hr. Based on the testing results and observed clay soils, infiltration is not recommended on this site. Therefore, the BMP will be a vegetated Managed Release Concept (MRC) basin with above ground plantings.

On the day of the infiltration testing, seepage was measured at a depth of 50-53 inches. Thus, the groundwater table appears to have been between 4 to 4.5 feet deep at the locations of the three test pits. It should be noted that the tests were conducted in late Summer; and there was no rain on the day of testing. As a result, the design for the MRC Basin at Marcus Hook Compressor station is proposed to include an impervious liner.

## VII. VOLUME REDUCTION AND WATER QUALITY REQUIREMENTS

Table VI-1 below details the watershed where each site is located, and if there is an applicable Act 167 Stormwater Management Plan for the watershed.

| **Table VII-1: Act 167 Stormwater Management Plans** | | | |
|---|---|---|---|
| **Site Location** | **Watershed** | **Act 167 Plan Title** | **Date** |
| Quakertown Compressor Station | Tohickon Creek | Tohickon Creek Watershed Act 167 Stormwater Management Plan | February 28, 2002 |
| East Perkiomen Blowdown | Perkiomen Creek | East Branch of Perkiomen Creek Watershed Act 167 Stormwater Management Plan | May 5, 2004 |
| Skippack Pike Valve Tap | Perkiomen Creek | | |
| Perkiomen Creek Blowdown | Perkiomen Creek | | |
| Schuylkill River Blowdown | Schuylkill River | County-wide Act 167 Stormwater Management Model Ordinance | March 27, 2013 |
| Cromby Blowdown | Stony Run | | |
| French Creek Blowdown | French Creek | | |
| Mainline Valve 2 | Valley Creek | Valley Creek Watershed Stormwater Management Plan | July 30, 2010 |
| Paoli Pike Blowdown | Ridley Creek | County-wide Act 167 Stormwater Management Model Ordinance | March 27, 2013 |
| Chester Creek Blowdown | Chester Creek | Act 167 Stormwater Management Plan Chester Creek Watershed | June 2002 |
| Mainline Valve 1 | Chester Creek | | |
| Transco Meter Station | Naamans Creek | No Act 167 Stormwater Management Plan | |
| Marcus Hook Compressor Station | Naamans Creek | | |

A verification of Act 167 regulations is included in Appendix E. Calculations are included in Appendix E to demonstrate that all stormwater management criteria set forth within the Tohickon Creek Watershed Act 167 Stormwater Management Plan has been met for water quality, volume and flood control. PADEP criteria set forth by PADEP's Stormwater Best Management Practices Manual, dated December 2006, was more restrictive than the criteria that was set forth within the Tohickon Creek Watershed Act 167 Stormwater Management Plan.

There is not an applicable Act 167 Stormwater Management Plan for Naaman's Creek. All other watersheds within the project limits follow the standard design criteria from Sections 102.8(g)(2) and (3), which states that post construction management requirements are met for all areas that are restored to pre-construction conditions or to a condition of meadow in good condition or better.

Therefore, this project follows the criteria set forth by PADEP's Stormwater Best Management Practices Manual, dated December 2006. As per the requirements of CG-1 in the Pennsylvania Stormwater BMP Manual, "post-development total runoff volume for all storms equal or less than the two (2)-year 24-hour duration precipitation must not increase, while factoring in that twenty percent (20%) of the existing impervious area of a project site, when present, shall be considered meadow in the model for existing conditions." Through stormwater BMPs, the BMPs will statically store the 2-year volume increase to ensure that the runoff volume does not increase after construction is complete. The 2-year, 24-hour rainfall duration was determined using PennDOT Publication 584, Chapter 7, Appendix 7A.

In order to meet the requirements of the PADEP ESCGP-3 permit, standard BMP worksheets 4, 5 and 5b were completed to confirm that no negative impacts would occur for volume control. The spreadsheets indicated above are included in Appendix D.1. Per Chapter 102.8(g)(2), the Existing Conditions 2-yr, 24-hr runoff volume was calculated using 20% of impervious and gravel as meadow and all non-forested areas, which includes brush areas, were also considered meadow in existing conditions.

Stormwater management calculations were performed using the SCS TR-55 method for volume calculations. Stormwater BMPs were routed through HydroCAD, Version 10.0. Analysis for the project sites were performed for the 2-, 10-, 50-, and 100-year storm events for both the pre-developed condition and the post-developed conditions. All rainfall data was determined using PennDOT Publication 584, Chapter 7, Appendix 7A.

Below is a summary of pre- and post-construction runoff volumes to demonstrate that there will not be any increases at each respective project site.

**Table VII-2: Runoff Volume Summary**

| | Quakertown Compressor Station | Transco Meter Station | Marcus Hook Compressor Station |
|---|---|---|---|
| Existing Conditions 2-yr, 24-hr Runoff Volume (CF) | 8,460 | 2,295 | 52,844 |
| Proposed Conditions 2-yr, 24-hr Runoff Volume (CF) | 12,504 | 7,513 | 56,248 |
| 2-yr Volume Increase (CF) | 4,044 | 4873 | 3,405 |
| Storage Volume of Proposed BMPs (CF) | 6,674 | 4,880 | 18,619 |
| DIFFERENCE (CF) | 2,630 | 7 | 15,214 |

The stormwater management design achieves volume reduction criteria, but 90% of the disturbed area cannot be controlled by BMPs for any of the three (3) sites. However, the proposed design will maintain and protect existing water quality and existing and designated uses. To demonstrate how the proposed design will be more protective, Tables VI-3, VI-4 and VI-5 show the pre- and post-construction pollutant loads within the disturbed areas. In all cases, the increase of pollutant load runoff increased minimally, as calculated with PADEP Worksheet 12 and 13. Worksheets 12 and 13 are included within Appendix D.1. With the addition of a pollutant reducing BMP, the total pollutant load will not exceed pre-existing conditions.

For Quakertown Compressor Station, the land use consists of brush, meadow, impervious and gravel in pre-construction conditions. During construction, the brush will be converted to impervious with the addition of a new building and gravel will surround the building for truck access. All disturbed gravel areas will either be restored to existing covers or converted to vegetation. The new building and gravel swale will drain to the BMP which will remove an adequate pollutant load to mitigate the increase in post-construction pollutant loads.

Pre-treatment for the MRC Basin consists of using two (2) jellyfish membrane filtration system devices, which provides high flow pretreatment and membrane filtration in a compact stand-alone system. Jellyfish devices remove floatables, trash, oil, debris, TSS, fine silt-sized particles, and a high percentage of particulate-bound pollutants, including phosphorus, nitrogen, metals and hydrocarbons.

**Table VII-3: Quakertown Compressor Station Water Quality Summary**

| Pollutant Type | Pollutant Load within LOD | | | Pollutant Reduction Achieved through BMP | Pollutant Load after BMP installation |
|---|---|---|---|---|---|
| | Pre-construction | Post-construction | Increase | | |
| TSS (lbs) | 50.78 | 50.96 | 0.19 | 16.48 | 34.49 |
| TP (lbs) | 0.17 | 0.15 | -0.02 | 0.10 | 0.04 |
| $NO_3$ (lbs) | 0.33 | 0.38 | 0.05 | 0.05 | 0.34 |

For Transco Meter Station, the land use is a combination of woods and brush in pre-construction conditions. During construction, the land will be converted to gravel for the entire limit of disturbance. Through the addition of a subsurface detention basin, the BMP will remove an adequate pollutant load to mitigate the increase in pollutant loads caused by converting the site from woods and brush to gravel.

**Table VII-4: Transco Meter Station Water Quality Summary**

| Pollutant Type | Pollutant Load within LOD | | | Pollutant Reduction Achieved through BMP | Pollutant Load after BMP installation |
|---|---|---|---|---|---|
| | Pre-construction | Post-construction | Increase | | |
| TSS (lbs) | 27.97 | 39.68 | 11.71 | 24.14 | 15.54 |
| TP (lbs) | 0.11 | 0.10 | -0.01 | 0.06 | 0.04 |
| $NO_3$ (lbs) | 0.14 | 0.276 | 0.13 | 0.05 | 0.22 |

For Marcus Hook Compressor Station, the existing land uses is primarily gravel and impervious, with a small portion of meadow within an existing swale that will be restored to existing conditions after construction. A new impervious access road and building will be constructed within the existing gravel areas. The remaining disturbed gravel areas will either be restored to existing conditions or converted to vegetation. Through the addition of a surface detention basin, the BMP will remove an adequate pollutant load to mitigate the increase in pollutant loads.

Per MRC design guidelines, the use of a vegetated MRC BMP is a sufficient water quality demonstration and no additional water quality calculations are needed.

# VIII. RATE REQUIREMENTS

As stated in Section VI of this PCSM Narrative, PADEP criteria set forth by PADEP's Stormwater Best Management Practices Manual, dated December 2006, was more restrictive than the criteria set forth within the Tohickon Creek Watershed Act 167 Stormwater Management Plan. There is not an applicable Act 167 Stormwater Management Plan for Naaman's Creek. All other watersheds within the project limits follow the standard design criteria from Sections 102.8(g)(2) and 102.8(g)(3), which states that post construction management requirements are met for all areas that are restored to pre-construction conditions or to a condition of meadow in good condition or better.

Therefore, this project follows the criteria set forth by PADEP, which states that the post development peak rates is to be less than or equal to pre development peak rate.

Stormwater management calculations were performed using the SCS TR-55 method for runoff peak rate calculations. Stormwater BMPs were routed through HydroCAD, Version 10.0. Analysis for the project sites were performed for the 2-, 10-, 50-, and 100-year storm events for both the pre-developed condition

and the post-developed conditions. All rainfall data was determined using PennDOT Publication 584, Chapter 7, Appendix 7A.

A comparison between the analyzed conditions was made to assess the hydrological effects of the project and determine the best BMP to mitigate the volume and rate increases. The BMP facilities have been designed to manage the net change in peak rate for all storm events in a manner not to exceed pre-construction rates. Tables VII-1, VII-2 and VII-3 below outline the pre- and post-construction peak rates to show that there will not be any increases at any project site.

**Table VIII-1: Quakertown Compressor Station Peak Rate Summary**

| Storm | Existing Peak Rate | Proposed Peak Rate | | | | Net Change |
|---|---|---|---|---|---|---|
| | | BMP Inflow | BMP Outflow | Bypass | Total | |
| | (cfs) | (cfs) | (cfs) | (cfs) | (cfs) | (cfs) |
| 2-yr | 2.53.281 | 2.84 | 0.01 | 2.22 | 2.22 | -1.06 |
| 10-yr | 5.78 | 4.52 | 0.36 | 3.47 | 3.47 | -2.31 |
| 50-yr | 9.37 | 6.84 | 2.89 | 5.18 | 5.18 | -4.19 |
| 100-yr | 11.40 | 8.13 | 3.92 | 6.13 | 6.14 | -5.26 |

**Table VIII-2: Transco Meter Station Peak Rate Summary**

| Storm | Existing Peak Rate | Proposed Peak Rate | | | | Net Change |
|---|---|---|---|---|---|---|
| | | BMP Inflow | BMP Outflow | Bypass | Total | |
| | (cfs) | (cfs) | (cfs) | (cfs) | (cfs) | (cfs) |
| 2-yr | 1.24 | 2.19 | 0.03 | 1.04 | 1.04 | -0.20 |
| 10-yr | 2.75 | 3.55 | 0.47 | 1.80 | 1.80 | -0.95 |
| 50-yr | 5.19 | 5.49 | 2.72 | 2.90 | 4.00 | -1.19 |
| 100-yr | 6.66 | 6.59 | 3.47 | 3.53 | 5.88 | -0.78 |

**Table VIII-3: Marcus Hook Compressor Station Peak Rate Summary**

| Storm | Existing Peak Rate | Proposed Peak Rate | | | | Net Change |
|---|---|---|---|---|---|---|
| | | BMP Inflow | BMP Outflow | Bypass | Total | |
| | (cfs) | (cfs) | (cfs) | (cfs) | (cfs) | (cfs) |
| 2-yr | 24.89 | 6.34 | 0.01 | 16.19 | 16.19 | -8.70 |
| 10-yr | 39.85 | 13.87 | 0.78 | 25.08 | 25.09 | -14.76 |
| 50-yr | 61.06 | 21.20 | 5.27 | 37.65 | 41.99 | -19.07 |
| 100-yr | 73.15 | 25.39 | 5.66 | 44.31 | 50.18 | -22.97 |

For all three (3) sites with new impervious areas proposed: Quakertown Compressor Station, Transco Meter Station, and Marcus Hook Compressor Station, the stormwater management facilities discussed in the Post Construction Stormwater Management (PCSM) Report are added to mitigate any increase in peak runoff rates, thereby preventing erosion, damage, or nuisance to the downstream point of interest (POI). As

mentioned in Section I of this report, the remaining ten (10) sites will be restored to existing conditions and will have no change to discharge quantity or quality. Therefore, any off-site discharge at all project sites will not cause erosion, damage, or a nuisance to off-site properties.

# IX. OFF-SITE DISCHARGE ANALYSIS

In existing conditions, the entire Quakertown Compressor Station site drains to a delineated wetland to the North of the project site. The wetland drains to Tohickon Creek, which is located approximately 1,900 ft from the project site. In proposed conditions, the drainage pattern over the areas of earth disturbance will continue to drain to the delineated wetland. Site drainage to the surface water will travel via sheet flow from proposed gravel surfaces and from concentrated flow from the underground MRC basin.

At Transco Meter Station, there is an existing roadside swale that drains west to east along Ridge Road to a storm sewer under Fed Ex Drive. In existing conditions, the drainage at the project site drains off-site to this existing roadside swale, which eventually leads to Naaman's Creek approximately 2,790 feet Southwest of the project site.

There is a proposed bypass swale along the North property boundary that will shift the upstream drainage pattern that was previously draining through the site and discharging to the roadside swale along Ridge Road. In proposed conditions, the upstream drainage from the bypass swale will flow directly to a delineated wetland to the west of the project site. All proposed earth disturbance south of the bypass swale will drain to the roadside swale along Ridge Road as originally intended. Site drainage will travel to the existing drainage swale via sheet flow from proposed gravel surfaces and from concentrated flow from the subsurface infiltration bed (BMP 6.4.3). As noted in Table VII-2, the overall peak rate is decreased in post construction conditions. In addition, a channel analysis of the existing channel was performed to confirm that the flow path downstream of the outlet point is stable flow. An analysis that shows table flow for the existing channel can be found in Appendix D.3. Since the flow is stable to the existing channel, it is concluded that the proposed conditions prevent erosion, damage, or nuisance to the downstream point of interest (POI).

At Marcus Hook Compressor station, there are two (2) existing swales that collects sheet flow from the project site in existing and proposed conditions. One swale drains Northwest-Southwest and another drains East to West. These two swales merge at the most Southern end of the project site and drains off-site towards Naaman's Creek. Naaman's Creek is located approximately 2,020 feet Southwest of the project site.

The drainage pattern from existing to proposed conditions is not altered. All post construction drains to the Southernmost swale to Naaman's Creek via sheet flow or concentrated outflow from a surface MRC basin. As noted in Table VII-3, the overall peak rate is decreased in post construction conditions. In addition, a channel analysis of the existing channel was performed to confirm that the flow path downstream of the outlet point is stable flow. An analysis that shows table flow for the existing channel can be found in Appendix D.3. Since the flow is stable to the existing channel, it is concluded that the proposed conditions prevent erosion, damage, or nuisance to the downstream point of interest (POI).

An exhibit is included on Appendix D.3 to demonstrate the flow paths to Naaman's Creek.

As mentioned in Section I of this report, the remaining ten (10) sites will be restored to existing conditions and will have no change to discharge quantity or quality. Therefore, any off-site discharge at all project sites will not cause erosion, damage, or a nuisance to off-site properties.

# X. BMP INSTALLATION SEQUENCE

A sequence of construction was developed to minimize land clearing and grading, and to minimize soil compaction.

**Quakertown Compressor Station (Non-vegetated MRC: Underground Storage Chamber)**

1. Install stabilized rock construction entrances where vehicles will enter construction areas from public roads at the direction of the environmental inspector (EI) based on site conditions and clearing access needs.
2. Install wood matting and protective fence to provide ingress/egress to the limit of disturbance. Whenever possible, work should be scheduled for low flow seasons.
3. Install compost filter sock, sediment barriers, or other county conservation district approved sediment barriers/BMPs prior to clearing an area.
4. Install the MRC BMP during the final phases of site construction to prevent sedimentation and/or damage from construction activity. After installation, prevent sediment-laden water from entering via overland, inlets and pipes.
5. Install and maintain proper E&S BMPs during construction. Provide E&S proposed on the site so that the construction runoff is directed away from the StormTank system.
6. Complete site grading and stabilize the soil within the limit of the disturbance. Do no finalize the StormTank system's excavation and construction until the drainage area is fully stabilized.
7. Install the JellyFish Membrane Filtration system, as indicated on the Shop Drawings and Specifications from Contech.
8. Excavate to the proposed invert depths. Manually grade and scarify the existing soil surface. The bottom of the system shall be at level grade. Do not compact in-situ soils.
9. Place geotextile, impervious liner and aggregate immediately after approval of subgrade preparation to prevent accumulation of debris or sediment. Prevent runoff and sediment from entering the storage bed.
10. Install StormTank modules by hand, as indicated on Shop Drawings. Take care to avoid damage to geotextile.
11. Upon completion of module installation, wrap the module in geotextile fabric and impervious liner. Place stone aggregate on top of the geotextile. Inspect all geotextile, ensuring that no damage exists which will allow sediment into the system.
12. Complete surface grading above the StormTank system, using suitable equipment to avoid excess compaction.
13. Maintain E&S BMPs until the site is fully stabilized.

**Transco Meter Station (StormTank - Subsurface Infiltration Bed: BMP 6.4.3)**

1. Protect subsurface infiltration bed area from compaction prior to installation.

2. Areas for proposed StormTank system shall be clearly marked before any site work begins to avoid soil disturbance during construction.
3. Provide E&S proposed on the site so that the construction runoff is directed away from the StormTank system.
4. Complete site grading and stabilize the soil within the limit of the disturbance. Do no finalize the StormTank system's excavation and construction until the drainage area is fully stabilized.
5. Excavate to the proposed invert depths. Manually grade and scarify the existing soil surface. The bottom of the system shall be at level grade. Do not compact in-situ soils.
6. Place geotextile and aggregate immediately after approval of subgrade preparation to prevent accumulation of debris or sediment. Prevent runoff and sediment from entering the storage bed.
7. Install StormTank modules by hand, as indicated on Shop Drawings. Take care to avoid damage to geotextile.
8. Upon completion of module installation, wrap the module in geotextile fabric. Place stone aggregate on top of the geotextile. Inspect all geotextile, ensuring that no damage exists which will allow sediment into the system.
9. Complete surface grading above the StormTank system, using suitable equipment to avoid excess compaction.
10. Maintain E&S BMPs until the site is fully stabilized.

**Marcus Hook Compressor Station (Vegetated MRC BMP)**

1. Grade sediment basin and install all appurtent works per the design drawings. Area under embankment shall be cleared, grubbed, and stripped of topsoil to a depth of two feet prior to any placement and compaction of earthen fill. Accumulated sediment shall be removed when it has reached the clean out elevation on the stake.
2. Install and maintain proper E&S BMPs during construction.
3. Complete site grading and stabilize the soil within the limit of disturbance.
4. Install the MRC BMP during the final phases of site construction to prevent sedimentation and/or damage from construction activity. After installation, prevent sediment-laden water from entering via overland, inlets and pipes. Do not finalize the BMP excavation and construction until the drainage area is fully stabilized.
5. Accumulated sediment shall be removed and disturbed areas shall be stabilized inside the basin before conversion to the MRC BMP. Excavate the MRC BMP bottom to an uncompacted subgrade free from rocks and debris. Do not compact the subgrade. Install outlet control structures, underdrain piping with aggregate envelope and cleanouts.
6. Place soil media gently. Do not compact soil media. The placement of soil media should be done from outside the BMP footprint to avoid compaction by construction equipment. Equipment should never drive over placed soil media.
7. Place geotextile, impervious liner and aggregate immediately after approval of subgrade preparation to prevent accumulation of debris or sediment. Prevent runoff and sediment from entering the storage bed.
8. Presoak the planting soil prior to planting vegetation to aid in settlement.

9. Complete final grading to achieve proposed basin design elevations, leaving space for topsoil as needed.
10. Seed and stabilize disturbed area. Vegetate with native plantings.
11. Maintain E&S BMPs until the site is fully stabilized.

## XI. GEOLOGIC FORMATIONS OR SOIL CONDITIONS

There are no known geologic formations or soil conditions identified at the site that have the potential to cause pollution during construction.

## XII. POTENTIAL THERMAL IMPACTS TO SURFACE WATERS

Thermal impacts associated with the project will be minimized and/or mitigated through the incorporation of various BMPs, which include a subsurface and subsurface MRC basins and a subsurface infiltration bed. Runoff from the impervious areas will be directed to the BMPs where the travel time is increased to infiltrate and/or store runoff, reducing the quantity and temperature of the runoff.

The surface basin at Marcus Hook Compressor Station will be vegetated. Landscaping and vegetative cover will mimic natural ecosystems, resulting in a system that is resistant to climatic stresses. Additionally, the basin's outlet structure is designed to promote the slow release of outflow to the surface waters.

The subsurface basin at Transco Meter Station will temporarily store stormwater runoff beneath the surface, away from direct sunlight and will promote infiltration which will release water into the groundwater instead of discharging to the surface waters.

The subsurface basin at Quakertown Compressor Station will temporarily store stormwater runoff beneath the surface, away from direct sunlight and will promote the slow release of outflow to the surface waters.

At the main line valve sites, thermal impacts will be avoided by site restoration activities. The disturbed areas will be restored and seeded as soon as practicable and /or directing runoff to vegetated areas to reduce the temperature of runoff prior to discharge into the streams.

## XIII. EXISTING/PROPOSED RIPARIAN FOREST BUFFERS

The proposed earth disturbance activities at Paoli Pike Blowdown are to be conducted within 150 feet of Ridley Creek, which is classified as an HQ watershed. Per PA Code 102.14(d)(1), oil and gas activities for which site restoration is part of the permit are not required to provide a mandatory riparian buffer so long as any existing riparian buffer is undisturbed to the extent practicable. The proposed earth disturbance is limited to a proposed valve replacement and associated site work. The disturbed area is limited to 3,445 SF, which will be restored to existing conditions after construction. Therefore, a riparian buffer waiver is being requested for this project since the project is a of a temporary nature where the site will be fully restored to it's pre-existing conditions during the ESCGP permit term.

# I. ANTIDEGRADATION REQUIREMENTS

Compliance with antidegradation implementation is required, including evaluation of non-discharge alternatives and ABACT for where activities will be conducted in special protection watersheds (HQ/EV) or siltation impaired waters. The following surface waters are HQ and siltation impaired waters:

- Tohickon Creek (siltation-impaired)
- Perkiomen Creek (siltation-impaired)
- Schuylkill River (siltation-impaired)
- Stony Run (HQ, siltation-impaired)
- Valley Creek (siltation-impaired)
- Ridley Creek (HQ, siltation-impaired)
- Chester Creek (siltation-impaired)

All sites within the watersheds listed above, with the exception of the Quakertown Compressor Station within the Tohickon Creek watershed, will be restored to pre-existing conditions. By limiting the disturbed areas, limiting extent and duration of disturbance and performing site restoration, these practices will eliminate the net change in rate, volume and water quality after construction. ABACT controls include, but are not limited to, rock construction entrances with wash racks, compost filter sock, riparian buffers and rock-lined channels.

At Quakertown Compressor Station within the Tohickon Creek watershed, non-discharge BMPs of limiting the disturbed areas, limiting extent and duration of disturbance and partially restoring the sites will aid in the protection of Tohickon Creek. Roof drainage will discharge to a non-vegetated MRC BMP. This proposed BMP will eliminate the net change in rate, volume and water quality after construction.

# II. LONG TERM OPERATION AND MAINTENANCE SCHEDULE

A long-term operation and maintenance schedule, which provides for inspection of PCSM BMPs, includes the following maintenance practices to ensure proper function and operation. The Permittee shall be responsible for the inspection, maintenance, and repair of the Post Construction Stormwater Management BMPs to ensure that the facilities continue to function as designed. The program must provide for completion of a written report documenting each inspection and all BMP repair and maintenance activities and how access to the PCSM/Site Restoration BMPs will be provided.

**Quakertown Compressor Station (Non-vegetated MRC: Underground Storage Chamber)**

| Activity | Frequency |
|---|---|
| Inspect erosion control and flow spreading devices until soil settlement and vegetative establishment of contributing areas has occurred. | Biweekly |
| Inspect inlet controls, outlet structures, and storage areas for trash and sediment accumulation. | Monthly for the first year after installation to determine ongoing maintenance frequency |
| Regularly clean out catch basins to reduce sediment load to detention system. Clean intermediate sump boxes, replace filters, and otherwise clean pretreatment areas in directly connected systems. | As needed |
| Remove sediment and debris from subsurface detention SMP sedimentation chamber, as applicable, when the sediment zone is 3/4 full. | |
| Remove sediment and debris from pipe/vault systems. Sediment depth is not to reach a maximum depth of four inches below the SMP's outlet invert elevation. Removal of sediment from grid systems must be per manufacturer's recommendations or as per the site specific maintenance schedule. | |
| Inspect subsurface detention facility and control structures. | Quarterly |
| Remove floating debris and accumulated petroleum products. | |
| Maintain records of all inspections and maintenance activity. | On-going |

**Quakertown Compressor Station (Jellyfish Membrane Filtration System)**

| Activity | Frequency |
|---|---|
| Assess the sediment and floatable pollutant accumulation, and to ensure proper system functionality. | Minimum of quarterly during first year of operation, after each major storm event, and required immediately after an upstream oil, fuel or other chemical spill |
| Measure oil and sediment depth in several locations, by lowering a sediment probe until contact is made with the floor of the structure. Record sediment depth, and presences of any oil layers. | Quarterly |
| Inspect the MAW or inlet bay for floatable pollutants such as trash, debris, and oil sheen | |

| | |
|---|---|
| Remove sediment and debris from pipe/vault systems. Sediment depth is not to reach a maximum depth of four inches below the SMP's outlet invert elevation. Removal of sediment from grid systems must be per manufacturer's recommendations or as per the site specific maintenance schedule. | |
| Inspect cartridge lids. Missing or damaged cartridge lids to be replaced | |
| Inspect the cartridge deck for standing water, and/or sediment on the deck. No standing water under normal operating conditions. | |
| Maintain records of all inspections and maintenance activity. | On-going |

**Transco Meter Station (StormTank - Subsurface Infiltration Bed: BMP 6.4.3)**

| Activity | Frequency |
|---|---|
| Inspect erosion control and flow spreading devices until soil settlement and vegetative establishment of contributing areas has occurred. | Biweekly |
| Inspect inlet controls, outlet structures, and storage areas for trash and sediment accumulation. | Monthly for the first year after installation to determine ongoing maintenance frequency |
| Regularly clean out catch basins to reduce sediment load to detention system. Clean intermediate sump boxes, replace filters, and otherwise clean pretreatment areas in directly connected systems. | As needed |
| Remove sediment and debris from subsurface detention SMP sedimentation chamber, as applicable, when the sediment zone is 3/4 full. | |
| Remove sediment and debris from pipe/vault systems. Sediment depth is not to reach a maximum depth of four inches below the SMP's outlet invert elevation. Removal of sediment from grid systems must be per manufacturer's recommendations or as per the site specific maintenance schedule. | |
| Inspect subsurface detention facility and control structures. | Quarterly |
| Remove floating debris and accumulated petroleum products. | |
| Maintain records of all inspections and maintenance activity. | On-going |

**Marcus Hook Compressor Station (Vegetated MRC BMP)**

| Activity | Frequency |
|---|---|
| Keep overflow free and clear of leaves. | As needed. |
| Remove accumulated sediment as required to maintain infiltration through the MRCs soil media and to maintain water quality functionality. Restore original cross section. Properly dispose of sediment. | |

| | |
|---|---|
| Clean and inspect upgradient catch basins and inlets | Annually, or more often if historic maintenance records suggest a more frequent cleaning. |
| Inspect for accumulation of sediment, damage to outlet control structures, erosion, signs of water contamination/spills, and instability | Bi-yearly, or more if historical maintenance deems it is necessary |
| Inspect soil and repair eroded areas. | Monthly |
| Remove litter and debris. | |
| Avoid excessive compaction by mowers. Mow only as appropriate for vegetative species. | On-going |
| Maintain in good condition the vegetation for the basin and the contributing drainage area and revegetate any bare spots. | |
| Evaluate the drain down time of the SMP after a storm of at least 0.8 inch to ensure an SMP drain down time of less than 72 hours. | |

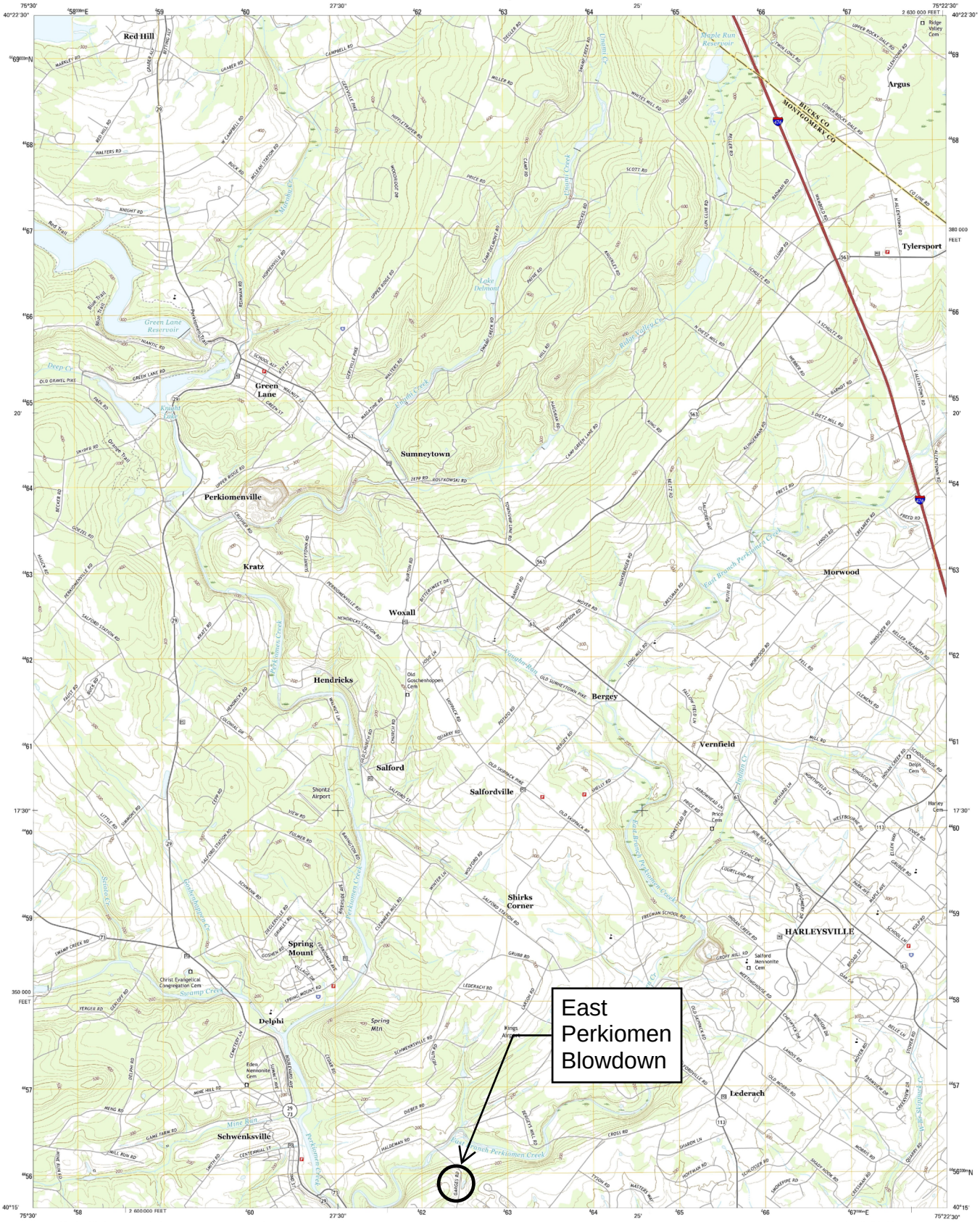
# Appendix A

Location Map

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map US Topo

# PERKIOMENVILLE QUADRANGLE
PENNSYLVANIA
7.5-MINUTE SERIES




**Produced by the United States Geological Survey**
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and 1 000-meter grid: Universal Transverse Mercator, Zone 18T
10 000-foot ticks: Pennsylvania Coordinate System of 1983 (south zone)

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery.....NAIP, June 2013
Roads..... U.S. Census Bureau, 2015 - 2016
Names.....GNIS, 2016
Hydrography.....National Hydrography Dataset, 2013
Contours.....National Elevation Dataset, 2011
Boundaries.....Multiple sources; see metadata file 1972 - 2016

Wetlands.....FWS National Wetlands Inventory 1977 - 2014

12° 5'
215 MILS
6° 17'
5 MILS
MN
GN

UTM GRID AND 2016 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

| U.S. National Grid |
|---|
| 100,000-m Square ID |
| VK |
| Grid Zone Designation |
| 18T |

SCALE 1:24 000

KILOMETERS: 1 0.5 0 1 2
METERS: 1000 500 0 1000 2000
MILES: 1 0.5 0 1
FEET: 1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

CONTOUR INTERVAL 20 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.19

PENNSYLVANIA
QUADRANGLE LOCATION

| | | |
|---|---|---|
| 1 | 2 | 3 |
| 4 | | 5 |
| 6 | 7 | 8 |

ADJOINING QUADRANGLES

1 East Greenville
2 Milford Square
3 Quakertown
4 Sassamansville
5 Telford
6 Phoenixville
7 Collegeville
8 Lansdale

ROAD CLASSIFICATION
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

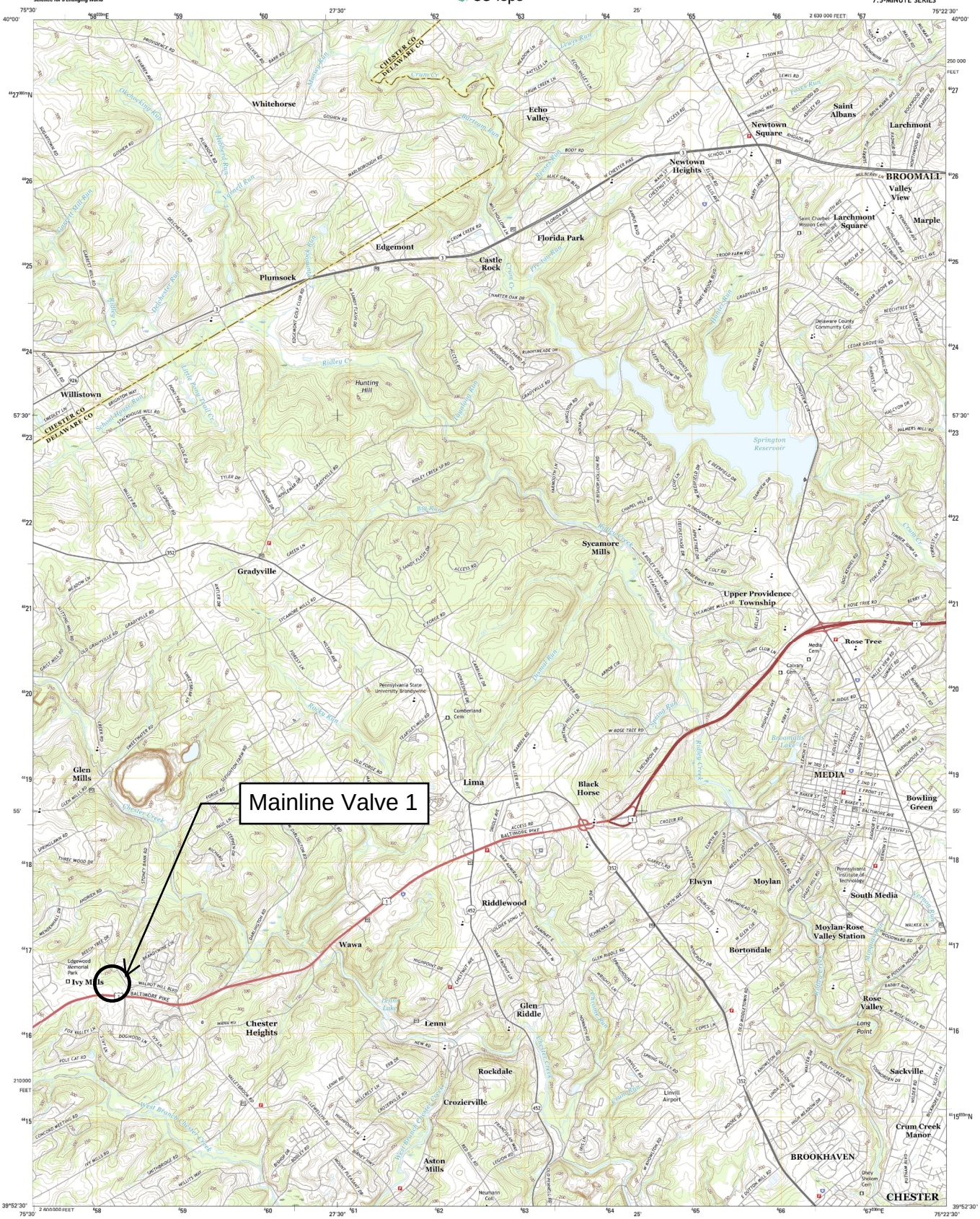
PERKIOMENVILLE, PA
2016

NSN 7643013934795
NGA REF NO. USGS24K34795

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map
US Topo

MEDIA QUADRANGLE
PENNSYLVANIA
7.5-MINUTE SERIES




**Produced by the United States Geological Survey**
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and 1 000-meter grid: Universal Transverse Mercator, Zone 18S
10 000-foot ticks: Pennsylvania Coordinate System of 1983 (south zone)

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery.....NAIP, June 2013
Roads..... U.S. Census Bureau, 2015 - 2016
Names.....GNIS, 2016
Hydrography.....National Hydrography Dataset, 2013
Contours.....National Elevation Dataset, 2000
Boundaries.....Multiple sources; see metadata file 1972 - 2016

Wetlands.....FWS National Wetlands Inventory 1977 - 2014

UTM GRID AND 2016 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

| U.S. National Grid |
|---|
| 100,000-m Square ID |
| VK |
| Grid Zone Designation |
| 18S |

SCALE 1:24 000

KILOMETERS
METERS
MILES
FEET

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.19

PENNSYLVANIA
QUADRANGLE LOCATION

| 1 | 2 | 3 |
|---|---|---|
| 4 | | 5 |
| 6 | 7 | 8 |

ADJOINING QUADRANGLES

1 Malvern
2 Valley Forge
3 Norristown
4 West Chester
5 Lansdowne
6 Wilmington North
7 Marcus Hook
8 Bridgeport

ROAD CLASSIFICATION
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

MEDIA, PA
2016

NSN 7643013918612
NGA REF NO. USGSX24K28647

USGS
science for a changing world

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map
US Topo

MALVERN QUADRANGLE
PENNSYLVANIA-CHESTER CO.
7.5-MINUTE SERIES

Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid: Universal Transverse Mercator, Zone 18T
10 000-foot ticks: Pennsylvania Coordinate System of 1983 (south zone)

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery.....NAIP, June 2013
Roads.....U.S. Census Bureau, 2015 - 2016
Names.....GNIS, 2016
Hydrography.....National Hydrography Dataset, 2013
Contours.....National Elevation Dataset, 2011
Boundaries.....Multiple sources; see metadata file 1972 - 2016
Wetlands.....FWS National Wetlands Inventory 1977 - 2014

UTM GRID AND 2016 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.19

ROAD CLASSIFICATION
Expressway — Local Connector
Secondary Hwy — Local Road
Ramp — 4WD
Interstate Route — US Route — State Route

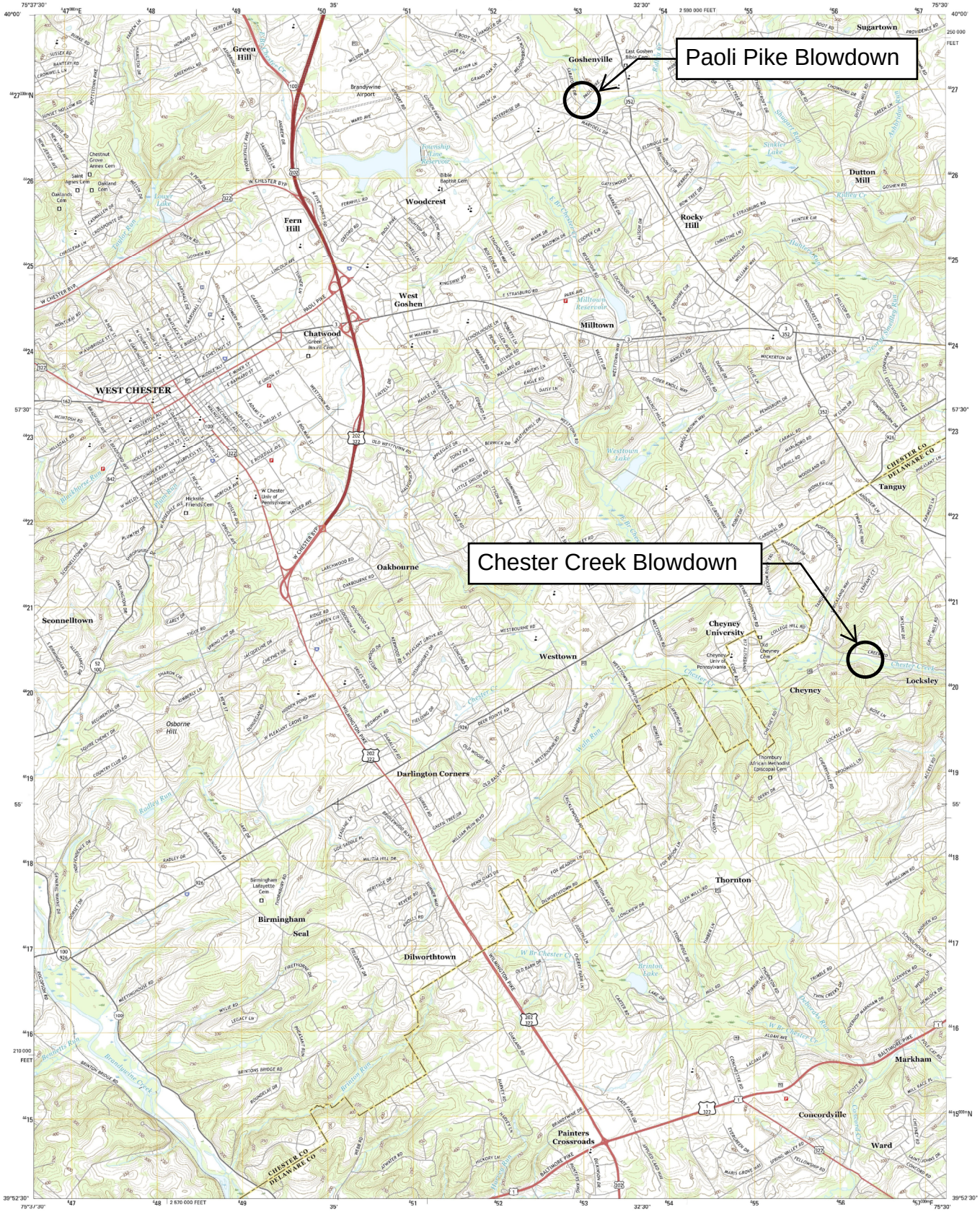
1 Pottstown
2 Phoenixville
3 Collegeville
4 Downingtown
5 Valley Forge
6 Unionville
7 West Chester
8 Media
ADJOINING QUADRANGLES

MALVERN, PA
2016

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map US Topo

WEST CHESTER QUADRANGLE
PENNSYLVANIA
7.5-MINUTE SERIES




**Produced by the United States Geological Survey**
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and 1 000-meter grid: Universal Transverse Mercator, Zone 18S
10 000-foot ticks: Pennsylvania Coordinate System of 1983 (south zone)

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery.....NAIP, June 2013
Roads.....U.S. Census Bureau, 2015 - 2016
Names.....GNIS, 2016
Hydrography.....National Hydrography Dataset, 2013
Contours.....National Elevation Dataset, 2000
Boundaries.....Multiple sources; see metadata file 1972 - 2016

Wetlands.....FWS National Wetlands Inventory 1977 - 2014

UTM GRID AND 2016 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

MN
11° 55'
212 MILS
GN
0° 22'
6 MILS

U.S. National Grid
100,000-m Square ID
VK
Grid Zone Designation
18S

SCALE 1:24 000

KILOMETERS 1 0.5 0 1 2
METERS 1000 500 0 1000 2000
MILES 1 0.5 0 1
FEET 1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.19

PENNSYLVANIA
QUADRANGLE LOCATION

| | | |
|---|---|---|
| 1 | 2 | 3 |
| 4 | | 5 |
| 6 | 7 | 8 |

1 Downingtown
2 Malvern
3 Valley Forge
4 Unionville
5 Media
6 Kennett Square
7 Wilmington North
8 Marcus Hook

ADJOINING QUADRANGLES

ROAD CLASSIFICATION

Expressway — Local Connector
Secondary Hwy — Local Road
Ramp — 4WD
Interstate Route — US Route — State Route

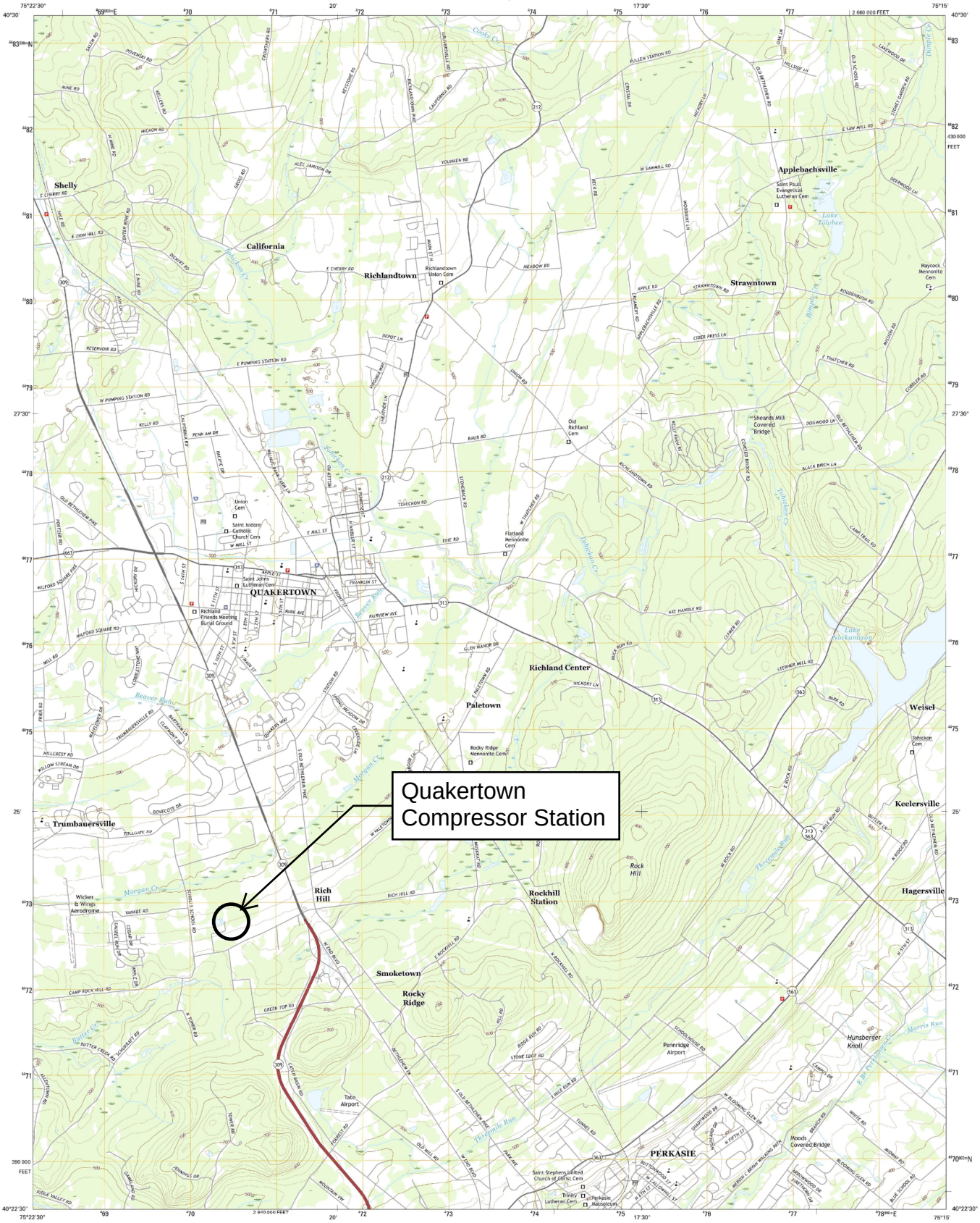
WEST CHESTER, PA
2016

NSN. 7643013919832
NGA REF NO. USGSX24K8159

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map US Topo

# QUAKERTOWN QUADRANGLE
PENNSYLVANIA-BUCKS CO.
7.5-MINUTE SERIES




Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid: Universal Transverse Mercator, Zone 18T
10 000-foot ticks: Pennsylvania Coordinate System of 1983
(south zone)

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery.....NAIP, June 2013
Roads..... U.S. Census Bureau, 2015 - 2016
Names.....GNIS, 2016
Hydrography.....National Hydrography Dataset, 2013
Contours.....National Elevation Dataset, 2011
Boundaries.....Multiple sources; see metadata file 1972 - 2016

Wetlands.....FWS National Wetlands Inventory 1977 - 2014

UTM GRID AND 2016 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

| U.S. National Grid |
|---|
| 100,000-m Square ID |
| VK |
| Grid Zone Designation |
| 18T |

SCALE 1:24 000

KILOMETERS 0 0.5 1 2
METERS 1000 500 0 1000 2000
MILES 1 0.5 0 1
FEET 1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

CONTOUR INTERVAL 20 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011. A metadata file associated with this product is draft version 0.6.19

PENNSYLVANIA
QUADRANGLE LOCATION

| 1 | 2 | 3 |
|---|---|---|
| 4 | | 5 |
| 6 | 7 | 8 |

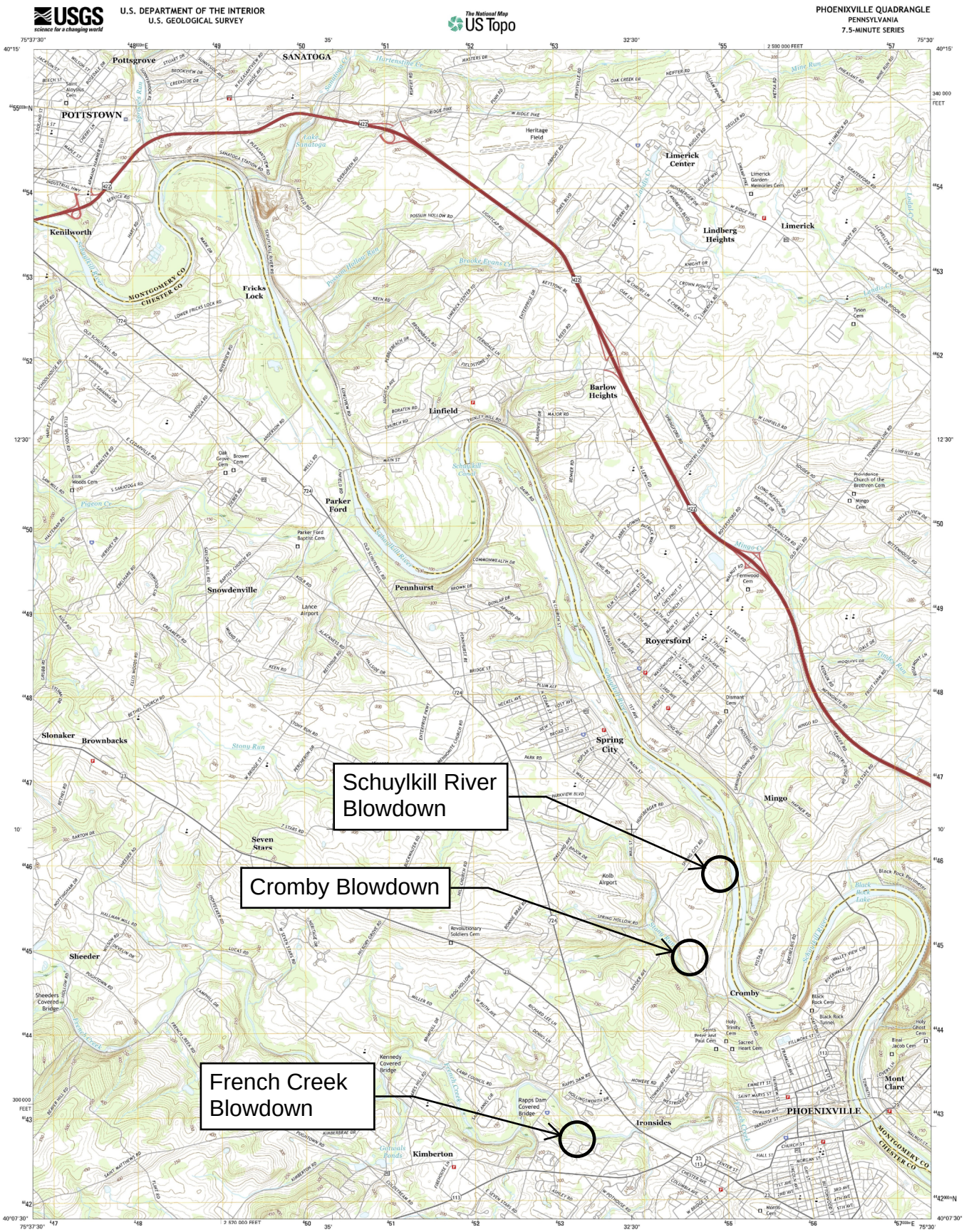
1 Allentown East
2 Hellertown
3 Riegelsville
4 Milford Square
5 Bedminster
6 Perkiomenville
7 Telford
8 Doylestown

ADJOINING QUADRANGLES

ROAD CLASSIFICATION
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

QUAKERTOWN, PA
2016

NSN 7643016374740
NGA REF NO. USGX243674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U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
The National Map
US Topo
PHOENIXVILLE QUADRANGLE
PENNSYLVANIA
7.5-MINUTE SERIES
Schuylkill River Blowdown
Cromby Blowdown
French Creek Blowdown
Pottsgrove
SANATOGA
POTTSTOWN
Kenilworth
Fricks Lock
Limerick Center
Limerick
Lindberg Heights
Barlow Heights
Linfield
Parker Ford
Snowdenville
Pennhurst
Royersford
Spring City
Slonaker
Brownbacks
Seven Stars
Mingo
Sheeder
Cromby
Mont Clare
PHOENIXVILLE
Ironsides
Kimberton
MONTGOMERY CO
CHESTER CO
Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid: Universal Transverse Mercator, Zone 18T
10 000-foot ticks: Pennsylvania Coordinate System of 1983
(south zone)
This map is not a legal document. Boundaries may be
generalized for this map scale. Private lands within government
reservations may not be shown. Obtain permission before
entering private lands.
Imagery....NAIP, June 2013
Roads.... U.S. Census Bureau, 2015 - 2016
Names....GNIS, 2016
Hydrography....National Hydrography Dataset, 2013
Contours....National Elevation Dataset, 2011
Boundaries....Multiple sources; see metadata file 1972 - 2016
Wetlands....FWS National Wetlands Inventory 1977 - 2014
UTM GRID AND 2016 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET
U.S. National Grid
100,000-m Square ID
VK
Grid Zone Designation
18T
SCALE 1:24 000
KILOMETERS
METERS
MILES
FEET
CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988
This map was produced to conform with the
National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.19
PENNSYLVANIA
QUADRANGLE LOCATION
ADJOINING QUADRANGLES
1 Boyertown
2 Sassamansville
3 Perkiomenville
4 Pottstown
5 Collegeville
6 Downingtown
7 Malvern
8 Valley Forge
ROAD CLASSIFICATION
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route
PHOENIXVILLE, PA
2016
NGA REF NO. USGS24K34982

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map US Topo

COLLEGEVILLE QUADRANGLE
PENNSYLVANIA
7.5-MINUTE SERIES

Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and 1 000 meter grid: Universal Transverse Mercator, Zone 18T
10 000-foot ticks: Pennsylvania Coordinate System of 1983 (south zone)

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery.....NAIP, June 2013
Roads..... U.S. Census Bureau, 2015 - 2016
Names.....GNIS, 2016
Hydrography.....National Hydrography Dataset, 2013
Contours.....National Elevation Dataset, 2011
Boundaries.....Multiple sources; see metadata file 1972 - 2016

Wetlands.....FWS National Wetlands Inventory 1977 - 2014

UTM GRID AND 2016 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

U.S. National Grid
100,000-m Square ID
VK
Grid Zone Designation
18T

SCALE 1:24 000

KILOMETERS
METERS
MILES
FEET

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.19

QUADRANGLE LOCATION

ADJOINING QUADRANGLES
1 Sassamansville
2 Perkiomenville
3 Telford
4 Phoenixville
5 Lansdale
6 Malvern
7 Valley Forge
8 Norristown

ROAD CLASSIFICATION
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

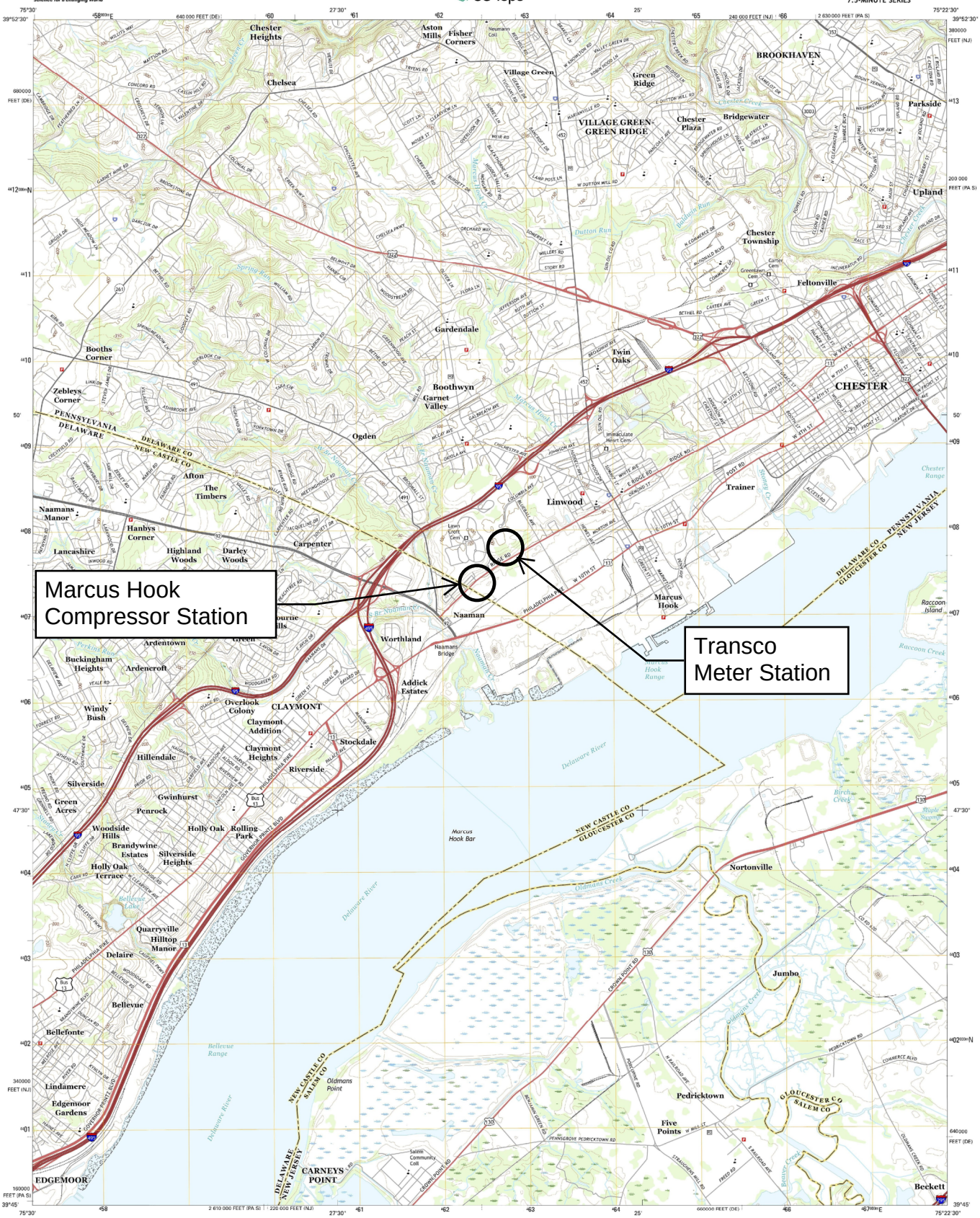
COLLEGEVILLE, PA
2016

NSN 7643013934257
NGA REF NO. USGSX24K9707

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map US Topo

# MARCUS HOOK QUADRANGLE
PENNSYLVANIA-DELAWARE-NEW JERSEY
7.5-MINUTE SERIES




**Produced by the United States Geological Survey**
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid: Universal Transverse Mercator, Zone 18S
10 000-foot ticks: Pennsylvania Coordinate System of 1983
(south zone), Delaware Coordinate System of 1983, New Jersey
Coordinate System of 1983

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering.

Imagery.....NAIP, September 2013
Roads.....U.S. Census Bureau, 2015 - 2016
Names.....GNIS, 2016
Hydrography.....National Hydrography Dataset, 2013
Contours.....National Elevation Dataset, 2000
Boundaries.....Multiple sources; see metadata file 1972 - 2016

Wetlands.....FWS National Wetlands Inventory 1977 - 2014

MN
11° 57'
213 MILS
GN
0° 17'
5 MILS
UTM GRID AND 2016 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

| U.S. National Grid |
|---|
| 100,000-m Square ID |
| VK |
| Grid Zone Designation 18S |

SCALE 1:24 000

KILOMETERS 1 0.5 0 1 2
METERS 1000 500 0 1000 2000
MILES 1 0.5 0 1
FEET 1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011. A metadata file associated with this product is draft version 0.6.19

PENNSYLVANIA
QUADRANGLE LOCATION

| | | |
|---|---|---|
| 1 | 2 | 3 |
| 4 | | 5 |
| 6 | 7 | 8 |

1 West Chester
2 Media
3 Lansdowne
4 Wilmington North
5 Bridgeport
6 Wilmington South
7 Penns Grove
8 Woodstown

ADJOINING QUADRANGLES

ROAD CLASSIFICATION
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

MARCUS HOOK, PA-DE-NJ
2016

NGA REF NO. USGSX24K27853

# Appendix B

Soil Data

# Hydrologic Soil Group—Delaware County, Pennsylvania

Map Scale: 1:269 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 3 7 14 21

Feet: 0 10 20 40 60

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil 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 1:20,000.

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:
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: Delaware County, Pennsylvania
Survey Area Data: Version 16, Sep 19, 2018

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

Date(s) aerial images were photographed: Aug 18, 2014—Sep 22, 2014

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| We | Wehadkee silt loam | B/D | 0.1 | 100.0% |
| **Totals for Area of Interest** | | | **0.1** | **100.0%** |

## 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

Map Scale: 1:470 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 5 10 20 30

Feet: 0 20 40 80 120

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil 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:
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: Chester County, Pennsylvania
Survey Area Data: Version 11, Sep 18, 2018

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

Date(s) aerial images were photographed: Jul 25, 2014—Aug 11, 2014

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| PeB | Penn silt loam, 3 to 8 percent slopes | B | 0.2 | 100.0% |
| **Totals for Area of Interest** | | | **0.2** | **100.0%** |

## 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.

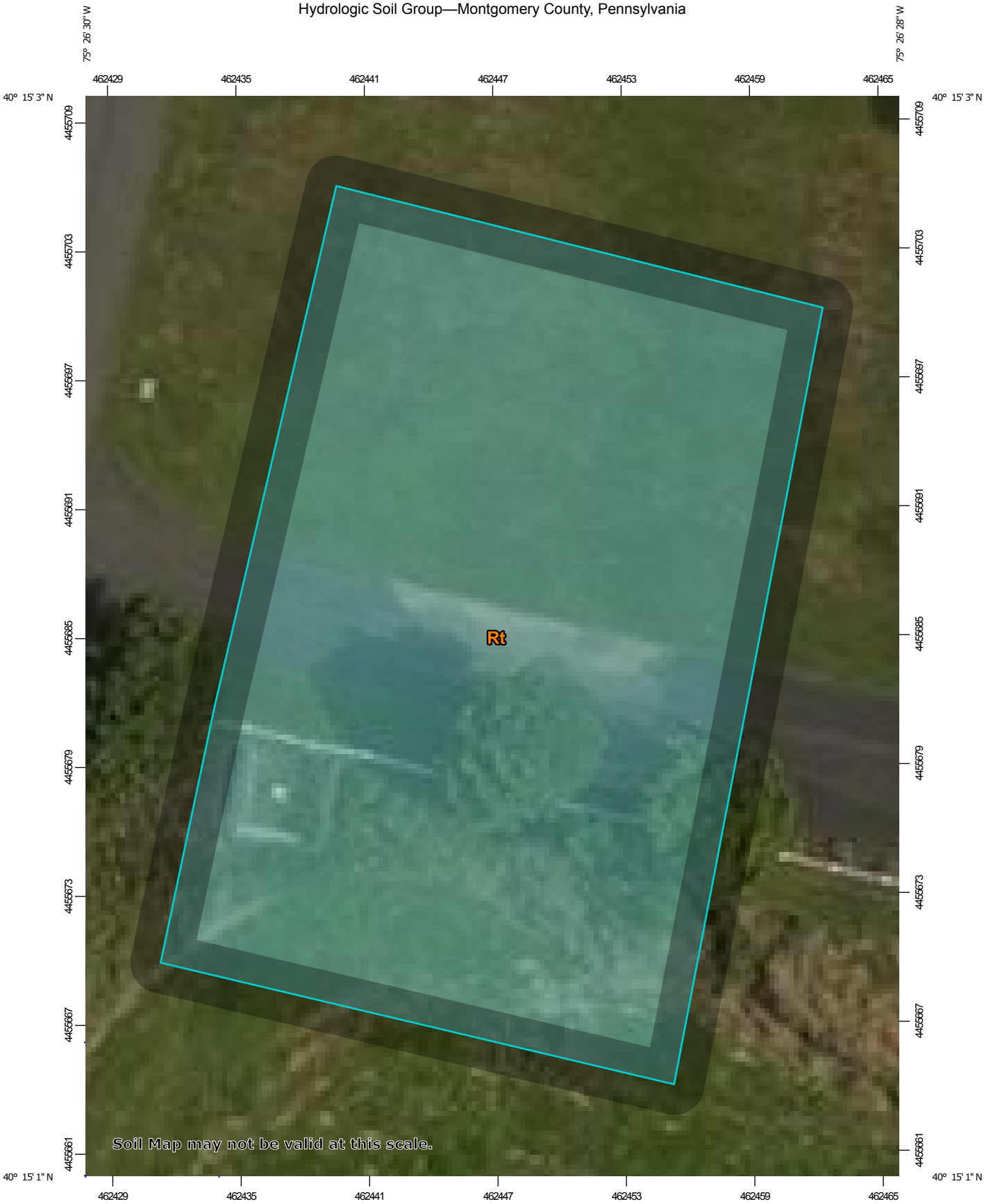
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher




Map Scale: 1:245 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 3 7 14 21

Feet: 0 10 20 40 60

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil 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 1:12,000.

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:
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: Montgomery County, Pennsylvania
Survey Area Data: Version 13, Sep 19, 2018

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

Date(s) aerial images were photographed: Jul 25, 2014—Aug 11, 2014

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| Rt | Rowland silt loam, terrace | C | 0.2 | 100.0% |
| **Totals for Area of Interest** | | | **0.2** | **100.0%** |

## 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

Map Scale: 1:2,440 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 35 70 140 210

Feet: 0 100 200 400 600

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil 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:
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: Chester County, Pennsylvania
Survey Area Data: Version 11, Sep 18, 2018

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

Date(s) aerial images were photographed: Jul 25, 2014—Aug 11, 2014

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| PeB | Penn silt loam, 3 to 8 percent slopes | B | 1.9 | 61.8% |
| PeC | Penn silt loam, 8 to 15 percent slopes | B | 0.2 | 7.0% |
| PeD | Penn silt loam, 15 to 25 percent slopes | B | 0.6 | 18.4% |
| ReB | Readington silt loam, 3 to 8 percent slopes | C | 0.4 | 12.2% |
| UrxB | Urban land-Penn complex, 0 to 8 percent slopes | | 0.0 | 0.6% |
| **Totals for Area of Interest** | | | **3.0** | **100.0%** |

## 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.

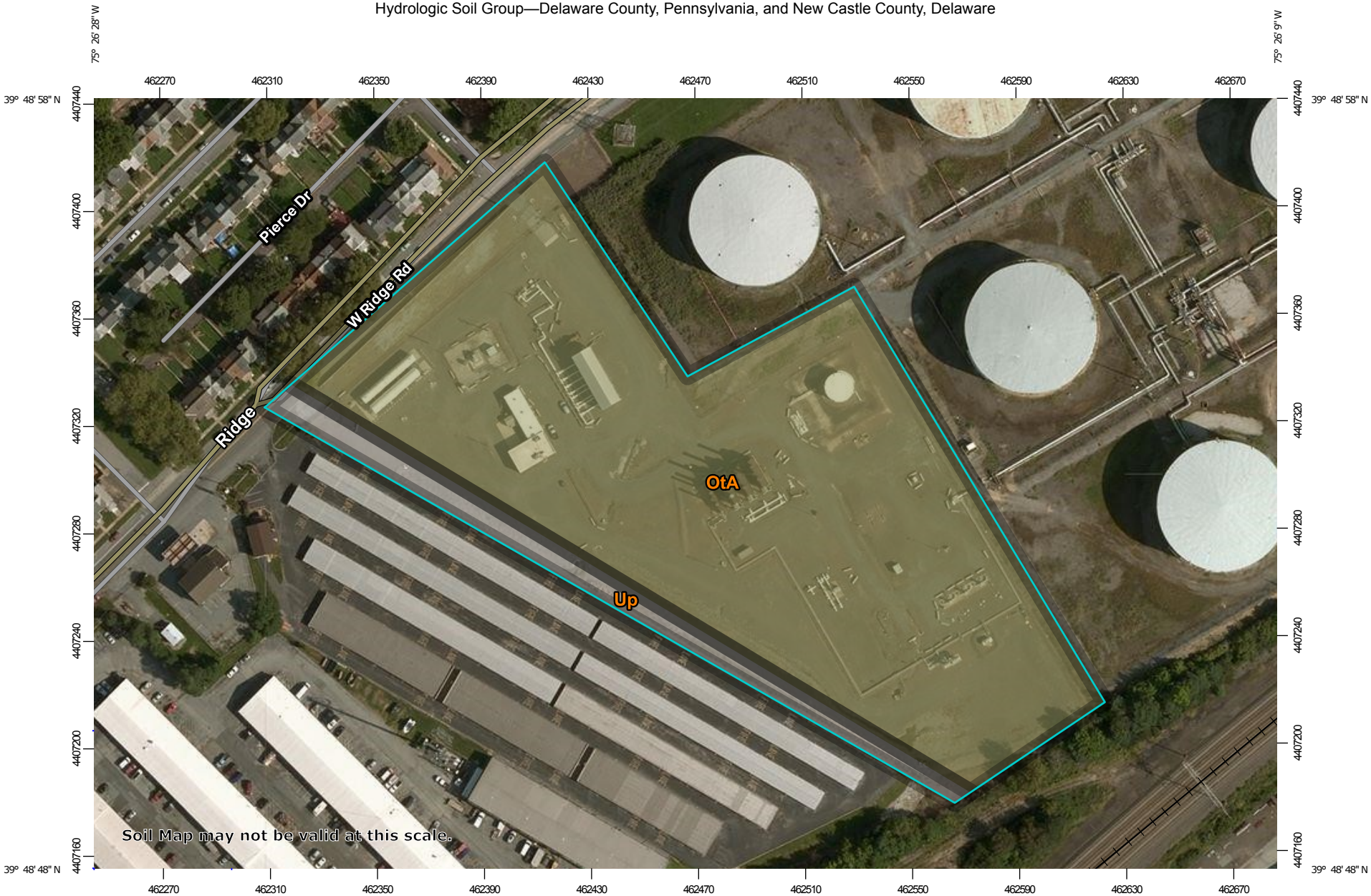
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher




Map Scale: 1:2,020 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil 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 scales ranging from 1:20,000 to 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:
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: Delaware County, Pennsylvania
Survey Area Data: Version 16, Sep 19, 2018

Soil Survey Area: New Castle County, Delaware
Survey Area Data: Version 13, Sep 14, 2018

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Aug 18, 2014—Sep 22, 2014

## MAP LEGEND

## MAP INFORMATION

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| OtA | Othello silt loams, 0 to 2 percent slopes, northern coastal plain | C/D | 7.4 | 91.5% |
| **Subtotals for Soil Survey Area** | | | **7.4** | **91.5%** |
| **Totals for Area of Interest** | | | **8.0** | **100.0%** |

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| Up | Urban land | | 0.7 | 8.5% |
| **Subtotals for Soil Survey Area** | | | **0.7** | **8.5%** |
| **Totals for Area of Interest** | | | **8.0** | **100.0%** |

## 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

Map Scale: 1:415 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 5 10 20 30

Feet: 0 20 40 80 120

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil 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 1:20,000.

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:
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: Delaware County, Pennsylvania
Survey Area Data: Version 16, Sep 19, 2018

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

Date(s) aerial images were photographed: Aug 18, 2014—Sep 22, 2014

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| GeB | Glenelg channery loam, 3 to 8 percent slopes | B | 0.1 | 100.0% |
| **Totals for Area of Interest** | | | **0.1** | **100.0%** |

## 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

Map Scale: 1:266 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 3 7 14 21

Feet: 0 10 20 40 60

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil 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:
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: Chester County, Pennsylvania
Survey Area Data: Version 11, Sep 18, 2018

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

Date(s) aerial images were photographed: Jul 25, 2014—Aug 11, 2014

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| MaC | Manor loam, 8 to 15 percent slopes | B | 0.1 | 100.0% |
| **Totals for Area of Interest** | | | **0.1** | **100.0%** |

## 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

# Hydrologic Soil Group—Chester County, Pennsylvania

Map Scale: 1:301 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 4 8 16 24

Feet: 0 10 20 40 60

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil 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:
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: Chester County, Pennsylvania
Survey Area Data: Version 11, Sep 18, 2018

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

Date(s) aerial images were photographed: Jul 25, 2014—Aug 11, 2014

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| Ha | Hatboro silt loam | B/D | 0.2 | 100.0% |
| **Totals for Area of Interest** | | | **0.2** | **100.0%** |

## 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

# Hydrologic Soil Group—Montgomery County, Pennsylvania

Map Scale: 1:508 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 5 10 20 30

Feet: 0 20 40 80 120

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil 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 1:12,000.

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:
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: Montgomery County, Pennsylvania
Survey Area Data: Version 13, Sep 19, 2018

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

Date(s) aerial images were photographed: Jul 25, 2014—Aug 11, 2014

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| Bo | Bowmansville-Knauers silt loams | C/D | 0.2 | 85.5% |
| ReA | Readington silt loam, 0 to 3 percent slopes | C | 0.0 | 14.5% |
| **Totals for Area of Interest** | | | **0.3** | **100.0%** |

## 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

# Hydrologic Soil Group—Bucks County, Pennsylvania

## 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:
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: Bucks County, Pennsylvania
Survey Area Data: Version 15, Sep 18, 2018

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

Date(s) aerial images were photographed: Jul 18, 2011—Mar 16, 2017

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| AmB | Amwell silt loam, 3 to 8 percent slopes | D | 1.4 | 98.6% |
| UdB | Udorthents, shale and sandstone | A | 0.0 | 1.4% |
| **Totals for Area of Interest** | | | **1.5** | **100.0%** |

## 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.

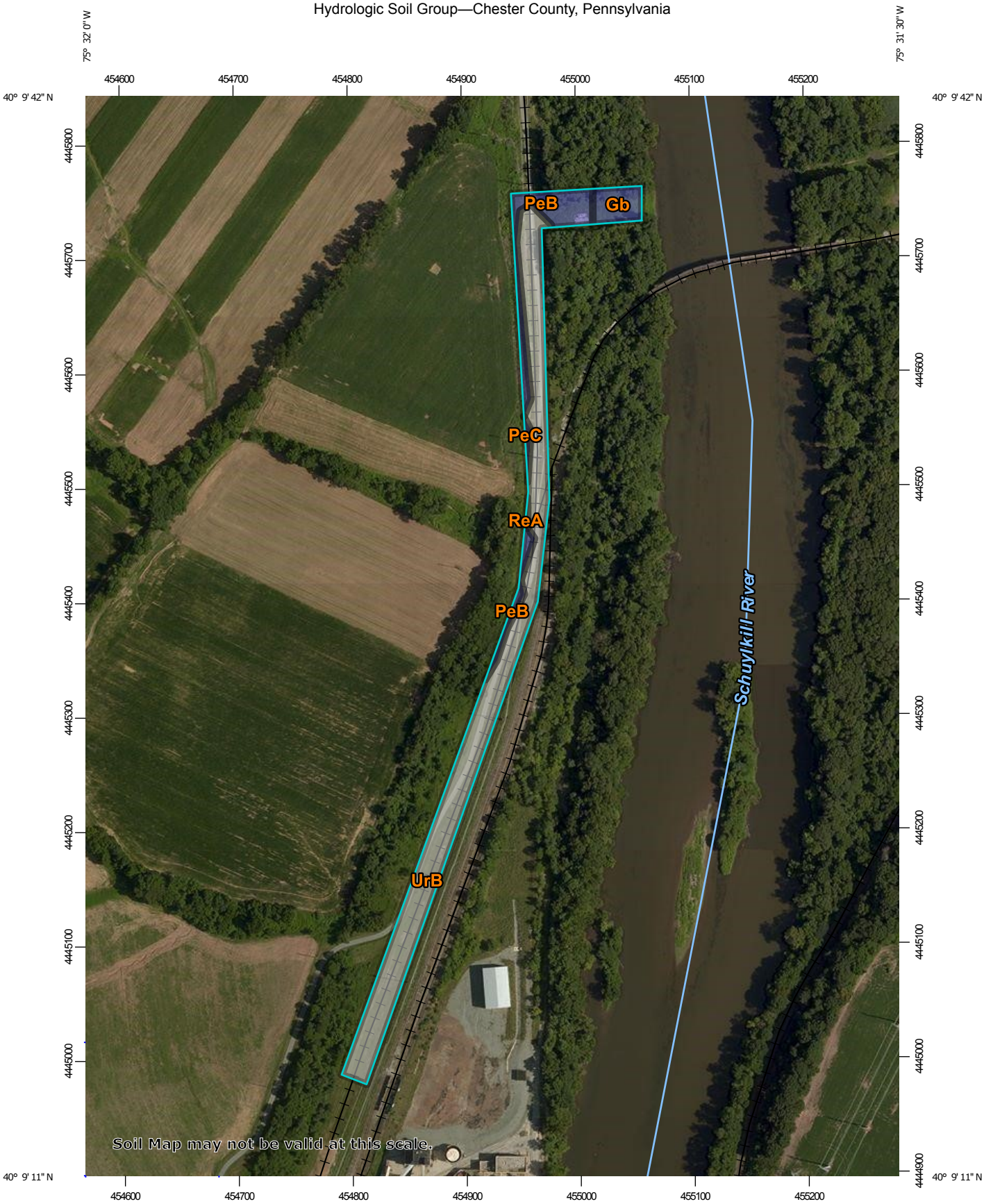
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher




Map Scale: 1:4,600 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil 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:
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: Chester County, Pennsylvania
Survey Area Data: Version 11, Sep 18, 2018

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

Date(s) aerial images were photographed: Jul 25, 2014—Aug 11, 2014

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| Gb | Gibraltar silt loam | B | 0.3 | 6.6% |
| PeB | Penn silt loam, 3 to 8 percent slopes | B | 0.8 | 15.8% |
| PeC | Penn silt loam, 8 to 15 percent slopes | B | 0.0 | 0.8% |
| ReA | Readington silt loam, 0 to 3 percent slopes | C | 0.0 | 0.2% |
| UrB | Urban land, 0 to 8 percent slopes | | 3.8 | 76.6% |
| **Totals for Area of Interest** | | | **5.0** | **100.0%** |

## 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

# Hydrologic Soil Group—Montgomery County, Pennsylvania

Map Scale: 1:362 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 5 10 20 30

Feet: 0 15 30 60 90

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil 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 1:12,000.

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:
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: Montgomery County, Pennsylvania
Survey Area Data: Version 13, Sep 19, 2018

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

Date(s) aerial images were photographed: Jul 25, 2014—Aug 11, 2014

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| PeB | Penn silt loam, 3 to 8 percent slopes | B | 0.1 | 36.3% |
| PeC | Penn silt loam, 8 to 15 percent slopes | B | 0.1 | 63.7% |
| **Totals for Area of Interest** | | | **0.2** | **100.0%** |

## 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.

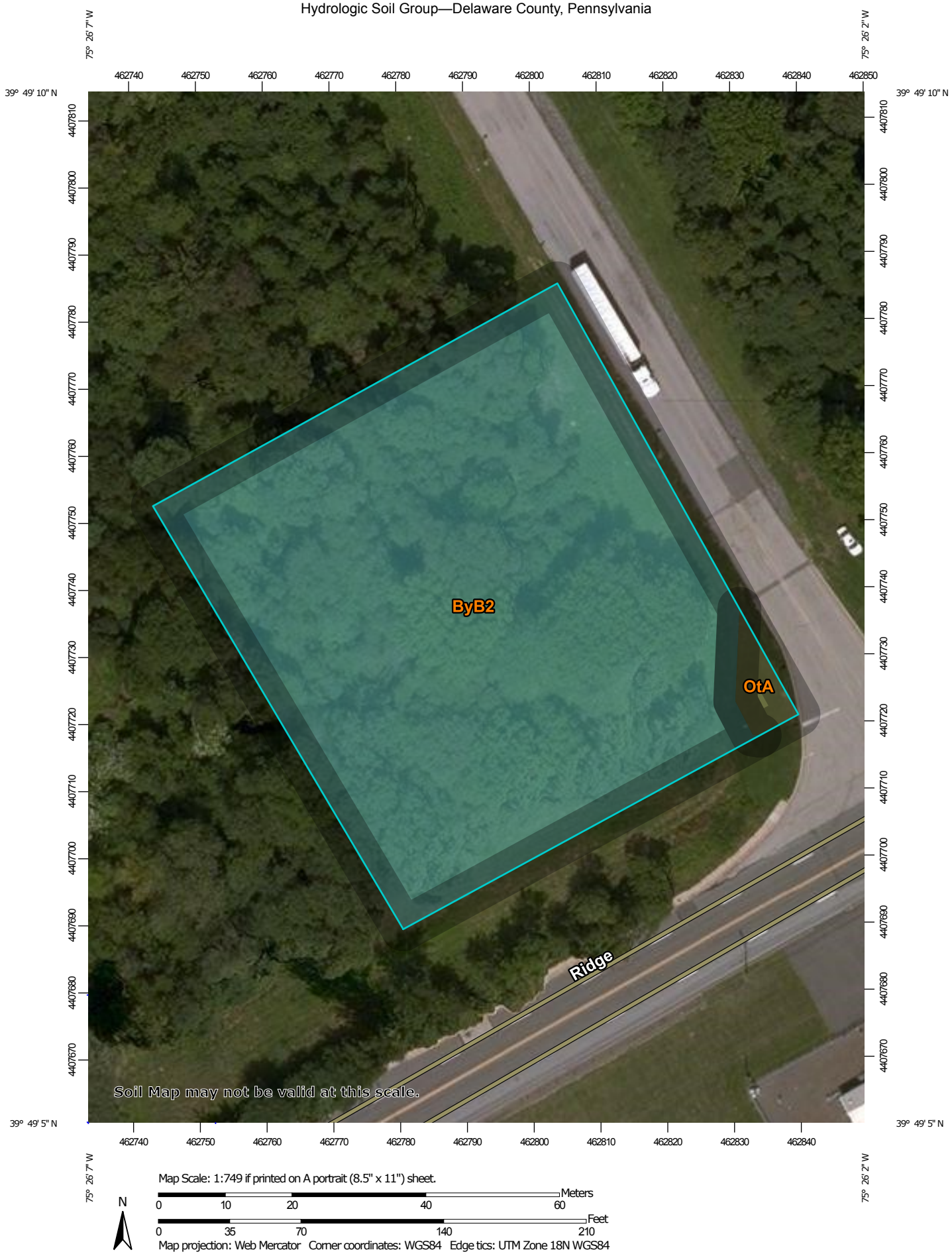
## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher

# Hydrologic Soil Group—Delaware County, Pennsylvania




Map Scale: 1:749 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 10 20 40 60

Feet: 0 35 70 140 210

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

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

**Soil 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 1:20,000.

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:
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: Delaware County, Pennsylvania
Survey Area Data: Version 16, Sep 19, 2018

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

Date(s) aerial images were photographed: Aug 18, 2014—Sep 22, 2014

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

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| ByB2 | Butlertown silt loam, 3 to 8 percent slopes, moderately eroded | C | 1.2 | 98.2% |
| OtA | Othello silt loams, 0 to 2 percent slopes, northern coastal plain | C/D | 0.0 | 1.8% |
| **Totals for Area of Interest** | | | **1.2** | **100.0%** |

## 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

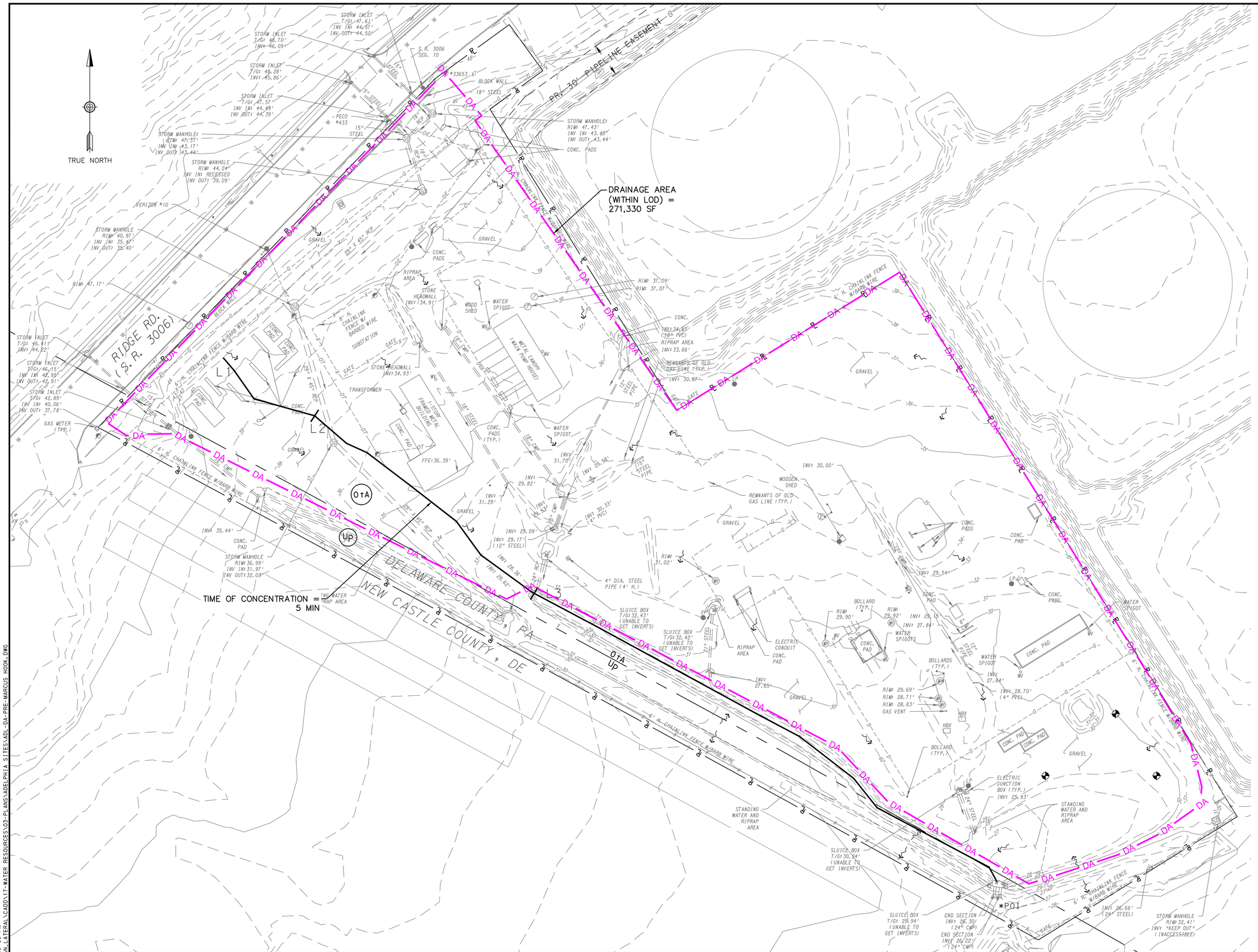
*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher

# Appendix C

## Drainage Area Maps




## LEGEND

- 324 — EXISTING 1' CONTOUR
- 325 — EXISTING 5' CONTOUR
- EXISTING TREE LINE
- X — EXISTING FENCE LINE
- E — EXISTING OVERHEAD ELECTRIC
- EXISTING UTILITY POLE
- W — EXISTING WATER LINE
- G — EXISTING GAS LINE
- S — EXISTING SEWER LINE
- EXISTING GAS EASEMENT
- UTILITY EASEMENT
- PL — EXISTING PROPERTY LINE
- WL — EXISTING WETLAND BOUNDARY
- EXISTING WETLAND AREA
- 100-YEAR FLOOD PLAIN
- SOIL BOUNDARY
- We — SOIL TYPE
- DA — DRAINAGE AREA
- EXISTING TIME OF CONCENTRATION FLOW PATH

NOTES:

1. ALL AREA WITHIN THE LIMIT OF DISTURBANCE IS CONSIDERED GRAVEL, UNLESS OTHERWISE NOTED.
2. THE EXISTING DRAINAGE AREA INCLUDES THE AREA WITHIN THE LIMIT OF DISTURBANCE AND THE OFF-SITE AREA THAT DRAIN TO THE PROPOSED BMP. THE DRAINAGE UPSTREAM OF THE PROJECT SITE WAS NOT INCLUDED IN THE CALCULATIONS SINCE THE NET CHANGE IN VOLUME/RATE OF RUNOFF IS NEGLIGIBLE.
3. RECEIVING STREAM AND CHAPTER 93 CLASSIFICATION (DESIGNATED AND EXISTING USE): NAAMANS CREEK-WWF, MF
3. NAAMANS CREEK IS LOCATED APPROXIMATELY 2,020 FT SW OF THE PROJECT SITE

| EXISTING PEAK RATES TO POINT OF INTEREST | |
|---|---|
| STORM | RATE OF RUNOFF (CFS) |
| 2 YEAR | 24.89 |
| 10 YEAR | 39.85 |
| 50 YEAR | 61.06 |
| 100 YEAR | 73.15 |

VOLUME OF RUNOFF (2-YR) = 52,844 CF

ADELPHIA GATEWAY

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
SHINY M. MATHEW
ENGINEER
NO. PE082407

20 0 40 80
SCALE: 1"=40'

DATE: _____

| REV | DESCRIPTION | CHK | DATE | APP | DATE |
|---|---|---|---|---|---|
| 2 | REVISED TO ADDRESS DEP COMMENTS | ATH | 03/24/20 | SMM | 03/24/20 |
| 1 | REVISED TO ADDRESS DEP COMMENTS | ATH | 11/15/19 | SMM | 11/15/19 |

REVISION

| | INTL | DATE |
|---|---|---|
| DRAWN BY | RY | 03/24/20 |
| DESIGNED BY | AH | 03/24/20 |
| CHECKED BY | SMM | 03/24/20 |
| APPROVED BY | | |
| JOB NO. | 18-00672-006 | |
| PLOT SCALE | 1"=40' | |
| MODEL ID | | |

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Philadelphia, PA 19103
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# DRAINAGE AREA MAP
# EXISTING CONDITIONS
# MARCUS HOOK COMPRESSOR STATION

| SCALE | DRAWING NUMBER | REV |
|---|---|---|
| 1"=40' | DA-1 | |

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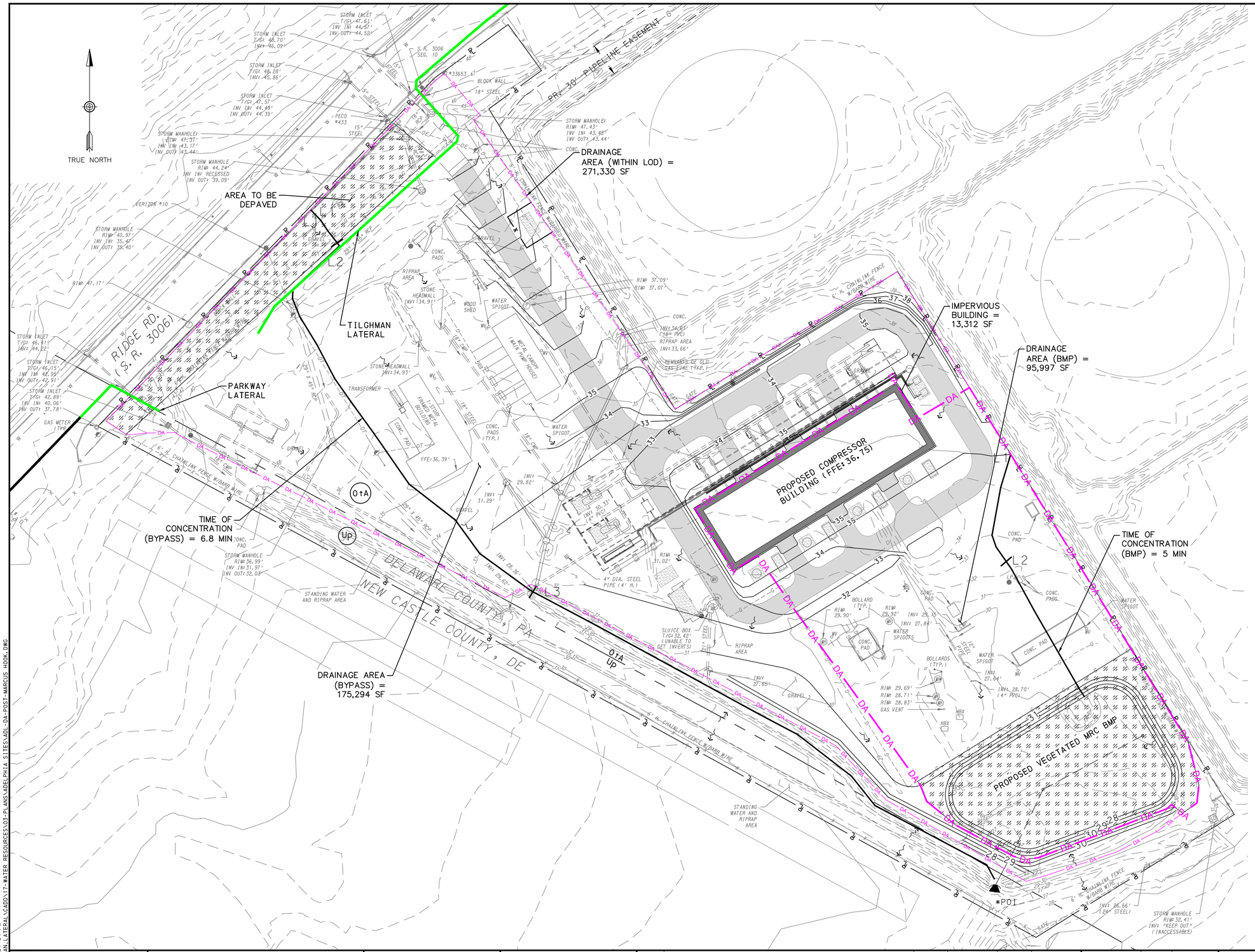


## LEGEND

| | |
|---|---|
| 324 | EXISTING 1' CONTOUR |
| 325 | EXISTING 5' CONTOUR |
| | EXISTING TREE LINE |
| X X | EXISTING FENCE LINE |
| E | EXISTING OVERHEAD ELECTRIC |
| | EXISTING UTILITY POLE |
| W | EXISTING WATER LINE |
| G | EXISTING GAS LINE |
| S | EXISTING SEWER LINE |
| | EXISTING GAS EASEMENT |
| | UTILITY EASEMENT |
| PL | EXISTING PROPERTY LINE |
| WL | EXISTING WETLAND BOUNDARY |
| | EXISTING WETLAND AREA |
| | 100-YEAR FLOOD PLAIN |
| | SOIL BOUNDARY |
| We | SOIL TYPE |
| DA DA | DRAINAGE AREA |
| | EXISTING TIME OF CONCENTRATION FLOW PATH |
| | DEPAVED/VEGETATED AREA |
| | PROPOSED PAVE |

NOTES:

1. ALL AREA WITHIN THE LIMIT OF DISTURBANCE IS CONSIDERED GRAVEL, UNLESS OTHERWISE NOTED.
2. THE PROPOSED DRAINAGE AREA INCLUDES THE AREA WITHIN THE LIMIT OF DISTURBANCE AND THE OFF-SITE AREA THAT DRAIN TO THE PROPOSED BMP. THE DRAINAGE UPSTREAM OF THE PROJECT SITE WAS NOT INCLUDED IN THE CALCULATIONS SINCE THE NET CHANGE IN VOLUME/RATE OF RUNOFF IS NEGLIGIBLE.
2. RECEIVING STREAM AND CHAPTER 93 CLASSIFICATION (DESIGNATED AND EXISTING USE): NAAMANS CREEK-WWF, MF
3. NAAMANS CREEK IS LOCATED APPROXIMATELY 2,020 FT SW OF THE PROJECT SITE

| PROPOSED PEAK RATES TO POINT OF INTEREST | |
|---|---|
| STORM | RATE OF RUNOFF (CFS) |
| 2 YEAR | 16.19 |
| 10 YEAR | 25.09 |
| 50 YEAR | 41.99 |
| 100 YEAR | 50.18 |

VOLUME OF RUNOFF (2-YR) = 56,248 CF

ADELPHIA GATEWAY

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
SHINY M. MATHEW
ENGINEER
NO. PE082407

20 0 40 80
SCALE: 1"=40'

DATE: _____

| REV | DESCRIPTION | CHK | DATE | APP | DATE |
|---|---|---|---|---|---|
| 2 | REVISED TO ADDRESS DEP COMMENTS | ATH | 03/24/20 | SMM | 03/24/20 |
| 1 | REVISED TO ADDRESS DEP COMMENTS | ATH | 11/15/19 | SMM | 11/15/19 |

REVISION

| | | |
|---|---|---|
| DRAWN BY | INTL | DATE |
| DESIGNED BY | RY | 03/24/20 |
| CHECKED BY | AH | 03/24/20 |
| APPROVED BY | SMM | 03/24/20 |
| JOB NO. | 18-00672-006 | |
| PLOT SCALE | 1"=40' | |
| MODEL ID | | |

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# DRAINAGE AREA MAP
# PROPOSED CONDITIONS
# MARCUS HOOK COMPRESSOR STATION

| SCALE | DRAWING NUMBER | REV |
|---|---|---|
| 1"=40' | DA-2 | |

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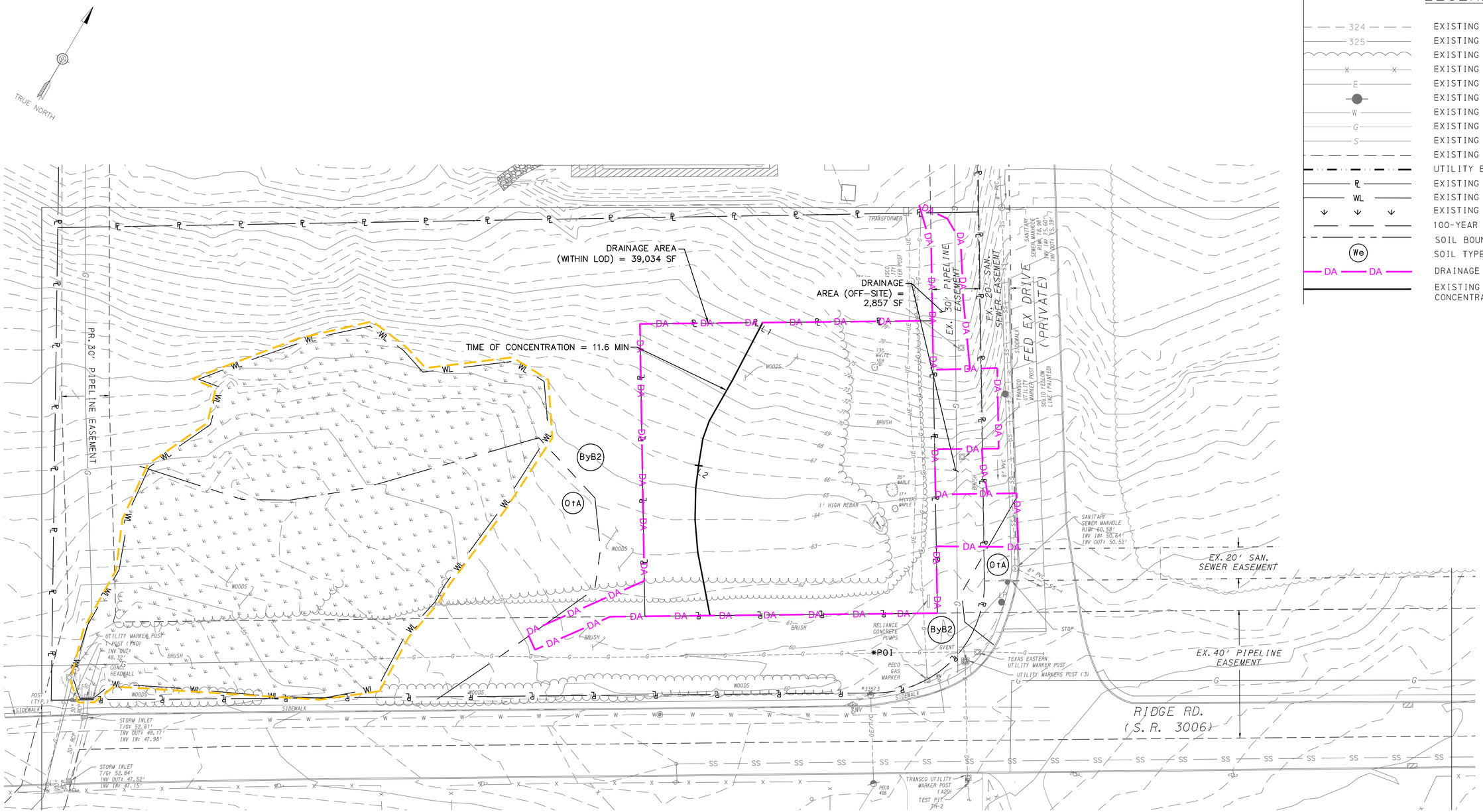


## LEGEND

| | |
|---|---|
| 324 | EXISTING 1' CONTOUR |
| 325 | EXISTING 5' CONTOUR |
| | EXISTING TREE LINE |
| X X | EXISTING FENCE LINE |
| E | EXISTING OVERHEAD ELECTRIC |
| | EXISTING UTILITY POLE |
| W | EXISTING WATER LINE |
| G | EXISTING GAS LINE |
| S | EXISTING SEWER LINE |
| | EXISTING GAS EASEMENT |
| | UTILITY EASEMENT |
| PL | EXISTING PROPERTY LINE |
| WL | EXISTING WETLAND BOUNDARY |
| | EXISTING WETLAND AREA |
| | 100-YEAR FLOOD PLAIN |
| | SOIL BOUNDARY |
| We | SOIL TYPE |
| DA DA | DRAINAGE AREA |
| | EXISTING TIME OF CONCENTRATION FLOW PATH |

NOTES:

1. ALL AREA WITHIN THE LIMIT OF DISTURBANCE IS CONSIDERED BRUSH AND WOODS, IN GOOD CONDITION, IN EXISTING CONDITIONS.
2. THE EXISTING DRAINAGE AREA INCLUDES THE AREA WITHIN THE LIMIT OF DISTURBANCE AND THE OFF-SITE AREA THAT DRAIN TO THE PROPOSED BMP. THE DRAINAGE UPSTREAM OF THE PROJECT SITE WAS NOT INCLUDED IN THE CALCULATIONS SINCE THE NET CHANGE IN VOLUME/RATE OF RUNOFF IS NEGLIGIBLE.
2. RECEIVING STREAM AND CHAPTER 93 CLASSIFICATION (DESIGNATED AND EXISTING USE): NAAMANS CREEK-WWF, MF
3. NAAMANS CREEK IS LOCATED APPROXIMATELY 3,790 FT SW OF THE PROJECT SITE.

| EXISTING PEAK RATE TO POINT OF INTEREST | |
|---|---|
| STORM | RATE OF RUNOFF (CFS) |
| 2 YEAR | 1.24 |
| 10 YEAR | 2.75 |
| 50-YEAR | 5.19 |
| 100 YEAR | 6.66 |

VOLUME OF RUNOFF (2-YR) = 2,925 CF

ADELPHIA GATEWAY

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL ENGINEER
SHINY M. MATHEW
NO. PE082407

15 0 30 60
SCALE: 1"=30'

DATE: _____

| REV | DESCRIPTION | CHK | DATE | APP | DATE |
|---|---|---|---|---|---|
| 2 | REVISED TO ADDRESS DEP COMMENTS | ATH | 03/24/20 | SMM | 03/24/20 |
| 1 | REVISED TO ADDRESS DEP COMMENTS | ATH | 11/15/19 | SMM | 11/15/19 |

REVISION

| | INTL | DATE |
|---|---|---|
| DRAWN BY | | |
| DESIGNED BY | RY | 03/24/20 |
| CHECKED BY | AH | 03/24/20 |
| APPROVED BY | SMM | 03/24/20 |
| JOB NO. | 18-00672-006 | |
| PLOT SCALE | 1"=30' | |
| MODEL ID | | |

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# DRAINAGE AREA MAP EXISTING CONDITIONS TRANSCO METER STATION

| SCALE | DRAWING NUMBER | REV |
|---|---|---|
| 1"=30' | DA-3 | |

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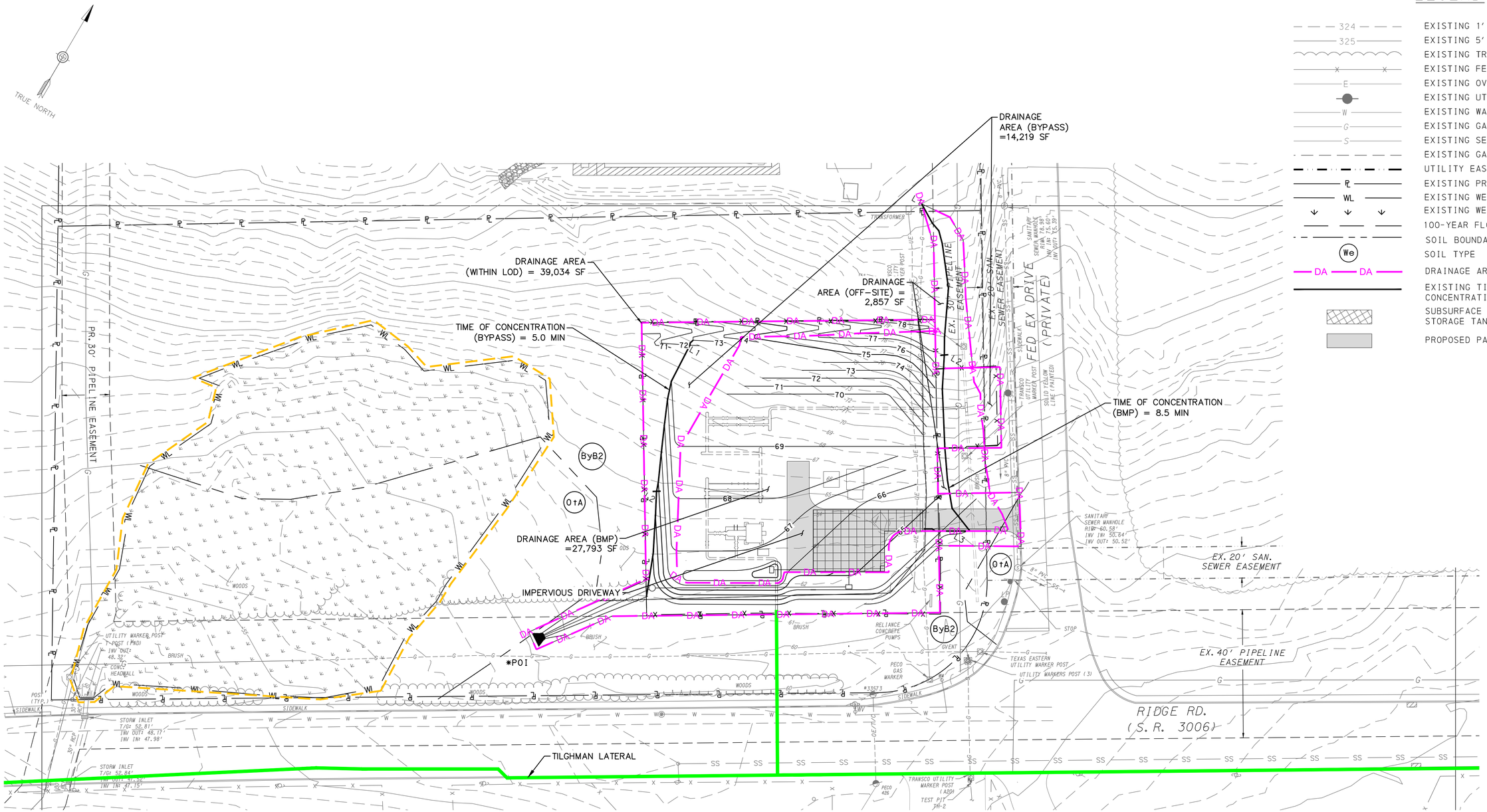


## LEGEND

| | |
|---|---|
| 324 | EXISTING 1' CONTOUR |
| 325 | EXISTING 5' CONTOUR |
| | EXISTING TREE LINE |
| X X | EXISTING FENCE LINE |
| E | EXISTING OVERHEAD ELECTRIC |
| | EXISTING UTILITY POLE |
| W | EXISTING WATER LINE |
| G | EXISTING GAS LINE |
| S | EXISTING SEWER LINE |
| | EXISTING GAS EASEMENT |
| | UTILITY EASEMENT |
| PL | EXISTING PROPERTY LINE |
| WL | EXISTING WETLAND BOUNDARY |
| | EXISTING WETLAND AREA |
| | 100-YEAR FLOOD PLAIN |
| | SOIL BOUNDARY |
| We | SOIL TYPE |
| DA DA | DRAINAGE AREA |
| | EXISTING TIME OF CONCENTRATION FLOW PATH |
| | SUBSURFACE STORAGE TANK |
| | PROPOSED PAVE |

NOTES:

1. ALL AREA WITHIN THE LIMIT OF DISTURBANCE IS CONSIDERED GRAVEL, UNLESS OTHERWISE NOTED.
2. THE PROPOSED DRAINAGE AREA INCLUDES THE AREA WITHIN THE LIMIT OF DISTURBANCE AND THE OFF-SITE AREA THAT DRAIN TO THE PROPOSED BMP. THE DRAINAGE UPSTREAM OF THE PROJECT SITE WAS NOT INCLUDED IN THE CALCULATIONS SINCE THE NET CHANGE IN VOLUME/RATE OF RUNOFF IS NEGLIGIBLE.
3. RECEIVING STREAM AND CHAPTER 93 CLASSIFICATION (DESIGNATED AND EXISTING USE): NAAMANS CREEK-WWF, MF
4. NAAMANS CREEK IS LOCATED APPROXIMATELY 3,790 FT SW OF THE PROJECT SITE

| PROPOSED PEAK RATES TO POINT OF INTEREST | |
|---|---|
| STORM | PEAK RATE (CFS) |
| 2 YEAR | 1.04 |
| 10 YEAR | 1.80 |
| 50 YEAR | 4.00 |
| 100 YEAR | 5.88 |

VOLUME OF RUNOFF (2-YR) = 7,798 CF

ADELPHIA GATEWAY

COMMONWEALTH OF PENNSYLVANIA REGISTERED PROFESSIONAL ENGINEER SHINY M. MATHEW NO. PE082407

15 0 30 60

SCALE: 1"=30'

DATE: _____

| REV | DESCRIPTION | CHK | DATE | APP | DATE |
|---|---|---|---|---|---|
| 2 | REVISED TO ADDRESS DEP COMMENTS | ATH | 03/24/20 | SMM | 03/24/20 |
| 1 | REVISED TO ADDRESS DEP COMMENTS | ATH | 11/15/19 | SMM | 11/15/19 |

REVISION

| | INTL | DATE |
|---|---|---|
| DRAWN BY | | |
| DESIGNED BY | RY | 03/24/20 |
| CHECKED BY | AH | 03/24/20 |
| APPROVED BY | SMM | 03/24/20 |
| JOB NO. | 18-00672-006 | |
| PLOT SCALE | 1"=30' | |
| MODEL ID | | |

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# DRAINAGE AREA MAP PROPOSED CONDITIONS TRANSCO METER STATION

| SCALE | DRAWING NUMBER | REV |
|---|---|---|
| 1"=30' | DA-4 | |

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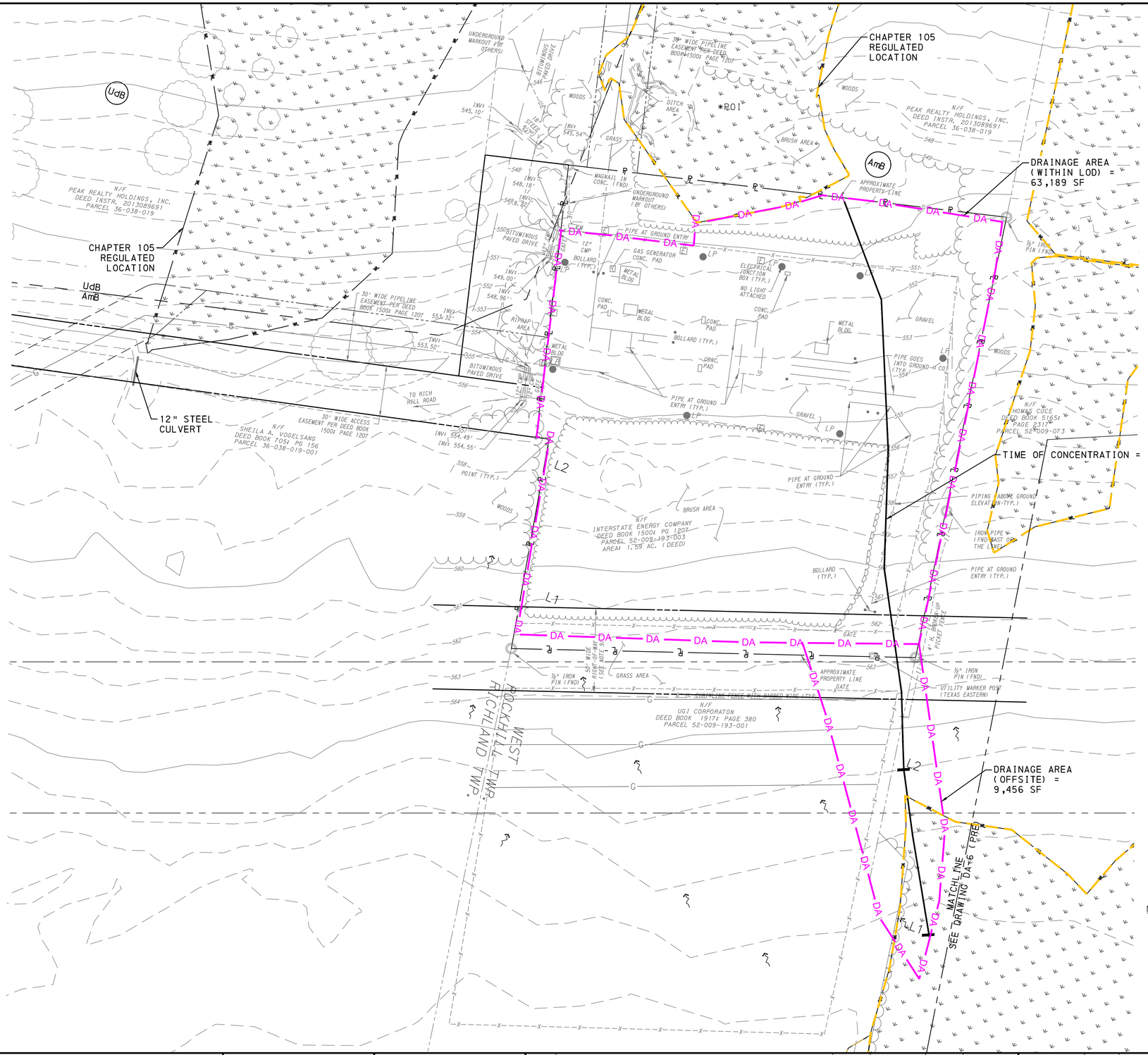


## LEGEND

| | |
|---|---|
| 324 | EXISTING 1' CONTOUR |
| 325 | EXISTING 5' CONTOUR |
| | EXISTING TREE LINE |
| X X | EXISTING FENCE LINE |
| E | EXISTING OVERHEAD ELECTRIC |
| | EXISTING UTILITY POLE |
| W | EXISTING WATER LINE |
| G | EXISTING GAS LINE |
| S | EXISTING SEWER LINE |
| | EXISTING GAS EASEMENT |
| | UTILITY EASEMENT |
| PL | EXISTING PROPERTY LINE |
| WL | EXISTING WETLAND BOUNDARY |
| | EXISTING WETLAND AREA |
| | 100-YEAR FLOOD PLAIN |
| | SOIL BOUNDARY |
| We | SOIL TYPE |
| DA DA | DRAINAGE AREA |
| | EXISTING TIME OF CONCENTRATION FLOW PATH |

| EXISTING PEAK RATES TO POINT OF INTEREST | |
|---|---|
| STORM | RATE OF RUNOFF (CFS) |
| 2 YEAR | 3.28 |
| 10 YEAR | 5.78 |
| 50 YEAR | 9.37 |
| 100 YEAR | 111.40 |

VOLUME OF RUNOFF (2-YR) = 8,742 CF

NOTES:

2. THE EXISTING DRAINAGE AREA INCLUDES THE AREA WITHIN THE LIMIT OF DISTURBANCE AND THE OFF-SITE AREA THAT DRAIN TO THE PROPOSED BMP. THE DRAINAGE UPSTREAM OF THE PROJECT SITE WAS NOT INCLUDED IN THE CALCULATIONS SINCE THE NET CHANGE IN VOLUME/RATE OF RUNOFF IS NEGLIGIBLE.
3. RECEIVING STREAM AND CHAPTER 93 CLASSIFICATION (DESIGNATED AND EXISTING USE): TOHICKON CREEK-TSF, SILTATION-IMPAIRED
4. TOHICKON CREEK IS LOCATED APPROXIMATELY 1,900 FT N OF THE PROJECT SITE

ADELPHIA GATEWAY

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
SHINY M. MATHEW
ENGINEER
NO. PE082407

15 0 30 60
SCALE: 1"=30'

DATE: _____

| REV | DESCRIPTION | CHK | DATE | APP | DATE |
|---|---|---|---|---|---|
| 2 | REVISED TO ADDRESS DEP COMMENTS | ATH | 03/24/20 | SMM | 03/24/20 |
| 1 | REVISED TO ADDRESS DEP COMMENTS | ATH | 11/15/19 | SMM | 11/15/19 |

REVISION

| | | |
|---|---|---|
| DRAWN BY | INTL | DATE |
| DESIGNED BY | RY | 03/24/20 |
| CHECKED BY | AH | 03/24/20 |
| APPROVED BY | SMM | 03/24/20 |
| JOB NO. | 18-00672-006 | |
| PLOT SCALE | 1"=30' | |
| MODEL ID | | |

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Philadelphia, PA 19103
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# DRAINAGE AREA MAP
# EXISTING CONDITIONS
# QUAKERTOWN COMPRESSOR STATION

| SCALE | DRAWING NUMBER | REV |
|---|---|---|
| 1"=30' | DA-5 | |

DATE PRINTED: 3/24/2020 6:39:49 PM
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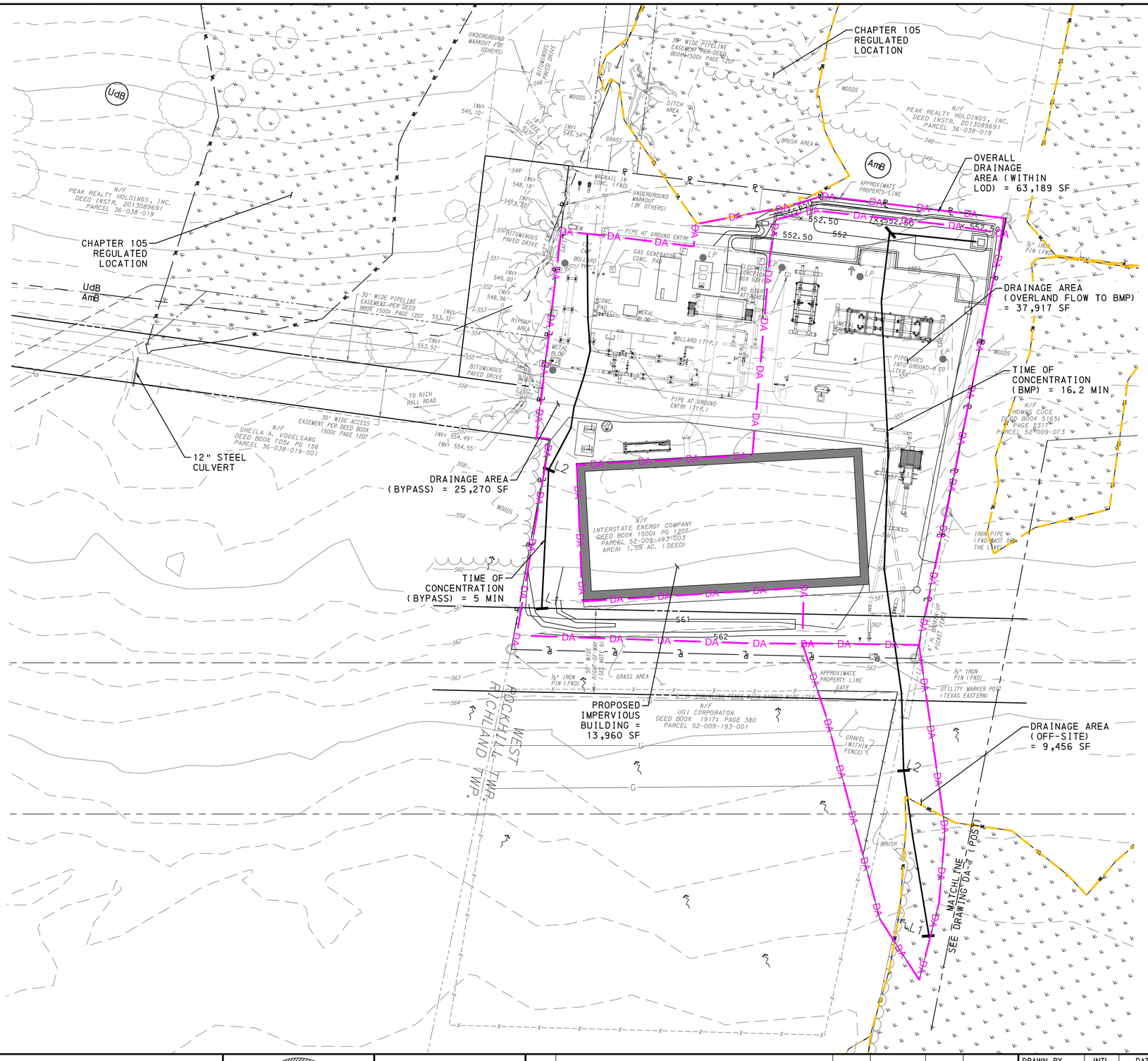


## LEGEND

| | |
|---|---|
| 324 | EXISTING 1' CONTOUR |
| 325 | EXISTING 5' CONTOUR |
| | EXISTING TREE LINE |
| X X | EXISTING FENCE LINE |
| E | EXISTING OVERHEAD ELECTRIC |
| | EXISTING UTILITY POLE |
| W | EXISTING WATER LINE |
| G | EXISTING GAS LINE |
| S | EXISTING SEWER LINE |
| | EXISTING GAS EASEMENT |
| | UTILITY EASEMENT |
| PL | EXISTING PROPERTY LINE |
| WL | EXISTING WETLAND BOUNDARY |
| | EXISTING WETLAND AREA |
| | 100-YEAR FLOOD PLAIN |
| | SOIL BOUNDARY |
| We | SOIL TYPE |
| DA DA | DRAINAGE AREA |
| | EXISTING TIME OF CONCENTRATION FLOW PATH |
| | SUBSURFACE STORAGE TANK |

| PROPOSED PEAK RATES TO POINT OF INTEREST | |
|---|---|
| STORM | RATE OF RUNOFF (CFS) |
| 2 YEAR | 2.22 |
| 10 YEAR | 3.47 |
| 50 YEAR | 5.18 |
| 100 YEAR | 6.13 |

VOLUME OF RUNOFF (2-YR) = 12,504 CF

NOTES:

1. ALL AREA WITHIN THE LIMIT OF DISTURBANCE IS CONSIDERED GRAVEL, UNLESS OTHERWISE NOTED.
2. THE PROPOSED DRAINAGE AREA INCLUDES THE AREA WITHIN THE LIMIT OF DISTURBANCE AND THE OFF-SITE AREA THAT DRAIN TO THE PROPOSED BMP. THE DRAINAGE UPSTREAM OF THE PROJECT SITE WAS NOT INCLUDED IN THE CALCULATIONS SINCE THE NET CHANGE IN VOLUME/RATE OF RUNOFF IS NEGLIGIBLE.
3. RECEIVING STREAM AND CHAPTER 93 CLASSIFICATION (DESIGNATED AND EXISTING USE): TOHICKON CREEK-TSF, SILTATION-IMPAIRED
4. TOHICKON CREEK IS LOCATED APPROXIMATELY 1,900 FT N OF THE PROJECT SITE

ADELPHIA GATEWAY

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL ENGINEER
SHINY M. MATHEW
NO. PE082407

15 0 30 60
SCALE: 1"=30'

DATE: _____

| REV | DESCRIPTION | CHK | DATE | APP | DATE |
|---|---|---|---|---|---|
| 2 | REVISED TO ADDRESS DEP COMMENTS | ATH | 03/24/20 | SMM | 03/24/20 |
| 1 | REVISED TO ADDRESS DEP COMMENTS | ATH | 11/15/19 | SMM | 11/15/19 |

REVISION

| | INTL | DATE |
|---|---|---|
| DRAWN BY | | |
| DESIGNED BY | RY | 03/24/20 |
| CHECKED BY | AH | 03/24/20 |
| APPROVED BY | SMM | 03/24/20 |
| JOB NO. | 18-00672-006 | |
| PLOT SCALE | 1"=30' | |
| MODEL ID | | |

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# DRAINAGE AREA MAP
# PROPOSED CONDITIONS
# QUAKERTOWN COMPRESSOR STATION

| SCALE | DRAWING NUMBER | REV |
|---|---|---|
| 1"=30' | DA-6 | |

DATE PRINTED: 3/24/2020 6:40:56 PM
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# Appendix D

## Stormwater Management Computations

# Appendix D.1

Project_Adelphia Gateway Pipeline | Job No._18-00672-005
Subject Worksheet 4 | Sheet No.___1___ of ___2___
Computed By RRY Date 2/5/2019 | Checked By: ATH Date: 3/19/2019

**PROJECT:** Adelphia Gateway Pipeline
**Drainage Area:** Quakertown Compressor Station
**2-Year Rainfall:** 3.16 in

**Total Site Area:** _____ acres
**Protected Site Area:** _____ acres
**Managed Area:** _____ acres

**Existing Conditions:**

| Cover Type/Condition | Soil Type | Area (sf) | Area (ac) | CN | S | Ia (0.2*S) | Q Runoff[1] (in) | Runoff Volume[2] ($ft^3$) |
|---|---|---|---|---|---|---|---|---|
| Impervious | D | 242 | 0.01 | 98 | 0.20 | 0.04 | 2.93 | 59.09 |
| Woods, Good | D | 2,978 | 0.07 | 77 | 2.99 | 0.60 | 1.18 | 292.84 |
| Gravel (Including R/W) | D | 27,193 | 0.62 | 91 | 0.99 | 0.20 | 2.22 | 5030.71 |
| Meadow | D | 29,779 | 0.68 | 78 | 2.82 | 0.56 | 1.24 | 3077.16 |
| TOTAL: | | 60,192 | | | | | | 8459.80 |

Note: 20% of existing gravel and impervious is considered meadow. All non-forested pervious areas are considered meadow.

**Developed Conditions:**

| Cover Type/Condition | Soil Type | Area (sf) | Area (ac) | CN | S | Ia (0.2*S) | Q Runoff[1] (in) | Runoff Volume[2] ($ft^3$) |
|---|---|---|---|---|---|---|---|---|
| Impervious | D | 14,113 | 0.324 | 98 | 0.20 | 0.04 | 2.93 | 3446.03 |
| Gravel (Including R/W) | D | 48,961 | 1.124 | 91 | 0.99 | 0.20 | 2.22 | 9057.87 |
| TOTAL: | | 63,075 | | | | | | 12503.90 |

**2-Year Volume Increase ($ft^3$): 4044.10**

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

1. Runoff (in) = $Q = (P-0.2S)^2 / (P+0.8S)$ where
   P = 2-Year Rainfall (in)
   S = (1000/CN)-10
2. Runoff Volume (CF) = Q x Area x 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.**

Project Adelphia Gateway Pipeline | Job No. 18-00672-005
Subject Worksheet 5 | Sheet No. 2 of 2
Computed By RRY Date 3/1/2019 | Checked By: ATH Date: 3/20/2020

## Worksheet 5. Structural BMP Volume Credits

**PROJECT:** Adelphia Gateway Pipeline
**Drainage Area:** Quakertown Compressor Station
**2-Year Rainfall:** 3.19 in

**By:** RRY **Checked:** ATH
**Date:** 3/1/19 **Date:** 3/19/19

**SUB-BASIN:**

**Required Control Volume ($ft^3$) – *from Worksheet 4*:** 4044.10
**Non-structural Volume Credit ($ft^3$) – *from Worksheet 3*:** - 0
*(maximum is 25% of required volume)*

**Structural Volume Reqmt ($ft^3$):** = 4044.10
*(Required Control Volume minus Non-structural Credit)*

| Proposed BMP | | Area ($ft^2$) | Storage Volume ($ft^3$) |
|---|---|---|---|
| 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 | | |
| 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 | | |
| 6.7.1 | Riparian Buffer/Riparian Forest Buffer Restoration | | |
| 6.7.2 | Landscape Restoration / Reforestation | | |
| 6.7.3 | Soil Amendment | | |
| 6.8.1 | Level Spreader | | |
| 6.8.2 | Special Storage Areas | | |
| *Other* | **Non-vegetated MRC BMP: Underground Storage Chambers** | 3843 | 6674 |

**Total Structure Volume ($ft^3$):** 6674
**Structural Volume Requirement ($ft^3$):** 4044.10

**DIFFERENCE:** 2629.9

## 90% DISTURBED AREA COMPLIANCE

**Adelphia Quakertown**

| | | |
|---|---|---|
| Disturbed / Non-Restoration Are | 1.45 | ac |
| Total Drainage Area Treated (including onsite areas only ) | 0.87 | ac |
| **90% of the disturbed area** | **1.31** | **ac** |
| **% of Disturbed Area Treated in BMPs** | **60.00** | % |

## Worksheet 12 – Water Quality Analysis of Pollutant Loading from All Disturbed Areas

**Quakertown (PRE)**

| | |
|---|---|
| Total Site Area (AC) | 1.45 |
| Total Disturbed Area (AC) | 1.45 |
| Disturbed Area Controlled by BMPs (AC) | 0.87 |
| 2-Year, 24 Hour Rainfall (in) | 3.16 |

**Total Disturbed Areas:**

| | | Pollutant | | | | | Pollutant Load* | | |
|---|---|---|---|---|---|---|---|---|---|
| | Land Cover Classification | TSS EMC (mg/l) | TP EMC (mg/l) | Nitrate-Nitrite EMC (mg/l as N) | Cover (Acres) | Runoff Volume (AF) | TSS** (LBS) | TP** (LBS) | $NO_3$ (LBS) |
| Pervious Surfaces | Forest | 39 | 0.15 | 0.17 | 0.13 | 0.04 | 3.72 | 0.01 | 0.02 |
| | Meadow | 47 | 0.19 | 0.3 | 0.526 | 0.14 | 17.58 | 0.07 | 0.11 |
| | Fertilized Planting Area | 55 | 1.34 | 0.73 | | | | | |
| | Native Planting Area | 55 | 0.4 | 0.33 | | | | | |
| | Lawn, Low-Input | 180 | 0.4 | 0.44 | | | | | |
| | Lawn, High-Input | 180 | 2.22 | 1.46 | | | | | |
| | Golf Course Fairway/Green | 305 | 1.07 | 1.84 | | | | | |
| | Grassed Athletic Field | 200 | 1.07 | 1.01 | | | | | |
| Impervious Surfaces | Rooftop | 21 | 0.13 | 0.32 | | | | | |
| | High Traffic Street/Highway | 261 | 0.4 | 0.83 | | | | | |
| | Medium Traffic Street | 113 | 0.33 | 0.58 | | | | | |
| | Low Traffic/Residential Street | 86 | 0.36 | 0.47 | | | | | |
| | Res. Driveway, Play Courts, etc. | 60 | 0.46 | 0.47 | | | | | |
| | High Traffic Parking Lot | 120 | 0.39 | 0.6 | | | | | |
| | Low Traffic Parking Lot | 58 | 0.15 | 0.39 | 0.79 | 0.2073176 | 32.465931 | 0.0839636 | 0.2183054 |
| | | | | | | **TOTAL LOAD** | 53.77 | 0.17 | 0.35 |

*Pollutant Load = [EMC, mg/l] X [Volume, AF] X [2.7, Unit Conversion]

**TSS and TP calculations only required for projects not meeting CG1/CG2 or not controlling less than 90% of the disturbed area

## Worksheet 12 – Water Quality Analysis of Pollutant Loading from All Disturbed Areas

**Quakertown (POST)**

| | |
|---|---|
| Total Site Area (AC) | 1.45 |
| Total Disturbed Area (AC) | 1.45 |
| Disturbed Area Controlled by BMPs (AC) | 0.87 |
| 2-Year, 24 Hour Rainfall (in) | 3.16 |

**Total Disturbed Areas:**

| | | Pollutant | | | | | Pollutant Load* | | |
|---|---|---|---|---|---|---|---|---|---|
| | Land Cover Classification | TSS EMC (mg/l) | TP EMC (mg/l) | Nitrate-Nitrite EMC (mg/l as N) | Cover (Acres) | Runoff Volume (AF) | TSS** (LBS) | TP** (LBS) | $NO_3$ (LBS) |
| Pervious Surfaces | Forest | 39 | 0.15 | 0.17 | | | | | |
| | Meadow | 47 | 0.19 | 0.3 | | | | | |
| | Fertilized Planting Area | 55 | 1.34 | 0.73 | | | | | |
| | Native Planting Area | 55 | 0.4 | 0.33 | | | | | |
| | Lawn, Low-Input | 180 | 0.4 | 0.44 | | | | | |
| | Lawn, High-Input | 180 | 2.22 | 1.46 | | | | | |
| | Golf Course Fairway/Green | 305 | 1.07 | 1.84 | | | | | |
| | Grassed Athletic Field | 200 | 1.07 | 1.01 | | | | | |
| Impervious Surfaces | Rooftop | 21 | 0.13 | 0.32 | 0.32 | 0.0842667 | 4.77792 | 0.0295776 | 0.0728064 |
| | High Traffic Street/Highway | 261 | 0.4 | 0.83 | | | | | |
| | Medium Traffic Street | 113 | 0.33 | 0.58 | | | | | |
| | Low Traffic/Residential Street | 86 | 0.36 | 0.47 | | | | | |
| | Res. Driveway, Play Courts, etc. | 60 | 0.46 | 0.47 | | | | | |
| | High Traffic Parking Lot | 120 | 0.39 | 0.6 | | | | | |
| | Low Traffic Parking Lot | 58 | 0.15 | 0.39 | 1.13 | 0.2975667 | 46.59894 | 0.1205145 | 0.3133377 |
| | | | | | | **TOTAL LOAD** | 51.38 | 0.15 | 0.39 |

*Pollutant Load = [EMC, mg/l] X [Volume, AF] X [2.7, Unit Conversion]

**TSS and TP calculations only required for projects not meeting CG1/CG2 or not controlling less than 90% of the disturbed area

Project: Adelphia Job No._____
Subject: Worksheet 13-Quakertown Meter Station Sheet No.___4___ of ___4___
Computed By: RRY Date: 2/26/19 Checked By: ATH Date 3/20/2020

## Worksheet 13 - Pollutant Reduction Through BMP Applications*

*Fill this worksheet out for each BMP type with different pollutant removal efficiencies. Sum pollutant reduction achieved for all BMP types on final sheet.

**BMP TYPE:** Non-vegetated Underground System

| | |
|---|---|
| Disturbed Area Controlled by BMPs (AC) | 0.87 |
| 2-Year, 24 Hour Rainfall (in) | 3.16 |

**Total Disturbed Areas:**

| | | Pollutant | | | | | Pollutant Load** | | |
|---|---|---|---|---|---|---|---|---|---|
| | Land Cover Classification | TSS EMC (mg/l) | TP EMC (mg/l) | Nitrate-Nitrite EMC (mg/l as N) | Cover (Acres) | Runoff Volume (AF) | TSS*** (LBS) | TP*** (LBS) | $NO_3$ (LBS) |
| Pervious Surfaces | Forest | 39 | 0.15 | 0.17 | | | | | |
| | Meadow | 47 | 0.19 | 0.3 | | | | | |
| | Fertilized Planting Area | 55 | 1.34 | 0.73 | | | | | |
| | Native Planting Area | 55 | 0.4 | 0.33 | | | | | |
| | Lawn, Low-Input | 180 | 0.4 | 0.44 | | | | | |
| | Lawn, High-Input | 180 | 2.22 | 1.46 | | | | | |
| | Golf Course Fairway/Green | 305 | 1.07 | 1.84 | | | | | |
| | Grassed Athletic Field | 200 | 1.07 | 1.01 | | | | | |
| Impervious Surfaces | Rooftop | 21 | 0.13 | 0.32 | 0.32 | 0.0842667 | 4.77792 | 0.0295776 | 0.0728064 |
| | High Traffic Street/Highway | 261 | 0.4 | 0.83 | | | | | |
| | Medium Traffic Street | 113 | 0.33 | 0.58 | | | | | |
| | Low Traffic/Residential Street | 86 | 0.36 | 0.47 | | | | | |
| | Res. Driveway, Play Courts, etc. | 60 | 0.46 | 0.47 | | | | | |
| | High Traffic Parking Lot | 120 | 0.39 | 0.6 | | | | | |
| | Low Traffic Parking Lot | 58 | 0.15 | 0.39 | 0.55 | 0.1448333 | 22.6809 | 0.0586575 | 0.1525095 |
| | TOTAL LOAD TO THIS BMP TYPE | | | | | | 27.46 | 0.09 | 0.23 |
| | LLUTANT REMOVAL EFFICIENCIES FROM APPENDIX A. STORMWATER MANUAL | | | | | | 60% | 40% | 20% |
| | POLLUTANT REDUCTION ACHIEVED BY THIS BMP TYPE (LBS) | | | | | | 16.48 | 0.04 | 0.05 |

*The pollutant removal efficiencies used are based off of a dry extended detention basin (BMP 6.6.3)
**Pollutant Load = [EMC, mg/l] X [Volume, AF] X [2.7, Unit Conversion]

***TSS and TP calculations only required for projects not meeting CG1/CG2 or not controlling less than 90% of the disturbed area

Project: Adelphia
Subject: Transco Meter Station LOD
Computed By: RRY Date: 2/5/2019

Job No. 18-00672-005
Sheet No. 1 of 2
Checked By: ATH Date: 3/20/2020

Check one: ☑ Present ☐ Developed

**TRANSCO METER STATION: EXISTING CONDITIONS WITHIN LOD**

## 1. Runoff curve number

| Soil name and hydrologic group | Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio | CN Table 2-2a | CN | CN | Area ☒ acres ☐ mi2 ☐ % | Product of CN x area |
|---|---|---|---|---|---|---|
| C | Woods, Good | 70 | | | 0.597 | 41.818 |
| C | Meadow | 71 | | | 0.268 | 19.028 |
| D | Meadow | 78 | | | 0.007 | 0.543 |
| | | | | **Totals** ➡ | 0.87 | 61.39 |

CN(weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{61.39}{0.87} = 70.37$ ; **Use CN** ➡ 70

## 2. Runoff

| | Storm #1 | Storm #2 | Storm #3 | Storm #4 |
|---|---|---|---|---|
| Frequency ..... yr | 2-YR | 10-YR | 50-YR | 100-YR |
| Rainfall, P (24-hour) ..... in | 3.40 | 4.95 | 7.16 | 8.43 |
| Runoff, Q ..... in | 0.97 | 2.03 | 3.79 | 4.88 |

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S}$$

$$I_a = 0.2S \qquad S = \frac{1000}{CN} - 10$$

(SCS Method)

Project: Adelphia
Job No. 18-00672-005
Subject: Transco Meter Station DA and LOD
Sheet No. 2 of 2
Computed By: RRY Date: 2/5/2019
Checked By: ATH Date: 3/20/2020

Check one: ☑ Present ☐ Developed

**TRANSCO METER STATION: EXISTING CONDITIONS WITHIN LOD AND OFF-SITE DRAINAGE AREA**

## 1. Runoff curve number

| Soil name and hydrologic group | Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio | CN Table 2-2a | CN | CN | Area ☒ acres ☐ mi2 ☐ % | Product of CN x area |
|---|---|---|---|---|---|---|
| C | Woods, Good | 70 | | | 0.597 | 41.818 |
| C | Meadow | 71 | | | 0.268 | 19.028 |
| D | Meadow | 78 | | | 0.007 | 0.543 |
| C | Brush, Good | 65 | | | 0.000 | 0.000 |
| D | Brush, Good | 73 | | | 0.066 | 4.788 |
| | | | | **Totals** ➡ | 0.94 | 66.18 |

CN(weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{66.18}{0.94} = 70.55$ ; **Use CN** ➡ 71

## 2. Runoff

| | Storm #1 | Storm #2 | Storm #3 | Storm #4 |
|---|---|---|---|---|
| Frequency ..... yr | 2-YR | 10-YR | 50-YR | 100-YR |
| Rainfall, P (24-hour) ..... in | 3.40 | 4.95 | 7.16 | 8.43 |
| Runoff, Q ..... in | 0.98 | 2.04 | 3.81 | 4.90 |

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S}$$

$$I_a = 0.2S \qquad S = \frac{1000}{CN} - 10$$

(SCS Method)

## 90% DISTURBED AREA COMPLIANCE

**Adelphia Transco**

| | | |
|---|---|---|
| Disturbed / Non-Restoration Are | 0.87 | ac |
| Total Drainage Area Treated (including onsite areas only ) | 0.64 | ac |
| **90% of the disturbed area** | **0.78** | **ac** |
| **% of Disturbed Area Treated in BMPs** | **73.56** | % |

## Worksheet 12 – Water Quality Analysis of Pollutant Loading from All Disturbed Areas

**Transco (PRE)**

| | |
|---|---|
| Total Site Area (AC) | 0.87 |
| Total Disturbed Area (AC) | 0.87 |
| Disturbed Area Controlled by BMPs (AC) | 0.64 |
| 2-Year, 24 Hour Rainfall (in) | 3.4 |

**Total Disturbed Areas:**

| | | Pollutant | | | | | Pollutant Load* | | |
|---|---|---|---|---|---|---|---|---|---|
| | Land Cover Classification | TSS EMC (mg/l) | TP EMC (mg/l) | Nitrate- #VALUE! (mg/l as N) | Cover (Acres) | Runoff Volume (AF) | TSS** (LBS) | TP** (LBS) | $NO_3$ (LBS) |
| Pervious Surfaces | Forest | 39 | 0.15 | 0.17 | 0.60 | 0.17 | 17.82 | 0.07 | 0.08 |
| | Meadow | 47 | 0.19 | 0.3 | 0.28 | 0.08 | 9.89 | 0.04 | 0.06 |
| | Fertilized Planting Area | 55 | 1.34 | 0.73 | | | | | |
| | Native Planting Area | 55 | 0.4 | 0.33 | | | | | |
| | Lawn, Low-Input | 180 | 0.4 | 0.44 | | | | | |
| | Lawn, High-Input | 180 | 2.22 | 1.46 | | | | | |
| | Golf Course Fairway/Green | 305 | 1.07 | 1.84 | | | | | |
| | Grassed Athletic Field | 200 | 1.07 | 1.01 | | | | | |
| Impervious Surfaces | Rooftop | 21 | 0.13 | 0.32 | | | | | |
| | High Traffic Street/Highway | 261 | 0.4 | 0.83 | | | | | |
| | Medium Traffic Street | 113 | 0.33 | 0.58 | | | | | |
| | Low Traffic/Residential Street | 86 | 0.36 | 0.47 | | | | | |
| | Res. Driveway, Play Courts, etc. | 60 | 0.46 | 0.47 | | | | | |
| | High Traffic Parking Lot | 120 | 0.39 | 0.6 | | | | | |
| | Low Traffic Parking Lot | 58 | 0.15 | 0.39 | | | | | |
| | | | | | | **TOTAL LOAD** | 27.71 | 0.11 | 0.14 |

*Pollutant Load = [EMC, mg/l] X [Volume, AF] X [2.7, Unit Conversion]

**TSS and TP calculations only required for projects not meeting CG1/CG2 or not controlling less than 90% of the disturbed area

## Worksheet 12 – Water Quality Analysis of Pollutant Loading from All Disturbed Areas

**Transco (POST)**

| | |
|---|---|
| Total Site Area (AC) | 0.87 |
| Total Disturbed Area (AC) | 0.87 |
| Disturbed Area Controlled by BMPs (AC) | 0.64 |
| 2-Year, 24 Hour Rainfall (in) | 3.4 |

**Total Disturbed Areas:**

| | | Pollutant | | | | | Pollutant Load* | | |
|---|---|---|---|---|---|---|---|---|---|
| | Land Cover Classification | TSS EMC (mg/l) | TP EMC (mg/l) | Nitrate- #VALUE! (mg/l as N) | Cover (Acres) | Runoff Volume (AF) | TSS** (LBS) | TP** (LBS) | $NO_3$ (LBS) |
| Pervious Surfaces | Forest | 39 | 0.15 | 0.17 | | | | | |
| | Meadow | 47 | 0.19 | 0.3 | | | | | |
| | Fertilized Planting Area | 55 | 1.34 | 0.73 | | | | | |
| | Native Planting Area | 55 | 0.4 | 0.33 | | | | | |
| | Lawn, Low-Input | 180 | 0.4 | 0.44 | | | | | |
| | Lawn, High-Input | 180 | 2.22 | 1.46 | | | | | |
| | Golf Course Fairway/Green | 305 | 1.07 | 1.84 | | | | | |
| | Grassed Athletic Field | 200 | 1.07 | 1.01 | | | | | |
| Impervious Surfaces | Rooftop | 21 | 0.13 | 0.32 | | | | | |
| | High Traffic Street/Highway | 261 | 0.4 | 0.83 | | | | | |
| | Medium Traffic Street | 113 | 0.33 | 0.58 | | | | | |
| | Low Traffic/Residential Street | 86 | 0.36 | 0.47 | | | | | |
| | Res. Driveway, Play Courts, etc. | 60 | 0.46 | 0.47 | | | | | |
| | High Traffic Parking Lot | 120 | 0.39 | 0.6 | | | | | |
| | Low Traffic Parking Lot | 58 | 0.15 | 0.39 | 0.87 | 0.2465 | 38.6019 | 0.0998325 | 0.2595645 |
| | | | | | | **TOTAL LOAD** | 38.60 | 0.10 | 0.26 |

*Pollutant Load = [EMC, mg/l] X [Volume, AF] X [2.7, Unit Conversion]

**TSS and TP calculations only required for projects not meeting CG1/CG2 or not controlling less than 90% of the disturbed area

## Worksheet 13 - Pollutant Reduction Through BMP Applications*

*Fill this worksheet out for each BMP type with different pollutant removal efficiencies. Sum pollutant reduction achieved for all BMP types on final sheet.

**BMP TYPE:** Subsurface Storm-Tank

| | |
|---|---|
| Disturbed Area Controlled by BMPs (AC) | 0.64 |
| 2-Year, 24 Hour Rainfall (in) | 3.4 |

**Total Disturbed Areas:**

| | | Pollutant | | | | | Pollutant Load** | | |
|---|---|---|---|---|---|---|---|---|---|
| | Land Cover Classification | TSS EMC (mg/l) | TP EMC (mg/l) | Nitrate-Nitrite EMC (mg/l as N) | Cover (Acres) | Runoff Volume (AF) | TSS*** (LBS) | TP*** (LBS) | $NO_3$ (LBS) |
| Pervious Surfaces | Forest | 39 | 0.15 | 0.17 | | 0.00 | | | |
| | Meadow | 47 | 0.19 | 0.3 | | 0.00 | | | |
| | Fertilized Planting Area | 55 | 1.34 | 0.73 | | 0 | | | |
| | Native Planting Area | 55 | 0.4 | 0.33 | | 0 | | | |
| | Lawn, Low-Input | 180 | 0.4 | 0.44 | | 0 | | | |
| | Lawn, High-Input | 180 | 2.22 | 1.46 | | 0 | | | |
| | Golf Course Fairway/Green | 305 | 1.07 | 1.84 | | 0 | | | |
| | Grassed Athletic Field | 200 | 1.07 | 1.01 | | 0 | | | |
| Impervious Surfaces | Rooftop | 21 | 0.13 | 0.32 | | 0 | | | |
| | High Traffic Street/Highway | 261 | 0.4 | 0.83 | | 0 | | | |
| | Medium Traffic Street | 113 | 0.33 | 0.58 | | 0.00 | | | |
| | Low Traffic/Residential Street | 86 | 0.36 | 0.47 | | 0.00 | | | |
| | Res. Driveway, Play Courts, etc. | 60 | 0.46 | 0.47 | | 0.00 | | | |
| | High Traffic Parking Lot | 120 | 0.39 | 0.6 | | 0.00 | | | |
| | Low Traffic Parking Lot | 58 | 0.15 | 0.39 | 0.57 | 0.16 | 25.42401 | 0.0657518 | 0.1709546 |
| | TOTAL LOAD TO THIS BMP TYPE | | | | | | 25.42 | 0.07 | 0.17 |
| | LLUTANT REMOVAL EFFICIENCES FROM APPENDIX A. STORMWATER MANUAL | | | | | | 85% | 85% | 30% |
| | POLLUTANT REDUCTION ACHIEVED BY THIS BMP TYPE (LBS) | | | | | | 21.61 | 0.06 | 0.05 |

**Pollutant Load = [EMC, mg/l] X [Volume, AF] X [2.7, Unit Conversion]

***TSS and TP calculations only required for projects not meeting CG1/CG2 or not controlling less than 90% of the disturbed area

Project: Adelphia
Subject: Marcus Hook Compressor Station
Computed By: RRY Date: 2/5/2019

Job No. 18-00672-005
Sheet No. 1 of 1
Checked By: ATH Date: 3/20/2020

Check one: ☑ Present ☐ Developed

**MARCUS HOOK COMPRESSOR STATION STATION: EXISTING CONDITIONS WITHIN LOD**

## 1. Runoff curve number

| Soil name and hydrologic group | Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio | CN Table 2-2a | CN | CN | Area ☒ acres ☐ mi2 ☐ % | Product of CN x area |
|---|---|---|---|---|---|---|
| D | Impervious | 98 | | | 0.56 | 55.274 |
| D | Meadow | 78 | | | 1.25 | 97.171 |
| D | Gravel | 91 | | | 4.42 | 402.136 |
| | | | | **Totals** ➡ | 6.23 | 554.58 |

CN(weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{554.58}{6.23} = 89.03$ ; **Use CN** ➡ 89

## 2. Runoff

| | Storm #1 | Storm #2 | Storm #3 | Storm #4 |
|---|---|---|---|---|
| Frequency ..... yr | 2-YR | 10-YR | 50-YR | 100-YR |
| Rainfall, P (24-hour) ..... in | 3.40 | 4.95 | 7.16 | 8.43 |
| Runoff, Q ..... in | 2.27 | 3.73 | 5.87 | 7.11 |

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S}$$

$$I_a = 0.2S \qquad S = \frac{1000}{CN} - 10$$

(SCS Method)

## 90% DISTURBED AREA COMPLIANCE

**Adelphia Marcus Hook**

| | | |
|---|---|---|
| Disturbed / Non-Restoration Are | 6.23 | ac |
| Total Drainage Area Treated (including onsite areas only ) | 2.20 | ac |
| **90% of the disturbed area** | **5.61** | **ac** |
| **% of Disturbed Area Treated in BMPs** | **35.32** | % |

## Worksheet 12 – Water Quality Analysis of Pollutant Loading from All Disturbed Areas

**Marcus Hook (PRE)**

| | |
|---|---|
| Total Site Area (AC) | 6.84 |
| Total Disturbed Area (AC) | 6.84 |
| Disturbed Area Controlled by BMPs (AC) | 2.20 |
| 2-Year, 24 Hour Rainfall (in) | 3.4 |

**Total Disturbed Areas:**

| | | Pollutant | | | | | Pollutant Load* | | |
|---|---|---|---|---|---|---|---|---|---|
| | Land Cover Classification | TSS EMC (mg/l) | TP EMC (mg/l) | Nitrate-Nitrite EMC (mg/l as N) | Cover (Acres) | Runoff Volume (AF) | TSS** (LBS) | TP** (LBS) | $NO_3$ (LBS) |
| Pervious Surfaces | Forest | 39 | 0.15 | 0.17 | | | | | |
| | Meadow | 47 | 0.19 | 0.3 | 1.25 | 0.35 | 44.79 | 0.18 | 0.29 |
| | Fertilized Planting Area | 55 | 1.34 | 0.73 | | | | | |
| | Native Planting Area | 55 | 0.4 | 0.33 | | | | | |
| | Lawn, Low-Input | 180 | 0.4 | 0.44 | | | | | |
| | Lawn, High-Input | 180 | 2.22 | 1.46 | | | | | |
| | Golf Course Fairway/Green | 305 | 1.07 | 1.84 | | | | | |
| | Grassed Athletic Field | 200 | 1.07 | 1.01 | | | | | |
| Impervious Surfaces | Rooftop | 21 | 0.13 | 0.32 | | | | | |
| | High Traffic Street/Highway | 261 | 0.4 | 0.83 | | | | | |
| | Medium Traffic Street | 113 | 0.33 | 0.58 | | | | | |
| | Low Traffic/Residential Street | 86 | 0.36 | 0.47 | | | | | |
| | Res. Driveway, Play Courts, etc. | 60 | 0.46 | 0.47 | | | | | |
| | High Traffic Parking Lot | 120 | 0.39 | 0.6 | | | | | |
| | Low Traffic Parking Lot | 58 | 0.15 | 0.39 | 6.23 | 1.7648493 | 276.37539 | 0.7147639 | 1.8583863 |
| | | | | | | **TOTAL LOAD** | 321.17 | 0.90 | 2.14 |

*Pollutant Load = [EMC, mg/l] X [Volume, AF] X [2.7, Unit Conversion]

**TSS and TP calculations only required for projects not meeting CG1/CG2 or not controlling less than 90% of the disturbed area

## Worksheet 12 – Water Quality Analysis of Pollutant Loading from All Disturbed Areas

**Marcus Hook (PRE)**

| | |
|---|---|
| Total Site Area (AC) | 6.84 |
| Total Disturbed Area (AC) | 6.84 |
| Disturbed Area Controlled by BMPs (AC) | 2.20 |
| 2-Year, 24 Hour Rainfall (in) | 3.4 |

**Total Disturbed Areas:**

| | | Pollutant | | | | | Pollutant Load* | | |
|---|---|---|---|---|---|---|---|---|---|
| | Land Cover Classification | TSS EMC (mg/l) | TP EMC (mg/l) | Nitrate-Nitrite EMC (mg/l as N) | Cover (Acres) | Runoff Volume (AF) | TSS** (LBS) | TP** (LBS) | $NO_3$ (LBS) |
| Pervious Surfaces | Forest | 39 | 0.15 | 0.17 | | | | | |
| | Meadow | 47 | 0.19 | 0.3 | | | | | |
| | Fertilized Planting Area | 55 | 1.34 | 0.73 | | | | | |
| | Native Planting Area | 55 | 0.4 | 0.33 | 0.86 | 0.2432725 | 36.125966 | 0.2627343 | 0.2167558 |
| | Lawn, Low-Input | 180 | 0.4 | 0.44 | | | | | |
| | Lawn, High-Input | 180 | 2.22 | 1.46 | | | | | |
| | Golf Course Fairway/Green | 305 | 1.07 | 1.84 | | | | | |
| | Grassed Athletic Field | 200 | 1.07 | 1.01 | | | | | |
| Impervious Surfaces | Rooftop | 21 | 0.13 | 0.32 | 0.31 | 0.0865871 | 4.9094876 | 0.0303921 | 0.0748112 |
| | High Traffic Street/Highway | 261 | 0.4 | 0.83 | | | | | |
| | Medium Traffic Street | 113 | 0.33 | 0.58 | | | | | |
| | Low Traffic/Residential Street | 86 | 0.36 | 0.47 | | | | | |
| | Res. Driveway, Play Courts, etc. | 60 | 0.46 | 0.47 | | | | | |
| | High Traffic Parking Lot | 120 | 0.39 | 0.6 | | | | | |
| | Low Traffic Parking Lot | 58 | 0.15 | 0.39 | 5.07 | 1.4353071 | 224.76909 | 0.5812994 | 1.5113784 |
| | | | | | | **TOTAL LOAD** | 265.80 | 0.87 | 1.80 |

*Pollutant Load = [EMC, mg/l] X [Volume, AF] X [2.7, Unit Conversion]

**TSS and TP calculations only required for projects not meeting CG1/CG2 or not controlling less than 90% of the disturbed area

## Worksheet 13 - Pollutant Reduction Through BMP Applications*

*Fill this worksheet out for each BMP type with different pollutant removal efficiencies. Sum pollutant reduction achieved for all BMP types on final sheet.

**BMP TYPE:** Detention Basin

| | |
|---|---|
| Disturbed Area Controlled by BMPs (AC) | 2.20 |
| 2-Year, 24 Hour Rainfall (in) | 3.4 |

**Total Disturbed Areas:**

| | | Pollutant | | | | | Pollutant Load** | | |
|---|---|---|---|---|---|---|---|---|---|
| | Land Cover Classification | TSS EMC (mg/l) | TP EMC (mg/l) | Nitrate-Nitrite EMC (mg/l as N) | Cover (Acres) | Runoff Volume (AF) | TSS*** (LBS) | TP*** (LBS) | $NO_3$ (LBS) |
| Pervious Surfaces | Forest | 39 | 0.15 | 0.17 | | 0.00 | | | |
| | Meadow | 47 | 0.19 | 0.3 | | 0.00 | | | |
| | Fertilized Planting Area | 55 | 1.34 | 0.73 | | 0 | | | |
| | Native Planting Area | 55 | 0.4 | 0.33 | 0.59 | 0.1671667 | 24.82425 | 0.18054 | 0.1489455 |
| | Lawn, Low-Input | 180 | 0.4 | 0.44 | | 0 | | | |
| | Lawn, High-Input | 180 | 2.22 | 1.46 | | 0 | | | |
| | Golf Course Fairway/Green | 305 | 1.07 | 1.84 | | 0 | | | |
| | Grassed Athletic Field | 200 | 1.07 | 1.01 | | 0 | | | |
| Impervious Surfaces | Rooftop | 21 | 0.13 | 0.32 | 0.31 | 0.0870382 | 4.935064 | 0.0305504 | 0.075201 |
| | High Traffic Street/Highway | 261 | 0.4 | 0.83 | | 0 | | | |
| | Medium Traffic Street | 113 | 0.33 | 0.58 | | 0.00 | | | |
| | Low Traffic/Residential Street | 86 | 0.36 | 0.47 | | 0.00 | | | |
| | Res. Driveway, Play Courts, etc. | 60 | 0.46 | 0.47 | | 0.00 | | | |
| | High Traffic Parking Lot | 120 | 0.39 | 0.6 | | 0.00 | | | |
| | Low Traffic Parking Lot | 58 | 0.15 | 0.39 | 1.30 | 0.37 | 57.681 | 0.149175 | 0.387855 |
| | TOTAL LOAD TO THIS BMP TYPE | | | | | | 87.44 | 0.36 | 0.61 |
| | LLUTANT REMOVAL EFFICIENCES FROM APPENDIX A. STORMWATER MANUAL | | | | | | 85% | 85% | 30% |
| | POLLUTANT REDUCTION ACHIEVED BY THIS BMP TYPE (LBS) | | | | | | 74.32 | 0.31 | 0.18 |

**Pollutant Load = [EMC, mg/l] X [Volume, AF] X [2.7, Unit Conversion]

***TSS and TP calculations only required for projects not meeting CG1/CG2 or not controlling less than 90% of the disturbed area

# Appendix D.2

**STANDARD E&S WORKSHEET #10**
**Rational Method**

| | | | |
|---|---|---|---|
| **PROJECT NAME:** | Adelphia | | |
| **LOCATION:** | Transco and Marcus Hook Stations | | |
| **PREPARED BY:** | RY | **DATE:** | 5/1/2019 |
| **CHECKED BY:** | ATH | **DATE:** | 5/19/2019 |

**DETERMINE WATERSHED "C" VALUE**

| Channel Number | Drainage Area Number | Type of Cover | C VALUE | AREA (acres) | (C X A) | $C_w$ |
|---|---|---|---|---|---|---|
| Off-site (Transco) | - | Impervious | 0.9 | 0.11 | 0.10 | 0.61 |
| | - | Gravel | 0.6 | 0.77 | 0.46 | |
| | - | Brush | 0.3 | 0.07 | 0.02 | |
| Off-site (Marcus Hook) | - | Impervious | 0.9 | 1.39 | 1.25 | 0.62 |
| | - | Gravel | 0.6 | 4.60 | 2.76 | |
| | - | Grass | 0.3 | 0.86 | 0.26 | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

**DETERMINE INTENSITY:**

| Channel Number | Tc | R2 | R10 | I2 | I10 |
|---|---|---|---|---|---|
| Off-site (Transco) | 5.00 | - | - | - | 6.50 |
| Off-site (Marcus Hook) | 5.00 | - | - | - | 6.50 |
| | | | | | |

**DETERMINE PEAK RUNOFF RATES (Q = C I A)**

| Channel Number | C VALUE | I (in./hr.) | A (acres) | Q2 (cfs) | Q10 (cfs) |
|---|---|---|---|---|---|
| Off-site (Transco) | 0.61 | 6.50 | 0.94 | - | 3.74 |
| Off-site (Marcus Hook) | 0.62 | 6.50 | 5.98 | - | 24.23 |
| | | | | | |

**STANDARD E&S WORKSHEET #11**
**Channel Design Data**

| | | | |
|---|---|---|---|
| **PROJECT NAME:** | Adelphia | | |
| **LOCATION:** | Transco and Marcus Hook Stations | | |
| **PREPARED BY:** | RY | **DATE:** | 5/1/2019 |
| **CHECKED BY:** | ATH | **DATE:** | 5/19/2019 |

| | | | | | |
|---|---|---|---|---|---|
| **CHANNEL OR CHANNEL SECTION** | Off-site (Transco) | Off-site (MH) | | | |
| **TEMPORARY OR PERMANENT (T or P)** | PERM | PERM | | | |
| **DESIGN STORM (2, 5, or 10 YR)** | 10 YR | 10 YR | | | |
| **ACRES (AC)** | 0.94 | 5.98 | | | |
| **MULTIPLIER (1.6, 2.25, or 2.75)[1]** | N/A | N/A | | | |
| **Qr (REQUIRED CAPACITY) (CFS)** | 3.74 | 24.23 | | | |
| **Q (CALCULATED AT FLOW DEPTH d) (CFS)** | 3.74 | 24.23 | | | |
| **PROTECTIVE LINING [2]** | Veg | R-4 | | | |
| **n (MANNING'S COEFFICIENT) [2]** | 0.080 | 0.038 | | | |
| **Va (ALLOWABLE VELOCITY) (FPS)** | 3.00 | 9.00 | | | |
| **V (CALCULATED AT FLOW DEPTH d) (FPS)** | 0.98 | 2.89 | | | |
| **$t_a$ (MAX. ALLOWABLE SHEAR STRESS) (LB/FT$^2$)** | 1.00 | 2.00 | | | |
| **td (SHEAR STRESS AT FLOW DEPTH d) (LB/FT2)** | 0.30 | 0.55 | | | |
| **CHANNEL BOTTOM WIDTH (FT)** | 6 | 6 | | | |
| **CHANNEL SIDE SLOPES (H:V)** | 4 | 4 | | | |
| **D (TOTAL DEPTH) (FT)** | 0.98 | 1.13 | | | |
| **CHANNEL TOP WIDTH @ D (FT)** | 13.85 | 15.05 | | | |
| **d (CALCULATED FLOW DEPTH) (FT)** | 0.48 | 0.88 | | | |
| **CHANNEL TOP WIDTH @ FLOW DEPTH d (FT)** | 9.85 | 13.05 | | | |
| **BOTTOM WIDTH:DEPTH RATIO (12:1 MAX)** | 12.5 | 6.8 | | | |
| **$d_{50}$ STONE SIZE (IN)** | 0.25 | 0.25 | | | |
| **A (CROSS-SECTIONAL AREA) (SQ.FT.)** | 3.82 | 8.39 | | | |
| **R (HYDRAULIC RADIUS)** | 0.38 | 0.63 | | | |
| **S (BED SLOPE) [3] (FT/FT)** | 0.0100 | 0.0100 | | | |
| **$S_c$ (CRITICAL SLOPE) (FT/FT)** | 0.1299 | 0.0248 | | | |
| **0.7 $S_c$ (FT/FT)** | 0.0909 | 0.0174 | | | |
| **1.3 $S_c$ (FT/FT)** | 0.1688 | 0.0322 | | | |
| **STABLE FLOW (Y/N)** | Y | Y | | | |
| **FREEBOARD BASED ON UNSTABLE FLOW (FT)** | N/A | N/A | | | |
| **FREEBOARD BASED ON STABLE FLOW (FT)** | 0.12 | 0.22 | | | |
| **MINIMUM REQUIRED FREEBOARD [4] (FT)** | 0.5 | 0.25 | | | |
| **DESIGN METHOD FOR PROTECTIVE LINING[5]** | V | V | | | |

1. Use 1.6 for Temporary Channels; 2.25 for Temporary Channels in Special Protection (HQ or EV) Watersheds; 2.75 for Permanent Channels. For Rational Method, enter "N/A" and attach Worksheets 9 and 10. For TR-55, enter N/A" and attach appropriate Worksheets.
2. Adjust "n" value for changes in channel liner and flow depth. For vegetated channels, provide data for manufactured linings without vegetation and with vegetation in separate columns.
3. Slopes may not be averaged
4. Minumum Freeboard is 0.5 ft. OR 1/4 Total Channel Depth, whichever is greater
5. Permissible velocity lining design method is not acceptable for channels with a bed slope of 10% or greater. Shear stress lining design method is required for channels with a bed slope of 10% or greater. Shear stress lining design method may be used for any channel bed slope.

United States Department of Agriculture

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

# Custom Soil Resource Report for Delaware County, Pennsylvania, and New Castle County, Delaware

March 24, 2020

# Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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# How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

# Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

# Custom Soil Resource Report
## Soil Map

Map Scale: 1:8,080 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 350 700 1400 2100

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

## MAP LEGEND

**Area of Interest (AOI)**

- Area of Interest (AOI)

**Soils**

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

**Special Point Features**

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

**Water Features**

- Streams and Canals

**Transportation**

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

**Background**

- Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at scales ranging from 1:20,000 to 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:
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: Delaware County, Pennsylvania
Survey Area Data: Version 17, Sep 17, 2019

Soil Survey Area: New Castle County, Delaware
Survey Area Data: Version 14, Sep 13, 2019

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

## MAP LEGEND

## MAP INFORMATION

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

Date(s) aerial images were photographed: May 26, 2019—Jul 10, 2019

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

# Map Unit Legend

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| BeB2 | Beltsville silt loam, 3 to 8 percent slopes, moderately eroded | 2.9 | 2.0% |
| ByA | Butlertown silt loam, 0 to 3 percent slopes | 2.3 | 1.6% |
| ByB2 | Butlertown silt loam, 3 to 8 percent slopes, moderately eroded | 25.3 | 17.4% |
| Ma | Made land, gravelly materials | 30.1 | 20.7% |
| OtA | Othello silt loams, 0 to 2 percent slopes, northern coastal plain | 70.5 | 48.5% |
| **Subtotals for Soil Survey Area** | | **131.0** | **90.3%** |
| **Totals for Area of Interest** | | **145.1** | **100.0%** |

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| Up | Urban land | 14.1 | 9.7% |
| **Subtotals for Soil Survey Area** | | **14.1** | **9.7%** |
| **Totals for Area of Interest** | | **145.1** | **100.0%** |

# Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different

management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

# Delaware County, Pennsylvania

## BeB2—Beltsville silt loam, 3 to 8 percent slopes, moderately eroded

### Map Unit Setting

*National map unit symbol:* 121d4
*Elevation:* 0 to 650 feet
*Mean annual precipitation:* 35 to 55 inches
*Mean annual air temperature:* 45 to 61 degrees F
*Frost-free period:* 160 to 250 days
*Farmland classification:* Farmland of statewide importance

### Map Unit Composition

*Beltsville and similar soils:* 85 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Beltsville

#### Setting

*Landform:* Flats
*Landform position (two-dimensional):* Summit, shoulder, backslope
*Landform position (three-dimensional):* Interfluve, side slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Concave, linear
*Parent material:* Silty eolian deposits over fluviomarine deposits

#### Typical profile

*H1 - 0 to 7 inches:* silt loam
*H2 - 7 to 48 inches:* silt loam
*H3 - 48 to 60 inches:* silt loam
*H4 - 60 to 64 inches:* gravelly sandy clay loam

#### Properties and qualities

*Slope:* 3 to 8 percent
*Depth to restrictive feature:* 20 to 48 inches to fragipan; 60 to 80 inches to lithic bedrock
*Natural drainage class:* Moderately well drained
*Runoff class:* Medium
*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately high (0.00 to 0.20 in/hr)
*Depth to water table:* About 18 to 30 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water storage in profile:* High (about 9.6 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 2e
*Hydrologic Soil Group:* C
*Hydric soil rating:* No

### Minor Components

#### Othello

*Percent of map unit:* 5 percent

*Landform:* Terraces
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Tread
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* Yes

**Sassafras**

*Percent of map unit:* 5 percent
*Landform:* Hillslopes
*Landform position (two-dimensional):* Summit
*Landform position (three-dimensional):* Side slope, interfluve
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* No

**Butlertown**

*Percent of map unit:* 5 percent
*Landform:* Coastal plains
*Landform position (two-dimensional):* Footslope, toeslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear, concave
*Hydric soil rating:* No

## ByA—Butlertown silt loam, 0 to 3 percent slopes

### Map Unit Setting

*National map unit symbol:* 121dk
*Elevation:* 0 to 800 feet
*Mean annual precipitation:* 35 to 55 inches
*Mean annual air temperature:* 48 to 61 degrees F
*Frost-free period:* 160 to 240 days
*Farmland classification:* All areas are prime farmland

### Map Unit Composition

*Butlertown and similar soils:* 85 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Butlertown

#### Setting

*Landform:* Coastal plains
*Landform position (two-dimensional):* Footslope, toeslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear, concave
*Parent material:* Thick deposits silty over sandy fluvial coastal plain sediments

**Typical profile**

*H1 - 0 to 8 inches:* silt loam
*H2 - 8 to 34 inches:* silt loam
*H3 - 34 to 50 inches:* silt loam
*H4 - 50 to 60 inches:* silt loam

**Properties and qualities**

*Slope:* 0 to 3 percent
*Depth to restrictive feature:* 25 to 40 inches to fragipan
*Natural drainage class:* Well drained
*Runoff class:* Medium
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)
*Depth to water table:* About 24 to 48 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water storage in profile:* Moderate (about 6.5 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 2w
*Hydrologic Soil Group:* C
*Hydric soil rating:* No

## Minor Components

**Beltsville**

*Percent of map unit:* 6 percent
*Landform:* Flats
*Landform position (two-dimensional):* Summit, shoulder, backslope
*Landform position (three-dimensional):* Interfluve, side slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Concave, linear
*Hydric soil rating:* No

**Othello**

*Percent of map unit:* 5 percent
*Landform:* Terraces
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Tread
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* Yes

**Woodstown**

*Percent of map unit:* 4 percent
*Landform:* Terraces
*Landform position (two-dimensional):* Footslope
*Landform position (three-dimensional):* Tread
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* No

## ByB2—Butlertown silt loam, 3 to 8 percent slopes, moderately eroded

### Map Unit Setting

*National map unit symbol:* 121dl
*Elevation:* 0 to 800 feet
*Mean annual precipitation:* 35 to 55 inches
*Mean annual air temperature:* 48 to 61 degrees F
*Frost-free period:* 160 to 240 days
*Farmland classification:* All areas are prime farmland

### Map Unit Composition

*Butlertown and similar soils:* 85 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Butlertown

#### Setting

*Landform:* Coastal plains
*Landform position (two-dimensional):* Toeslope, footslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear, concave
*Parent material:* Thick deposits silty over sandy fluvial coastal plain sediments

#### Typical profile

*H1 - 0 to 8 inches:* silt loam
*H2 - 8 to 34 inches:* silt loam
*H3 - 34 to 50 inches:* silt loam
*H4 - 50 to 60 inches:* silt loam

#### Properties and qualities

*Slope:* 3 to 8 percent
*Depth to restrictive feature:* 25 to 40 inches to fragipan
*Natural drainage class:* Well drained
*Runoff class:* High
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)
*Depth to water table:* About 24 to 48 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water storage in profile:* Moderate (about 6.5 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 3e
*Hydrologic Soil Group:* C
*Hydric soil rating:* No

### Minor Components

#### Beltsville

*Percent of map unit:* 6 percent
*Landform:* Flats
*Landform position (two-dimensional):* Summit, shoulder, backslope
*Landform position (three-dimensional):* Interfluve, side slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Concave, linear
*Hydric soil rating:* No

#### Othello

*Percent of map unit:* 5 percent
*Landform:* Terraces
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Tread
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* Yes

#### Woodstown

*Percent of map unit:* 4 percent
*Landform:* Terraces
*Landform position (two-dimensional):* Footslope
*Landform position (three-dimensional):* Tread
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* No

## Ma—Made land, gravelly materials

### Map Unit Setting

*National map unit symbol:* 121fv
*Elevation:* 200 to 1,500 feet
*Mean annual precipitation:* 36 to 55 inches
*Mean annual air temperature:* 45 to 57 degrees F
*Frost-free period:* 160 to 214 days
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Udorthents, shale and sandstone, and similar soils:* 85 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Udorthents, Shale And Sandstone

#### Setting

*Landform:* Ridges
*Landform position (two-dimensional):* Summit, shoulder, backslope
*Landform position (three-dimensional):* Nose slope, interfluve, side slope

*Down-slope shape:* Convex, linear
*Across-slope shape:* Convex, linear
*Parent material:* Graded areas of sandstone and shale

**Typical profile**

*Ap - 0 to 6 inches:* silt loam
*C - 6 to 60 inches:* silt loam

**Properties and qualities**

*Slope:* 0 to 8 percent
*Depth to restrictive feature:* 20 to 99 inches to lithic bedrock
*Natural drainage class:* Well drained
*Runoff class:* Very high
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to high (0.06 to 6.00 in/hr)
*Depth to water table:* About 60 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water storage in profile:* Very low (about 2.9 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 7s
*Hydrologic Soil Group:* A
*Hydric soil rating:* No

## Minor Components

**Penn**

*Percent of map unit:* 5 percent
*Landform:* Hillslopes
*Landform position (two-dimensional):* Shoulder, backslope
*Landform position (three-dimensional):* Side slope, nose slope
*Down-slope shape:* Linear, convex
*Across-slope shape:* Convex, linear
*Hydric soil rating:* No

**Abbottstown**

*Percent of map unit:* 2 percent
*Landform:* Hillslopes
*Landform position (two-dimensional):* Footslope, toeslope
*Landform position (three-dimensional):* Base slope, head slope
*Down-slope shape:* Concave, linear
*Across-slope shape:* Concave, linear
*Hydric soil rating:* No

**Readington**

*Percent of map unit:* 2 percent
*Landform:* Hillslopes
*Landform position (two-dimensional):* Footslope, backslope
*Landform position (three-dimensional):* Base slope, head slope, side slope
*Down-slope shape:* Concave, linear
*Across-slope shape:* Concave, linear
*Hydric soil rating:* No

**Reaville**

*Percent of map unit:* 2 percent
*Landform:* Hillslopes

*Landform position (two-dimensional):* Footslope, summit
*Landform position (three-dimensional):* Interfluve, base slope
*Down-slope shape:* Concave, linear
*Across-slope shape:* Concave, linear
*Hydric soil rating:* No

**Bowmansville**

*Percent of map unit:* 2 percent
*Landform:* Flood plains
*Landform position (two-dimensional):* Footslope, toeslope
*Landform position (three-dimensional):* Head slope
*Down-slope shape:* Concave, linear
*Across-slope shape:* Linear, concave
*Hydric soil rating:* No

**Berks**

*Percent of map unit:* 1 percent
*Landform:* Valleys, ridges
*Landform position (two-dimensional):* Backslope
*Landform position (three-dimensional):* Side slope
*Down-slope shape:* Convex, linear
*Across-slope shape:* Convex, linear
*Hydric soil rating:* No

**Croton**

*Percent of map unit:* 1 percent
*Landform:* Depressions
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Concave, linear
*Across-slope shape:* Linear, concave
*Hydric soil rating:* Yes

## OtA—Othello silt loams, 0 to 2 percent slopes, northern coastal plain

### Map Unit Setting

*National map unit symbol:* 2thwm
*Elevation:* 0 to 300 feet
*Mean annual precipitation:* 40 to 50 inches
*Mean annual air temperature:* 46 to 64 degrees F
*Frost-free period:* 190 to 250 days
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Othello, drained, and similar soils:* 50 percent
*Othello, undrained, and similar soils:* 30 percent
*Minor components:* 20 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Othello, Drained

#### Setting

*Landform:* Flats, depressions, swales
*Landform position (two-dimensional):* Footslope
*Landform position (three-dimensional):* Talf, dip
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear, concave
*Parent material:* Silty eolian deposits over fluviomarine deposits

#### Typical profile

*Ap - 0 to 9 inches:* silt loam
*Btg - 9 to 29 inches:* silt loam
*2BCg - 29 to 34 inches:* sandy loam
*2Cg - 34 to 80 inches:* loamy sand

#### Properties and qualities

*Slope:* 0 to 2 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Poorly drained
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.57 in/hr)
*Depth to water table:* About 10 to 20 inches
*Frequency of flooding:* None
*Frequency of ponding:* Rare
*Salinity, maximum in profile:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
*Available water storage in profile:* Moderate (about 8.8 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 3w
*Hydrologic Soil Group:* C/D
*Hydric soil rating:* Yes

### Description of Othello, Undrained

#### Setting

*Landform:* Depressions, swales, flats, drainageways
*Landform position (two-dimensional):* Footslope
*Landform position (three-dimensional):* Dip, talf
*Down-slope shape:* Concave, linear
*Across-slope shape:* Concave, linear
*Parent material:* Silty eolian deposits over fluviomarine deposits

#### Typical profile

*Oe - 0 to 2 inches:* peat
*A - 2 to 4 inches:* silt loam
*Eg - 4 to 10 inches:* silt loam
*Btg - 10 to 29 inches:* silt loam
*2BCg - 29 to 35 inches:* sandy loam
*2Cg - 35 to 80 inches:* loamy sand

#### Properties and qualities

*Slope:* 0 to 2 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Poorly drained

*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.57 in/hr)
*Depth to water table:* About 0 to 10 inches
*Frequency of flooding:* None
*Frequency of ponding:* Occasional
*Salinity, maximum in profile:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
*Available water storage in profile:* High (about 9.6 inches)

**Interpretive groups**
*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 5w
*Hydrologic Soil Group:* C/D
*Hydric soil rating:* Yes

**Minor Components**

**Fallsington, undrained**
*Percent of map unit:* 8 percent
*Landform:* Swales, flats, drainageways, depressions
*Landform position (two-dimensional):* Footslope
*Landform position (three-dimensional):* Dip, talf
*Down-slope shape:* Concave, linear
*Across-slope shape:* Linear, concave
*Hydric soil rating:* Yes

**Kentuck, undrained**
*Percent of map unit:* 7 percent
*Landform:* Flats, depressions, swales
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Talf, dip
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear, concave
*Hydric soil rating:* Yes

**Mattapex**
*Percent of map unit:* 5 percent
*Landform:* Flats, depressions, broad interstream divides, swales
*Landform position (two-dimensional):* Summit, footslope
*Landform position (three-dimensional):* Talf, dip
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear, concave
*Hydric soil rating:* No

# New Castle County, Delaware

## Up—Urban land

### Map Unit Setting

*National map unit symbol:* 2p7dx
*Elevation:* 0 to 300 feet
*Mean annual precipitation:* 42 to 48 inches
*Mean annual air temperature:* 52 to 58 degrees F
*Frost-free period:* 180 to 220 days
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Urban land:* 90 percent
*Minor components:* 10 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Urban Land

#### Setting

*Landform:* Flats
*Down-slope shape:* Linear
*Across-slope shape:* Linear

### Minor Components

#### Udorthents, loamy

*Percent of map unit:* 10 percent
*Landform:* Broad interstream divides
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* No

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# Quakertown Compressor Station

Project: Adelphia
Subject: Quakertown Compressor Station
Computed By: RRY Date: 2/5/2019

Job No. 18-00672-005
Sheet No. 1 of 2
Checked By: ATH Date: 3/19/2019

Check one: ☑ Present ☐ Developed

**QUAKERTOWN COMPRESSOR STATION: EXISTING CONDITIONS WITHIN LOD**

## 1. Runoff curve number

| Soil name and hydrologic group | Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio | CN Table 2-2a | CN | CN | Area ☒ acres ☐ mi2 ☐ % | Product of CN x area |
|---|---|---|---|---|---|---|
| D | Impervious | 98 | | | 0.006 | 0.544 |
| D | Woods, Good | 77 | | | 0.134 | 10.343 |
| D | Meadow | 78 | | | 0.684 | 53.323 |
| D | Gravel | 91 | | | 0.624 | 56.809 |
| D | Brush, Good | 78 | | | 0.000 | 0.000 |
| | | | | **Totals** ➡ | 1.45 | 121.02 |

CN(weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{121.02}{1.45} = 83.59$ ; **Use CN** ➡ 84

## 2. Runoff

| | Storm #1 | Storm #2 | Storm #3 | Storm #4 |
|---|---|---|---|---|
| Frequency ..... yr | 2-YR | 10-YR | 50-YR | 100-YR |
| Rainfall, P (24-hour) ..... in | 3.16 | 4.57 | 6.53 | 7.63 |
| Runoff, Q ..... in | 1.62 | 2.84 | 4.65 | 5.69 |

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S}$$

$$I_a = 0.2S \qquad S = \frac{1000}{CN} - 10$$

(SCS Method)

Project: Adelphia
Subject: Quakertown Compressor Station
Computed By: RRY Date: 2/5/2019

Job No. 18-00672-005
Sheet No. 2 of 2
Checked By: ATH Date: 3/19/2019

Check one: ☑ Present ☐ Developed

**QUAKERTOWN COMPRESSOR STATION: EXISTING CONDITIONS WITHIN LOD AND OFF-SITE DRAINAGE AREA**

## 1. Runoff curve number

| Soil name and hydrologic group | Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio | CN Table 2-2a | CN | CN | Area ☒ acres ☐ mi2 ☐ % | Product of CN x area |
|---|---|---|---|---|---|---|
| D | Impervious | 98 | | | 0.006 | 0.544 |
| D | Woods, Good | 77 | | | 0.134 | 10.343 |
| D | Meadow | 78 | | | 0.684 | 53.323 |
| D | Gravel | 91 | | | 0.674 | 61.322 |
| D | Brush, Good | 73 | | | 0.167 | 12.227 |
| | | | | **Totals** | 1.66 | 137.76 |

CN(weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{137.76}{1.66} = 82.74$ ; **Use CN** 83

## 2. Runoff

| | Storm #1 | Storm #2 | Storm #3 | Storm #4 |
|---|---|---|---|---|
| Frequency ..... yr | 2-YR | 10-YR | 50-YR | 100-YR |
| Rainfall, P (24-hour) ..... in | 3.16 | 4.57 | 6.53 | 7.63 |
| Runoff, Q ..... in | 1.56 | 2.76 | 4.56 | 5.60 |

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S}$$

$$I_a = 0.2S \qquad S = \frac{1000}{CN} - 10$$

(SCS Method)

Project: Adelphia Job No. 18-00672-005
Subject: Quakertown Compressor Station LOD Sheet No. 1 of 4
Computed By: RRY Date: 2/5/2019 Checked By: ATH Date: 3/19/2019

Check one: ☐ Present ☑ Developed

**QUAKERTOWN COMPRESSOR STATION: PROPOSED CONDITIONS WITHIN LOD**

## 1. Runoff curve number

| Soil name and hydrologic group | Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio | CN Table 2-2a | CN | CN | Area ☒ acres ☐ mi2 ☐ % | Product of CN x area |
|---|---|---|---|---|---|---|
| D | Impervious | 98 | | | 0.324 | 31.735 |
| D | Gravel | 91 | | | 1.124 | 102.310 |
| | | | | **Totals** ➡ | 1.45 | 134.05 |

CN(weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{134.05}{1.45} = 92.57$ ; **Use CN** ➡ 93

## 2. Runoff

| | Storm #1 | Storm #2 | Storm #3 | Storm #4 |
|---|---|---|---|---|
| Frequency ..... yr | 2-YR | 10-YR | 50-YR | 100-YR |
| Rainfall, P (24-hour) ..... in | 3.16 | 4.57 | 6.53 | 7.63 |
| Runoff, Q ..... in | 2.37 | 3.73 | 5.66 | 6.74 |

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S}$$

$$I_a = 0.2S \qquad S = \frac{1000}{CN} - 10$$

(SCS Method)

Project: Adelphia Job No._18-00672-005_____
Subject: Quakertown Compressor Station LOD and DA Sheet No.__2__ of ___4___
Computed By: RRY Date: 2/5/2019 Checked By: ATH Date: 3/20/2020

Check one: ☐ Present ☑ Developed

**QUAKERTOWN COMPRESSOR STATION: PROPOSED CONDITIONS WITHIN LOD AND OFF-SITE DRAINAGE AREA**

## 1. Runoff curve number

| Soil name and hydrologic group | Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio | CN Table 2-2a | CN | CN | Area ☒ acres ☐ mi2 ☐ % | Product of CN x area |
|---|---|---|---|---|---|---|
| D | Impervious | 98 | | | 0.326 | 31.949 |
| D | Gravel | 91 | | | 1.177 | 107.073 |
| D | Brush, Good | 73 | | | 0.167 | 12.227 |
| | | | | **Totals** ➡ | 1.67 | 151.25 |

CN(weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{151.25}{1.67} = 90.56$ ; **Use CN** ➡ 91

## 2. Runoff

| | Storm #1 | Storm #2 | Storm #3 | Storm #4 |
|---|---|---|---|---|
| Frequency ..... yr | 2-YR | 10-YR | 50-YR | 100-YR |
| Rainfall, P (24-hour) ..... in | 3.16 | 4.57 | 6.53 | 7.63 |
| Runoff, Q ..... in | 2.18 | 3.52 | 5.43 | 6.51 |

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S}$$

$$I_a = 0.2S \qquad S = \frac{1000}{CN} - 10$$

(SCS Method)

Project: Adelphia | Job No._18-00672-005_____
Subject: Quakertown Compressor Station Swale | Sheet No.__3__ of ___4___
Computed By: RRY Date: 2/5/2019 | Checked By: ATH Date: 3/20/2020

Check one: ☐ Present ☑ Developed

**QUAKERTOWN COMPRESSOR STATION: PROPOSED CONDITIONS TO BMP**

## 1. Runoff curve number

| Soil name and hydrologic group | Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio | CN Table 2-2a | CN | CN | Area ☒ acres ☐ mi2 ☐ % | Product of CN x area |
|---|---|---|---|---|---|---|
| D | Impervious | 98 | | | 0.324 | 31.735 |
| D | Gravel | 91 | | | 0.599 | 54.481 |
| D | Brush, Good | 73 | | | 0.167 | 12.227 |
| | | | | **Totals** ➡ | 1.09 | 98.44 |

CN(weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{98.44}{1.09} = 90.31$ ; **Use CN** ➡ 90

## 2. Runoff

| | Storm #1 | Storm #2 | Storm #3 | Storm #4 |
|---|---|---|---|---|
| Frequency ..... yr | 2-YR | 10-YR | 50-YR | 100-YR |
| Rainfall, P (24-hour) ..... in | 3.16 | 4.57 | 6.53 | 7.63 |
| Runoff, Q ..... in | 2.16 | 3.49 | 5.40 | 6.48 |

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S}$$

$$I_a = 0.2S \qquad S = \frac{1000}{CN} - 10$$

(SCS Method)

Project: Adelphia | Job No._18-00672-005_____
Subject: Quakertown Compressor Station Bypass | Sheet No.__4__ of ___4___
Computed By: RRY Date: 2/5/2019 | Checked By: ATH Date: 3/20/2020

Check one: ☐ Present ☑ Developed

**QUAKERTOWN COMPRESSOR STATION: PROPOSED CONDITIONS (BYPASS)**

## 1. Runoff curve number

| Soil name and hydrologic group | Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio | CN Table 2-2a | CN | CN | Area ☒ acres ☐ mi2 ☐ % | Product of CN x area |
|---|---|---|---|---|---|---|
| D | Impervious | 98 | | | 0.002 | 0.214 |
| D | Gravel | 91 | | | 0.578 | 52.592 |
| | | | | **Totals** ➡ | 0.58 | 52.81 |

CN(weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{52.81}{0.58} = 91.03$ ; **Use CN** ➡ 91

## 2. Runoff

| | Storm #1 | Storm #2 | Storm #3 | Storm #4 |
|---|---|---|---|---|
| Frequency ..... yr | 2-YR | 10-YR | 50-YR | 100-YR |
| Rainfall, P (24-hour) ..... in | 3.16 | 4.57 | 6.53 | 7.63 |
| Runoff, Q ..... in | 2.22 | 3.57 | 5.48 | 6.56 |

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S}$$

$$I_a = 0.2S \qquad S = \frac{1000}{CN} - 10$$

(SCS Method)

# Worksheet 3: Time of concentration ($T_c$) or travel time ($T_t$)

| | | | | | |
|---|---|---|---|---|---|
| Project | Adelphia | By | RRY | Date | 4/26/2019 |
| Location | Quakertown Compressor Station | Checked | ATH | Date | 4/26/2019 |

Circle one: Present Developed

Circle one: $T_c$ $T_t$

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Sheet flow calculated using Rational Method Nomograph.
Include a map, schematic, or description of flow segments.

| Sheet Flow (Applicable to $T_c$ only) | | Segment ID | L1 | | | | |
|---|---|---|---|---|---|---|---|
| 1. Surface description (table 3-1) | | | Dense grasses (Brush) | | | | |
| 2. Manning's roughness coeff., n (table 3-1) | | | 0.24 | | | | |
| 3. Flow length, L (total L < 150 ft) | | ft | 100.00 | | | | |
| 4. Two-yr 24-hr rainfall, P2 | | in | 3.16 | | | | |
| 5. Land slope, s | | ft/ft | 0.020 | | | | |
| 6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}s^{0.4}}$ | Compute $T_t$ | hr | 0.239 | + | | = | 0.239 |

| Shallow Concentrated Flow | | Segment ID | L2 | | | | |
|---|---|---|---|---|---|---|---|
| 7. Surface description (paved or unpaved) | | | Unpaved | | | | |
| 8. Flow length, L | | ft | 343.00 | | | | |
| 9. Watercourse slope, s | | ft/ft | 0.055 | | | | |
| 10. Average velocity, V (figure 3-1) | | ft/s | 3.80 | | | | |
| 11. $T_t = \frac{L}{3600V}$ | Compute $T_t$ | hr | 0.025 | + | | = | 0.025 |

| Channel Flow | | Segment ID | | | | | |
|---|---|---|---|---|---|---|---|
| 12. Cross sectional flow area, a | | $ft^2$ | | | | | |
| 13. Wetted perimeter, $p_w$ | | ft | | | | | |
| 14. Hydraulic radius, $r = \frac{a}{p_w}$ | | ft | | | | | |
| 15. Channel slope, s | | ft/ft | | | | | |
| 16. Manning's roughness coeff., n | | | | | | | |
| 17. $V = \frac{1.49r^{2/3}s^{1/2}}{n}$ | Compute V | ft/s | | | | | |
| 18. Flow length, L | | ft | | | | | |
| 19. $T_t = \frac{L}{3600V}$ | Compute $T_t$ | hr | | + | | = | |

20. Watershed or subarea $T_c$ or $T_t$ (add $T_t$ in steps 6, 11, and 19) — Total min. 15.86

MIN (min) 5.00

# Worksheet 3: Time of concentration ($T_c$) or travel time ($T_t$)

| | | | | | |
|---|---|---|---|---|---|
| Project | Adelphia | By | RRY | Date | 4/26/2019 |
| Location | Quakertown Compressor Station | Checked | ATH | Date | 4/26/2019 |

Circle one: Present Developed

Circle one: $T_c$ $T_t$

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Sheet flow calculated using Rational Method Nomograph.
Include a map, schematic, or description of flow segments.

| Sheet Flow (Applicable to $T_c$ only) | | Segment ID | L1 | | | | |
|---|---|---|---|---|---|---|---|
| 1. Surface description (table 3-1) | | | Dense grasses (Brush) | | | | |
| 2. Manning's roughness coeff., n (table 3-1) | | | 0.24 | | | | |
| 3. Flow length, L (total L < 150 ft) | | ft | 100.00 | | | | |
| 4. Two-yr 24-hr rainfall, P2 | | in | 3.16 | | | | |
| 5. Land slope, s | | ft/ft | 0.020 | | | | |
| 6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}s^{0.4}}$ | Compute $T_t$ | hr | 0.239 | + | | = | 0.239 |

| Shallow Concentrated Flow | | Segment ID | L2 | | | | |
|---|---|---|---|---|---|---|---|
| 7. Surface description (paved or unpaved) | | | Unpaved | | | | |
| 8. Flow length, L | | ft | 321.00 | | | | |
| 9. Watercourse slope, s | | ft/ft | 0.059 | | | | |
| 10. Average velocity, V (figure 3-1) | | ft/s | 3.93 | | | | |
| 11. $T_t = \frac{L}{3600V}$ | Compute $T_t$ | hr | 0.023 | + | | = | 0.023 |

| Channel Flow | | Segment ID | L3 | | | | |
|---|---|---|---|---|---|---|---|
| 12. Cross sectional flow area, a | | $ft^2$ | 1.00 | | | | |
| 13. Wetted perimeter, $p_w$ | | ft | 4.03 | | | | |
| 14. Hydraulic radius, $r = \frac{a}{p_w}$ | | ft | 0.25 | | | | |
| | | | | | | | |
| 15. Channel slope, s | | ft/ft | 0.005 | | | | |
| 16. Manning's roughness coeff., n | | | 0.024 | | | | |
| 17. $V = \frac{1.49r^{2/3}s^{1/2}}{n}$ | Compute V | ft/s | 1.73 | | | | |
| | | | | | | | |
| 18. Flow length, L | | ft | 50.00 | | | | |
| 19. $T_t = \frac{L}{3600V}$ | Compute $T_t$ | hr | 0.008 | + | | = | 0.008 |

20. Watershed or subarea $T_c$ or $T_t$ (add $T_t$ in steps 6, 11, and 19) — Total min. 16.20

MIN (min) 5.00

# Worksheet 3: Time of concentration ($T_c$) or travel time ($T_t$)

| | | | | | |
|---|---|---|---|---|---|
| Project | Adelphia | By | RRY | Date | 4/26/2019 |
| Location | Quakertown Compressor Station - Bypass | Checked | ATH | Date | 4/26/2019 |

Circle one: Present (Developed)

Circle one: ($T_c$) $T_t$

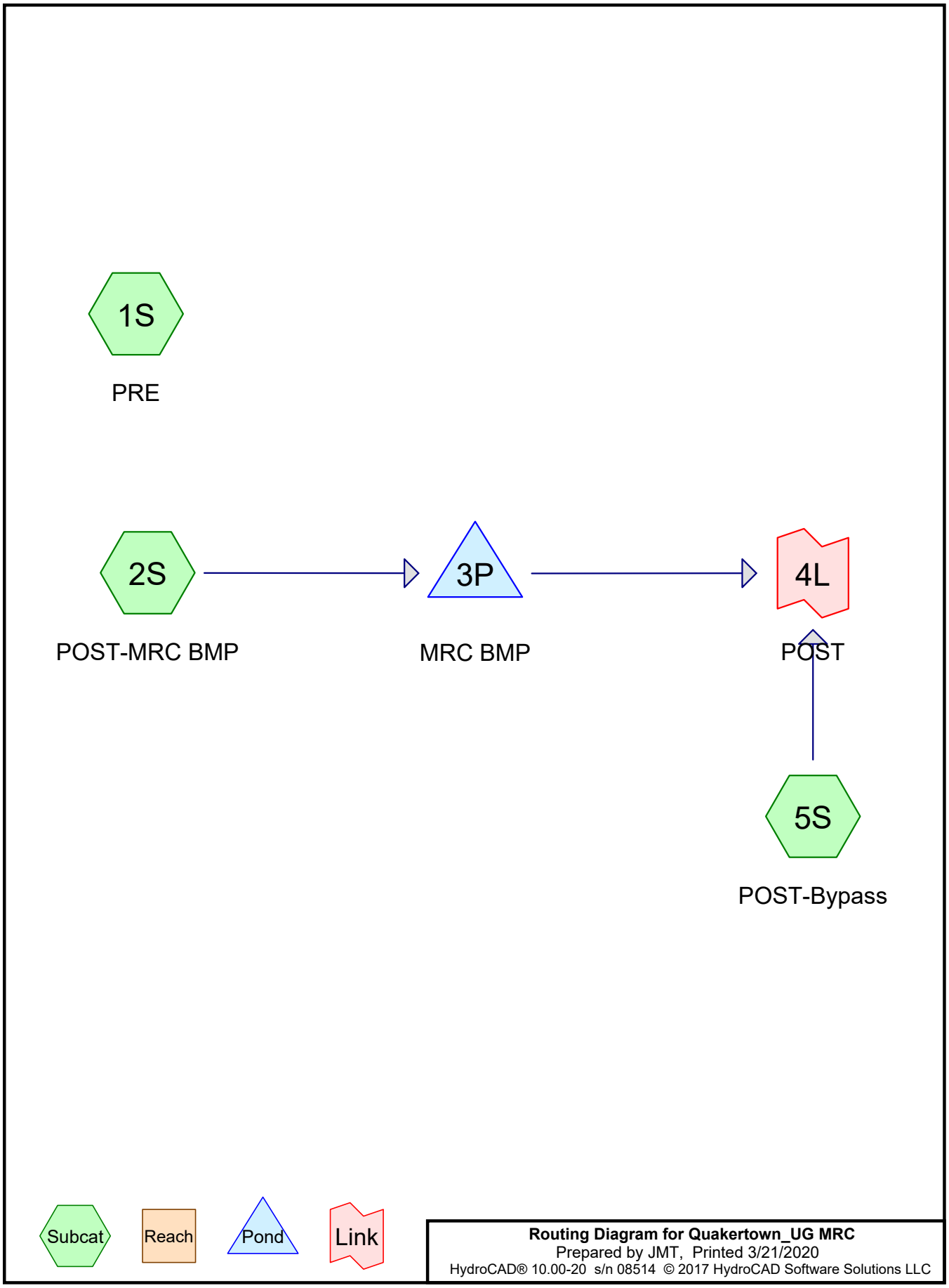
NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Sheet flow calculated using Rational Method Nomograph.
Include a map, schematic, or description of flow segments.

| Sheet Flow (Applicable to $T_c$ only) | | Segment ID | L1 | | | | |
|---|---|---|---|---|---|---|---|
| 1. Surface description (table 3-1) | | | Gravel | | | | |
| 2. Manning's roughness coeff., n (table 3-1) | | | 0.01 | | | | |
| 3. Flow length, L (total L < 150 ft) | | ft | 100.00 | | | | |
| 4. Two-yr 24-hr rainfall, P2 | | in | 3.16 | | | | |
| 5. Land slope, s | | ft/ft | 0.043 | | | | |
| 6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}s^{0.4}}$ | Compute $T_t$ | hr | 0.015 | + | | = | 0.015 |

| Shallow Concentrated Flow | | Segment ID | L2 | | | | |
|---|---|---|---|---|---|---|---|
| 7. Surface description (paved or unpaved) | | | Unpaved | | | | |
| 8. Flow length, L | | ft | 127.70 | | | | |
| 9. Watercourse slope, s | | ft/ft | 0.053 | | | | |
| 10. Average velocity, V (figure 3-1) | | ft/s | 3.71 | | | | |
| 11. $T_t = \frac{L}{3600V}$ | Compute $T_t$ | hr | 0.010 | + | | = | 0.010 |

| Channel Flow | | Segment ID | | | | | |
|---|---|---|---|---|---|---|---|
| 12. Cross sectional flow area, a | | $ft^2$ | | | | | |
| 13. Wetted perimeter, $p_w$ | | ft | | | | | |
| 14. Hydraulic radius, $r = \frac{a}{p_w}$ | | ft | | | | | |
| 15. Channel slope, s | | ft/ft | | | | | |
| 16. Manning's roughness coeff., n | | | | | | | |
| 17. $V = \frac{1.49r^{2/3}s^{1/2}}{n}$ | Compute V | ft/s | | | | | |
| 18. Flow length, L | | ft | | | | | |
| 19. $T_t = \frac{L}{3600V}$ | Compute $T_t$ | hr | | + | | = | |

| | | |
|---|---|---|
| 20. Watershed or subarea $T_c$ or $T_t$ (add $T_t$ in steps 6, 11, and 19) | Total min. | 1.47 |
| | MIN (min) | 5.00 |


1S
PRE
2S
POST-MRC BMP
3P
MRC BMP
4L
POST
5S
POST-Bypass
Subcat
Reach
Pond
Link
Routing Diagram for Quakertown_UG MRC
Prepared by JMT, Printed 3/21/2020
HydroCAD® 10.00-20 s/n 08514 © 2017 HydroCAD Software Solutions LLC

## Area Listing (all nodes)

| Area (sq-ft) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 7,884 | 73 | Brush, good (2S) |
| 80,063 | 91 | Gravel (1S, 2S, 5S) |
| 14,462 | 98 | Impervious (1S, 2S, 5S) |
| 29,795 | 78 | Meadow (20% and On-site Brush) (1S) |
| 7,275 | 73 | Onsite Brush, Good (1S) |
| 5,837 | 77 | Woods, Good (1S) |
| **145,316** | **87** | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (sq-ft) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 0 | HSG A | |
| 0 | HSG B | |
| 0 | HSG C | |
| 0 | HSG D | |
| 145,316 | Other | 1S, 2S, 5S |
| **145,316** | | **TOTAL AREA** |

## Ground Covers (all nodes)

| HSG-A (sq-ft) | HSG-B (sq-ft) | HSG-C (sq-ft) | HSG-D (sq-ft) | Other (sq-ft) | Total (sq-ft) | Ground Cover |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 7,884 | 7,884 | Brush, good |
| 0 | 0 | 0 | 0 | 80,063 | 80,063 | Gravel |
| 0 | 0 | 0 | 0 | 14,462 | 14,462 | Impervious |
| 0 | 0 | 0 | 0 | 29,795 | 29,795 | Meadow (20% and On-site Brush) |
| 0 | 0 | 0 | 0 | 7,275 | 7,275 | Onsite Brush, Good |
| 0 | 0 | 0 | 0 | 5,837 | 5,837 | Woods, Good |
| **0** | **0** | **0** | **0** | **145,316** | **145,316** | **TOTAL AREA** |

## Pipe Listing (all nodes)

| Line# | Node Number | In-Invert (feet) | Out-Invert (feet) | Length (feet) | Slope (ft/ft) | n | Diam/Width (inches) | Height (inches) | Inside-Fill (inches) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 3P | 548.50 | 548.40 | 10.0 | 0.0100 | 0.011 | 12.0 | 0.0 | 0.0 |

Time span=0.00-360.00 hrs, dt=0.05 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: PRE** Runoff Area=1.665 ac 0.36% Impervious Runoff Depth=1.21"
Tc=15.8 min CN=83 Runoff=2.51 cfs 7,308 cf

**Subcatchment2S: POST-MRC BMP** Runoff Area=1.091 ac 29.70% Impervious Runoff Depth=1.71"
Tc=16.2 min CN=90 Runoff=2.29 cfs 6,775 cf

**Subcatchment5S: POST-Bypass** Runoff Area=0.580 ac 0.34% Impervious Runoff Depth=1.79"
Tc=5.0 min CN=91 Runoff=1.82 cfs 3,776 cf

**Pond 3P: MRC BMP** Peak Elev=548.53' Storage=6,771 cf Inflow=2.29 cfs 6,775 cf
Outflow=0.00 cfs 101 cf

**Link 4L: POST** Inflow=1.82 cfs 3,877 cf
Primary=1.82 cfs 3,877 cf

**Total Runoff Area = 145,316 sf Runoff Volume = 17,858 cf Average Runoff Depth = 1.47"**
**90.05% Pervious = 130,854 sf 9.95% Impervious = 14,462 sf**

## Summary for Subcatchment 1S: PRE

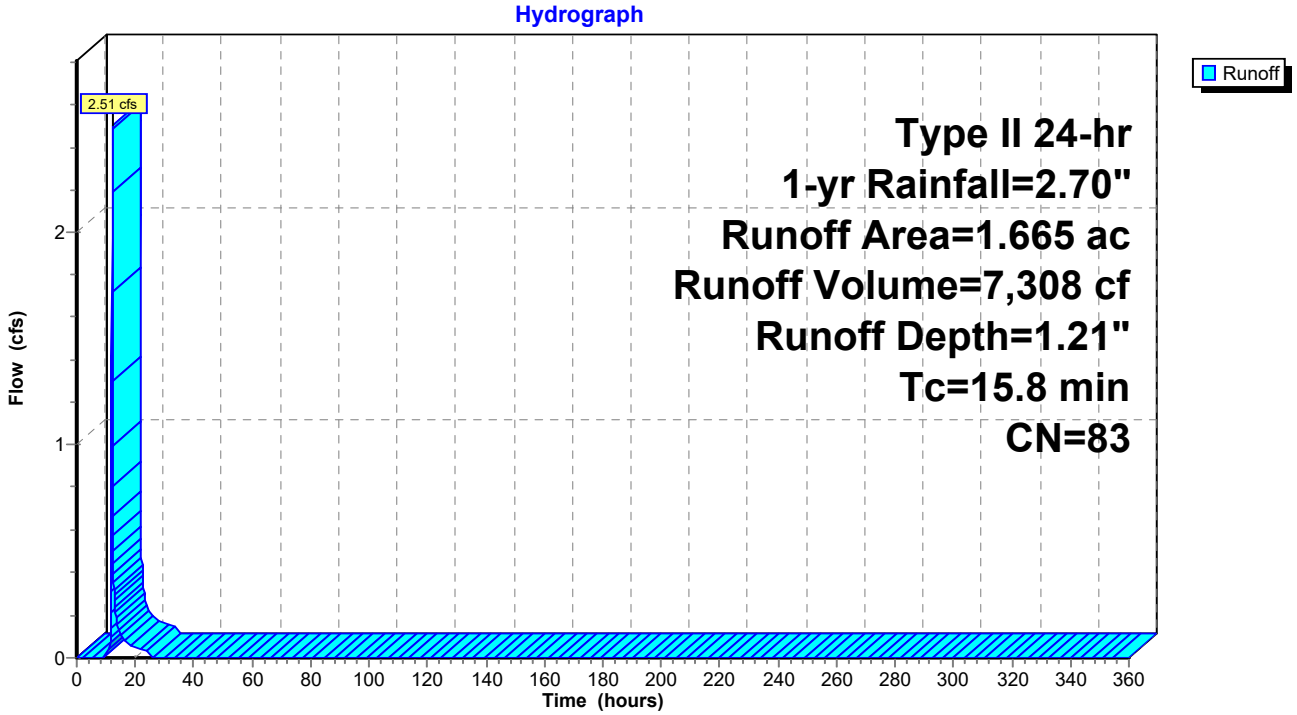
Runoff = 2.51 cfs @ 12.09 hrs, Volume= 7,308 cf, Depth= 1.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-yr Rainfall=2.70"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 0.006 | 98 | Impervious |
| * | 0.134 | 77 | Woods, Good |
| * | 0.684 | 78 | Meadow (20% and On-site Brush) |
| * | 0.674 | 91 | Gravel |
| * | 0.167 | 73 | Onsite Brush, Good |
| | 1.665 | 83 | Weighted Average |
| | 1.659 | | 99.64% Pervious Area |
| | 0.006 | | 0.36% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.8 | | | | | **Direct Entry, Tc** |

## Subcatchment 1S: PRE



## Hydrograph for Subcatchment 1S: PRE

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 |
| 5.00 | 0.17 | 0.00 | 0.00 |
| 10.00 | 0.49 | 0.00 | **0.01** |
| 15.00 | 2.30 | 0.91 | **0.10** |
| 20.00 | **2.57** | **1.11** | 0.05 |
| 25.00 | **2.70** | **1.21** | 0.00 |
| 30.00 | 2.70 | 1.21 | 0.00 |
| 35.00 | 2.70 | 1.21 | 0.00 |
| 40.00 | 2.70 | 1.21 | 0.00 |
| 45.00 | 2.70 | 1.21 | 0.00 |
| 50.00 | 2.70 | 1.21 | 0.00 |
| 55.00 | 2.70 | 1.21 | 0.00 |
| 60.00 | 2.70 | 1.21 | 0.00 |
| 65.00 | 2.70 | 1.21 | 0.00 |
| 70.00 | 2.70 | 1.21 | 0.00 |
| 75.00 | 2.70 | 1.21 | 0.00 |
| 80.00 | 2.70 | 1.21 | 0.00 |
| 85.00 | 2.70 | 1.21 | 0.00 |
| 90.00 | 2.70 | 1.21 | 0.00 |
| 95.00 | 2.70 | 1.21 | 0.00 |
| 100.00 | 2.70 | 1.21 | 0.00 |
| 105.00 | 2.70 | 1.21 | 0.00 |
| 110.00 | 2.70 | 1.21 | 0.00 |
| 115.00 | 2.70 | 1.21 | 0.00 |
| 120.00 | 2.70 | 1.21 | 0.00 |
| 125.00 | 2.70 | 1.21 | 0.00 |
| 130.00 | 2.70 | 1.21 | 0.00 |
| 135.00 | 2.70 | 1.21 | 0.00 |
| 140.00 | 2.70 | 1.21 | 0.00 |
| 145.00 | 2.70 | 1.21 | 0.00 |
| 150.00 | 2.70 | 1.21 | 0.00 |
| 155.00 | 2.70 | 1.21 | 0.00 |
| 160.00 | 2.70 | 1.21 | 0.00 |
| 165.00 | 2.70 | 1.21 | 0.00 |
| 170.00 | 2.70 | 1.21 | 0.00 |
| 175.00 | 2.70 | 1.21 | 0.00 |
| 180.00 | 2.70 | 1.21 | 0.00 |
| 185.00 | 2.70 | 1.21 | 0.00 |
| 190.00 | 2.70 | 1.21 | 0.00 |
| 195.00 | 2.70 | 1.21 | 0.00 |
| 200.00 | 2.70 | 1.21 | 0.00 |
| 205.00 | 2.70 | 1.21 | 0.00 |
| 210.00 | 2.70 | 1.21 | 0.00 |
| 215.00 | 2.70 | 1.21 | 0.00 |
| 220.00 | 2.70 | 1.21 | 0.00 |
| 225.00 | 2.70 | 1.21 | 0.00 |
| 230.00 | 2.70 | 1.21 | 0.00 |
| 235.00 | 2.70 | 1.21 | 0.00 |
| 240.00 | 2.70 | 1.21 | 0.00 |
| 245.00 | 2.70 | 1.21 | 0.00 |
| 250.00 | 2.70 | 1.21 | 0.00 |
| 255.00 | 2.70 | 1.21 | 0.00 |
| 260.00 | 2.70 | 1.21 | 0.00 |
| 265.00 | 2.70 | 1.21 | 0.00 |
| 270.00 | 2.70 | 1.21 | 0.00 |
| 275.00 | 2.70 | 1.21 | 0.00 |
| 280.00 | 2.70 | 1.21 | 0.00 |
| 285.00 | 2.70 | 1.21 | 0.00 |
| 290.00 | 2.70 | 1.21 | 0.00 |
| 295.00 | 2.70 | 1.21 | 0.00 |
| 300.00 | 2.70 | 1.21 | 0.00 |
| 305.00 | 2.70 | 1.21 | 0.00 |
| 310.00 | 2.70 | 1.21 | 0.00 |
| 315.00 | 2.70 | 1.21 | 0.00 |
| 320.00 | 2.70 | 1.21 | 0.00 |
| 325.00 | 2.70 | 1.21 | 0.00 |
| 330.00 | 2.70 | 1.21 | 0.00 |
| 335.00 | 2.70 | 1.21 | 0.00 |
| 340.00 | 2.70 | 1.21 | 0.00 |
| 345.00 | 2.70 | 1.21 | 0.00 |
| 350.00 | 2.70 | 1.21 | 0.00 |
| 355.00 | 2.70 | 1.21 | 0.00 |
| 360.00 | 2.70 | 1.21 | 0.00 |

## Summary for Subcatchment 2S: POST-MRC BMP

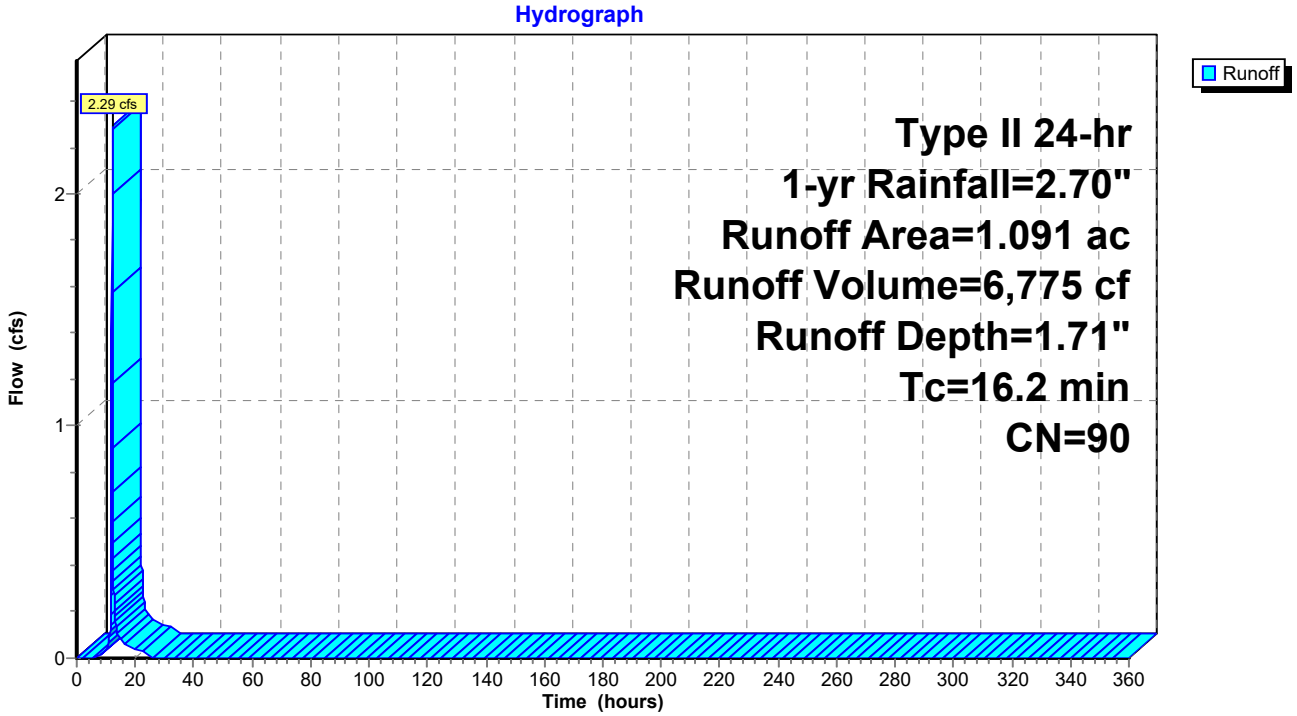
Runoff = 2.29 cfs @ 12.08 hrs, Volume= 6,775 cf, Depth= 1.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-yr Rainfall=2.70"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 0.586 | 91 | Gravel |
| * | 0.324 | 98 | Impervious |
| * | 0.181 | 73 | Brush, good |
| | 1.091 | 90 | Weighted Average |
| | 0.767 | | 70.30% Pervious Area |
| | 0.324 | | 29.70% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 16.2 | | | | | **Direct Entry, Tc** |

## Subcatchment 2S: POST-MRC BMP



## Hydrograph for Subcatchment 2S: POST-MRC BMP

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 |
| 5.00 | 0.17 | 0.00 | 0.00 |
| 10.00 | 0.49 | 0.05 | **0.03** |
| 15.00 | 2.30 | 1.36 | **0.08** |
| 20.00 | **2.57** | **1.59** | 0.04 |
| 25.00 | **2.70** | **1.71** | 0.00 |
| 30.00 | 2.70 | 1.71 | 0.00 |
| 35.00 | 2.70 | 1.71 | 0.00 |
| 40.00 | 2.70 | 1.71 | 0.00 |
| 45.00 | 2.70 | 1.71 | 0.00 |
| 50.00 | 2.70 | 1.71 | 0.00 |
| 55.00 | 2.70 | 1.71 | 0.00 |
| 60.00 | 2.70 | 1.71 | 0.00 |
| 65.00 | 2.70 | 1.71 | 0.00 |
| 70.00 | 2.70 | 1.71 | 0.00 |
| 75.00 | 2.70 | 1.71 | 0.00 |
| 80.00 | 2.70 | 1.71 | 0.00 |
| 85.00 | 2.70 | 1.71 | 0.00 |
| 90.00 | 2.70 | 1.71 | 0.00 |
| 95.00 | 2.70 | 1.71 | 0.00 |
| 100.00 | 2.70 | 1.71 | 0.00 |
| 105.00 | 2.70 | 1.71 | 0.00 |
| 110.00 | 2.70 | 1.71 | 0.00 |
| 115.00 | 2.70 | 1.71 | 0.00 |
| 120.00 | 2.70 | 1.71 | 0.00 |
| 125.00 | 2.70 | 1.71 | 0.00 |
| 130.00 | 2.70 | 1.71 | 0.00 |
| 135.00 | 2.70 | 1.71 | 0.00 |
| 140.00 | 2.70 | 1.71 | 0.00 |
| 145.00 | 2.70 | 1.71 | 0.00 |
| 150.00 | 2.70 | 1.71 | 0.00 |
| 155.00 | 2.70 | 1.71 | 0.00 |
| 160.00 | 2.70 | 1.71 | 0.00 |
| 165.00 | 2.70 | 1.71 | 0.00 |
| 170.00 | 2.70 | 1.71 | 0.00 |
| 175.00 | 2.70 | 1.71 | 0.00 |
| 180.00 | 2.70 | 1.71 | 0.00 |
| 185.00 | 2.70 | 1.71 | 0.00 |
| 190.00 | 2.70 | 1.71 | 0.00 |
| 195.00 | 2.70 | 1.71 | 0.00 |
| 200.00 | 2.70 | 1.71 | 0.00 |
| 205.00 | 2.70 | 1.71 | 0.00 |
| 210.00 | 2.70 | 1.71 | 0.00 |
| 215.00 | 2.70 | 1.71 | 0.00 |
| 220.00 | 2.70 | 1.71 | 0.00 |
| 225.00 | 2.70 | 1.71 | 0.00 |
| 230.00 | 2.70 | 1.71 | 0.00 |
| 235.00 | 2.70 | 1.71 | 0.00 |
| 240.00 | 2.70 | 1.71 | 0.00 |
| 245.00 | 2.70 | 1.71 | 0.00 |
| 250.00 | 2.70 | 1.71 | 0.00 |
| 255.00 | 2.70 | 1.71 | 0.00 |
| 260.00 | 2.70 | 1.71 | 0.00 |
| 265.00 | 2.70 | 1.71 | 0.00 |
| 270.00 | 2.70 | 1.71 | 0.00 |
| 275.00 | 2.70 | 1.71 | 0.00 |
| 280.00 | 2.70 | 1.71 | 0.00 |
| 285.00 | 2.70 | 1.71 | 0.00 |
| 290.00 | 2.70 | 1.71 | 0.00 |
| 295.00 | 2.70 | 1.71 | 0.00 |
| 300.00 | 2.70 | 1.71 | 0.00 |
| 305.00 | 2.70 | 1.71 | 0.00 |
| 310.00 | 2.70 | 1.71 | 0.00 |
| 315.00 | 2.70 | 1.71 | 0.00 |
| 320.00 | 2.70 | 1.71 | 0.00 |
| 325.00 | 2.70 | 1.71 | 0.00 |
| 330.00 | 2.70 | 1.71 | 0.00 |
| 335.00 | 2.70 | 1.71 | 0.00 |
| 340.00 | 2.70 | 1.71 | 0.00 |
| 345.00 | 2.70 | 1.71 | 0.00 |
| 350.00 | 2.70 | 1.71 | 0.00 |
| 355.00 | 2.70 | 1.71 | 0.00 |
| 360.00 | 2.70 | 1.71 | 0.00 |

## Summary for Subcatchment 5S: POST-Bypass

[49] Hint: Tc<2dt may require smaller dt

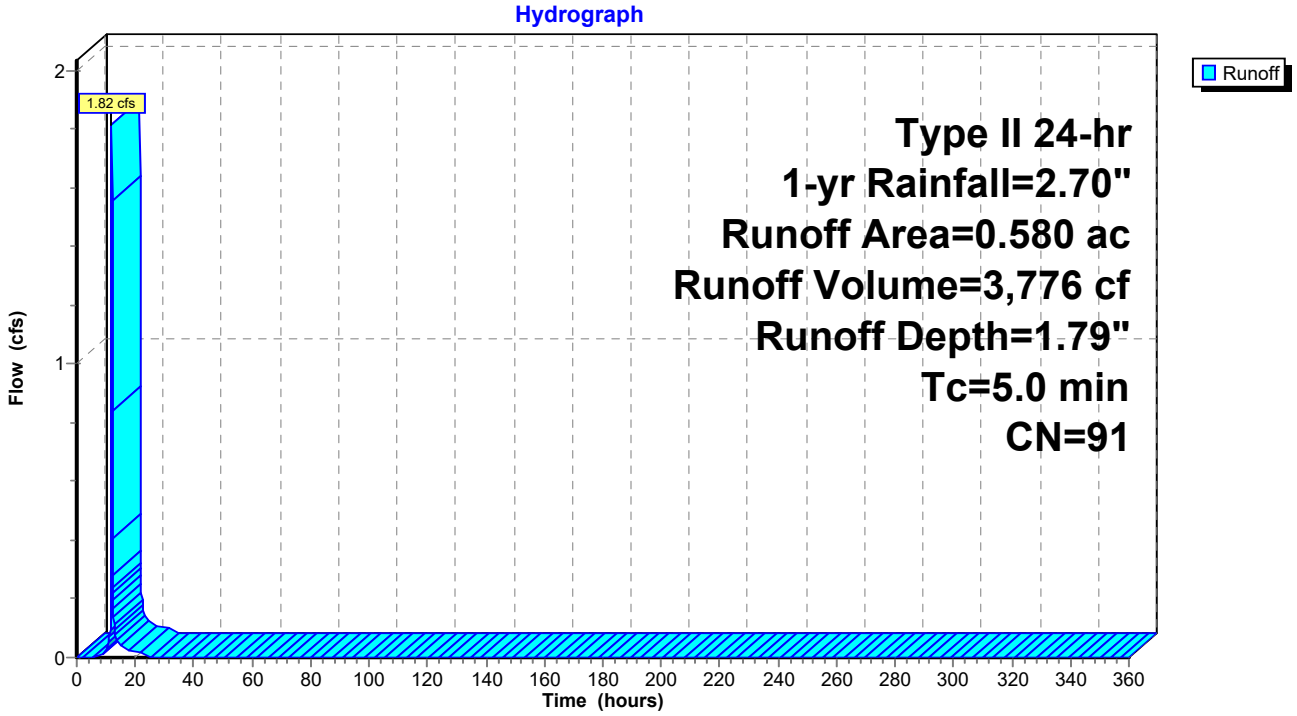
Runoff = 1.82 cfs @ 11.95 hrs, Volume= 3,776 cf, Depth= 1.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-yr Rainfall=2.70"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 0.002 | 98 | Impervious |
| * | 0.578 | 91 | Gravel |
| | 0.580 | 91 | Weighted Average |
| | 0.578 | | 99.66% Pervious Area |
| | 0.002 | | 0.34% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry, Tc** |

### Subcatchment 5S: POST-Bypass



## Hydrograph for Subcatchment 5S: POST-Bypass

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 |
| 5.00 | 0.17 | 0.00 | 0.00 |
| 10.00 | 0.49 | 0.07 | **0.02** |
| 15.00 | 2.30 | 1.43 | **0.04** |
| 20.00 | **2.57** | **1.67** | 0.02 |
| 25.00 | **2.70** | **1.79** | 0.00 |
| 30.00 | 2.70 | 1.79 | 0.00 |
| 35.00 | 2.70 | 1.79 | 0.00 |
| 40.00 | 2.70 | 1.79 | 0.00 |
| 45.00 | 2.70 | 1.79 | 0.00 |
| 50.00 | 2.70 | 1.79 | 0.00 |
| 55.00 | 2.70 | 1.79 | 0.00 |
| 60.00 | 2.70 | 1.79 | 0.00 |
| 65.00 | 2.70 | 1.79 | 0.00 |
| 70.00 | 2.70 | 1.79 | 0.00 |
| 75.00 | 2.70 | 1.79 | 0.00 |
| 80.00 | 2.70 | 1.79 | 0.00 |
| 85.00 | 2.70 | 1.79 | 0.00 |
| 90.00 | 2.70 | 1.79 | 0.00 |
| 95.00 | 2.70 | 1.79 | 0.00 |
| 100.00 | 2.70 | 1.79 | 0.00 |
| 105.00 | 2.70 | 1.79 | 0.00 |
| 110.00 | 2.70 | 1.79 | 0.00 |
| 115.00 | 2.70 | 1.79 | 0.00 |
| 120.00 | 2.70 | 1.79 | 0.00 |
| 125.00 | 2.70 | 1.79 | 0.00 |
| 130.00 | 2.70 | 1.79 | 0.00 |
| 135.00 | 2.70 | 1.79 | 0.00 |
| 140.00 | 2.70 | 1.79 | 0.00 |
| 145.00 | 2.70 | 1.79 | 0.00 |
| 150.00 | 2.70 | 1.79 | 0.00 |
| 155.00 | 2.70 | 1.79 | 0.00 |
| 160.00 | 2.70 | 1.79 | 0.00 |
| 165.00 | 2.70 | 1.79 | 0.00 |
| 170.00 | 2.70 | 1.79 | 0.00 |
| 175.00 | 2.70 | 1.79 | 0.00 |
| 180.00 | 2.70 | 1.79 | 0.00 |
| 185.00 | 2.70 | 1.79 | 0.00 |
| 190.00 | 2.70 | 1.79 | 0.00 |
| 195.00 | 2.70 | 1.79 | 0.00 |
| 200.00 | 2.70 | 1.79 | 0.00 |
| 205.00 | 2.70 | 1.79 | 0.00 |
| 210.00 | 2.70 | 1.79 | 0.00 |
| 215.00 | 2.70 | 1.79 | 0.00 |
| 220.00 | 2.70 | 1.79 | 0.00 |
| 225.00 | 2.70 | 1.79 | 0.00 |
| 230.00 | 2.70 | 1.79 | 0.00 |
| 235.00 | 2.70 | 1.79 | 0.00 |
| 240.00 | 2.70 | 1.79 | 0.00 |
| 245.00 | 2.70 | 1.79 | 0.00 |
| 250.00 | 2.70 | 1.79 | 0.00 |
| 255.00 | 2.70 | 1.79 | 0.00 |
| 260.00 | 2.70 | 1.79 | 0.00 |
| 265.00 | 2.70 | 1.79 | 0.00 |
| 270.00 | 2.70 | 1.79 | 0.00 |
| 275.00 | 2.70 | 1.79 | 0.00 |
| 280.00 | 2.70 | 1.79 | 0.00 |
| 285.00 | 2.70 | 1.79 | 0.00 |
| 290.00 | 2.70 | 1.79 | 0.00 |
| 295.00 | 2.70 | 1.79 | 0.00 |
| 300.00 | 2.70 | 1.79 | 0.00 |
| 305.00 | 2.70 | 1.79 | 0.00 |
| 310.00 | 2.70 | 1.79 | 0.00 |
| 315.00 | 2.70 | 1.79 | 0.00 |
| 320.00 | 2.70 | 1.79 | 0.00 |
| 325.00 | 2.70 | 1.79 | 0.00 |
| 330.00 | 2.70 | 1.79 | 0.00 |
| 335.00 | 2.70 | 1.79 | 0.00 |
| 340.00 | 2.70 | 1.79 | 0.00 |
| 345.00 | 2.70 | 1.79 | 0.00 |
| 350.00 | 2.70 | 1.79 | 0.00 |
| 355.00 | 2.70 | 1.79 | 0.00 |
| 360.00 | 2.70 | 1.79 | 0.00 |

## Summary for Pond 3P: MRC BMP

Inflow Area = 47,524 sf, 29.70% Impervious, Inflow Depth = 1.71" for 1-yr event
Inflow = 2.29 cfs @ 12.08 hrs, Volume= 6,775 cf
Outflow = 0.00 cfs @ 24.49 hrs, Volume= 101 cf, Atten= 100%, Lag= 744.5 min
Primary = 0.00 cfs @ 24.49 hrs, Volume= 101 cf

Routing by Stor-Ind method, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
Peak Elev= 548.53' @ 24.49 hrs Surf.Area= 3,886 sf Storage= 6,771 cf

Plug-Flow detention time= 2,022.1 min calculated for 101 cf (1% of inflow)
Center-of-Mass det. time= 1,710.4 min ( 2,530.4 - 820.0 )

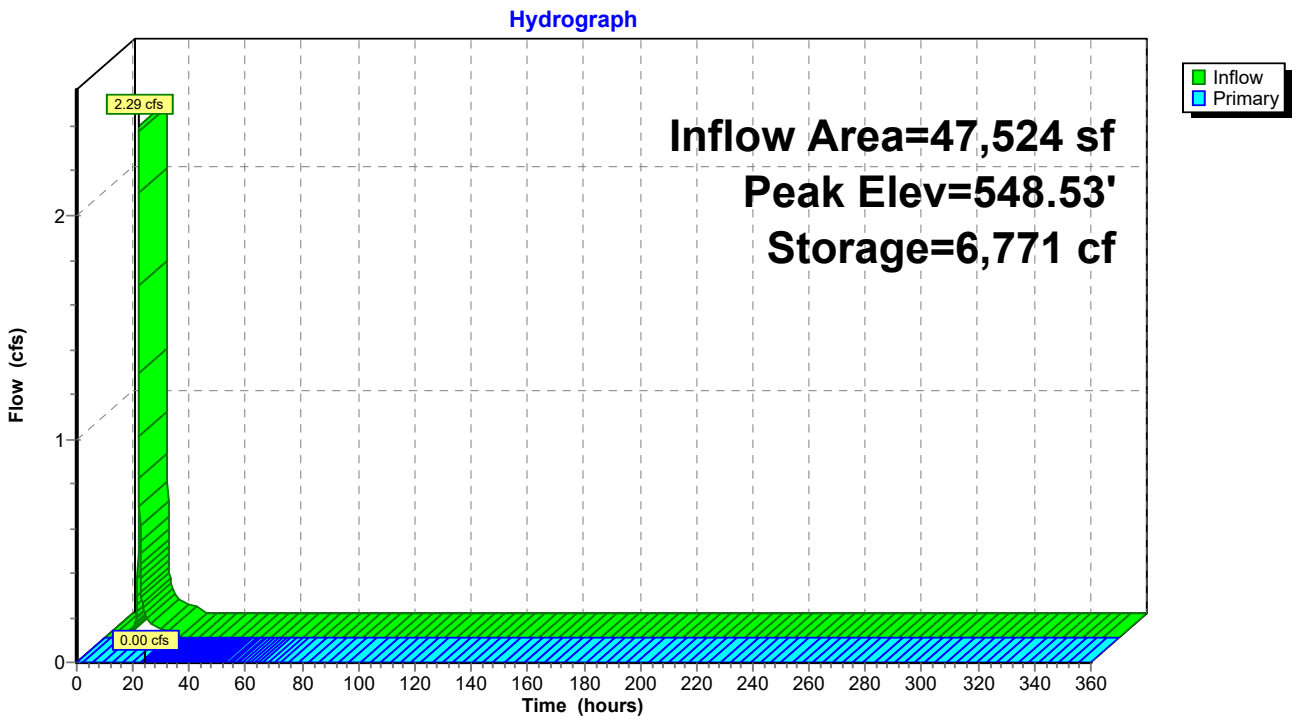
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 545.00' | 12,386 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc)<br>12,639 cf Overall x 98.0% Voids |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 545.00 | 1,943 | 0 | 0 |
| 546.00 | 1,943 | 1,943 | 1,943 |
| 547.00 | 1,943 | 1,943 | 3,886 |
| 548.00 | 1,943 | 1,943 | 5,829 |
| 548.49 | 1,943 | 952 | 6,781 |
| 548.50 | 3,886 | 29 | 6,810 |
| 549.00 | 3,886 | 1,943 | 8,753 |
| 550.00 | 3,886 | 3,886 | 12,639 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 548.50' | **12.0" Round Culvert**<br>L= 10.0' RCP, groove end projecting, Ke= 0.200<br>Inlet / Outlet Invert= 548.50' / 548.40' S= 0.0100 '/' Cc= 0.900<br>n= 0.011, Flow Area= 0.79 sf |
| #2 | Device 1 | 545.00' | **0.7" Vert. Orifice/Grate** C= 0.600 |
| #3 | Device 1 | 548.95' | **2.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

**Primary OutFlow** Max=0.00 cfs @ 24.49 hrs HW=548.53' (Free Discharge)
└─**1=Culvert** (Passes 0.00 cfs of 0.00 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.00 cfs @ 0.77 fps)
  └─**3=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

## Pond 3P: MRC BMP



## Hydrograph for Pond 3P: MRC BMP

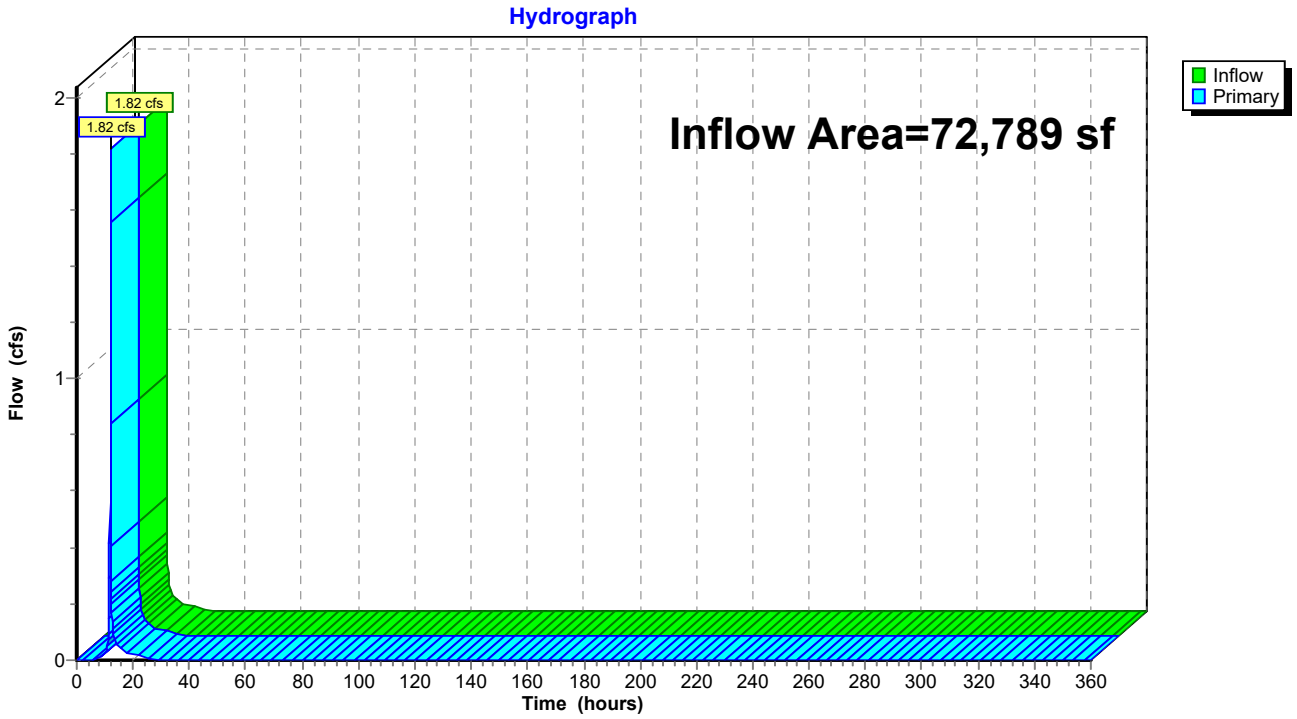
| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 0.00 | 0.00 | 0 | 545.00 | 0.00 |
| 10.00 | **0.03** | 171 | 545.09 | 0.00 |
| 20.00 | **0.04** | **6,280** | **548.30** | **0.00** |
| 30.00 | 0.00 | **6,746** | **548.52** | **0.00** |
| 40.00 | 0.00 | 6,716 | 548.51 | 0.00 |
| 50.00 | 0.00 | 6,698 | 548.51 | 0.00 |
| 60.00 | 0.00 | 6,688 | 548.50 | 0.00 |
| 70.00 | 0.00 | 6,682 | 548.50 | 0.00 |
| 80.00 | 0.00 | 6,679 | 548.50 | 0.00 |
| 90.00 | 0.00 | 6,677 | 548.50 | 0.00 |
| 100.00 | 0.00 | 6,676 | 548.50 | 0.00 |
| 110.00 | 0.00 | 6,675 | 548.50 | 0.00 |
| 120.00 | 0.00 | 6,675 | 548.50 | 0.00 |
| 130.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 140.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 150.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 160.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 170.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 180.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 190.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 200.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 210.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 220.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 230.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 240.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 250.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 260.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 270.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 280.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 290.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 300.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 310.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 320.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 330.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 340.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 350.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 360.00 | 0.00 | 6,674 | 548.50 | 0.00 |

## Summary for Link 4L: POST

Inflow Area = 72,789 sf, 19.51% Impervious, Inflow Depth = 0.64" for 1-yr event
Inflow = 1.82 cfs @ 11.95 hrs, Volume= 3,877 cf
Primary = 1.82 cfs @ 11.95 hrs, Volume= 3,877 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs

### Link 4L: POST



## Hydrograph for Link 4L: POST

| Time (hours) | Inflow (cfs) | Elevation (feet) | Primary (cfs) | Time (hours) | Inflow (cfs) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | **0.00** | 0.00 | 260.00 | 0.00 | 0.00 | 0.00 |
| 5.00 | 0.00 | 0.00 | 0.00 | 265.00 | 0.00 | 0.00 | 0.00 |
| 10.00 | **0.02** | 0.00 | **0.02** | 270.00 | 0.00 | 0.00 | 0.00 |
| 15.00 | **0.04** | 0.00 | **0.04** | 275.00 | 0.00 | 0.00 | 0.00 |
| 20.00 | 0.02 | 0.00 | 0.02 | 280.00 | 0.00 | 0.00 | 0.00 |
| 25.00 | 0.00 | 0.00 | 0.00 | 285.00 | 0.00 | 0.00 | 0.00 |
| 30.00 | 0.00 | 0.00 | 0.00 | 290.00 | 0.00 | 0.00 | 0.00 |
| 35.00 | 0.00 | 0.00 | 0.00 | 295.00 | 0.00 | 0.00 | 0.00 |
| 40.00 | 0.00 | 0.00 | 0.00 | 300.00 | 0.00 | 0.00 | 0.00 |
| 45.00 | 0.00 | 0.00 | 0.00 | 305.00 | 0.00 | 0.00 | 0.00 |
| 50.00 | 0.00 | 0.00 | 0.00 | 310.00 | 0.00 | 0.00 | 0.00 |
| 55.00 | 0.00 | 0.00 | 0.00 | 315.00 | 0.00 | 0.00 | 0.00 |
| 60.00 | 0.00 | 0.00 | 0.00 | 320.00 | 0.00 | 0.00 | 0.00 |
| 65.00 | 0.00 | 0.00 | 0.00 | 325.00 | 0.00 | 0.00 | 0.00 |
| 70.00 | 0.00 | 0.00 | 0.00 | 330.00 | 0.00 | 0.00 | 0.00 |
| 75.00 | 0.00 | 0.00 | 0.00 | 335.00 | 0.00 | 0.00 | 0.00 |
| 80.00 | 0.00 | 0.00 | 0.00 | 340.00 | 0.00 | 0.00 | 0.00 |
| 85.00 | 0.00 | 0.00 | 0.00 | 345.00 | 0.00 | 0.00 | 0.00 |
| 90.00 | 0.00 | 0.00 | 0.00 | 350.00 | 0.00 | 0.00 | 0.00 |
| 95.00 | 0.00 | 0.00 | 0.00 | 355.00 | 0.00 | 0.00 | 0.00 |
| 100.00 | 0.00 | 0.00 | 0.00 | 360.00 | 0.00 | 0.00 | 0.00 |
| 105.00 | 0.00 | 0.00 | 0.00 | | | | |
| 110.00 | 0.00 | 0.00 | 0.00 | | | | |
| 115.00 | 0.00 | 0.00 | 0.00 | | | | |
| 120.00 | 0.00 | 0.00 | 0.00 | | | | |
| 125.00 | 0.00 | 0.00 | 0.00 | | | | |
| 130.00 | 0.00 | 0.00 | 0.00 | | | | |
| 135.00 | 0.00 | 0.00 | 0.00 | | | | |
| 140.00 | 0.00 | 0.00 | 0.00 | | | | |
| 145.00 | 0.00 | 0.00 | 0.00 | | | | |
| 150.00 | 0.00 | 0.00 | 0.00 | | | | |
| 155.00 | 0.00 | 0.00 | 0.00 | | | | |
| 160.00 | 0.00 | 0.00 | 0.00 | | | | |
| 165.00 | 0.00 | 0.00 | 0.00 | | | | |
| 170.00 | 0.00 | 0.00 | 0.00 | | | | |
| 175.00 | 0.00 | 0.00 | 0.00 | | | | |
| 180.00 | 0.00 | 0.00 | 0.00 | | | | |
| 185.00 | 0.00 | 0.00 | 0.00 | | | | |
| 190.00 | 0.00 | 0.00 | 0.00 | | | | |
| 195.00 | 0.00 | 0.00 | 0.00 | | | | |
| 200.00 | 0.00 | 0.00 | 0.00 | | | | |
| 205.00 | 0.00 | 0.00 | 0.00 | | | | |
| 210.00 | 0.00 | 0.00 | 0.00 | | | | |
| 215.00 | 0.00 | 0.00 | 0.00 | | | | |
| 220.00 | 0.00 | 0.00 | 0.00 | | | | |
| 225.00 | 0.00 | 0.00 | 0.00 | | | | |
| 230.00 | 0.00 | 0.00 | 0.00 | | | | |
| 235.00 | 0.00 | 0.00 | 0.00 | | | | |
| 240.00 | 0.00 | 0.00 | 0.00 | | | | |
| 245.00 | 0.00 | 0.00 | 0.00 | | | | |
| 250.00 | 0.00 | 0.00 | 0.00 | | | | |
| 255.00 | 0.00 | 0.00 | 0.00 | | | | |

Time span=0.00-360.00 hrs, dt=0.05 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: PRE** Runoff Area=1.665 ac 0.36% Impervious Runoff Depth=0.22"
Tc=15.8 min CN=83 Runoff=0.71 cfs 1,330 cf

**Subcatchment2S: POST-MRC BMP** Runoff Area=1.091 ac 29.70% Impervious Runoff Depth=0.46"
Tc=16.2 min CN=90 Runoff=1.05 cfs 1,813 cf

**Subcatchment5S: POST-Bypass** Runoff Area=0.580 ac 0.34% Impervious Runoff Depth=0.50"
Tc=5.0 min CN=91 Runoff=0.93 cfs 1,062 cf

**Pond 3P: MRC BMP** Peak Elev=545.95' Storage=1,813 cf Inflow=1.05 cfs 1,813 cf
Outflow=0.00 cfs 0 cf

**Link 4L: POST** Inflow=0.93 cfs 1,062 cf
Primary=0.93 cfs 1,062 cf

**Total Runoff Area = 145,316 sf Runoff Volume = 4,205 cf Average Runoff Depth = 0.35"**
**90.05% Pervious = 130,854 sf 9.95% Impervious = 14,462 sf**

## Summary for Subcatchment 1S: PRE

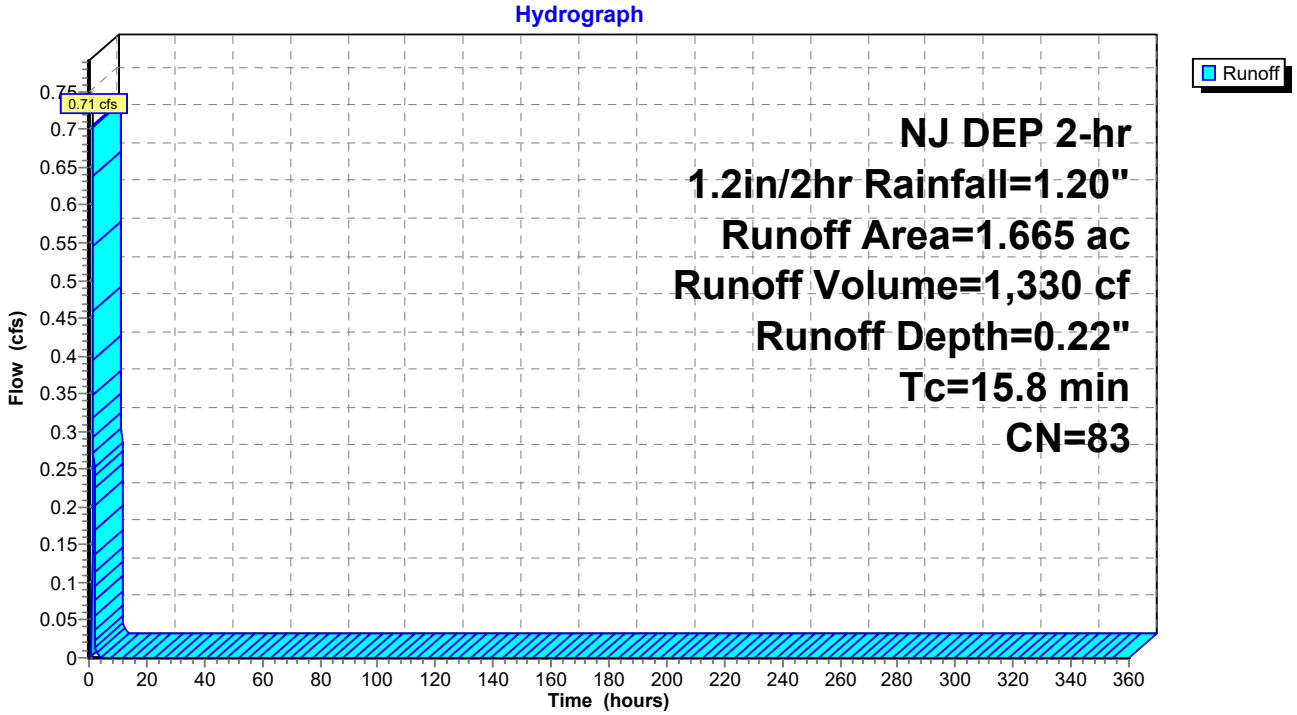
Runoff = 0.71 cfs @ 1.28 hrs, Volume= 1,330 cf, Depth= 0.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr 1.2in/2hr Rainfall=1.20"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 0.006 | 98 | Impervious |
| * | 0.134 | 77 | Woods, Good |
| * | 0.684 | 78 | Meadow (20% and On-site Brush) |
| * | 0.674 | 91 | Gravel |
| * | 0.167 | 73 | Onsite Brush, Good |
| | 1.665 | 83 | Weighted Average |
| | 1.659 | | 99.64% Pervious Area |
| | 0.006 | | 0.36% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.8 | | | | | **Direct Entry, Tc** |

### Subcatchment 1S: PRE



## Hydrograph for Subcatchment 1S: PRE

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|
| 0.00 | **0.00** | **0.00** | **0.00** |
| 5.00 | **1.20** | **0.22** | **0.00** |
| 10.00 | 1.20 | 0.22 | 0.00 |
| 15.00 | 1.20 | 0.22 | 0.00 |
| 20.00 | 1.20 | 0.22 | 0.00 |
| 25.00 | 1.20 | 0.22 | 0.00 |
| 30.00 | 1.20 | 0.22 | 0.00 |
| 35.00 | 1.20 | 0.22 | 0.00 |
| 40.00 | 1.20 | 0.22 | 0.00 |
| 45.00 | 1.20 | 0.22 | 0.00 |
| 50.00 | 1.20 | 0.22 | 0.00 |
| 55.00 | 1.20 | 0.22 | 0.00 |
| 60.00 | 1.20 | 0.22 | 0.00 |
| 65.00 | 1.20 | 0.22 | 0.00 |
| 70.00 | 1.20 | 0.22 | 0.00 |
| 75.00 | 1.20 | 0.22 | 0.00 |
| 80.00 | 1.20 | 0.22 | 0.00 |
| 85.00 | 1.20 | 0.22 | 0.00 |
| 90.00 | 1.20 | 0.22 | 0.00 |
| 95.00 | 1.20 | 0.22 | 0.00 |
| 100.00 | 1.20 | 0.22 | 0.00 |
| 105.00 | 1.20 | 0.22 | 0.00 |
| 110.00 | 1.20 | 0.22 | 0.00 |
| 115.00 | 1.20 | 0.22 | 0.00 |
| 120.00 | 1.20 | 0.22 | 0.00 |
| 125.00 | 1.20 | 0.22 | 0.00 |
| 130.00 | 1.20 | 0.22 | 0.00 |
| 135.00 | 1.20 | 0.22 | 0.00 |
| 140.00 | 1.20 | 0.22 | 0.00 |
| 145.00 | 1.20 | 0.22 | 0.00 |
| 150.00 | 1.20 | 0.22 | 0.00 |
| 155.00 | 1.20 | 0.22 | 0.00 |
| 160.00 | 1.20 | 0.22 | 0.00 |
| 165.00 | 1.20 | 0.22 | 0.00 |
| 170.00 | 1.20 | 0.22 | 0.00 |
| 175.00 | 1.20 | 0.22 | 0.00 |
| 180.00 | 1.20 | 0.22 | 0.00 |
| 185.00 | 1.20 | 0.22 | 0.00 |
| 190.00 | 1.20 | 0.22 | 0.00 |
| 195.00 | 1.20 | 0.22 | 0.00 |
| 200.00 | 1.20 | 0.22 | 0.00 |
| 205.00 | 1.20 | 0.22 | 0.00 |
| 210.00 | 1.20 | 0.22 | 0.00 |
| 215.00 | 1.20 | 0.22 | 0.00 |
| 220.00 | 1.20 | 0.22 | 0.00 |
| 225.00 | 1.20 | 0.22 | 0.00 |
| 230.00 | 1.20 | 0.22 | 0.00 |
| 235.00 | 1.20 | 0.22 | 0.00 |
| 240.00 | 1.20 | 0.22 | 0.00 |
| 245.00 | 1.20 | 0.22 | 0.00 |
| 250.00 | 1.20 | 0.22 | 0.00 |
| 255.00 | 1.20 | 0.22 | 0.00 |
| 260.00 | 1.20 | 0.22 | 0.00 |
| 265.00 | 1.20 | 0.22 | 0.00 |
| 270.00 | 1.20 | 0.22 | 0.00 |
| 275.00 | 1.20 | 0.22 | 0.00 |
| 280.00 | 1.20 | 0.22 | 0.00 |
| 285.00 | 1.20 | 0.22 | 0.00 |
| 290.00 | 1.20 | 0.22 | 0.00 |
| 295.00 | 1.20 | 0.22 | 0.00 |
| 300.00 | 1.20 | 0.22 | 0.00 |
| 305.00 | 1.20 | 0.22 | 0.00 |
| 310.00 | 1.20 | 0.22 | 0.00 |
| 315.00 | 1.20 | 0.22 | 0.00 |
| 320.00 | 1.20 | 0.22 | 0.00 |
| 325.00 | 1.20 | 0.22 | 0.00 |
| 330.00 | 1.20 | 0.22 | 0.00 |
| 335.00 | 1.20 | 0.22 | 0.00 |
| 340.00 | 1.20 | 0.22 | 0.00 |
| 345.00 | 1.20 | 0.22 | 0.00 |
| 350.00 | 1.20 | 0.22 | 0.00 |
| 355.00 | 1.20 | 0.22 | 0.00 |
| 360.00 | 1.20 | 0.22 | 0.00 |

## Summary for Subcatchment 2S: POST-MRC BMP

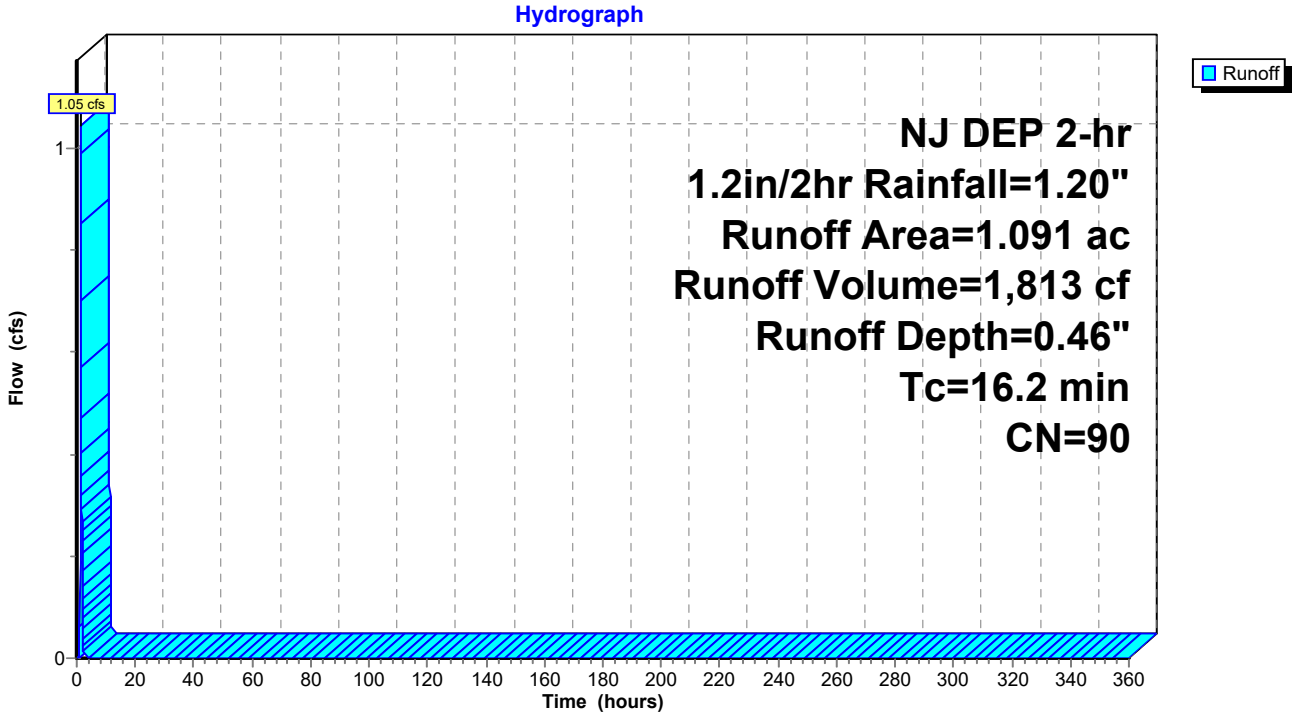
Runoff = 1.05 cfs @ 1.26 hrs, Volume= 1,813 cf, Depth= 0.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr 1.2in/2hr Rainfall=1.20"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 0.586 | 91 | Gravel |
| * | 0.324 | 98 | Impervious |
| * | 0.181 | 73 | Brush, good |
| | 1.091 | 90 | Weighted Average |
| | 0.767 | | 70.30% Pervious Area |
| | 0.324 | | 29.70% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 16.2 | | | | | **Direct Entry, Tc** |

### Subcatchment 2S: POST-MRC BMP



## Hydrograph for Subcatchment 2S: POST-MRC BMP

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|
| 0.00 | **0.00** | **0.00** | **0.00** |
| 5.00 | **1.20** | **0.46** | **0.00** |
| 10.00 | 1.20 | 0.46 | 0.00 |
| 15.00 | 1.20 | 0.46 | 0.00 |
| 20.00 | 1.20 | 0.46 | 0.00 |
| 25.00 | 1.20 | 0.46 | 0.00 |
| 30.00 | 1.20 | 0.46 | 0.00 |
| 35.00 | 1.20 | 0.46 | 0.00 |
| 40.00 | 1.20 | 0.46 | 0.00 |
| 45.00 | 1.20 | 0.46 | 0.00 |
| 50.00 | 1.20 | 0.46 | 0.00 |
| 55.00 | 1.20 | 0.46 | 0.00 |
| 60.00 | 1.20 | 0.46 | 0.00 |
| 65.00 | 1.20 | 0.46 | 0.00 |
| 70.00 | 1.20 | 0.46 | 0.00 |
| 75.00 | 1.20 | 0.46 | 0.00 |
| 80.00 | 1.20 | 0.46 | 0.00 |
| 85.00 | 1.20 | 0.46 | 0.00 |
| 90.00 | 1.20 | 0.46 | 0.00 |
| 95.00 | 1.20 | 0.46 | 0.00 |
| 100.00 | 1.20 | 0.46 | 0.00 |
| 105.00 | 1.20 | 0.46 | 0.00 |
| 110.00 | 1.20 | 0.46 | 0.00 |
| 115.00 | 1.20 | 0.46 | 0.00 |
| 120.00 | 1.20 | 0.46 | 0.00 |
| 125.00 | 1.20 | 0.46 | 0.00 |
| 130.00 | 1.20 | 0.46 | 0.00 |
| 135.00 | 1.20 | 0.46 | 0.00 |
| 140.00 | 1.20 | 0.46 | 0.00 |
| 145.00 | 1.20 | 0.46 | 0.00 |
| 150.00 | 1.20 | 0.46 | 0.00 |
| 155.00 | 1.20 | 0.46 | 0.00 |
| 160.00 | 1.20 | 0.46 | 0.00 |
| 165.00 | 1.20 | 0.46 | 0.00 |
| 170.00 | 1.20 | 0.46 | 0.00 |
| 175.00 | 1.20 | 0.46 | 0.00 |
| 180.00 | 1.20 | 0.46 | 0.00 |
| 185.00 | 1.20 | 0.46 | 0.00 |
| 190.00 | 1.20 | 0.46 | 0.00 |
| 195.00 | 1.20 | 0.46 | 0.00 |
| 200.00 | 1.20 | 0.46 | 0.00 |
| 205.00 | 1.20 | 0.46 | 0.00 |
| 210.00 | 1.20 | 0.46 | 0.00 |
| 215.00 | 1.20 | 0.46 | 0.00 |
| 220.00 | 1.20 | 0.46 | 0.00 |
| 225.00 | 1.20 | 0.46 | 0.00 |
| 230.00 | 1.20 | 0.46 | 0.00 |
| 235.00 | 1.20 | 0.46 | 0.00 |
| 240.00 | 1.20 | 0.46 | 0.00 |
| 245.00 | 1.20 | 0.46 | 0.00 |
| 250.00 | 1.20 | 0.46 | 0.00 |
| 255.00 | 1.20 | 0.46 | 0.00 |
| 260.00 | 1.20 | 0.46 | 0.00 |
| 265.00 | 1.20 | 0.46 | 0.00 |
| 270.00 | 1.20 | 0.46 | 0.00 |
| 275.00 | 1.20 | 0.46 | 0.00 |
| 280.00 | 1.20 | 0.46 | 0.00 |
| 285.00 | 1.20 | 0.46 | 0.00 |
| 290.00 | 1.20 | 0.46 | 0.00 |
| 295.00 | 1.20 | 0.46 | 0.00 |
| 300.00 | 1.20 | 0.46 | 0.00 |
| 305.00 | 1.20 | 0.46 | 0.00 |
| 310.00 | 1.20 | 0.46 | 0.00 |
| 315.00 | 1.20 | 0.46 | 0.00 |
| 320.00 | 1.20 | 0.46 | 0.00 |
| 325.00 | 1.20 | 0.46 | 0.00 |
| 330.00 | 1.20 | 0.46 | 0.00 |
| 335.00 | 1.20 | 0.46 | 0.00 |
| 340.00 | 1.20 | 0.46 | 0.00 |
| 345.00 | 1.20 | 0.46 | 0.00 |
| 350.00 | 1.20 | 0.46 | 0.00 |
| 355.00 | 1.20 | 0.46 | 0.00 |
| 360.00 | 1.20 | 0.46 | 0.00 |

## Summary for Subcatchment 5S: POST-Bypass

[49] Hint: Tc<2dt may require smaller dt

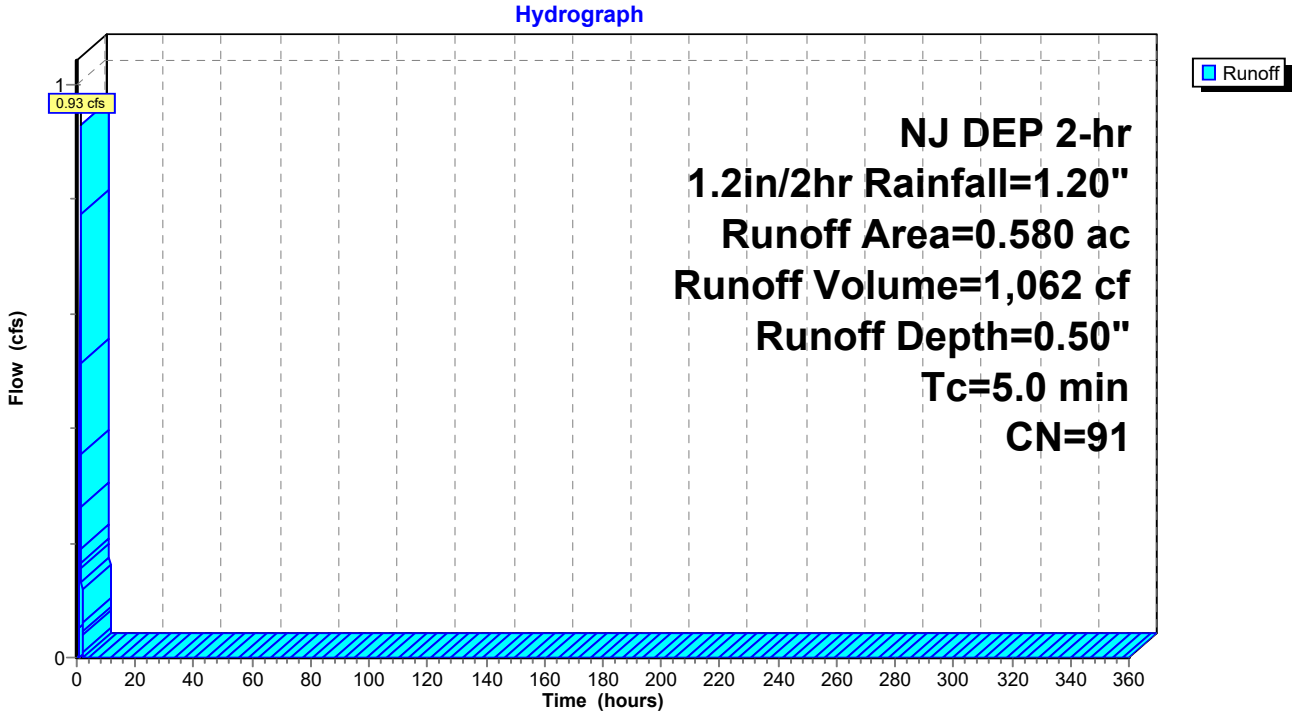
Runoff = 0.93 cfs @ 1.10 hrs, Volume= 1,062 cf, Depth= 0.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr 1.2in/2hr Rainfall=1.20"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 0.002 | 98 | Impervious |
| * | 0.578 | 91 | Gravel |
| | 0.580 | 91 | Weighted Average |
| | 0.578 | | 99.66% Pervious Area |
| | 0.002 | | 0.34% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry, Tc** |

## Subcatchment 5S: POST-Bypass



## Hydrograph for Subcatchment 5S: POST-Bypass

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|
| 0.00 | **0.00** | **0.00** | **0.00** |
| 5.00 | **1.20** | **0.50** | **0.00** |
| 10.00 | 1.20 | 0.50 | 0.00 |
| 15.00 | 1.20 | 0.50 | 0.00 |
| 20.00 | 1.20 | 0.50 | 0.00 |
| 25.00 | 1.20 | 0.50 | 0.00 |
| 30.00 | 1.20 | 0.50 | 0.00 |
| 35.00 | 1.20 | 0.50 | 0.00 |
| 40.00 | 1.20 | 0.50 | 0.00 |
| 45.00 | 1.20 | 0.50 | 0.00 |
| 50.00 | 1.20 | 0.50 | 0.00 |
| 55.00 | 1.20 | 0.50 | 0.00 |
| 60.00 | 1.20 | 0.50 | 0.00 |
| 65.00 | 1.20 | 0.50 | 0.00 |
| 70.00 | 1.20 | 0.50 | 0.00 |
| 75.00 | 1.20 | 0.50 | 0.00 |
| 80.00 | 1.20 | 0.50 | 0.00 |
| 85.00 | 1.20 | 0.50 | 0.00 |
| 90.00 | 1.20 | 0.50 | 0.00 |
| 95.00 | 1.20 | 0.50 | 0.00 |
| 100.00 | 1.20 | 0.50 | 0.00 |
| 105.00 | 1.20 | 0.50 | 0.00 |
| 110.00 | 1.20 | 0.50 | 0.00 |
| 115.00 | 1.20 | 0.50 | 0.00 |
| 120.00 | 1.20 | 0.50 | 0.00 |
| 125.00 | 1.20 | 0.50 | 0.00 |
| 130.00 | 1.20 | 0.50 | 0.00 |
| 135.00 | 1.20 | 0.50 | 0.00 |
| 140.00 | 1.20 | 0.50 | 0.00 |
| 145.00 | 1.20 | 0.50 | 0.00 |
| 150.00 | 1.20 | 0.50 | 0.00 |
| 155.00 | 1.20 | 0.50 | 0.00 |
| 160.00 | 1.20 | 0.50 | 0.00 |
| 165.00 | 1.20 | 0.50 | 0.00 |
| 170.00 | 1.20 | 0.50 | 0.00 |
| 175.00 | 1.20 | 0.50 | 0.00 |
| 180.00 | 1.20 | 0.50 | 0.00 |
| 185.00 | 1.20 | 0.50 | 0.00 |
| 190.00 | 1.20 | 0.50 | 0.00 |
| 195.00 | 1.20 | 0.50 | 0.00 |
| 200.00 | 1.20 | 0.50 | 0.00 |
| 205.00 | 1.20 | 0.50 | 0.00 |
| 210.00 | 1.20 | 0.50 | 0.00 |
| 215.00 | 1.20 | 0.50 | 0.00 |
| 220.00 | 1.20 | 0.50 | 0.00 |
| 225.00 | 1.20 | 0.50 | 0.00 |
| 230.00 | 1.20 | 0.50 | 0.00 |
| 235.00 | 1.20 | 0.50 | 0.00 |
| 240.00 | 1.20 | 0.50 | 0.00 |
| 245.00 | 1.20 | 0.50 | 0.00 |
| 250.00 | 1.20 | 0.50 | 0.00 |
| 255.00 | 1.20 | 0.50 | 0.00 |
| 260.00 | 1.20 | 0.50 | 0.00 |
| 265.00 | 1.20 | 0.50 | 0.00 |
| 270.00 | 1.20 | 0.50 | 0.00 |
| 275.00 | 1.20 | 0.50 | 0.00 |
| 280.00 | 1.20 | 0.50 | 0.00 |
| 285.00 | 1.20 | 0.50 | 0.00 |
| 290.00 | 1.20 | 0.50 | 0.00 |
| 295.00 | 1.20 | 0.50 | 0.00 |
| 300.00 | 1.20 | 0.50 | 0.00 |
| 305.00 | 1.20 | 0.50 | 0.00 |
| 310.00 | 1.20 | 0.50 | 0.00 |
| 315.00 | 1.20 | 0.50 | 0.00 |
| 320.00 | 1.20 | 0.50 | 0.00 |
| 325.00 | 1.20 | 0.50 | 0.00 |
| 330.00 | 1.20 | 0.50 | 0.00 |
| 335.00 | 1.20 | 0.50 | 0.00 |
| 340.00 | 1.20 | 0.50 | 0.00 |
| 345.00 | 1.20 | 0.50 | 0.00 |
| 350.00 | 1.20 | 0.50 | 0.00 |
| 355.00 | 1.20 | 0.50 | 0.00 |
| 360.00 | 1.20 | 0.50 | 0.00 |

## Summary for Pond 3P: MRC BMP

Inflow Area = 47,524 sf, 29.70% Impervious, Inflow Depth = 0.46" for 1.2in/2hr event
Inflow = 1.05 cfs @ 1.26 hrs, Volume= 1,813 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
Peak Elev= 545.95' @ 2.95 hrs Surf.Area= 1,943 sf Storage= 1,813 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

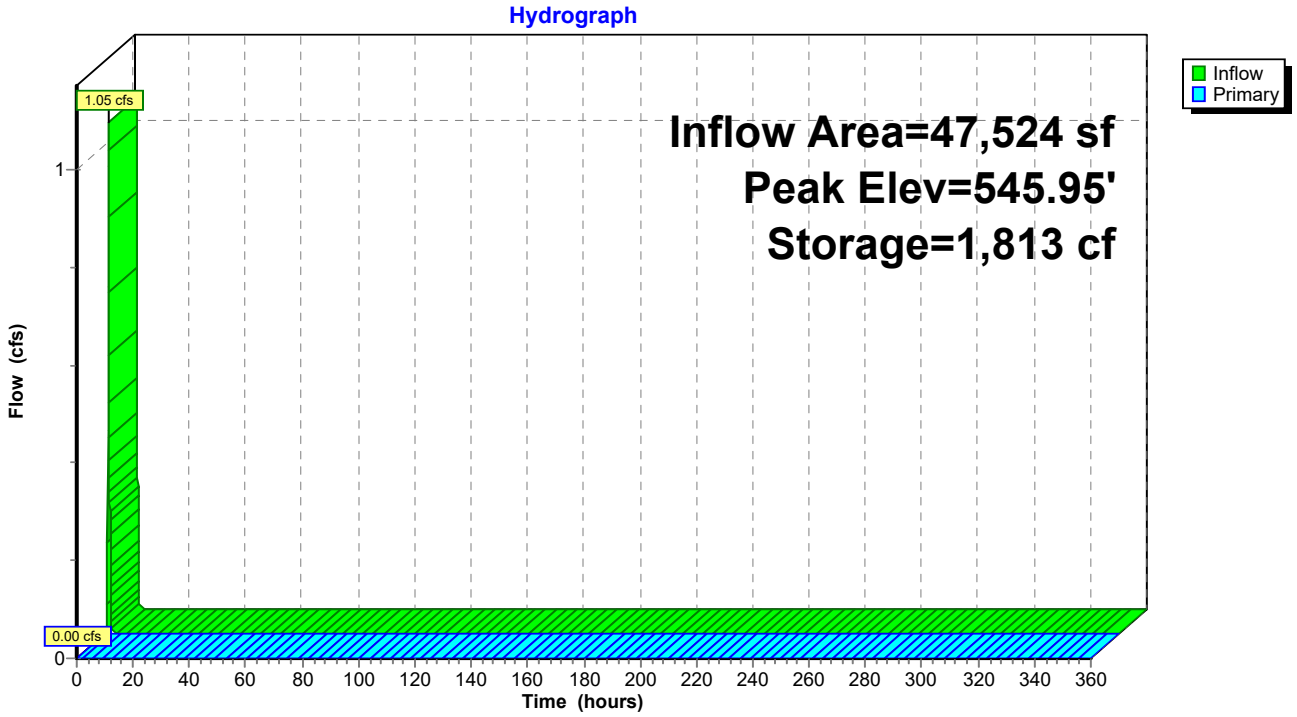
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 545.00' | 12,386 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc)<br>12,639 cf Overall x 98.0% Voids |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 545.00 | 1,943 | 0 | 0 |
| 546.00 | 1,943 | 1,943 | 1,943 |
| 547.00 | 1,943 | 1,943 | 3,886 |
| 548.00 | 1,943 | 1,943 | 5,829 |
| 548.49 | 1,943 | 952 | 6,781 |
| 548.50 | 3,886 | 29 | 6,810 |
| 549.00 | 3,886 | 1,943 | 8,753 |
| 550.00 | 3,886 | 3,886 | 12,639 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 548.50' | **12.0" Round Culvert**<br>L= 10.0' RCP, groove end projecting, Ke= 0.200<br>Inlet / Outlet Invert= 548.50' / 548.40' S= 0.0100 '/' Cc= 0.900<br>n= 0.011, Flow Area= 0.79 sf |
| #2 | Device 1 | 545.00' | **0.7" Vert. Orifice/Grate** C= 0.600 |
| #3 | Device 1 | 548.95' | **2.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=545.00' (Free Discharge)
└─**1=Culvert** ( Controls 0.00 cfs)
  ├─**2=Orifice/Grate** ( Controls 0.00 cfs)
  └─**3=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

## Pond 3P: MRC BMP



## Hydrograph for Pond 3P: MRC BMP

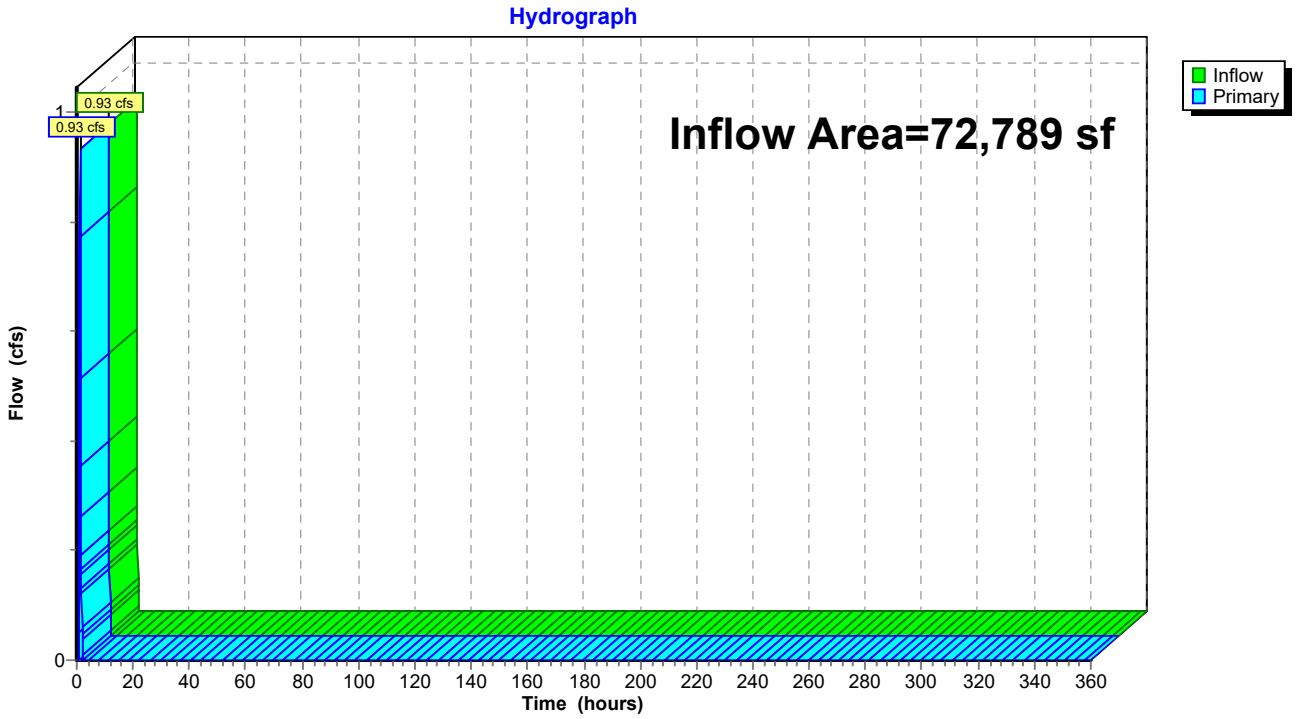
| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 0.00 | **0.00** | **0** | **545.00** | **0.00** |
| 10.00 | **0.00** | **1,813** | **545.95** | 0.00 |
| 20.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 30.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 40.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 50.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 60.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 70.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 80.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 90.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 100.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 110.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 120.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 130.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 140.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 150.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 160.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 170.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 180.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 190.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 200.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 210.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 220.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 230.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 240.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 250.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 260.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 270.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 280.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 290.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 300.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 310.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 320.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 330.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 340.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 350.00 | 0.00 | 1,813 | 545.95 | 0.00 |
| 360.00 | 0.00 | 1,813 | 545.95 | 0.00 |

## Summary for Link 4L: POST

Inflow Area = 72,789 sf, 19.51% Impervious, Inflow Depth = 0.18" for 1.2in/2hr event
Inflow = 0.93 cfs @ 1.10 hrs, Volume= 1,062 cf
Primary = 0.93 cfs @ 1.10 hrs, Volume= 1,062 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs

## Link 4L: POST



## Hydrograph for Link 4L: POST

| Time (hours) | Inflow (cfs) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|
| 0.00 | **0.00** | **0.00** | **0.00** |
| 5.00 | **0.00** | 0.00 | **0.00** |
| 10.00 | 0.00 | 0.00 | 0.00 |
| 15.00 | 0.00 | 0.00 | 0.00 |
| 20.00 | 0.00 | 0.00 | 0.00 |
| 25.00 | 0.00 | 0.00 | 0.00 |
| 30.00 | 0.00 | 0.00 | 0.00 |
| 35.00 | 0.00 | 0.00 | 0.00 |
| 40.00 | 0.00 | 0.00 | 0.00 |
| 45.00 | 0.00 | 0.00 | 0.00 |
| 50.00 | 0.00 | 0.00 | 0.00 |
| 55.00 | 0.00 | 0.00 | 0.00 |
| 60.00 | 0.00 | 0.00 | 0.00 |
| 65.00 | 0.00 | 0.00 | 0.00 |
| 70.00 | 0.00 | 0.00 | 0.00 |
| 75.00 | 0.00 | 0.00 | 0.00 |
| 80.00 | 0.00 | 0.00 | 0.00 |
| 85.00 | 0.00 | 0.00 | 0.00 |
| 90.00 | 0.00 | 0.00 | 0.00 |
| 95.00 | 0.00 | 0.00 | 0.00 |
| 100.00 | 0.00 | 0.00 | 0.00 |
| 105.00 | 0.00 | 0.00 | 0.00 |
| 110.00 | 0.00 | 0.00 | 0.00 |
| 115.00 | 0.00 | 0.00 | 0.00 |
| 120.00 | 0.00 | 0.00 | 0.00 |
| 125.00 | 0.00 | 0.00 | 0.00 |
| 130.00 | 0.00 | 0.00 | 0.00 |
| 135.00 | 0.00 | 0.00 | 0.00 |
| 140.00 | 0.00 | 0.00 | 0.00 |
| 145.00 | 0.00 | 0.00 | 0.00 |
| 150.00 | 0.00 | 0.00 | 0.00 |
| 155.00 | 0.00 | 0.00 | 0.00 |
| 160.00 | 0.00 | 0.00 | 0.00 |
| 165.00 | 0.00 | 0.00 | 0.00 |
| 170.00 | 0.00 | 0.00 | 0.00 |
| 175.00 | 0.00 | 0.00 | 0.00 |
| 180.00 | 0.00 | 0.00 | 0.00 |
| 185.00 | 0.00 | 0.00 | 0.00 |
| 190.00 | 0.00 | 0.00 | 0.00 |
| 195.00 | 0.00 | 0.00 | 0.00 |
| 200.00 | 0.00 | 0.00 | 0.00 |
| 205.00 | 0.00 | 0.00 | 0.00 |
| 210.00 | 0.00 | 0.00 | 0.00 |
| 215.00 | 0.00 | 0.00 | 0.00 |
| 220.00 | 0.00 | 0.00 | 0.00 |
| 225.00 | 0.00 | 0.00 | 0.00 |
| 230.00 | 0.00 | 0.00 | 0.00 |
| 235.00 | 0.00 | 0.00 | 0.00 |
| 240.00 | 0.00 | 0.00 | 0.00 |
| 245.00 | 0.00 | 0.00 | 0.00 |
| 250.00 | 0.00 | 0.00 | 0.00 |
| 255.00 | 0.00 | 0.00 | 0.00 |
| 260.00 | 0.00 | 0.00 | 0.00 |
| 265.00 | 0.00 | 0.00 | 0.00 |
| 270.00 | 0.00 | 0.00 | 0.00 |
| 275.00 | 0.00 | 0.00 | 0.00 |
| 280.00 | 0.00 | 0.00 | 0.00 |
| 285.00 | 0.00 | 0.00 | 0.00 |
| 290.00 | 0.00 | 0.00 | 0.00 |
| 295.00 | 0.00 | 0.00 | 0.00 |
| 300.00 | 0.00 | 0.00 | 0.00 |
| 305.00 | 0.00 | 0.00 | 0.00 |
| 310.00 | 0.00 | 0.00 | 0.00 |
| 315.00 | 0.00 | 0.00 | 0.00 |
| 320.00 | 0.00 | 0.00 | 0.00 |
| 325.00 | 0.00 | 0.00 | 0.00 |
| 330.00 | 0.00 | 0.00 | 0.00 |
| 335.00 | 0.00 | 0.00 | 0.00 |
| 340.00 | 0.00 | 0.00 | 0.00 |
| 345.00 | 0.00 | 0.00 | 0.00 |
| 350.00 | 0.00 | 0.00 | 0.00 |
| 355.00 | 0.00 | 0.00 | 0.00 |
| 360.00 | 0.00 | 0.00 | 0.00 |

Time span=0.00-360.00 hrs, dt=0.05 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: PRE** Runoff Area=1.665 ac 0.36% Impervious Runoff Depth=1.58"
Tc=15.8 min CN=83 Runoff=3.28 cfs 9,528 cf

**Subcatchment2S: POST-MRC BMP** Runoff Area=1.091 ac 29.70% Impervious Runoff Depth=2.13"
Tc=16.2 min CN=90 Runoff=2.84 cfs 8,442 cf

**Subcatchment5S: POST-Bypass** Runoff Area=0.580 ac 0.34% Impervious Runoff Depth=2.22"
Tc=5.0 min CN=91 Runoff=2.22 cfs 4,676 cf

**Pond 3P: MRC BMP** Peak Elev=548.91' Storage=8,231 cf Inflow=2.84 cfs 8,442 cf
Outflow=0.01 cfs 1,768 cf

**Link 4L: POST** Inflow=2.22 cfs 6,443 cf
Primary=2.22 cfs 6,443 cf

**Total Runoff Area = 145,316 sf Runoff Volume = 22,645 cf Average Runoff Depth = 1.87"**
**90.05% Pervious = 130,854 sf 9.95% Impervious = 14,462 sf**

## Summary for Subcatchment 1S: PRE

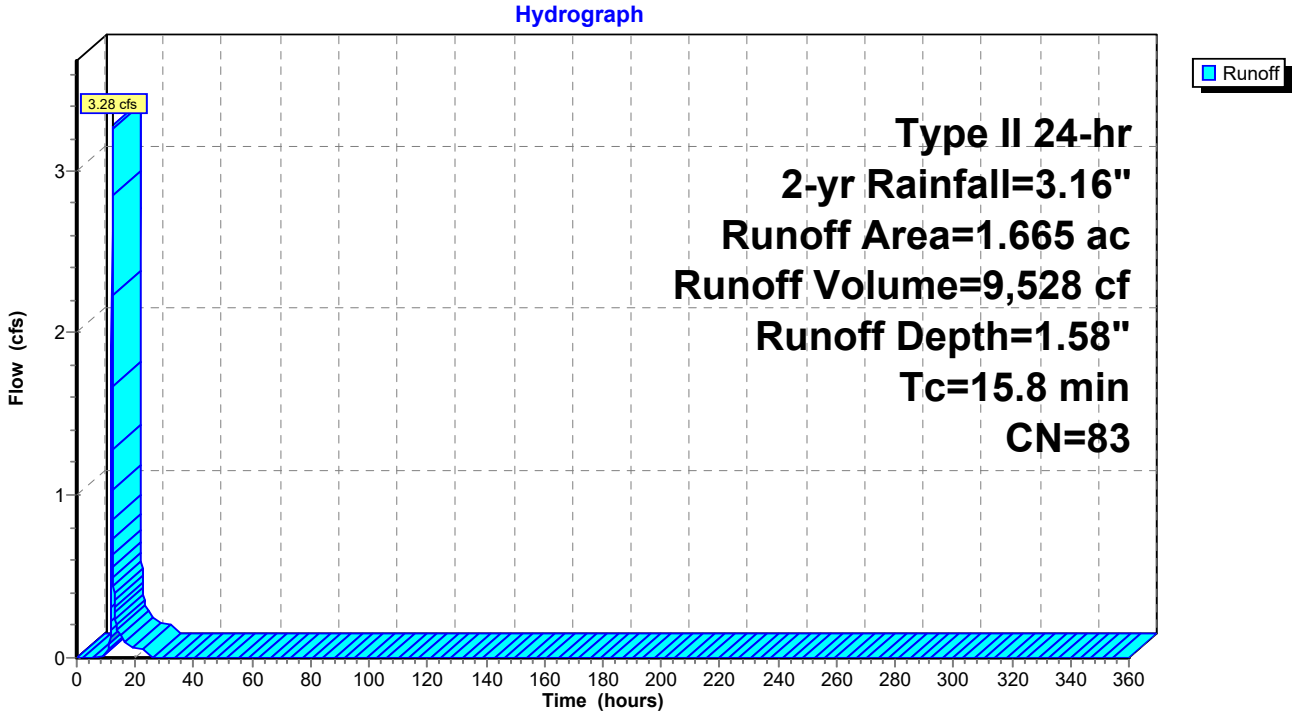
Runoff = 3.28 cfs @ 12.08 hrs, Volume= 9,528 cf, Depth= 1.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=3.16"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 0.006 | 98 | Impervious |
| * | 0.134 | 77 | Woods, Good |
| * | 0.684 | 78 | Meadow (20% and On-site Brush) |
| * | 0.674 | 91 | Gravel |
| * | 0.167 | 73 | Onsite Brush, Good |
| | 1.665 | 83 | Weighted Average |
| | 1.659 | | 99.64% Pervious Area |
| | 0.006 | | 0.36% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.8 | | | | | **Direct Entry, Tc** |

## Subcatchment 1S: PRE



## Hydrograph for Subcatchment 1S: PRE

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 |
| 5.00 | 0.20 | 0.00 | 0.00 |
| 10.00 | 0.57 | 0.01 | **0.02** |
| 15.00 | 2.70 | 1.21 | **0.13** |
| 20.00 | **3.01** | **1.45** | 0.06 |
| 25.00 | **3.16** | **1.58** | 0.00 |
| 30.00 | 3.16 | 1.58 | 0.00 |
| 35.00 | 3.16 | 1.58 | 0.00 |
| 40.00 | 3.16 | 1.58 | 0.00 |
| 45.00 | 3.16 | 1.58 | 0.00 |
| 50.00 | 3.16 | 1.58 | 0.00 |
| 55.00 | 3.16 | 1.58 | 0.00 |
| 60.00 | 3.16 | 1.58 | 0.00 |
| 65.00 | 3.16 | 1.58 | 0.00 |
| 70.00 | 3.16 | 1.58 | 0.00 |
| 75.00 | 3.16 | 1.58 | 0.00 |
| 80.00 | 3.16 | 1.58 | 0.00 |
| 85.00 | 3.16 | 1.58 | 0.00 |
| 90.00 | 3.16 | 1.58 | 0.00 |
| 95.00 | 3.16 | 1.58 | 0.00 |
| 100.00 | 3.16 | 1.58 | 0.00 |
| 105.00 | 3.16 | 1.58 | 0.00 |
| 110.00 | 3.16 | 1.58 | 0.00 |
| 115.00 | 3.16 | 1.58 | 0.00 |
| 120.00 | 3.16 | 1.58 | 0.00 |
| 125.00 | 3.16 | 1.58 | 0.00 |
| 130.00 | 3.16 | 1.58 | 0.00 |
| 135.00 | 3.16 | 1.58 | 0.00 |
| 140.00 | 3.16 | 1.58 | 0.00 |
| 145.00 | 3.16 | 1.58 | 0.00 |
| 150.00 | 3.16 | 1.58 | 0.00 |
| 155.00 | 3.16 | 1.58 | 0.00 |
| 160.00 | 3.16 | 1.58 | 0.00 |
| 165.00 | 3.16 | 1.58 | 0.00 |
| 170.00 | 3.16 | 1.58 | 0.00 |
| 175.00 | 3.16 | 1.58 | 0.00 |
| 180.00 | 3.16 | 1.58 | 0.00 |
| 185.00 | 3.16 | 1.58 | 0.00 |
| 190.00 | 3.16 | 1.58 | 0.00 |
| 195.00 | 3.16 | 1.58 | 0.00 |
| 200.00 | 3.16 | 1.58 | 0.00 |
| 205.00 | 3.16 | 1.58 | 0.00 |
| 210.00 | 3.16 | 1.58 | 0.00 |
| 215.00 | 3.16 | 1.58 | 0.00 |
| 220.00 | 3.16 | 1.58 | 0.00 |
| 225.00 | 3.16 | 1.58 | 0.00 |
| 230.00 | 3.16 | 1.58 | 0.00 |
| 235.00 | 3.16 | 1.58 | 0.00 |
| 240.00 | 3.16 | 1.58 | 0.00 |
| 245.00 | 3.16 | 1.58 | 0.00 |
| 250.00 | 3.16 | 1.58 | 0.00 |
| 255.00 | 3.16 | 1.58 | 0.00 |
| 260.00 | 3.16 | 1.58 | 0.00 |
| 265.00 | 3.16 | 1.58 | 0.00 |
| 270.00 | 3.16 | 1.58 | 0.00 |
| 275.00 | 3.16 | 1.58 | 0.00 |
| 280.00 | 3.16 | 1.58 | 0.00 |
| 285.00 | 3.16 | 1.58 | 0.00 |
| 290.00 | 3.16 | 1.58 | 0.00 |
| 295.00 | 3.16 | 1.58 | 0.00 |
| 300.00 | 3.16 | 1.58 | 0.00 |
| 305.00 | 3.16 | 1.58 | 0.00 |
| 310.00 | 3.16 | 1.58 | 0.00 |
| 315.00 | 3.16 | 1.58 | 0.00 |
| 320.00 | 3.16 | 1.58 | 0.00 |
| 325.00 | 3.16 | 1.58 | 0.00 |
| 330.00 | 3.16 | 1.58 | 0.00 |
| 335.00 | 3.16 | 1.58 | 0.00 |
| 340.00 | 3.16 | 1.58 | 0.00 |
| 345.00 | 3.16 | 1.58 | 0.00 |
| 350.00 | 3.16 | 1.58 | 0.00 |
| 355.00 | 3.16 | 1.58 | 0.00 |
| 360.00 | 3.16 | 1.58 | 0.00 |

## Summary for Subcatchment 2S: POST-MRC BMP

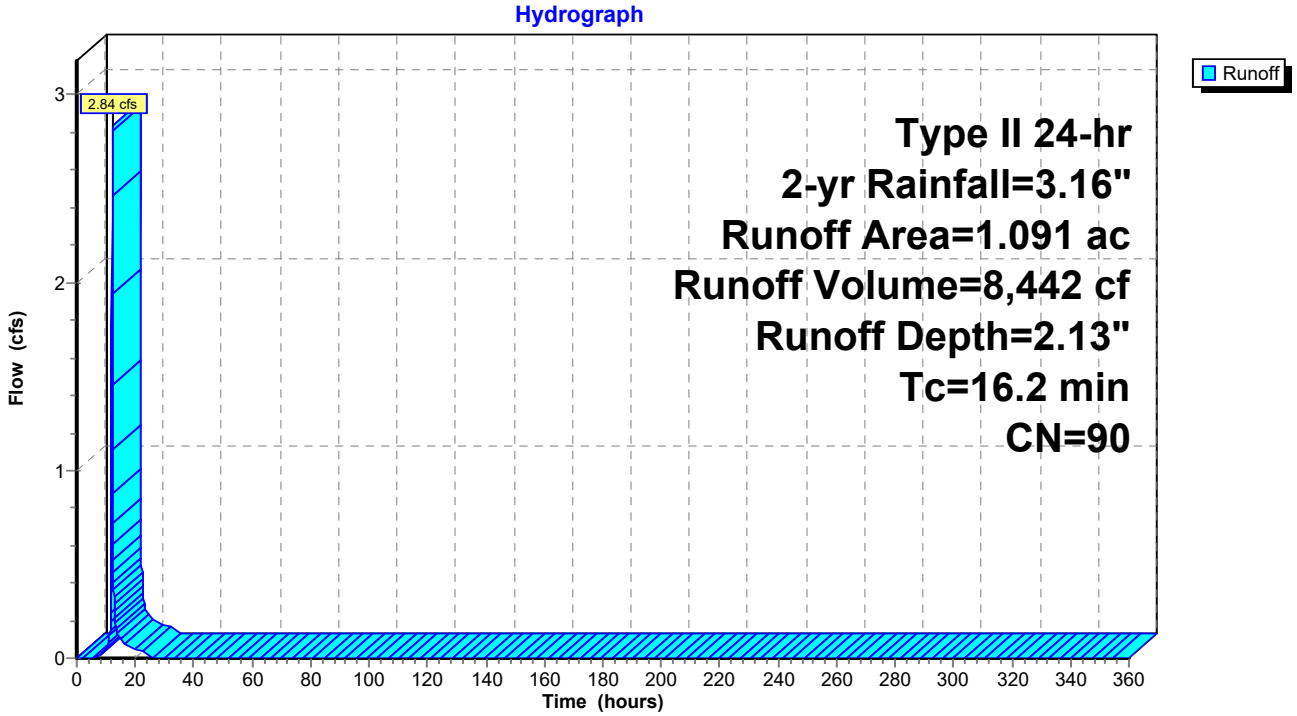
Runoff = 2.84 cfs @ 12.08 hrs, Volume= 8,442 cf, Depth= 2.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=3.16"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 0.586 | 91 | Gravel |
| * | 0.324 | 98 | Impervious |
| * | 0.181 | 73 | Brush, good |
| | 1.091 | 90 | Weighted Average |
| | 0.767 | | 70.30% Pervious Area |
| | 0.324 | | 29.70% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 16.2 | | | | | **Direct Entry, Tc** |

### Subcatchment 2S: POST-MRC BMP



## Hydrograph for Subcatchment 2S: POST-MRC BMP

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 |
| 5.00 | 0.20 | 0.00 | 0.00 |
| 10.00 | 0.57 | 0.08 | **0.05** |
| 15.00 | 2.70 | 1.71 | **0.10** |
| 20.00 | **3.01** | **1.99** | 0.04 |
| 25.00 | **3.16** | **2.13** | 0.00 |
| 30.00 | 3.16 | 2.13 | 0.00 |
| 35.00 | 3.16 | 2.13 | 0.00 |
| 40.00 | 3.16 | 2.13 | 0.00 |
| 45.00 | 3.16 | 2.13 | 0.00 |
| 50.00 | 3.16 | 2.13 | 0.00 |
| 55.00 | 3.16 | 2.13 | 0.00 |
| 60.00 | 3.16 | 2.13 | 0.00 |
| 65.00 | 3.16 | 2.13 | 0.00 |
| 70.00 | 3.16 | 2.13 | 0.00 |
| 75.00 | 3.16 | 2.13 | 0.00 |
| 80.00 | 3.16 | 2.13 | 0.00 |
| 85.00 | 3.16 | 2.13 | 0.00 |
| 90.00 | 3.16 | 2.13 | 0.00 |
| 95.00 | 3.16 | 2.13 | 0.00 |
| 100.00 | 3.16 | 2.13 | 0.00 |
| 105.00 | 3.16 | 2.13 | 0.00 |
| 110.00 | 3.16 | 2.13 | 0.00 |
| 115.00 | 3.16 | 2.13 | 0.00 |
| 120.00 | 3.16 | 2.13 | 0.00 |
| 125.00 | 3.16 | 2.13 | 0.00 |
| 130.00 | 3.16 | 2.13 | 0.00 |
| 135.00 | 3.16 | 2.13 | 0.00 |
| 140.00 | 3.16 | 2.13 | 0.00 |
| 145.00 | 3.16 | 2.13 | 0.00 |
| 150.00 | 3.16 | 2.13 | 0.00 |
| 155.00 | 3.16 | 2.13 | 0.00 |
| 160.00 | 3.16 | 2.13 | 0.00 |
| 165.00 | 3.16 | 2.13 | 0.00 |
| 170.00 | 3.16 | 2.13 | 0.00 |
| 175.00 | 3.16 | 2.13 | 0.00 |
| 180.00 | 3.16 | 2.13 | 0.00 |
| 185.00 | 3.16 | 2.13 | 0.00 |
| 190.00 | 3.16 | 2.13 | 0.00 |
| 195.00 | 3.16 | 2.13 | 0.00 |
| 200.00 | 3.16 | 2.13 | 0.00 |
| 205.00 | 3.16 | 2.13 | 0.00 |
| 210.00 | 3.16 | 2.13 | 0.00 |
| 215.00 | 3.16 | 2.13 | 0.00 |
| 220.00 | 3.16 | 2.13 | 0.00 |
| 225.00 | 3.16 | 2.13 | 0.00 |
| 230.00 | 3.16 | 2.13 | 0.00 |
| 235.00 | 3.16 | 2.13 | 0.00 |
| 240.00 | 3.16 | 2.13 | 0.00 |
| 245.00 | 3.16 | 2.13 | 0.00 |
| 250.00 | 3.16 | 2.13 | 0.00 |
| 255.00 | 3.16 | 2.13 | 0.00 |
| 260.00 | 3.16 | 2.13 | 0.00 |
| 265.00 | 3.16 | 2.13 | 0.00 |
| 270.00 | 3.16 | 2.13 | 0.00 |
| 275.00 | 3.16 | 2.13 | 0.00 |
| 280.00 | 3.16 | 2.13 | 0.00 |
| 285.00 | 3.16 | 2.13 | 0.00 |
| 290.00 | 3.16 | 2.13 | 0.00 |
| 295.00 | 3.16 | 2.13 | 0.00 |
| 300.00 | 3.16 | 2.13 | 0.00 |
| 305.00 | 3.16 | 2.13 | 0.00 |
| 310.00 | 3.16 | 2.13 | 0.00 |
| 315.00 | 3.16 | 2.13 | 0.00 |
| 320.00 | 3.16 | 2.13 | 0.00 |
| 325.00 | 3.16 | 2.13 | 0.00 |
| 330.00 | 3.16 | 2.13 | 0.00 |
| 335.00 | 3.16 | 2.13 | 0.00 |
| 340.00 | 3.16 | 2.13 | 0.00 |
| 345.00 | 3.16 | 2.13 | 0.00 |
| 350.00 | 3.16 | 2.13 | 0.00 |
| 355.00 | 3.16 | 2.13 | 0.00 |
| 360.00 | 3.16 | 2.13 | 0.00 |

## Summary for Subcatchment 5S: POST-Bypass

[49] Hint: Tc<2dt may require smaller dt

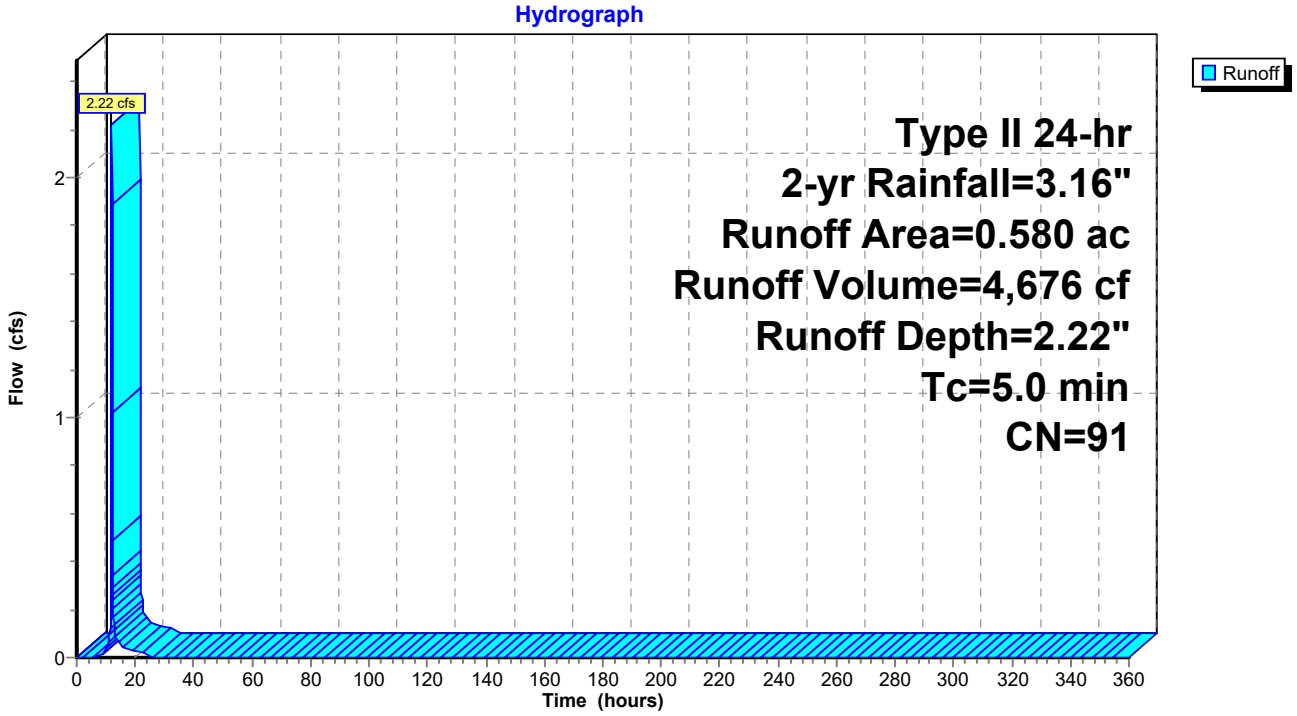
Runoff = 2.22 cfs @ 11.95 hrs, Volume= 4,676 cf, Depth= 2.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=3.16"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 0.002 | 98 | Impervious |
| * | 0.578 | 91 | Gravel |
| | 0.580 | 91 | Weighted Average |
| | 0.578 | | 99.66% Pervious Area |
| | 0.002 | | 0.34% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry, Tc** |

### Subcatchment 5S: POST-Bypass



## Hydrograph for Subcatchment 5S: POST-Bypass

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 |
| 5.00 | 0.20 | 0.00 | 0.00 |
| 10.00 | 0.57 | 0.10 | **0.03** |
| 15.00 | 2.70 | 1.79 | **0.05** |
| 20.00 | **3.01** | **2.08** | 0.02 |
| 25.00 | **3.16** | **2.22** | 0.00 |
| 30.00 | 3.16 | 2.22 | 0.00 |
| 35.00 | 3.16 | 2.22 | 0.00 |
| 40.00 | 3.16 | 2.22 | 0.00 |
| 45.00 | 3.16 | 2.22 | 0.00 |
| 50.00 | 3.16 | 2.22 | 0.00 |
| 55.00 | 3.16 | 2.22 | 0.00 |
| 60.00 | 3.16 | 2.22 | 0.00 |
| 65.00 | 3.16 | 2.22 | 0.00 |
| 70.00 | 3.16 | 2.22 | 0.00 |
| 75.00 | 3.16 | 2.22 | 0.00 |
| 80.00 | 3.16 | 2.22 | 0.00 |
| 85.00 | 3.16 | 2.22 | 0.00 |
| 90.00 | 3.16 | 2.22 | 0.00 |
| 95.00 | 3.16 | 2.22 | 0.00 |
| 100.00 | 3.16 | 2.22 | 0.00 |
| 105.00 | 3.16 | 2.22 | 0.00 |
| 110.00 | 3.16 | 2.22 | 0.00 |
| 115.00 | 3.16 | 2.22 | 0.00 |
| 120.00 | 3.16 | 2.22 | 0.00 |
| 125.00 | 3.16 | 2.22 | 0.00 |
| 130.00 | 3.16 | 2.22 | 0.00 |
| 135.00 | 3.16 | 2.22 | 0.00 |
| 140.00 | 3.16 | 2.22 | 0.00 |
| 145.00 | 3.16 | 2.22 | 0.00 |
| 150.00 | 3.16 | 2.22 | 0.00 |
| 155.00 | 3.16 | 2.22 | 0.00 |
| 160.00 | 3.16 | 2.22 | 0.00 |
| 165.00 | 3.16 | 2.22 | 0.00 |
| 170.00 | 3.16 | 2.22 | 0.00 |
| 175.00 | 3.16 | 2.22 | 0.00 |
| 180.00 | 3.16 | 2.22 | 0.00 |
| 185.00 | 3.16 | 2.22 | 0.00 |
| 190.00 | 3.16 | 2.22 | 0.00 |
| 195.00 | 3.16 | 2.22 | 0.00 |
| 200.00 | 3.16 | 2.22 | 0.00 |
| 205.00 | 3.16 | 2.22 | 0.00 |
| 210.00 | 3.16 | 2.22 | 0.00 |
| 215.00 | 3.16 | 2.22 | 0.00 |
| 220.00 | 3.16 | 2.22 | 0.00 |
| 225.00 | 3.16 | 2.22 | 0.00 |
| 230.00 | 3.16 | 2.22 | 0.00 |
| 235.00 | 3.16 | 2.22 | 0.00 |
| 240.00 | 3.16 | 2.22 | 0.00 |
| 245.00 | 3.16 | 2.22 | 0.00 |
| 250.00 | 3.16 | 2.22 | 0.00 |
| 255.00 | 3.16 | 2.22 | 0.00 |
| 260.00 | 3.16 | 2.22 | 0.00 |
| 265.00 | 3.16 | 2.22 | 0.00 |
| 270.00 | 3.16 | 2.22 | 0.00 |
| 275.00 | 3.16 | 2.22 | 0.00 |
| 280.00 | 3.16 | 2.22 | 0.00 |
| 285.00 | 3.16 | 2.22 | 0.00 |
| 290.00 | 3.16 | 2.22 | 0.00 |
| 295.00 | 3.16 | 2.22 | 0.00 |
| 300.00 | 3.16 | 2.22 | 0.00 |
| 305.00 | 3.16 | 2.22 | 0.00 |
| 310.00 | 3.16 | 2.22 | 0.00 |
| 315.00 | 3.16 | 2.22 | 0.00 |
| 320.00 | 3.16 | 2.22 | 0.00 |
| 325.00 | 3.16 | 2.22 | 0.00 |
| 330.00 | 3.16 | 2.22 | 0.00 |
| 335.00 | 3.16 | 2.22 | 0.00 |
| 340.00 | 3.16 | 2.22 | 0.00 |
| 345.00 | 3.16 | 2.22 | 0.00 |
| 350.00 | 3.16 | 2.22 | 0.00 |
| 355.00 | 3.16 | 2.22 | 0.00 |
| 360.00 | 3.16 | 2.22 | 0.00 |

## Summary for Pond 3P: MRC BMP

Inflow Area = 47,524 sf, 29.70% Impervious, Inflow Depth = 2.13" for 2-yr event
Inflow = 2.84 cfs @ 12.08 hrs, Volume= 8,442 cf
Outflow = 0.01 cfs @ 24.32 hrs, Volume= 1,768 cf, Atten= 100%, Lag= 734.3 min
Primary = 0.01 cfs @ 24.32 hrs, Volume= 1,768 cf

Routing by Stor-Ind method, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
Peak Elev= 548.91' @ 24.32 hrs Surf.Area= 3,886 sf Storage= 8,231 cf

Plug-Flow detention time= 2,667.7 min calculated for 1,768 cf (21% of inflow)
Center-of-Mass det. time= 2,518.8 min ( 3,332.5 - 813.8 )

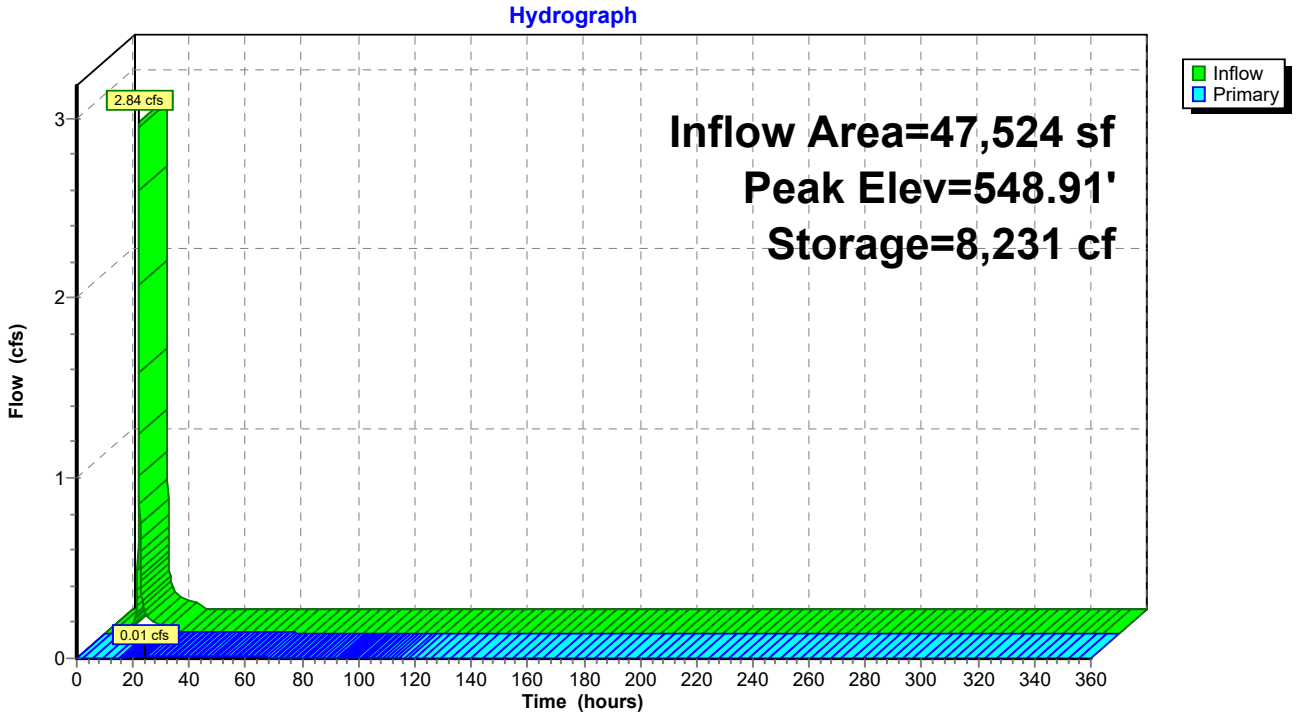
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 545.00' | 12,386 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc)<br>12,639 cf Overall x 98.0% Voids |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 545.00 | 1,943 | 0 | 0 |
| 546.00 | 1,943 | 1,943 | 1,943 |
| 547.00 | 1,943 | 1,943 | 3,886 |
| 548.00 | 1,943 | 1,943 | 5,829 |
| 548.49 | 1,943 | 952 | 6,781 |
| 548.50 | 3,886 | 29 | 6,810 |
| 549.00 | 3,886 | 1,943 | 8,753 |
| 550.00 | 3,886 | 3,886 | 12,639 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 548.50' | **12.0" Round Culvert**<br>L= 10.0' RCP, groove end projecting, Ke= 0.200<br>Inlet / Outlet Invert= 548.50' / 548.40' S= 0.0100 '/' Cc= 0.900<br>n= 0.011, Flow Area= 0.79 sf |
| #2 | Device 1 | 545.00' | **0.7" Vert. Orifice/Grate** C= 0.600 |
| #3 | Device 1 | 548.95' | **2.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

**Primary OutFlow** Max=0.01 cfs @ 24.32 hrs HW=548.91' (Free Discharge)
└─**1=Culvert** (Passes 0.01 cfs of 0.59 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.01 cfs @ 3.08 fps)
  └─**3=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

## Pond 3P: MRC BMP



## Hydrograph for Pond 3P: MRC BMP

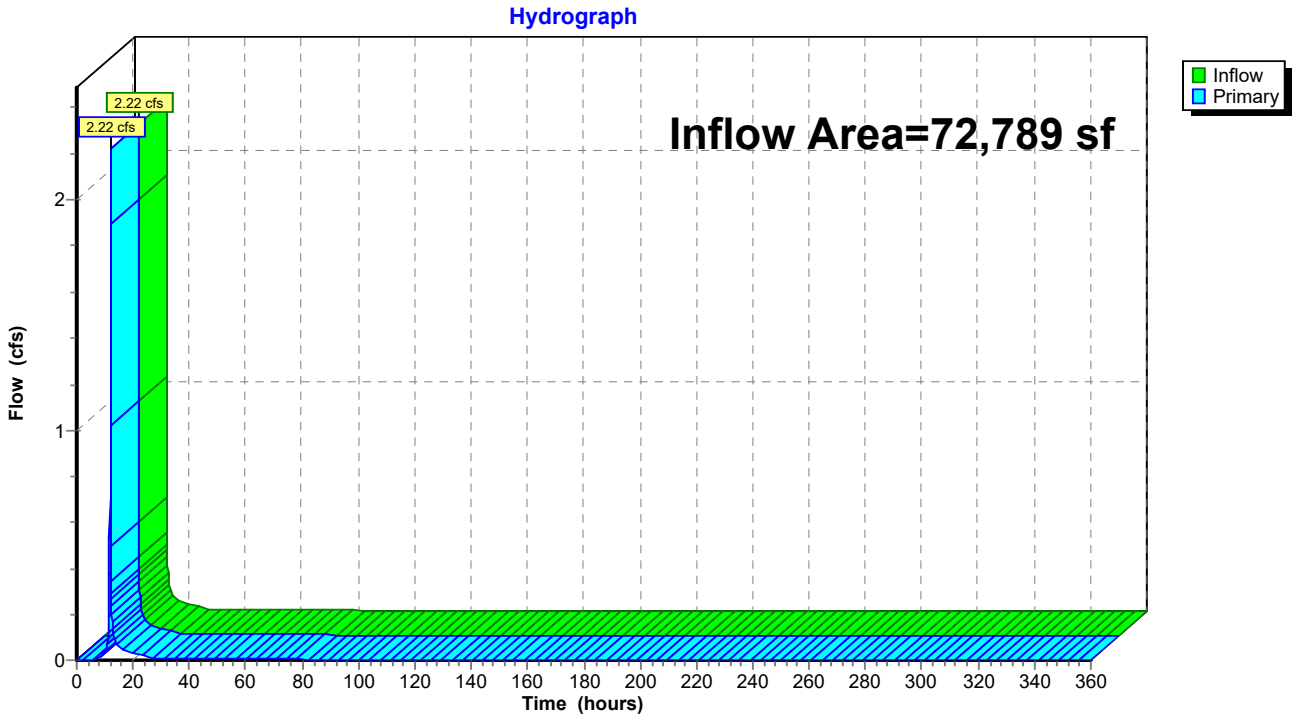
| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 0.00 | 0.00 | 0 | 545.00 | 0.00 |
| 10.00 | **0.05** | 284 | 545.15 | 0.00 |
| 20.00 | **0.04** | **7,761** | **548.79** | **0.01** |
| 30.00 | 0.00 | **8,071** | **548.87** | **0.01** |
| 40.00 | 0.00 | 7,804 | 548.80 | 0.01 |
| 50.00 | 0.00 | 7,566 | 548.73 | 0.01 |
| 60.00 | 0.00 | 7,356 | 548.68 | 0.01 |
| 70.00 | 0.00 | 7,175 | 548.63 | 0.00 |
| 80.00 | 0.00 | 7,021 | 548.59 | 0.00 |
| 90.00 | 0.00 | 6,897 | 548.56 | 0.00 |
| 100.00 | 0.00 | 6,804 | 548.53 | 0.00 |
| 110.00 | 0.00 | 6,750 | 548.52 | 0.00 |
| 120.00 | 0.00 | 6,718 | 548.51 | 0.00 |
| 130.00 | 0.00 | 6,699 | 548.51 | 0.00 |
| 140.00 | 0.00 | 6,689 | 548.50 | 0.00 |
| 150.00 | 0.00 | 6,683 | 548.50 | 0.00 |
| 160.00 | 0.00 | 6,679 | 548.50 | 0.00 |
| 170.00 | 0.00 | 6,677 | 548.50 | 0.00 |
| 180.00 | 0.00 | 6,676 | 548.50 | 0.00 |
| 190.00 | 0.00 | 6,675 | 548.50 | 0.00 |
| 200.00 | 0.00 | 6,675 | 548.50 | 0.00 |
| 210.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 220.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 230.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 240.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 250.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 260.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 270.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 280.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 290.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 300.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 310.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 320.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 330.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 340.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 350.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 360.00 | 0.00 | 6,674 | 548.50 | 0.00 |

## Summary for Link 4L: POST

Inflow Area = 72,789 sf, 19.51% Impervious, Inflow Depth = 1.06" for 2-yr event
Inflow = 2.22 cfs @ 11.95 hrs, Volume= 6,443 cf
Primary = 2.22 cfs @ 11.95 hrs, Volume= 6,443 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs

### Link 4L: POST



## Hydrograph for Link 4L: POST

| Time (hours) | Inflow (cfs) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|
| 0.00 | 0.00 | **0.00** | 0.00 |
| 5.00 | 0.00 | 0.00 | 0.00 |
| 10.00 | **0.03** | 0.00 | **0.03** |
| 15.00 | **0.05** | 0.00 | **0.05** |
| 20.00 | 0.03 | 0.00 | 0.03 |
| 25.00 | 0.01 | 0.00 | 0.01 |
| 30.00 | 0.01 | 0.00 | 0.01 |
| 35.00 | 0.01 | 0.00 | 0.01 |
| 40.00 | 0.01 | 0.00 | 0.01 |
| 45.00 | 0.01 | 0.00 | 0.01 |
| 50.00 | 0.01 | 0.00 | 0.01 |
| 55.00 | 0.01 | 0.00 | 0.01 |
| 60.00 | 0.01 | 0.00 | 0.01 |
| 65.00 | 0.01 | 0.00 | 0.01 |
| 70.00 | 0.00 | 0.00 | 0.00 |
| 75.00 | 0.00 | 0.00 | 0.00 |
| 80.00 | 0.00 | 0.00 | 0.00 |
| 85.00 | 0.00 | 0.00 | 0.00 |
| 90.00 | 0.00 | 0.00 | 0.00 |
| 95.00 | 0.00 | 0.00 | 0.00 |
| 100.00 | 0.00 | 0.00 | 0.00 |
| 105.00 | 0.00 | 0.00 | 0.00 |
| 110.00 | 0.00 | 0.00 | 0.00 |
| 115.00 | 0.00 | 0.00 | 0.00 |
| 120.00 | 0.00 | 0.00 | 0.00 |
| 125.00 | 0.00 | 0.00 | 0.00 |
| 130.00 | 0.00 | 0.00 | 0.00 |
| 135.00 | 0.00 | 0.00 | 0.00 |
| 140.00 | 0.00 | 0.00 | 0.00 |
| 145.00 | 0.00 | 0.00 | 0.00 |
| 150.00 | 0.00 | 0.00 | 0.00 |
| 155.00 | 0.00 | 0.00 | 0.00 |
| 160.00 | 0.00 | 0.00 | 0.00 |
| 165.00 | 0.00 | 0.00 | 0.00 |
| 170.00 | 0.00 | 0.00 | 0.00 |
| 175.00 | 0.00 | 0.00 | 0.00 |
| 180.00 | 0.00 | 0.00 | 0.00 |
| 185.00 | 0.00 | 0.00 | 0.00 |
| 190.00 | 0.00 | 0.00 | 0.00 |
| 195.00 | 0.00 | 0.00 | 0.00 |
| 200.00 | 0.00 | 0.00 | 0.00 |
| 205.00 | 0.00 | 0.00 | 0.00 |
| 210.00 | 0.00 | 0.00 | 0.00 |
| 215.00 | 0.00 | 0.00 | 0.00 |
| 220.00 | 0.00 | 0.00 | 0.00 |
| 225.00 | 0.00 | 0.00 | 0.00 |
| 230.00 | 0.00 | 0.00 | 0.00 |
| 235.00 | 0.00 | 0.00 | 0.00 |
| 240.00 | 0.00 | 0.00 | 0.00 |
| 245.00 | 0.00 | 0.00 | 0.00 |
| 250.00 | 0.00 | 0.00 | 0.00 |
| 255.00 | 0.00 | 0.00 | 0.00 |
| 260.00 | 0.00 | 0.00 | 0.00 |
| 265.00 | 0.00 | 0.00 | 0.00 |
| 270.00 | 0.00 | 0.00 | 0.00 |
| 275.00 | 0.00 | 0.00 | 0.00 |
| 280.00 | 0.00 | 0.00 | 0.00 |
| 285.00 | 0.00 | 0.00 | 0.00 |
| 290.00 | 0.00 | 0.00 | 0.00 |
| 295.00 | 0.00 | 0.00 | 0.00 |
| 300.00 | 0.00 | 0.00 | 0.00 |
| 305.00 | 0.00 | 0.00 | 0.00 |
| 310.00 | 0.00 | 0.00 | 0.00 |
| 315.00 | 0.00 | 0.00 | 0.00 |
| 320.00 | 0.00 | 0.00 | 0.00 |
| 325.00 | 0.00 | 0.00 | 0.00 |
| 330.00 | 0.00 | 0.00 | 0.00 |
| 335.00 | 0.00 | 0.00 | 0.00 |
| 340.00 | 0.00 | 0.00 | 0.00 |
| 345.00 | 0.00 | 0.00 | 0.00 |
| 350.00 | 0.00 | 0.00 | 0.00 |
| 355.00 | 0.00 | 0.00 | 0.00 |
| 360.00 | 0.00 | 0.00 | 0.00 |

Time span=0.00-360.00 hrs, dt=0.05 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: PRE** Runoff Area=1.665 ac 0.36% Impervious Runoff Depth=2.79"
Tc=15.8 min CN=83 Runoff=5.78 cfs 16,850 cf

**Subcatchment2S: POST-MRC BMP** Runoff Area=1.091 ac 29.70% Impervious Runoff Depth=3.46"
Tc=16.2 min CN=90 Runoff=4.52 cfs 13,714 cf

**Subcatchment5S: POST-Bypass** Runoff Area=0.580 ac 0.34% Impervious Runoff Depth=3.57"
Tc=5.0 min CN=91 Runoff=3.47 cfs 7,507 cf

**Pond 3P: MRC BMP** Peak Elev=549.11' Storage=8,980 cf Inflow=4.52 cfs 13,714 cf
Outflow=0.36 cfs 7,040 cf

**Link 4L: POST** Inflow=3.47 cfs 14,547 cf
Primary=3.47 cfs 14,547 cf

**Total Runoff Area = 145,316 sf Runoff Volume = 38,071 cf Average Runoff Depth = 3.14"**
**90.05% Pervious = 130,854 sf 9.95% Impervious = 14,462 sf**

## Summary for Subcatchment 1S: PRE

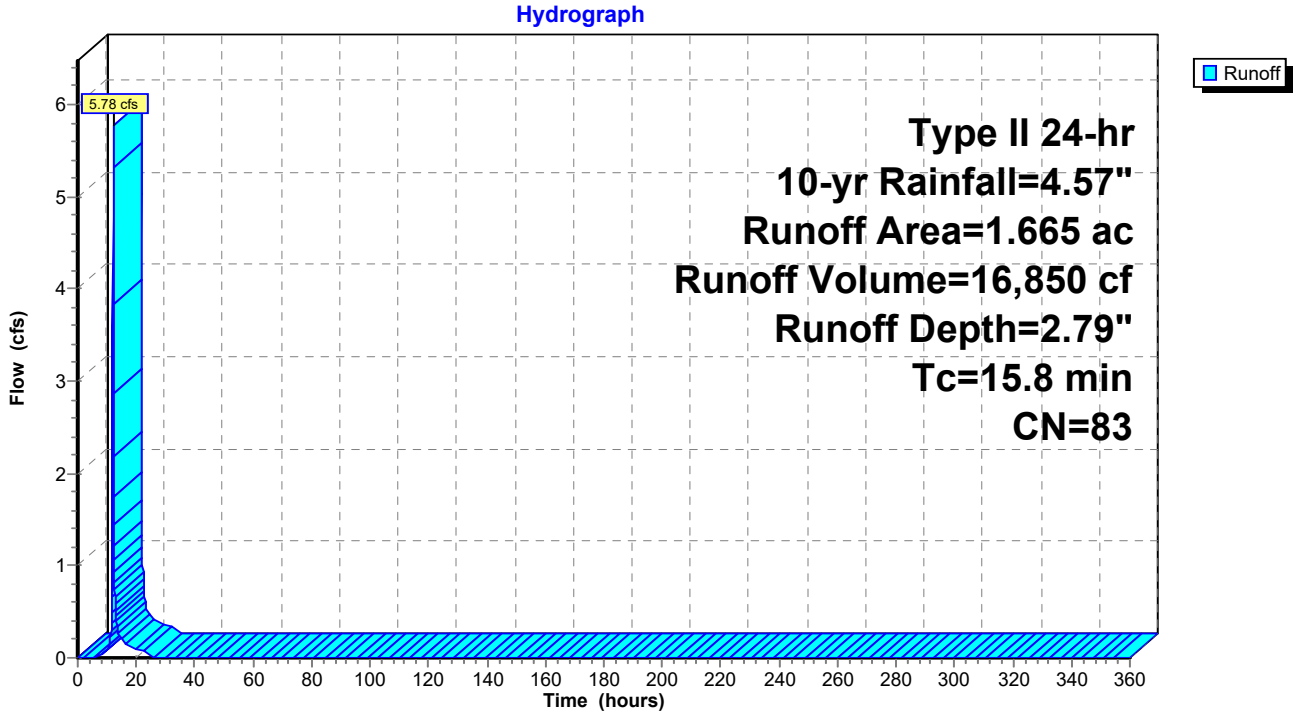
Runoff = 5.78 cfs @ 12.08 hrs, Volume= 16,850 cf, Depth= 2.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.57"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 0.006 | 98 | Impervious |
| * | 0.134 | 77 | Woods, Good |
| * | 0.684 | 78 | Meadow (20% and On-site Brush) |
| * | 0.674 | 91 | Gravel |
| * | 0.167 | 73 | Onsite Brush, Good |
| | 1.665 | 83 | Weighted Average |
| | 1.659 | | 99.64% Pervious Area |
| | 0.006 | | 0.36% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.8 | | | | | **Direct Entry, Tc** |

## Subcatchment 1S: PRE



## Hydrograph for Subcatchment 1S: PRE

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 |
| 5.00 | 0.29 | 0.00 | 0.00 |
| 10.00 | 0.83 | 0.07 | **0.08** |
| 15.00 | 3.90 | 2.20 | **0.21** |
| 20.00 | **4.35** | **2.59** | 0.09 |
| 25.00 | **4.57** | **2.79** | 0.00 |
| 30.00 | 4.57 | 2.79 | 0.00 |
| 35.00 | 4.57 | 2.79 | 0.00 |
| 40.00 | 4.57 | 2.79 | 0.00 |
| 45.00 | 4.57 | 2.79 | 0.00 |
| 50.00 | 4.57 | 2.79 | 0.00 |
| 55.00 | 4.57 | 2.79 | 0.00 |
| 60.00 | 4.57 | 2.79 | 0.00 |
| 65.00 | 4.57 | 2.79 | 0.00 |
| 70.00 | 4.57 | 2.79 | 0.00 |
| 75.00 | 4.57 | 2.79 | 0.00 |
| 80.00 | 4.57 | 2.79 | 0.00 |
| 85.00 | 4.57 | 2.79 | 0.00 |
| 90.00 | 4.57 | 2.79 | 0.00 |
| 95.00 | 4.57 | 2.79 | 0.00 |
| 100.00 | 4.57 | 2.79 | 0.00 |
| 105.00 | 4.57 | 2.79 | 0.00 |
| 110.00 | 4.57 | 2.79 | 0.00 |
| 115.00 | 4.57 | 2.79 | 0.00 |
| 120.00 | 4.57 | 2.79 | 0.00 |
| 125.00 | 4.57 | 2.79 | 0.00 |
| 130.00 | 4.57 | 2.79 | 0.00 |
| 135.00 | 4.57 | 2.79 | 0.00 |
| 140.00 | 4.57 | 2.79 | 0.00 |
| 145.00 | 4.57 | 2.79 | 0.00 |
| 150.00 | 4.57 | 2.79 | 0.00 |
| 155.00 | 4.57 | 2.79 | 0.00 |
| 160.00 | 4.57 | 2.79 | 0.00 |
| 165.00 | 4.57 | 2.79 | 0.00 |
| 170.00 | 4.57 | 2.79 | 0.00 |
| 175.00 | 4.57 | 2.79 | 0.00 |
| 180.00 | 4.57 | 2.79 | 0.00 |
| 185.00 | 4.57 | 2.79 | 0.00 |
| 190.00 | 4.57 | 2.79 | 0.00 |
| 195.00 | 4.57 | 2.79 | 0.00 |
| 200.00 | 4.57 | 2.79 | 0.00 |
| 205.00 | 4.57 | 2.79 | 0.00 |
| 210.00 | 4.57 | 2.79 | 0.00 |
| 215.00 | 4.57 | 2.79 | 0.00 |
| 220.00 | 4.57 | 2.79 | 0.00 |
| 225.00 | 4.57 | 2.79 | 0.00 |
| 230.00 | 4.57 | 2.79 | 0.00 |
| 235.00 | 4.57 | 2.79 | 0.00 |
| 240.00 | 4.57 | 2.79 | 0.00 |
| 245.00 | 4.57 | 2.79 | 0.00 |
| 250.00 | 4.57 | 2.79 | 0.00 |
| 255.00 | 4.57 | 2.79 | 0.00 |
| 260.00 | 4.57 | 2.79 | 0.00 |
| 265.00 | 4.57 | 2.79 | 0.00 |
| 270.00 | 4.57 | 2.79 | 0.00 |
| 275.00 | 4.57 | 2.79 | 0.00 |
| 280.00 | 4.57 | 2.79 | 0.00 |
| 285.00 | 4.57 | 2.79 | 0.00 |
| 290.00 | 4.57 | 2.79 | 0.00 |
| 295.00 | 4.57 | 2.79 | 0.00 |
| 300.00 | 4.57 | 2.79 | 0.00 |
| 305.00 | 4.57 | 2.79 | 0.00 |
| 310.00 | 4.57 | 2.79 | 0.00 |
| 315.00 | 4.57 | 2.79 | 0.00 |
| 320.00 | 4.57 | 2.79 | 0.00 |
| 325.00 | 4.57 | 2.79 | 0.00 |
| 330.00 | 4.57 | 2.79 | 0.00 |
| 335.00 | 4.57 | 2.79 | 0.00 |
| 340.00 | 4.57 | 2.79 | 0.00 |
| 345.00 | 4.57 | 2.79 | 0.00 |
| 350.00 | 4.57 | 2.79 | 0.00 |
| 355.00 | 4.57 | 2.79 | 0.00 |
| 360.00 | 4.57 | 2.79 | 0.00 |

## Summary for Subcatchment 2S: POST-MRC BMP

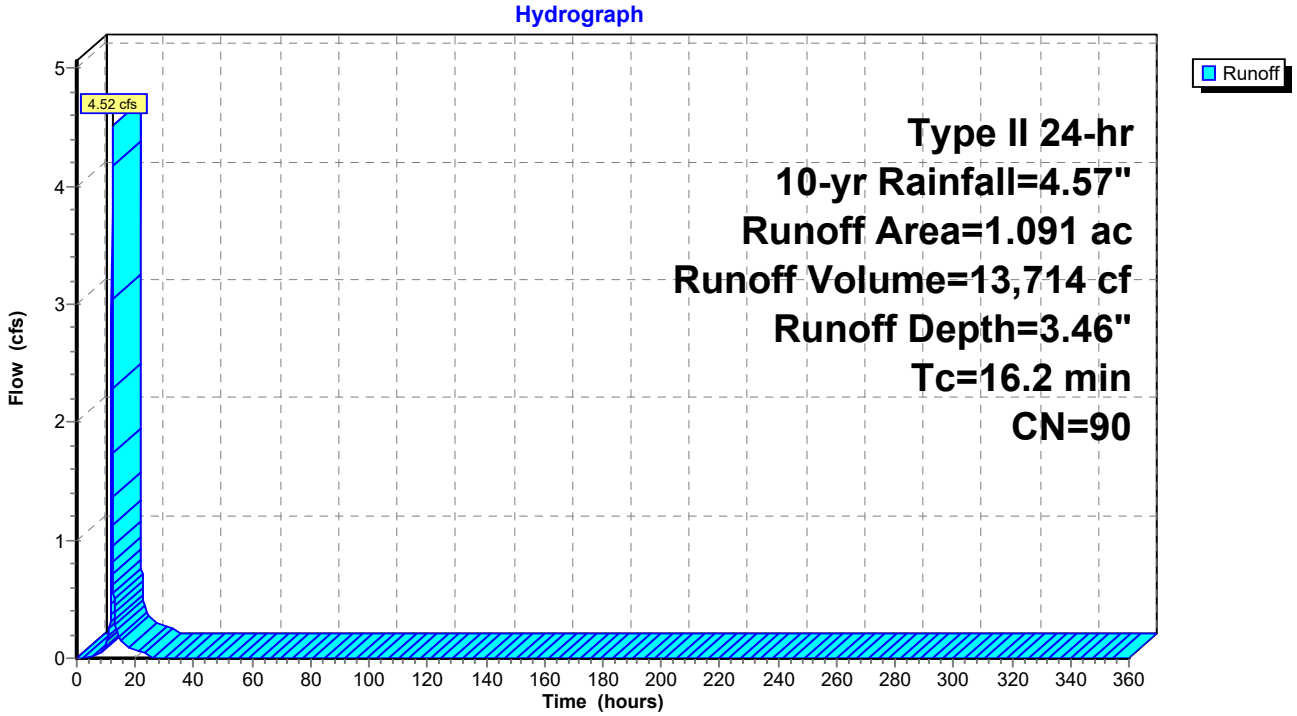
Runoff = 4.52 cfs @ 12.08 hrs, Volume= 13,714 cf, Depth= 3.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.57"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 0.586 | 91 | Gravel |
| * | 0.324 | 98 | Impervious |
| * | 0.181 | 73 | Brush, good |
| | 1.091 | 90 | Weighted Average |
| | 0.767 | | 70.30% Pervious Area |
| | 0.324 | | 29.70% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 16.2 | | | | | **Direct Entry, Tc** |

## Subcatchment 2S: POST-MRC BMP



## Hydrograph for Subcatchment 2S: POST-MRC BMP

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 |
| 5.00 | 0.29 | 0.00 | 0.01 |
| 10.00 | 0.83 | 0.21 | **0.10** |
| 15.00 | 3.90 | 2.82 | **0.15** |
| 20.00 | **4.35** | **3.25** | 0.07 |
| 25.00 | **4.57** | **3.46** | 0.00 |
| 30.00 | 4.57 | 3.46 | 0.00 |
| 35.00 | 4.57 | 3.46 | 0.00 |
| 40.00 | 4.57 | 3.46 | 0.00 |
| 45.00 | 4.57 | 3.46 | 0.00 |
| 50.00 | 4.57 | 3.46 | 0.00 |
| 55.00 | 4.57 | 3.46 | 0.00 |
| 60.00 | 4.57 | 3.46 | 0.00 |
| 65.00 | 4.57 | 3.46 | 0.00 |
| 70.00 | 4.57 | 3.46 | 0.00 |
| 75.00 | 4.57 | 3.46 | 0.00 |
| 80.00 | 4.57 | 3.46 | 0.00 |
| 85.00 | 4.57 | 3.46 | 0.00 |
| 90.00 | 4.57 | 3.46 | 0.00 |
| 95.00 | 4.57 | 3.46 | 0.00 |
| 100.00 | 4.57 | 3.46 | 0.00 |
| 105.00 | 4.57 | 3.46 | 0.00 |
| 110.00 | 4.57 | 3.46 | 0.00 |
| 115.00 | 4.57 | 3.46 | 0.00 |
| 120.00 | 4.57 | 3.46 | 0.00 |
| 125.00 | 4.57 | 3.46 | 0.00 |
| 130.00 | 4.57 | 3.46 | 0.00 |
| 135.00 | 4.57 | 3.46 | 0.00 |
| 140.00 | 4.57 | 3.46 | 0.00 |
| 145.00 | 4.57 | 3.46 | 0.00 |
| 150.00 | 4.57 | 3.46 | 0.00 |
| 155.00 | 4.57 | 3.46 | 0.00 |
| 160.00 | 4.57 | 3.46 | 0.00 |
| 165.00 | 4.57 | 3.46 | 0.00 |
| 170.00 | 4.57 | 3.46 | 0.00 |
| 175.00 | 4.57 | 3.46 | 0.00 |
| 180.00 | 4.57 | 3.46 | 0.00 |
| 185.00 | 4.57 | 3.46 | 0.00 |
| 190.00 | 4.57 | 3.46 | 0.00 |
| 195.00 | 4.57 | 3.46 | 0.00 |
| 200.00 | 4.57 | 3.46 | 0.00 |
| 205.00 | 4.57 | 3.46 | 0.00 |
| 210.00 | 4.57 | 3.46 | 0.00 |
| 215.00 | 4.57 | 3.46 | 0.00 |
| 220.00 | 4.57 | 3.46 | 0.00 |
| 225.00 | 4.57 | 3.46 | 0.00 |
| 230.00 | 4.57 | 3.46 | 0.00 |
| 235.00 | 4.57 | 3.46 | 0.00 |
| 240.00 | 4.57 | 3.46 | 0.00 |
| 245.00 | 4.57 | 3.46 | 0.00 |
| 250.00 | 4.57 | 3.46 | 0.00 |
| 255.00 | 4.57 | 3.46 | 0.00 |
| 260.00 | 4.57 | 3.46 | 0.00 |
| 265.00 | 4.57 | 3.46 | 0.00 |
| 270.00 | 4.57 | 3.46 | 0.00 |
| 275.00 | 4.57 | 3.46 | 0.00 |
| 280.00 | 4.57 | 3.46 | 0.00 |
| 285.00 | 4.57 | 3.46 | 0.00 |
| 290.00 | 4.57 | 3.46 | 0.00 |
| 295.00 | 4.57 | 3.46 | 0.00 |
| 300.00 | 4.57 | 3.46 | 0.00 |
| 305.00 | 4.57 | 3.46 | 0.00 |
| 310.00 | 4.57 | 3.46 | 0.00 |
| 315.00 | 4.57 | 3.46 | 0.00 |
| 320.00 | 4.57 | 3.46 | 0.00 |
| 325.00 | 4.57 | 3.46 | 0.00 |
| 330.00 | 4.57 | 3.46 | 0.00 |
| 335.00 | 4.57 | 3.46 | 0.00 |
| 340.00 | 4.57 | 3.46 | 0.00 |
| 345.00 | 4.57 | 3.46 | 0.00 |
| 350.00 | 4.57 | 3.46 | 0.00 |
| 355.00 | 4.57 | 3.46 | 0.00 |
| 360.00 | 4.57 | 3.46 | 0.00 |

## Summary for Subcatchment 5S: POST-Bypass

[49] Hint: Tc<2dt may require smaller dt

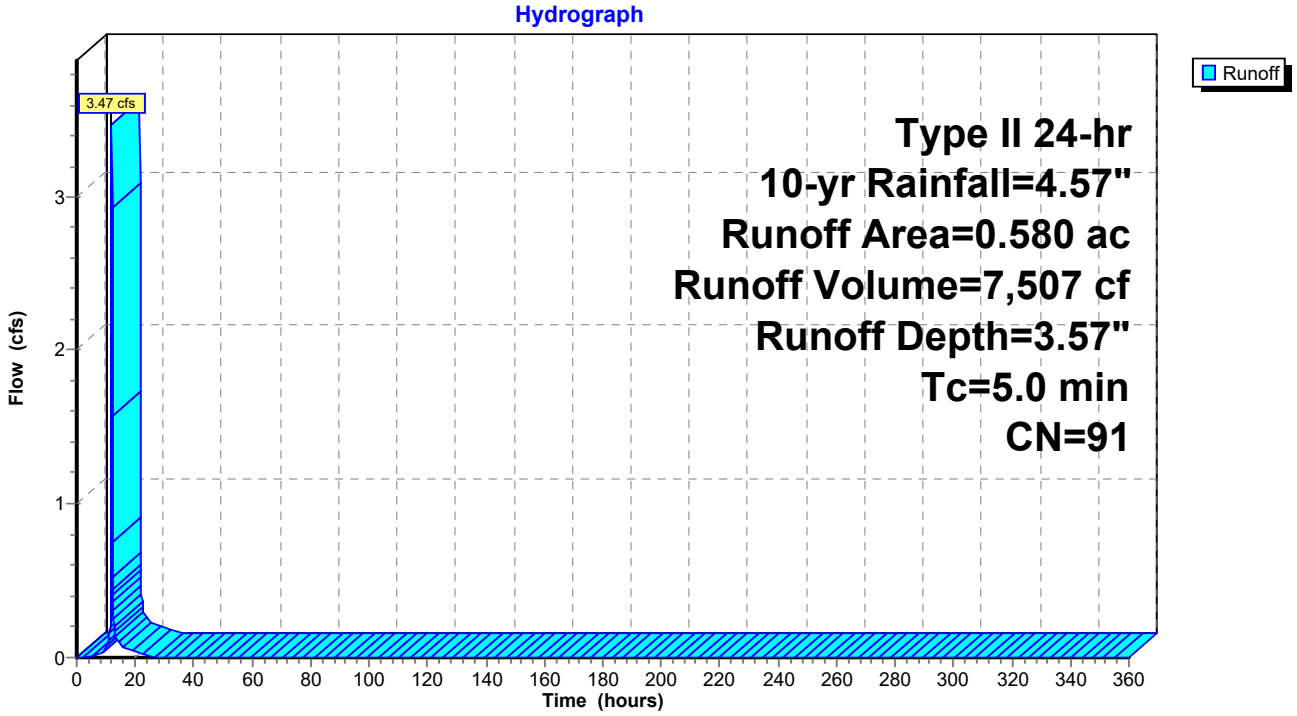
Runoff = 3.47 cfs @ 11.95 hrs, Volume= 7,507 cf, Depth= 3.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.57"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 0.002 | 98 | Impervious |
| * | 0.578 | 91 | Gravel |
| | 0.580 | 91 | Weighted Average |
| | 0.578 | | 99.66% Pervious Area |
| | 0.002 | | 0.34% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry, Tc** |

### Subcatchment 5S: POST-Bypass



## Hydrograph for Subcatchment 5S: POST-Bypass

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 |
| 5.00 | 0.29 | 0.01 | 0.01 |
| 10.00 | 0.83 | 0.24 | **0.06** |
| 15.00 | 3.90 | 2.92 | **0.08** |
| 20.00 | **4.35** | **3.35** | 0.03 |
| 25.00 | **4.57** | **3.57** | 0.00 |
| 30.00 | 4.57 | 3.57 | 0.00 |
| 35.00 | 4.57 | 3.57 | 0.00 |
| 40.00 | 4.57 | 3.57 | 0.00 |
| 45.00 | 4.57 | 3.57 | 0.00 |
| 50.00 | 4.57 | 3.57 | 0.00 |
| 55.00 | 4.57 | 3.57 | 0.00 |
| 60.00 | 4.57 | 3.57 | 0.00 |
| 65.00 | 4.57 | 3.57 | 0.00 |
| 70.00 | 4.57 | 3.57 | 0.00 |
| 75.00 | 4.57 | 3.57 | 0.00 |
| 80.00 | 4.57 | 3.57 | 0.00 |
| 85.00 | 4.57 | 3.57 | 0.00 |
| 90.00 | 4.57 | 3.57 | 0.00 |
| 95.00 | 4.57 | 3.57 | 0.00 |
| 100.00 | 4.57 | 3.57 | 0.00 |
| 105.00 | 4.57 | 3.57 | 0.00 |
| 110.00 | 4.57 | 3.57 | 0.00 |
| 115.00 | 4.57 | 3.57 | 0.00 |
| 120.00 | 4.57 | 3.57 | 0.00 |
| 125.00 | 4.57 | 3.57 | 0.00 |
| 130.00 | 4.57 | 3.57 | 0.00 |
| 135.00 | 4.57 | 3.57 | 0.00 |
| 140.00 | 4.57 | 3.57 | 0.00 |
| 145.00 | 4.57 | 3.57 | 0.00 |
| 150.00 | 4.57 | 3.57 | 0.00 |
| 155.00 | 4.57 | 3.57 | 0.00 |
| 160.00 | 4.57 | 3.57 | 0.00 |
| 165.00 | 4.57 | 3.57 | 0.00 |
| 170.00 | 4.57 | 3.57 | 0.00 |
| 175.00 | 4.57 | 3.57 | 0.00 |
| 180.00 | 4.57 | 3.57 | 0.00 |
| 185.00 | 4.57 | 3.57 | 0.00 |
| 190.00 | 4.57 | 3.57 | 0.00 |
| 195.00 | 4.57 | 3.57 | 0.00 |
| 200.00 | 4.57 | 3.57 | 0.00 |
| 205.00 | 4.57 | 3.57 | 0.00 |
| 210.00 | 4.57 | 3.57 | 0.00 |
| 215.00 | 4.57 | 3.57 | 0.00 |
| 220.00 | 4.57 | 3.57 | 0.00 |
| 225.00 | 4.57 | 3.57 | 0.00 |
| 230.00 | 4.57 | 3.57 | 0.00 |
| 235.00 | 4.57 | 3.57 | 0.00 |
| 240.00 | 4.57 | 3.57 | 0.00 |
| 245.00 | 4.57 | 3.57 | 0.00 |
| 250.00 | 4.57 | 3.57 | 0.00 |
| 255.00 | 4.57 | 3.57 | 0.00 |
| 260.00 | 4.57 | 3.57 | 0.00 |
| 265.00 | 4.57 | 3.57 | 0.00 |
| 270.00 | 4.57 | 3.57 | 0.00 |
| 275.00 | 4.57 | 3.57 | 0.00 |
| 280.00 | 4.57 | 3.57 | 0.00 |
| 285.00 | 4.57 | 3.57 | 0.00 |
| 290.00 | 4.57 | 3.57 | 0.00 |
| 295.00 | 4.57 | 3.57 | 0.00 |
| 300.00 | 4.57 | 3.57 | 0.00 |
| 305.00 | 4.57 | 3.57 | 0.00 |
| 310.00 | 4.57 | 3.57 | 0.00 |
| 315.00 | 4.57 | 3.57 | 0.00 |
| 320.00 | 4.57 | 3.57 | 0.00 |
| 325.00 | 4.57 | 3.57 | 0.00 |
| 330.00 | 4.57 | 3.57 | 0.00 |
| 335.00 | 4.57 | 3.57 | 0.00 |
| 340.00 | 4.57 | 3.57 | 0.00 |
| 345.00 | 4.57 | 3.57 | 0.00 |
| 350.00 | 4.57 | 3.57 | 0.00 |
| 355.00 | 4.57 | 3.57 | 0.00 |
| 360.00 | 4.57 | 3.57 | 0.00 |

## Summary for Pond 3P: MRC BMP

Inflow Area = 47,524 sf, 29.70% Impervious, Inflow Depth = 3.46" for 10-yr event
Inflow = 4.52 cfs @ 12.08 hrs, Volume= 13,714 cf
Outflow = 0.36 cfs @ 12.99 hrs, Volume= 7,040 cf, Atten= 92%, Lag= 54.6 min
Primary = 0.36 cfs @ 12.99 hrs, Volume= 7,040 cf

Routing by Stor-Ind method, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
Peak Elev= 549.11' @ 12.99 hrs Surf.Area= 3,886 sf Storage= 8,980 cf

Plug-Flow detention time= 995.1 min calculated for 7,040 cf (51% of inflow)
Center-of-Mass det. time= 881.7 min ( 1,681.8 - 800.1 )

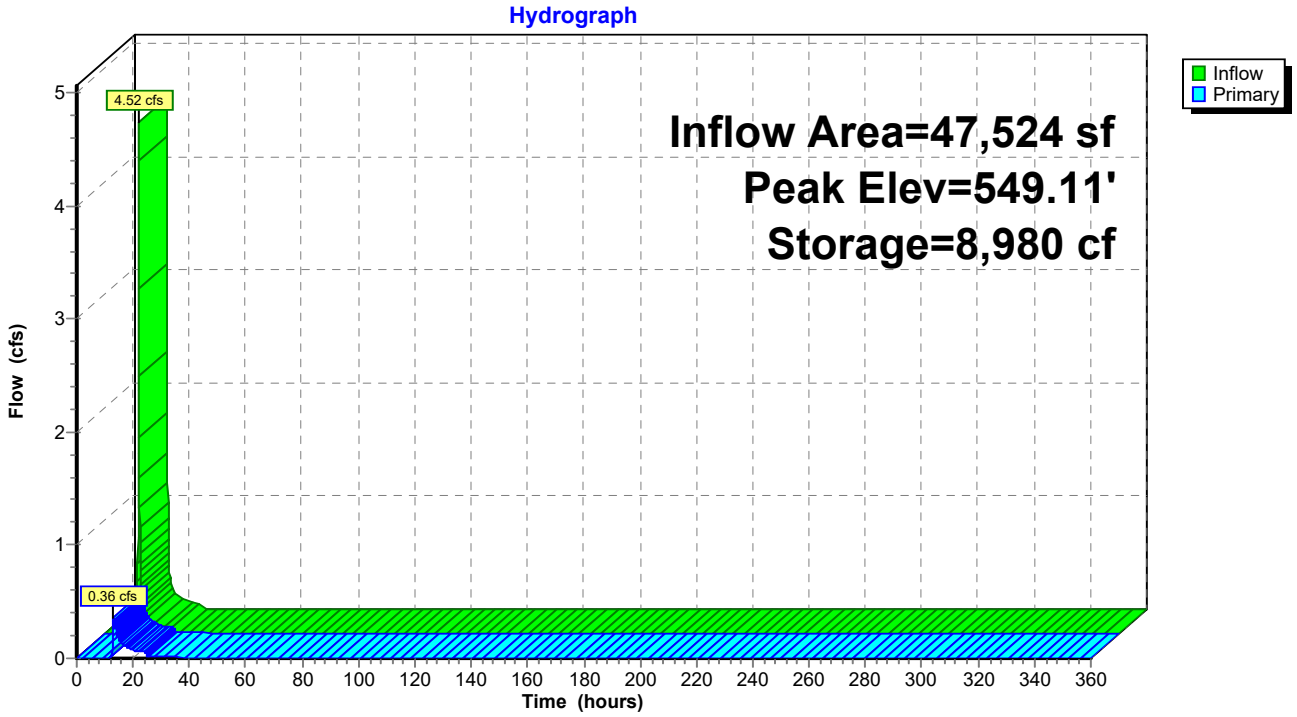
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 545.00' | 12,386 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc)<br>12,639 cf Overall x 98.0% Voids |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 545.00 | 1,943 | 0 | 0 |
| 546.00 | 1,943 | 1,943 | 1,943 |
| 547.00 | 1,943 | 1,943 | 3,886 |
| 548.00 | 1,943 | 1,943 | 5,829 |
| 548.49 | 1,943 | 952 | 6,781 |
| 548.50 | 3,886 | 29 | 6,810 |
| 549.00 | 3,886 | 1,943 | 8,753 |
| 550.00 | 3,886 | 3,886 | 12,639 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 548.50' | **12.0" Round Culvert**<br>L= 10.0' RCP, groove end projecting, Ke= 0.200<br>Inlet / Outlet Invert= 548.50' / 548.40' S= 0.0100 '/' Cc= 0.900<br>n= 0.011, Flow Area= 0.79 sf |
| #2 | Device 1 | 545.00' | **0.7" Vert. Orifice/Grate** C= 0.600 |
| #3 | Device 1 | 548.95' | **2.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

**Primary OutFlow** Max=0.35 cfs @ 12.99 hrs HW=549.11' (Free Discharge)
└─**1=Culvert** (Passes 0.35 cfs of 1.16 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.01 cfs @ 3.75 fps)
  └─**3=Broad-Crested Rectangular Weir** (Weir Controls 0.34 cfs @ 1.10 fps)

## Pond 3P: MRC BMP



## Hydrograph for Pond 3P: MRC BMP

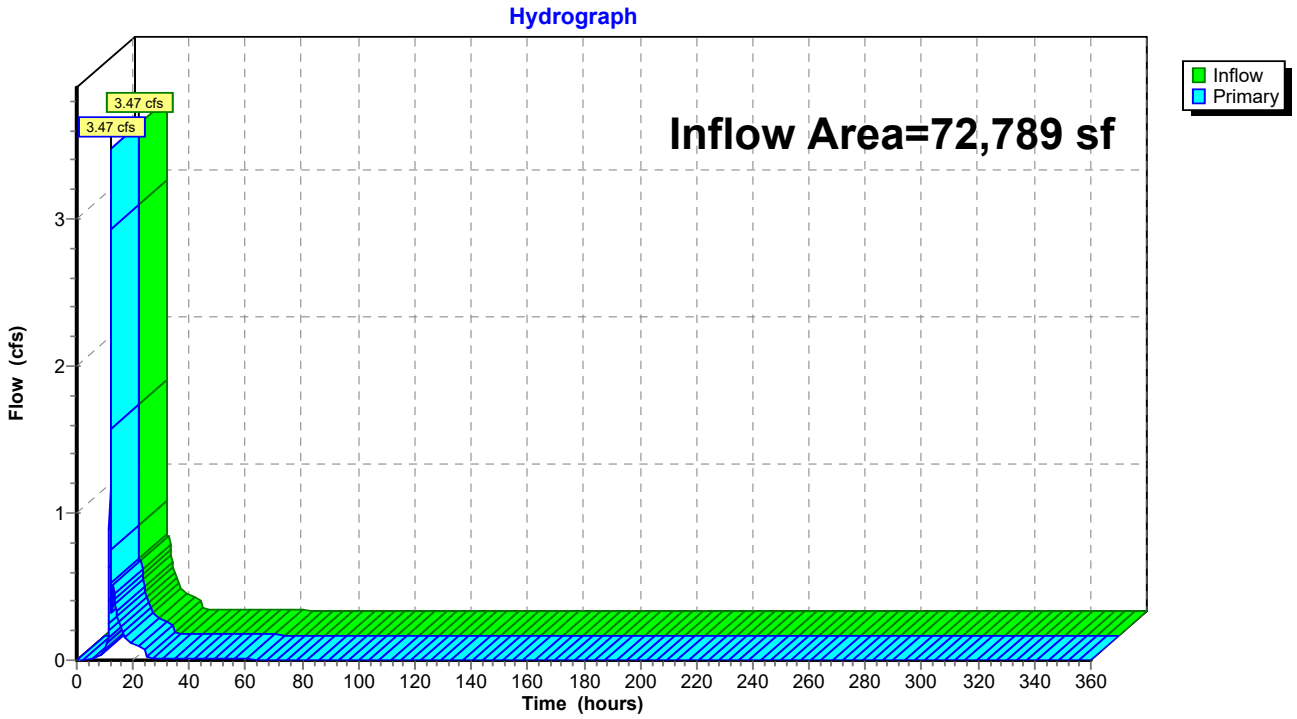
| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 0.00 | 0.00 | 0 | 545.00 | 0.00 |
| 10.00 | **0.10** | **748** | **545.39** | **0.00** |
| 20.00 | **0.07** | **8,577** | **549.00** | **0.07** |
| 30.00 | 0.00 | 8,260 | 548.92 | 0.01 |
| 40.00 | 0.00 | 7,975 | 548.84 | 0.01 |
| 50.00 | 0.00 | 7,719 | 548.77 | 0.01 |
| 60.00 | 0.00 | 7,490 | 548.71 | 0.01 |
| 70.00 | 0.00 | 7,290 | 548.66 | 0.01 |
| 80.00 | 0.00 | 7,119 | 548.62 | 0.00 |
| 90.00 | 0.00 | 6,975 | 548.58 | 0.00 |
| 100.00 | 0.00 | 6,860 | 548.55 | 0.00 |
| 110.00 | 0.00 | 6,782 | 548.53 | 0.00 |
| 120.00 | 0.00 | 6,737 | 548.52 | 0.00 |
| 130.00 | 0.00 | 6,710 | 548.51 | 0.00 |
| 140.00 | 0.00 | 6,695 | 548.51 | 0.00 |
| 150.00 | 0.00 | 6,686 | 548.50 | 0.00 |
| 160.00 | 0.00 | 6,681 | 548.50 | 0.00 |
| 170.00 | 0.00 | 6,678 | 548.50 | 0.00 |
| 180.00 | 0.00 | 6,676 | 548.50 | 0.00 |
| 190.00 | 0.00 | 6,675 | 548.50 | 0.00 |
| 200.00 | 0.00 | 6,675 | 548.50 | 0.00 |
| 210.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 220.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 230.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 240.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 250.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 260.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 270.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 280.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 290.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 300.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 310.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 320.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 330.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 340.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 350.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 360.00 | 0.00 | 6,674 | 548.50 | 0.00 |

## Summary for Link 4L: POST

Inflow Area = 72,789 sf, 19.51% Impervious, Inflow Depth = 2.40" for 10-yr event
Inflow = 3.47 cfs @ 11.95 hrs, Volume= 14,547 cf
Primary = 3.47 cfs @ 11.95 hrs, Volume= 14,547 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs

### Link 4L: POST



## Hydrograph for Link 4L: POST

| Time (hours) | Inflow (cfs) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|
| 0.00 | 0.00 | **0.00** | 0.00 |
| 5.00 | 0.01 | 0.00 | 0.01 |
| 10.00 | **0.06** | 0.00 | **0.06** |
| 15.00 | **0.25** | 0.00 | **0.25** |
| 20.00 | 0.11 | 0.00 | 0.11 |
| 25.00 | 0.02 | 0.00 | 0.02 |
| 30.00 | 0.01 | 0.00 | 0.01 |
| 35.00 | 0.01 | 0.00 | 0.01 |
| 40.00 | 0.01 | 0.00 | 0.01 |
| 45.00 | 0.01 | 0.00 | 0.01 |
| 50.00 | 0.01 | 0.00 | 0.01 |
| 55.00 | 0.01 | 0.00 | 0.01 |
| 60.00 | 0.01 | 0.00 | 0.01 |
| 65.00 | 0.01 | 0.00 | 0.01 |
| 70.00 | 0.01 | 0.00 | 0.01 |
| 75.00 | 0.00 | 0.00 | 0.00 |
| 80.00 | 0.00 | 0.00 | 0.00 |
| 85.00 | 0.00 | 0.00 | 0.00 |
| 90.00 | 0.00 | 0.00 | 0.00 |
| 95.00 | 0.00 | 0.00 | 0.00 |
| 100.00 | 0.00 | 0.00 | 0.00 |
| 105.00 | 0.00 | 0.00 | 0.00 |
| 110.00 | 0.00 | 0.00 | 0.00 |
| 115.00 | 0.00 | 0.00 | 0.00 |
| 120.00 | 0.00 | 0.00 | 0.00 |
| 125.00 | 0.00 | 0.00 | 0.00 |
| 130.00 | 0.00 | 0.00 | 0.00 |
| 135.00 | 0.00 | 0.00 | 0.00 |
| 140.00 | 0.00 | 0.00 | 0.00 |
| 145.00 | 0.00 | 0.00 | 0.00 |
| 150.00 | 0.00 | 0.00 | 0.00 |
| 155.00 | 0.00 | 0.00 | 0.00 |
| 160.00 | 0.00 | 0.00 | 0.00 |
| 165.00 | 0.00 | 0.00 | 0.00 |
| 170.00 | 0.00 | 0.00 | 0.00 |
| 175.00 | 0.00 | 0.00 | 0.00 |
| 180.00 | 0.00 | 0.00 | 0.00 |
| 185.00 | 0.00 | 0.00 | 0.00 |
| 190.00 | 0.00 | 0.00 | 0.00 |
| 195.00 | 0.00 | 0.00 | 0.00 |
| 200.00 | 0.00 | 0.00 | 0.00 |
| 205.00 | 0.00 | 0.00 | 0.00 |
| 210.00 | 0.00 | 0.00 | 0.00 |
| 215.00 | 0.00 | 0.00 | 0.00 |
| 220.00 | 0.00 | 0.00 | 0.00 |
| 225.00 | 0.00 | 0.00 | 0.00 |
| 230.00 | 0.00 | 0.00 | 0.00 |
| 235.00 | 0.00 | 0.00 | 0.00 |
| 240.00 | 0.00 | 0.00 | 0.00 |
| 245.00 | 0.00 | 0.00 | 0.00 |
| 250.00 | 0.00 | 0.00 | 0.00 |
| 255.00 | 0.00 | 0.00 | 0.00 |
| 260.00 | 0.00 | 0.00 | 0.00 |
| 265.00 | 0.00 | 0.00 | 0.00 |
| 270.00 | 0.00 | 0.00 | 0.00 |
| 275.00 | 0.00 | 0.00 | 0.00 |
| 280.00 | 0.00 | 0.00 | 0.00 |
| 285.00 | 0.00 | 0.00 | 0.00 |
| 290.00 | 0.00 | 0.00 | 0.00 |
| 295.00 | 0.00 | 0.00 | 0.00 |
| 300.00 | 0.00 | 0.00 | 0.00 |
| 305.00 | 0.00 | 0.00 | 0.00 |
| 310.00 | 0.00 | 0.00 | 0.00 |
| 315.00 | 0.00 | 0.00 | 0.00 |
| 320.00 | 0.00 | 0.00 | 0.00 |
| 325.00 | 0.00 | 0.00 | 0.00 |
| 330.00 | 0.00 | 0.00 | 0.00 |
| 335.00 | 0.00 | 0.00 | 0.00 |
| 340.00 | 0.00 | 0.00 | 0.00 |
| 345.00 | 0.00 | 0.00 | 0.00 |
| 350.00 | 0.00 | 0.00 | 0.00 |
| 355.00 | 0.00 | 0.00 | 0.00 |
| 360.00 | 0.00 | 0.00 | 0.00 |

Time span=0.00-360.00 hrs, dt=0.05 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: PRE** Runoff Area=1.665 ac 0.36% Impervious Runoff Depth=4.59"
Tc=15.8 min CN=83 Runoff=9.37 cfs 27,716 cf

**Subcatchment2S: POST-MRC BMP** Runoff Area=1.091 ac 29.70% Impervious Runoff Depth=5.36"
Tc=16.2 min CN=90 Runoff=6.84 cfs 21,240 cf

**Subcatchment5S: POST-Bypass** Runoff Area=0.580 ac 0.34% Impervious Runoff Depth=5.48"
Tc=5.0 min CN=91 Runoff=5.18 cfs 11,531 cf

**Pond 3P: MRC BMP** Peak Elev=549.60' Storage=10,846 cf Inflow=6.84 cfs 21,240 cf
Outflow=2.89 cfs 14,566 cf

**Link 4L: POST** Inflow=5.18 cfs 26,096 cf
Primary=5.18 cfs 26,096 cf

**Total Runoff Area = 145,316 sf Runoff Volume = 60,486 cf Average Runoff Depth = 4.99"**
**90.05% Pervious = 130,854 sf 9.95% Impervious = 14,462 sf**

## Summary for Subcatchment 1S: PRE

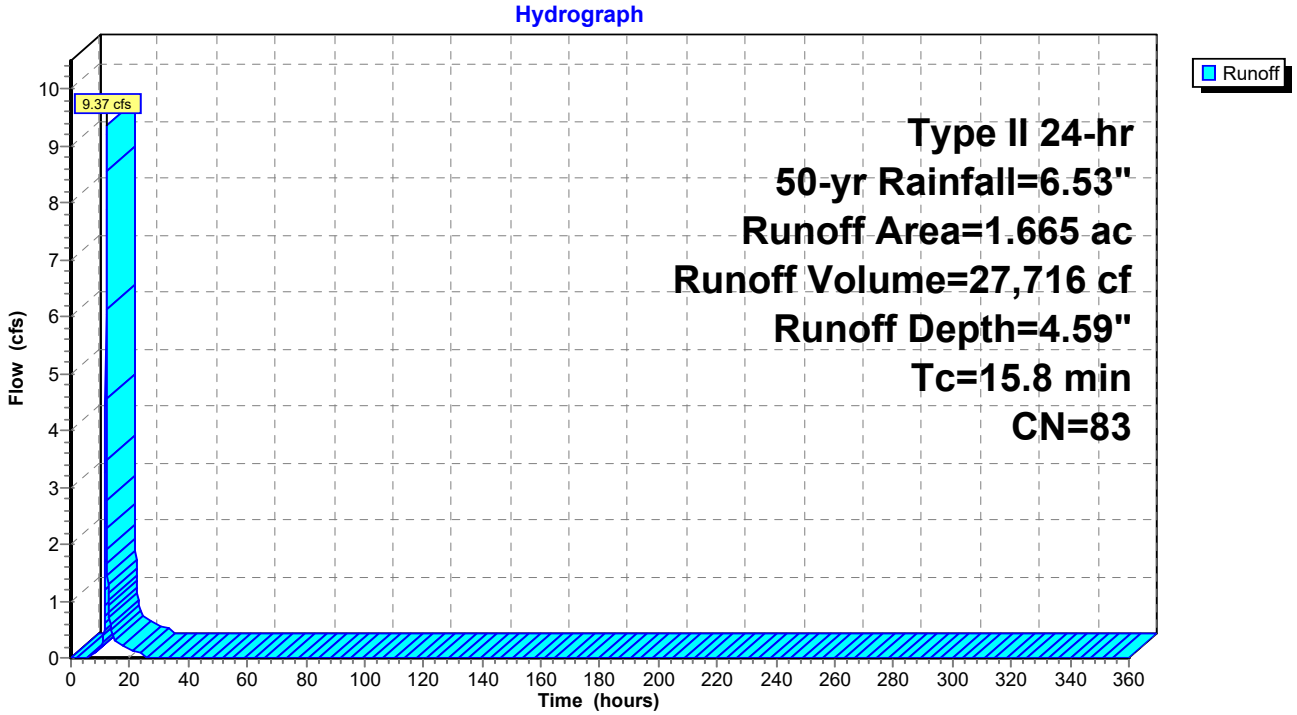
Runoff = 9.37 cfs @ 12.08 hrs, Volume= 27,716 cf, Depth= 4.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
Type II 24-hr 50-yr Rainfall=6.53"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 0.006 | 98 | Impervious |
| * | 0.134 | 77 | Woods, Good |
| * | 0.684 | 78 | Meadow (20% and On-site Brush) |
| * | 0.674 | 91 | Gravel |
| * | 0.167 | 73 | Onsite Brush, Good |
| | 1.665 | 83 | Weighted Average |
| | 1.659 | | 99.64% Pervious Area |
| | 0.006 | | 0.36% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.8 | | | | | **Direct Entry, Tc** |

## Subcatchment 1S: PRE



## Hydrograph for Subcatchment 1S: PRE

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 |
| 5.00 | 0.41 | 0.00 | 0.00 |
| 10.00 | 1.18 | 0.21 | **0.18** |
| 15.00 | 5.57 | 3.70 | **0.32** |
| 20.00 | **6.22** | **4.29** | 0.14 |
| 25.00 | **6.53** | **4.59** | 0.00 |
| 30.00 | 6.53 | 4.59 | 0.00 |
| 35.00 | 6.53 | 4.59 | 0.00 |
| 40.00 | 6.53 | 4.59 | 0.00 |
| 45.00 | 6.53 | 4.59 | 0.00 |
| 50.00 | 6.53 | 4.59 | 0.00 |
| 55.00 | 6.53 | 4.59 | 0.00 |
| 60.00 | 6.53 | 4.59 | 0.00 |
| 65.00 | 6.53 | 4.59 | 0.00 |
| 70.00 | 6.53 | 4.59 | 0.00 |
| 75.00 | 6.53 | 4.59 | 0.00 |
| 80.00 | 6.53 | 4.59 | 0.00 |
| 85.00 | 6.53 | 4.59 | 0.00 |
| 90.00 | 6.53 | 4.59 | 0.00 |
| 95.00 | 6.53 | 4.59 | 0.00 |
| 100.00 | 6.53 | 4.59 | 0.00 |
| 105.00 | 6.53 | 4.59 | 0.00 |
| 110.00 | 6.53 | 4.59 | 0.00 |
| 115.00 | 6.53 | 4.59 | 0.00 |
| 120.00 | 6.53 | 4.59 | 0.00 |
| 125.00 | 6.53 | 4.59 | 0.00 |
| 130.00 | 6.53 | 4.59 | 0.00 |
| 135.00 | 6.53 | 4.59 | 0.00 |
| 140.00 | 6.53 | 4.59 | 0.00 |
| 145.00 | 6.53 | 4.59 | 0.00 |
| 150.00 | 6.53 | 4.59 | 0.00 |
| 155.00 | 6.53 | 4.59 | 0.00 |
| 160.00 | 6.53 | 4.59 | 0.00 |
| 165.00 | 6.53 | 4.59 | 0.00 |
| 170.00 | 6.53 | 4.59 | 0.00 |
| 175.00 | 6.53 | 4.59 | 0.00 |
| 180.00 | 6.53 | 4.59 | 0.00 |
| 185.00 | 6.53 | 4.59 | 0.00 |
| 190.00 | 6.53 | 4.59 | 0.00 |
| 195.00 | 6.53 | 4.59 | 0.00 |
| 200.00 | 6.53 | 4.59 | 0.00 |
| 205.00 | 6.53 | 4.59 | 0.00 |
| 210.00 | 6.53 | 4.59 | 0.00 |
| 215.00 | 6.53 | 4.59 | 0.00 |
| 220.00 | 6.53 | 4.59 | 0.00 |
| 225.00 | 6.53 | 4.59 | 0.00 |
| 230.00 | 6.53 | 4.59 | 0.00 |
| 235.00 | 6.53 | 4.59 | 0.00 |
| 240.00 | 6.53 | 4.59 | 0.00 |
| 245.00 | 6.53 | 4.59 | 0.00 |
| 250.00 | 6.53 | 4.59 | 0.00 |
| 255.00 | 6.53 | 4.59 | 0.00 |
| 260.00 | 6.53 | 4.59 | 0.00 |
| 265.00 | 6.53 | 4.59 | 0.00 |
| 270.00 | 6.53 | 4.59 | 0.00 |
| 275.00 | 6.53 | 4.59 | 0.00 |
| 280.00 | 6.53 | 4.59 | 0.00 |
| 285.00 | 6.53 | 4.59 | 0.00 |
| 290.00 | 6.53 | 4.59 | 0.00 |
| 295.00 | 6.53 | 4.59 | 0.00 |
| 300.00 | 6.53 | 4.59 | 0.00 |
| 305.00 | 6.53 | 4.59 | 0.00 |
| 310.00 | 6.53 | 4.59 | 0.00 |
| 315.00 | 6.53 | 4.59 | 0.00 |
| 320.00 | 6.53 | 4.59 | 0.00 |
| 325.00 | 6.53 | 4.59 | 0.00 |
| 330.00 | 6.53 | 4.59 | 0.00 |
| 335.00 | 6.53 | 4.59 | 0.00 |
| 340.00 | 6.53 | 4.59 | 0.00 |
| 345.00 | 6.53 | 4.59 | 0.00 |
| 350.00 | 6.53 | 4.59 | 0.00 |
| 355.00 | 6.53 | 4.59 | 0.00 |
| 360.00 | 6.53 | 4.59 | 0.00 |

## Summary for Subcatchment 2S: POST-MRC BMP

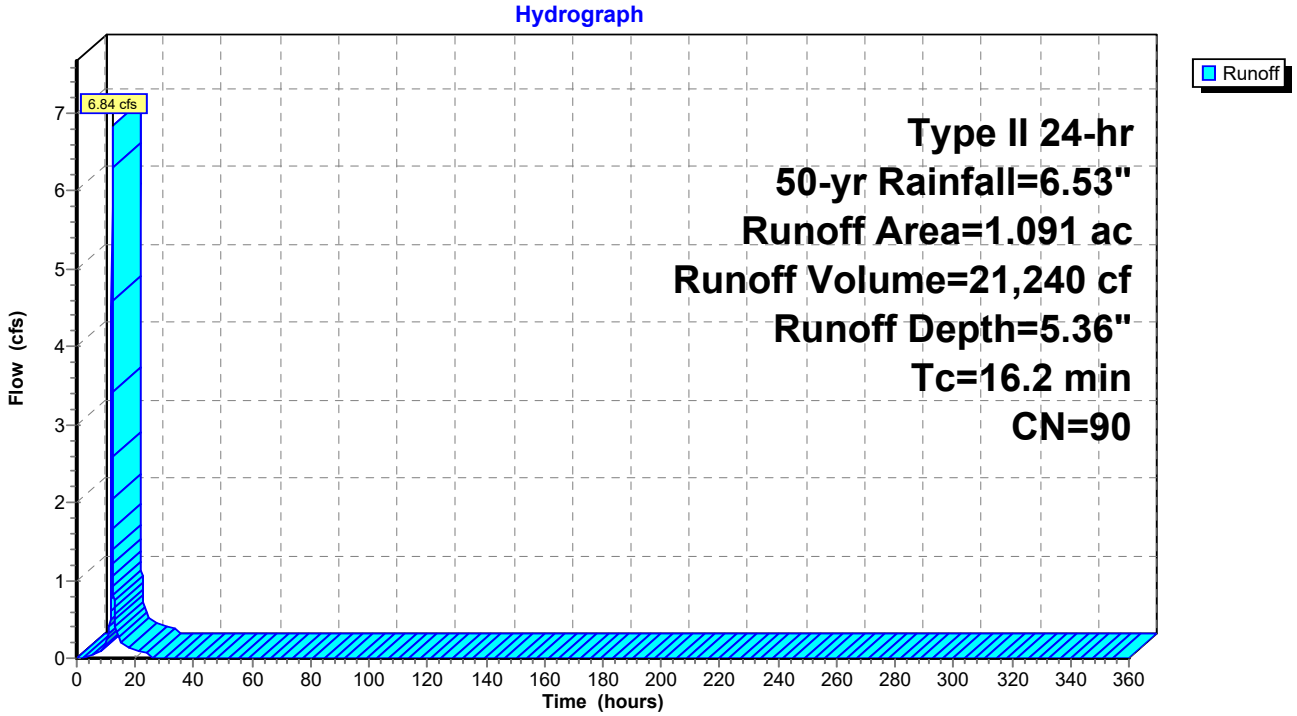
Runoff = 6.84 cfs @ 12.08 hrs, Volume= 21,240 cf, Depth= 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
Type II 24-hr 50-yr Rainfall=6.53"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 0.586 | 91 | Gravel |
| * | 0.324 | 98 | Impervious |
| * | 0.181 | 73 | Brush, good |
| | 1.091 | 90 | Weighted Average |
| | 0.767 | | 70.30% Pervious Area |
| | 0.324 | | 29.70% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 16.2 | | | | | **Direct Entry, Tc** |

## Subcatchment 2S: POST-MRC BMP



## Hydrograph for Subcatchment 2S: POST-MRC BMP

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 |
| 5.00 | 0.41 | 0.03 | 0.03 |
| 10.00 | 1.18 | 0.44 | **0.18** |
| 15.00 | 5.57 | 4.43 | **0.22** |
| 20.00 | **6.22** | **5.06** | 0.10 |
| 25.00 | **6.53** | **5.36** | 0.00 |
| 30.00 | 6.53 | 5.36 | 0.00 |
| 35.00 | 6.53 | 5.36 | 0.00 |
| 40.00 | 6.53 | 5.36 | 0.00 |
| 45.00 | 6.53 | 5.36 | 0.00 |
| 50.00 | 6.53 | 5.36 | 0.00 |
| 55.00 | 6.53 | 5.36 | 0.00 |
| 60.00 | 6.53 | 5.36 | 0.00 |
| 65.00 | 6.53 | 5.36 | 0.00 |
| 70.00 | 6.53 | 5.36 | 0.00 |
| 75.00 | 6.53 | 5.36 | 0.00 |
| 80.00 | 6.53 | 5.36 | 0.00 |
| 85.00 | 6.53 | 5.36 | 0.00 |
| 90.00 | 6.53 | 5.36 | 0.00 |
| 95.00 | 6.53 | 5.36 | 0.00 |
| 100.00 | 6.53 | 5.36 | 0.00 |
| 105.00 | 6.53 | 5.36 | 0.00 |
| 110.00 | 6.53 | 5.36 | 0.00 |
| 115.00 | 6.53 | 5.36 | 0.00 |
| 120.00 | 6.53 | 5.36 | 0.00 |
| 125.00 | 6.53 | 5.36 | 0.00 |
| 130.00 | 6.53 | 5.36 | 0.00 |
| 135.00 | 6.53 | 5.36 | 0.00 |
| 140.00 | 6.53 | 5.36 | 0.00 |
| 145.00 | 6.53 | 5.36 | 0.00 |
| 150.00 | 6.53 | 5.36 | 0.00 |
| 155.00 | 6.53 | 5.36 | 0.00 |
| 160.00 | 6.53 | 5.36 | 0.00 |
| 165.00 | 6.53 | 5.36 | 0.00 |
| 170.00 | 6.53 | 5.36 | 0.00 |
| 175.00 | 6.53 | 5.36 | 0.00 |
| 180.00 | 6.53 | 5.36 | 0.00 |
| 185.00 | 6.53 | 5.36 | 0.00 |
| 190.00 | 6.53 | 5.36 | 0.00 |
| 195.00 | 6.53 | 5.36 | 0.00 |
| 200.00 | 6.53 | 5.36 | 0.00 |
| 205.00 | 6.53 | 5.36 | 0.00 |
| 210.00 | 6.53 | 5.36 | 0.00 |
| 215.00 | 6.53 | 5.36 | 0.00 |
| 220.00 | 6.53 | 5.36 | 0.00 |
| 225.00 | 6.53 | 5.36 | 0.00 |
| 230.00 | 6.53 | 5.36 | 0.00 |
| 235.00 | 6.53 | 5.36 | 0.00 |
| 240.00 | 6.53 | 5.36 | 0.00 |
| 245.00 | 6.53 | 5.36 | 0.00 |
| 250.00 | 6.53 | 5.36 | 0.00 |
| 255.00 | 6.53 | 5.36 | 0.00 |
| 260.00 | 6.53 | 5.36 | 0.00 |
| 265.00 | 6.53 | 5.36 | 0.00 |
| 270.00 | 6.53 | 5.36 | 0.00 |
| 275.00 | 6.53 | 5.36 | 0.00 |
| 280.00 | 6.53 | 5.36 | 0.00 |
| 285.00 | 6.53 | 5.36 | 0.00 |
| 290.00 | 6.53 | 5.36 | 0.00 |
| 295.00 | 6.53 | 5.36 | 0.00 |
| 300.00 | 6.53 | 5.36 | 0.00 |
| 305.00 | 6.53 | 5.36 | 0.00 |
| 310.00 | 6.53 | 5.36 | 0.00 |
| 315.00 | 6.53 | 5.36 | 0.00 |
| 320.00 | 6.53 | 5.36 | 0.00 |
| 325.00 | 6.53 | 5.36 | 0.00 |
| 330.00 | 6.53 | 5.36 | 0.00 |
| 335.00 | 6.53 | 5.36 | 0.00 |
| 340.00 | 6.53 | 5.36 | 0.00 |
| 345.00 | 6.53 | 5.36 | 0.00 |
| 350.00 | 6.53 | 5.36 | 0.00 |
| 355.00 | 6.53 | 5.36 | 0.00 |
| 360.00 | 6.53 | 5.36 | 0.00 |

## Summary for Subcatchment 5S: POST-Bypass

[49] Hint: Tc<2dt may require smaller dt

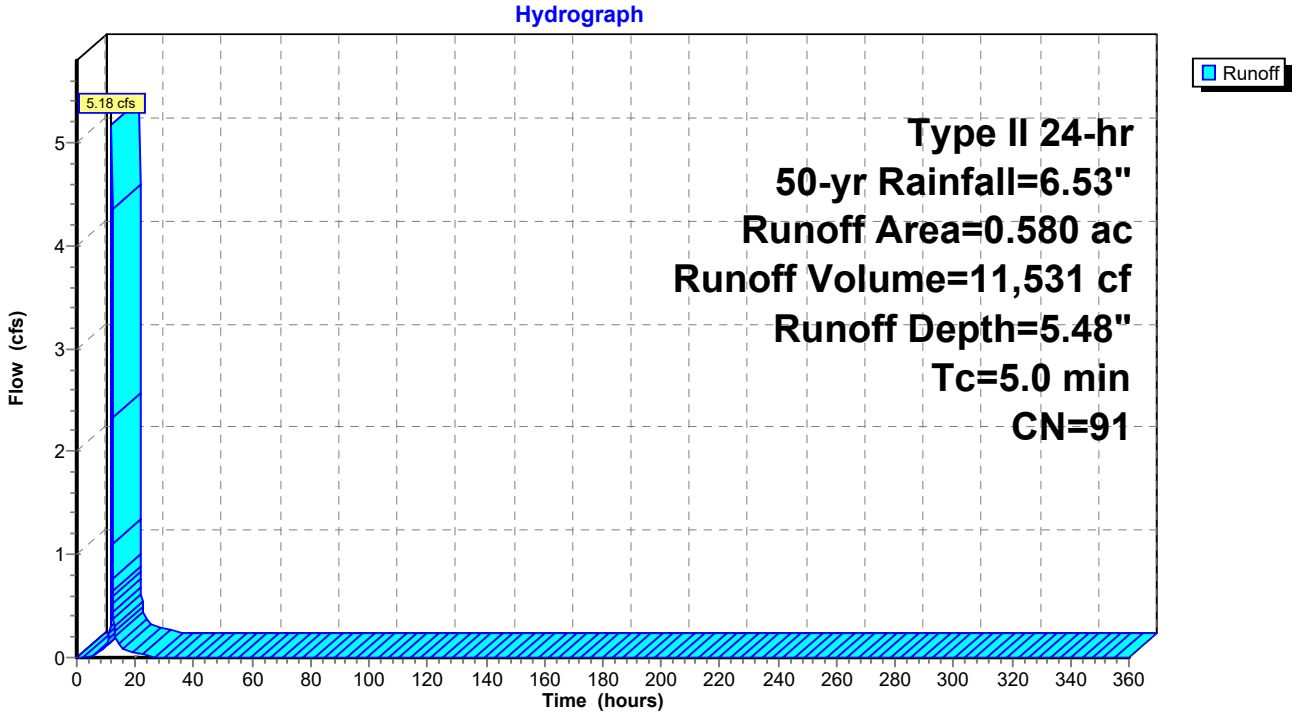
Runoff = 5.18 cfs @ 11.95 hrs, Volume= 11,531 cf, Depth= 5.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
Type II 24-hr 50-yr Rainfall=6.53"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 0.002 | 98 | Impervious |
| * | 0.578 | 91 | Gravel |
| | 0.580 | 91 | Weighted Average |
| | 0.578 | | 99.66% Pervious Area |
| | 0.002 | | 0.34% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry, Tc** |

### Subcatchment 5S: POST-Bypass



## Hydrograph for Subcatchment 5S: POST-Bypass

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 |
| 5.00 | 0.41 | 0.04 | 0.02 |
| 10.00 | 1.18 | 0.49 | **0.11** |
| 15.00 | 5.57 | 4.54 | **0.11** |
| 20.00 | **6.22** | **5.17** | 0.05 |
| 25.00 | **6.53** | **5.48** | 0.00 |
| 30.00 | 6.53 | 5.48 | 0.00 |
| 35.00 | 6.53 | 5.48 | 0.00 |
| 40.00 | 6.53 | 5.48 | 0.00 |
| 45.00 | 6.53 | 5.48 | 0.00 |
| 50.00 | 6.53 | 5.48 | 0.00 |
| 55.00 | 6.53 | 5.48 | 0.00 |
| 60.00 | 6.53 | 5.48 | 0.00 |
| 65.00 | 6.53 | 5.48 | 0.00 |
| 70.00 | 6.53 | 5.48 | 0.00 |
| 75.00 | 6.53 | 5.48 | 0.00 |
| 80.00 | 6.53 | 5.48 | 0.00 |
| 85.00 | 6.53 | 5.48 | 0.00 |
| 90.00 | 6.53 | 5.48 | 0.00 |
| 95.00 | 6.53 | 5.48 | 0.00 |
| 100.00 | 6.53 | 5.48 | 0.00 |
| 105.00 | 6.53 | 5.48 | 0.00 |
| 110.00 | 6.53 | 5.48 | 0.00 |
| 115.00 | 6.53 | 5.48 | 0.00 |
| 120.00 | 6.53 | 5.48 | 0.00 |
| 125.00 | 6.53 | 5.48 | 0.00 |
| 130.00 | 6.53 | 5.48 | 0.00 |
| 135.00 | 6.53 | 5.48 | 0.00 |
| 140.00 | 6.53 | 5.48 | 0.00 |
| 145.00 | 6.53 | 5.48 | 0.00 |
| 150.00 | 6.53 | 5.48 | 0.00 |
| 155.00 | 6.53 | 5.48 | 0.00 |
| 160.00 | 6.53 | 5.48 | 0.00 |
| 165.00 | 6.53 | 5.48 | 0.00 |
| 170.00 | 6.53 | 5.48 | 0.00 |
| 175.00 | 6.53 | 5.48 | 0.00 |
| 180.00 | 6.53 | 5.48 | 0.00 |
| 185.00 | 6.53 | 5.48 | 0.00 |
| 190.00 | 6.53 | 5.48 | 0.00 |
| 195.00 | 6.53 | 5.48 | 0.00 |
| 200.00 | 6.53 | 5.48 | 0.00 |
| 205.00 | 6.53 | 5.48 | 0.00 |
| 210.00 | 6.53 | 5.48 | 0.00 |
| 215.00 | 6.53 | 5.48 | 0.00 |
| 220.00 | 6.53 | 5.48 | 0.00 |
| 225.00 | 6.53 | 5.48 | 0.00 |
| 230.00 | 6.53 | 5.48 | 0.00 |
| 235.00 | 6.53 | 5.48 | 0.00 |
| 240.00 | 6.53 | 5.48 | 0.00 |
| 245.00 | 6.53 | 5.48 | 0.00 |
| 250.00 | 6.53 | 5.48 | 0.00 |
| 255.00 | 6.53 | 5.48 | 0.00 |
| 260.00 | 6.53 | 5.48 | 0.00 |
| 265.00 | 6.53 | 5.48 | 0.00 |
| 270.00 | 6.53 | 5.48 | 0.00 |
| 275.00 | 6.53 | 5.48 | 0.00 |
| 280.00 | 6.53 | 5.48 | 0.00 |
| 285.00 | 6.53 | 5.48 | 0.00 |
| 290.00 | 6.53 | 5.48 | 0.00 |
| 295.00 | 6.53 | 5.48 | 0.00 |
| 300.00 | 6.53 | 5.48 | 0.00 |
| 305.00 | 6.53 | 5.48 | 0.00 |
| 310.00 | 6.53 | 5.48 | 0.00 |
| 315.00 | 6.53 | 5.48 | 0.00 |
| 320.00 | 6.53 | 5.48 | 0.00 |
| 325.00 | 6.53 | 5.48 | 0.00 |
| 330.00 | 6.53 | 5.48 | 0.00 |
| 335.00 | 6.53 | 5.48 | 0.00 |
| 340.00 | 6.53 | 5.48 | 0.00 |
| 345.00 | 6.53 | 5.48 | 0.00 |
| 350.00 | 6.53 | 5.48 | 0.00 |
| 355.00 | 6.53 | 5.48 | 0.00 |
| 360.00 | 6.53 | 5.48 | 0.00 |

## Summary for Pond 3P: MRC BMP

Inflow Area = 47,524 sf, 29.70% Impervious, Inflow Depth = 5.36" for 50-yr event
Inflow = 6.84 cfs @ 12.08 hrs, Volume= 21,240 cf
Outflow = 2.89 cfs @ 12.28 hrs, Volume= 14,566 cf, Atten= 58%, Lag= 12.5 min
Primary = 2.89 cfs @ 12.28 hrs, Volume= 14,566 cf

Routing by Stor-Ind method, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
Peak Elev= 549.60' @ 12.28 hrs Surf.Area= 3,886 sf Storage= 10,846 cf

Plug-Flow detention time= 549.0 min calculated for 14,564 cf (69% of inflow)
Center-of-Mass det. time= 453.5 min ( 1,241.6 - 788.1 )

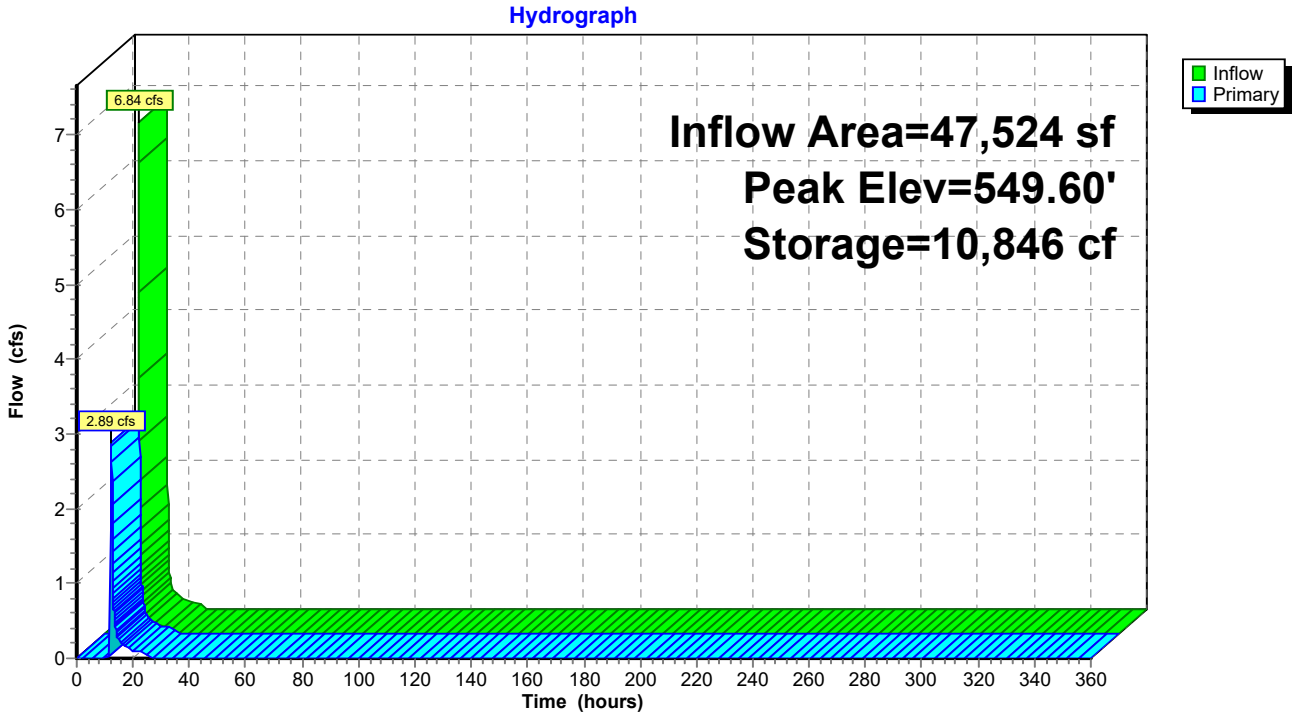
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 545.00' | 12,386 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc)<br>12,639 cf Overall x 98.0% Voids |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 545.00 | 1,943 | 0 | 0 |
| 546.00 | 1,943 | 1,943 | 1,943 |
| 547.00 | 1,943 | 1,943 | 3,886 |
| 548.00 | 1,943 | 1,943 | 5,829 |
| 548.49 | 1,943 | 952 | 6,781 |
| 548.50 | 3,886 | 29 | 6,810 |
| 549.00 | 3,886 | 1,943 | 8,753 |
| 550.00 | 3,886 | 3,886 | 12,639 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 548.50' | **12.0" Round Culvert**<br>L= 10.0' RCP, groove end projecting, Ke= 0.200<br>Inlet / Outlet Invert= 548.50' / 548.40' S= 0.0100 '/' Cc= 0.900<br>n= 0.011, Flow Area= 0.79 sf |
| #2 | Device 1 | 545.00' | **0.7" Vert. Orifice/Grate** C= 0.600 |
| #3 | Device 1 | 548.95' | **2.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

**Primary OutFlow** Max=2.88 cfs @ 12.28 hrs HW=549.59' (Free Discharge)
└─**1=Culvert** (Barrel Controls 2.88 cfs @ 4.18 fps)
  ├─**2=Orifice/Grate** (Passes < 0.01 cfs potential flow)
  └─**3=Broad-Crested Rectangular Weir** (Passes < 3.22 cfs potential flow)

## Pond 3P: MRC BMP



## Hydrograph for Pond 3P: MRC BMP

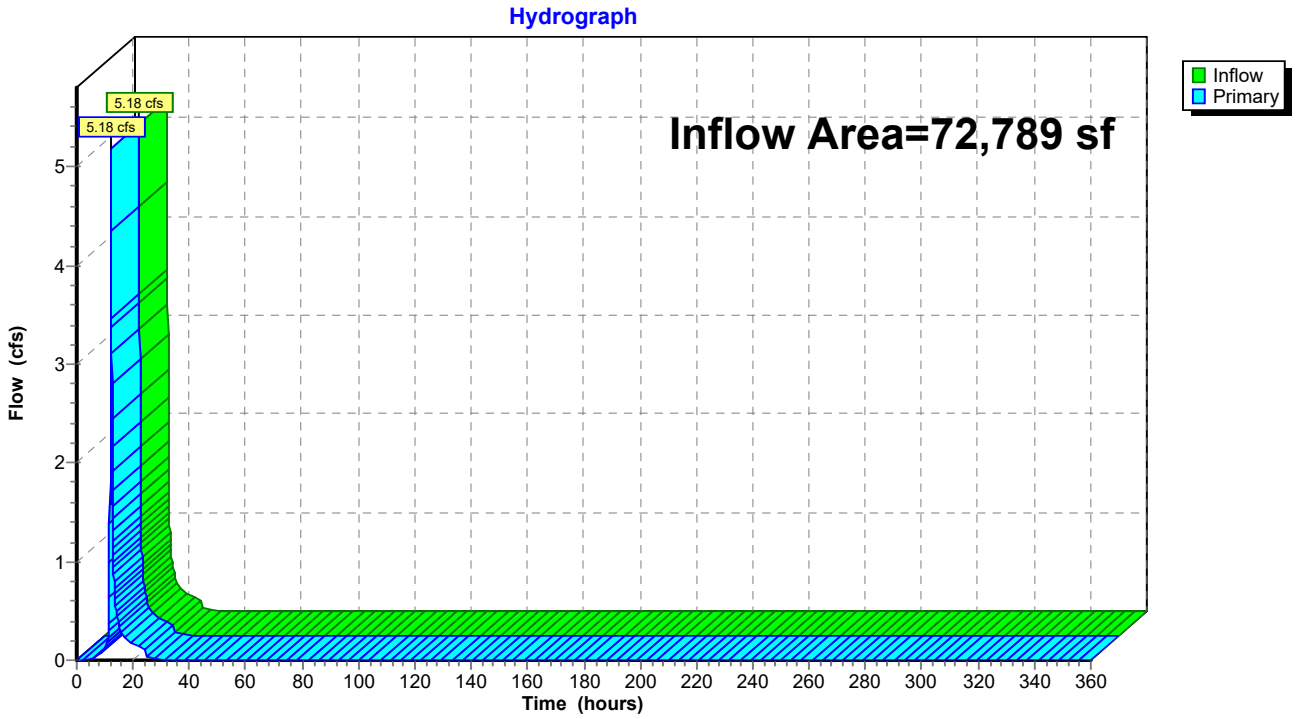
| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 0.00 | 0.00 | 0 | 545.00 | 0.00 |
| 10.00 | **0.18** | **1,591** | **545.84** | **0.00** |
| 20.00 | **0.10** | **8,631** | **549.01** | **0.10** |
| 30.00 | 0.00 | 8,268 | 548.92 | 0.01 |
| 40.00 | 0.00 | 7,983 | 548.84 | 0.01 |
| 50.00 | 0.00 | 7,725 | 548.78 | 0.01 |
| 60.00 | 0.00 | 7,496 | 548.72 | 0.01 |
| 70.00 | 0.00 | 7,295 | 548.66 | 0.01 |
| 80.00 | 0.00 | 7,123 | 548.62 | 0.00 |
| 90.00 | 0.00 | 6,979 | 548.58 | 0.00 |
| 100.00 | 0.00 | 6,863 | 548.55 | 0.00 |
| 110.00 | 0.00 | 6,784 | 548.53 | 0.00 |
| 120.00 | 0.00 | 6,738 | 548.52 | 0.00 |
| 130.00 | 0.00 | 6,711 | 548.51 | 0.00 |
| 140.00 | 0.00 | 6,695 | 548.51 | 0.00 |
| 150.00 | 0.00 | 6,686 | 548.50 | 0.00 |
| 160.00 | 0.00 | 6,681 | 548.50 | 0.00 |
| 170.00 | 0.00 | 6,678 | 548.50 | 0.00 |
| 180.00 | 0.00 | 6,676 | 548.50 | 0.00 |
| 190.00 | 0.00 | 6,675 | 548.50 | 0.00 |
| 200.00 | 0.00 | 6,675 | 548.50 | 0.00 |
| 210.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 220.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 230.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 240.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 250.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 260.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 270.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 280.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 290.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 300.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 310.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 320.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 330.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 340.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 350.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 360.00 | 0.00 | 6,674 | 548.50 | 0.00 |

## Summary for Link 4L: POST

Inflow Area = 72,789 sf, 19.51% Impervious, Inflow Depth = 4.30" for 50-yr event
Inflow = 5.18 cfs @ 11.95 hrs, Volume= 26,096 cf
Primary = 5.18 cfs @ 11.95 hrs, Volume= 26,096 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs

### Link 4L: POST



## Hydrograph for Link 4L: POST

| Time (hours) | Inflow (cfs) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|
| 0.00 | 0.00 | **0.00** | 0.00 |
| 5.00 | 0.02 | 0.00 | 0.02 |
| 10.00 | **0.11** | 0.00 | **0.11** |
| 15.00 | **0.36** | 0.00 | **0.36** |
| 20.00 | 0.15 | 0.00 | 0.15 |
| 25.00 | 0.03 | 0.00 | 0.03 |
| 30.00 | 0.01 | 0.00 | 0.01 |
| 35.00 | 0.01 | 0.00 | 0.01 |
| 40.00 | 0.01 | 0.00 | 0.01 |
| 45.00 | 0.01 | 0.00 | 0.01 |
| 50.00 | 0.01 | 0.00 | 0.01 |
| 55.00 | 0.01 | 0.00 | 0.01 |
| 60.00 | 0.01 | 0.00 | 0.01 |
| 65.00 | 0.01 | 0.00 | 0.01 |
| 70.00 | 0.01 | 0.00 | 0.01 |
| 75.00 | 0.00 | 0.00 | 0.00 |
| 80.00 | 0.00 | 0.00 | 0.00 |
| 85.00 | 0.00 | 0.00 | 0.00 |
| 90.00 | 0.00 | 0.00 | 0.00 |
| 95.00 | 0.00 | 0.00 | 0.00 |
| 100.00 | 0.00 | 0.00 | 0.00 |
| 105.00 | 0.00 | 0.00 | 0.00 |
| 110.00 | 0.00 | 0.00 | 0.00 |
| 115.00 | 0.00 | 0.00 | 0.00 |
| 120.00 | 0.00 | 0.00 | 0.00 |
| 125.00 | 0.00 | 0.00 | 0.00 |
| 130.00 | 0.00 | 0.00 | 0.00 |
| 135.00 | 0.00 | 0.00 | 0.00 |
| 140.00 | 0.00 | 0.00 | 0.00 |
| 145.00 | 0.00 | 0.00 | 0.00 |
| 150.00 | 0.00 | 0.00 | 0.00 |
| 155.00 | 0.00 | 0.00 | 0.00 |
| 160.00 | 0.00 | 0.00 | 0.00 |
| 165.00 | 0.00 | 0.00 | 0.00 |
| 170.00 | 0.00 | 0.00 | 0.00 |
| 175.00 | 0.00 | 0.00 | 0.00 |
| 180.00 | 0.00 | 0.00 | 0.00 |
| 185.00 | 0.00 | 0.00 | 0.00 |
| 190.00 | 0.00 | 0.00 | 0.00 |
| 195.00 | 0.00 | 0.00 | 0.00 |
| 200.00 | 0.00 | 0.00 | 0.00 |
| 205.00 | 0.00 | 0.00 | 0.00 |
| 210.00 | 0.00 | 0.00 | 0.00 |
| 215.00 | 0.00 | 0.00 | 0.00 |
| 220.00 | 0.00 | 0.00 | 0.00 |
| 225.00 | 0.00 | 0.00 | 0.00 |
| 230.00 | 0.00 | 0.00 | 0.00 |
| 235.00 | 0.00 | 0.00 | 0.00 |
| 240.00 | 0.00 | 0.00 | 0.00 |
| 245.00 | 0.00 | 0.00 | 0.00 |
| 250.00 | 0.00 | 0.00 | 0.00 |
| 255.00 | 0.00 | 0.00 | 0.00 |
| 260.00 | 0.00 | 0.00 | 0.00 |
| 265.00 | 0.00 | 0.00 | 0.00 |
| 270.00 | 0.00 | 0.00 | 0.00 |
| 275.00 | 0.00 | 0.00 | 0.00 |
| 280.00 | 0.00 | 0.00 | 0.00 |
| 285.00 | 0.00 | 0.00 | 0.00 |
| 290.00 | 0.00 | 0.00 | 0.00 |
| 295.00 | 0.00 | 0.00 | 0.00 |
| 300.00 | 0.00 | 0.00 | 0.00 |
| 305.00 | 0.00 | 0.00 | 0.00 |
| 310.00 | 0.00 | 0.00 | 0.00 |
| 315.00 | 0.00 | 0.00 | 0.00 |
| 320.00 | 0.00 | 0.00 | 0.00 |
| 325.00 | 0.00 | 0.00 | 0.00 |
| 330.00 | 0.00 | 0.00 | 0.00 |
| 335.00 | 0.00 | 0.00 | 0.00 |
| 340.00 | 0.00 | 0.00 | 0.00 |
| 345.00 | 0.00 | 0.00 | 0.00 |
| 350.00 | 0.00 | 0.00 | 0.00 |
| 355.00 | 0.00 | 0.00 | 0.00 |
| 360.00 | 0.00 | 0.00 | 0.00 |

Time span=0.00-360.00 hrs, dt=0.05 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: PRE** Runoff Area=1.665 ac 0.36% Impervious Runoff Depth=5.62"
Tc=15.8 min CN=83 Runoff=11.40 cfs 33,996 cf

**Subcatchment2S: POST-MRC BMP** Runoff Area=1.091 ac 29.70% Impervious Runoff Depth=6.44"
Tc=16.2 min CN=90 Runoff=8.13 cfs 25,511 cf

**Subcatchment5S: POST-Bypass** Runoff Area=0.580 ac 0.34% Impervious Runoff Depth=6.56"
Tc=5.0 min CN=91 Runoff=6.13 cfs 13,810 cf

**Pond 3P: MRC BMP** Peak Elev=549.95' Storage=12,195 cf Inflow=8.13 cfs 25,511 cf
Outflow=3.92 cfs 18,837 cf

**Link 4L: POST** Inflow=6.14 cfs 32,647 cf
Primary=6.14 cfs 32,647 cf

**Total Runoff Area = 145,316 sf Runoff Volume = 73,317 cf Average Runoff Depth = 6.05"**
**90.05% Pervious = 130,854 sf 9.95% Impervious = 14,462 sf**

## Summary for Subcatchment 1S: PRE

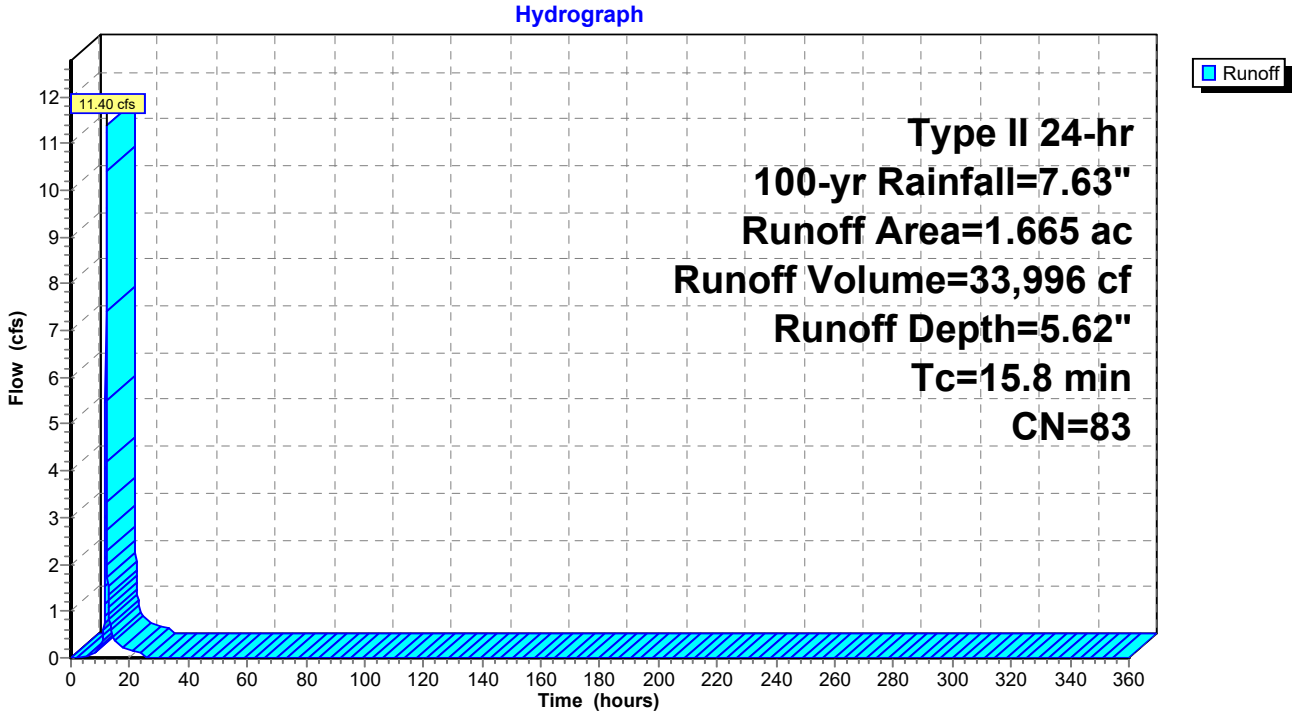
Runoff = 11.40 cfs @ 12.07 hrs, Volume= 33,996 cf, Depth= 5.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=7.63"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 0.006 | 98 | Impervious |
| * | 0.134 | 77 | Woods, Good |
| * | 0.684 | 78 | Meadow (20% and On-site Brush) |
| * | 0.674 | 91 | Gravel |
| * | 0.167 | 73 | Onsite Brush, Good |
| | 1.665 | 83 | Weighted Average |
| | 1.659 | | 99.64% Pervious Area |
| | 0.006 | | 0.36% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.8 | | | | | **Direct Entry, Tc** |

## Subcatchment 1S: PRE



## Hydrograph for Subcatchment 1S: PRE

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 |
| 5.00 | 0.48 | 0.00 | 0.01 |
| 10.00 | 1.38 | 0.31 | **0.24** |
| 15.00 | 6.51 | 4.57 | **0.38** |
| 20.00 | **7.26** | **5.28** | 0.17 |
| 25.00 | **7.63** | **5.62** | 0.00 |
| 30.00 | 7.63 | 5.62 | 0.00 |
| 35.00 | 7.63 | 5.62 | 0.00 |
| 40.00 | 7.63 | 5.62 | 0.00 |
| 45.00 | 7.63 | 5.62 | 0.00 |
| 50.00 | 7.63 | 5.62 | 0.00 |
| 55.00 | 7.63 | 5.62 | 0.00 |
| 60.00 | 7.63 | 5.62 | 0.00 |
| 65.00 | 7.63 | 5.62 | 0.00 |
| 70.00 | 7.63 | 5.62 | 0.00 |
| 75.00 | 7.63 | 5.62 | 0.00 |
| 80.00 | 7.63 | 5.62 | 0.00 |
| 85.00 | 7.63 | 5.62 | 0.00 |
| 90.00 | 7.63 | 5.62 | 0.00 |
| 95.00 | 7.63 | 5.62 | 0.00 |
| 100.00 | 7.63 | 5.62 | 0.00 |
| 105.00 | 7.63 | 5.62 | 0.00 |
| 110.00 | 7.63 | 5.62 | 0.00 |
| 115.00 | 7.63 | 5.62 | 0.00 |
| 120.00 | 7.63 | 5.62 | 0.00 |
| 125.00 | 7.63 | 5.62 | 0.00 |
| 130.00 | 7.63 | 5.62 | 0.00 |
| 135.00 | 7.63 | 5.62 | 0.00 |
| 140.00 | 7.63 | 5.62 | 0.00 |
| 145.00 | 7.63 | 5.62 | 0.00 |
| 150.00 | 7.63 | 5.62 | 0.00 |
| 155.00 | 7.63 | 5.62 | 0.00 |
| 160.00 | 7.63 | 5.62 | 0.00 |
| 165.00 | 7.63 | 5.62 | 0.00 |
| 170.00 | 7.63 | 5.62 | 0.00 |
| 175.00 | 7.63 | 5.62 | 0.00 |
| 180.00 | 7.63 | 5.62 | 0.00 |
| 185.00 | 7.63 | 5.62 | 0.00 |
| 190.00 | 7.63 | 5.62 | 0.00 |
| 195.00 | 7.63 | 5.62 | 0.00 |
| 200.00 | 7.63 | 5.62 | 0.00 |
| 205.00 | 7.63 | 5.62 | 0.00 |
| 210.00 | 7.63 | 5.62 | 0.00 |
| 215.00 | 7.63 | 5.62 | 0.00 |
| 220.00 | 7.63 | 5.62 | 0.00 |
| 225.00 | 7.63 | 5.62 | 0.00 |
| 230.00 | 7.63 | 5.62 | 0.00 |
| 235.00 | 7.63 | 5.62 | 0.00 |
| 240.00 | 7.63 | 5.62 | 0.00 |
| 245.00 | 7.63 | 5.62 | 0.00 |
| 250.00 | 7.63 | 5.62 | 0.00 |
| 255.00 | 7.63 | 5.62 | 0.00 |
| 260.00 | 7.63 | 5.62 | 0.00 |
| 265.00 | 7.63 | 5.62 | 0.00 |
| 270.00 | 7.63 | 5.62 | 0.00 |
| 275.00 | 7.63 | 5.62 | 0.00 |
| 280.00 | 7.63 | 5.62 | 0.00 |
| 285.00 | 7.63 | 5.62 | 0.00 |
| 290.00 | 7.63 | 5.62 | 0.00 |
| 295.00 | 7.63 | 5.62 | 0.00 |
| 300.00 | 7.63 | 5.62 | 0.00 |
| 305.00 | 7.63 | 5.62 | 0.00 |
| 310.00 | 7.63 | 5.62 | 0.00 |
| 315.00 | 7.63 | 5.62 | 0.00 |
| 320.00 | 7.63 | 5.62 | 0.00 |
| 325.00 | 7.63 | 5.62 | 0.00 |
| 330.00 | 7.63 | 5.62 | 0.00 |
| 335.00 | 7.63 | 5.62 | 0.00 |
| 340.00 | 7.63 | 5.62 | 0.00 |
| 345.00 | 7.63 | 5.62 | 0.00 |
| 350.00 | 7.63 | 5.62 | 0.00 |
| 355.00 | 7.63 | 5.62 | 0.00 |
| 360.00 | 7.63 | 5.62 | 0.00 |

## Summary for Subcatchment 2S: POST-MRC BMP

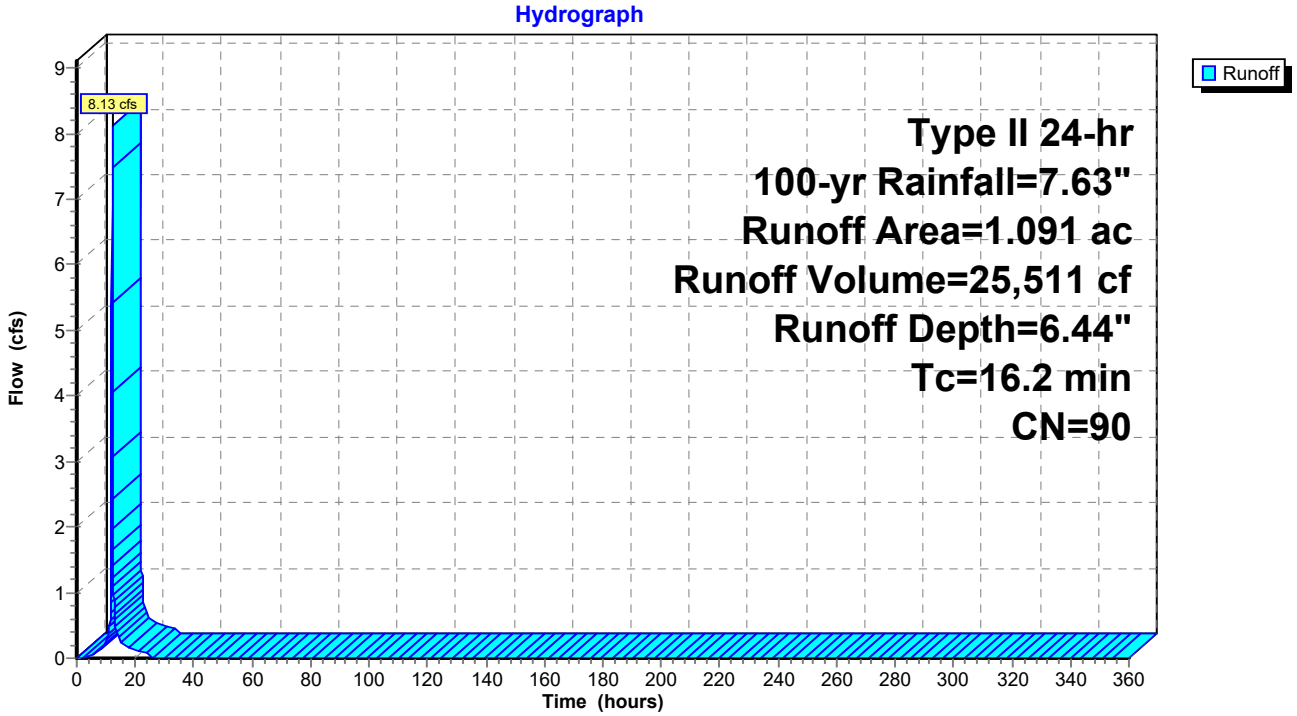
Runoff = 8.13 cfs @ 12.08 hrs, Volume= 25,511 cf, Depth= 6.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=7.63"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 0.586 | 91 | Gravel |
| * | 0.324 | 98 | Impervious |
| * | 0.181 | 73 | Brush, good |
| | 1.091 | 90 | Weighted Average |
| | 0.767 | | 70.30% Pervious Area |
| | 0.324 | | 29.70% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 16.2 | | | | | **Direct Entry, Tc** |

## Subcatchment 2S: POST-MRC BMP



## Hydrograph for Subcatchment 2S: POST-MRC BMP

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 |
| 5.00 | 0.48 | 0.05 | 0.04 |
| 10.00 | 1.38 | 0.59 | **0.23** |
| 15.00 | 6.51 | 5.35 | **0.26** |
| 20.00 | **7.26** | **6.08** | 0.11 |
| 25.00 | **7.63** | **6.44** | 0.00 |
| 30.00 | 7.63 | 6.44 | 0.00 |
| 35.00 | 7.63 | 6.44 | 0.00 |
| 40.00 | 7.63 | 6.44 | 0.00 |
| 45.00 | 7.63 | 6.44 | 0.00 |
| 50.00 | 7.63 | 6.44 | 0.00 |
| 55.00 | 7.63 | 6.44 | 0.00 |
| 60.00 | 7.63 | 6.44 | 0.00 |
| 65.00 | 7.63 | 6.44 | 0.00 |
| 70.00 | 7.63 | 6.44 | 0.00 |
| 75.00 | 7.63 | 6.44 | 0.00 |
| 80.00 | 7.63 | 6.44 | 0.00 |
| 85.00 | 7.63 | 6.44 | 0.00 |
| 90.00 | 7.63 | 6.44 | 0.00 |
| 95.00 | 7.63 | 6.44 | 0.00 |
| 100.00 | 7.63 | 6.44 | 0.00 |
| 105.00 | 7.63 | 6.44 | 0.00 |
| 110.00 | 7.63 | 6.44 | 0.00 |
| 115.00 | 7.63 | 6.44 | 0.00 |
| 120.00 | 7.63 | 6.44 | 0.00 |
| 125.00 | 7.63 | 6.44 | 0.00 |
| 130.00 | 7.63 | 6.44 | 0.00 |
| 135.00 | 7.63 | 6.44 | 0.00 |
| 140.00 | 7.63 | 6.44 | 0.00 |
| 145.00 | 7.63 | 6.44 | 0.00 |
| 150.00 | 7.63 | 6.44 | 0.00 |
| 155.00 | 7.63 | 6.44 | 0.00 |
| 160.00 | 7.63 | 6.44 | 0.00 |
| 165.00 | 7.63 | 6.44 | 0.00 |
| 170.00 | 7.63 | 6.44 | 0.00 |
| 175.00 | 7.63 | 6.44 | 0.00 |
| 180.00 | 7.63 | 6.44 | 0.00 |
| 185.00 | 7.63 | 6.44 | 0.00 |
| 190.00 | 7.63 | 6.44 | 0.00 |
| 195.00 | 7.63 | 6.44 | 0.00 |
| 200.00 | 7.63 | 6.44 | 0.00 |
| 205.00 | 7.63 | 6.44 | 0.00 |
| 210.00 | 7.63 | 6.44 | 0.00 |
| 215.00 | 7.63 | 6.44 | 0.00 |
| 220.00 | 7.63 | 6.44 | 0.00 |
| 225.00 | 7.63 | 6.44 | 0.00 |
| 230.00 | 7.63 | 6.44 | 0.00 |
| 235.00 | 7.63 | 6.44 | 0.00 |
| 240.00 | 7.63 | 6.44 | 0.00 |
| 245.00 | 7.63 | 6.44 | 0.00 |
| 250.00 | 7.63 | 6.44 | 0.00 |
| 255.00 | 7.63 | 6.44 | 0.00 |
| 260.00 | 7.63 | 6.44 | 0.00 |
| 265.00 | 7.63 | 6.44 | 0.00 |
| 270.00 | 7.63 | 6.44 | 0.00 |
| 275.00 | 7.63 | 6.44 | 0.00 |
| 280.00 | 7.63 | 6.44 | 0.00 |
| 285.00 | 7.63 | 6.44 | 0.00 |
| 290.00 | 7.63 | 6.44 | 0.00 |
| 295.00 | 7.63 | 6.44 | 0.00 |
| 300.00 | 7.63 | 6.44 | 0.00 |
| 305.00 | 7.63 | 6.44 | 0.00 |
| 310.00 | 7.63 | 6.44 | 0.00 |
| 315.00 | 7.63 | 6.44 | 0.00 |
| 320.00 | 7.63 | 6.44 | 0.00 |
| 325.00 | 7.63 | 6.44 | 0.00 |
| 330.00 | 7.63 | 6.44 | 0.00 |
| 335.00 | 7.63 | 6.44 | 0.00 |
| 340.00 | 7.63 | 6.44 | 0.00 |
| 345.00 | 7.63 | 6.44 | 0.00 |
| 350.00 | 7.63 | 6.44 | 0.00 |
| 355.00 | 7.63 | 6.44 | 0.00 |
| 360.00 | 7.63 | 6.44 | 0.00 |

## Summary for Subcatchment 5S: POST-Bypass

[49] Hint: Tc<2dt may require smaller dt

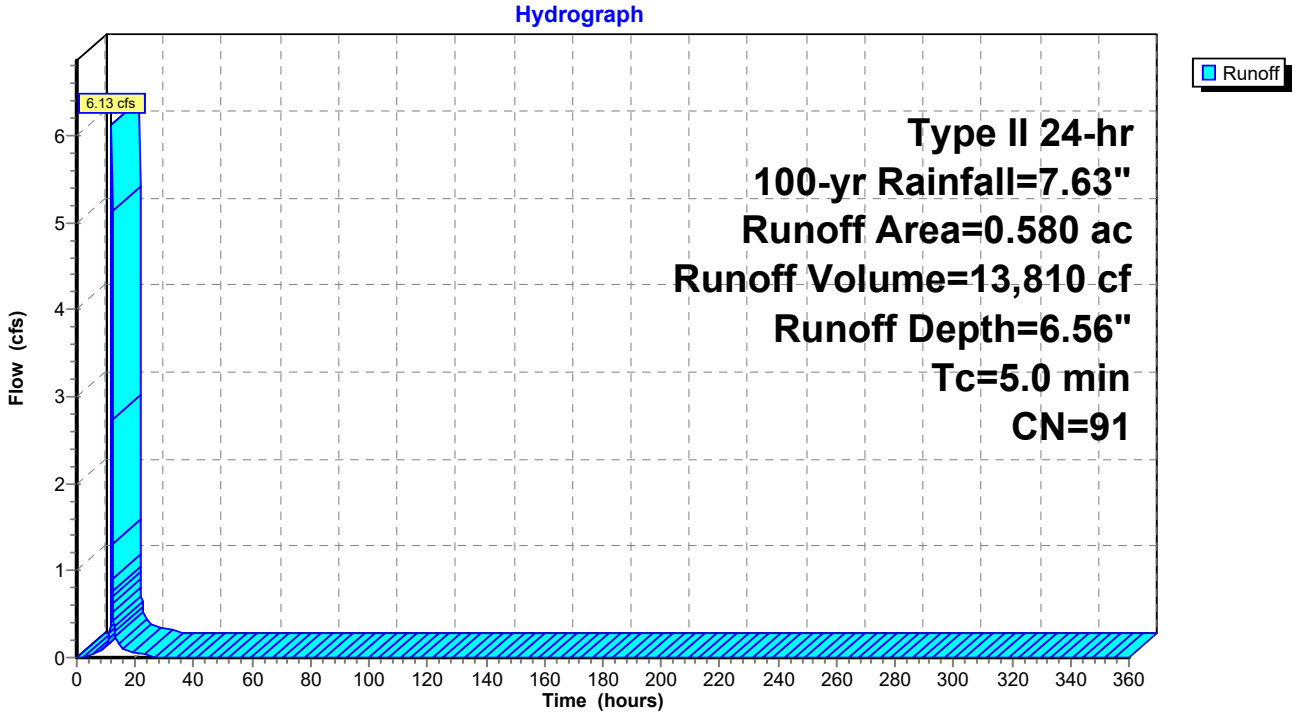
Runoff = 6.13 cfs @ 11.95 hrs, Volume= 13,810 cf, Depth= 6.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=7.63"

| | Area (ac) | CN | Description |
|---|---|---|---|
| * | 0.002 | 98 | Impervious |
| * | 0.578 | 91 | Gravel |
| | 0.580 | 91 | Weighted Average |
| | 0.578 | | 99.66% Pervious Area |
| | 0.002 | | 0.34% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry, Tc** |

### Subcatchment 5S: POST-Bypass



## Hydrograph for Subcatchment 5S: POST-Bypass

| Time (hours) | Precip. (inches) | Excess (inches) | Runoff (cfs) |
|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 |
| 5.00 | 0.48 | 0.06 | 0.03 |
| 10.00 | 1.38 | 0.64 | **0.14** |
| 15.00 | 6.51 | 5.46 | **0.13** |
| 20.00 | **7.26** | **6.20** | 0.06 |
| 25.00 | **7.63** | **6.56** | 0.00 |
| 30.00 | 7.63 | 6.56 | 0.00 |
| 35.00 | 7.63 | 6.56 | 0.00 |
| 40.00 | 7.63 | 6.56 | 0.00 |
| 45.00 | 7.63 | 6.56 | 0.00 |
| 50.00 | 7.63 | 6.56 | 0.00 |
| 55.00 | 7.63 | 6.56 | 0.00 |
| 60.00 | 7.63 | 6.56 | 0.00 |
| 65.00 | 7.63 | 6.56 | 0.00 |
| 70.00 | 7.63 | 6.56 | 0.00 |
| 75.00 | 7.63 | 6.56 | 0.00 |
| 80.00 | 7.63 | 6.56 | 0.00 |
| 85.00 | 7.63 | 6.56 | 0.00 |
| 90.00 | 7.63 | 6.56 | 0.00 |
| 95.00 | 7.63 | 6.56 | 0.00 |
| 100.00 | 7.63 | 6.56 | 0.00 |
| 105.00 | 7.63 | 6.56 | 0.00 |
| 110.00 | 7.63 | 6.56 | 0.00 |
| 115.00 | 7.63 | 6.56 | 0.00 |
| 120.00 | 7.63 | 6.56 | 0.00 |
| 125.00 | 7.63 | 6.56 | 0.00 |
| 130.00 | 7.63 | 6.56 | 0.00 |
| 135.00 | 7.63 | 6.56 | 0.00 |
| 140.00 | 7.63 | 6.56 | 0.00 |
| 145.00 | 7.63 | 6.56 | 0.00 |
| 150.00 | 7.63 | 6.56 | 0.00 |
| 155.00 | 7.63 | 6.56 | 0.00 |
| 160.00 | 7.63 | 6.56 | 0.00 |
| 165.00 | 7.63 | 6.56 | 0.00 |
| 170.00 | 7.63 | 6.56 | 0.00 |
| 175.00 | 7.63 | 6.56 | 0.00 |
| 180.00 | 7.63 | 6.56 | 0.00 |
| 185.00 | 7.63 | 6.56 | 0.00 |
| 190.00 | 7.63 | 6.56 | 0.00 |
| 195.00 | 7.63 | 6.56 | 0.00 |
| 200.00 | 7.63 | 6.56 | 0.00 |
| 205.00 | 7.63 | 6.56 | 0.00 |
| 210.00 | 7.63 | 6.56 | 0.00 |
| 215.00 | 7.63 | 6.56 | 0.00 |
| 220.00 | 7.63 | 6.56 | 0.00 |
| 225.00 | 7.63 | 6.56 | 0.00 |
| 230.00 | 7.63 | 6.56 | 0.00 |
| 235.00 | 7.63 | 6.56 | 0.00 |
| 240.00 | 7.63 | 6.56 | 0.00 |
| 245.00 | 7.63 | 6.56 | 0.00 |
| 250.00 | 7.63 | 6.56 | 0.00 |
| 255.00 | 7.63 | 6.56 | 0.00 |
| 260.00 | 7.63 | 6.56 | 0.00 |
| 265.00 | 7.63 | 6.56 | 0.00 |
| 270.00 | 7.63 | 6.56 | 0.00 |
| 275.00 | 7.63 | 6.56 | 0.00 |
| 280.00 | 7.63 | 6.56 | 0.00 |
| 285.00 | 7.63 | 6.56 | 0.00 |
| 290.00 | 7.63 | 6.56 | 0.00 |
| 295.00 | 7.63 | 6.56 | 0.00 |
| 300.00 | 7.63 | 6.56 | 0.00 |
| 305.00 | 7.63 | 6.56 | 0.00 |
| 310.00 | 7.63 | 6.56 | 0.00 |
| 315.00 | 7.63 | 6.56 | 0.00 |
| 320.00 | 7.63 | 6.56 | 0.00 |
| 325.00 | 7.63 | 6.56 | 0.00 |
| 330.00 | 7.63 | 6.56 | 0.00 |
| 335.00 | 7.63 | 6.56 | 0.00 |
| 340.00 | 7.63 | 6.56 | 0.00 |
| 345.00 | 7.63 | 6.56 | 0.00 |
| 350.00 | 7.63 | 6.56 | 0.00 |
| 355.00 | 7.63 | 6.56 | 0.00 |
| 360.00 | 7.63 | 6.56 | 0.00 |

## Summary for Pond 3P: MRC BMP

Inflow Area = 47,524 sf, 29.70% Impervious, Inflow Depth = 6.44" for 100-yr event
Inflow = 8.13 cfs @ 12.08 hrs, Volume= 25,511 cf
Outflow = 3.92 cfs @ 12.26 hrs, Volume= 18,837 cf, Atten= 52%, Lag= 11.2 min
Primary = 3.92 cfs @ 12.26 hrs, Volume= 18,837 cf

Routing by Stor-Ind method, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs
Peak Elev= 549.95' @ 12.26 hrs Surf.Area= 3,886 sf Storage= 12,195 cf

Plug-Flow detention time= 452.1 min calculated for 18,834 cf (74% of inflow)
Center-of-Mass det. time= 363.2 min ( 1,146.5 - 783.3 )

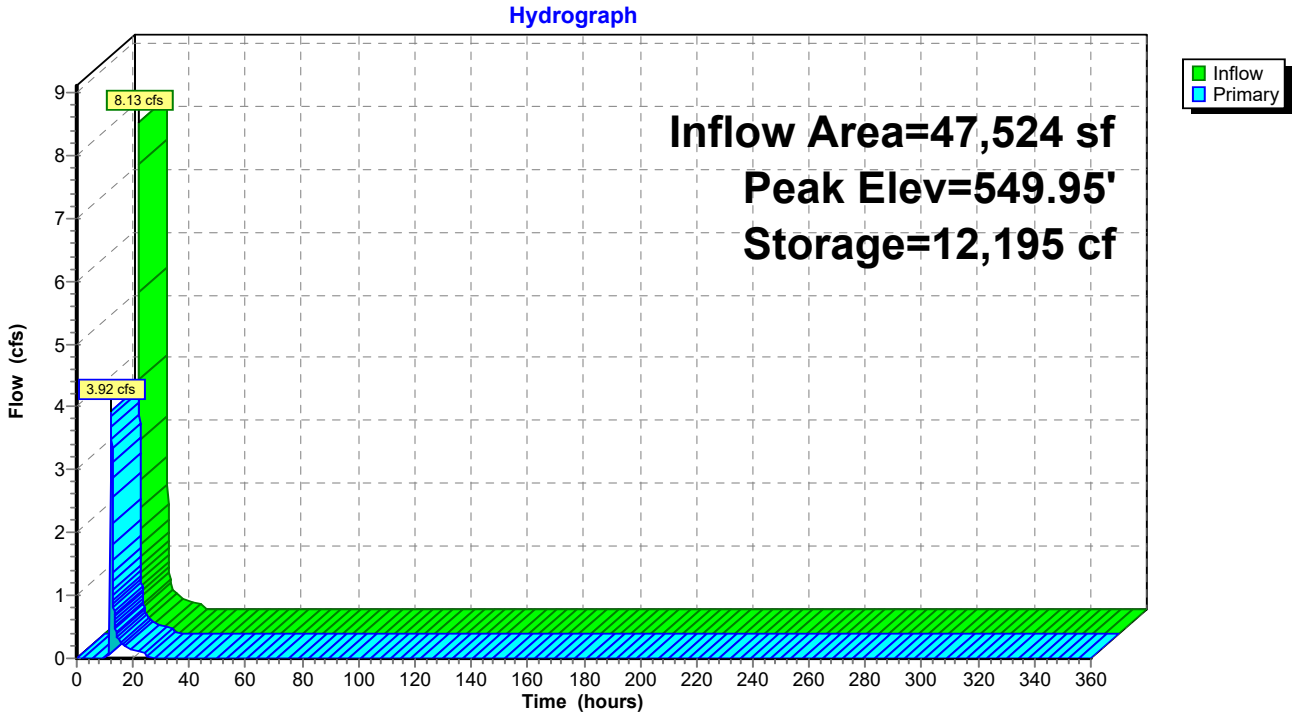
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 545.00' | 12,386 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc)<br>12,639 cf Overall x 98.0% Voids |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 545.00 | 1,943 | 0 | 0 |
| 546.00 | 1,943 | 1,943 | 1,943 |
| 547.00 | 1,943 | 1,943 | 3,886 |
| 548.00 | 1,943 | 1,943 | 5,829 |
| 548.49 | 1,943 | 952 | 6,781 |
| 548.50 | 3,886 | 29 | 6,810 |
| 549.00 | 3,886 | 1,943 | 8,753 |
| 550.00 | 3,886 | 3,886 | 12,639 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 548.50' | **12.0" Round Culvert**<br>L= 10.0' RCP, groove end projecting, Ke= 0.200<br>Inlet / Outlet Invert= 548.50' / 548.40' S= 0.0100 '/' Cc= 0.900<br>n= 0.011, Flow Area= 0.79 sf |
| #2 | Device 1 | 545.00' | **0.7" Vert. Orifice/Grate** C= 0.600 |
| #3 | Device 1 | 548.95' | **2.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

**Primary OutFlow** Max=3.90 cfs @ 12.26 hrs HW=549.94' (Free Discharge)
└─**1=Culvert** (Barrel Controls 3.90 cfs @ 4.96 fps)
  ├─**2=Orifice/Grate** (Passes < 0.02 cfs potential flow)
  └─**3=Broad-Crested Rectangular Weir** (Passes < 6.58 cfs potential flow)

## Pond 3P: MRC BMP



## Hydrograph for Pond 3P: MRC BMP

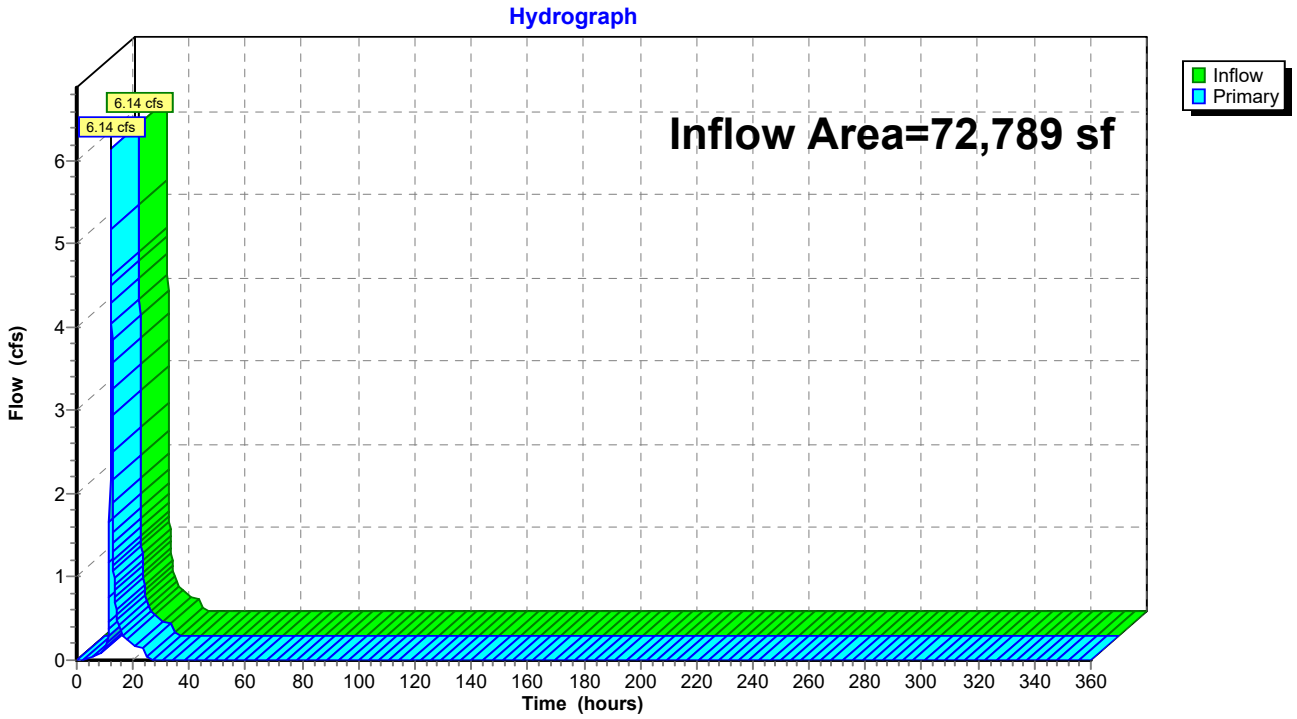
| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|---|
| 0.00 | 0.00 | 0 | 545.00 | 0.00 |
| 10.00 | **0.23** | **2,130** | **546.12** | **0.00** |
| 20.00 | **0.11** | **8,661** | **549.02** | **0.12** |
| 30.00 | 0.00 | 8,270 | 548.92 | 0.01 |
| 40.00 | 0.00 | 7,985 | 548.84 | 0.01 |
| 50.00 | 0.00 | 7,727 | 548.78 | 0.01 |
| 60.00 | 0.00 | 7,498 | 548.72 | 0.01 |
| 70.00 | 0.00 | 7,297 | 548.66 | 0.01 |
| 80.00 | 0.00 | 7,124 | 548.62 | 0.00 |
| 90.00 | 0.00 | 6,980 | 548.58 | 0.00 |
| 100.00 | 0.00 | 6,864 | 548.55 | 0.00 |
| 110.00 | 0.00 | 6,784 | 548.53 | 0.00 |
| 120.00 | 0.00 | 6,738 | 548.52 | 0.00 |
| 130.00 | 0.00 | 6,711 | 548.51 | 0.00 |
| 140.00 | 0.00 | 6,696 | 548.51 | 0.00 |
| 150.00 | 0.00 | 6,686 | 548.50 | 0.00 |
| 160.00 | 0.00 | 6,681 | 548.50 | 0.00 |
| 170.00 | 0.00 | 6,678 | 548.50 | 0.00 |
| 180.00 | 0.00 | 6,676 | 548.50 | 0.00 |
| 190.00 | 0.00 | 6,675 | 548.50 | 0.00 |
| 200.00 | 0.00 | 6,675 | 548.50 | 0.00 |
| 210.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 220.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 230.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 240.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 250.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 260.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 270.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 280.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 290.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 300.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 310.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 320.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 330.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 340.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 350.00 | 0.00 | 6,674 | 548.50 | 0.00 |
| 360.00 | 0.00 | 6,674 | 548.50 | 0.00 |

## Summary for Link 4L: POST

Inflow Area = 72,789 sf, 19.51% Impervious, Inflow Depth = 5.38" for 100-yr event
Inflow = 6.14 cfs @ 11.95 hrs, Volume= 32,647 cf
Primary = 6.14 cfs @ 11.95 hrs, Volume= 32,647 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-360.00 hrs, dt= 0.05 hrs

### Link 4L: POST



## Hydrograph for Link 4L: POST

| Time (hours) | Inflow (cfs) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|
| 0.00 | 0.00 | **0.00** | 0.00 |
| 5.00 | 0.03 | 0.00 | 0.03 |
| 10.00 | **0.14** | 0.00 | **0.14** |
| 15.00 | **0.42** | 0.00 | **0.42** |
| 20.00 | 0.18 | 0.00 | 0.18 |
| 25.00 | 0.03 | 0.00 | 0.03 |
| 30.00 | 0.01 | 0.00 | 0.01 |
| 35.00 | 0.01 | 0.00 | 0.01 |
| 40.00 | 0.01 | 0.00 | 0.01 |
| 45.00 | 0.01 | 0.00 | 0.01 |
| 50.00 | 0.01 | 0.00 | 0.01 |
| 55.00 | 0.01 | 0.00 | 0.01 |
| 60.00 | 0.01 | 0.00 | 0.01 |
| 65.00 | 0.01 | 0.00 | 0.01 |
| 70.00 | 0.01 | 0.00 | 0.01 |
| 75.00 | 0.00 | 0.00 | 0.00 |
| 80.00 | 0.00 | 0.00 | 0.00 |
| 85.00 | 0.00 | 0.00 | 0.00 |
| 90.00 | 0.00 | 0.00 | 0.00 |
| 95.00 | 0.00 | 0.00 | 0.00 |
| 100.00 | 0.00 | 0.00 | 0.00 |
| 105.00 | 0.00 | 0.00 | 0.00 |
| 110.00 | 0.00 | 0.00 | 0.00 |
| 115.00 | 0.00 | 0.00 | 0.00 |
| 120.00 | 0.00 | 0.00 | 0.00 |
| 125.00 | 0.00 | 0.00 | 0.00 |
| 130.00 | 0.00 | 0.00 | 0.00 |
| 135.00 | 0.00 | 0.00 | 0.00 |
| 140.00 | 0.00 | 0.00 | 0.00 |
| 145.00 | 0.00 | 0.00 | 0.00 |
| 150.00 | 0.00 | 0.00 | 0.00 |
| 155.00 | 0.00 | 0.00 | 0.00 |
| 160.00 | 0.00 | 0.00 | 0.00 |
| 165.00 | 0.00 | 0.00 | 0.00 |
| 170.00 | 0.00 | 0.00 | 0.00 |
| 175.00 | 0.00 | 0.00 | 0.00 |
| 180.00 | 0.00 | 0.00 | 0.00 |
| 185.00 | 0.00 | 0.00 | 0.00 |
| 190.00 | 0.00 | 0.00 | 0.00 |
| 195.00 | 0.00 | 0.00 | 0.00 |
| 200.00 | 0.00 | 0.00 | 0.00 |
| 205.00 | 0.00 | 0.00 | 0.00 |
| 210.00 | 0.00 | 0.00 | 0.00 |
| 215.00 | 0.00 | 0.00 | 0.00 |
| 220.00 | 0.00 | 0.00 | 0.00 |
| 225.00 | 0.00 | 0.00 | 0.00 |
| 230.00 | 0.00 | 0.00 | 0.00 |
| 235.00 | 0.00 | 0.00 | 0.00 |
| 240.00 | 0.00 | 0.00 | 0.00 |
| 245.00 | 0.00 | 0.00 | 0.00 |
| 250.00 | 0.00 | 0.00 | 0.00 |
| 255.00 | 0.00 | 0.00 | 0.00 |
| 260.00 | 0.00 | 0.00 | 0.00 |
| 265.00 | 0.00 | 0.00 | 0.00 |
| 270.00 | 0.00 | 0.00 | 0.00 |
| 275.00 | 0.00 | 0.00 | 0.00 |
| 280.00 | 0.00 | 0.00 | 0.00 |
| 285.00 | 0.00 | 0.00 | 0.00 |
| 290.00 | 0.00 | 0.00 | 0.00 |
| 295.00 | 0.00 | 0.00 | 0.00 |
| 300.00 | 0.00 | 0.00 | 0.00 |
| 305.00 | 0.00 | 0.00 | 0.00 |
| 310.00 | 0.00 | 0.00 | 0.00 |
| 315.00 | 0.00 | 0.00 | 0.00 |
| 320.00 | 0.00 | 0.00 | 0.00 |
| 325.00 | 0.00 | 0.00 | 0.00 |
| 330.00 | 0.00 | 0.00 | 0.00 |
| 335.00 | 0.00 | 0.00 | 0.00 |
| 340.00 | 0.00 | 0.00 | 0.00 |
| 345.00 | 0.00 | 0.00 | 0.00 |
| 350.00 | 0.00 | 0.00 | 0.00 |
| 355.00 | 0.00 | 0.00 | 0.00 |
| 360.00 | 0.00 | 0.00 | 0.00 |

1. Runoff Capture – The runoff from the 1.2-inch/2-hour storm from the contributing watershed that the MRC is intended to treat should be captured and managed by the MRC BMP, filtered through vegetated media or treated and filtered to the extent practicable through the on-site undisturbed soils or other acceptable treatment systems, and released as indicated in MRC Standard 2. The MRC may be designed for offsetting when contributing non-regulated earth disturbance is present in the contributing drainage area, but the total volume managed may not exceed the volume of runoff generated in the 2-year/24-hour storm. Uncompacted pervious surfaces outside the disturbed area should be bypassed to the maximum extent practical.

   NOTE – Runoff from existing similar impervious and compacted pervious areas can be used to offset undetained areas. The runoff volume for the 1.2 inch/2-hour storm from the two areas must be equivalent (See Figure 4). In addition, the pollutant contribution as determined through land use of the two areas should be similar.

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

The MRC basin is designed to capture and manage the runoff from the 1.2-inch/2-hour storm from the contributing watershed. The total 1.2-inch/2-hour storm runoff volume permanently removed is defined by runoff removed by the underdrain and evapotranspiration. A total of 0 CF is being removed by the underdrain and 0 CF via evapotranspiration since the MRC basin is non-vegetated. The HydroCAD model indicates that 0 CF was released through the primary outlet control for Pond 3P.

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

App. D.2, Supporting Calculations – HydroCAD Output, Page 25

Parameters for ET calculations – Refer to MRC calculations, App. D.2, Supporting Calculations

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2. Release Rate for the 1.2-inch/2-hour storm – The stormwater release rate from the MRC BMP for the 1.2inch/2-hour storm should not exceed 0.01 cubic feet per second (cfs) from the equivalent impervious area. To obtain the equivalent impervious area being managed by a MRC BMP, determine the total volume of runoff generated during the 1.2-inch/2-hour event from all pervious and impervious areas contributing to the MRC and divide by 0.0833 feet. This release rate is rounded to the nearest hundredth of a cfs (e.g., 1.576 ac. is 0.01576 cfs, rounded to 0.02 cfs). Routing is necessary to demonstrate compliance with the standard for release rate.

   NOTE – This release rate (0.01 cfs / equivalent impervious acre) is approximately the expected rate of interflow (lateral movement of stormwater to a stream) after a 2-year/24-hour storm event for a Pennsylvania non-karst watershed based on the NRCS curvilinear unit hydrograph.

Releasing at this rate will produce a condition where baseflow contributions will be similar to that of an undeveloped area during and after storm events. As the level of outflow would be similar to what would be expected during and after the storm, it would not be expected to impact the storm event's effects on flooding and erosion. This rate should also be used for karst watersheds unless it can be demonstrated that interflow on a particular project site differs from this standard (such a demonstration would be considered an alternative to the MRC Design Standard).

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

The allowable release rate is determined by 0.01 x equivalent impervious area. The equivalent impervious area was determined using HydroCAD and using the Runoff for the inflow to the MRC. Refer to Pond 3P, where the inflow volume is 1,813 CF. This results in an allowable release rate of 0.01 cfs. The criteria is met by reviewing the outflow at Pond 3P for the 2-in/24 hour storm, which is 0.01 cfs.

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

App. D.2, Supporting Calculations – HydroCAD Output, Page 25 and 37

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3. Internal Water Storage (IWS) – A volume for IWS should be provided that is at least one foot deep below the lowest structural outlet (i.e. the outlet for the underdrain) in the MRC BMP to encourage ET, infiltration and denitrification. To encourage ET, the overall soil media depth of a facility including the IWS can be no deeper than four (4) feet, and up to 50% of the IWS void volume can be included (only for vegetated MRC BMPs) as available storage during hydrologic routings to demonstrate compliance with the standards for the release rate (No. 2 above) and peak flow attenuation (No. 4 below). For soil media, a void space of 30% can be used to describe the soil volume storage and recovery. If an alternate void space is used for soil media, specific data demonstrating the void space should be submitted. For non-vegetated MRC designs, the IWS must be above the underdrain, but below the outlet, to promote a change of the stormwater stored during rain events.

Use of Liners – The MRC BMP should not have an impervious liner installed unless environmental or geological conditions necessitate use of a liner, or if an existing structure would be damaged as a result of not lining the facility.

NOTE – The presence of a project site in an area of known karst conditions does not, in itself, serve as evidence of the applicability of MRC to a project site or to the use of a liner to avoid infiltration. DEP and delegated CDs reserve the right to request a detailed subsurface

investigation where considered warranted to evaluate the likelihood of sinkhole formation as a result of post-construction stormwater management.

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

The UG stormtank bottom elevation, bottom IWS elevation, is 545.00 ft. The overall stormtank depth is 5 ft. The IWS is 3.5 ft since the upturned elbow invert is 548.50. A liner is proposed due to high groundwater.

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

Design Plan PCSM-13 to PCSM-15 & MRC calculations, App. D.2, Supporting Calculations

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4. Peak Flow Attenuation for the 2-year/24-hour Event – The peak flow from the post-construction 2-year/24hour storm should be managed back to the pre-construction 1-year/24-hour storm peak flow, unless an approved and current Act 167 Plan or another requirement (such as limited capacity of a downstream channel) is more restrictive. In general, this rate is determined at the project point of interest. In the event the MRC drainage area is part of a larger overall site with non-MRC BMPs, only the MRC drainage peak flows must be managed back to the 1-year/24-hour level and overflows can be combined with flows from the non-MRC BMPs.

   In situations where the pre-construction drainage area to the MRC BMP varies significantly compared to the post-construction drainage area, the post-construction drainage area boundary to the MRC BMP (using existing land uses) can be used to calculate the target pre-construction 1-year/24-hour rate, as long as all areas in question are in close proximity to the MRC BMP and drain to the same surface water. In cases where the BMP is managing additional volume to offset adjacent areas that could not be captured in the MRC BMP, the targeted pre-construction 1-year/24-hour release rate should be calculated based on the combined flow rates from the BMP drainage area and adjacent area.

   NOTE – This standard is used to ensure that MRC does not contribute to channel-eroding flows in receiving surface waters.

   Flows Greater Than 2-Year/24-Hour Storm – The recommended design for MRC BMPs is to bypass storm events larger than the 2-year/24-hour storm to a rate control BMP; however, DEP understands that site and cost limitations may not allow for this bypass. When it is

demonstrated by the licensed professional engineer that larger storm events cannot reasonably be bypassed, the MRC BMP surface component should be designed to manage the post-construction 10-, 50- and 100-year/24-hour storm event peak flows to their corresponding pre-construction rates and the MRC BMP should have an increased (i.e., more frequent) inspection and maintenance schedule that includes inspection and repair after extreme events (10-, 50- and 100-year/24-hour storm events).

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

Using HydroCAD, the 1-Yr/24-Hr Pre-Development Peak Rate (cfs) at Subcatchment 1S is 2.51 CFS. The 2-Yr/24-HR Post-Development Peak Rate (cfs) at Link 4L is 2.22 CFS.

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

App. D.2, Supporting Calculations – HydroCAD Output, Page 6 and 30

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5. Stormwater BMP Manual – Follow the design considerations for BMPs as presented in the Pennsylvania Stormwater Best Management Practices Manual (Stormwater BMP Manual) (363-0300-002), as revised. MRC may be incorporated into the design of any BMP by a licensed professional engineer.

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

The design followed the criteria set forth under 6.4.3 in the PA Stormwater BMP Manual.

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

Design Plan PCSM-13 to PCSM-15

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6. MRC BMP Selection – Standard MRC BMPs include the following system types:

   a. Vegetated MRC – Vegetation must be provided for 75% of the surface of the MRC BMP. Native vegetation should be selected by the licensed professional engineer in consultation with a professional that is knowledgeable in native plant ecology. Vegetation should be selected based on the plants' ability to grow within the anticipated conditions considering the depth and duration of stormwater stored in the MRC BMP.

b. Non-vegetated MRC: Porous Pavement – Porous pavements with a storage bed require a vacuum street sweeping maintenance regime adequate for the drainage area characteristics; the vacuum street sweeping equipment must provide adequate suction capacity to remove particles on the pavement's surface to provide a sufficient water quality demonstration and to maintain flow pathways.

c. Non-vegetated MRC: Underground Storage Chambers – The use of the MRC BMP with non-vegetated, non-porous pavement stormwater practices must have pre-treatment, post-treatment, or a combination of both pre- and post-treatment measures incorporated into the design, to provide sufficient water quality. Underground storage chambers must be accessible for maintenance, and for this reason underground storage is not recommended to be rock beds. Pre- and post-treatment can be achieved through a treatment train concept that includes other BMPs listed in the Stormwater BMP Manual (as revised) so that the combination of BMPs provide 85% removal of TSS and associated Phosphorus. The MRC is considered a primary BMP for nitrate removal through the use of the IWS. Preferred pre- and post-treatment BMPs include: level spreader with vegetated filter strip, vegetated swale, other vegetated systems, and manufactured treatment devices. An applicant must demonstrate that the treatment train will meet water requirements by using Worksheets 11 – 13 or by providing an alternative water quality demonstration that is acceptable to DEP.

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

The MRC proposed is non-vegetated with underground storage chambers. Two (2) jellyfish membrane filtration devices are being utilized as pre-treatment. Jellyfish device removes floatables, trash, oil, debris, TSS, fine silt-sized particles, and a high percentage of particulate-bound pollutants, including phosphorus, nitrogen, metals and hydrocarbons. Worksheets 12 & 13 were completed to indicate that water quality criteria is met.

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

WQ BMP Calculations, App D.1

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7. Pre-Development Site Characterization and Assessment of Soil and Geology – Adequate and appropriate soils and geologic testing and evaluation must be performed to demonstrate the infiltration capacity of the entire project site to the satisfaction of DEP. At a minimum, one infiltration test for every 40,000 square feet of disturbed acreage should be performed with a minimum of four tests, equally distributed across a site. The infiltration tests must be done in the most accommodating soil horizon for infiltration as demonstrated by a deep hole test within

100 feet of the infiltration test. All other sections of Appendix C Protocol 1, Site Evaluation and Soil Infiltration Testing and Appendix C Protocol 2, Infiltration Systems Guidelines per the Stormwater BMP Manual (as revised) should be followed to clearly demonstrate the infiltration capability of on-site undisturbed soils at applicable elevations and for a variety of locations. Soil probes and infiltration test locations should be identified on the PCSM Plan drawing(s). The use of soil borings as a substitute for test pits can be used as a planning tool but will not generally be accepted for final design of infiltration MRC BMPs.

NOTE – The above recommended number of infiltration tests per disturbed area is to be based upon the disturbed area that is not considered a restoration activity or road maintenance activity. For example, a large sewer main installation project disturbs 30 acres in total, with 29 acres of disturbance for the sewer line installation (that will be covered by a restoration plan) and 1 acre of disturbance for a pumping station that requires a PCSM plan. The recommended number of infiltration tests would be based on the 1 acre, not 30 acres.

NOTE – The minimum number of tests can be reduced, if it can be demonstrated that the subsurface conditions are uniform; however, this is considered a deviation from MRC Design Standards, requiring an individual permit.

NOTE – Infiltration tests resulting in saturated hydraulic conductivities (as identified in the field) of less than or equal to 0.2 inches per hour classify as extremely limited. This is a saturated hydraulic conductivity representative of the lower part of the range of HSG C soils and HSG D soils.

NOTE – Results from the infiltration testing can be used to describe infiltration losses for unlined MRC BMPs as per Appendix C of the Stormwater BMP Manual (as revised).

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

Soil infiltration testing at Quakertown Compressor Station was performed on May 7, 2019 using the Double Ring Infiltration Test method. Two (2) test infiltration tests were performed at the basin bottom elevation. The infiltration testing resulted in infiltration rates of 0.12 and 0.08 in/hr, respectively. Both infiltration test pits demonstrated silty clay loam at the testing depth. Based on the findings of a shallow limiting zone, decomposing rock, clay soils and poor infiltration rates, infiltration was not recommended at this site.

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

PCSM Narrative, Page 10 and App F

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8. Separation Distance – At least one foot of separation distance should be maintained between groundwater or the seasonally high-water table and the bottom footprint of the MRC BMP's soil media; however, a two-foot separation is preferred. There is no minimum separation required between bedrock or hardpan and the MRC BMP's soil media.

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

On the day of the infiltration testing, the test pit was first extended to 4 feet deep. After about two hours there was some seepage and the bottom of the test pit showed signs of groundwater. The decomposed rock stratum was encountered in the test pit at about 3 feet deep. The groundwater table on May 7 appears to have been between 3 to 4 feet deep at the location of the test pit (elevations 548.5 to 547.5 feet). It should be noted that the test was conducted in springtime in which there has been a normal amount of rainfall including some light rain on the day before and no rain on the day of the testing. As a result, the design for the MRC Basin at Quakertown Compressor station is proposed to include an impervious liner.

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

PCSM Narrative, Page 10 and App F

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9. Ponding Depth and Drawdown time – The maximum ponding time (i.e., the time after end of storm event for stored surface water to lower to soil surface) should not exceed 72 hours for any storm event. In general, a maximum ponding depth (i.e., storage depth above BMP surface) of one to two feet at the peak of the 2-year/24hour storm event should not be exceeded for the design of surface BMPs. In accordance with MRC Design Standard 4, the MRC might incorporate a multi-stage detention facility with the upper portions of the facility providing flow attenuation for storm events greater than a 2-year/24-hour storm, to meet 25 Pa. Code § 102.8(g)(3). An engineered overflow structure or reinforced spillway / berm should be installed to provide safe conveyance for storm events greater than a 2-year/24-hour storm. Ponding depth for storms larger than the 2year/24-hour storm should not exceed four feet, and drawdown to the MRC BMP surface should not exceed 72 hours for all design storms. For underground storage chambers and porous pavement MRC systems, drawdown to the IWS storage level should not exceed 7 days.

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

For the underground storage system, the maximum drawdown time to the IWS storage level (548.50) is 150 hours, which is less than 7 days.

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

HydroCAD Output, Refer to Hydrograph Tables (Page 39, 51, 63 & 75)

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10. Soil Media – The selection of soil media should be done by considering anticipated pollutants to be treated and the vegetation that will be used. On-site soils should be evaluated for desired characteristics and infiltration capabilities as listed below. The depth of the soil media above the invert elevation of the underdrain pipe should be a minimum of 2 feet (24 inches) to provide pollutant removal. If on-site undisturbed soils are unsuitable for the purpose of providing IWS, an additional one to two feet of suitable soil media should be provided below the underdrain.

    Soil Media Drainage – The designer will need to exercise caution when selecting a soil media, as there is a delicate balance between infiltration rate and residence time. As noted in Appendix C, Protocol 2 of the Stormwater BMP Manual (as revised), the design soil infiltration rate should be between 0.1 inch per hour and 10 inches per hour for native soils. To maximize water quality treatment, the residence time within the soil media used in MRC BMPs should be selected to be close to the parameters established for infiltration into native soils. The designer will need to select a soil media that provide the proper infiltration rate and ponding time to achieve water quality for the anticipated life cycle of the BMP.

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

N/A

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

N/A

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11. Underdrain Design – The licensed professional engineer can refer to PennDOT Publication 408 Section 610 for specifications of underdrains. However, underdrains should have a minimum flow rate of 10 gallons (1.34 cubic feet) per minute per linear foot of pipe not considering the flow control orifice or upturned elbow. For non-vegetated MRC BMPs, the underdrain should be located at the bottom of the IWS to promote movement of water from previous storms. There may need to be multiple underdrains, or longer underdrains, to provide adequate design

capacity for drainage. Section 6.4.7 (Constructed Filter) of the Stormwater BMP Manual (as revised) has recommended design standards for lateral spacing of multiple underdrains.

IWS Outflow with Capped / Orifice Underdrain – It is highly recommended that an upturned elbow or an elevated weir be designed at the outlet of the underdrain (see Figure 1). The upturned elbow or elevated weir will create a zone within the soil media, referred to as the IWS. Research has shown that IWS can reduce runoff volume and improve water quality treatment. The upturned elbow or elevated weir can also help if site conditions present daylighting issues for the underdrain's discharge elevation. Underdrains should be capped within an outlet structure when used to allow access for maintenance. The cap should be drilled to provide an appropriately sized orifice. Figure 5 below provides an example of an underdrain detail. Note that all cleanouts and angles within the underdrain should not exceed 45 degrees. For lined, nonvegetated MRCs the underdrain leading to the upturned elbow should be located at the bottom of the IWS.

Underdrain Aggregate Envelope – A 6-inch stone envelope of AASHTO #57 should be placed around the underdrain. A geotextile (or pea gravel diaphragm) is needed around the aggregate envelope. Note that the stone should not be placed throughout the bottom of the BMP, but just in the envelope of the underdrain.

Cleanout for Underdrain – The underdrain(s) should be equipped with a clean-out for maintenance. The design of any clean-out should ensure that surface water does not enter the underdrain system through the top of the cleanout. Consideration must be given for cleaning and inspecting underdrains and access to the upturned elbow or elevated weir.

Orifices – An appropriately sized orifice is necessary on the outlet of the underdrain to control flow to the required release rate (see Figure 6). The orifice should be clean, smooth and sanded so that no burs or irregularities are present. The orifice should be on a plate or cap of sufficient thickness, and the edges of the orifice should be ground so that flow through the orifice is smooth. Orifices should be vertical. The orifice plate and other connections should be water-tight and accessible for maintenance. Control valves cannot be substituted for an orifice.

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

An upturned elbow is proposed (548.50 FT outlet pipe invert). A .75" orifice is proposed prior to the bend in the upturned elbow to slowly release to the required release rate.

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

Refer to MRC Calculations, App. D.2, Supporting Calculations and Design Plan PCSM-13 to PCSM-15

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12. Discharge Flow Path – The MRC BMP should be directed to a suitably vegetated flow path, which can safely convey the releases without erosion or loss of stability. The discharge should be dispersed through the use of a level spreader. A licensed professional engineer can provide an analysis, with calculations, which identifies that a level spreader is not necessary, or that discharge to a channel will not cause increased erosion

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

The discharge of the MRC Basin drains to an existing channel and an appropriately sized rip-rap apron for energy dissipation is proposed at the downstream pipe outlet.

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

Riprap calculations, App. D.2, Supporting Calculations

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13. Antidegradation Requirements – Where the stormwater from the project site discharges to a special protection surface water, an MRC BMP can be used to satisfy the Antidegradation Best Available Combination of Technologies (ABACT) regulatory requirements from Chapters 93 and 102 (assuming that non-discharge alternatives do not exist).

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

The project site ultimately drains to Tohickon Creek, which is not a siltation impaired surface water. At Quakertown Compressor Station within the Tohickon Creek watershed, non-discharge BMPs of limiting the disturbed areas, limiting extent and duration of disturbance and partially restoring the sites will aid in the protection of Tohickon Creek. The MRC BMP will eliminate the net change in rate, volume and water quality after construction.

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

PCSM Narrative, Page 20

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**SEAL AND CERTIFICATION BY LICENSED PROFESSIONAL**

I, Allison Hill , do hereby certify pursuant to the penalties of 18 Pa.C.S.A. 4904 to the best of my knowledge, information and belief, that the accompanying report and drawings are in conformance with Chapter 102 of the rules and regulations of the Department of Environmental Protection.

Allison Hill

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF CLEAN WATER

# MANAGED RELEASE CONCEPT (MRC) DESIGN SUMMARY

***Complete One Design Summary Sheet for Each BMP Designed for MRC***

## GENERAL INFORMATION

| | | | |
|---|---|---|---|
| Applicant Name: | **Allison Hill, PE, JMT** | Project Name: | **Adelphia - Quakertown Compressor Station** |
| Applicant Address: | **1600 Market St, Suite 520** | Municipality: | **Richland & West Rockill Twp** |
| City, State, Zip: | Philadelphia, PA 19103 | County: | **Bucks County** |

Permit Type: ☐ NPDES PAG-02 ☐ NPDES IP ☒ ESCGP ☐ ESP

| | Pre-Development | Post-Development | Change |
|---|---|---|---|
| Impervious Area (acres): | 0.006 | 0.32 | 0.314 |

## MRC BMP INFORMATION

MRC BMP Type: **Non-Vegetated: Underground** Stormwater BMP Manual Section: **6.4.3**

Will the BMP Include Vegetation? ☐ Yes ☒ No

*If Yes, Identify Proposed Vegetation:* _____

For Non-Vegetated BMPs Will There Be Pre- or Post-Treatment? ☒ Yes (Pre-) ☐ Yes (Post-) ☐ No

*If Yes, Identify Proposed Pre- or Post-Treatment:* **Jellyfish membrane filtration system manholes (2)**

Name of Surface Water to Receive MRC BMP Discharges: **Tohickon Creek**

Designated Use of Surface Water: **TSF** Existing Use of Surface Water (if different): _____

Is the Surface Water Impaired? ☒ Yes ☐ No

*If Yes, Identify Cause(s):* **Siltation Impaired**

Will the BMP Have a Liner? ☒ Yes ☐ No

*If Yes, Identify the Type or Liner Material:* **30 mil impervious liner**

BMP Media Description: _____

Are Any Deviations from MRC Design Standards Proposed? ☐ Yes ☒ No

*If Yes, Identify Deviations:* _____

## MRC BMP DESIGN VALUES AND STANDARDS

| Parameter | Design Value | Design Standard |
|---|---|---|
| Actual Contributing Impervious Area to BMP (acres) | **0.32** | |
| Equivalent Contributing Impervious Area to BMP (acres) | **0.50** | |
| MRC BMP Release Rate (cfs) | **0.01** | *No greater than 0.01 cfs / acre of equivalent contributing impervious* |
| BMP Footprint Area ($ft^2$) | **3,875** | |
| Total Drainage Area to BMP (acres) | **1.01** | |
| Bottom BMP Elevation (ft) | **545.00** | |

**MRC BMP Design Summary**

| Parameter | Design Value | Design Standard |
|---|---|---|
| 2-Yr/24-Hr Storm Ponding Depth (ft) | **-** | *1 ft (recommended) (2 ft max)* |
| Max. Ponding Depth (ft) | **-** | *4 ft (max)* |
| Overflow Bypass Elevation (ft) | **548.95** | |
| Media Depth (ft) | **-** | *2 ft (min) – 4 ft (max)* |
| Media Void Space (%) | **-** | |
| Internal Water Storage (IWS) Depth (ft) | **3.50** | |
| Top of IWS Elevation (ft) | **548.50** | |
| Underdrain Pipe Diameter (in) | **-** | |
| Underdrain Orifice Diameter (in) | **-** | |
| Underdrain Outlet Elevation (ft) | **-** | |
| IWS Used for Routing (%) | **50** | *50% max* |
| Separation Distance (Groundwater) (ft) | **N/A** | *1 ft (min) (2 ft recommended)* |
| Infiltration Rate (in/hr) | **N/A** | |
| 1-Yr/24-Hr **Pre**-Development Peak Rate (cfs) | **2.65** | |
| 2-Yr/24-Hr **Post**-Development Peak Rate (cfs) | **2.22** | *1-Yr/24-Hr Pre-Development Peak Rate (or per approved Act 167 Plan)* |
| 10-Yr/24-Hr **Post**-Development Peak Rate (cfs) | **3.47** | *10-Yr/24-Hr Pre-Development Peak Rate* |
| 50-Yr/24-Hr **Post**-Development Peak Rate (cfs) | **5.18** | *50-Yr/24-Hr Pre-Development Peak Rate* |
| 100-Yr/24-Hr **Post**-Development Peak Rate (cfs) | **6.14** | *100-Yr/24-Hr Pre-Development Peak Rate* |
| a. Total 2-Yr/24-Hr Runoff Volume Managed by BMP (cf) | **6,674** | |
| b. Total 1.2-inch/2-Hr Runoff Vol. Permanently Removed (cf) | **0** | |
| c. 2-Yr/24-Hr Volume Managed (cf) | **6,674** | *Difference of a. and b.* |
| Ponding Time @ 2-Yr/24-Hr Storm (hrs) | **-** | *72 hrs max* |
| Ponding Time @ 10-Yr/24-Hr Storm (hrs) | **-** | *72 hrs max* |
| Ponding Time @ 50-Yr/24-Hr Storm (hrs) | **-** | *72 hrs max* |
| Ponding Time @ 100-Yr/24-Hr Storm (hrs) | **-** | *72 hrs max* |

Allison Hill

**Licensed P.E. Name**

Allison Hill

**Licensed P.E. Signature**

PE082423

**License No.**

3/23/2020

**Date**

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SPEC YOUR SYSTEM: SAVE

MODULE 1

## INPUTS

### PROJECTS & INPUTS INFORMATION

PROJECT NAME
Adelphia

ENGINEER
ATH

CITY
QUAKERTOWN

STATE / COUNTRY
Pennsylvania, United States

UNITS
US

LINER
Yes

LINER LOCATION
Module

STACKING
Double

HEIGHTS
60

STONE STORAGE

All

STONE POROSITY

40

# DIMENSIONS

## MODULE

FOOTPRINT

3870 sf

PERIMETER

417 ft

## EXCAVATION

FOOTPRINT

4307 sf

PERIMETER

425 ft

## STONE

LEVELING BED

1 ft

TOP BACKFILL

1 ft

COMPACTED FILL

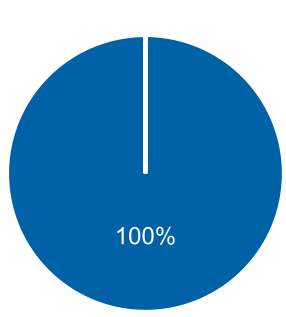
1 ft

# RESULTS

STORMTANK
Expect Results

## RESULTS: CAPACITY

| | | |
|---|---|---|
| STONE STORAGE VOLUME | 0 | cf |
| MODULE STORAGE VOLUME | 18,706.72 | cf |
| TOTAL STORAGE VOLUME | 18,706.72 | cf |




*(Estimations include 10% for scrap and overlap)*

## RESULTS: QUANTITIES

| | | |
|---|---|---|
| REQUIRED EXCAVATION | 1,276.15 | cy |
| REQUIRED STONE | 399.96 | cy |
| ESTIMATED GEOTEXTILE | | |
| SURROUNDING MODULE | 2,425.93 | sy |
| SURROUNDING EXCAVATING | 1,430.74 | sy |
| ESTIMATED LINER | 10916.67 | sf |

*(Estimations include 10% for scrap and overlap)*

## RESULTS: BASIN DETAIL

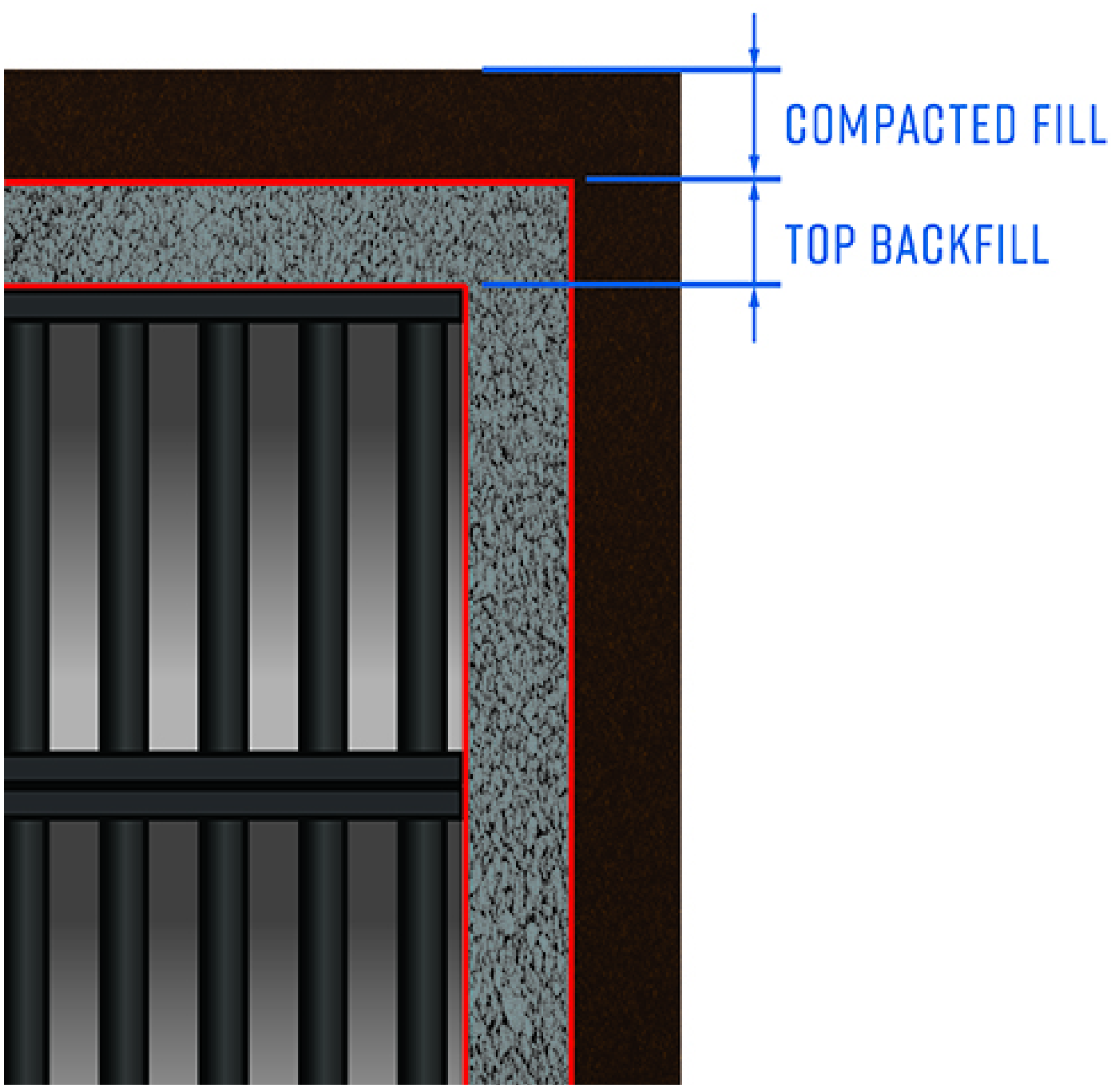
STORMTANK
Expect Results

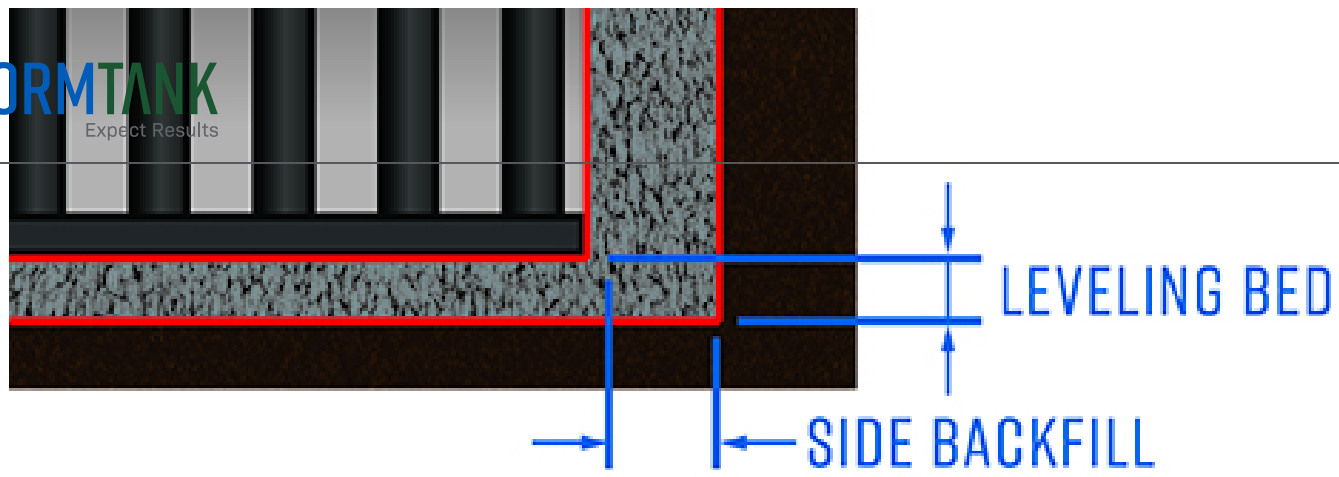
## COMPONENT QUANTITIES

| | BOTTOM LAYER | TOP LAYER | TOTAL |
|---|---|---|---|
| HEIGHT | 24 | 36 | 60 |
| # OF MODULES | 860 | 860 | 1,720 |
| # OF PLATENS | 1,720 | 1,720 | 3,440 |
| # OF SIDE PANELS | 278 | 278 | 556 |
| # OF COLUMNS | 6,880 | 6,880 | 13,760 |
| # OF STACKING PINS | 1720 | N/A | 1,720 |

## RESULTS: BASIN DETAIL

### CROSS-SECTION






SAVE

## SYSTEMS

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MODULE 25 SERIES

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GROUNDPRO

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# Roof Leaders to MH-1

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.012 | |
| Channel Slope | 0.00500 | ft/ft |
| Diameter | 1.00 | ft |
| Discharge | 1.77 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.59 | ft |
| Flow Area | 0.48 | $ft^2$ |
| Wetted Perimeter | 1.74 | ft |
| Hydraulic Radius | 0.27 | ft |
| Top Width | 0.98 | ft |
| Critical Depth | 0.57 | ft |
| Percent Full | 58.7 | % |
| Critical Slope | 0.00558 | ft/ft |
| Velocity | 3.70 | ft/s |
| Velocity Head | 0.21 | ft |
| Specific Energy | 0.80 | ft |
| Froude Number | 0.93 | |
| Maximum Discharge | 2.94 | $ft^3/s$ |
| Discharge Full | 2.73 | $ft^3/s$ |
| Slope Full | 0.00210 | 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 | % |
| Normal Depth Over Rise | 58.65 | % |
| Downstream Velocity | Infinity | ft/s |

# Roof Leaders to MH-1

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.59 | ft |
| Critical Depth | 0.57 | ft |
| Channel Slope | 0.00500 | ft/ft |
| Critical Slope | 0.00558 | ft/ft |

# Roof Leaders to JellyFish

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.012 | |
| Channel Slope | 0.05000 | ft/ft |
| Diameter | 1.00 | ft |
| Discharge | 1.77 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.31 | ft |
| Flow Area | 0.20 | $ft^2$ |
| Wetted Perimeter | 1.18 | ft |
| Hydraulic Radius | 0.17 | ft |
| Top Width | 0.92 | ft |
| Critical Depth | 0.57 | ft |
| Percent Full | 30.7 | % |
| Critical Slope | 0.00559 | ft/ft |
| Velocity | 8.64 | ft/s |
| Velocity Head | 1.16 | ft |
| Specific Energy | 1.47 | ft |
| Froude Number | 3.23 | |
| Maximum Discharge | 9.28 | $ft^3/s$ |
| Discharge Full | 8.63 | $ft^3/s$ |
| Slope Full | 0.00210 | ft/ft |
| Flow Type | SuperCritical | |

## 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 | % |
| Normal Depth Over Rise | 30.72 | % |
| Downstream Velocity | Infinity | ft/s |

# Roof Leaders to JellyFish

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.31 | ft |
| Critical Depth | 0.57 | ft |
| Channel Slope | 0.05000 | ft/ft |
| Critical Slope | 0.00559 | ft/ft |

**STANDARD E&S WORKSHEET #10**
**Rational Method**

| | | | |
|---|---|---|---|
| **PROJECT NAME** | Adelphia | | |
| **LOCATION:** | Quakertown | | |
| **PREPARED BY:** | RY | **DATE:** | 3/1/2019 |
| **CHECKED BY:** | ATH | **DATE:** | 3/19/2019 |

**DETERMINE WATERSHED "C" VALUE**

| Channel Number | Drainage Area Number | Type of Cover | C VALUE | AREA (acres) | (C X A) | $C_w$ |
|---|---|---|---|---|---|---|
| CH-1 | - | Gravel | 0.6 | 0.98 | 0.59 | 0.49 |
| | - | Brush | 0.3 | 0.56 | 0.17 | |
| | - | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

**DETERMINE INTENSITY:**

| Channel Number | Tc | R2 | R10 | I2 | I10 |
|---|---|---|---|---|---|
| CH-1 | 15.00 | - | - | - | 4.16 |
| | | | | | |

**DETERMINE PEAK RUNOFF RATES (Q = C I A)**

| Channel Number | C VALUE | I (in./hr.) | A (acres) | Q2 (cfs) | Q10 (cfs) |
|---|---|---|---|---|---|
| CH-1 | 0.49 | 4.16 | 1.54 | - | 3.14 |
| | | | | | |

**STANDARD E&S WORKSHEET #11**
**Channel Design Data**

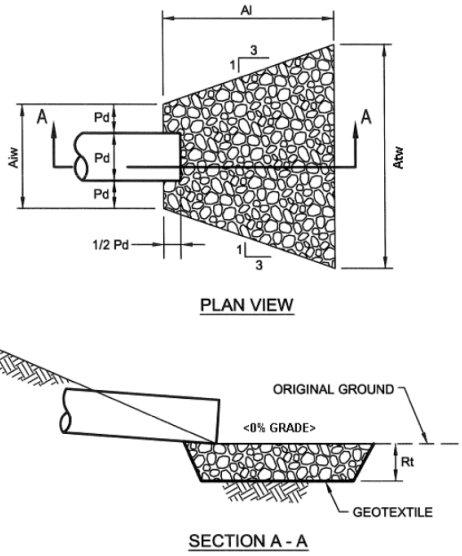
| | | | |
|---|---|---|---|
| **PROJECT NAME:** | Adelphia | | |
| **LOCATION:** | Quakertown | | |
| **PREPARED BY:** | RY | **DATE:** | 3/1/2019 |
| **CHECKED BY:** | ATH | **DATE:** | 3/19/2019 |

| | | | | | |
|---|---|---|---|---|---|
| **CHANNEL OR CHANNEL SECTION** | CH-1 | | | | |
| **TEMPORARY OR PERMANENT (T or P)** | PERM | | | | |
| **DESIGN STORM (2, 5, or 10 YR)** | 10 YR | | | | |
| **ACRES (AC)** | CH-1 | | | | |
| **MULTIPLIER (1.6, 2.25, or 2.75)[1]** | N/A | | | | |
| **Qr (REQUIRED CAPACITY) (CFS)** | 4.16 | | | | |
| **Q (CALCULATED AT FLOW DEPTH d) (CFS)** | 4.16 | | | | |
| **PROTECTIVE LINING [2]** | R-3 | | | | |
| **n (MANNING'S COEFFICIENT) [2]** | 0.042 | | | | |
| **Va (ALLOWABLE VELOCITY) (FPS)** | 6.50 | | | | |
| **V (CALCULATED AT FLOW DEPTH d) (FPS)** | 1.89 | | | | |
| **$t_a$ (MAX. ALLOWABLE SHEAR STRESS) (LB/FT$^2$)** | 1.00 | | | | |
| **td (SHEAR STRESS AT FLOW DEPTH d) (LB/FT2)** | 0.37 | | | | |
| **CHANNEL BOTTOM WIDTH (FT)** | 2 | | | | |
| **CHANNEL SIDE SLOPES (H:V)** | 3 | | | | |
| **D (TOTAL DEPTH) (FT)** | 1.09 | | | | |
| **CHANNEL TOP WIDTH @ D (FT)** | 8.51 | | | | |
| **d (CALCULATED FLOW DEPTH) (FT)** | 0.59 | | | | |
| **CHANNEL TOP WIDTH @ FLOW DEPTH d (FT)** | 5.51 | | | | |
| **BOTTOM WIDTH:DEPTH RATIO (12:1 MAX)** | 3.4 | | | | |
| **$d_{50}$ STONE SIZE (IN)** | 0.25 | | | | |
| **A (CROSS-SECTIONAL AREA) (SQ.FT.)** | 2.20 | | | | |
| **R (HYDRAULIC RADIUS)** | 0.39 | | | | |
| **S (BED SLOPE) [3] (FT/FT)** | 0.0100 | | | | |
| **$S_c$ (CRITICAL SLOPE) (FT/FT)** | 0.0358 | | | | |
| **0.7 $S_c$ (FT/FT)** | 0.0251 | | | | |
| **1.3 $S_c$ (FT/FT)** | 0.0466 | | | | |
| **STABLE FLOW (Y/N)** | Y | | | | |
| **FREEBOARD BASED ON UNSTABLE FLOW (FT)** | N/A | | | | |
| **FREEBOARD BASED ON STABLE FLOW (FT)** | 0.15 | | | | |
| **MINIMUM REQUIRED FREEBOARD [4] (FT)** | 0.5 | | | | |
| **DESIGN METHOD FOR PROTECTIVE LINING[5]** | V | | | | |

1. Use 1.6 for Temporary Channels; 2.25 for Temporary Channels in Special Protection (HQ or EV) Watersheds; 2.75 for Permanent Channels. For Rational Method, enter "N/A" and attach Worksheets 9 and 10. For TR-55, enter N/A" and attach appropriate Worksheets.
2. Adjust "n" value for changes in channel liner and flow depth. For vegetated channels, provide data for manufactured linings without vegetation and with vegetation in separate columns.
3. Slopes may not be averaged
4. Minumum Freeboard is 0.5 ft. OR 1/4 Total Channel Depth, whichever is greater
5. Permissible velocity lining design method is not acceptable for channels with a bed slope of 10% or greater. Shear stress lining design method is required for channels with a bed slope of 10% or greater. Shear stress lining design method may be used for any channel bed slope.

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

PROJECT NAME: Adelphia Gateway
LOCATION: Quakertown Compressor Station
PREPARED BY: RRY DATE: 04/19/19
CHECKED BY: ATH DATE: 05/16/19



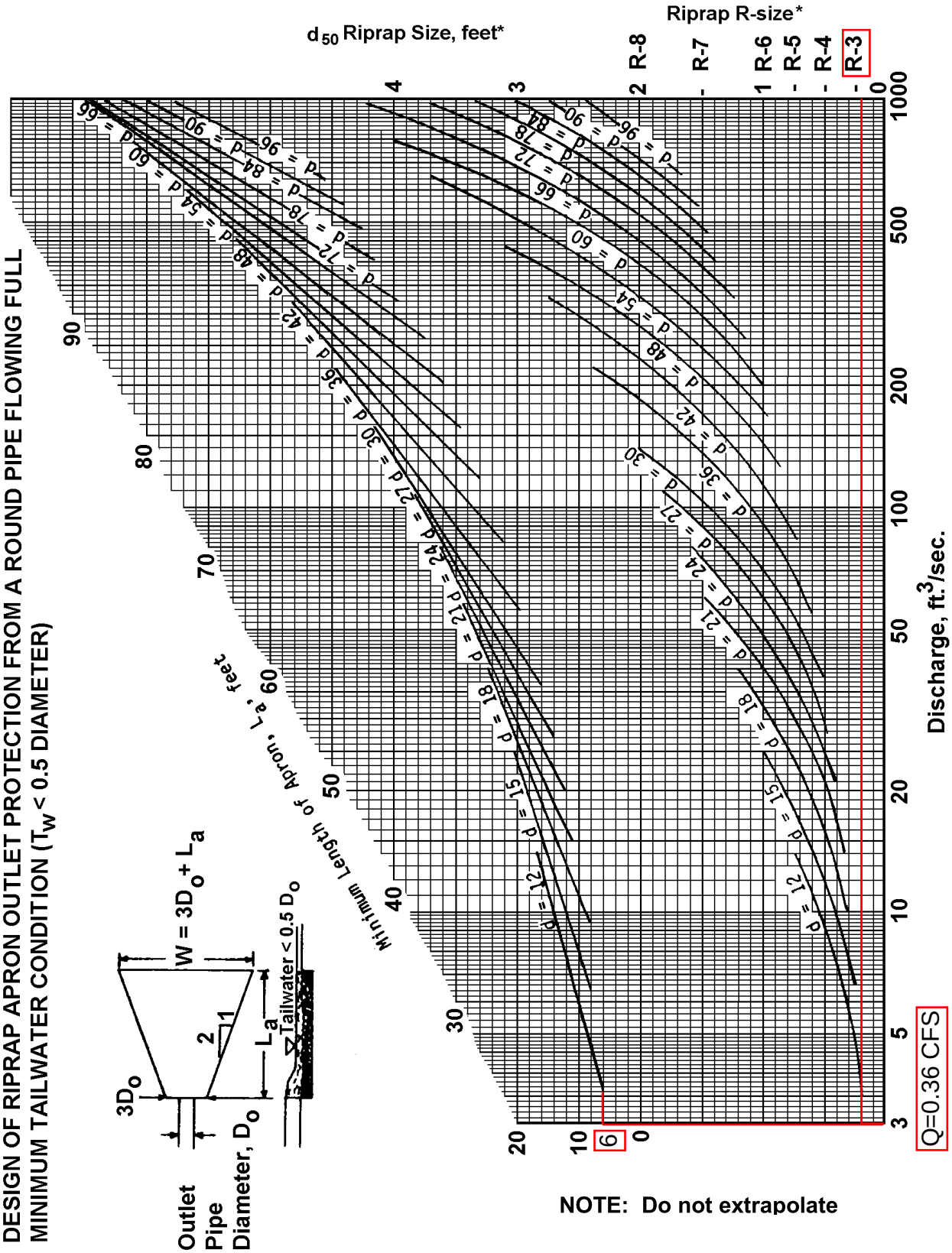

| NO. | PIPE DIA. Do (in.) | TAIL WATER COND. (Max or Min) | MAN. "n" FOR PIPE | PIPE SLOPE (FT/FT) | Q (CFS) | V* (FPS) | RIPRAP SIZE | Rt (in) | Al (ft) | Aiw (ft) | Atw (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Q-1 | 12 | MIN | 0.011 | 0.01 | 0.36 | 0.4586 | R-3 | 12 | 6 | 3 | 9 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

***: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 > 0.05 ft/ft.**

# FIGURE 9.3
## Riprap Apron Design, Minimum Tailwater Condition

Quakertown Compressor Station

**DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL**
**MINIMUM TAILWATER CONDITION ($T_W$ < 0.5 DIAMETER)**




* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase $d_{50}$ stone size and/or provide velocity reduction device.

Adapted from USDA - NRCS

**Not to be used for Box Culverts**

# Transco Meter Station

Project: Adelphia
Subject: Transco Meter Station LOD
Computed By: RRY Date: 2/5/2019

Job No. 18-00672-005
Sheet No. 1 of 2
Checked By: ATH Date: 3/19/2019

Check one: ☑ Present ☐ Developed

**TRANSCO METER STATION: EXISTING CONDITIONS WITHIN LOD**

## 1. Runoff curve number

| Soil name and hydrologic group | Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio | CN Table 2-2a | CN | CN | Area ☒ acres ☐ mi2 ☐ % | Product of CN x area |
|---|---|---|---|---|---|---|
| C | Woods, Good | 70 | | | 0.700 | 49.006 |
| C | Meadow | 71 | | | 0.190 | 13.497 |
| D | Meadow | 78 | | | 0.007 | 0.543 |
| | | | | **Totals** ➡ | 0.90 | 63.05 |

CN(weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{63.05}{0.90} = 70.27$ ; **Use CN** ➡ 70

## 2. Runoff

| | Storm #1 | Storm #2 | Storm #3 | Storm #4 |
|---|---|---|---|---|
| Frequency ..... yr | 2-YR | 10-YR | 50-YR | 100-YR |
| Rainfall, P (24-hour) ..... in | 3.40 | 4.95 | 7.16 | 8.43 |
| Runoff, Q ..... in | 0.96 | 2.02 | 3.78 | 4.87 |

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S}$$

$$I_a = 0.2S \qquad S = \frac{1000}{CN} - 10$$

(SCS Method)

Project: Adelphia | Job No. 18-00672-005
Subject: Transco Meter Station DA and LOD | Sheet No. 2 of 2
Computed By: RRY Date: 2/5/2019 | Checked By: ATH Date: 3/19/2019

Check one: ☑ Present ☐ Developed

**TRANSCO METER STATION: EXISTING CONDITIONS WITHIN LOD AND OFF-SITE DRAINAGE AREA**

## 1. Runoff curve number

| Soil name and hydrologic group | Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio | CN Table 2-2a | CN | CN | Area ☒ acres ☐ mi2 ☐ % | Product of CN x area |
|---|---|---|---|---|---|---|
| C | Woods, Good | 70 | | | 0.700 | 49.006 |
| C | Meadow | 71 | | | 0.190 | 13.497 |
| D | Meadow | 78 | | | 0.007 | 0.543 |
| C | Brush, Good | 65 | | | 0.000 | 0.000 |
| D | Brush, Good | 73 | | | 0.065 | 4.726 |
| | | | | **Totals** ➡ | 0.96 | 67.77 |

CN(weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{67.77}{0.96} = 70.46$ ; **Use CN** ➡ 70

## 2. Runoff

| | Storm #1 | Storm #2 | Storm #3 | Storm #4 |
|---|---|---|---|---|
| Frequency ..... yr | 2-YR | 10-YR | 50-YR | 100-YR |
| Rainfall, P (24-hour) ..... in | 3.40 | 4.95 | 7.16 | 8.43 |
| Runoff, Q ..... in | 0.97 | 2.04 | 3.80 | 4.89 |

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S}$$

$$I_a = 0.2S \qquad S = \frac{1000}{CN} - 10$$

(SCS Method)

Project: Adelphia
Subject: Transco Meter Station LOD
Computed By: RRY Date: 2/5/2019

Job No. 18-00672-005
Sheet No. 1 of 4
Checked By: ATH Date: 3/19/2019

Check one: ☐ Present ☑ Developed

**TRANSCO METER STATION: PROPOSED CONDITIONS WITHIN LOD**

## 1. Runoff curve number

| Soil name and hydrologic group | Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio | CN Table 2-2a | CN | CN | Area ☒ acres ☐ mi2 ☐ % | Product of CN x area |
|---|---|---|---|---|---|---|
| C | Impervious | 98 | | | 0.103 | 10.128 |
| D | Impervious | 98 | | | 0.004 | 0.373 |
| C | Meadow | 71 | | | 0.024 | 1.700 |
| C | Gravel | 89 | | | 0.762 | 67.827 |
| D | Gravel | 91 | | | 0.003 | 0.282 |
| | | | | **Totals** ➡ | 0.90 | 80.31 |

CN(weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{80.31}{0.90} = 89.60$ ; **Use CN** ➡ 90

## 2. Runoff

| | Storm #1 | Storm #2 | Storm #3 | Storm #4 |
|---|---|---|---|---|
| Frequency ..... yr | 2-YR | 10-YR | 50-YR | 100-YR |
| Rainfall, P (24-hour) ..... in | 3.40 | 4.95 | 7.16 | 8.43 |
| Runoff, Q ..... in | 2.32 | 3.79 | 5.93 | 7.18 |

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S}$$

$$I_a = 0.2S \qquad S = \frac{1000}{CN} - 10$$

(SCS Method)

Project: Adelphia
Job No. 18-00672-005
Subject: Transco Meter Station DA and LOD
Sheet No. 2 of 4
Computed By: RRY Date: 2/5/2019
Checked By: ATH Date: 3/19/2019

Check one: ☐ Present ☑ Developed

**TRANSCO METER STATION: PROPOSED CONDITIONS WITHIN LOD AND OFF-SITE DRAINAGE AREA**

## 1. Runoff curve number

| Soil name and hydrologic group | Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio | CN Table 2-2a | CN | CN | Area ☒ acres ☐ mi2 ☐ % | Product of CN x area |
|---|---|---|---|---|---|---|
| C | Impervious | 98 | | | 0.103 | 10.128 |
| D | Impervious | 98 | | | 0.004 | 0.373 |
| C | Meadow | 71 | | | 0.024 | 1.700 |
| C | Gravel | 89 | | | 0.762 | 67.827 |
| D | Gravel | 91 | | | 0.003 | 0.282 |
| C | Brush, Good | 65 | | | 0.066 | 4.262 |
| | | | | **Totals** | 0.96 | 84.57 |

CN(weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{84.57}{0.96} = 87.93$ ; **Use CN** 88

## 2. Runoff

| | Storm #1 | Storm #2 | Storm #3 | Storm #4 |
|---|---|---|---|---|
| Frequency ..... yr | 2-YR | 10-YR | 50-YR | 100-YR |
| Rainfall, P (24-hour) ..... in | 3.40 | 4.95 | 7.16 | 8.43 |
| Runoff, Q ..... in | 2.17 | 3.61 | 5.74 | 6.98 |

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S}$$

$$I_a = 0.2S \qquad S = \frac{1000}{CN} - 10$$

(SCS Method)

Project: Adelphia
Subject: Transco Meter Station BMP
Computed By: RRY Date: 2/5/2019

Job No. 18-00672-005
Sheet No. 3 of 4
Checked By: ATH Date: 3/19/2019

Check one: ☐ Present ☑ Developed

**TRANSCO METER STATION: PROPOSED CONDITIONS TO BMP**

## 1. Runoff curve number

| Soil name and hydrologic group | Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio | CN Table 2-2a | CN | CN | Area ☒ acres ☐ mi2 ☐ % | Product of CN x area |
|---|---|---|---|---|---|---|
| C | Impervious | 98 | | | 0.103 | 10.086 |
| C | Gravel | 89 | | | 0.470 | 41.791 |
| C | Brush, Good | 65 | | | 0.066 | 4.262 |
| | | | | **Totals** | 0.64 | 56.14 |

CN(weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{56.14}{0.64} = 87.99$ ; **Use CN** 88

## 2. Runoff

| | Storm #1 | Storm #2 | Storm #3 | Storm #4 |
|---|---|---|---|---|
| Frequency ..... yr | 2-YR | 10-YR | 50-YR | 100-YR |
| Rainfall, P (24-hour) ..... in | 3.40 | 4.95 | 7.16 | 8.43 |
| Runoff, Q ..... in | 2.18 | 3.62 | 5.75 | 6.99 |

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S}$$

$$I_a = 0.2S \qquad S = \frac{1000}{CN} - 10$$

(SCS Method)

Project: Adelphia
Subject: Transco Meter Station Bypass
Computed By: RRY Date: 2/5/2019

Job No. 18-00672-005
Sheet No. 4 of 4
Checked By: ATH Date: 3/19/2019

Check one: ☐ Present ☑ Developed

**TRANSCO METER STATION: PROPOSED CONDITIONS (BYPASS)**

## 1. Runoff curve number

| Soil name and hydrologic group | Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio | CN Table 2-2a | CN | CN | Area ☒ acres ☐ mi2 ☐ % | Product of CN x area |
|---|---|---|---|---|---|---|
| D | Impervious | 98 | | | 0.004 | 0.373 |
| C | Meadow | 0 | | | 0.024 | 0.000 |
| C | Gravel | 89 | | | 0.293 | 26.036 |
| D | Gravel | 91 | | | 0.003 | 0.282 |
| | | | | **Totals** ➡ | 0.32 | 26.69 |

CN(weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{26.69}{0.32} = 82.54$ ; **Use CN** ➡ 83

## 2. Runoff

| | Storm #1 | Storm #2 | Storm #3 | Storm #4 |
|---|---|---|---|---|
| Frequency ..... yr | 2-YR | 10-YR | 50-YR | 100-YR |
| Rainfall, P (24-hour) ..... in | 3.40 | 4.95 | 7.16 | 8.43 |
| Runoff, Q ..... in | 1.74 | 3.08 | 5.13 | 6.33 |

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S}$$

$$I_a = 0.2S \qquad S = \frac{1000}{CN} - 10$$

(SCS Method)

# Worksheet 3: Time of concentration ($T_c$) or travel time ($T_t$)

| | | | | | |
|---|---|---|---|---|---|
| Project | Adelphia | By | RRY | Date | 2/5/2019 |
| Location | Marcus Hook Compressor Station | Checked | ATH | Date | 3/19/2019 |

Circle one: (Present) Developed

Circle one: ($T_c$) $T_t$

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Sheet flow calculated using Rational Method Nomograph.
Include a map, schematic, or description of flow segments.

| Sheet Flow (Applicable to $T_c$ only) | | Segment ID | L1 | | | | |
|---|---|---|---|---|---|---|---|
| 1. Surface description (table 3-1) | | | Gravel | | | | |
| 2. Manning's roughness coeff., n (table 3-1) | | | 0.01 | | | | |
| 3. Flow length, L (total L < 150 ft) | | ft | 100.00 | | | | |
| 4. Two-yr 24-hr rainfall, P2 | | in | 3.40 | | | | |
| 5. Land slope, s | | ft/ft | 0.033 | | | | |
| 6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}s^{0.4}}$ | Compute $T_t$ | hr | 0.015 | + | | = | 0.015 |

| Shallow Concentrated Flow | | Segment ID | L2 | | | | |
|---|---|---|---|---|---|---|---|
| 7. Surface description (paved or unpaved) | | | Unpaved | | | | |
| 8. Flow length, L | | ft | 250.00 | | | | |
| 9. Watercourse slope, s | | ft/ft | 0.035 | | | | |
| 10. Average velocity, V (figure 3-1) | | ft/s | 3.02 | | | | |
| 11. $T_t = \frac{L}{3600V}$ | Compute $T_t$ | hr | 0.023 | + | | = | 0.023 |

| Channel Flow | | Segment ID | L3 | | | | |
|---|---|---|---|---|---|---|---|
| 12. Cross sectional flow area, a | | $ft^2$ | 12.00 | | | | |
| 13. Wetted perimeter, $p_w$ | | ft | 12.65 | | | | |
| 14. Hydraulic radius, $r = \frac{a}{p_w}$ | | ft | 0.95 | | | | |
| | | | | | | | |
| 15. Channel slope, s | | ft/ft | 0.005 | | | | |
| 16. Manning's roughness coeff., n | | | 0.033 | | | | |
| 17. $V = \frac{1.49r^{2/3}s^{1/2}}{n}$ | Compute V | ft/s | 3.08 | | | | |
| | | | | | | | |
| 18. Flow length, L | | ft | 483.10 | | | | |
| 19. $T_t = \frac{L}{3600V}$ | Compute $T_t$ | hr | 0.044 | + | | = | 0.044 |

| | | |
|---|---|---|
| 20. Watershed or subarea $T_c$ or $T_t$ (add $T_t$ in steps 6, 11, and 19) | Total min. | 4.88 |
| | MIN (min) | 5.00 |

# Worksheet 3: Time of concentration ($T_c$) or travel time ($T_t$)

| | | | | | |
|---|---|---|---|---|---|
| Project | Adelphia | By | RRY | Date | 2/26/2019 |
| Location | Transco Meter Station | Checked | ATH | Date | 3/19/2019 |

Circle one: (Present) Developed

Circle one: ($T_c$) $T_t$

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Sheet flow calculated using Rational Method Nomograph.
Include a map, schematic, or description of flow segments.

| Sheet Flow (Applicable to $T_c$ only) | | Segment ID | L1 | | | | |
|---|---|---|---|---|---|---|---|
| 1. Surface description (table 3-1) | | | Woods - Light Underbrush | | | | |
| 2. Manning's roughness coeff., n (table 3-1) | | | 0.40 | | | | |
| 3. Flow length, L (total L < 150 ft) | | ft | 100.00 | | | | |
| 4. Two-yr 24-hr rainfall, P2 | | in | 3.40 | | | | |
| 5. Land slope, s | | ft/ft | 0.095 | | | | |
| 6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}s^{0.4}}$ | Compute $T_t$ | hr | 0.186 | + | | = | 0.186 |

| Shallow Concentrated Flow | | Segment ID | L2 | | | | |
|---|---|---|---|---|---|---|---|
| 7. Surface description (paved or unpaved) | | | Unpaved | | | | |
| 8. Flow length, L | | ft | 95.90 | | | | |
| 9. Watercourse slope, s | | ft/ft | 0.047 | | | | |
| 10. Average velocity, V (figure 3-1) | | ft/s | 3.50 | | | | |
| 11. $T_t = \frac{L}{3600V}$ | Compute $T_t$ | hr | 0.008 | + | | = | 0.008 |

| Channel Flow | | Segment ID | | | | | |
|---|---|---|---|---|---|---|---|
| 12. Cross sectional flow area, a | | $ft^2$ | | | | | |
| 13. Wetted perimeter, $p_w$ | | ft | | | | | |
| 14. Hydraulic radius, $r = \frac{a}{p_w}$ | | ft | | | | | |
| 15. Channel slope, s | | ft/ft | | | | | |
| 16. Manning's roughness coeff., n | | | | | | | |
| 17. $V = \frac{1.49r^{2/3}s^{1/2}}{n}$ | Compute V | ft/s | | | | | |
| 18. Flow length, L | | ft | | | | | |
| 19. $T_t = \frac{L}{3600V}$ | Compute $T_t$ | hr | | + | | = | |

20. Watershed or subarea $T_c$ or $T_t$ (add $T_t$ in steps 6, 11, and 19) — Total min. 11.63

MIN (min) 5.00

# Worksheet 3: Time of concentration ($T_c$) or travel time ($T_t$)

| | | | | | |
|---|---|---|---|---|---|
| Project | Adelphia | By | RRY | Date | 2/26/2019 |
| Location | Transco Meter Station - BMP | Checked | ATH | Date | 3/19/2019 |

Circle one: Present (Developed)

Circle one: ($T_c$) $T_t$

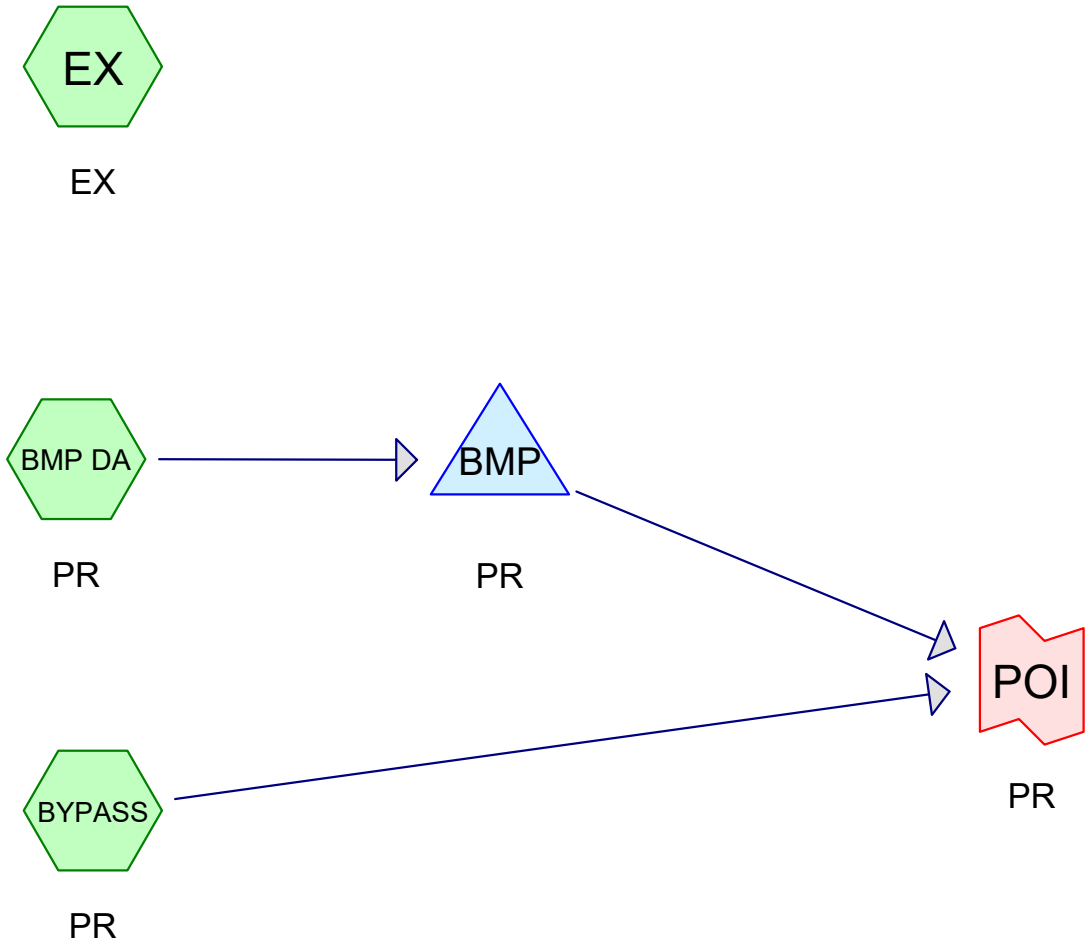
NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Sheet flow calculated using Rational Method Nomograph.
Include a map, schematic, or description of flow segments.

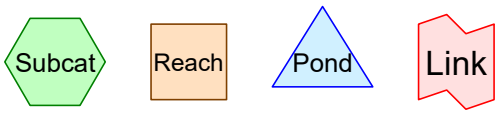
| Sheet Flow (Applicable to $T_c$ only) | | Segment ID | L1 | | | | |
|---|---|---|---|---|---|---|---|
| 1. Surface description (table 3-1) | | | Dense Grass | | | | |
| 2. Manning's roughness coeff., n (table 3-1) | | | 0.24 | | | | |
| 3. Flow length, L (total L < 150 ft) | | ft | 100.00 | | | | |
| 4. Two-yr 24-hr rainfall, P2 | | in | 3.40 | | | | |
| 5. Land slope, s | | ft/ft | 0.080 | | | | |
| 6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$ | Compute $T_t$ | hr | 0.133 | + | | = | 0.133 |

| Shallow Concentrated Flow | | Segment ID | L2 | | | | |
|---|---|---|---|---|---|---|---|
| 7. Surface description (paved or unpaved) | | | Paved | | | | |
| 8. Flow length, L | | ft | 115.40 | | | | |
| 9. Watercourse slope, s | | ft/ft | 0.130 | | | | |
| 10. Average velocity, V (figure 3-1) | | ft/s | 7.30 | | | | |
| 11. $T_t = \frac{L}{3600V}$ | Compute $T_t$ | hr | 0.004 | + | | = | 0.004 |

| Channel Flow | | Segment ID | L3 | | | | |
|---|---|---|---|---|---|---|---|
| 12. Cross sectional flow area, a | | $ft^2$ | 1.00 | | | | |
| 13. Wetted perimeter, $p_w$ | | ft | 4.03 | | | | |
| 14. Hydraulic radius, $r = \frac{a}{p_w}$ | | ft | 0.25 | | | | |
| | | | | | | | |
| 15. Channel slope, s | | ft/ft | 0.005 | | | | |
| 16. Manning's roughness coeff., n | | | 0.024 | | | | |
| 17. $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$ | Compute V | ft/s | 1.73 | | | | |
| | | | | | | | |
| 18. Flow length, L | | ft | 29.50 | | | | |
| 19. $T_t = \frac{L}{3600V}$ | Compute $T_t$ | hr | 0.005 | + | | = | 0.005 |

| | | |
|---|---|---|
| 20. Watershed or subarea $T_c$ or $T_t$ (add $T_t$ in steps 6, 11, and 19) | Total min. | 8.50 |
| | MIN (min) | 5.00 |




**Routing Diagram for Transco**
Prepared by JMT, Printed 3/24/2020
HydroCAD® 10.00-20 s/n 08514 © 2017 HydroCAD Software Solutions LLC

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 0.638 | 88 | (BMP DA) |
| 0.326 | 83 | (BYPASS) |
| 0.962 | 70 | (EX) |
| **1.926** | **78** | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 0.000 | HSG A | |
| 0.000 | HSG B | |
| 0.000 | HSG C | |
| 0.000 | HSG D | |
| 1.926 | Other | BMP DA, BYPASS, EX |
| **1.926** | | **TOTAL AREA** |

## Ground Covers (all nodes)

| HSG-A (acres) | HSG-B (acres) | HSG-C (acres) | HSG-D (acres) | Other (acres) | Total (acres) | Ground Cover | Subcatchment Numbers |
|---|---|---|---|---|---|---|---|
| 0.000 | 0.000 | 0.000 | 0.000 | 1.926 | 1.926 | | BMP DA, BYPASS, EX |
| **0.000** | **0.000** | **0.000** | **0.000** | **1.926** | **1.926** | **TOTAL AREA** | |

## Pipe Listing (all nodes)

| Line# | Node Number | In-Invert (feet) | Out-Invert (feet) | Length (feet) | Slope (ft/ft) | n | Diam/Width (inches) | Height (inches) | Inside-Fill (inches) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | BMP | 61.00 | 60.75 | 52.0 | 0.0048 | 0.012 | 12.0 | 0.0 | 0.0 |

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment BMP DA: PR** Runoff Area=27,793 sf 0.00% Impervious Runoff Depth>2.03"
Tc=8.5 min CN=88 Runoff=2.19 cfs 0.108 af

**Subcatchment BYPASS: PR** Runoff Area=14,219 sf 0.00% Impervious Runoff Depth>1.64"
Tc=5.0 min CN=83 Runoff=1.04 cfs 0.045 af

**Subcatchment EX: EX** Runoff Area=41,900 sf 0.00% Impervious Runoff Depth>0.85"
Tc=11.6 min CN=70 Runoff=1.24 cfs 0.068 af

**Pond BMP: PR** Peak Elev=61.09' Storage=4,244 cf Inflow=2.19 cfs 0.108 af
Discarded=0.01 cfs 0.006 af Primary=0.02 cfs 0.005 af Outflow=0.03 cfs 0.010 af

**Link POI: PR** Inflow=1.04 cfs 0.049 af
Primary=1.04 cfs 0.049 af

**Total Runoff Area = 1.926 ac Runoff Volume = 0.220 af Average Runoff Depth = 1.37"**
**100.00% Pervious = 1.926 ac 0.00% Impervious = 0.000 ac**

## Summary for Subcatchment BMP DA: PR

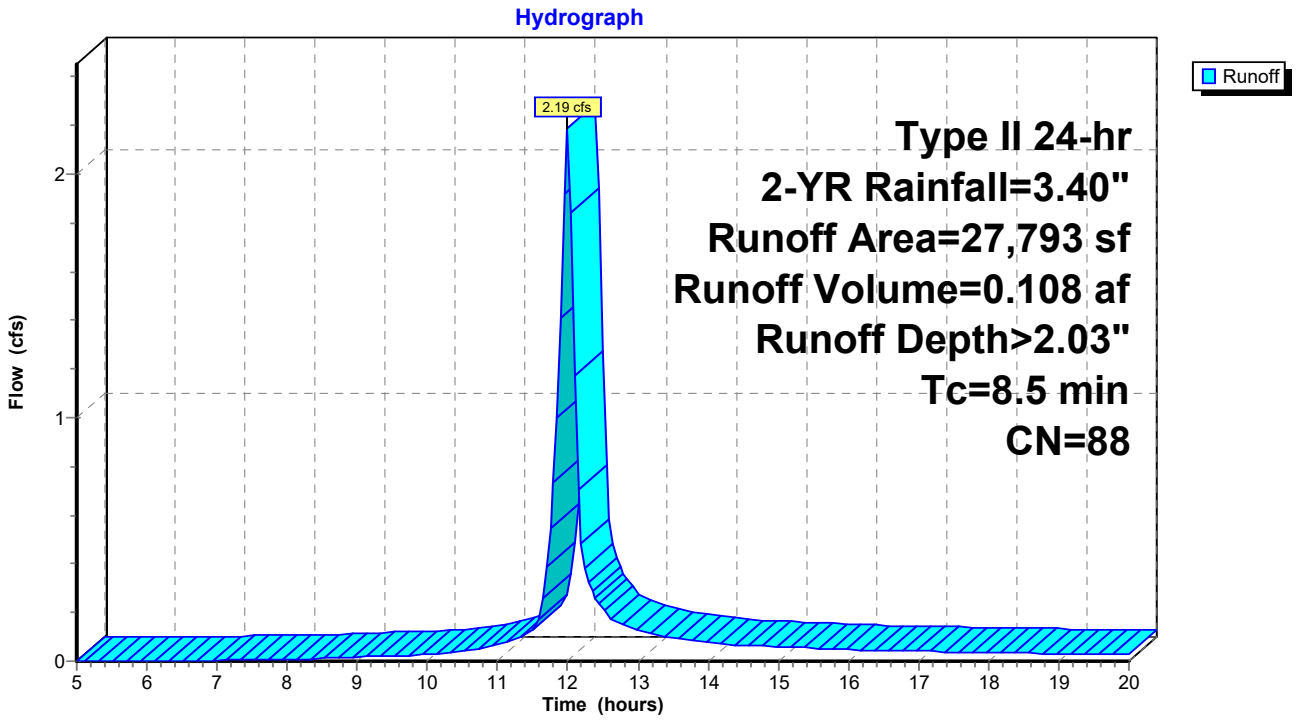
Runoff = 2.19 cfs @ 12.00 hrs, Volume= 0.108 af, Depth> 2.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YR Rainfall=3.40"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 27,793 | 88 | |
| | 27,793 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 8.5 | | | | | **Direct Entry,** |

## Subcatchment BMP DA: PR



## Summary for Subcatchment BYPASS: PR

[49] Hint: Tc<2dt may require smaller dt

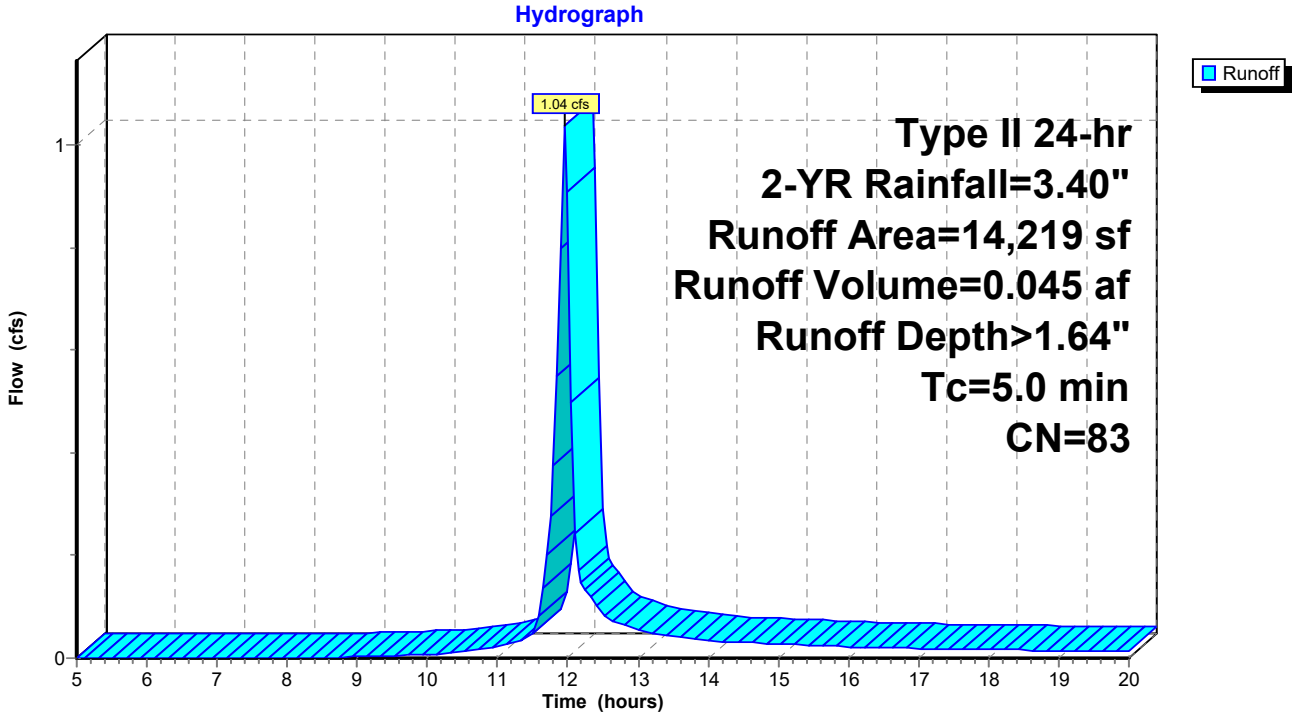
Runoff = 1.04 cfs @ 11.96 hrs, Volume= 0.045 af, Depth> 1.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YR Rainfall=3.40"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 14,219 | 83 | |
| | 14,219 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

### Subcatchment BYPASS: PR



## Summary for Subcatchment EX: EX

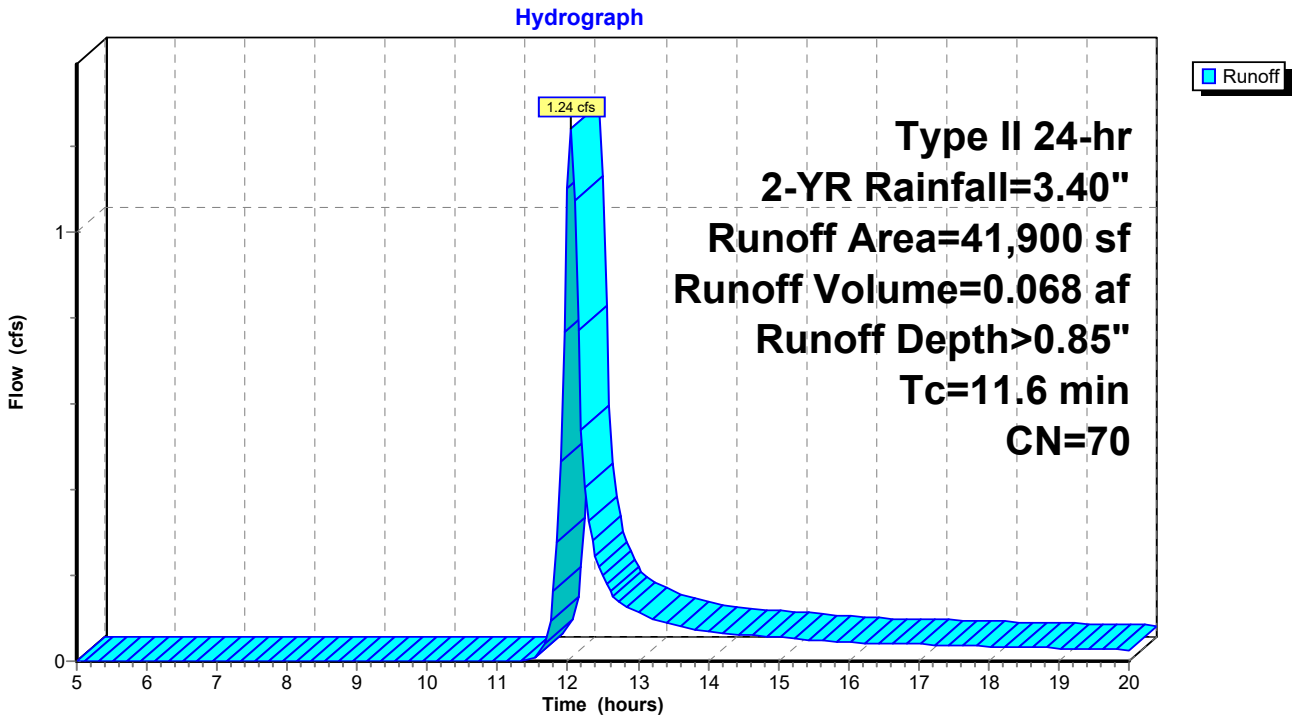
Runoff = 1.24 cfs @ 12.05 hrs, Volume= 0.068 af, Depth> 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YR Rainfall=3.40"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 41,900 | 70 | |
| | 41,900 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 11.6 | | | | | **Direct Entry,** |

## Subcatchment EX: EX



## Summary for Pond BMP: PR

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 0.638 ac, | 0.00% Impervious, | Inflow Depth > | 2.03" | for 2-YR event |
| Inflow = | 2.19 cfs @ | 12.00 hrs, | Volume= | 0.108 af | |
| Outflow = | 0.03 cfs @ | 19.26 hrs, | Volume= | 0.010 af, | Atten= 99%, Lag= 436.0 min |
| Discarded = | 0.01 cfs @ | 10.40 hrs, | Volume= | 0.006 af | |
| Primary = | 0.02 cfs @ | 19.26 hrs, | Volume= | 0.005 af | |

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 61.09' @ 19.26 hrs Surf.Area= 2,075 sf Storage= 4,244 cf

Plug-Flow detention time= 374.1 min calculated for 0.010 af (10% of inflow)
Center-of-Mass det. time= 216.0 min ( 989.6 - 773.6 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 59.00' | 8,134 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc)<br>8,300 cf Overall x 98.0% Voids |

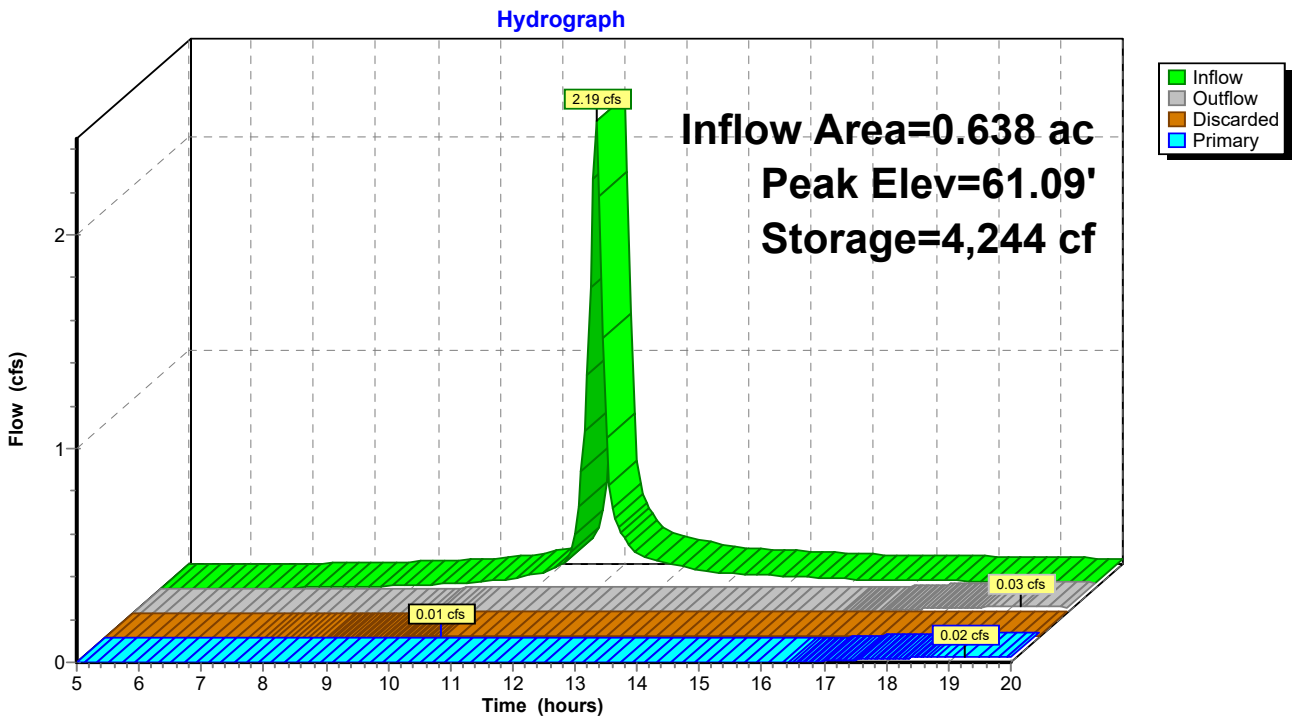
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 59.00 | 2,075 | 0 | 0 |
| 63.00 | 2,075 | 8,300 | 8,300 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 61.00' | **12.0" Round Outlet Pipe**<br>L= 52.0' RCP, groove end projecting, Ke= 0.200<br>Inlet / Outlet Invert= 61.00' / 60.75' S= 0.0048 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.79 sf |
| #2 | Discarded | 59.00' | **0.130 in/hr Exfiltration over Surface area** |
| #3 | Device 1 | 61.00' | **12.0" Vert. Orifice/Grate** C= 0.600 |
| #4 | Device 2 | 59.00' | **2.0" Vert. Orifice/Grate** C= 0.600 |
| #5 | Device 2 | 61.50' | **2.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

**Discarded OutFlow** Max=0.01 cfs @ 10.40 hrs HW=59.08' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.01 cfs)
  ├─**4=Orifice/Grate** (Passes 0.01 cfs of 0.01 cfs potential flow)
  └─**5=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

**Primary OutFlow** Max=0.02 cfs @ 19.26 hrs HW=61.09' (Free Discharge)
└─**1=Outlet Pipe** (Barrel Controls 0.02 cfs @ 1.04 fps)
  └─**3=Orifice/Grate** (Passes 0.02 cfs of 0.03 cfs potential flow)

## Pond BMP: PR

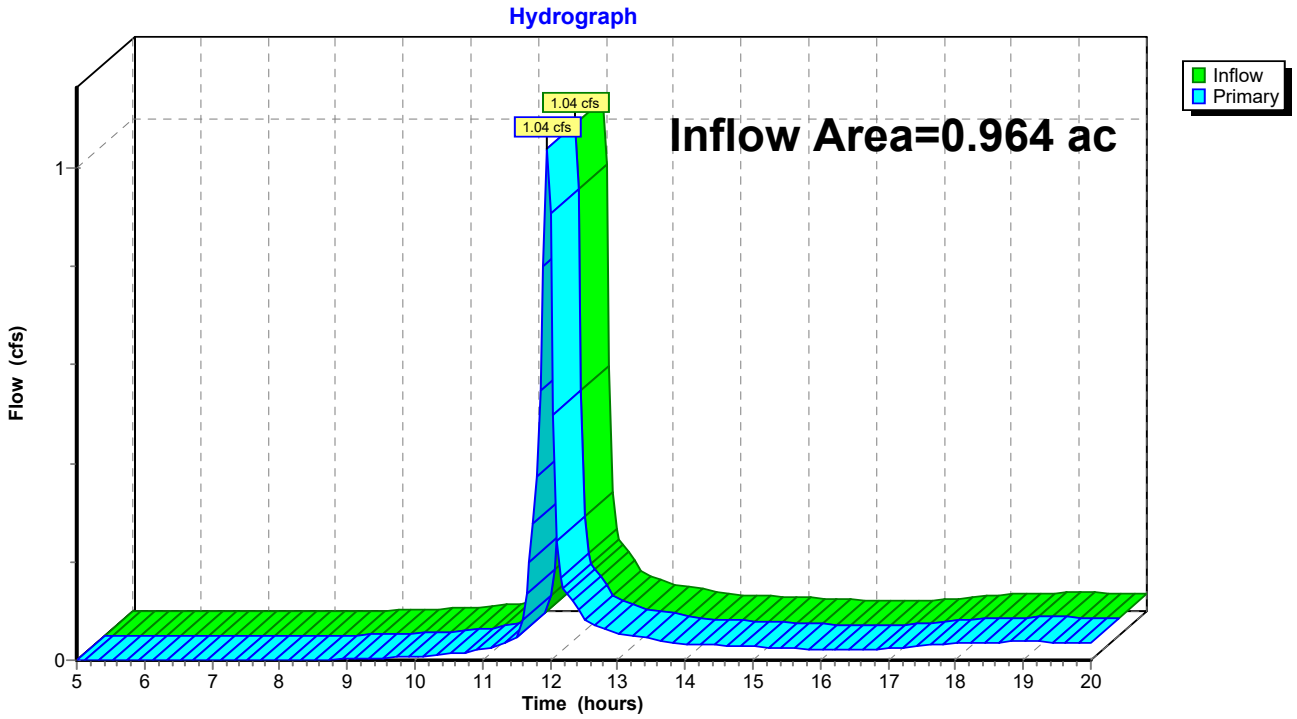

Hydrograph
Inflow
Outflow
Discarded
Primary
2.19 cfs
Inflow Area=0.638 ac
Peak Elev=61.09'
Storage=4,244 cf
0.03 cfs
0.01 cfs
0.02 cfs
Flow (cfs)
0
1
2
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Time (hours)

## Summary for Link POI: PR

Inflow Area = 0.964 ac, 0.00% Impervious, Inflow Depth > 0.61" for 2-YR event
Inflow = 1.04 cfs @ 11.96 hrs, Volume= 0.049 af
Primary = 1.04 cfs @ 11.96 hrs, Volume= 0.049 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Link POI: PR



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment BMP DA: PR** Runoff Area=27,793 sf 0.00% Impervious Runoff Depth>3.39"
Tc=8.5 min CN=88 Runoff=3.55 cfs 0.180 af

**Subcatchment BYPASS: PR** Runoff Area=14,219 sf 0.00% Impervious Runoff Depth>2.91"
Tc=5.0 min CN=83 Runoff=1.80 cfs 0.079 af

**Subcatchment EX: EX** Runoff Area=41,900 sf 0.00% Impervious Runoff Depth>1.82"
Tc=11.6 min CN=70 Runoff=2.75 cfs 0.146 af

**Pond BMP: PR** Peak Elev=61.36' Storage=4,802 cf Inflow=3.55 cfs 0.180 af
Discarded=0.01 cfs 0.007 af Primary=0.41 cfs 0.075 af Outflow=0.42 cfs 0.082 af

**Link POI: PR** Inflow=1.80 cfs 0.154 af
Primary=1.80 cfs 0.154 af

**Total Runoff Area = 1.926 ac Runoff Volume = 0.405 af Average Runoff Depth = 2.52"**
**100.00% Pervious = 1.926 ac 0.00% Impervious = 0.000 ac**

## Summary for Subcatchment BMP DA: PR

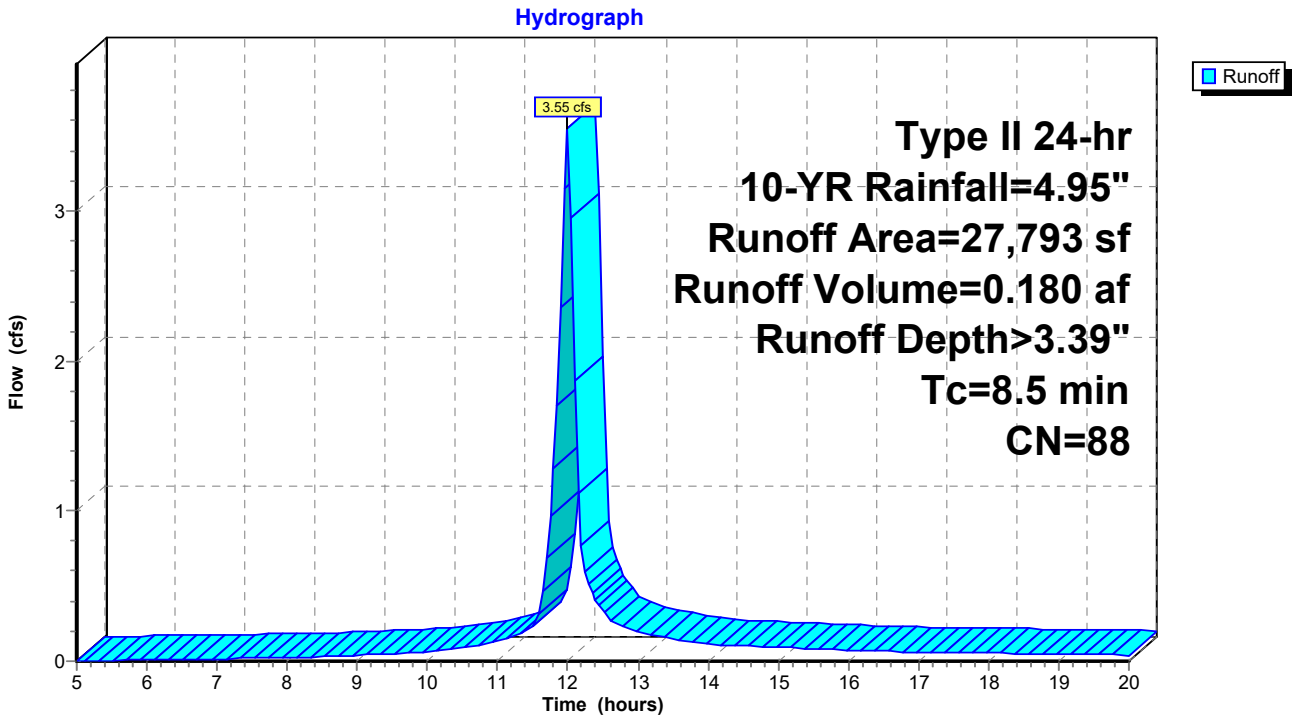
Runoff = 3.55 cfs @ 11.99 hrs, Volume= 0.180 af, Depth> 3.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YR Rainfall=4.95"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 27,793 | 88 | |
| | 27,793 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 8.5 | | | | | **Direct Entry,** |

## Subcatchment BMP DA: PR



## Summary for Subcatchment BYPASS: PR

[49] Hint: Tc<2dt may require smaller dt

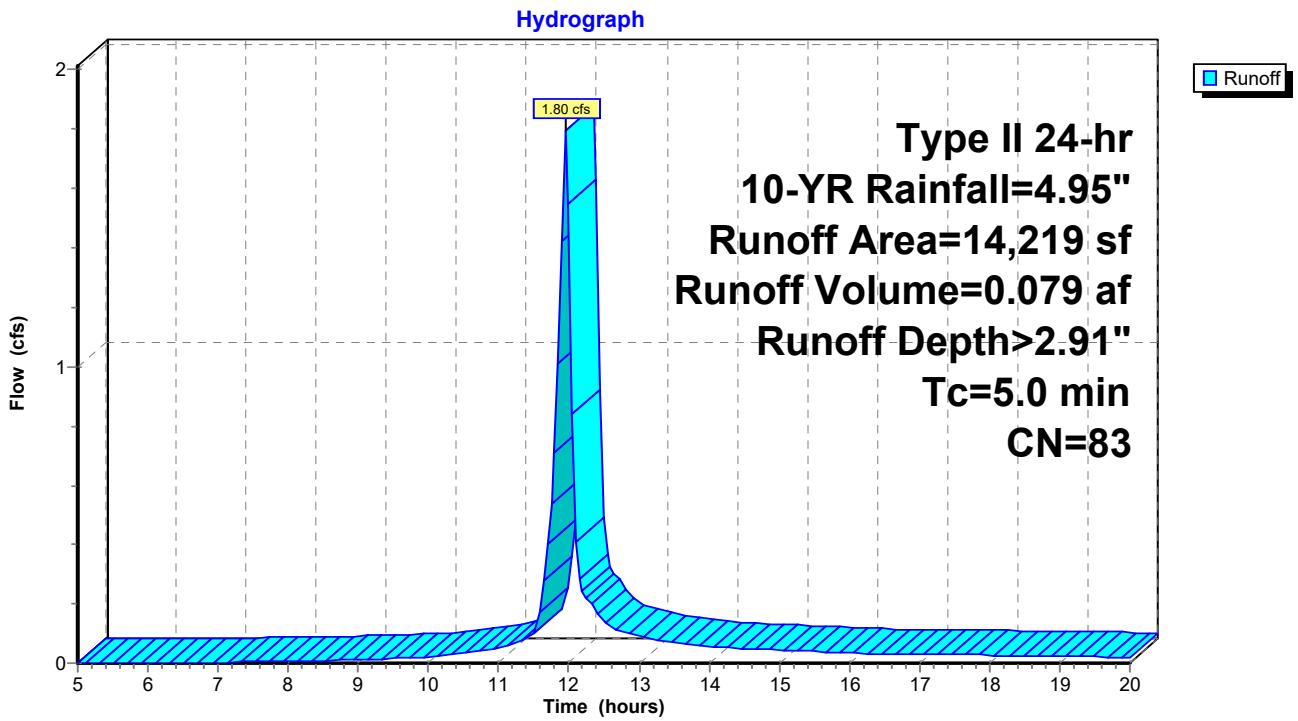
Runoff = 1.80 cfs @ 11.95 hrs, Volume= 0.079 af, Depth> 2.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YR Rainfall=4.95"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 14,219 | 83 | |
| | 14,219 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

### Subcatchment BYPASS: PR



## Summary for Subcatchment EX: EX

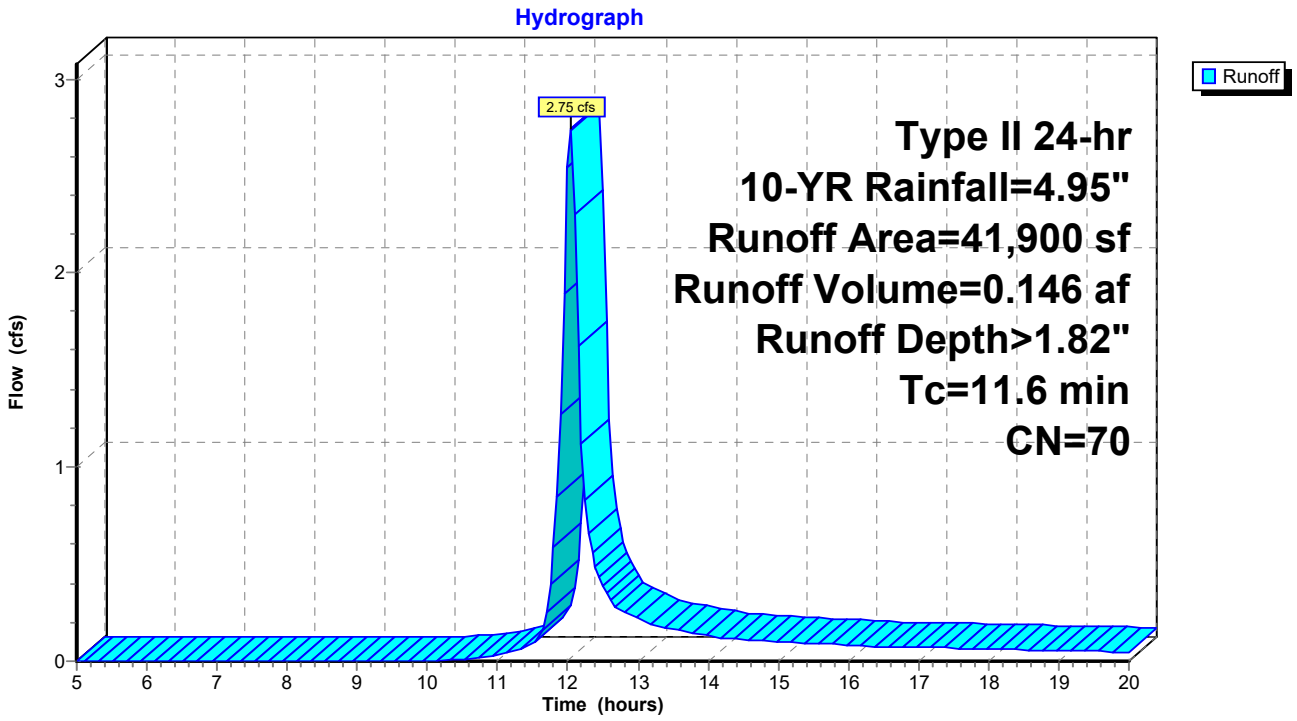
Runoff = 2.75 cfs @ 12.04 hrs, Volume= 0.146 af, Depth> 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YR Rainfall=4.95"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 41,900 | 70 | |
| | 41,900 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 11.6 | | | | | **Direct Entry,** |

### Subcatchment EX: EX



## Summary for Pond BMP: PR

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 0.638 ac, | 0.00% Impervious, | Inflow Depth > | 3.39" | for 10-YR event |
| Inflow = | 3.55 cfs @ | 11.99 hrs, | Volume= | 0.180 af | |
| Outflow = | 0.42 cfs @ | 12.39 hrs, | Volume= | 0.082 af, | Atten= 88%, Lag= 23.7 min |
| Discarded = | 0.01 cfs @ | 8.65 hrs, | Volume= | 0.007 af | |
| Primary = | 0.41 cfs @ | 12.39 hrs, | Volume= | 0.075 af | |

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 61.36' @ 12.39 hrs Surf.Area= 2,075 sf Storage= 4,802 cf

Plug-Flow detention time= 189.1 min calculated for 0.081 af (45% of inflow)
Center-of-Mass det. time= 105.9 min ( 867.6 - 761.7 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 59.00' | 8,134 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc)<br>8,300 cf Overall x 98.0% Voids |

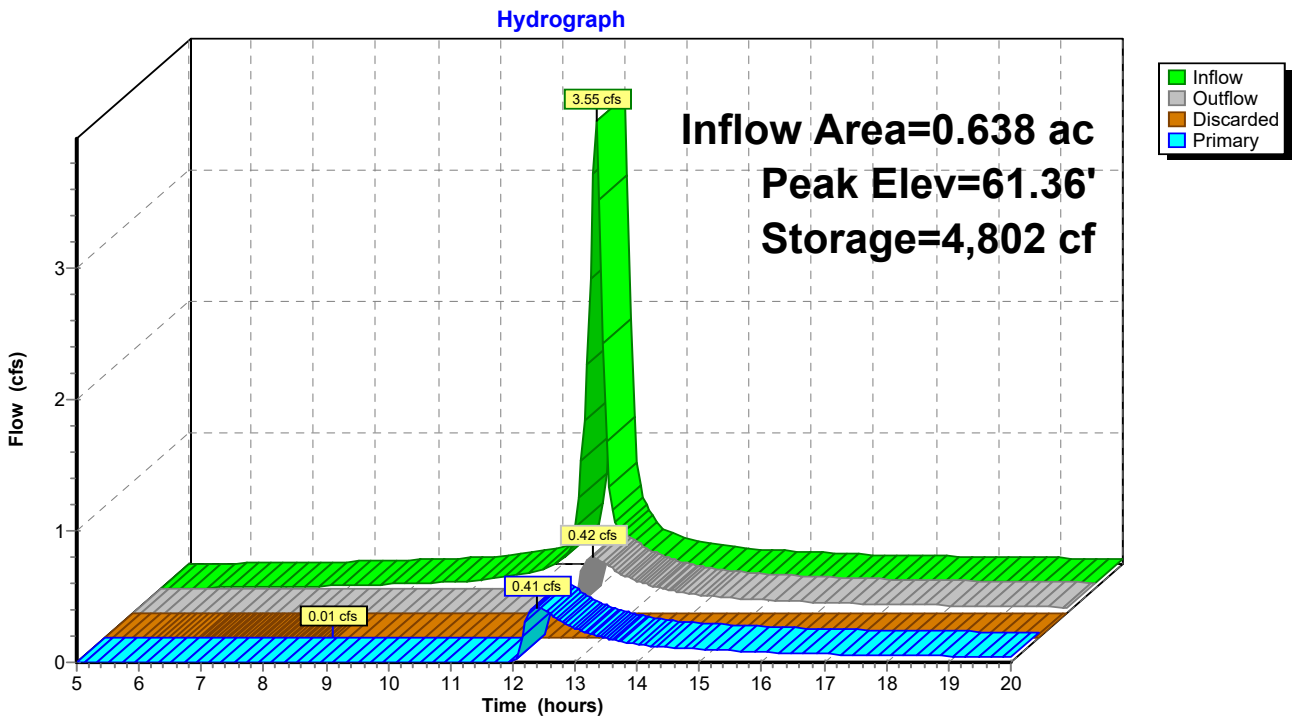
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 59.00 | 2,075 | 0 | 0 |
| 63.00 | 2,075 | 8,300 | 8,300 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 61.00' | **12.0" Round Outlet Pipe**<br>L= 52.0' RCP, groove end projecting, Ke= 0.200<br>Inlet / Outlet Invert= 61.00' / 60.75' S= 0.0048 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.79 sf |
| #2 | Discarded | 59.00' | **0.130 in/hr Exfiltration over Surface area** |
| #3 | Device 1 | 61.00' | **12.0" Vert. Orifice/Grate** C= 0.600 |
| #4 | Device 2 | 59.00' | **2.0" Vert. Orifice/Grate** C= 0.600 |
| #5 | Device 2 | 61.50' | **2.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

**Discarded OutFlow** Max=0.01 cfs @ 8.65 hrs HW=59.08' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.01 cfs)
  ├─**4=Orifice/Grate** (Passes 0.01 cfs of 0.01 cfs potential flow)
  └─**5=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

**Primary OutFlow** Max=0.41 cfs @ 12.39 hrs HW=61.36' (Free Discharge)
└─**1=Outlet Pipe** (Barrel Controls 0.41 cfs @ 2.41 fps)
  └─**3=Orifice/Grate** (Passes 0.41 cfs of 0.52 cfs potential flow)

## Pond BMP: PR

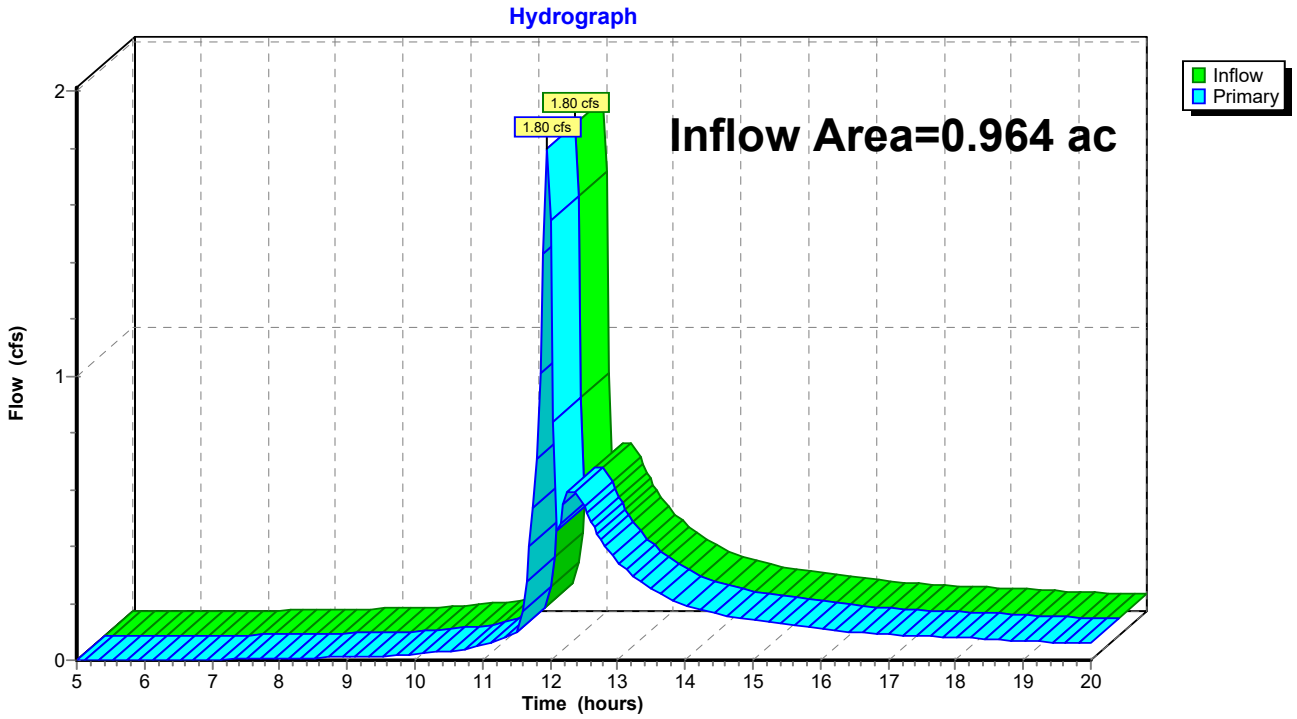

Hydrograph
Inflow
Outflow
Discarded
Primary
Inflow Area=0.638 ac
Peak Elev=61.36'
Storage=4,802 cf
3.55 cfs
0.42 cfs
0.41 cfs
0.01 cfs
Flow (cfs)
0
1
2
3
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Time (hours)

## Summary for Link POI: PR

Inflow Area = 0.964 ac, 0.00% Impervious, Inflow Depth > 1.92" for 10-YR event
Inflow = 1.80 cfs @ 11.95 hrs, Volume= 0.154 af
Primary = 1.80 cfs @ 11.95 hrs, Volume= 0.154 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

## Link POI: PR



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment BMP DA: PR** Runoff Area=27,793 sf 0.00% Impervious Runoff Depth>5.39"
Tc=8.5 min CN=88 Runoff=5.49 cfs 0.287 af

**Subcatchment BYPASS: PR** Runoff Area=14,219 sf 0.00% Impervious Runoff Depth>4.85"
Tc=5.0 min CN=83 Runoff=2.90 cfs 0.132 af

**Subcatchment EX: EX** Runoff Area=41,900 sf 0.00% Impervious Runoff Depth>3.45"
Tc=11.6 min CN=70 Runoff=5.19 cfs 0.277 af

**Pond BMP: PR** Peak Elev=62.09' Storage=6,285 cf Inflow=5.49 cfs 0.287 af
Discarded=0.01 cfs 0.007 af Primary=2.65 cfs 0.180 af Outflow=2.66 cfs 0.187 af

**Link POI: PR** Inflow=3.85 cfs 0.312 af
Primary=3.85 cfs 0.312 af

**Total Runoff Area = 1.926 ac Runoff Volume = 0.695 af Average Runoff Depth = 4.33"**
**100.00% Pervious = 1.926 ac 0.00% Impervious = 0.000 ac**

## Summary for Subcatchment BMP DA: PR

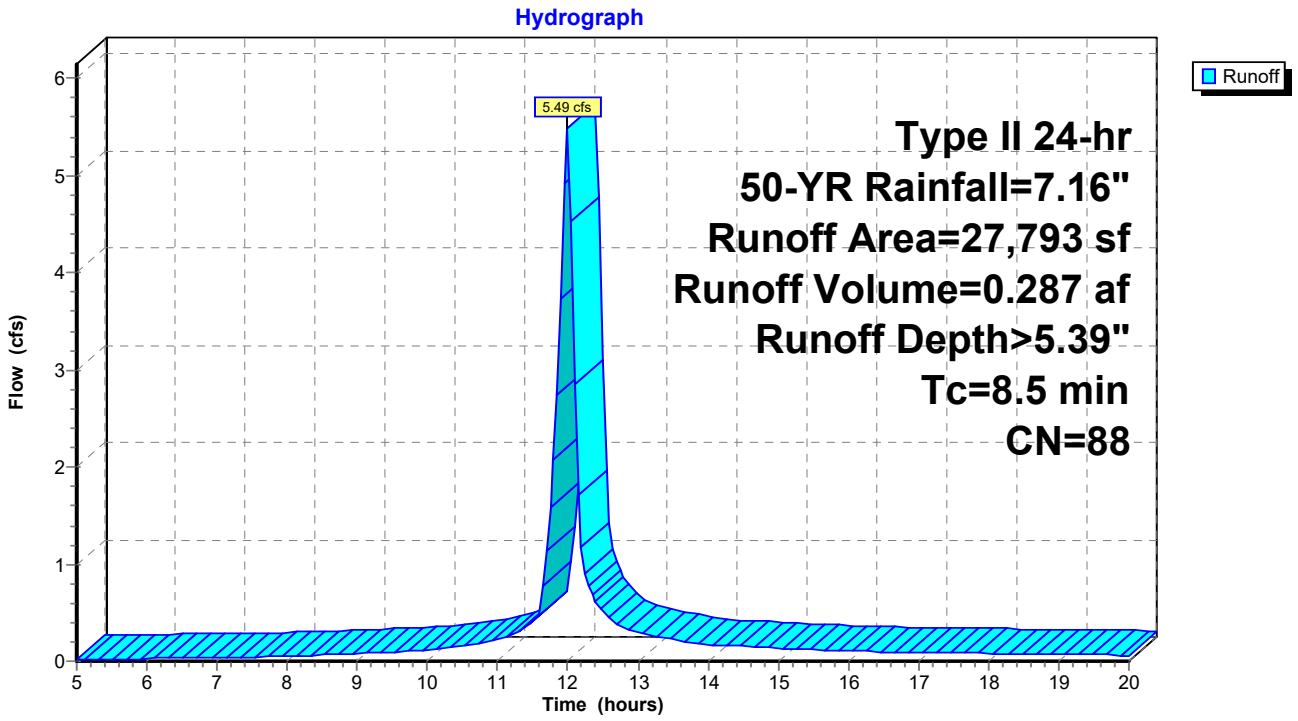
Runoff = 5.49 cfs @ 11.99 hrs, Volume= 0.287 af, Depth> 5.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 50-YR Rainfall=7.16"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 27,793 | 88 | |
| | 27,793 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 8.5 | | | | | **Direct Entry,** |

## Subcatchment BMP DA: PR



## Summary for Subcatchment BYPASS: PR

[49] Hint: Tc<2dt may require smaller dt

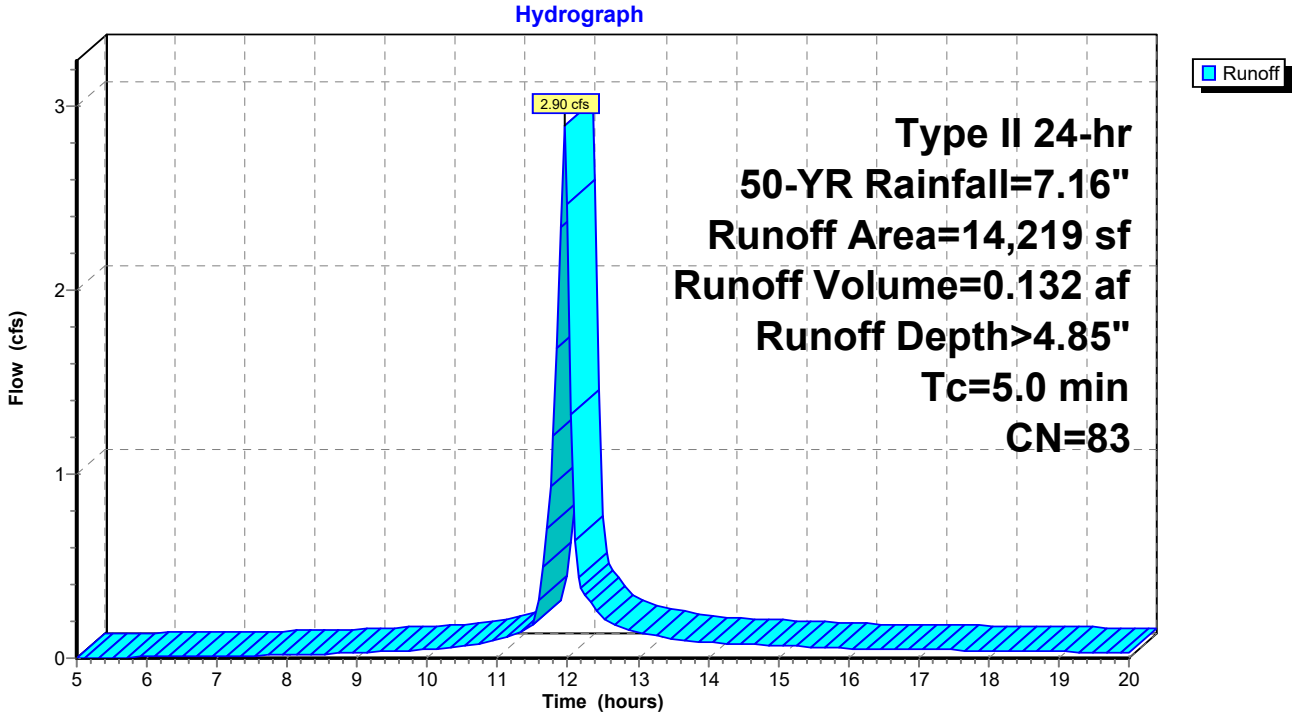
Runoff = 2.90 cfs @ 11.95 hrs, Volume= 0.132 af, Depth> 4.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 50-YR Rainfall=7.16"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 14,219 | 83 | |
| | 14,219 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

### Subcatchment BYPASS: PR



## Summary for Subcatchment EX: EX

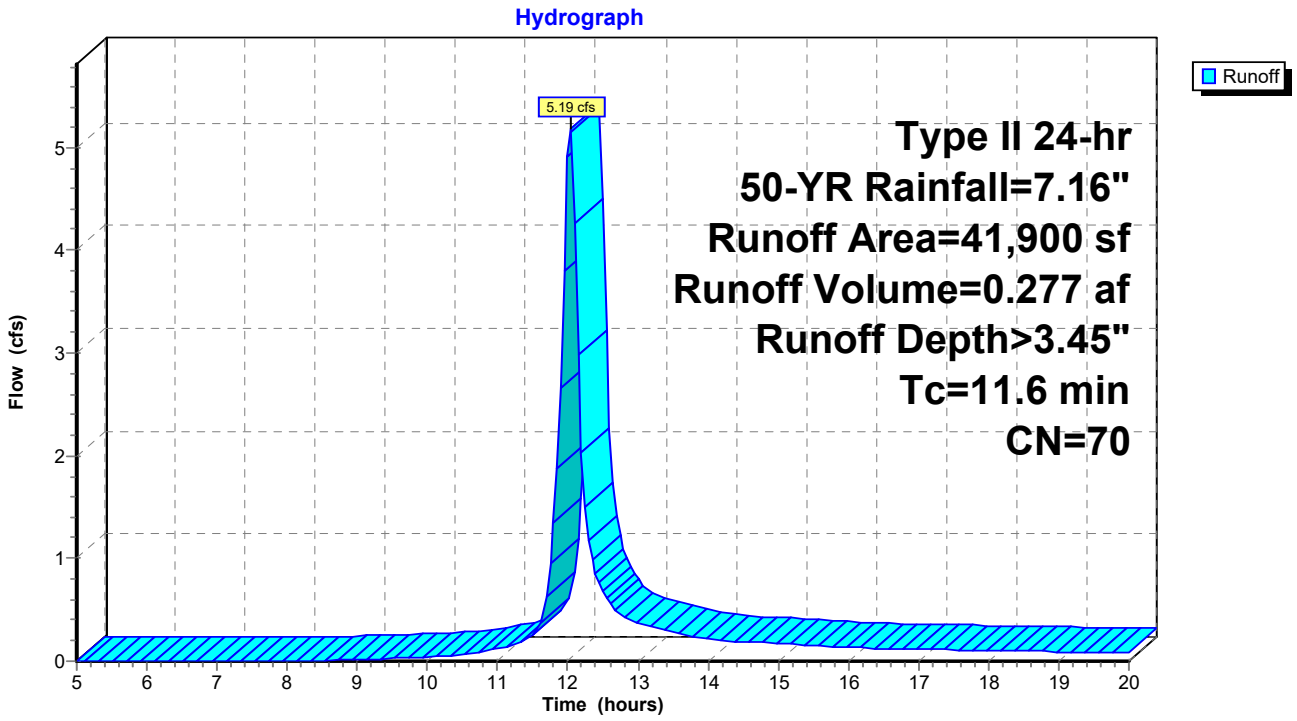
Runoff = 5.19 cfs @ 12.04 hrs, Volume= 0.277 af, Depth> 3.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 50-YR Rainfall=7.16"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 41,900 | 70 | |
| | 41,900 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 11.6 | | | | | **Direct Entry,** |

### Subcatchment EX: EX



## Summary for Pond BMP: PR

[82] Warning: Early inflow requires earlier time span

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 0.638 ac, | 0.00% Impervious, | Inflow Depth > | 5.39" | for 50-YR event |
| Inflow = | 5.49 cfs @ | 11.99 hrs, | Volume= | 0.287 af | |
| Outflow = | 2.66 cfs @ | 12.12 hrs, | Volume= | 0.187 af, | Atten= 52%, Lag= 7.3 min |
| Discarded = | 0.01 cfs @ | 7.00 hrs, | Volume= | 0.007 af | |
| Primary = | 2.65 cfs @ | 12.12 hrs, | Volume= | 0.180 af | |

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 62.09' @ 12.11 hrs Surf.Area= 2,075 sf Storage= 6,285 cf

Plug-Flow detention time= 135.7 min calculated for 0.187 af (65% of inflow)
Center-of-Mass det. time= 66.4 min ( 818.5 - 752.0 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 59.00' | 8,134 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc)<br>8,300 cf Overall x 98.0% Voids |

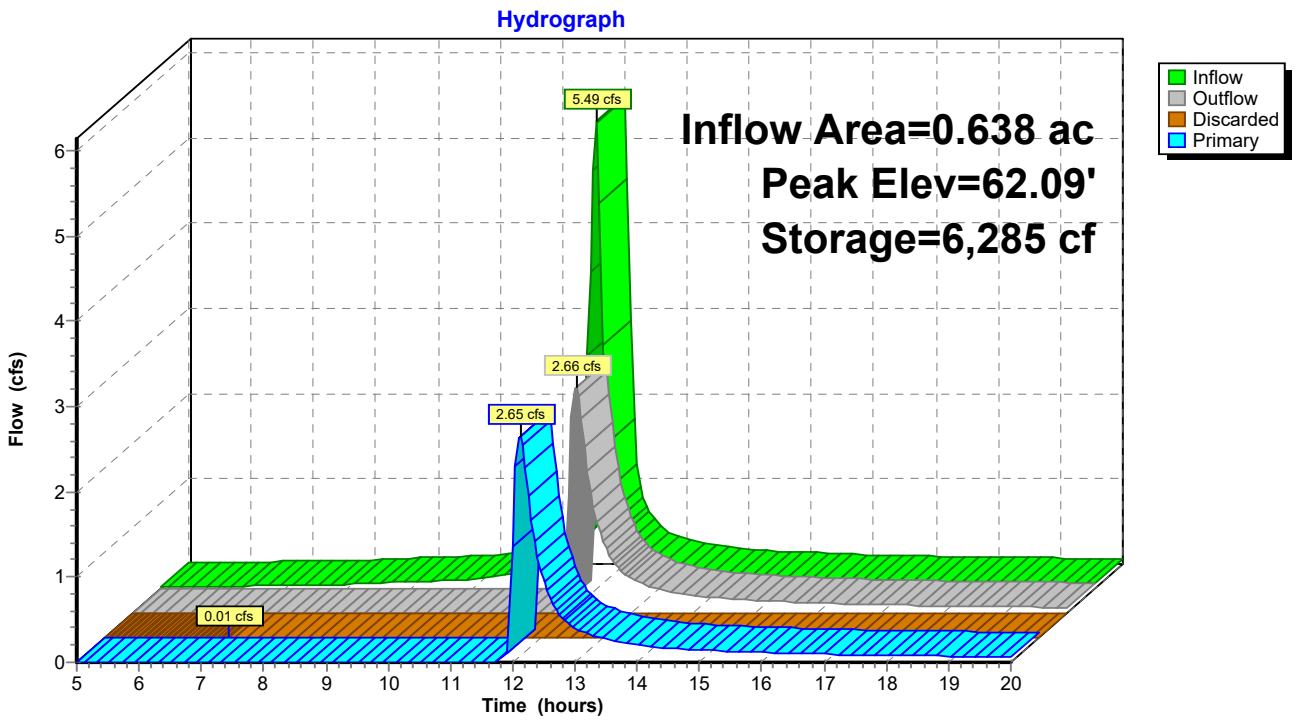
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 59.00 | 2,075 | 0 | 0 |
| 63.00 | 2,075 | 8,300 | 8,300 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 61.00' | **12.0" Round Outlet Pipe**<br>L= 52.0' RCP, groove end projecting, Ke= 0.200<br>Inlet / Outlet Invert= 61.00' / 60.75' S= 0.0048 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.79 sf |
| #2 | Discarded | 59.00' | **0.130 in/hr Exfiltration over Surface area** |
| #3 | Device 1 | 61.00' | **12.0" Vert. Orifice/Grate** C= 0.600 |
| #4 | Device 2 | 59.00' | **2.0" Vert. Orifice/Grate** C= 0.600 |
| #5 | Device 2 | 61.50' | **2.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

**Discarded OutFlow** Max=0.01 cfs @ 7.00 hrs HW=59.08' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.01 cfs)
  ├─**4=Orifice/Grate** (Passes 0.01 cfs of 0.01 cfs potential flow)
  └─**5=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

**Primary OutFlow** Max=2.61 cfs @ 12.12 hrs HW=62.08' (Free Discharge)
└─**1=Outlet Pipe** (Barrel Controls 2.61 cfs @ 3.84 fps)
  └─**3=Orifice/Grate** (Passes 2.61 cfs of 2.87 cfs potential flow)

## Pond BMP: PR

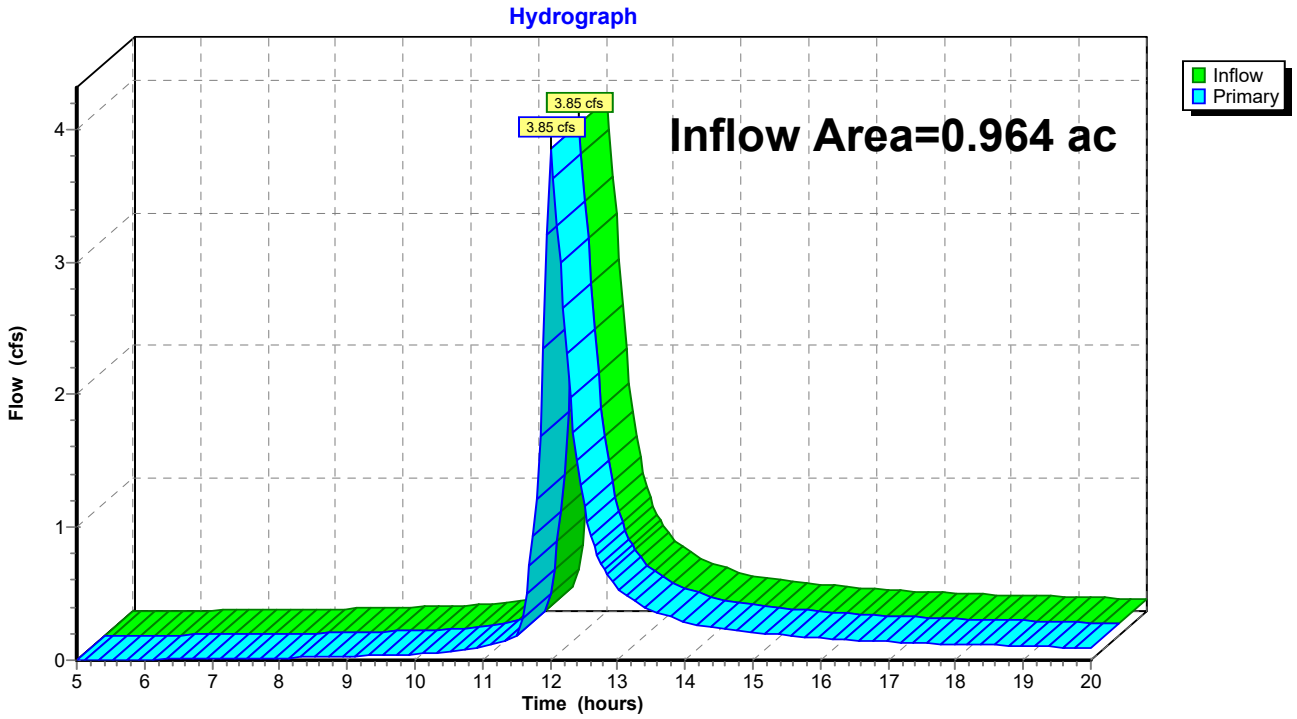

Hydrograph
Inflow
Outflow
Discarded
Primary
Inflow Area=0.638 ac
Peak Elev=62.09'
Storage=6,285 cf
5.49 cfs
2.66 cfs
2.65 cfs
0.01 cfs
Flow (cfs)
Time (hours)
0
1
2
3
4
5
6
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

## Summary for Link POI: PR

Inflow Area = 0.964 ac, 0.00% Impervious, Inflow Depth > 3.88" for 50-YR event
Inflow = 3.85 cfs @ 12.01 hrs, Volume= 0.312 af
Primary = 3.85 cfs @ 12.01 hrs, Volume= 0.312 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

## Link POI: PR



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**SubcatchmentBMP DA: PR** Runoff Area=27,793 sf 0.00% Impervious Runoff Depth>6.55"
Tc=8.5 min CN=88 Runoff=6.59 cfs 0.348 af

**SubcatchmentBYPASS: PR** Runoff Area=14,219 sf 0.00% Impervious Runoff Depth>5.99"
Tc=5.0 min CN=83 Runoff=3.53 cfs 0.163 af

**SubcatchmentEX: EX** Runoff Area=41,900 sf 0.00% Impervious Runoff Depth>4.47"
Tc=11.6 min CN=70 Runoff=6.66 cfs 0.358 af

**Pond BMP: PR** Peak Elev=62.51' Storage=7,138 cf Inflow=6.59 cfs 0.348 af
Discarded=0.01 cfs 0.007 af Primary=3.41 cfs 0.240 af Outflow=3.42 cfs 0.248 af

**Link POI: PR** Inflow=5.79 cfs 0.403 af
Primary=5.79 cfs 0.403 af

**Total Runoff Area = 1.926 ac Runoff Volume = 0.869 af Average Runoff Depth = 5.42"**
**100.00% Pervious = 1.926 ac 0.00% Impervious = 0.000 ac**

## Summary for Subcatchment BMP DA: PR

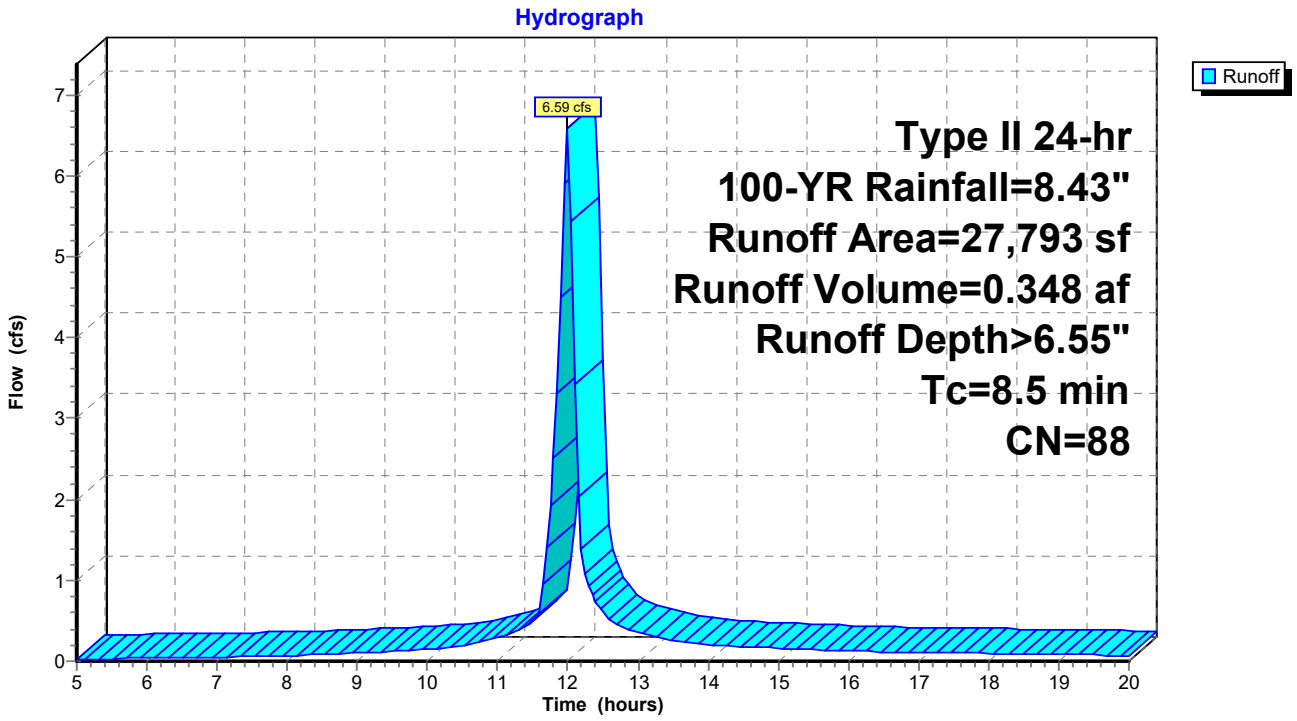
Runoff = 6.59 cfs @ 11.99 hrs, Volume= 0.348 af, Depth> 6.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YR Rainfall=8.43"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 27,793 | 88 | |
| | 27,793 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 8.5 | | | | | **Direct Entry,** |

## Subcatchment BMP DA: PR



## Summary for Subcatchment BYPASS: PR

[49] Hint: Tc<2dt may require smaller dt

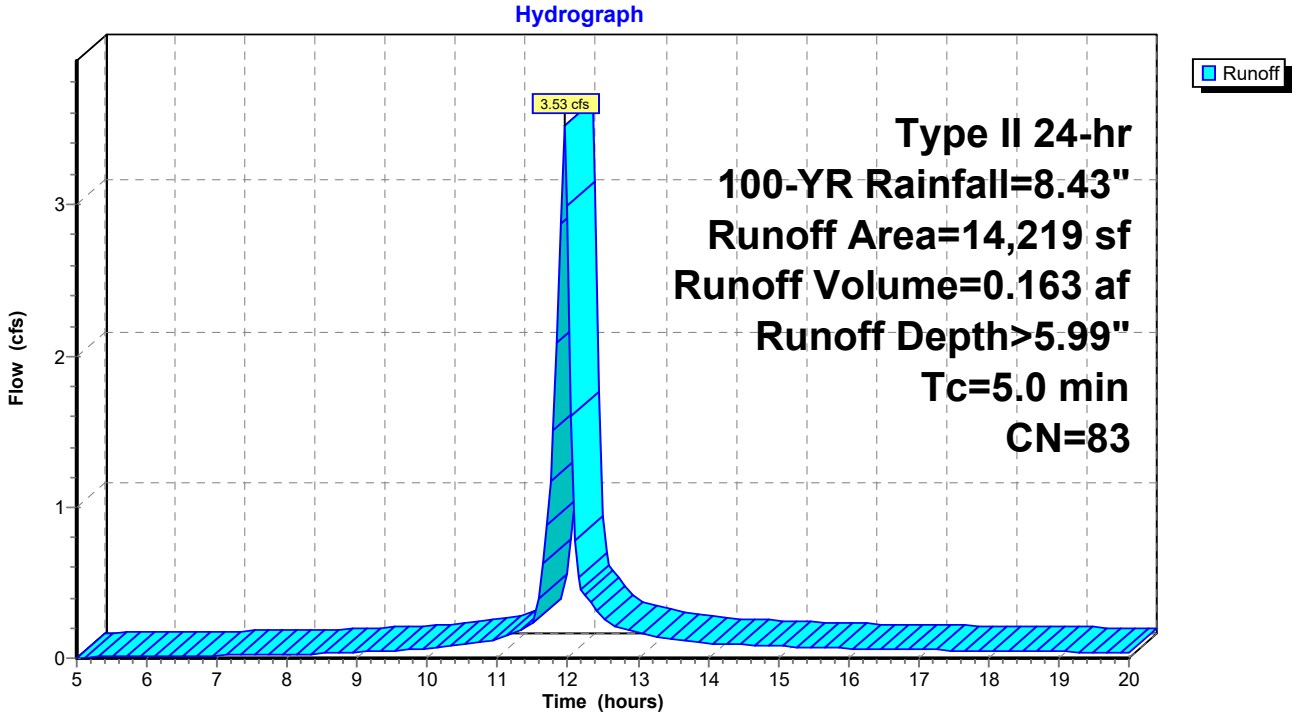
Runoff = 3.53 cfs @ 11.95 hrs, Volume= 0.163 af, Depth> 5.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YR Rainfall=8.43"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 14,219 | 83 | |
| | 14,219 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

### Subcatchment BYPASS: PR



## Summary for Subcatchment EX: EX

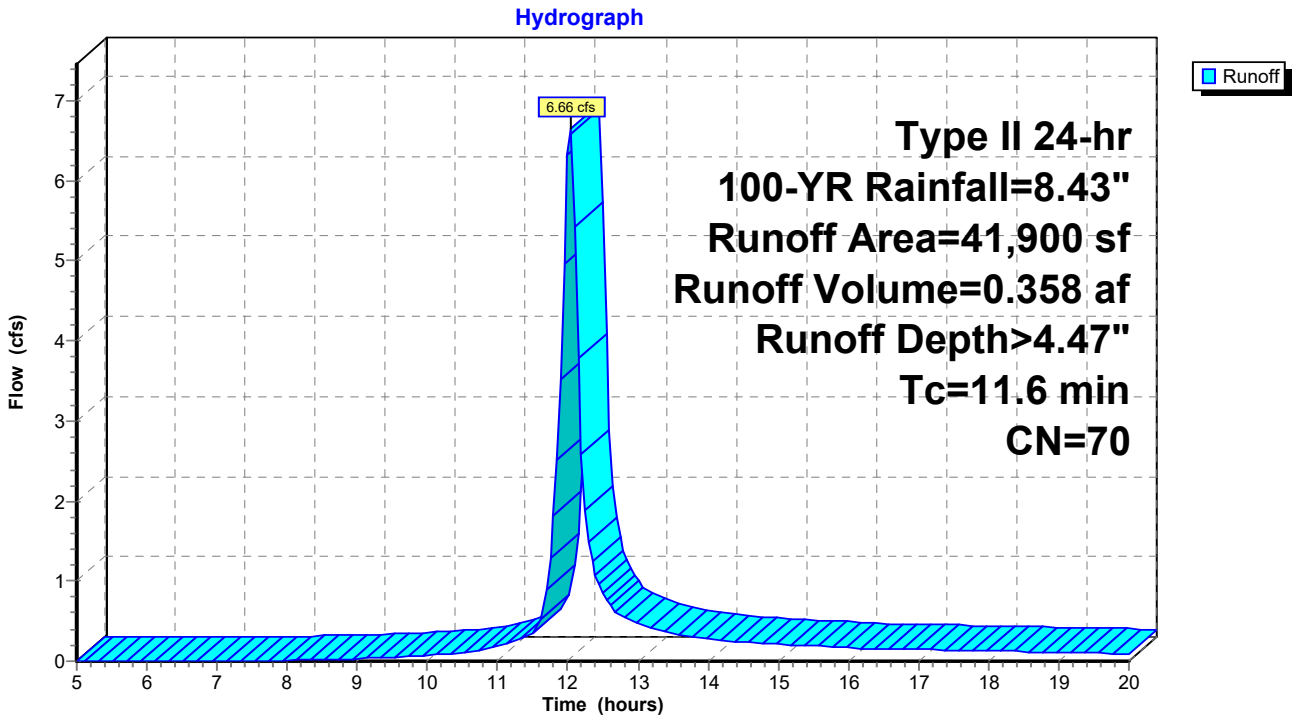
Runoff = 6.66 cfs @ 12.03 hrs, Volume= 0.358 af, Depth> 4.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YR Rainfall=8.43"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 41,900 | 70 | |
| | 41,900 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 11.6 | | | | | **Direct Entry,** |

## Subcatchment EX: EX



## Summary for Pond BMP: PR

[82] Warning: Early inflow requires earlier time span

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 0.638 ac, | 0.00% Impervious, | Inflow Depth > | 6.55" | for 100-YR event |
| Inflow = | 6.59 cfs @ | 11.99 hrs, | Volume= | 0.348 af | |
| Outflow = | 3.42 cfs @ | 12.11 hrs, | Volume= | 0.248 af, | Atten= 48%, Lag= 6.8 min |
| Discarded = | 0.01 cfs @ | 6.45 hrs, | Volume= | 0.007 af | |
| Primary = | 3.41 cfs @ | 12.11 hrs, | Volume= | 0.240 af | |

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 62.51' @ 12.11 hrs Surf.Area= 2,075 sf Storage= 7,138 cf

Plug-Flow detention time= 124.3 min calculated for 0.248 af (71% of inflow)
Center-of-Mass det. time= 59.9 min ( 808.4 - 748.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 59.00' | 8,134 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc)<br>8,300 cf Overall x 98.0% Voids |

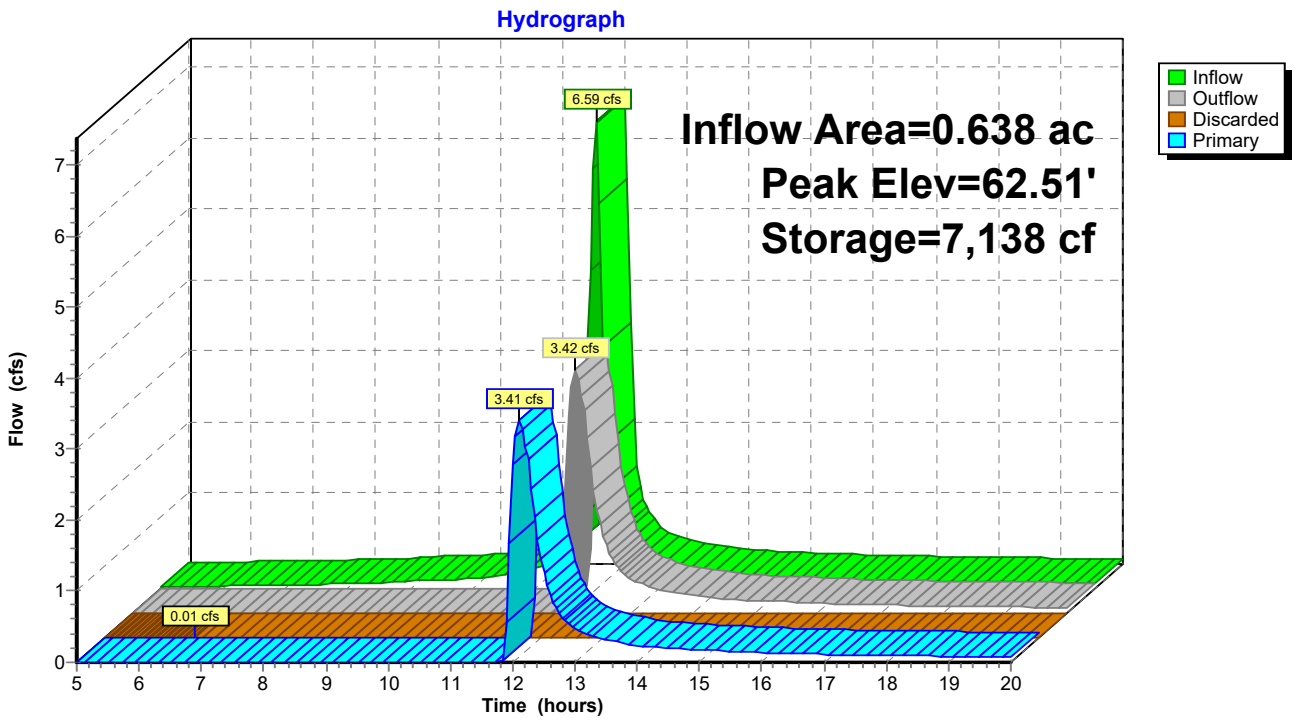
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 59.00 | 2,075 | 0 | 0 |
| 63.00 | 2,075 | 8,300 | 8,300 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 61.00' | **12.0" Round Outlet Pipe**<br>L= 52.0' RCP, groove end projecting, Ke= 0.200<br>Inlet / Outlet Invert= 61.00' / 60.75' S= 0.0048 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.79 sf |
| #2 | Discarded | 59.00' | **0.130 in/hr Exfiltration over Surface area** |
| #3 | Device 1 | 61.00' | **12.0" Vert. Orifice/Grate** C= 0.600 |
| #4 | Device 2 | 59.00' | **2.0" Vert. Orifice/Grate** C= 0.600 |
| #5 | Device 2 | 61.50' | **2.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

**Discarded OutFlow** Max=0.01 cfs @ 6.45 hrs HW=59.08' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.01 cfs)
  ├─**4=Orifice/Grate** (Passes 0.01 cfs of 0.01 cfs potential flow)
  └─**5=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

**Primary OutFlow** Max=3.39 cfs @ 12.11 hrs HW=62.50' (Free Discharge)
└─**1=Outlet Pipe** (Barrel Controls 3.39 cfs @ 4.32 fps)
  └─**3=Orifice/Grate** (Passes 3.39 cfs of 3.78 cfs potential flow)

## Pond BMP: PR


Hydrograph
Inflow
Outflow
Discarded
Primary
Inflow Area=0.638 ac
Peak Elev=62.51'
Storage=7,138 cf
6.59 cfs
3.42 cfs
3.41 cfs
0.01 cfs
Flow (cfs)
Time (hours)
0
1
2
3
4
5
6
7
5
6
7
8
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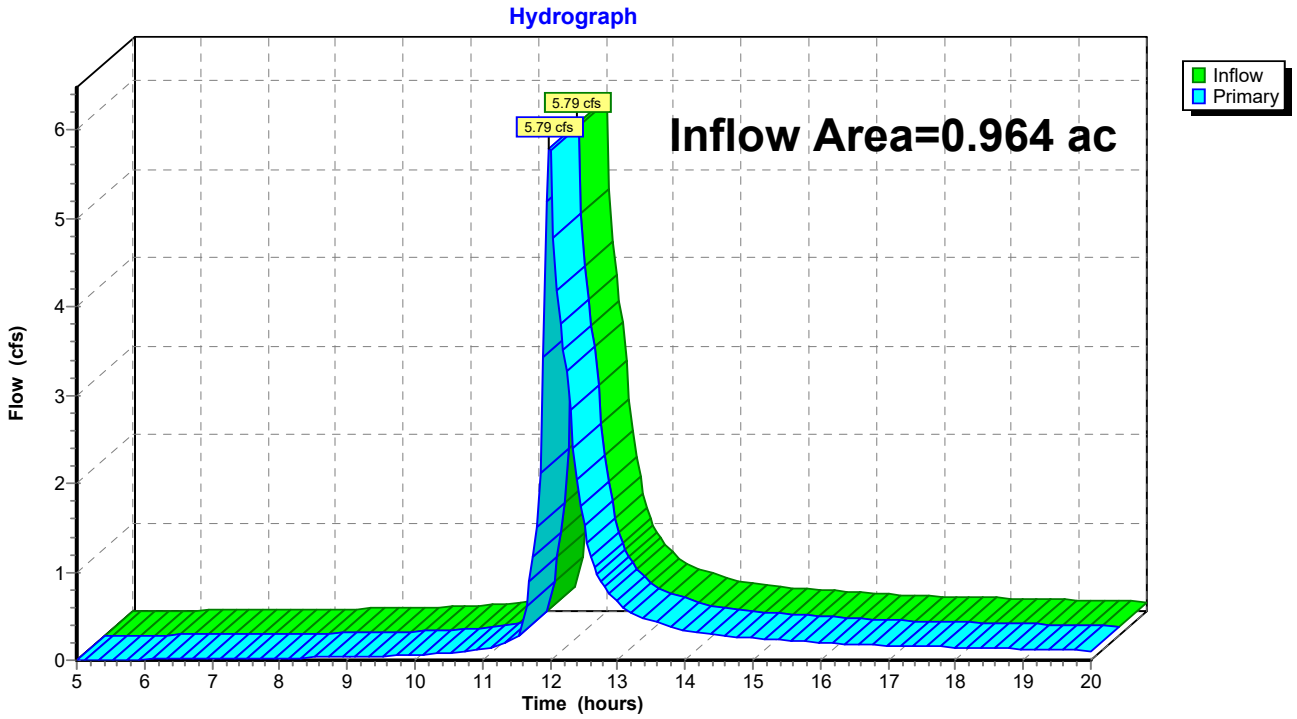
10
11
12
13
14
15
16
17
18
19
20

## Summary for Link POI: PR

Inflow Area = 0.964 ac, 0.00% Impervious, Inflow Depth > 5.02" for 100-YR event
Inflow = 5.79 cfs @ 11.99 hrs, Volume= 0.403 af
Primary = 5.79 cfs @ 11.99 hrs, Volume= 0.403 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

## Link POI: PR



# STORMTANK VOLUME CALCULATOR

StormTank Modules are designed around existing structures and tight constraints. To calculate max storage capacity, we recommend using our convenient volume calculator tool.

SPEC YOUR SYSTEM:

*SAVE*

WELCOME

*LOG IN* | *REGISTER*

SEND TO A PRO

## INPUTS

### PROJECTS & INPUTS INFORMATION

PROJECT NAME
Adelphia - Transco

ENGINEER
ATH

CITY
MARCUS HOOK

STATE / COUNTRY
Pennsylvania, United States

UNITS
US

LINER
No

LINER LOCATION
N/A

STACKING
Double

HEIGHTS
48

STONE STORAGE
All

POROSITY
40



# DIMENSIONS

## MODULE

FOOTPRINT
2075 sf

PERIMETER
217 ft

## EXCAVATION

FOOTPRINT
2525 sf

PERIMETER
233 ft

## STONE

LEVELING BED
1 ft

TOP BACKFILL
1 ft

COMPACTED FILL
1 ft

# RESULTS: CAPACITY

| | | |
|---|---|---|
| STONE STORAGE VOLUME | 2,740 | cf |
| MODULE STORAGE VOLUME | 7,982.76 | cf |
| TOTAL STORAGE VOLUME | 10,722.76 | cf |

*(Estimations include 10% for scrap and overlap)*

STORMTANK Expect Results

# RESULTS: QUANTITIES

| | | |
|---|---|---|
| REQUIRED EXCAVATION | 654.63 | cy |
| REQUIRED STONE | 253.70 | cy |
| ESTIMATED GEOTEXTILE | | |
| SURROUNDING MODULE | 619.51 | sy |
| SURROUNDING EXCAVATING | 796.05 | sy |
| ESTIMATED LINER | 0 | sf |

*(Estimations include 10% for scrap and overlap)*

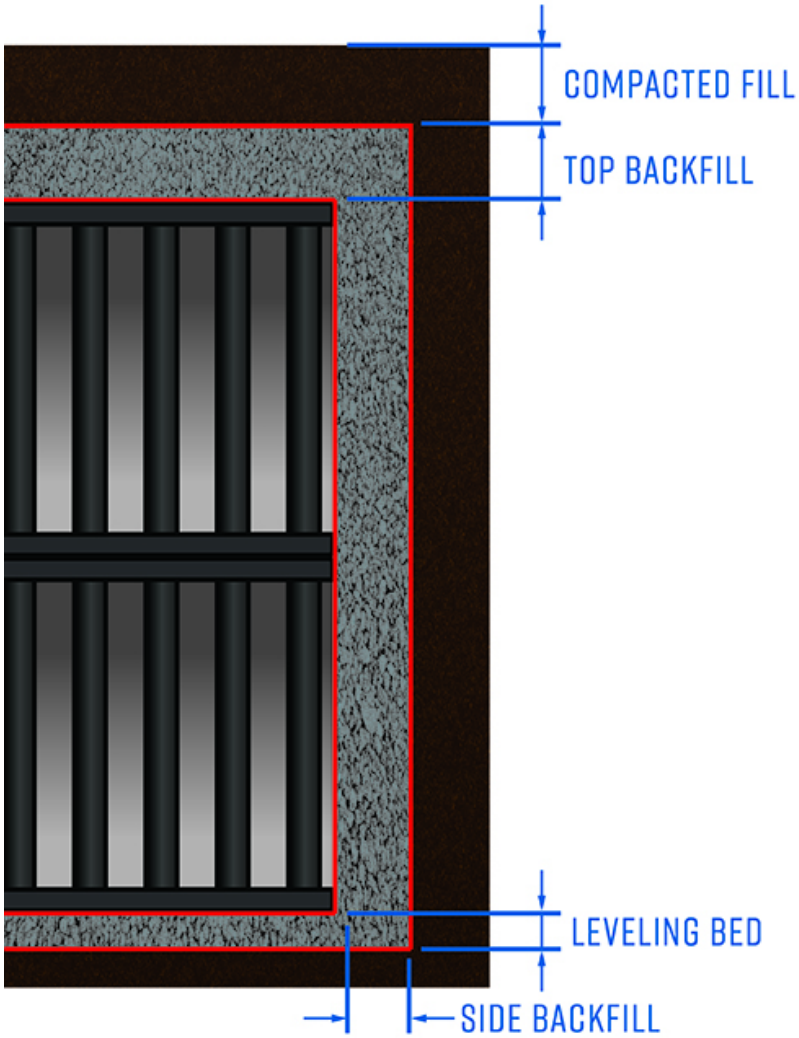
# RESULTS: BASIN DETAIL

## COMPONENT QUANTITIES

| | BOTTOM LAYER | TOP LAYER | TOTAL |
|---|---|---|---|
| HEIGHT | 18 | 30 | 48 |
| # OF MODULES | 461 | 461 | 922 |
| # OF PLATENS | 922 | 922 | 1,844 |
| # OF SIDE PANELS | 145 | 145 | 289 |
| # OF COLUMNS | 3,689 | 3,689 | 7,378 |
| # OF STACKING PINS | 922 | N/A | 922 |

# RESULTS: BASIN DETAIL

## CROSS-SECTION


COMPACTED FILL
TOP BACKFILL
LEVELING BED
SIDE BACKFILL

## SYSTEMS

*MODULE*

*PACK*

*SHIELD*

## ABOUT

*OUR PROCESS*

*ABOUT US*

*SUBMIT AN IDEA*

*CONTACT US*

## FIND A PRO

## SPEC YOUR SYSTEM

## RESOURCES

## KNOWLEDGE CENTER

*BASICS OF DESIGNING AN UNDERGROUND INFILTRATION...*

*UNDERGROUND BASIN ALLOWS FOR LANDLOCKED EXPANSION*

*KICK BACK & RELAX*

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# Worksheet for Transco IN - 1

## Project Description

| | |
|---|---|
| Solve For | Efficiency |

## Input Data

| | | |
|---|---|---|
| Discharge | 0.38 | ft³/s |
| Slope | 0.04000 | ft/ft |
| Gutter Width | 8.00 | ft |
| Gutter Cross Slope | 0.11 | ft/ft |
| Road Cross Slope | 0.11 | ft/ft |
| Roughness Coefficient | 0.012 | |
| Grate Width | 2.00 | ft |
| Grate Length | 4.00 | ft |
| Grate Type | P-50 mm (P-1-7/8") | |
| Clogging | 50.00 | % |

## Options

| | |
|---|---|
| Grate Flow Option | Exclude None |

## Results

| | | |
|---|---|---|
| Efficiency | 100.00 | % |
| Intercepted Flow | 0.38 | ft³/s |
| Bypass Flow | 0.00 | ft³/s |
| Spread | 1.20 | ft |
| Depth | 0.13 | ft |
| Flow Area | 0.08 | ft² |
| Gutter Depression | 0.00 | ft |
| Total Depression | 0.00 | ft |
| Velocity | 4.83 | ft/s |
| Splash Over Velocity | 8.13 | ft/s |
| Frontal Flow Factor | 1.00 | |
| Side Flow Factor | 0.18 | |
| Grate Flow Ratio | 1.00 | |
| Active Grate Length | 2.00 | ft |

# Worksheet for Transco IN - 2

## Project Description

| | |
|---|---|
| Solve For | Spread |

## Input Data

| | | |
|---|---|---|
| Discharge | 1.58 | $ft^3/s$ |
| Gutter Width | 8.00 | ft |
| Gutter Cross Slope | 0.04 | ft/ft |
| Road Cross Slope | 0.04 | ft/ft |
| Grate Width | 2.00 | ft |
| Grate Length | 4.00 | ft |
| Local Depression | 0.50 | in |
| Local Depression Width | 4.00 | ft |
| Grate Type | P-50 mm (P-1-7/8") | |
| Clogging | 50.00 | % |

## Results

| | | |
|---|---|---|
| Spread | 6.60 | ft |
| Depth | 0.23 | ft |
| Gutter Depression | 0.00 | ft |
| Total Depression | 0.04 | ft |
| Open Grate Area | 3.60 | $ft^2$ |
| Active Grate Weir Length | 6.00 | ft |

# Worksheet for Transco IN - 3

## Project Description

| | |
|---|---|
| Solve For | Spread |

## Input Data

| | | |
|---|---|---|
| Discharge | 0.73 | ft³/s |
| Gutter Width | 4.00 | ft |
| Gutter Cross Slope | 0.01 | ft/ft |
| Road Cross Slope | 0.01 | ft/ft |
| Grate Width | 2.00 | ft |
| Grate Length | 4.00 | ft |
| Local Depression | 0.50 | in |
| Local Depression Width | 4.00 | ft |
| Grate Type | P-50 mm (P-1-7/8") | |
| Clogging | 50.00 | % |

## Results

| | | |
|---|---|---|
| Spread | 20.39 | ft |
| Depth | 0.10 | ft |
| Gutter Depression | 0.00 | ft |
| Total Depression | 0.04 | ft |
| Open Grate Area | 3.60 | ft² |
| Active Grate Weir Length | 6.00 | ft |

# Worksheet for Transco Pipe from IN - 1

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Full Flow Diameter |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.00500 | ft/ft |
| Normal Depth | 0.62 | ft |
| Diameter | 0.62 | ft |
| Discharge | 0.38 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Diameter | 0.62 | ft |
| Normal Depth | 0.62 | ft |
| Flow Area | 0.30 | $ft^2$ |
| Wetted Perimeter | 1.95 | ft |
| Hydraulic Radius | 0.15 | ft |
| Top Width | 0.00 | ft |
| Critical Depth | 0.29 | ft |
| Percent Full | 100.0 | % |
| Critical Slope | 0.02406 | ft/ft |
| Velocity | 1.26 | ft/s |
| Velocity Head | 0.02 | ft |
| Specific Energy | 0.64 | ft |
| Froude Number | 0.00 | |
| Maximum Discharge | 0.41 | $ft^3/s$ |
| Discharge Full | 0.38 | $ft^3/s$ |
| Slope Full | 0.00499 | 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 Transco Pipe from IN - 1

## GVF Output Data

| | | |
|---|---|---|
| Normal Depth Over Rise | 100.00 | % |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.62 | ft |
| Critical Depth | 0.29 | ft |
| Channel Slope | 0.00500 | ft/ft |
| Critical Slope | 0.02406 | ft/ft |

# Worksheet for Transco Pipe from IN - 3

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Full Flow Diameter |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.024 | |
| Channel Slope | 0.00500 | ft/ft |
| Normal Depth | 0.73 | ft |
| Diameter | 0.73 | ft |
| Discharge | 0.60 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Diameter | 0.73 | ft |
| Normal Depth | 0.73 | ft |
| Flow Area | 0.42 | $ft^2$ |
| Wetted Perimeter | 2.31 | ft |
| Hydraulic Radius | 0.18 | ft |
| Top Width | 0.00 | ft |
| Critical Depth | 0.35 | ft |
| Percent Full | 100.0 | % |
| Critical Slope | 0.02285 | ft/ft |
| Velocity | 1.41 | ft/s |
| Velocity Head | 0.03 | ft |
| Specific Energy | 0.77 | ft |
| Froude Number | 0.00 | |
| Maximum Discharge | 0.65 | $ft^3/s$ |
| Discharge Full | 0.60 | $ft^3/s$ |
| Slope Full | 0.00500 | 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 Transco Pipe from IN - 3

## GVF Output Data

| | | |
|---|---|---|
| Normal Depth Over Rise | 100.00 | % |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.73 | ft |
| Critical Depth | 0.35 | ft |
| Channel Slope | 0.00500 | ft/ft |
| Critical Slope | 0.02285 | ft/ft |

**STANDARD E&S WORKSHEET #10**
**Rational Method**

**PROJECT NAME** Adelphia
**LOCATION:** Transco
**PREPARED BY:** AT **DATE:** 3/2/2020
**CHECKED BY:** ATH **DATE:** 3/2/2020

**DETERMINE WATERSHED "C" VALUE**

| Channel Number | Drainage Area Number | Type of Cover | C VALUE | AREA (acres) | (C X A) | $C_w$ |
|---|---|---|---|---|---|---|
| CH-2 | - | Woods | 0.2 | 0.31 | 0.06 | 0.26 |
| | - | Grass | 0.3 | 0.10 | 0.03 | |
| | - | Gravel | 0.6 | 0.04 | 0.02 | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

**DETERMINE INTENSITY:**

| Channel Number | Tc | R2 | R10 | I2 | I10 |
|---|---|---|---|---|---|
| CH-2 | 5.00 | - | - | - | 6.49 |
| | | | | | |
| | | | | | |

**DETERMINE PEAK RUNOFF RATES (Q = C I A)**

| Channel Number | C VALUE | I (in./hr.) | A (acres) | Q2 (cfs) | Q10 (cfs) |
|---|---|---|---|---|---|
| CH-3 | 0.26 | 6.49 | 0.46 | - | 0.76 |
| | | | | | |
| | | | | | |

**STANDARD E&S WORKSHEET #11**
**Channel Design Data**

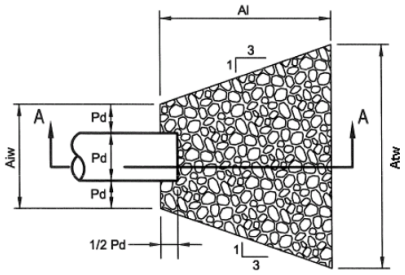
| | | | |
|---|---|---|---|
| **PROJECT NAME:** | Adelphia | | |
| **LOCATION:** | Transco | | |
| **PREPARED BY:** | RY | **DATE:** | 3/1/2019 |
| **CHECKED BY:** | ATH | **DATE:** | 3/19/2019 |

| | | | | | |
|---|---|---|---|---|---|
| **CHANNEL OR CHANNEL SECTION** | CH-2 | | | | |
| **TEMPORARY OR PERMANENT (T or P)** | PERM | | | | |
| **DESIGN STORM (2, 5, or 10 YR)** | 10 YR | | | | |
| **ACRES (AC)** | 0.53 | | | | |
| **MULTIPLIER (1.6, 2.25, or 2.75)[1]** | N/A | | | | |
| **Qr (REQUIRED CAPACITY) (CFS)** | 0.76 | | | | |
| **Q (CALCULATED AT FLOW DEPTH d) (CFS)** | 0.76 | | | | |
| **PROTECTIVE LINING [2]** | R-3 | | | | |
| **n (MANNING'S COEFFICIENT) [2]** | 0.065 | | | | |
| **Va (ALLOWABLE VELOCITY) (FPS)** | 6.50 | | | | |
| **V (CALCULATED AT FLOW DEPTH d) (FPS)** | 1.49 | | | | |
| **$t_a$ (MAX. ALLOWABLE SHEAR STRESS) (LB/FT$^2$)** | 1.00 | | | | |
| **td (SHEAR STRESS AT FLOW DEPTH d) (LB/FT2)** | 0.61 | | | | |
| **CHANNEL BOTTOM WIDTH (FT)** | 2 | | | | |
| **CHANNEL SIDE SLOPES (H:V)** | 3 | | | | |
| **D (TOTAL DEPTH) (FT)** | 0.70 | | | | |
| **CHANNEL TOP WIDTH @ D (FT)** | 6.18 | | | | |
| **d (CALCULATED FLOW DEPTH) (FT)** | 0.20 | | | | |
| **CHANNEL TOP WIDTH @ FLOW DEPTH d (FT)** | 3.18 | | | | |
| **BOTTOM WIDTH:DEPTH RATIO (12:1 MAX)** | 10.2 | | | | |
| **$d_{50}$ STONE SIZE (IN)** | 0.25 | | | | |
| **A (CROSS-SECTIONAL AREA) (SQ.FT.)** | 0.51 | | | | |
| **R (HYDRAULIC RADIUS)** | 0.16 | | | | |
| **S (BED SLOPE) [3] (FT/FT)** | 0.0500 | | | | |
| **$S_c$ (CRITICAL SLOPE) (FT/FT)** | 0.1158 | | | | |
| **0.7 $S_c$ (FT/FT)** | 0.0811 | | | | |
| **1.3 $S_c$ (FT/FT)** | 0.1506 | | | | |
| **STABLE FLOW (Y/N)** | Y | | | | |
| **FREEBOARD BASED ON UNSTABLE FLOW (FT)** | N/A | | | | |
| **FREEBOARD BASED ON STABLE FLOW (FT)** | 0.05 | | | | |
| **MINIMUM REQUIRED FREEBOARD [4] (FT)** | 0.5 | | | | |
| **DESIGN METHOD FOR PROTECTIVE LINING[5]** | V | | | | |

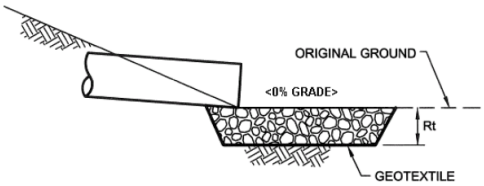
1. Use 1.6 for Temporary Channels; 2.25 for Temporary Channels in Special Protection (HQ or EV) Watersheds; 2.75 for Permanent Channels. For Rational Method, enter "N/A" and attach Worksheets 9 and 10. For TR-55, enter N/A" and attach appropriate Worksheets.
2. Adjust "n" value for changes in channel liner and flow depth. For vegetated channels, provide data for manufactured linings without vegetation and with vegetation in separate columns.
3. Slopes may not be averaged
4. Minumum Freeboard is 0.5 ft. OR 1/4 Total Channel Depth, whichever is greater
5. Permissible velocity lining design method is not acceptable for channels with a bed slope of 10% or greater. Shear stress lining design method is required for channels with a bed slope of 10% or greater. Shear stress lining design method may be used for any channel bed slope.

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

PROJECT NAME: Adelphia Gateway
LOCATION: Transco Meter Station
PREPARED BY: RRY DATE: 04/19/19
CHECKED BY: ATH DATE: 05/16/19




PLAN VIEW



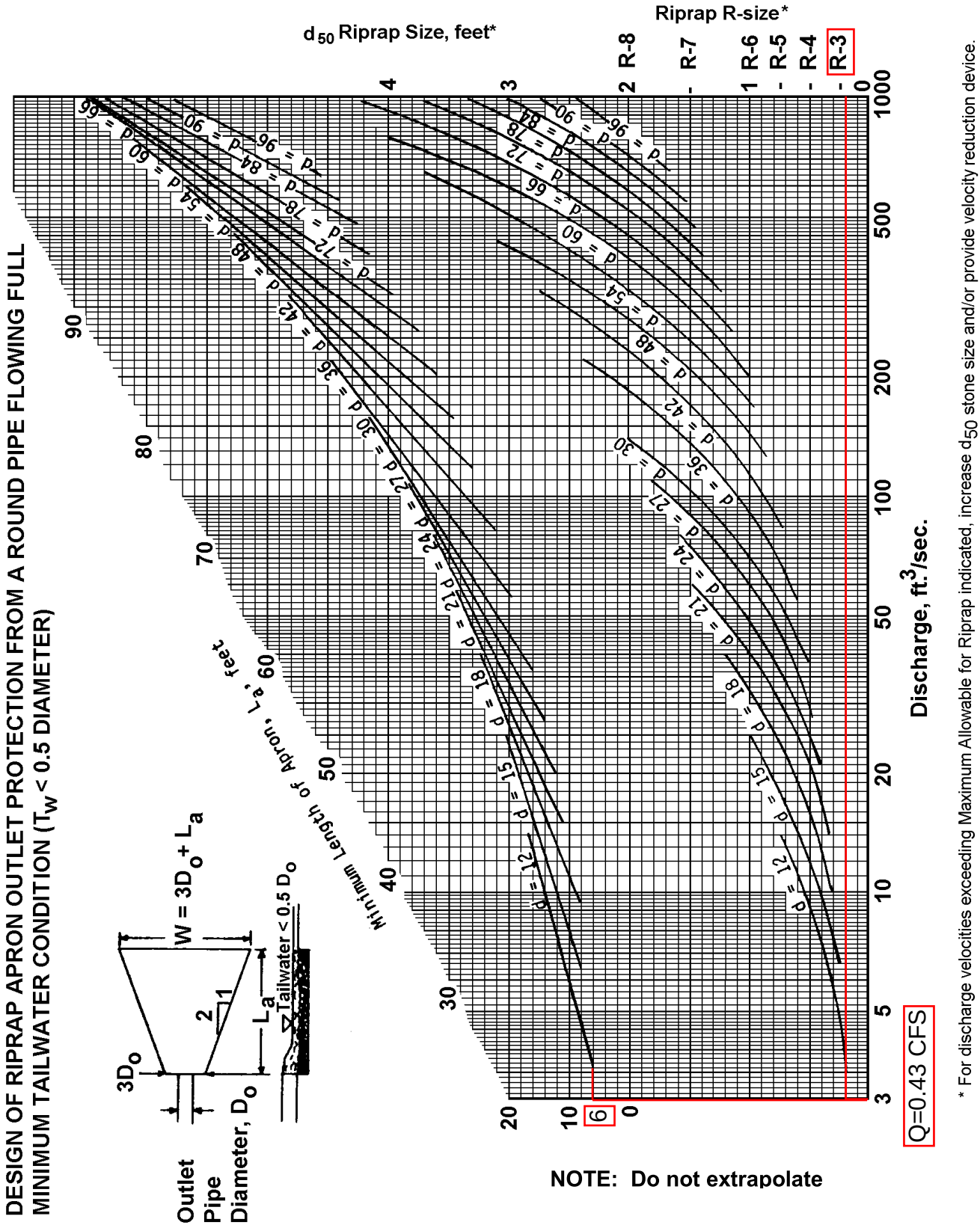

SECTION A - A

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| T-1 | 12 | MAX | 0.012 | 0.005 | 0.46 | 0.586 | R-3 | 12 | 6 | 3 | 5.4 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

***: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 > 0.05 ft/ft.**

# FIGURE 9.3
## Riprap Apron Design, Minimum Tailwater Condition

Transco Meter Station




* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase $d_{50}$ stone size and/or provide velocity reduction device.

Adapted from USDA - NRCS

**Not to be used for Box Culverts**

# Marcus Hook Compressor Station

Project: Adelphia
Subject: Marcus Hook Compressor Station
Computed By: RRY Date: 2/5/2019

Job No. 18-00672-005
Sheet No. 1 of 1
Checked By: ATH Date: 3/19/2019

Check one: ☑ Present ☐ Developed

**MARCUS HOOK COMPRESSOR STATION STATION: EXISTING CONDITIONS WITHIN LOD**

## 1. Runoff curve number

| Soil name and hydrologic group | Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio | CN Table 2-2a | CN | CN | Area ☒ acres ☐ mi2 ☐ % | Product of CN x area |
|---|---|---|---|---|---|---|
| D | Impervious | 98 | | | 0.56 | 55.274 |
| D | Meadow | 78 | | | 1.25 | 97.171 |
| D | Gravel | 91 | | | 4.42 | 402.136 |
| | | | | **Totals** ➡ | 6.23 | 554.58 |

CN(weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{554.58}{6.23} = 89.03$ ; **Use CN** ➡ 89

## 2. Runoff

| | Storm #1 | Storm #2 | Storm #3 | Storm #4 |
|---|---|---|---|---|
| Frequency ..... yr | 2-YR | 10-YR | 50-YR | 100-YR |
| Rainfall, P (24-hour) ..... in | 3.40 | 4.95 | 7.16 | 8.43 |
| Runoff, Q ..... in | 2.27 | 3.73 | 5.87 | 7.11 |

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S}$$

$$I_a = 0.2S \qquad S = \frac{1000}{CN} - 10$$

(SCS Method)

Project: Adelphia Job No. 18-00672-005
Subject: Marcus Hook Compressor Station LOD Sheet No. 1 of 3
Computed By: RRY Date: 2/5/2019 Checked By: ATH Date: 3/19/2019

Check one: ☐ Present ☑ Developed

**MARCUS HOOK COMPRESSOR STATION: PROPOSED CONDITIONS WITHIN LOD**

## 1. Runoff curve number

| Soil name and hydrologic group | Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio | CN Table 2-2a | CN | CN | Area ☒ acres ☐ mi2 ☐ % | Product of CN x area |
|---|---|---|---|---|---|---|
| D | Impervious | 98 | | | 1.387 | 135.954 |
| D | Gravel | 91 | | | 3.983 | 362.452 |
| D | Open Space, Good | 80 | | | 0.859 | 68.689 |
| | | | | **Totals** | 6.23 | 567.09 |

CN(weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{567.09}{6.23} = 91.04$ ; **Use CN** 91

## 2. Runoff

| | Storm #1 | Storm #2 | Storm #3 | Storm #4 |
|---|---|---|---|---|
| Frequency ..... yr | 2-YR | 10-YR | 50-YR | 100-YR |
| Rainfall, P (24-hour) ..... in | 3.40 | 4.95 | 7.16 | 8.43 |
| Runoff, Q ..... in | 2.45 | 3.94 | 6.10 | 7.35 |

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S}$$

$$I_a = 0.2S \qquad S = \frac{1000}{CN} - 10$$

(SCS Method)

Project: Adelphia Job No._18-00672-005_____
Subject: Marcus Hook Compressor Station BMP Sheet No.___2___ of ___3___
Computed By: RRY Date: 2/5/2019 Checked By: ATH Date: 3/19/2019

Check one: ☐ Present ☑ Developed

**MARCUS HOOK COMPRESSOR STATION: PROPOSED CONDITIONS TO BMP**

## 1. Runoff curve number

| Soil name and hydrologic group | Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio | CN Table 2-2a | CN | CN | Area ☒ acres ☐ mi2 ☐ % | Product of CN x area |
|---|---|---|---|---|---|---|
| D | Impervious | 98 | | | 0.483 | 47.353 |
| D | Gravel | 91 | | | 1.133 | 103.100 |
| D | Open Space, Good | 80 | | | 0.588 | 47.010 |
| | | | | **Totals** ➡ | 2.20 | 197.46 |

CN(weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{197.46}{2.20} = 89.60$ ; **Use CN** ➡ 90

## 2. Runoff

| | Storm #1 | Storm #2 | Storm #3 | Storm #4 |
|---|---|---|---|---|
| Frequency ..... yr | 2-YR | 10-YR | 50-YR | 100-YR |
| Rainfall, P (24-hour) ..... in | 3.40 | 4.95 | 7.16 | 8.43 |
| Runoff, Q ..... in | 2.32 | 3.79 | 5.93 | 7.18 |

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S}$$

$$I_a = 0.2S \qquad S = \frac{1000}{CN} - 10$$

(SCS Method)

Project: Adelphia Job No. 18-00672-005
Subject: Marcus Hook Compressor Station Bypass Sheet No. 3 of 3
Computed By: RRY Date: 2/5/2019 Checked By: ATH Date: 3/19/2019

Check one: ☐ Present ☑ Developed

**MARCUS HOOK COMPRESSOR STATION: PROPOSED CONDITIONS (BYPASS)**

## 1. Runoff curve number

| Soil name and hydrologic group | Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio | CN Table 2-2a | CN | CN | Area ☒ acres ☐ mi2 ☐ % | Product of CN x area |
|---|---|---|---|---|---|---|
| D | Impervious | 98 | | | 0.904 | 88.600 |
| D | Gravel | 91 | | | 2.850 | 259.352 |
| D | Open Space, Good | 80 | | | 0.271 | 21.679 |
| | | | | **Totals** | 4.03 | 369.63 |

CN(weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{369.63}{4.03} = 91.83$ ; **Use CN** 92

## 2. Runoff

| | Storm #1 | Storm #2 | Storm #3 | Storm #4 |
|---|---|---|---|---|
| Frequency ..... yr | 2-YR | 10-YR | 50-YR | 100-YR |
| Rainfall, P (24-hour) ..... in | 3.40 | 4.95 | 7.16 | 8.43 |
| Runoff, Q ..... in | 2.53 | 4.02 | 6.19 | 7.45 |

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S}$$

$$I_a = 0.2S \qquad S = \frac{1000}{CN} - 10$$

(SCS Method)

# Worksheet 3: Time of concentration ($T_c$) or travel time ($T_t$)

| | | | | | |
|---|---|---|---|---|---|
| Project | Adelphia | By | RRY | Date | 2/5/2019 |
| Location | Marcus Hook Compressor Station - BMP | Checked | ATH | Date | 3/19/2019 |

Circle one: Present (Developed)

Circle one: ($T_c$) $T_t$

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Sheet flow calculated using Rational Method Nomograph.
Include a map, schematic, or description of flow segments.

| Sheet Flow (Applicable to $T_c$ only) | | Segment ID | L1 | | | | |
|---|---|---|---|---|---|---|---|
| 1. Surface description (table 3-1) | | | Gravel | | | | |
| 2. Manning's roughness coeff., n (table 3-1) | | | 0.01 | | | | |
| 3. Flow length, L (total L < 150 ft) | | ft | 100.00 | | | | |
| 4. Two-yr 24-hr rainfall, P2 | | in | 3.40 | | | | |
| 5. Land slope, s | | ft/ft | 0.028 | | | | |
| 6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$ | Compute $T_t$ | hr | 0.017 | + | | = | 0.017 |

| Shallow Concentrated Flow | | Segment ID | L2 | | | | |
|---|---|---|---|---|---|---|---|
| 7. Surface description (paved or unpaved) | | | Unpaved | | | | |
| 8. Flow length, L | | ft | 137.30 | | | | |
| 9. Watercourse slope, s | | ft/ft | 0.031 | | | | |
| 10. Average velocity, V (figure 3-1) | | ft/s | 2.84 | | | | |
| 11. $T_t = \frac{L}{3600V}$ | Compute $T_t$ | hr | 0.013 | + | | = | 0.013 |

| Channel Flow | | Segment ID | | | | | |
|---|---|---|---|---|---|---|---|
| 12. Cross sectional flow area, a | | $ft^2$ | | | | | |
| 13. Wetted perimeter, $p_w$ | | ft | | | | | |
| 14. Hydraulic radius, $r = \frac{a}{p_w}$ | | ft | | | | | |
| 15. Channel slope, s | | ft/ft | | | | | |
| 16. Manning's roughness coeff., n | | | | | | | |
| 17. $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$ | Compute V | ft/s | | | | | |
| 18. Flow length, L | | ft | | | | | |
| 19. $T_t = \frac{L}{3600V}$ | Compute $T_t$ | hr | | + | | = | |

20. Watershed or subarea $T_c$ or $T_t$ (add $T_t$ in steps 6, 11, and 19) — Total min. 1.83

MIN (min) 5.00

# Worksheet 3: Time of concentration ($T_c$) or travel time ($T_t$)

| | | | | | |
|---|---|---|---|---|---|
| Project | Adelphia | By | RRY | Date | 2/5/2019 |
| Location | Marcus Hook Compressor Station - Bypass | Checked | ATH | Date | 3/19/2019 |

Circle one: Present (Developed)

Circle one: ($T_c$) $T_t$

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Sheet flow calculated using Rational Method Nomograph.
Include a map, schematic, or description of flow segments.

| Sheet Flow (Applicable to $T_c$ only) | | Segment ID | L1 | | | | |
|---|---|---|---|---|---|---|---|
| 1. Surface description (table 3-1) | | | Grass | | | | |
| 2. Manning's roughness coeff., n (table 3-1) | | | 0.15 | | | | |
| 3. Flow length, L (total L < 150 ft) | | ft | 37.60 | | | | |
| 4. Two-yr 24-hr rainfall, P2 | | in | 3.40 | | | | |
| 5. Land slope, s | | ft/ft | 0.160 | | | | |
| 6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}s^{0.4}}$ | Compute $T_t$ | hr | 0.032 | + | | = | 0.032 |

| Shallow Concentrated Flow | | Segment ID | L2 | | | | |
|---|---|---|---|---|---|---|---|
| 7. Surface description (paved or unpaved) | | | Unpaved | | | | |
| 8. Flow length, L | | ft | 406.40 | | | | |
| 9. Watercourse slope, s | | ft/ft | 0.032 | | | | |
| 10. Average velocity, V (figure 3-1) | | ft/s | 2.89 | | | | |
| 11. $T_t = \frac{L}{3600V}$ | Compute $T_t$ | hr | 0.039 | + | | = | 0.039 |

| Channel Flow | | Segment ID | L3 | | | | |
|---|---|---|---|---|---|---|---|
| 12. Cross sectional flow area, a | | $ft^2$ | 12.00 | | | | |
| 13. Wetted perimeter, $p_w$ | | ft | 12.65 | | | | |
| 14. Hydraulic radius, $r = \frac{a}{p_w}$ | | ft | 0.95 | | | | |
| | | | | | | | |
| 15. Channel slope, s | | ft/ft | 0.005 | | | | |
| 16. Manning's roughness coeff., n | | | 0.033 | | | | |
| 17. $V = \frac{1.49r^{2/3}s^{1/2}}{n}$ | Compute V | ft/s | 3.08 | | | | |
| | | | | | | | |
| 18. Flow length, L | | ft | 483.10 | | | | |
| 19. $T_t = \frac{L}{3600V}$ | Compute $T_t$ | hr | 0.044 | + | | = | 0.044 |

20. Watershed or subarea $T_c$ or $T_t$ (add $T_t$ in steps 6, 11, and 19)

| | |
|---|---|
| Total min. | 6.85 |
| MIN (min) | 5.00 |

# Worksheet 3: Time of concentration ($T_c$) or travel time ($T_t$)

| | | | | | |
|---|---|---|---|---|---|
| Project | Adelphia | By | RRY | Date | 2/5/2019 |
| Location | Marcus Hook Compressor Station | Checked | ATH | Date | 3/19/2019 |

Circle one: (Present) Developed

Circle one: ($T_c$) $T_t$

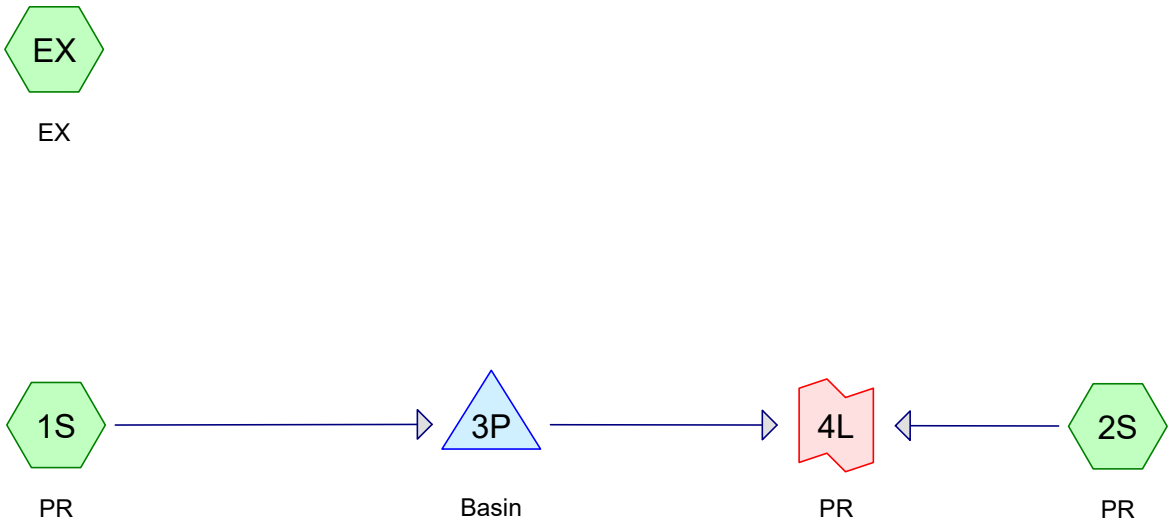
NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Sheet flow calculated using Rational Method Nomograph.
Include a map, schematic, or description of flow segments.

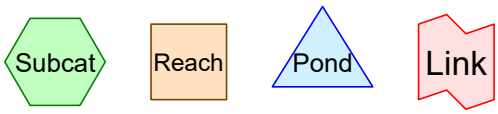
| Sheet Flow (Applicable to $T_c$ only) | | Segment ID | L1 | | | | |
|---|---|---|---|---|---|---|---|
| 1. Surface description (table 3-1) | | | Gravel | | | | |
| 2. Manning's roughness coeff., n (table 3-1) | | | 0.01 | | | | |
| 3. Flow length, L (total L < 150 ft) | | ft | 100.00 | | | | |
| 4. Two-yr 24-hr rainfall, P2 | | in | 3.40 | | | | |
| 5. Land slope, s | | ft/ft | 0.033 | | | | |
| 6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}s^{0.4}}$ | Compute $T_t$ | hr | 0.015 | + | | = | 0.015 |

| Shallow Concentrated Flow | | Segment ID | L2 | | | | |
|---|---|---|---|---|---|---|---|
| 7. Surface description (paved or unpaved) | | | Unpaved | | | | |
| 8. Flow length, L | | ft | 250.00 | | | | |
| 9. Watercourse slope, s | | ft/ft | 0.035 | | | | |
| 10. Average velocity, V (figure 3-1) | | ft/s | 3.02 | | | | |
| 11. $T_t = \frac{L}{3600V}$ | Compute $T_t$ | hr | 0.023 | + | | = | 0.023 |

| Channel Flow | | Segment ID | L3 | | | | |
|---|---|---|---|---|---|---|---|
| 12. Cross sectional flow area, a | | $ft^2$ | 12.00 | | | | |
| 13. Wetted perimeter, $p_w$ | | ft | 12.65 | | | | |
| 14. Hydraulic radius, $r = \frac{a}{p_w}$ | | ft | 0.95 | | | | |
| | | | | | | | |
| 15. Channel slope, s | | ft/ft | 0.005 | | | | |
| 16. Manning's roughness coeff., n | | | 0.033 | | | | |
| 17. $V = \frac{1.49r^{2/3}s^{1/2}}{n}$ | Compute V | ft/s | 3.08 | | | | |
| | | | | | | | |
| 18. Flow length, L | | ft | 483.10 | | | | |
| 19. $T_t = \frac{L}{3600V}$ | Compute $T_t$ | hr | 0.044 | + | | = | 0.044 |

| | | |
|---|---|---|
| 20. Watershed or subarea $T_c$ or $T_t$ (add $T_t$ in steps 6, 11, and 19) | Total min. | 4.88 |
| | MIN (min) | 5.00 |




**Routing Diagram for Marcus Hook_MRC**
Prepared by JMT, Printed 3/23/2020
HydroCAD® 10.00-20 s/n 08514 © 2017 HydroCAD Software Solutions LLC

## Area Listing (all nodes)

| Area (sq-ft) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 365,994 | 91 | Gravel (1S, 2S, EX) |
| 84,999 | 98 | Impervious (1S, 2S, EX) |
| 59,598 | 78 | Meadow (20% Imp & Gravel) (EX) |
| 37,401 | 80 | Open Space (1S, 2S) |
| **547,992** | **90** | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (sq-ft) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 0 | HSG A | |
| 0 | HSG B | |
| 0 | HSG C | |
| 0 | HSG D | |
| 547,992 | Other | 1S, 2S, EX |
| **547,992** | | **TOTAL AREA** |

## Ground Covers (all nodes)

| HSG-A (sq-ft) | HSG-B (sq-ft) | HSG-C (sq-ft) | HSG-D (sq-ft) | Other (sq-ft) | Total (sq-ft) | Ground Cover |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 365,994 | 365,994 | Gravel |
| 0 | 0 | 0 | 0 | 84,999 | 84,999 | Impervious |
| 0 | 0 | 0 | 0 | 59,598 | 59,598 | Meadow (20% Imp & Gravel) |
| 0 | 0 | 0 | 0 | 37,401 | 37,401 | Open Space |
| **0** | **0** | **0** | **0** | **547,992** | **547,992** | **TOTAL AREA** |

## Pipe Listing (all nodes)

| Line# | Node Number | In-Invert (feet) | Out-Invert (feet) | Length (feet) | Slope (ft/ft) | n | Diam/Width (inches) | Height (inches) | Inside-Fill (inches) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 3P | 26.00 | 25.75 | 55.0 | 0.0045 | 0.012 | 12.0 | 0.0 | 0.0 |

Time span=0.00-300.00 hrs, dt=0.05 hrs, 6001 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: PR** Runoff Area=95,997 sf 21.93% Impervious Runoff Depth=0.48"
Tc=5.0 min CN=87/98 Runoff=3.18 cfs 3,846 cf

**Subcatchment2S: PR** Runoff Area=175,333 sf 22.46% Impervious Runoff Depth=0.58"
Tc=6.8 min CN=90/98 Runoff=6.57 cfs 8,420 cf

**SubcatchmentEX: EX** Runoff Area=276,662 sf 8.88% Impervious Runoff Depth=0.43"
Tc=5.0 min CN=88/98 Runoff=8.46 cfs 9,903 cf

**Pond 3P: Basin** Peak Elev=25.52' Storage=3,846 cf Inflow=3.18 cfs 3,846 cf
Discarded=0.00 cfs 63 cf Primary=0.00 cfs 0 cf Outflow=0.00 cfs 63 cf

**Link 4L: PR** Inflow=6.57 cfs 8,420 cf
Primary=6.57 cfs 8,420 cf

**Total Runoff Area = 547,992 sf Runoff Volume = 22,169 cf Average Runoff Depth = 0.49"**
**84.49% Pervious = 462,993 sf 15.51% Impervious = 84,999 sf**

## Summary for Subcatchment 1S: PR

[49] Hint: Tc<2dt may require smaller dt

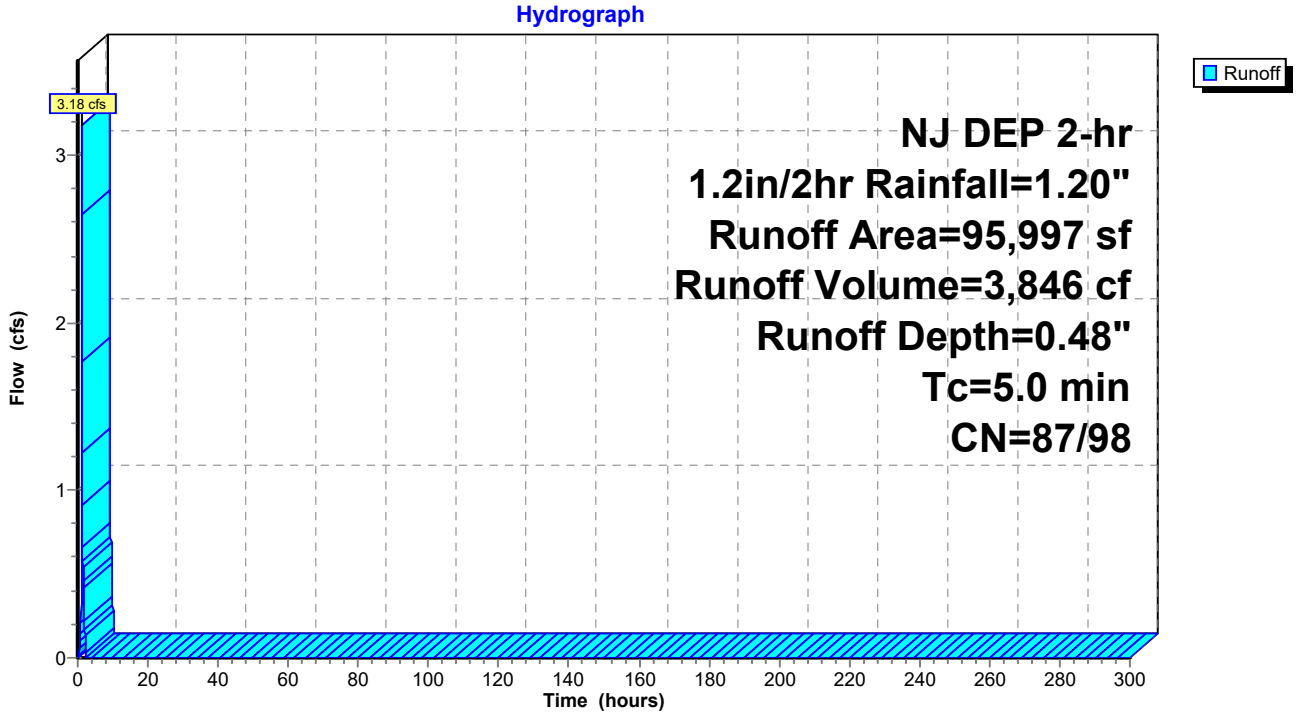
Runoff = 3.18 cfs @ 1.10 hrs, Volume= 3,846 cf, Depth= 0.48"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-300.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr 1.2in/2hr Rainfall=1.20"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 21,048 | 98 | Impervious |
| * | 49,352 | 91 | Gravel |
| * | 25,597 | 80 | Open Space |
| | 95,997 | 90 | Weighted Average |
| | 74,949 | 87 | 78.07% Pervious Area |
| | 21,048 | 98 | 21.93% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

### Subcatchment 1S: PR



## Hydrograph for Subcatchment 1S: PR

| Time (hours) | Precip. (inches) | Perv.Excess (inches) | Imp.Excess (inches) | Runoff (cfs) |
|---|---|---|---|---|
| 0.00 | **0.00** | **0.00** | **0.00** | **0.00** |
| 10.00 | **1.20** | **0.34** | **0.99** | **0.00** |
| 20.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 30.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 40.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 50.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 60.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 70.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 80.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 90.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 100.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 110.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 120.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 130.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 140.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 150.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 160.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 170.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 180.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 190.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 200.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 210.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 220.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 230.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 240.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 250.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 260.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 270.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 280.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 290.00 | 1.20 | 0.34 | 0.99 | 0.00 |
| 300.00 | 1.20 | 0.34 | 0.99 | 0.00 |

## Summary for Subcatchment 2S: PR

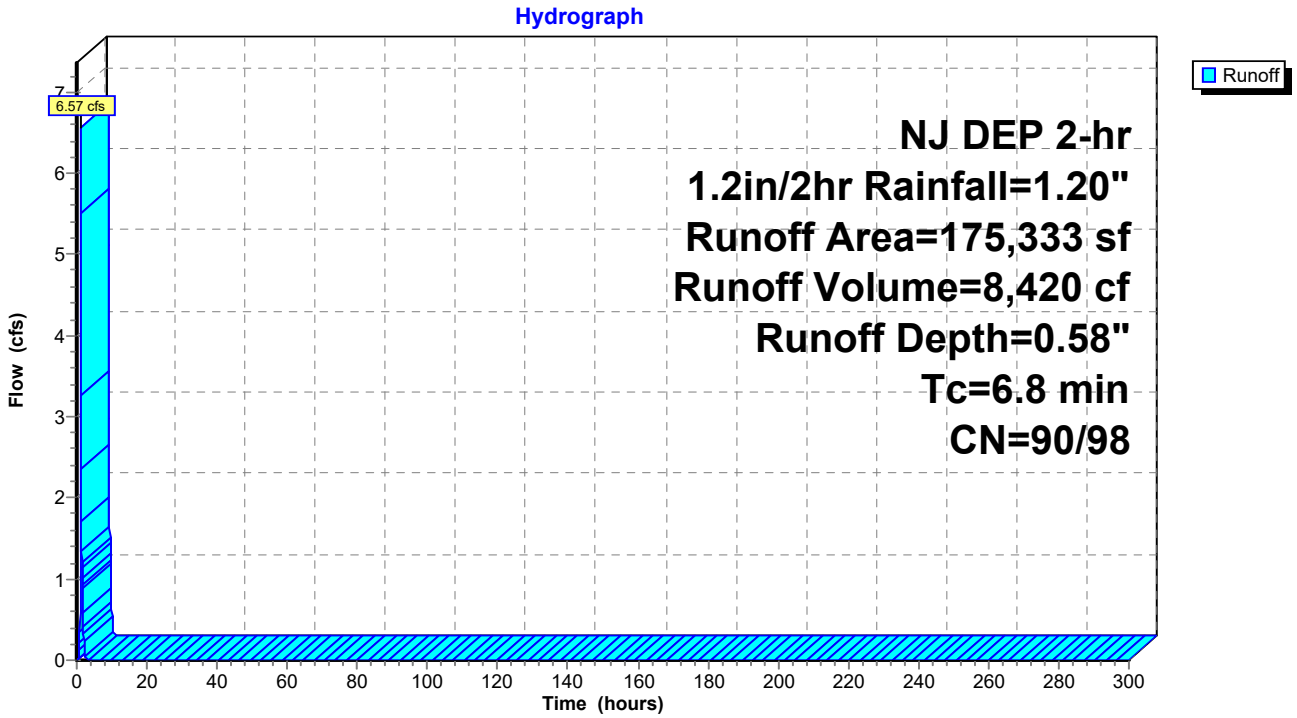
Runoff = 6.57 cfs @ 1.12 hrs, Volume= 8,420 cf, Depth= 0.58"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-300.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr 1.2in/2hr Rainfall=1.20"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 39,382 | 98 | Impervious |
| * | 124,147 | 91 | Gravel |
| * | 11,804 | 80 | Open Space |
| | 175,333 | 92 | Weighted Average |
| | 135,951 | 90 | 77.54% Pervious Area |
| | 39,382 | 98 | 22.46% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.8 | | | | | **Direct Entry,** |

## Subcatchment 2S: PR



## Hydrograph for Subcatchment 2S: PR

| Time (hours) | Precip. (inches) | Perv.Excess (inches) | Imp.Excess (inches) | Runoff (cfs) |
|---|---|---|---|---|
| 0.00 | **0.00** | **0.00** | **0.00** | **0.00** |
| 10.00 | **1.20** | **0.46** | **0.99** | **0.00** |
| 20.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 30.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 40.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 50.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 60.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 70.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 80.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 90.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 100.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 110.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 120.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 130.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 140.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 150.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 160.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 170.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 180.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 190.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 200.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 210.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 220.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 230.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 240.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 250.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 260.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 270.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 280.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 290.00 | 1.20 | 0.46 | 0.99 | 0.00 |
| 300.00 | 1.20 | 0.46 | 0.99 | 0.00 |

## Summary for Subcatchment EX: EX

[49] Hint: Tc<2dt may require smaller dt

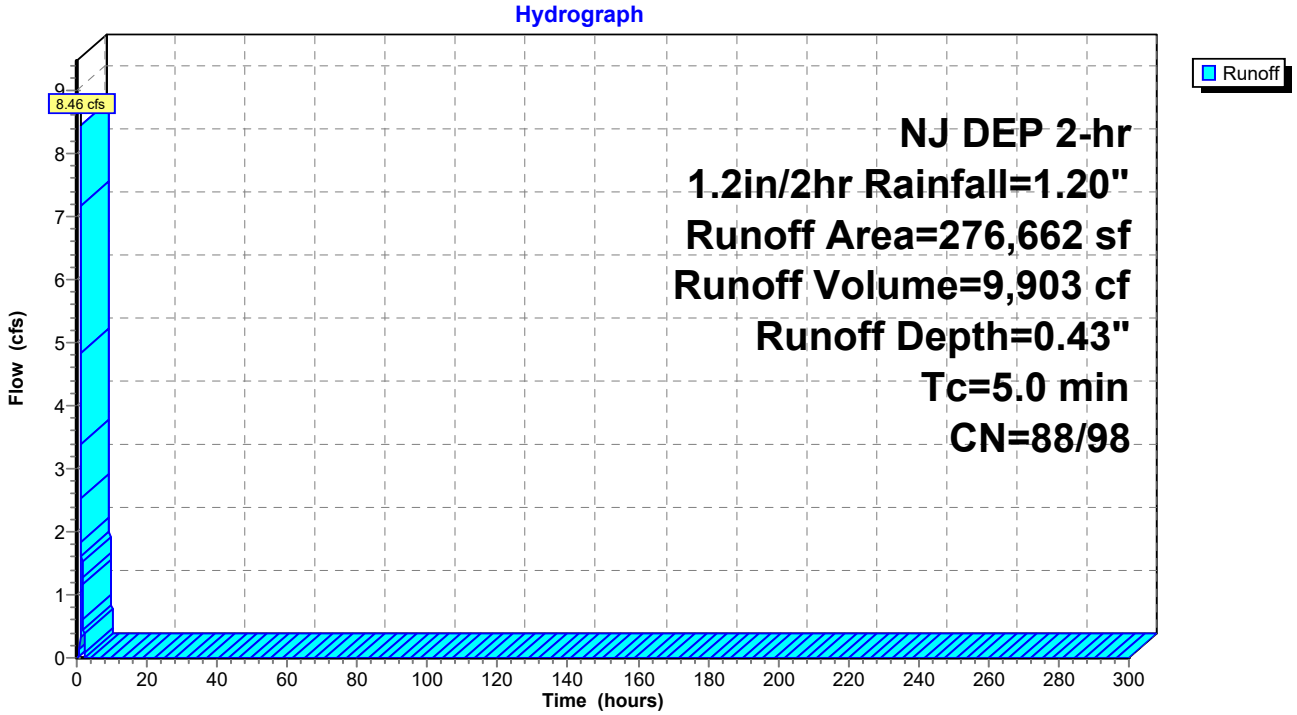
Runoff = 8.46 cfs @ 1.11 hrs, Volume= 9,903 cf, Depth= 0.43"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-300.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr 1.2in/2hr Rainfall=1.20"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 24,569 | 98 | Impervious |
| * | 59,598 | 78 | Meadow (20% Imp & Gravel) |
| * | 192,495 | 91 | Gravel |
| | 276,662 | 89 | Weighted Average |
| | 252,093 | 88 | 91.12% Pervious Area |
| | 24,569 | 98 | 8.88% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment EX: EX



## Hydrograph for Subcatchment EX: EX

| Time (hours) | Precip. (inches) | Perv.Excess (inches) | Imp.Excess (inches) | Runoff (cfs) |
|---|---|---|---|---|
| 0.00 | **0.00** | **0.00** | **0.00** | **0.00** |
| 10.00 | **1.20** | **0.38** | **0.99** | **0.00** |
| 20.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 30.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 40.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 50.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 60.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 70.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 80.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 90.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 100.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 110.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 120.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 130.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 140.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 150.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 160.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 170.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 180.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 190.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 200.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 210.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 220.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 230.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 240.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 250.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 260.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 270.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 280.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 290.00 | 1.20 | 0.38 | 0.99 | 0.00 |
| 300.00 | 1.20 | 0.38 | 0.99 | 0.00 |

## Summary for Pond 3P: Basin

Inflow Area = 95,997 sf, 21.93% Impervious, Inflow Depth = 0.48" for 1.2in/2hr event
Inflow = 3.18 cfs @ 1.10 hrs, Volume= 3,846 cf
Outflow = 0.00 cfs @ 0.90 hrs, Volume= 63 cf, Atten= 100%, Lag= 0.0 min
Discarded = 0.00 cfs @ 0.90 hrs, Volume= 63 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-300.00 hrs, dt= 0.05 hrs
Peak Elev= 25.52' @ 2.30 hrs Surf.Area= 2,525 sf Storage= 3,846 cf

Plug-Flow detention time= 8,986.4 min calculated for 63 cf (2% of inflow)
Center-of-Mass det. time= 8,948.2 min ( 9,022.2 - 74.1 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 24.00' | 52,014 cf | **area (Prismatic)**Listed below (Recalc) |

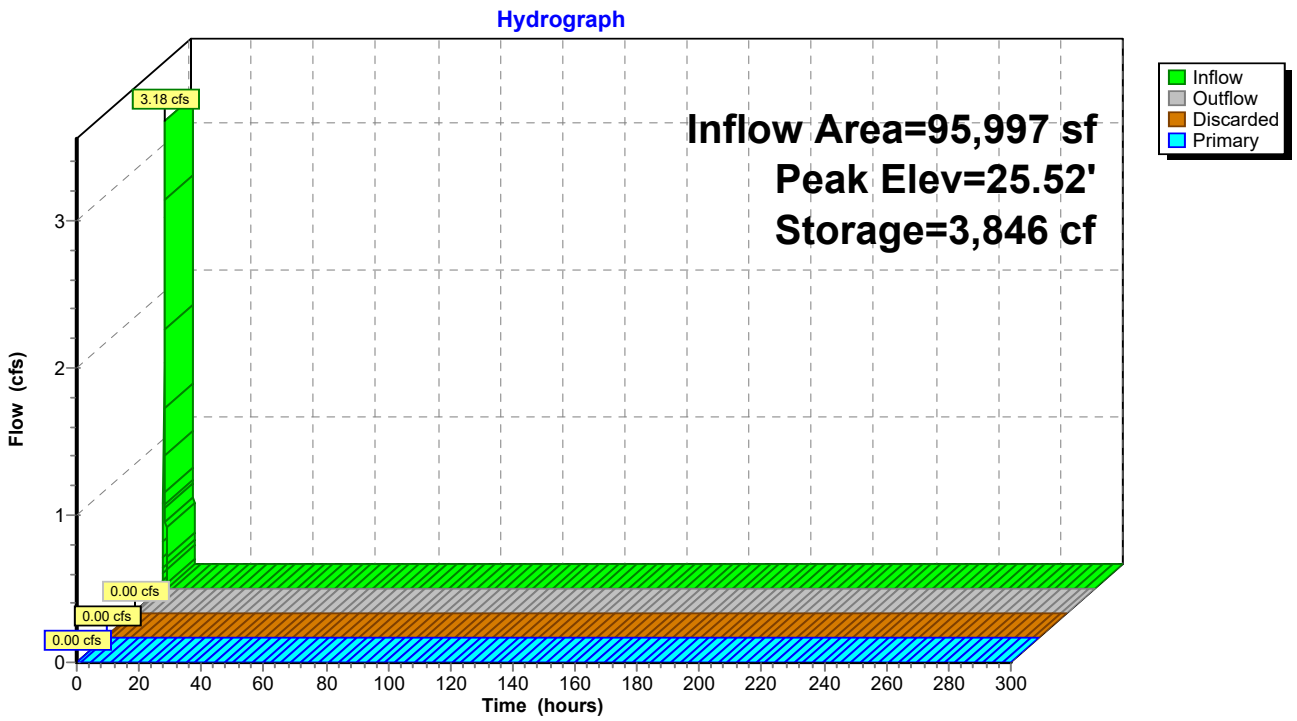
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 24.00 | 2,525 | 0 | 0 |
| 25.00 | 2,525 | 2,525 | 2,525 |
| 25.99 | 2,525 | 2,500 | 5,025 |
| 26.00 | 5,050 | 38 | 5,063 |
| 26.99 | 5,050 | 4,999 | 10,062 |
| 27.00 | 5,050 | 51 | 10,113 |
| 27.99 | 5,050 | 4,999 | 15,112 |
| 28.00 | 16,833 | 109 | 15,222 |
| 29.00 | 18,382 | 17,608 | 32,829 |
| 30.00 | 19,987 | 19,185 | 52,014 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 26.00' | **12.0" Round Outlet Pipe**<br>L= 55.0' RCP, groove end projecting, Ke= 0.200<br>Inlet / Outlet Invert= 26.00' / 25.75' S= 0.0045 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.79 sf |
| #2 | Device 1 | 25.25' | **0.6" Vert. Underdrain Cap** C= 0.600 |
| #3 | Device 1 | 28.20' | **48.0" x 24.0" Horiz. Outlet Structure Top** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Discarded | 24.00' | **0.001 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=0.00 cfs @ 0.90 hrs HW=24.07' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 0.00 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=24.00' TW=24.00' (Fixed TW Elev= 24.00')
└─**1=Outlet Pipe** ( Controls 0.00 cfs)
  ├─**2=Underdrain Cap** ( Controls 0.00 cfs)
  └─**3=Outlet Structure Top** ( Controls 0.00 cfs)

## Pond 3P: Basin



## Hydrograph for Pond 3P: Basin

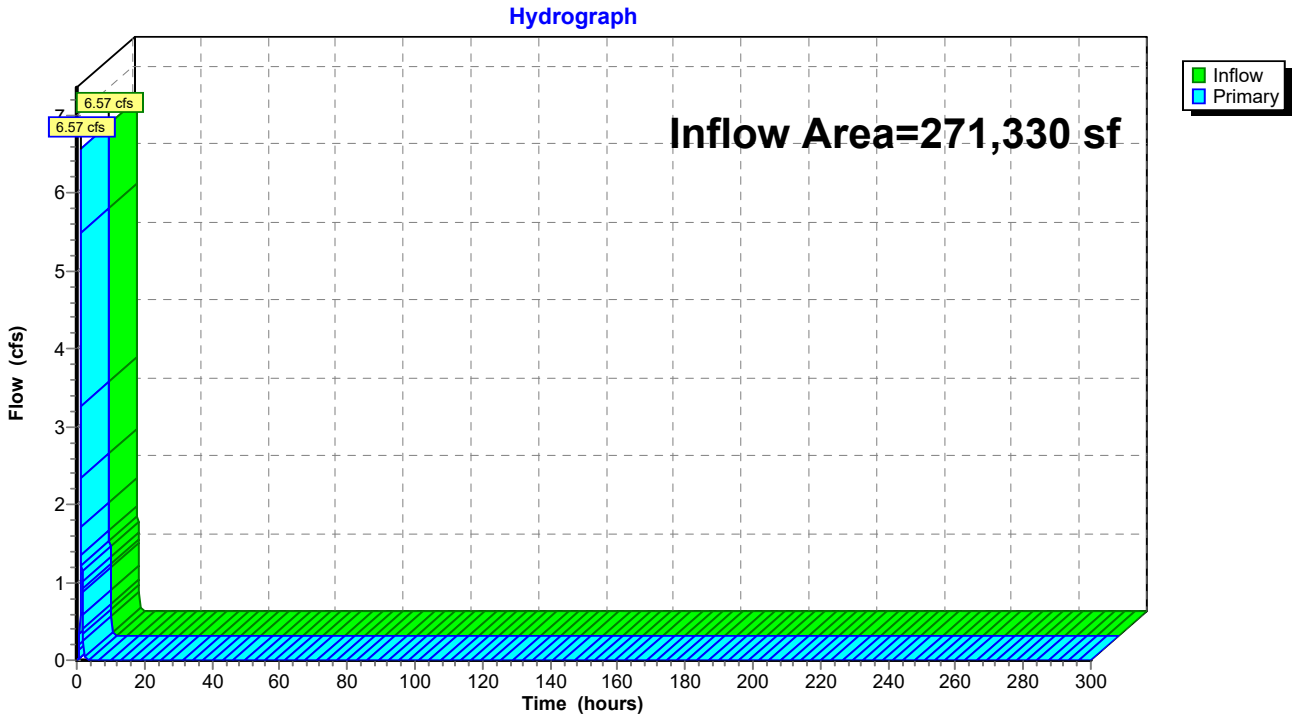
| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Outflow (cfs) | Discarded (cfs) | Primary (cfs) |
|---|---|---|---|---|---|---|
| 0.00 | **0.00** | **0** | **24.00** | **0.00** | **0.00** | **0.00** |
| 10.00 | **0.00** | **3,844** | **25.52** | **0.00** | **0.00** | 0.00 |
| 20.00 | 0.00 | 3,842 | 25.52 | 0.00 | 0.00 | 0.00 |
| 30.00 | 0.00 | 3,840 | 25.52 | 0.00 | 0.00 | 0.00 |
| 40.00 | 0.00 | 3,838 | 25.52 | 0.00 | 0.00 | 0.00 |
| 50.00 | 0.00 | 3,836 | 25.52 | 0.00 | 0.00 | 0.00 |
| 60.00 | 0.00 | 3,834 | 25.52 | 0.00 | 0.00 | 0.00 |
| 70.00 | 0.00 | 3,832 | 25.52 | 0.00 | 0.00 | 0.00 |
| 80.00 | 0.00 | 3,830 | 25.52 | 0.00 | 0.00 | 0.00 |
| 90.00 | 0.00 | 3,827 | 25.52 | 0.00 | 0.00 | 0.00 |
| 100.00 | 0.00 | 3,825 | 25.51 | 0.00 | 0.00 | 0.00 |
| 110.00 | 0.00 | 3,823 | 25.51 | 0.00 | 0.00 | 0.00 |
| 120.00 | 0.00 | 3,821 | 25.51 | 0.00 | 0.00 | 0.00 |
| 130.00 | 0.00 | 3,819 | 25.51 | 0.00 | 0.00 | 0.00 |
| 140.00 | 0.00 | 3,817 | 25.51 | 0.00 | 0.00 | 0.00 |
| 150.00 | 0.00 | 3,815 | 25.51 | 0.00 | 0.00 | 0.00 |
| 160.00 | 0.00 | 3,813 | 25.51 | 0.00 | 0.00 | 0.00 |
| 170.00 | 0.00 | 3,811 | 25.51 | 0.00 | 0.00 | 0.00 |
| 180.00 | 0.00 | 3,808 | 25.51 | 0.00 | 0.00 | 0.00 |
| 190.00 | 0.00 | 3,806 | 25.51 | 0.00 | 0.00 | 0.00 |
| 200.00 | 0.00 | 3,804 | 25.51 | 0.00 | 0.00 | 0.00 |
| 210.00 | 0.00 | 3,802 | 25.51 | 0.00 | 0.00 | 0.00 |
| 220.00 | 0.00 | 3,800 | 25.50 | 0.00 | 0.00 | 0.00 |
| 230.00 | 0.00 | 3,798 | 25.50 | 0.00 | 0.00 | 0.00 |
| 240.00 | 0.00 | 3,796 | 25.50 | 0.00 | 0.00 | 0.00 |
| 250.00 | 0.00 | 3,794 | 25.50 | 0.00 | 0.00 | 0.00 |
| 260.00 | 0.00 | 3,792 | 25.50 | 0.00 | 0.00 | 0.00 |
| 270.00 | 0.00 | 3,790 | 25.50 | 0.00 | 0.00 | 0.00 |
| 280.00 | 0.00 | 3,787 | 25.50 | 0.00 | 0.00 | 0.00 |
| 290.00 | 0.00 | 3,785 | 25.50 | 0.00 | 0.00 | 0.00 |
| 300.00 | 0.00 | 3,783 | 25.50 | 0.00 | 0.00 | 0.00 |

## Summary for Link 4L: PR

Inflow Area = 271,330 sf, 22.27% Impervious, Inflow Depth = 0.37" for 1.2in/2hr event
Inflow = 6.57 cfs @ 1.12 hrs, Volume= 8,420 cf
Primary = 6.57 cfs @ 1.12 hrs, Volume= 8,420 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-300.00 hrs, dt= 0.05 hrs

### Link 4L: PR



## Hydrograph for Link 4L: PR

| Time (hours) | Inflow (cfs) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|
| 0.00 | **0.00** | **0.00** | **0.00** |
| 5.00 | **0.00** | 0.00 | **0.00** |
| 10.00 | 0.00 | 0.00 | 0.00 |
| 15.00 | 0.00 | 0.00 | 0.00 |
| 20.00 | 0.00 | 0.00 | 0.00 |
| 25.00 | 0.00 | 0.00 | 0.00 |
| 30.00 | 0.00 | 0.00 | 0.00 |
| 35.00 | 0.00 | 0.00 | 0.00 |
| 40.00 | 0.00 | 0.00 | 0.00 |
| 45.00 | 0.00 | 0.00 | 0.00 |
| 50.00 | 0.00 | 0.00 | 0.00 |
| 55.00 | 0.00 | 0.00 | 0.00 |
| 60.00 | 0.00 | 0.00 | 0.00 |
| 65.00 | 0.00 | 0.00 | 0.00 |
| 70.00 | 0.00 | 0.00 | 0.00 |
| 75.00 | 0.00 | 0.00 | 0.00 |
| 80.00 | 0.00 | 0.00 | 0.00 |
| 85.00 | 0.00 | 0.00 | 0.00 |
| 90.00 | 0.00 | 0.00 | 0.00 |
| 95.00 | 0.00 | 0.00 | 0.00 |
| 100.00 | 0.00 | 0.00 | 0.00 |
| 105.00 | 0.00 | 0.00 | 0.00 |
| 110.00 | 0.00 | 0.00 | 0.00 |
| 115.00 | 0.00 | 0.00 | 0.00 |
| 120.00 | 0.00 | 0.00 | 0.00 |
| 125.00 | 0.00 | 0.00 | 0.00 |
| 130.00 | 0.00 | 0.00 | 0.00 |
| 135.00 | 0.00 | 0.00 | 0.00 |
| 140.00 | 0.00 | 0.00 | 0.00 |
| 145.00 | 0.00 | 0.00 | 0.00 |
| 150.00 | 0.00 | 0.00 | 0.00 |
| 155.00 | 0.00 | 0.00 | 0.00 |
| 160.00 | 0.00 | 0.00 | 0.00 |
| 165.00 | 0.00 | 0.00 | 0.00 |
| 170.00 | 0.00 | 0.00 | 0.00 |
| 175.00 | 0.00 | 0.00 | 0.00 |
| 180.00 | 0.00 | 0.00 | 0.00 |
| 185.00 | 0.00 | 0.00 | 0.00 |
| 190.00 | 0.00 | 0.00 | 0.00 |
| 195.00 | 0.00 | 0.00 | 0.00 |
| 200.00 | 0.00 | 0.00 | 0.00 |
| 205.00 | 0.00 | 0.00 | 0.00 |
| 210.00 | 0.00 | 0.00 | 0.00 |
| 215.00 | 0.00 | 0.00 | 0.00 |
| 220.00 | 0.00 | 0.00 | 0.00 |
| 225.00 | 0.00 | 0.00 | 0.00 |
| 230.00 | 0.00 | 0.00 | 0.00 |
| 235.00 | 0.00 | 0.00 | 0.00 |
| 240.00 | 0.00 | 0.00 | 0.00 |
| 245.00 | 0.00 | 0.00 | 0.00 |
| 250.00 | 0.00 | 0.00 | 0.00 |
| 255.00 | 0.00 | 0.00 | 0.00 |
| 260.00 | 0.00 | 0.00 | 0.00 |
| 265.00 | 0.00 | 0.00 | 0.00 |
| 270.00 | 0.00 | 0.00 | 0.00 |
| 275.00 | 0.00 | 0.00 | 0.00 |
| 280.00 | 0.00 | 0.00 | 0.00 |
| 285.00 | 0.00 | 0.00 | 0.00 |
| 290.00 | 0.00 | 0.00 | 0.00 |
| 295.00 | 0.00 | 0.00 | 0.00 |
| 300.00 | 0.00 | 0.00 | 0.00 |

Time span=0.00-300.00 hrs, dt=0.05 hrs, 6001 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: PR** Runoff Area=95,997 sf 21.93% Impervious Runoff Depth=1.68"
Tc=5.0 min CN=87/98 Runoff=6.34 cfs 13,435 cf

**Subcatchment2S: PR** Runoff Area=175,333 sf 22.46% Impervious Runoff Depth=1.86"
Tc=6.8 min CN=90/98 Runoff=12.05 cfs 27,215 cf

**SubcatchmentEX: EX** Runoff Area=276,662 sf 8.88% Impervious Runoff Depth=1.62"
Tc=5.0 min CN=88/98 Runoff=17.99 cfs 37,299 cf

**Pond 3P: Basin** Peak Elev=27.57' Storage=12,969 cf Inflow=6.34 cfs 13,435 cf
Discarded=0.00 cfs 123 cf Primary=0.01 cfs 7,779 cf Outflow=0.01 cfs 7,901 cf

**Link 4L: PR** Inflow=12.05 cfs 34,994 cf
Primary=12.05 cfs 34,994 cf

**Total Runoff Area = 547,992 sf Runoff Volume = 77,950 cf Average Runoff Depth = 1.71"**
**84.49% Pervious = 462,993 sf 15.51% Impervious = 84,999 sf**

## Summary for Subcatchment 1S: PR

[49] Hint: Tc<2dt may require smaller dt

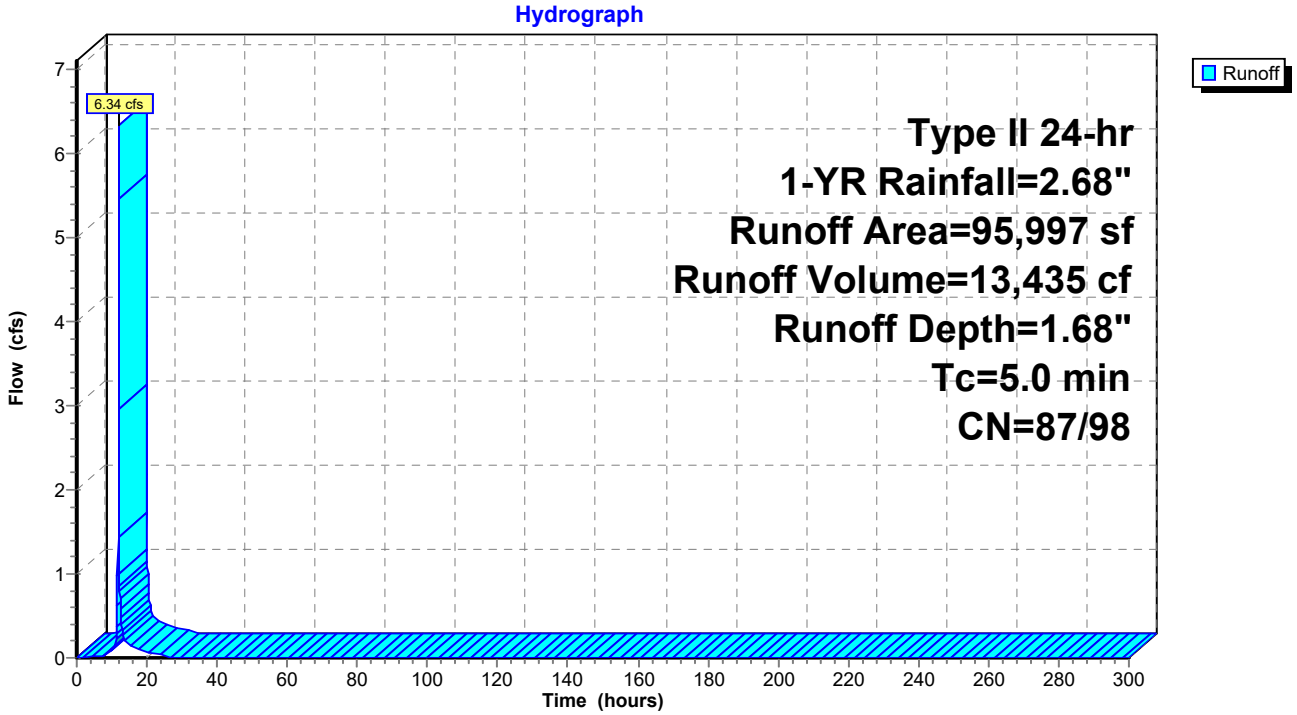
Runoff = 6.34 cfs @ 11.95 hrs, Volume= 13,435 cf, Depth= 1.68"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-300.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-YR Rainfall=2.68"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 21,048 | 98 | Impervious |
| * | 49,352 | 91 | Gravel |
| * | 25,597 | 80 | Open Space |
| | 95,997 | 90 | Weighted Average |
| | 74,949 | 87 | 78.07% Pervious Area |
| | 21,048 | 98 | 21.93% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

### Subcatchment 1S: PR



## Hydrograph for Subcatchment 1S: PR

| Time (hours) | Precip. (inches) | Perv.Excess (inches) | Imp.Excess (inches) | Runoff (cfs) |
|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10.00 | 0.49 | 0.02 | 0.30 | **0.08** |
| 20.00 | **2.55** | **1.35** | **2.32** | **0.07** |
| 30.00 | **2.68** | **1.46** | **2.45** | 0.00 |
| 40.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 50.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 60.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 70.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 80.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 90.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 100.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 110.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 120.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 130.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 140.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 150.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 160.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 170.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 180.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 190.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 200.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 210.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 220.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 230.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 240.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 250.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 260.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 270.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 280.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 290.00 | 2.68 | 1.46 | 2.45 | 0.00 |
| 300.00 | 2.68 | 1.46 | 2.45 | 0.00 |

## Summary for Subcatchment 2S: PR

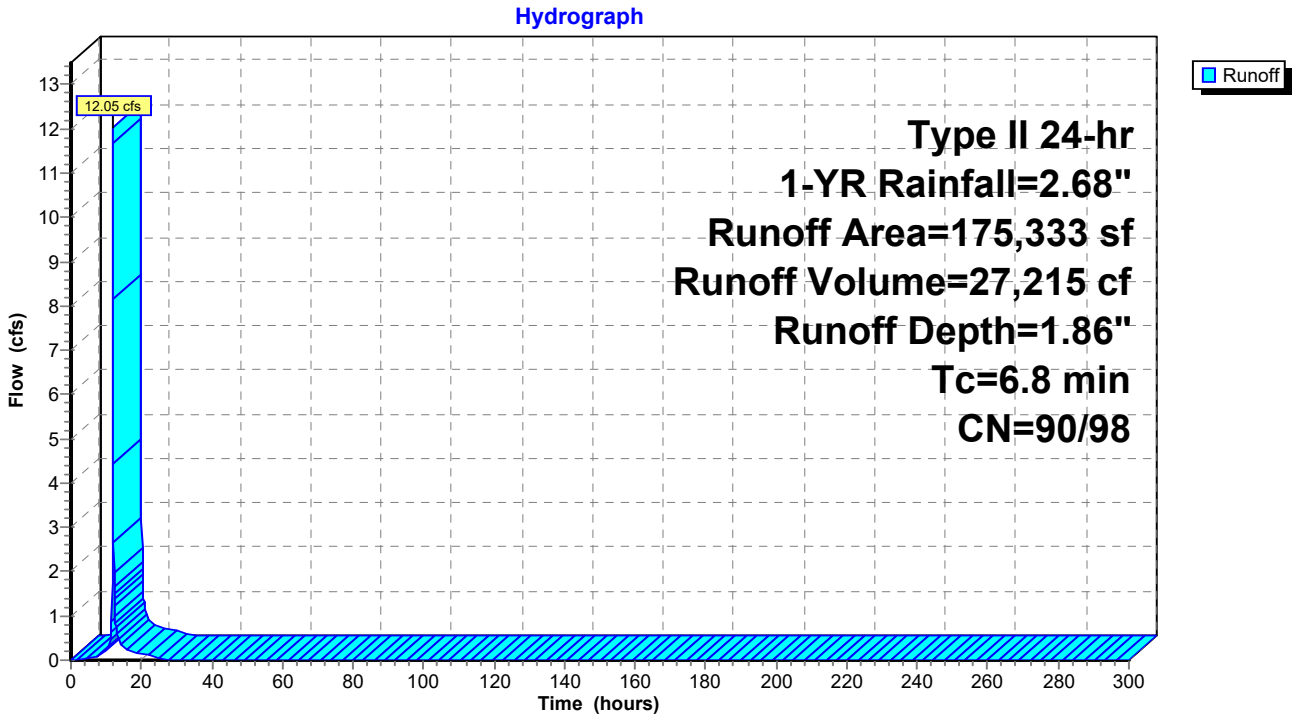
Runoff = 12.05 cfs @ 11.98 hrs, Volume= 27,215 cf, Depth= 1.86"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-300.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-YR Rainfall=2.68"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 39,382 | 98 | Impervious |
| * | 124,147 | 91 | Gravel |
| * | 11,804 | 80 | Open Space |
| | 175,333 | 92 | Weighted Average |
| | 135,951 | 90 | 77.54% Pervious Area |
| | 39,382 | 98 | 22.46% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.8 | | | | | **Direct Entry,** |

## Subcatchment 2S: PR



## Hydrograph for Subcatchment 2S: PR

| Time (hours) | Precip. (inches) | Perv.Excess (inches) | Imp.Excess (inches) | Runoff (cfs) |
|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10.00 | 0.49 | 0.05 | 0.30 | **0.19** |
| 20.00 | **2.55** | **1.58** | **2.32** | **0.13** |
| 30.00 | **2.68** | **1.69** | **2.45** | 0.00 |
| 40.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 50.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 60.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 70.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 80.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 90.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 100.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 110.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 120.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 130.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 140.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 150.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 160.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 170.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 180.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 190.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 200.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 210.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 220.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 230.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 240.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 250.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 260.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 270.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 280.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 290.00 | 2.68 | 1.69 | 2.45 | 0.00 |
| 300.00 | 2.68 | 1.69 | 2.45 | 0.00 |

## Summary for Subcatchment EX: EX

[49] Hint: Tc<2dt may require smaller dt

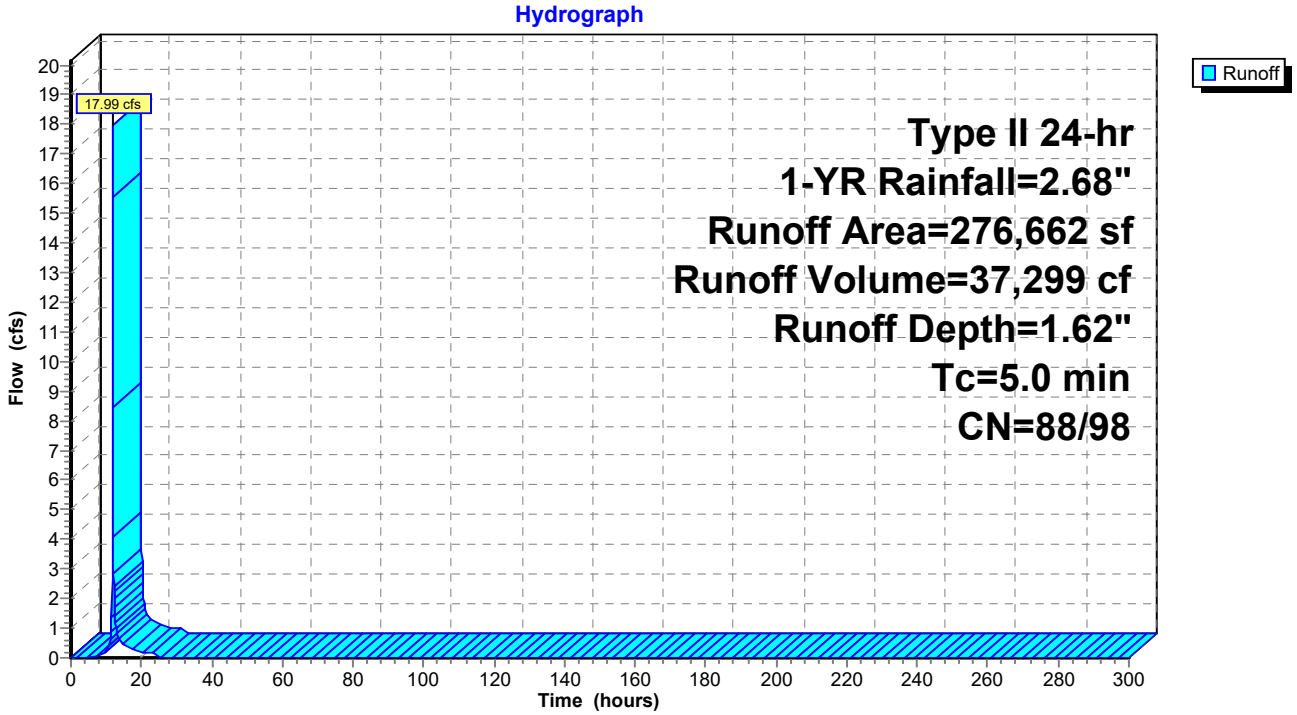
Runoff = 17.99 cfs @ 11.96 hrs, Volume= 37,299 cf, Depth= 1.62"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-300.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-YR Rainfall=2.68"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 24,569 | 98 | Impervious |
| * | 59,598 | 78 | Meadow (20% Imp & Gravel) |
| * | 192,495 | 91 | Gravel |
| | 276,662 | 89 | Weighted Average |
| | 252,093 | 88 | 91.12% Pervious Area |
| | 24,569 | 98 | 8.88% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

### Subcatchment EX: EX



## Hydrograph for Subcatchment EX: EX

| Time (hours) | Precip. (inches) | Perv.Excess (inches) | Imp.Excess (inches) | Runoff (cfs) |
|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10.00 | 0.49 | 0.03 | 0.30 | **0.20** |
| 20.00 | **2.55** | **1.43** | **2.32** | **0.20** |
| 30.00 | **2.68** | **1.54** | **2.45** | 0.00 |
| 40.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 50.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 60.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 70.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 80.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 90.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 100.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 110.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 120.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 130.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 140.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 150.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 160.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 170.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 180.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 190.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 200.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 210.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 220.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 230.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 240.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 250.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 260.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 270.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 280.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 290.00 | 2.68 | 1.54 | 2.45 | 0.00 |
| 300.00 | 2.68 | 1.54 | 2.45 | 0.00 |

## Summary for Pond 3P: Basin

Inflow Area = 95,997 sf, 21.93% Impervious, Inflow Depth = 1.68" for 1-YR event
Inflow = 6.34 cfs @ 11.95 hrs, Volume= 13,435 cf
Outflow = 0.01 cfs @ 24.12 hrs, Volume= 7,901 cf, Atten= 100%, Lag= 729.6 min
Discarded = 0.00 cfs @ 11.95 hrs, Volume= 123 cf
Primary = 0.01 cfs @ 24.12 hrs, Volume= 7,779 cf

Routing by Stor-Ind method, Time Span= 0.00-300.00 hrs, dt= 0.05 hrs
Peak Elev= 27.57' @ 24.12 hrs Surf.Area= 5,050 sf Storage= 12,969 cf

Plug-Flow detention time= 6,977.9 min calculated for 7,901 cf (59% of inflow)
Center-of-Mass det. time= 6,864.6 min ( 7,665.8 - 801.1 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 24.00' | 52,014 cf | **area (Prismatic)**Listed below (Recalc) |

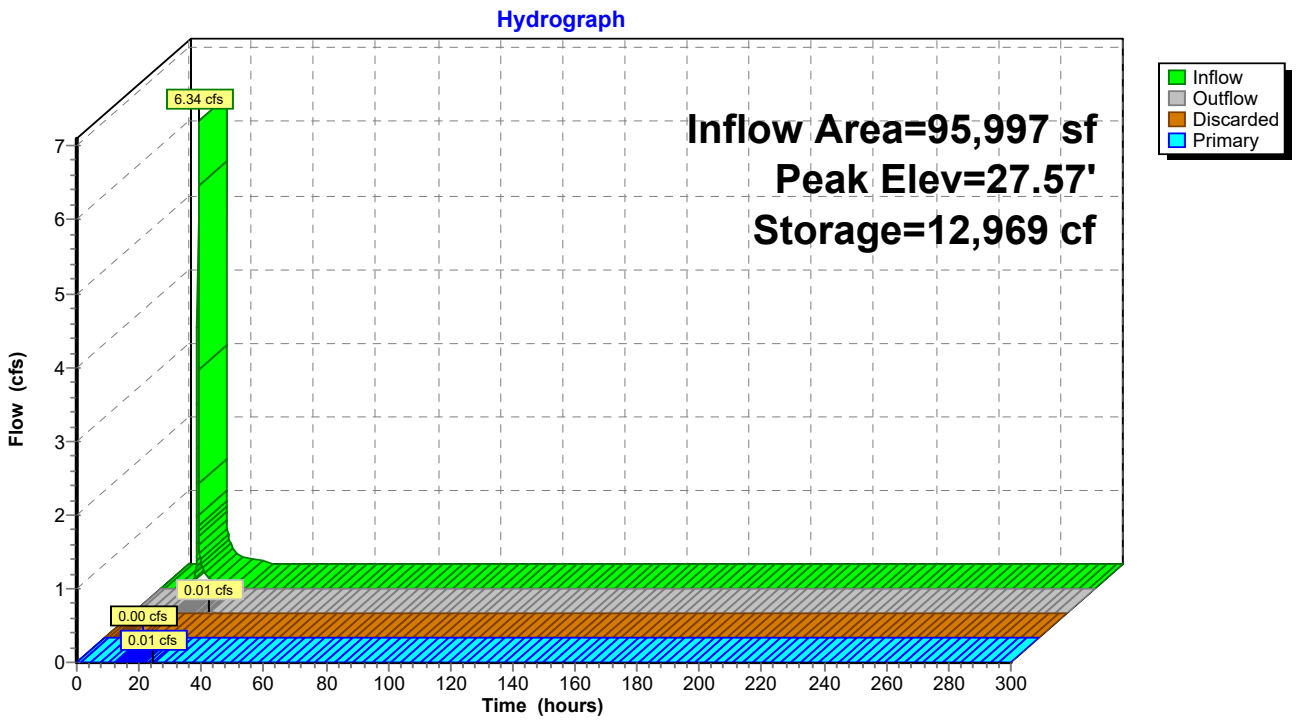
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 24.00 | 2,525 | 0 | 0 |
| 25.00 | 2,525 | 2,525 | 2,525 |
| 25.99 | 2,525 | 2,500 | 5,025 |
| 26.00 | 5,050 | 38 | 5,063 |
| 26.99 | 5,050 | 4,999 | 10,062 |
| 27.00 | 5,050 | 51 | 10,113 |
| 27.99 | 5,050 | 4,999 | 15,112 |
| 28.00 | 16,833 | 109 | 15,222 |
| 29.00 | 18,382 | 17,608 | 32,829 |
| 30.00 | 19,987 | 19,185 | 52,014 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 26.00' | **12.0" Round Outlet Pipe**<br>L= 55.0' RCP, groove end projecting, Ke= 0.200<br>Inlet / Outlet Invert= 26.00' / 25.75' S= 0.0045 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.79 sf |
| #2 | Device 1 | 25.25' | **0.6" Vert. Underdrain Cap** C= 0.600 |
| #3 | Device 1 | 28.20' | **48.0" x 24.0" Horiz. Outlet Structure Top** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Discarded | 24.00' | **0.001 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=0.00 cfs @ 11.95 hrs HW=26.01' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 0.00 cfs)

**Primary OutFlow** Max=0.01 cfs @ 24.12 hrs HW=27.57' TW=24.00' (Fixed TW Elev= 24.00')
└─**1=Outlet Pipe** (Passes 0.01 cfs of 3.48 cfs potential flow)
  ├─**2=Underdrain Cap** (Orifice Controls 0.01 cfs @ 6.02 fps)
  └─**3=Outlet Structure Top** ( Controls 0.00 cfs)

## Pond 3P: Basin



## Hydrograph for Pond 3P: Basin

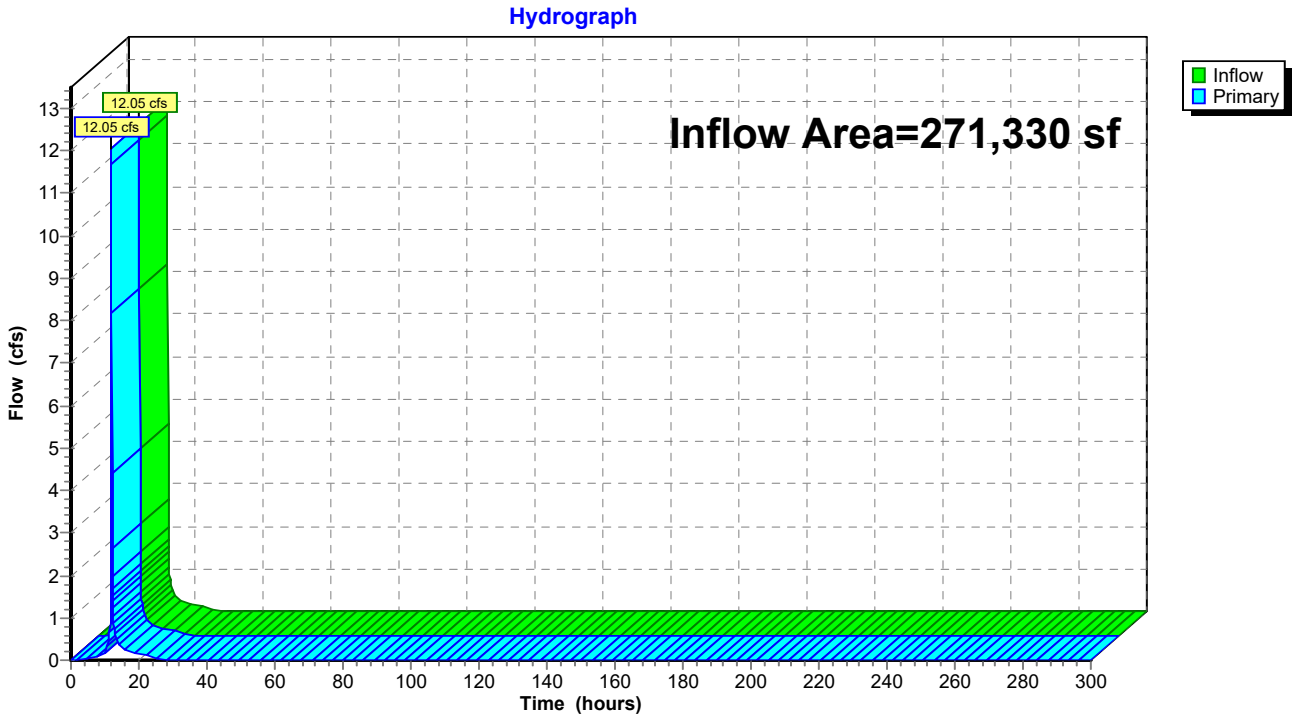
| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Outflow (cfs) | Discarded (cfs) | Primary (cfs) |
|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0 | 24.00 | 0.00 | 0.00 | 0.00 |
| 10.00 | **0.08** | 639 | 24.25 | 0.00 | **0.00** | 0.00 |
| 20.00 | **0.07** | **12,220** | **27.42** | **0.01** | **0.00** | **0.01** |
| 30.00 | 0.00 | **12,719** | **27.52** | **0.01** | 0.00 | **0.01** |
| 40.00 | 0.00 | 12,302 | 27.43 | 0.01 | 0.00 | 0.01 |
| 50.00 | 0.00 | 11,896 | 27.35 | 0.01 | 0.00 | 0.01 |
| 60.00 | 0.00 | 11,502 | 27.28 | 0.01 | 0.00 | 0.01 |
| 70.00 | 0.00 | 11,119 | 27.20 | 0.01 | 0.00 | 0.01 |
| 80.00 | 0.00 | 10,748 | 27.13 | 0.01 | 0.00 | 0.01 |
| 90.00 | 0.00 | 10,388 | 27.05 | 0.01 | 0.00 | 0.01 |
| 100.00 | 0.00 | 10,040 | 26.99 | 0.01 | 0.00 | 0.01 |
| 110.00 | 0.00 | 9,704 | 26.92 | 0.01 | 0.00 | 0.01 |
| 120.00 | 0.00 | 9,380 | 26.85 | 0.01 | 0.00 | 0.01 |
| 130.00 | 0.00 | 9,066 | 26.79 | 0.01 | 0.00 | 0.01 |
| 140.00 | 0.00 | 8,765 | 26.73 | 0.01 | 0.00 | 0.01 |
| 150.00 | 0.00 | 8,475 | 26.68 | 0.01 | 0.00 | 0.01 |
| 160.00 | 0.00 | 8,197 | 26.62 | 0.01 | 0.00 | 0.01 |
| 170.00 | 0.00 | 7,931 | 26.57 | 0.01 | 0.00 | 0.01 |
| 180.00 | 0.00 | 7,676 | 26.52 | 0.01 | 0.00 | 0.01 |
| 190.00 | 0.00 | 7,433 | 26.47 | 0.01 | 0.00 | 0.01 |
| 200.00 | 0.00 | 7,201 | 26.42 | 0.01 | 0.00 | 0.01 |
| 210.00 | 0.00 | 6,982 | 26.38 | 0.01 | 0.00 | 0.01 |
| 220.00 | 0.00 | 6,774 | 26.34 | 0.01 | 0.00 | 0.01 |
| 230.00 | 0.00 | 6,577 | 26.30 | 0.01 | 0.00 | 0.01 |
| 240.00 | 0.00 | 6,393 | 26.26 | 0.00 | 0.00 | 0.00 |
| 250.00 | 0.00 | 6,220 | 26.23 | 0.00 | 0.00 | 0.00 |
| 260.00 | 0.00 | 6,059 | 26.20 | 0.00 | 0.00 | 0.00 |
| 270.00 | 0.00 | 5,910 | 26.17 | 0.00 | 0.00 | 0.00 |
| 280.00 | 0.00 | 5,772 | 26.14 | 0.00 | 0.00 | 0.00 |
| 290.00 | 0.00 | 5,647 | 26.12 | 0.00 | 0.00 | 0.00 |
| 300.00 | 0.00 | 5,534 | 26.09 | 0.00 | 0.00 | 0.00 |

## Summary for Link 4L: PR

Inflow Area = 271,330 sf, 22.27% Impervious, Inflow Depth > 1.55" for 1-YR event
Inflow = 12.05 cfs @ 11.98 hrs, Volume= 34,994 cf
Primary = 12.05 cfs @ 11.98 hrs, Volume= 34,994 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-300.00 hrs, dt= 0.05 hrs

### Link 4L: PR



## Hydrograph for Link 4L: PR

| Time (hours) | Inflow (cfs) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|
| 0.00 | 0.00 | **0.00** | 0.00 |
| 5.00 | 0.02 | 0.00 | 0.02 |
| 10.00 | **0.19** | 0.00 | **0.19** |
| 15.00 | **0.31** | 0.00 | **0.31** |
| 20.00 | 0.14 | 0.00 | 0.14 |
| 25.00 | 0.01 | 0.00 | 0.01 |
| 30.00 | 0.01 | 0.00 | 0.01 |
| 35.00 | 0.01 | 0.00 | 0.01 |
| 40.00 | 0.01 | 0.00 | 0.01 |
| 45.00 | 0.01 | 0.00 | 0.01 |
| 50.00 | 0.01 | 0.00 | 0.01 |
| 55.00 | 0.01 | 0.00 | 0.01 |
| 60.00 | 0.01 | 0.00 | 0.01 |
| 65.00 | 0.01 | 0.00 | 0.01 |
| 70.00 | 0.01 | 0.00 | 0.01 |
| 75.00 | 0.01 | 0.00 | 0.01 |
| 80.00 | 0.01 | 0.00 | 0.01 |
| 85.00 | 0.01 | 0.00 | 0.01 |
| 90.00 | 0.01 | 0.00 | 0.01 |
| 95.00 | 0.01 | 0.00 | 0.01 |
| 100.00 | 0.01 | 0.00 | 0.01 |
| 105.00 | 0.01 | 0.00 | 0.01 |
| 110.00 | 0.01 | 0.00 | 0.01 |
| 115.00 | 0.01 | 0.00 | 0.01 |
| 120.00 | 0.01 | 0.00 | 0.01 |
| 125.00 | 0.01 | 0.00 | 0.01 |
| 130.00 | 0.01 | 0.00 | 0.01 |
| 135.00 | 0.01 | 0.00 | 0.01 |
| 140.00 | 0.01 | 0.00 | 0.01 |
| 145.00 | 0.01 | 0.00 | 0.01 |
| 150.00 | 0.01 | 0.00 | 0.01 |
| 155.00 | 0.01 | 0.00 | 0.01 |
| 160.00 | 0.01 | 0.00 | 0.01 |
| 165.00 | 0.01 | 0.00 | 0.01 |
| 170.00 | 0.01 | 0.00 | 0.01 |
| 175.00 | 0.01 | 0.00 | 0.01 |
| 180.00 | 0.01 | 0.00 | 0.01 |
| 185.00 | 0.01 | 0.00 | 0.01 |
| 190.00 | 0.01 | 0.00 | 0.01 |
| 195.00 | 0.01 | 0.00 | 0.01 |
| 200.00 | 0.01 | 0.00 | 0.01 |
| 205.00 | 0.01 | 0.00 | 0.01 |
| 210.00 | 0.01 | 0.00 | 0.01 |
| 215.00 | 0.01 | 0.00 | 0.01 |
| 220.00 | 0.01 | 0.00 | 0.01 |
| 225.00 | 0.01 | 0.00 | 0.01 |
| 230.00 | 0.01 | 0.00 | 0.01 |
| 235.00 | 0.01 | 0.00 | 0.01 |
| 240.00 | 0.00 | 0.00 | 0.00 |
| 245.00 | 0.00 | 0.00 | 0.00 |
| 250.00 | 0.00 | 0.00 | 0.00 |
| 255.00 | 0.00 | 0.00 | 0.00 |
| 260.00 | 0.00 | 0.00 | 0.00 |
| 265.00 | 0.00 | 0.00 | 0.00 |
| 270.00 | 0.00 | 0.00 | 0.00 |
| 275.00 | 0.00 | 0.00 | 0.00 |
| 280.00 | 0.00 | 0.00 | 0.00 |
| 285.00 | 0.00 | 0.00 | 0.00 |
| 290.00 | 0.00 | 0.00 | 0.00 |
| 295.00 | 0.00 | 0.00 | 0.00 |
| 300.00 | 0.00 | 0.00 | 0.00 |

Time span=0.00-300.00 hrs, dt=0.05 hrs, 6001 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: PR** Runoff Area=95,997 sf 21.93% Impervious Runoff Depth=2.33"
Tc=5.0 min CN=87/98 Runoff=8.71 cfs 18,625 cf

**Subcatchment2S: PR** Runoff Area=175,333 sf 22.46% Impervious Runoff Depth=2.54"
Tc=6.8 min CN=90/98 Runoff=16.19 cfs 37,068 cf

**SubcatchmentEX: EX** Runoff Area=276,662 sf 8.88% Impervious Runoff Depth=2.27"
Tc=5.0 min CN=88/98 Runoff=24.89 cfs 52,232 cf

**Pond 3P: Basin** Peak Elev=28.17' Storage=18,028 cf Inflow=8.71 cfs 18,625 cf
Discarded=0.00 cfs 188 cf Primary=0.01 cfs 11,131 cf Outflow=0.01 cfs 11,318 cf

**Link 4L: PR** Inflow=16.19 cfs 48,199 cf
Primary=16.19 cfs 48,199 cf

**Total Runoff Area = 547,992 sf Runoff Volume = 107,926 cf Average Runoff Depth = 2.36"**
**84.49% Pervious = 462,993 sf 15.51% Impervious = 84,999 sf**

## Summary for Subcatchment 1S: PR

[49] Hint: Tc<2dt may require smaller dt

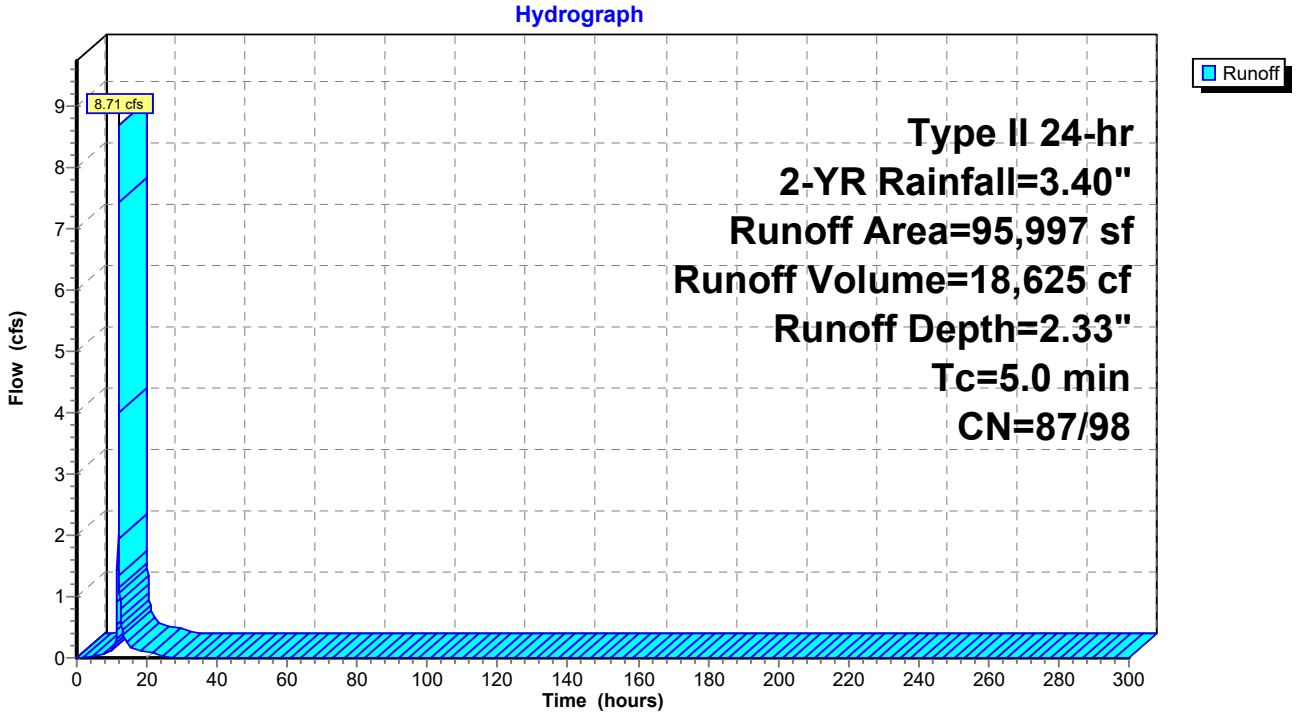
Runoff = 8.71 cfs @ 11.95 hrs, Volume= 18,625 cf, Depth= 2.33"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-300.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YR Rainfall=3.40"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 21,048 | 98 | Impervious |
| * | 49,352 | 91 | Gravel |
| * | 25,597 | 80 | Open Space |
| | 95,997 | 90 | Weighted Average |
| | 74,949 | 87 | 78.07% Pervious Area |
| | 21,048 | 98 | 21.93% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

### Subcatchment 1S: PR



## Hydrograph for Subcatchment 1S: PR

| Time (hours) | Precip. (inches) | Perv.Excess (inches) | Imp.Excess (inches) | Runoff (cfs) |
|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10.00 | 0.62 | 0.06 | 0.42 | **0.13** |
| 20.00 | **3.24** | **1.95** | **3.00** | **0.09** |
| 30.00 | **3.40** | **2.09** | **3.17** | 0.00 |
| 40.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 50.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 60.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 70.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 80.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 90.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 100.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 110.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 120.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 130.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 140.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 150.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 160.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 170.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 180.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 190.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 200.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 210.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 220.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 230.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 240.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 250.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 260.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 270.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 280.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 290.00 | 3.40 | 2.09 | 3.17 | 0.00 |
| 300.00 | 3.40 | 2.09 | 3.17 | 0.00 |

## Summary for Subcatchment 2S: PR

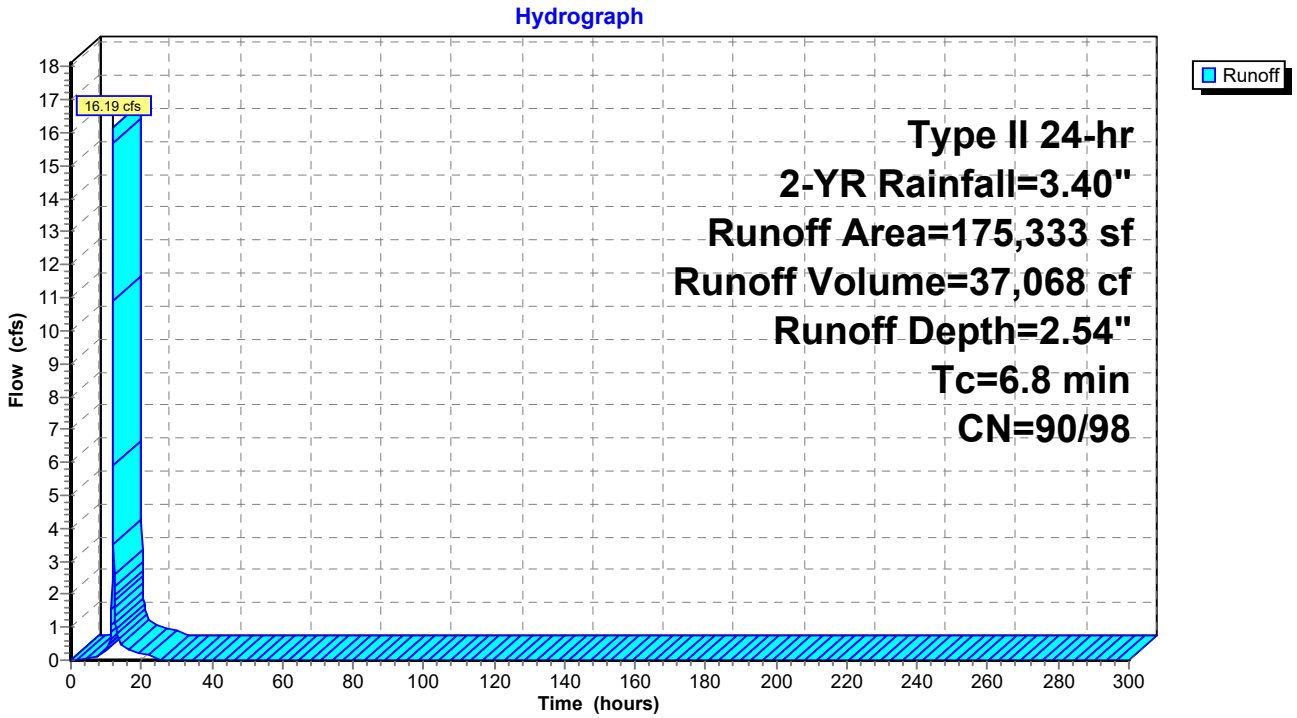
Runoff = 16.19 cfs @ 11.98 hrs, Volume= 37,068 cf, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-300.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YR Rainfall=3.40"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 39,382 | 98 | Impervious |
| * | 124,147 | 91 | Gravel |
| * | 11,804 | 80 | Open Space |
| | 175,333 | 92 | Weighted Average |
| | 135,951 | 90 | 77.54% Pervious Area |
| | 39,382 | 98 | 22.46% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.8 | | | | | **Direct Entry,** |

## Subcatchment 2S: PR



## Hydrograph for Subcatchment 2S: PR

| Time (hours) | Precip. (inches) | Perv.Excess (inches) | Imp.Excess (inches) | Runoff (cfs) |
|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10.00 | 0.62 | 0.10 | 0.42 | **0.29** |
| 20.00 | **3.24** | **2.20** | **3.00** | **0.17** |
| 30.00 | **3.40** | **2.35** | **3.17** | 0.00 |
| 40.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 50.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 60.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 70.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 80.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 90.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 100.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 110.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 120.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 130.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 140.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 150.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 160.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 170.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 180.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 190.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 200.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 210.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 220.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 230.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 240.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 250.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 260.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 270.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 280.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 290.00 | 3.40 | 2.35 | 3.17 | 0.00 |
| 300.00 | 3.40 | 2.35 | 3.17 | 0.00 |

## Summary for Subcatchment EX: EX

[49] Hint: Tc<2dt may require smaller dt

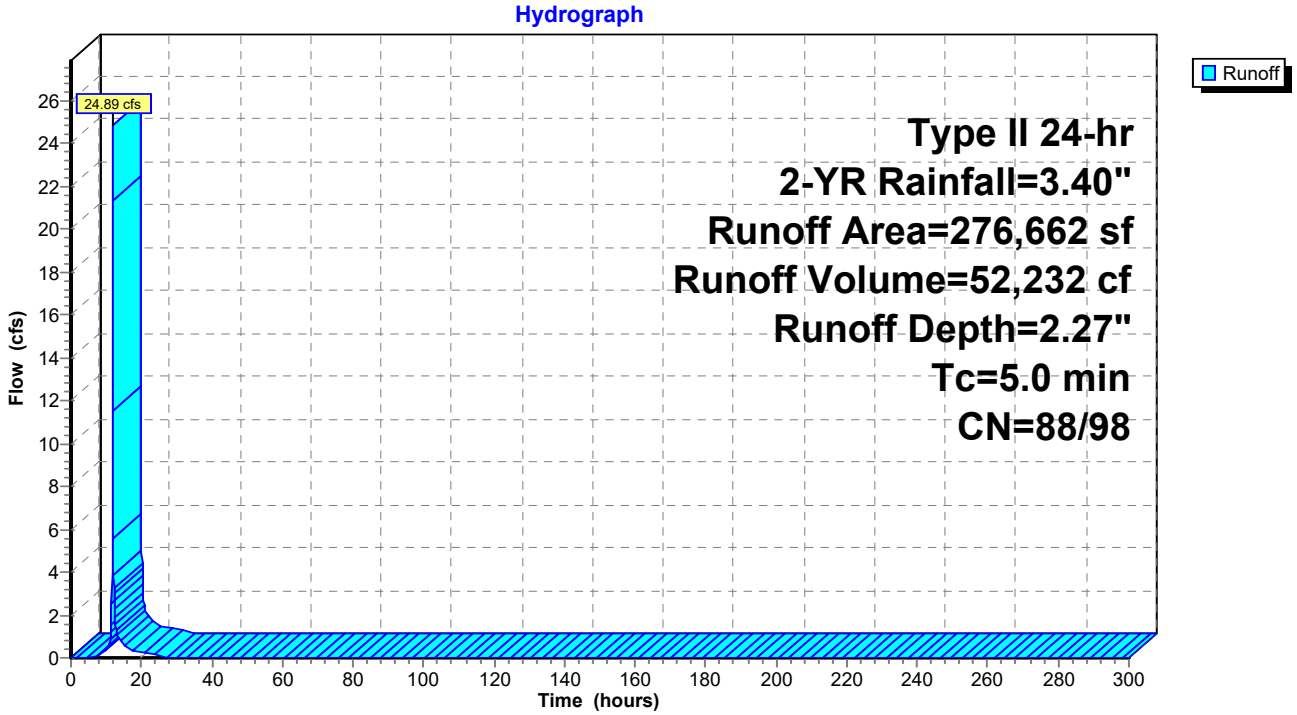
Runoff = 24.89 cfs @ 11.95 hrs, Volume= 52,232 cf, Depth= 2.27"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-300.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YR Rainfall=3.40"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 24,569 | 98 | Impervious |
| * | 59,598 | 78 | Meadow (20% Imp & Gravel) |
| * | 192,495 | 91 | Gravel |
| | 276,662 | 89 | Weighted Average |
| | 252,093 | 88 | 91.12% Pervious Area |
| | 24,569 | 98 | 8.88% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

### Subcatchment EX: EX



## Hydrograph for Subcatchment EX: EX

| Time (hours) | Precip. (inches) | Perv.Excess (inches) | Imp.Excess (inches) | Runoff (cfs) |
|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10.00 | 0.62 | 0.07 | 0.42 | **0.34** |
| 20.00 | **3.24** | **2.03** | **3.00** | **0.26** |
| 30.00 | **3.40** | **2.18** | **3.17** | 0.00 |
| 40.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 50.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 60.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 70.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 80.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 90.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 100.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 110.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 120.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 130.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 140.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 150.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 160.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 170.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 180.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 190.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 200.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 210.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 220.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 230.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 240.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 250.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 260.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 270.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 280.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 290.00 | 3.40 | 2.18 | 3.17 | 0.00 |
| 300.00 | 3.40 | 2.18 | 3.17 | 0.00 |

## Summary for Pond 3P: Basin

Inflow Area = 95,997 sf, 21.93% Impervious, Inflow Depth = 2.33" for 2-YR event
Inflow = 8.71 cfs @ 11.95 hrs, Volume= 18,625 cf
Outflow = 0.01 cfs @ 24.12 hrs, Volume= 11,318 cf, Atten= 100%, Lag= 729.9 min
Discarded = 0.00 cfs @ 24.12 hrs, Volume= 188 cf
Primary = 0.01 cfs @ 24.12 hrs, Volume= 11,131 cf

Routing by Stor-Ind method, Time Span= 0.00-300.00 hrs, dt= 0.05 hrs
Peak Elev= 28.17' @ 24.12 hrs Surf.Area= 17,089 sf Storage= 18,028 cf

Plug-Flow detention time= 7,558.0 min calculated for 11,317 cf (61% of inflow)
Center-of-Mass det. time= 7,450.2 min ( 8,244.0 - 793.8 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 24.00' | 52,014 cf | **area (Prismatic)**Listed below (Recalc) |

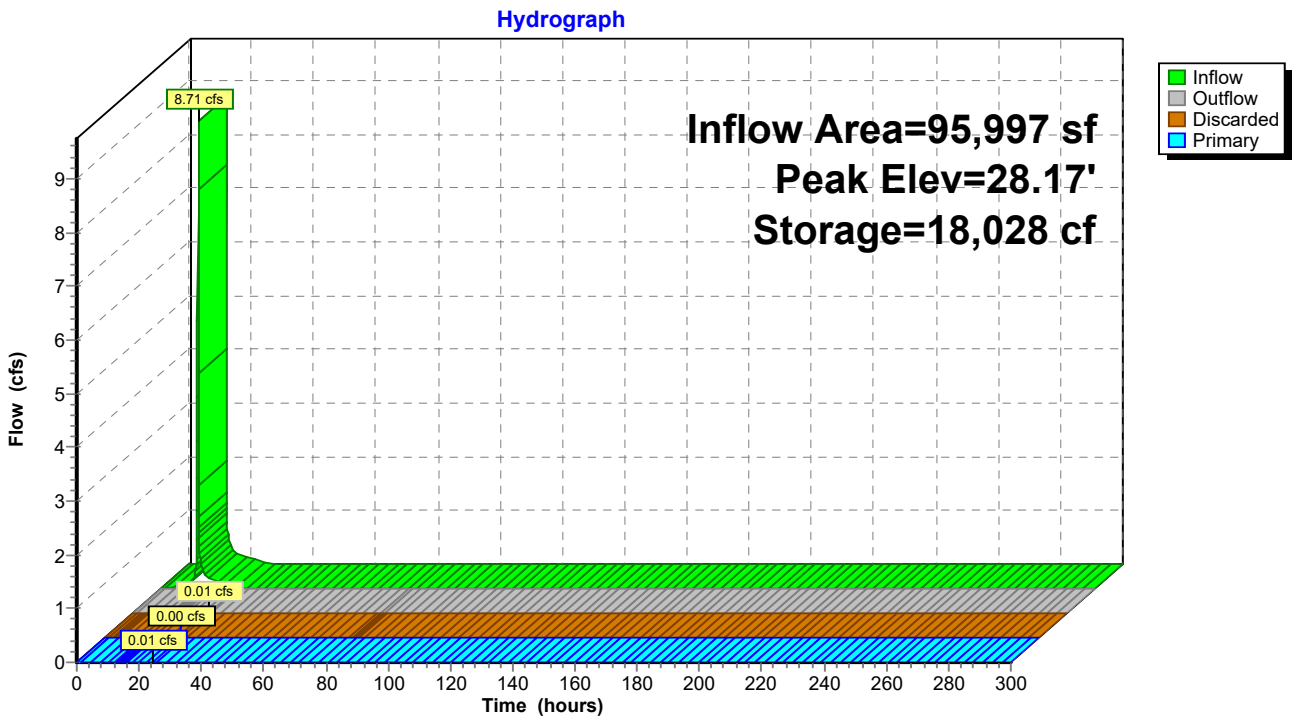
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 24.00 | 2,525 | 0 | 0 |
| 25.00 | 2,525 | 2,525 | 2,525 |
| 25.99 | 2,525 | 2,500 | 5,025 |
| 26.00 | 5,050 | 38 | 5,063 |
| 26.99 | 5,050 | 4,999 | 10,062 |
| 27.00 | 5,050 | 51 | 10,113 |
| 27.99 | 5,050 | 4,999 | 15,112 |
| 28.00 | 16,833 | 109 | 15,222 |
| 29.00 | 18,382 | 17,608 | 32,829 |
| 30.00 | 19,987 | 19,185 | 52,014 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 26.00' | **12.0" Round Outlet Pipe**<br>L= 55.0' RCP, groove end projecting, Ke= 0.200<br>Inlet / Outlet Invert= 26.00' / 25.75' S= 0.0045 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.79 sf |
| #2 | Device 1 | 25.25' | **0.6" Vert. Underdrain Cap** C= 0.600 |
| #3 | Device 1 | 28.20' | **48.0" x 24.0" Horiz. Outlet Structure Top** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Discarded | 24.00' | **0.001 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=0.00 cfs @ 24.12 hrs HW=28.17' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 0.00 cfs)

**Primary OutFlow** Max=0.01 cfs @ 24.12 hrs HW=28.17' TW=24.00' (Fixed TW Elev= 24.00')
└─**1=Outlet Pipe** (Passes 0.01 cfs of 4.59 cfs potential flow)
  ├─**2=Underdrain Cap** (Orifice Controls 0.01 cfs @ 7.09 fps)
  └─**3=Outlet Structure Top** ( Controls 0.00 cfs)

## Pond 3P: Basin



## Hydrograph for Pond 3P: Basin

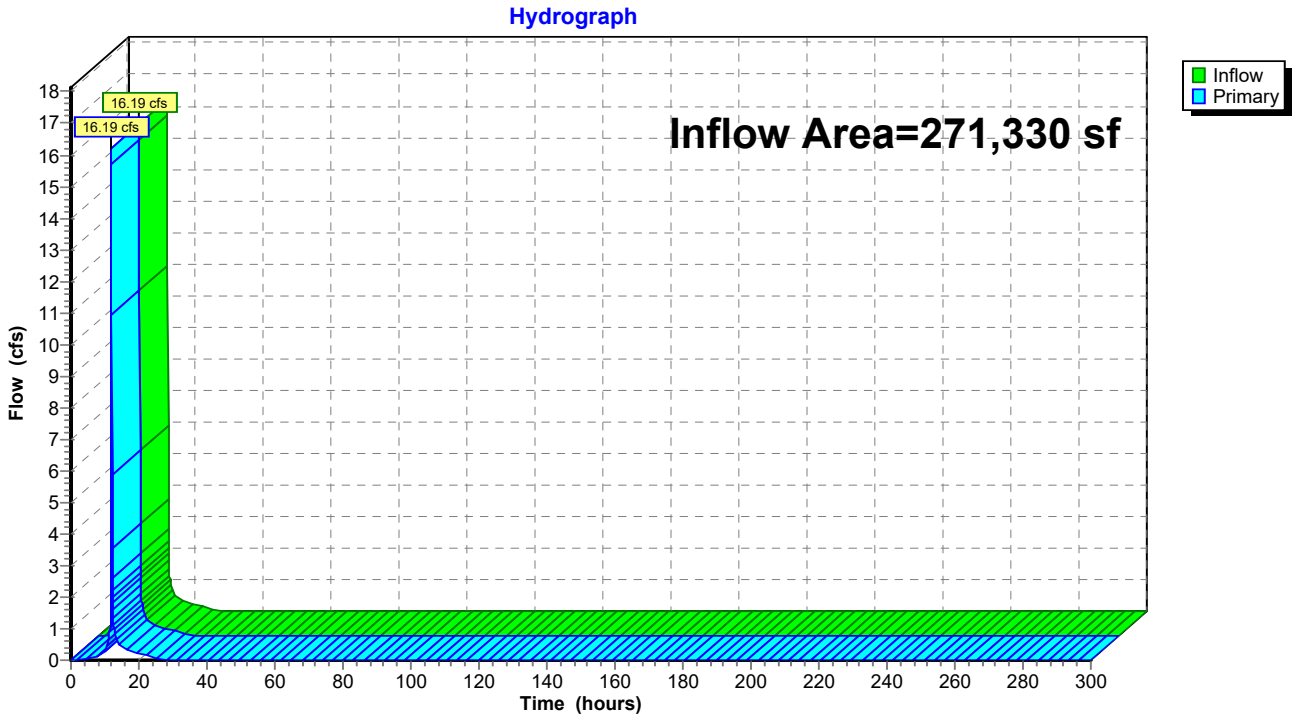
| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Outflow (cfs) | Discarded (cfs) | Primary (cfs) |
|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0 | 24.00 | 0.00 | 0.00 | 0.00 |
| 10.00 | **0.13** | 1,051 | 24.42 | 0.00 | 0.00 | 0.00 |
| 20.00 | **0.09** | **17,022** | **28.11** | **0.01** | **0.00** | **0.01** |
| 30.00 | 0.00 | **17,727** | **28.15** | **0.01** | **0.00** | **0.01** |
| 40.00 | 0.00 | 17,216 | 28.12 | 0.01 | 0.00 | 0.01 |
| 50.00 | 0.00 | 16,708 | 28.09 | 0.01 | 0.00 | 0.01 |
| 60.00 | 0.00 | 16,204 | 28.06 | 0.01 | 0.00 | 0.01 |
| 70.00 | 0.00 | 15,704 | 28.03 | 0.01 | 0.00 | 0.01 |
| 80.00 | 0.00 | 15,207 | 28.00 | 0.01 | 0.00 | 0.01 |
| 90.00 | 0.00 | 14,725 | 27.91 | 0.01 | 0.00 | 0.01 |
| 100.00 | 0.00 | 14,256 | 27.82 | 0.01 | 0.00 | 0.01 |
| 110.00 | 0.00 | 13,798 | 27.73 | 0.01 | 0.00 | 0.01 |
| 120.00 | 0.00 | 13,352 | 27.64 | 0.01 | 0.00 | 0.01 |
| 130.00 | 0.00 | 12,918 | 27.56 | 0.01 | 0.00 | 0.01 |
| 140.00 | 0.00 | 12,495 | 27.47 | 0.01 | 0.00 | 0.01 |
| 150.00 | 0.00 | 12,084 | 27.39 | 0.01 | 0.00 | 0.01 |
| 160.00 | 0.00 | 11,684 | 27.31 | 0.01 | 0.00 | 0.01 |
| 170.00 | 0.00 | 11,296 | 27.23 | 0.01 | 0.00 | 0.01 |
| 180.00 | 0.00 | 10,919 | 27.16 | 0.01 | 0.00 | 0.01 |
| 190.00 | 0.00 | 10,554 | 27.09 | 0.01 | 0.00 | 0.01 |
| 200.00 | 0.00 | 10,201 | 27.02 | 0.01 | 0.00 | 0.01 |
| 210.00 | 0.00 | 9,859 | 26.95 | 0.01 | 0.00 | 0.01 |
| 220.00 | 0.00 | 9,529 | 26.88 | 0.01 | 0.00 | 0.01 |
| 230.00 | 0.00 | 9,211 | 26.82 | 0.01 | 0.00 | 0.01 |
| 240.00 | 0.00 | 8,904 | 26.76 | 0.01 | 0.00 | 0.01 |
| 250.00 | 0.00 | 8,609 | 26.70 | 0.01 | 0.00 | 0.01 |
| 260.00 | 0.00 | 8,325 | 26.65 | 0.01 | 0.00 | 0.01 |
| 270.00 | 0.00 | 8,053 | 26.59 | 0.01 | 0.00 | 0.01 |
| 280.00 | 0.00 | 7,793 | 26.54 | 0.01 | 0.00 | 0.01 |
| 290.00 | 0.00 | 7,544 | 26.49 | 0.01 | 0.00 | 0.01 |
| 300.00 | 0.00 | 7,308 | 26.44 | 0.01 | 0.00 | 0.01 |

## Summary for Link 4L: PR

Inflow Area = 271,330 sf, 22.27% Impervious, Inflow Depth > 2.13" for 2-YR event
Inflow = 16.19 cfs @ 11.98 hrs, Volume= 48,199 cf
Primary = 16.19 cfs @ 11.98 hrs, Volume= 48,199 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-300.00 hrs, dt= 0.05 hrs

### Link 4L: PR



## Hydrograph for Link 4L: PR

| Time (hours) | Inflow (cfs) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|
| 0.00 | 0.00 | **0.00** | 0.00 |
| 5.00 | 0.03 | 0.00 | 0.03 |
| 10.00 | **0.29** | 0.00 | **0.29** |
| 15.00 | **0.41** | 0.00 | **0.41** |
| 20.00 | 0.19 | 0.00 | 0.19 |
| 25.00 | 0.01 | 0.00 | 0.01 |
| 30.00 | 0.01 | 0.00 | 0.01 |
| 35.00 | 0.01 | 0.00 | 0.01 |
| 40.00 | 0.01 | 0.00 | 0.01 |
| 45.00 | 0.01 | 0.00 | 0.01 |
| 50.00 | 0.01 | 0.00 | 0.01 |
| 55.00 | 0.01 | 0.00 | 0.01 |
| 60.00 | 0.01 | 0.00 | 0.01 |
| 65.00 | 0.01 | 0.00 | 0.01 |
| 70.00 | 0.01 | 0.00 | 0.01 |
| 75.00 | 0.01 | 0.00 | 0.01 |
| 80.00 | 0.01 | 0.00 | 0.01 |
| 85.00 | 0.01 | 0.00 | 0.01 |
| 90.00 | 0.01 | 0.00 | 0.01 |
| 95.00 | 0.01 | 0.00 | 0.01 |
| 100.00 | 0.01 | 0.00 | 0.01 |
| 105.00 | 0.01 | 0.00 | 0.01 |
| 110.00 | 0.01 | 0.00 | 0.01 |
| 115.00 | 0.01 | 0.00 | 0.01 |
| 120.00 | 0.01 | 0.00 | 0.01 |
| 125.00 | 0.01 | 0.00 | 0.01 |
| 130.00 | 0.01 | 0.00 | 0.01 |
| 135.00 | 0.01 | 0.00 | 0.01 |
| 140.00 | 0.01 | 0.00 | 0.01 |
| 145.00 | 0.01 | 0.00 | 0.01 |
| 150.00 | 0.01 | 0.00 | 0.01 |
| 155.00 | 0.01 | 0.00 | 0.01 |
| 160.00 | 0.01 | 0.00 | 0.01 |
| 165.00 | 0.01 | 0.00 | 0.01 |
| 170.00 | 0.01 | 0.00 | 0.01 |
| 175.00 | 0.01 | 0.00 | 0.01 |
| 180.00 | 0.01 | 0.00 | 0.01 |
| 185.00 | 0.01 | 0.00 | 0.01 |
| 190.00 | 0.01 | 0.00 | 0.01 |
| 195.00 | 0.01 | 0.00 | 0.01 |
| 200.00 | 0.01 | 0.00 | 0.01 |
| 205.00 | 0.01 | 0.00 | 0.01 |
| 210.00 | 0.01 | 0.00 | 0.01 |
| 215.00 | 0.01 | 0.00 | 0.01 |
| 220.00 | 0.01 | 0.00 | 0.01 |
| 225.00 | 0.01 | 0.00 | 0.01 |
| 230.00 | 0.01 | 0.00 | 0.01 |
| 235.00 | 0.01 | 0.00 | 0.01 |
| 240.00 | 0.01 | 0.00 | 0.01 |
| 245.00 | 0.01 | 0.00 | 0.01 |
| 250.00 | 0.01 | 0.00 | 0.01 |
| 255.00 | 0.01 | 0.00 | 0.01 |
| 260.00 | 0.01 | 0.00 | 0.01 |
| 265.00 | 0.01 | 0.00 | 0.01 |
| 270.00 | 0.01 | 0.00 | 0.01 |
| 275.00 | 0.01 | 0.00 | 0.01 |
| 280.00 | 0.01 | 0.00 | 0.01 |
| 285.00 | 0.01 | 0.00 | 0.01 |
| 290.00 | 0.01 | 0.00 | 0.01 |
| 295.00 | 0.01 | 0.00 | 0.01 |
| 300.00 | 0.01 | 0.00 | 0.01 |

Time span=0.00-300.00 hrs, dt=0.05 hrs, 6001 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: PR** Runoff Area=95,997 sf 21.93% Impervious Runoff Depth=3.78"
Tc=5.0 min CN=87/98 Runoff=13.87 cfs 30,253 cf

**Subcatchment2S: PR** Runoff Area=175,333 sf 22.46% Impervious Runoff Depth=4.03"
Tc=6.8 min CN=90/98 Runoff=25.08 cfs 58,838 cf

**SubcatchmentEX: EX** Runoff Area=276,662 sf 8.88% Impervious Runoff Depth=3.72"
Tc=5.0 min CN=88/98 Runoff=39.85 cfs 85,729 cf

**Pond 3P: Basin** Peak Elev=28.27' Storage=19,831 cf Inflow=13.87 cfs 30,253 cf
Discarded=0.00 cfs 204 cf Primary=0.78 cfs 22,447 cf Outflow=0.78 cfs 22,651 cf

**Link 4L: PR** Inflow=25.09 cfs 81,284 cf
Primary=25.09 cfs 81,284 cf

**Total Runoff Area = 547,992 sf Runoff Volume = 174,820 cf Average Runoff Depth = 3.83"**
**84.49% Pervious = 462,993 sf 15.51% Impervious = 84,999 sf**

## Summary for Subcatchment 1S: PR

[49] Hint: Tc<2dt may require smaller dt

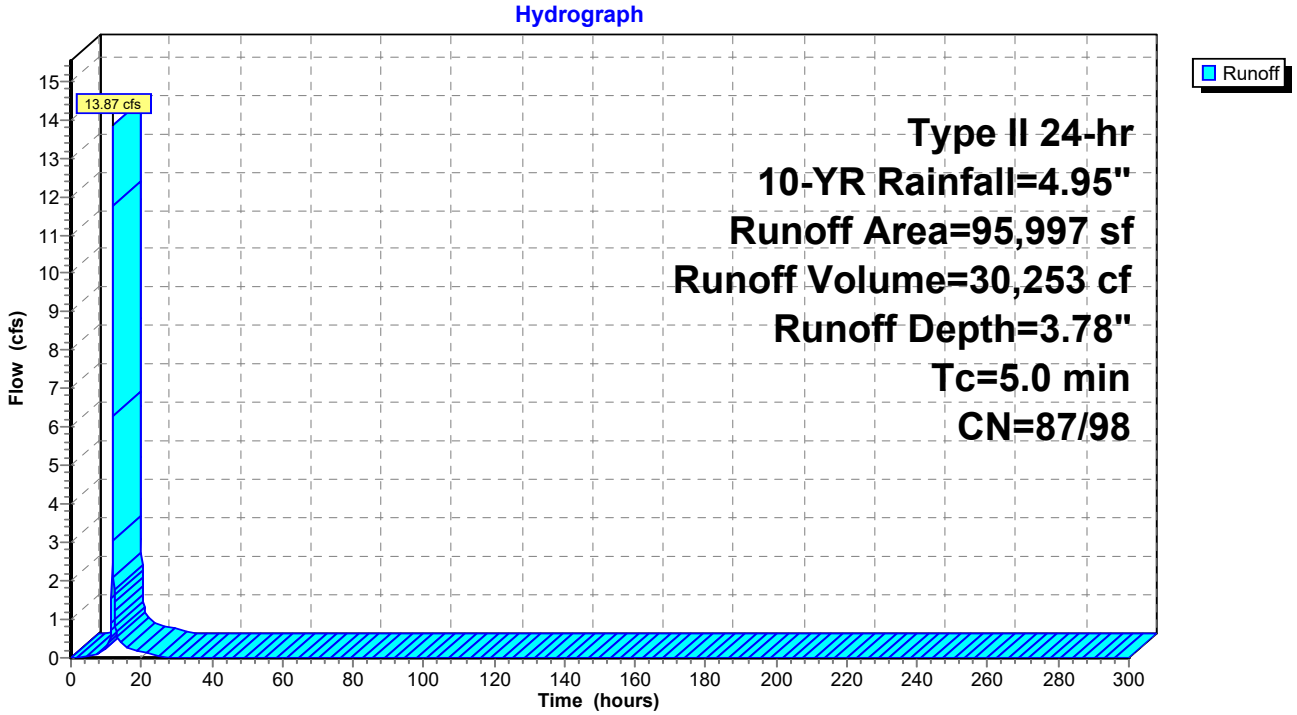
Runoff = 13.87 cfs @ 11.95 hrs, Volume= 30,253 cf, Depth= 3.78"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-300.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YR Rainfall=4.95"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 21,048 | 98 | Impervious |
| * | 49,352 | 91 | Gravel |
| * | 25,597 | 80 | Open Space |
| | 95,997 | 90 | Weighted Average |
| | 74,949 | 87 | 78.07% Pervious Area |
| | 21,048 | 98 | 21.93% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

### Subcatchment 1S: PR



## Hydrograph for Subcatchment 1S: PR

| Time (hours) | Precip. (inches) | Perv.Excess (inches) | Imp.Excess (inches) | Runoff (cfs) |
|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10.00 | 0.90 | 0.17 | 0.69 | **0.25** |
| 20.00 | **4.71** | **3.30** | **4.48** | **0.14** |
| 30.00 | **4.95** | **3.52** | **4.71** | 0.00 |
| 40.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 50.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 60.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 70.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 80.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 90.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 100.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 110.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 120.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 130.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 140.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 150.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 160.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 170.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 180.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 190.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 200.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 210.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 220.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 230.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 240.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 250.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 260.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 270.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 280.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 290.00 | 4.95 | 3.52 | 4.71 | 0.00 |
| 300.00 | 4.95 | 3.52 | 4.71 | 0.00 |

## Summary for Subcatchment 2S: PR

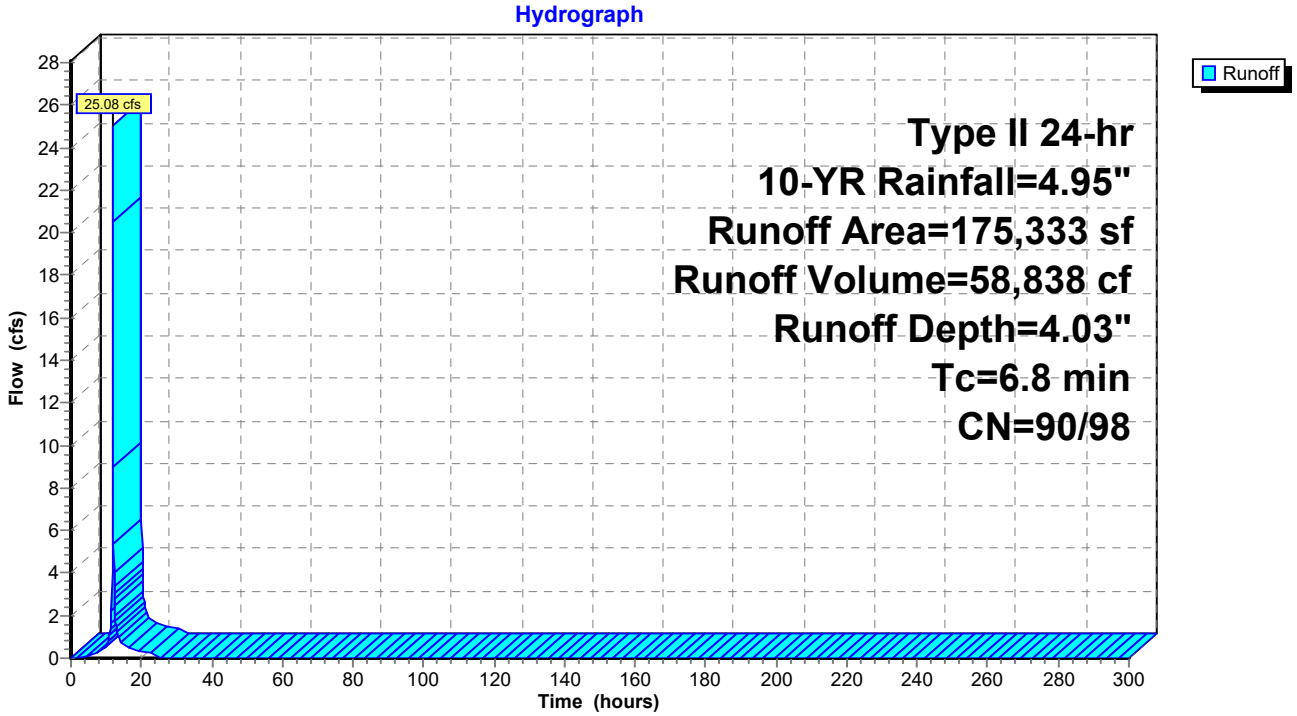
Runoff = 25.08 cfs @ 11.98 hrs, Volume= 58,838 cf, Depth= 4.03"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-300.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YR Rainfall=4.95"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 39,382 | 98 | Impervious |
| * | 124,147 | 91 | Gravel |
| * | 11,804 | 80 | Open Space |
| | 175,333 | 92 | Weighted Average |
| | 135,951 | 90 | 77.54% Pervious Area |
| | 39,382 | 98 | 22.46% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.8 | | | | | **Direct Entry,** |

## Subcatchment 2S: PR



## Hydrograph for Subcatchment 2S: PR

| Time (hours) | Precip. (inches) | Perv.Excess (inches) | Imp.Excess (inches) | Runoff (cfs) |
|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10.00 | 0.90 | 0.25 | 0.69 | **0.53** |
| 20.00 | **4.71** | **3.60** | **4.48** | **0.26** |
| 30.00 | **4.95** | **3.83** | **4.71** | 0.00 |
| 40.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 50.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 60.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 70.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 80.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 90.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 100.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 110.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 120.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 130.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 140.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 150.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 160.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 170.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 180.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 190.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 200.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 210.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 220.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 230.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 240.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 250.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 260.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 270.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 280.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 290.00 | 4.95 | 3.83 | 4.71 | 0.00 |
| 300.00 | 4.95 | 3.83 | 4.71 | 0.00 |

## Summary for Subcatchment EX: EX

[49] Hint: Tc<2dt may require smaller dt

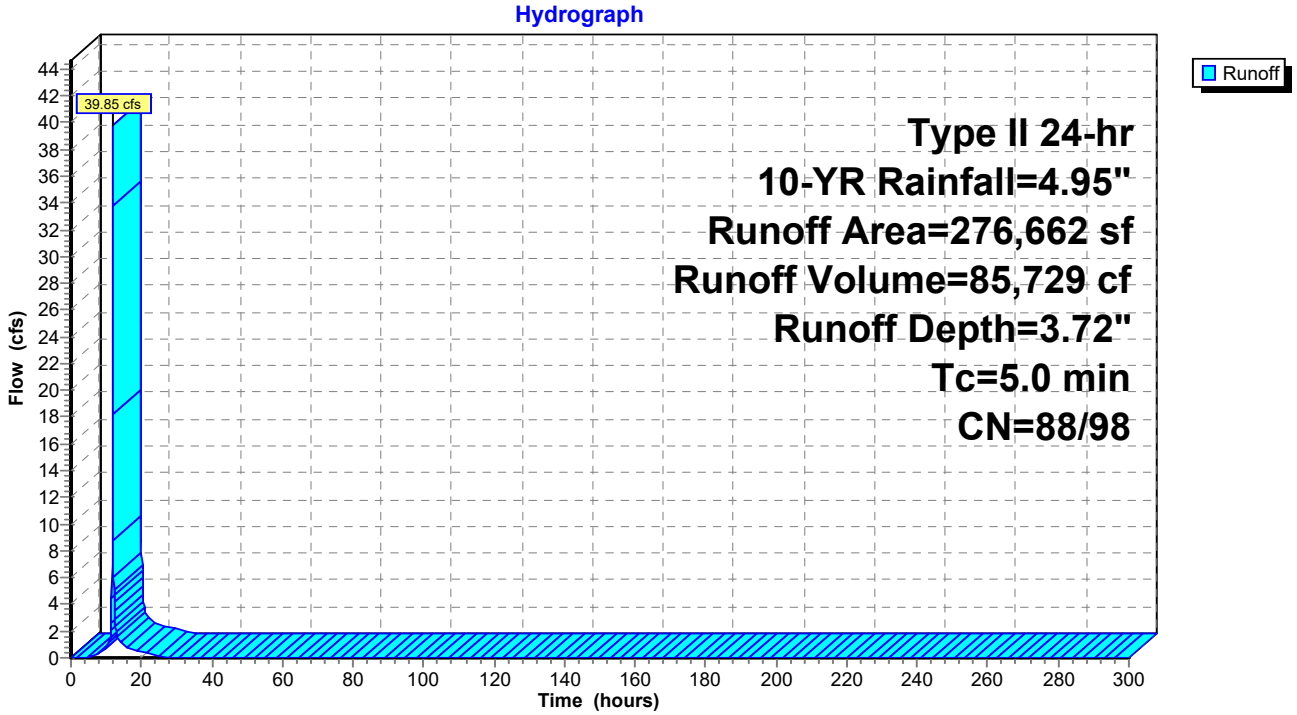
Runoff = 39.85 cfs @ 11.95 hrs, Volume= 85,729 cf, Depth= 3.72"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-300.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YR Rainfall=4.95"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 24,569 | 98 | Impervious |
| * | 59,598 | 78 | Meadow (20% Imp & Gravel) |
| * | 192,495 | 91 | Gravel |
| | 276,662 | 89 | Weighted Average |
| | 252,093 | 88 | 91.12% Pervious Area |
| | 24,569 | 98 | 8.88% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

### Subcatchment EX: EX



## Hydrograph for Subcatchment EX: EX

| Time (hours) | Precip. (inches) | Perv.Excess (inches) | Imp.Excess (inches) | Runoff (cfs) |
|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10.00 | 0.90 | 0.20 | 0.69 | **0.69** |
| 20.00 | **4.71** | **3.40** | **4.48** | **0.40** |
| 30.00 | **4.95** | **3.62** | **4.71** | 0.00 |
| 40.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 50.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 60.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 70.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 80.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 90.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 100.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 110.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 120.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 130.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 140.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 150.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 160.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 170.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 180.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 190.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 200.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 210.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 220.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 230.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 240.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 250.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 260.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 270.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 280.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 290.00 | 4.95 | 3.62 | 4.71 | 0.00 |
| 300.00 | 4.95 | 3.62 | 4.71 | 0.00 |

## Summary for Pond 3P: Basin

Inflow Area = 95,997 sf, 21.93% Impervious, Inflow Depth = 3.78" for 10-YR event
Inflow = 13.87 cfs @ 11.95 hrs, Volume= 30,253 cf
Outflow = 0.78 cfs @ 12.79 hrs, Volume= 22,651 cf, Atten= 94%, Lag= 50.3 min
Discarded = 0.00 cfs @ 12.79 hrs, Volume= 204 cf
Primary = 0.78 cfs @ 12.79 hrs, Volume= 22,447 cf

Routing by Stor-Ind method, Time Span= 0.00-300.00 hrs, dt= 0.05 hrs
Peak Elev= 28.27' @ 12.79 hrs Surf.Area= 17,252 sf Storage= 19,831 cf

Plug-Flow detention time= 4,061.3 min calculated for 22,647 cf (75% of inflow)
Center-of-Mass det. time= 3,972.5 min ( 4,755.2 - 782.7 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 24.00' | 52,014 cf | **area (Prismatic)**Listed below (Recalc) |

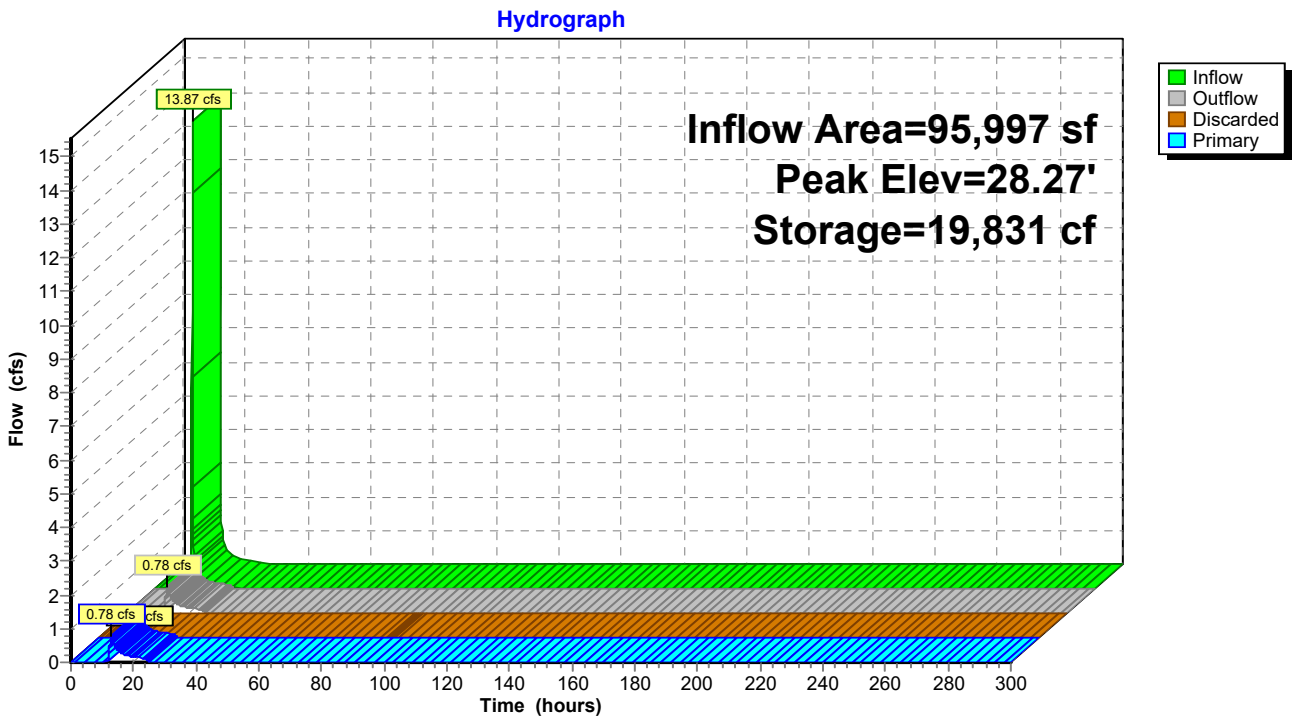
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 24.00 | 2,525 | 0 | 0 |
| 25.00 | 2,525 | 2,525 | 2,525 |
| 25.99 | 2,525 | 2,500 | 5,025 |
| 26.00 | 5,050 | 38 | 5,063 |
| 26.99 | 5,050 | 4,999 | 10,062 |
| 27.00 | 5,050 | 51 | 10,113 |
| 27.99 | 5,050 | 4,999 | 15,112 |
| 28.00 | 16,833 | 109 | 15,222 |
| 29.00 | 18,382 | 17,608 | 32,829 |
| 30.00 | 19,987 | 19,185 | 52,014 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 26.00' | **12.0" Round Outlet Pipe**<br>L= 55.0' RCP, groove end projecting, Ke= 0.200<br>Inlet / Outlet Invert= 26.00' / 25.75' S= 0.0045 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.79 sf |
| #2 | Device 1 | 25.25' | **0.6" Vert. Underdrain Cap** C= 0.600 |
| #3 | Device 1 | 28.20' | **48.0" x 24.0" Horiz. Outlet Structure Top** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Discarded | 24.00' | **0.001 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=0.00 cfs @ 12.79 hrs HW=28.27' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 0.00 cfs)

**Primary OutFlow** Max=0.75 cfs @ 12.79 hrs HW=28.27' TW=24.00' (Fixed TW Elev= 24.00')
└─**1=Outlet Pipe** (Passes 0.75 cfs of 4.75 cfs potential flow)
  ├─**2=Underdrain Cap** (Orifice Controls 0.01 cfs @ 7.26 fps)
  └─**3=Outlet Structure Top** (Weir Controls 0.73 cfs @ 0.87 fps)

## Pond 3P: Basin



## Hydrograph for Pond 3P: Basin

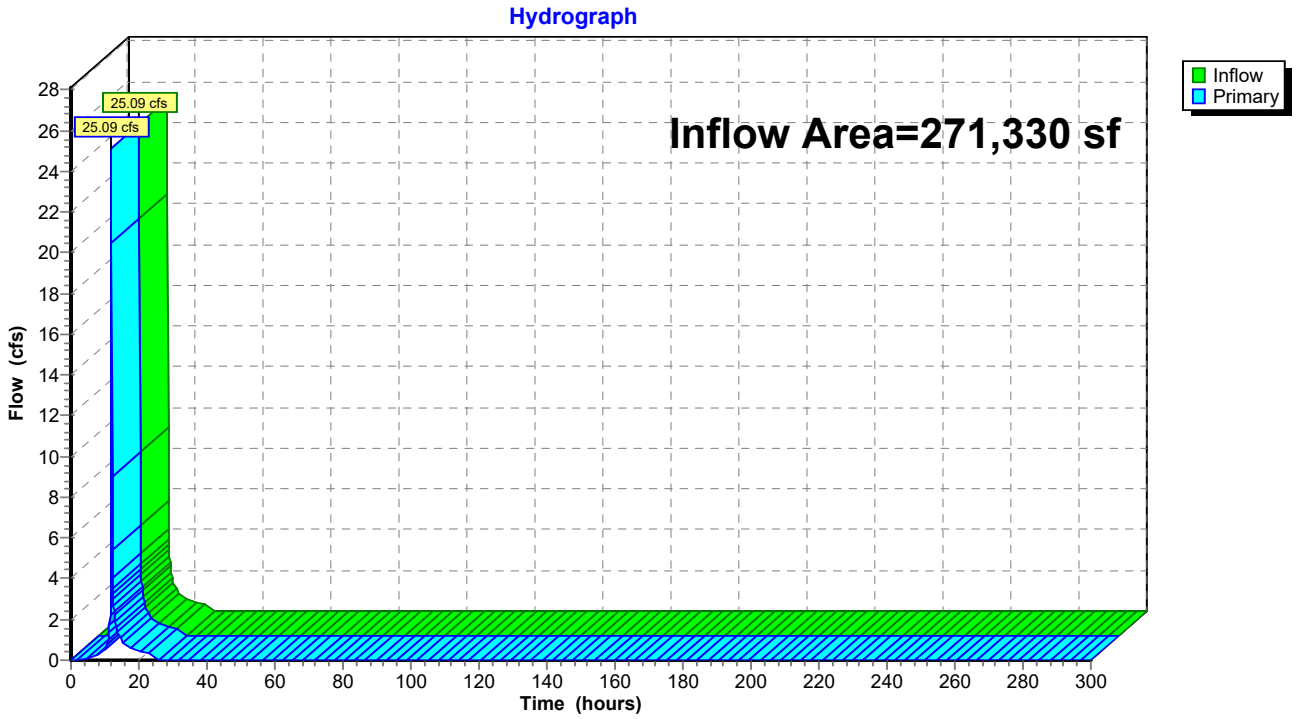
| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Outflow (cfs) | Discarded (cfs) | Primary (cfs) |
|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0 | 24.00 | 0.00 | 0.00 | 0.00 |
| 10.00 | **0.25** | **2,204** | **24.87** | **0.00** | **0.00** | **0.00** |
| 20.00 | **0.14** | **18,863** | **28.21** | **0.15** | **0.00** | **0.15** |
| 30.00 | 0.00 | 18,366 | 28.19 | 0.01 | 0.00 | 0.01 |
| 40.00 | 0.00 | 17,851 | 28.16 | 0.01 | 0.00 | 0.01 |
| 50.00 | 0.00 | 17,339 | 28.13 | 0.01 | 0.00 | 0.01 |
| 60.00 | 0.00 | 16,830 | 28.10 | 0.01 | 0.00 | 0.01 |
| 70.00 | 0.00 | 16,325 | 28.07 | 0.01 | 0.00 | 0.01 |
| 80.00 | 0.00 | 15,824 | 28.04 | 0.01 | 0.00 | 0.01 |
| 90.00 | 0.00 | 15,326 | 28.01 | 0.01 | 0.00 | 0.01 |
| 100.00 | 0.00 | 14,840 | 27.94 | 0.01 | 0.00 | 0.01 |
| 110.00 | 0.00 | 14,368 | 27.84 | 0.01 | 0.00 | 0.01 |
| 120.00 | 0.00 | 13,907 | 27.75 | 0.01 | 0.00 | 0.01 |
| 130.00 | 0.00 | 13,458 | 27.66 | 0.01 | 0.00 | 0.01 |
| 140.00 | 0.00 | 13,021 | 27.58 | 0.01 | 0.00 | 0.01 |
| 150.00 | 0.00 | 12,595 | 27.49 | 0.01 | 0.00 | 0.01 |
| 160.00 | 0.00 | 12,181 | 27.41 | 0.01 | 0.00 | 0.01 |
| 170.00 | 0.00 | 11,779 | 27.33 | 0.01 | 0.00 | 0.01 |
| 180.00 | 0.00 | 11,388 | 27.25 | 0.01 | 0.00 | 0.01 |
| 190.00 | 0.00 | 11,009 | 27.18 | 0.01 | 0.00 | 0.01 |
| 200.00 | 0.00 | 10,641 | 27.10 | 0.01 | 0.00 | 0.01 |
| 210.00 | 0.00 | 10,285 | 27.03 | 0.01 | 0.00 | 0.01 |
| 220.00 | 0.00 | 9,940 | 26.97 | 0.01 | 0.00 | 0.01 |
| 230.00 | 0.00 | 9,608 | 26.90 | 0.01 | 0.00 | 0.01 |
| 240.00 | 0.00 | 9,286 | 26.84 | 0.01 | 0.00 | 0.01 |
| 250.00 | 0.00 | 8,977 | 26.78 | 0.01 | 0.00 | 0.01 |
| 260.00 | 0.00 | 8,679 | 26.72 | 0.01 | 0.00 | 0.01 |
| 270.00 | 0.00 | 8,392 | 26.66 | 0.01 | 0.00 | 0.01 |
| 280.00 | 0.00 | 8,118 | 26.60 | 0.01 | 0.00 | 0.01 |
| 290.00 | 0.00 | 7,855 | 26.55 | 0.01 | 0.00 | 0.01 |
| 300.00 | 0.00 | 7,603 | 26.50 | 0.01 | 0.00 | 0.01 |

## Summary for Link 4L: PR

Inflow Area = 271,330 sf, 22.27% Impervious, Inflow Depth > 3.59" for 10-YR event
Inflow = 25.09 cfs @ 11.98 hrs, Volume= 81,284 cf
Primary = 25.09 cfs @ 11.98 hrs, Volume= 81,284 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-300.00 hrs, dt= 0.05 hrs

### Link 4L: PR



## Hydrograph for Link 4L: PR

| Time (hours) | Inflow (cfs) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|
| 0.00 | 0.00 | **0.00** | 0.00 |
| 5.00 | 0.09 | 0.00 | 0.09 |
| 10.00 | **0.53** | 0.00 | **0.53** |
| 15.00 | **0.95** | 0.00 | **0.95** |
| 20.00 | 0.41 | 0.00 | 0.41 |
| 25.00 | 0.02 | 0.00 | 0.02 |
| 30.00 | 0.01 | 0.00 | 0.01 |
| 35.00 | 0.01 | 0.00 | 0.01 |
| 40.00 | 0.01 | 0.00 | 0.01 |
| 45.00 | 0.01 | 0.00 | 0.01 |
| 50.00 | 0.01 | 0.00 | 0.01 |
| 55.00 | 0.01 | 0.00 | 0.01 |
| 60.00 | 0.01 | 0.00 | 0.01 |
| 65.00 | 0.01 | 0.00 | 0.01 |
| 70.00 | 0.01 | 0.00 | 0.01 |
| 75.00 | 0.01 | 0.00 | 0.01 |
| 80.00 | 0.01 | 0.00 | 0.01 |
| 85.00 | 0.01 | 0.00 | 0.01 |
| 90.00 | 0.01 | 0.00 | 0.01 |
| 95.00 | 0.01 | 0.00 | 0.01 |
| 100.00 | 0.01 | 0.00 | 0.01 |
| 105.00 | 0.01 | 0.00 | 0.01 |
| 110.00 | 0.01 | 0.00 | 0.01 |
| 115.00 | 0.01 | 0.00 | 0.01 |
| 120.00 | 0.01 | 0.00 | 0.01 |
| 125.00 | 0.01 | 0.00 | 0.01 |
| 130.00 | 0.01 | 0.00 | 0.01 |
| 135.00 | 0.01 | 0.00 | 0.01 |
| 140.00 | 0.01 | 0.00 | 0.01 |
| 145.00 | 0.01 | 0.00 | 0.01 |
| 150.00 | 0.01 | 0.00 | 0.01 |
| 155.00 | 0.01 | 0.00 | 0.01 |
| 160.00 | 0.01 | 0.00 | 0.01 |
| 165.00 | 0.01 | 0.00 | 0.01 |
| 170.00 | 0.01 | 0.00 | 0.01 |
| 175.00 | 0.01 | 0.00 | 0.01 |
| 180.00 | 0.01 | 0.00 | 0.01 |
| 185.00 | 0.01 | 0.00 | 0.01 |
| 190.00 | 0.01 | 0.00 | 0.01 |
| 195.00 | 0.01 | 0.00 | 0.01 |
| 200.00 | 0.01 | 0.00 | 0.01 |
| 205.00 | 0.01 | 0.00 | 0.01 |
| 210.00 | 0.01 | 0.00 | 0.01 |
| 215.00 | 0.01 | 0.00 | 0.01 |
| 220.00 | 0.01 | 0.00 | 0.01 |
| 225.00 | 0.01 | 0.00 | 0.01 |
| 230.00 | 0.01 | 0.00 | 0.01 |
| 235.00 | 0.01 | 0.00 | 0.01 |
| 240.00 | 0.01 | 0.00 | 0.01 |
| 245.00 | 0.01 | 0.00 | 0.01 |
| 250.00 | 0.01 | 0.00 | 0.01 |
| 255.00 | 0.01 | 0.00 | 0.01 |
| 260.00 | 0.01 | 0.00 | 0.01 |
| 265.00 | 0.01 | 0.00 | 0.01 |
| 270.00 | 0.01 | 0.00 | 0.01 |
| 275.00 | 0.01 | 0.00 | 0.01 |
| 280.00 | 0.01 | 0.00 | 0.01 |
| 285.00 | 0.01 | 0.00 | 0.01 |
| 290.00 | 0.01 | 0.00 | 0.01 |
| 295.00 | 0.01 | 0.00 | 0.01 |
| 300.00 | 0.01 | 0.00 | 0.01 |

Time span=0.00-300.00 hrs, dt=0.05 hrs, 6001 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: PR** Runoff Area=95,997 sf 21.93% Impervious Runoff Depth=5.92"
Tc=5.0 min CN=87/98 Runoff=21.20 cfs 47,328 cf

**Subcatchment2S: PR** Runoff Area=175,333 sf 22.46% Impervious Runoff Depth=6.19"
Tc=6.8 min CN=90/98 Runoff=37.65 cfs 90,462 cf

**SubcatchmentEX: EX** Runoff Area=276,662 sf 8.88% Impervious Runoff Depth=5.85"
Tc=5.0 min CN=88/98 Runoff=61.06 cfs 134,943 cf

**Pond 3P: Basin** Peak Elev=28.62' Storage=25,921 cf Inflow=21.20 cfs 47,328 cf
Discarded=0.00 cfs 205 cf Primary=5.27 cfs 39,516 cf Outflow=5.27 cfs 39,721 cf

**Link 4L: PR** Inflow=41.99 cfs 129,978 cf
Primary=41.99 cfs 129,978 cf

**Total Runoff Area = 547,992 sf Runoff Volume = 272,734 cf Average Runoff Depth = 5.97"**
**84.49% Pervious = 462,993 sf 15.51% Impervious = 84,999 sf**

## Summary for Subcatchment 1S: PR

[49] Hint: Tc<2dt may require smaller dt

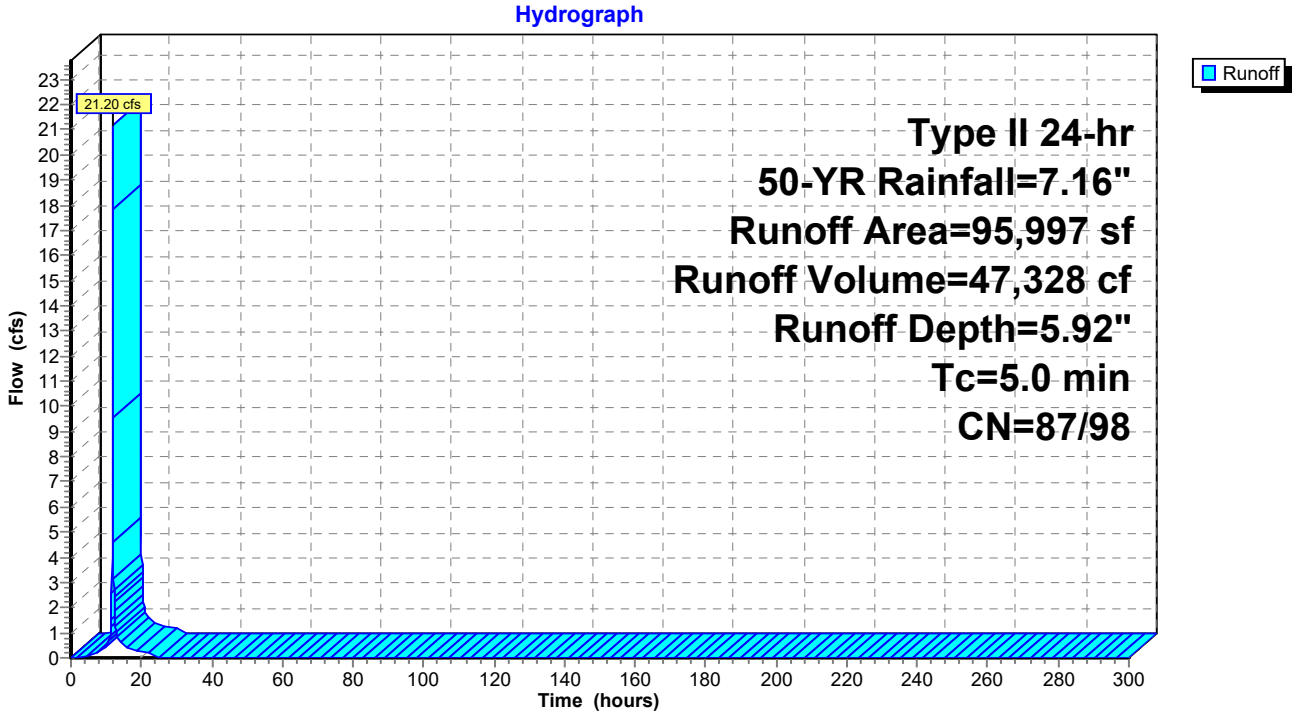
Runoff = 21.20 cfs @ 11.95 hrs, Volume= 47,328 cf, Depth= 5.92"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-300.00 hrs, dt= 0.05 hrs
Type II 24-hr 50-YR Rainfall=7.16"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 21,048 | 98 | Impervious |
| * | 49,352 | 91 | Gravel |
| * | 25,597 | 80 | Open Space |
| | 95,997 | 90 | Weighted Average |
| | 74,949 | 87 | 78.07% Pervious Area |
| | 21,048 | 98 | 21.93% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

### Subcatchment 1S: PR



## Hydrograph for Subcatchment 1S: PR

| Time (hours) | Precip. (inches) | Perv.Excess (inches) | Imp.Excess (inches) | Runoff (cfs) |
|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10.00 | 1.30 | 0.40 | 1.08 | **0.44** |
| 20.00 | **6.82** | **5.30** | **6.58** | **0.20** |
| 30.00 | **7.16** | **5.63** | **6.92** | 0.00 |
| 40.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 50.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 60.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 70.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 80.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 90.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 100.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 110.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 120.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 130.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 140.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 150.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 160.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 170.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 180.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 190.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 200.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 210.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 220.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 230.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 240.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 250.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 260.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 270.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 280.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 290.00 | 7.16 | 5.63 | 6.92 | 0.00 |
| 300.00 | 7.16 | 5.63 | 6.92 | 0.00 |

## Summary for Subcatchment 2S: PR

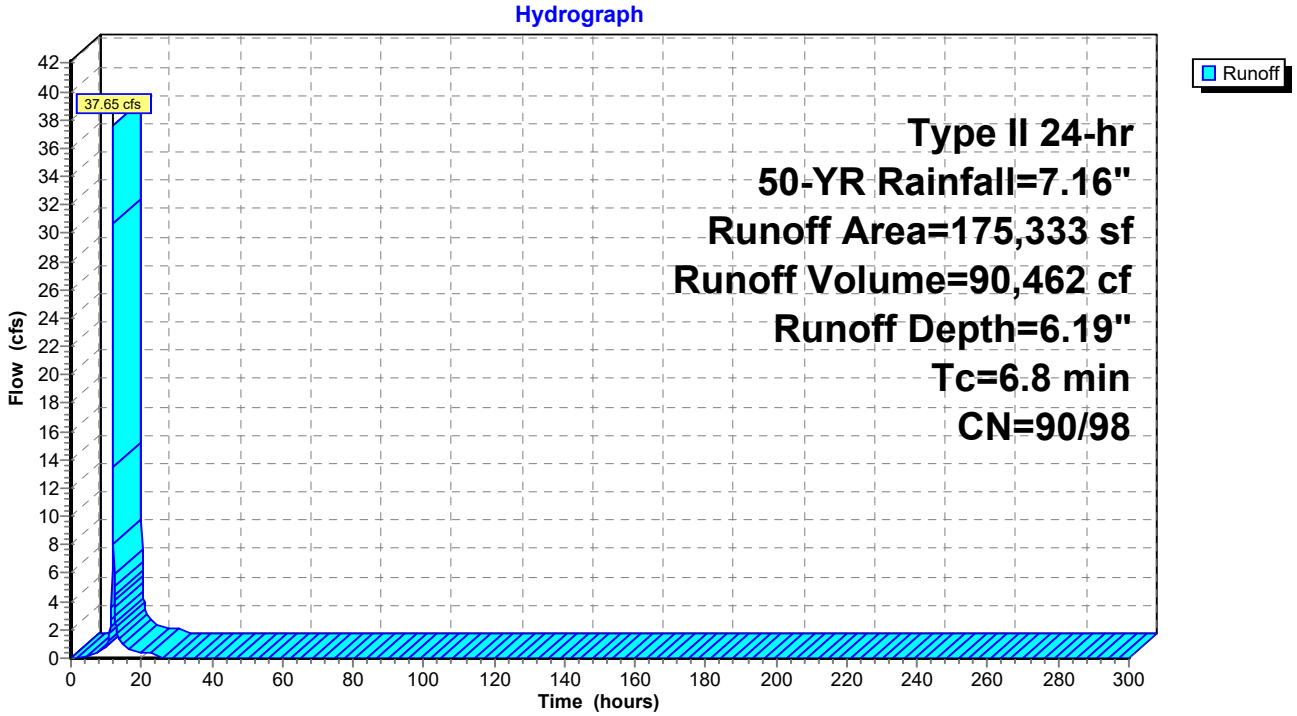
Runoff = 37.65 cfs @ 11.98 hrs, Volume= 90,462 cf, Depth= 6.19"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-300.00 hrs, dt= 0.05 hrs
Type II 24-hr 50-YR Rainfall=7.16"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 39,382 | 98 | Impervious |
| * | 124,147 | 91 | Gravel |
| * | 11,804 | 80 | Open Space |
| | 175,333 | 92 | Weighted Average |
| | 135,951 | 90 | 77.54% Pervious Area |
| | 39,382 | 98 | 22.46% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.8 | | | | | **Direct Entry,** |

## Subcatchment 2S: PR



## Hydrograph for Subcatchment 2S: PR

| Time (hours) | Precip. (inches) | Perv.Excess (inches) | Imp.Excess (inches) | Runoff (cfs) |
|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10.00 | 1.30 | 0.53 | 1.08 | **0.88** |
| 20.00 | **6.82** | **5.64** | **6.58** | **0.38** |
| 30.00 | **7.16** | **5.98** | **6.92** | 0.00 |
| 40.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 50.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 60.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 70.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 80.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 90.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 100.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 110.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 120.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 130.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 140.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 150.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 160.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 170.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 180.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 190.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 200.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 210.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 220.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 230.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 240.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 250.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 260.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 270.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 280.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 290.00 | 7.16 | 5.98 | 6.92 | 0.00 |
| 300.00 | 7.16 | 5.98 | 6.92 | 0.00 |

## Summary for Subcatchment EX: EX

[49] Hint: Tc<2dt may require smaller dt

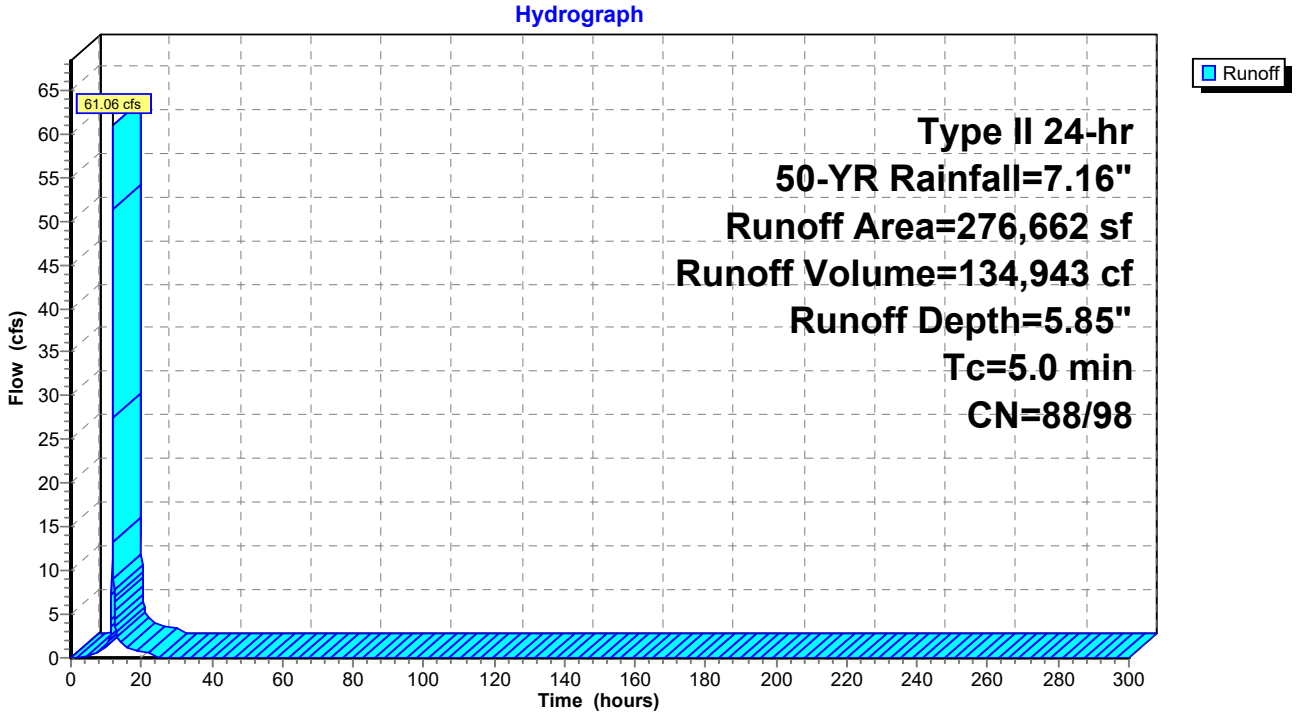
Runoff = 61.06 cfs @ 11.95 hrs, Volume= 134,943 cf, Depth= 5.85"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-300.00 hrs, dt= 0.05 hrs
Type II 24-hr 50-YR Rainfall=7.16"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 24,569 | 98 | Impervious |
| * | 59,598 | 78 | Meadow (20% Imp & Gravel) |
| * | 192,495 | 91 | Gravel |
| | 276,662 | 89 | Weighted Average |
| | 252,093 | 88 | 91.12% Pervious Area |
| | 24,569 | 98 | 8.88% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment EX: EX



## Hydrograph for Subcatchment EX: EX

| Time (hours) | Precip. (inches) | Perv.Excess (inches) | Imp.Excess (inches) | Runoff (cfs) |
|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10.00 | 1.30 | 0.44 | 1.08 | **1.24** |
| 20.00 | **6.82** | **5.42** | **6.58** | **0.59** |
| 30.00 | **7.16** | **5.75** | **6.92** | 0.00 |
| 40.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 50.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 60.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 70.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 80.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 90.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 100.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 110.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 120.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 130.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 140.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 150.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 160.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 170.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 180.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 190.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 200.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 210.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 220.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 230.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 240.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 250.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 260.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 270.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 280.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 290.00 | 7.16 | 5.75 | 6.92 | 0.00 |
| 300.00 | 7.16 | 5.75 | 6.92 | 0.00 |

## Summary for Pond 3P: Basin

Inflow Area = 95,997 sf, 21.93% Impervious, Inflow Depth = 5.92" for 50-YR event
Inflow = 21.20 cfs @ 11.95 hrs, Volume= 47,328 cf
Outflow = 5.27 cfs @ 12.10 hrs, Volume= 39,721 cf, Atten= 75%, Lag= 9.1 min
Discarded = 0.00 cfs @ 12.10 hrs, Volume= 205 cf
Primary = 5.27 cfs @ 12.10 hrs, Volume= 39,516 cf

Routing by Stor-Ind method, Time Span= 0.00-300.00 hrs, dt= 0.05 hrs
Peak Elev= 28.62' @ 12.10 hrs Surf.Area= 17,790 sf Storage= 25,921 cf

Plug-Flow detention time= 2,363.0 min calculated for 39,721 cf (84% of inflow)
Center-of-Mass det. time= 2,291.7 min ( 3,064.1 - 772.4 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 24.00' | 52,014 cf | **area (Prismatic)** Listed below (Recalc) |

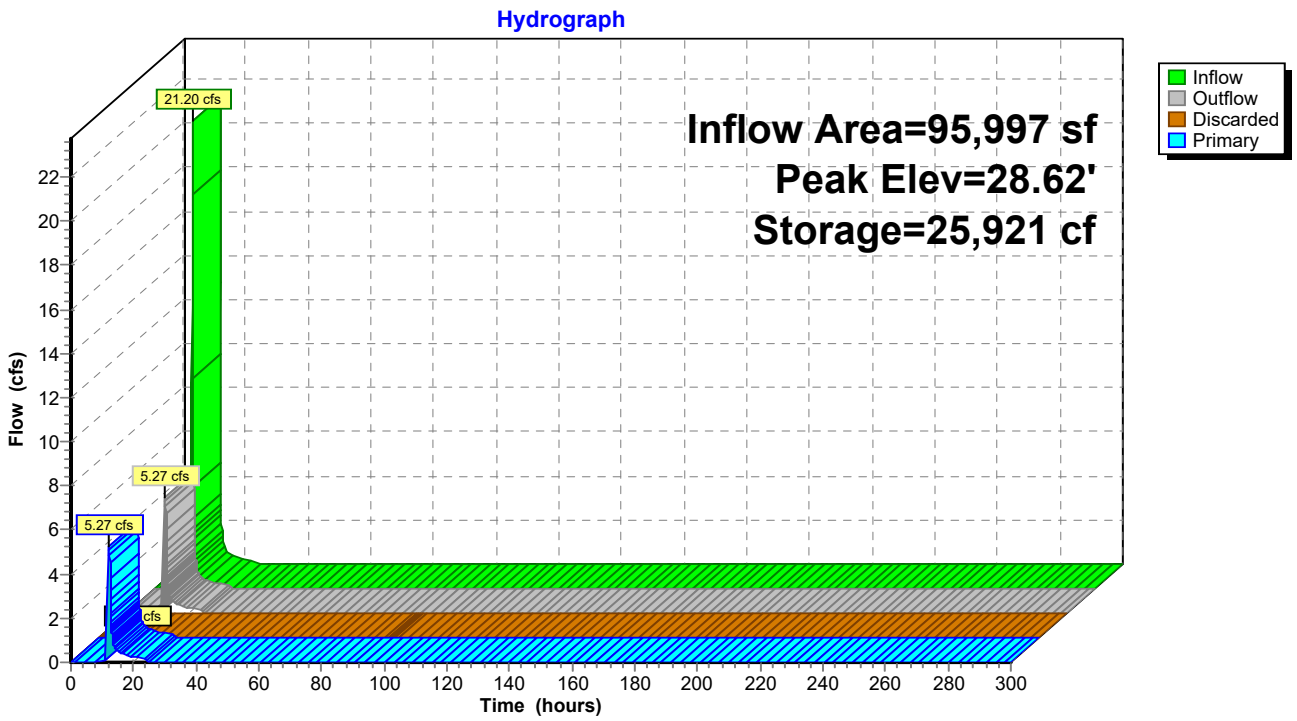
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 24.00 | 2,525 | 0 | 0 |
| 25.00 | 2,525 | 2,525 | 2,525 |
| 25.99 | 2,525 | 2,500 | 5,025 |
| 26.00 | 5,050 | 38 | 5,063 |
| 26.99 | 5,050 | 4,999 | 10,062 |
| 27.00 | 5,050 | 51 | 10,113 |
| 27.99 | 5,050 | 4,999 | 15,112 |
| 28.00 | 16,833 | 109 | 15,222 |
| 29.00 | 18,382 | 17,608 | 32,829 |
| 30.00 | 19,987 | 19,185 | 52,014 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 26.00' | **12.0" Round Outlet Pipe**<br>L= 55.0' RCP, groove end projecting, Ke= 0.200<br>Inlet / Outlet Invert= 26.00' / 25.75' S= 0.0045 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.79 sf |
| #2 | Device 1 | 25.25' | **0.6" Vert. Underdrain Cap** C= 0.600 |
| #3 | Device 1 | 28.20' | **48.0" x 24.0" Horiz. Outlet Structure Top** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Discarded | 24.00' | **0.001 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=0.00 cfs @ 12.10 hrs HW=28.62' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 0.00 cfs)

**Primary OutFlow** Max=5.27 cfs @ 12.10 hrs HW=28.62' TW=24.00' (Fixed TW Elev= 24.00')
└─**1=Outlet Pipe** (Barrel Controls 5.27 cfs @ 6.71 fps)
  ├─**2=Underdrain Cap** (Passes < 0.02 cfs potential flow)
  └─**3=Outlet Structure Top** (Passes < 10.57 cfs potential flow)

## Pond 3P: Basin



## Hydrograph for Pond 3P: Basin

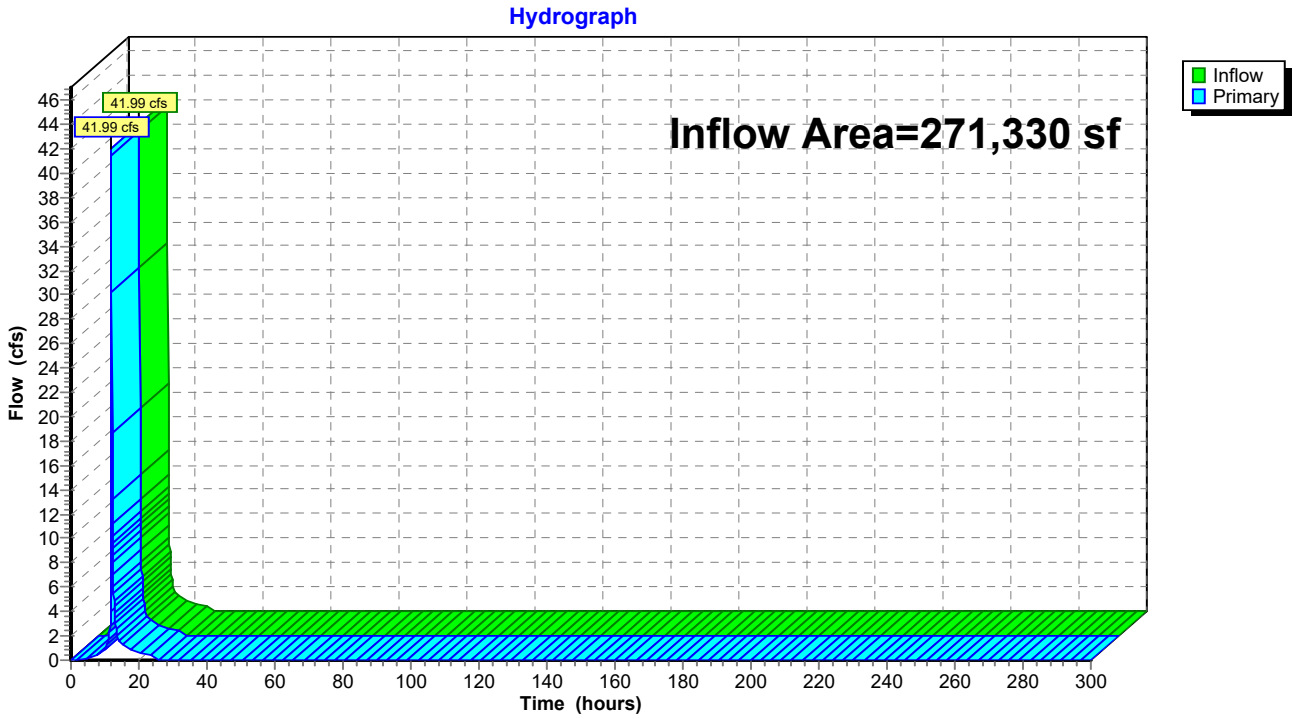
| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Outflow (cfs) | Discarded (cfs) | Primary (cfs) |
|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0 | 24.00 | 0.00 | 0.00 | 0.00 |
| 10.00 | **0.44** | **4,261** | **25.69** | **0.00** | **0.00** | **0.00** |
| 20.00 | **0.20** | **18,993** | **28.22** | **0.22** | **0.00** | **0.22** |
| 30.00 | 0.00 | 18,376 | 28.19 | 0.01 | 0.00 | 0.01 |
| 40.00 | 0.00 | 17,861 | 28.16 | 0.01 | 0.00 | 0.01 |
| 50.00 | 0.00 | 17,349 | 28.13 | 0.01 | 0.00 | 0.01 |
| 60.00 | 0.00 | 16,840 | 28.10 | 0.01 | 0.00 | 0.01 |
| 70.00 | 0.00 | 16,335 | 28.07 | 0.01 | 0.00 | 0.01 |
| 80.00 | 0.00 | 15,833 | 28.04 | 0.01 | 0.00 | 0.01 |
| 90.00 | 0.00 | 15,335 | 28.01 | 0.01 | 0.00 | 0.01 |
| 100.00 | 0.00 | 14,849 | 27.94 | 0.01 | 0.00 | 0.01 |
| 110.00 | 0.00 | 14,377 | 27.84 | 0.01 | 0.00 | 0.01 |
| 120.00 | 0.00 | 13,916 | 27.75 | 0.01 | 0.00 | 0.01 |
| 130.00 | 0.00 | 13,467 | 27.66 | 0.01 | 0.00 | 0.01 |
| 140.00 | 0.00 | 13,030 | 27.58 | 0.01 | 0.00 | 0.01 |
| 150.00 | 0.00 | 12,604 | 27.49 | 0.01 | 0.00 | 0.01 |
| 160.00 | 0.00 | 12,189 | 27.41 | 0.01 | 0.00 | 0.01 |
| 170.00 | 0.00 | 11,787 | 27.33 | 0.01 | 0.00 | 0.01 |
| 180.00 | 0.00 | 11,395 | 27.25 | 0.01 | 0.00 | 0.01 |
| 190.00 | 0.00 | 11,016 | 27.18 | 0.01 | 0.00 | 0.01 |
| 200.00 | 0.00 | 10,648 | 27.11 | 0.01 | 0.00 | 0.01 |
| 210.00 | 0.00 | 10,292 | 27.04 | 0.01 | 0.00 | 0.01 |
| 220.00 | 0.00 | 9,947 | 26.97 | 0.01 | 0.00 | 0.01 |
| 230.00 | 0.00 | 9,614 | 26.90 | 0.01 | 0.00 | 0.01 |
| 240.00 | 0.00 | 9,292 | 26.84 | 0.01 | 0.00 | 0.01 |
| 250.00 | 0.00 | 8,983 | 26.78 | 0.01 | 0.00 | 0.01 |
| 260.00 | 0.00 | 8,684 | 26.72 | 0.01 | 0.00 | 0.01 |
| 270.00 | 0.00 | 8,398 | 26.66 | 0.01 | 0.00 | 0.01 |
| 280.00 | 0.00 | 8,123 | 26.61 | 0.01 | 0.00 | 0.01 |
| 290.00 | 0.00 | 7,860 | 26.55 | 0.01 | 0.00 | 0.01 |
| 300.00 | 0.00 | 7,608 | 26.50 | 0.01 | 0.00 | 0.01 |

## Summary for Link 4L: PR

Inflow Area = 271,330 sf, 22.27% Impervious, Inflow Depth > 5.75" for 50-YR event
Inflow = 41.99 cfs @ 11.99 hrs, Volume= 129,978 cf
Primary = 41.99 cfs @ 11.99 hrs, Volume= 129,978 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-300.00 hrs, dt= 0.05 hrs

### Link 4L: PR



## Hydrograph for Link 4L: PR

| Time (hours) | Inflow (cfs) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|
| 0.00 | 0.00 | **0.00** | 0.00 |
| 5.00 | 0.20 | 0.00 | 0.20 |
| 10.00 | **0.88** | 0.00 | **0.88** |
| 15.00 | **1.40** | 0.00 | **1.40** |
| 20.00 | 0.60 | 0.00 | 0.60 |
| 25.00 | 0.03 | 0.00 | 0.03 |
| 30.00 | 0.01 | 0.00 | 0.01 |
| 35.00 | 0.01 | 0.00 | 0.01 |
| 40.00 | 0.01 | 0.00 | 0.01 |
| 45.00 | 0.01 | 0.00 | 0.01 |
| 50.00 | 0.01 | 0.00 | 0.01 |
| 55.00 | 0.01 | 0.00 | 0.01 |
| 60.00 | 0.01 | 0.00 | 0.01 |
| 65.00 | 0.01 | 0.00 | 0.01 |
| 70.00 | 0.01 | 0.00 | 0.01 |
| 75.00 | 0.01 | 0.00 | 0.01 |
| 80.00 | 0.01 | 0.00 | 0.01 |
| 85.00 | 0.01 | 0.00 | 0.01 |
| 90.00 | 0.01 | 0.00 | 0.01 |
| 95.00 | 0.01 | 0.00 | 0.01 |
| 100.00 | 0.01 | 0.00 | 0.01 |
| 105.00 | 0.01 | 0.00 | 0.01 |
| 110.00 | 0.01 | 0.00 | 0.01 |
| 115.00 | 0.01 | 0.00 | 0.01 |
| 120.00 | 0.01 | 0.00 | 0.01 |
| 125.00 | 0.01 | 0.00 | 0.01 |
| 130.00 | 0.01 | 0.00 | 0.01 |
| 135.00 | 0.01 | 0.00 | 0.01 |
| 140.00 | 0.01 | 0.00 | 0.01 |
| 145.00 | 0.01 | 0.00 | 0.01 |
| 150.00 | 0.01 | 0.00 | 0.01 |
| 155.00 | 0.01 | 0.00 | 0.01 |
| 160.00 | 0.01 | 0.00 | 0.01 |
| 165.00 | 0.01 | 0.00 | 0.01 |
| 170.00 | 0.01 | 0.00 | 0.01 |
| 175.00 | 0.01 | 0.00 | 0.01 |
| 180.00 | 0.01 | 0.00 | 0.01 |
| 185.00 | 0.01 | 0.00 | 0.01 |
| 190.00 | 0.01 | 0.00 | 0.01 |
| 195.00 | 0.01 | 0.00 | 0.01 |
| 200.00 | 0.01 | 0.00 | 0.01 |
| 205.00 | 0.01 | 0.00 | 0.01 |
| 210.00 | 0.01 | 0.00 | 0.01 |
| 215.00 | 0.01 | 0.00 | 0.01 |
| 220.00 | 0.01 | 0.00 | 0.01 |
| 225.00 | 0.01 | 0.00 | 0.01 |
| 230.00 | 0.01 | 0.00 | 0.01 |
| 235.00 | 0.01 | 0.00 | 0.01 |
| 240.00 | 0.01 | 0.00 | 0.01 |
| 245.00 | 0.01 | 0.00 | 0.01 |
| 250.00 | 0.01 | 0.00 | 0.01 |
| 255.00 | 0.01 | 0.00 | 0.01 |
| 260.00 | 0.01 | 0.00 | 0.01 |
| 265.00 | 0.01 | 0.00 | 0.01 |
| 270.00 | 0.01 | 0.00 | 0.01 |
| 275.00 | 0.01 | 0.00 | 0.01 |
| 280.00 | 0.01 | 0.00 | 0.01 |
| 285.00 | 0.01 | 0.00 | 0.01 |
| 290.00 | 0.01 | 0.00 | 0.01 |
| 295.00 | 0.01 | 0.00 | 0.01 |
| 300.00 | 0.01 | 0.00 | 0.01 |

Time span=0.00-300.00 hrs, dt=0.05 hrs, 6001 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: PR** Runoff Area=95,997 sf 21.93% Impervious Runoff Depth=7.16"
Tc=5.0 min CN=87/98 Runoff=25.39 cfs 57,266 cf

**Subcatchment2S: PR** Runoff Area=175,333 sf 22.46% Impervious Runoff Depth=7.44"
Tc=6.8 min CN=90/98 Runoff=44.31 cfs 108,779 cf

**SubcatchmentEX: EX** Runoff Area=276,662 sf 8.88% Impervious Runoff Depth=7.10"
Tc=5.0 min CN=88/98 Runoff=73.15 cfs 163,590 cf

**Pond 3P: Basin** Peak Elev=28.90' Storage=31,040 cf Inflow=25.39 cfs 57,266 cf
Discarded=0.00 cfs 205 cf Primary=5.66 cfs 49,452 cf Outflow=5.66 cfs 49,657 cf

**Link 4L: PR** Inflow=50.18 cfs 158,230 cf
Primary=50.18 cfs 158,230 cf

**Total Runoff Area = 547,992 sf Runoff Volume = 329,635 cf Average Runoff Depth = 7.22"**
**84.49% Pervious = 462,993 sf 15.51% Impervious = 84,999 sf**

## Summary for Subcatchment 1S: PR

[49] Hint: Tc<2dt may require smaller dt

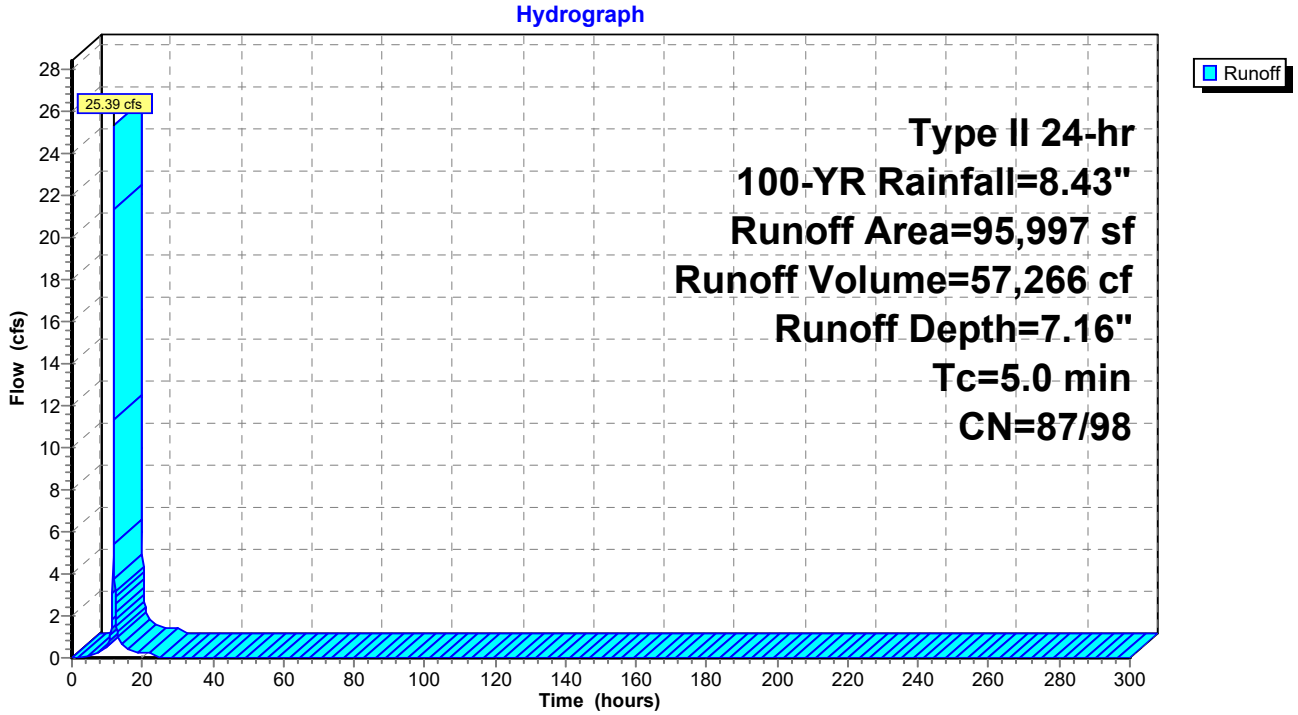
Runoff = 25.39 cfs @ 11.95 hrs, Volume= 57,266 cf, Depth= 7.16"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-300.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YR Rainfall=8.43"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 21,048 | 98 | Impervious |
| * | 49,352 | 91 | Gravel |
| * | 25,597 | 80 | Open Space |
| | 95,997 | 90 | Weighted Average |
| | 74,949 | 87 | 78.07% Pervious Area |
| | 21,048 | 98 | 21.93% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

### Subcatchment 1S: PR



## Hydrograph for Subcatchment 1S: PR

| Time (hours) | Precip. (inches) | Perv.Excess (inches) | Imp.Excess (inches) | Runoff (cfs) |
|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10.00 | 1.53 | 0.55 | 1.31 | **0.55** |
| 20.00 | **8.03** | **6.47** | **7.79** | **0.24** |
| 30.00 | **8.43** | **6.87** | **8.19** | 0.00 |
| 40.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 50.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 60.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 70.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 80.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 90.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 100.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 110.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 120.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 130.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 140.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 150.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 160.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 170.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 180.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 190.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 200.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 210.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 220.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 230.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 240.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 250.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 260.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 270.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 280.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 290.00 | 8.43 | 6.87 | 8.19 | 0.00 |
| 300.00 | 8.43 | 6.87 | 8.19 | 0.00 |

## Summary for Subcatchment 2S: PR

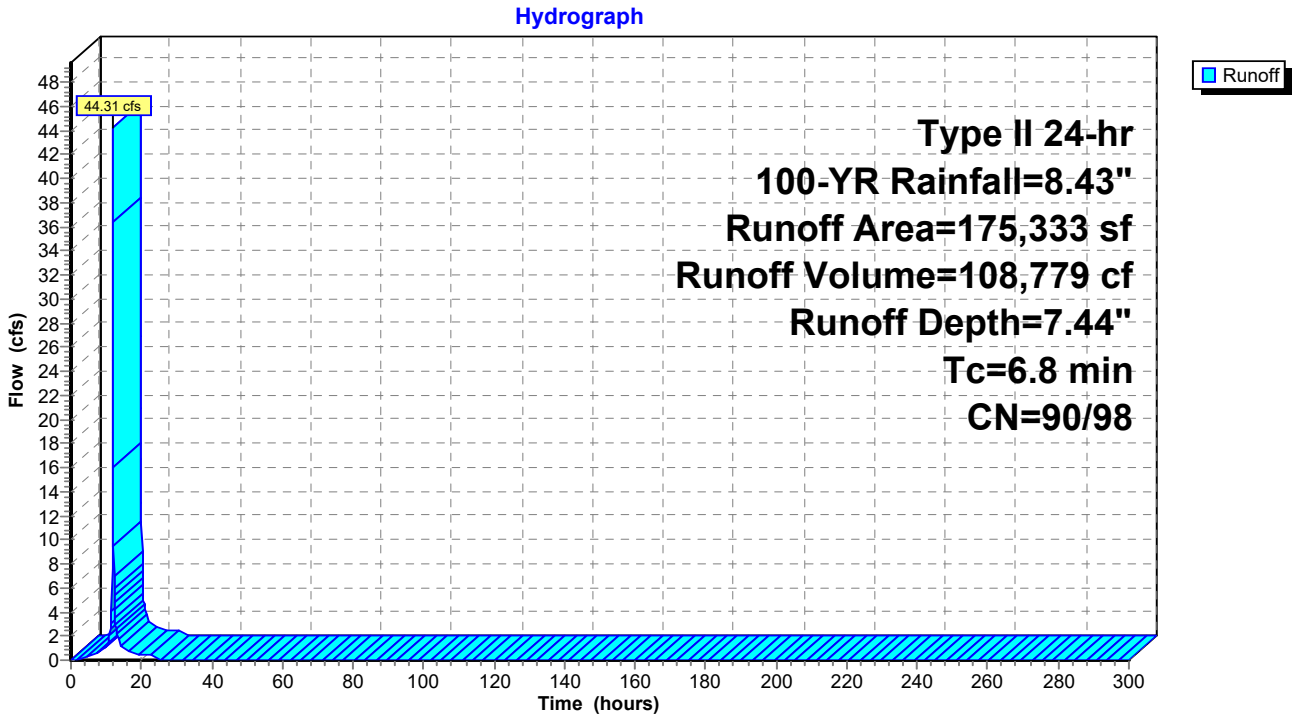
Runoff = 44.31 cfs @ 11.97 hrs, Volume= 108,779 cf, Depth= 7.44"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-300.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YR Rainfall=8.43"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 39,382 | 98 | Impervious |
| * | 124,147 | 91 | Gravel |
| * | 11,804 | 80 | Open Space |
| | 175,333 | 92 | Weighted Average |
| | 135,951 | 90 | 77.54% Pervious Area |
| | 39,382 | 98 | 22.46% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.8 | | | | | **Direct Entry,** |

## Subcatchment 2S: PR



## Hydrograph for Subcatchment 2S: PR

| Time (hours) | Precip. (inches) | Perv.Excess (inches) | Imp.Excess (inches) | Runoff (cfs) |
|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10.00 | 1.53 | 0.70 | 1.31 | **1.09** |
| 20.00 | **8.03** | **6.83** | **7.79** | **0.45** |
| 30.00 | **8.43** | **7.23** | **8.19** | 0.00 |
| 40.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 50.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 60.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 70.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 80.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 90.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 100.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 110.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 120.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 130.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 140.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 150.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 160.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 170.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 180.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 190.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 200.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 210.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 220.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 230.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 240.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 250.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 260.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 270.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 280.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 290.00 | 8.43 | 7.23 | 8.19 | 0.00 |
| 300.00 | 8.43 | 7.23 | 8.19 | 0.00 |

## Summary for Subcatchment EX: EX

[49] Hint: Tc<2dt may require smaller dt

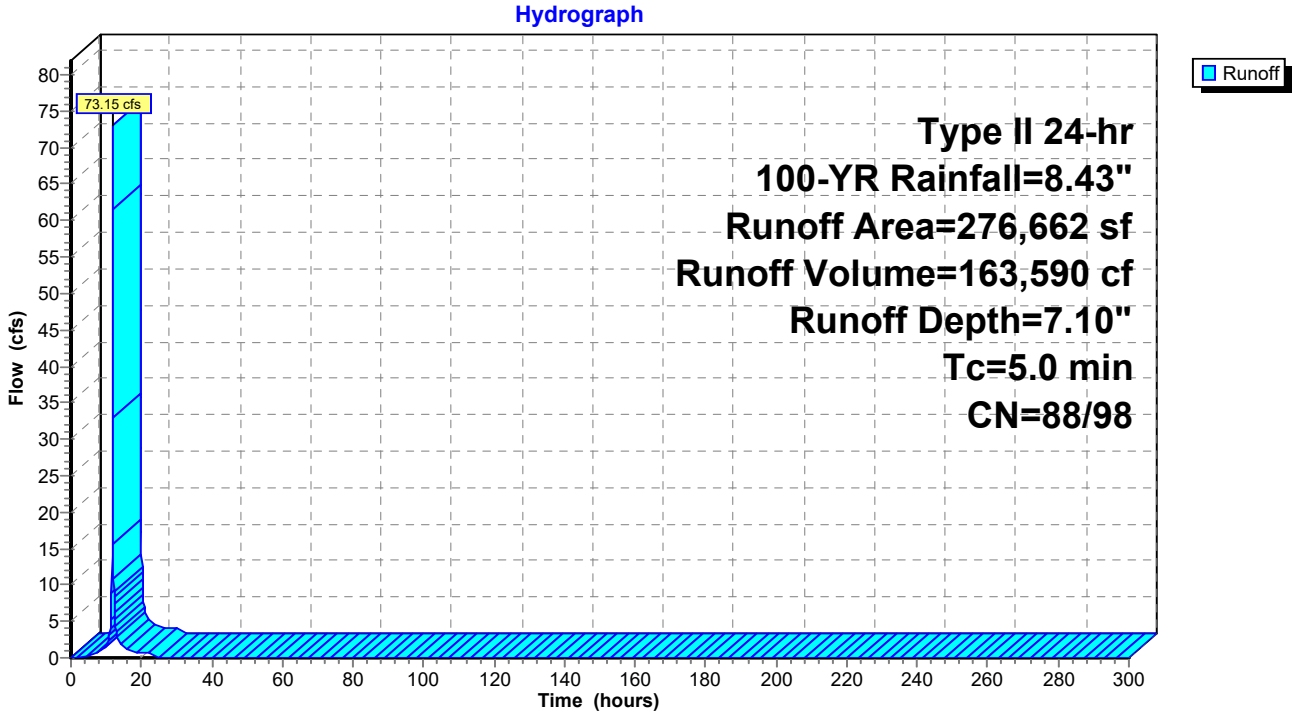
Runoff = 73.15 cfs @ 11.95 hrs, Volume= 163,590 cf, Depth= 7.10"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-300.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YR Rainfall=8.43"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 24,569 | 98 | Impervious |
| * | 59,598 | 78 | Meadow (20% Imp & Gravel) |
| * | 192,495 | 91 | Gravel |
| | 276,662 | 89 | Weighted Average |
| | 252,093 | 88 | 91.12% Pervious Area |
| | 24,569 | 98 | 8.88% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

### Subcatchment EX: EX



## Hydrograph for Subcatchment EX: EX

| Time (hours) | Precip. (inches) | Perv.Excess (inches) | Imp.Excess (inches) | Runoff (cfs) |
|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10.00 | 1.53 | 0.60 | 1.31 | **1.56** |
| 20.00 | **8.03** | **6.59** | **7.79** | **0.70** |
| 30.00 | **8.43** | **6.99** | **8.19** | 0.00 |
| 40.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 50.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 60.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 70.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 80.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 90.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 100.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 110.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 120.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 130.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 140.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 150.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 160.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 170.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 180.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 190.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 200.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 210.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 220.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 230.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 240.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 250.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 260.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 270.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 280.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 290.00 | 8.43 | 6.99 | 8.19 | 0.00 |
| 300.00 | 8.43 | 6.99 | 8.19 | 0.00 |

## Summary for Pond 3P: Basin

Inflow Area = 95,997 sf, 21.93% Impervious, Inflow Depth = 7.16" for 100-YR event
Inflow = 25.39 cfs @ 11.95 hrs, Volume= 57,266 cf
Outflow = 5.66 cfs @ 12.11 hrs, Volume= 49,657 cf, Atten= 78%, Lag= 9.6 min
Discarded = 0.00 cfs @ 12.11 hrs, Volume= 205 cf
Primary = 5.66 cfs @ 12.11 hrs, Volume= 49,452 cf

Routing by Stor-Ind method, Time Span= 0.00-300.00 hrs, dt= 0.05 hrs
Peak Elev= 28.90' @ 12.11 hrs Surf.Area= 18,231 sf Storage= 31,040 cf

Plug-Flow detention time= 1,912.1 min calculated for 49,657 cf (87% of inflow)
Center-of-Mass det. time= 1,848.8 min ( 2,616.9 - 768.1 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 24.00' | 52,014 cf | **area (Prismatic)**Listed below (Recalc) |

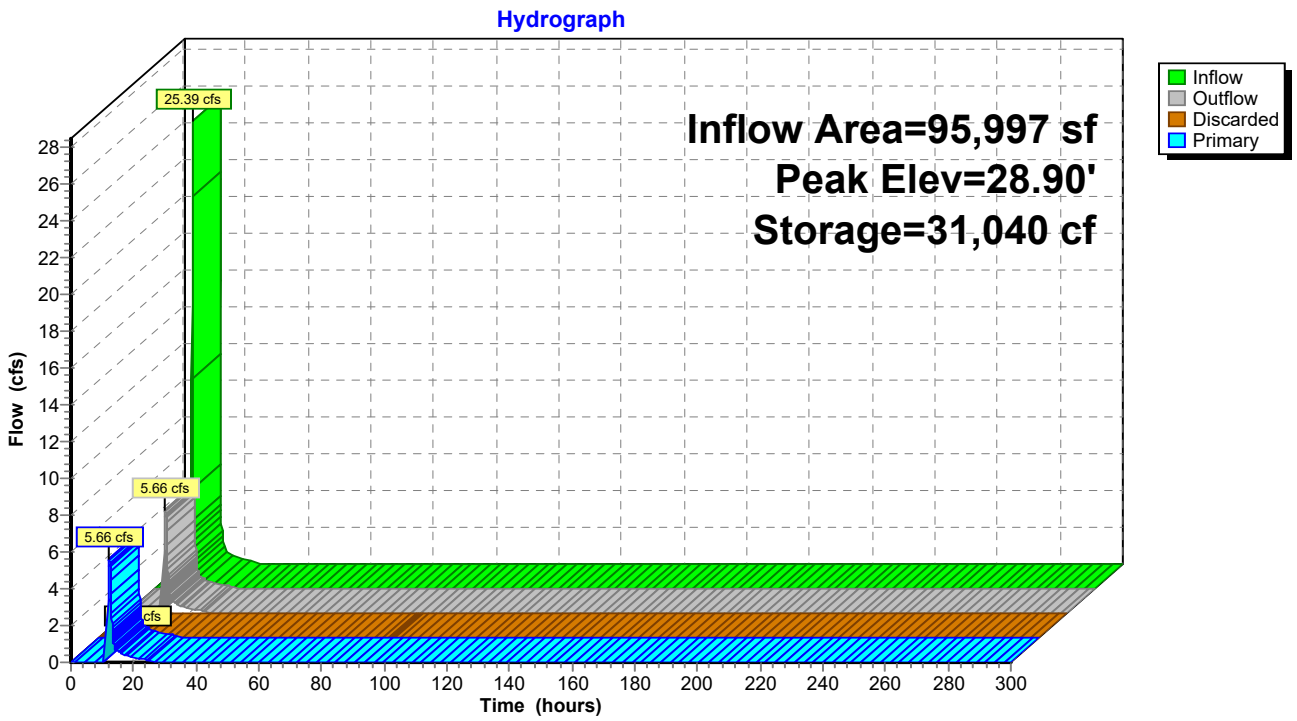
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 24.00 | 2,525 | 0 | 0 |
| 25.00 | 2,525 | 2,525 | 2,525 |
| 25.99 | 2,525 | 2,500 | 5,025 |
| 26.00 | 5,050 | 38 | 5,063 |
| 26.99 | 5,050 | 4,999 | 10,062 |
| 27.00 | 5,050 | 51 | 10,113 |
| 27.99 | 5,050 | 4,999 | 15,112 |
| 28.00 | 16,833 | 109 | 15,222 |
| 29.00 | 18,382 | 17,608 | 32,829 |
| 30.00 | 19,987 | 19,185 | 52,014 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 26.00' | **12.0" Round Outlet Pipe**<br>L= 55.0' RCP, groove end projecting, Ke= 0.200<br>Inlet / Outlet Invert= 26.00' / 25.75' S= 0.0045 '/' Cc= 0.900<br>n= 0.012, Flow Area= 0.79 sf |
| #2 | Device 1 | 25.25' | **0.6" Vert. Underdrain Cap** C= 0.600 |
| #3 | Device 1 | 28.20' | **48.0" x 24.0" Horiz. Outlet Structure Top** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Discarded | 24.00' | **0.001 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=0.00 cfs @ 12.11 hrs HW=28.90' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 0.00 cfs)

**Primary OutFlow** Max=5.65 cfs @ 12.11 hrs HW=28.90' TW=24.00' (Fixed TW Elev= 24.00')
└─**1=Outlet Pipe** (Barrel Controls 5.65 cfs @ 7.20 fps)
  ├─**2=Underdrain Cap** (Passes < 0.02 cfs potential flow)
  └─**3=Outlet Structure Top** (Passes < 22.93 cfs potential flow)

## Pond 3P: Basin



## Hydrograph for Pond 3P: Basin

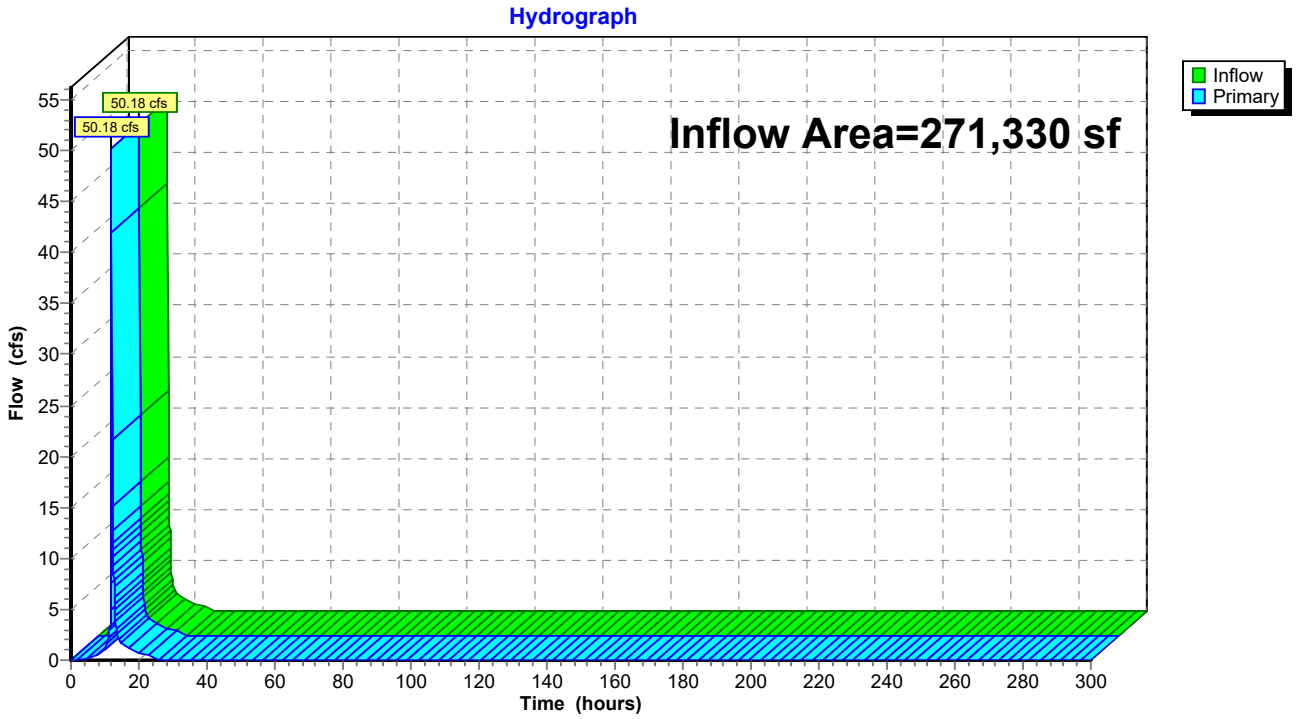
| Time (hours) | Inflow (cfs) | Storage (cubic-feet) | Elevation (feet) | Outflow (cfs) | Discarded (cfs) | Primary (cfs) |
|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0 | 24.00 | 0.00 | 0.00 | 0.00 |
| 10.00 | **0.55** | **5,587** | **26.10** | **0.00** | **0.00** | **0.00** |
| 20.00 | **0.24** | **19,067** | **28.23** | **0.26** | **0.00** | **0.26** |
| 30.00 | 0.00 | 18,381 | 28.19 | 0.01 | 0.00 | 0.01 |
| 40.00 | 0.00 | 17,865 | 28.16 | 0.01 | 0.00 | 0.01 |
| 50.00 | 0.00 | 17,353 | 28.13 | 0.01 | 0.00 | 0.01 |
| 60.00 | 0.00 | 16,844 | 28.10 | 0.01 | 0.00 | 0.01 |
| 70.00 | 0.00 | 16,339 | 28.07 | 0.01 | 0.00 | 0.01 |
| 80.00 | 0.00 | 15,838 | 28.04 | 0.01 | 0.00 | 0.01 |
| 90.00 | 0.00 | 15,340 | 28.01 | 0.01 | 0.00 | 0.01 |
| 100.00 | 0.00 | 14,853 | 27.94 | 0.01 | 0.00 | 0.01 |
| 110.00 | 0.00 | 14,381 | 27.85 | 0.01 | 0.00 | 0.01 |
| 120.00 | 0.00 | 13,920 | 27.75 | 0.01 | 0.00 | 0.01 |
| 130.00 | 0.00 | 13,471 | 27.66 | 0.01 | 0.00 | 0.01 |
| 140.00 | 0.00 | 13,033 | 27.58 | 0.01 | 0.00 | 0.01 |
| 150.00 | 0.00 | 12,607 | 27.49 | 0.01 | 0.00 | 0.01 |
| 160.00 | 0.00 | 12,193 | 27.41 | 0.01 | 0.00 | 0.01 |
| 170.00 | 0.00 | 11,790 | 27.33 | 0.01 | 0.00 | 0.01 |
| 180.00 | 0.00 | 11,399 | 27.25 | 0.01 | 0.00 | 0.01 |
| 190.00 | 0.00 | 11,019 | 27.18 | 0.01 | 0.00 | 0.01 |
| 200.00 | 0.00 | 10,651 | 27.11 | 0.01 | 0.00 | 0.01 |
| 210.00 | 0.00 | 10,295 | 27.04 | 0.01 | 0.00 | 0.01 |
| 220.00 | 0.00 | 9,950 | 26.97 | 0.01 | 0.00 | 0.01 |
| 230.00 | 0.00 | 9,617 | 26.90 | 0.01 | 0.00 | 0.01 |
| 240.00 | 0.00 | 9,295 | 26.84 | 0.01 | 0.00 | 0.01 |
| 250.00 | 0.00 | 8,985 | 26.78 | 0.01 | 0.00 | 0.01 |
| 260.00 | 0.00 | 8,687 | 26.72 | 0.01 | 0.00 | 0.01 |
| 270.00 | 0.00 | 8,400 | 26.66 | 0.01 | 0.00 | 0.01 |
| 280.00 | 0.00 | 8,125 | 26.61 | 0.01 | 0.00 | 0.01 |
| 290.00 | 0.00 | 7,862 | 26.55 | 0.01 | 0.00 | 0.01 |
| 300.00 | 0.00 | 7,610 | 26.50 | 0.01 | 0.00 | 0.01 |

## Summary for Link 4L: PR

Inflow Area = 271,330 sf, 22.27% Impervious, Inflow Depth > 7.00" for 100-YR event
Inflow = 50.18 cfs @ 11.98 hrs, Volume= 158,230 cf
Primary = 50.18 cfs @ 11.98 hrs, Volume= 158,230 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-300.00 hrs, dt= 0.05 hrs

### Link 4L: PR



## Hydrograph for Link 4L: PR

| Time (hours) | Inflow (cfs) | Elevation (feet) | Primary (cfs) |
|---|---|---|---|
| 0.00 | 0.00 | **0.00** | 0.00 |
| 5.00 | 0.27 | 0.00 | 0.27 |
| 10.00 | **1.09** | 0.00 | **1.09** |
| 15.00 | **1.63** | 0.00 | **1.63** |
| 20.00 | 0.71 | 0.00 | 0.71 |
| 25.00 | 0.03 | 0.00 | 0.03 |
| 30.00 | 0.01 | 0.00 | 0.01 |
| 35.00 | 0.01 | 0.00 | 0.01 |
| 40.00 | 0.01 | 0.00 | 0.01 |
| 45.00 | 0.01 | 0.00 | 0.01 |
| 50.00 | 0.01 | 0.00 | 0.01 |
| 55.00 | 0.01 | 0.00 | 0.01 |
| 60.00 | 0.01 | 0.00 | 0.01 |
| 65.00 | 0.01 | 0.00 | 0.01 |
| 70.00 | 0.01 | 0.00 | 0.01 |
| 75.00 | 0.01 | 0.00 | 0.01 |
| 80.00 | 0.01 | 0.00 | 0.01 |
| 85.00 | 0.01 | 0.00 | 0.01 |
| 90.00 | 0.01 | 0.00 | 0.01 |
| 95.00 | 0.01 | 0.00 | 0.01 |
| 100.00 | 0.01 | 0.00 | 0.01 |
| 105.00 | 0.01 | 0.00 | 0.01 |
| 110.00 | 0.01 | 0.00 | 0.01 |
| 115.00 | 0.01 | 0.00 | 0.01 |
| 120.00 | 0.01 | 0.00 | 0.01 |
| 125.00 | 0.01 | 0.00 | 0.01 |
| 130.00 | 0.01 | 0.00 | 0.01 |
| 135.00 | 0.01 | 0.00 | 0.01 |
| 140.00 | 0.01 | 0.00 | 0.01 |
| 145.00 | 0.01 | 0.00 | 0.01 |
| 150.00 | 0.01 | 0.00 | 0.01 |
| 155.00 | 0.01 | 0.00 | 0.01 |
| 160.00 | 0.01 | 0.00 | 0.01 |
| 165.00 | 0.01 | 0.00 | 0.01 |
| 170.00 | 0.01 | 0.00 | 0.01 |
| 175.00 | 0.01 | 0.00 | 0.01 |
| 180.00 | 0.01 | 0.00 | 0.01 |
| 185.00 | 0.01 | 0.00 | 0.01 |
| 190.00 | 0.01 | 0.00 | 0.01 |
| 195.00 | 0.01 | 0.00 | 0.01 |
| 200.00 | 0.01 | 0.00 | 0.01 |
| 205.00 | 0.01 | 0.00 | 0.01 |
| 210.00 | 0.01 | 0.00 | 0.01 |
| 215.00 | 0.01 | 0.00 | 0.01 |
| 220.00 | 0.01 | 0.00 | 0.01 |
| 225.00 | 0.01 | 0.00 | 0.01 |
| 230.00 | 0.01 | 0.00 | 0.01 |
| 235.00 | 0.01 | 0.00 | 0.01 |
| 240.00 | 0.01 | 0.00 | 0.01 |
| 245.00 | 0.01 | 0.00 | 0.01 |
| 250.00 | 0.01 | 0.00 | 0.01 |
| 255.00 | 0.01 | 0.00 | 0.01 |
| 260.00 | 0.01 | 0.00 | 0.01 |
| 265.00 | 0.01 | 0.00 | 0.01 |
| 270.00 | 0.01 | 0.00 | 0.01 |
| 275.00 | 0.01 | 0.00 | 0.01 |
| 280.00 | 0.01 | 0.00 | 0.01 |
| 285.00 | 0.01 | 0.00 | 0.01 |
| 290.00 | 0.01 | 0.00 | 0.01 |
| 295.00 | 0.01 | 0.00 | 0.01 |
| 300.00 | 0.01 | 0.00 | 0.01 |

1. Runoff Capture – The runoff from the 1.2-inch/2-hour storm from the contributing watershed that the MRC is intended to treat should be captured and managed by the MRC BMP, filtered through vegetated media or treated and filtered to the extent practicable through the on-site undisturbed soils or other acceptable treatment systems, and released as indicated in MRC Standard 2. The MRC may be designed for offsetting when contributing non-regulated earth disturbance is present in the contributing drainage area, but the total volume managed may not exceed the volume of runoff generated in the 2-year/24-hour storm. Uncompacted pervious surfaces outside the disturbed area should be bypassed to the maximum extent practical.

   NOTE – Runoff from existing similar impervious and compacted pervious areas can be used to offset undetained areas. The runoff volume for the 1.2 inch/2-hour storm from the two areas must be equivalent (See Figure 4). In addition, the pollutant contribution as determined through land use of the two areas should be similar.

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

The MRC basin is designed to capture and manage the runoff from the 1.2-inch/2-hour storm from the contributing watershed. The total 1.2-inch/2-hour storm runoff volume permanently removed is defined by runoff removed by the underdrain and evapotranspiration. A total of 63 CF is being removed by the underdrain and 5,050 CF via evapotranspiration (30% soil void x (50% x 2 ft IWS depth) x 16,833 SF basin bottom. The HydroCAD model indicates that 63 CF was released through the primary outlet control for Pond 3P.

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

App. D.2, Supporting Calculations, Supporting Calculations – HydroCAD Output, Page 13

Parameters for ET calculations – Refer to MRC calculations, App. D.2, Supporting Calculations

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2. Release Rate for the 1.2-inch/2-hour storm – The stormwater release rate from the MRC BMP for the 1.2inch/2-hour storm should not exceed 0.01 cubic feet per second (cfs) from the equivalent impervious area. To obtain the equivalent impervious area being managed by a MRC BMP, determine the total volume of runoff generated during the 1.2-inch/2-hour event from all pervious and impervious areas contributing to the MRC and divide by 0.0833 feet. This release rate is rounded to the nearest hundredth of a cfs (e.g., 1.576 ac. is 0.01576 cfs, rounded to 0.02 cfs). Routing is necessary to demonstrate compliance with the standard for release rate.

   NOTE – This release rate (0.01 cfs / equivalent impervious acre) is approximately the expected rate of interflow (lateral movement of stormwater to a stream) after a 2-year/24-hour storm

event for a Pennsylvania non-karst watershed based on the NRCS curvilinear unit hydrograph. Releasing at this rate will produce a condition where baseflow contributions will be similar to that of an undeveloped area during and after storm events. As the level of outflow would be similar to what would be expected during and after the storm, it would not be expected to impact the storm event's effects on flooding and erosion. This rate should also be used for karst watersheds unless it can be demonstrated that interflow on a particular project site differs from this standard (such a demonstration would be considered an alternative to the MRC Design Standard).

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

The allowable release rate is determined by 0.01 x equivalent impervious area. The equivalent impervious area was determined using HydroCAD and using the Runoff for the inflow to the MRC. Refer to Pond 3P, where the inflow volume is 3,846 CF. This results in an allowable release rate of 0.01 cfs. The criteria is met by reviewing the outflow at Pond 3P for the 2-in/24 hour storm, which is 0.01 cfs.

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

App. D.2, Supporting Calculations, Supporting Calculations – HydroCAD Output, Page 13 and 37

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3. Internal Water Storage (IWS) – A volume for IWS should be provided that is at least one foot deep below the lowest structural outlet (i.e. the outlet for the underdrain) in the MRC BMP to encourage ET, infiltration and denitrification. To encourage ET, the overall soil media depth of a facility including the IWS can be no deeper than four (4) feet, and up to 50% of the IWS void volume can be included (only for vegetated MRC BMPs) as available storage during hydrologic routings to demonstrate compliance with the standards for the release rate (No. 2 above) and peak flow attenuation (No. 4 below). For soil media, a void space of 30% can be used to describe the soil volume storage and recovery. If an alternate void space is used for soil media, specific data demonstrating the void space should be submitted. For non-vegetated MRC designs, the IWS must be above the underdrain, but below the outlet, to promote a change of the stormwater stored during rain events.

   Use of Liners – The MRC BMP should not have an impervious liner installed unless environmental or geological conditions necessitate use of a liner, or if an existing structure would be damaged as a result of not lining the facility.

   NOTE – The presence of a project site in an area of known karst conditions does not, in itself, serve as evidence of the applicability of MRC to a project site or to the use of a liner to avoid infiltration. DEP and delegated CDs reserve the right to request a detailed subsurface

investigation where considered warranted to evaluate the likelihood of sinkhole formation as a result of post-construction stormwater management.

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

The soil media bottom elevation, bottom IWS elevation, is 24.00 ft, which is 1 ft below the outlet for the underdrain. The overall soil media depth of a facility including the IWS is 4 ft and 50% of the IWS depth is 2 ft since the outlet elevation is 26 ft. For soil media, a void space of 30% was be used to describe the soil volume storage and recovery. A liner is proposed due to high groundwater.

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

Design Plan PCSM-9 & MRC calculations, App. D.2, Supporting Calculations

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4. Peak Flow Attenuation for the 2-year/24-hour Event – The peak flow from the post-construction 2-year/24hour storm should be managed back to the pre-construction 1-year/24-hour storm peak flow, unless an approved and current Act 167 Plan or another requirement (such as limited capacity of a downstream channel) is more restrictive. In general, this rate is determined at the project point of interest. In the event the MRC drainage area is part of a larger overall site with non-MRC BMPs, only the MRC drainage peak flows must be managed back to the 1-year/24-hour level and overflows can be combined with flows from the non-MRC BMPs.

   In situations where the pre-construction drainage area to the MRC BMP varies significantly compared to the post-construction drainage area, the post-construction drainage area boundary to the MRC BMP (using existing land uses) can be used to calculate the target pre-construction 1-year/24-hour rate, as long as all areas in question are in close proximity to the MRC BMP and drain to the same surface water. In cases where the BMP is managing additional volume to offset adjacent areas that could not be captured in the MRC BMP, the targeted pre-construction 1-year/24-hour release rate should be calculated based on the combined flow rates from the BMP drainage area and adjacent area.

   NOTE – This standard is used to ensure that MRC does not contribute to channel-eroding flows in receiving surface waters.

   Flows Greater Than 2-Year/24-Hour Storm – The recommended design for MRC BMPs is to bypass storm events larger than the 2-year/24-hour storm to a rate control BMP; however, DEP

understands that site and cost limitations may not allow for this bypass. When it is demonstrated by the licensed professional engineer that larger storm events cannot reasonably be bypassed, the MRC BMP surface component should be designed to manage the post-construction 10-, 50- and 100-year/24-hour storm event peak flows to their corresponding pre-construction rates and the MRC BMP should have an increased (i.e., more frequent) inspection and maintenance schedule that includes inspection and repair after extreme events (10-, 50- and 100-year/24-hour storm events).

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

Using HydroCAD, the 1-Yr/24-Hr Pre-Development Peak Rate (cfs) at Subcatchment EX is 17.99 CFS. The 2-Yr/24-HR Post-Development Peak Rate (cfs) at Link 4L is 16.19 CFS.

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

App. D.2, Supporting Calculations, Supporting Calculations – HydroCAD Output, Page 18 and 30

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5. Stormwater BMP Manual – Follow the design considerations for BMPs as presented in the Pennsylvania Stormwater Best Management Practices Manual (Stormwater BMP Manual) (363-0300-002), as revised. MRC may be incorporated into the design of any BMP by a licensed professional engineer.

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

The design followed the criteria set forth under 6.4.5 in the PA Stormwater BMP Manual.

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

Design Plan PCSM-8 and PCSM-9

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6. MRC BMP Selection – Standard MRC BMPs include the following system types:

   a. Vegetated MRC – Vegetation must be provided for 75% of the surface of the MRC BMP. Native vegetation should be selected by the licensed professional engineer in consultation with a professional that is knowledgeable in native plant ecology. Vegetation should be selected based on the plants' ability to grow within the anticipated conditions considering the depth and duration of stormwater stored in the MRC BMP.

b. Non-vegetated MRC: Porous Pavement – Porous pavements with a storage bed require a vacuum street sweeping maintenance regime adequate for the drainage area characteristics; the vacuum street sweeping equipment must provide adequate suction capacity to remove particles on the pavement's surface to provide a sufficient water quality demonstration and to maintain flow pathways.

c. Non-vegetated MRC: Underground Storage Chambers – The use of the MRC BMP with non-vegetated, non-porous pavement stormwater practices must have pre-treatment, post-treatment, or a combination of both pre- and post-treatment measures incorporated into the design, to provide sufficient water quality. Underground storage chambers must be accessible for maintenance, and for this reason underground storage is not recommended to be rock beds. Pre- and post-treatment can be achieved through a treatment train concept that includes other BMPs listed in the Stormwater BMP Manual (as revised) so that the combination of BMPs provide 85% removal of TSS and associated Phosphorus. The MRC is considered a primary BMP for nitrate removal through the use of the IWS. Preferred pre- and post-treatment BMPs include: level spreader with vegetated filter strip, vegetated swale, other vegetated systems, and manufactured treatment devices. An applicant must demonstrate that the treatment train will meet water requirements by using Worksheets 11 – 13 or by providing an alternative water quality demonstration that is acceptable to DEP.

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

Vegetation throughout the basin will be Ernst Seed Rain Garden Mix, or approved equal. This was selected based on the plants' ability to grow within the anticipated conditions considering the depth and duration of stormwater stored in the MRC BMP.

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

Seed mix noted on MRC Calculations, App. D.2, Supporting Calculations and PCSM-3

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7. Pre-Development Site Characterization and Assessment of Soil and Geology – Adequate and appropriate soils and geologic testing and evaluation must be performed to demonstrate the infiltration capacity of the entire project site to the satisfaction of DEP. At a minimum, one infiltration test for every 40,000 square feet of disturbed acreage should be performed with a minimum of four tests, equally distributed across a site. The infiltration tests must be done in the most accommodating soil horizon for infiltration as demonstrated by a deep hole test within 100 feet of the infiltration test. All other sections of Appendix C Protocol 1, Site Evaluation and Soil Infiltration Testing and Appendix C Protocol 2, Infiltration Systems Guidelines per the

Stormwater BMP Manual (as revised) should be followed to clearly demonstrate the infiltration capability of on-site undisturbed soils at applicable elevations and for a variety of locations. Soil probes and infiltration test locations should be identified on the PCSM Plan drawing(s). The use of soil borings as a substitute for test pits can be used as a planning tool but will not generally be accepted for final design of infiltration MRC BMPs.

NOTE – The above recommended number of infiltration tests per disturbed area is to be based upon the disturbed area that is not considered a restoration activity or road maintenance activity. For example, a large sewer main installation project disturbs 30 acres in total, with 29 acres of disturbance for the sewer line installation (that will be covered by a restoration plan) and 1 acre of disturbance for a pumping station that requires a PCSM plan. The recommended number of infiltration tests would be based on the 1 acre, not 30 acres.

NOTE – The minimum number of tests can be reduced, if it can be demonstrated that the subsurface conditions are uniform; however, this is considered a deviation from MRC Design Standards, requiring an individual permit.

NOTE – Infiltration tests resulting in saturated hydraulic conductivities (as identified in the field) of less than or equal to 0.2 inches per hour classify as extremely limited. This is a saturated hydraulic conductivity representative of the lower part of the range of HSG C soils and HSG D soils.

NOTE – Results from the infiltration testing can be used to describe infiltration losses for unlined MRC BMPs as per Appendix C of the Stormwater BMP Manual (as revised).

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

In September 2019, infiltration testing was completed on the southern portion of the site. This work was completed by JMT and AGI to determine the soil conditions and feasibility of infiltration. Testing was completed in three (3) test pits at varying depths between 3’-6’ based on the proposed BMP elevations. The testing results varied from 0.04-0.08 in/hr. Based on the testing results and observed clay soils, infiltration is not recommended on this site. Therefore, the BMP will be a vegetated Managed Release Concept (MRC) basin with above ground plantings.

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

PCSM Narrative, Page 11 and App F

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8. Separation Distance – At least one foot of separation distance should be maintained between groundwater or the seasonally high-water table and the bottom footprint of the MRC BMP's soil media; however, a two-foot separation is preferred. There is no minimum separation required between bedrock or hardpan and the MRC BMP's soil media.

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

On the day of the infiltration testing, seepage was measured at a depth of 50-53 inches. Thus, the groundwater table appears to have been between 4 to 4.5 feet deep at the locations of the three test pits. It should be noted that the tests were conducted in late Summer; and there was no rain on the day of testing. As a result, the design for the MRC Basin at Marcus Hook Compressor station is proposed to include an impervious liner.

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

PCSM Narrative, Page 11-12 and App F

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9. Ponding Depth and Drawdown time – The maximum ponding time (i.e., the time after end of storm event for stored surface water to lower to soil surface) should not exceed 72 hours for any storm event. In general, a maximum ponding depth (i.e., storage depth above BMP surface) of one to two feet at the peak of the 2-year/24hour storm event should not be exceeded for the design of surface BMPs. In accordance with MRC Design Standard 4, the MRC might incorporate a multi-stage detention facility with the upper portions of the facility providing flow attenuation for storm events greater than a 2-year/24-hour storm, to meet 25 Pa. Code § 102.8(g)(3). An engineered overflow structure or reinforced spillway / berm should be installed to provide safe conveyance for storm events greater than a 2-year/24-hour storm. Ponding depth for storms larger than the 2year/24-hour storm should not exceed four feet, and drawdown to the MRC BMP surface should not exceed 72 hours for all design storms. For underground storage chambers and porous pavement MRC systems, drawdown to the IWS storage level should not exceed 7 days.

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

The maximum ponding time does not exceed 72 hours for any storm event with a maximum ponding depth of 0.2 ft. An outlet structure with an overflow grate is installed to provide safe conveyance for storm events greater than a 2-year/24-hour storm.

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

Ponding depths noted on MRC Calculations, App. D.2, Supporting Calculations and HydroCAD Output, Refer to Hydrograph Tables (Page 39, 51, 63 & 75)

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10. Soil Media – The selection of soil media should be done by considering anticipated pollutants to be treated and the vegetation that will be used. On-site soils should be evaluated for desired characteristics and infiltration capabilities as listed below. The depth of the soil media above the invert elevation of the underdrain pipe should be a minimum of 2 feet (24 inches) to provide pollutant removal. If on-site undisturbed soils are unsuitable for the purpose of providing IWS, an additional one to two feet of suitable soil media should be provided below the underdrain.

    Soil Media Drainage – The designer will need to exercise caution when selecting a soil media, as there is a delicate balance between infiltration rate and residence time. As noted in Appendix C, Protocol 2 of the Stormwater BMP Manual (as revised), the design soil infiltration rate should be between 0.1 inch per hour and 10 inches per hour for native soils. To maximize water quality treatment, the residence time within the soil media used in MRC BMPs should be selected to be close to the parameters established for infiltration into native soils. The designer will need to select a soil media that provide the proper infiltration rate and ponding time to achieve water quality for the anticipated life cycle of the BMP.

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

Stormwater soil mix, >55% coarse sand, <15% fine sand, <20% silt, <10-15% clay. The depth of the soil media above the invert elevation of the underdrain pipe is 2 feet.

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

Soil media noted on MRC Calculations, App. D.2, Supporting Calculations

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11. Underdrain Design – The licensed professional engineer can refer to PennDOT Publication 408 Section 610 for specifications of underdrains. However, underdrains should have a minimum flow rate of 10 gallons (1.34 cubic feet) per minute per linear foot of pipe not considering the flow control orifice or upturned elbow. For non-vegetated MRC BMPs, the underdrain should be located at the bottom of the IWS to promote movement of water from previous storms. There may need to be multiple underdrains, or longer underdrains, to provide adequate design

capacity for drainage. Section 6.4.7 (Constructed Filter) of the Stormwater BMP Manual (as revised) has recommended design standards for lateral spacing of multiple underdrains.

IWS Outflow with Capped / Orifice Underdrain – It is highly recommended that an upturned elbow or an elevated weir be designed at the outlet of the underdrain (see Figure 1). The upturned elbow or elevated weir will create a zone within the soil media, referred to as the IWS. Research has shown that IWS can reduce runoff volume and improve water quality treatment. The upturned elbow or elevated weir can also help if site conditions present daylighting issues for the underdrain's discharge elevation. Underdrains should be capped within an outlet structure when used to allow access for maintenance. The cap should be drilled to provide an appropriately sized orifice. Figure 5 below provides an example of an underdrain detail. Note that all cleanouts and angles within the underdrain should not exceed 45 degrees. For lined, nonvegetated MRCs the underdrain leading to the upturned elbow should be located at the bottom of the IWS.

Underdrain Aggregate Envelope – A 6-inch stone envelope of AASHTO #57 should be placed around the underdrain. A geotextile (or pea gravel diaphragm) is needed around the aggregate envelope. Note that the stone should not be placed throughout the bottom of the BMP, but just in the envelope of the underdrain.

Cleanout for Underdrain – The underdrain(s) should be equipped with a clean-out for maintenance. The design of any clean-out should ensure that surface water does not enter the underdrain system through the top of the cleanout. Consideration must be given for cleaning and inspecting underdrains and access to the upturned elbow or elevated weir.

Orifices – An appropriately sized orifice is necessary on the outlet of the underdrain to control flow to the required release rate (see Figure 6). The orifice should be clean, smooth and sanded so that no burs or irregularities are present. The orifice should be on a plate or cap of sufficient thickness, and the edges of the orifice should be ground so that flow through the orifice is smooth. Orifices should be vertical. The orifice plate and other connections should be water-tight and accessible for maintenance. Control valves cannot be substituted for an orifice.

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

A 6" underdrain is proposed embedded in a 6-inch stone envelope of AASHTO #57 and wrapped in geotextile. A cleanout is proposed to connect to the underdrain. An upturned elbow is proposed (25.00 FT underdrain invert and 26.00 FT outlet pipe invert). A 5/8" orifice is proposed prior to the bend in the upturned elbow to slowly release to the required release rate.

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

Refer to MRC Calculations, App. D.2, Supporting Calculations and Design Plan PCSM-9

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12. Discharge Flow Path – The MRC BMP should be directed to a suitably vegetated flow path, which can safely convey the releases without erosion or loss of stability. The discharge should be dispersed through the use of a level spreader. A licensed professional engineer can provide an analysis, with calculations, which identifies that a level spreader is not necessary, or that discharge to a channel will not cause increased erosion

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

The discharge of the MRC Basin drains to an existing channel and an appropriately sized rip-rap apron for energy dissipation is proposed at the downstream pipe outlet.

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

Riprap calculations, App. D.2, Supporting Calculations, Supporting Calculations

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13. Antidegradation Requirements – Where the stormwater from the project site discharges to a special protection surface water, an MRC BMP can be used to satisfy the Antidegradation Best Available Combination of Technologies (ABACT) regulatory requirements from Chapters 93 and 102 (assuming that non-discharge alternatives do not exist).

**In the space below, the licensed professional should document and demonstrate how this design standard was specifically addressed in the PCSM Report (Narrative, Calculations, H&H Model, etc.).**

The project site ultimately drains to Naaman's Creek, which is not a special protection surface water.

**In the space below, the licensed professional should provide the cross reference (i.e. page number) to the specific location in the PCSM Report that addresses this design standard.**

PCSM Narrative, Page 9

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**SEAL AND CERTIFICATION BY LICENSED PROFESSIONAL**

I, Allison Hill , do hereby certify pursuant to the penalties of 18 Pa.C.S.A. 4904 to the best of my knowledge, information and belief, that the accompanying report and drawings are in conformance with Chapter 102 of the rules and regulations of the Department of Environmental Protection.

Allison Hill

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF CLEAN WATER

# MANAGED RELEASE CONCEPT (MRC) DESIGN SUMMARY

***Complete One Design Summary Sheet for Each BMP Designed for MRC***

## GENERAL INFORMATION

Applicant Name: **Allison Hill, PE, JMT**

Project Name: **Adelphia - Marcus Hook Compressor Station**

Applicant Address: **1600 Market St, Suite 520**

Municipality: **Lower Chichester Twp**

City, State, Zip: Philadelphia, PA 19103

County: **Delaware County**

Permit Type: ☐ NPDES PAG-02 ☐ NPDES IP ☒ ESCGP ☐ ESP

| | Pre-Development | Post-Development | Change |
|---|---|---|---|
| Impervious Area (acres): | 0.56 | 1.39 | 0.83 |

## MRC BMP INFORMATION

MRC BMP Type: **Vegetated Surface Basin**

Stormwater BMP Manual Section: **6.4.5**

Will the BMP Include Vegetation? ☒ Yes ☐ No

*If Yes, Identify Proposed Vegetation:* **Ernst Seed Rain Garden Mix, or approved equal**

For Non-Vegetated BMPs Will There Be Pre- or Post-Treatment? ☐ Yes (Pre-) ☐ Yes (Post-) ☐ No

*If Yes, Identify Proposed Pre- or Post-Treatment:* _____

Name of Surface Water to Receive MRC BMP Discharges: **Naamans Creek**

Designated Use of Surface Water: **WWF, MF**

Existing Use of Surface Water (if different): _____

Is the Surface Water Impaired? ☐ Yes ☒ No

*If Yes, Identify Cause(s):* _____

Will the BMP Have a Liner? ☒ Yes ☐ No

*If Yes, Identify the Type or Liner Material:* _____

BMP Media Description: **Stormwater soil mix, >55% coarse sand, <15% fine sand, <20% silt, <10-15% clay**

Are Any Deviations from MRC Design Standards Proposed? ☐ Yes ☒ No

*If Yes, Identify Deviations:* _____

## MRC BMP DESIGN VALUES AND STANDARDS

| Parameter | Design Value | Design Standard |
|---|---|---|
| Actual Contributing Impervious Area to BMP (acres) | **0.48** | |
| Equivalent Contributing Impervious Area to BMP (acres) | **1.06** | |
| MRC BMP Release Rate (cfs) | **0.01** | *No greater than 0.01 cfs / acre of equivalent contributing impervious* |
| BMP Footprint Area ($ft^2$) | **3,843** | |
| Total Drainage Area to BMP (acres) | **2.19** | |
| Bottom BMP Elevation (ft) | **28.00** | |

**MRC BMP Design Summary**

| Parameter | Design Value | Design Standard |
|---|---|---|
| 2-Yr/24-Hr Storm Ponding Depth (ft) | **28.31** | *1 ft (recommended) (2 ft max)* |
| Max. Ponding Depth (ft) | **0.31** | *4 ft (max)* |
| Overflow Bypass Elevation (ft) | **28.20** | |
| Media Depth (ft) | **3** | *2 ft (min) – 4 ft (max)* |
| Media Void Space (%) | **30.00** | |
| Internal Water Storage (IWS) Depth (ft) | **1.00** | |
| Top of IWS Elevation (ft) | **26.00** | |
| Underdrain Pipe Diameter (in) | **6** | |
| Underdrain Orifice Diameter (in) | **0.625** | |
| Underdrain Outlet Elevation (ft) | **25.00** | |
| IWS Used for Routing (%) | **50** | *50% max* |
| Separation Distance (Groundwater) (ft) | **N/A** | *1 ft (min) (2 ft recommended)* |
| Infiltration Rate (in/hr) | **N/A** | |
| 1-Yr/24-Hr **Pre**-Development Peak Rate (cfs) | **17.99** | |
| 2-Yr/24-Hr **Post**-Development Peak Rate (cfs) | **16.19** | *1-Yr/24-Hr Pre-Development Peak Rate (or per approved Act 167 Plan)* |
| 10-Yr/24-Hr **Post**-Development Peak Rate (cfs) | **25.09** | *10-Yr/24-Hr Pre-Development Peak Rate* |
| 50-Yr/24-Hr **Post**-Development Peak Rate (cfs) | **40.50** | *50-Yr/24-Hr Pre-Development Peak Rate* |
| 100-Yr/24-Hr **Post**-Development Peak Rate (cfs) | **50.42** | *100-Yr/24-Hr Pre-Development Peak Rate* |
| a. Total 2-Yr/24-Hr Runoff Volume Managed by BMP (cf) | **18,619** | |
| b. Total 1.2-inch/2-Hr Runoff Vol. Permanently Removed (cf) | **5,113** | |
| c. 2-Yr/24-Hr Volume Managed (cf) | **13,506** | *Difference of a. and b.* |
| Ponding Time @ 2-Yr/24-Hr Storm (hrs) | **66** | *72 hrs max* |
| Ponding Time @ 10-Yr/24-Hr Storm (hrs) | **66** | *72 hrs max* |
| Ponding Time @ 50-Yr/24-Hr Storm (hrs) | **68** | *72 hrs max* |
| Ponding Time @ 100-Yr/24-Hr Storm (hrs) | **70** | *72 hrs max* |

Allison Hill

**Licensed P.E. Name**

Allison Hill

**Licensed P.E. Signature**

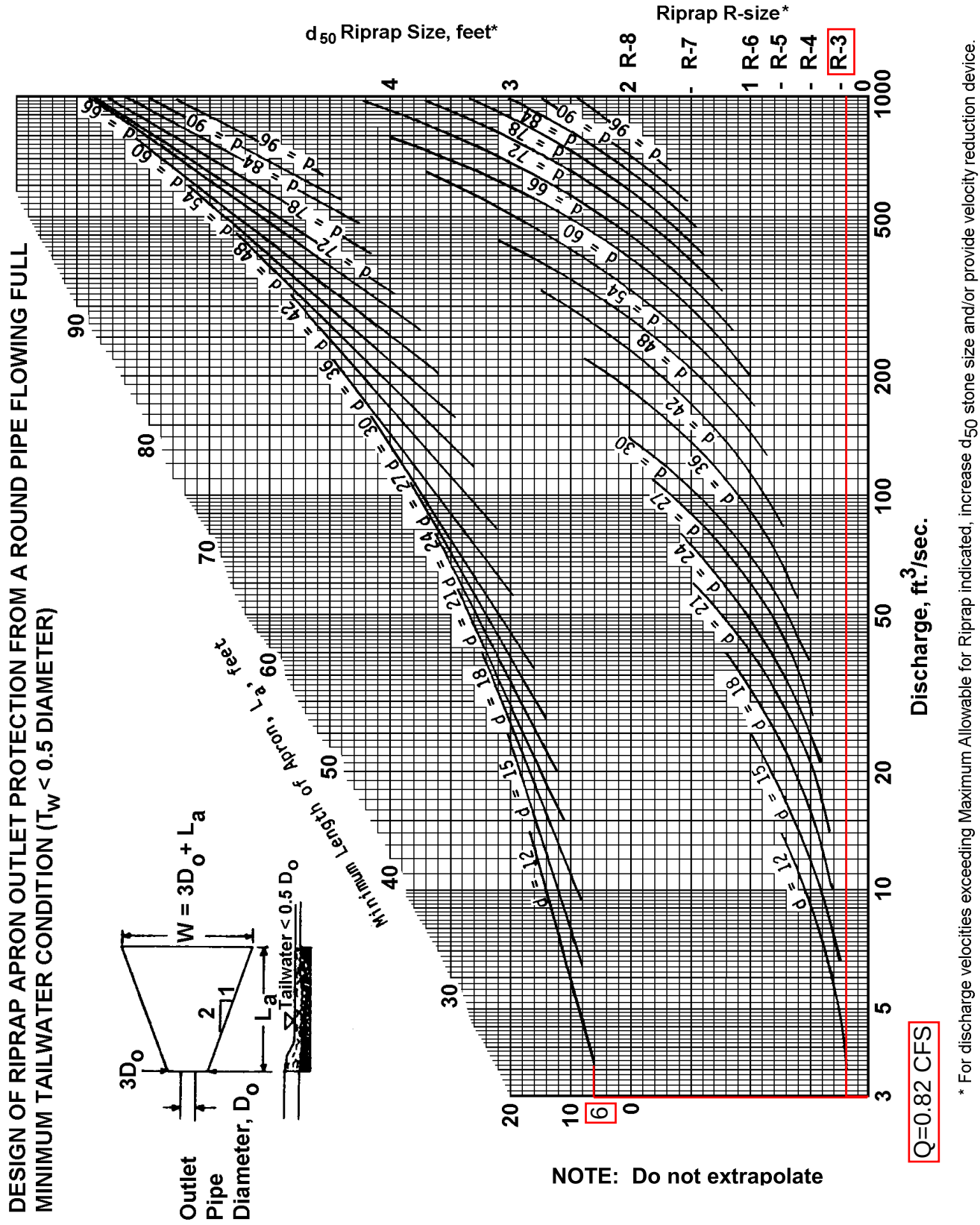
PE082423

**License No.**

3/23/2020

**Date**

# FIGURE 9.3
## Riprap Apron Design, Minimum Tailwater Condition

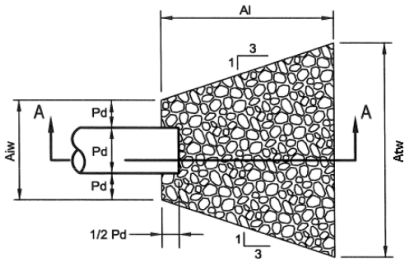



Adapted from USDA - NRCS

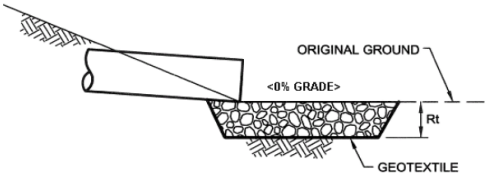
**Not to be used for Box Culverts**

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

PROJECT NAME: Adelphia Gateway
LOCATION: Marcus Hook Compressor Station
PREPARED BY: RRY DATE: 04/19/19
CHECKED BY: ATH DATE: 05/16/19




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) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| M-1 | 12 | MAX | 0.012 | 0.005 | 0.78 | 0.9936 | R-3 | 12 | 6 | 3 | 5.4 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
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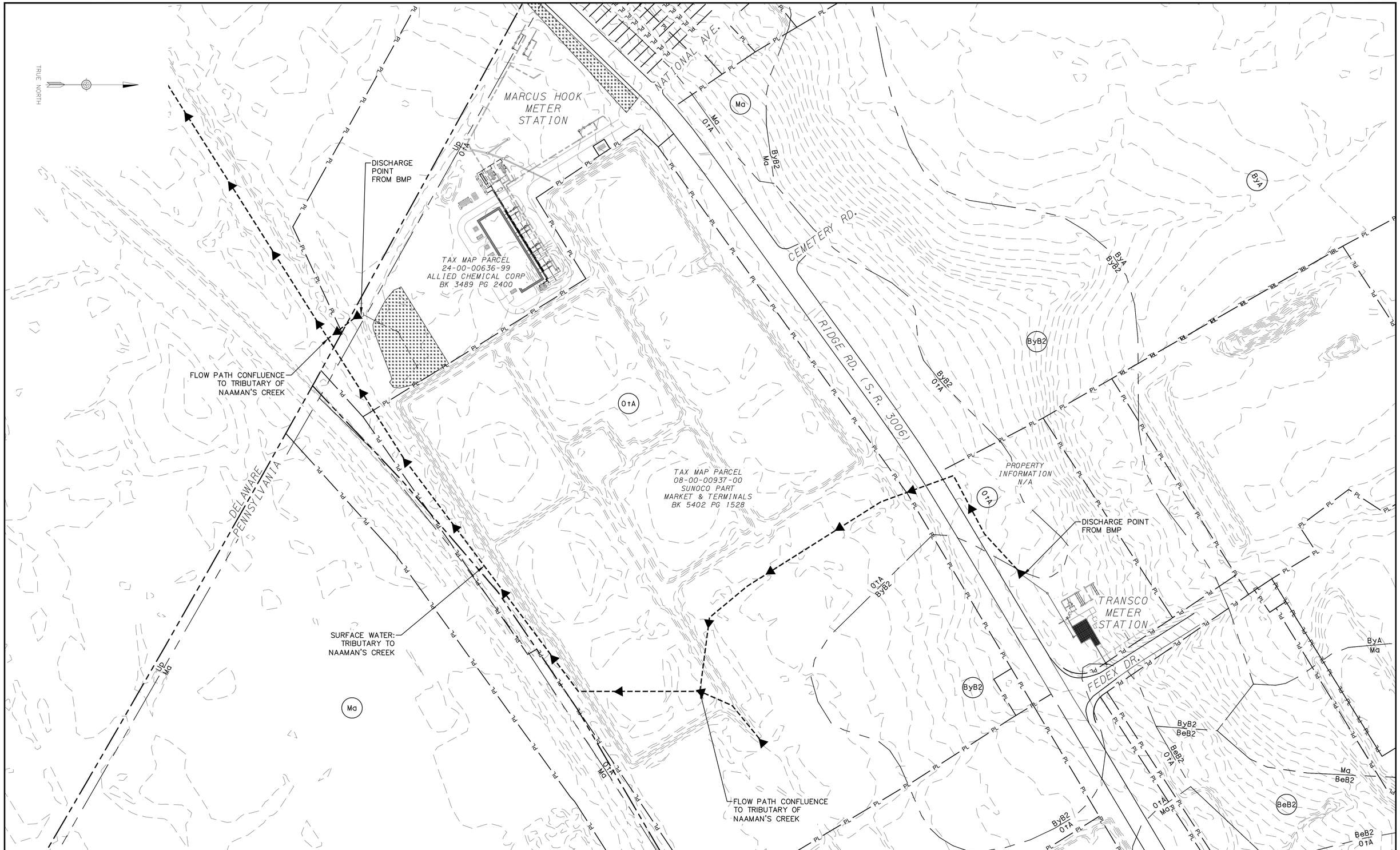
| | | | | | | | | | | | |

***: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 > 0.05 ft/ft.**

# Appendix D.3




ADELPHIA GATEWAY

50 0 100 200

SCALE: 1"=100'

DATE: _____

| REV | DESCRIPTION | CHK | DATE | APP | DATE |
|---|---|---|---|---|---|
| 2 | REVISED TO ADDRESS DEP COMMENTS | ATH | 03/24/20 | SMM | 03/24/20 |
| 1 | REVISED TO ADDRESS DEP COMMENTS | ATH | 11/15/19 | SMM | 11/15/19 |

REVISION

| | INTL | DATE |
|---|---|---|
| DRAWN BY | | |
| DESIGNED BY | RY | 03/24/20 |
| CHECKED BY | AH | 03/24/20 |
| APPROVED BY | SMM | 03/24/20 |
| JOB NO. | 18-00672-006 | |
| PLOT SCALE | 1"=100' | |
| MODEL ID | | |

JMT

Johnson, Mirmiran & Thompson
1600 Market Street, Suite 520
Philadelphia, PA 19103
T: 267-256-0300

# OFF-SITE ANALYSIS EXHIBIT

| SCALE | DRAWING NUMBER | REV |
|---|---|---|
| 1"=100' | S-1 | |

**STANDARD E&S WORKSHEET #10**
**Rational Method**

| | | | |
|---|---|---|---|
| **PROJECT NAME:** | Adelphia | | |
| **LOCATION:** | Transco and Marcus Hook Stations | | |
| **PREPARED BY:** | RY | **DATE:** | 5/1/2019 |
| **CHECKED BY:** | ATH | **DATE:** | 5/19/2019 |

**DETERMINE WATERSHED "C" VALUE**

| Channel Number | Drainage Area Number | Type of Cover | C VALUE | AREA (acres) | (C X A) | $C_w$ |
|---|---|---|---|---|---|---|
| Off-site (Transco) | - | Impervious | 0.9 | 0.11 | 0.10 | 0.61 |
| | - | Gravel | 0.6 | 0.77 | 0.46 | |
| | - | Brush | 0.3 | 0.07 | 0.02 | |
| Off-site (Marcus Hook) | - | Impervious | 0.9 | 1.39 | 1.25 | 0.62 |
| | - | Gravel | 0.6 | 4.60 | 2.76 | |
| | - | Grass | 0.3 | 0.86 | 0.26 | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

**DETERMINE INTENSITY:**

| Channel Number | Tc | R2 | R10 | I2 | I10 |
|---|---|---|---|---|---|
| Off-site (Transco) | 5.00 | - | - | - | 6.50 |
| Off-site (Marcus Hook) | 5.00 | - | - | - | 6.50 |
| | | | | | |

**DETERMINE PEAK RUNOFF RATES (Q = C I A)**

| Channel Number | C VALUE | I (in./hr.) | A (acres) | Q2 (cfs) | Q10 (cfs) |
|---|---|---|---|---|---|
| Off-site (Transco) | 0.61 | 6.50 | 0.94 | - | 3.74 |
| Off-site (Marcus Hook) | 0.62 | 6.50 | 5.98 | - | 24.23 |
| | | | | | |

**STANDARD E&S WORKSHEET #11**
**Channel Design Data**

| | | | |
|---|---|---|---|
| **PROJECT NAME:** | Adelphia | | |
| **LOCATION:** | Transco and Marcus Hook Stations | | |
| **PREPARED BY:** | RY | **DATE:** | 5/1/2019 |
| **CHECKED BY:** | ATH | **DATE:** | 5/19/2019 |

| | | | | | |
|---|---|---|---|---|---|
| **CHANNEL OR CHANNEL SECTION** | Off-site (Transco) | Off-site (MH) | | | |
| **TEMPORARY OR PERMANENT (T or P)** | PERM | PERM | | | |
| **DESIGN STORM (2, 5, or 10 YR)** | 10 YR | 10 YR | | | |
| **ACRES (AC)** | 0.94 | 5.98 | | | |
| **MULTIPLIER (1.6, 2.25, or 2.75)[1]** | N/A | N/A | | | |
| **Qr (REQUIRED CAPACITY) (CFS)** | 3.74 | 24.23 | | | |
| **Q (CALCULATED AT FLOW DEPTH d) (CFS)** | 3.74 | 24.23 | | | |
| **PROTECTIVE LINING [2]** | Veg | R-4 | | | |
| **n (MANNING'S COEFFICIENT) [2]** | 0.080 | 0.038 | | | |
| **Va (ALLOWABLE VELOCITY) (FPS)** | 3.00 | 9.00 | | | |
| **V (CALCULATED AT FLOW DEPTH d) (FPS)** | 0.98 | 2.89 | | | |
| **$t_a$ (MAX. ALLOWABLE SHEAR STRESS) (LB/FT$^2$)** | 1.00 | 2.00 | | | |
| **td (SHEAR STRESS AT FLOW DEPTH d) (LB/FT2)** | 0.30 | 0.55 | | | |
| **CHANNEL BOTTOM WIDTH (FT)** | 6 | 6 | | | |
| **CHANNEL SIDE SLOPES (H:V)** | 4 | 4 | | | |
| **D (TOTAL DEPTH) (FT)** | 0.98 | 1.13 | | | |
| **CHANNEL TOP WIDTH @ D (FT)** | 13.85 | 15.05 | | | |
| **d (CALCULATED FLOW DEPTH) (FT)** | 0.48 | 0.88 | | | |
| **CHANNEL TOP WIDTH @ FLOW DEPTH d (FT)** | 9.85 | 13.05 | | | |
| **BOTTOM WIDTH:DEPTH RATIO (12:1 MAX)** | 12.5 | 6.8 | | | |
| **$d_{50}$ STONE SIZE (IN)** | 0.25 | 0.25 | | | |
| **A (CROSS-SECTIONAL AREA) (SQ.FT.)** | 3.82 | 8.39 | | | |
| **R (HYDRAULIC RADIUS)** | 0.38 | 0.63 | | | |
| **S (BED SLOPE) [3] (FT/FT)** | 0.0100 | 0.0100 | | | |
| **$S_c$ (CRITICAL SLOPE) (FT/FT)** | 0.1299 | 0.0248 | | | |
| **0.7 $S_c$ (FT/FT)** | 0.0909 | 0.0174 | | | |
| **1.3 $S_c$ (FT/FT)** | 0.1688 | 0.0322 | | | |
| **STABLE FLOW (Y/N)** | Y | Y | | | |
| **FREEBOARD BASED ON UNSTABLE FLOW (FT)** | N/A | N/A | | | |
| **FREEBOARD BASED ON STABLE FLOW (FT)** | 0.12 | 0.22 | | | |
| **MINIMUM REQUIRED FREEBOARD [4] (FT)** | 0.5 | 0.25 | | | |
| **DESIGN METHOD FOR PROTECTIVE LINING[5]** | V | V | | | |

1. Use 1.6 for Temporary Channels; 2.25 for Temporary Channels in Special Protection (HQ or EV) Watersheds; 2.75 for Permanent Channels. For Rational Method, enter "N/A" and attach Worksheets 9 and 10. For TR-55, enter N/A" and attach appropriate Worksheets.
2. Adjust "n" value for changes in channel liner and flow depth. For vegetated channels, provide data for manufactured linings without vegetation and with vegetation in separate columns.
3. Slopes may not be averaged
4. Minumum Freeboard is 0.5 ft. OR 1/4 Total Channel Depth, whichever is greater
5. Permissible velocity lining design method is not acceptable for channels with a bed slope of 10% or greater. Shear stress lining design method is required for channels with a bed slope of 10% or greater. Shear stress lining design method may be used for any channel bed slope.

United States Department of Agriculture

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

# Custom Soil Resource Report for Delaware County, Pennsylvania, and New Castle County, Delaware

March 24, 2020

# Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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# How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

# Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

# Custom Soil Resource Report
## Soil Map

Map Scale: 1:8,080 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 350 700 1400 2100

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

## MAP LEGEND

**Area of Interest (AOI)**

- Area of Interest (AOI)

**Soils**

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

**Special Point Features**

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

**Water Features**

- Streams and Canals

**Transportation**

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

**Background**

- Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at scales ranging from 1:20,000 to 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:
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: Delaware County, Pennsylvania
Survey Area Data: Version 17, Sep 17, 2019

Soil Survey Area: New Castle County, Delaware
Survey Area Data: Version 14, Sep 13, 2019

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

## MAP LEGEND

## MAP INFORMATION

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

Date(s) aerial images were photographed: May 26, 2019—Jul 10, 2019

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

# Map Unit Legend

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| BeB2 | Beltsville silt loam, 3 to 8 percent slopes, moderately eroded | 2.9 | 2.0% |
| ByA | Butlertown silt loam, 0 to 3 percent slopes | 2.3 | 1.6% |
| ByB2 | Butlertown silt loam, 3 to 8 percent slopes, moderately eroded | 25.3 | 17.4% |
| Ma | Made land, gravelly materials | 30.1 | 20.7% |
| OtA | Othello silt loams, 0 to 2 percent slopes, northern coastal plain | 70.5 | 48.5% |
| **Subtotals for Soil Survey Area** | | **131.0** | **90.3%** |
| **Totals for Area of Interest** | | **145.1** | **100.0%** |

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| Up | Urban land | 14.1 | 9.7% |
| **Subtotals for Soil Survey Area** | | **14.1** | **9.7%** |
| **Totals for Area of Interest** | | **145.1** | **100.0%** |

# Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different

management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

# Delaware County, Pennsylvania

## BeB2—Beltsville silt loam, 3 to 8 percent slopes, moderately eroded

### Map Unit Setting

*National map unit symbol:* 121d4
*Elevation:* 0 to 650 feet
*Mean annual precipitation:* 35 to 55 inches
*Mean annual air temperature:* 45 to 61 degrees F
*Frost-free period:* 160 to 250 days
*Farmland classification:* Farmland of statewide importance

### Map Unit Composition

*Beltsville and similar soils:* 85 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Beltsville

#### Setting

*Landform:* Flats
*Landform position (two-dimensional):* Summit, shoulder, backslope
*Landform position (three-dimensional):* Interfluve, side slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Concave, linear
*Parent material:* Silty eolian deposits over fluviomarine deposits

#### Typical profile

*H1 - 0 to 7 inches:* silt loam
*H2 - 7 to 48 inches:* silt loam
*H3 - 48 to 60 inches:* silt loam
*H4 - 60 to 64 inches:* gravelly sandy clay loam

#### Properties and qualities

*Slope:* 3 to 8 percent
*Depth to restrictive feature:* 20 to 48 inches to fragipan; 60 to 80 inches to lithic bedrock
*Natural drainage class:* Moderately well drained
*Runoff class:* Medium
*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately high (0.00 to 0.20 in/hr)
*Depth to water table:* About 18 to 30 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water storage in profile:* High (about 9.6 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 2e
*Hydrologic Soil Group:* C
*Hydric soil rating:* No

### Minor Components

#### Othello

*Percent of map unit:* 5 percent

*Landform:* Terraces
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Tread
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* Yes

**Sassafras**

*Percent of map unit:* 5 percent
*Landform:* Hillslopes
*Landform position (two-dimensional):* Summit
*Landform position (three-dimensional):* Side slope, interfluve
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* No

**Butlertown**

*Percent of map unit:* 5 percent
*Landform:* Coastal plains
*Landform position (two-dimensional):* Footslope, toeslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear, concave
*Hydric soil rating:* No

## ByA—Butlertown silt loam, 0 to 3 percent slopes

### Map Unit Setting

*National map unit symbol:* 121dk
*Elevation:* 0 to 800 feet
*Mean annual precipitation:* 35 to 55 inches
*Mean annual air temperature:* 48 to 61 degrees F
*Frost-free period:* 160 to 240 days
*Farmland classification:* All areas are prime farmland

### Map Unit Composition

*Butlertown and similar soils:* 85 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Butlertown

#### Setting

*Landform:* Coastal plains
*Landform position (two-dimensional):* Footslope, toeslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear, concave
*Parent material:* Thick deposits silty over sandy fluvial coastal plain sediments

**Typical profile**

*H1 - 0 to 8 inches:* silt loam
*H2 - 8 to 34 inches:* silt loam
*H3 - 34 to 50 inches:* silt loam
*H4 - 50 to 60 inches:* silt loam

**Properties and qualities**

*Slope:* 0 to 3 percent
*Depth to restrictive feature:* 25 to 40 inches to fragipan
*Natural drainage class:* Well drained
*Runoff class:* Medium
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)
*Depth to water table:* About 24 to 48 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water storage in profile:* Moderate (about 6.5 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 2w
*Hydrologic Soil Group:* C
*Hydric soil rating:* No

## Minor Components

**Beltsville**

*Percent of map unit:* 6 percent
*Landform:* Flats
*Landform position (two-dimensional):* Summit, shoulder, backslope
*Landform position (three-dimensional):* Interfluve, side slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Concave, linear
*Hydric soil rating:* No

**Othello**

*Percent of map unit:* 5 percent
*Landform:* Terraces
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Tread
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* Yes

**Woodstown**

*Percent of map unit:* 4 percent
*Landform:* Terraces
*Landform position (two-dimensional):* Footslope
*Landform position (three-dimensional):* Tread
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* No

## ByB2—Butlertown silt loam, 3 to 8 percent slopes, moderately eroded

### Map Unit Setting

*National map unit symbol:* 121dl
*Elevation:* 0 to 800 feet
*Mean annual precipitation:* 35 to 55 inches
*Mean annual air temperature:* 48 to 61 degrees F
*Frost-free period:* 160 to 240 days
*Farmland classification:* All areas are prime farmland

### Map Unit Composition

*Butlertown and similar soils:* 85 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Butlertown

#### Setting

*Landform:* Coastal plains
*Landform position (two-dimensional):* Toeslope, footslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear, concave
*Parent material:* Thick deposits silty over sandy fluvial coastal plain sediments

#### Typical profile

*H1 - 0 to 8 inches:* silt loam
*H2 - 8 to 34 inches:* silt loam
*H3 - 34 to 50 inches:* silt loam
*H4 - 50 to 60 inches:* silt loam

#### Properties and qualities

*Slope:* 3 to 8 percent
*Depth to restrictive feature:* 25 to 40 inches to fragipan
*Natural drainage class:* Well drained
*Runoff class:* High
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)
*Depth to water table:* About 24 to 48 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water storage in profile:* Moderate (about 6.5 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 3e
*Hydrologic Soil Group:* C
*Hydric soil rating:* No

### Minor Components

#### Beltsville

*Percent of map unit:* 6 percent
*Landform:* Flats
*Landform position (two-dimensional):* Summit, shoulder, backslope
*Landform position (three-dimensional):* Interfluve, side slope
*Down-slope shape:* Linear, concave
*Across-slope shape:* Concave, linear
*Hydric soil rating:* No

#### Othello

*Percent of map unit:* 5 percent
*Landform:* Terraces
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Tread
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* Yes

#### Woodstown

*Percent of map unit:* 4 percent
*Landform:* Terraces
*Landform position (two-dimensional):* Footslope
*Landform position (three-dimensional):* Tread
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* No

## Ma—Made land, gravelly materials

### Map Unit Setting

*National map unit symbol:* 121fv
*Elevation:* 200 to 1,500 feet
*Mean annual precipitation:* 36 to 55 inches
*Mean annual air temperature:* 45 to 57 degrees F
*Frost-free period:* 160 to 214 days
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Udorthents, shale and sandstone, and similar soils:* 85 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Udorthents, Shale And Sandstone

#### Setting

*Landform:* Ridges
*Landform position (two-dimensional):* Summit, shoulder, backslope
*Landform position (three-dimensional):* Nose slope, interfluve, side slope

*Down-slope shape:* Convex, linear
*Across-slope shape:* Convex, linear
*Parent material:* Graded areas of sandstone and shale

**Typical profile**

*Ap - 0 to 6 inches:* silt loam
*C - 6 to 60 inches:* silt loam

**Properties and qualities**

*Slope:* 0 to 8 percent
*Depth to restrictive feature:* 20 to 99 inches to lithic bedrock
*Natural drainage class:* Well drained
*Runoff class:* Very high
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to high (0.06 to 6.00 in/hr)
*Depth to water table:* About 60 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water storage in profile:* Very low (about 2.9 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 7s
*Hydrologic Soil Group:* A
*Hydric soil rating:* No

## Minor Components

**Penn**

*Percent of map unit:* 5 percent
*Landform:* Hillslopes
*Landform position (two-dimensional):* Shoulder, backslope
*Landform position (three-dimensional):* Side slope, nose slope
*Down-slope shape:* Linear, convex
*Across-slope shape:* Convex, linear
*Hydric soil rating:* No

**Abbottstown**

*Percent of map unit:* 2 percent
*Landform:* Hillslopes
*Landform position (two-dimensional):* Footslope, toeslope
*Landform position (three-dimensional):* Base slope, head slope
*Down-slope shape:* Concave, linear
*Across-slope shape:* Concave, linear
*Hydric soil rating:* No

**Readington**

*Percent of map unit:* 2 percent
*Landform:* Hillslopes
*Landform position (two-dimensional):* Footslope, backslope
*Landform position (three-dimensional):* Base slope, head slope, side slope
*Down-slope shape:* Concave, linear
*Across-slope shape:* Concave, linear
*Hydric soil rating:* No

**Reaville**

*Percent of map unit:* 2 percent
*Landform:* Hillslopes

*Landform position (two-dimensional):* Footslope, summit
*Landform position (three-dimensional):* Interfluve, base slope
*Down-slope shape:* Concave, linear
*Across-slope shape:* Concave, linear
*Hydric soil rating:* No

**Bowmansville**

*Percent of map unit:* 2 percent
*Landform:* Flood plains
*Landform position (two-dimensional):* Footslope, toeslope
*Landform position (three-dimensional):* Head slope
*Down-slope shape:* Concave, linear
*Across-slope shape:* Linear, concave
*Hydric soil rating:* No

**Berks**

*Percent of map unit:* 1 percent
*Landform:* Valleys, ridges
*Landform position (two-dimensional):* Backslope
*Landform position (three-dimensional):* Side slope
*Down-slope shape:* Convex, linear
*Across-slope shape:* Convex, linear
*Hydric soil rating:* No

**Croton**

*Percent of map unit:* 1 percent
*Landform:* Depressions
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Base slope
*Down-slope shape:* Concave, linear
*Across-slope shape:* Linear, concave
*Hydric soil rating:* Yes

## OtA—Othello silt loams, 0 to 2 percent slopes, northern coastal plain

### Map Unit Setting

*National map unit symbol:* 2thwm
*Elevation:* 0 to 300 feet
*Mean annual precipitation:* 40 to 50 inches
*Mean annual air temperature:* 46 to 64 degrees F
*Frost-free period:* 190 to 250 days
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Othello, drained, and similar soils:* 50 percent
*Othello, undrained, and similar soils:* 30 percent
*Minor components:* 20 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Othello, Drained

#### Setting

*Landform:* Flats, depressions, swales
*Landform position (two-dimensional):* Footslope
*Landform position (three-dimensional):* Talf, dip
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear, concave
*Parent material:* Silty eolian deposits over fluviomarine deposits

#### Typical profile

*Ap - 0 to 9 inches:* silt loam
*Btg - 9 to 29 inches:* silt loam
*2BCg - 29 to 34 inches:* sandy loam
*2Cg - 34 to 80 inches:* loamy sand

#### Properties and qualities

*Slope:* 0 to 2 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Poorly drained
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.57 in/hr)
*Depth to water table:* About 10 to 20 inches
*Frequency of flooding:* None
*Frequency of ponding:* Rare
*Salinity, maximum in profile:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
*Available water storage in profile:* Moderate (about 8.8 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 3w
*Hydrologic Soil Group:* C/D
*Hydric soil rating:* Yes

### Description of Othello, Undrained

#### Setting

*Landform:* Depressions, swales, flats, drainageways
*Landform position (two-dimensional):* Footslope
*Landform position (three-dimensional):* Dip, talf
*Down-slope shape:* Concave, linear
*Across-slope shape:* Concave, linear
*Parent material:* Silty eolian deposits over fluviomarine deposits

#### Typical profile

*Oe - 0 to 2 inches:* peat
*A - 2 to 4 inches:* silt loam
*Eg - 4 to 10 inches:* silt loam
*Btg - 10 to 29 inches:* silt loam
*2BCg - 29 to 35 inches:* sandy loam
*2Cg - 35 to 80 inches:* loamy sand

#### Properties and qualities

*Slope:* 0 to 2 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Poorly drained

*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.57 in/hr)
*Depth to water table:* About 0 to 10 inches
*Frequency of flooding:* None
*Frequency of ponding:* Occasional
*Salinity, maximum in profile:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
*Available water storage in profile:* High (about 9.6 inches)

**Interpretive groups**
*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 5w
*Hydrologic Soil Group:* C/D
*Hydric soil rating:* Yes

**Minor Components**

**Fallsington, undrained**
*Percent of map unit:* 8 percent
*Landform:* Swales, flats, drainageways, depressions
*Landform position (two-dimensional):* Footslope
*Landform position (three-dimensional):* Dip, talf
*Down-slope shape:* Concave, linear
*Across-slope shape:* Linear, concave
*Hydric soil rating:* Yes

**Kentuck, undrained**
*Percent of map unit:* 7 percent
*Landform:* Flats, depressions, swales
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Talf, dip
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear, concave
*Hydric soil rating:* Yes

**Mattapex**
*Percent of map unit:* 5 percent
*Landform:* Flats, depressions, broad interstream divides, swales
*Landform position (two-dimensional):* Summit, footslope
*Landform position (three-dimensional):* Talf, dip
*Down-slope shape:* Linear, concave
*Across-slope shape:* Linear, concave
*Hydric soil rating:* No

# New Castle County, Delaware

## Up—Urban land

### Map Unit Setting

*National map unit symbol:* 2p7dx
*Elevation:* 0 to 300 feet
*Mean annual precipitation:* 42 to 48 inches
*Mean annual air temperature:* 52 to 58 degrees F
*Frost-free period:* 180 to 220 days
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Urban land:* 90 percent
*Minor components:* 10 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Urban Land

#### Setting

*Landform:* Flats
*Down-slope shape:* Linear
*Across-slope shape:* Linear

### Minor Components

#### Udorthents, loamy

*Percent of map unit:* 10 percent
*Landform:* Broad interstream divides
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Hydric soil rating:* No

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# Appendix E

## Act 167 Verification

**SWM Regulation Matrix**
**Tohickon Creek Watershed**

| | | Act 167 Ordinance [2] | | DEP Chapter 102 |
|---|---|---|---|---|
| | | https://app.sharebase.com/#/document/199625/share/129-ENsGtQiZmzuKRfUA8zAQVOKLHUE | | |
| | | | | |
| **Water Quality** | Volume | The Water Quality Volume (WQv) is the storage capacity needed to capture and to treat a portion of stormwater runoff from the developed area of the site produced from 1 inch rainfall event.<br>WQv=[(1.0)(Rv)(A)]/12, where Rv=0.05+0.09I, where I=impervious surface ratio of the site | Section IV, Page 53 | 90% of area within LOD to be controlled by Best Management Practices (BMP). If it does not, provide water quality anaylsis for pollutant loading from the disturbed areas per BMP. |
| | Infiltration Requirements | Infiltration BMPs are required to infiltrate the Recharge Volume (Re). The volume to be recharged from the site is directly related to the amount of impervious cover created and the existing soil characteristics. | Section IV, Page 53 | |
| | | | | |
| **Stream Bank Erosion** | | N/A | | Manage the 2-year volume increase from pre and post development. [1] |
| | | | | |
| **Flood Control** | | Site located in Area 101, based on Hydrologic Release Rate District Map:<br>100% Release Rate District | Section IV, Page 45 | For the 2- to 100-yr storm events, the post development peak rates is to be less than or equal to pre development peak rate. [1] |
| | | | | |

[1] Per PADEP BMP Manual, Volume Control Guideline 1 - 20% of existing impervious area, when present, shall be considered meadow (good condition) in the model for existing conditions for redevelopment.

[2] Tohickon Creek Watershed Act 167 Stormwater Management Plan, adopted February 28, 2002

**SWM Calculations**
**Tohickon Creek Watershed**

**Water Quality:**

The Water Quality Volume (WQv) is the storage capacity needed to capture and to treat a portion of stormwater runoff from the developed area of the site produced from 1 inch rainfall event.

Total Site Area, A (ac) = 1.47
Impervious Area (ac) = 0.37
Impervious Surface Ratio = 0.2519

Rv = 0.05+0.09I
Rv = 0.0727

WQv = [(1.0)(Rv)(A)]/12
WQv (ac-ft) = 0.0089
WQv (CF) = 387.51

Storage Volume of the Proposed Rain Garden = 2198 CF.
***This criteria is met.***

**Infiltration:**

Infiltration BMPs are required to infiltrate the Recharge Volume (Re). The volume to be recharged from the site is directly related to the amount of impervious cover created and the existing soil characteristics.

Total Site Area, A (ac) = 1.47
Soil specific recharge factor = 0.07 (Soil Group D, Table 3.2)

Rv = 0.05+0.9I
Rv = 0.2767

Re = [(S)(Rv)(A)]/12
Re (ac-ft) = 0.0024
Re (CF) = 103.28

Storage Volume of the Proposed Rain Garden = 2198 CF.
***This criteria is met.***

**Flood Control:**

| Storm | Existing Peak Rate (cfs) | Proposed Peak Rate (cfs) |
|---|---|---|
| 2-yr | 3.12 | 2.29 |
| 10-yr | 5.64 | 5.57 |
| 50-yr | 9.29 | 8.64 |
| 100-yr | 11.37 | 10.03 |

***This criteria is met.***

**SWM Regulation Matrix**
**East Branch of Perkiomen Creek Watershed**

| | | Act 167 Ordinance [2] | | DEP Chapter 102 |
|---|---|---|---|---|
| | | https://www.montcopa.org/DocumentCenter/View/6585/East-Branch-Perkiomen-Creek-Watershed-Stormwater-Management-Plan?bidId= | | |
| | | | | |
| **Water Quality** | Volume | The Water Quality Volume (WQv) is the storage capacity needed to capture and to treat a portion of stormwater runoff from the developed area of the site produced from 90% of the average annual rainfall (P).<br>WQv=[(P)(Rv)(A)]/12, where P = 1.95 inches and Rv=0.05+0.009I, where I=% of the are that is impervious | Section 303, Page 16 | 90% of area within LOD to be controlled by Best Management Practices (BMP). If it does not, provide water quality anaylsis for pollutant loading from the disturbed areas per BMP. |
| | Infiltration Requirements | Infiltration BMPs are required to infiltrate the Recharge Volume (Re). Re is computed by multiplying total impervious area by the infiltration requirement. See Figure 304-1 to obtain infiltration requirement (I) based on SCS Curve Number (CN). | Section 304, Page 17 | |
| | | | | |
| **Stream Bank Erosion** | | Design BMPs to detain the proposed conditions 2-year, 24-hour design storm to the existing conditions 1-year flow. | Section 305, Page 20 | Manage the 2-year volume increase from pre and post development. [1] |
| | | | | |
| **Flood Control** | | Release Rate District C-2 (map in App D):<br>Proposed 2-year to Existing 1-year<br>Proposed 5-year to Existing 2-year | Section 306, Page 21 | For the 2- to 100-yr storm events, the post development peak rates is to be less than or equal to pre development peak rate. [1] |
| | | | | |

[1] Per PADEP BMP Manual, Volume Control Guideline 1 - 20% of existing impervious area, when present, shall be considered meadow (good condition) in the model for existing conditions for redevelopment.

[2] East Branch of Perkiomen Creek Watershed Act 167 Stormwater Management Plan, adopted May 5, 2004

**SWM Regulation Matrix**
**Schuylkill River Watershed**

| | | Act 167 Ordinance [2] | | DEP Chapter 102 |
|---|---|---|---|---|
| | | http://www.chesco.org/DocumentCenter/View/12603/Addendum_Append-Model-Ordinance-PADEP-Approved?bidId= | | |
| | | | | |
| **Water Quality** | Volume | For Regulated Activities involving Redevelopment, whichever is less of the following volume options shall be infiltrated: 1. The volume of a minimum of one (1)-inch of runoff from all Proposed Impervious Surfaces; or the 2-year, 24-hour volume increase. | Section 305, Page 48 | 90% of area within LOD to be controlled by Best Management Practices (BMP). If it does not, provide water quality anaylsis for pollutant loading from the disturbed areas per BMP. |
| | Infiltration Requirements | If infiltration can not be physically accomplished the Applicant shall be responsible for demonstrating with data or calculations to the satisfaction of the Municipal Engineer why this infiltration volume cannot be physically accomplished on the Site (e.g., shallow depth to bedrock or limiting zone, open voids, steep slopes, etc.) and what alternative volume can be infiltrated; however in all cases at least the first one-half (0.5) inch of runoff volume shall be infiltrated. | Section 306, Page 49 | |
| | | | | |
| **Stream Bank Erosion** | | The peak flow rate of the Post-construction two (2)-year, twenty-four (24)-hour design storm shall be reduced to the Predevelopment peak flow rate of the one (1)- year, twenty-four (24)-hour duration precipitation. | Section 307, Page 53 | Manage the 2-year volume increase from pre and post development. [1] |
| | | | | |
| **Flood Control** | | For the 2- to 100-yr storm events, the post development peak rates is to be less than or equal to pre development peak rate. (Redevolpment Regulated Activities) | Section 308, Page 55 | For the 2- to 100-yr storm events, the post development peak rates is to be less than or equal to pre development peak rate. [1] |
| | | | | |

[1] Per PADEP BMP Manual, Volume Control Guideline 1 - 20% of existing impervious area, when present, shall be considered meadow (good condition) in the model for existing conditions for redevelopment.

[2] County-wide Act 167 Stormwater Management Model Ordinance, dated March 27, 2013

**SWM Regulation Matrix**
**Stony Run Watershed**

| | | Act 167 Ordinance [2] | | DEP Chapter 102 |
|---|---|---|---|---|
| | | http://www.chesco.org/DocumentCenter/View/12603/Addendum_Append-Model-Ordinance-PADEP-Approved?bidId= | | |
| | | | | |
| **Water Quality** | Volume | For Regulated Activities involving Redevelopment, whichever is less of the following volume options shall be infiltrated: 1. The volume of a minimum of one (1)-inch of runoff from all Proposed Impervious Surfaces; or the 2-year, 24-hour volume increase. | Section 305, Page 48 | 90% of area within LOD to be controlled by Best Management Practices (BMP). If it does not, provide water quality anaylsis for pollutant loading from the disturbed areas per BMP. |
| | Infiltration Requirements | If infiltration can not be physically accomplished the Applicant shall be responsible for demonstrating with data or calculations to the satisfaction of the Municipal Engineer why this infiltration volume cannot be physically accomplished on the Site (e.g., shallow depth to bedrock or limiting zone, open voids, steep slopes, etc.) and what alternative volume can be infiltrated; however in all cases at least the first one-half (0.5) inch of runoff volume shall be infiltrated. | Section 306, Page 49 | |
| | | | | |
| **Stream Bank Erosion** | | The peak flow rate of the Post-construction two (2)-year, twenty-four (24)-hour design storm shall be reduced to the Predevelopment peak flow rate of the one (1)- year, twenty-four (24)-hour duration precipitation. | Section 307, Page 53 | Manage the 2-year volume increase from pre and post development. [1] |
| | | | | |
| **Flood Control** | | For the 2- to 100-yr storm events, the post development peak rates is to be less than or equal to pre development peak rate. (Redevolpment Regulated Activities) | Section 308, Page 55 | For the 2- to 100-yr storm events, the post development peak rates is to be less than or equal to pre development peak rate. [1] |
| | | | | |

[1] Per PADEP BMP Manual, Volume Control Guideline 1 - 20% of existing impervious area, when present, shall be considered meadow (good condition) in the model for existing conditions for redevelopment.

[2] County-wide Act 167 Stormwater Management Model Ordinance, dated March 27, 2013

**SWM Regulation Matrix**
**French Creek Watershed**

| | | Act 167 Ordinance [2] | | DEP Chapter 102 |
|---|---|---|---|---|
| | | http://www.chesco.org/DocumentCenter/View/12603/Addendum_Append-Model-Ordinance-PADEP-Approved?bidId= | | |
| | | | | |
| **Water Quality** | Volume | For Regulated Activities involving Redevelopment, whichever is less of the following volume options shall be infiltrated: 1. The volume of a minimum of one (1)-inch of runoff from all Proposed Impervious Surfaces; or the 2-year, 24-hour volume increase. | Section 305, Page 48 | 90% of area within LOD to be controlled by Best Management Practices (BMP). If it does not, provide water quality anaylsis for pollutant loading from the disturbed areas per BMP. |
| | Infiltration Requirements | If infiltration can not be physically accomplished the Applicant shall be responsible for demonstrating with data or calculations to the satisfaction of the Municipal Engineer why this infiltration volume cannot be physically accomplished on the Site (e.g., shallow depth to bedrock or limiting zone, open voids, steep slopes, etc.) and what alternative volume can be infiltrated; however in all cases at least the first one-half (0.5) inch of runoff volume shall be infiltrated. | Section 306, Page 49 | |
| | | | | |
| **Stream Bank Erosion** | | The peak flow rate of the Post-construction two (2)-year, twenty-four (24)-hour design storm shall be reduced to the Predevelopment peak flow rate of the one (1)- year, twenty-four (24)-hour duration precipitation. | Section 307, Page 53 | Manage the 2-year volume increase from pre and post development. [1] |
| | | | | |
| **Flood Control** | | For the 2- to 100-yr storm events, the post development peak rates is to be less than or equal to pre development peak rate. (Redevolpment Regulated Activities) | Section 308, Page 55 | For the 2- to 100-yr storm events, the post development peak rates is to be less than or equal to pre development peak rate. [1] |
| | | | | |

[1] Per PADEP BMP Manual, Volume Control Guideline 1 - 20% of existing impervious area, when present, shall be considered meadow (good condition) in the model for existing conditions for redevelopment.

[2] County-wide Act 167 Stormwater Management Model Ordinance, dated March 27, 2013

**SWM Regulation Matrix**
**Valley Creek Watershed**

| | | Act 167 Ordinance [2] | DEP Chapter 102 |
|---|---|---|---|
| | | https://pa-chestercounty2.civicplus.com/1986/Valley-Creek-SWM-Plan | |
| | | | |
| **Water Quality** | Volume | For Re-development Sites, the post-development total runoff volume must not exceed the pre- development total runoff volume for all storms equal to or less than the 2-year storm event, where the pre-development runoff is calculated using the Re-Development Ground Cover Assumption, which states that calculations must assume ground cover for at least 20% of the impervious surface areas to be "meadow". | 90% of area within LOD to be controlled by Best Management Practices (BMP). If it does not, provide water quality anaylsis for pollutant loading from the disturbed areas per BMP. |
| | Infiltration Requirements | For Re-Development Projects, infiltrate a minimum of 0.5-inch (one-half of an inch) of runoff from new and replacement impervious surfaces to partially restore and protect groundwater recharge and stream baseflows | |
| | | | |
| **Stream Bank Erosion** | | The 1-year, 24 hour storm event shall be attenuated for at least 24 hours (i.e., the stormwater runoff will be released over a minimum of 24 hours). | Manage the 2-year volume increase from pre and post development. [1] |
| | | | |
| **Flood Control** | | Using the Re-Development Ground Cover Assumption, which states that calculations must assume ground cover for at least 20% of the impervious surface areas to be "meadow". Reduce peak rates as follows:<br>Post 2-year to Pre 1-year<br>Post 5-year to Pre 1-year<br>Post 25-year to Pre 25-year<br>Post 50-year to Pre 50-year<br>Post 100-year to Pre 100-year<br>Depending on the municipality, Reduce the peak rate of runoff of the 10-year, 24-hour design storm event to not exceed the pre-development peak rate of the 2-year, 24-hour design storm event, OR Reduce the peak rate of runoff of the 10-year, 24-hour design storm event to not exceed the pre-development peak rate of the 10-year, 24-hour design storm event. | For the 2- to 100-yr storm events, the post development peak rates is to be less than or equal to pre development peak rate. [1] |
| | | | |

[1] Per PADEP BMP Manual, Volume Control Guideline 1 - 20% of existing impervious area, when present, shall be considered meadow (good condition) in the model for existing conditions for redevelopment.

[2] Valley Creek Watershed Stormwater Management Plan, dated July 30, 2010 (with Errata sheet dated 2/4/2011)

**SWM Regulation Matrix**
**Ridley Creek Watershed**

| | | Act 167 Ordinance [2] | | DEP Chapter 102 |
|---|---|---|---|---|
| | | http://www.chesco.org/DocumentCenter/View/12603/Addendum_Append-Model-Ordinance-PADEP-Approved?bidId= | | |
| | | | | |
| **Water Quality** | Volume | For Regulated Activities involving Redevelopment, whichever is less of the following volume options shall be infiltrated: 1. The volume of a minimum of one (1)-inch of runoff from all Proposed Impervious Surfaces; or the 2-year, 24-hour volume increase. | Section 305, Page 48 | 90% of area within LOD to be controlled by Best Management Practices (BMP). If it does not, provide water quality anaylsis for pollutant loading from the disturbed areas per BMP. |
| | Infiltration Requirements | If infiltration can not be physically accomplished the Applicant shall be responsible for demonstrating with data or calculations to the satisfaction of the Municipal Engineer why this infiltration volume cannot be physically accomplished on the Site (e.g., shallow depth to bedrock or limiting zone, open voids, steep slopes, etc.) and what alternative volume can be infiltrated; however in all cases at least the first one-half (0.5) inch of runoff volume shall be infiltrated. | Section 306, Page 49 | |
| | | | | |
| **Stream Bank Erosion** | | The peak flow rate of the Post-construction two (2)-year, twenty-four (24)-hour design storm shall be reduced to the Predevelopment peak flow rate of the one (1)- year, twenty-four (24)-hour duration precipitation. | Section 307, Page 53 | Manage the 2-year volume increase from pre and post development. [1] |
| | | | | |
| **Flood Control** | | For the 2- to 100-yr storm events, the post development peak rates is to be less than or equal to pre development peak rate. (Redevolpment Regulated Activities) | Section 308, Page 55 | For the 2- to 100-yr storm events, the post development peak rates is to be less than or equal to pre development peak rate. [1] |
| | | | | |

[1] Per PADEP BMP Manual, Volume Control Guideline 1 - 20% of existing impervious area, when present, shall be considered meadow (good condition) in the model for existing conditions for redevelopment.

[2] County-wide Act 167 Stormwater Management Model Ordinance, dated March 27, 2013

**SWM Regulation Matrix**
**Chester Creek Watershed**

| | | Act 167 Ordinance [2] | | DEP Chapter 102 |
|---|---|---|---|---|
| | | | | |
| | | | | |
| **Water Quality** | Volume | The volume of storage to be provided shall be no less than the net increase in runoff from the 2-year storm event, or one (1) inch of runoff from the total area draining to the infiltration facility, whichever is greater. | Section 404, Page 28 | 90% of area within LOD to be controlled by Best Management Practices (BMP). If it does not, provide water quality anaylsis for pollutant loading from the disturbed areas per BMP. |
| | Infiltration Requirements | The applicant shall first provide infiltration facilities in areas where soils are suitable for infiltration and shall direct the runoff from impervious surfaces into these infiltration facilities. | Section 404, Page 28 | |
| | | | | |
| **Stream Bank Erosion** | | Detain the 2-year, 24 hour design storm runoff. Provisions shall be made so that the detained runoff takes a mininum of 24 hours to drain from the facility from a point where the maximum volume of water is caputured. | Section 404, Page 29 | Manage the 2-year volume increase from pre and post development. [1] |
| | | | | |
| **Flood Control** | | Post-development peak discharge for all design storms must be no greater than 505 of the pre-development peak discharges | Section 403, Page 27 | For the 2- to 100-yr storm events, the post development peak rates is to be less than or equal to pre development peak rate. [1] |
| | | | | |

[1] Per PADEP BMP Manual, Volume Control Guideline 1 - 20% of existing impervious area, when present, shall be considered meadow (good condition) in the model for existing conditions for redevelopment.

[2] Act 167 Stormwater Management Plan Chester Creek Watershed, dated June 2002

# Appendix F

## Infiltration Testing Reports

May 15, 2019

# GEOTECHNICAL DESIGN MEMORANDUM

# ADELPHIA GATEWAY, LLC
# TRANSCO METER STATION
# INFILTRATION TESTING REPORT
# DELAWARE COUNTY, PENNSYLVANIA

**Submitted to:**
**Hunt, Guillot and Associates (HGA)**
One Metroplex Drive, Suite 100
Birmingham, Alabama 35209

May 15, 2019

Mr. Richard Healy
Hunt, Guillot and Associates (HGA)
One Metroplex Drive, Suite 100
Birmingham, Alabama 35209

Reference: Geotechnical Design Memorandum
re. Infiltration Testing
**TRANSCO Meter Station**
Bucks County, Pennsylvania
JMT Job No. 18-00672-006

Dear Mr. Healy:

Johnson, Mirmiran & Thompson, Inc. (JMT) is pleased to submit this geotechnical engineering analysis for the above-referenced project. This report contains a discussion of our understanding of the project, exploration procedures, the exploration results, and our recommendations for the design of the StormTank detention basin/stormwater management (SWM) facility for the proposed Adelphia Gateway, LLC, TRANSCO Meter Station project in Delaware County, Pennsylvania.

It has been our pleasure to be of service to you. If you have any questions or require any additional information, please do not hesitate to contact this office.

Very truly yours,

**JOHNSON, MIRMIRAN AND THOMPSON, INC.**

Michael E. Leffler, P.E.
Vice President

## 1.0 INTRODUCTION

This memorandum was prepared for the Adelphia Gateway, LLC in accordance with our agreement. Johnson, Mirmiran & Thompson, Inc. (JMT) has completed the Geotechnical Design Memorandum for the design of the proposed TRANCO Meter Station StromTank detention basin/stormwater management (SWM) facility in Delaware County, Pennsylvania.

## 2.0 SUBSURFACE EXPLORATION

A single test pit (TP-1) was dug by a backhoe on May 9, 2019 to perform two Double Ring Infiltration Tests. It was roughly 20' long x 3' to 4' wide. The two tests were conducted at depths of 4.5 and 5.5 feet below existing grade which in both cases were at the same approximate elevation, namely 58.5 feet above Mean Seal Level (MSL). But the test pit was extended two feet deeper to elevation 56.5 feet to investigate the presence of limiting layers. The tests were scheduled to be 6 inches to a foot higher, but because of the presence of cobbles, an accurate test result could not be achieved. Therefore, the tests were taken a little deeper, but still in the same material minus the cobbles.

The existing ground elevation of the test pit at a point midway between the two tests is approximately 63.5 feet, and the proposed elevation at this same point is 65.4 feet. The locations of the detention basin facility, the test pit, and the two infiltration tests are displayed in the plan view in Appendix A. The two test locations and are about 10 feet apart. A log of the test pit is included in Appendix B. The Double Ring Infiltration Test results are shown in Appendix C.

## 3.0 GEOLOGIC SETTING

The project site is located in Delaware County, in southeast Pennsylvania. The proposed TRANSCO Meter Station is located at the corner of West Ridge Road and Fed Ex Drive. It is about 2,000 feet from the Pennsylvania/Delaware state line. The ridge for which the road is named is the surface expression of the Fall Line which is the boundary between the Piedmont to the west and the Atlantic Coastal Plane to the east. West Ridge Road parallels the "Northeast Corridor" which is about 1000 feet to the southeast. The Northeast Corridor is the AMTRAK and CSXT electrified rail line that connects the metropolitan areas from Washington D.C. to Boston. Both West Ridge Road and the rail lines parallel the Delaware River which is the major topographic feature in the area.

The site is within the transition zone between the Atlantic Coastal Plain Physiographic Province, and the Piedmont Physiographic Province. This zone is characterized by the presence of relatively thin coastal plain unconsolidated sediments overlying the igneous and metamorphic rocks of the Piedmont. The top of rock drops sharply towards the southeast.

Topography is low relief, and surface drainage in this area is southeasterly towards a series of creeks which outlet into the Delaware River.

The Coastal Plain sediments on site are mapped as the Quaternary Age Trenton Gravel which is a product of Delaware River deposits. It is described in the literature as gray or pale-reddish-brown very gravelly sand interstratified with cross bedded sand and clay-silt beds and includes areas of Holocene alluvium and swamp deposits. The Trenton, overlies crystalline rock of lower Paleozoic age which outcrops to the west. Two rock formations are mapped within the project limits of the adjacent pipeline project. The shows the portion of the project west of the intersection of Ridge Road and Summit Street to be underlain by anorthosite. The later mapping, shown in the ˘ ˘ ˆ˙ ˘ˆ ˆ˙ ˘ ˝ ¸ ˘ °˝ ˘ ~ ˘ ! ˝ ˆ " # $ describes the rock as the Ardentown Granite Suite. The primary difference in minerology between granite and anorthosite is that the granite would contain more quartz and would be slightly harder to drill. To the east of Summit Street, which is between 2018 borings B-3.1 and B-3.2 (from the subsurface investigation for the adjacent 16” Tilghman Lateral HDD pipeline project), the rock type is mapped as the Wissahickon Formation on the 1980 map and as Chester Park Gneiss on the 2005 map. Wissahickon is an older mapping unit which includes both gneiss and schist. The later mapping which defines the area as gneiss is confirmed by the cores recovered from 2018 borings B-5.2 and B-8.2. The hardness and strength of gneiss is generally considered to be equivalent to a granite. The transition from residual soil to gneissic rock is frequently gradational. The 2018 borings show the presence of silty sand material having high STP blow counts which are shown on the logs as 50/<6”. This material is described as decomposed rock and usually becomes denser with depth and will contain gravel size rock fragments.

## 4.0 SOIL CONDITIONS

The subsurface conditions at the meter station site were evaluated for infiltration by using the data from test pit TP-1. Three strata were revealed in the test pit. They were logged by one of our (JMT’s) Geotechnical Engineers, and they are: Stratum A – SILT with a trace of clay down to 3.5 feet deep; Stratum B – Gravelly and Cobbly SILT down to 4.5 feet deep; and Stratum C – SILT down to 7 feet deep (elevation 56.5 feet). The cobbles of Stratum B typically ranged between 3 to 6 inches in diameter with the largest cobble being approximately 12 inches in diameter. The

USDA textural classification for all three strata is the same. It is right on the line between Silty Loam and Silt.

## 5.0 GROUNDWATER CONDITIONS

On the day of the infiltration testing, groundwater was not encountered in the test pit. (Neither were any limiting layers encountered in the test pit.) It should be noted that the testing was conducted in springtime in which there has been a normal amount of rainfall. In fact, there was some ponded water on the site. There was also some light rain on the day of testing (the two tests were covered during the rain).

The lack of a recorded water level reflects the conditions at the time of the infiltration testing only. Fluctuations in the location of hydrostatic groundwater level and perched water levels can occur as a result of seasonal variations in evaporation, precipitation, surface water run-off, leaking utilities and other factors.

## 6.0 ANALYSIS AND RECOMMENDATIONS

A StormTank detention basin facility near the east corner of the meter station is being considered for stormwater management. In the proposed design, the detention basins will drain both through an outlet pipe as well as through seepage through the porous base that will not be sealed by an impermeable liner.

Soil Infiltration testing was performed on May 9, 2019 using the Double Ring Infiltration Test method. The total test pit dimensions are 20 feet x 3 to 4 feet, and the tests were conducted at 4.5 and 5.5 feet deep. The test pit was dug by Boring Brothers, Inc. who used a backhoe. The two infiltration tests were performed by a two man team from AGI. The results are as follows:

| Infiltration Test | Ground Surface Elev. | Test Depth | USDA Textural Class. | Average Infiltration Rate (in./hr.) |
|---|---|---|---|---|
| PT-3 | 63.0 | 2 (EL 58.5) | Silty Loam to Silt | 0.24 |
| PT-4 | 64.0 | 2 (EL 58.5) | Silty Loam to Silt | 0.28 |

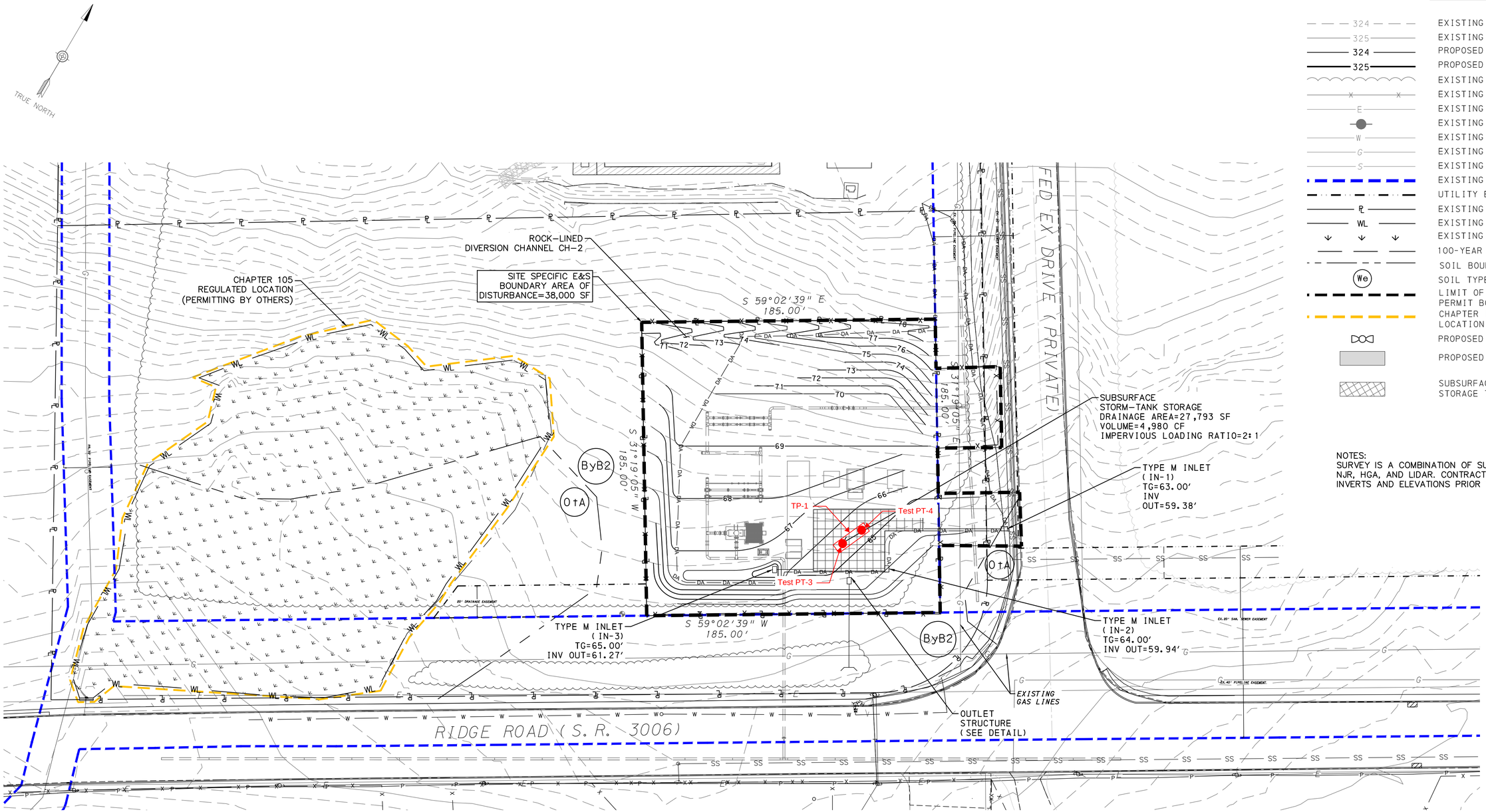
The test pit revealed Silty Loam to Silt soils with an average infiltration rate of 0.26 inches per hour with no limiting layer such as impervious clay, bedrock, or groundwater. Based on the Pennsylvania Department of Environmental Protection (DEP) # % &ˆ ˇ ˆ ˇ ˆ

[illegible], the use of infiltration in SWM facilities is permissible only when the soils will provide infiltration rates between 0.1 and 10 inches per hour. Furthermore, infiltration is generally permissible only when there is a two foot clearance above the regularly occurring seasonally high water table, and there is a minimum depth to bedrock of two feet. Therefore, the use of infiltration is permissible at this site.

# APPENDICES

# APPENDIX A

- **Plan View**




## LEGEND

- EXISTING 1' CONTOUR
- EXISTING 5' CONTOUR
- PROPOSED 1' CONTOUR
- PROPOSED 5' CONTOUR
- EXISTING TREE LINE
- EXISTING FENCE LINE
- EXISTING OVERHEAD ELECTRIC
- EXISTING UTILITY POLE
- EXISTING WATER LINE
- EXISTING GAS LINE
- EXISTING SEWER LINE
- EXISTING GAS EASEMENT
- UTILITY EASEMENT
- EXISTING PROPERTY LINE
- EXISTING WETLAND BOUNDARY
- EXISTING WETLAND AREA
- 100-YEAR FLOOD PLAIN
- SOIL BOUNDARY
- SOIL TYPE
- LIMIT OF DISTURBANCE/ PERMIT BOUNDARY
- CHAPTER 105 REGULATED LOCATION
- PROPOSED VALVE LOCATION
- PROPOSED PAVE
- SUBSURFACE STORAGE TANK

NOTES:
SURVEY IS A COMBINATION OF SURVEY PROVIDED BY NJR, HGA, AND LIDAR. CONTRACTOR TO FIELD VERIFY INVERTS AND ELEVATIONS PRIOR TO CONSTRUCTION.

| Test ID | Northing | Easting | Depth to Basin Bottom (ft) | Depth to Bottom Excavation Limit (ft) |
|---|---|---|---|---|
| TP-3 | 2618839.464 | 185309.603 | 4 | 6 |
| TP-4 | 2618850.295 | 185335.208 | 5 | 7 |

ADELPHIA GATEWAY

15 0 30 60
SCALE: 1"=30'

DATE: _____

| REV | DESCRIPTION | CHK | DATE | APP | DATE |
|---|---|---|---|---|---|

REVISION

| | |
|---|---|
| DRAWN BY | INTL |
| DESIGNED BY | -- |
| CHECKED BY | -- |
| APPROVED BY | -- |
| JOB NO. | 18-00672-004 |
| PLOT SCALE | 1"=30' |
| MODEL ID | |

JMT
Johnson, Mirmiran & Thompson
1600 Market Street, Suite 520
Philadelphia, PA 19103
T: 267-256-0300

POST CONSTRUCTION STORMWATER MANAGEMENT PLAN
TRANSCO METER STATION

| SCALE | DRAWING NUMBER | REV |
|---|---|---|
| 1"=30' | PCSM-7 | |

DATE PRINTED: 3/25/2019 10:14:07 AM
G:\2018\180672.205_TILGHMAN_LATERAL\CADD\17-WATER RESOURCES\03-PLANS\ADELPHIA SITES\ADL-SWM-TRANSCO.DWG

# APPENDIX B

- **Test Pit TP-1 Log**

# Johnson, Mirmiran and Thompson, Inc.
## 40 Wight Avenue
## Hunt Valley, MD 20130

# TEST PIT NUMBER: TP-1



**CLIENT** NJR Clean Energy Ventures
**PROJECT NAME** TRANSCO METER STATION
**PROJECT NUMBER** 18-00672-010
**PROJECT LOCATION** Marcus Hook, PA

**GROUND ELEVATION** _____ **SIZE** "
**DATE STARTED** 5/9/19 **COMPLETED** 5/9/19
**EXCAVATION CONTRACTOR / RIG** Boring Brothers Inc. /
**EXCAVATION METHOD** Backhoe **LOGGED BY** MEL
**NORTH -** _____ **EAST -** _____

**GROUND WATER & CAVED DEPTH LEVELS**
**AT TIME OF EXCAVATION** Dry
**AT END OF EXCAVATION** Dry
**AUGERS PULLED EXCAVATION** Dry **CAVED EXCAVATION** N/A
**EXCAVATION** Dry **CAVED EXCAVATION** ---

| DEPTH (ft) | U.S.C.S. | GRAPHIC LOG | STRATA DEPTH | MATERIAL DESCRIPTION | STRATUM | REMARKS |
|---|---|---|---|---|---|---|
| 0 | OL | | 0' | Topsoil and Root Mat | A | |
| | ML | | 0.5' | SILT, trace Clay, Moist, Brown and Gary | A | |
| | ML | | 3.5' | Gravelly and Cobbly SILT, Moist, Brown | B | |
| 5 | ML | | 4.5' | SILT, Moist, Gray and Brown | C | |
| | | | | Bottom of test pit at 7.0 feet | | |

# APPENDIX C

- **Double Ring Infiltration Test Results**

**AMERICAN GEOTECH, INC.**
Civil/Geotechnical Engineers and Material Testing Laboratories
Main Office: 1801 Penn Ave., Wyomissing Hills, PA 19609; Tel.: (610) 670-9055 / Fax: (610) 678-2719
Branch Office: 209 Main Street, Woodbridge, NJ 07095; Tel.: (732) 750-1668

# INFILTRATION RATE

(PA CODE 73.15)
(ASTM D 3385-94)

| | | | |
|---|---|---|---|
| Client: | **JMT** | Date: | **5/9/2014** |
| Project: | **INFILTRATION TESTS** | Surface Condition: | **Grass** |
| Location: | **TRANSCO METER STATION** | AGI Project No.: | |

**SOIL DESCRIPTION: One Soil Sample taken at 2' from the excavation bottom.**

0 to 4 Inches: Grass and Black Organics
4" to 2 ft: Gray to Brown Silt
2 to 4 ft : Brown Silt with Clay and Pieces of Decomposed Rock
4-4.5 ft: Brown to Gray Sandy SILT with gravel

Weather Conditions: Cloudy
Temperature: 58
Soil Condition: grass

**See Figure 1 for locations**

**Pre-Soaking Table**

| Test Pit | Trial | Time | Escaped Time | ΔH (mm) | ΔH (Inches) |
|---|---|---|---|---|---|
| PT-4 | S | 9:54 | | | |
| | E | 10:54 | 60 Min | 5 | 0.195 |
| PT-3 | S | 10:40 | | | |
| | E | 11:40 | 60 Min | 4 | 0.156 |

**NOTE:**
Both PT locations had a 1 hr presoak before any tests periods were performed.

**INFILTRATION TEST: (ASTM D3385-94)**

| TEST LOCATION | READING INTERVAL (MIN.) | OUTER RING DIAMETER (INCHES) | INNNER RING DIAMETER (INCHES) | DEPTH OF THE TEST (FEET) | READING NO.1 MM OF DROP | READING NO.2 MM OF DROP | READING NO.3 MM OF DROP | READING NO.4 MM OF DROP | READING NO.5 MM OF DROP |
|---|---|---|---|---|---|---|---|---|---|
| PT-3 | 30 | 12.00 | 6.00 | 4.5' | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 |
| PT-4 | 30 | 12.00 | 6.00 | 4.5' | 3.50 | 3.50 | 3.50 | 3.50 | 3.50 |
| | | | | | | | | | |
| | | | | | | | | | |

**CALCULATION OF AVERAGE INFILTRATION RAT**

| TEST HOLE NO | DROP DURING FINAL PERIOD MM/30 MIN | DROP DURING FINAL PERIOD INCHES/30 MIN | INFILTRATION RATE MM/HR MM/HOUR | INFILTRATION RATE INCHES/HR INCHES/HOUR |
|---|---|---|---|---|
| PT-3 | 3.00 | 0.118 | 6.00 | 0.24 |
| PT-4 | 3.50 | 0.138 | 7.00 | 0.28 |
| | | | | |
| | | | | |

**Infiltration Rates vary from 0.24 to 0.28 in/hour with an avg Infiltration rate of**

**AVG INFILTRATION RATE = 0.26 in/hour**
**6.5 mm/hour**

**INSPECTOR :** SP **DATE:** 5/9/2019
**CHECKED BY :** KC **DATE:** 5/10/2019

May 10, 2019

# GEOTECHNICAL DESIGN MEMORANDUM

# ADELPHIA GATEWAY, LLC
# QUAKERTOWN COMPRESSOR STATION
# INFILTRATION TESTING REPORT
# BUCKS COUNTY, PENNSYLVANIA

**Submitted to:**
**Hunt, Guillot and Associates (HGA)**
One Metroplex Drive, Suite 100
Birmingham, Alabama 35209

May 10, 2019

Mr. Richard Healy
Hunt, Guillot and Associates (HGA)
One Metroplex Drive, Suite 100
Birmingham, Alabama 35209

Reference: Geotechnical Design Memorandum
re. Infiltration Testing
**Quakertown Compressor Station**
Bucks County, Pennsylvania
JMT Job No. 18-00672-006

Dear Mr. Healy:

Johnson, Mirmiran & Thompson, Inc. (JMT) is pleased to submit this geotechnical engineering analysis for the above-referenced project. This report contains a discussion of our understanding of the project, exploration procedures, the exploration results, and our recommendations for the design of the rain garden/stormwater management (SWM) facility for the proposed Adelphia Gateway, LLC, Quakertown Compressor Station project in Bucks County, Pennsylvania.

It has been our pleasure to be of service to you. If you have any questions or require any additional information, please do not hesitate to contact this office.

Very truly yours,

**JOHNSON, MIRMIRAN AND THOMPSON, INC.**

Patrick E. Ostrowski, P.E.
Associate

Michael E. Leffler, P.E.
Vice President

## 1.0 INTRODUCTION

This memorandum was prepared for the Adelphia Gateway, LLC in accordance with our agreement. Johnson, Mirmiran & Thompson, Inc. (JMT) has completed the Geotechnical Design Memorandum for the design of the proposed Quakertown Compressor Station rain garden/stormwater management (SWM) facility in Bucks County, Pennsylvania.

## 2.0 SUBSURFACE EXPLORATION

The subsurface investigation consisting of a total of seven test borings was performed by our sub-consultant American Geotech Incorporated (AGI) on April 17 and 24, 2018 for the Compressor Station project itself. However, two of the borings (borings B-5 and B-5A) were close to the proposed rain garden and should suffice to define the subsurface at the location of the rain garden. These two borings were drilled using a SIMCO HS 2800 truck-mounted rig.

Bedrock was not sampled in any of the borings. However, all the borings were terminated at the point of auger refusal on firm bedrock surface. The borings were terminated between 4.6 to 9.3 feet deep.

We used the Unified Soil Classification System (USCS) to analyze the samples. A plan view of the site in which the boring locations are displayed is included in Appendix A. Boring Logs of test borings B-5 and B-5A are included in Appendix B.

*On the day of the Two Double Ring Infiltration Tests, a single trench was dug by a backhoe. It was roughly 20' long x 2.5' wide. The two tests were conducted at 2 feet deep, but the pit was extended to 5' deep. The locations of the rain garden and the two infiltration tests are displayed on a second plan view that is included in Appendix A. A log of the test pit is included in Appendix C. The soil in the test pit was visually classified by using the USDA Textural Classification System. The Double Ring Infiltration Test results are shown in Appendix D.*

## 3.0 GEOLOGIC SETTING

The project site is in Bucks County, Pennsylvania, about 15 miles southeast of Allentown, and about 14 miles west of the Pennsylvania state line with New Jersey. It is within the Gettysburg-Newark Lowland Section of the Piedmont Physiographic Province. This lowland is underlain by bands of Triassic and Jurassic sediments trending southwest from Newark, New Jersey to Gettysburg, Pennsylvania. In this area, the Triassic Period sediments frequently are cut by dikes

of Diabase rock. A dike is formed when magma intrudes into a crack within a pre-existing rock body. Dikes are usually near vertical to vertical and cut across existing bedding/foliation. In this area, the pre-existing rock is mapped as the Brunswick Formation which is composed of mudstone, siltstone and shale. The Diabase dike which cuts through the Brunswick is an igneous rock, which is hard and durable, and frequently meets specifications for quality aggregates used in highway pavements.

The virgin soils encountered in this area are the residual product of in-place chemical weathering of the parent rock presently underlying the site. The typical residual soil profile can consist of silty to clayey soils near the surface, where soil weathering is more advanced, underlain by more sandy silts and silty sands that generally become denser with depth down to the top of the parent bedrock. The relative density of the residual soils is primarily dependent upon the degree of weathering, surface disturbance, groundwater action, and residual mineral bonding. The boundary between soil and rock, termed decomposed rock, is not sharply defined. This transitional zone can contain layers of more resistant rock as well as highly weathered materials. The decomposed rock is considered as residual material with blow counts greater than 60 blows per foot. Decomposed Rock can have rock like characteristics and rock excavation methods of removal may be required to remove these materials where more resistive layers are present.

All of the borings encountered diabase at relatively shallow depths. Based on the borings, the entire footprint of the proposed compressor complex is underlain by a diabase dike.

## 4.0 SOIL CONDITIONS

The subsurface conditions at the site were evaluated by using the data from the 7 soil test borings completed for the proposed compressor station structures. Three strata were defined by these borings:

**Stratum A – Soft Lean Clay (CL):** Approximately the top 2.5 to 3 feet in every boring (except Boring B-5) encountered this stratum consisting of soft Lean Clay in which the blow counts ranged from 3 to 4 blows per foot (bpf). In Boring B-5, there was Lean Clay at the top, but the blow counts were 8 bpf indicating stiff soil conditions.

**Stratum B – Very Stiff Lean Clay (CL) or Dense Coarse Grained Soil (SM, GC-GM, GM, or GC):** This stratum consists of a consistent depth: from about 3 feet deep to on average 6.75 feet deep, and a consistent blow count or N value ranging from 31 to 36 bpf. This stratum consists of two

different soil types. One is granular found in Borings B-1, B-2, and B-5A; and the other is cohesive found in Borings B-3, B-4, B-5, and B-6.

**Stratum C – Decomposed Rock:** Decomposed Rock, designated Stratum C, was encountered in every boring. This stratum ranged from about 0.5 to 3.5 feet thick. The lone N value for a sample taken in the stratum was 50 blows for a penetration of 1 inch in boring B-2.

*Please see Appendix C for the test pit log. In the test pit, stratum A was observed to 3 feet deep underlain by Stratum C. The USDA textural classification for stratum A in the location of the proposed rain garden is Silty Clay Loam. (It should be noted that the soil in the test pit was visually classified by one of our (JMT's) Geotechnical Engineers.)*

## 5.0 GROUNDWATER CONDITIONS

On the day of the infiltration testing, the test pit was first extended to 4 feet deep. After about two hours there was some seepage and the bottom of the test pit showed signs of groundwater. The decomposed rock stratum was encountered in the test pit at about 3 feet deep. In order to try to get a better indication of the groundwater level, the test pit was extended to 5 feet deep, and the seepage stopped. Therefore, the decomposed rock stratum should be considered as a limiting layer. Thus, the groundwater table on May 7 appears to have been between 3 to 4 feet deep at the location of the test pit (elevations 548.5 to 547.5 feet). It should be noted that the test was conducted in springtime in which there has been a normal amount of rainfall including some light rain on the day before and no rain on the day of the testing.

The recorded water level reflects the conditions at the time of this infiltration testing only. Fluctuations in the location of hydrostatic groundwater level and perched water levels can occur as a result of seasonal variations in evaporation, precipitation, surface water run-off, leaking utilities and other factors.

## 6.0 ANALYSIS AND RECOMMENDATIONS

A rain garden along the northeast corner of the compressor station is being considered as a stormwater management facility. Based on the Pennsylvania Department of the Environment al Protection (DEP) *2006 Pennsylvania Stormwater Best Management Practices Manual,* the use of infiltration in SWM facilities is generally permissible only when the there is a two foot clearance above the regularly occurring seasonally high water table. (See Section 5.0 above for groundwater level information.) In addition, a minimum depth to bedrock of 2 feet must be

maintained to assure adequate pollutant removal. A decomposed rock stratum, which may be considered a limiting layer, was encountered in the test pit at 3 feet deep, elevation 548.5 feet.

Soil Infiltration testing was performed on May 7, 2019 using the Double Ring Infiltration Test method. The total test pit dimensions are 20 feet x 2.5 feet, and the tests were conducted at 2 feet deep. The test pit was dug by Eichelbergers, Inc. who used a Case-580 backhoe. The two infiltration tests were performed by a two man team from AGI. The locations of the two infiltration tests are shown in Appendix A. The results are as follows:

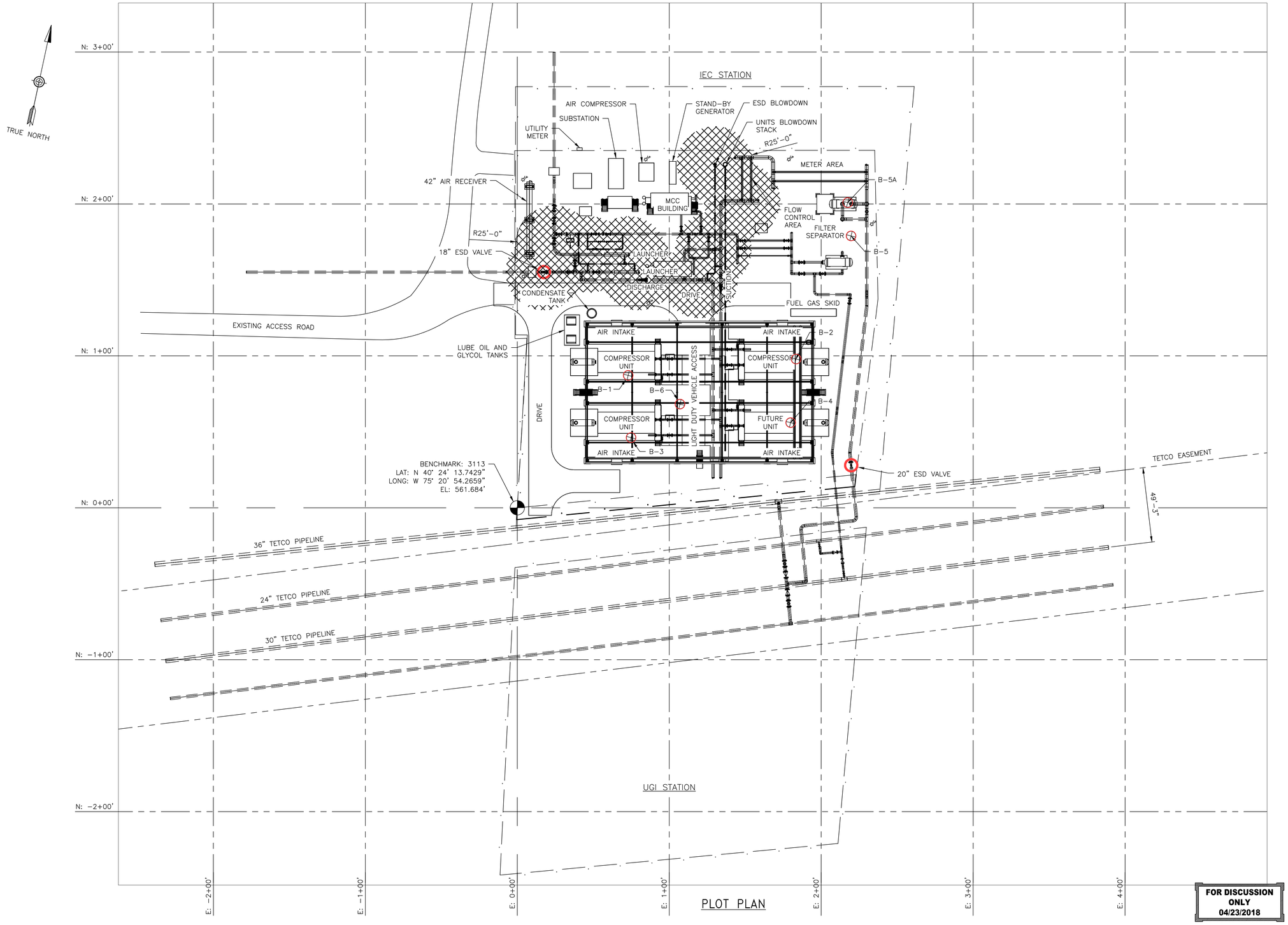
| Infiltration Test | Ground Surface Elev. | Test Depth | USDA Textural Class. | Average Infiltration Rate (in./hr.) |
|---|---|---|---|---|
| 1 | 551.5 | 2 (EL 549.5) | Silty Clay Loam | 0.12 |
| 2 | 551.5 | 2 (EL 549.5) | Silty Clay Loam | 0.08 |

Based on the subsurface conditions revealed by the test pit as well as the results of the infiltration test, infiltration is not recommended at this site. Specifically, the test pit revealed clay soils with an average infiltration rate of 0.1 inch per hour overlying a shallow limiting zone comprised of a decomposed rock stratum. Also, the test pit revealed groundwater seepage at 4 feet deep. Therefore, the groundwater level should be considered to be between 3 to 4 feet deep below the existing ground surface.

# APPENDICES

# APPENDIX A

- **Boring Plan View**
- **Rain Garden/Infiltration Test Pit Plan View**




PLOT PLAN

LEGEND:

⊕ SOIL BORINGS DRILLED ON: 4/17/2018 AND 4/24/2018

**FOR DISCUSSION ONLY 04/23/2018**

**DRAWING IN PROGRESS**
**LAST UPDATED: 5/23/2018**
**BY: agroff**


CONFIDENTIAL

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ADELPHIA GATEWAY

| REV | DESCRIPTION | CHK | DATE | APP | DATE |
|---|---|---|---|---|---|
| | | | | | |

REVISION

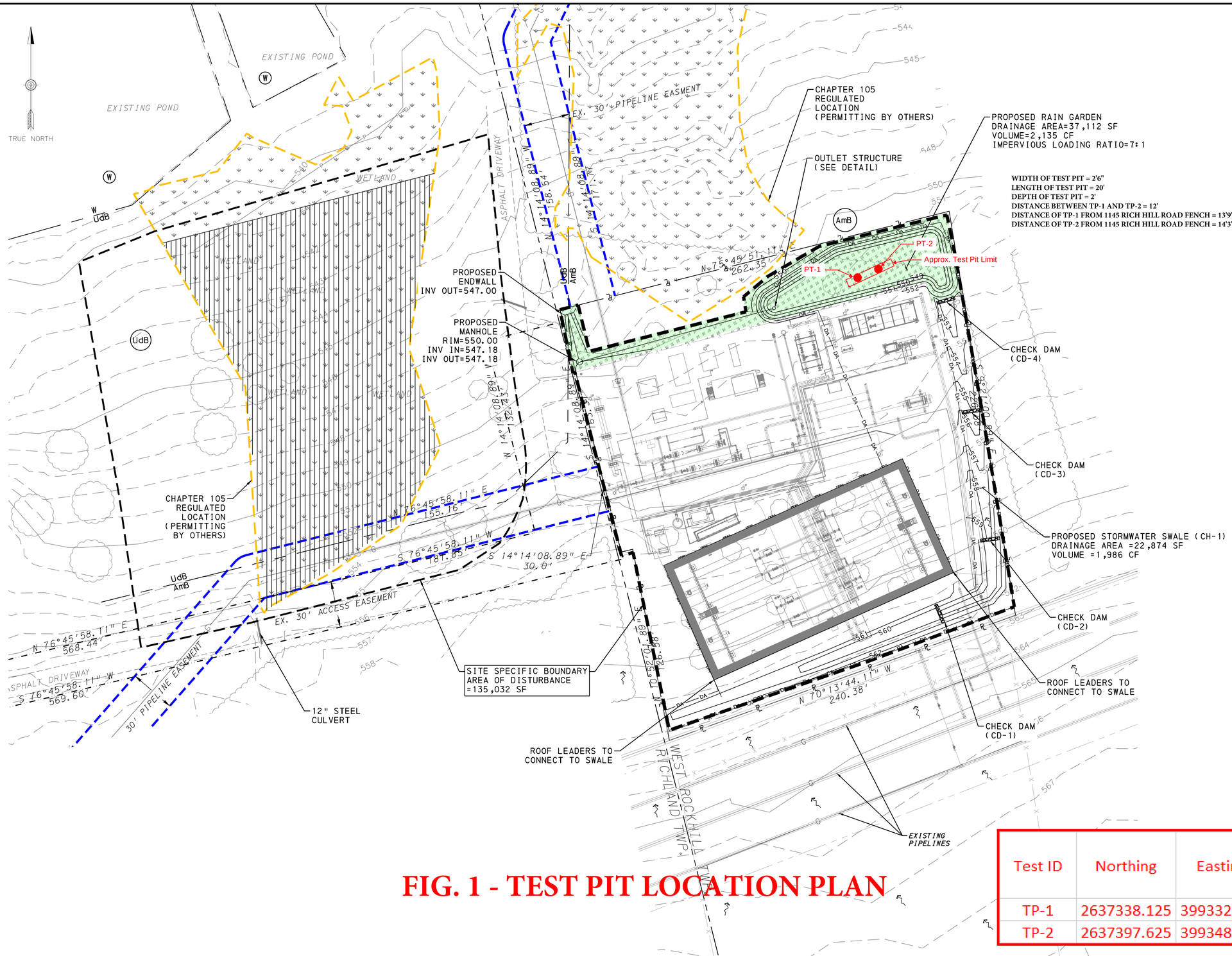
| | | |
|---|---|---|
| DRAWN BY | KDJ | 02/19/18 |
| DESIGNED BY | HGA | 02/19/18 |
| CHECKED BY | DNS | 03/14/18 |
| APPROVED BY | RCH | 03/14/18 |
| HGA JOB NO. | 8.A17022.04 | |
| PLOT SCALE | | |
| MODEL ID | | |


HGA
www.hga-llc.com
One Metroplex Drive, Suite 100
Birmingham, AL 35209
T: 205-970-4977
FIRM #: NR


# ADELPHIA GATEWAY, LLC
# QUAKERTOWN METER STATION
# PLOT PLAN
# BUCKS COUNTY, PENNSYLVANIA

| SCALE | DRAWING NUMBER | REV |
|---|---|---|
| 1"=30'−0" | 8.A17022.04-101− BORING LOCATIONS 001 | |

5/23/2018 1:33:35 PM agroff ALUA




# FIG. 1 - TEST PIT LOCATION PLAN

## LEGEND

| | |
|---|---|
| 324 | EXISTING 1' CONTOUR |
| 325 | EXISTING 5' CONTOUR |
| 324 | PROPOSED 1' CONTOUR |
| 325 | PROPOSED 5' CONTOUR |
| | EXISTING TREE LINE |
| X | EXISTING FENCE LINE |
| E | EXISTING OVERHEAD ELECTRIC |
| | EXISTING UTILITY POLE |
| W | EXISTING WATER LINE |
| G | EXISTING GAS LINE |
| S | EXISTING SEWER LINE |
| | EXISTING GAS EASEMENT |
| | UTILITY EASEMENT |
| PL | EXISTING PROPERTY LINE |
| WL | EXISTING WETLAND BOUNDARY |
| | EXISTING WETLAND AREA |
| | 100-YEAR FLOOD PLAIN |
| | SOIL BOUNDARY |
| We | SOIL TYPE |
| | LIMIT OF DISTURBANCE/ PERMIT BOUNDARY |
| | CHAPTER 105 REGULATED LOCATION |
| | PROPOSED VALVE LOCATION |
| | VEGETATED AREA |

NOTES:
SURVEY IS A COMBINATION OF SURVEY PROVIDED BY NJR, HGA, AND LIDAR. CONTRACTOR TO FIELD VERIFY INVERTS AND ELEVATIONS PRIOR TO CONSTRUCTION.

| Test ID | Northing | Easting | Depth to Basin Bottom (ft) | Depth to Bottom Excavation Limit (ft) |
|---|---|---|---|---|
| TP-1 | 2637338.125 | 399332.875 | 1.5 | 3.5 |
| TP-2 | 2637397.625 | 399348.375 | 2.5 | 4.5 |

ADELPHIA GATEWAY

15 0 30 60
SCALE: 1"=30'

DATE: _____

| REV | DESCRIPTION | CHK | DATE | APP | DATE |
|---|---|---|---|---|---|
| | | | | | |

REVISION

| | |
|---|---|
| DRAWN BY | INTL |
| DESIGNED BY | -- |
| CHECKED BY | -- |
| APPROVED BY | -- |
| JOB NO. | 18-00672-004 |
| PLOT SCALE | 1"=30' |
| MODEL ID | |

JMT
Johnson, Mirmiran & Thompson
1600 Market Street, Suite 520
Philadelphia, PA 19103
T: 267-256-0300

POST CONSTRUCTION STORMWATER MANAGEMENT PLAN
QUAKERTOWN COMPRESSOR STATION

| SCALE | DRAWING NUMBER | REV |
|---|---|---|
| 1"=30' | PCSM-9 | |

DATE PRINTED: 3/25/2019 10:15:53 AM
Q:\2018\180672-205_TILGHMAN_LATERAL\CADD\17-WATER RESOURCES\03-PLANS\ADELPHIA SITES\ADL-SWM-QUAKERTOWN.DWG

# APPENDIX B

- **Test Boring Logs for Borings B-5 and B-5A**

JMT

# BORING NUMBER: B-5

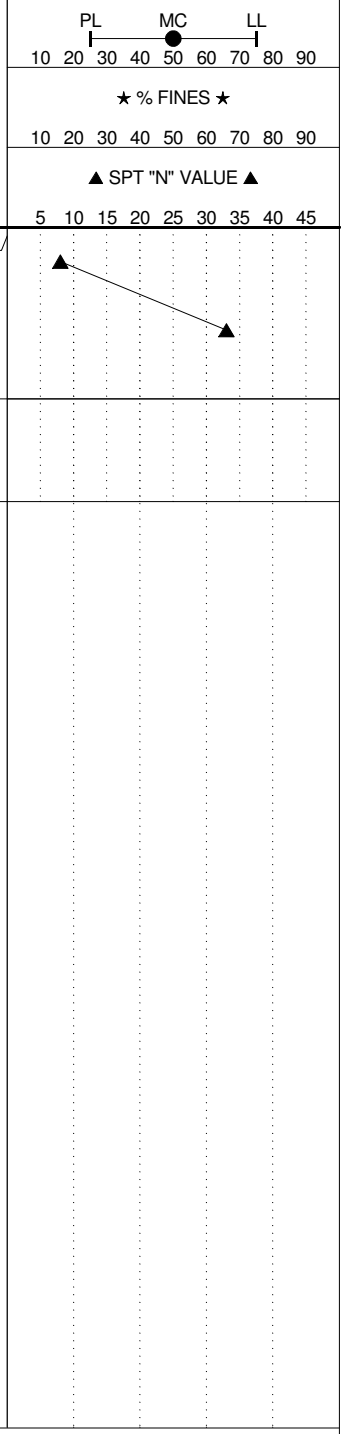


**CLIENT** Hunt, Guillot & Associates, LLC
**PROJECT NAME** Quakertown Gas Line Compressor Site
**PROJECT NUMBER** 18-00672-001
**PROJECT LOCATION** Quakertown, PA

**GROUND ELEVATION** 554.22 ft **HAMMER TYPE** CATHEAD
**DATE STARTED** 4/17/18 **COMPLETED** 4/17/18
**DRILLING CONTRACTOR / RIG** AGI /
**DRILLING METHOD** 3 1/4" Hollow Stem Auger **LOGGED BY**
**NORTH -** 399288.619 **EAST -** 2637385.798

**GROUND WATER & CAVED DEPTH LEVELS**
**AT TIME OF DRILLING** Dry
**AT END OF DRILLING** Dry
**AUGERS PULLED** Dry **CAVED** ---
**CAVED** ---

| ELEVATION (feet) | DEPTH (ft) | SAMPLE TYPE / NUMBER | SAMPLE LENGTH | SAMPLE REC. (in) | CORE RECOVERY % | RQD % | BLOW COUNTS (N VALUE) | STRATA DEPTH (ft) | MATERIAL DESCRIPTION | U.S.C.S. | GRAPHIC LOG | STRATUM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 554 | 0 | | | | | | | 0' | Crushed Stone Parking Surface | | | A |
| 553 | | SPT S-1 | 24 | 19 | | | 3-6-2-10 (8) | 0.25' | Sandy Silty LEAN CLAY, with Rock Fragments, Stiff to Hard, Moist, Dark Brown | CL | | B |
| 552 | | | | | | | | | | | | |
| 551 | | SPT S-2 | 24 | 15 | | | 7-13-20-72 (33) | | | | | |
| 550 | | | | | | | | | | | | |
| 549 | 5 | | | | | | | 5' | DECOMPOSED ROCK (SILT and Rock Fragments) Dry, Gray and Black | | | C |
| 548 | | | | | | | | | | | | |
| 547 | | | | | | | | | | | | |
| | | | | | | | | | Bottom of Boring at 8.0 feet | | | |




**REMARKS: Auger Refusal at 8 feet. Location and elevation approximated from USGS National Map**

JOHNSON, MIRMIRAN & THOMPSON
Engineering A Brighter Future®

JMT

# BORING NUMBER: B-5A

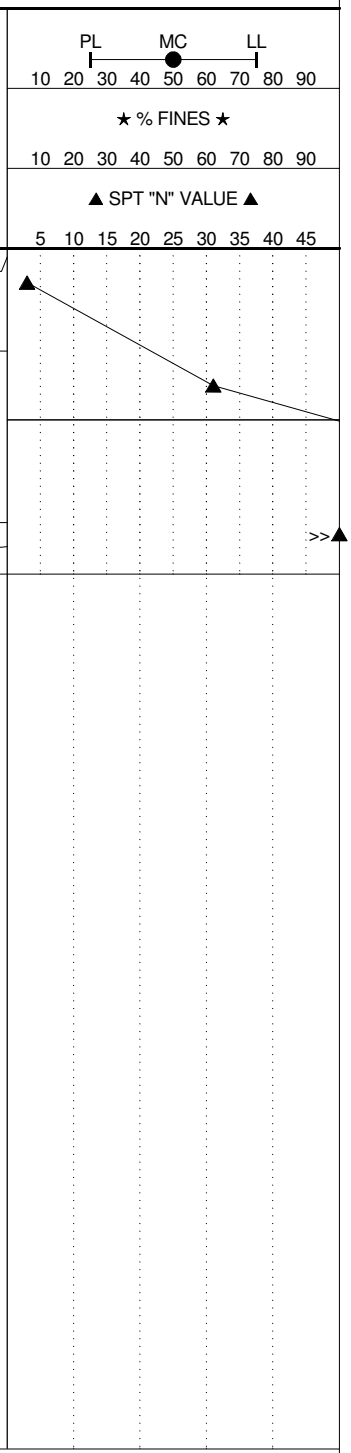


**CLIENT** Hunt, Guillot & Associates, LLC
**PROJECT NAME** Quakertown Gas Line Compressor Site
**PROJECT NUMBER** 18-00672-001
**PROJECT LOCATION** Quakertown, PA
**GROUND ELEVATION** 552.31 ft
**HAMMER TYPE** CATHEAD
**DATE STARTED** 4/24/18
**COMPLETED** 4/24/18
**DRILLING CONTRACTOR / RIG** AGI /
**DRILLING METHOD** 3 1/4" Hollow Stem Auge
**LOGGED BY**
**NORTH -** 399313.312
**EAST -** 2637385.106

**GROUND WATER & CAVED DEPTH LEVELS**
**AT TIME OF DRILLING** Dry
**AT END OF DRILLING** Dry
**AUGERS PULLED** Dry
**CAVED** ---
**CAVED** ---

| ELEVATION (feet) | DEPTH (ft) | SAMPLE TYPE / NUMBER | SAMPLE LENGTH | SAMPLE REC. (in) | CORE RECOVERY % | RQD % | BLOW COUNTS (N VALUE) | STRATA DEPTH (ft) | MATERIAL DESCRIPTION | U.S.C.S. | GRAPHIC LOG | STRATUM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 552 | 0 | | | | | | | 0' | Crushed Stone Parking Surfrace | | | A |
| 551 | | SPT S-1 | 24 | 9 | | | 0-1-2-4 (3) | 0.25' | Silty LEAN CLAY with Rock Fragments, Very Soft, Moist, Brown and Gray | CL | | A |
| 550 | | | | | | | | | | | | |
| 549 | | SPT S-2 | 24 | 12 | | | 7-12-19-21 (31) | 3' | Silty SAND with Rock Fragments, Medium Dense, Moist, Light Gray | SM | | B |
| 548 | 5 | | | | | | | | | | | |
| 547 | | | | | | | | | | | | |
| 546 | | | | | | | | | | | | |
| 545 | | | | | | | | | | | | |
| 544 | | SPT S-3 | 8 | 6 | | | 32-50/2" | 8' | ROCK FRAGMENTS with Silt, Very Dense Dry, Brown and Black | | | B |
| 543 | | | | | | | | 8.7' | DECOMPOSED ROCK (Rock Fragments and Silt), Dry, Gray and Black | | | C |

Bottom of Boring at 9.5 feet




**REMARKS: SPT Refusal at 8.4 feet, Auger Refusal at 9.5 feet. Location and elevation approximated from USGS National Map**

# APPENDIX C

- **Test Pit Log**

# TEST PIT NUMBER: TP-1



**Johnson Mirmiran & Thompson, Inc.**
**40 Wight Avenue**
**Hunt Valley, Maryland 21030**

**CLIENT** Hunt Guillot and Associates
**PROJECT NAME** Quakertown Compressor Station Rain Garden/SWM Facility
**PROJECT NUMBER** 18-00672-006
**PROJECT LOCATION** Quakertown, Bucks County, Pennsylvania
**GROUND ELEVATION** 551.5 ft **SIZE** "
**DATE STARTED** 5/7/19 **COMPLETED** 5/7/19
**EXCAVATION CONTRACTOR / RIG** Eichelbergers, Inc. / Case-580
**EXCAVATION METHOD** Test Pit **LOGGED BY** PEO
**NORTH -** **EAST -**

**GROUND WATER & CAVED DEPTH LEVELS**
**AT TIME OF EXCAVATION** ---
**AT END OF EXCAVATION** 4.0 ft / EL 547.5
**AUGERS PULLED EXCAVATION** --- **CAVED EXCAVATION** ---
**EXCAVATION** --- **CAVED EXCAVATION** ---

| DEPTH (ft) | ELEVATION (feet) | SAMPLE TYPE / NUMBER | U.S.C.S. | GRAPHIC LOG | STRATA DEPTH | MATERIAL DESCRIPTION | STRATUM | REMARKS |
|---|---|---|---|---|---|---|---|---|
| 0.0 | 551.5 | | | | 0' | Topsoil (8") | A | |
| | 551.0 | | | | 0.67' | Clayey SILT, Trace Fine Sand, Moist, Brown (USDA Classification: Silty Clay Loam, Easy Excavation Effort) | A | |
| | 550.5 | | | | | | | |
| | 550.0 | | | | | | | |
| | 549.5 | | | | | | | |
| 2.5 | 549.0 | | | | | | | |
| | 548.5 | | | | 3' | DECOMPOSED ROCK (Clayey SILT), Some Cobble Sized Rock Fragments, Brown (Dificult Excavation Effort) | C | |
| | 548.0 | | | | | | | |
| | 547.5 | | | | | | | |
| | 547.0 | | | | | | | |
| 5.0 | 546.5 | | | | | Bottom of test pit at 5.0 feet | | |

# APPENDIX D

- **Double Ring Infiltration Test Results**

**AMERICAN GEOTECH, INC.**
Civil/Geotechnical Engineers and Material Testing Laboratories
Main Office: 1801 Penn Ave., Wyomissing Hills, PA 19609; Tel.: (610) 670-9055 / Fax: (610) 678-2719
Branch Office: 209 Main Street, Woodbridge, NJ 07095; Tel.: (732) 750-1668

# DOUBLE RING INFILTRATION TEST

(PA CODE 73.15)
(FOLLOW THE GUIDANCE OF ASTM D 3385)

| | | | |
|---|---|---|---|
| Client: | **JMT** | Date: | **5/7/2014** |
| Project: | **QUAKERTOWN** | Surface Condition: | **Grass** |
| Location: | **1145 RICH HILL ROAD** | AGI Project No.: | |

**SOIL DESCRIPTION:** **See Figure 1 for locations**
SAMPLE TAKEN FROM 2' BELOW TEST BOTTOM
**SANDY/CLAYEY SILT (ML OR ML-CL); MORE THAN 80% SILT**

Weather Conditions: Sunny
Temperature: 65
Soil Condition: grass

(see Ref. AGI Geotechnical Report and Boring logs)

**Pre-Soaking Table**

| Test Pit | Trial | Time | Escaped Time | ΔH (mm) | ΔH (Inches) |
|---|---|---|---|---|---|
| PT-1 | S | 10:23 | | | |
| | E | 12:23 | 60 Min | 5 | 0.195 |
| PT-2 | S | 10:46 | | | |
| | E | 12:46 | 60 Min | 9 | 0.351 |

**NOTE:**
Both PT locations had a 1 hr presoak before any tests periods were performed.

**INFILTRATION TEST:**

| TEST LOCATION | READING INTERVAL (MIN.) | OUTER RING DIAMETER (INCHES) | INNNER RING DIAMETER (INCHES) | DEPTH OF THE TEST (FEET) | READING NO.1 MM OF DROP | READING NO.2 MM OF DROP | READING NO.3 MM OF DROP | READING NO.4 MM OF DROP | READING NO.5 MM OF DROP |
|---|---|---|---|---|---|---|---|---|---|
| PT-1 | 30 | 12.00 | 6.00 | 2' | 2.00 | 1.50 | 1.50 | 1.50 | 1.50 |
| PT-2 | 30 | 12.00 | 6.00 | 2' | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| | | | | | | | | | |
| | | | | | | | | | |

**CALCULATION OF AVERAGE INFILTRATION RAT**

| TEST HOLE NO | DROP DURING FINAL PERIOD MM/30 MIN | DROP DURING FINAL PERIOD INCHES/30 MIN | INFILTRATION RATE MM/HR MM/HOUR | INFILTRATION RATE INCHES/HR INCHES/HOUR |
|---|---|---|---|---|
| PT-1 | 1.50 | 0.059 | 3.00 | 0.12 |
| PT-2 | 1.00 | 0.039 | 2.00 | 0.08 |
| | | | | |
| | | | | |

**Infiltration Rates vary from 0.08 to 0.10 in/hour with an avg Infiltration rate of**

**AVG INFILTRATION RATE = 0.10 in/hour**
**2.5 mm/hour**

**INSPECTOR :** SP **DATE:** 5/7/2019
**CHECKED BY :** KC **DATE:** 5/8/2019

1600 Market Street, Suite 520
Philadelphia, PA 19103
P. 267-256-0300
www.jmt.com