Stormwater Management Report

Wickham Memorial Library Renovations & Additions

656 Burnside Avenue
East Hartford, CT

PREPARED FOR
Town of East Hartford
740 Main Street
East Hartford, CT 06108

January 2019

benesch

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SECTION 1 - INTRODUCTION

The property is situated at 656 Burnside Avenue (U.S. Route 44), in East Hartford, Connecticut. For purposes of this analysis, the "site" is considered 1.43 acres that comprises the sub-watersheds associated with the library portion of the property. The property is owned by the Town of East Hartford and consists of approximately 9.26 total acres. The Wickham Memorial Public Library is located on site and is approximately 1,900 square feet in size. The project proposes a building addition (555 SF) on the northwest side of the existing building which will serve as a new elevator lobby. The project also proposes a small parking lot directly to the west of the building and will be accessed via the existing public safety parking lot. The property is bordered to the south by Burnside Avenue (Route 44), to the east by School Street, and to the north by Tolland Street and to the west by fifteen residential properties.

The project was prepared in accordance with the Town of East Hartford Zoning Regulations, the Town of East Hartford Manual of Technical Design, the Connecticut Department of Energy and Environmental Protection (CT DEEP) 2002 Connecticut Guidelines for Soil Erosion and Sediment Control, and the 2004 CT DEEP Water Quality Manual.

SECTION 2 – HYDROLOGY

The intent of the hydrologic analysis is to determine rates of runoff for maximum storm frequencies of 2, 5, 10, 25, and 100-year intervals under existing and proposed conditions for the designated offsite discharge points.

Methodology

The analysis to determine peak flows generated from the site was prepared using TR-55 procedures for calculating peak rates of runoff resulting from precipitation events and procedures for developing runoff hydrographs. HydroCAD software was utilized to perform hydrologic computations. Rainfall frequency estimates are based on data from Hartford County and are taken directly from Appendix C of the Town of East Hartford Manual of Technical Design. These frequencies were utilized to generate the peak flows. The following 24-hour, precipitation estimates were utilized:

2-Year	3.2 inches
5-Year	4.2 inches
10-Year	4.9 inches
25-Year	5.6 inches
100-Year	7.0 inches

Existing Conditions

Topography generally slopes from the east portion of the site adjacent School Street, to the west portion of the property. The existing elevations are approximate elevation 58 at the east side of the property and 54 at the west portion of the property. The east portion of the site was previously developed with a 1,900 square foot building currently known as the Wickham Memorial Library. The western portion of the site consists of cleared lawn area and several trees lined along Burnside Avenue. There are three offsite discharge points: 1) the northern portion of the site sheet flows north on the existing parking lot to a catch basin, 2) the western portion of the site discharges, via sheet flow to a yard drain located just south of the Police Department and 3) a small portion of the southeastern site discharges to Burnside Avenue.

NRCS soils mapping indicates the site consists of Windsor-Urban land complex. These soils are classified as hydrologic soil group "A" and are considered excessively drained. Drainage from the site is divided into three (3) separate subwatersheds that correspond with the discharge points:

- Subwatershed E1: This consists of the northern portion of the site that discharges to the existing parking lot to the north into a catch basin.

- Subwatershed E2: This consists of the western portion of the site that discharges, via sheet flow to a yard drain just south of the Police Department.
- Subwatershed E3: This consists of the southeast portion of the site that discharges via sheet flow to Burnside Avenue.

Existing Watershed Data (Existing Conditions Cover Characteristics and Existing Watershed Area Map) have been included as Appendix A.

Proposed Conditions

The discharge points remain the same under proposed conditions:

- Subwatershed P1: This consists of the portion of the site on the northern portion that discharges directly to the existing parking lot to the north into a catch basin.
- Subwatershed P2: This consists of the western portion of the site that first discharges to a rain garden where peak flows are detained and then eventually into the catch basin as described in Subwatershed P1.
- Subwatershed P3: This consists of the southeast portion of the site that discharges to Burnside Avenue.

Proposed Watershed Data (Proposed Conditions Cover Characteristics and Proposed Watershed Area Map) have been included as Appendix B.

Due to the slight increase in impervious area, we are proposing a rain garden on the southwestern portion of the site, which will serve two (2) purposes. It will provide water quality treatment (see Section 3) as well as peak-flow detention. The rain garden will also provide groundwater recharge. In addition, the rain garden will be constructed with an overflow drainage structure which will be connected to the existing catch basin to the north.

On Tuesday December 18, 2018 at approximately 10:00 am, the Town of East Hartford dug two test pits in the area of the center of the proposed rain garden. Alfred Benesch & Company was on site to observe soils and take measurements. The first test pit was to evaluate the soil profile which consists of 1 foot of topsoil and a uniform layer of fine loamy sand with traces of silt to a depth of 5 feet. There was no groundwater encountered at this depth. The second test pit was 3 feet deep (approximately the bottom elevation of the proposed rain garden) to determine percolation/infiltration rates. After presoaking the test pit for 8 minutes, another bucket of water was dumped into the pit to determine percolation rates. Every five minutes, the water surface elevation was measured to determine an infiltration rate of 36 in/hr. Benesch has chosen to use 10 in/hr in HydroCAD computations as a conservative approach. Field results and measurements can be found in Appendix D. These existing conditions were taken into account for design considerations of the rain garden. The rain garden has been sized large enough to accept peak flows of the 100-year storm event.

Peak Flow Comparison

Peak flows at the off-site analysis points are as follows:

Watershed	Storm Event (Type III)	Discharge Existing (cfs)	Discharge Proposed (cfs)
1 (Flow to Analysis Point CB)	2-Year	0.6	0.5
	5-Year	0.9	0.8
	10-Year	1.1	1.1
	25-Year	1.3	1.3
	100-Year	1.8	1.8
2 (Flow to Route 44)	2-Year	0.0	0.0
	5-Year	0.0	0.0
	10-Year	0.0	0.0
	25-Year	0.0	0.0
	100-Year	0.0	0.0

It can be seen that peak flow will be either maintained or reduced under proposed conditions for all design storms. Total site flow, the majority of which is discharged to a rain garden in the western portion of the site, has been decreased, thereby protecting against potential flooding.

SECTION 3 – STORMWATER QUALITY

The project has been designed to address both short-term and long-term stormwater quality. Short term (during construction) treatment has been provided in the form of erosion control measures and long-term (post construction) treatment has been provided through the use of Low Impact Development principals. Erosion control has been designed per the 2002 Connecticut Erosion Control Guidelines. Long-term stormwater quality has been designed to meet the stormwater quality standards set forth in the Stormwater Manual and the 2004 CT DEEP Stormwater Quality Manual.

Short Term Erosion Control

The proposed erosion and sedimentation controls consider the specific characteristics of the site and the anticipated construction activities, and have been designed in accordance with the 2002 CT DEEP Guidelines for Soil Erosion and Sediment Control, as required by Section 6 of the Town of East Hartford Manual of Technical Design. Additionally, a permit for Soil Erosion and Sedimentation Control will be obtained as required by the Town of East Hartford Planning and Zoning Commission.

Construction Entrances

Construction entrances will be utilized to remove sediment from construction vehicle tires and prevent it from being tracked onto adjoining paved roadway areas.

Erosion Control Barriers

Prior to any construction activity, hay bales, silt fence, or combination hay bale/silt fence barriers will be placed at the down gradient limits of construction. These barriers will be inspected once every seven calendar days and within 24 hours after every rainfall generating a discharge and replaced as necessary. Collected silt will be removed when one-half the barrier height is reached.

Soil Stabilization- Mulches

Structural (non-living) soil stabilization will be utilized to protect the soil surface on a temporary basis without the intention of promoting plant growth. When grading of the disturbed area will be suspended for a period of 30 or more consecutive days, but less than 5 months, disturbed areas will be stabilized within 7 days of the suspension of grading through the use of mulch, non-bituminous tackifiers, erosion control netting, or other approved materials appropriate for use as a temporary soil protector. For surfaces that are not to be reworked within 5 months but will be reworked within 1 year, use temporary seeding, seeding-type mulch (hay, straw, or cellulose fiber) or when slopes are less than 3:1, wood chips, bark chips or shredded bark.

Stockpile Management

The topsoil stockpiles which will be idle for at least 30 days will be stabilized with temporary seed and mulch no later than 7 days from the last use. Small stockpiles may be covered with impervious tarps or erosion control matting in lieu of seeding and mulching.

A geotextile silt fence or hay bale barrier will be installed around the stockpile area approximately 10 feet from the proposed toe of the slope.

Long Term Stormwater Quality

The project was designed with guidance and direction from the CT DEEP 2004 Connecticut Stormwater Quality Manual (2004 Manual).

The design intent of the 2004 Connecticut Stormwater Quality Manual is to provide a "stormwater treatment train," where stormwater quality is achieved through a series of treatment measures. Harmful pollutants, such as sediment, pathogens, organic material, hydrocarbons, metals, synthetic organic chemicals and deicing compounds, are carried by the low-flow storms. Many of these pollutants are associated with vehicular exhaust, engine leaks and deicing, therefore key areas of on-site treatment include parking lots and access drives. Additionally, rooftops are a concern as a result of atmospheric ambient accumulation. Since pollutants typically attach themselves to solid particles, treatment practices are designed to remove suspended solids.

The treatment for this site includes:

- Parking lot sweeping
- Biofiltration in the form of rain gardens/vegetated bioswales

In order to provide for treatment of the water quality volume, the rain garden has been designed to treat the water quality volume (WQV), as well as provide groundwater infiltration that meets the DEEP requirements for Groundwater Recharge Volume (GRV). The required WQV is 1,568 cf and the rain garden provides a WQV of 2,604 cf. The required GRV is 581 cf and the rain garden provides a GRV of 2,604 cf.

Computations for WQV and GRV can be viewed in Appendix C.

Maintenance and Operation

Operation and maintenance shall be the responsibility of the owner.

<u>During Construction</u>

- Dust Control: Moisten disturbed soil areas with water periodically, or use a non-asphaltic soil tacifier to minimize dust.
- Temporary Soil Protection: Inspect seeded areas weekly and within 24 hours after a storm generating a discharge.
- Hay Bale/ Silt Fence Barrier: Inspect the barrier at least once a week and within 24 hours after the end of a storm generating a discharge. For dewatering operations, inspect frequently before, during and after pumping operations. Remove the sediment deposits when the depth reaches one half the barrier heights. Repair or replace a barrier within 24 hours of observed failure. Maintain the barrier until the contributing disturbed area is stabilized.
- Construction Entrance/Exit Pad: Maintain the pad in a condition that will prevent tracking and washing of sediment onto paved surfaces. Place additional clean gravel on top of gravel that has become silted, or remove the silted gravel and replace the gravel to the depth removed with clean gravel, as conditions warrant. Remove immediately all sediment spilled, dropped, washed or tracked onto paved surfaces. Roads adjacent to the construction site shall be cleaned at the end of each day by hand sweeping or sweeper truck.

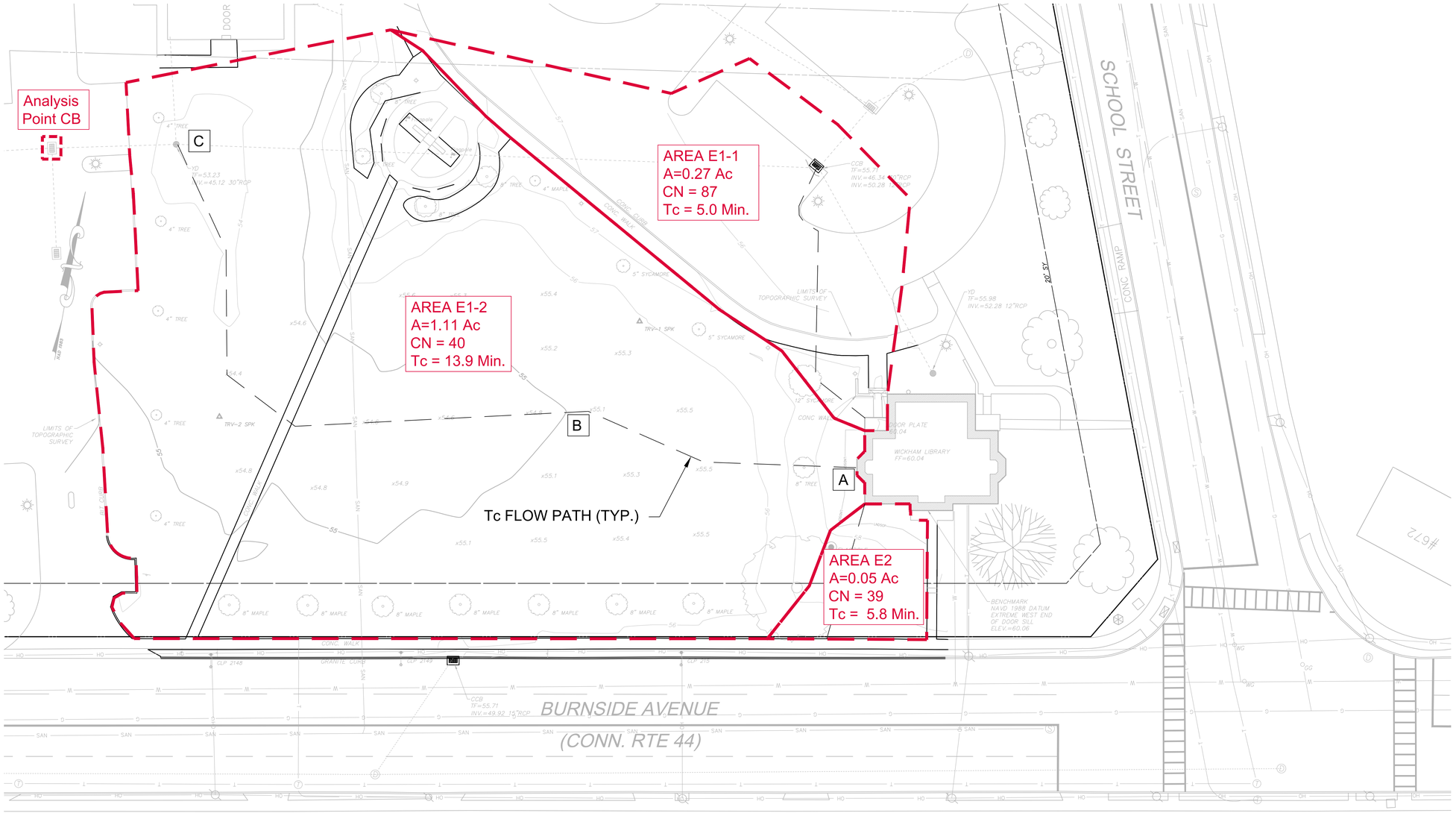
- Temporary Stockpiles: Inspect temporary stockpiles at the end of each workday to ensure that tarps are in place and secured. Temporary stockpiles that are expected to be inactive for more than 30 days should be temporarily seeded (see above).

After Construction

- Rain Gardens/Vegetated Bioswales: Inspect several times during the first few months to ensure that seed mix/grass cover is established. Inspect semi-annually and after major rain events for the first year. Inspect swales annually after the first year. Trash should be removed as accumulated. Sediment build-up should be removed when its depth is greater than four (4) inches. Grass should be reseeded if the side or bottom slopes exhibit erosion. Grass should be mowed once per month and should be cut to leave at least two (2) inches of height. The seed mix should be mowed 2 – 3 times per year. Mowing should not occur when the ground is soft, to avoid ruts.
- Parking Lot and Site Cleanup: Inspect on a regular basis not to exceed weekly for litter and debris.
- Parking Lot and Driveway Sweeping: At least twice a year, with the first occurring as soon as possible after snowmelt and the second not less than 90 days following the first.
- Landscaped Areas: Inspect semi-annually for erosion or dying vegetation. Repair and stabilize any bare or eroded areas and replace vegetation as soon as possible.

APPENDIX A

EXISTING WATERSHED DATA



Project Title:

Town of East Hartford
Wickham Memorial Library:
Renovations & Additions
656 Burnside Ave, East Hartford, CT 06108

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Revision:	*Description:*	*Date:*	*Revised By:*

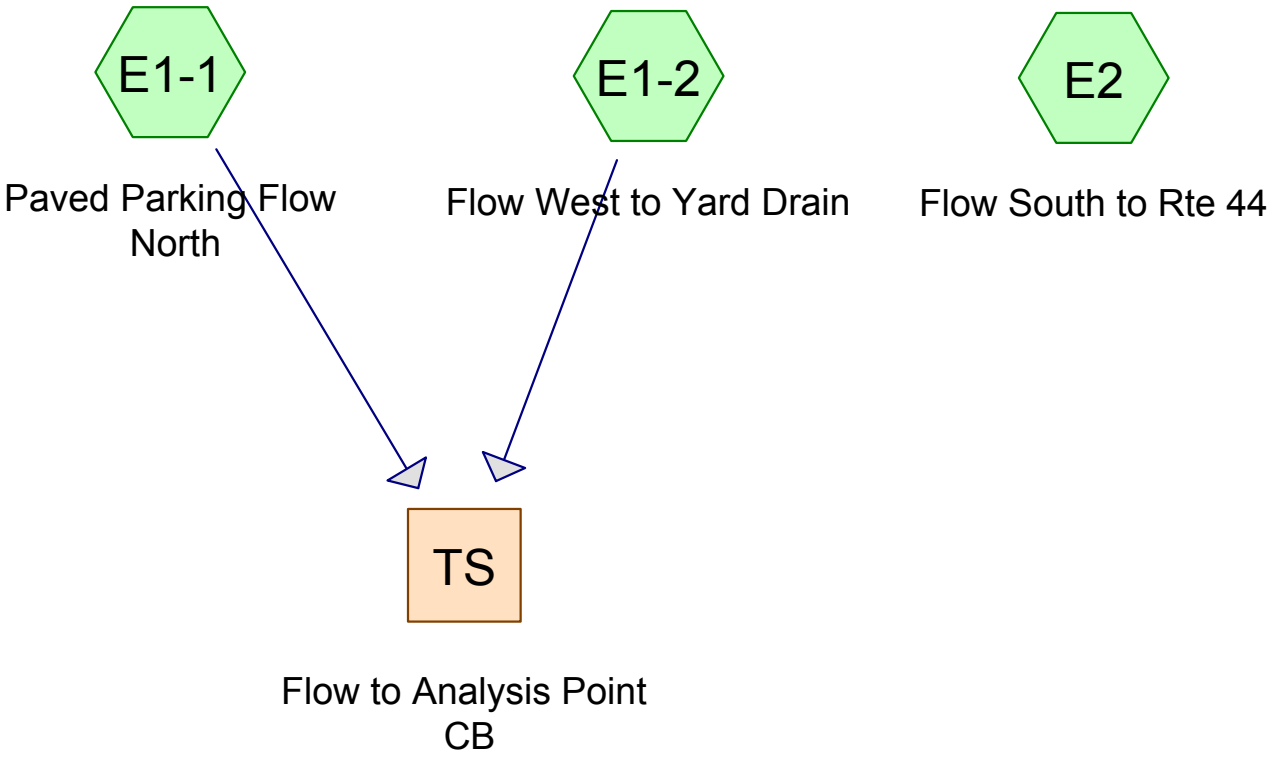
Drawing Title:

Existing Watershed Area Map

Date: 01.11.19
Scale: AS NOTED
Drawn By: JCO
Project Number: 17.322
Drawing Number: EWAM

Existing Watershed Cover Characteristics
Wickham Memorial Library- East Hartford, CT
Project # 70518.00

Watershed	Area (ac)	Impervious (ac)	Grass "A"	CN	Tc (min)
E1-1	0.27	0.22	0.05	87	5.0
E1-2	1.11	0.02	1.09	40	13.9
E2	0.05	0.00	0.05	39	5.8
Total	1.43	0.24	1.19	48.8	



Subcat Reach Pond Link

Routing Diagram for 70518 Existing
Prepared by Microsoft, Printed 1/4/2019

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.190	39	>75% Grass cover, Good, HSG A (E1-1, E1-2, E2)
0.240	98	Paved parking, HSG A (E1-1, E1-2)

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 E1-1: Paved Parking Flow Runoff Area=0.270 ac 81.48% Impervious Runoff Depth>1.79"
Tc=5.0 min CN=87 Runoff=0.61 cfs 0.040 af

Subcatchment E1-2: Flow West to Yard Drain Runoff Area=1.110 ac 1.80% Impervious Runoff Depth>0.00"
Flow Length=336' Tc=13.9 min CN=40 Runoff=0.00 cfs 0.000 af

Subcatchment E2: Flow South to Rte 44 Runoff Area=0.050 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=52' Slope=0.0200 '/' Tc=5.8 min CN=39 Runoff=0.00 cfs 0.000 af

Reach TS: Flow to Analysis Point CB Inflow=0.61 cfs 0.040 af
Outflow=0.61 cfs 0.040 af

Summary for Subcatchment E1-1: Paved Parking Flow North

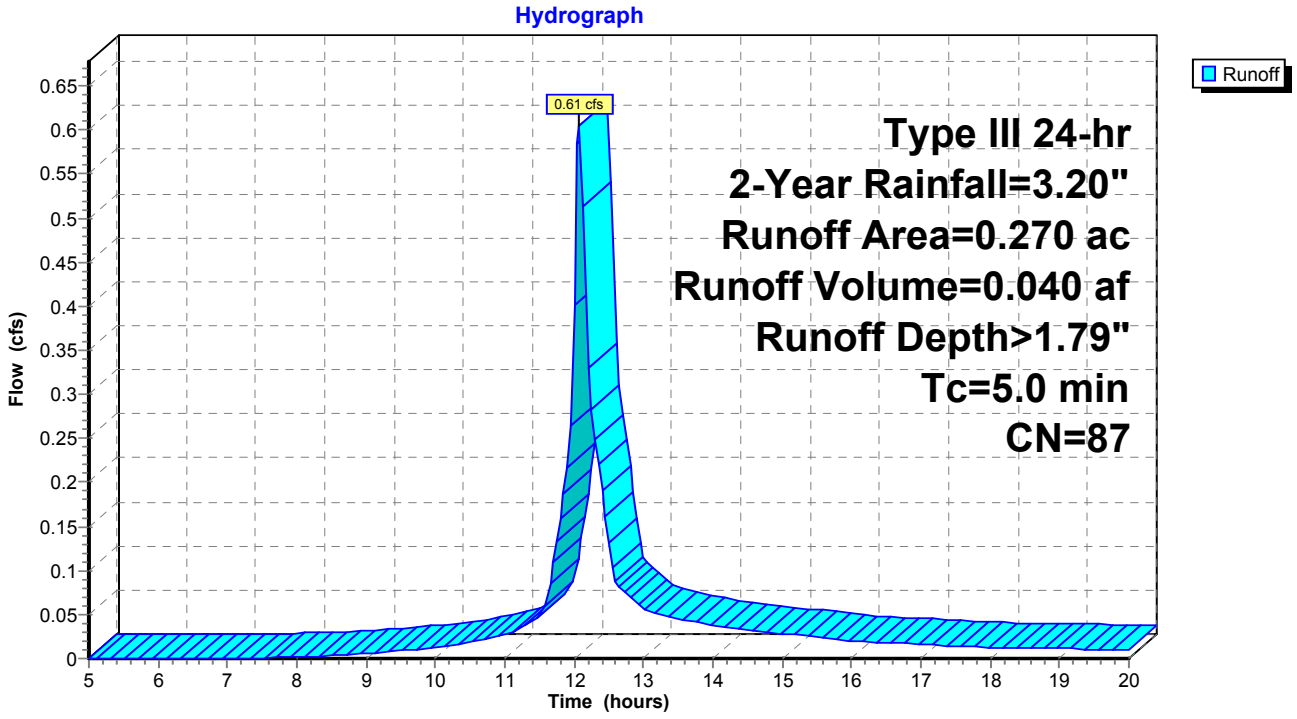
Runoff = 0.61 cfs @ 12.08 hrs, Volume= 0.040 af, Depth> 1.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (ac)	CN	Description
0.220	98	Paved parking, HSG A
0.050	39	>75% Grass cover, Good, HSG A
0.270	87	Weighted Average
0.050		18.52% Pervious Area
0.220		81.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct to meet min Tc**

Subcatchment E1-1: Paved Parking Flow North



Summary for Subcatchment E1-2: Flow West to Yard Drain

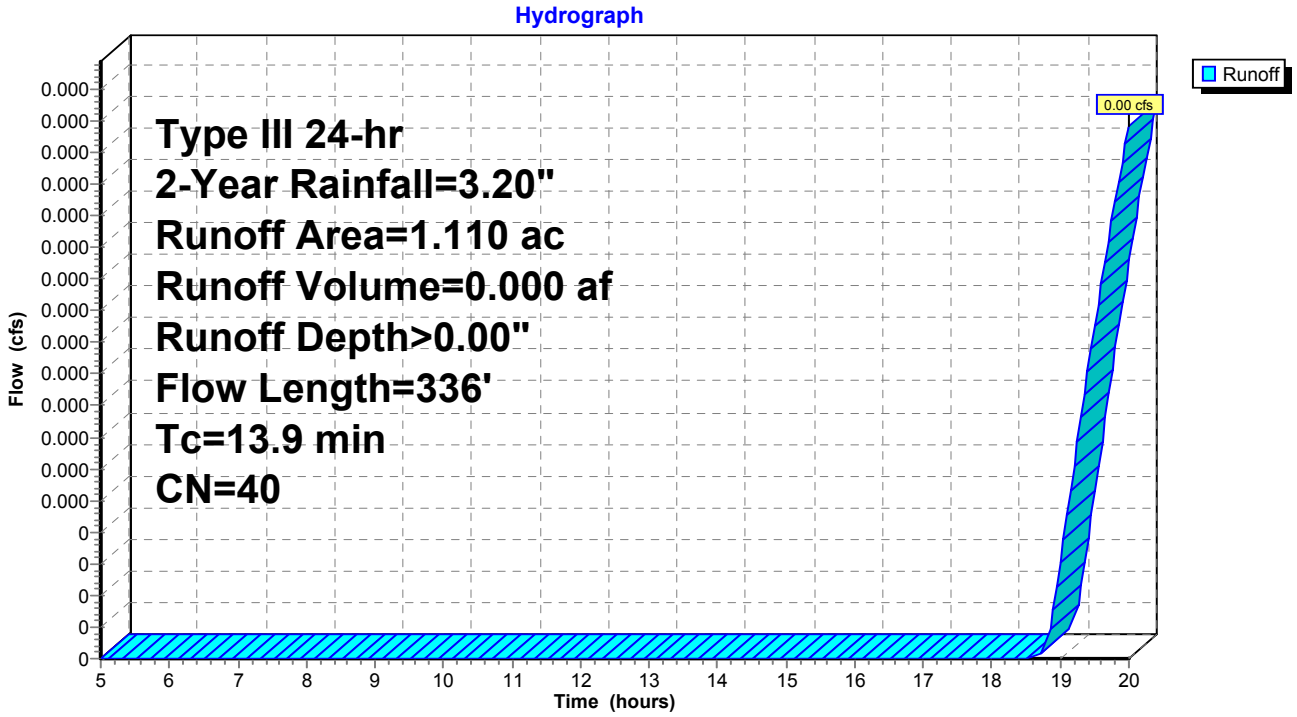
Runoff = 0.00 cfs @ 20.00 hrs, Volume= 0.000 af, Depth> 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (ac)	CN	Description
0.020	98	Paved parking, HSG A
1.090	39	>75% Grass cover, Good, HSG A
1.110	40	Weighted Average
1.090		98.20% Pervious Area
0.020		1.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0300	0.20		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 3.20"
5.6	236	0.0100	0.70		**Shallow Concentrated Flow, BC** Short Grass Pasture Kv= 7.0 fps
13.9	336	Total			

Subcatchment E1-2: Flow West to Yard Drain



Summary for Subcatchment E2: Flow South to Rte 44

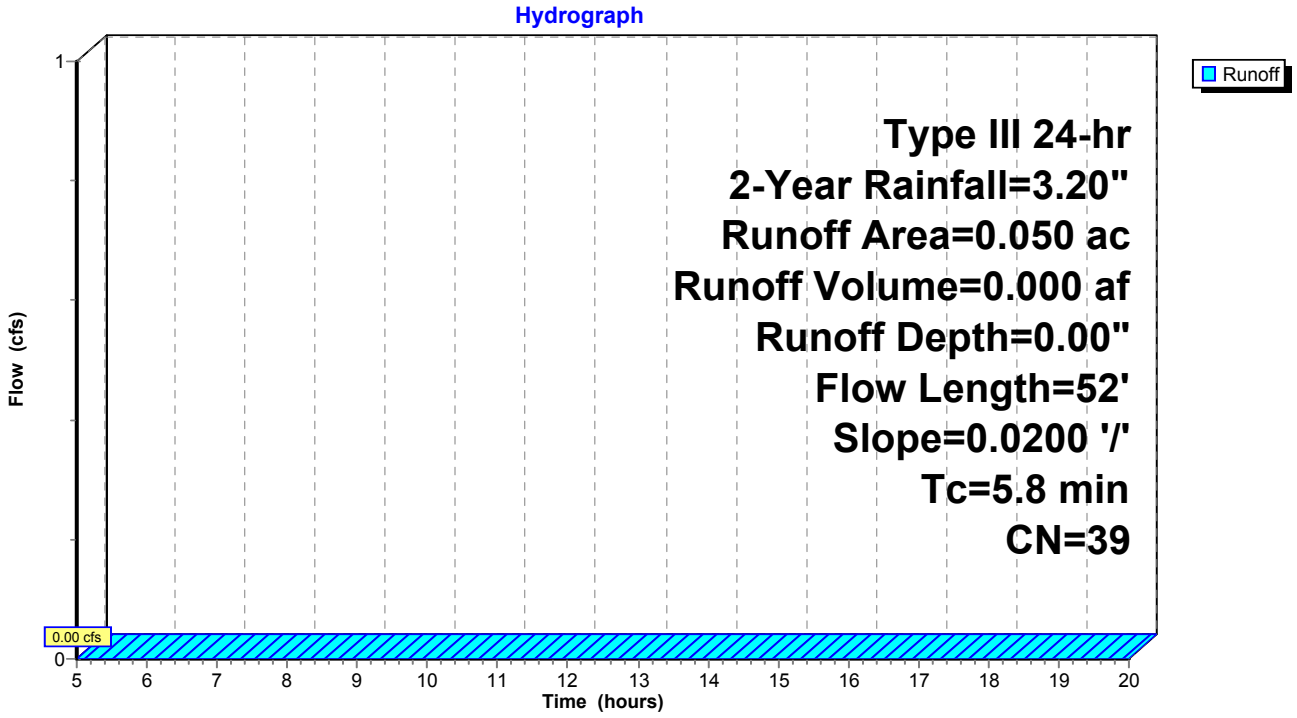
Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (ac)	CN	Description
0.050	39	>75% Grass cover, Good, HSG A
0.050		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	52	0.0200	0.15		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 3.20"

Subcatchment E2: Flow South to Rte 44

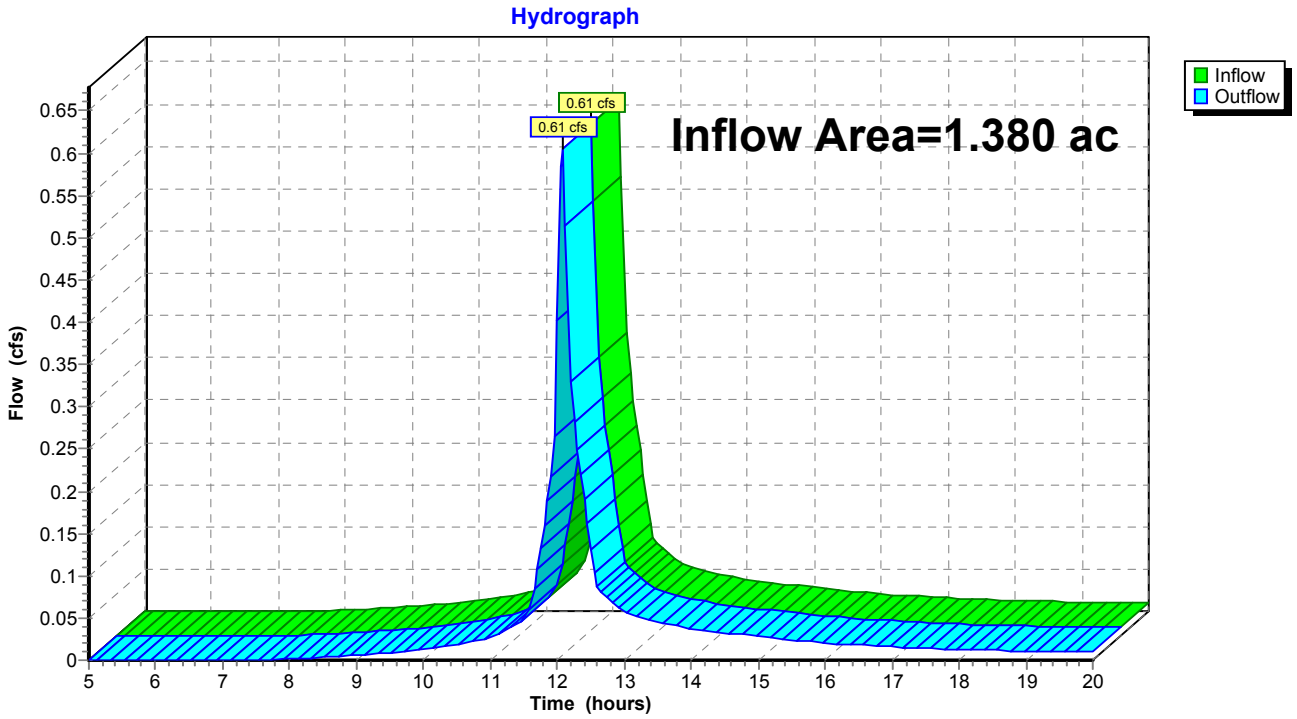


Summary for Reach TS: Flow to Analysis Point CB

Inflow Area = 1.380 ac, 17.39% Impervious, Inflow Depth > 0.35" for 2-Year event
Inflow = 0.61 cfs @ 12.08 hrs, Volume= 0.040 af
Outflow = 0.61 cfs @ 12.08 hrs, Volume= 0.040 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 TS: Flow to Analysis Point CB



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 E1-1: Paved Parking Flow Runoff Area=0.270 ac 81.48% Impervious Runoff Depth>2.65"
Tc=5.0 min CN=87 Runoff=0.89 cfs 0.060 af

Subcatchment E1-2: Flow West to Yard Drain Runoff Area=1.110 ac 1.80% Impervious Runoff Depth>0.06"
Flow Length=336' Tc=13.9 min CN=40 Runoff=0.01 cfs 0.006 af

Subcatchment E2: Flow South to Rte 44 Runoff Area=0.050 ac 0.00% Impervious Runoff Depth>0.05"
Flow Length=52' Slope=0.0200 '/' Tc=5.8 min CN=39 Runoff=0.00 cfs 0.000 af

Reach TS: Flow to Analysis Point CB Inflow=0.89 cfs 0.066 af
Outflow=0.89 cfs 0.066 af

Summary for Subcatchment E1-1: Paved Parking Flow North

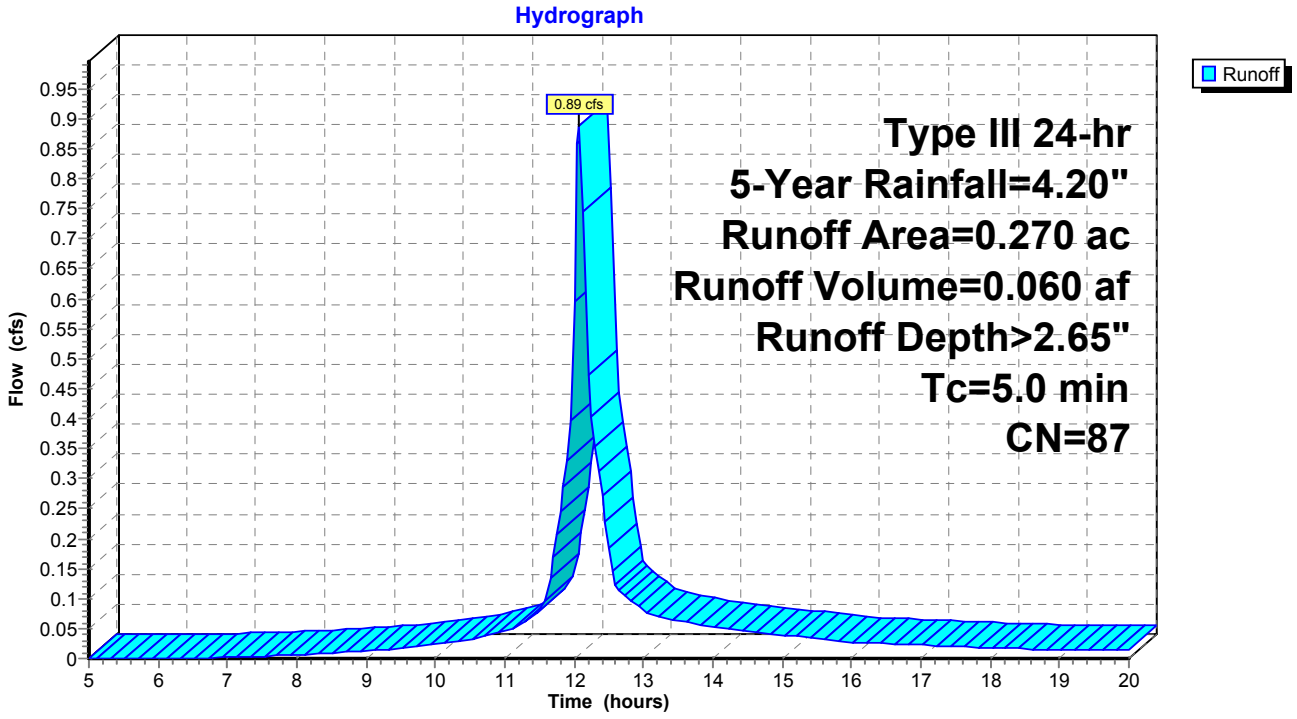
Runoff = 0.89 cfs @ 12.07 hrs, Volume= 0.060 af, Depth> 2.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 5-Year Rainfall=4.20"

Area (ac)	CN	Description
0.220	98	Paved parking, HSG A
0.050	39	>75% Grass cover, Good, HSG A
0.270	87	Weighted Average
0.050		18.52% Pervious Area
0.220		81.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct to meet min Tc**

Subcatchment E1-1: Paved Parking Flow North



Summary for Subcatchment E1-2: Flow West to Yard Drain

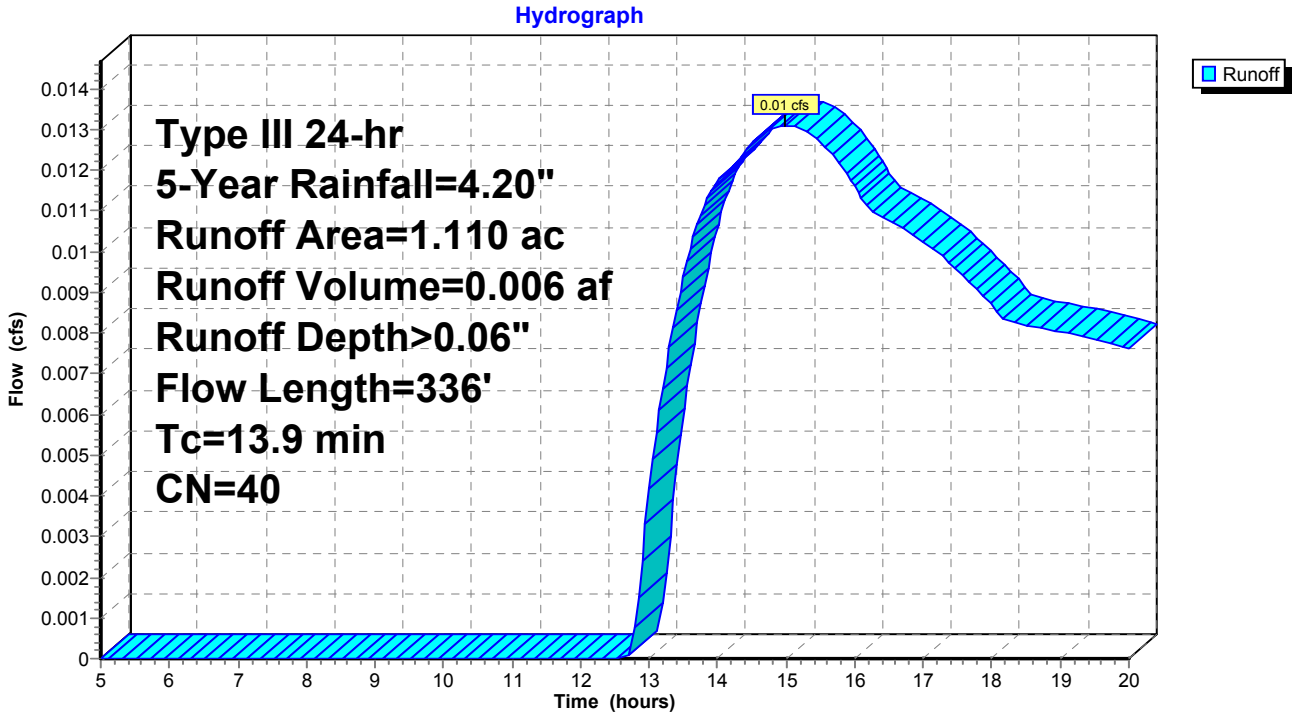
Runoff = 0.01 cfs @ 14.99 hrs, Volume= 0.006 af, Depth> 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 5-Year Rainfall=4.20"

Area (ac)	CN	Description
0.020	98	Paved parking, HSG A
1.090	39	>75% Grass cover, Good, HSG A
1.110	40	Weighted Average
1.090		98.20% Pervious Area
0.020		1.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0300	0.20		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 3.20"
5.6	236	0.0100	0.70		**Shallow Concentrated Flow, BC** Short Grass Pasture Kv= 7.0 fps
13.9	336	Total			

Subcatchment E1-2: Flow West to Yard Drain



Summary for Subcatchment E2: Flow South to Rte 44

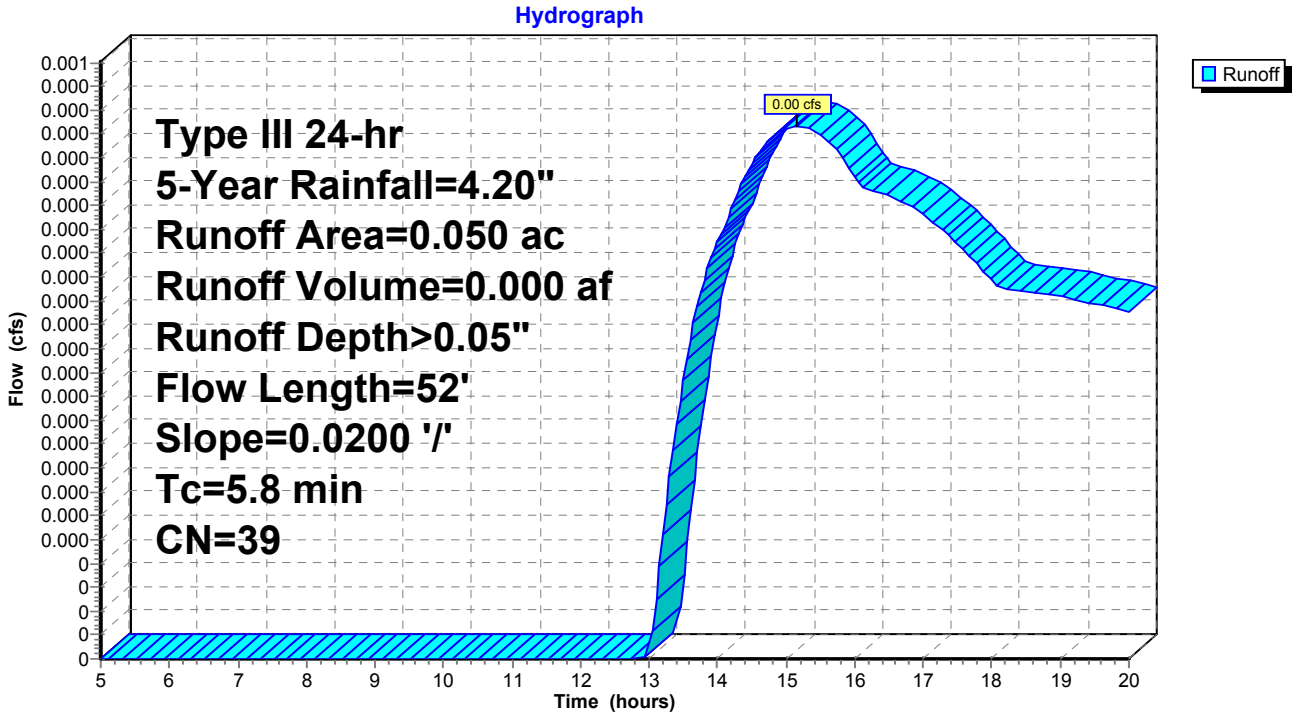
Runoff = 0.00 cfs @ 15.16 hrs, Volume= 0.000 af, Depth> 0.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 5-Year Rainfall=4.20"

Area (ac)	CN	Description
0.050	39	>75% Grass cover, Good, HSG A
0.050		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	52	0.0200	0.15		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 3.20"

Subcatchment E2: Flow South to Rte 44

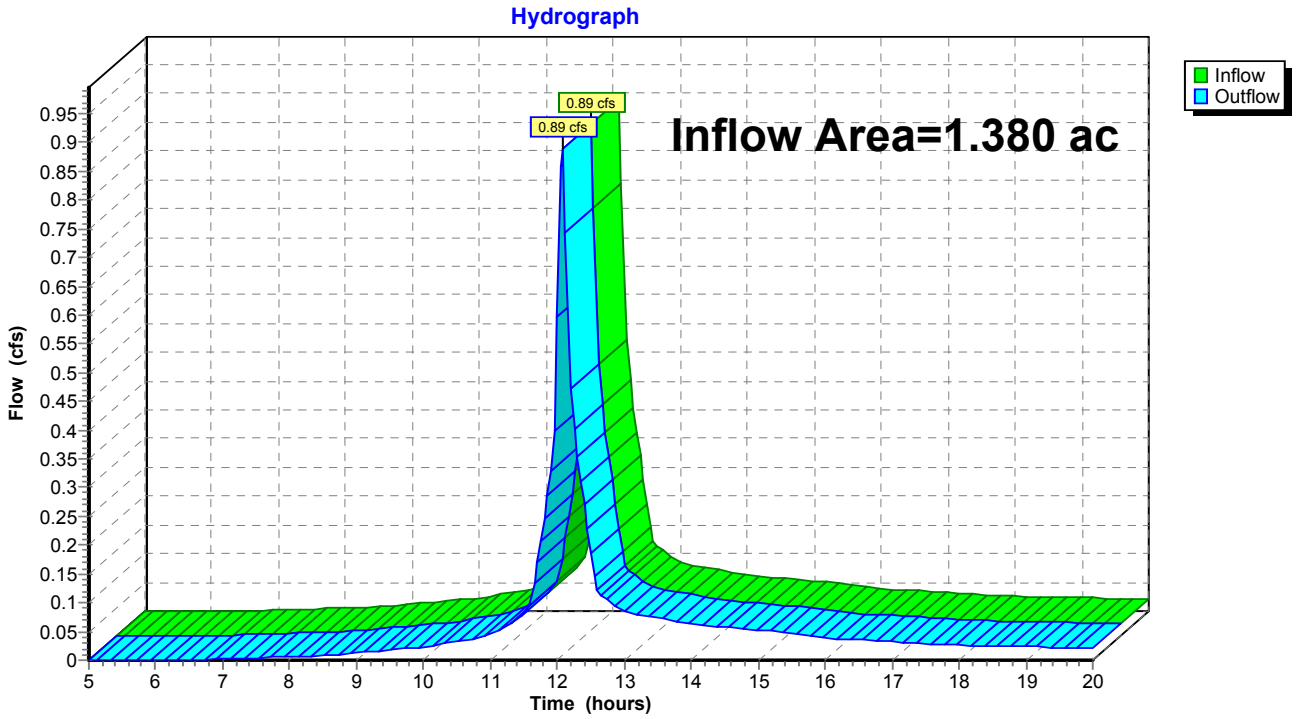


Summary for Reach TS: Flow to Analysis Point CB

Inflow Area = 1.380 ac, 17.39% Impervious, Inflow Depth > 0.57" for 5-Year event
Inflow = 0.89 cfs @ 12.07 hrs, Volume= 0.066 af
Outflow = 0.89 cfs @ 12.07 hrs, Volume= 0.066 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 TS: Flow to Analysis Point CB



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 E1-1: Paved Parking Flow Runoff Area=0.270 ac 81.48% Impervious Runoff Depth>3.27"
Tc=5.0 min CN=87 Runoff=1.09 cfs 0.074 af

Subcatchment E1-2: Flow West to Yard Drain Runoff Area=1.110 ac 1.80% Impervious Runoff Depth>0.17"
Flow Length=336' Tc=13.9 min CN=40 Runoff=0.04 cfs 0.016 af

Subcatchment E2: Flow South to Rte 44 Runoff Area=0.050 ac 0.00% Impervious Runoff Depth>0.14"
Flow Length=52' Slope=0.0200 '/' Tc=5.8 min CN=39 Runoff=0.00 cfs 0.001 af

Reach TS: Flow to Analysis Point CB Inflow=1.09 cfs 0.089 af
Outflow=1.09 cfs 0.089 af

Summary for Subcatchment E1-1: Paved Parking Flow North

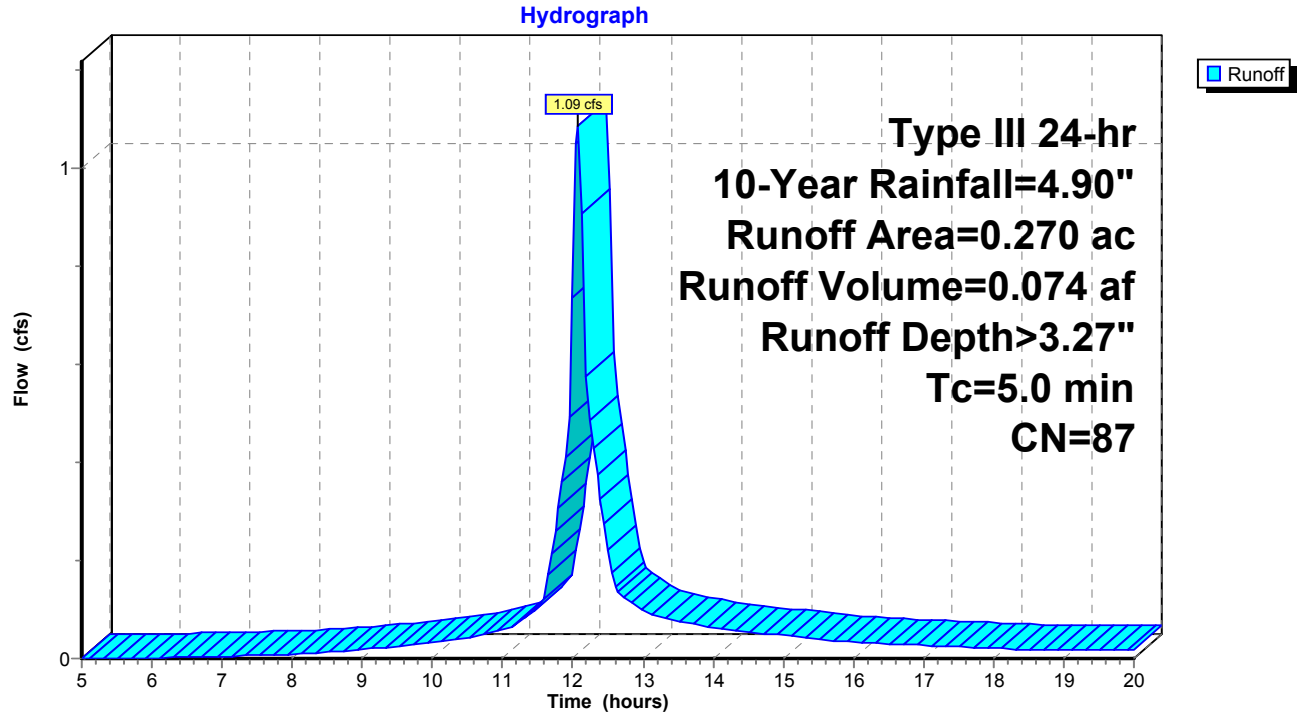
Runoff = 1.09 cfs @ 12.07 hrs, Volume= 0.074 af, Depth> 3.27"

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

Area (ac)	CN	Description
0.220	98	Paved parking, HSG A
0.050	39	>75% Grass cover, Good, HSG A
0.270	87	Weighted Average
0.050		18.52% Pervious Area
0.220		81.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct to meet min Tc**

Subcatchment E1-1: Paved Parking Flow North



Summary for Subcatchment E1-2: Flow West to Yard Drain

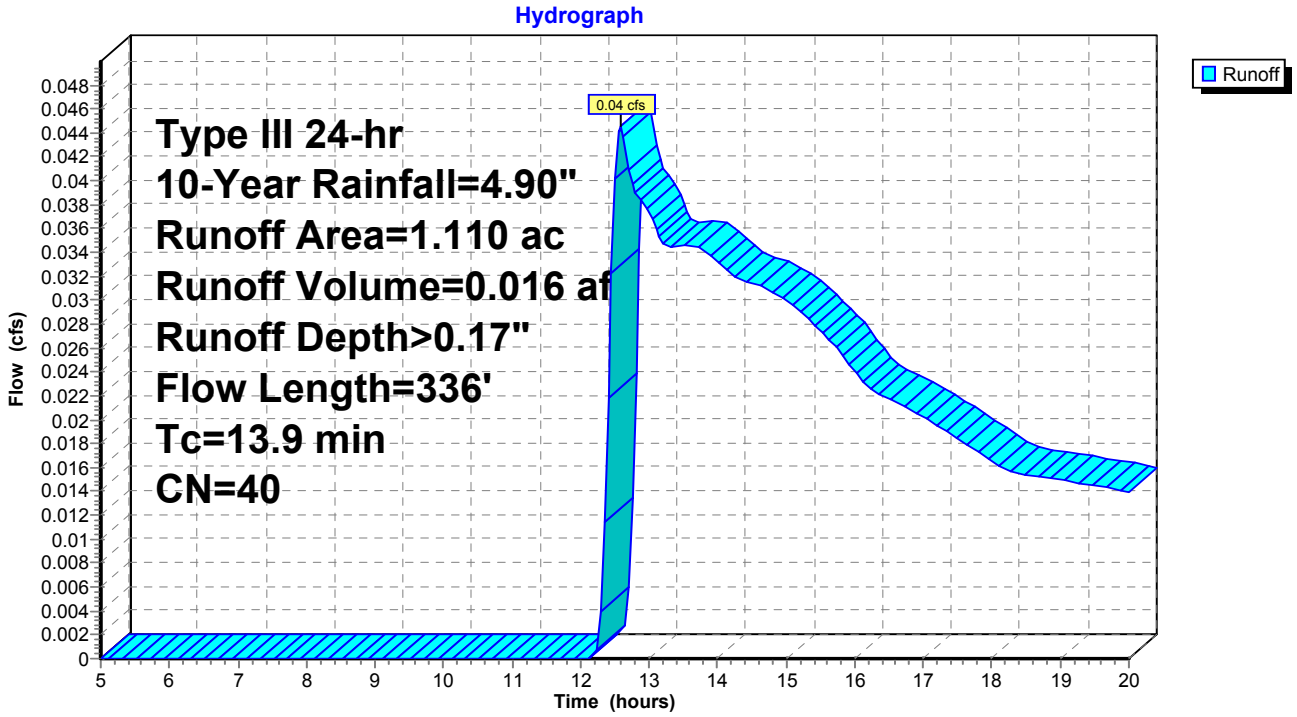
Runoff = 0.04 cfs @ 12.58 hrs, Volume= 0.016 af, Depth> 0.17"

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

Area (ac)	CN	Description
0.020	98	Paved parking, HSG A
1.090	39	>75% Grass cover, Good, HSG A
1.110	40	Weighted Average
1.090		98.20% Pervious Area
0.020		1.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0300	0.20		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 3.20"
5.6	236	0.0100	0.70		**Shallow Concentrated Flow, BC** Short Grass Pasture Kv= 7.0 fps
13.9	336	Total			

Subcatchment E1-2: Flow West to Yard Drain



Summary for Subcatchment E2: Flow South to Rte 44

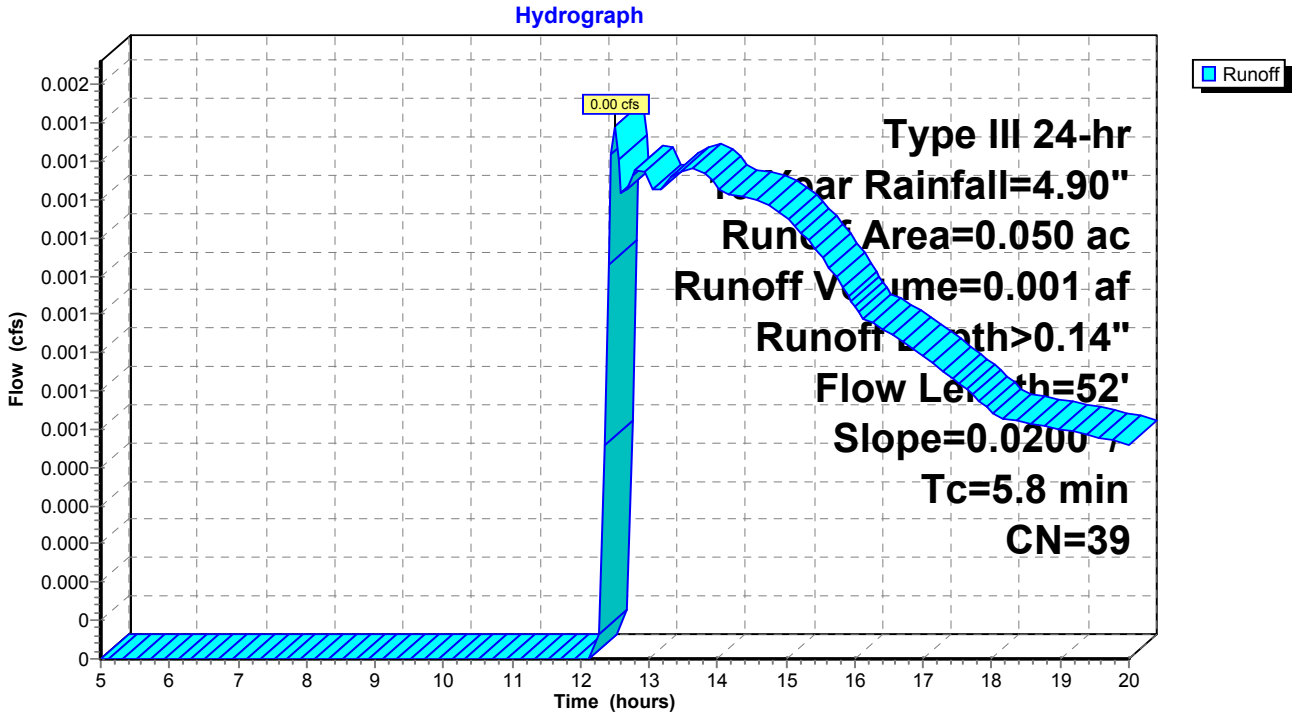
Runoff = 0.00 cfs @ 12.50 hrs, Volume= 0.001 af, Depth> 0.14"

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

Area (ac)	CN	Description
0.050	39	>75% Grass cover, Good, HSG A
0.050		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	52	0.0200	0.15		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 3.20"

Subcatchment E2: Flow South to Rte 44

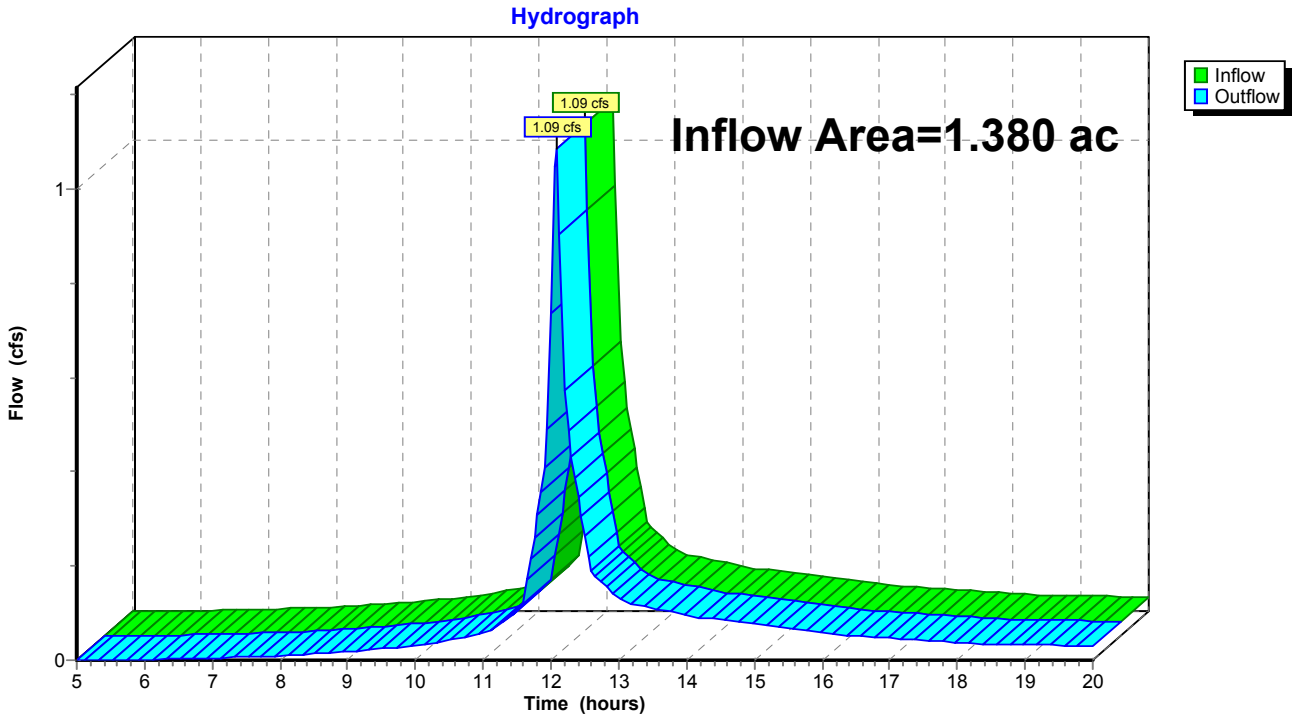


Summary for Reach TS: Flow to Analysis Point CB

Inflow Area = 1.380 ac, 17.39% Impervious, Inflow Depth > 0.78" for 10-Year event
Inflow = 1.09 cfs @ 12.07 hrs, Volume= 0.089 af
Outflow = 1.09 cfs @ 12.07 hrs, Volume= 0.089 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 TS: Flow to Analysis Point CB



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 E1-1: Paved Parking Flow Runoff Area=0.270 ac 81.48% Impervious Runoff Depth>3.90"
Tc=5.0 min CN=87 Runoff=1.28 cfs 0.088 af

Subcatchment E1-2: Flow West to Yard Drain Runoff Area=1.110 ac 1.80% Impervious Runoff Depth>0.32"
Flow Length=336' Tc=13.9 min CN=40 Runoff=0.14 cfs 0.029 af

Subcatchment E2: Flow South to Rte 44 Runoff Area=0.050 ac 0.00% Impervious Runoff Depth>0.28"
Flow Length=52' Slope=0.0200 '/' Tc=5.8 min CN=39 Runoff=0.01 cfs 0.001 af

Reach TS: Flow to Analysis Point CB Inflow=1.29 cfs 0.117 af
Outflow=1.29 cfs 0.117 af

Summary for Subcatchment E1-1: Paved Parking Flow North

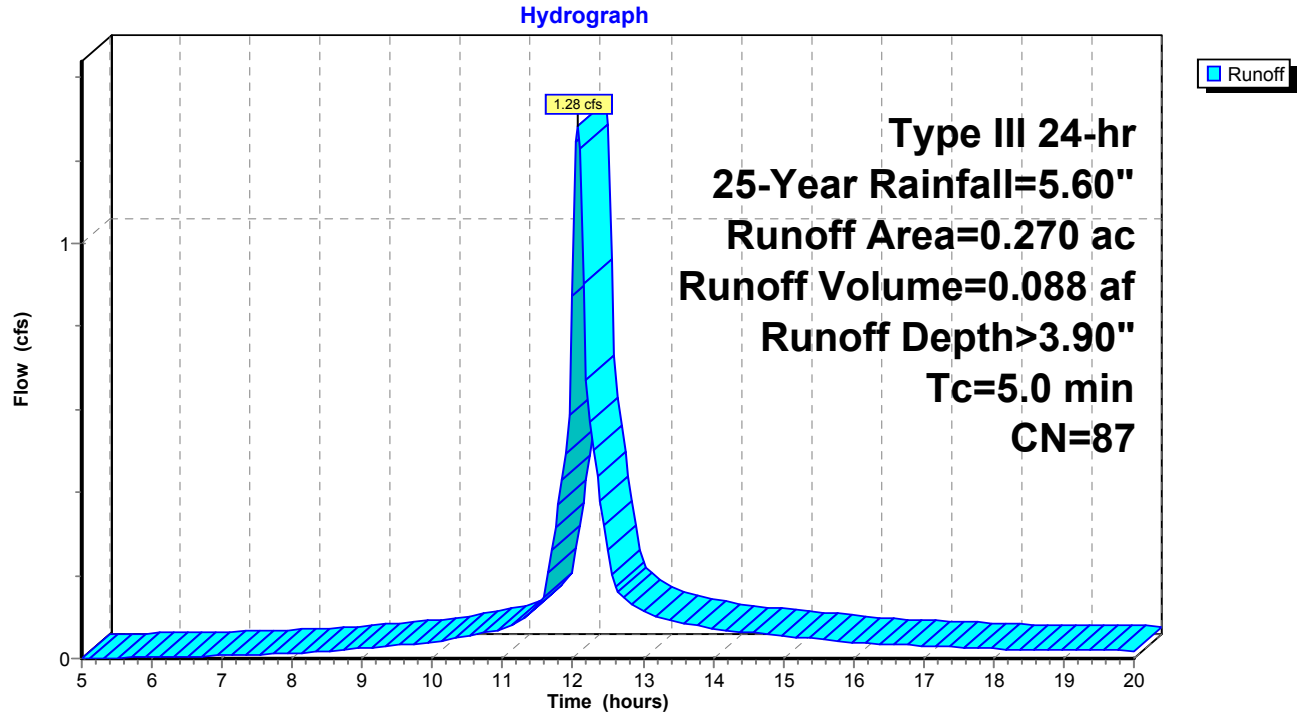
Runoff = 1.28 cfs @ 12.07 hrs, Volume= 0.088 af, Depth> 3.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.60"

Area (ac)	CN	Description
0.220	98	Paved parking, HSG A
0.050	39	>75% Grass cover, Good, HSG A
0.270	87	Weighted Average
0.050		18.52% Pervious Area
0.220		81.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct to meet min Tc**

Subcatchment E1-1: Paved Parking Flow North



Summary for Subcatchment E1-2: Flow West to Yard Drain

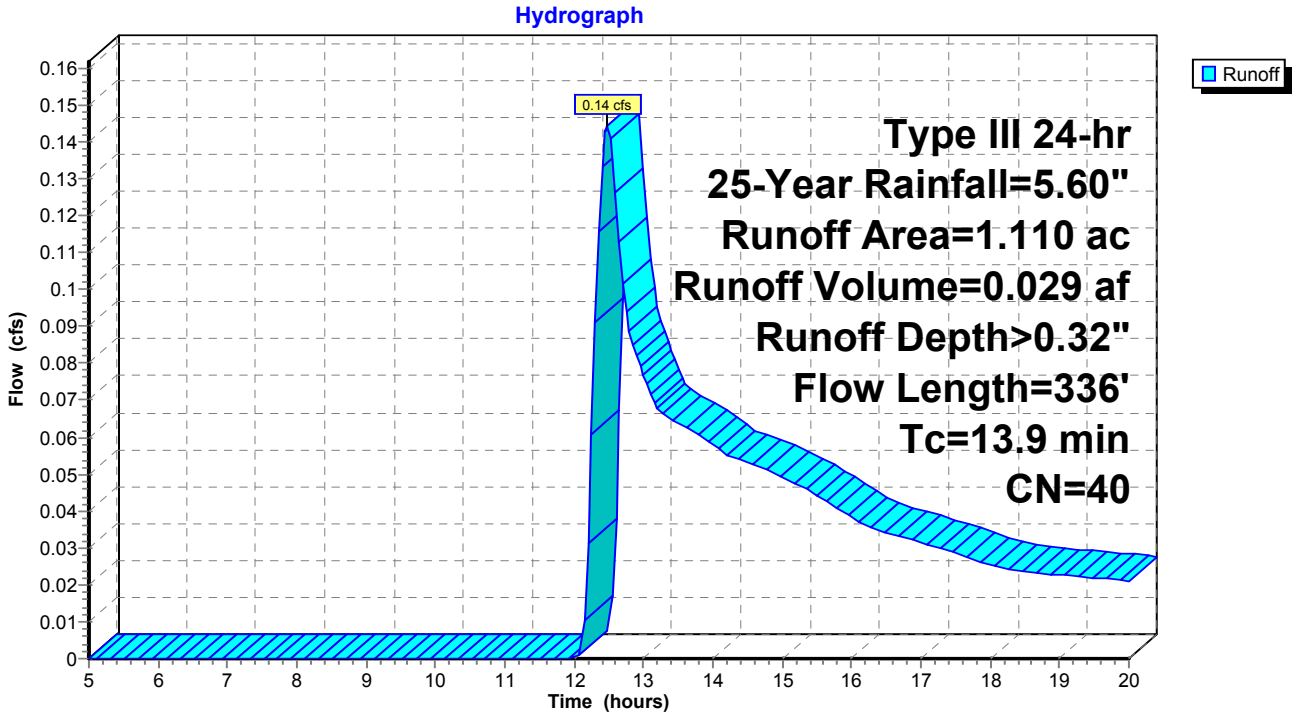
Runoff = 0.14 cfs @ 12.48 hrs, Volume= 0.029 af, Depth> 0.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.60"

Area (ac)	CN	Description
0.020	98	Paved parking, HSG A
1.090	39	>75% Grass cover, Good, HSG A
1.110	40	Weighted Average
1.090		98.20% Pervious Area
0.020		1.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0300	0.20		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 3.20"
5.6	236	0.0100	0.70		**Shallow Concentrated Flow, BC** Short Grass Pasture Kv= 7.0 fps
13.9	336	Total			

Subcatchment E1-2: Flow West to Yard Drain



Summary for Subcatchment E2: Flow South to Rte 44

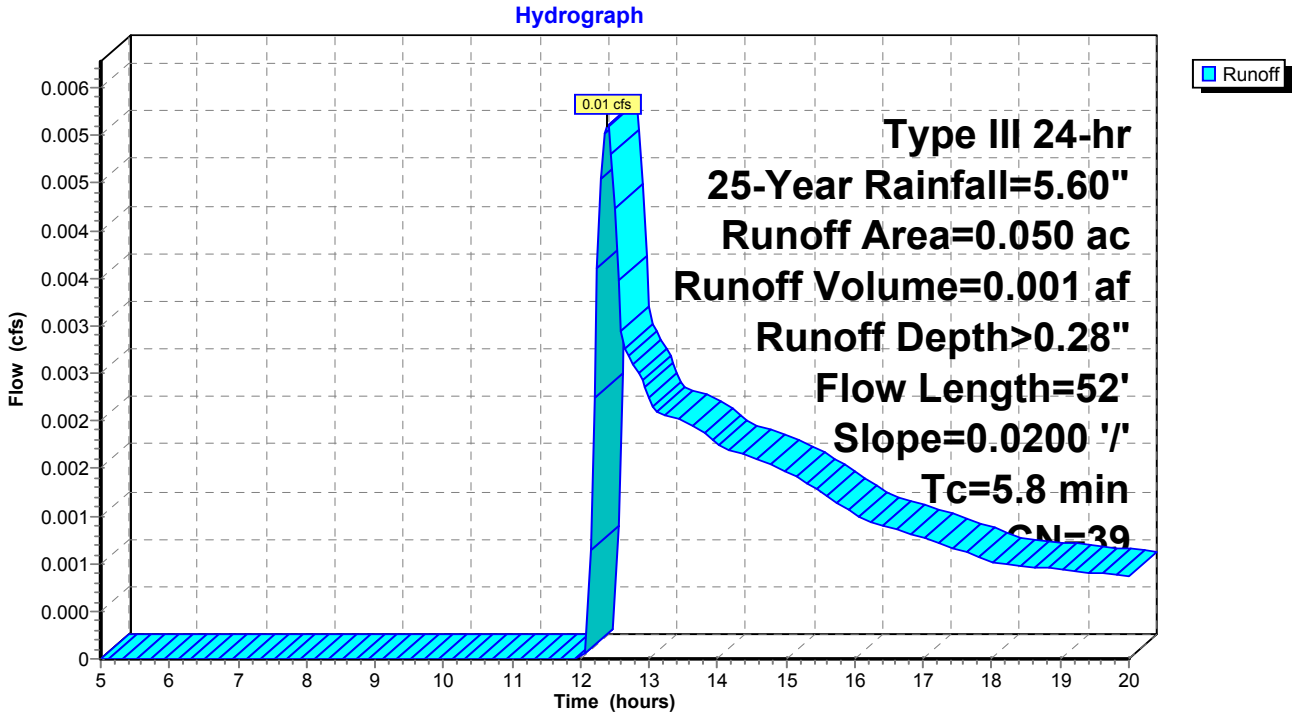
Runoff = 0.01 cfs @ 12.38 hrs, Volume= 0.001 af, Depth> 0.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.60"

Area (ac)	CN	Description
0.050	39	>75% Grass cover, Good, HSG A
0.050		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	52	0.0200	0.15		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 3.20"

Subcatchment E2: Flow South to Rte 44

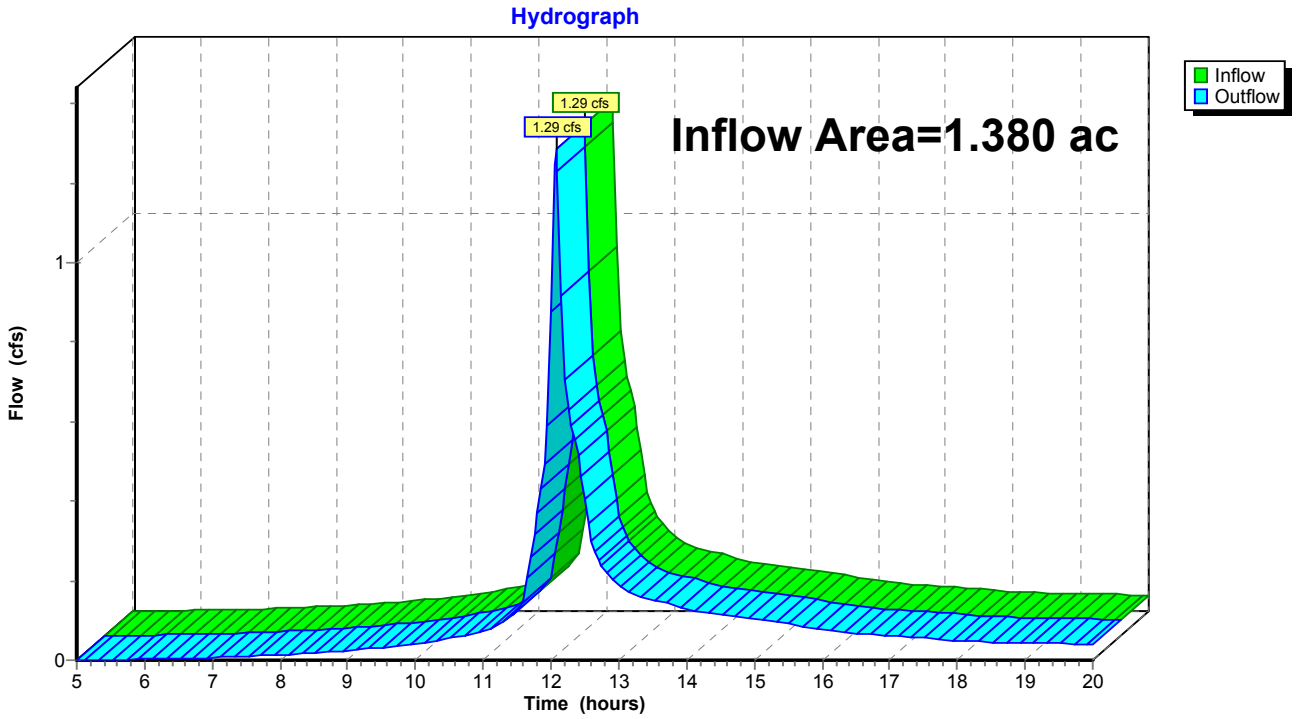


Summary for Reach TS: Flow to Analysis Point CB

Inflow Area = 1.380 ac, 17.39% Impervious, Inflow Depth > 1.02" for 25-Year event
Inflow = 1.29 cfs @ 12.07 hrs, Volume= 0.117 af
Outflow = 1.29 cfs @ 12.07 hrs, Volume= 0.117 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 TS: Flow to Analysis Point CB



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 E1-1: Paved Parking Flow Runoff Area=0.270 ac 81.48% Impervious Runoff Depth>5.18"
Tc=5.0 min CN=87 Runoff=1.68 cfs 0.117 af

Subcatchment E1-2: Flow West to Yard Drain Runoff Area=1.110 ac 1.80% Impervious Runoff Depth>0.73"
Flow Length=336' Tc=13.9 min CN=40 Runoff=0.48 cfs 0.067 af

Subcatchment E2: Flow South to Rte 44 Runoff Area=0.050 ac 0.00% Impervious Runoff Depth>0.66"
Flow Length=52' Slope=0.0200 '/' Tc=5.8 min CN=39 Runoff=0.02 cfs 0.003 af

Reach TS: Flow to Analysis Point CB Inflow=1.75 cfs 0.184 af
Outflow=1.75 cfs 0.184 af

Summary for Subcatchment E1-1: Paved Parking Flow North

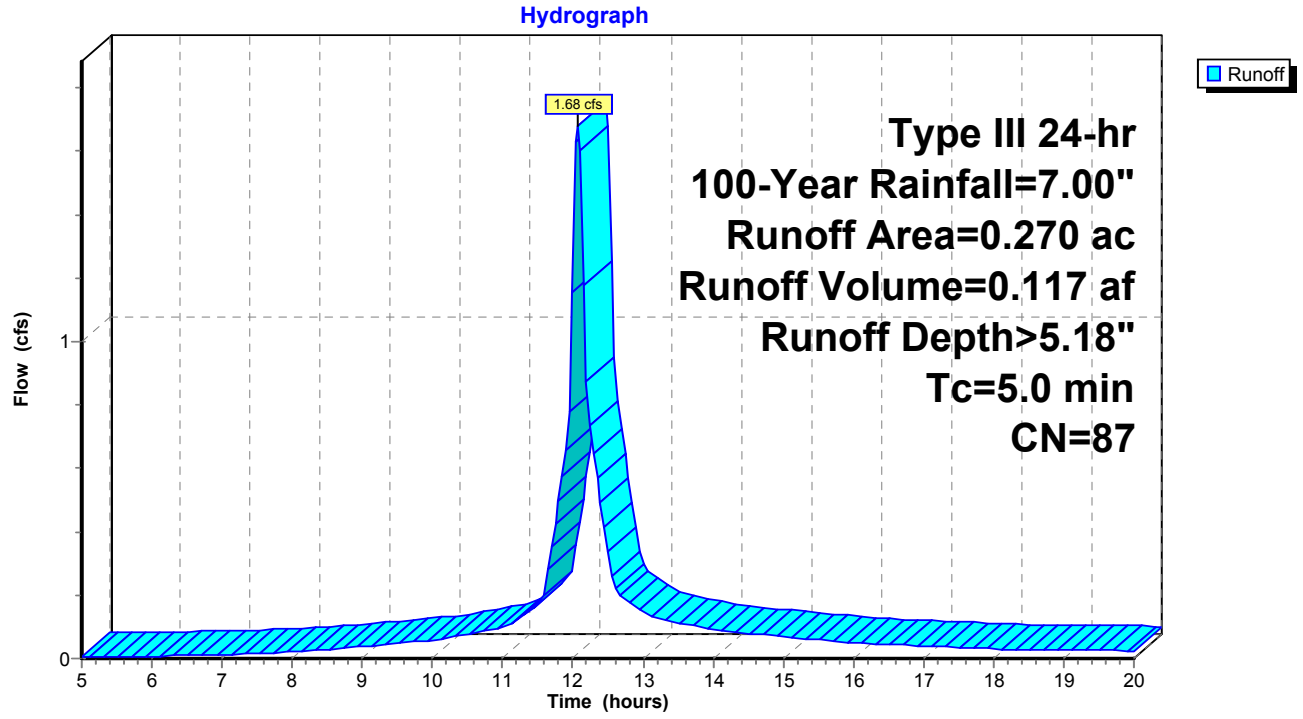
Runoff = 1.68 cfs @ 12.07 hrs, Volume= 0.117 af, Depth> 5.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.00"

Area (ac)	CN	Description
0.220	98	Paved parking, HSG A
0.050	39	>75% Grass cover, Good, HSG A
0.270	87	Weighted Average
0.050		18.52% Pervious Area
0.220		81.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct to meet min Tc**

Subcatchment E1-1: Paved Parking Flow North



Summary for Subcatchment E1-2: Flow West to Yard Drain

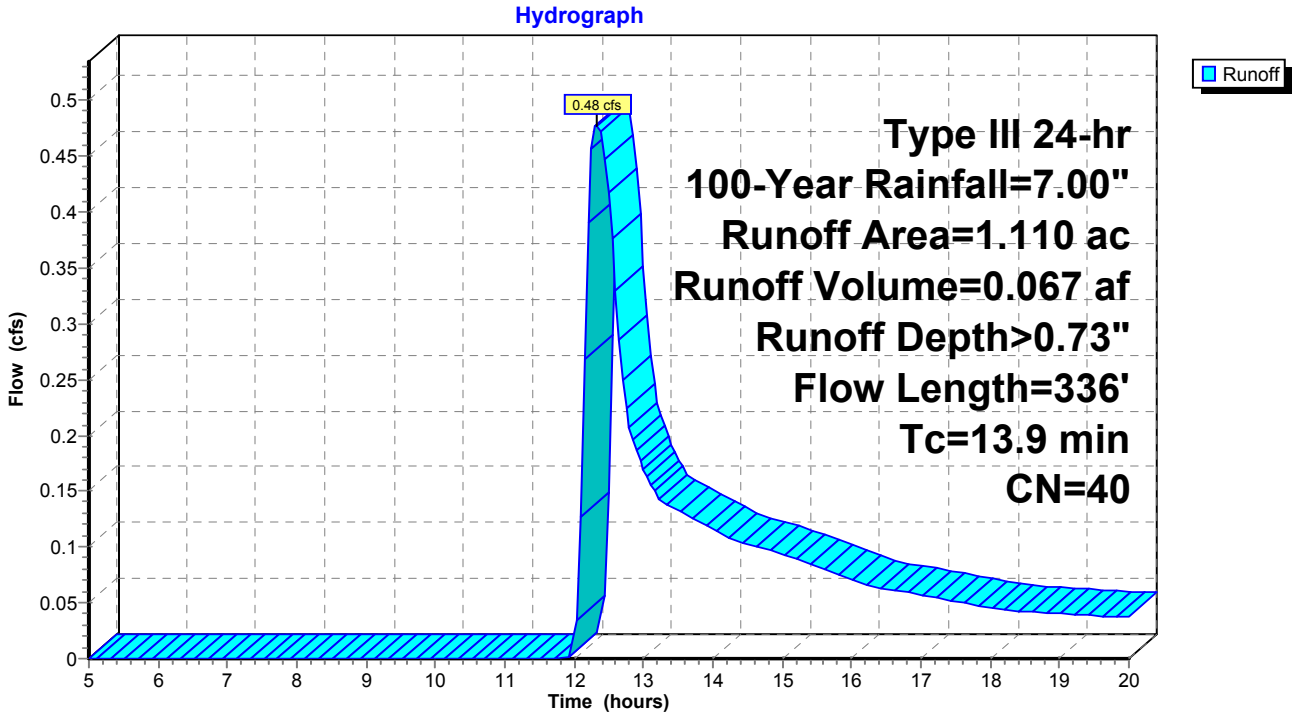
Runoff = 0.48 cfs @ 12.33 hrs, Volume= 0.067 af, Depth> 0.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.00"

Area (ac)	CN	Description
0.020	98	Paved parking, HSG A
1.090	39	>75% Grass cover, Good, HSG A
1.110	40	Weighted Average
1.090		98.20% Pervious Area
0.020		1.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0300	0.20		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 3.20"
5.6	236	0.0100	0.70		**Shallow Concentrated Flow, BC** Short Grass Pasture Kv= 7.0 fps
13.9	336	Total			

Subcatchment E1-2: Flow West to Yard Drain



Summary for Subcatchment E2: Flow South to Rte 44

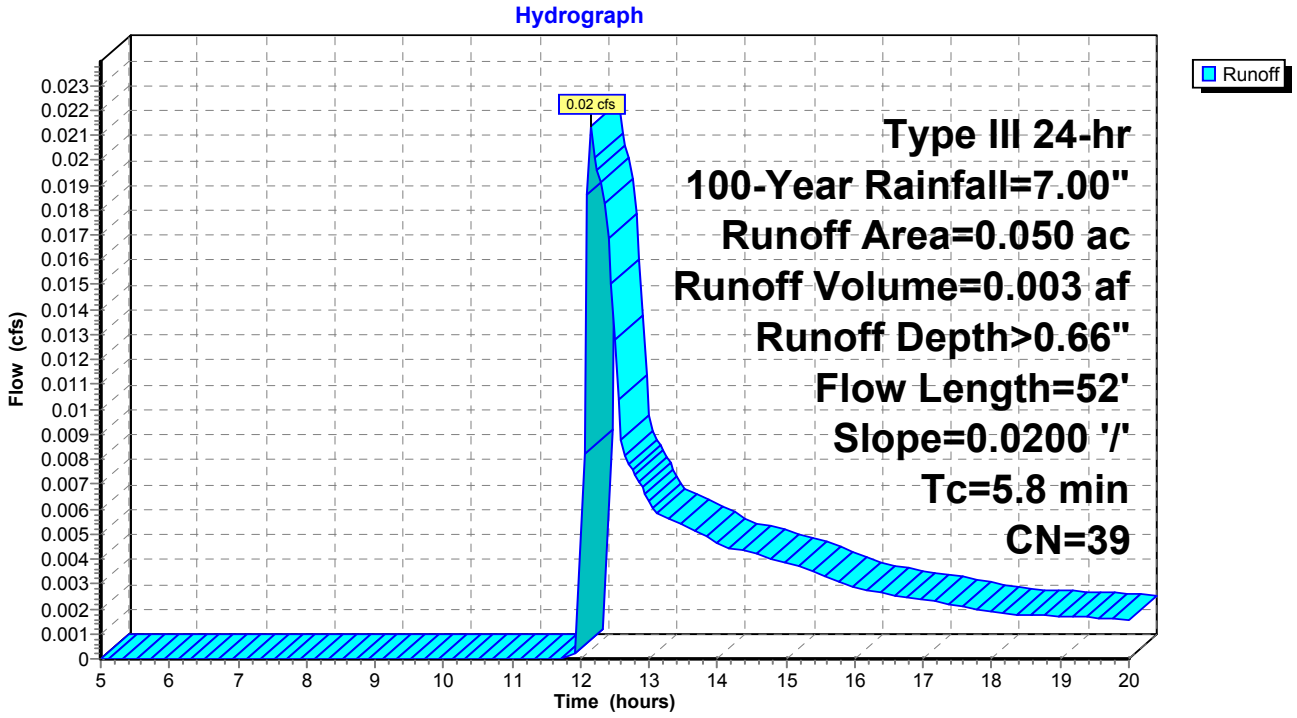
Runoff = 0.02 cfs @ 12.16 hrs, Volume= 0.003 af, Depth> 0.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.00"

Area (ac)	CN	Description
0.050	39	>75% Grass cover, Good, HSG A
0.050		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	52	0.0200	0.15		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 3.20"

Subcatchment E2: Flow South to Rte 44

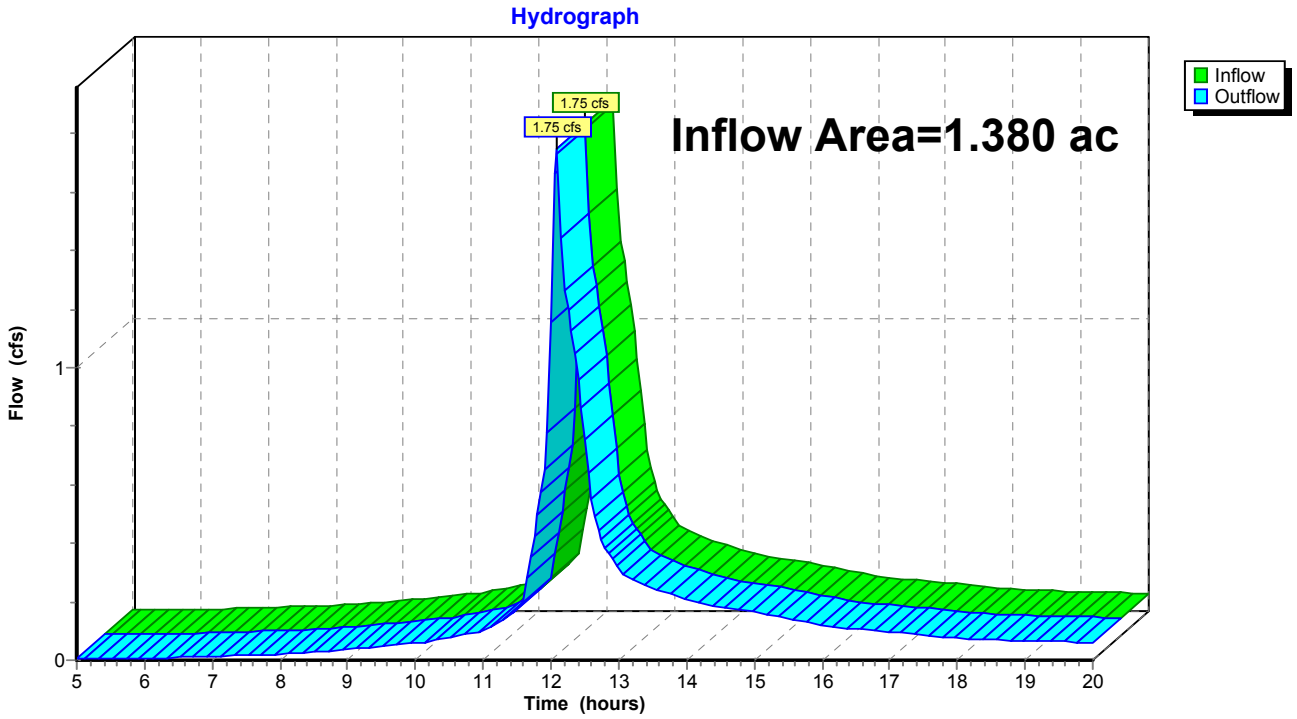


Summary for Reach TS: Flow to Analysis Point CB

Inflow Area = 1.380 ac, 17.39% Impervious, Inflow Depth > 1.60" for 100-Year event
Inflow = 1.75 cfs @ 12.08 hrs, Volume= 0.184 af
Outflow = 1.75 cfs @ 12.08 hrs, Volume= 0.184 af, Atten= 0%, Lag= 0.0 min

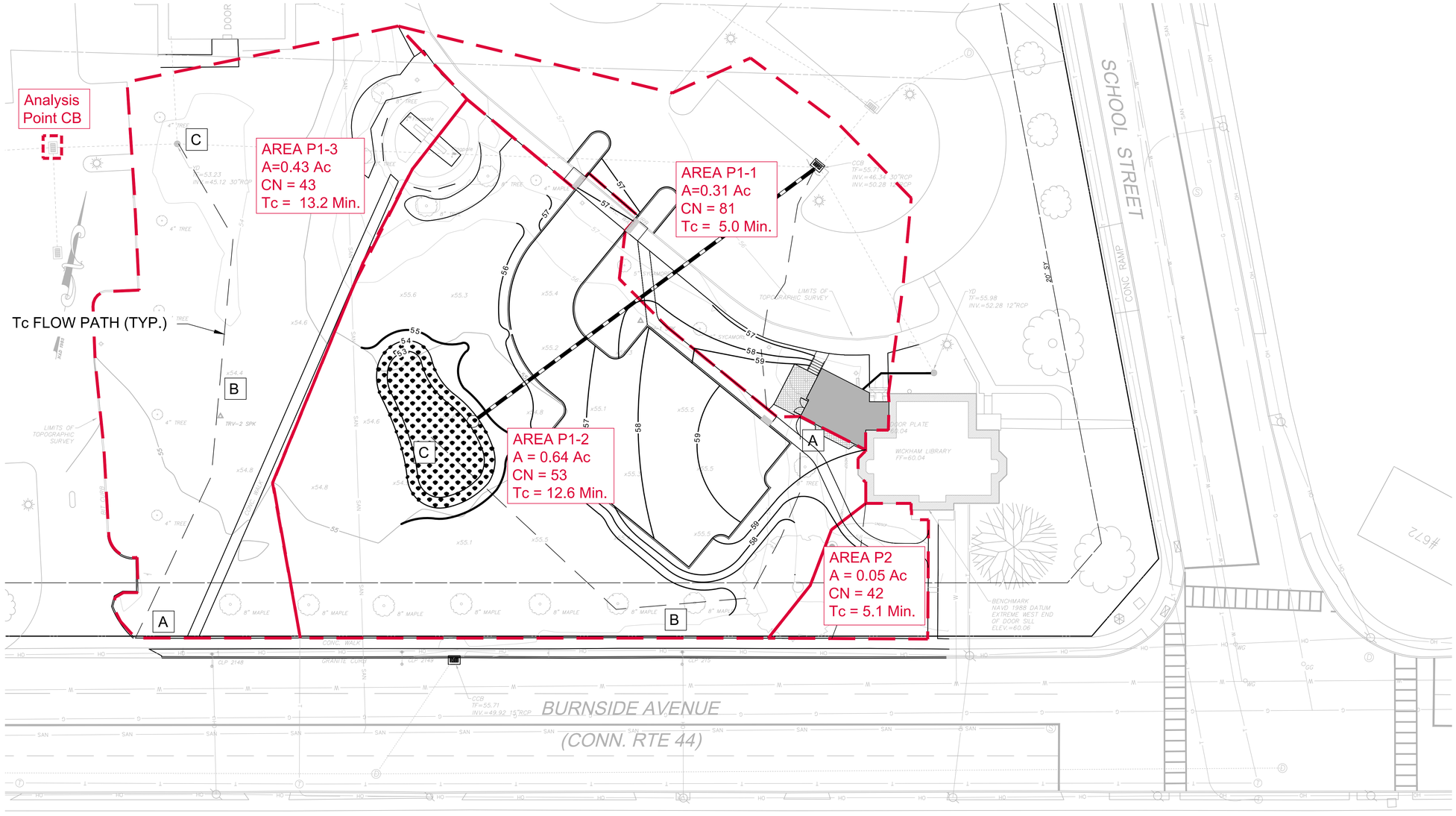
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach TS: Flow to Analysis Point CB



APPENDIX B

PROPOSED WATERSHED DATA



0 20' 40'

1" = 20'

Project Title:

Town of East Hartford
Wickham Memorial Library:
Renovations & Additions
656 Burnside Ave. East Hartford, CT 06108

benesch
Alfred Benesch & Company • www.benesch.com
120 Hebron Avenue • Glastonbury, Connecticut 06033
Phone: (860) 633-8341 • Fax: (860) 633-1068

SILVER / PETRUCELLI + ASSOCIATES
Architects / Engineers / Interior Designers
3190 Whitney Avenue, Hamden, CT 06518-2340
Tel. 203 230 9007 Fax. 203 230 8247
silverpetrucelli.com

Revision:	Description:	Date:	Revised By:

Drawing Title:

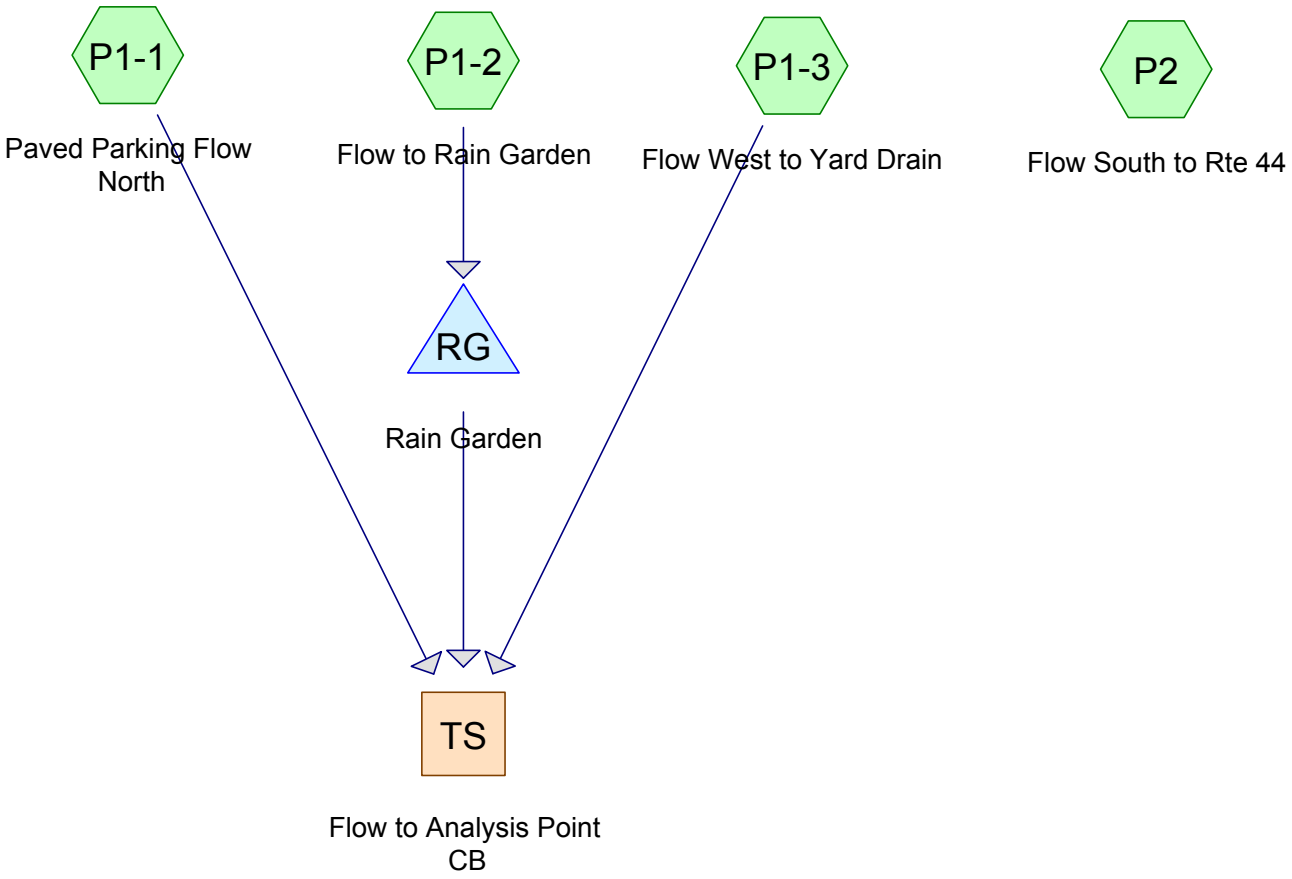
Proposed Watershed Area Map

Date: 01.11.19
Scale: AS NOTED
Drawn By: JCO
Project Number:

Drawing Number: PWAM

Proposed Watershed Cover Characteristics
Wickham Memorial Library- East Hartford, CT
Project # 70518.00

Watershed	Area (ac)	Impervious (ac)	Grass "A"	CN	Tc (min)
P1-1	0.31	0.22	0.09	81	5.0
P1-2	0.64	0.15	0.49	53	12.6
P1-3	0.43	0.03	0.40	43	13.2
P2	0.05	0.003	0.05	42	5.1
Total	1.43	0.40	1.03	55.7	



Subcat Reach Pond Link

Routing Diagram for 70518 Proposed
Prepared by Microsoft, Printed 1/4/2019

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.030	39	>75% Grass cover, Good, HSG A (P1-1, P1-2, P1-3, P2)
0.403	98	Paved parking, HSG A (P1-1, P1-2, P1-3, P2)

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 P1-1: Paved Parking Flow Runoff Area=0.310 ac 70.97% Impervious Runoff Depth>1.36"
Tc=5.0 min CN=81 Runoff=0.53 cfs 0.035 af

Subcatchment P1-2: Flow to Rain Garden Runoff Area=0.640 ac 23.44% Impervious Runoff Depth>0.16"
Flow Length=317' Tc=12.6 min CN=53 Runoff=0.04 cfs 0.009 af

Subcatchment P1-3: Flow West to Yard Drain Runoff Area=0.430 ac 6.98% Impervious Runoff Depth>0.01"
Flow Length=197' Tc=13.2 min CN=43 Runoff=0.00 cfs 0.000 af

Subcatchment P2: Flow South to Rte 44 Runoff Area=0.053 ac 5.66% Impervious Runoff Depth>0.01"
Flow Length=52' Slope=0.0280 '/' Tc=5.1 min CN=42 Runoff=0.00 cfs 0.000 af

Reach TS: Flow to Analysis Point CB Inflow=0.53 cfs 0.036 af
Outflow=0.53 cfs 0.036 af

Pond RG: Rain Garden Peak Elev=52.70' Storage=3 cf Inflow=0.04 cfs 0.009 af
Discarded=0.04 cfs 0.009 af Primary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.009 af

Summary for Subcatchment P1-1: Paved Parking Flow North

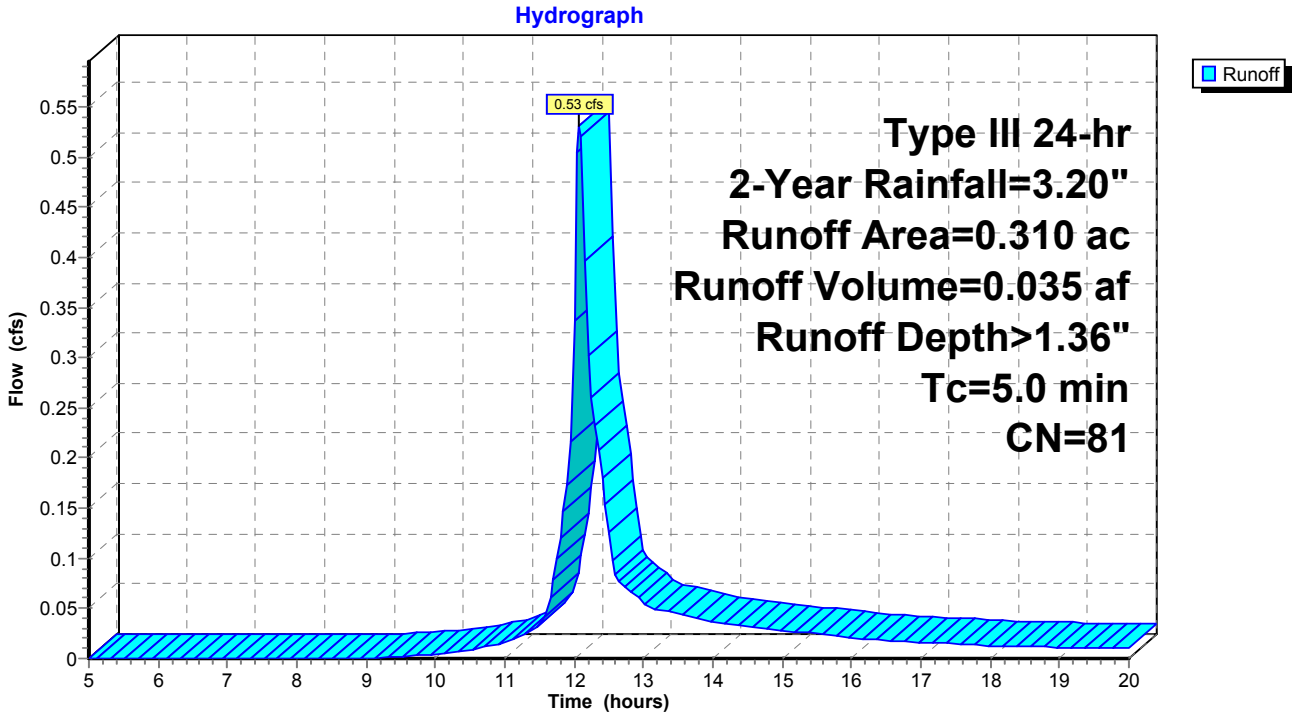
Runoff = 0.53 cfs @ 12.08 hrs, Volume= 0.035 af, Depth> 1.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (ac)	CN	Description
0.220	98	Paved parking, HSG A
0.090	39	>75% Grass cover, Good, HSG A
0.310	81	Weighted Average
0.090		29.03% Pervious Area
0.220		70.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct to meet min Tc**

Subcatchment P1-1: Paved Parking Flow North



Summary for Subcatchment P1-2: Flow to Rain Garden

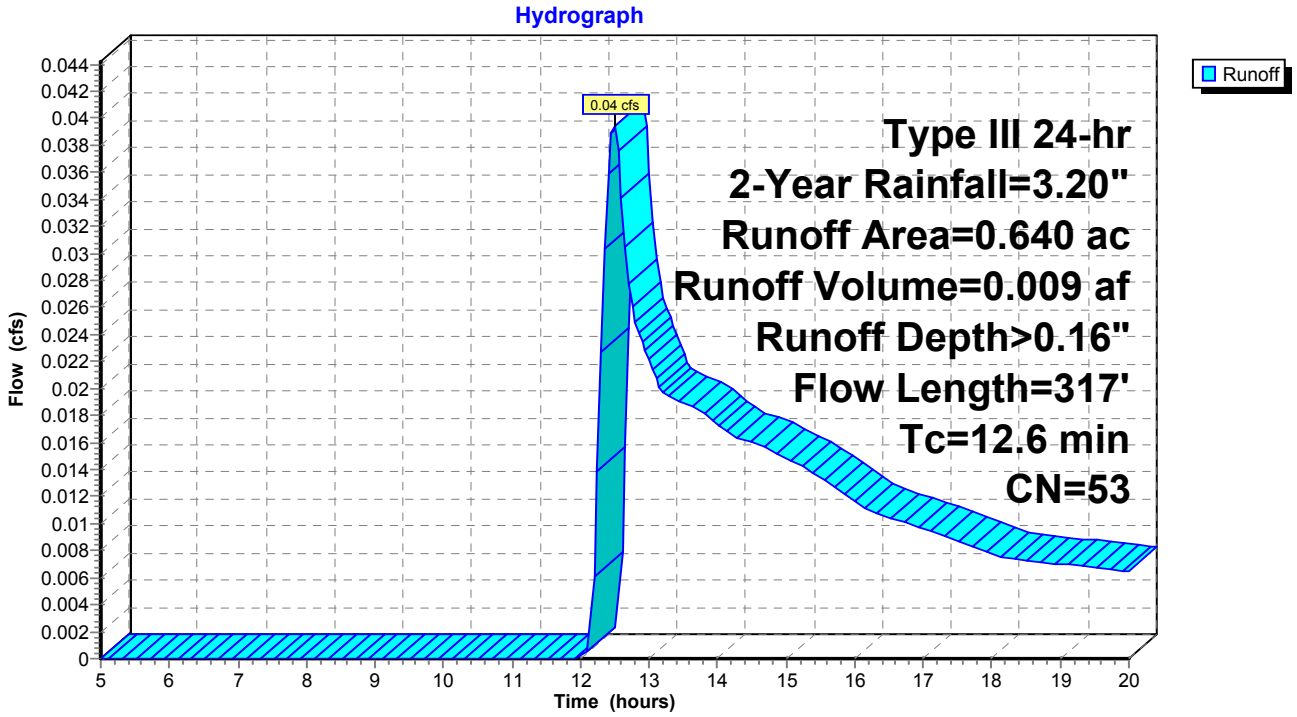
Runoff = 0.04 cfs @ 12.49 hrs, Volume= 0.009 af, Depth> 0.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (ac)	CN	Description
0.150	98	Paved parking, HSG A
0.490	39	>75% Grass cover, Good, HSG A
0.640	53	Weighted Average
0.490		76.56% Pervious Area
0.150		23.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	100	0.0400	0.22		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 3.20"
5.2	217	0.0100	0.70		**Shallow Concentrated Flow, BC** Short Grass Pasture Kv= 7.0 fps
12.6	317	Total			

Subcatchment P1-2: Flow to Rain Garden



Summary for Subcatchment P1-3: Flow West to Yard Drain

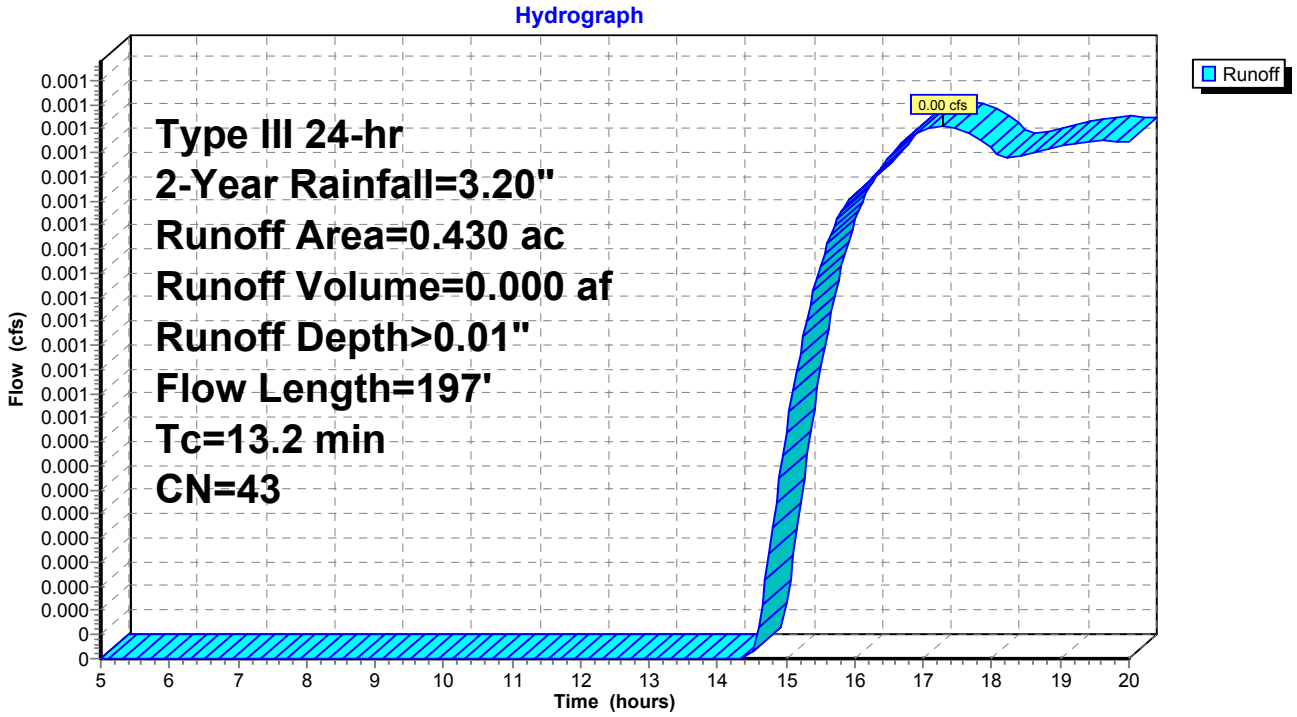
Runoff = 0.00 cfs @ 17.27 hrs, Volume= 0.000 af, Depth> 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (ac)	CN	Description
0.030	98	Paved parking, HSG A
0.400	39	>75% Grass cover, Good, HSG A
0.430	43	Weighted Average
0.400		93.02% Pervious Area
0.030		6.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	100	0.0150	0.15		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 3.20"
2.2	97	0.0110	0.73		**Shallow Concentrated Flow, BC** Short Grass Pasture Kv= 7.0 fps
13.2	197	Total			

Subcatchment P1-3: Flow West to Yard Drain



Summary for Subcatchment P2: Flow South to Rte 44

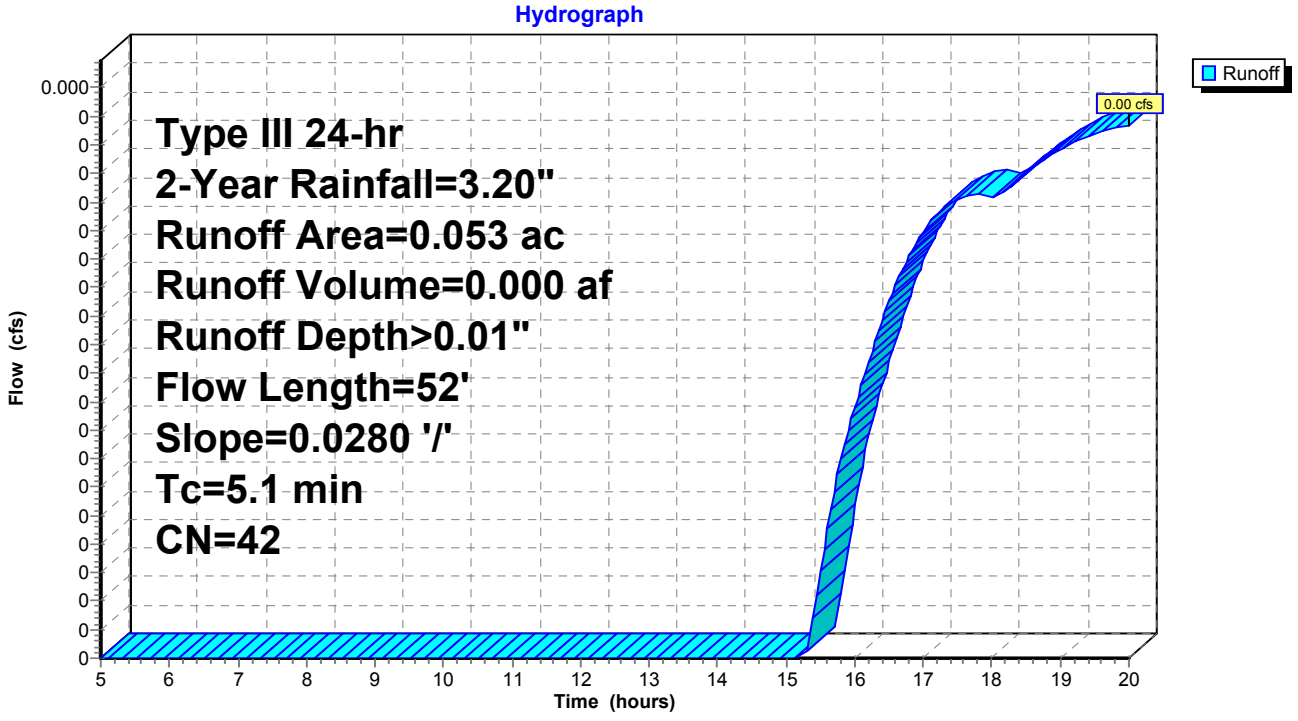
Runoff = 0.00 cfs @ 20.00 hrs, Volume= 0.000 af, Depth> 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (ac)	CN	Description
0.050	39	>75% Grass cover, Good, HSG A
0.003	98	Paved parking, HSG A
0.053	42	Weighted Average
0.050		94.34% Pervious Area
0.003		5.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	52	0.0280	0.17		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 3.20"

Subcatchment P2: Flow South to Rte 44

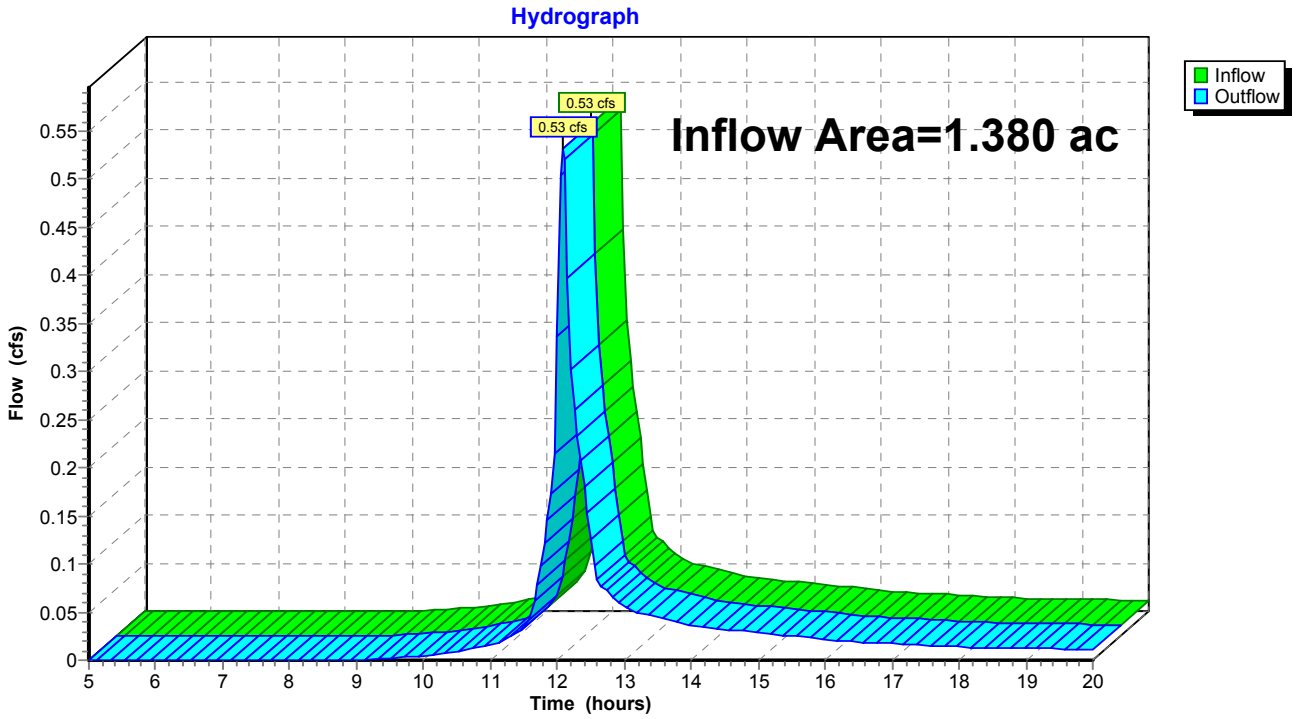


Summary for Reach TS: Flow to Analysis Point CB

Inflow Area = 1.380 ac, 28.99% Impervious, Inflow Depth > 0.31" for 2-Year event
Inflow = 0.53 cfs @ 12.08 hrs, Volume= 0.036 af
Outflow = 0.53 cfs @ 12.08 hrs, Volume= 0.036 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 TS: Flow to Analysis Point CB



Summary for Pond RG: Rain Garden

Inflow Area = 0.640 ac, 23.44% Impervious, Inflow Depth > 0.16" for 2-Year event
Inflow = 0.04 cfs @ 12.49 hrs, Volume= 0.009 af
Outflow = 0.04 cfs @ 12.51 hrs, Volume= 0.009 af, Atten= 1%, Lag= 1.5 min
Discarded = 0.04 cfs @ 12.51 hrs, Volume= 0.009 af
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= 52.70' @ 12.51 hrs Surf.Area= 909 sf Storage= 3 cf

Plug-Flow detention time= 1.5 min calculated for 0.009 af (100% of inflow)
Center-of-Mass det. time= 1.0 min (906.1 - 905.1)

Volume	Invert	Avail.Storage	Storage Description
#1	52.70'	2,604 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

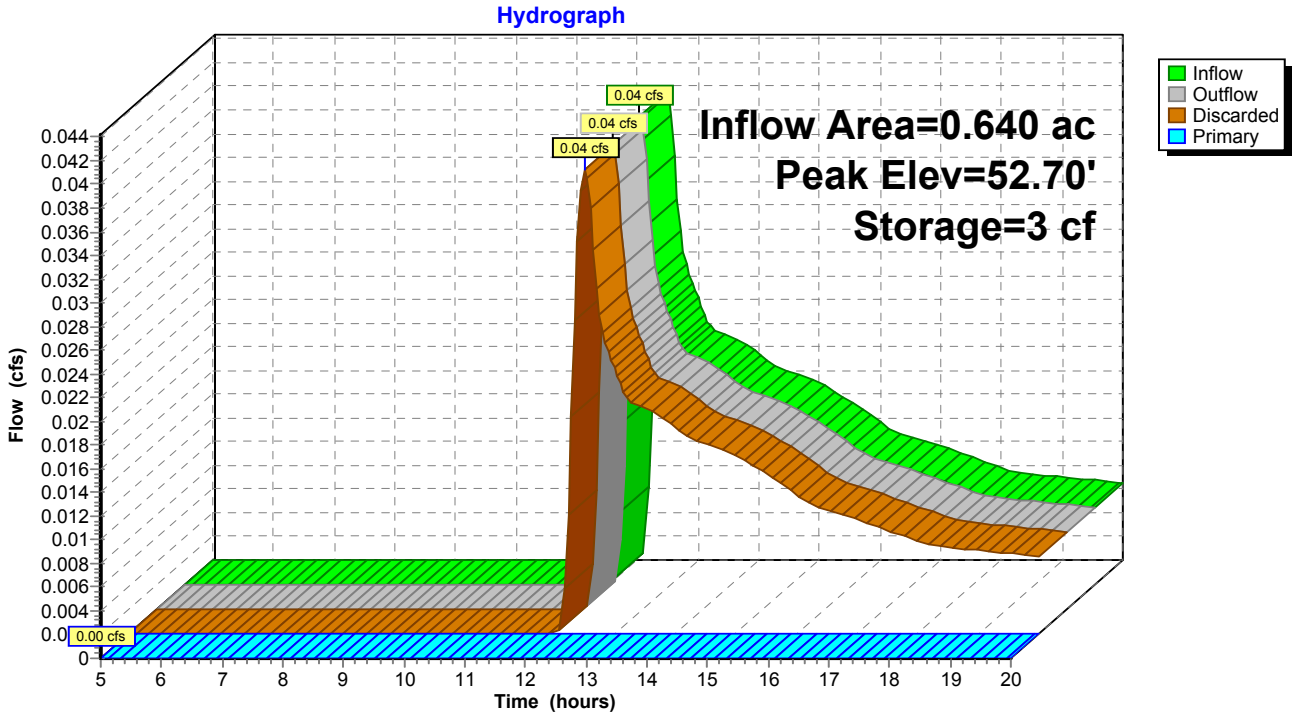
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
52.70	907	0	0
53.00	1,071	297	297
54.00	1,686	1,379	1,675
54.50	2,031	929	2,604

Device	Routing	Invert	Outlet Devices
#1	Primary	50.75'	**15.0" Round Culvert** L= 157.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.75' / 49.20' S= 0.0099 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.23 sf
#2	Device 1	53.80'	**12.0" Vert. Orifice/Grate** C= 0.600
#3	Discarded	52.70'	**10.000 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 48.30'

Discarded OutFlow Max=0.21 cfs @ 12.51 hrs HW=52.70' (Free Discharge)
└**3=Exfiltration** (Controls 0.21 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=52.70' (Free Discharge)
└**1=Culvert** (Passes 0.00 cfs of 6.80 cfs potential flow)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Pond RG: Rain Garden



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 P1-1: Paved Parking Flow Runoff Area=0.310 ac 70.97% Impervious Runoff Depth>2.14"
Tc=5.0 min CN=81 Runoff=0.83 cfs 0.055 af

Subcatchment P1-2: Flow to Rain Garden Runoff Area=0.640 ac 23.44% Impervious Runoff Depth>0.45"
Flow Length=317' Tc=12.6 min CN=53 Runoff=0.18 cfs 0.024 af

Subcatchment P1-3: Flow West to Yard Drain Runoff Area=0.430 ac 6.98% Impervious Runoff Depth>0.13"
Flow Length=197' Tc=13.2 min CN=43 Runoff=0.01 cfs 0.005 af

Subcatchment P2: Flow South to Rte 44 Runoff Area=0.053 ac 5.66% Impervious Runoff Depth>0.10"
Flow Length=52' Slope=0.0280 '/' Tc=5.1 min CN=42 Runoff=0.00 cfs 0.000 af

Reach TS: Flow to Analysis Point CB Inflow=0.83 cfs 0.060 af
Outflow=0.83 cfs 0.060 af

Pond RG: Rain Garden Peak Elev=52.72' Storage=16 cf Inflow=0.18 cfs 0.024 af
Discarded=0.18 cfs 0.024 af Primary=0.00 cfs 0.000 af Outflow=0.18 cfs 0.024 af

Summary for Subcatchment P1-1: Paved Parking Flow North

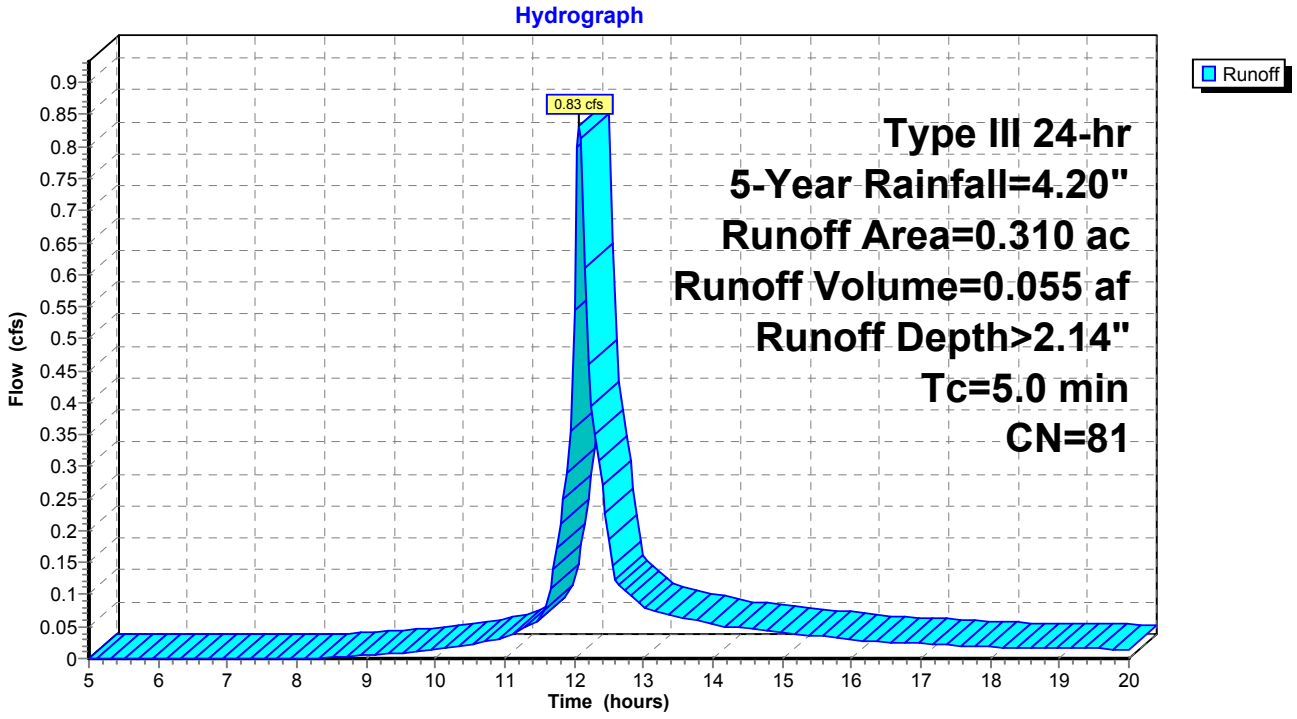
Runoff = 0.83 cfs @ 12.08 hrs, Volume= 0.055 af, Depth> 2.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 5-Year Rainfall=4.20"

Area (ac)	CN	Description
0.220	98	Paved parking, HSG A
0.090	39	>75% Grass cover, Good, HSG A
0.310	81	Weighted Average
0.090		29.03% Pervious Area
0.220		70.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct to meet min Tc**

Subcatchment P1-1: Paved Parking Flow North



Summary for Subcatchment P1-2: Flow to Rain Garden

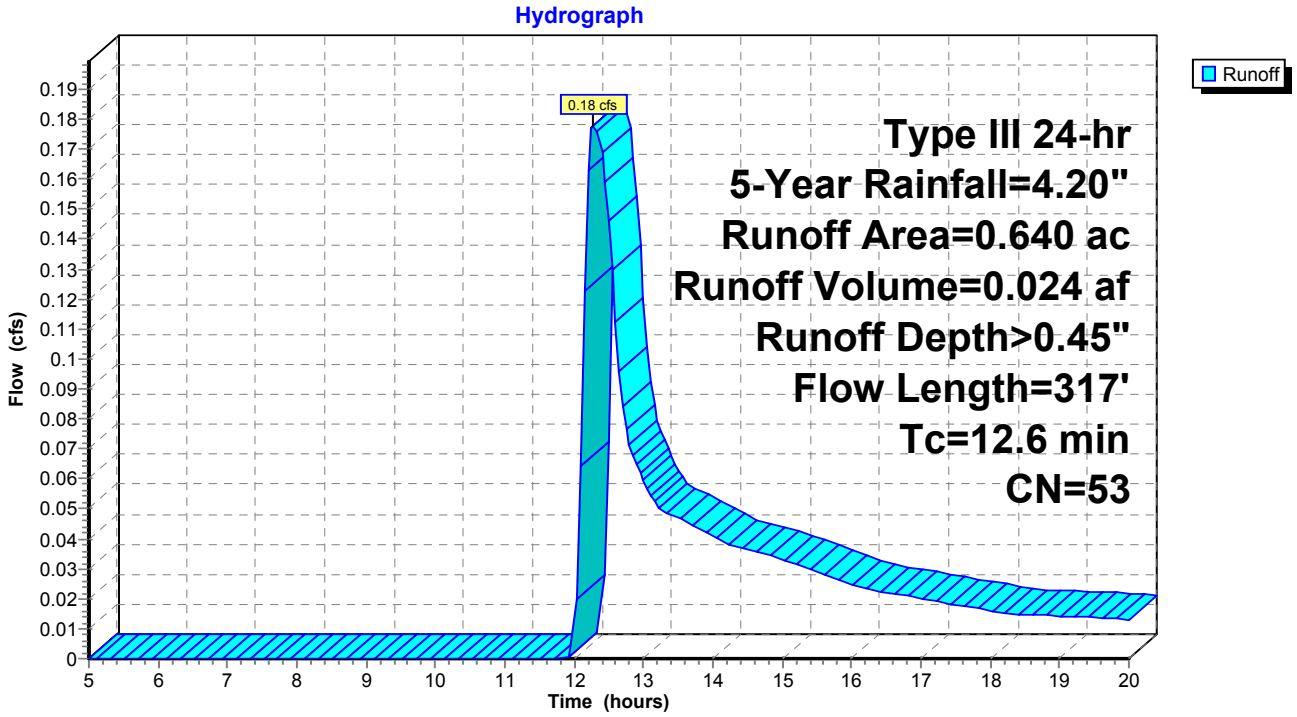
Runoff = 0.18 cfs @ 12.28 hrs, Volume= 0.024 af, Depth> 0.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 5-Year Rainfall=4.20"

Area (ac)	CN	Description
0.150	98	Paved parking, HSG A
0.490	39	>75% Grass cover, Good, HSG A
0.640	53	Weighted Average
0.490		76.56% Pervious Area
0.150		23.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	100	0.0400	0.22		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 3.20"
5.2	217	0.0100	0.70		**Shallow Concentrated Flow, BC** Short Grass Pasture Kv= 7.0 fps
12.6	317	Total			

Subcatchment P1-2: Flow to Rain Garden



Summary for Subcatchment P1-3: Flow West to Yard Drain

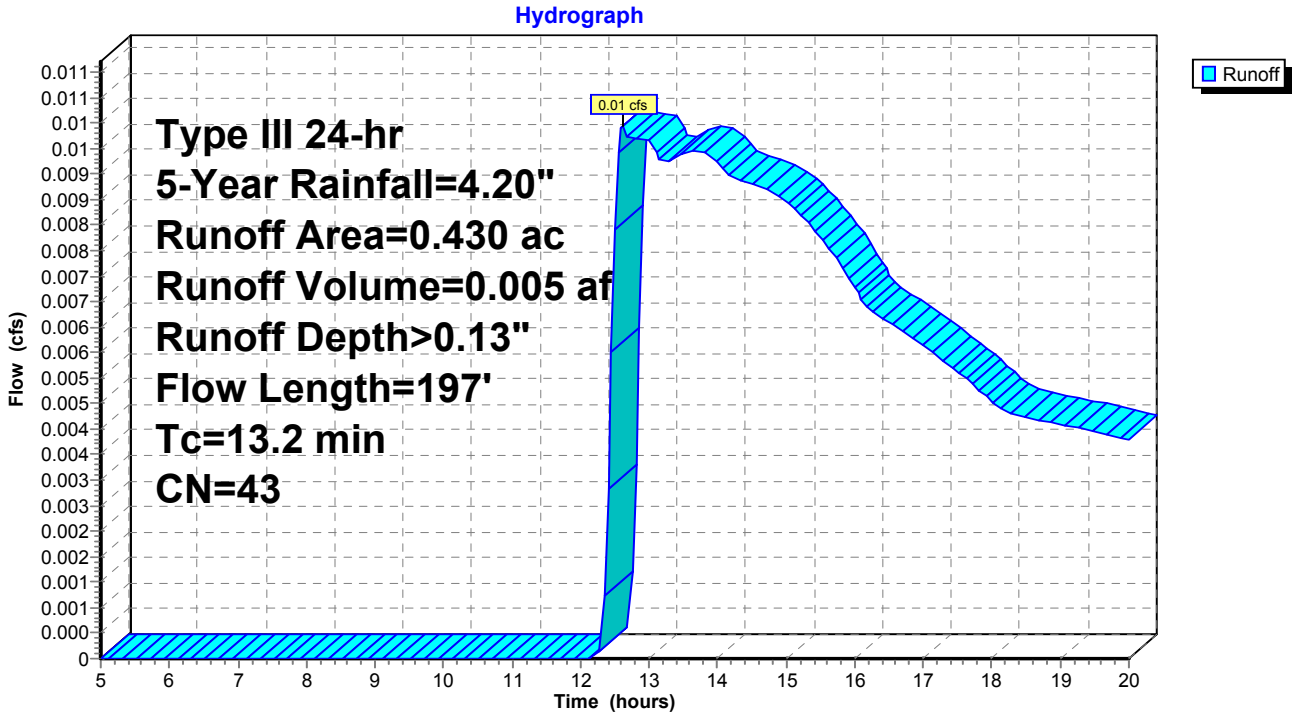
Runoff = 0.01 cfs @ 12.62 hrs, Volume= 0.005 af, Depth> 0.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 5-Year Rainfall=4.20"

Area (ac)	CN	Description
0.030	98	Paved parking, HSG A
0.400	39	>75% Grass cover, Good, HSG A
0.430	43	Weighted Average
0.400		93.02% Pervious Area
0.030		6.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	100	0.0150	0.15		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 3.20"
2.2	97	0.0110	0.73		**Shallow Concentrated Flow, BC** Short Grass Pasture Kv= 7.0 fps
13.2	197	Total			

Subcatchment P1-3: Flow West to Yard Drain



Summary for Subcatchment P2: Flow South to Rte 44

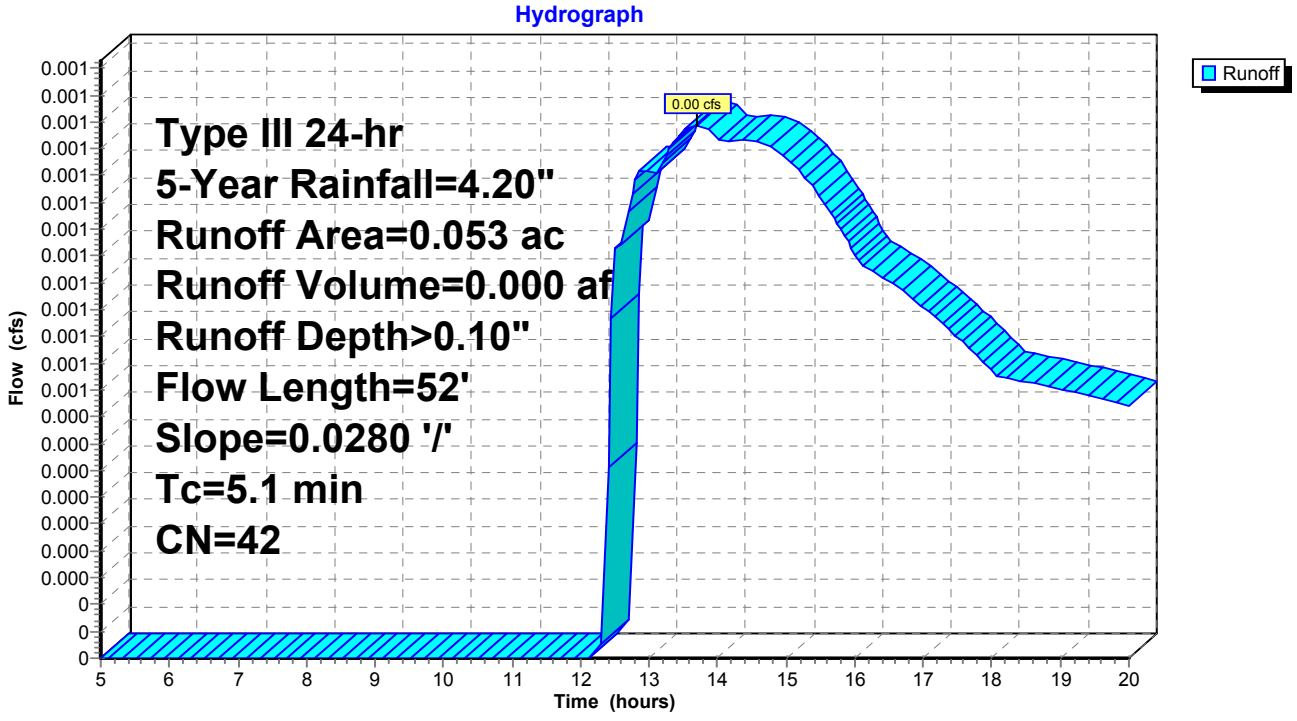
Runoff = 0.00 cfs @ 13.70 hrs, Volume= 0.000 af, Depth> 0.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 5-Year Rainfall=4.20"

Area (ac)	CN	Description
0.050	39	>75% Grass cover, Good, HSG A
0.003	98	Paved parking, HSG A
0.053	42	Weighted Average
0.050		94.34% Pervious Area
0.003		5.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	52	0.0280	0.17		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 3.20"

Subcatchment P2: Flow South to Rte 44

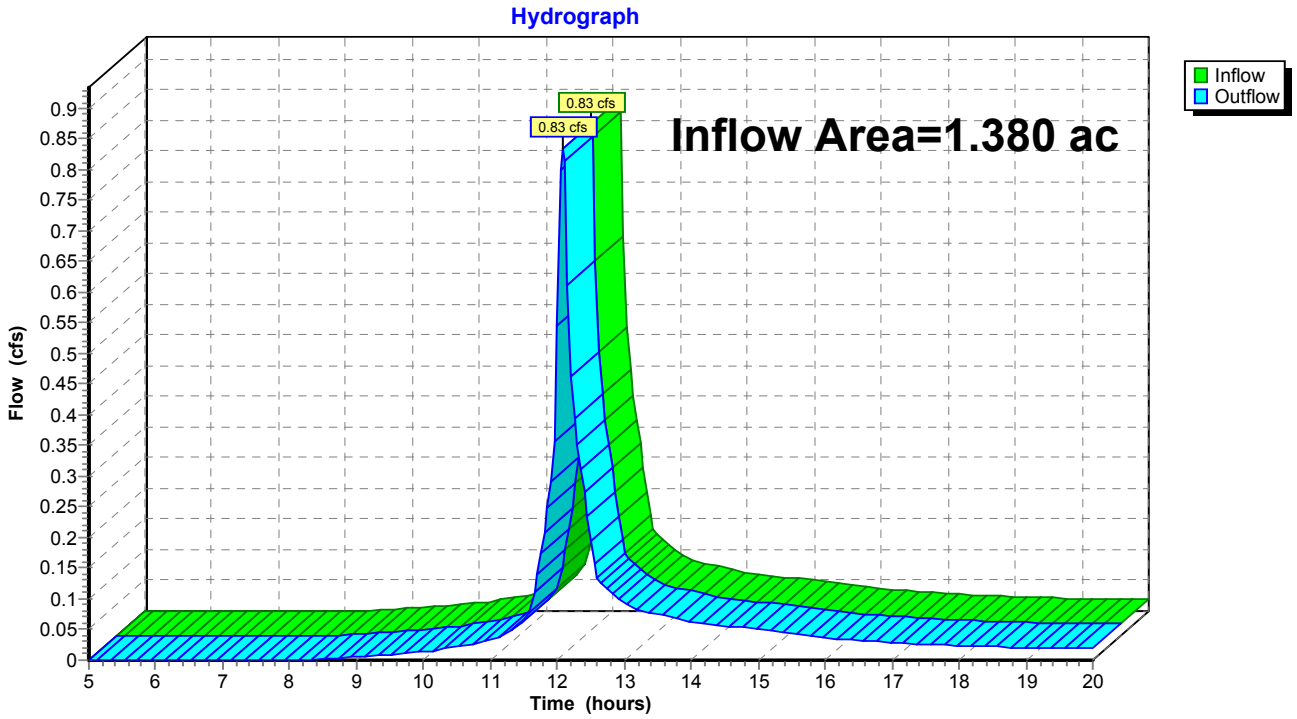


Summary for Reach TS: Flow to Analysis Point CB

Inflow Area = 1.380 ac, 28.99% Impervious, Inflow Depth > 0.52" for 5-Year event
Inflow = 0.83 cfs @ 12.08 hrs, Volume= 0.060 af
Outflow = 0.83 cfs @ 12.08 hrs, Volume= 0.060 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 TS: Flow to Analysis Point CB



Summary for Pond RG: Rain Garden

Inflow Area = 0.640 ac, 23.44% Impervious, Inflow Depth > 0.45" for 5-Year event
Inflow = 0.18 cfs @ 12.28 hrs, Volume= 0.024 af
Outflow = 0.18 cfs @ 12.32 hrs, Volume= 0.024 af, Atten= 0%, Lag= 2.1 min
Discarded = 0.18 cfs @ 12.32 hrs, Volume= 0.024 af
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= 52.72' @ 12.32 hrs Surf.Area= 917 sf Storage= 16 cf

Plug-Flow detention time= 1.5 min calculated for 0.024 af (100% of inflow)
Center-of-Mass det. time= 1.1 min (868.1 - 867.0)

Volume	Invert	Avail.Storage	Storage Description
#1	52.70'	2,604 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

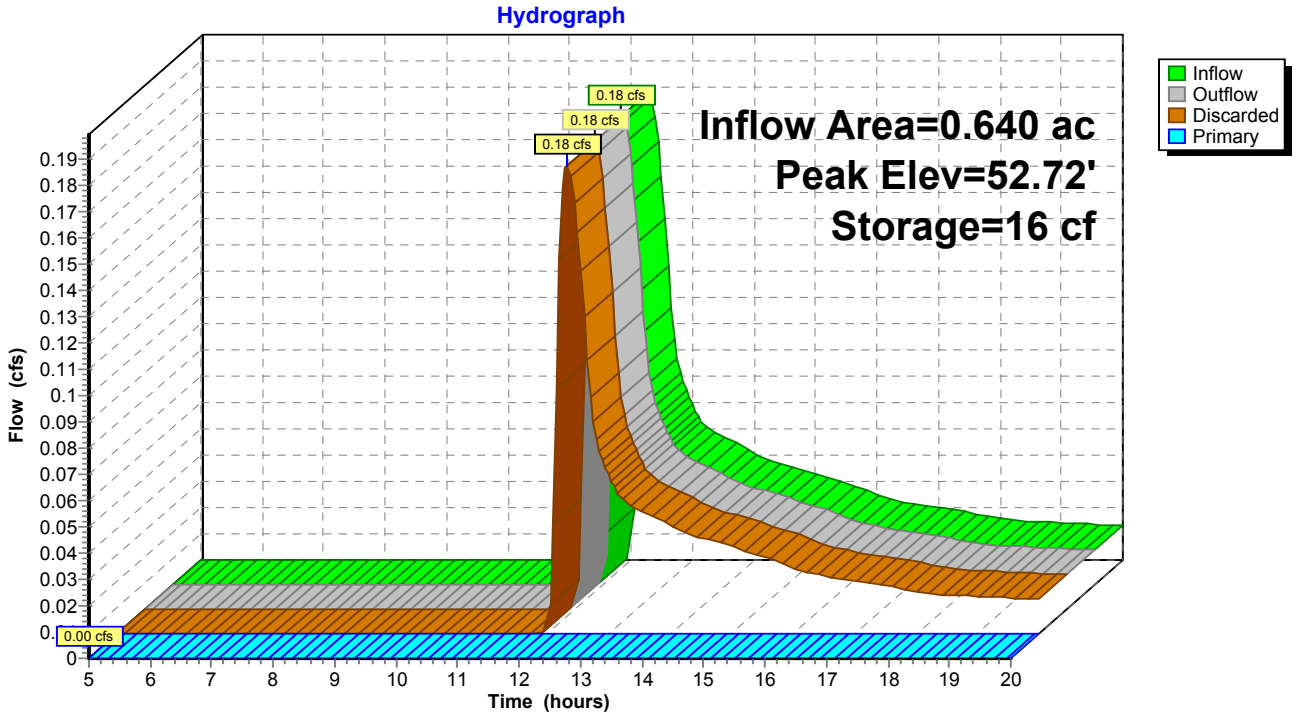
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
52.70	907	0	0
53.00	1,071	297	297
54.00	1,686	1,379	1,675
54.50	2,031	929	2,604

Device	Routing	Invert	Outlet Devices
#1	Primary	50.75'	**15.0" Round Culvert** L= 157.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.75' / 49.20' S= 0.0099 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.23 sf
#2	Device 1	53.80'	**12.0" Vert. Orifice/Grate** C= 0.600
#3	Discarded	52.70'	**10.000 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 48.30'

Discarded OutFlow Max=0.21 cfs @ 12.32 hrs HW=52.72' (Free Discharge)
└**3=Exfiltration** (Controls 0.21 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=52.70' (Free Discharge)
└**1=Culvert** (Passes 0.00 cfs of 6.80 cfs potential flow)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Pond RG: Rain Garden



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 P1-1: Paved Parking Flow Runoff Area=0.310 ac 70.97% Impervious Runoff Depth>2.71"
Tc=5.0 min CN=81 Runoff=1.05 cfs 0.070 af

Subcatchment P1-2: Flow to Rain Garden Runoff Area=0.640 ac 23.44% Impervious Runoff Depth>0.72"
Flow Length=317' Tc=12.6 min CN=53 Runoff=0.35 cfs 0.038 af

Subcatchment P1-3: Flow West to Yard Drain Runoff Area=0.430 ac 6.98% Impervious Runoff Depth>0.27"
Flow Length=197' Tc=13.2 min CN=43 Runoff=0.05 cfs 0.010 af

Subcatchment P2: Flow South to Rte 44 Runoff Area=0.053 ac 5.66% Impervious Runoff Depth>0.24"
Flow Length=52' Slope=0.0280 '/' Tc=5.1 min CN=42 Runoff=0.00 cfs 0.001 af

Reach TS: Flow to Analysis Point CB Inflow=1.05 cfs 0.080 af
Outflow=1.05 cfs 0.080 af

Pond RG: Rain Garden Peak Elev=52.83' Storage=125 cf Inflow=0.35 cfs 0.038 af
Discarded=0.23 cfs 0.038 af Primary=0.00 cfs 0.000 af Outflow=0.23 cfs 0.038 af

Summary for Subcatchment P1-1: Paved Parking Flow North

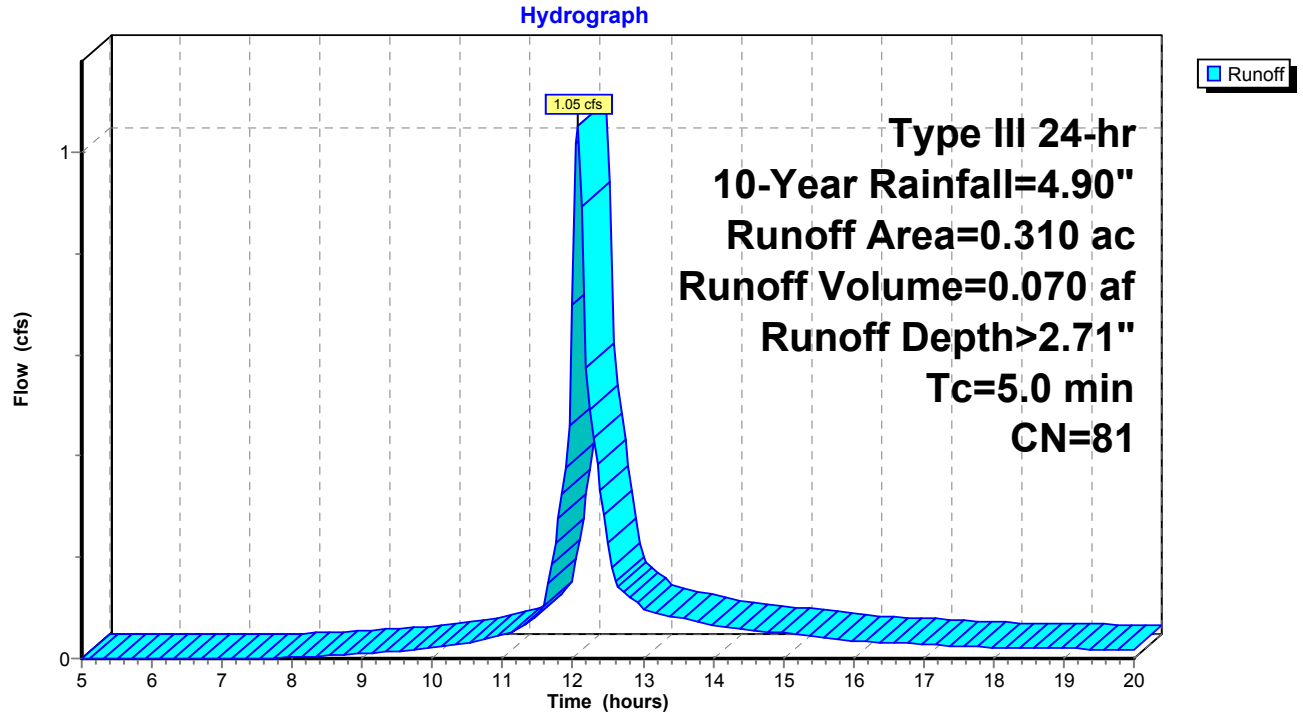
Runoff = 1.05 cfs @ 12.08 hrs, Volume= 0.070 af, Depth> 2.71"

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

Area (ac)	CN	Description
0.220	98	Paved parking, HSG A
0.090	39	>75% Grass cover, Good, HSG A
0.310	81	Weighted Average
0.090		29.03% Pervious Area
0.220		70.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct to meet min Tc**

Subcatchment P1-1: Paved Parking Flow North



Summary for Subcatchment P1-2: Flow to Rain Garden

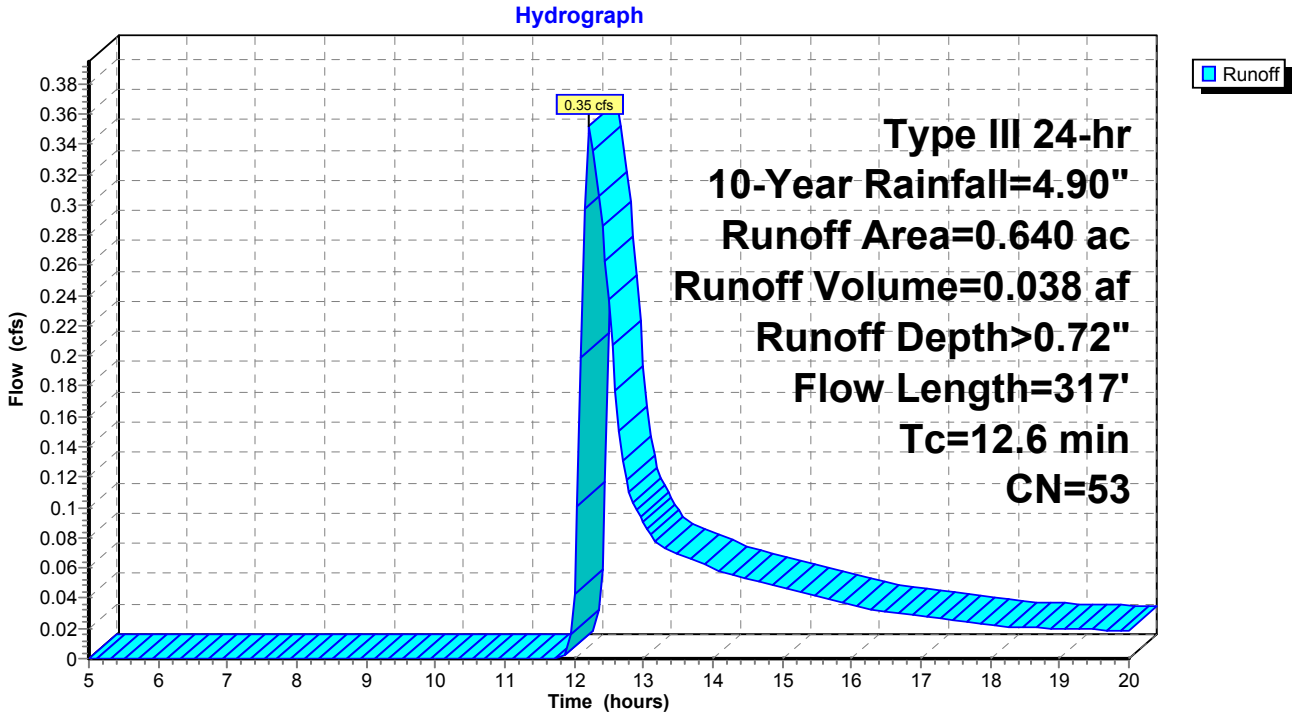
Runoff = 0.35 cfs @ 12.22 hrs, Volume= 0.038 af, Depth> 0.72"

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

Area (ac)	CN	Description
0.150	98	Paved parking, HSG A
0.490	39	>75% Grass cover, Good, HSG A
0.640	53	Weighted Average
0.490		76.56% Pervious Area
0.150		23.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	100	0.0400	0.22		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 3.20"
5.2	217	0.0100	0.70		**Shallow Concentrated Flow, BC** Short Grass Pasture Kv= 7.0 fps
12.6	317	Total			

Subcatchment P1-2: Flow to Rain Garden



Summary for Subcatchment P1-3: Flow West to Yard Drain

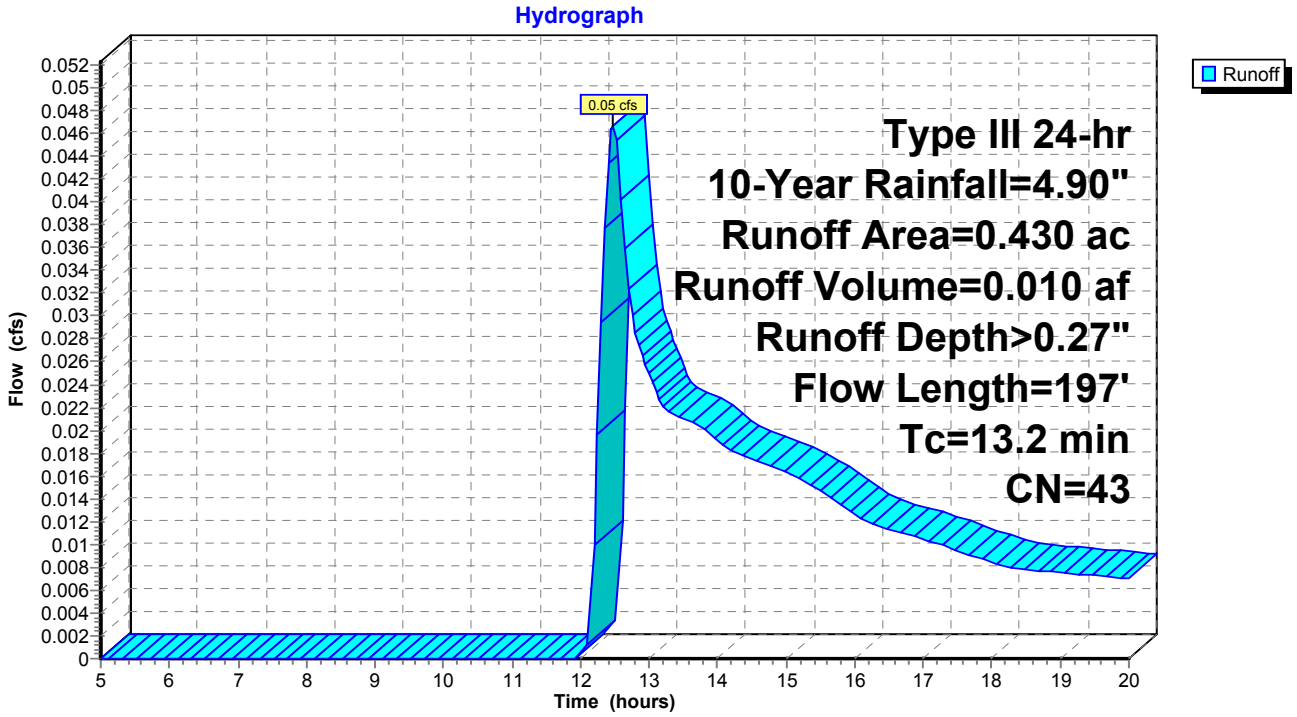
Runoff = 0.05 cfs @ 12.48 hrs, Volume= 0.010 af, Depth> 0.27"

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

Area (ac)	CN	Description
0.030	98	Paved parking, HSG A
0.400	39	>75% Grass cover, Good, HSG A
0.430	43	Weighted Average
0.400		93.02% Pervious Area
0.030		6.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	100	0.0150	0.15		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 3.20"
2.2	97	0.0110	0.73		**Shallow Concentrated Flow, BC** Short Grass Pasture Kv= 7.0 fps
13.2	197	Total			

Subcatchment P1-3: Flow West to Yard Drain



Summary for Subcatchment P2: Flow South to Rte 44

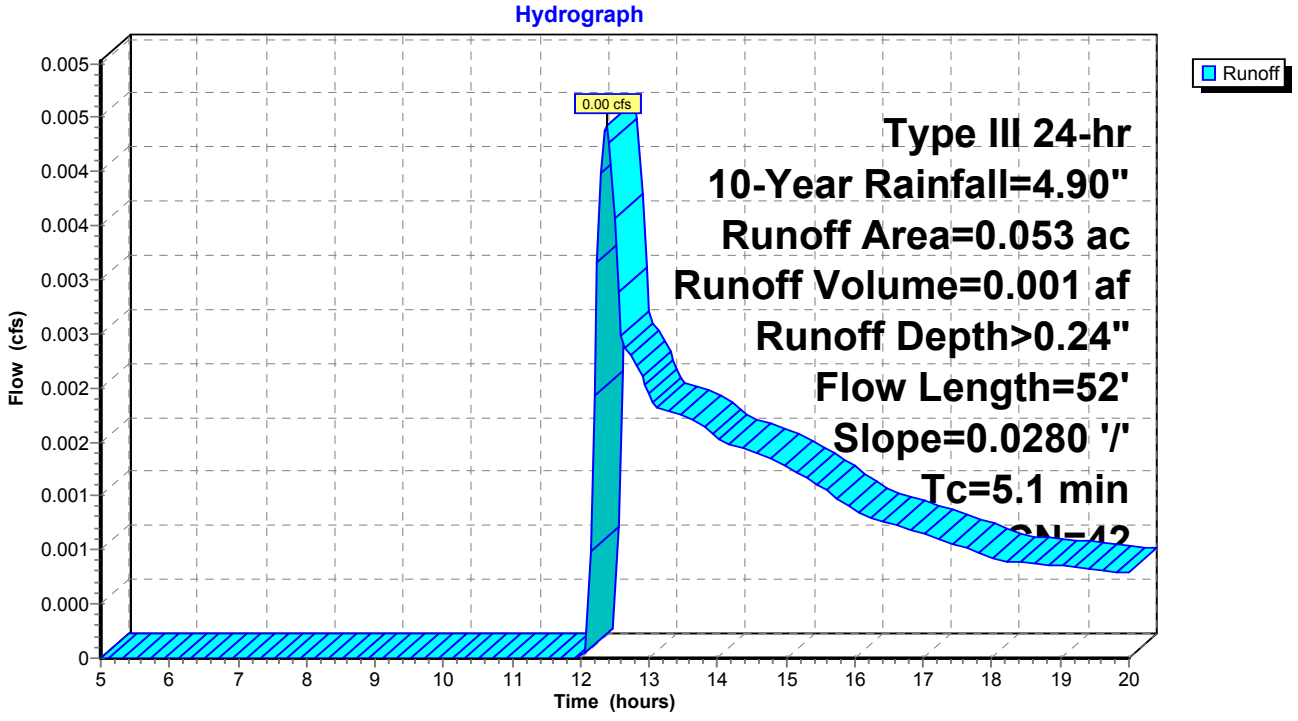
Runoff = 0.00 cfs @ 12.38 hrs, Volume= 0.001 af, Depth> 0.24"

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

Area (ac)	CN	Description
0.050	39	>75% Grass cover, Good, HSG A
0.003	98	Paved parking, HSG A
0.053	42	Weighted Average
0.050		94.34% Pervious Area
0.003		5.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	52	0.0280	0.17		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 3.20"

Subcatchment P2: Flow South to Rte 44

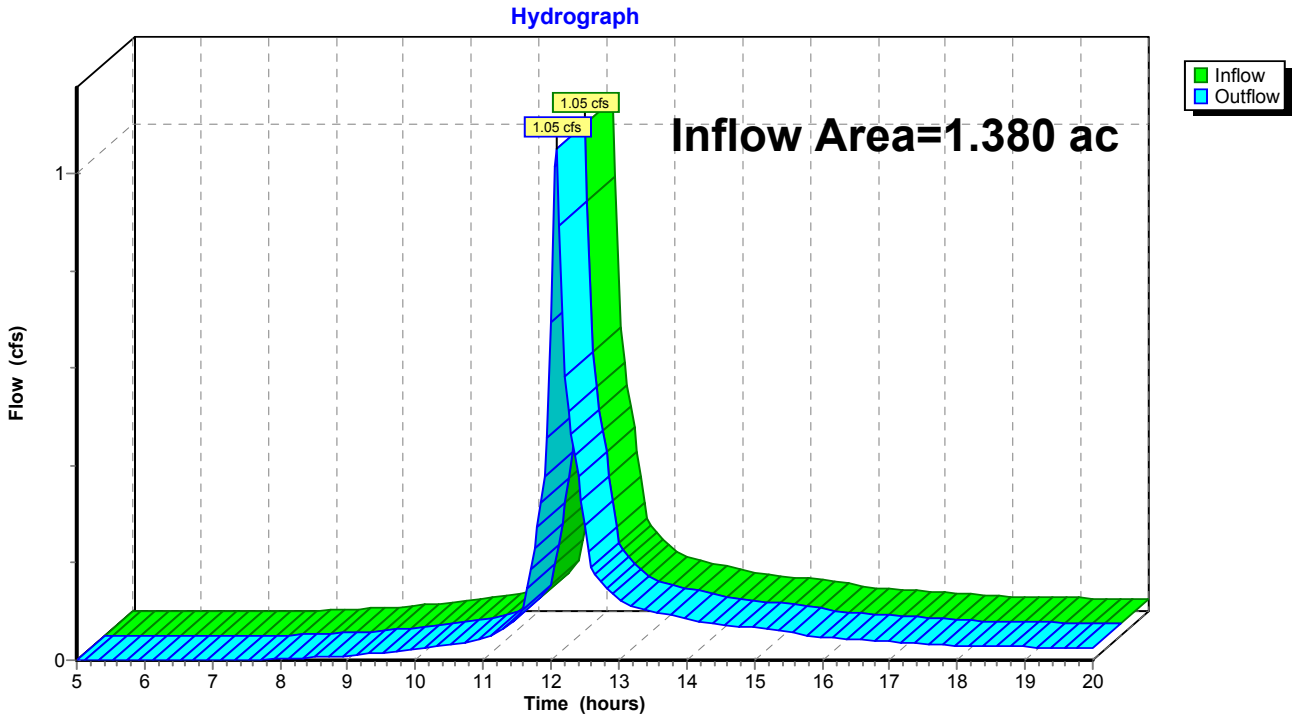


Summary for Reach TS: Flow to Analysis Point CB

Inflow Area = 1.380 ac, 28.99% Impervious, Inflow Depth > 0.69" for 10-Year event
Inflow = 1.05 cfs @ 12.08 hrs, Volume= 0.080 af
Outflow = 1.05 cfs @ 12.08 hrs, Volume= 0.080 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 TS: Flow to Analysis Point CB



Summary for Pond RG: Rain Garden

Inflow Area = 0.640 ac, 23.44% Impervious, Inflow Depth > 0.72" for 10-Year event
Inflow = 0.35 cfs @ 12.22 hrs, Volume= 0.038 af
Outflow = 0.23 cfs @ 12.51 hrs, Volume= 0.038 af, Atten= 34%, Lag= 16.9 min
Discarded = 0.23 cfs @ 12.51 hrs, Volume= 0.038 af
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= 52.83' @ 12.51 hrs Surf.Area= 980 sf Storage= 125 cf

Plug-Flow detention time= 3.2 min calculated for 0.038 af (100% of inflow)
Center-of-Mass det. time= 2.9 min (855.9 - 853.0)

Volume	Invert	Avail.Storage	Storage Description
#1	52.70'	2,604 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

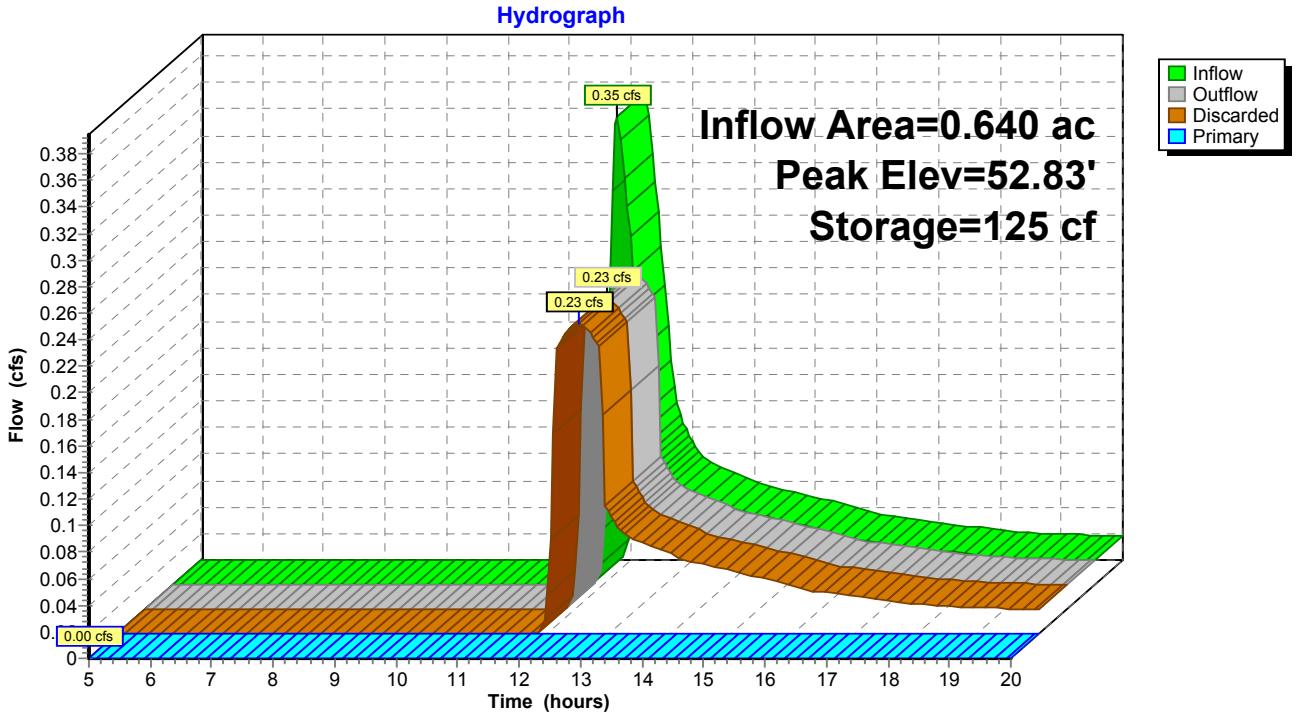
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
52.70	907	0	0
53.00	1,071	297	297
54.00	1,686	1,379	1,675
54.50	2,031	929	2,604

Device	Routing	Invert	Outlet Devices
#1	Primary	50.75'	**15.0" Round Culvert** L= 157.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.75' / 49.20' S= 0.0099 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.23 sf
#2	Device 1	53.80'	**12.0" Vert. Orifice/Grate** C= 0.600
#3	Discarded	52.70'	**10.000 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 48.30'

Discarded OutFlow Max=0.23 cfs @ 12.51 hrs HW=52.83' (Free Discharge)
└**3=Exfiltration** (Controls 0.23 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=52.70' (Free Discharge)
└**1=Culvert** (Passes 0.00 cfs of 6.80 cfs potential flow)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Pond RG: Rain Garden



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 P1-1: Paved Parking Flow Runoff Area=0.310 ac 70.97% Impervious Runoff Depth>3.30"
Tc=5.0 min CN=81 Runoff=1.27 cfs 0.085 af

Subcatchment P1-2: Flow to Rain Garden Runoff Area=0.640 ac 23.44% Impervious Runoff Depth>1.03"
Flow Length=317' Tc=12.6 min CN=53 Runoff=0.56 cfs 0.055 af

Subcatchment P1-3: Flow West to Yard Drain Runoff Area=0.430 ac 6.98% Impervious Runoff Depth>0.46"
Flow Length=197' Tc=13.2 min CN=43 Runoff=0.10 cfs 0.016 af

Subcatchment P2: Flow South to Rte 44 Runoff Area=0.053 ac 5.66% Impervious Runoff Depth>0.41"
Flow Length=52' Slope=0.0280 '/' Tc=5.1 min CN=42 Runoff=0.01 cfs 0.002 af

Reach TS: Flow to Analysis Point CB Inflow=1.28 cfs 0.102 af
Outflow=1.28 cfs 0.102 af

Pond RG: Rain Garden Peak Elev=53.05' Storage=350 cf Inflow=0.56 cfs 0.055 af
Discarded=0.27 cfs 0.055 af Primary=0.00 cfs 0.000 af Outflow=0.27 cfs 0.055 af

Summary for Subcatchment P1-1: Paved Parking Flow North

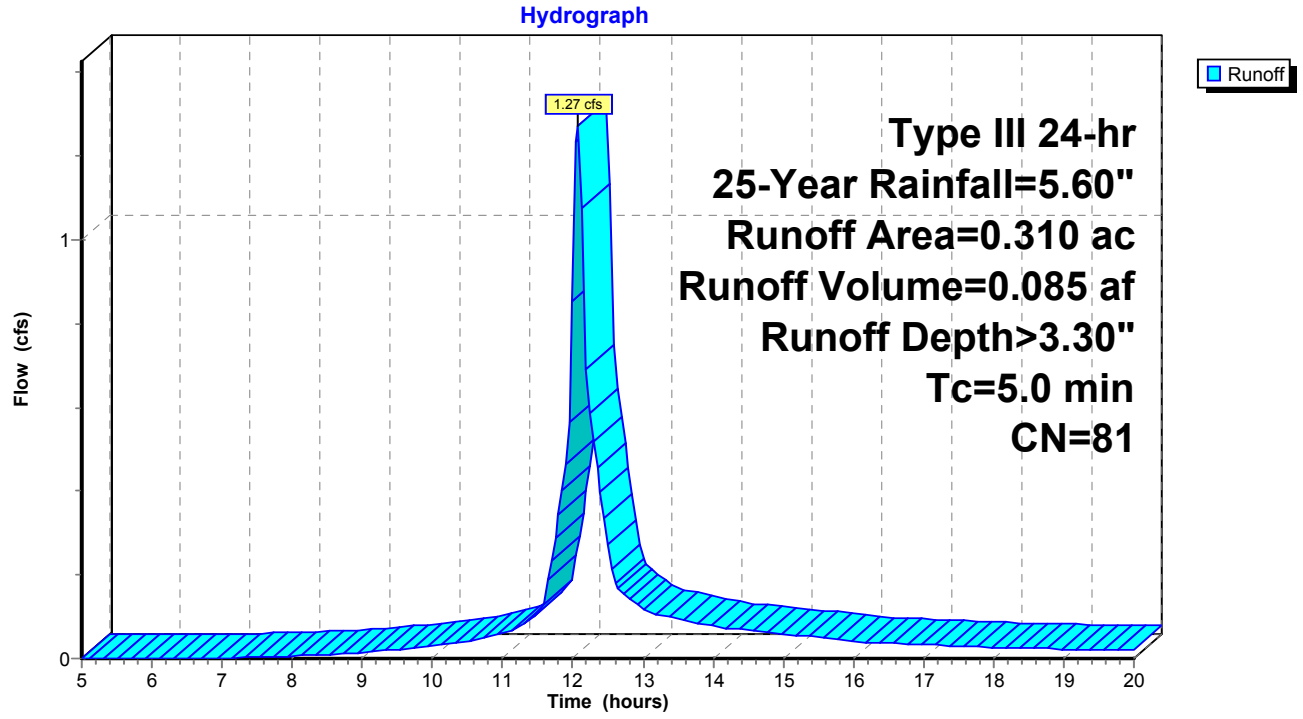
Runoff = 1.27 cfs @ 12.08 hrs, Volume= 0.085 af, Depth> 3.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.60"

Area (ac)	CN	Description
0.220	98	Paved parking, HSG A
0.090	39	>75% Grass cover, Good, HSG A
0.310	81	Weighted Average
0.090		29.03% Pervious Area
0.220		70.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct to meet min Tc**

Subcatchment P1-1: Paved Parking Flow North



Summary for Subcatchment P1-2: Flow to Rain Garden

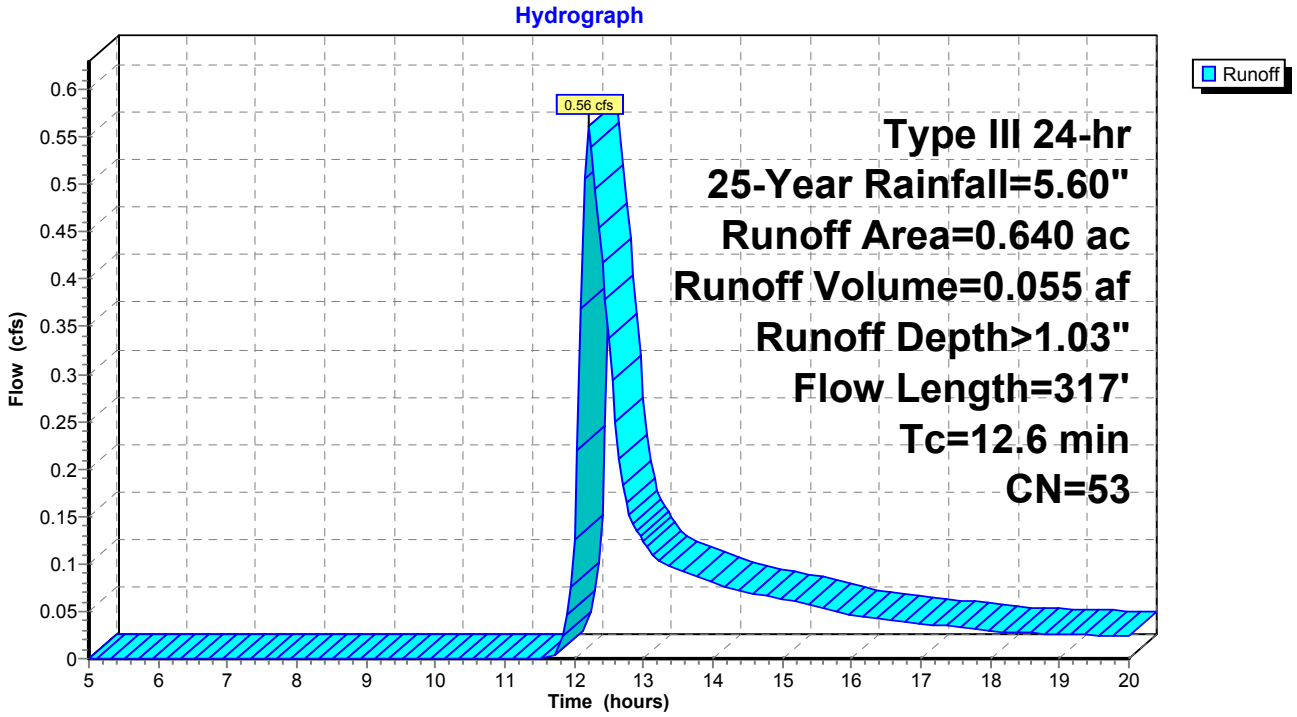
Runoff = 0.56 cfs @ 12.21 hrs, Volume= 0.055 af, Depth> 1.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.60"

Area (ac)	CN	Description
0.150	98	Paved parking, HSG A
0.490	39	>75% Grass cover, Good, HSG A
0.640	53	Weighted Average
0.490		76.56% Pervious Area
0.150		23.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	100	0.0400	0.22		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 3.20"
5.2	217	0.0100	0.70		**Shallow Concentrated Flow, BC** Short Grass Pasture Kv= 7.0 fps
12.6	317	Total			

Subcatchment P1-2: Flow to Rain Garden



Summary for Subcatchment P1-3: Flow West to Yard Drain

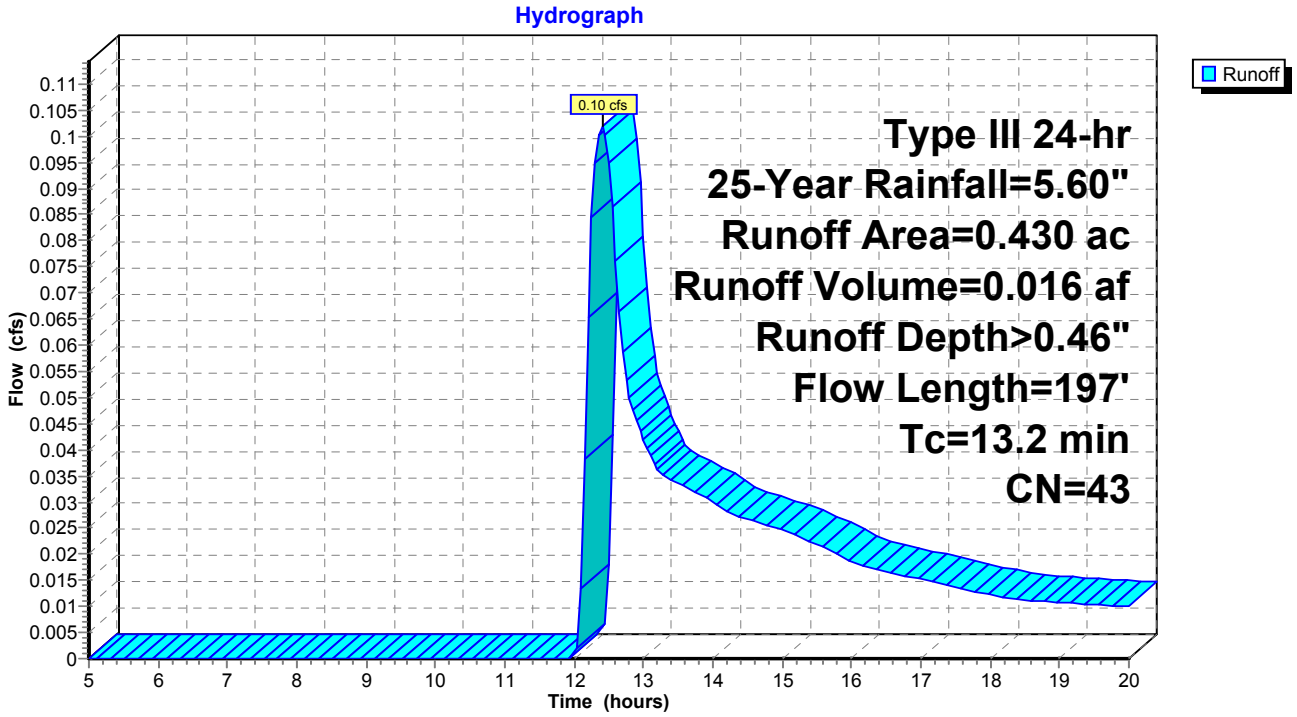
Runoff = 0.10 cfs @ 12.40 hrs, Volume= 0.016 af, Depth> 0.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.60"

Area (ac)	CN	Description
0.030	98	Paved parking, HSG A
0.400	39	>75% Grass cover, Good, HSG A
0.430	43	Weighted Average
0.400		93.02% Pervious Area
0.030		6.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	100	0.0150	0.15		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 3.20"
2.2	97	0.0110	0.73		**Shallow Concentrated Flow, BC** Short Grass Pasture Kv= 7.0 fps
13.2	197	Total			

Subcatchment P1-3: Flow West to Yard Drain



Summary for Subcatchment P2: Flow South to Rte 44

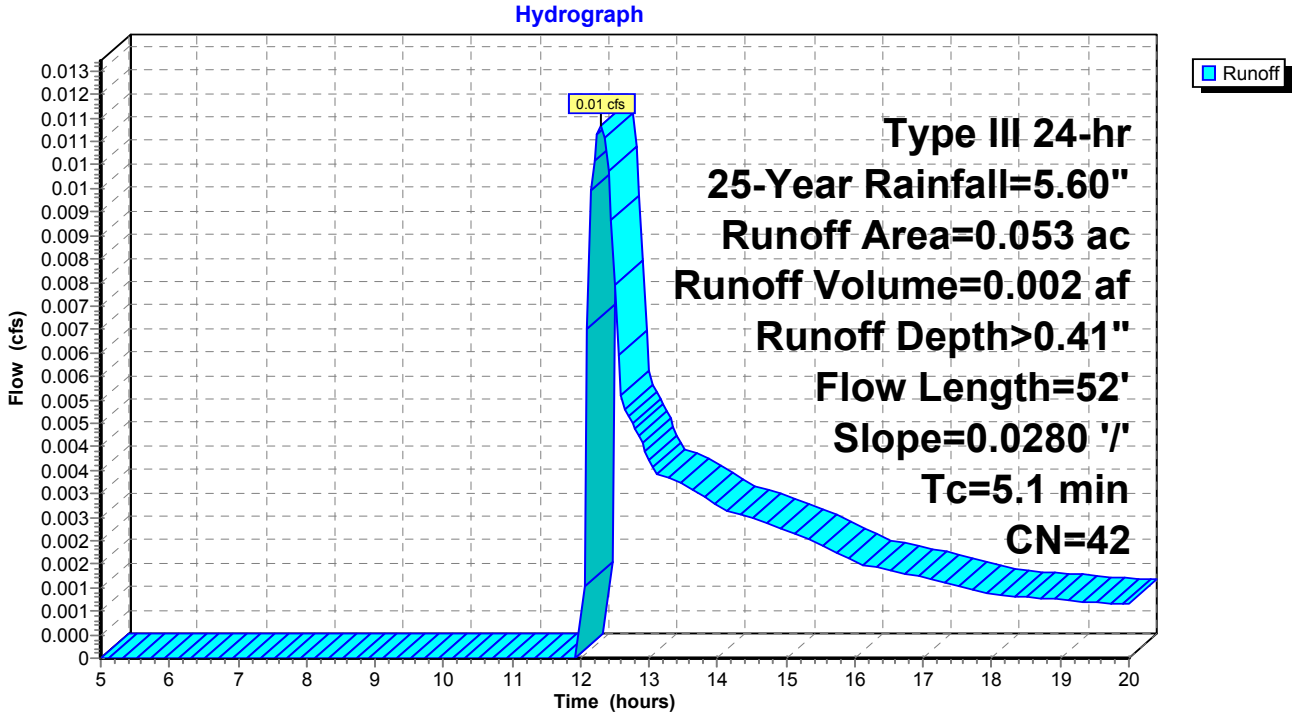
Runoff = 0.01 cfs @ 12.30 hrs, Volume= 0.002 af, Depth> 0.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.60"

Area (ac)	CN	Description
0.050	39	>75% Grass cover, Good, HSG A
0.003	98	Paved parking, HSG A
0.053	42	Weighted Average
0.050		94.34% Pervious Area
0.003		5.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	52	0.0280	0.17		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 3.20"

Subcatchment P2: Flow South to Rte 44

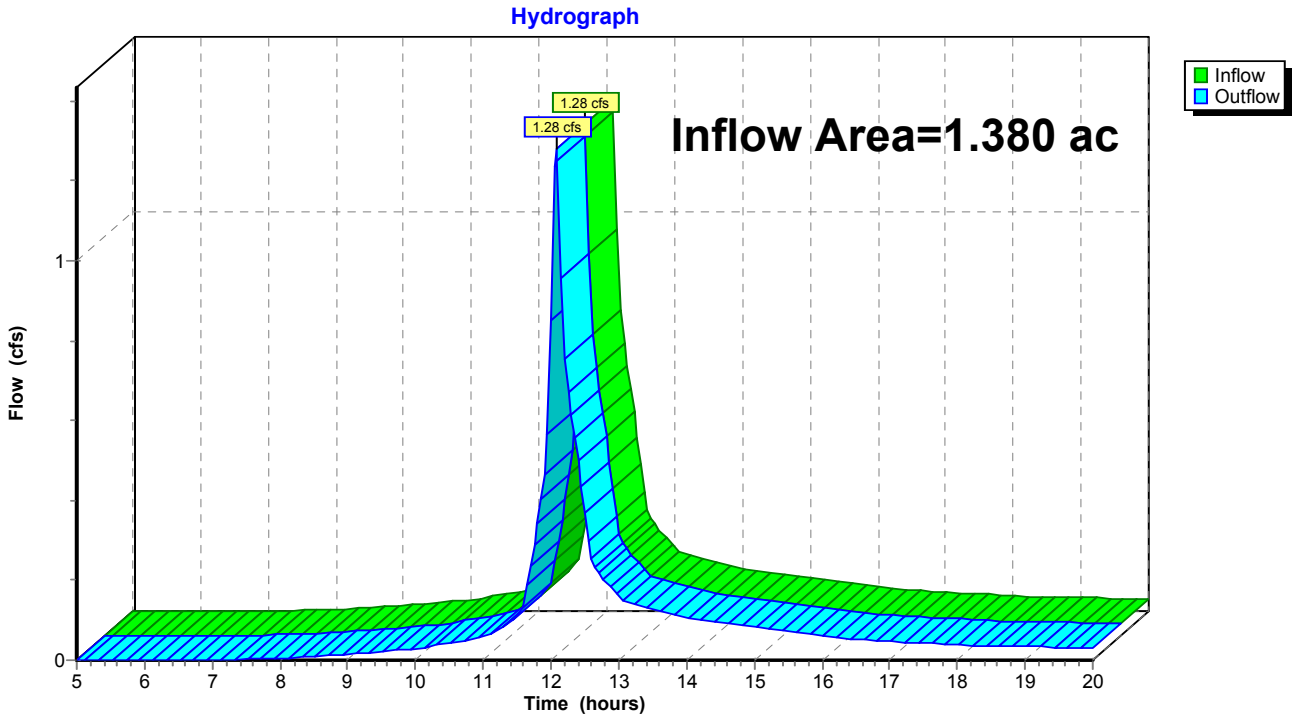


Summary for Reach TS: Flow to Analysis Point CB

Inflow Area = 1.380 ac, 28.99% Impervious, Inflow Depth > 0.88" for 25-Year event
Inflow = 1.28 cfs @ 12.08 hrs, Volume= 0.102 af
Outflow = 1.28 cfs @ 12.08 hrs, Volume= 0.102 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 TS: Flow to Analysis Point CB



Summary for Pond RG: Rain Garden

Inflow Area = 0.640 ac, 23.44% Impervious, Inflow Depth > 1.03" for 25-Year event
Inflow = 0.56 cfs @ 12.21 hrs, Volume= 0.055 af
Outflow = 0.27 cfs @ 12.57 hrs, Volume= 0.055 af, Atten= 51%, Lag= 21.7 min
Discarded = 0.27 cfs @ 12.57 hrs, Volume= 0.055 af
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= 53.05' @ 12.57 hrs Surf.Area= 1,101 sf Storage= 350 cf

Plug-Flow detention time= 7.9 min calculated for 0.055 af (100% of inflow)
Center-of-Mass det. time= 7.5 min (850.9 - 843.3)

Volume	Invert	Avail.Storage	Storage Description
#1	52.70'	2,604 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

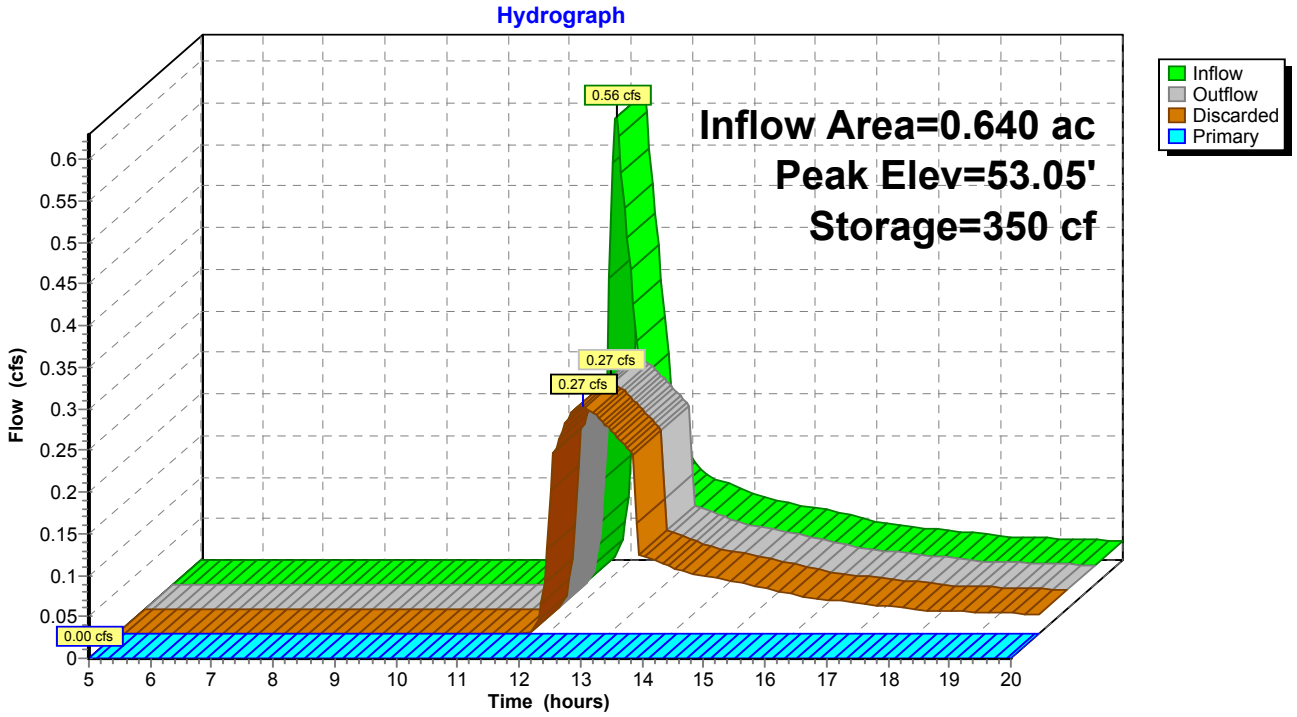
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
52.70	907	0	0
53.00	1,071	297	297
54.00	1,686	1,379	1,675
54.50	2,031	929	2,604

Device	Routing	Invert	Outlet Devices
#1	Primary	50.75'	**15.0" Round Culvert** L= 157.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.75' / 49.20' S= 0.0099 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.23 sf
#2	Device 1	53.80'	**12.0" Vert. Orifice/Grate** C= 0.600
#3	Discarded	52.70'	**10.000 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 48.30'

Discarded OutFlow Max=0.27 cfs @ 12.57 hrs HW=53.05' (Free Discharge)
└**3=Exfiltration** (Controls 0.27 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=52.70' (Free Discharge)
└**1=Culvert** (Passes 0.00 cfs of 6.80 cfs potential flow)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Pond RG: Rain Garden



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 P1-1: Paved Parking Flow Runoff Area=0.310 ac 70.97% Impervious Runoff Depth>4.52"
Tc=5.0 min CN=81 Runoff=1.73 cfs 0.117 af

Subcatchment P1-2: Flow to Rain Garden Runoff Area=0.640 ac 23.44% Impervious Runoff Depth>1.75"
Flow Length=317' Tc=12.6 min CN=53 Runoff=1.05 cfs 0.093 af

Subcatchment P1-3: Flow West to Yard Drain Runoff Area=0.430 ac 6.98% Impervious Runoff Depth>0.94"
Flow Length=197' Tc=13.2 min CN=43 Runoff=0.29 cfs 0.034 af

Subcatchment P2: Flow South to Rte 44 Runoff Area=0.053 ac 5.66% Impervious Runoff Depth>0.87"
Flow Length=52' Slope=0.0280 '/' Tc=5.1 min CN=42 Runoff=0.04 cfs 0.004 af

Reach TS: Flow to Analysis Point CB Inflow=1.83 cfs 0.150 af
Outflow=1.83 cfs 0.150 af

Pond RG: Rain Garden Peak Elev=53.52' Storage=941 cf Inflow=1.05 cfs 0.093 af
Discarded=0.37 cfs 0.093 af Primary=0.00 cfs 0.000 af Outflow=0.37 cfs 0.093 af

Summary for Subcatchment P1-1: Paved Parking Flow North

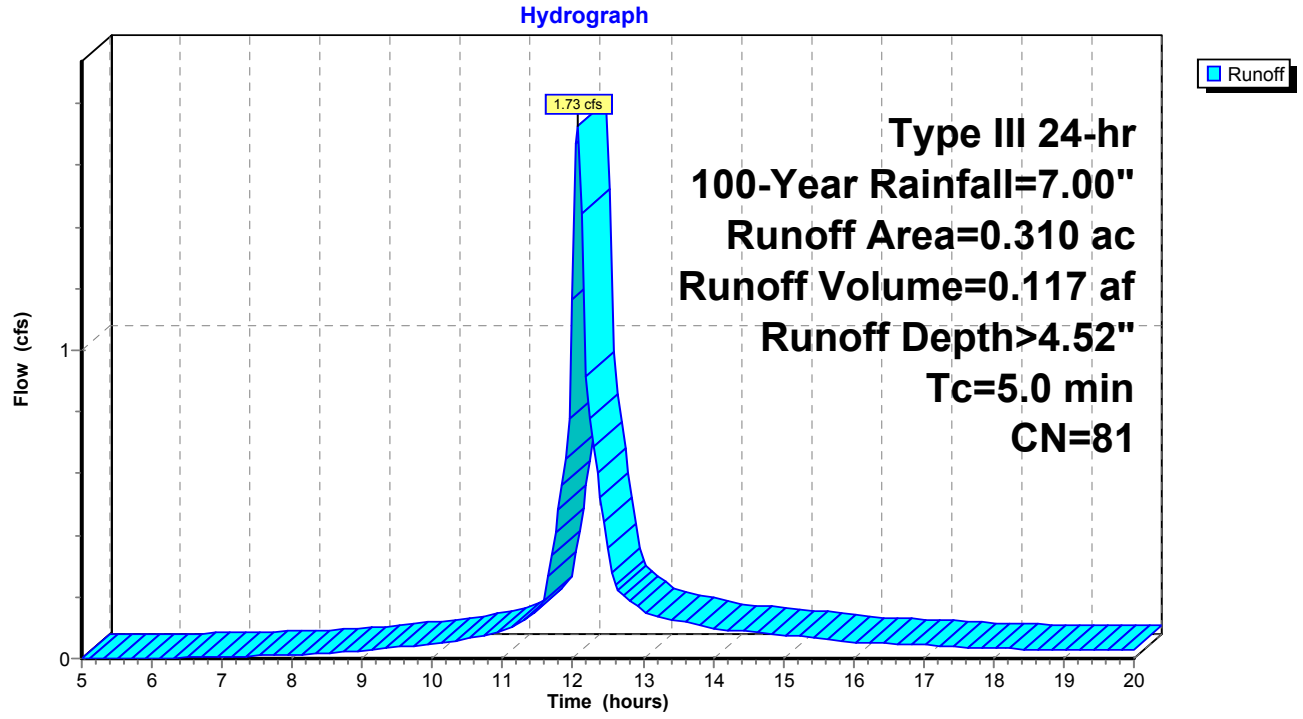
Runoff = 1.73 cfs @ 12.07 hrs, Volume= 0.117 af, Depth> 4.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.00"

Area (ac)	CN	Description
0.220	98	Paved parking, HSG A
0.090	39	>75% Grass cover, Good, HSG A
0.310	81	Weighted Average
0.090		29.03% Pervious Area
0.220		70.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Direct to meet min Tc**

Subcatchment P1-1: Paved Parking Flow North



Summary for Subcatchment P1-2: Flow to Rain Garden

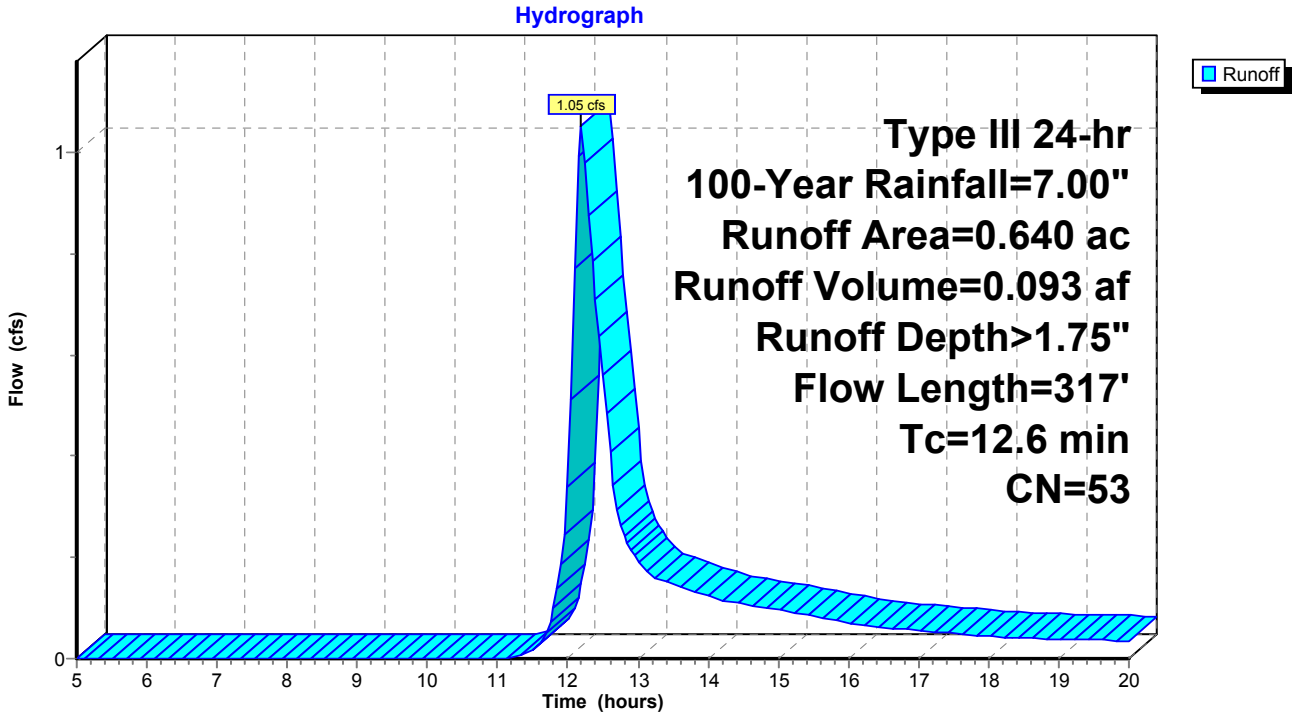
Runoff = 1.05 cfs @ 12.20 hrs, Volume= 0.093 af, Depth> 1.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.00"

Area (ac)	CN	Description
0.150	98	Paved parking, HSG A
0.490	39	>75% Grass cover, Good, HSG A
0.640	53	Weighted Average
0.490		76.56% Pervious Area
0.150		23.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	100	0.0400	0.22		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 3.20"
5.2	217	0.0100	0.70		**Shallow Concentrated Flow, BC** Short Grass Pasture Kv= 7.0 fps
12.6	317	Total			

Subcatchment P1-2: Flow to Rain Garden



Summary for Subcatchment P1-3: Flow West to Yard Drain

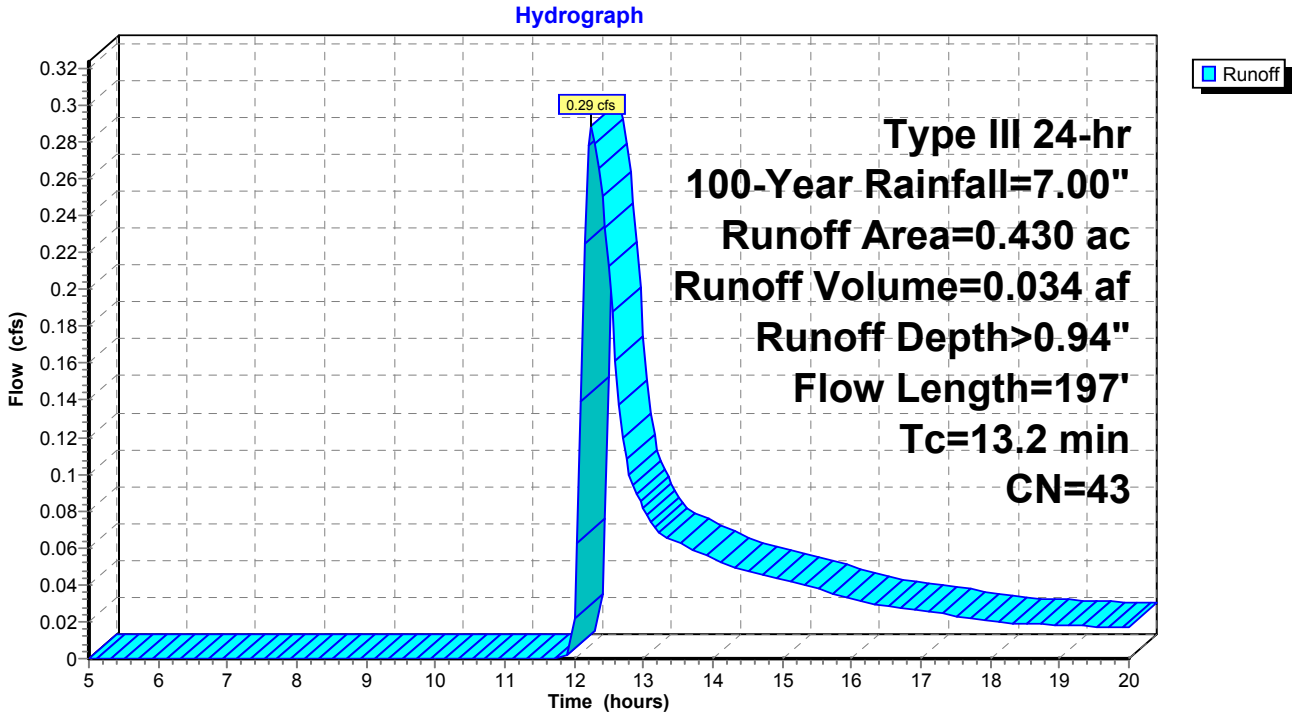
Runoff = 0.29 cfs @ 12.25 hrs, Volume= 0.034 af, Depth> 0.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.00"

Area (ac)	CN	Description
0.030	98	Paved parking, HSG A
0.400	39	>75% Grass cover, Good, HSG A
0.430	43	Weighted Average
0.400		93.02% Pervious Area
0.030		6.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	100	0.0150	0.15		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 3.20"
2.2	97	0.0110	0.73		**Shallow Concentrated Flow, BC** Short Grass Pasture Kv= 7.0 fps
13.2	197	Total			

Subcatchment P1-3: Flow West to Yard Drain



Summary for Subcatchment P2: Flow South to Rte 44

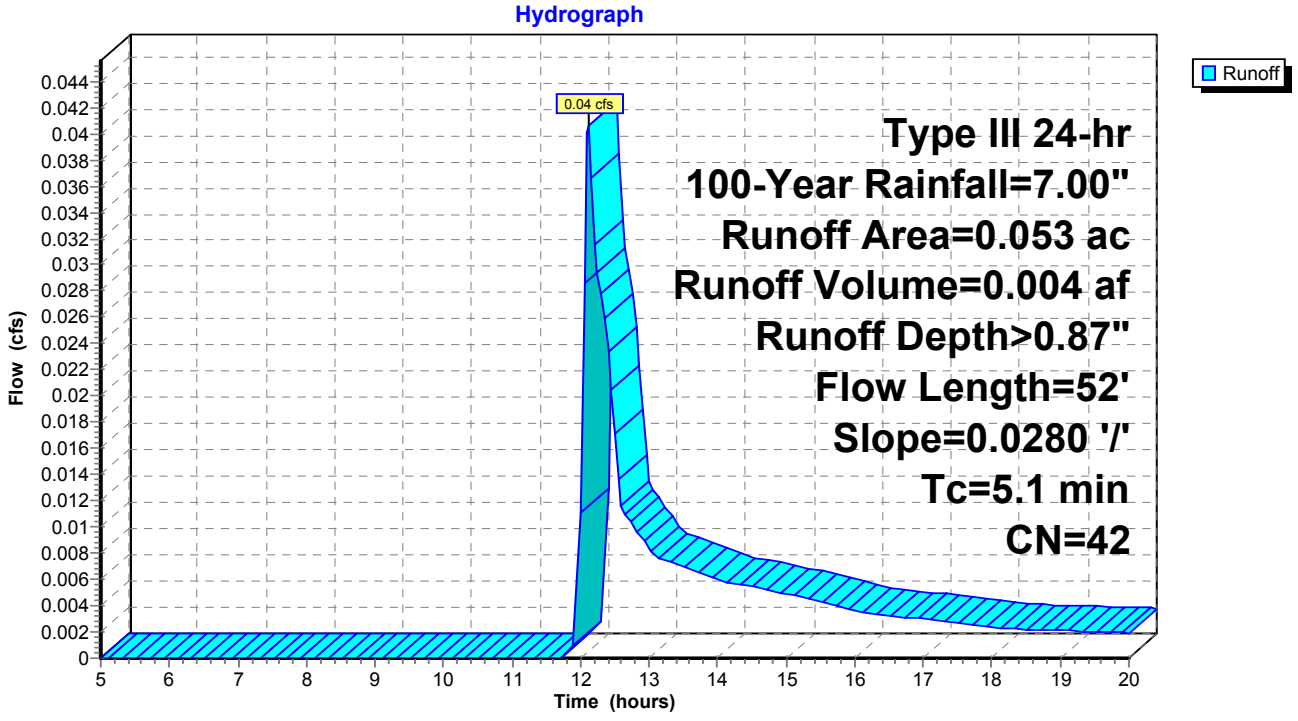
Runoff = 0.04 cfs @ 12.11 hrs, Volume= 0.004 af, Depth> 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.00"

Area (ac)	CN	Description
0.050	39	>75% Grass cover, Good, HSG A
0.003	98	Paved parking, HSG A
0.053	42	Weighted Average
0.050		94.34% Pervious Area
0.003		5.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	52	0.0280	0.17		**Sheet Flow, AB** Grass: Short n= 0.150 P2= 3.20"

Subcatchment P2: Flow South to Rte 44

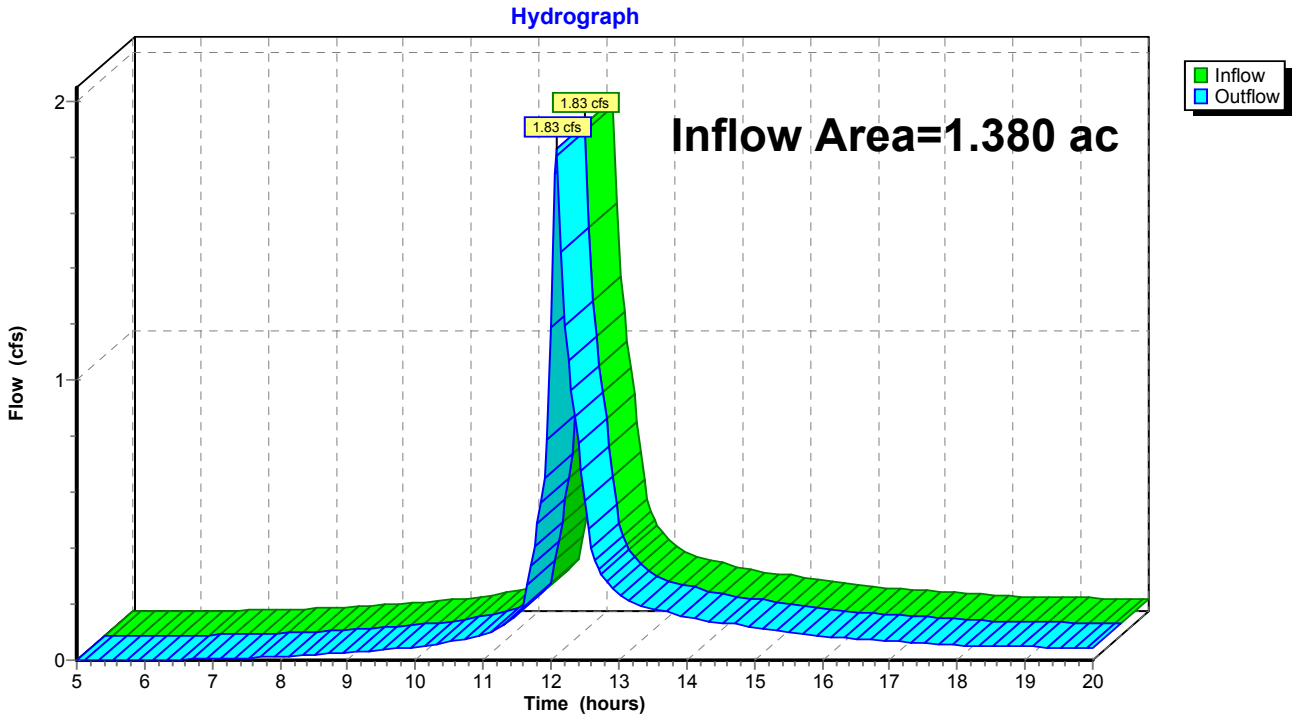


Summary for Reach TS: Flow to Analysis Point CB

Inflow Area = 1.380 ac, 28.99% Impervious, Inflow Depth > 1.31" for 100-Year event
Inflow = 1.83 cfs @ 12.08 hrs, Volume= 0.150 af
Outflow = 1.83 cfs @ 12.08 hrs, Volume= 0.150 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 TS: Flow to Analysis Point CB



Summary for Pond RG: Rain Garden

Inflow Area = 0.640 ac, 23.44% Impervious, Inflow Depth > 1.75" for 100-Year event
Inflow = 1.05 cfs @ 12.20 hrs, Volume= 0.093 af
Outflow = 0.37 cfs @ 12.63 hrs, Volume= 0.093 af, Atten= 65%, Lag= 25.8 min
Discarded = 0.37 cfs @ 12.63 hrs, Volume= 0.093 af
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= 53.52' @ 12.63 hrs Surf.Area= 1,393 sf Storage= 941 cf

Plug-Flow detention time= 19.3 min calculated for 0.093 af (100% of inflow)
Center-of-Mass det. time= 19.0 min (849.4 - 830.4)

Volume	Invert	Avail.Storage	Storage Description
#1	52.70'	2,604 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

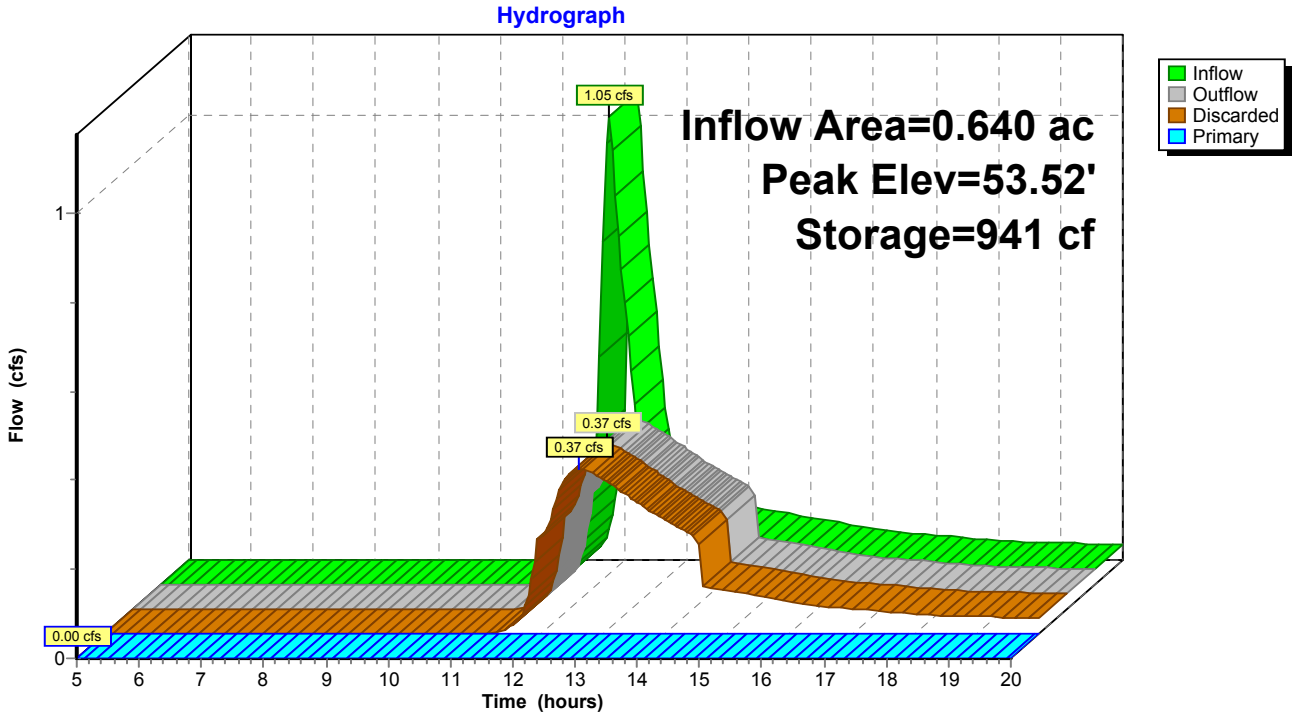
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
52.70	907	0	0
53.00	1,071	297	297
54.00	1,686	1,379	1,675
54.50	2,031	929	2,604

Device	Routing	Invert	Outlet Devices
#1	Primary	50.75'	**15.0" Round Culvert** L= 157.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.75' / 49.20' S= 0.0099 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.23 sf
#2	Device 1	53.80'	**12.0" Vert. Orifice/Grate** C= 0.600
#3	Discarded	52.70'	**10.000 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 48.30'

Discarded OutFlow Max=0.37 cfs @ 12.63 hrs HW=53.52' (Free Discharge)
└**3=Exfiltration** (Controls 0.37 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=52.70' (Free Discharge)
└**1=Culvert** (Passes 0.00 cfs of 6.80 cfs potential flow)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Pond RG: Rain Garden



APPENDIX C

WATER QUALITY VOLUME COMPUTATIONS

benesch

Comp. by: JCO Date: 12/17/18 Sheet 1 of _____

Chkd. by: _____ Date: _____ Job No. 70518.00

Project: WICKHAM MEMORIAL LIBRARY

Element: WQV & GRV

WQV

REQUIRED:

$$WQV = \frac{(1\text{ in})(R)(A)}{12\text{ in/ft}}$$

$A = 1.43$ ac

$I = 0.40\text{ac}/1.43\text{ ac} = 28\%$

$R = 0.05 + 0.009(28) = 0.302$

$$WQV = \frac{(1\text{ in})(0.302)(1.43\text{ ac})}{12\text{ in/hr}}(43{,}560\text{ SF/ac}) = 1{,}568\text{ cf}$$

PROVIDED:

2,604 cf – CUMULATIVE STORAGE OF RAIN GARDEN (HYDROCAD)

GRV

REQUIRED:

$$GRV = \frac{DAI}{12}$$

$D = 0.4$ in (SG "A")

$I = 0.28$

$A = 1.43$ ac

$$GRV = \frac{(0.4\text{ in})(1.43\text{ ac})(0.28)}{12\text{ in/ft}}(43{,}560\text{ SF/ac}) = 581\text{ cf}$$

PROVIDED:

2,604 cf – CUMULATIVE STORAGE OF RAIN GARDEN (HYDROCAD)

APPENDIX D

TEST PIT PERCOLATION RESULTS

Soil Classification: Fine loamy sand with traces of silt

Table 1: Percolation Measurements

Time Start	Depth (in)	Time End	Depth (in)	Duration (minutes)	Decrease in Water Surface (inches)	Infiltration (in/hr)
10:37 am	3.75	10:42 am	8.75	5	5	60
10:42 am	8.75	10:47 am	13	5	4.25	51
10:47 am	13	10:52 am	16	5	3	36

Photo 1: Percolation Test

Photo 2: Soil Profile

APPENDIX E

NRCS SOIL MAPPING

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 State of Connecticut

Wickham Memorial Library- East Hartford, CT

November 28, 2018

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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Contents

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: 1:565 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 5 10 20 30

Feet
0 25 50 100 150

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 1:12,000.

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: State of Connecticut
Survey Area Data: Version 17, Sep 5, 2018

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

Date(s) aerial images were photographed: Aug 27, 2016—Oct 30, 2017

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
236B	Windsor-Urban land complex, 0 to 8 percent slopes	1.0	100.0%
Totals for Area of Interest		**1.0**	**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.

State of Connecticut

236B—Windsor-Urban land complex, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2w2wq
Elevation: 0 to 920 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Windsor and similar soils: 40 percent
Urban land: 40 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Windsor

Setting

Landform: Deltas, dunes, outwash plains, outwash terraces
Landform position (three-dimensional): Riser, tread
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Parent material: Loose sandy glaciofluvial deposits derived from granite and/or loose sandy glaciofluvial deposits derived from schist and/or loose sandy glaciofluvial deposits derived from gneiss

Typical profile

A - 0 to 3 inches: loamy sand
Bw - 3 to 25 inches: loamy sand
C - 25 to 65 inches: sand

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 4.4 inches)

Interpretive groups

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

Description of Urban Land

Typical profile

M - 0 to 10 inches: cemented material

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 0 inches to manufactured layer
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Available water storage in profile: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: Unranked

Minor Components

Udorthents

Percent of map unit: 10 percent
Landform: Outwash plains, outwash terraces, deltas, dunes
Landform position (three-dimensional): Tread, riser
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Hinckley

Percent of map unit: 5 percent
Landform: Kames, deltas, outwash plains, eskers
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Deerfield

Percent of map unit: 5 percent
Landform: Outwash plains, terraces, deltas
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

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