Transcontinental Gas Pipe Line Company, LLC

Section 3-3 PCSM Plan for Compressor Station 200

Regional Energy Access Expansion Project – Compressor Station 200

April 2021
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SECTION 3.3.1
NARRATIVE

1. Project Description

Transcontinental Gas Pipe Line Company, LLC (Transco), indirectly owned by the Williams Companies, Inc. (Williams) is seeking authorization from the Federal Energy Regulatory Commission (FERC) under Section 7(c) of the Natural Gas Act and Part 157 of the Commissions regulations, to construct, own, operate, and maintain the proposed Project facilities associated with the Regional Energy Access Expansion Project (Project). The Project is an expansion of Transco's existing natural gas transmission system that will enable Transco to provide an incremental 829,400 dekatherms per day (Dth/d) of year-round firm transportation capacity from the Marcellus Shale production area in northeastern Pennsylvania (PA) to multiple delivery points along Transco's Leidy Line in PA, Transco's mainline at the Station 210 Zone 6 Pooling Point[1] in Mercer County, New Jersey (NJ) and multiple delivery points in Transco's Zone 6 in NJ, PA, and Maryland (MD).

The existing Compressor Station 200 component of the Project is located in East Whiteland Township, Chester County. Proposed are compressor station modifications to connect the existing Transco Mainline A into suction to support south flow.

This Post Construction Stormwater Management (PCSM) Plan has been developed for the Compressor Station 200 site. The PCSM Plan shall be designed and implemented to be consistent with the PCSM Plan under 25 Pa. Code § 102.8 (relating to PCSM requirements). The work and disturbed areas are located within Transco property, existing easements or legally obtained workspace. The limit of disturbance (LOD) for the Compressor Station 200 site will be approximately 3.16 acres. Subject to FERC's certification of the Project and receipt of the necessary permits and authorizations, Transco anticipates construction of the Project to start in second quarter 2023 to meet a proposed in-service date of fourth quarter 2024.

2. Topographic Features of the Area

A Project Location Map for Compressor Station 200 is included in Attachment 1. This map shows the topographical features of the general site vicinity and is based on the USGS 7.5 Minute topographical mapping of the Malvern, Pennsylvania quadrangles.

[1] A pooling point defines the aggregation of gas from multiple physical and/or virtual receipt points to a single physical or virtual point, and the disaggregation of gas from a single physical or virtual point to multiple physical and/or virtual delivery points.

3. Receiving Surface Waters

The following table (Table 1) lists each watershed located in Compressor Station 200 Project Area, its Chapter 93 Water Quality Standards, and Pennsylvania Fish and Boat Commission classifications. A Wetland and Watercourse Delineation Report is included in Attachment A of the ESCP permit application.

Table 1 – Receiving Waters

Watershed Name	Designated Use	Existing Use	PFBC Classification
Valley Creek (East)*	EV, MF	-	Naturally Producing Wild Trout Stream
Valley Creek (West)	CWF, MF	-	-

MF: Migratory Fishes, CWF: Cold Water Fishes, EV: Exceptional Value

*Disturbance located in this watershed only.

An evaluation of potential hydrologic impacts to wetlands associated with proposed PCSM facilities was undertaken at Compressor Station 200. One small, isolated wetland, W-T10-001A-1, is located downslope of the proposed Limits of Disturbance. The wetland has a slight depression in the landscape which allows water to collect. The upslope drainage area to this feature will not be changed by the installation of PCSM features; therefore, no significant changes to the hydrology of the wetland should occur.

4. Types, Depth, Slope, Locations & Limitation of the Soils and Geologic Formations

The soil associations on site were identified by soil map units as mapped in the Web Soil Survey website (https://websoilsurvey.sc.egov.usda.gov/) by the United States Dept. of Agriculture (USDA), Natural Resources Conservation Service (NRCS). There are two soil mapping units located within the LOD, see Table 2 below.

Table 2 – Soils Mapping Units with Limits of Disturbance

Soil Mapping Unit	Soil Series
CtA	Conestoga silt loam, 0 to 3 percent slopes
UrgB	Urban land-Conestoga complex, 0 to 8 percent slopes

Detailed descriptions and mapping of soil mapping units are provided in the Attachment 2. Soil use limitations (outlined in Table 3) were reviewed in relation to the Compressor Station 200 and resolutions were identified in Section 4.1.

Table 3 – Limitations of Pennsylvania Soils Pertaining to Earth Disturbance Projects (Erosion and Sediment Control Best Management Practice (BMP) Manual – Technical Guidance Number 363-3134-008/Page 401)																	
SOIL NAME	**SOIL WITH SLOPE CLASS**	**CUTBANKS CAVE**	**CORROSIVE TO CONCRETE\STEEL**	**DROUGHTY**	**EASILY ERODIBLE**	**FLOODING**	**DEPTH TO SATURATED ZONE/ SEASONAL HIGH-WATER TABLE**	**HYDRIC/ HYDRIC INCLUSIONS**	**LOW STRENGTH / LANDSLIDE PRONE**	**SLOW PERCOLATION**	**PIPING**	**POOR SOURCE OF TOPSOIL**	**FROST ACTION**	**SHRINK - SWELL**	**POTENTIAL SINKHOLE**	**PONDING**	**WETNESS**
Conestoga	CtA, UrgB	X	C/S						X	X	X		X		X		

4.1 Resolution of Soil Limitations

Transco proposes the following resolutions to compensate for soil limitations, summarized in Table 3 above:

1. To offset the caving of cutbanks, trenching operations will be conducted in accordance with the OSHA Technical Manual for Trenching.
2. Preventative coatings shall be used to prevent corrosion of concrete and/ or steel.
3. When bedrock is encountered it will be removed by mechanical methods or blasting. Blasting operations will conform with local, state, and federal regulations.
4. Precautions will be taken to prevent slope failure when working within low strength soils by flattening cut / fill slopes, not overloading, maintaining lateral support, and preventing saturation of soils. Low strength soils will not be used for roadway construction.
5. Excavation in soils prone to flooding, slow percolation, ponding, wetness, located in a seasonal high-water table, or which are hydric, will likely encounter water. Compensation will involve dewatering with appropriate means such as pump water filter bags, sediment traps, etc.

6. Soils that have the potential to swell, shrink, or heave due to frost action may cause damage to roadways or pads. Where foundations are critical, compensation may require removal and replacement of soils with suitable material.

7. In circumstances where soils appear to be a poor source of topsoil, drought or prone to wetness, soil testing will be performed to determine the appropriate applications of soil amendments to promote growth. Soils onsite that are fair sources of topsoil, will be identified, stripped and stockpiled for use during restoration.

8. In order to minimize erosion of soils that are easily erodible, compensation may involve providing a protective lining, to apply seed, mulch, erosion control blankets (either in rolls or hydraulically applied), tracking slopes, upstream diversions, waterbars, etc. to minimize soil erosion.

4.2 Geologic Formations

Transco retained Civil & Environmental Consultants, Inc. (CEC) of Pittsburgh, PA to perform a geohazard assessment, the following is provided from their 2020 report. Transco utilized United States Geological Survey (USGS), Geologic Map of Pennsylvania - Map 1, dated 1980 (online), to evaluate geologic hazards on the Project. The desktop analysis completed for the Project by CEC revealed that the Compressor Station 200 does not cross known, mapped, or inferred faults. No mines were identified in the site vicinity. Karst features were identified in the vicinity of the site. The analysis outlined that Compressor Station 200 lies within a zone of moderate to low landslide incidence and susceptibility.

Due to the moderate to low landslide incidence and susceptibility, a Geological Hazard Assessment and Mitigation Plan was completed by CEC and is submitted with this application (Attachment B). The Geological Hazard Assessment and Mitigation Plan identifies appropriate best management practices to avoid and mitigate for conditions encountered during construction.

Risk posed karst features are addressed in the Geological Hazard Assessment and Mitigation Plan was completed by CEC and is submitted with this application (Attachment B). The Geological Hazard Assessment and Mitigation Plan identifies appropriate best management practices to avoid and mitigate for conditions encountered during construction, and offers the following conclusions and recommendations:

- Soils consist of Urban land-Conestoga Complex developed on Cambrian-aged Ledger Formation bedrock (a crystalline dolomite).
- No risk of subsidence due to commercially mined coal seams, surface or deep mining.
- CEC concluded that carbonate rock is at the ground surface and that karst features do occur in this area.
- The risk of encountering arsenic bearings soils/rock during construction was deemed to be low.
- Radioactive soils/bedrock were not anticipated, and the Site is at a low potential risk for radon in indoor air but recommended that construction safety protocols consider radon accumulations in confined excavations and below grade structures.
- Issues related to arsenic bearing soils/rock were deemed to be unlikely.
- Little to no risk existed to construction from slope instability.
- Limited geohazard mitigation measures were recommended.
- Due to a limited risk of karst feature development CEC recommended:
    - If soluble limestone or other carbonate rocks be encountered, surface water best management practices should be implemented according to the erosion and sedimentation control plans to provide positive surface water drainage away from building areas, excavations, and exposed rock at all times before, during, and after construction.
    - Stormwater management plans should also incorporate use of watertight joints in piping and consideration of potential adverse impacts of infiltration, if used.
    - If bedrock is encountered, excavation other than blasting should be implemented.
    - Excavations should be closed as soon as possible after exposure.
    - Any proposed water utility trenches should be lined to prevent infiltration and/or underground piping should be leak proof and utilized gasketed joints.
    - Should sinkholes or other subsidence conditions occur, a geotechnical engineer should be notified to investigate in further detail and provide remedial recommendations.
    - CEC recommended having geotechnical personnel on-site during construction in areas where geohazard mitigation measures are recommended.
    - CEC also recommended periodic monitoring of field conditions in areas where drainage causes water to pool.

Based on a letter provided by Civil & Environmental Consultants, Inc. (CEC) dated February 22, 2022, it is unlikely that the proposed BMP will contribute to sinkhole development, and it is CEC's opinion that the site is suitable for the proposed method of infiltration. The CEC letter is included in Attachment 7.

5. Characterizations of Earth Disturbance Activities, Including Past, Present, and Proposed Land Uses

The Compressor Station 200 portion of the Project will involve the installation a gravel pad, proposed PCSM Best Management Practices (BMPs) and other compressor station modifications. Transco will use and implement the practices, measures, and details to control soil erosion and off-site sedimentation during construction. Using data taken from Google Earth and Multi-Resolution Land Characteristics (MRLC) Consortium website (https://www.mrlc.gov/viewer/), it is documented that the land has been utilized as a compressor station site since 1950 and will continue as such. In the future, this site will continue to be a compressor station site. The contractor will construct stormwater BMPs to mitigate the increase in volume and peak rates associated with construction. The proposed PCSM BMPs are designed to store the net increase in volume between the pre- and post-development 2-year rain events. Refer to the Stormwater BMP Sizing Calculations in Attachment 4 for additional information.

6. Post Construction Stormwater Management Best Management Practices, Installation Sequence and PCSM Critical Stages

Increases in stormwater runoff during and after construction shall be controlled by sequencing the operations and using a selection of Erosion and Sediment Control and Post Construction Stormwater Management BMPs. A drainage berm, trench drain, vegetated filter strip, and an infiltration berm will be installed across the developed area to convey the net increase in volume between the pre- and post-development 2-year storm events and mitigate the increase (pre-post development) in peak runoff for the 1-, 2-, 10-, 25-, 50-, and 100-year storm events. The drainage berm and trench drain will be constructed to direct the majority of runoff from the developed area to the infiltration berm. BMP design calculations and drawings are provided in Attachment 4 and PCSM Plan set. For these calculations, Test Pit BH 6 was selected and used for design criteria. See Attachment 3 for the specific infiltration data. A summary of the PCSM BMP design criteria is below.

Compressor Station 200: Design Criteria

Test Pits		PCSM BMP	
	BH 6		**Infiltration Berm**
Existing Ground Elevation (ft)	385.60	**Minimum Final Grade (ft)**	384.35
Elevation of Confining Layer (ft)	383.89 (SHWT)	**Interpreted Elevation of Confining Layer (ft)**	382.30
Depth to Confining Layer (in)	20.5 (SHWT)	**Provided Separation (in)**	24
Lowest Observed Infiltration Rate (in/hr)	0.125	**Infiltration Rate Used (in/hr)**	0.125

BMP Installation Sequence

The PCSM BMPs should be installed in a manner designed to:

1. Protect BMP areas associated with infiltration from compaction prior to and during installation. Decompact soils as necessary.
2. Maintain proper Perimeter and Erosion and Sediment Control Measures during construction.
3. Valve Yard Pad*
    a. As the valve yard pad reaches final grade, ensure the subgrade elevations direct stormwater runoff to drainage berm.
    b. Compact the subgrade fill to limit infiltration in the pad area.
    c. Place aggregate final cover to achieve final grade on valve yard pad.
4. Install Infiltration Berm and Vegetated Filter Strip*
    a. Complete site grading and stabilize within the limit of disturbance except where the Infiltration Berm will be constructed. Make every effort to minimize berm footprint and necessary zone of disturbance (including both removal of existing vegetation and disturbance of empty soil) in order to maximize infiltration.
    b. Lightly scarify the soil in the area of the proposed berm before delivering soil to site. Decompact infiltration area as necessary.
    c. Utilize suitable fill material to make up the major portion of the berm. Soil should be added in 8-inch lifts and compacted after each addition according to design specifications. The slope and shape of the berm should be graded out as soil

is added.

d. Protect the surface ponding area at the base of the berm and in the filter strip area from compaction. If compaction of this area does occur, scarify the soil to a depth of at least 8 inches.
e. Complete final grading of the berm and filter strip after the top layer of soil is added. Tamp soil down lightly and smooth sides of the berm. The crest and base of the berm should be at level grade.
f. Plant berm and filter strip with turf, meadow plants, shrubs or trees, as desired.
g. Mulch planted and disturbed areas with compost mulch to prevent erosion while plants become established.

5. Drainage Berm with Trench-drain*

    a. Construct drainage berm and trench drain shown in the plan. Install outlet protection as required.

6. All temporary E&S BMPs will be removed following site stabilization. Do not remove other Erosion and Sediment Control measures until site is fully stabilized.
7. All installed BMPs will be monitored until final site stabilization is achieved.*
8. Long term operation and maintenance guidelines discussed below shall be followed.
9. Submit Notice of Termination once the project is complete and permanently stabilized.

**Portions of the BMP Installation Sequence denoted with an asterisk (*) above are critical stages as discussed in Section below.*

PCSM Critical Stages

Critical points requiring visits by the licensed professional or delegate are as follows:

1. Upon commencement of construction activities to ascertain the Infiltration Berm and Vegetated Filter Strip areas have been flagged and fence erected to prevent access to the area.
2. At completion of the Drainage Berm to ensure it has been constructed to the proposed lines and grades, the specified lining materials have been installed in accordance with the requirements of the plans and specifications.
3. At the beginning of construction of the Infiltration Berm and Vegetated Filter Strip to ensure

the areas have not been compacted by construction activities.

4. During construction of the Infiltration Berm and Vegetated Filter Strip the licensed professional will observe that the BMPs are constructed in accordance with the plans and specifications.
5. Following installation of the Valve Yard Pad subgrade to ensure stormwater flow is directed to the Diversion Berm.
6. For final inspection of constructed BMPs to verify all installed PCSM BMPs are installed and not impacted by construction activities/runoff.
7. At the establishment of hard surface stabilization or 70% vegetation covers to allow removal of E&S controls.

7. Net Change in Volume and Rate of Runoff

An analysis of pre- and post-development stormwater runoff was performed for the proposed Compressor Station 200. The installation of the gravel pad will increase the volume of stormwater runoff between the pre and post development 2-year rain event due to the increase in the type and size of the impervious area. The increase in impervious area will increase the pre to post development peak runoff for the 1-, 2-, 10-, 25-, 50-, and 100-year storm events. In accordance with the East Whiteland Township Stormwater Management Standards, post-construction peak drainage rates have been reduced to 90% of the pre-development rate for a redeveloped regulated activity. Design calculations using HydroCAD software are included in Attachment 4. Refer to the Post-Construction Stormwater Management (PCSM) Plan drawings for additional information.

Pre- and Post-Construction Stormwater Volume for 2-yr Rainfall event

Pre-construction (cf)	Post-construction before BMPs (cf)	Post-construction after BMPs (cf)	Net (cf)
12,821	14,372	11,227	-1,594

Pre-Construction Peak Discharge Rates (cfs)

1-year	2-year	10-year	25-year	50-year	100-year
2.19	3.81	8.95	12.90	14.88	19.07

Post-Construction Peak Discharge Rates (cfs)

1-year	2-year	10-year	25-year	50-year	100-year
2.62	4.35	9.71	13.76	15.78	20.04

Post-Construction w/ BMPs Peak Discharge Rates (cfs)

1-year	2-year	10-year	25-year	50-year	100-year
1.33	2.49	6.29	10.44	11.98	16.02

Difference between Pre-Construction and Post-Construction w/ BMPs

	1-year	2-year	10-year	25-year	50-year	100-year
NET Difference	-0.86	-1.32	-2.66	-2.46	-2.90	-3.05

8. Temporary and Permanent Stabilization

Appropriate seed mixtures for temporary and permanent stabilization are outlined on the notes sheet of the plan drawings.

8.1. Permanent Stabilization

Upon final completion of an earth disturbance activity or stage or phase of an activity, the site shall immediately have topsoil restored, replaced, or amended, seeded, mulched or otherwise permanently stabilized and protected from accelerated erosion and sedimentation. E&S BMPs shall be implemented and maintained until the permanent stabilization is completed. Once permanent stabilization has been established, the temporary E&S BMPs shall be removed. Areas disturbed in the act of removing temporary E&S BMPs shall be permanently stabilized upon completion of the temporary E&S BMP removal activity. For an earth disturbance activity or stage or phase of an activity to be considered permanently stabilized, the disturbed areas shall be covered with one of the following:

- A minimum uniform 70% perennial vegetative cover, with a density capable of resisting accelerated erosion and sedimentation.
- An acceptable BMP which permanently minimizes accelerated erosion and sedimentation. When erosion and sedimentation controls are to be removed in agricultural non-sensitive areas (streams/wetlands), agricultural landowners shall maintain agricultural BMPs per PaDEP regulations.

8.2. Temporary Stabilization

Upon temporary cessation of an earth disturbance activity or stage or phase of an activity where a cessation of earth disturbance activities will exceed 4 days (including agricultural areas), the site shall be immediately seeded, mulched, or otherwise protected from accelerated erosion and sedimentation pending future earth disturbance activities. For an earth disturbance activity or stage or phase of an activity to be considered temporarily stabilized, the disturbed areas shall be covered with one of the following:

- A minimum uniform coverage of mulch and seed, with a density capable of resisting accelerated erosion and sedimentation.
- An acceptable BMP which temporarily minimizes accelerated erosion and sedimentation.

8.3. Stabilization During Non-Growing Season

When utility construction must be done and is completed during a non-growing season, interim stabilization BMPs must be implemented and adequately maintained. The application of straw mulch at the rate of 3.0 tons per acre is required. The BMPs should be inspected weekly (unless snow covered) and after each runoff event to identify areas that become bare. Temporary erosion and sediment pollution controls must be maintained.

8.4. Riparian Buffer Stabilization

No riparian buffer stabilization is necessary for the Compressor Station 200 site.

9. Long Term Operation and Maintenance Schedule

All BMPs should be properly maintained to ensure their effectiveness. Sheet flow conditions and infiltration must be sustained throughout the life of the BMP. BMPs should be inspected for clogging from sediment and debris, damage by foot or vehicular traffic, and flow channelization. Inspections should be made on a quarterly basis for the first two years following installation, and then twice per year thereafter. Inspections should also be made after every storm event greater that 1 inch during the establishment period. Erosion caused by discharges of BMPs within the site will be repaired and stabilized.

Trench drains should be inspected at least two times per year and after runoff events and cleaned as needed. Vegetation along the surface of the infiltration berm and vegetated filter strip should be maintained in good condition. Vehicles should not be parked or driven on an infiltration berm or vegetated filter strip and care should be taken to avoid excessive compaction by mowers. Inspect the infiltration berm after runoff events and make sure that runoff drains within 72 hours.

Level spreader shall be monitored for 2 years on a quarterly basis and semi-annually thereafter. Remove debris, overgrown vegetation, and other blockages as needed. Inspections shall be made following rainfall events exceeding 1 inch. Monitoring includes both the level spreader and the down slope area up to and including the receiving stream.

Operation and maintenance guidelines should be provided to facility owners and tenants. Sediment and debris should be routinely removed upon observation. If erosion is observed, measures should be taken to improve the dispersion method to address the source of erosion. Sediment should be removed when the BMP is thoroughly dry. Trash and debris removed from the site should be deposited only at suitable disposal/recycling sites and must comply with applicable local, state, and federal waste regulations. Grass cover should be mowed with low ground pressure equipment annually to control noxious weeds. Mowing should be done only when the soil is dry in order to prevent tracking damage to vegetation, soil compaction, and flow concentrations. If vegetative cover is not fully established within the designated time, it should be replaced with an alternative species. Unwanted or invasive growth should be removed on an annual basis.

Vegetated areas will be inspected weekly and after runoff events until permanent vegetation is achieved. Once the vegetation is established, inspections of health, diversity, and density should be performed at least twice per year, during both the growing and non-growing season. Vegetative cover should be sustained at 85% and reestablished if damage greater than 50% is observed. Damaged BMPs will be repaired as soon as possible upon discovery. Repairs will be made to restore damaged BMPs to the original design condition. Mowing will be performed annually.

The vegetated filter strips should be properly maintained to ensure their effectiveness. Sediment and debris should be routinely removed (biannually at minimum), or upon observation, when buildup exceeds 2 inches in depth over the filter strip. If erosion is observed, measures should be taken to maintain sheet flow over the filter strip. Re-grading may also be required when pools of standing water are observed along the slope. Grass cover should be mowed, with low ground pressure equipment, as needed to maintain a height of 4-6 inches. Mowing will be performed annually. Unwanted or invasive growth should be removed on an annual basis. All maintenance/mowing shall be performed when the soil is dry, to prevent tracking damage, soil compaction, and flow concentrations.

Transcontinental Gas Pipe Line Company, LLC. Will be responsible for the long term operation and maintenance of the post-construction stormwater management facilities proposed at the site.

10. Recycling and Disposal of Materials

The restoration will require the removal of the temporary materials. The temporary materials include, but may not be limited to, stone surfaces and associated geotextiles. The contractors are required to dispose of the materials at suitable disposal or recycling sites and in compliance with local, state and federal regulations.

Contractors are required to inventory and manage their construction site materials. The goal is to be aware of the materials on-site, ensure they are properly maintained, used, and disposed of, and to make sure the materials are not exposed to stormwater. The following materials or substances are expected to be present on-site during construction (Note: this list is not an all-inclusive list and the materials management plan can be modified to address additional materials used on-site):

- Acids
- Detergents
- Fertilizers (nitrogen/phosphorus)
- Hydroseeding mixtures
- Petroleum based products
- Sanitary wastes
- Soil stabilization additives
- Solder
- Solvents

These materials must be stored as appropriate and shall not contact storm or non-stormwater discharges. Contractor shall provide a weatherproof container to store chemicals or erodible substances that must be kept on the site. Contractor is responsible for reading, maintaining, and making employees and subcontractors aware of Safety Data Sheets (SDSs).

11. Thermal Impacts

Thermal impacts to surface waters are not anticipated. Most of the stormwater will be routed through the stormwater BMP designed to retain and infiltrate the first surge of water from the site. The first surge of water will be the warmest water for the duration of the storm event and will quickly cool as the storm event progresses. The BMPs are designed to capture and infiltrate this warmest surge of stormwater. Based on routing calculations, stormwater is retained in the BMPs for a period of 11.50 hours before being discharged during a 100-year/24-hour storm event.

This retention period is longer for less intense storms. Therefore, as a result of these measures, no significant thermal impact to the receiving waters is anticipated.

12. Antidegradation Requirements

Compressor Station 200 is located within an EV watershed; therefore, an evaluation for antidegradation requirements was performed. Transco used various criteria to evaluate parcels suitable for a compressor station within the hydraulic range required to meet the purpose and need of the project. The criteria for parcel evaluation included but was not limited to existing conditions, resource impacts, workspace, and reasonable availability. Based on the location selected for Compressor Station 200, impacts to EV watersheds are unavoidable. Transco determined that there are no cost-effective and environmental sound viable non-discharge alternatives for the project.

Construction activities within the EV watershed will result in increased discharge of stormwater to surface waters which will be mitigated by the implementation of post construction stormwater management (PCSM) BMPs. Proposed PCSM BMPs are designed with stormwater volume reduction and water quality treatment maximized to the extent practicable within the site constraints to maintain and protect existing water quality and existing and designated uses.

13. Riparian Buffers

Compressor Station 200 is not located within a riparian buffer.

14. Offsite Discharge Analysis

The stormwater BMP's being constructed at Compressor Station 200 are in areas that will discharge stormwater to offsite non-surface water. These areas have been analyzed to reduce the likelihood that these discharges will be erosive to adjacent property owners. The analysis has been performed in accordance with PADEP Document 3150-FS-DEP4124, "Off-Site Discharges of Stormwaters to Areas That Are Not Surface Waters". The full analysis is presented in Attachment 6 – Offsite Discharge Report. A summary of the findings for Compressor Station 200 is presented below.

Compressor Station 200 utilizes an infiltration berm and vegetated filter strip to release collected runoff through a spillway and three discharge pipes. The stormwater that flows over the spillway travels directly into a level spreader. Stormwater that flows through the discharge pipes discharges across a riprap apron. The level spreader and riprap apron both discharge towards the existing vegetated swale located southeast of the Limits of Disturbance. The stormwater is

discharged as sheet flow and travels along a vegetative flow path until it reaches an onsite drainage swale, which discharges to an existing culvert along N. Bacton Hill Road. The flow then continues along the swale on the west side N. Bacton Hill Road, where it enters a culvert, travels under N. Bacton Hill Road, and into an existing ephemeral stream on the east side of the road. The area downgradient of the proposed infiltration berm is over 90% vegetated. Calculations indicated that the discharge velocity of the proposed level spreader is 0.53 feet per second (fps) and into the proposed riprap apron is 2.56 fps, for the 10-yr 24-hr storm. During-construction the flow velocity in the existing swale increased from 3.40 feet per second to 3.47 feet per second for the 10 year, 24 hour storm event. This increase will likely be mitigated by the use of compost filter socks, which will retain/slow the flow before entering the swale. Since the outlet velocities are below 3.5 fps, downstream erosion will be minimal, if not negligible.

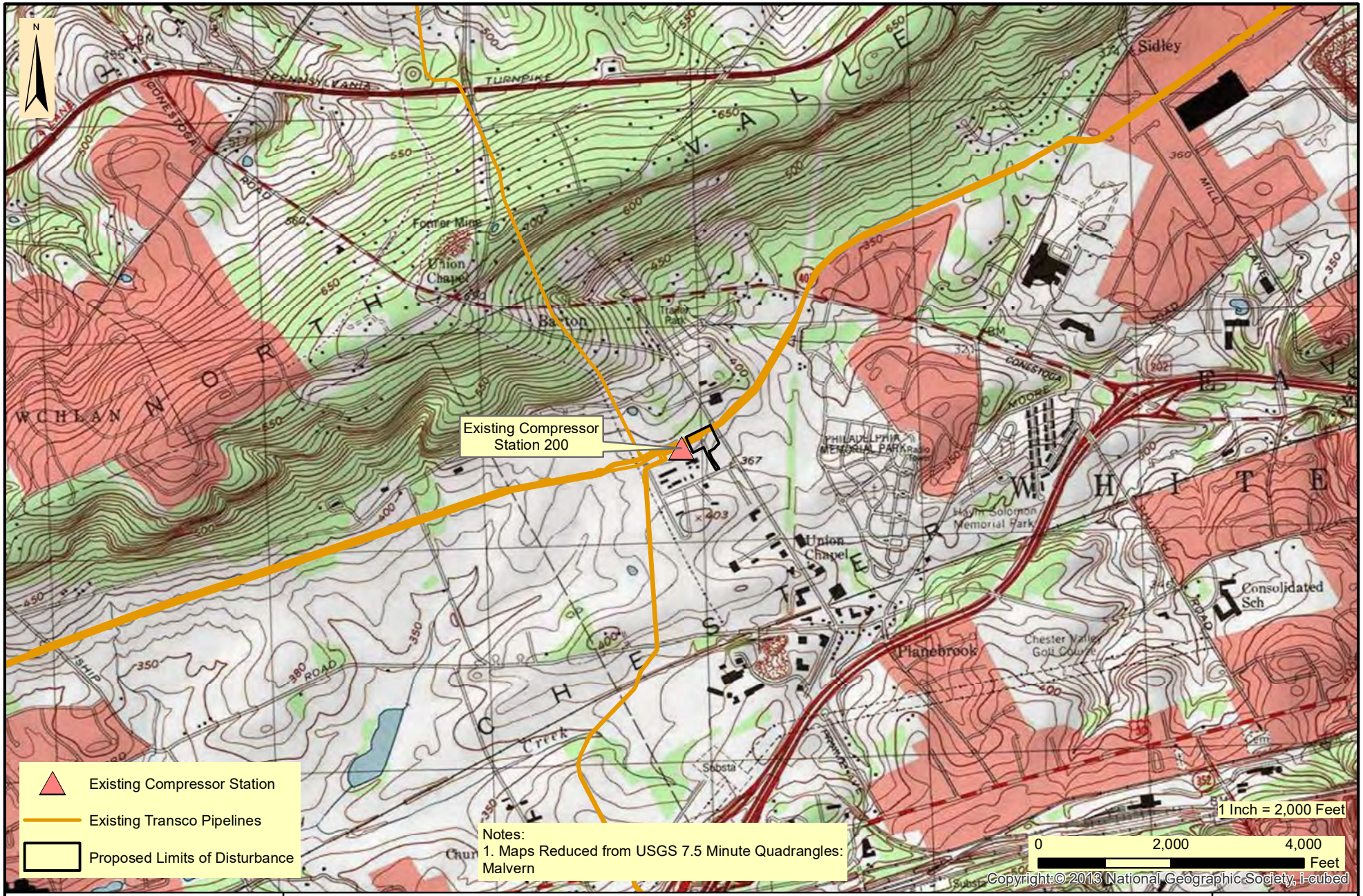
15. Non-Structural and Structural Water Quality BMP Description

The limit of disturbance will be reduced to the maximum extent possible by disturbing only those areas necessary to complete the proposed earthwork and BMP installations. Sensitive features such as wetlands and riparian buffers will be protected to the maximum extent possible. These areas will be clearly delineated in the field and protected prior to construction activities taking place. Existing vegetation is not to be removed from the protected area and the areas shall not be subject to grading or movement of existing soils. Protected areas that have been disturbed/compacted during construction will be restored using soil amendment and restoration.

16. The PCSM Plan Shall be Prepared by a Person Trained and Experienced in PCSM Methods and Techniques

These plans and narrative were prepared by Patrick Wozinski, P.E. (BAI Group) of State College, PA in accordance with the Pennsylvania Department of Environmental Protection Stormwater BMP Manual, December 2006. Plan preparer's resume is provided in Attachment C of the ESCP permit package).

ATTACHMENT 1
PROJECT LOCATION MAP



TRANSCONTINENTAL GAS PIPE LINE COMPANY, LLC

REGIONAL ENERGY ACCESS EXPANSION PROJECT

EXISTING COMPRESSOR STATION 200

PROJECT LOCATION MAP

EAST WHITELAND TOWNSHIP | CHESTER COUNTY | PENNSYLVANIA

Date: 3/26/2021

Drawn By: FTN

Figure Number: CS200-1

M:\GIS\PROJECTS\REGIONAL_ENERGY_ACCESS\PROJECT LOCATION MAPPING\REVISED_MAPPING_APRIL_2020\REA_CompressorStation200_ProjectLocation_8x11.mxd

ATTACHMENT 2
SOILS MAP AND REPORT

United States Department of Agriculture

NRCS

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 Chester County, Pennsylvania

January 27, 2021

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: 1:1,950 if printed on A portrait (8.5" x 11") 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 Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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 13, Jun 5, 2020

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
ClB	Clarksburg silt loam, 3 to 8 percent slopes	0.3	3.7%
CtA	Conestoga silt loam, 0 to 3 percent slopes	1.4	15.0%
Th	Thorndale silt loam	0.0	0.0%
UrgB	Urban land-Conestoga complex, 0 to 8 percent slopes	7.5	81.3%
Totals for Area of Interest		**9.2**	**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.

Chester County, Pennsylvania

ClB—Clarksburg silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: w6t9
Elevation: 200 to 1,500 feet
Mean annual precipitation: 32 to 48 inches
Mean annual air temperature: 48 to 57 degrees F
Frost-free period: 120 to 200 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Clarksburg and similar soils: 90 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Clarksburg

Setting

Landform: Valley flats
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Concave, linear
Parent material: Residuum weathered from limestone

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 27 inches: silt loam
H3 - 27 to 51 inches: silt loam
H4 - 51 to 84 inches: silt loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 20 to 36 inches to fragipan; 60 to 99 inches to
Drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Thorndale

Percent of map unit: 5 percent
Landform: Depressions

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear, concave
Hydric soil rating: Yes

CtA—Conestoga silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: pjhy
Elevation: 300 to 1,600 feet
Mean annual precipitation: 34 to 50 inches
Mean annual air temperature: 46 to 57 degrees F
Frost-free period: 140 to 200 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Conestoga and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Conestoga

Setting

Landform: Hillsides
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from schist and/or residuum weathered from limestone

Typical profile

Ap - 0 to 10 inches: silt loam
Bt - 10 to 38 inches: silty clay loam
C - 38 to 75 inches: channery loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 60 to 99 inches to lithic bedrock
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 7.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 1
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Clarksburg
Percent of map unit: 5 percent
Landform: Valley flats
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

Hollinger
Percent of map unit: 1 percent
Landform: Hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Interfluve, side slope, nose slope
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Duffield
Percent of map unit: 1 percent
Landform: Hills
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Letort
Percent of map unit: 1 percent
Landform: Hillslopes
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope, nose slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Pequea
Percent of map unit: 1 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Penlaw
Percent of map unit: 1 percent
Landform: Swales
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave

Across-slope shape: Concave
Hydric soil rating: No

Th—Thorndale silt loam

Map Unit Setting

National map unit symbol: pjkf
Elevation: 200 to 1,000 feet
Mean annual precipitation: 32 to 48 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 120 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Thorndale and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Thorndale

Setting

Landform: Drainageways, valleys, depressions
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Linear, concave
Across-slope shape: Concave
Parent material: Colluvium derived from calcareous shale and/or colluvium derived from limestone and siltstone

Typical profile

Ap - 0 to 9 inches: silt loam
Btg - 9 to 27 inches: silty clay loam
Bxg - 27 to 36 inches: silt loam
C - 36 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 20 to 36 inches to fragipan; 60 to 99 inches to lithic bedrock
Drainage class: Poorly drained
Runoff class: Very 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 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C/D

Hydric soil rating: Yes

UrgB—Urban land-Conestoga complex, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: pjn7
Elevation: 300 to 1,600 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 45 to 57 degrees F
Frost-free period: 140 to 215 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 50 percent
Conestoga and similar soils: 35 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform: Hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Interfluve, side slope, nose slope
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Parent material: Pavement, buildings and other artifically covered areas

Typical profile

C - 0 to 6 inches: variable

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 10 to 99 inches to lithic bedrock
Available water capacity: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: No

Description of Conestoga

Setting

Landform: Hillsides
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from schist and/or residuum weathered from limestone

Typical profile

Ap - 0 to 9 inches: silt loam
Bt - 9 to 40 inches: silty clay loam
C - 40 to 60 inches: loam

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 60 to 99 inches to lithic bedrock
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 7.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Clarksburg

Percent of map unit: 5 percent
Landform: Valley flats
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

Catoctin

Percent of map unit: 5 percent
Landform: Mountainsides
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Upper third of mountainflank
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Hagerstown

Percent of map unit: 3 percent
Landform: Valley floors
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Penlaw

Percent of map unit: 2 percent
Landform: Swales
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope

Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: No

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ATTACHMENT 3

SITE EVALUATION AND SOIL INFILTRATION TEST REPORT

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Civil, Environmental, & Geological Consultants

March 3, 2022

TRANSCONTINENTAL GAS PIPE LINE COMPANY, LLC.
A SUBSIDIARY OF THE WILLIAMS COMPANIES, INC.
REGIONAL ENERGY ACCESS EXPANSION PROJECT
COMPRESSOR STATION 200 PROJECT

SITE EVALUATION AND SOIL INFILTRATION TEST REPORT

1.0 SITE SOILS

Based upon mapping provided by the United States Department of Agriculture's Natural Resources Conservation Service (USDA NRCS) Web Soil Survey[1], the project areas under consideration for infiltration best management practices (BMP) are underlain by the following soil series: Urban land-Conestoga, 0 to 8 percent slopes (UrgB).

Urban land-Conestoga 0 to 8 percent slopes (UrgB) soils consist of flat, well drained soils, found on hillside side slopes and shoulders. The parent material is residuum weathered from schist and/or residuum weathered from limestone and pavement, buildings, and other artificially covered areas. Bedrock is typically found at approximately 10 to 99 inches below ground surface (bgs) with depth to the water table more than 80 inches bgs. The available water capacity of UrgB soils is moderate to very low.

The soil infiltration testing described in this report focused on UrgB soils. These soils are anticipated as being the primary soils in the areas of possible BMPs.

2.0 FIELD INVESTIGATION AND TESTING METHODOLOGY

BAI completed a total of six bore holes and 12 double-ring infiltrometer tests, two infiltration tests per bore hole. Locations were selected to be representative of the main soil series in the areas of potential infiltration BMPs. Figure 1 presents the locations of bore hole and corresponding double-ring infiltrometer tests.

Six soil bore holes (BH 1 through BH 6) were dug by hand for soil characterization up to 49 inches bgs on August 13, 2020. On August 14, 2020, infiltration tests 3 and 4 (IT 3A, IT 3B, IT 4A & IT 4B) were dug by hand to a depth of approximately 24 inches bgs to evaluate infiltration rates of shallow soils in the study area. On August 17, 2020, BAI returned to conduct the remaining infiltration tests (IT 1A to IT 2B, IT 5A to IT 6B. The infiltration tests used double-ring infiltrometer (DRI) tests.

The double-ring infiltration tests consisted of a 12-inch diameter outer ring (OR) and a 6-inch diameter inner ring (IR) set two inches deep into the bottom of each bore hole (approximately 26 inches below grade) to determine infiltration rates of shallow soils at various locations across the site. DRI testing was initiated by completing a one-hour pre-soak, which involved adding two inches of head to both the OR and IR. By noting the drop in head in each infiltrometer at 30-minute increments during the pre-soak, BAI determined that 30-minute testing intervals for the

[1] http://websoilsurvey.nrcs.usda.gov/app/

infiltration tests would be used for DRI testing as per the Pennsylvania stormwater Best Management Practices Manual (Document ID 363-0300-002) Appendix C.

Following the pre-soak, the bore holes were refilled to a two-inch head level in both the IR and OR. Drop in head was measured from a fixed reference point in the IR every 30 minutes for the infiltration tests. The IR and OR were refilled following each reading. Results for DRI tests are discussed in Section 3.0.

3.0 FINDINGS AND CONCLUSIONS

Based upon examination of each test pit, soils beneath the Site consist of brown (10YR 4/3) sandy silt to a depth of at least 8 inches bgs. From roughly 12 to 27 inches bgs a brown (10YR 5/8) channery loam was observed. The soil from 20 to 24 inches bgs consisted of a very firm brown (7.5YR 4/3) channery loam. At a depth of 27 inches bgs, a brown (10YR 5/6) sandy silt layer contained soil mottling (2.5Y 6/3), indicative of the seasonal high water table (SHWT). The depth of the SHWT was consistent throughout the Site. Testing was completed within the same soil series at six locations spread out in the areas of the potential BMP locations.

For the limiting zone investigation, each of the excavated bore holes had a limiting zone at the SHWT. Soil mottling, evidence of SHWT, was observed at each test pit. The SHWT was shallowest in BH 4 at approximately 10 inches below grade surface (bgs) and the deepest in bore hole BH 3 at 27 inches bgs. Neither bedrock nor the water table was encountered in the bore holes. The following table summarizes the limiting zones identified in each test pit.

Limiting Zone Investigation Results

Test Pit	Elevation (MSL ft)	Seasonal High Water Table (in)	Water Table (in)	Bedrock (in)	Total Depth (in)
BH 1	387.50	13	Not encountered	Not encountered	49
BH 2	387.00	12	Not encountered	Not encountered	47
BH 3	386.50	27	Not encountered	Not encountered	47
BH 4	385.70	10	Not encountered	Not encountered	47
BH 5	387.40	24	Not encountered	Not encountered	24
BH 6	385.60	20.5	Not encountered	Not encountered	46

Infiltration testing was completed within the same mapped soil series at the bore hole locations spread out in the areas of the potential BMP locations. Of these, the infiltration rates for BH 6 were used to design the BMP since it represents the area of the proposed BMPs. The following table summarizes the DRI readings for each bore hole relevant to the proposed BMP. Based on field observations, the infiltration testing was completed at an appropriate location in the soil profile and is representative to the BMP's infiltration elevation.

Infiltration Testing Results

Bore Hole	Hole	Testing Elevation	Reading Interval (min)	Reading 1 (in.)	Reading 2 (in.)	Reading 3 (in.)	Reading 4 (in.)	Infiltration Rate (in./hr)
BH 6	IT 6A	383.60'	30	0.125	0.125	0.125	0.125	0.25
	IT 6B	383.60'	30	0.125	0.125	0.125	0.125	0.25

The bedrock underlying the area of the proposed BMP is consists of the Ledger Formation, a Cambrian-aged massive, crystalline dolomite. As discussed by Civil & Environmental Consultants, Inc. (the geohazard consultant for this project) in their February 22, 2022 letter (included in Attachment 7), they concluded that the proposed BMP was unlikely to contribute to sinkhole development and it was their opinion that the site is suitable for the proposed method of infiltration. Their conclusions were based on several pieces of information including manual soil borings completed within the proposed BMP that found at least four feet of soil material exists between the bottom of the proposed BMP and competent bedrock.

The stipulated two-foot separation between the bottom of the BMP and the limiting zone was also satisfied based on field investigations in the area of the proposed BMP. More specifically, the SHWT was found in the area of the proposed BMP (based on redox features identified in BH-6) to be 20.5 inches bgs. Therefore the floor of the proposed will be raised with amendments from an existing ground elevation of 384' to 384.35' which will allow the two-foot separation.

The soils beneath the proposed BMP design (as observed in BH6) were observed to generally be a fine-grained, low-plasticity material (with some fine sand) down to 46 inches bgs. Within these 46 inches, a slightly more clay-rich zone with fine sand was noted down to about 10 inches bgs with a transition to a more silt-rich zone with fine sand. No redox features were observed in this material until a depth of about 21 inches bgs - to be conservative, infiltration testing was performed at this depth which found slow but acceptable rates of infiltration.

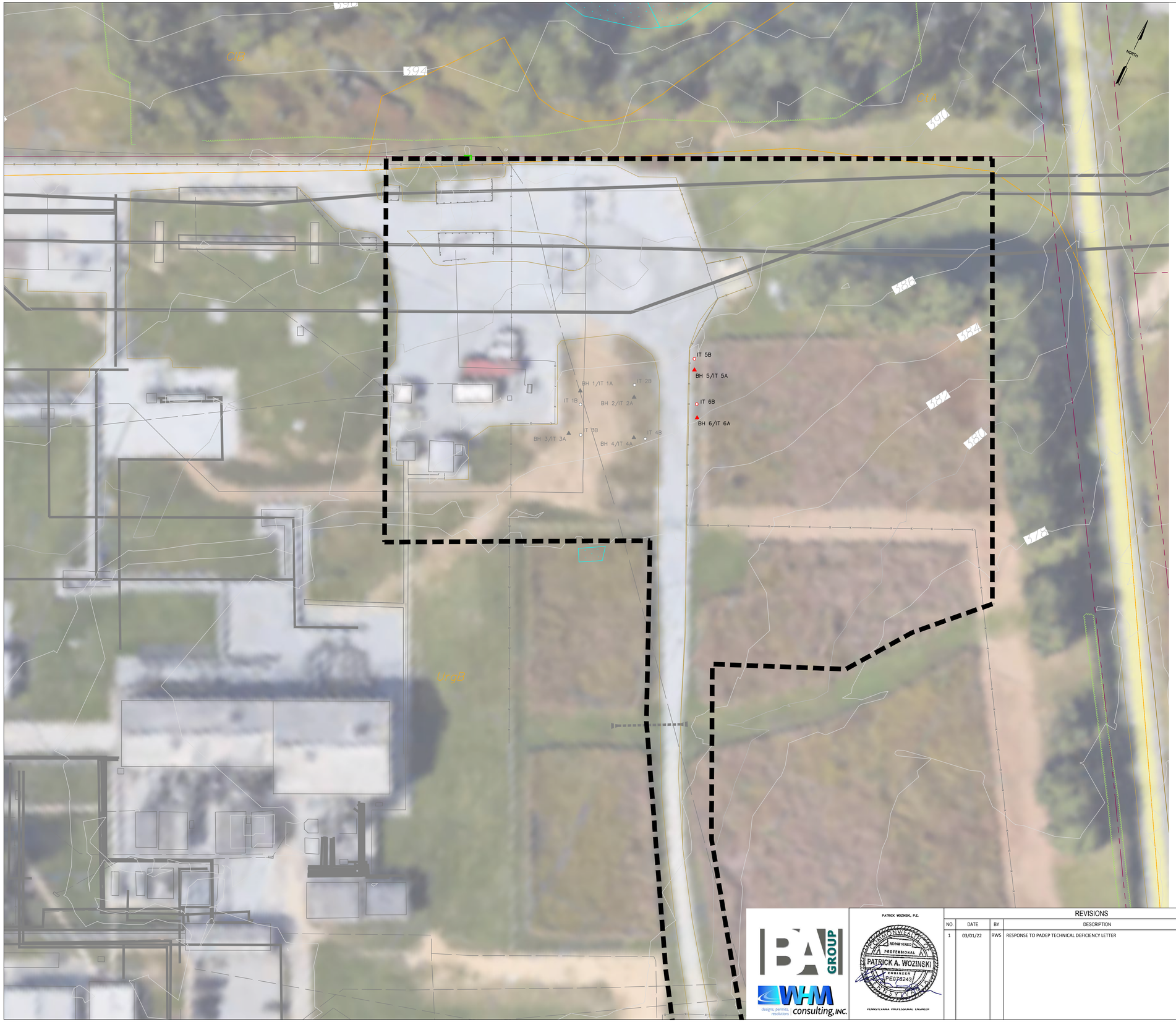
BH 6

The infiltration rate for BH 6/IT 6A was 0.25 iph based upon an average rate of drop of 0.125 inches over the last four 30-minute infiltration readings. The infiltration rate for IT 6B was 0.25 iph based upon an average rate of drop of 0.125 inches over the last four 30-minute infiltration readings.

4.0 REFERENCES

Pennsylvania Department of Environmental Protection. "Pennsylvania Stormwater Best Management Practices Manual" Document No. 363-0300-02, December 2006.

"Web Soil Survey - Home." Web Soil Survey - Home. United States Department of Agriculture, 6 Dec. 2013. Web. 18 December 2020. <http://websoilsurvey.nrcs.usda.gov/app/>.



LEGEND

- ROCK CONSTRUCTION ENTRANCE
- LIMITS OF DISTURBANCE
- DELINEATED WETLAND
- ApD — SOIL BOUNDARY / TYPE
- EXISTING TREELINE / TREE/SHRUB
- PROPERTY LINE
- EXISTING LEIDY / TGPL PIPELINES
- EXISTING FOREIGN PIPELINES
- EXISTING UTILITY POLE / TOWER
- EXISTING UTILITY LINE
- EXISTING VALVE
- EXISTING CULVERT
- EXISTING FENCE
- PROPOSED FENCE
- EXISTING STRUCTURE
- EXISTING ROAD (GRAVEL)
- EXISTING ROAD (PAVED)
- EXISTING GRAVEL AREAS
- PROPOSED GRAVEL
- 1250 — EXISTING GRADE MAJOR CONTOURS (2' C.I.)
- 1244 — EXISTING GRADE MINOR CONTOURS (10' C.I.)
- TP505 — BOREHOLE USED FOR BMP DESIGN
- IT 505A — INFILTRATION TEST USED FOR BMP DESIGN
- TP505 — BOREHOLE NOT USED FOR BMP DESIGN
- IT 505A — INFILTRATION TEST NOT USED FOR BMP DESIGN

PLAN NOTE

EACH INFILTRATION TEST LOCATION INDICATED WILL HAVE TWO INFILTRATION TESTS PERFORMED AT EACH DEPTH SELECTED BASED ON THE TST PIT OBSERVATIONS OF LIMITING ZONES AND/OR DEPTH OF THE BASE OF THE ANTICIPATED PCSM BMP AS RECOMMENDED IN APPENDIX C OF PADEP'S BMP MANUAL.

SOIL LEGEND

CiB CHIPPEWA SILT LOAM, 3 TO 8 PERCENT SLOPES
CtA CONESTOGA SILT LOAM, 0 TO 3 PERCENT SLOPES
UrgB URBAN LAND–CONESTOGA COMPLES, 0 TO 8 PERCENT SLOPES

EXISTING CONDITION NOTES/SOURCES

1. EXISTING ROADWAYS, CONTOURS, PROPERTY LINE, TREE LINE, ETC. ARE DERIVED FROM A FIELD SURVEY PERFORMED BY TRANSCO IN 2020.
2. PROPERTY BOUNDARIES BASED EITHER ON TAX PARCEL INFORMATION PROVIDED BY TRANSCO. PROPERTY BOUNDARY LOCATIONS BASED ON TAX PARCEL INFORMATION ARE APPROXIMATE.
3. PIPELINE ALIGNMENTS AND LIMITS OF DISTURBANCE PROVIDED BY TRANSCO.
4. STREAM AND WETLAND BOUNDARIES BASED ON SURVEYS CONDUCTED BY WHM CONSULTING IN 2020.
5. WETLANDS ASSOCIATED WITH THE ROCK SPRING EXPANSION PROJECT AREA WERE DIGITIZED FROM DRAWING NUMBER 24-1605-70-28-A/CS200 PREPARED BY URS.
6. DATUM BASED ON PENNSYLVANIA STATE PLANE COORDINATE SYSTEM, NAD 83 NORTH ZONE, NAVD88, ELEVATION MSL, DERIVED FROM GPS OBSERVATION.

SCALE
30 15 0 30
SCALE 1" =30'

BA GROUP
WHM consulting, INC.
designs, permits, resolutions

PATRICK WOZINSKI, P.E.
COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
PATRICK A. WOZINSKI
ENGINEER
PE076243
PENNSYLVANIA PROFESSIONAL ENGINEER

REVISIONS

NO.	DATE	BY	DESCRIPTION	W.O. NO.	CHK.	APP.
1	03/01/22	RWS	RESPONSE TO PADEP TECHNICAL DEFICIENCY LETTER			

TRANSCONTINENTAL GAS PIPE LINE COMPANY, LLC
REGIONAL ENERGY ACCESS EXPANSION PROJECT
CS200
SOIL BORE HOLE LOCATIONS

EXISTING CONDITIONS PLAN

EAST WHITELAND TWP, CHESTER COUNTY, PENNSYLVANIA

DRAWN BY: DRV	DATE: 03/31/21	ISSUED FOR BID:	SCALE: AS NOTED
CHECKED BY: EJL	DATE: 03/31/21	ISSUED FOR CONSTRUCTION:	REVISION:
APPROVED BY: PW	DATE: 03/31/21		SHEET 1
WO: 1232813	RID: 305	DRAWING NUMBER: 26-1000-70-28-D	OF 1

ATTACHMENT 4

PCSM PLAN BMP DESIGN WORKSHEETS AND CALCULATIONS

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Attachment 4

4.1 CN Table

4.2 Stormwater BMP Manual Appendix D Worksheet

4.3 BMP HydroCAD Report

4.4 BMP Erosion Control Blanket Report

4.5 Riprap Apron Worksheet

ATTACHMENT 4.1
CN TABLE

Table 2-2a Runoff curve numbers for urban areas [1/]

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area [2/]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3/]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4/]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5/]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

[1] Average runoff condition, and $I_a = 0.2S$.

[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2b Runoff curve numbers for cultivated agricultural lands [1/]

Cover description			Curve numbers for hydrologic soil group			
Cover type	Treatment [2/]	Hydrologic condition [3/]	A	B	C	D
Fallow	Bare soil	—	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
	C&T+ CR	Poor	65	73	79	81
		Good	61	70	77	80
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
	C&T+ CR	Poor	60	71	78	81
		Good	58	69	77	80
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
		Good	51	67	76	80

[1] Average runoff condition, and I_a=0.2S

[2] Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.

[3] Hydraulic condition is based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness.

Poor: Factors impair infiltration and tend to increase runoff.

Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

Table 2-2c Runoff curve numbers for other agricultural lands [1/]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. [2/]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. [3/]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 [4/]	48	65	73
Woods—grass combination (orchard or tree farm). [5/]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. [6/]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 [4/]	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

[1] Average runoff condition, and $I_a = 0.2S$.
[2] *Poor:* <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.
[3] *Poor*: <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.
[4] Actual curve number is less than 30; use CN = 30 for runoff computations.
[5] CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.
[6] *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

Table 2-2d Runoff curve numbers for arid and semiarid rangelands [1/]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition [2/]	A [3/]	B	C	D
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.	Poor		66	74	79
	Fair		48	57	63
	Good		30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory.	Poor		75	85	89
	Fair		58	73	80
	Good		41	61	71
Sagebrush with grass understory.	Poor		67	80	85
	Fair		51	63	70
	Good		35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus.	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

1 Average runoff condition, and $I_a = 0.2S$. For range in humid regions, use table 2-2c.
2 Poor: <30% ground cover (litter, grass, and brush overstory).
Fair: 30 to 70% ground cover.
Good: > 70% ground cover.
3 Curve numbers for group A have been developed only for desert shrub.

ATTACHMENT 4.2

STORMWATER BMP MANUAL
APPENDIX D WORKSHEET

General Information

Instructions | *General* | Volume | Rate | Quality

Project Name: **Compressor Station 200**

Application Type: **Individual E&S Application**

County: **Chester**

Municipality: **East Whiteland Township**

Project Type: **New Utilities**

◉ New Project ○ Minor / Major Amendment

Area: **3.16** acres
(In Watershed)

Total Earth Disturbance: **3.16** acres
(In Watershed)

No. of Post-Construction Discharge Points: **1**

Start DP Numbering at: **001**

Discharge Point (DP) No.	Drainage Area (DA) (acres)	Earth Disturbance in DA (acres)	Existing Impervious in DA (acres)	Proposed Impervious in DA (acres)	Receiving Waters	Ch. 93 Class	Structural BMP(s)
001	0.61	0.61	0.30	0.39	Discharge to Non-Surface Waters	EV, MF	Yes
Undetained Areas	2.55	2.55	0.63	0.64	Discharge to Non-Surface Waters	EV, MF	
Totals:	**3.16**	**3.16**	**0.93**	**1.03**			

Volume Management

Project: Compressor Station 200

Instructions | General | *Volume* | Rate | Quality

2-Year / 24-Hour Storm Event (NOAA Atlas 14): **3.3** inches

Alternative 2-Year / 24-Hour Storm Even _____ inches

Alternative Source: _____

Pre-Construction Conditions: *No. Rows:* **3** ☐ *Exempt from Meadow in Good Condition* ☑ *Automatically Calculate CN, Ia, Runoff and Volume*

Land Cover	Area (acres)	Soil Group	CN	Ia (in)	Q Runoff (in)	Runoff Volume (cf)
Pervious as Meadow	2.23	B	58	1.448	0.38	3,052
Impervious Areas: Paved Parking Lots, Roofs, Driveways, Etc. (Excluding ROW)	0.87	B	98	0.041	3.07	9,686
Impervious as Meadow	0.06	B	58	1.448	0.38	82
TOTAL (ACRES):	**3.16**				**TOTAL (CF):**	**12,821**

Post-Construction Conditions: *No. Rows:* **2**

Land Cover	Area (acres)	Soil Group	CN	Ia (in)	Q Runoff (in)	Runoff Volume (cf)
Meadow-Continuous Grass, Protected from Grazing and Generally Mowed for Hay	2.13	B	58	1.448	0.38	2,916
Impervious Areas: Paved Parking Lots, Roofs, Driveways, Etc. (Excluding ROW)	1.03	B	98	0.041	3.07	11,457
TOTAL (ACRES):	**3.16**				**TOTAL (CF):**	**14,372**

ET CHANGE IN VOLUME TO MANAGE (CF): **1,551**

Non-Structural BMP Volume Credits:

☐ Tree Planting Credit

☐ Other (attach calculations):

Structural BMP Volume Credits: *No. Structural BMPs:* **2** *Start BMP Numbering at:* **1**

DP No.	BMP No.	BMP Name	MRC?	Discharge	Incremental BMP DA (acres)	Volume Routed to BMP (CF)	Infiltration / Vegetated Area (SF)	Infiltration Rate (in/hr)	Infiltration Period (hrs)	Vegeta-ted?	Media Depth (ft)	Storage Volume (CF)	Infiltration Credit (CF)	ET Credit (CF)
001	1	Infiltration Berm & Retentive Grading	-	Off-Site	0.39	3,659	2,783	0.13	72	Yes	0.5	1,222	**1,535**	**477**
001	2	Vegetated Filter Strip	-	to BMP No. 1	0.22	1,133	5,170	0.00	1	Yes	0.7	0	**0**	**1,133**
												Totals:	**1,535**	**1,610**

INFILTRATION & ET CREDITS (CF):	**3,145**
NET CHANGE IN VOLUME TO MANAGE (CF):	**1,551**
TOTAL CREDITS (CF):	**3,145**

VOLUME REQUIREMENT SATISFIED

Rate Control

Project: Compressor Station 200

Instructions | General | Volume | *Rate* | Quality

Precipitation Amounts:

NOAA 2-Year 24-Hour Storm Event (in):	**3.3**	Alternative 2-Year 24-Hour Storm Event (in):	
NOAA 10-Year 24-Hour Storm Event (in):	**4.9**	Alternative 10-Year 24-Hour Storm Event (in):	
NOAA 50-Year 24-Hour Storm Event (in):	**6.53**	Alternative 50-Year 24-Hour Storm Event (in):	
NOAA 100-Year 24-Hour Storm Event (in):	**7.63**	Alternative 100-Year 24-Hour Storm Event (in):	

☑ **Report Summary of Peak Rates Only**

Attach model input and output data or other calculations to support the rates reported below.

	Peak Discharge Rates (cfs)			
	Pre-Construction	**Post-Construction**	**Net Change**	
2-Year Storm:	**3.81**	**2.49**	**-1.32**	***Rate Control Satisfied***
10-Year Storm:	**8.95**	**6.29**	**-2.66**	***Rate Control Satisfied***
50-Year Storm:	**14.88**	**11.98**	**-2.90**	***Rate Control Satisfied***
100-Year Storm:	**19.07**	**16.02**	**-3.05**	***Rate Control Satisfied***

Water Quality

Project: Compressor Station 200

PRINT

Instructions | General | Volume | Rate | *Quality*

Pre-Construction Pollutant Loads:

Land Cover (from Volume Worksheet)	Land Cover for Water Quality	Area (acres)	Soil Group	Runoff Volume (cf)	Pollutant Conc. (mg/L)			Pollutant Loads (lbs)		
					TSS	TP	TN	TSS	TP	TN
Pervious as Meadow	Grassland/Herbaceous	2.23	B	3,052	48.8	0.22	2.30	9.30	0.04	0.44
Impervious Areas: Paved Parking Lots, Roofs, Driveways, Etc. (Excluding ROW)	Residential	0.87	B	9,686	65.0	0.29	2.05	39.31	0.18	1.24
Impervious as Meadow	Grassland/Herbaceous	0.06	B	82	48.8	0.22	2.30	0.25	0.00	0.01
	TOTAL (ACRES):	**3.16**					**TOTALS:**	**48.87**	**0.22**	**1.69**

Post-Construction Pollutant Loads (without BMPs):

Land Cover (from Volume Worksheet)	Land Cover for Water Quality	Area (acres)	Soil Group	Runoff Volume (cf)	Pollutant Conc. (mg/L)			Pollutant Loads (lbs)		
					TSS	TP	TN	TSS	TP	TN
Meadow-Continuous Grass, Protected from Grazing and Generally Mowed for Hay	Grassland/Herbaceous	2.13	B	2,916	48.8	0.22	2.30	8.88	0.04	0.42
Impervious Areas: Paved Parking Lots, Roofs, Driveways, Etc. (Excluding ROW)	Residential	1.03	B	11,457	65.0	0.29	2.05	46.50	0.21	1.47
	TOTAL (ACRES):	**3.16**					**TOTALS:**	**55.38**	**0.25**	**1.89**

POLLUTANT LOAD REDUCTION REQUIREMENTS (LBS):	**6.52**	**0.03**	**0.20**

☐ **Characterize Undetained Areas (for Untreated Stormwater)**

Non-Structural BMP Water Quality Credits:

☐ Pervious Undetained Area Credit

☐ Other (attach calculations)

Structural BMP Water Quality Credits:

☑ *Use default BMP Outflows and Median BMP Outflow Concentrations*

DP No.	BMP No.	BMP Name	MRC?	BMP DA (acres)	Vol. Routed to BMP (CF)	Inf. & ET Credits (CF)	Capture & Buffer Credits (CF)	Outflow (CF)	Outflow Conc. (mg/L)			Pollutant Loads (lbs)		
									TSS	TP	TN	TSS	TP	TN
001	1	Infiltration Berm & Retentive Grading	-	0.39	3,659	2,012		1,647	24.00	0.20	0.85	2.47	0.02	0.09
001	2	Vegetated Filter Strip	-	0.22	1,133	1,133		0	-	-	-	-	-	-

	TSS	TP	TN
POLLUTANT LOADS FROM STRUCTURAL BMP (TREATED) OUTFLOWS (LBS):	**2.47**	**0.02**	**0.09**
POLLUTANT LOADS FROM UNTREATED STORMWATER (LBS):	**36.92**	**0.16**	**1.26**
NON-STRUCTURAL BMP WATER QUALITY CREDITS (LBS):			
NET POLLUTANT LOADS FROM SITE, POST-CONSTRUCTION (LBS):	**39.39**	**0.19**	**1.34**
POLLUTANT LOADS FROM SITE, PRE-CONSTRUCTION (LBS):	**48.87**	**0.22**	**1.69**

WATER QUALITY REQUIREMENT SATISFIED

CERTIFICATION

I certify under penalty of law and subject to the penalties of 18 Pa.C.S. § 4904 (relating to unsworn falsification to authorities) that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my 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. I further certify that the structure, function, and calculations contained in this spreadsheet have not been modified in comparison to the spreadsheet DEP has posted to its website or, if modifications were made, an explanation of the modifications made is attached to this spreadsheet.

Patrick Wozinski	2/3/2022
Spreadsheet User Name	Date

DEP PCSM SPREADSHEET

SUPPLEMENTAL CALCULATIONS FOR LOADING RATIOS AND INFILTRATION PERIOD

Transcontinental Gas Pipe Line Company, LLC
Regional Energy Access Expansion Project
PCSM Ratio Table - Compressor Station 200

Ratio Calculations

Site	Drainage Area (SF)	Impervious Area (SF)	Infiltration Area (SF)	Drainage Area : Infiltration Area Ratio[1]	Impervious Area : Infiltration Area Ratio[2]
Compressor Station 200					
Infiltation Berm	26,572	17,206	7,953	3.3 : 1	2.2 : 1

1. PADEP Stormwater BMP Manual recommends that BMPs be designed with a maximum total loading ratio of 8:1 relating total drainage area to infiltration area.
2. PADEP Stormwater BMP Manual requires BMPs to be designed with a maximum impervious loading ratio of 3:1 relating impervious drainage area to infiltration area in Karst areas.

Ratio 1= Drainage area/Infiltration Area
Ratio 2= Impervious Area/ Infiltration Area

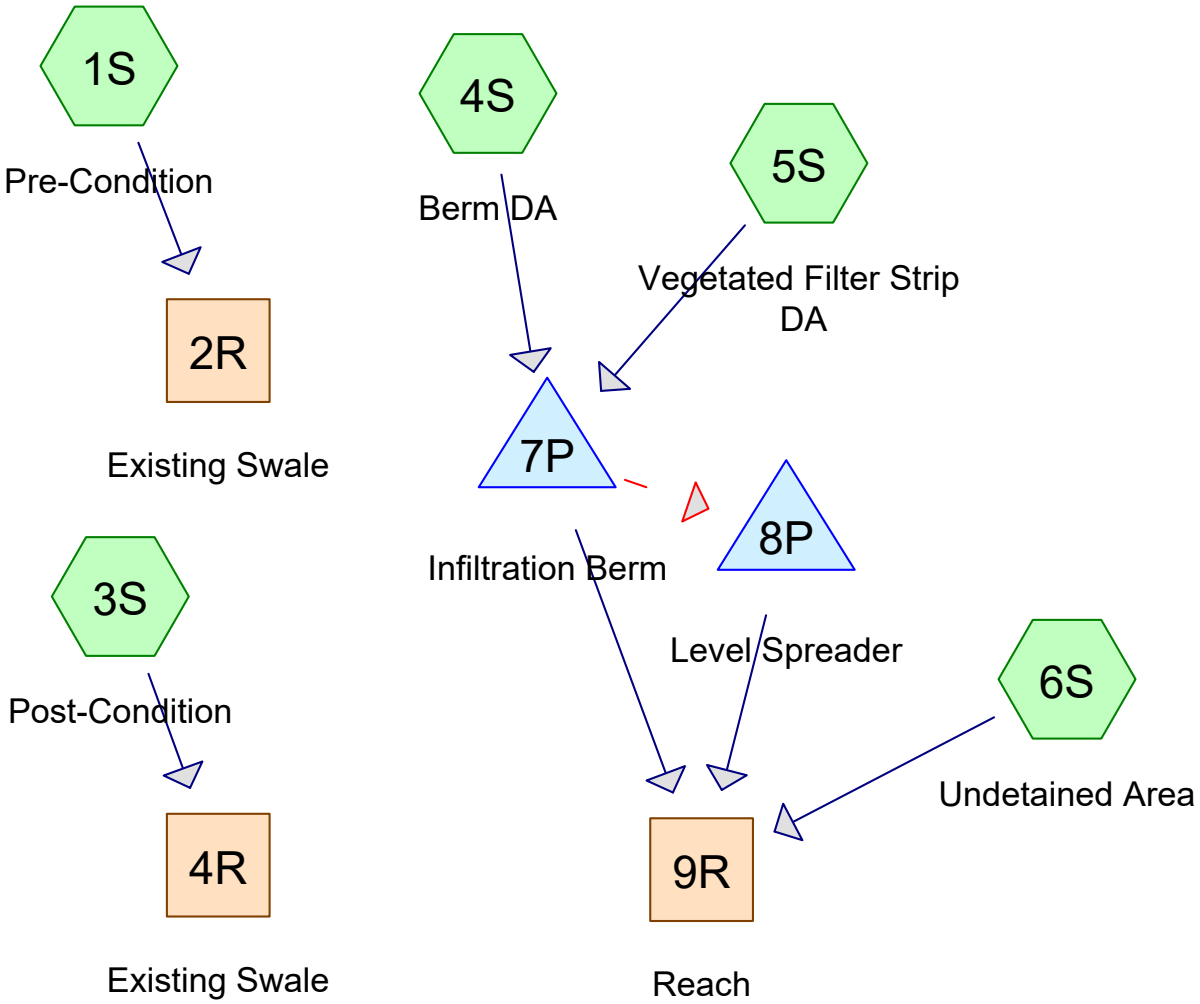
Infiltration Period (hrs) Calculations

Site	Pipe Outlet(ft)	Bottom(ft)	Depth (ft)	Infiltration rate (in/h)	Infiltration rate (ft/h)	Infiltration Period (hrs)
Compressor Station 200						
Infiltration Berm	385.10	384.35	0.75	0.125	0.010	72

Infiltration Period(hrs) = Depth(ft)/ Infiltration Rate(ft/h)

Depth(ft) = Spillway - Bottom

ATTACHMENT 4.3
BMP HYDROCAD REPORT



Subcat Reach Pond Link

Routing Diagram for CS200 - Pre, Post, Post w BMP_rev2
Prepared by {enter your company name here}, Printed 3/3/2022
HydroCAD® 10.00-26 s/n 09710 © 2020 HydroCAD Software Solutions LLC

Project Notes

Rainfall events imported from "NRCS-Rain.txt" for 7614 PA Chester-C

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
6.555	58	Meadow, non-grazed, HSG B (1S, 3S, 4S, 5S, 6S)
2.925	98	Paved roads w/curbs & sewers, HSG B (1S, 3S, 4S, 5S, 6S)
9.480	**70**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
9.480	HSG B	1S, 3S, 4S, 5S, 6S
0.000	HSG C	
0.000	HSG D	
0.000	Other	
9.480		**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	6.555	0.000	0.000	0.000	6.555	Meadow, non-grazed	1S, 3S, 4S, 5S, 6S
0.000	2.925	0.000	0.000	0.000	2.925	Paved roads w/curbs & sewers	1S, 3S, 4S, 5S, 6S
0.000	**9.480**	**0.000**	**0.000**	**0.000**	**9.480**	**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	7P	385.10	383.00	20.0	0.1050	0.013	3.0	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 1S: Pre-Condition Runoff Area=3.160 ac 27.53% Impervious Runoff Depth>0.45"
Flow Length=192' Slope=0.0400 '/' Tc=1.7 min CN=69 Runoff=2.19 cfs 0.119 af

Subcatchment 3S: Post-Condition Runoff Area=3.160 ac 32.59% Impervious Runoff Depth>0.53"
Flow Length=192' Slope=0.0400 '/' Tc=1.7 min CN=71 Runoff=2.62 cfs 0.138 af

Subcatchment 4S: Berm DA Runoff Area=0.389 ac 69.15% Impervious Runoff Depth>1.30"
Flow Length=192' Tc=1.2 min CN=86 Runoff=0.80 cfs 0.042 af

Subcatchment 5S: Vegetated Filter Strip DA Runoff Area=0.221 ac 57.01% Impervious Runoff Depth>0.99"
Flow Length=90' Slope=0.0200 '/' Tc=0.9 min CN=81 Runoff=0.35 cfs 0.018 af

Subcatchment 6S: Undetained Area Runoff Area=2.550 ac 24.71% Impervious Runoff Depth>0.42"
Flow Length=380' Slope=0.0200 '/' Tc=5.2 min CN=68 Runoff=1.33 cfs 0.089 af

Reach 2R: Existing Swale Avg. Flow Depth=0.65' Max Vel=2.35 fps Inflow=2.19 cfs 0.119 af
n=0.035 L=250.0' S=0.0160 '/' Capacity=39.88 cfs Outflow=1.82 cfs 0.119 af

Reach 4R: Existing Swale Avg. Flow Depth=0.70' Max Vel=2.47 fps Inflow=2.62 cfs 0.138 af
n=0.035 L=250.0' S=0.0160 '/' Capacity=39.88 cfs Outflow=2.20 cfs 0.138 af

Reach 9R: Reach Inflow=1.33 cfs 0.111 af
Outflow=1.33 cfs 0.111 af

Pond 7P: Infiltration Berm Peak Elev=385.23' Storage=1,596 cf Inflow=1.15 cfs 0.060 af
Discarded=0.01 cfs 0.007 af Primary=0.07 cfs 0.022 af Secondary=0.00 cfs 0.000 af Outflow=0.08 cfs 0.029 af

Pond 8P: Level Spreader Peak Elev=384.65' Storage=0 cf Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 9.480 ac Runoff Volume = 0.406 af Average Runoff Depth = 0.51"
69.15% Pervious = 6.555 ac 30.85% Impervious = 2.925 ac

Summary for Subcatchment 1S: Pre-Condition

[49] Hint: Tc<2dt may require smaller dt

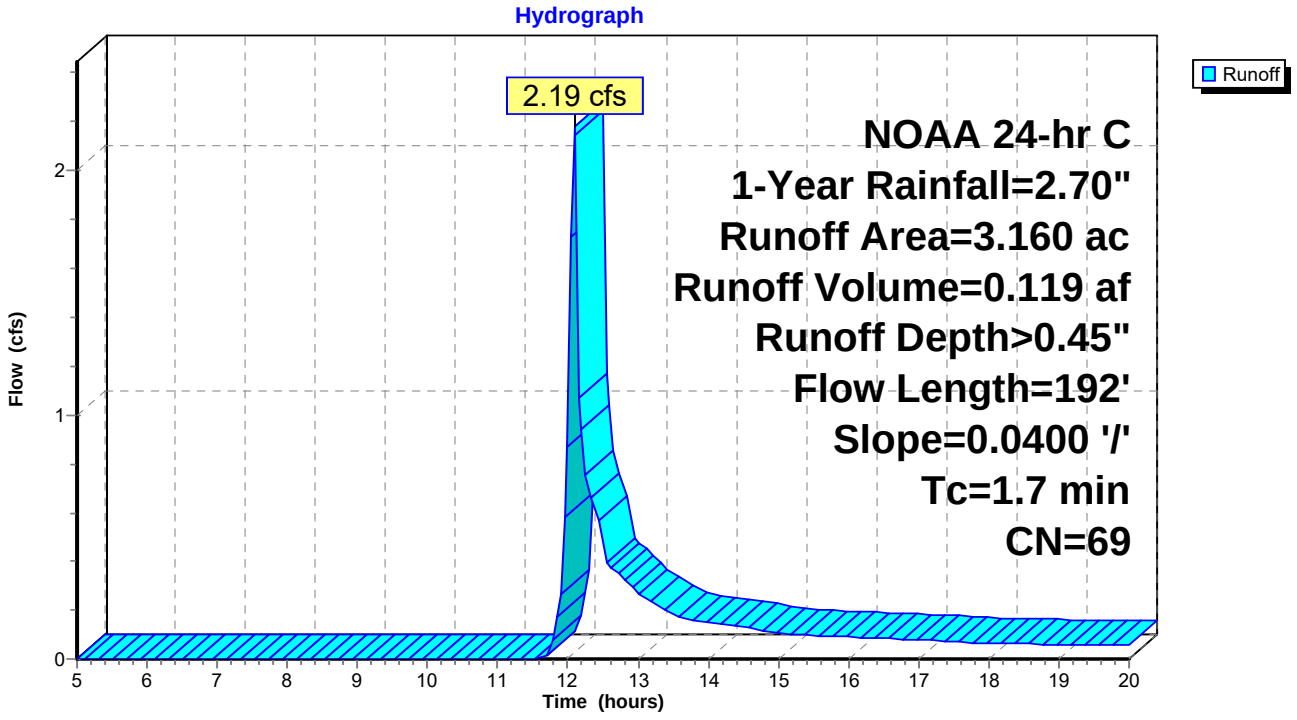
Runoff = 2.19 cfs @ 12.09 hrs, Volume= 0.119 af, Depth> 0.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.70"

Area (ac)	CN	Description
2.290	58	Meadow, non-grazed, HSG B
0.870	98	Paved roads w/curbs & sewers, HSG B
3.160	69	Weighted Average
2.290		72.47% Pervious Area
0.870		27.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	50	0.0400	1.60		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 3.30"
0.3	70	0.0400	4.06		**Shallow Concentrated Flow, SCF1** Paved Kv= 20.3 fps
0.9	72	0.0400	1.40		**Shallow Concentrated Flow, SCF2** Short Grass Pasture Kv= 7.0 fps
1.7	192	Total			

Subcatchment 1S: Pre-Condition



Summary for Subcatchment 3S: Post-Condition

[49] Hint: Tc<2dt may require smaller dt

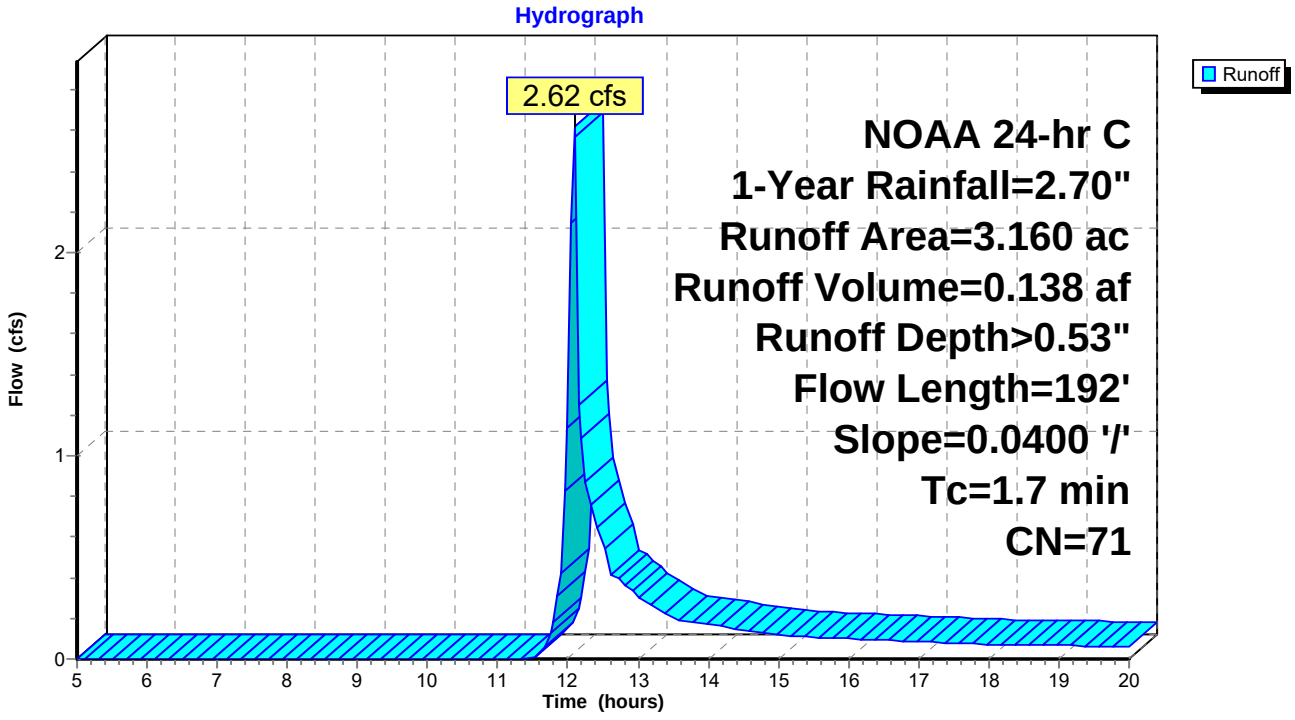
Runoff = 2.62 cfs @ 12.09 hrs, Volume= 0.138 af, Depth> 0.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.70"

Area (ac)	CN	Description
2.130	58	Meadow, non-grazed, HSG B
1.030	98	Paved roads w/curbs & sewers, HSG B
3.160	71	Weighted Average
2.130		67.41% Pervious Area
1.030		32.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	50	0.0400	1.60		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 3.30"
0.3	70	0.0400	4.06		**Shallow Concentrated Flow, SCF1** Paved Kv= 20.3 fps
0.9	72	0.0400	1.40		**Shallow Concentrated Flow, SCF2** Short Grass Pasture Kv= 7.0 fps
1.7	192	Total			

Subcatchment 3S: Post-Condition



Summary for Subcatchment 4S: Berm DA

[49] Hint: Tc<2dt may require smaller dt

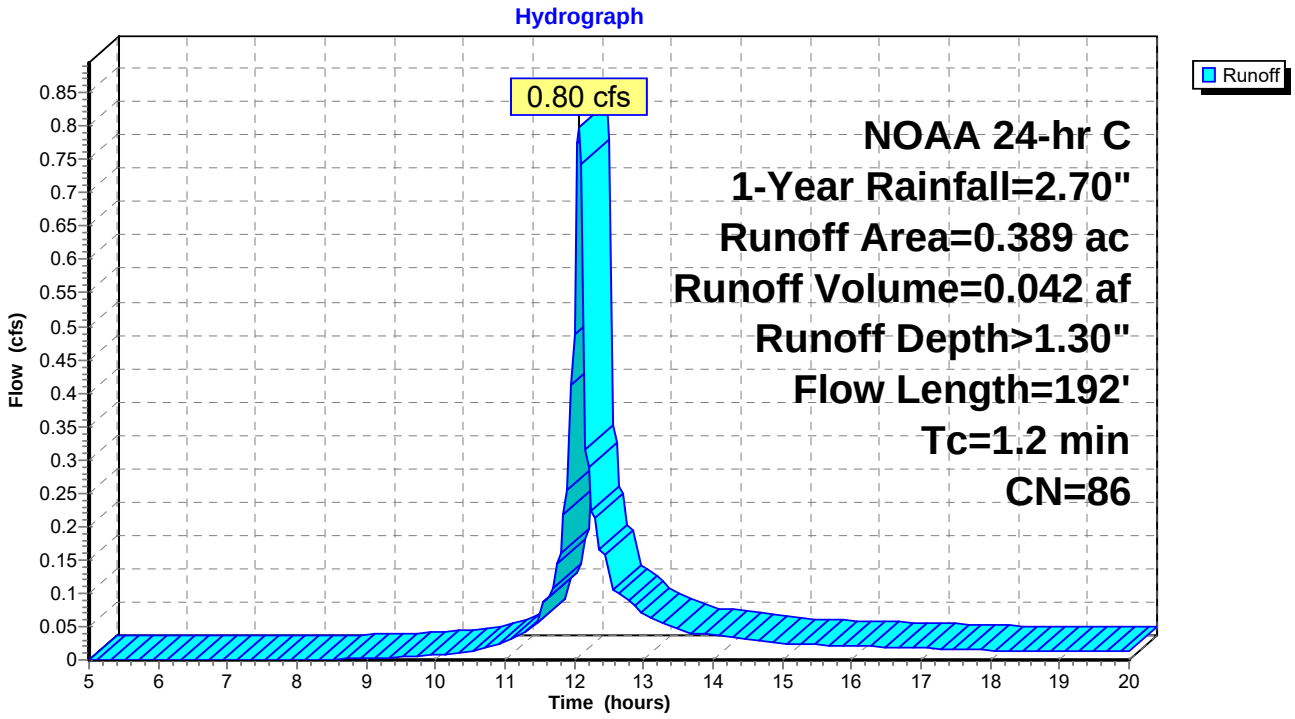
Runoff = 0.80 cfs @ 12.07 hrs, Volume= 0.042 af, Depth> 1.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.70"

Area (ac)	CN	Description
0.120	58	Meadow, non-grazed, HSG B
0.269	98	Paved roads w/curbs & sewers, HSG B
0.389	86	Weighted Average
0.120		30.85% Pervious Area
0.269		69.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	50	0.0400	1.60		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.30"
0.7	142	0.0280	3.40		**Shallow Concentrated Flow, SCF** Paved Kv= 20.3 fps
1.2	192	Total			

Subcatchment 4S: Berm DA



Summary for Subcatchment 5S: Vegetated Filter Strip DA

[49] Hint: Tc<2dt may require smaller dt

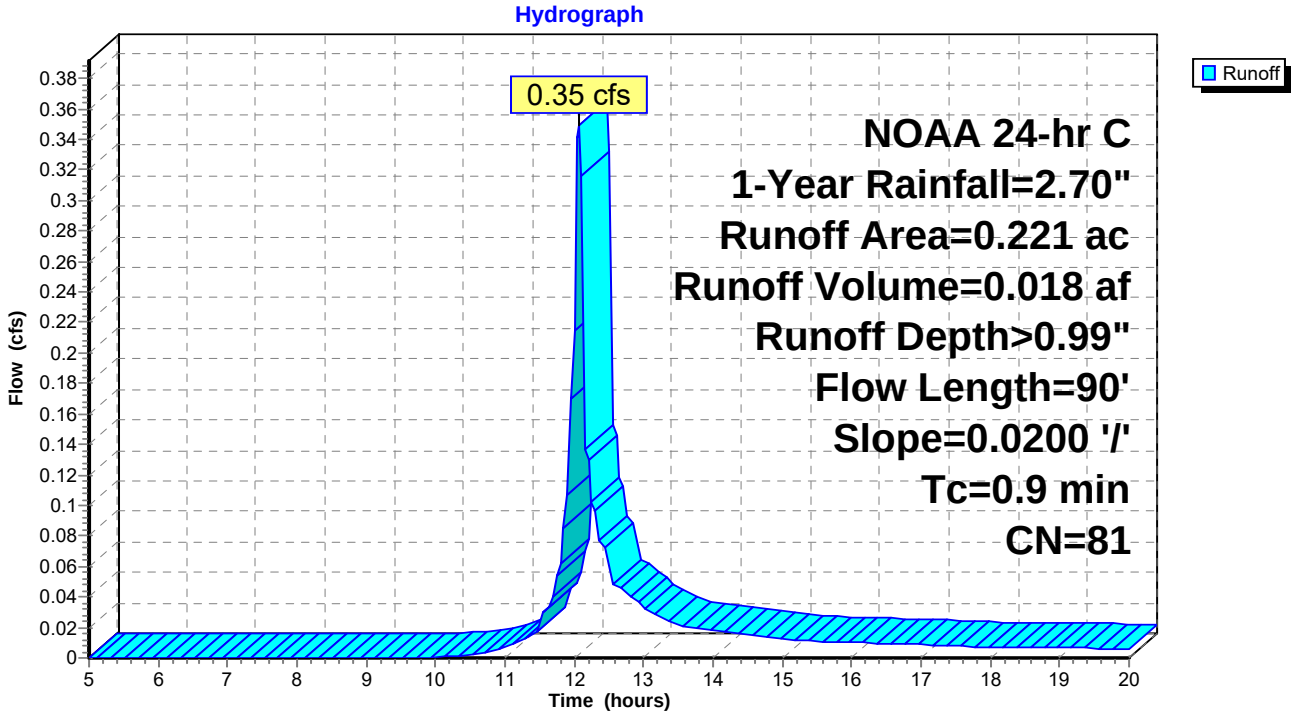
Runoff = 0.35 cfs @ 12.07 hrs, Volume= 0.018 af, Depth> 0.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.70"

Area (ac)	CN	Description
0.095	58	Meadow, non-grazed, HSG B
0.126	98	Paved roads w/curbs & sewers, HSG B
0.221	81	Weighted Average
0.095		42.99% Pervious Area
0.126		57.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.22		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.30"
0.2	40	0.0200	2.87		**Shallow Concentrated Flow, SCF** Paved Kv= 20.3 fps
0.9	90	Total			

Subcatchment 5S: Vegetated Filter Strip DA



Summary for Subcatchment 6S: Undetained Area

[49] Hint: Tc<2dt may require smaller dt

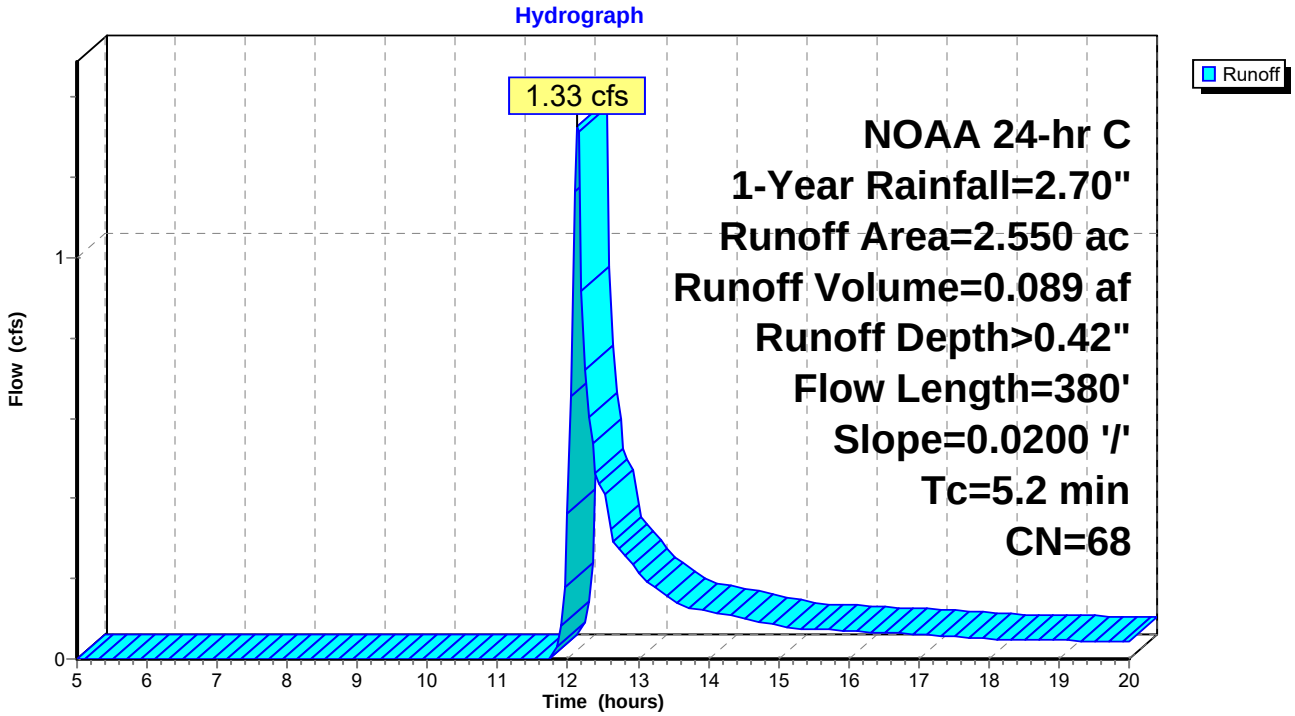
Runoff = 1.33 cfs @ 12.14 hrs, Volume= 0.089 af, Depth> 0.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.70"

Area (ac)	CN	Description
1.920	58	Meadow, non-grazed, HSG B
0.630	98	Paved roads w/curbs & sewers, HSG B
2.550	68	Weighted Average
1.920		75.29% Pervious Area
0.630		24.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.40		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.30"
0.6	80	0.0200	2.28		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
3.4	200	0.0200	0.99		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
5.2	380	Total			

Subcatchment 6S: Undetained Area



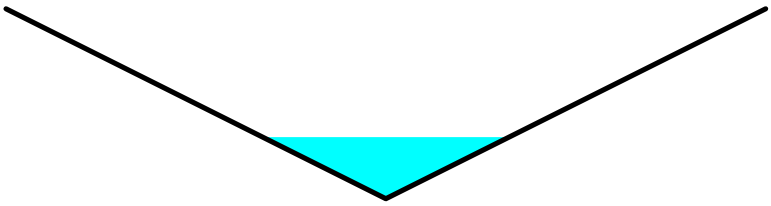
Summary for Reach 2R: Existing Swale

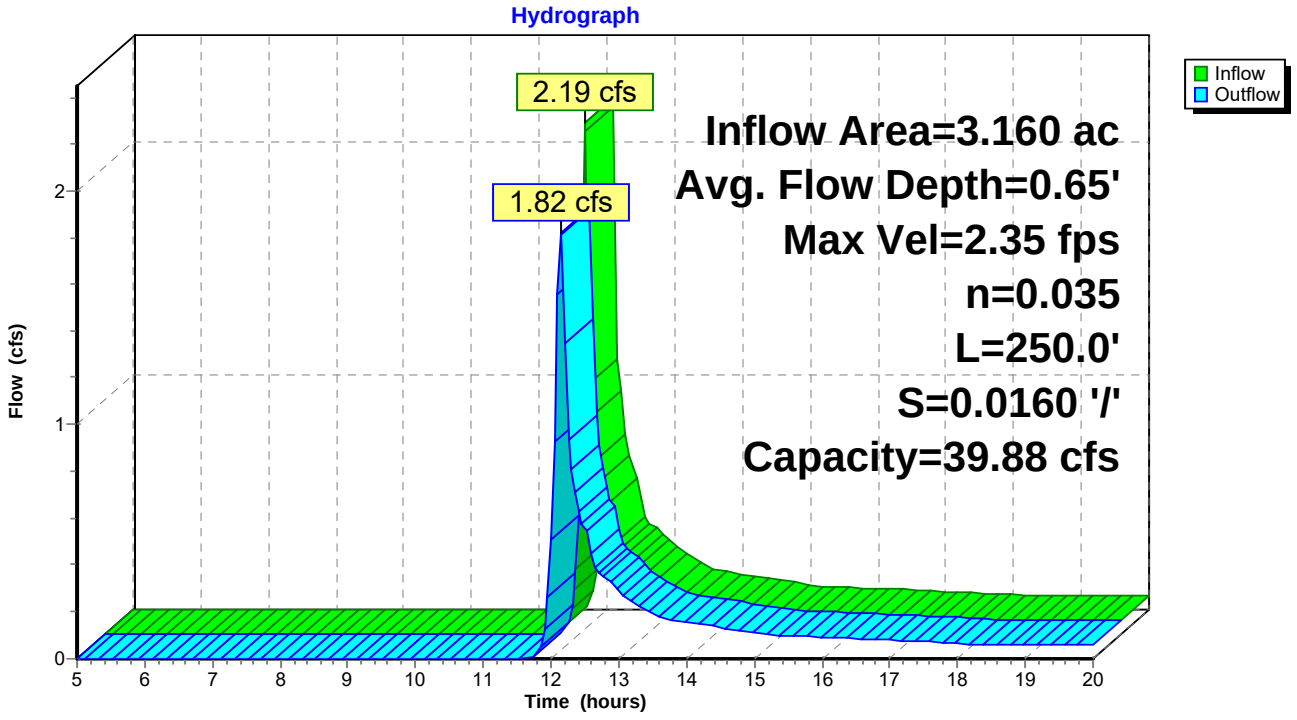
Inflow Area = 3.160 ac, 27.53% Impervious, Inflow Depth > 0.45" for 1-Year event
Inflow = 2.19 cfs @ 12.09 hrs, Volume= 0.119 af
Outflow = 1.82 cfs @ 12.14 hrs, Volume= 0.119 af, Atten= 17%, Lag= 3.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.35 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 1.17 fps, Avg. Travel Time= 3.6 min

Peak Storage= 210 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.65'
Bank-Full Depth= 2.00' Flow Area= 8.0 sf, Capacity= 39.88 cfs

0.00' x 2.00' deep channel, n= 0.035
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 250.0' Slope= 0.0160 '/'
Inlet Invert= 382.00', Outlet Invert= 378.00'





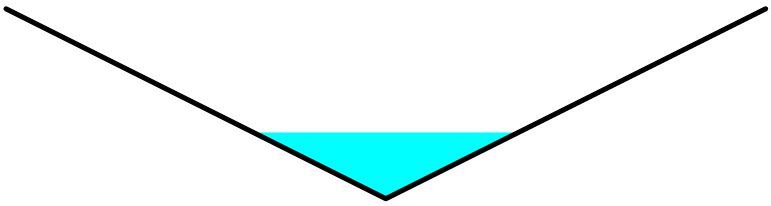
Summary for Reach 4R: Existing Swale

Inflow Area = 3.160 ac, 32.59% Impervious, Inflow Depth > 0.53" for 1-Year event
Inflow = 2.62 cfs @ 12.09 hrs, Volume= 0.138 af
Outflow = 2.20 cfs @ 12.14 hrs, Volume= 0.138 af, Atten= 16%, Lag= 3.0 min

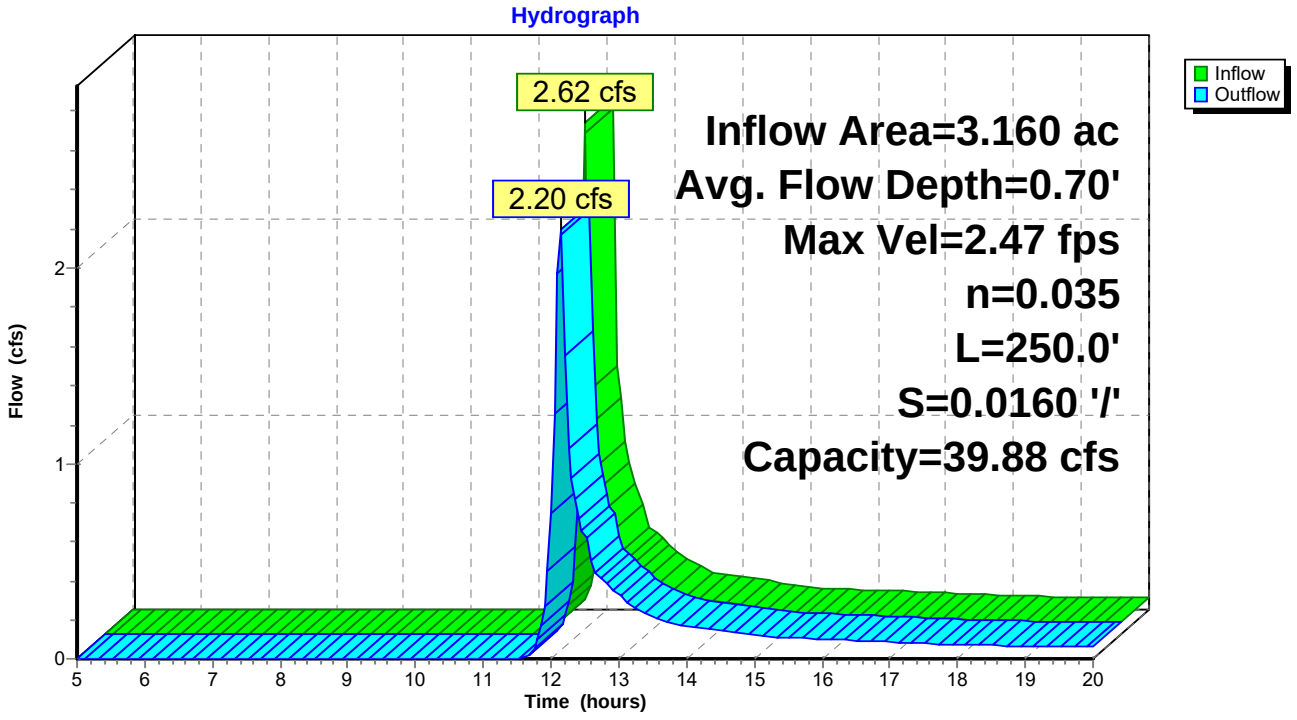
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.47 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 1.20 fps, Avg. Travel Time= 3.5 min

Peak Storage= 243 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.70'
Bank-Full Depth= 2.00' Flow Area= 8.0 sf, Capacity= 39.88 cfs

0.00' x 2.00' deep channel, n= 0.035
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 250.0' Slope= 0.0160 '/'
Inlet Invert= 382.00', Outlet Invert= 378.00'



Reach 4R: Existing Swale



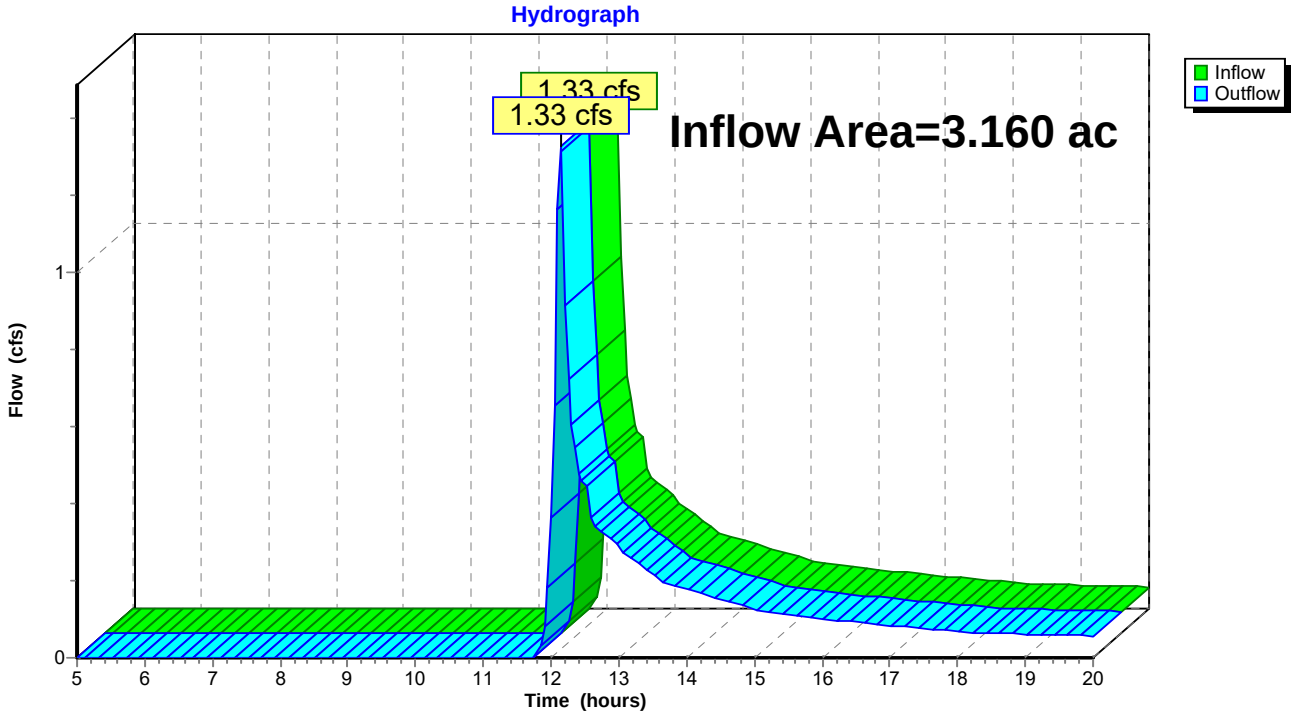
Summary for Reach 9R: Reach

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3.160 ac, 32.44% Impervious, Inflow Depth > 0.42" for 1-Year event
Inflow = 1.33 cfs @ 12.14 hrs, Volume= 0.111 af
Outflow = 1.33 cfs @ 12.14 hrs, Volume= 0.111 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach 9R: Reach



Summary for Pond 7P: Infiltration Berm

Inflow Area = 0.610 ac, 64.75% Impervious, Inflow Depth > 1.19" for 1-Year event
Inflow = 1.15 cfs @ 12.07 hrs, Volume= 0.060 af
Outflow = 0.08 cfs @ 13.26 hrs, Volume= 0.029 af, Atten= 93%, Lag= 71.4 min
Discarded = 0.01 cfs @ 13.26 hrs, Volume= 0.007 af
Primary = 0.07 cfs @ 13.26 hrs, Volume= 0.022 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 385.23' @ 13.26 hrs Surf.Area= 3,082 sf Storage= 1,596 cf

Plug-Flow detention time= 203.4 min calculated for 0.029 af (48% of inflow)
Center-of-Mass det. time= 120.7 min (912.9 - 792.2)

Volume	Invert	Avail.Storage	Storage Description
#1	384.35'	4,692 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
384.35	476	0	0
385.10	2,783	1,222	1,222
385.50	3,723	1,301	2,523
386.00	4,950	2,168	4,692

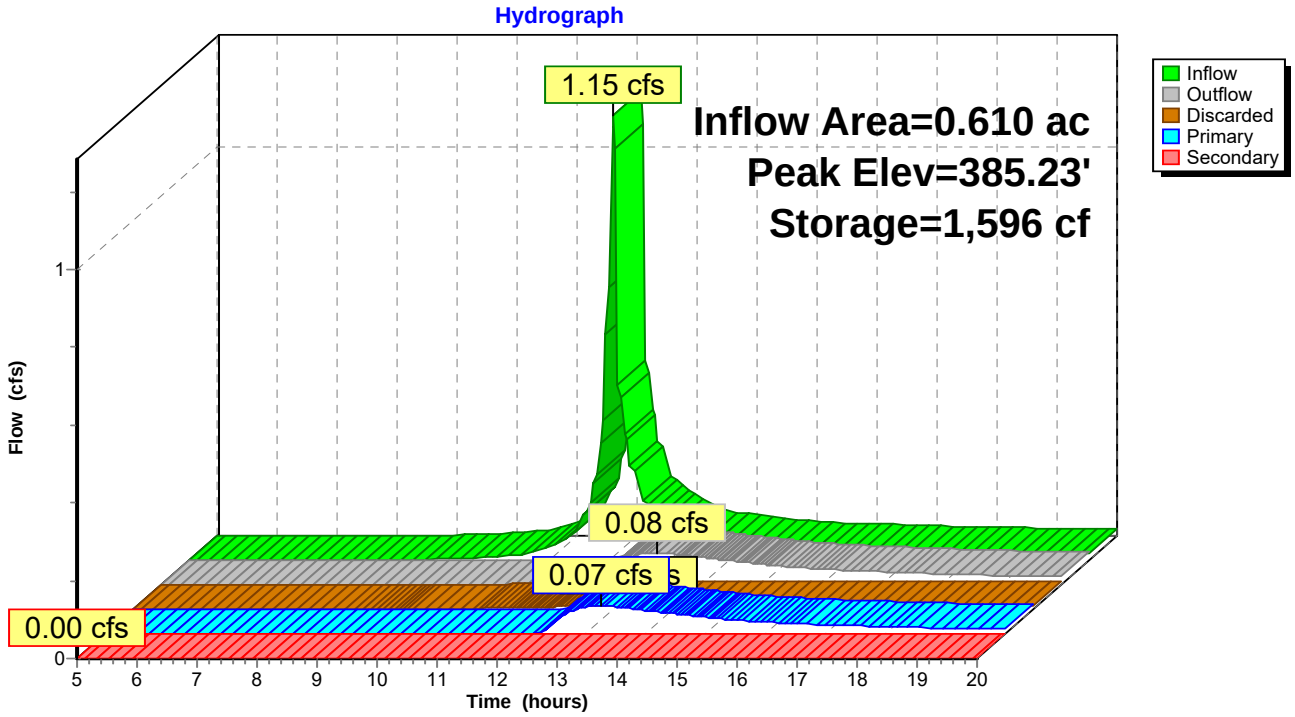
Device	Routing	Invert	Outlet Devices
#1	Primary	385.10'	**3.0" Round Culvert X 3.00** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 385.10' / 383.00' S= 0.1050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.05 sf
#2	Secondary	385.60'	**4.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#3	Discarded	384.35'	**0.125 in/hr Exfiltration over Surface area from 284.30' - 385.10'** Conductivity to Groundwater Elevation = 382.30' Excluded Surface area = 0 sf

Discarded OutFlow Max=0.01 cfs @ 13.26 hrs HW=385.23' (Free Discharge)
└**3=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.07 cfs @ 13.26 hrs HW=385.23' (Free Discharge)
└**1=Culvert** (Inlet Controls 0.07 cfs @ 0.96 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=384.35' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 7P: Infiltration Berm



Summary for Pond 8P: Level Spreader

[92] Warning: Device #1 is above defined storage

Inflow	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af
Outflow	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af, Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 384.65' @ 5.00 hrs Surf.Area= 0 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

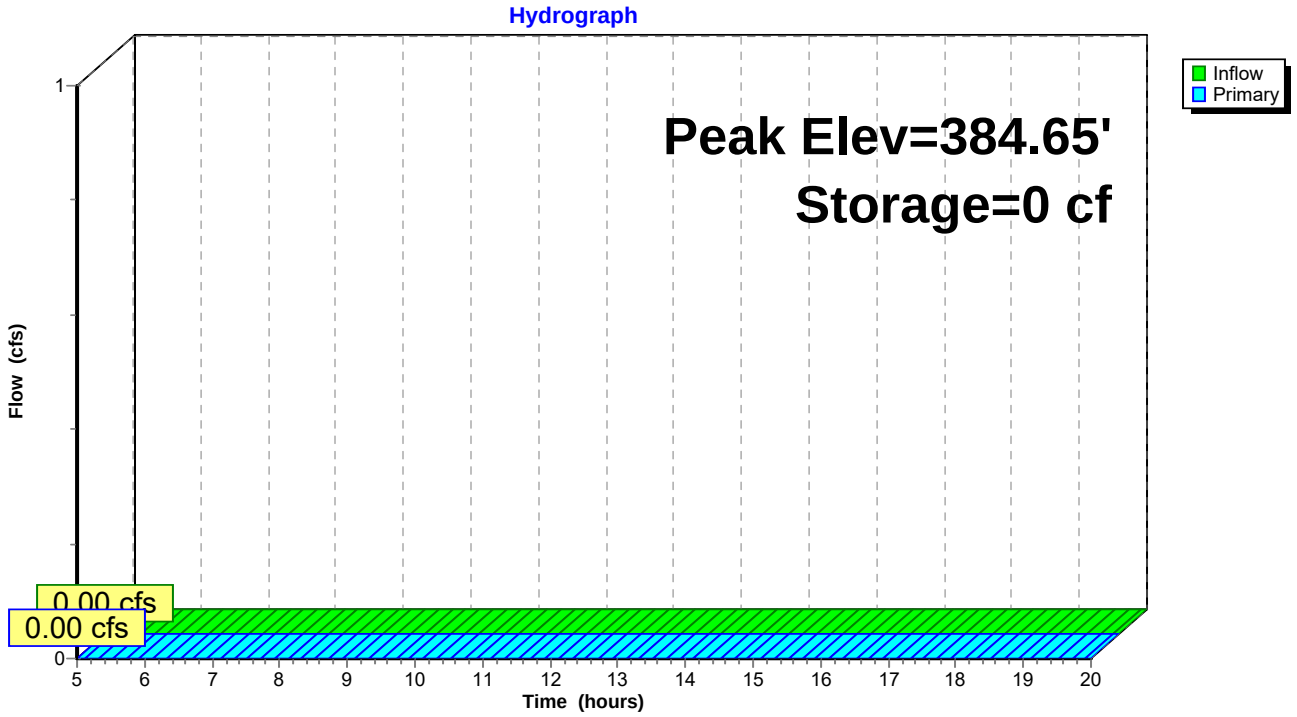
Volume	Invert	Avail.Storage	Storage Description
#1	384.65'	84 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
384.65	0	0	0
385.40	225	84	84

Device	Routing	Invert	Outlet Devices
#1	Primary	385.40'	**20.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=384.65' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 8P: Level Spreader



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 1S: Pre-Condition Runoff Area=3.160 ac 27.53% Impervious Runoff Depth>0.75"
Flow Length=192' Slope=0.0400 '/' Tc=1.7 min CN=69 Runoff=3.81 cfs 0.196 af

Subcatchment 3S: Post-Condition Runoff Area=3.160 ac 32.59% Impervious Runoff Depth>0.84"
Flow Length=192' Slope=0.0400 '/' Tc=1.7 min CN=71 Runoff=4.35 cfs 0.222 af

Subcatchment 4S: Berm DA Runoff Area=0.389 ac 69.15% Impervious Runoff Depth>1.78"
Flow Length=192' Tc=1.2 min CN=86 Runoff=1.08 cfs 0.058 af

Subcatchment 5S: Vegetated Filter Strip DA Runoff Area=0.221 ac 57.01% Impervious Runoff Depth>1.42"
Flow Length=90' Slope=0.0200 '/' Tc=0.9 min CN=81 Runoff=0.50 cfs 0.026 af

Subcatchment 6S: Undetained Area Runoff Area=2.550 ac 24.71% Impervious Runoff Depth>0.70"
Flow Length=380' Slope=0.0200 '/' Tc=5.2 min CN=68 Runoff=2.42 cfs 0.148 af

Reach 2R: Existing Swale Avg. Flow Depth=0.81' Max Vel=2.72 fps Inflow=3.81 cfs 0.196 af
n=0.035 L=250.0' S=0.0160 '/' Capacity=39.88 cfs Outflow=3.21 cfs 0.196 af

Reach 4R: Existing Swale Avg. Flow Depth=0.85' Max Vel=2.82 fps Inflow=4.35 cfs 0.222 af
n=0.035 L=250.0' S=0.0160 '/' Capacity=39.88 cfs Outflow=3.68 cfs 0.221 af

Reach 9R: Reach Inflow=2.49 cfs 0.193 af
Outflow=2.49 cfs 0.193 af

Pond 7P: Infiltration Berm Peak Elev=385.34' Storage=1,943 cf Inflow=1.58 cfs 0.084 af
Discarded=0.01 cfs 0.008 af Primary=0.19 cfs 0.044 af Secondary=0.00 cfs 0.000 af Outflow=0.20 cfs 0.052 af

Pond 8P: Level Spreader Peak Elev=384.65' Storage=0 cf Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 9.480 ac Runoff Volume = 0.650 af Average Runoff Depth = 0.82"
69.15% Pervious = 6.555 ac 30.85% Impervious = 2.925 ac

Summary for Subcatchment 1S: Pre-Condition

[49] Hint: Tc<2dt may require smaller dt

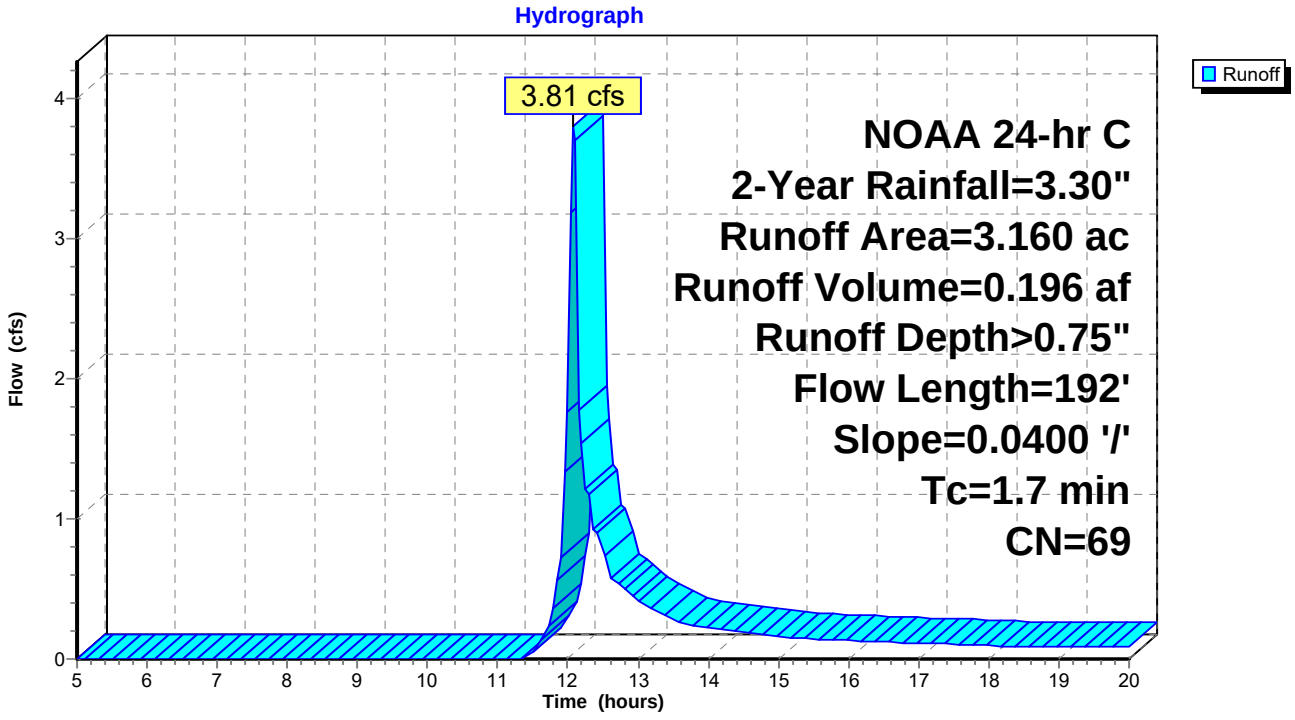
Runoff = 3.81 cfs @ 12.09 hrs, Volume= 0.196 af, Depth> 0.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-Year Rainfall=3.30"

Area (ac)	CN	Description
2.290	58	Meadow, non-grazed, HSG B
0.870	98	Paved roads w/curbs & sewers, HSG B
3.160	69	Weighted Average
2.290		72.47% Pervious Area
0.870		27.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	50	0.0400	1.60		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 3.30"
0.3	70	0.0400	4.06		**Shallow Concentrated Flow, SCF1** Paved Kv= 20.3 fps
0.9	72	0.0400	1.40		**Shallow Concentrated Flow, SCF2** Short Grass Pasture Kv= 7.0 fps
1.7	192	Total			

Subcatchment 1S: Pre-Condition



Summary for Subcatchment 3S: Post-Condition

[49] Hint: Tc<2dt may require smaller dt

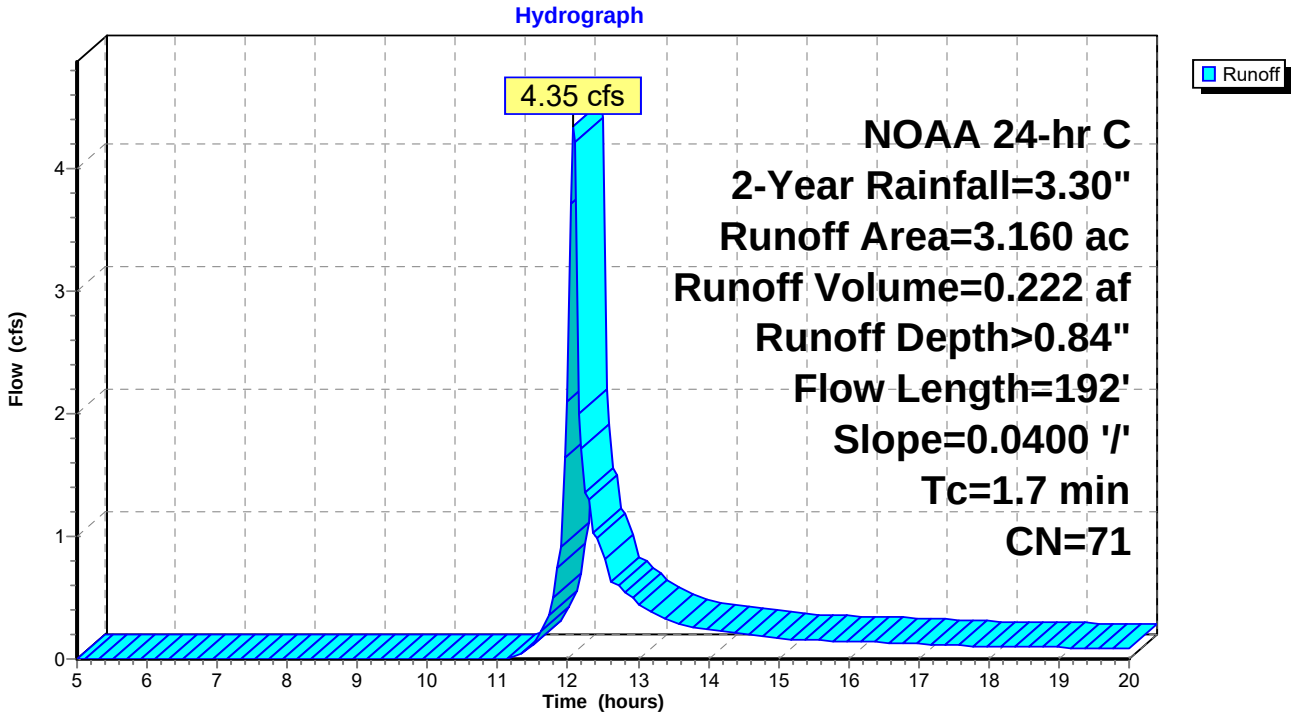
Runoff = 4.35 cfs @ 12.08 hrs, Volume= 0.222 af, Depth> 0.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-Year Rainfall=3.30"

Area (ac)	CN	Description
2.130	58	Meadow, non-grazed, HSG B
1.030	98	Paved roads w/curbs & sewers, HSG B
3.160	71	Weighted Average
2.130		67.41% Pervious Area
1.030		32.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	50	0.0400	1.60		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 3.30"
0.3	70	0.0400	4.06		**Shallow Concentrated Flow, SCF1** Paved Kv= 20.3 fps
0.9	72	0.0400	1.40		**Shallow Concentrated Flow, SCF2** Short Grass Pasture Kv= 7.0 fps
1.7	192	Total			

Subcatchment 3S: Post-Condition



Summary for Subcatchment 4S: Berm DA

[49] Hint: Tc<2dt may require smaller dt

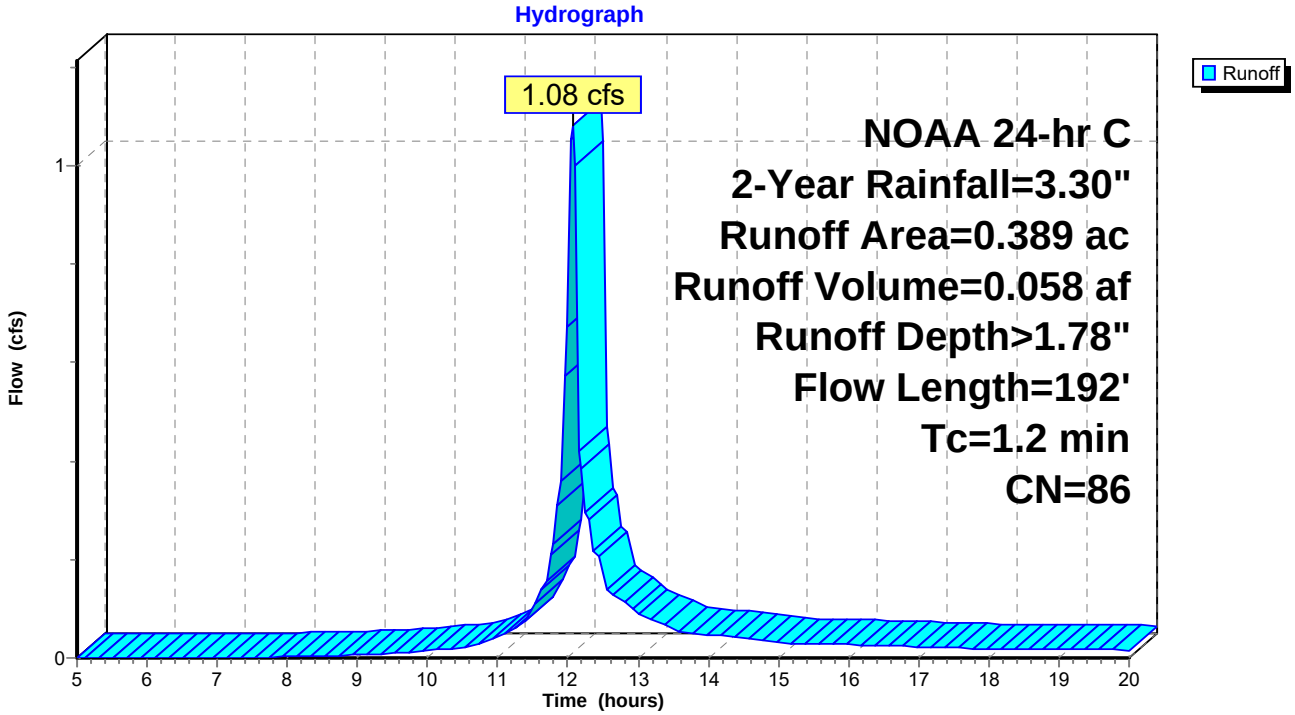
Runoff = 1.08 cfs @ 12.07 hrs, Volume= 0.058 af, Depth> 1.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-Year Rainfall=3.30"

Area (ac)	CN	Description
0.120	58	Meadow, non-grazed, HSG B
0.269	98	Paved roads w/curbs & sewers, HSG B
0.389	86	Weighted Average
0.120		30.85% Pervious Area
0.269		69.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	50	0.0400	1.60		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.30"
0.7	142	0.0280	3.40		**Shallow Concentrated Flow, SCF** Paved Kv= 20.3 fps
1.2	192	Total			

Subcatchment 4S: Berm DA



Summary for Subcatchment 5S: Vegetated Filter Strip DA

[49] Hint: Tc<2dt may require smaller dt

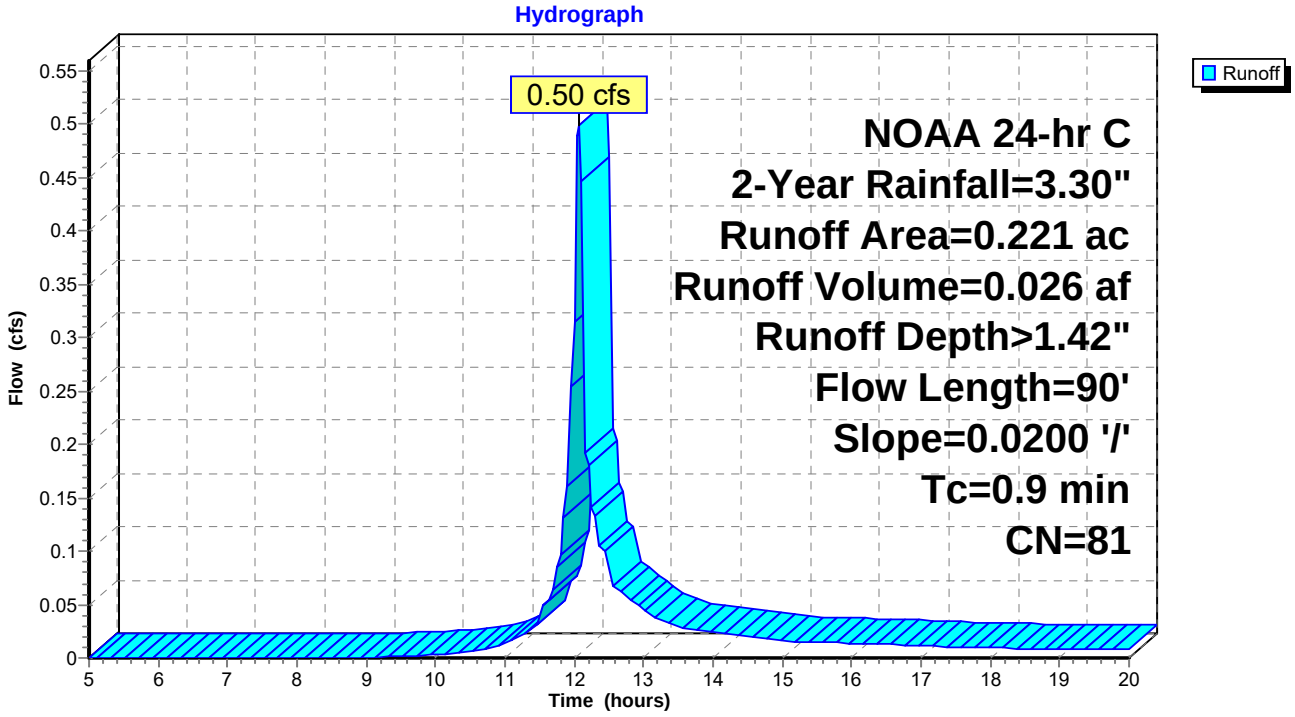
Runoff = 0.50 cfs @ 12.07 hrs, Volume= 0.026 af, Depth> 1.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-Year Rainfall=3.30"

Area (ac)	CN	Description
0.095	58	Meadow, non-grazed, HSG B
0.126	98	Paved roads w/curbs & sewers, HSG B
0.221	81	Weighted Average
0.095		42.99% Pervious Area
0.126		57.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.22		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.30"
0.2	40	0.0200	2.87		**Shallow Concentrated Flow, SCF** Paved Kv= 20.3 fps
0.9	90	Total			

Subcatchment 5S: Vegetated Filter Strip DA



Summary for Subcatchment 6S: Undetained Area

[49] Hint: Tc<2dt may require smaller dt

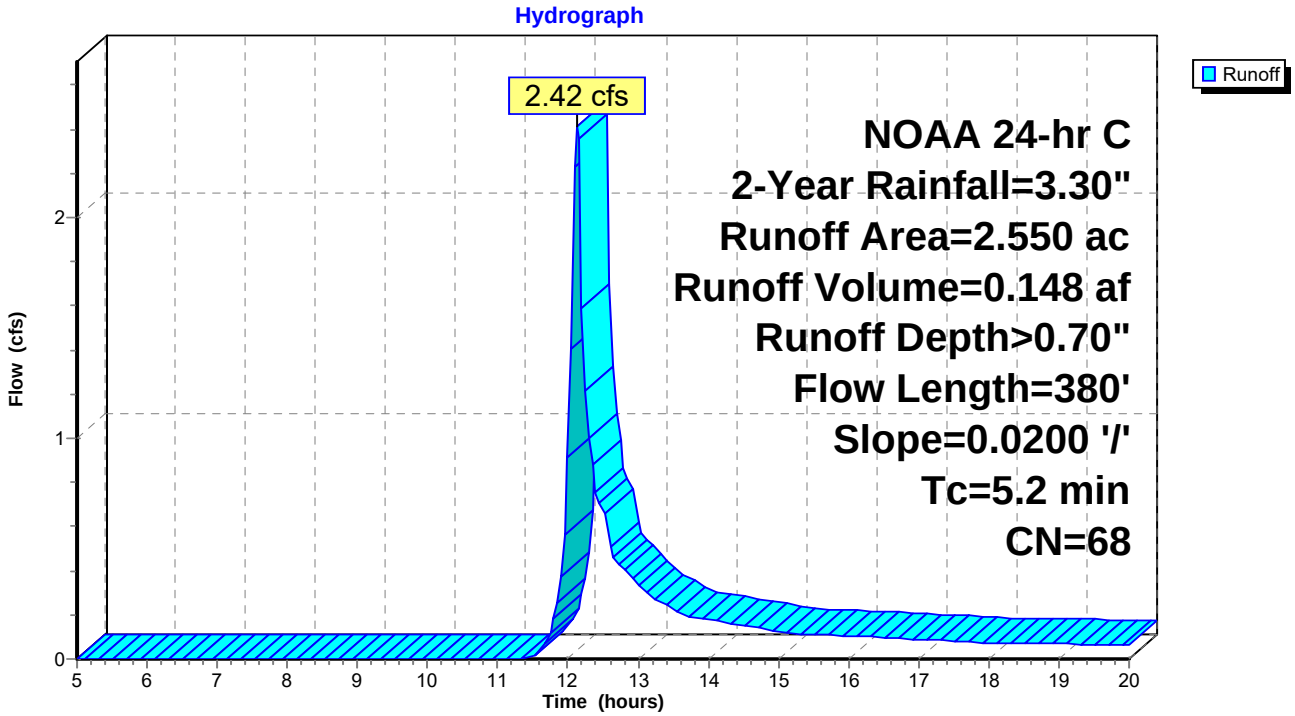
Runoff = 2.42 cfs @ 12.13 hrs, Volume= 0.148 af, Depth> 0.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-Year Rainfall=3.30"

Area (ac)	CN	Description
1.920	58	Meadow, non-grazed, HSG B
0.630	98	Paved roads w/curbs & sewers, HSG B
2.550	68	Weighted Average
1.920		75.29% Pervious Area
0.630		24.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.40		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.30"
0.6	80	0.0200	2.28		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
3.4	200	0.0200	0.99		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
5.2	380	Total			

Subcatchment 6S: Undetained Area



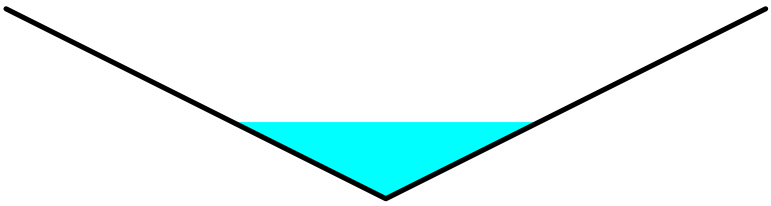
Summary for Reach 2R: Existing Swale

Inflow Area = 3.160 ac, 27.53% Impervious, Inflow Depth > 0.75" for 2-Year event
Inflow = 3.81 cfs @ 12.09 hrs, Volume= 0.196 af
Outflow = 3.21 cfs @ 12.13 hrs, Volume= 0.196 af, Atten= 16%, Lag= 2.6 min

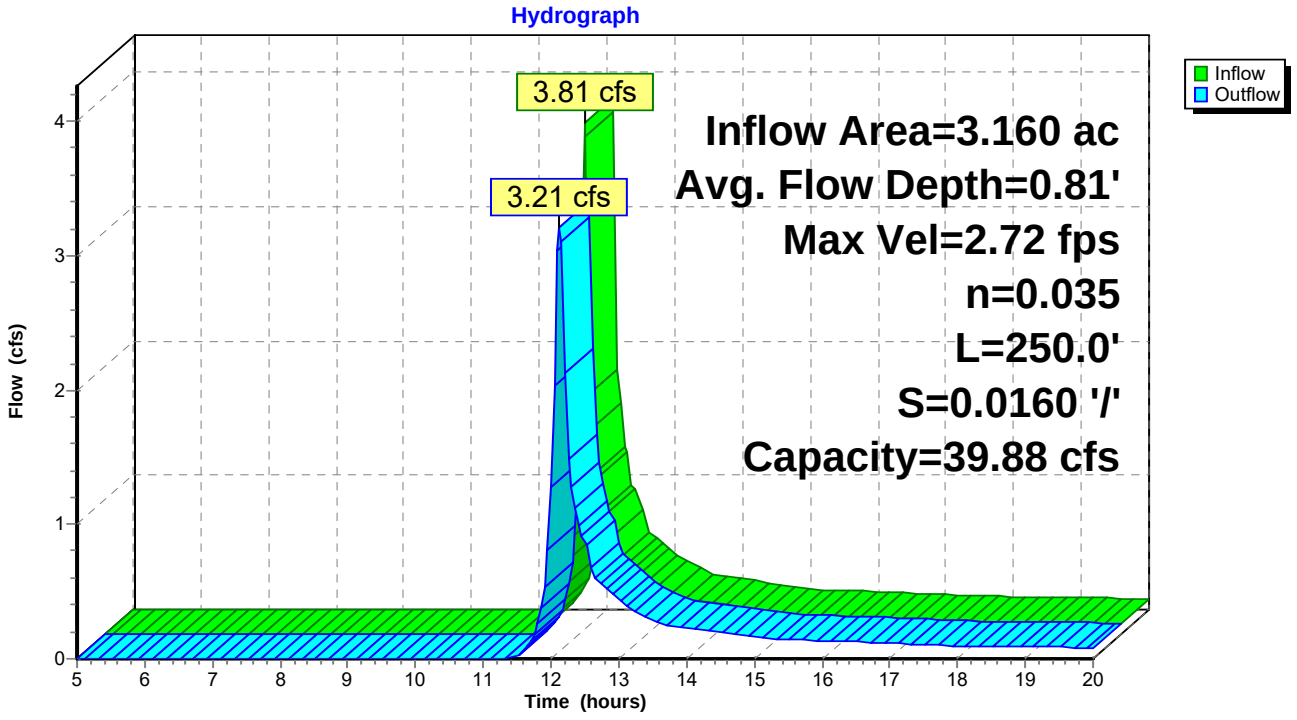
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.72 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 1.29 fps, Avg. Travel Time= 3.2 min

Peak Storage= 326 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.81'
Bank-Full Depth= 2.00' Flow Area= 8.0 sf, Capacity= 39.88 cfs

0.00' x 2.00' deep channel, n= 0.035
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 250.0' Slope= 0.0160 '/'
Inlet Invert= 382.00', Outlet Invert= 378.00'



Reach 2R: Existing Swale



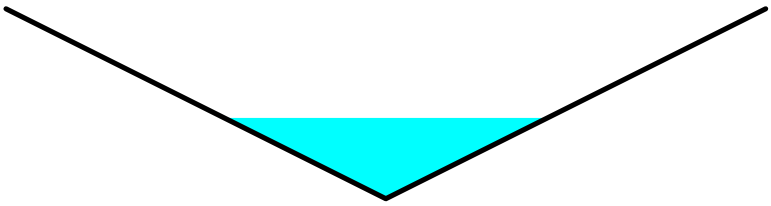
Summary for Reach 4R: Existing Swale

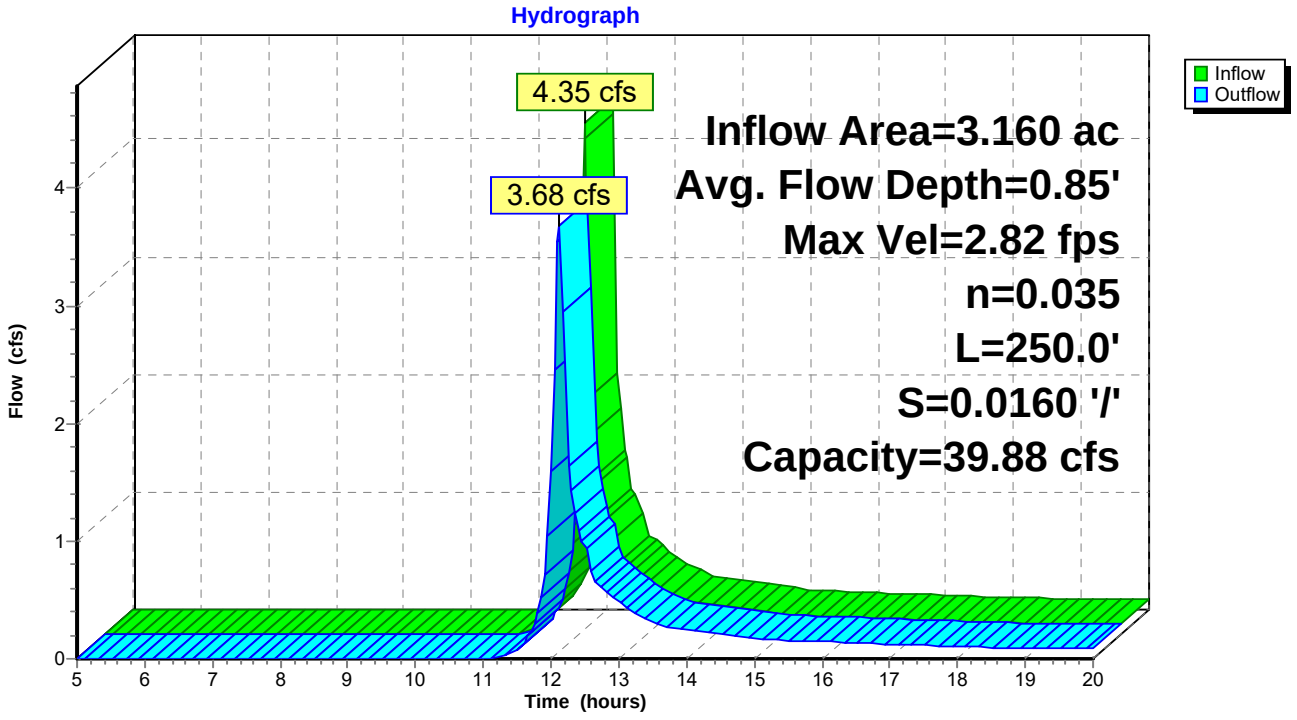
Inflow Area = 3.160 ac, 32.59% Impervious, Inflow Depth > 0.84" for 2-Year event
Inflow = 4.35 cfs @ 12.08 hrs, Volume= 0.222 af
Outflow = 3.68 cfs @ 12.12 hrs, Volume= 0.221 af, Atten= 15%, Lag= 2.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.82 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 1.31 fps, Avg. Travel Time= 3.2 min

Peak Storage= 362 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.85'
Bank-Full Depth= 2.00' Flow Area= 8.0 sf, Capacity= 39.88 cfs

0.00' x 2.00' deep channel, n= 0.035
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 250.0' Slope= 0.0160 '/'
Inlet Invert= 382.00', Outlet Invert= 378.00'





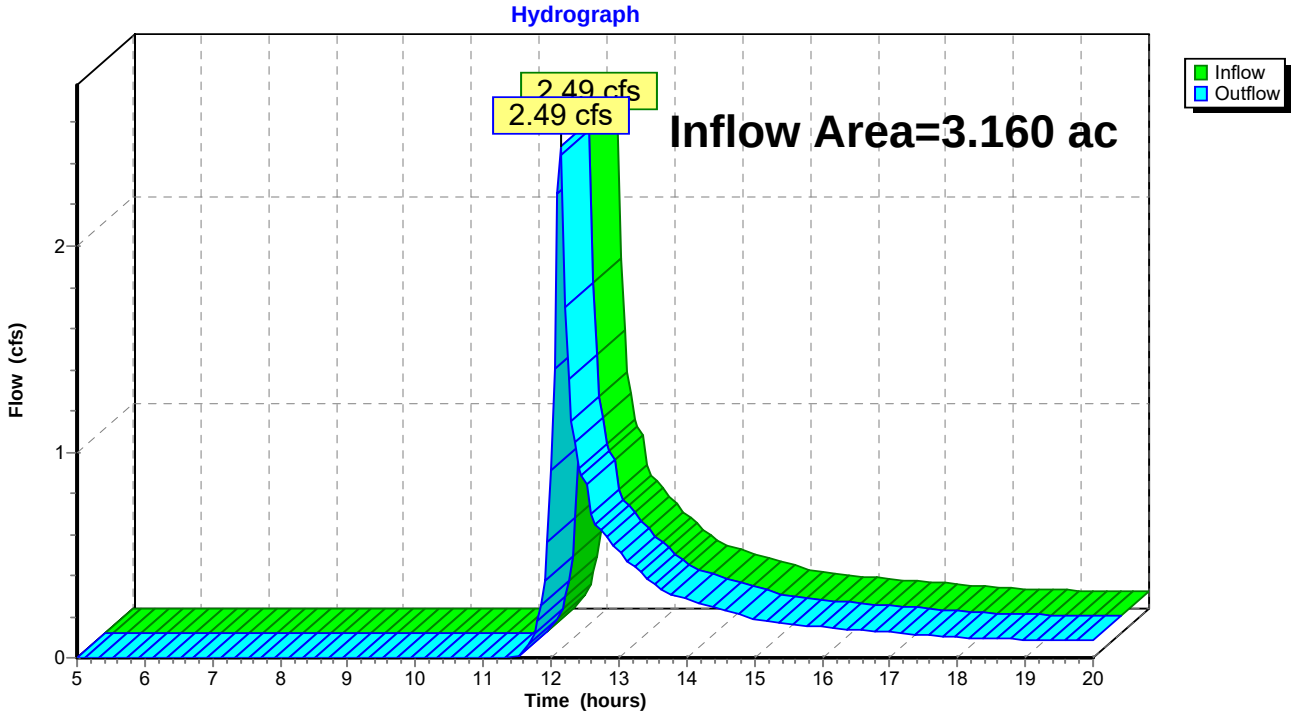
Summary for Reach 9R: Reach

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3.160 ac, 32.44% Impervious, Inflow Depth > 0.73" for 2-Year event
Inflow = 2.49 cfs @ 12.13 hrs, Volume= 0.193 af
Outflow = 2.49 cfs @ 12.13 hrs, Volume= 0.193 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach 9R: Reach



Summary for Pond 7P: Infiltration Berm

Inflow Area = 0.610 ac, 64.75% Impervious, Inflow Depth > 1.65" for 2-Year event
Inflow = 1.58 cfs @ 12.07 hrs, Volume= 0.084 af
Outflow = 0.20 cfs @ 12.61 hrs, Volume= 0.052 af, Atten= 88%, Lag= 32.3 min
Discarded = 0.01 cfs @ 12.61 hrs, Volume= 0.008 af
Primary = 0.19 cfs @ 12.61 hrs, Volume= 0.044 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 385.34' @ 12.61 hrs Surf.Area= 3,336 sf Storage= 1,943 cf

Plug-Flow detention time= 162.6 min calculated for 0.052 af (62% of inflow)
Center-of-Mass det. time= 89.5 min (874.4 - 785.0)

Volume	Invert	Avail.Storage	Storage Description
#1	384.35'	4,692 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
384.35	476	0	0
385.10	2,783	1,222	1,222
385.50	3,723	1,301	2,523
386.00	4,950	2,168	4,692

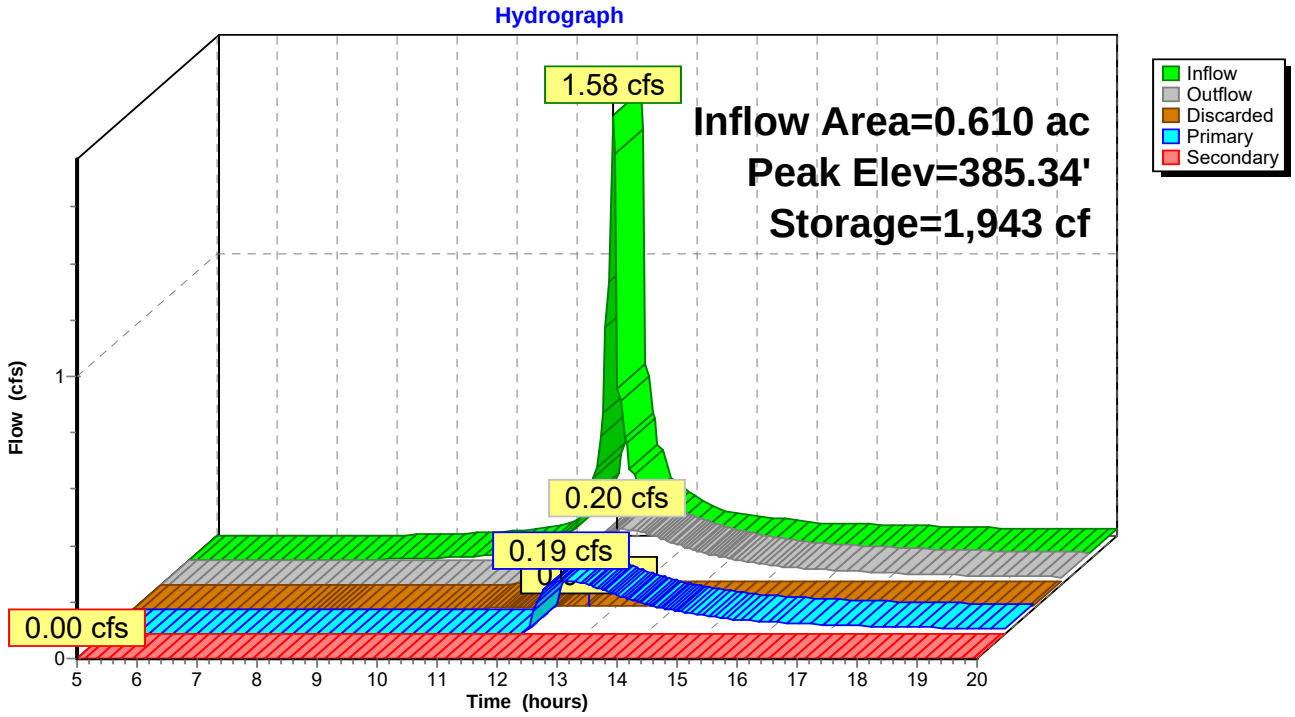
Device	Routing	Invert	Outlet Devices
#1	Primary	385.10'	**3.0" Round Culvert X 3.00** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 385.10' / 383.00' S= 0.1050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.05 sf
#2	Secondary	385.60'	**4.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#3	Discarded	384.35'	**0.125 in/hr Exfiltration over Surface area from 284.30' - 385.10'** Conductivity to Groundwater Elevation = 382.30' Excluded Surface area = 0 sf

Discarded OutFlow Max=0.01 cfs @ 12.61 hrs HW=385.34' (Free Discharge)
└**3=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.19 cfs @ 12.61 hrs HW=385.34' (Free Discharge)
└**1=Culvert** (Inlet Controls 0.19 cfs @ 1.30 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=384.35' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 7P: Infiltration Berm



Summary for Pond 8P: Level Spreader

[92] Warning: Device #1 is above defined storage

Inflow	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af
Outflow	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af, Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	5.00 hrs,	Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 384.65' @ 5.00 hrs Surf.Area= 0 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

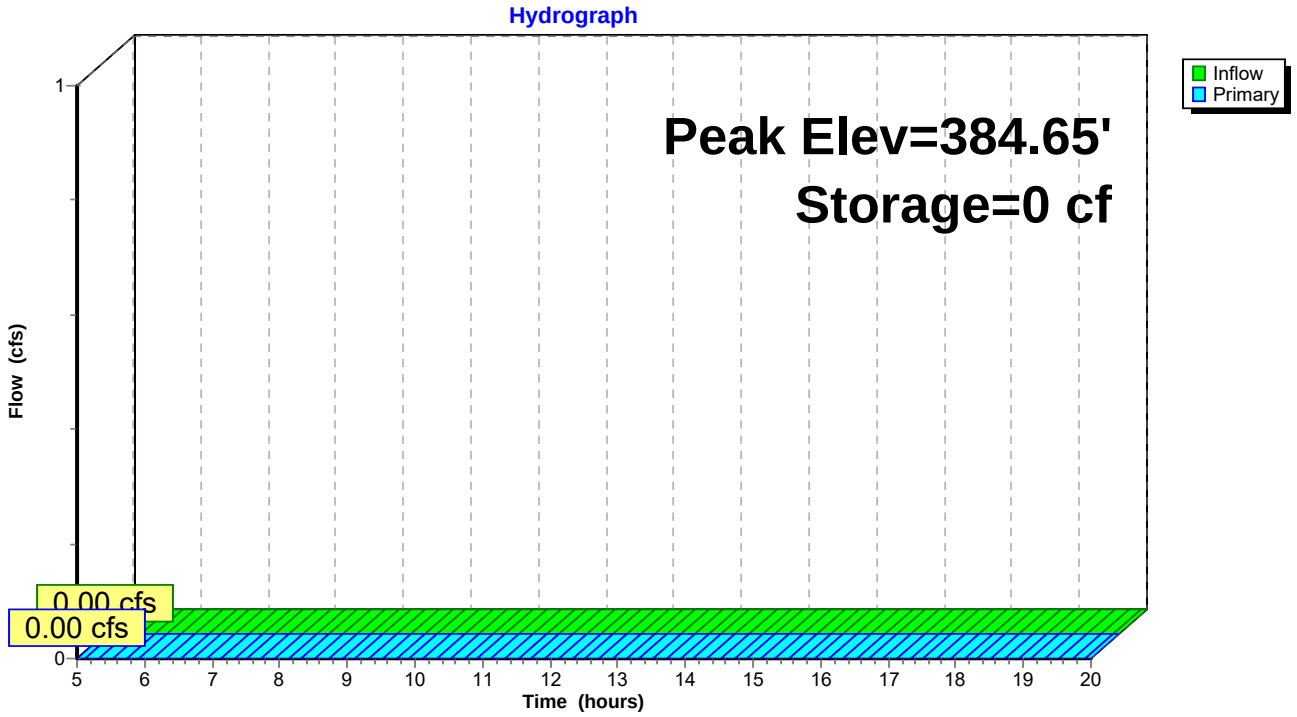
Volume	Invert	Avail.Storage	Storage Description
#1	384.65'	84 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
384.65	0	0	0
385.40	225	84	84

Device	Routing	Invert	Outlet Devices
#1	Primary	385.40'	**20.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=384.65' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 8P: Level Spreader



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 1S: Pre-Condition Runoff Area=3.160 ac 27.53% Impervious Runoff Depth>1.71"
Flow Length=192' Slope=0.0400 '/' Tc=1.7 min CN=69 Runoff=8.95 cfs 0.451 af

Subcatchment 3S: Post-Condition Runoff Area=3.160 ac 32.59% Impervious Runoff Depth>1.86"
Flow Length=192' Slope=0.0400 '/' Tc=1.7 min CN=71 Runoff=9.71 cfs 0.491 af

Subcatchment 4S: Berm DA Runoff Area=0.389 ac 69.15% Impervious Runoff Depth>3.15"
Flow Length=192' Tc=1.2 min CN=86 Runoff=1.86 cfs 0.102 af

Subcatchment 5S: Vegetated Filter Strip DA Runoff Area=0.221 ac 57.01% Impervious Runoff Depth>2.69"
Flow Length=90' Slope=0.0200 '/' Tc=0.9 min CN=81 Runoff=0.93 cfs 0.050 af

Subcatchment 6S: Undetained Area Runoff Area=2.550 ac 24.71% Impervious Runoff Depth>1.64"
Flow Length=380' Slope=0.0200 '/' Tc=5.2 min CN=68 Runoff=5.94 cfs 0.348 af

Reach 2R: Existing Swale Avg. Flow Depth=1.13' Max Vel=3.40 fps Inflow=8.95 cfs 0.451 af
n=0.035 L=250.0' S=0.0160 '/' Capacity=39.88 cfs Outflow=7.86 cfs 0.450 af

Reach 4R: Existing Swale Avg. Flow Depth=1.16' Max Vel=3.47 fps Inflow=9.71 cfs 0.491 af
n=0.035 L=250.0' S=0.0160 '/' Capacity=39.88 cfs Outflow=8.58 cfs 0.490 af

Reach 9R: Reach Inflow=6.29 cfs 0.456 af
Outflow=6.29 cfs 0.456 af

Pond 7P: Infiltration Berm Peak Elev=385.68' Storage=3,228 cf Inflow=2.78 cfs 0.152 af
Discarded=0.01 cfs 0.009 af Primary=0.38 cfs 0.101 af Secondary=0.21 cfs 0.008 af Outflow=0.60 cfs 0.118 af

Pond 8P: Level Spreader Peak Elev=385.44' Storage=84 cf Inflow=0.21 cfs 0.008 af
Outflow=0.40 cfs 0.007 af

Total Runoff Area = 9.480 ac Runoff Volume = 1.442 af Average Runoff Depth = 1.83"
69.15% Pervious = 6.555 ac 30.85% Impervious = 2.925 ac

Summary for Subcatchment 1S: Pre-Condition

[49] Hint: Tc<2dt may require smaller dt

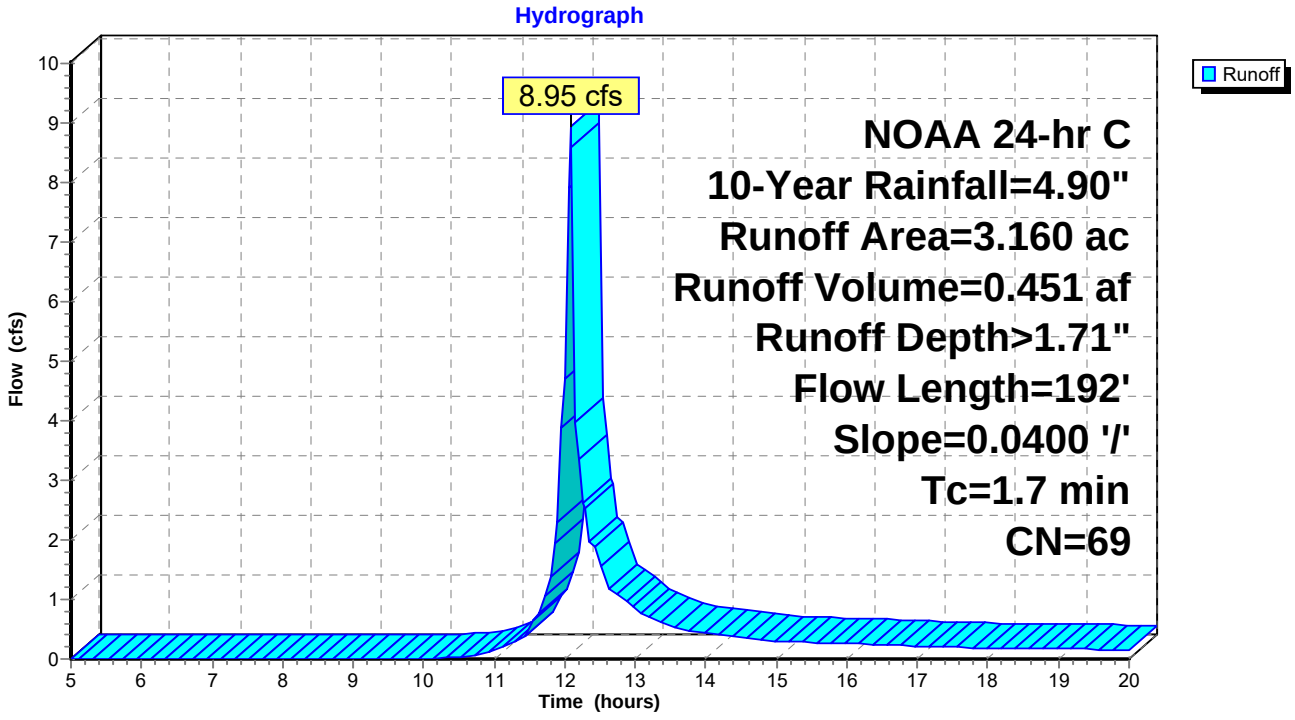
Runoff = 8.95 cfs @ 12.08 hrs, Volume= 0.451 af, Depth> 1.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.90"

Area (ac)	CN	Description
2.290	58	Meadow, non-grazed, HSG B
0.870	98	Paved roads w/curbs & sewers, HSG B
3.160	69	Weighted Average
2.290		72.47% Pervious Area
0.870		27.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	50	0.0400	1.60		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 3.30"
0.3	70	0.0400	4.06		**Shallow Concentrated Flow, SCF1** Paved Kv= 20.3 fps
0.9	72	0.0400	1.40		**Shallow Concentrated Flow, SCF2** Short Grass Pasture Kv= 7.0 fps
1.7	192	Total			

Subcatchment 1S: Pre-Condition



Summary for Subcatchment 3S: Post-Condition

[49] Hint: Tc<2dt may require smaller dt

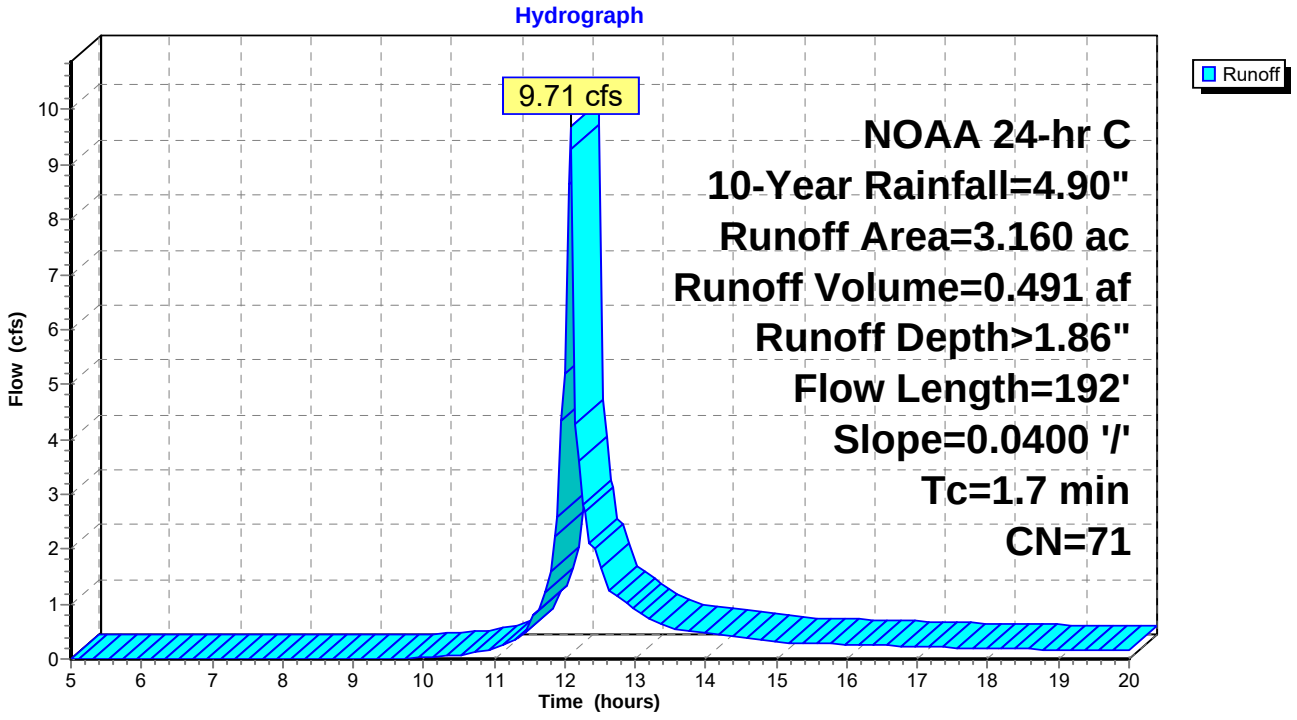
Runoff = 9.71 cfs @ 12.08 hrs, Volume= 0.491 af, Depth> 1.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.90"

Area (ac)	CN	Description
2.130	58	Meadow, non-grazed, HSG B
1.030	98	Paved roads w/curbs & sewers, HSG B
3.160	71	Weighted Average
2.130		67.41% Pervious Area
1.030		32.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	50	0.0400	1.60		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 3.30"
0.3	70	0.0400	4.06		**Shallow Concentrated Flow, SCF1** Paved Kv= 20.3 fps
0.9	72	0.0400	1.40		**Shallow Concentrated Flow, SCF2** Short Grass Pasture Kv= 7.0 fps
1.7	192	Total			

Subcatchment 3S: Post-Condition



Summary for Subcatchment 4S: Berm DA

[49] Hint: Tc<2dt may require smaller dt

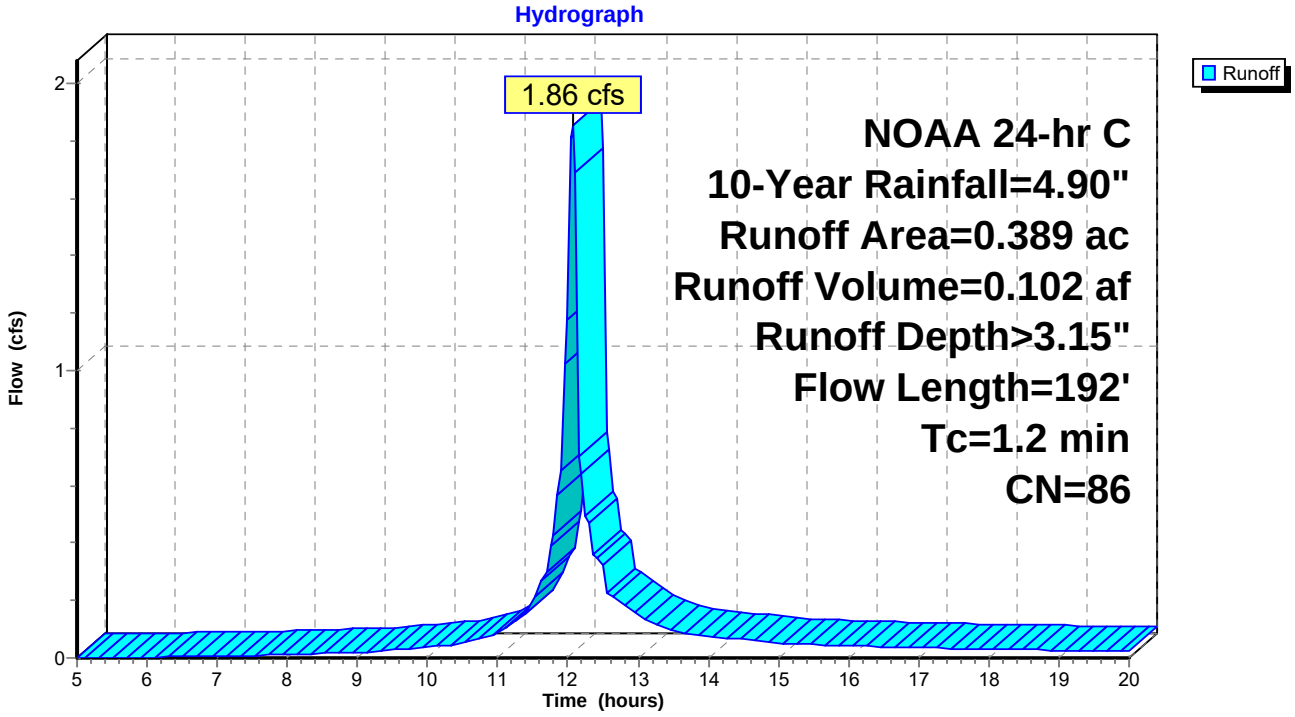
Runoff = 1.86 cfs @ 12.07 hrs, Volume= 0.102 af, Depth> 3.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.90"

Area (ac)	CN	Description
0.120	58	Meadow, non-grazed, HSG B
0.269	98	Paved roads w/curbs & sewers, HSG B
0.389	86	Weighted Average
0.120		30.85% Pervious Area
0.269		69.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	50	0.0400	1.60		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.30"
0.7	142	0.0280	3.40		**Shallow Concentrated Flow, SCF** Paved Kv= 20.3 fps
1.2	192	Total			

Subcatchment 4S: Berm DA



Summary for Subcatchment 5S: Vegetated Filter Strip DA

[49] Hint: Tc<2dt may require smaller dt

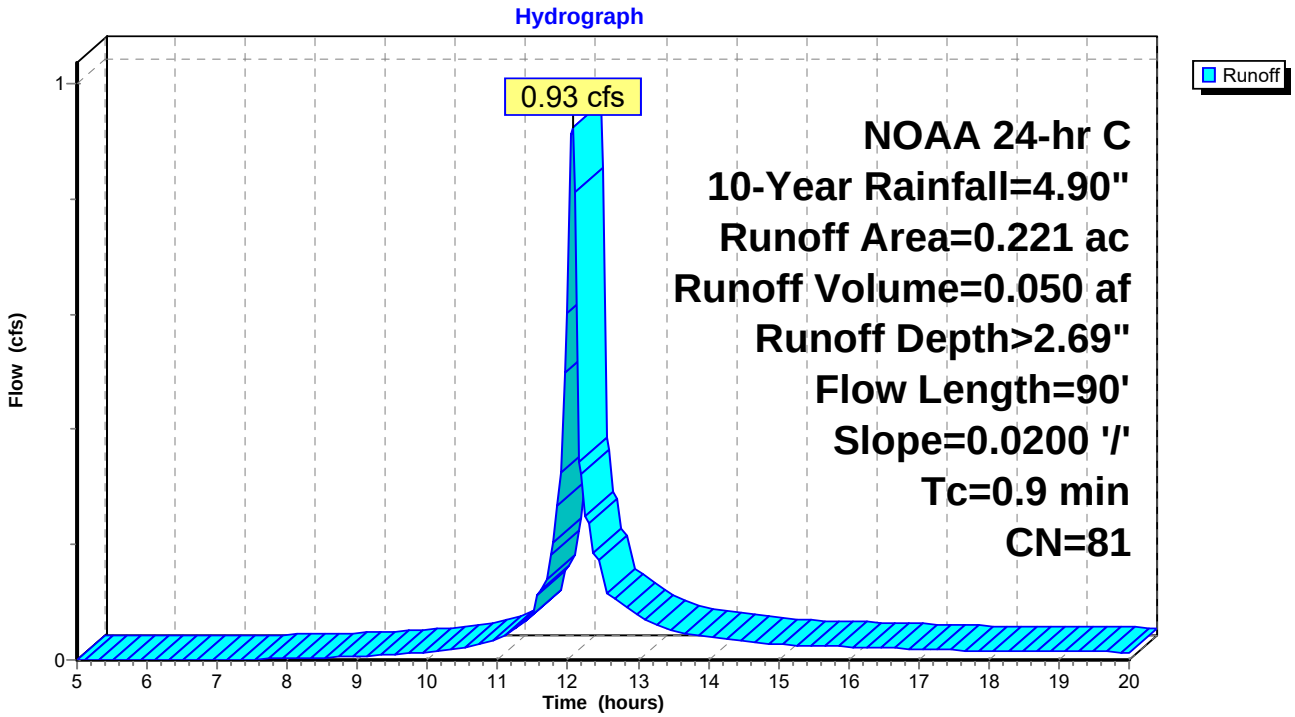
Runoff = 0.93 cfs @ 12.06 hrs, Volume= 0.050 af, Depth> 2.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.90"

Area (ac)	CN	Description
0.095	58	Meadow, non-grazed, HSG B
0.126	98	Paved roads w/curbs & sewers, HSG B
0.221	81	Weighted Average
0.095		42.99% Pervious Area
0.126		57.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.22		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.30"
0.2	40	0.0200	2.87		**Shallow Concentrated Flow, SCF** Paved Kv= 20.3 fps
0.9	90	Total			

Subcatchment 5S: Vegetated Filter Strip DA



Summary for Subcatchment 6S: Undetained Area

[49] Hint: Tc<2dt may require smaller dt

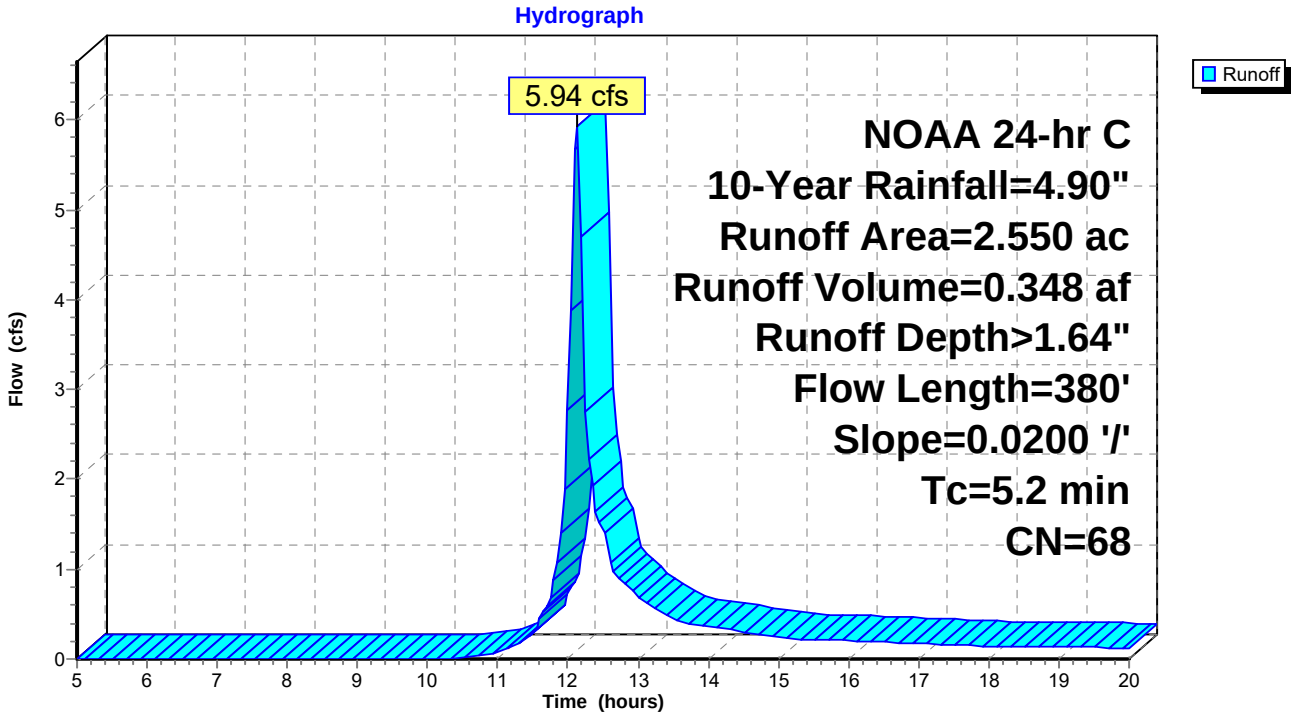
Runoff = 5.94 cfs @ 12.13 hrs, Volume= 0.348 af, Depth> 1.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.90"

Area (ac)	CN	Description
1.920	58	Meadow, non-grazed, HSG B
0.630	98	Paved roads w/curbs & sewers, HSG B
2.550	68	Weighted Average
1.920		75.29% Pervious Area
0.630		24.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.40		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.30"
0.6	80	0.0200	2.28		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
3.4	200	0.0200	0.99		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
5.2	380	Total			

Subcatchment 6S: Undetained Area



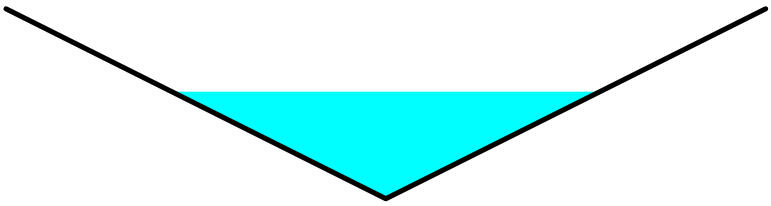
Summary for Reach 2R: Existing Swale

Inflow Area = 3.160 ac, 27.53% Impervious, Inflow Depth > 1.71" for 10-Year event
Inflow = 8.95 cfs @ 12.08 hrs, Volume= 0.451 af
Outflow = 7.86 cfs @ 12.11 hrs, Volume= 0.450 af, Atten= 12%, Lag= 1.7 min

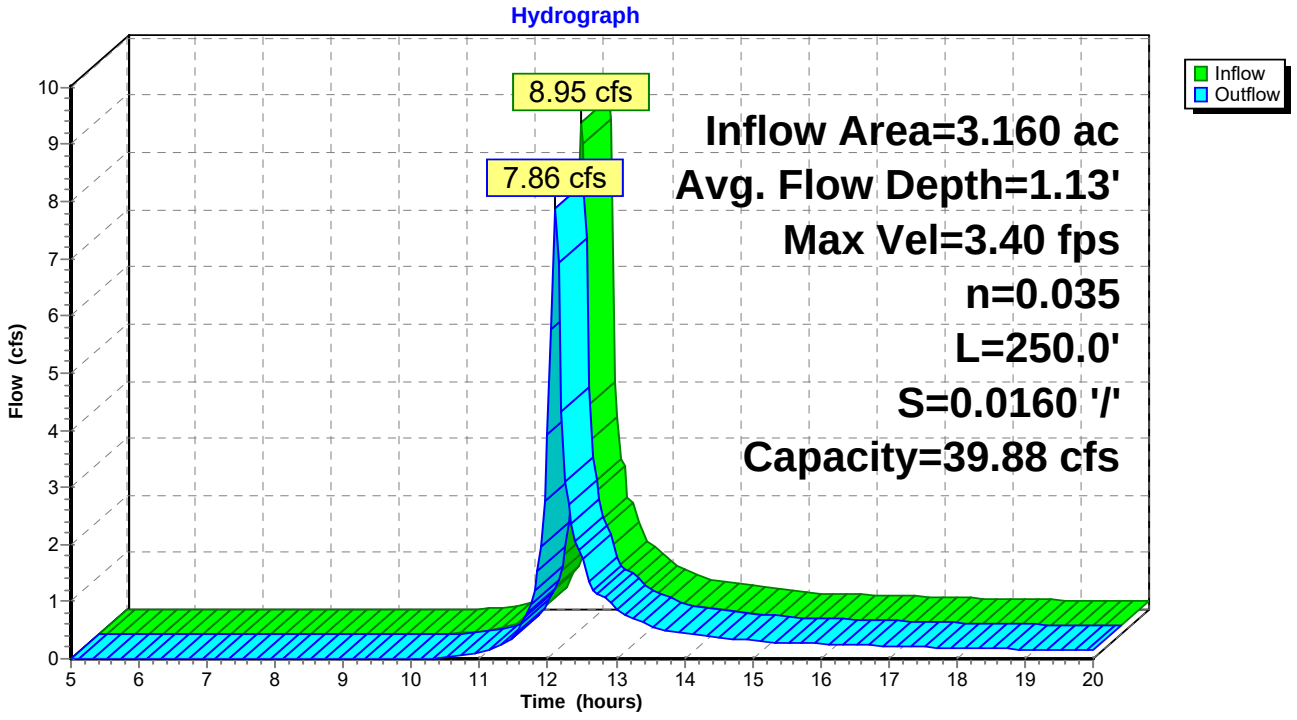
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.40 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 1.49 fps, Avg. Travel Time= 2.8 min

Peak Storage= 634 cf @ 12.10 hrs
Average Depth at Peak Storage= 1.13'
Bank-Full Depth= 2.00' Flow Area= 8.0 sf, Capacity= 39.88 cfs

0.00' x 2.00' deep channel, n= 0.035
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 250.0' Slope= 0.0160 '/'
Inlet Invert= 382.00', Outlet Invert= 378.00'



Reach 2R: Existing Swale



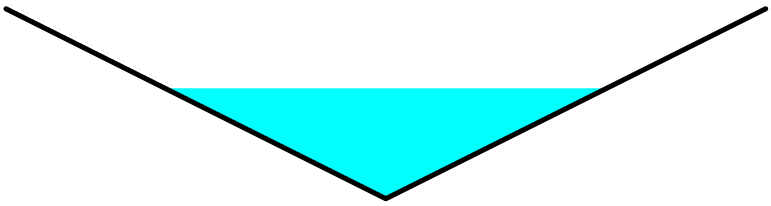
Summary for Reach 4R: Existing Swale

Inflow Area = 3.160 ac, 32.59% Impervious, Inflow Depth > 1.86" for 10-Year event
Inflow = 9.71 cfs @ 12.08 hrs, Volume= 0.491 af
Outflow = 8.58 cfs @ 12.11 hrs, Volume= 0.490 af, Atten= 12%, Lag= 1.7 min

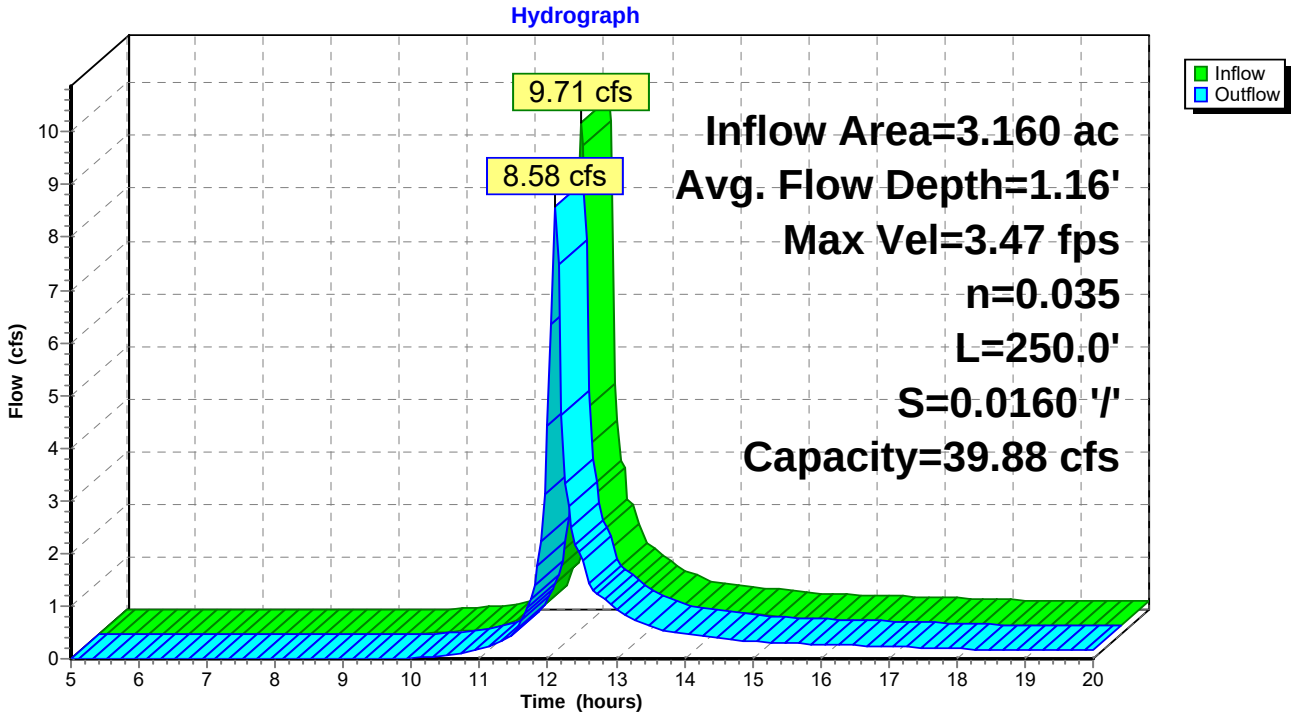
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.47 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 1.50 fps, Avg. Travel Time= 2.8 min

Peak Storage= 676 cf @ 12.09 hrs
Average Depth at Peak Storage= 1.16'
Bank-Full Depth= 2.00' Flow Area= 8.0 sf, Capacity= 39.88 cfs

0.00' x 2.00' deep channel, n= 0.035
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 250.0' Slope= 0.0160 '/'
Inlet Invert= 382.00', Outlet Invert= 378.00'



Reach 4R: Existing Swale



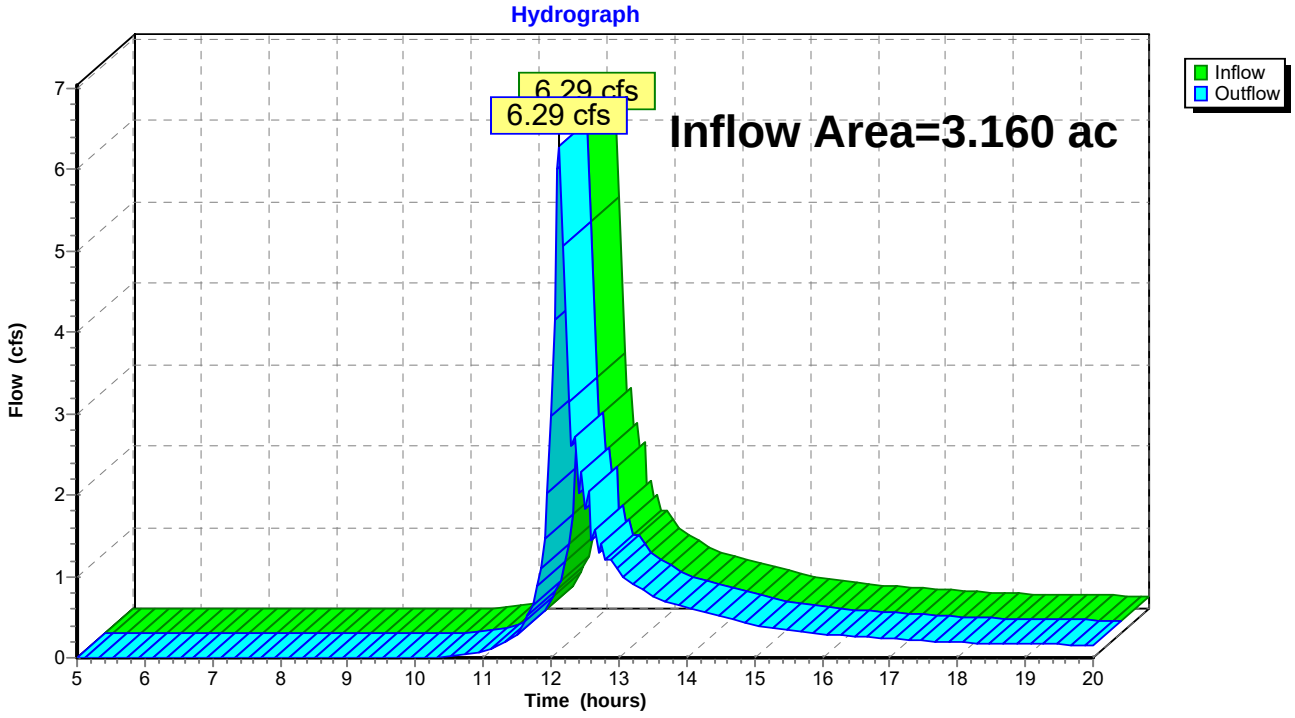
Summary for Reach 9R: Reach

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3.160 ac, 32.44% Impervious, Inflow Depth > 1.73" for 10-Year event
Inflow = 6.29 cfs @ 12.13 hrs, Volume= 0.456 af
Outflow = 6.29 cfs @ 12.13 hrs, Volume= 0.456 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach 9R: Reach



Summary for Pond 7P: Infiltration Berm

Inflow Area = 0.610 ac, 64.75% Impervious, Inflow Depth > 2.98" for 10-Year event
Inflow = 2.78 cfs @ 12.07 hrs, Volume= 0.152 af
Outflow = 0.60 cfs @ 12.34 hrs, Volume= 0.118 af, Atten= 78%, Lag= 16.6 min
Discarded = 0.01 cfs @ 12.34 hrs, Volume= 0.009 af
Primary = 0.38 cfs @ 12.34 hrs, Volume= 0.101 af
Secondary = 0.21 cfs @ 12.34 hrs, Volume= 0.008 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 385.68' @ 12.34 hrs Surf.Area= 4,162 sf Storage= 3,228 cf

Plug-Flow detention time= 133.7 min calculated for 0.118 af (78% of inflow)
Center-of-Mass det. time= 78.1 min (849.6 - 771.5)

Volume	Invert	Avail.Storage	Storage Description
#1	384.35'	4,692 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
384.35	476	0	0
385.10	2,783	1,222	1,222
385.50	3,723	1,301	2,523
386.00	4,950	2,168	4,692

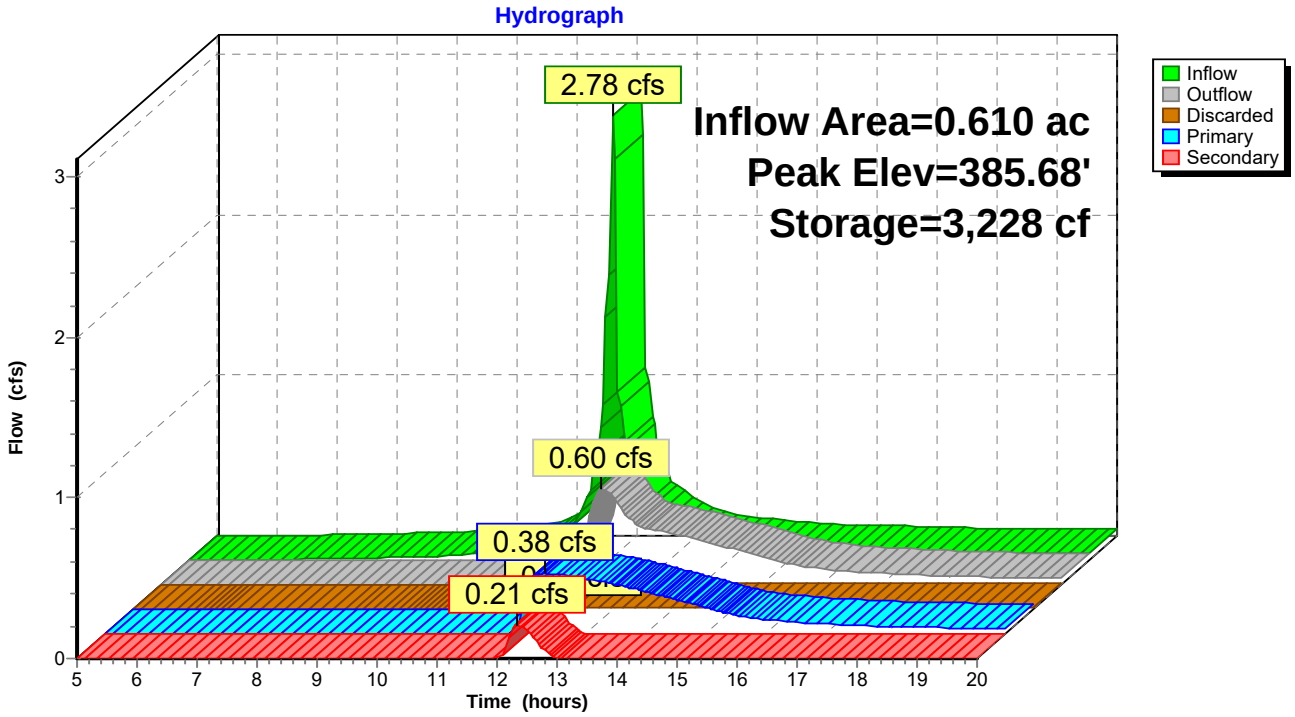
Device	Routing	Invert	Outlet Devices
#1	Primary	385.10'	**3.0" Round Culvert X 3.00** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 385.10' / 383.00' S= 0.1050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.05 sf
#2	Secondary	385.60'	**4.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#3	Discarded	384.35'	**0.125 in/hr Exfiltration over Surface area from 284.30' - 385.10'** Conductivity to Groundwater Elevation = 382.30' Excluded Surface area = 0 sf

Discarded OutFlow Max=0.01 cfs @ 12.34 hrs HW=385.68' (Free Discharge)
└**3=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.38 cfs @ 12.34 hrs HW=385.68' (Free Discharge)
└**1=Culvert** (Inlet Controls 0.38 cfs @ 2.56 fps)

Secondary OutFlow Max=0.21 cfs @ 12.34 hrs HW=385.68' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 0.21 cfs @ 0.66 fps)

Pond 7P: Infiltration Berm



Summary for Pond 8P: Level Spreader

[92] Warning: Device #1 is above defined storage
[93] Warning: Storage range exceeded by 0.04'
[88] Warning: Qout>Qin may require smaller dt or Finer Routing
[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=5)

Inflow	=	0.21 cfs @	12.34 hrs, Volume=	0.008 af
Outflow	=	0.40 cfs @	12.35 hrs, Volume=	0.007 af, Atten= 0%, Lag= 0.4 min
Primary	=	0.40 cfs @	12.35 hrs, Volume=	0.007 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 385.44' @ 12.35 hrs Surf.Area= 225 sf Storage= 84 cf

Plug-Flow detention time= 8.7 min calculated for 0.007 af (81% of inflow)
Center-of-Mass det. time= 4.8 min (752.1 - 747.3)

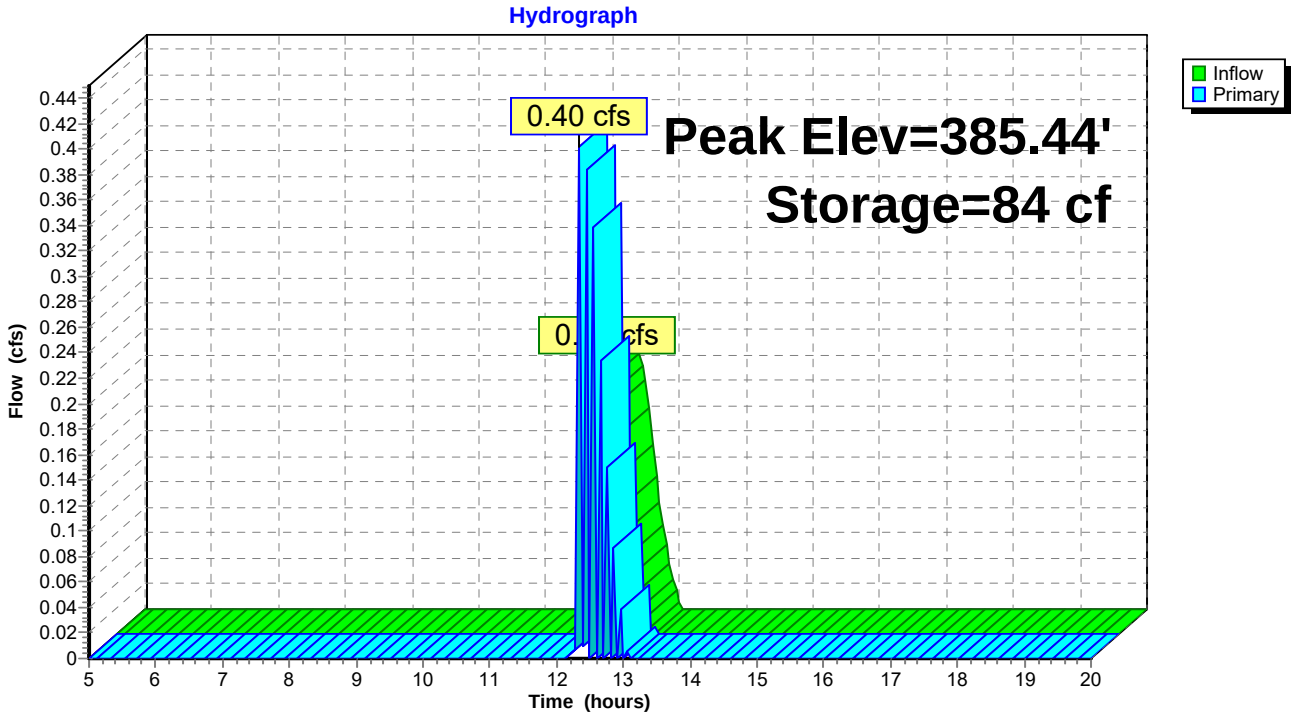
Volume	Invert	Avail.Storage	Storage Description
#1	384.65'	84 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
384.65	0	0	0
385.40	225	84	84

Device	Routing	Invert	Outlet Devices
#1	Primary	385.40'	**20.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=0.40 cfs @ 12.35 hrs HW=385.44' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 0.40 cfs @ 0.53 fps)

Pond 8P: Level Spreader



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 1S: Pre-Condition Runoff Area=3.160 ac 27.53% Impervious Runoff Depth>2.49"
Flow Length=192' Slope=0.0400 '/' Tc=1.7 min CN=69 Runoff=12.90 cfs 0.654 af

Subcatchment 3S: Post-Condition Runoff Area=3.160 ac 32.59% Impervious Runoff Depth>2.66"
Flow Length=192' Slope=0.0400 '/' Tc=1.7 min CN=71 Runoff=13.76 cfs 0.702 af

Subcatchment 4S: Berm DA Runoff Area=0.389 ac 69.15% Impervious Runoff Depth>4.13"
Flow Length=192' Tc=1.2 min CN=86 Runoff=2.39 cfs 0.134 af

Subcatchment 5S: Vegetated Filter Strip DA Runoff Area=0.221 ac 57.01% Impervious Runoff Depth>3.62"
Flow Length=90' Slope=0.0200 '/' Tc=0.9 min CN=81 Runoff=1.23 cfs 0.067 af

Subcatchment 6S: Undetained Area Runoff Area=2.550 ac 24.71% Impervious Runoff Depth>2.39"
Flow Length=380' Slope=0.0200 '/' Tc=5.2 min CN=68 Runoff=8.66 cfs 0.509 af

Reach 2R: Existing Swale Avg. Flow Depth=1.30' Max Vel=3.73 fps Inflow=12.90 cfs 0.654 af
n=0.035 L=250.0' S=0.0160 '/' Capacity=39.88 cfs Outflow=11.54 cfs 0.653 af

Reach 4R: Existing Swale Avg. Flow Depth=1.33' Max Vel=3.79 fps Inflow=13.76 cfs 0.702 af
n=0.035 L=250.0' S=0.0160 '/' Capacity=39.88 cfs Outflow=12.37 cfs 0.700 af

Reach 9R: Reach Inflow=10.44 cfs 0.665 af
Outflow=10.44 cfs 0.665 af

Pond 7P: Infiltration Berm Peak Elev=385.82' Storage=3,837 cf Inflow=3.62 cfs 0.201 af
Discarded=0.01 cfs 0.009 af Primary=0.43 cfs 0.120 af Secondary=0.98 cfs 0.036 af Outflow=1.42 cfs 0.166 af

Pond 8P: Level Spreader Peak Elev=385.49' Storage=84 cf Inflow=0.98 cfs 0.036 af
Outflow=1.58 cfs 0.036 af

Total Runoff Area = 9.480 ac Runoff Volume = 2.065 af Average Runoff Depth = 2.61"
69.15% Pervious = 6.555 ac 30.85% Impervious = 2.925 ac

Summary for Subcatchment 1S: Pre-Condition

[49] Hint: Tc<2dt may require smaller dt

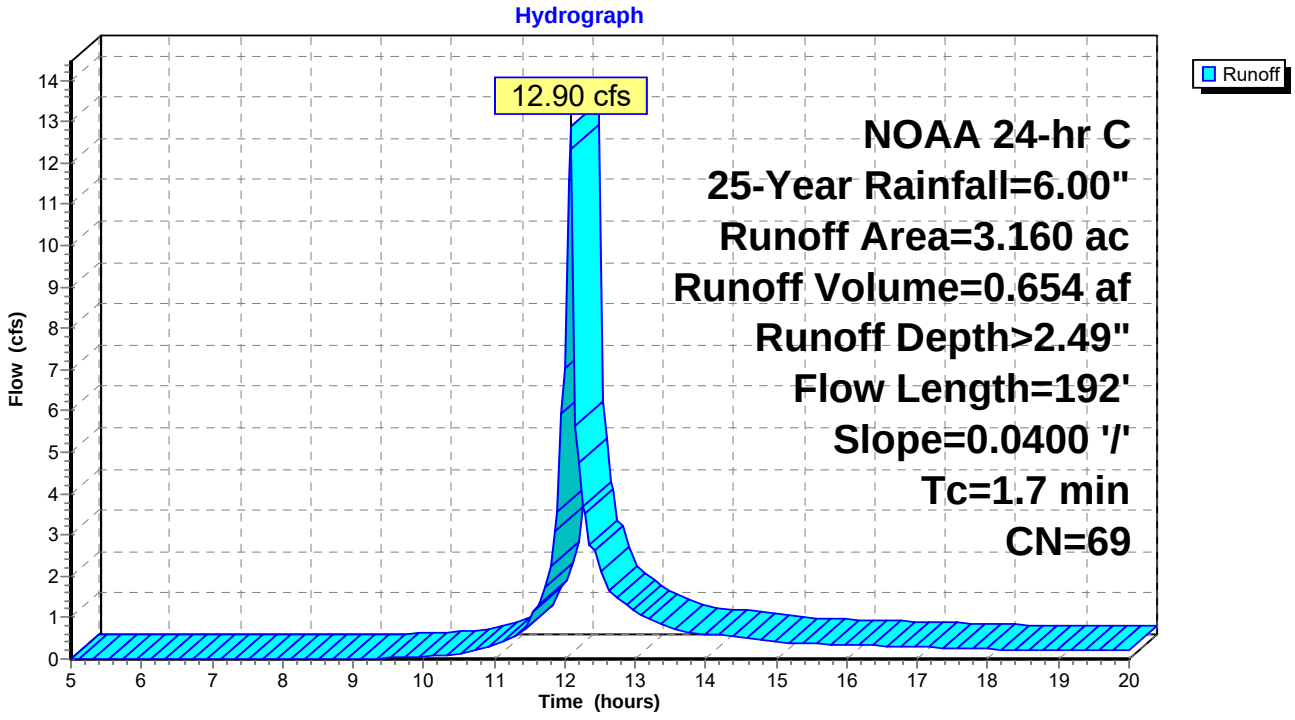
Runoff = 12.90 cfs @ 12.08 hrs, Volume= 0.654 af, Depth> 2.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-Year Rainfall=6.00"

Area (ac)	CN	Description
2.290	58	Meadow, non-grazed, HSG B
0.870	98	Paved roads w/curbs & sewers, HSG B
3.160	69	Weighted Average
2.290		72.47% Pervious Area
0.870		27.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	50	0.0400	1.60		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 3.30"
0.3	70	0.0400	4.06		**Shallow Concentrated Flow, SCF1** Paved Kv= 20.3 fps
0.9	72	0.0400	1.40		**Shallow Concentrated Flow, SCF2** Short Grass Pasture Kv= 7.0 fps
1.7	192	Total			

Subcatchment 1S: Pre-Condition



Summary for Subcatchment 3S: Post-Condition

[49] Hint: Tc<2dt may require smaller dt

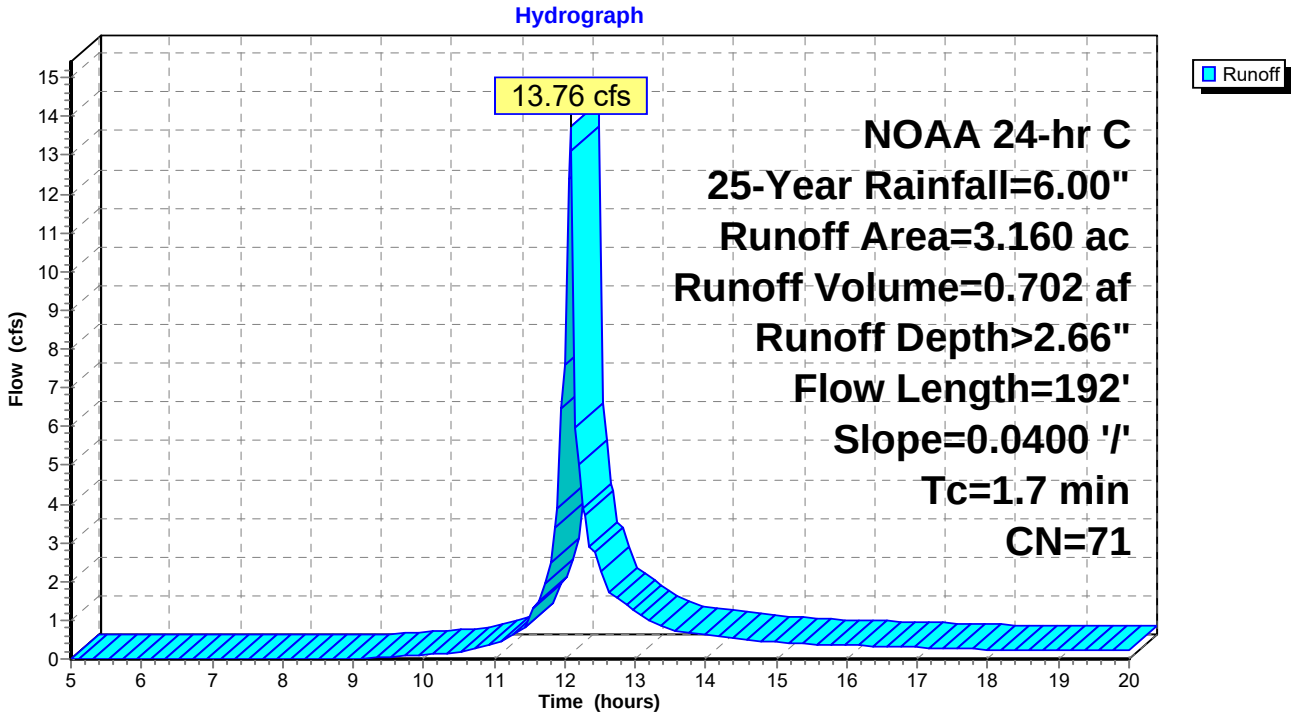
Runoff = 13.76 cfs @ 12.08 hrs, Volume= 0.702 af, Depth> 2.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-Year Rainfall=6.00"

Area (ac)	CN	Description
2.130	58	Meadow, non-grazed, HSG B
1.030	98	Paved roads w/curbs & sewers, HSG B
3.160	71	Weighted Average
2.130		67.41% Pervious Area
1.030		32.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	50	0.0400	1.60		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 3.30"
0.3	70	0.0400	4.06		**Shallow Concentrated Flow, SCF1** Paved Kv= 20.3 fps
0.9	72	0.0400	1.40		**Shallow Concentrated Flow, SCF2** Short Grass Pasture Kv= 7.0 fps
1.7	192	Total			

Subcatchment 3S: Post-Condition



Summary for Subcatchment 4S: Berm DA

[49] Hint: Tc<2dt may require smaller dt

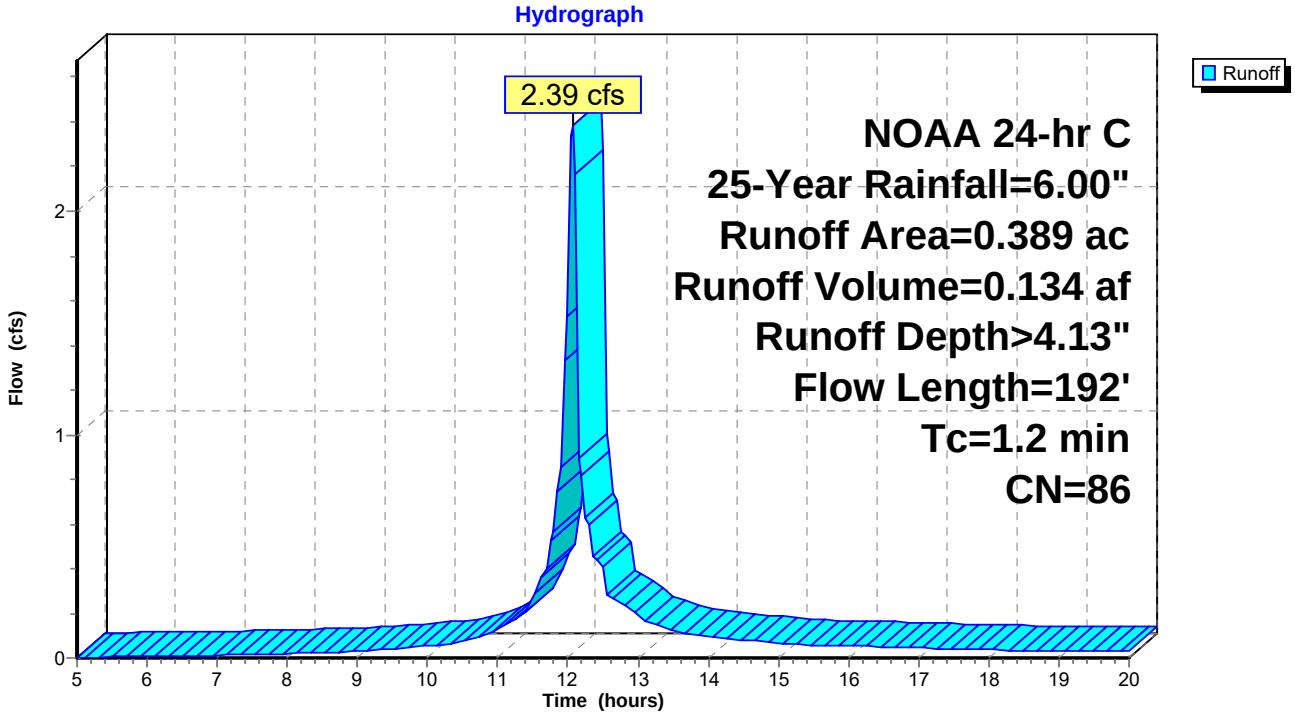
Runoff = 2.39 cfs @ 12.07 hrs, Volume= 0.134 af, Depth> 4.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-Year Rainfall=6.00"

Area (ac)	CN	Description
0.120	58	Meadow, non-grazed, HSG B
0.269	98	Paved roads w/curbs & sewers, HSG B
0.389	86	Weighted Average
0.120		30.85% Pervious Area
0.269		69.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	50	0.0400	1.60		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.30"
0.7	142	0.0280	3.40		**Shallow Concentrated Flow, SCF** Paved Kv= 20.3 fps
1.2	192	Total			

Subcatchment 4S: Berm DA



Summary for Subcatchment 5S: Vegetated Filter Strip DA

[49] Hint: Tc<2dt may require smaller dt

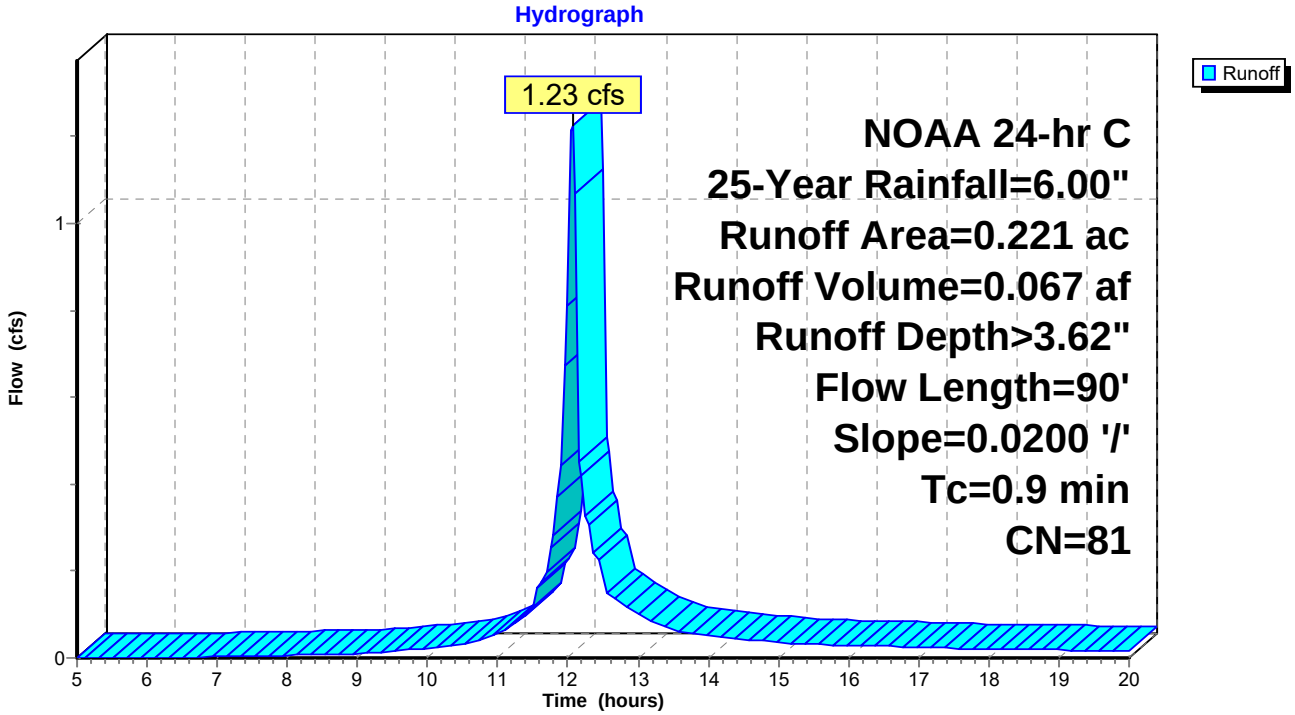
Runoff = 1.23 cfs @ 12.06 hrs, Volume= 0.067 af, Depth> 3.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-Year Rainfall=6.00"

Area (ac)	CN	Description
0.095	58	Meadow, non-grazed, HSG B
0.126	98	Paved roads w/curbs & sewers, HSG B
0.221	81	Weighted Average
0.095		42.99% Pervious Area
0.126		57.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.22		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.30"
0.2	40	0.0200	2.87		**Shallow Concentrated Flow, SCF** Paved Kv= 20.3 fps
0.9	90	Total			

Subcatchment 5S: Vegetated Filter Strip DA



Summary for Subcatchment 6S: Undetained Area

[49] Hint: Tc<2dt may require smaller dt

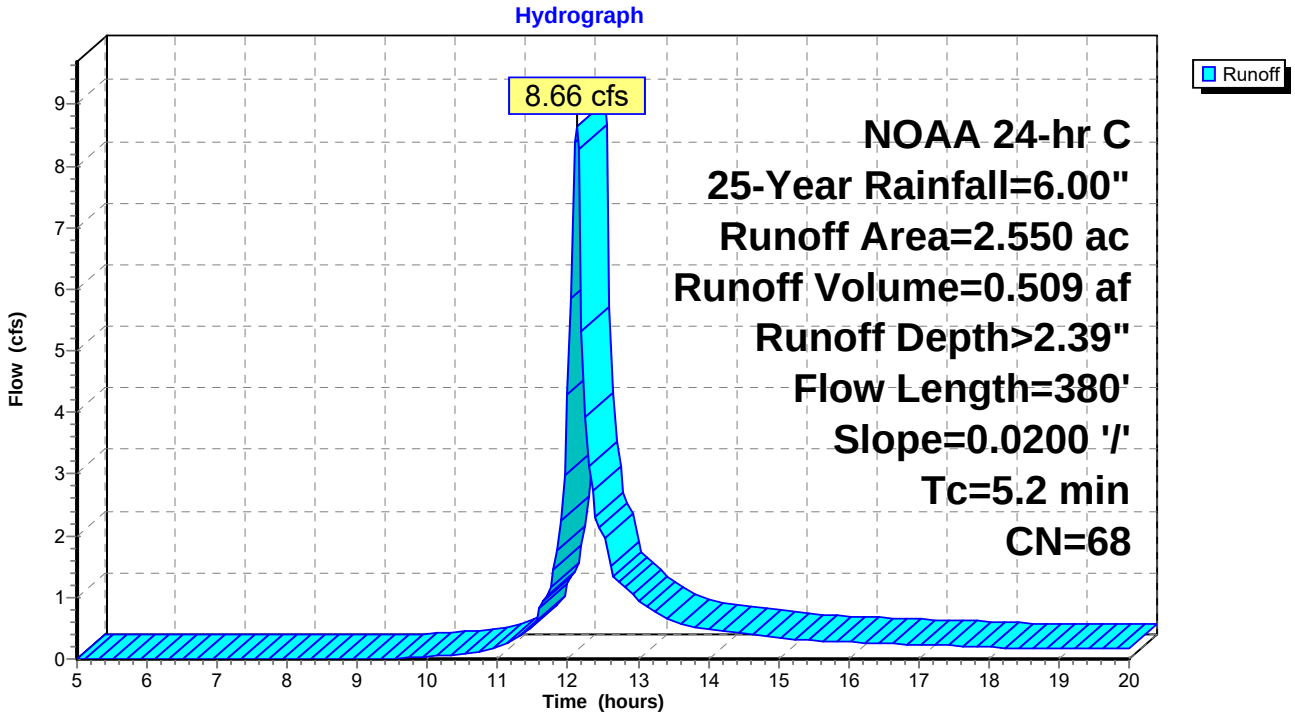
Runoff = 8.66 cfs @ 12.12 hrs, Volume= 0.509 af, Depth> 2.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 25-Year Rainfall=6.00"

Area (ac)	CN	Description
1.920	58	Meadow, non-grazed, HSG B
0.630	98	Paved roads w/curbs & sewers, HSG B
2.550	68	Weighted Average
1.920		75.29% Pervious Area
0.630		24.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.40		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.30"
0.6	80	0.0200	2.28		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
3.4	200	0.0200	0.99		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
5.2	380	Total			

Subcatchment 6S: Undetained Area



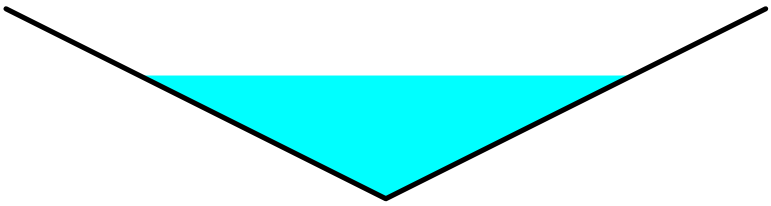
Summary for Reach 2R: Existing Swale

Inflow Area = 3.160 ac, 27.53% Impervious, Inflow Depth > 2.49" for 25-Year event
Inflow = 12.90 cfs @ 12.08 hrs, Volume= 0.654 af
Outflow = 11.54 cfs @ 12.11 hrs, Volume= 0.653 af, Atten= 11%, Lag= 1.5 min

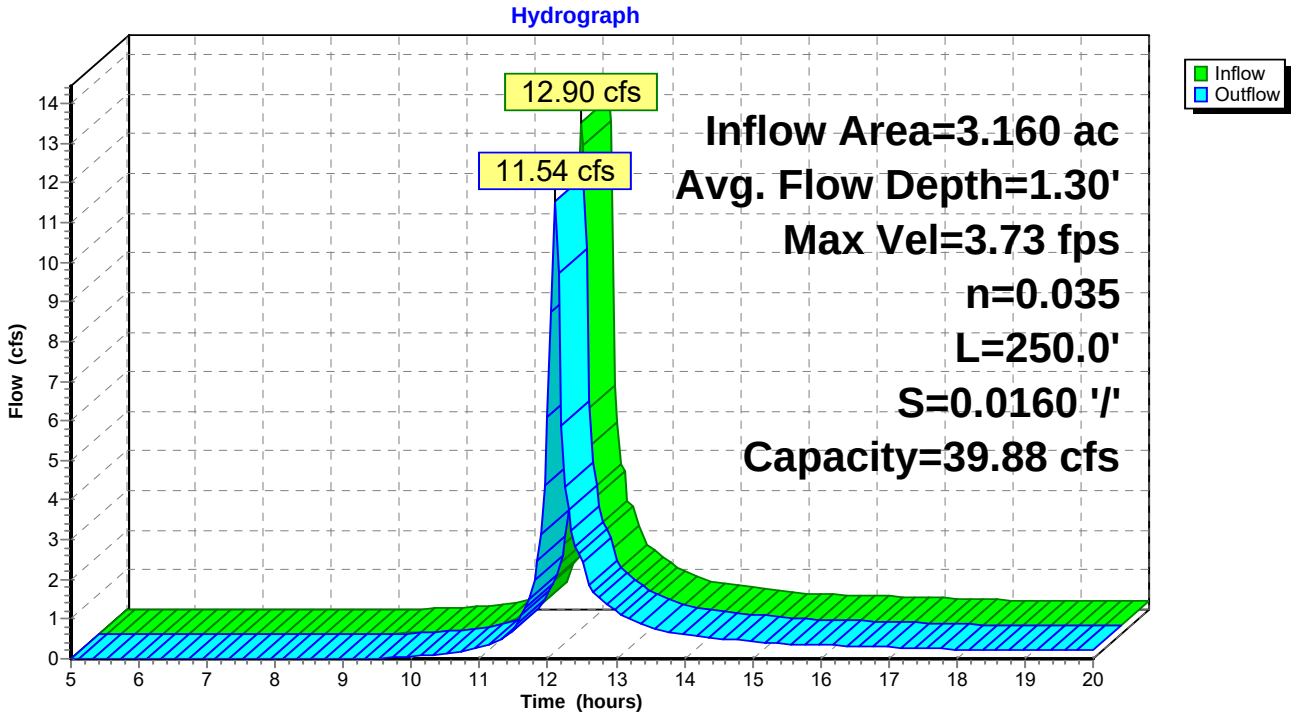
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.73 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 1.58 fps, Avg. Travel Time= 2.6 min

Peak Storage= 840 cf @ 12.09 hrs
Average Depth at Peak Storage= 1.30'
Bank-Full Depth= 2.00' Flow Area= 8.0 sf, Capacity= 39.88 cfs

0.00' x 2.00' deep channel, n= 0.035
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 250.0' Slope= 0.0160 '/'
Inlet Invert= 382.00', Outlet Invert= 378.00'



Reach 2R: Existing Swale



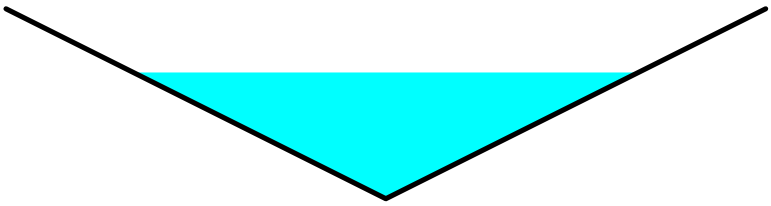
Summary for Reach 4R: Existing Swale

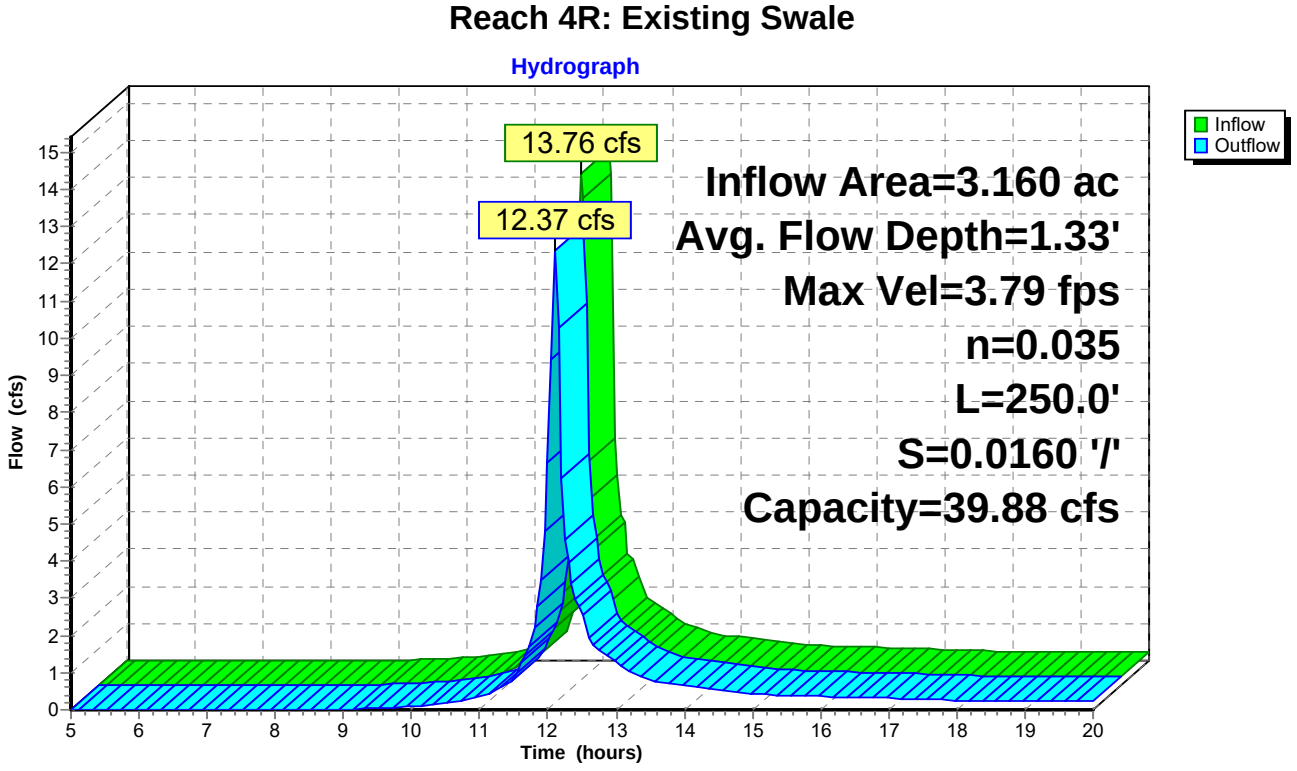
Inflow Area = 3.160 ac, 32.59% Impervious, Inflow Depth > 2.66" for 25-Year event
Inflow = 13.76 cfs @ 12.08 hrs, Volume= 0.702 af
Outflow = 12.37 cfs @ 12.10 hrs, Volume= 0.700 af, Atten= 10%, Lag= 1.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.79 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 1.58 fps, Avg. Travel Time= 2.6 min

Peak Storage= 884 cf @ 12.09 hrs
Average Depth at Peak Storage= 1.33'
Bank-Full Depth= 2.00' Flow Area= 8.0 sf, Capacity= 39.88 cfs

0.00' x 2.00' deep channel, n= 0.035
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 250.0' Slope= 0.0160 '/'
Inlet Invert= 382.00', Outlet Invert= 378.00'





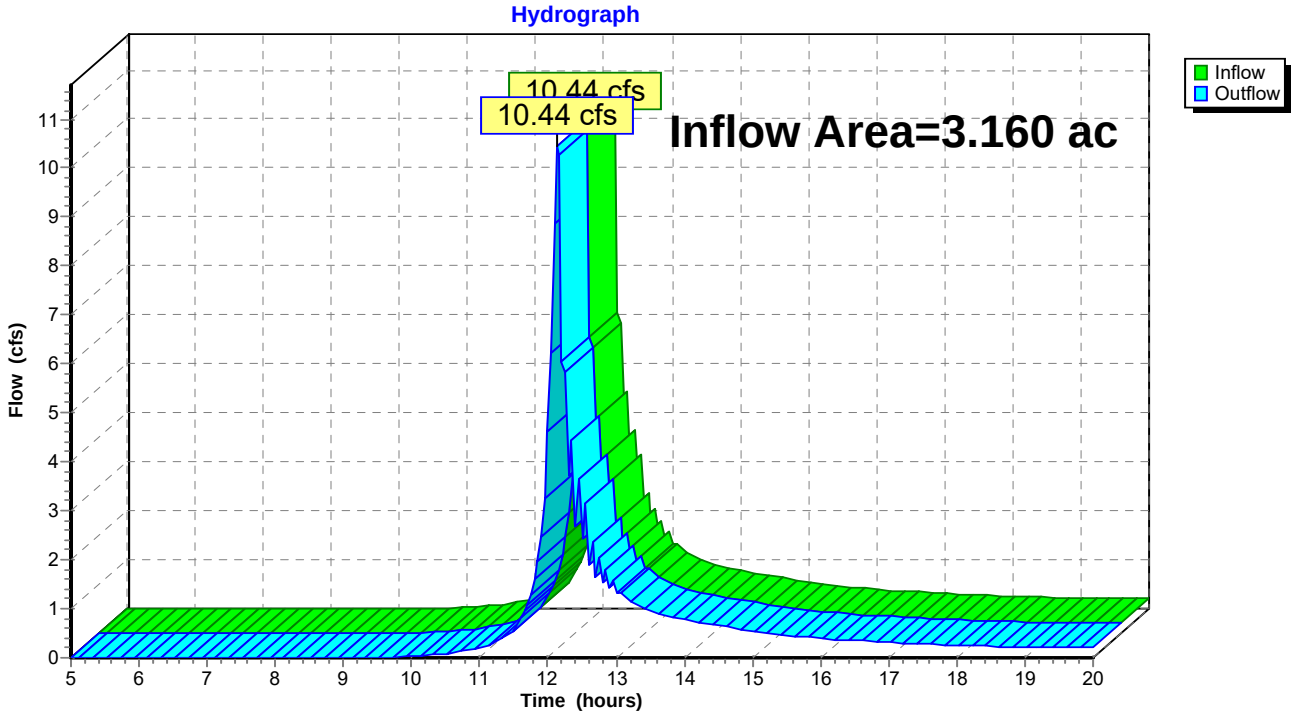
Summary for Reach 9R: Reach

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3.160 ac, 32.44% Impervious, Inflow Depth > 2.52" for 25-Year event
Inflow = 10.44 cfs @ 12.14 hrs, Volume= 0.665 af
Outflow = 10.44 cfs @ 12.14 hrs, Volume= 0.665 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach 9R: Reach



Summary for Pond 7P: Infiltration Berm

Inflow Area = 0.610 ac, 64.75% Impervious, Inflow Depth > 3.94" for 25-Year event
Inflow = 3.62 cfs @ 12.06 hrs, Volume= 0.201 af
Outflow = 1.42 cfs @ 12.17 hrs, Volume= 0.166 af, Atten= 61%, Lag= 6.4 min
Discarded = 0.01 cfs @ 12.17 hrs, Volume= 0.009 af
Primary = 0.43 cfs @ 12.17 hrs, Volume= 0.120 af
Secondary = 0.98 cfs @ 12.17 hrs, Volume= 0.036 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 385.82' @ 12.17 hrs Surf.Area= 4,506 sf Storage= 3,837 cf

Plug-Flow detention time= 117.0 min calculated for 0.166 af (83% of inflow)
Center-of-Mass det. time= 68.1 min (833.1 - 765.0)

Volume	Invert	Avail.Storage	Storage Description
#1	384.35'	4,692 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
384.35	476	0	0
385.10	2,783	1,222	1,222
385.50	3,723	1,301	2,523
386.00	4,950	2,168	4,692

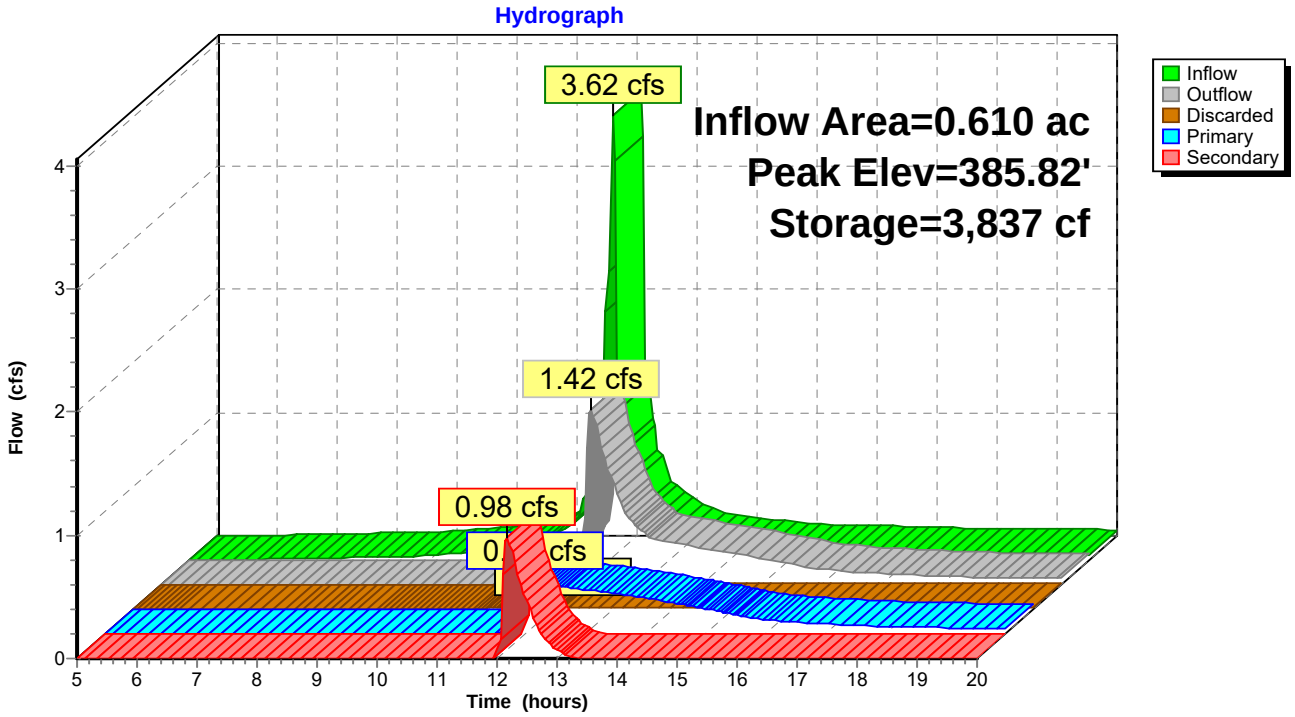
Device	Routing	Invert	Outlet Devices
#1	Primary	385.10'	**3.0" Round Culvert X 3.00** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 385.10' / 383.00' S= 0.1050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.05 sf
#2	Secondary	385.60'	**4.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#3	Discarded	384.35'	**0.125 in/hr Exfiltration over Surface area from 284.30' - 385.10'** Conductivity to Groundwater Elevation = 382.30' Excluded Surface area = 0 sf

Discarded OutFlow Max=0.01 cfs @ 12.17 hrs HW=385.81' (Free Discharge)
└**3=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.43 cfs @ 12.17 hrs HW=385.81' (Free Discharge)
└**1=Culvert** (Inlet Controls 0.43 cfs @ 2.92 fps)

Secondary OutFlow Max=0.94 cfs @ 12.17 hrs HW=385.81' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 0.94 cfs @ 1.10 fps)

Pond 7P: Infiltration Berm



Summary for Pond 8P: Level Spreader

[92] Warning: Device #1 is above defined storage
[93] Warning: Storage range exceeded by 0.09'
[88] Warning: Qout>Qin may require smaller dt or Finer Routing
[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=9)

Inflow	=	0.98 cfs @	12.17 hrs,	Volume=	0.036 af
Outflow	=	1.58 cfs @	12.15 hrs,	Volume=	0.036 af, Atten= 0%, Lag= 0.0 min
Primary	=	1.58 cfs @	12.15 hrs,	Volume=	0.036 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 385.49' @ 12.15 hrs Surf.Area= 225 sf Storage= 84 cf

Plug-Flow detention time= 2.4 min calculated for 0.035 af (98% of inflow)
Center-of-Mass det. time= 1.7 min (744.6 - 742.9)

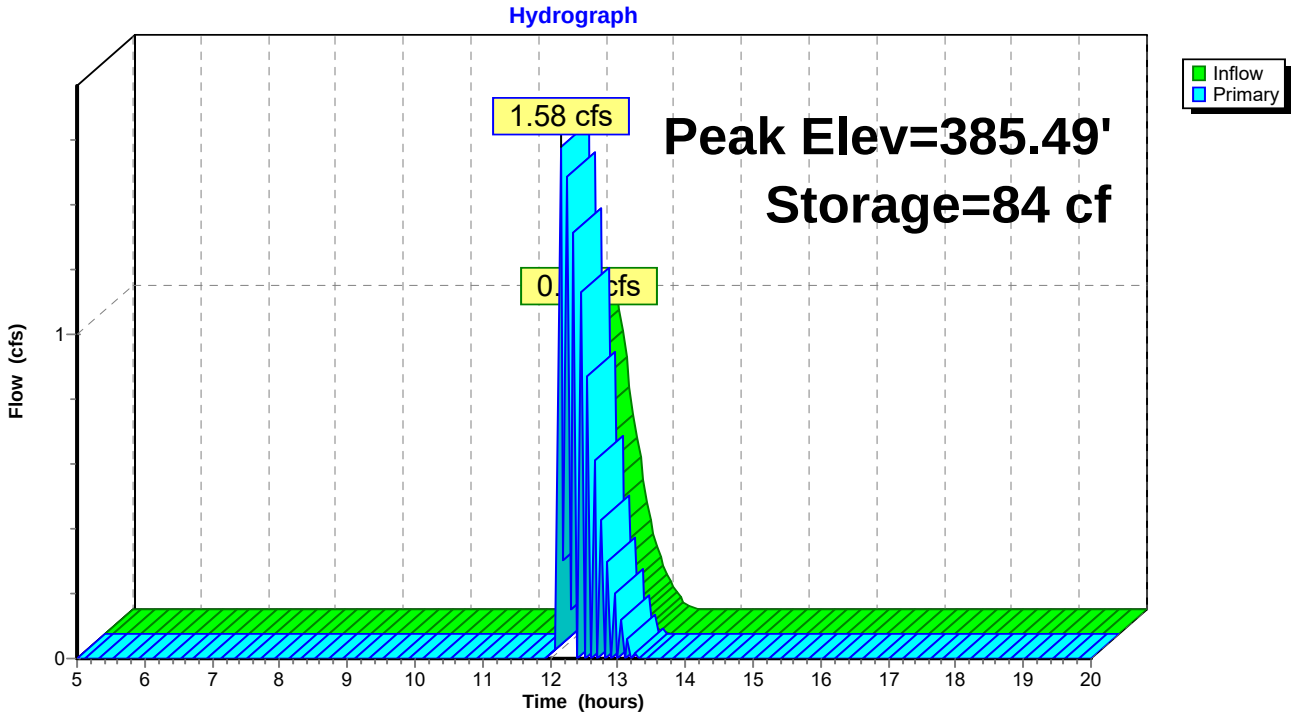
Volume	Invert	Avail.Storage	Storage Description
#1	384.65'	84 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
384.65	0	0	0
385.40	225	84	84

Device	Routing	Invert	Outlet Devices
#1	Primary	385.40'	**20.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=1.51 cfs @ 12.15 hrs HW=385.49' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 1.51 cfs @ 0.82 fps)

Pond 8P: Level Spreader



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 1S: Pre-Condition Runoff Area=3.160 ac 27.53% Impervious Runoff Depth>2.88"
Flow Length=192' Slope=0.0400 '/' Tc=1.7 min CN=69 Runoff=14.88 cfs 0.758 af

Subcatchment 3S: Post-Condition Runoff Area=3.160 ac 32.59% Impervious Runoff Depth>3.07"
Flow Length=192' Slope=0.0400 '/' Tc=1.7 min CN=71 Runoff=15.78 cfs 0.808 af

Subcatchment 4S: Berm DA Runoff Area=0.389 ac 69.15% Impervious Runoff Depth>4.61"
Flow Length=192' Tc=1.2 min CN=86 Runoff=2.65 cfs 0.149 af

Subcatchment 5S: Vegetated Filter Strip DA Runoff Area=0.221 ac 57.01% Impervious Runoff Depth>4.08"
Flow Length=90' Slope=0.0200 '/' Tc=0.9 min CN=81 Runoff=1.37 cfs 0.075 af

Subcatchment 6S: Undetained Area Runoff Area=2.550 ac 24.71% Impervious Runoff Depth>2.78"
Flow Length=380' Slope=0.0200 '/' Tc=5.2 min CN=68 Runoff=10.04 cfs 0.591 af

Reach 2R: Existing Swale Avg. Flow Depth=1.37' Max Vel=3.87 fps Inflow=14.88 cfs 0.758 af
n=0.035 L=250.0' S=0.0160 '/' Capacity=39.88 cfs Outflow=13.40 cfs 0.756 af

Reach 4R: Existing Swale Avg. Flow Depth=1.40' Max Vel=3.92 fps Inflow=15.78 cfs 0.808 af
n=0.035 L=250.0' S=0.0160 '/' Capacity=39.88 cfs Outflow=14.26 cfs 0.807 af

Reach 9R: Reach Inflow=11.98 cfs 0.769 af
Outflow=11.98 cfs 0.769 af

Pond 7P: Infiltration Berm Peak Elev=385.88' Storage=4,101 cf Inflow=4.02 cfs 0.224 af
Discarded=0.01 cfs 0.010 af Primary=0.45 cfs 0.129 af Secondary=1.41 cfs 0.051 af Outflow=1.88 cfs 0.190 af

Pond 8P: Level Spreader Peak Elev=385.49' Storage=84 cf Inflow=1.41 cfs 0.051 af
Outflow=1.51 cfs 0.049 af

Total Runoff Area = 9.480 ac Runoff Volume = 2.381 af Average Runoff Depth = 3.01"
69.15% Pervious = 6.555 ac 30.85% Impervious = 2.925 ac

Summary for Subcatchment 1S: Pre-Condition

[49] Hint: Tc<2dt may require smaller dt

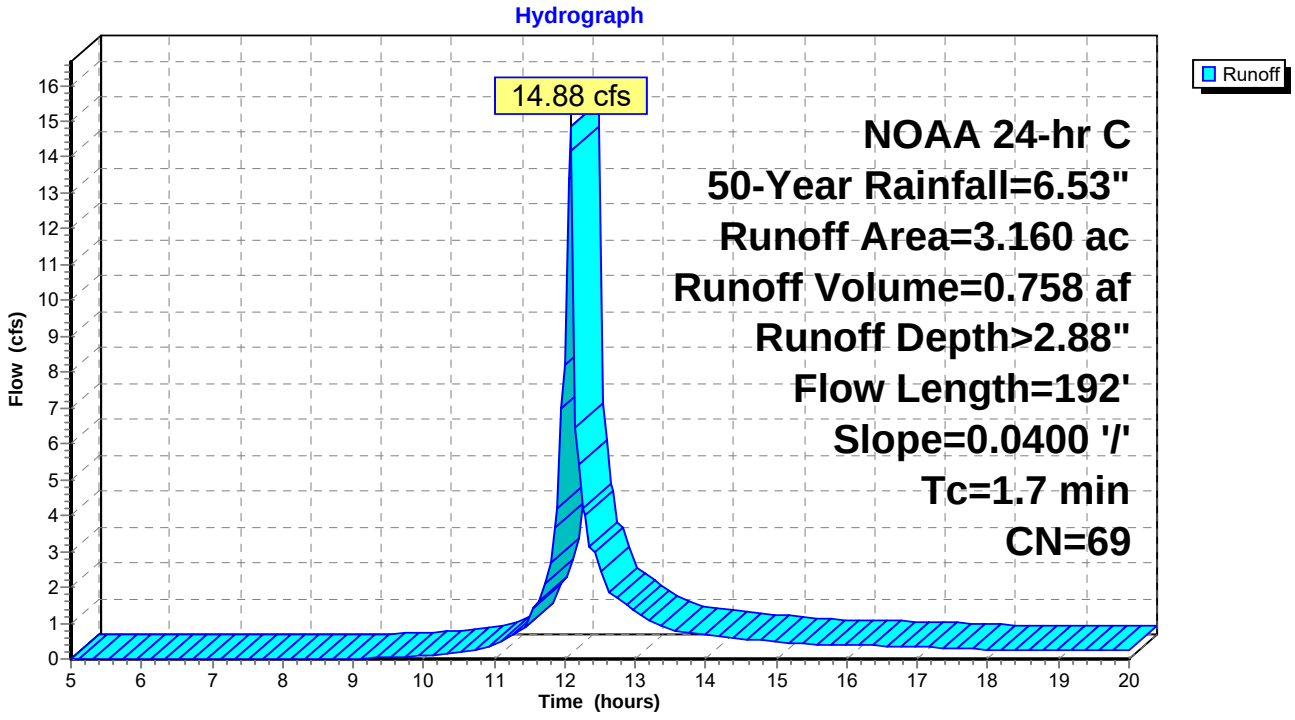
Runoff = 14.88 cfs @ 12.08 hrs, Volume= 0.758 af, Depth> 2.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 50-Year Rainfall=6.53"

Area (ac)	CN	Description
2.290	58	Meadow, non-grazed, HSG B
0.870	98	Paved roads w/curbs & sewers, HSG B
3.160	69	Weighted Average
2.290		72.47% Pervious Area
0.870		27.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	50	0.0400	1.60		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 3.30"
0.3	70	0.0400	4.06		**Shallow Concentrated Flow, SCF1** Paved Kv= 20.3 fps
0.9	72	0.0400	1.40		**Shallow Concentrated Flow, SCF2** Short Grass Pasture Kv= 7.0 fps
1.7	192	Total			

Subcatchment 1S: Pre-Condition



Summary for Subcatchment 3S: Post-Condition

[49] Hint: Tc<2dt may require smaller dt

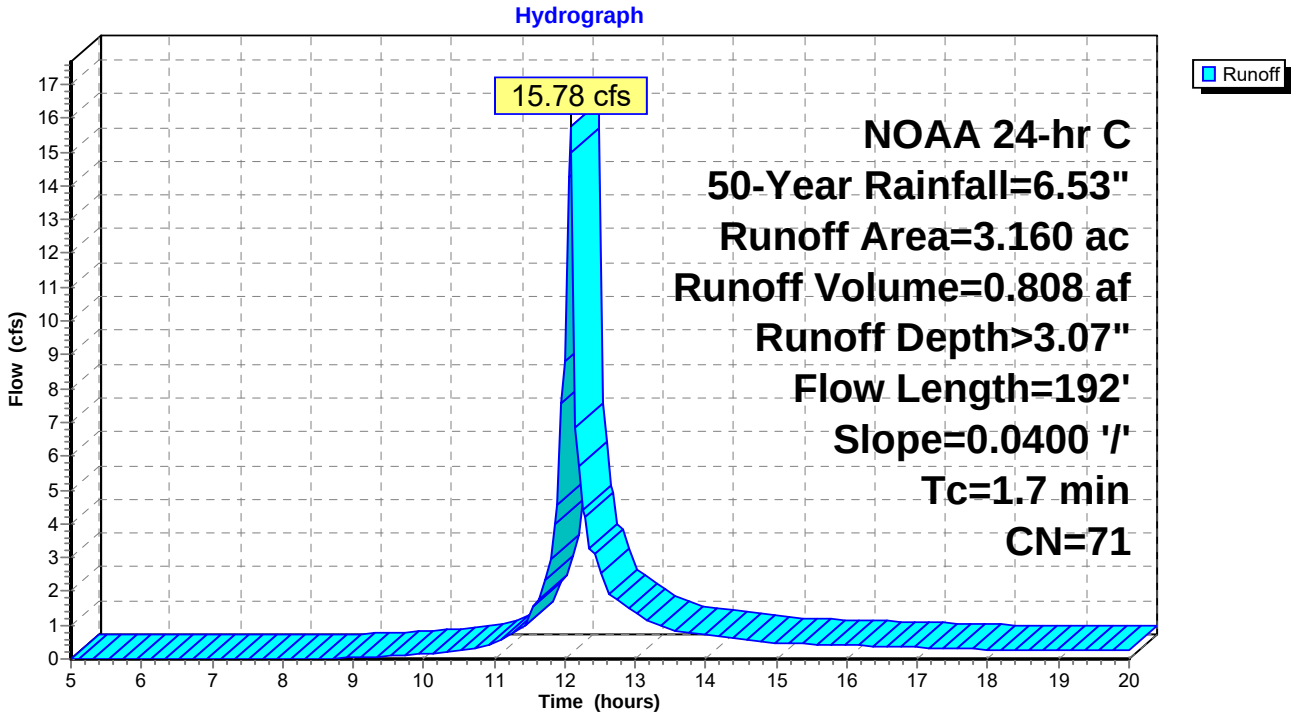
Runoff = 15.78 cfs @ 12.08 hrs, Volume= 0.808 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 50-Year Rainfall=6.53"

Area (ac)	CN	Description
2.130	58	Meadow, non-grazed, HSG B
1.030	98	Paved roads w/curbs & sewers, HSG B
3.160	71	Weighted Average
2.130		67.41% Pervious Area
1.030		32.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	50	0.0400	1.60		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 3.30"
0.3	70	0.0400	4.06		**Shallow Concentrated Flow, SCF1** Paved Kv= 20.3 fps
0.9	72	0.0400	1.40		**Shallow Concentrated Flow, SCF2** Short Grass Pasture Kv= 7.0 fps
1.7	192	Total			

Subcatchment 3S: Post-Condition



Summary for Subcatchment 4S: Berm DA

[49] Hint: Tc<2dt may require smaller dt

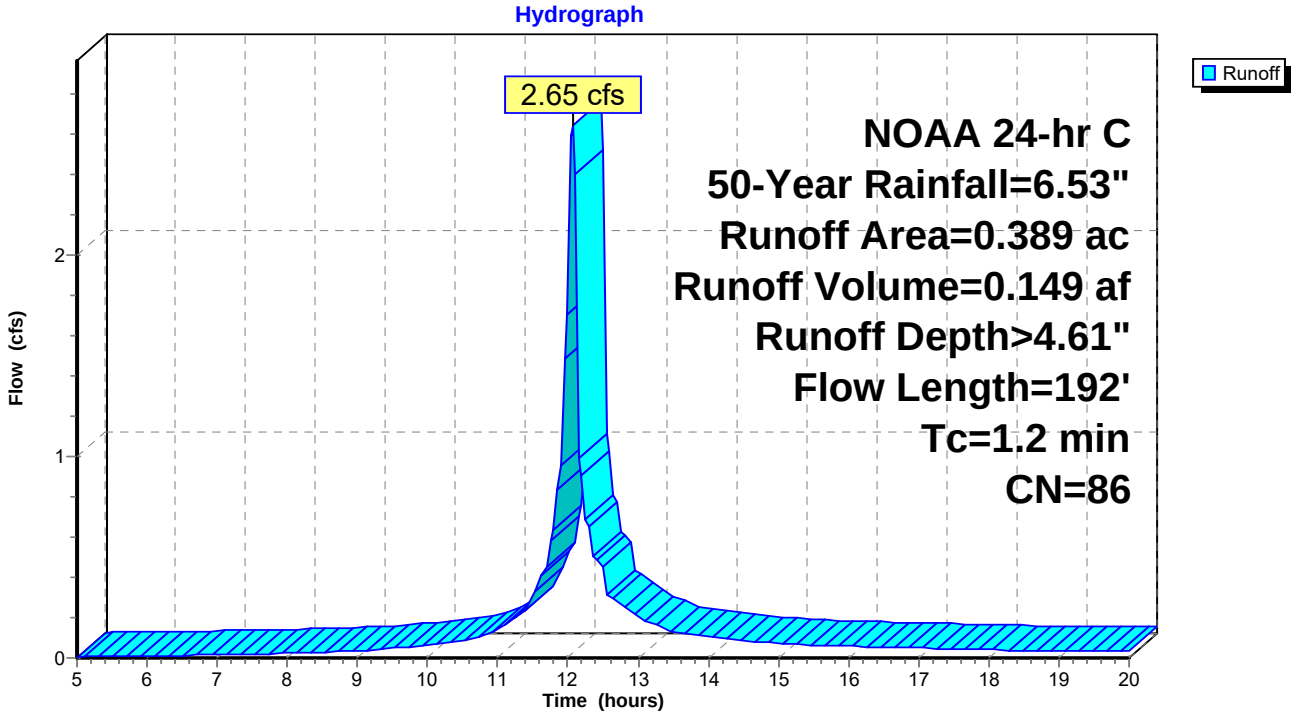
Runoff = 2.65 cfs @ 12.07 hrs, Volume= 0.149 af, Depth> 4.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 50-Year Rainfall=6.53"

Area (ac)	CN	Description
0.120	58	Meadow, non-grazed, HSG B
0.269	98	Paved roads w/curbs & sewers, HSG B
0.389	86	Weighted Average
0.120		30.85% Pervious Area
0.269		69.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	50	0.0400	1.60		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.30"
0.7	142	0.0280	3.40		**Shallow Concentrated Flow, SCF** Paved Kv= 20.3 fps
1.2	192	Total			

Subcatchment 4S: Berm DA



Summary for Subcatchment 5S: Vegetated Filter Strip DA

[49] Hint: Tc<2dt may require smaller dt

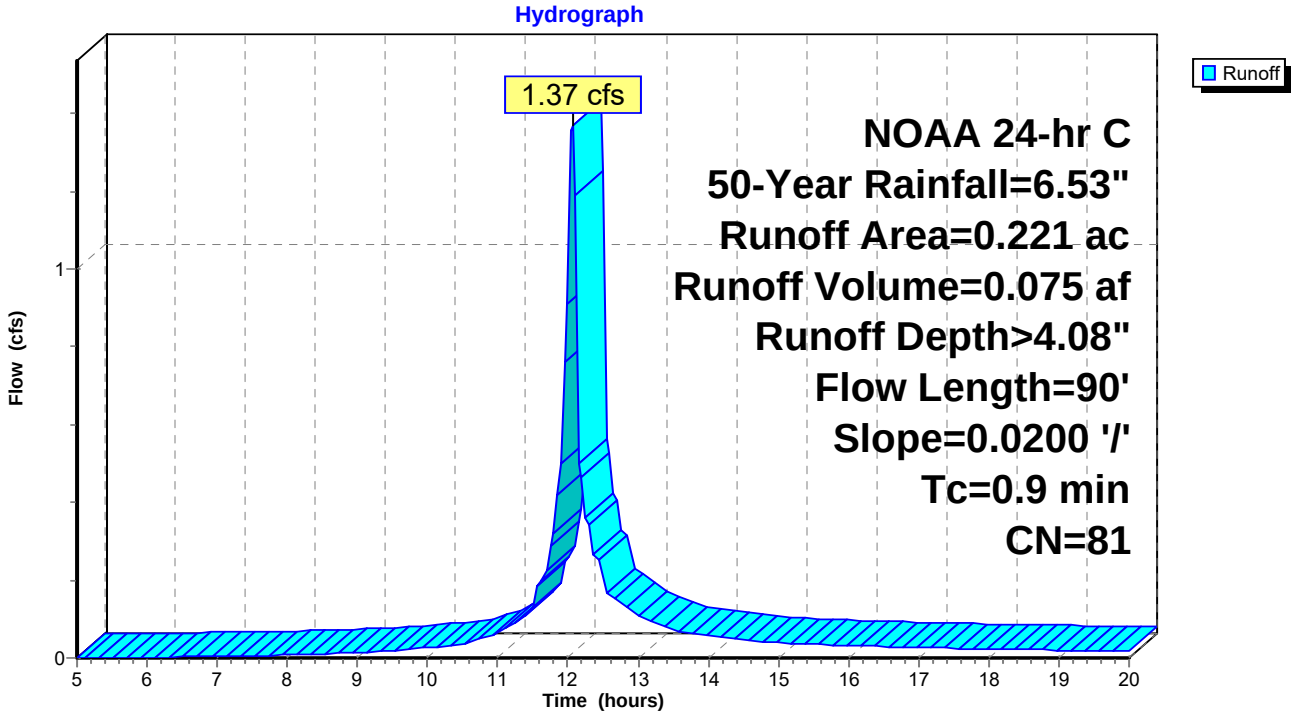
Runoff = 1.37 cfs @ 12.06 hrs, Volume= 0.075 af, Depth> 4.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 50-Year Rainfall=6.53"

Area (ac)	CN	Description
0.095	58	Meadow, non-grazed, HSG B
0.126	98	Paved roads w/curbs & sewers, HSG B
0.221	81	Weighted Average
0.095		42.99% Pervious Area
0.126		57.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.22		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.30"
0.2	40	0.0200	2.87		**Shallow Concentrated Flow, SCF** Paved Kv= 20.3 fps
0.9	90	Total			

Subcatchment 5S: Vegetated Filter Strip DA



Summary for Subcatchment 6S: Undetained Area

[49] Hint: Tc<2dt may require smaller dt

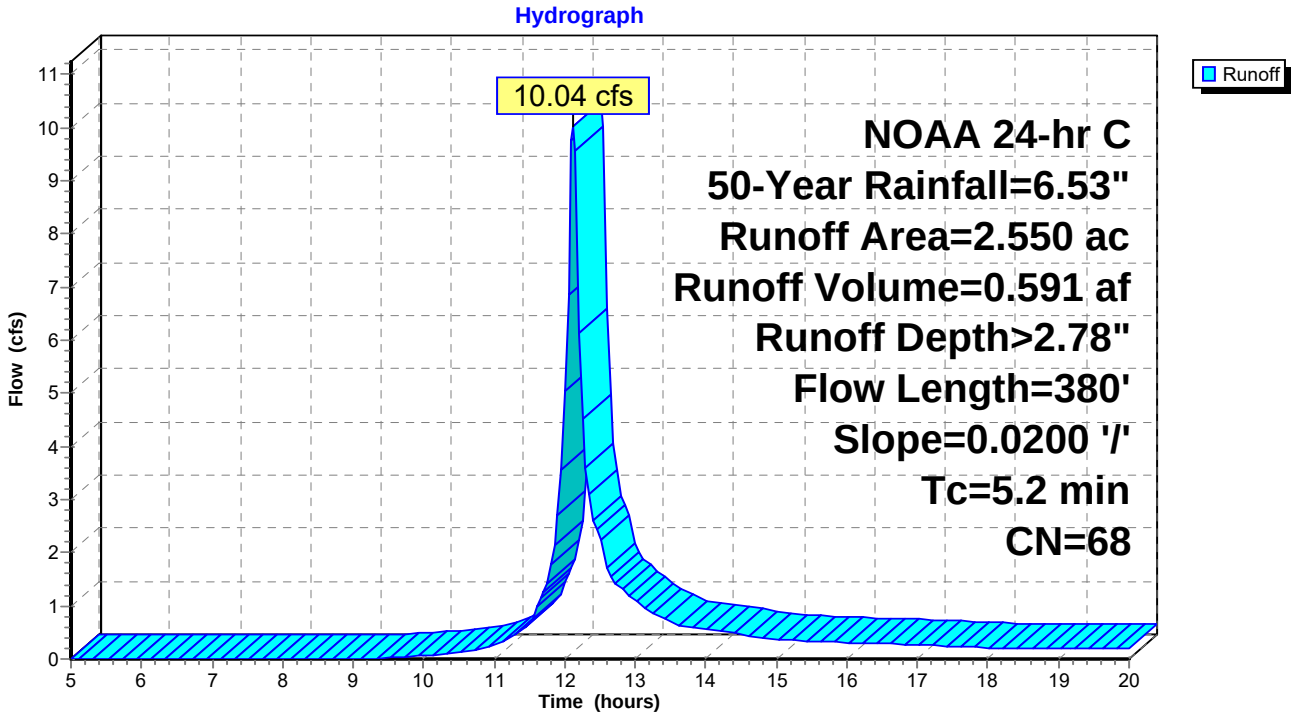
Runoff = 10.04 cfs @ 12.12 hrs, Volume= 0.591 af, Depth> 2.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 50-Year Rainfall=6.53"

Area (ac)	CN	Description
1.920	58	Meadow, non-grazed, HSG B
0.630	98	Paved roads w/curbs & sewers, HSG B
2.550	68	Weighted Average
1.920		75.29% Pervious Area
0.630		24.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.40		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.30"
0.6	80	0.0200	2.28		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
3.4	200	0.0200	0.99		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
5.2	380	Total			

Subcatchment 6S: Undetained Area



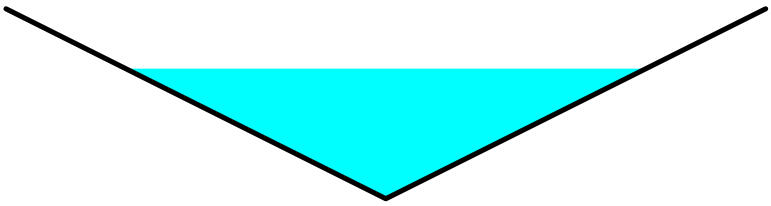
Summary for Reach 2R: Existing Swale

Inflow Area = 3.160 ac, 27.53% Impervious, Inflow Depth > 2.88" for 50-Year event
Inflow = 14.88 cfs @ 12.08 hrs, Volume= 0.758 af
Outflow = 13.40 cfs @ 12.10 hrs, Volume= 0.756 af, Atten= 10%, Lag= 1.5 min

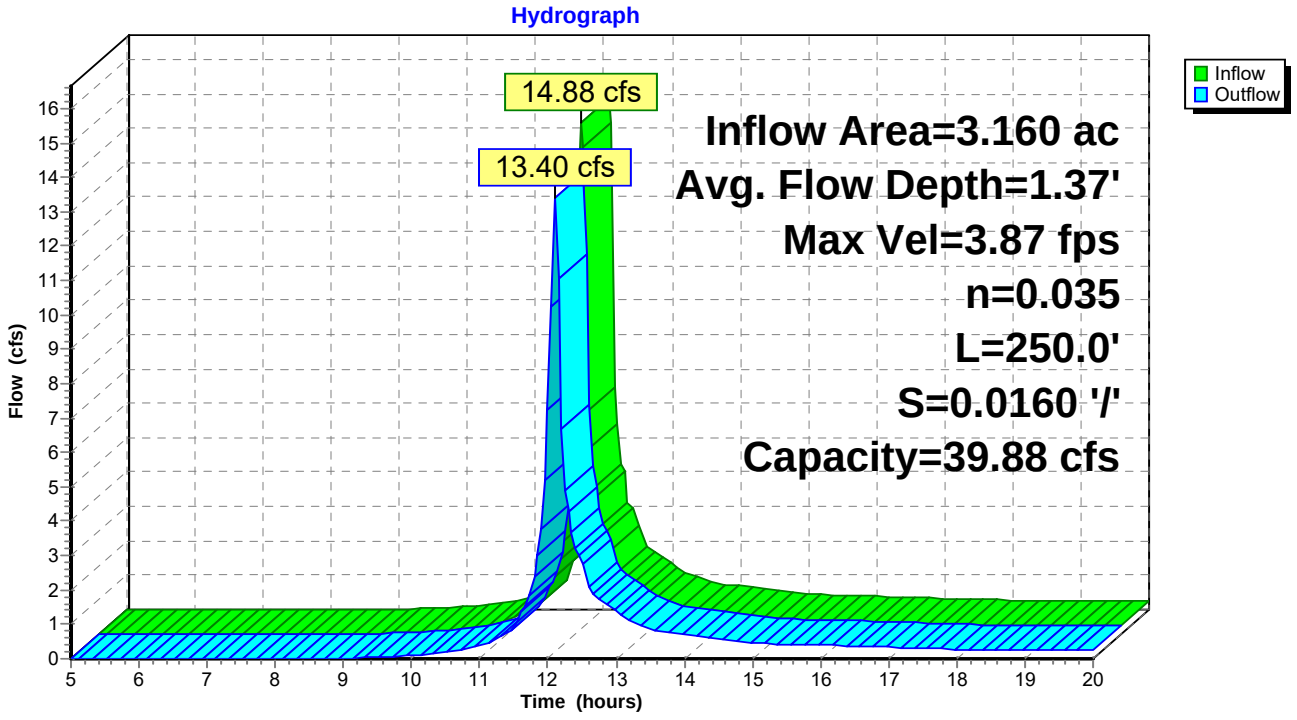
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.87 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 1.61 fps, Avg. Travel Time= 2.6 min

Peak Storage= 937 cf @ 12.09 hrs
Average Depth at Peak Storage= 1.37'
Bank-Full Depth= 2.00' Flow Area= 8.0 sf, Capacity= 39.88 cfs

0.00' x 2.00' deep channel, n= 0.035
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 250.0' Slope= 0.0160 '/'
Inlet Invert= 382.00', Outlet Invert= 378.00'



Reach 2R: Existing Swale



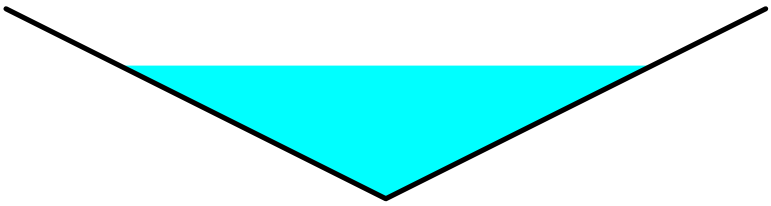
Summary for Reach 4R: Existing Swale

Inflow Area = 3.160 ac, 32.59% Impervious, Inflow Depth > 3.07" for 50-Year event
Inflow = 15.78 cfs @ 12.08 hrs, Volume= 0.808 af
Outflow = 14.26 cfs @ 12.10 hrs, Volume= 0.807 af, Atten= 10%, Lag= 1.4 min

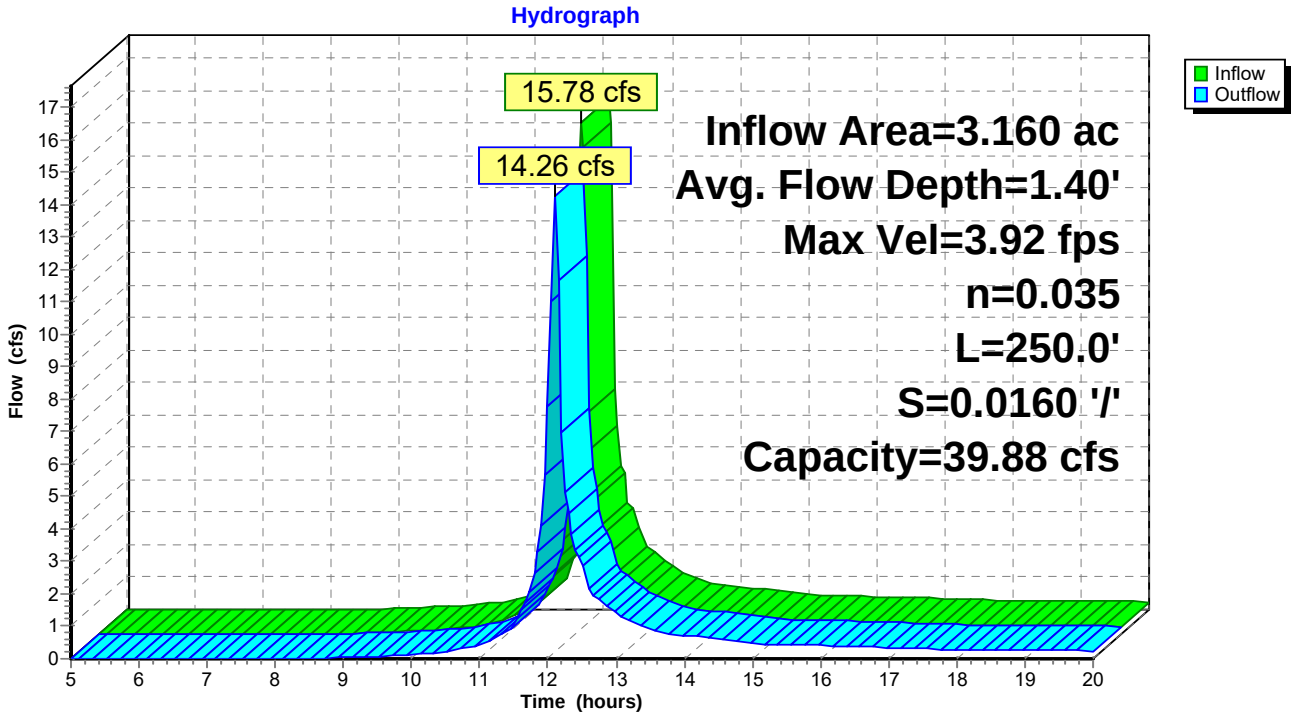
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.92 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 1.61 fps, Avg. Travel Time= 2.6 min

Peak Storage= 981 cf @ 12.09 hrs
Average Depth at Peak Storage= 1.40'
Bank-Full Depth= 2.00' Flow Area= 8.0 sf, Capacity= 39.88 cfs

0.00' x 2.00' deep channel, n= 0.035
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 250.0' Slope= 0.0160 '/'
Inlet Invert= 382.00', Outlet Invert= 378.00'



Reach 4R: Existing Swale



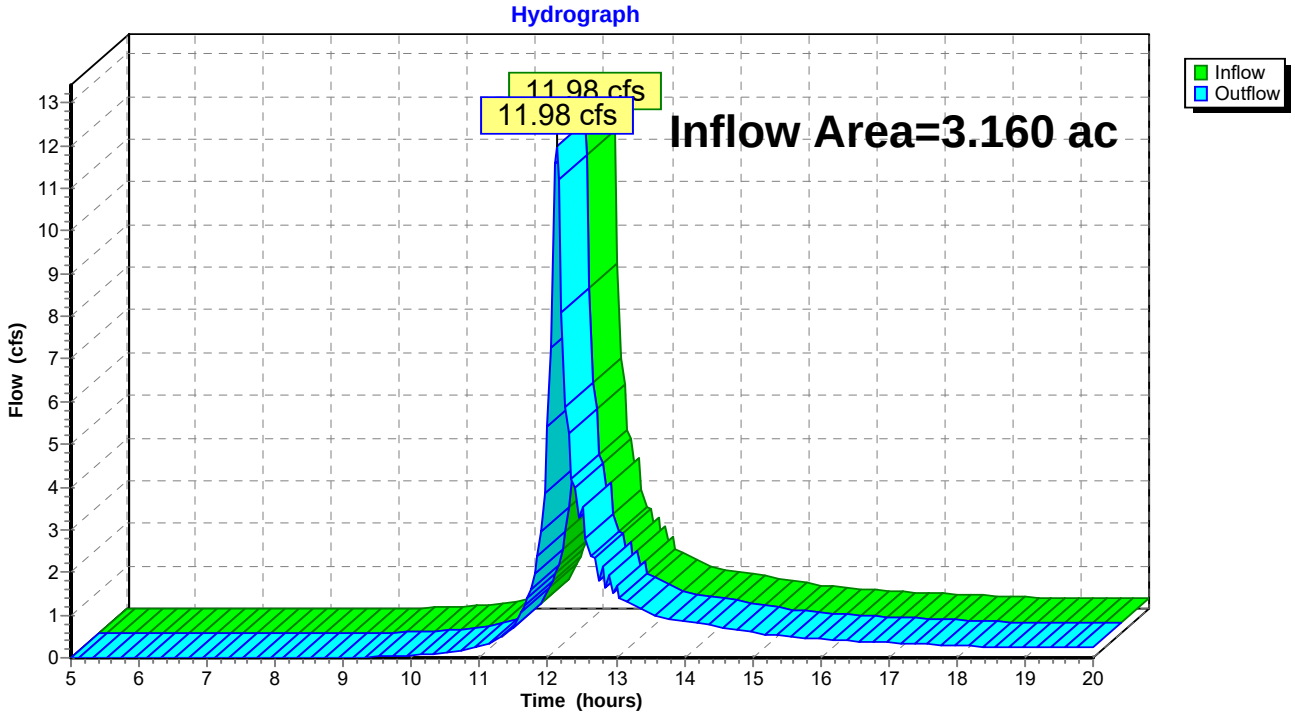
Summary for Reach 9R: Reach

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3.160 ac, 32.44% Impervious, Inflow Depth > 2.92" for 50-Year event
Inflow = 11.98 cfs @ 12.12 hrs, Volume= 0.769 af
Outflow = 11.98 cfs @ 12.12 hrs, Volume= 0.769 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach 9R: Reach



Summary for Pond 7P: Infiltration Berm

Inflow Area = 0.610 ac, 64.75% Impervious, Inflow Depth > 4.41" for 50-Year event
Inflow = 4.02 cfs @ 12.06 hrs, Volume= 0.224 af
Outflow = 1.88 cfs @ 12.16 hrs, Volume= 0.190 af, Atten= 53%, Lag= 5.7 min
Discarded = 0.01 cfs @ 12.16 hrs, Volume= 0.010 af
Primary = 0.45 cfs @ 12.16 hrs, Volume= 0.129 af
Secondary = 1.41 cfs @ 12.16 hrs, Volume= 0.051 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 385.88' @ 12.16 hrs Surf.Area= 4,648 sf Storage= 4,101 cf

Plug-Flow detention time= 110.8 min calculated for 0.190 af (84% of inflow)
Center-of-Mass det. time= 64.9 min (827.3 - 762.5)

Volume	Invert	Avail.Storage	Storage Description
#1	384.35'	4,692 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
384.35	476	0	0
385.10	2,783	1,222	1,222
385.50	3,723	1,301	2,523
386.00	4,950	2,168	4,692

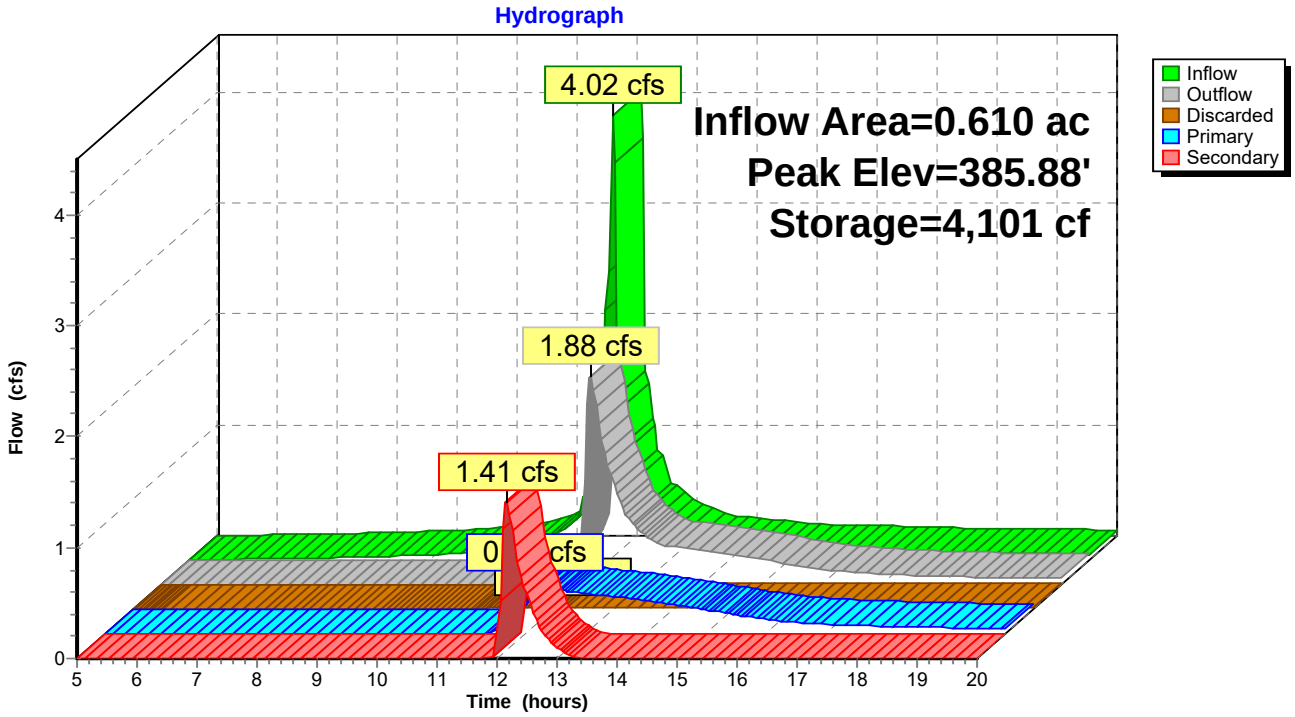
Device	Routing	Invert	Outlet Devices
#1	Primary	385.10'	**3.0" Round Culvert X 3.00** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 385.10' / 383.00' S= 0.1050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.05 sf
#2	Secondary	385.60'	**4.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#3	Discarded	384.35'	**0.125 in/hr Exfiltration over Surface area from 284.30' - 385.10'** Conductivity to Groundwater Elevation = 382.30' Excluded Surface area = 0 sf

Discarded OutFlow Max=0.01 cfs @ 12.16 hrs HW=385.87' (Free Discharge)
└**3=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.45 cfs @ 12.16 hrs HW=385.87' (Free Discharge)
└**1=Culvert** (Inlet Controls 0.45 cfs @ 3.06 fps)

Secondary OutFlow Max=1.39 cfs @ 12.16 hrs HW=385.87' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 1.39 cfs @ 1.27 fps)

Pond 7P: Infiltration Berm



Summary for Pond 8P: Level Spreader

[92] Warning: Device #1 is above defined storage
[93] Warning: Storage range exceeded by 0.09'
[88] Warning: Qout>Qin may require smaller dt or Finer Routing
[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=10)

Inflow	=	1.41 cfs @	12.16 hrs,	Volume=	0.051 af
Outflow	=	1.51 cfs @	12.19 hrs,	Volume=	0.049 af, Atten= 0%, Lag= 2.0 min
Primary	=	1.51 cfs @	12.19 hrs,	Volume=	0.049 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 385.49' @ 12.19 hrs Surf.Area= 225 sf Storage= 84 cf

Plug-Flow detention time= 2.4 min calculated for 0.049 af (97% of inflow)
Center-of-Mass det. time= 1.1 min (743.0 - 741.9)

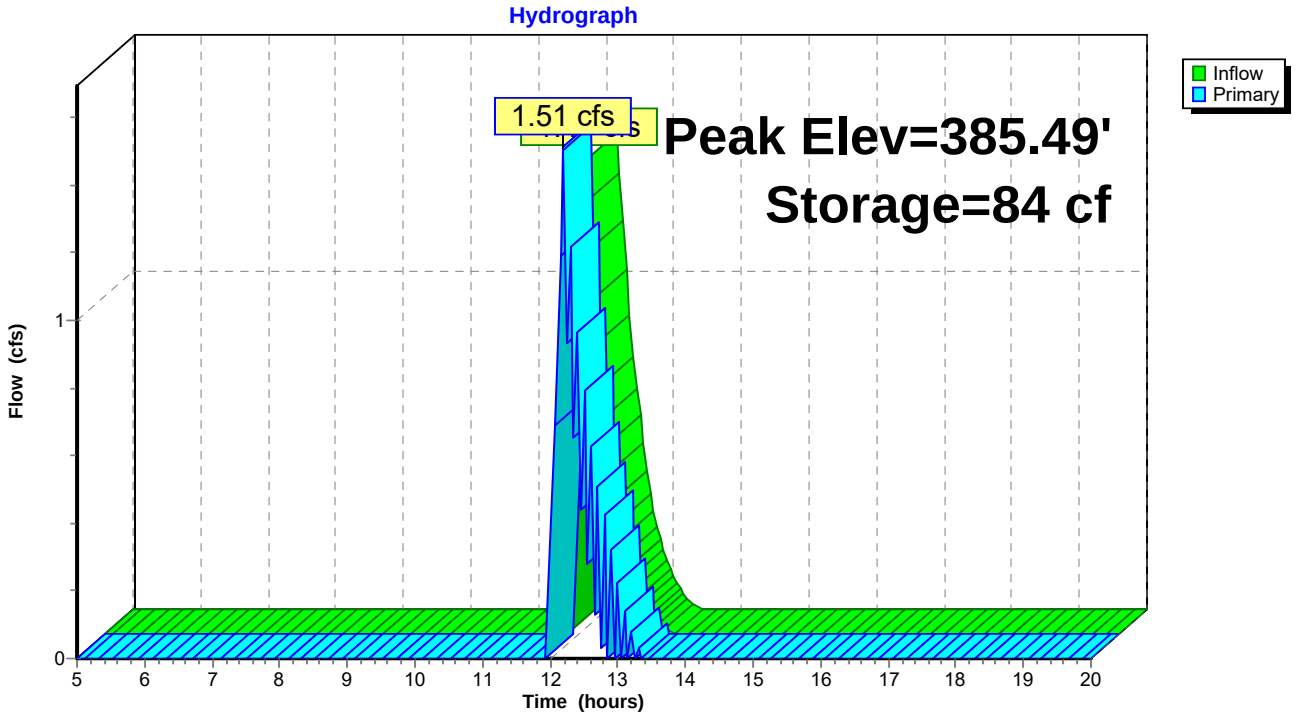
Volume	Invert	Avail.Storage	Storage Description
#1	384.65'	84 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
384.65	0	0	0
385.40	225	84	84

Device	Routing	Invert	Outlet Devices
#1	Primary	385.40'	**20.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=1.46 cfs @ 12.19 hrs HW=385.49' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 1.46 cfs @ 0.81 fps)

Pond 8P: Level Spreader



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 1S: Pre-Condition Runoff Area=3.160 ac 27.53% Impervious Runoff Depth>3.73"
Flow Length=192' Slope=0.0400 '/' Tc=1.7 min CN=69 Runoff=19.07 cfs 0.981 af

Subcatchment 3S: Post-Condition Runoff Area=3.160 ac 32.59% Impervious Runoff Depth>3.94"
Flow Length=192' Slope=0.0400 '/' Tc=1.7 min CN=71 Runoff=20.04 cfs 1.038 af

Subcatchment 4S: Berm DA Runoff Area=0.389 ac 69.15% Impervious Runoff Depth>5.60"
Flow Length=192' Tc=1.2 min CN=86 Runoff=3.18 cfs 0.182 af

Subcatchment 5S: Vegetated Filter Strip DA Runoff Area=0.221 ac 57.01% Impervious Runoff Depth>5.05"
Flow Length=90' Slope=0.0200 '/' Tc=0.9 min CN=81 Runoff=1.68 cfs 0.093 af

Subcatchment 6S: Undetained Area Runoff Area=2.550 ac 24.71% Impervious Runoff Depth>3.61"
Flow Length=380' Slope=0.0200 '/' Tc=5.2 min CN=68 Runoff=12.99 cfs 0.768 af

Reach 2R: Existing Swale Avg. Flow Depth=1.51' Max Vel=4.12 fps Inflow=19.07 cfs 0.981 af
n=0.035 L=250.0' S=0.0160 '/' Capacity=39.88 cfs Outflow=17.37 cfs 0.979 af

Reach 4R: Existing Swale Avg. Flow Depth=1.54' Max Vel=4.17 fps Inflow=20.04 cfs 1.038 af
n=0.035 L=250.0' S=0.0160 '/' Capacity=39.88 cfs Outflow=18.30 cfs 1.036 af

Reach 9R: Reach Inflow=16.02 cfs 0.996 af
Outflow=16.02 cfs 0.996 af

Pond 7P: Infiltration Berm Peak Elev=385.97' Storage=4,554 cf Inflow=4.85 cfs 0.274 af
Discarded=0.01 cfs 0.010 af Primary=0.48 cfs 0.148 af Secondary=2.26 cfs 0.081 af Outflow=2.76 cfs 0.239 af

Pond 8P: Level Spreader Peak Elev=385.54' Storage=84 cf Inflow=2.26 cfs 0.081 af
Outflow=2.78 cfs 0.080 af

Total Runoff Area = 9.480 ac Runoff Volume = 3.061 af Average Runoff Depth = 3.87"
69.15% Pervious = 6.555 ac 30.85% Impervious = 2.925 ac

Summary for Subcatchment 1S: Pre-Condition

[49] Hint: Tc<2dt may require smaller dt

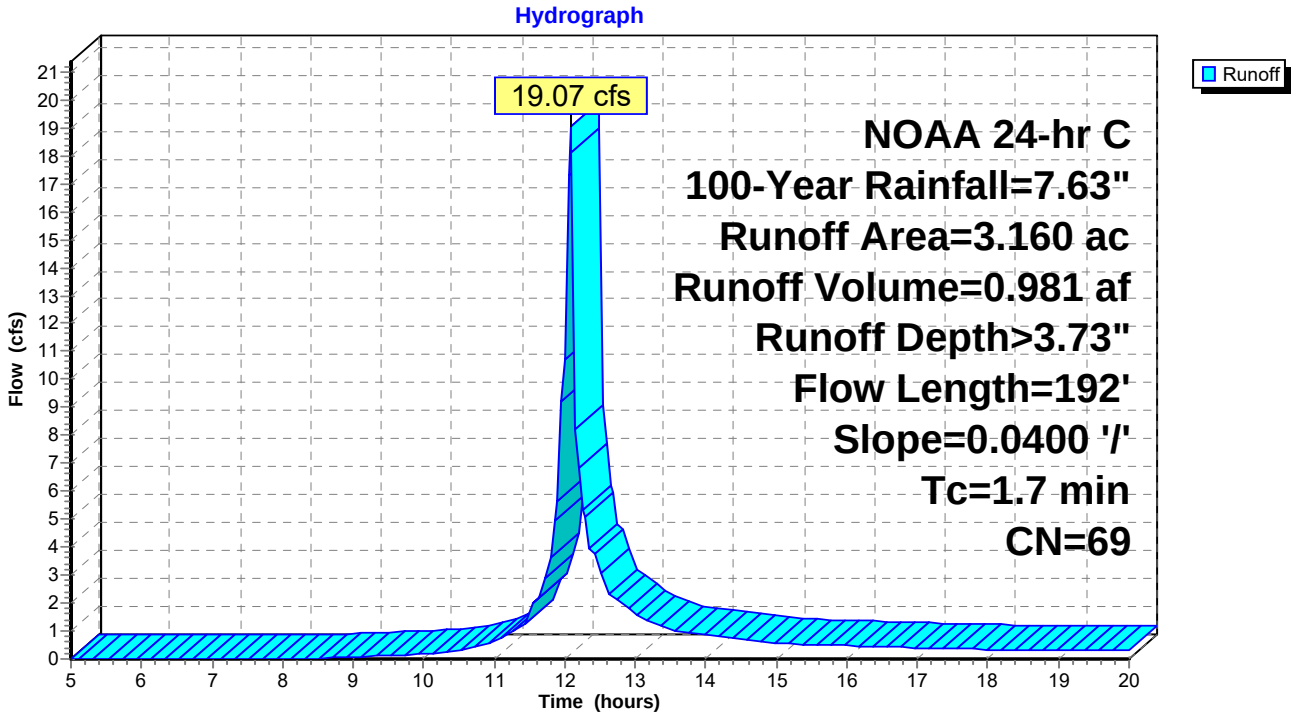
Runoff = 19.07 cfs @ 12.08 hrs, Volume= 0.981 af, Depth> 3.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=7.63"

Area (ac)	CN	Description
2.290	58	Meadow, non-grazed, HSG B
0.870	98	Paved roads w/curbs & sewers, HSG B
3.160	69	Weighted Average
2.290		72.47% Pervious Area
0.870		27.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	50	0.0400	1.60		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 3.30"
0.3	70	0.0400	4.06		**Shallow Concentrated Flow, SCF1** Paved Kv= 20.3 fps
0.9	72	0.0400	1.40		**Shallow Concentrated Flow, SCF2** Short Grass Pasture Kv= 7.0 fps
1.7	192	Total			

Subcatchment 1S: Pre-Condition



Summary for Subcatchment 3S: Post-Condition

[49] Hint: Tc<2dt may require smaller dt

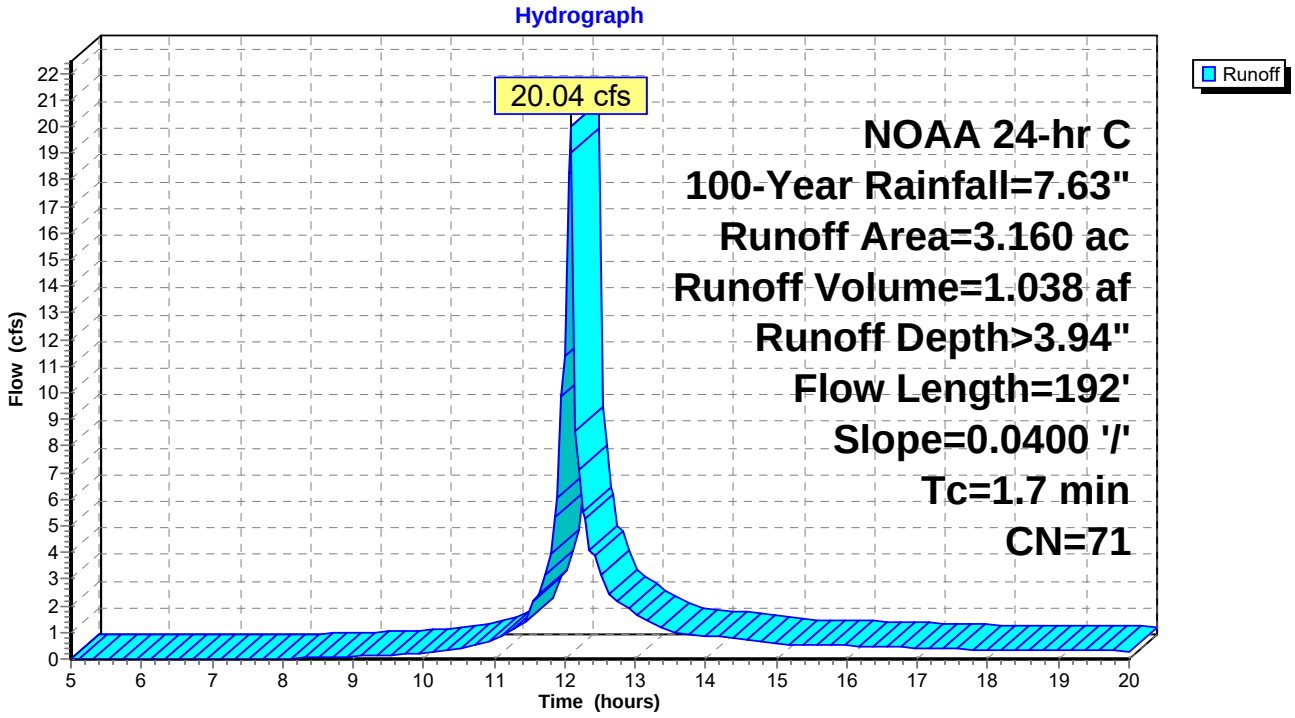
Runoff = 20.04 cfs @ 12.08 hrs, Volume= 1.038 af, Depth> 3.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=7.63"

Area (ac)	CN	Description
2.130	58	Meadow, non-grazed, HSG B
1.030	98	Paved roads w/curbs & sewers, HSG B
3.160	71	Weighted Average
2.130		67.41% Pervious Area
1.030		32.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	50	0.0400	1.60		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 3.30"
0.3	70	0.0400	4.06		**Shallow Concentrated Flow, SCF1** Paved Kv= 20.3 fps
0.9	72	0.0400	1.40		**Shallow Concentrated Flow, SCF2** Short Grass Pasture Kv= 7.0 fps
1.7	192	Total			

Subcatchment 3S: Post-Condition



Summary for Subcatchment 4S: Berm DA

[49] Hint: Tc<2dt may require smaller dt

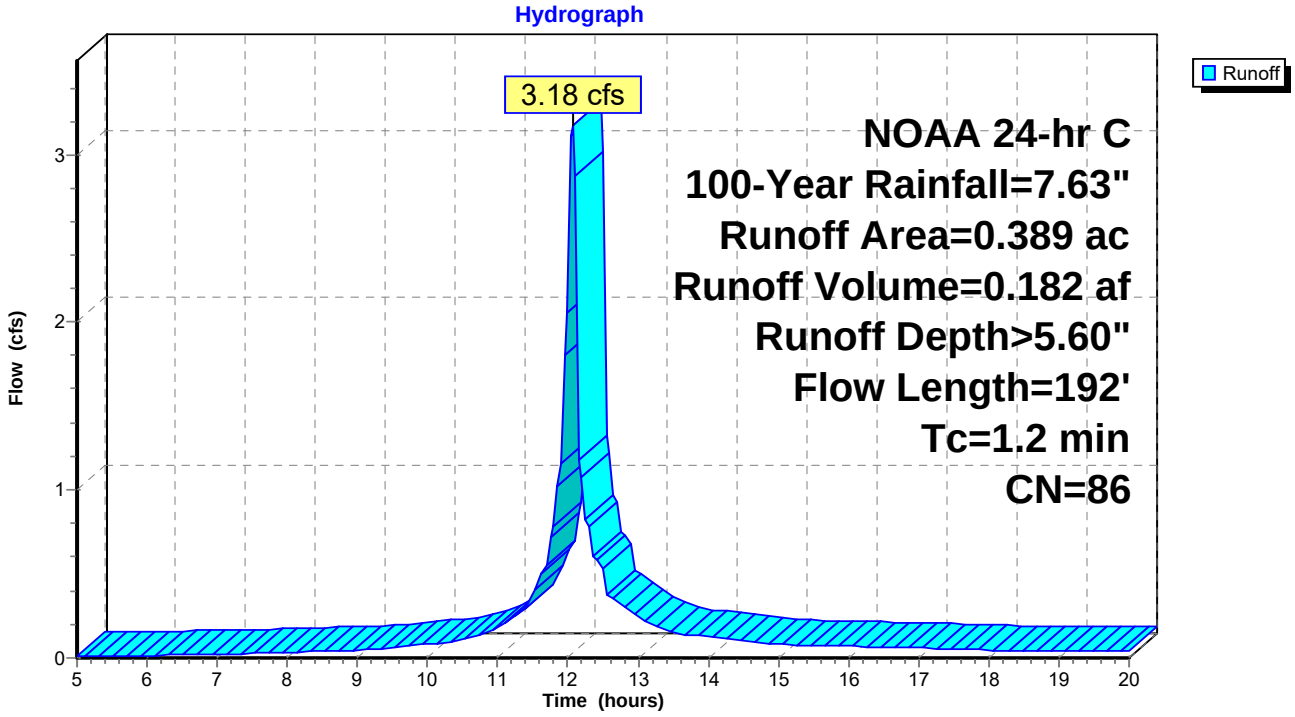
Runoff = 3.18 cfs @ 12.07 hrs, Volume= 0.182 af, Depth> 5.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=7.63"

Area (ac)	CN	Description
0.120	58	Meadow, non-grazed, HSG B
0.269	98	Paved roads w/curbs & sewers, HSG B
0.389	86	Weighted Average
0.120		30.85% Pervious Area
0.269		69.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	50	0.0400	1.60		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.30"
0.7	142	0.0280	3.40		**Shallow Concentrated Flow, SCF** Paved Kv= 20.3 fps
1.2	192	Total			

Subcatchment 4S: Berm DA



Summary for Subcatchment 5S: Vegetated Filter Strip DA

[49] Hint: Tc<2dt may require smaller dt

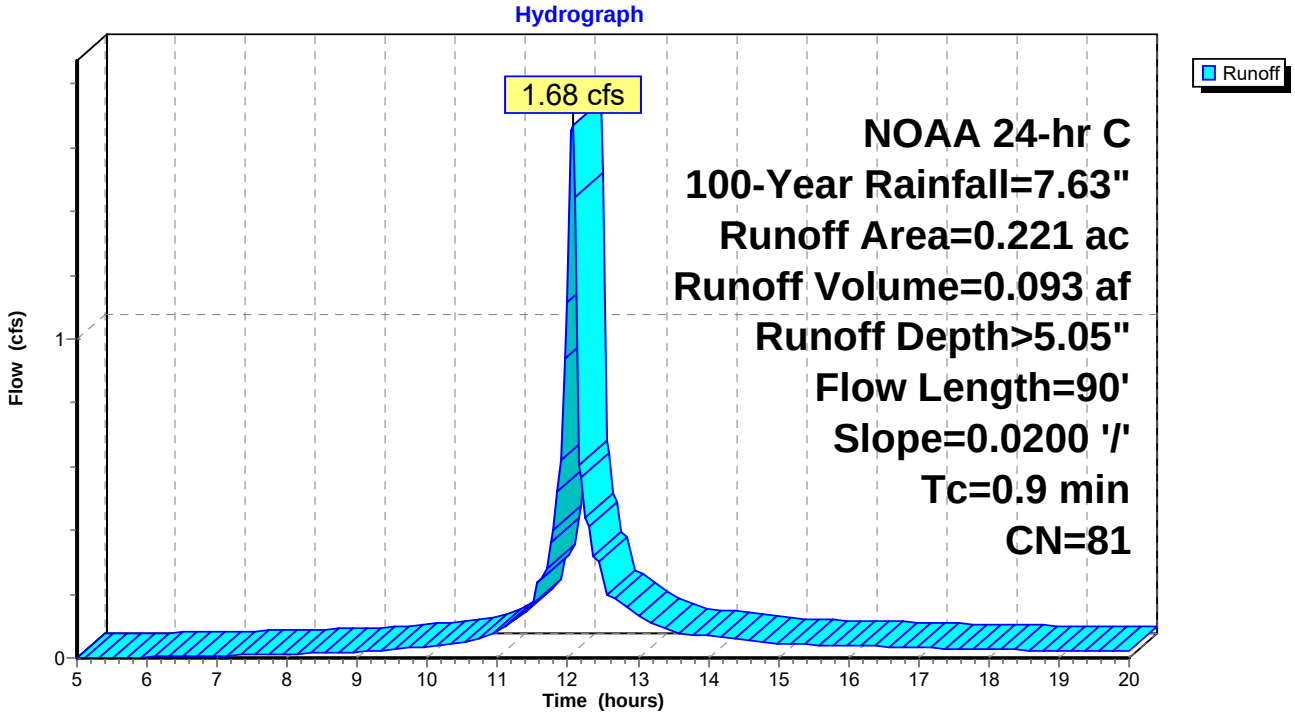
Runoff = 1.68 cfs @ 12.06 hrs, Volume= 0.093 af, Depth> 5.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=7.63"

Area (ac)	CN	Description
0.095	58	Meadow, non-grazed, HSG B
0.126	98	Paved roads w/curbs & sewers, HSG B
0.221	81	Weighted Average
0.095		42.99% Pervious Area
0.126		57.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.22		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.30"
0.2	40	0.0200	2.87		**Shallow Concentrated Flow, SCF** Paved Kv= 20.3 fps
0.9	90	Total			

Subcatchment 5S: Vegetated Filter Strip DA



Summary for Subcatchment 6S: Undetained Area

[49] Hint: Tc<2dt may require smaller dt

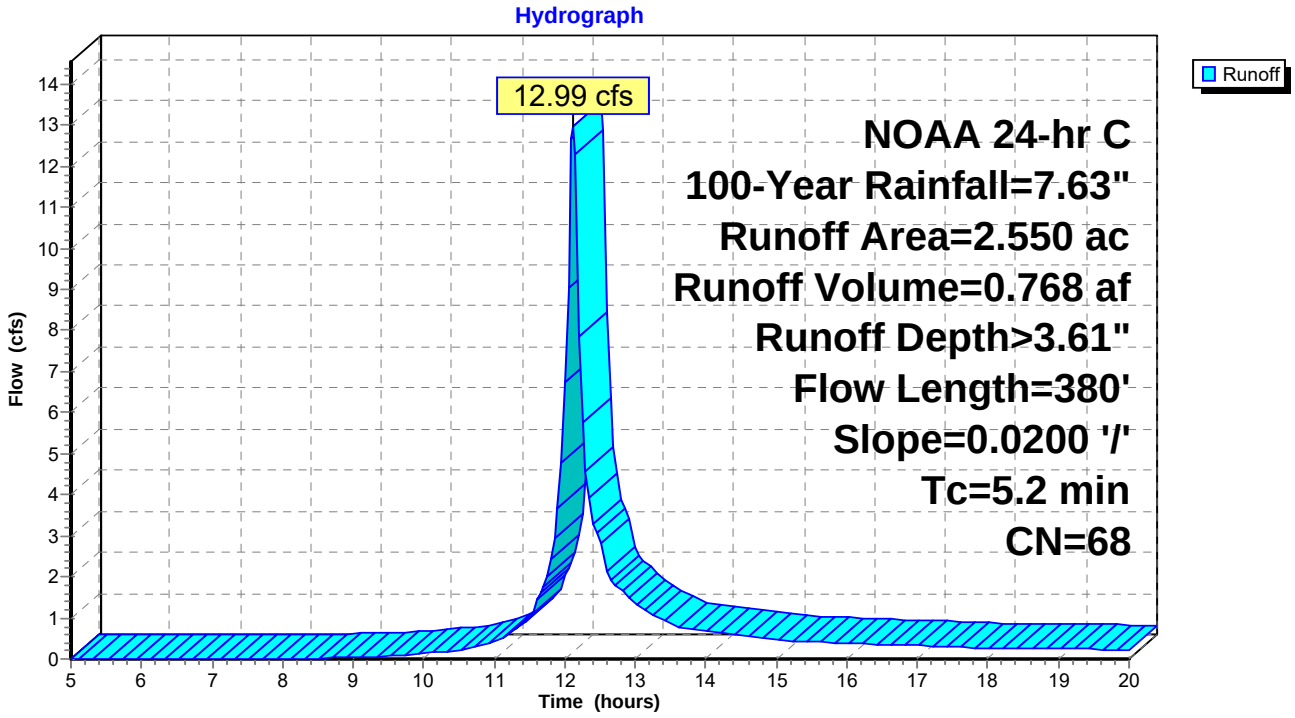
Runoff = 12.99 cfs @ 12.12 hrs, Volume= 0.768 af, Depth> 3.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=7.63"

Area (ac)	CN	Description
1.920	58	Meadow, non-grazed, HSG B
0.630	98	Paved roads w/curbs & sewers, HSG B
2.550	68	Weighted Average
1.920		75.29% Pervious Area
0.630		24.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.40		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.30"
0.6	80	0.0200	2.28		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
3.4	200	0.0200	0.99		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
5.2	380	Total			

Subcatchment 6S: Undetained Area



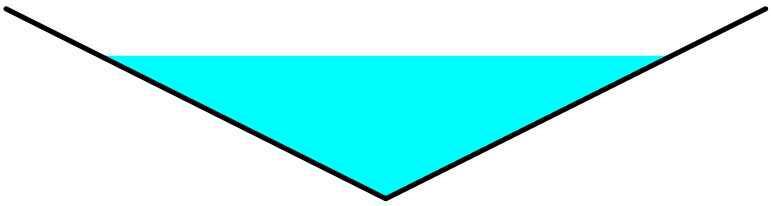
Summary for Reach 2R: Existing Swale

Inflow Area = 3.160 ac, 27.53% Impervious, Inflow Depth > 3.73" for 100-Year event
Inflow = 19.07 cfs @ 12.08 hrs, Volume= 0.981 af
Outflow = 17.37 cfs @ 12.10 hrs, Volume= 0.979 af, Atten= 9%, Lag= 1.4 min

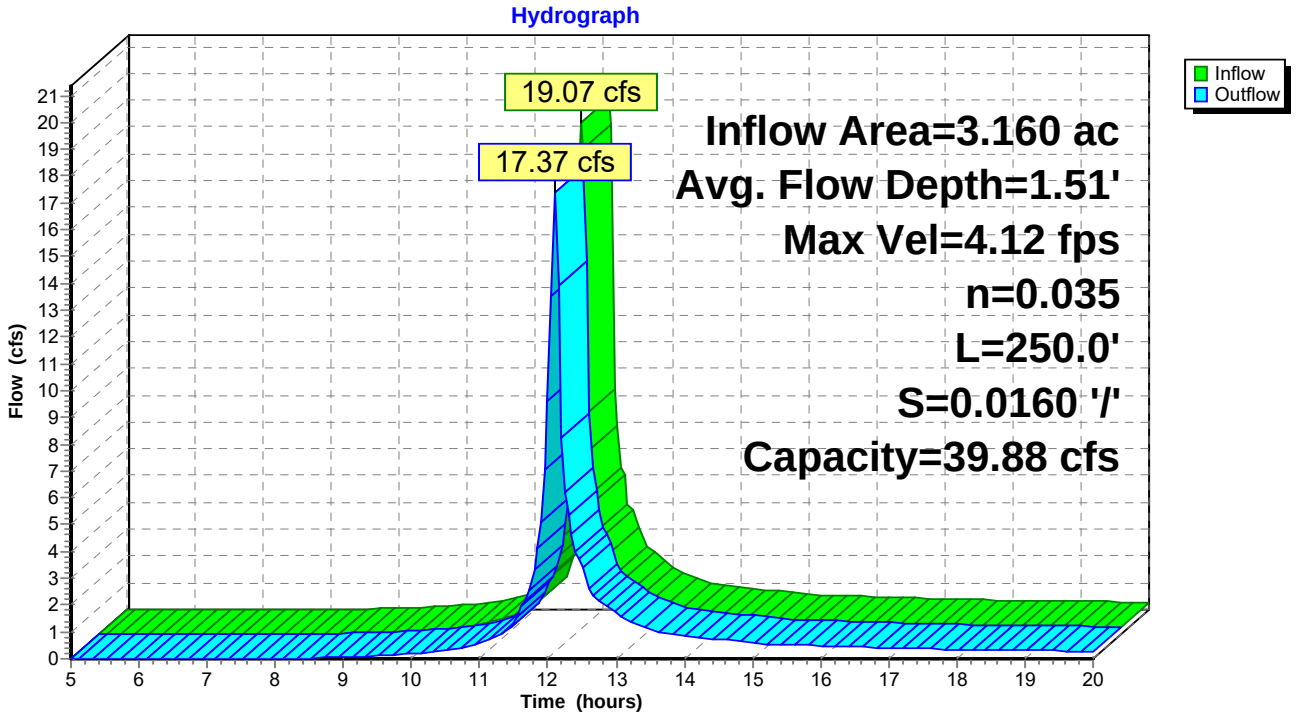
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.12 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 1.67 fps, Avg. Travel Time= 2.5 min

Peak Storage= 1,134 cf @ 12.09 hrs
Average Depth at Peak Storage= 1.51'
Bank-Full Depth= 2.00' Flow Area= 8.0 sf, Capacity= 39.88 cfs

0.00' x 2.00' deep channel, n= 0.035
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 250.0' Slope= 0.0160 '/'
Inlet Invert= 382.00', Outlet Invert= 378.00'



Reach 2R: Existing Swale



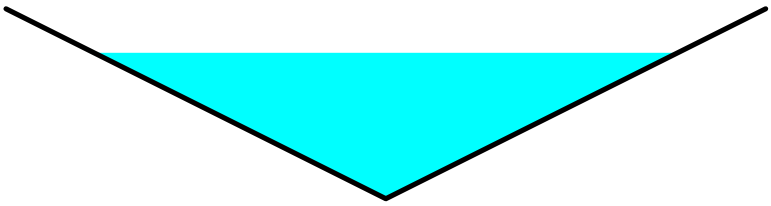
Summary for Reach 4R: Existing Swale

Inflow Area = 3.160 ac, 32.59% Impervious, Inflow Depth > 3.94" for 100-Year event
Inflow = 20.04 cfs @ 12.08 hrs, Volume= 1.038 af
Outflow = 18.30 cfs @ 12.10 hrs, Volume= 1.036 af, Atten= 9%, Lag= 1.3 min

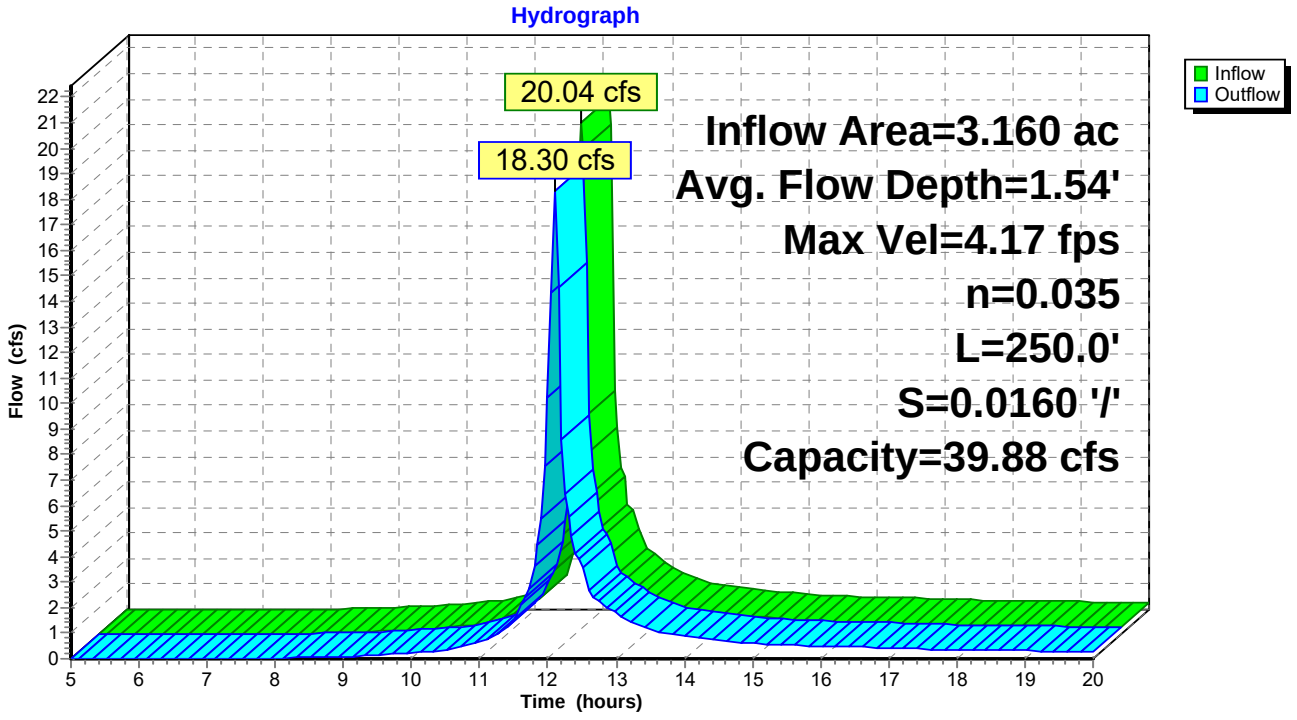
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.17 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 1.68 fps, Avg. Travel Time= 2.5 min

Peak Storage= 1,178 cf @ 12.09 hrs
Average Depth at Peak Storage= 1.54'
Bank-Full Depth= 2.00' Flow Area= 8.0 sf, Capacity= 39.88 cfs

0.00' x 2.00' deep channel, n= 0.035
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 250.0' Slope= 0.0160 '/'
Inlet Invert= 382.00', Outlet Invert= 378.00'



Reach 4R: Existing Swale



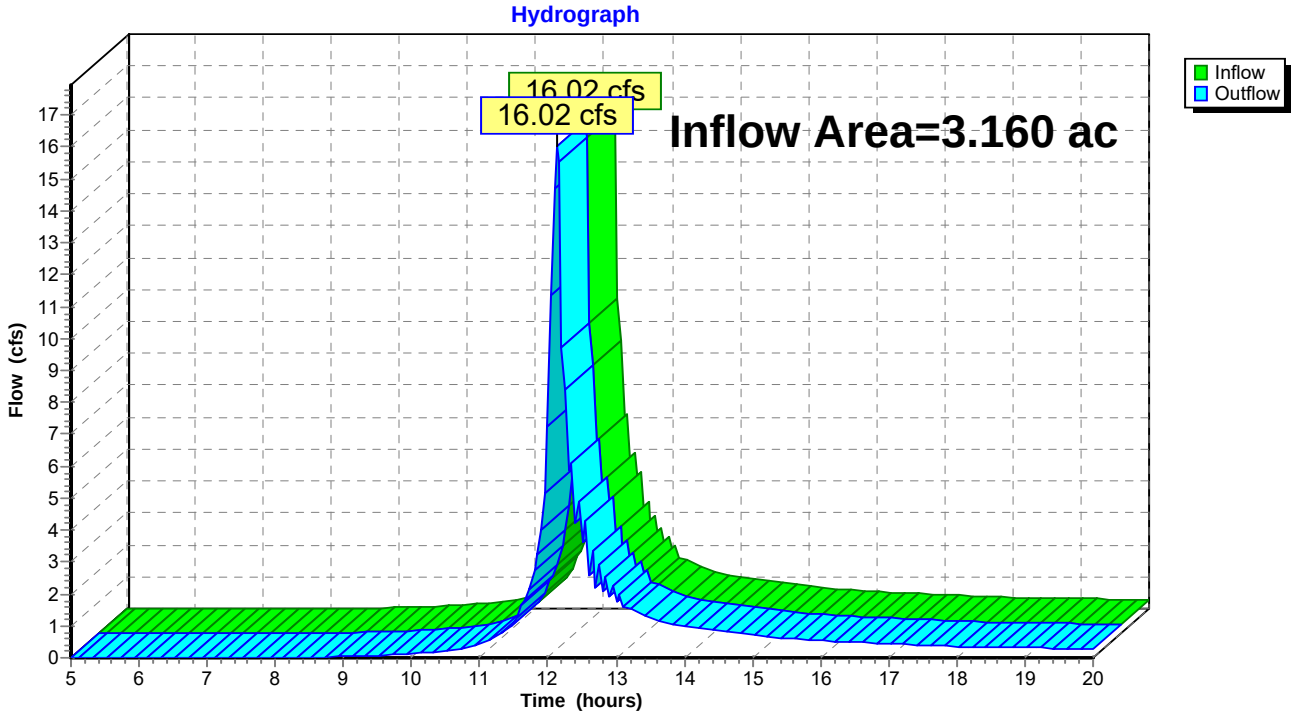
Summary for Reach 9R: Reach

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3.160 ac, 32.44% Impervious, Inflow Depth > 3.78" for 100-Year event
Inflow = 16.02 cfs @ 12.13 hrs, Volume= 0.996 af
Outflow = 16.02 cfs @ 12.13 hrs, Volume= 0.996 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach 9R: Reach



Summary for Pond 7P: Infiltration Berm

[82] Warning: Early inflow requires earlier time span

Inflow Area = 0.610 ac, 64.75% Impervious, Inflow Depth > 5.40" for 100-Year event
Inflow = 4.85 cfs @ 12.06 hrs, Volume= 0.274 af
Outflow = 2.76 cfs @ 12.14 hrs, Volume= 0.239 af, Atten= 43%, Lag= 4.6 min
Discarded = 0.01 cfs @ 12.14 hrs, Volume= 0.010 af
Primary = 0.48 cfs @ 12.14 hrs, Volume= 0.148 af
Secondary = 2.26 cfs @ 12.14 hrs, Volume= 0.081 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 385.97' @ 12.14 hrs Surf.Area= 4,881 sf Storage= 4,554 cf

Plug-Flow detention time= 100.3 min calculated for 0.238 af (87% of inflow)
Center-of-Mass det. time= 60.0 min (818.0 - 758.1)

Volume	Invert	Avail.Storage	Storage Description
#1	384.35'	4,692 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
384.35	476	0	0
385.10	2,783	1,222	1,222
385.50	3,723	1,301	2,523
386.00	4,950	2,168	4,692

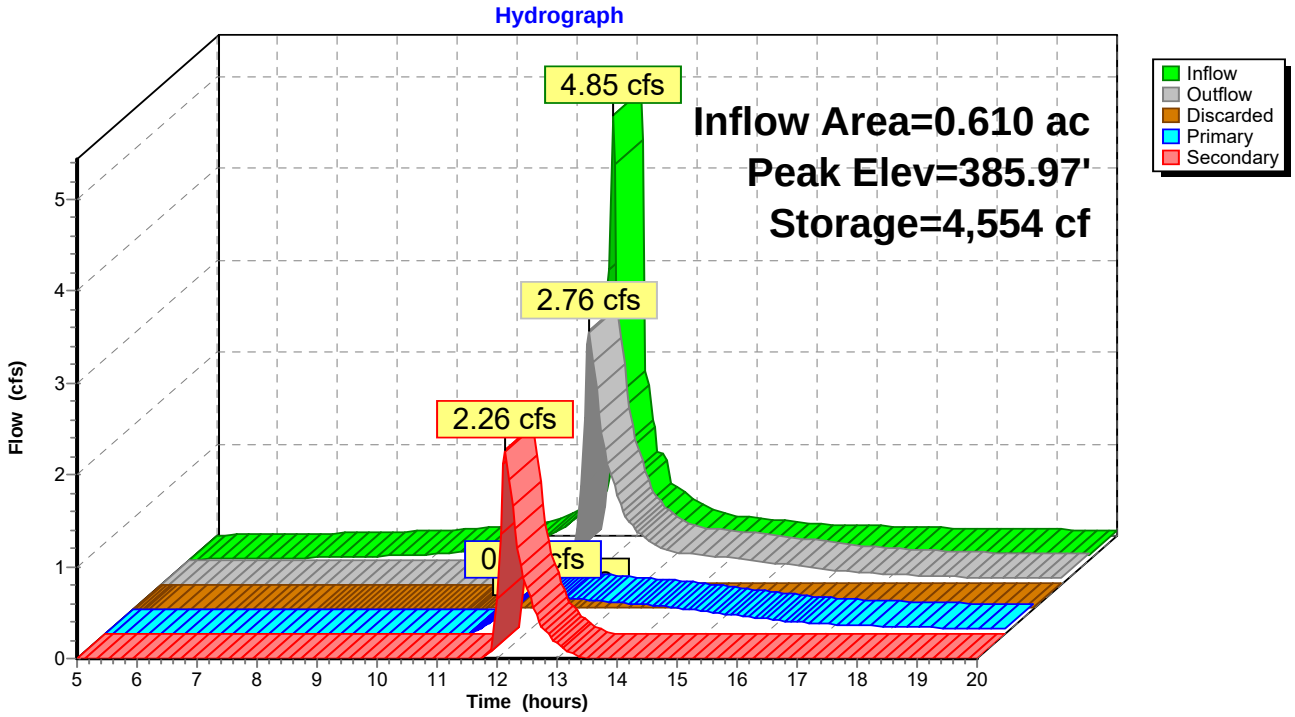
Device	Routing	Invert	Outlet Devices
#1	Primary	385.10'	**3.0" Round Culvert X 3.00** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 385.10' / 383.00' S= 0.1050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.05 sf
#2	Secondary	385.60'	**4.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#3	Discarded	384.35'	**0.125 in/hr Exfiltration over Surface area from 284.30' - 385.10'** Conductivity to Groundwater Elevation = 382.30' Excluded Surface area = 0 sf

Discarded OutFlow Max=0.01 cfs @ 12.14 hrs HW=385.97' (Free Discharge)
└**3=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.48 cfs @ 12.14 hrs HW=385.97' (Free Discharge)
└**1=Culvert** (Inlet Controls 0.48 cfs @ 3.28 fps)

Secondary OutFlow Max=2.23 cfs @ 12.14 hrs HW=385.97' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 2.23 cfs @ 1.51 fps)

Pond 7P: Infiltration Berm



Summary for Pond 8P: Level Spreader

[92] Warning: Device #1 is above defined storage
[93] Warning: Storage range exceeded by 0.14'
[88] Warning: Qout>Qin may require smaller dt or Finer Routing
[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=12)

Inflow	=	2.26 cfs @	12.14 hrs, Volume=	0.081 af
Outflow	=	2.78 cfs @	12.15 hrs, Volume=	0.080 af, Atten= 0%, Lag= 0.5 min
Primary	=	2.78 cfs @	12.15 hrs, Volume=	0.080 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 385.54' @ 12.15 hrs Surf.Area= 225 sf Storage= 84 cf

Plug-Flow detention time= 1.7 min calculated for 0.080 af (99% of inflow)
Center-of-Mass det. time= 1.0 min (741.5 - 740.5)

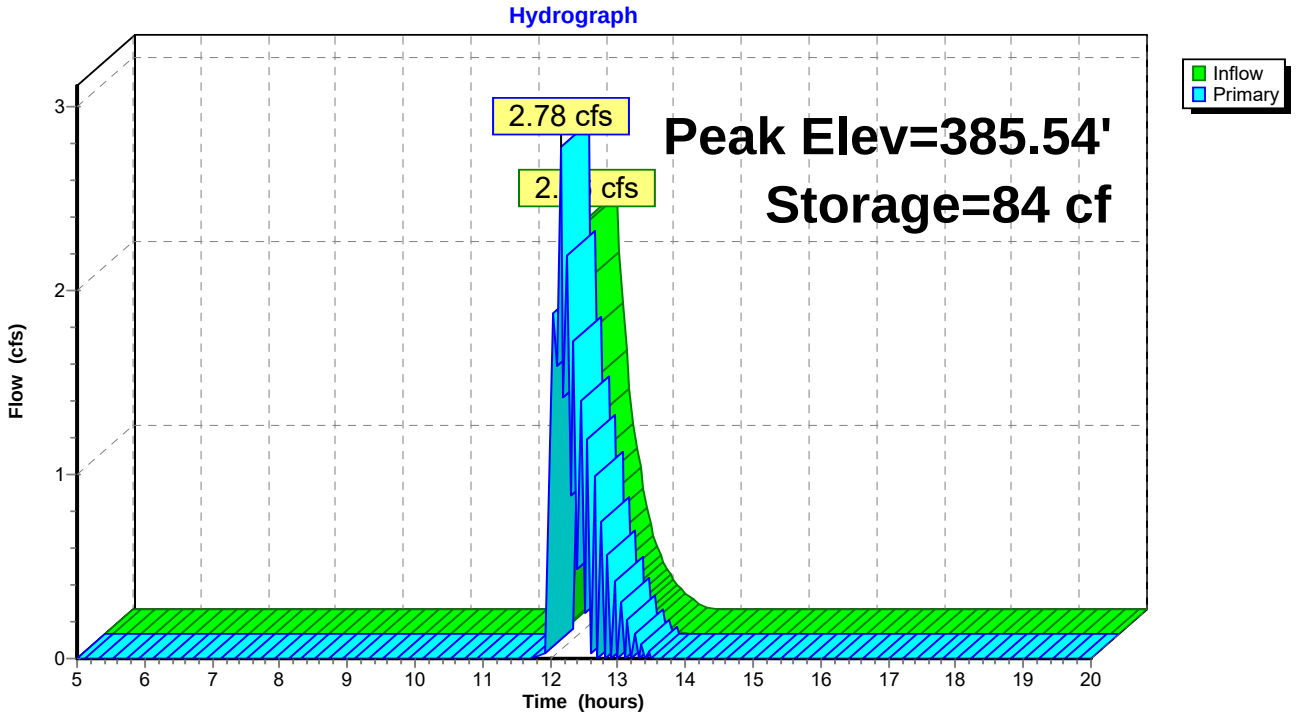
Volume	Invert	Avail.Storage	Storage Description
#1	384.65'	84 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
384.65	0	0	0
385.40	225	84	84

Device	Routing	Invert	Outlet Devices
#1	Primary	385.40'	**20.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=2.73 cfs @ 12.15 hrs HW=385.54' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 2.73 cfs @ 1.00 fps)

Pond 8P: Level Spreader



ATTACHMENT 4.4

BMP EROSION CONTROL BLANKET REPORT

North American Green
5401 St. Wendel-Cynthiana Rd.
Poseyville, Indiana 47633
Tel. 800.772.2040
>Fax 812.867.0247
www.nagreen.com
ECMDS v7.0

SPILLWAY ANALYSIS

> > > CS200 - Berm

Name	CS200 - Berm
Discharge	0.93
Peak Flow Period	12.5
Channel Slope	0.5
Channel Bottom Width	4
Low Flow Liner	
Retardence Class	C 6-12 in
Vegetation Type	Sod Former
Vegetation Density	Good 65-79%
Soil Type	Silt Loam (SM)

SC150BN

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
SC150BN Unvegetated	Straight	0.93 cfs	3.72 ft/s	0.04 ft	0.032	2 lbs/ft2	1.23 lbs/ft2	1.62	STABLE	D
Underlying Substrate	Straight	0.93 cfs	3.72 ft/s	0.04 ft	0.032	1.47 lbs/ft2	1.21 lbs/ft2	1.21	STABLE	D

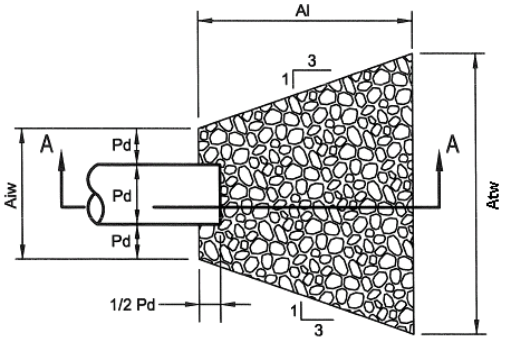
Unreinforced Vegetation - Class C - Sod Former - Good 65-79%

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
Unreinforced Vegetation	Straight	0.93 cfs	4.07 ft/s	0.06 ft	0.038	4 lbs/ft2	1.79 lbs/ft2	2.24	STABLE	--
Underlying Substrate	Straight	0.93 cfs	4.07 ft/s	0.06 ft	0.038	1.85 lbs/ft2	1.74 lbs/ft2	1.07	STABLE	--

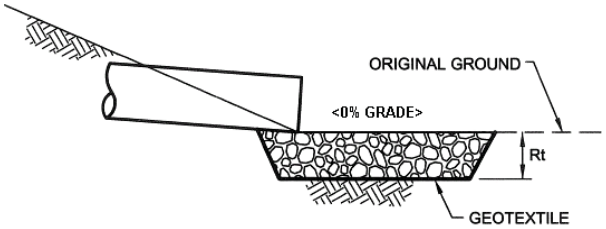
ATTACHMENT 4.5
RIPRAP APRON WORKSHEET

STANDARD E&S WORKSHEET # 20
Riprap Apron Outlet Protection

PROJECT NAME: Williams REAE – CS200
LOCATION: Chester County, PA
PREPARED BY: JR DATE: 02/25/2022
CHECKED BY: PW DATE: 02/25/2022



PLAN VIEW

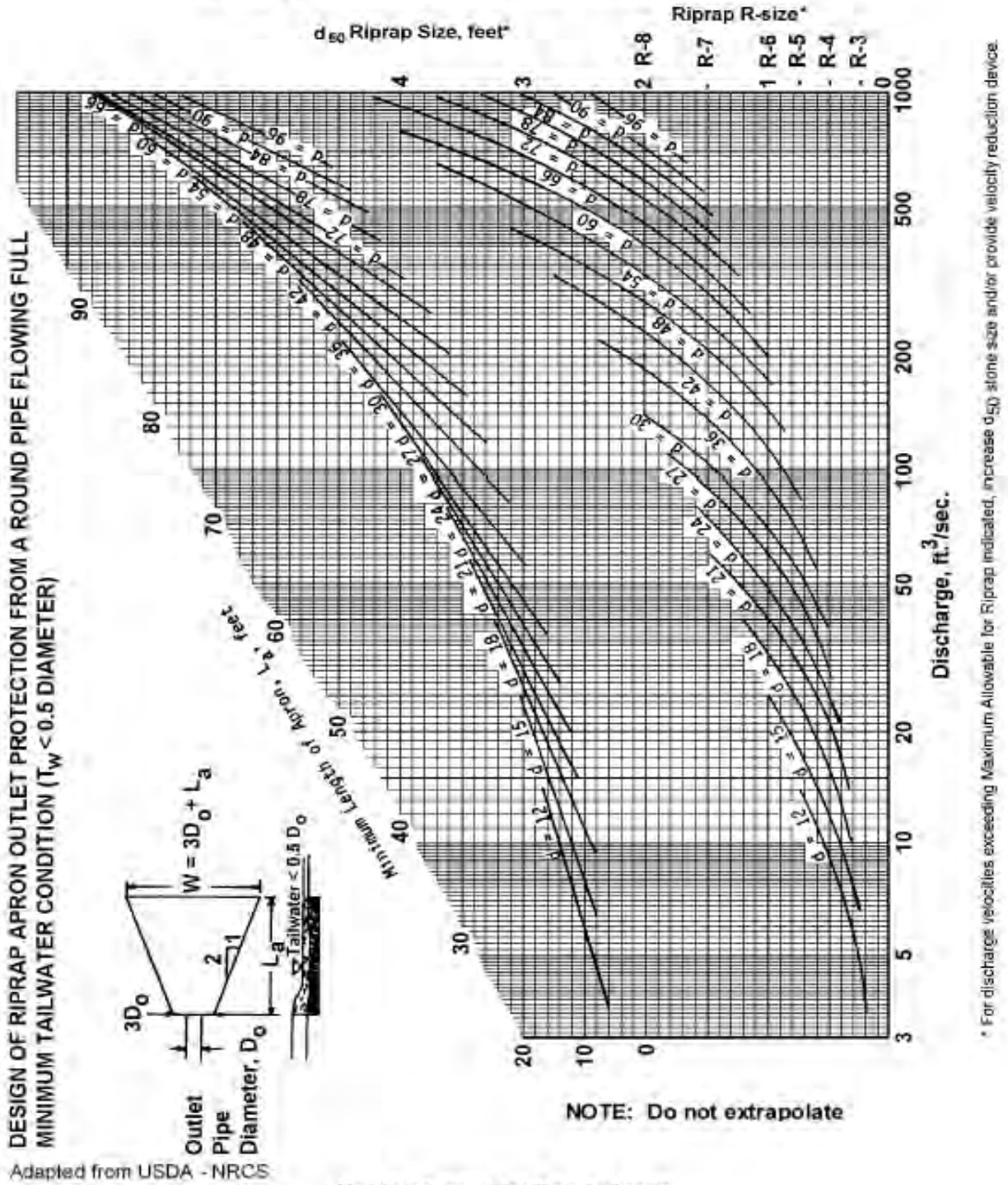


SECTION A - A

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)
RA1	9	MIN	0.02	0.11	0.38	2.56	R-3	9	6	2.25	8.25

***: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

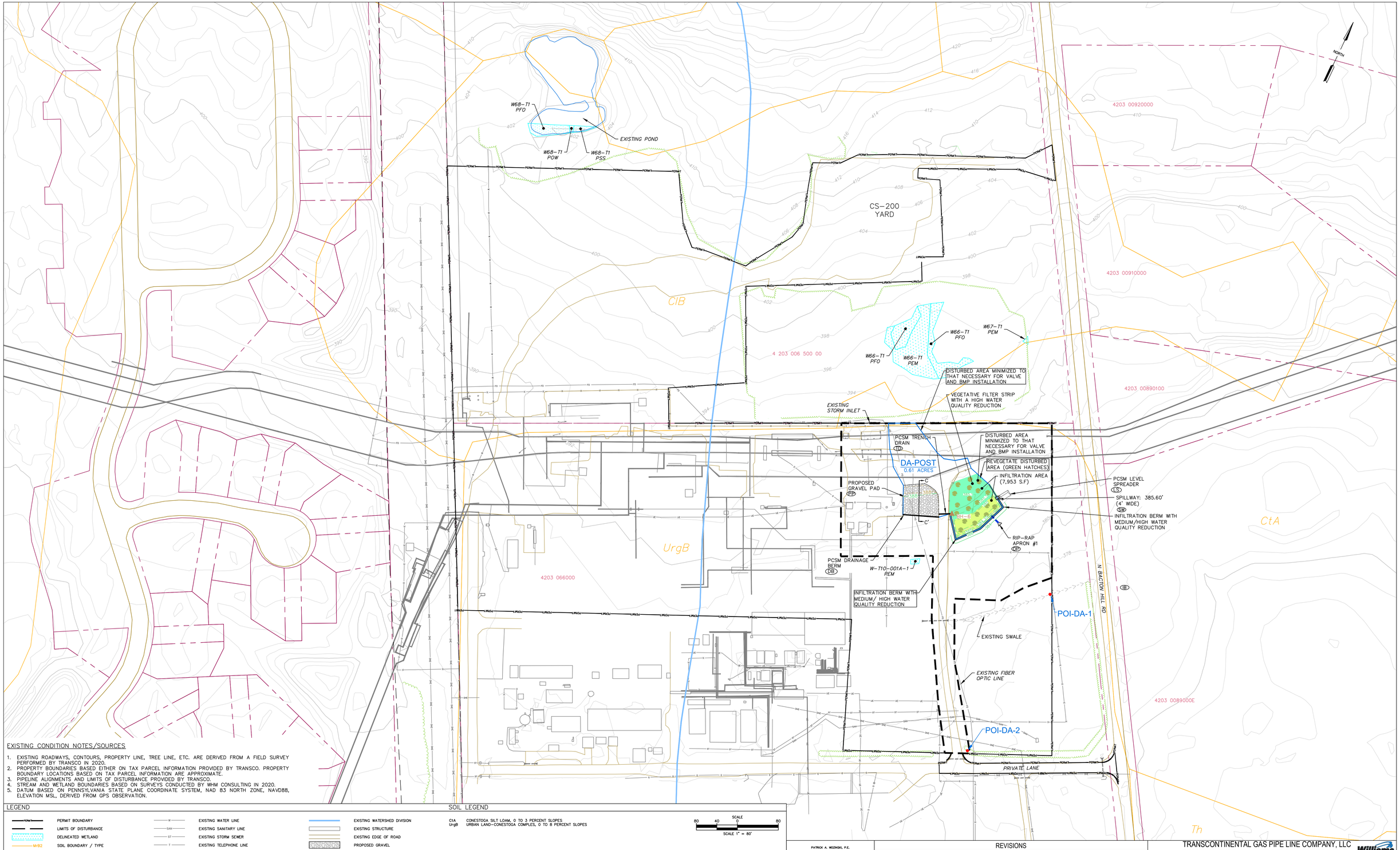


Adapted from USDA - NRCS

Not to be used for Box Culverts

ATTACHMENT 5

NON-STRUCTURAL AND STRUCTURAL WATER QUALITY BMPS MAP



EXISTING CONDITION NOTES/SOURCES

1. EXISTING ROADWAYS, CONTOURS, PROPERTY LINE, TREE LINE, ETC. ARE DERIVED FROM A FIELD SURVEY PERFORMED BY TRANSCO IN 2020.
2. PROPERTY BOUNDARIES BASED EITHER ON TAX PARCEL INFORMATION PROVIDED BY TRANSCO. PROPERTY BOUNDARY LOCATIONS BASED ON TAX PARCEL INFORMATION ARE APPROXIMATE.
3. PIPELINE ALIGNMENTS AND LIMITS OF DISTURBANCE PROVIDED BY TRANSCO.
4. STREAM AND WETLAND BOUNDARIES BASED ON SURVEYS CONDUCTED BY WHM CONSULTING IN 2020.
5. DATUM BASED ON PENNSYLVANIA STATE PLANE COORDINATE SYSTEM, NAD 83 NORTH ZONE, NAVD88, ELEVATION MSL, DERIVED FROM GPS OBSERVATION.

LEGEND

PERMIT BOUNDARY	EXISTING WATER LINE
LIMITS OF DISTURBANCE	EXISTING SANITARY LINE
DELINEATED WETLAND	EXISTING STORM SEWER
SOIL BOUNDARY / TYPE	EXISTING TELEPHONE LINE
EXISTING TREELINE / TREE/SHRUB	EXISTING FIBER OPTIC LINE
PROPERTY LINE	EXISTING UNDERGROUND CABLE LINE
EXISTING LEIDY / TGPL PIPELINES	EXISTING STORM INLET
EXISTING FOREIGN PIPELINES	EXISTING SANITARY MANHOLE
EXISTING UTILITY POLE / TOWER	EXISTING COMMUNICATION/ELECTRIC MANHOLE
EXISTING VALVE	EXISTING FIRE HYDRANT
EXISTING CULVERT	EXISTING POWER POLE
EXISTING ELECTRIC LINE	EXISTING EASEMENT
EXISTING UNDERGROUND ELECTRIC LINE	EXISTING RIGHT-OF-WAY
EXISTING GAS LINE	EXISTING FENCE
	PROPOSED FENCE
	EXISTING WATERSHED DIVISION
	EXISTING STRUCTURE
	EXISTING EDGE OF ROAD
	PROPOSED GRAVEL
	EXISTING GRADE MAJOR CONTOURS (10' C.I.)
	EXISTING GRADE MINOR CONTOURS (2' C.I.)
	PROPOSED GRADE MAJOR CONTOURS (10' C.I.)
	PROPOSED GRADE MINOR CONTOURS (2' C.I.)
	PROPOSED PAD SUBGRADE MAJOR CONTOURS (10' C.I.)
	PROPOSED PAD SUBGRADE MINOR CONTOURS (2' C.I.)
	TEST PIT LOCATION
	PROPOSED INFILTRATION AREA
	PROPOSED VEGETATED FILTER STRIP

SOIL LEGEND

CtA	CONESTOGA SILT LOAM, 0 TO 3 PERCENT SLOPES
UrgB	URBAN LAND-CONESTOGA COMPLEX, 0 TO 8 PERCENT SLOPES

SCALE
80 40 0 80
SCALE 1" = 80'

PATRICK A. WOZINSKI, P.E.
COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL ENGINEER
PATRICK A. WOZINSKI
PE076243
PENNSYLVANIA PROFESSIONAL ENGINEER

REVISIONS

NO.	DATE	BY	DESCRIPTION	W.O. NO.	CHK.	APP.
1	06/29/21	RHM	REVISED PER PADEP COMMENTS.			
2	03/01/22	RHM	RESPONSE TO PADEP TECHNICAL DEFICIENCY LETTER			

TRANSCONTINENTAL GAS PIPE LINE COMPANY, LLC
REGIONAL ENERGY ACCESS EXPANSION PROJECT - COMPRESSOR STATON 200
POST CONSTRUCTION STORMWATER MANAGEMENT PLAN
ATTACHMENT 5 WATER QUALITY BMP'S MAP
EAST WHITELAND TWP., CHESTER COUNTY, PENNSYLVANIA

DRAWN BY: DRV	DATE: 03/31/21	ISSUED FOR BID:	SCALE:
CHECKED BY: RJN	DATE: 03/31/21	ISSUED FOR CONSTRUCTION:	REVISION:
APPROVED BY: PW	DATE: 03/31/21		SHEET 1
WO: 1232813	RID: 305	DRAWING NUMBER: 26-1000-70-28-D	OF 1

ATTACHMENT 6
OFFSITE DISCHARGE REPORT

Transcontinental Gas Pipe Line Company, LLC

Offsite Discharge Report

Regional Energy Access Expansion Project

Compressor Station 200

April 2021
(Revised March 2022)

1.0 Project Description

Transcontinental Gas Pipe Line Company, LLC (Transco), a subsidiary of The Williams Companies, Inc., is proposing the Regional Energy Access Expansion Project (Project). The existing Compressor Station 200 component of the Project is located in East Whiteland Township, Chester County. Proposed are compressor station modifications to connect the existing Transco Mainline A into suction to support south flow. This new facility will require Erosion and Sediment (E&S) Control and Post Construction Stormwater Management (PCSM) Best Management Practices (BMPs) to manage stormwater runoff during and after construction.

Transco has developed an Offsite Discharge Report for the discharges associated with the proposed BMP's. An Offsite Discharge Report is performed to ensure that no offsite erosion will occur downstream of the proposed activities. The analysis conducted for this project followed the sequence outlined in PaDEP's factsheet for offsite discharges (Document #3930-FS-DEP4124).

2.0 Conveyance Best Management Practices

Increases in stormwater runoff during and after construction shall be controlled by sequencing the operations, minimizing the extent and duration of disturbance, and using a selection of E&S Control and PCSM BMPs. During construction, compost filter sock will be used to retain/slow the flow leaving the construction area before entering an existing vegetated swale to the southeast. Post construction, a drainage berm and trench drain will be constructed to direct the majority of runoff from the developed area to the infiltration berm. In addition, a spillway will allow excess water to leave the infiltration berm and be discharged via a level spreader at the base of the spillway. Water will eventually flow into the existing vegetated swale southeast of the Limits of Disturbance. These BMP's will be installed to convey the net increase in volume between the pre and post development 2-year storm events and mitigate the increase (pre-post development) in peak runoff for the 2-, 10-, 50-, and 100-year storm events.

2.1 Infiltration Berm

The infiltration berm releases water through a spillway and three discharge pipes. Stormwater that flows over the spillway travels directly into a level spreader. Stormwater that flows through the discharge pipes and discharges across a riprap apron. The level spreader and riprap apron both discharge towards the vegetated area located southeast of the Limits of Disturbance. The stormwater is discharged as sheet flow and travels along a vegetative flow path until it reaches an onsite drainage swale, which discharges to an

existing culvert along N. Bacton Hill Road. The flow then continues along the swale on the west side N. Bacton Hill Road, where it enters a culvert, travels under N. Bacton Hill Road, and into an existing ephemeral stream on the east side of the road. The area downgradient of the proposed infiltration berm is over 90% vegetated. The flow path is depicted on Exhibit 1.0. Soil types and erodibility factors within the flow path are shown on Table 1.

Table 1 – Soils Mapped within Flow Path

Soil Mapping Unit	Soil Erodibility Factor, K_f
UrgB	$K_f = 0.37$
Th	$K_f = 0.37$

The soil erodibility factors are shown in Table 1. K values range from 0.02 to 0.69, a low K value indicates the soil will not easily erode whereas a high K value means the soil will easily erode. Based on a K value of 0.37, both soils are considered moderately susceptible to erosion. Neither soil is listed as easily erodible in Table E.1: Limitations of Pennsylvania Soils Pertaining to Earthmoving Projects in the PaDEP Erosion and Sediment Pollution Control Program Manual, March 2012. Photos were taken along the flow path of the downstream area to show the vegetative cover:

Photo 1: Existing Area at Proposed Level Spreader and Riprap Apron

Photo 2: Area Downgradient of the Proposed Level Spreader and Riprap Apron

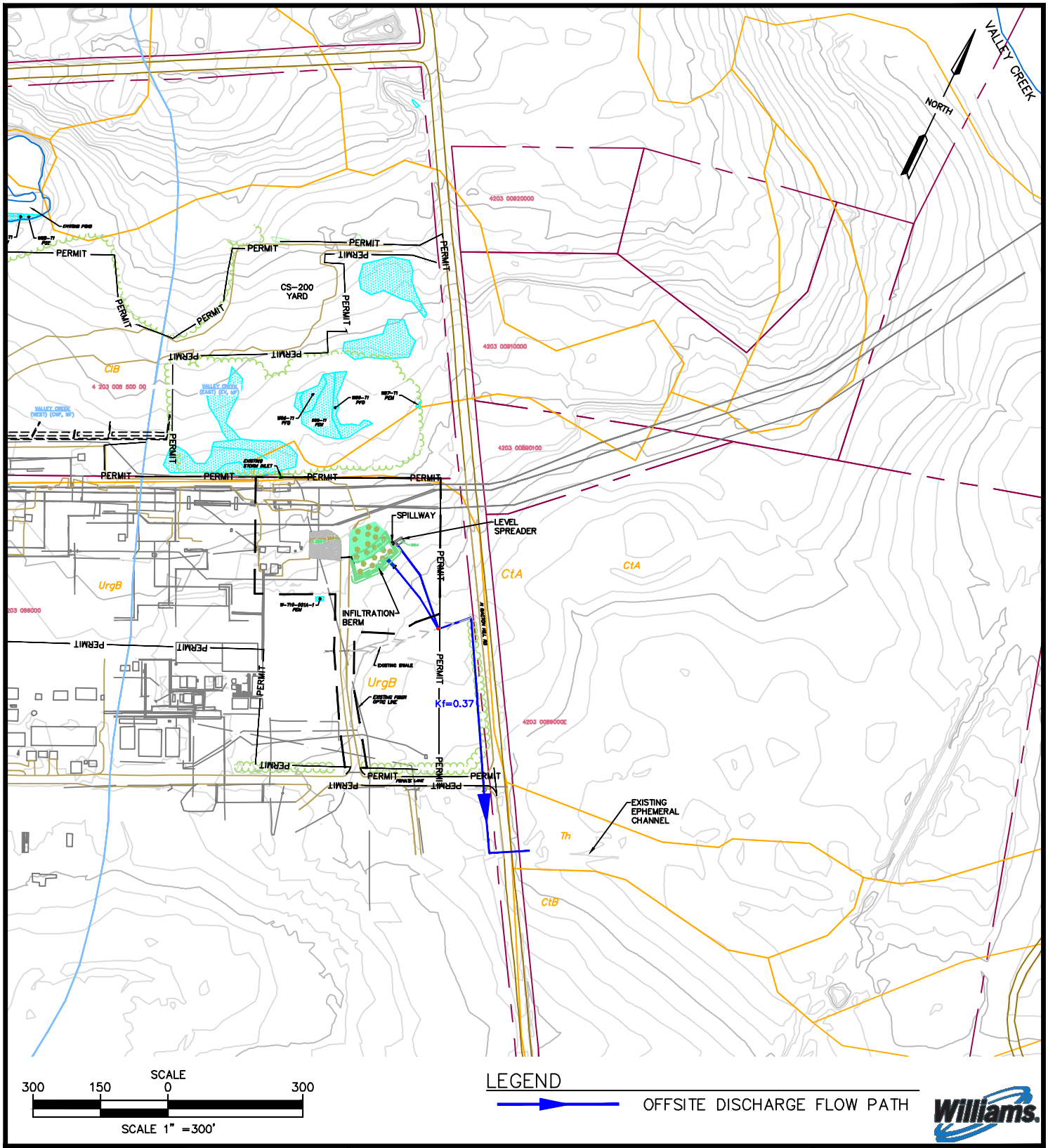
Photo 3: Existing Ephemeral Stream on the east side of N. Bacton Hill Road

Photo 1 shows the existing condition where the level spreader is proposed. The area will be graded to facilitate the installation of the level spreader and revegetated. Photo 2 shows the areas downgradient of the proposed level spreader and riprap apron, which is over 90% vegetated. Photo 3 shows the existing ephemeral stream where the flow from the project eventually discharges.

In the E&S and PCSM Narrative, site calculations are provided that show the Pre-, During-, and Post-Construction runoff flow rates and volumes. The calculations show a minor increase in the during-construction discharge rates. During-construction the flow velocity in the existing swale increased from 3.40 feet per second to 3.47 feet per second for the 10 year, 24 hour storm event. This increase will likely be mitigated by the use of compost filter socks, which will retain/slow the flow before entering the swale. The calculations show a reduction in the post-construction discharge rates and volumes. Post-construction calculations indicated that the discharge velocity at the proposed level spreader is 0.53 feet per second and into the proposed riprap apron is 2.56 feet per second for the for the 10 year, 24-hour storm event. Since all the outlet velocities are below 3.5 feet per second downstream erosion will be minimal if not negligible. If any erosion occurs along the flow path, Transco will repair as necessary.

3.0 Conclusion

Based on the existing vegetative conditions, low discharge velocities from the BMPs, and the reduced flow rates and volumes from the site, downgradient soil erosion is not anticipated as a result of the proposed development of this site.



designs, permits, resolutions | consulting, INC.
366 WALKER DRIVE, SUITE 300
STATE COLLEGE, PA 16801
TELEPHONE: (814)-689-1650 FAX: (814)-689-1557

TRANSCONTINENTAL GAS PIPE LINE COMPANY, LLC
REGIONAL ENERGY ACCESS EXPANSION PROJECT
COMPRESSOR STATION 200

EROSION AND SEDIMENTATION CONTROL PLAN

FLOW PATH

EAST WHITELAND TWP CHESTER COUNTY PENNSYLVANIA

DATE: 02/22/22
DRAWN BY: RWS
CHECKED: PW
WHM DRAWING NO: FLOW PATH

EXHIBIT 1.0

ATTACHMENT 7
CEC GEOHAZARD RESPONSE LETTER

February 22, 2022

Mr. Brent Baldwin, P.E.
Transcontinental Gas Pipe Line Company, LLC
2800 Post Oak Blvd.
Houston, TX 77056

Dear Mr. Baldwin:

Subject: Response to Technical Deficiencies
Comments 126 and 127
East Whiteland Township, Chester County, Pennsylvania
CEC Project 303-105.1000

Civil & Environmental Consultants, Inc. is submitting this letter in response to the January 7, 2022, Technical Deficiency Letter for Regional Energy Access Expansion (REAE) Project, DEP Application Number ESG830021-00. Specifically, the Pennsylvania Department of Environmental Protection (PADEP) provided comments relative to the Erosion & Sediment Control Permit for Compressor Station 200 (CS200) prepared by BAI Group, LLC (BAI). Comments 126 and 127 from the Technical Deficiency letter pertain to the Civil & Environmental Consultants, Inc (CEC) Geohazard Assessment Report for Compressor Station 200 dated September 4, 2020 (Report). Comments from PADEP are as follows:

126. It appears that a desktop literature review has been provided in the geotechnical report. Please confirm that a thorough geotechnical investigation has been performed, including but not limited to suggested methodologies presented in Chapter 7 of the PA SW BMP Manual or other relevant literature (i.e. site reconnaissance including a thorough field examination for applicable features, drilling of boreholes, determination of groundwater elevations, geophysical surveys). Please consult with the geotechnical engineer and provide all necessary changes. [25 Pa Code §102.11(a)(2)]

127. Please provide a statement from Geotechnical Engineer on letterhead within the PCSM Narrative regarding the site's suitability for infiltration and add a note to the PCSM Plan to refer to this statement. [25 Pa Code §102.11(a)(2)]

The following sections of this letter include a discussion, data obtained, conclusions and recommendations, standard of care and report limitations, and closing remarks.

1.0 BACKGROUND

Transcontinental Gas Pipeline Company, LLC (Transco) is proposing modifications to the existing Compressor Station 200 Facility in conjunction with the REAE Facilities project. As part of the CEC Geohazard Assessment Report development, CEC reviewed mapping and identified the regional presence of soluble limestone and karst geologic features indicative of limestone solution. The reviewed mapping indicated that the site is located in an area with carbonate rock and a density of

mapped karst features estimated of approximately 2 to 3 karst features per acre in the lowland area of Chester County. The mapping reviewed does not identify any karst features within the proposed permit boundary. In addition, the facility was constructed in 1950 and has no history of sinkhole development within the proposed permit boundary.

CEC concluded that based on the geologic descriptions of the site bedrock formations and available mapping of known karst bedrock, there is a limited risk of karst feature development in the site soil and bedrock units.

2.0 ADDITIONAL DATA OBTAINED

2.1 AECOM Report

Williams retained AECOM to prepare a geotechnical report titled Geotechnical Investigation report, dated September 1, 2017, for a previously proposed project. The findings of the report indicate the regional presence of soluble limestone. In addition, twelve test borings were drilled from 15 to 30 feet below the existing ground surface (bgs) as part of the report development. None of the borings drilled encountered bedrock or ground water. The report also indicates that no infiltration of water into the subsurface should be planned within 100 feet of buildings as a preventive design measure based on the presence of soluble limestone.

2.2 BAI Field Investigations

BAI conducted fieldwork and the design for two separate projects for Transco at CS200 including soil characterization and infiltration testing. On Sept 23 and 24, 2020, 15 test pits were advanced with an excavator with total depths ranging from 5.5 to 6 ft. below ground surface (bgs) in an area located on the northwestern section of the CS200 facility (for a separate and non-REAE project) located approximately 250 feet north of the proposed REAE PCSM BMP. No bedrock or groundwater was encountered in these test pits.

On August Aug 13, 14 and 17 of 2020, in the immediate area of the proposed BMP for REAE, six boreholes were advanced manually with shovels and augers with total depths ranging from two to four ft. bgs. No bedrock or groundwater was encountered in these test pits.

2.3 Transco Investigation

On February 3, 2021, CS200 plant personnel manually advanced three push probes in the center of the proposed BMP. The probes were advanced unobstructed to a depth of 4.5, 5 and 7 ft. bgs. Bedrock was not encountered in the probe locations.

2.4 PCSM BMP

Appendix C of the Pennsylvania Stormwater Best Management Practices Manual indicates that locations that are not preferred for BMPs are areas with soil mantels less than three feet in Karst

topography. Furthermore, Appendix C indicates that except for surface discharge BMPs (filter strips, etc.), the designer is cautioned regarding the proposal of systems that are significantly lower than the existing grade. It is our understanding that one of the reviewers who developed the technical deficiency comments indicated that 4-feet of separation is desired.

The proposed PCSM BMP designed by BAI consists of a vegetative filter strip and an infiltration berm. It is our understanding that the presence of redoximorphic features in the soil indicate a possible limiting zone which BAI has addressed by ensuring two feet of separation exists between the bottom of the designed stormwater BMP and these features. This was accomplished by infiltration occurring behind the berm at or near the current existing ground surface elevation. The infiltration area is approximately 7,953 square feet and is located over 100 feet horizontally from the nearest building structure.

3.0 CONCLUSIONS

Review of available geologic information indicates the regional presence of soluble limestone and karst geologic features indicative of limestone solution. Subsurface investigation data, including test boring and test pit results, were reviewed. The data indicates that the top of bedrock is at least 15-feet bgs at the subject site. It is CEC's opinion that a thorough geotechnical investigation has been performed to support the PCSM BMP design.

Given that the proposed stormwater PCSM will consists of a vegetative filter strip and an infiltration berm with infiltration occurring at or near the existing ground surface, CEC concludes that at least 4-feet of a soil mantel will be present in the infiltration area based on the data reviewed. Additionally, the BMP will be located at least 100-feet from building structures as recommended in the AECOM report. As such, it is unlikely that the proposed BMP will contribute to sinkhole development, and it is CEC's opinion that the site is suitable for the proposed method of infiltration.

4.0 CLOSING REMARKS

CEC appreciates this opportunity to be of service to Transco. Please call if you have any questions or comments.

Very truly yours,

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

Michael L. Schumaker, P.E.
Principal

303-105.1000-RC-CS200-2.22.22

SECTION 3.3.2
DRAWINGS