

# STORMWATER MANAGEMENT ANALYSIS FOR

**21-27 HANCOCK STREET,  
NEWBURYPORT, MA**

**Prepared for:**

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Newburyport, MA

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**Project No. 2020-087  
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## 1.0 INTRODUCTION

**Caswell Development** is proposing to redevelop the site located at 21 and 27 Hancock Street, Newburyport, MA with the construction of two 2-family townhomes. The following report addresses the hydrologic calculations and stormwater management design proposed at the site.

## 2.0 EXISTING CONDITION

The limit of work for the project is the parcels of land shown in the Town of Newburyport's Assessor's Database as Map 25, Parcels 42 and 43. These two parcels are identified as 27 Hancock Street and 21-25 Hancock Street, with Leavitt Court, currently a "paper street" running between the two parcels and currently providing access to the single-family home located at 27 Hancock Street. The 21-25 Hancock Street parcel is approximately 16,228 SF of area and the 27 Hancock Street parcel is approximately 16,400 SF. Therefore the total area of the two parcels is 0.49 acres (32,628 SF). The total subject site, including the Leavitt Court area is 0.85 acres (36,954 SF).

The 27 Hancock Street parcel currently consists of a single-family home surrounded by a paved driveway, lawn area, landscaping and some wooded area. The 21-25 Hancock Street parcel currently consists of a large automobile garage with three garage bays, also with paved driveway access, some surrounding lawn area and plenty of surrounding wooded area in the rear. The existing site is 47.4% impervious.

### 2.1 Existing Hydrology

For the design purposes of this study, due to limits of available survey information, the drainage areas have been defined by the parcel boundaries. Within these parcel boundaries, there are two design discharge points located at the site, consisting of two catchment areas within the property, neither of which currently have any sort of a present stormwater system.

The first design discharge point is located in the northern corner of the site, where it abuts the Clipper City Rail Trail. The second design discharge point is at the east corner of the site where it drains to neighboring property. The two catchment areas are divided by a highpoint that runs through the center of the site, dividing it into two drainage areas.

Design Point 1, located at the connection with the rail trail property, drains into a small ravine-like area as it flows offsite. The area that drains to Design Point 2, drains across a somewhat low sloping grass area in the rear of the property as it flows offsite and enters the neighbor's yard.

### 2.2 FEMA Flood Insurance Rate Map

According to the FEMA Flood Insurance Rate Map Number 25009C0136G, with an effective date of July 16, 2014, the site is located within a Zone X, which is "areas determined to be outside the 0.2% annual chance floodplain." (See Appendix C: FEMA Flood Insurance Rate Map)

### 2.3 Soils

According to the Natural Resources Conservation Service (NRCS) Web Soil Survey, the soils across the entire site is classified as Merrimac Fine Sandy Loam, 0 to 3 percent slopes. This soil classification is recognized as part of Hydrologic Soil Group A, which was used for the purposes of hydrologic calculations across the entire site. Additionally, soils infiltration tests were done on the

site in March, 2021 and infiltration rates at the raingarden, drywell and Cultec locations were found to be between 17-18 in/hr. (See Appendix D: Soils Information)

### 3.0 PROPOSED CONDITION

The project proposes the redevelopment of the site at 21-27 Hancock Street with the construction of two 2-family townhomes, each with driveway access from either directly off Hancock Street or from Leavitt Court, which is proposed to be constructed as a paved 20' wide roadway. There will also be a side driveway proposed for access to one of the townhomes. The proposed site will include 7,924 SF of roof area, along with 6,456 SF of paved roadway and driveway area. The rest of the site will consist of landscaping/lawn or wooded area. The proposed site is 39.5% impervious. This is an 8.3% decrease in impervious area. This alone reduces the stormwater flow off the property. In the interest of controlling runoff to ensure there is no impact to the abutting properties we have provided on site stormwater mitigation including a rain garden and infiltration pipe imbedded in stone for the new private drive. A drywell and infiltration chambers are provided to handle the driveway off Hancock Street and roof area of the two units on the easterly side of the property.

#### 3.1 Proposed Hydrology

In the proposed design, there are still two design points, both of which are in the same locations as discussed above in the existing hydrology. These design points and their drainage areas are addressed below:

##### Design Point 1 – Rail Trail

- 10S – This subcatchment consists of the lawn area, and the rear section of the roof area that drains to the northern corner where it flows to the Clipper City Rail Trail. The subcatchment also includes roof area that is directed via downspouts/spreaders.
- 20S – This subcatchment consists of the proposed roadway surface and the center lawn and landscaping area, as well as the roof areas that drain toward the inner section of the site. This drainage area flows to a raingarden at the rear of the roadway. This raingarden is proposed to be 8" deep and will include a 6" overflow outlet that will drain to a 12" perforated pipe set below the raingarden. This 12" pipe will be set in 2' x 2' x 40' of crushed stone. Once the perforated pipe and stone is filled with runoff, and then the raingarden fills with runoff, it will overtop via a broad crested weir (4' wide flat lawn) along the raingarden edge. Any overflow from the raingarden will be directed via a grass swale to the northern corner of the property to Design Point 1.

It should be noted that the drainage calculations of this design only include the raingarden in the model and not the perforated pipe/crushed stone system below. It was done this way to avoid any excess complexity that the perforated pipe/stone system set below the raingarden would pose to the model, leading to possible inaccuracies in flow rates. Based on the stone area's bottom width of 40' x 2' and an infiltration rate of 17 in/hr (determined in the field), the stone area would exfiltrate approximately 0.03--05 CFS (cubic feet per second) which would only have a marginal impact on the discarded rates within the model.

##### Design Point 2 – Eastern Abutters

- 30S – This subcatchment consists of the driveway and some lawn and walkway area that drains to a 300 gallon drywell. This drywell includes an overflow via the rim that releases any excess flow further "downstream" joining the flow across subcatchment 40S toward Design Point 2.

- **40S** – This subcatchment includes all of the lawn area on the eastern portion of the property that drains directly down the topography to the eastern property boundary.
- **41S** – This subcatchment consists solely of the portion of the roof that would drain directly to the eastern abutters. The runoff from this roof surface (shown on the Drainage Area Plan – C401) is directed, via gutters and downspouts, to an infiltration system consisting of three Cultec R-330XLHD recharge chambers that will hold and infiltrate the roof runoff. Any excess will be directed via an overflow weir to Design Point 2 along with the rest of the runoff from subcatchment 40S.

See hydrologic model below for summarized hydrologic calculations of offsite flow rates and volumes for the two separate design points and the totals. See Appendix B: Existing and Proposed Drainage Areas for detailed layouts of the above discussed drainage areas.

#### 4.0 HYDROLOGIC MODEL

The hydrologic model was developed in HydroCAD. Both existing and proposed conditions are modeled for the 2-year, 10-year, 25-year, and 100-year 24-hour storm events. HydroCAD allows for variable rainfall intensity throughout the storm duration, peaking near the middle of the Type III, 24-hour storm. The drainage areas' time of concentration ( $t_c$ ) has been calculated for each catchment area. For Design Point 1 we have not included the discharge from the overflow standpipe with infiltration pipe. We were having issues including this feature in the model. This is minimal regarding the rate of stormwater mitigation with between 0.03 and 0.05 cfs of rate reductions not accounted for in the model. This rate is based upon using the infiltration rate or 17" per hour as determined in the double ring infiltrometer test. Complete calculations, performed using the HydroCAD software, are included in the appendix.

Table 4.1: Hydrological Calculation Summary

Rainfall Event		Design Point 1		Design Point 2		Total	
		<i>Existing</i>	<b>Proposed</b>	<i>Existing</i>	<b>Proposed</b>	<i>Existing</i>	<b>Proposed</b>
<b>2 Yr</b>	Rate (cfs)	<i>1.10</i>	0.55	<i>0.00</i>	0.00	<i>1.10</i>	0.55
	Volume (cf)	<i>2,838</i>	1,326	<i>116</i>	0	<i>2,955</i>	1,326
<b>10 Yr</b>	Rate (cfs)	<i>2.04</i>	1.28	<i>0.13</i>	0.12	<i>2.07</i>	1.34
	Volume (cf)	<i>5,315</i>	3,410	<i>747</i>	207	<i>6,062</i>	3,617
<b>25 Yr</b>	Rate (cfs)	<i>2.80</i>	2.06	<i>0.41</i>	0.20	<i>3.06</i>	2.26
	Volume (cf)	<i>7,371</i>	5,377	<i>1,529</i>	563	<i>8,900</i>	5,940
<b>100 Yr</b>	Rate (cfs)	<i>4.37</i>	3.83	<i>1.22</i>	1.00	<i>5.32</i>	4.74
	Volume (cf)	<i>11,789</i>	10,009	<i>3,706</i>	1,758	<i>15,495</i>	11,767

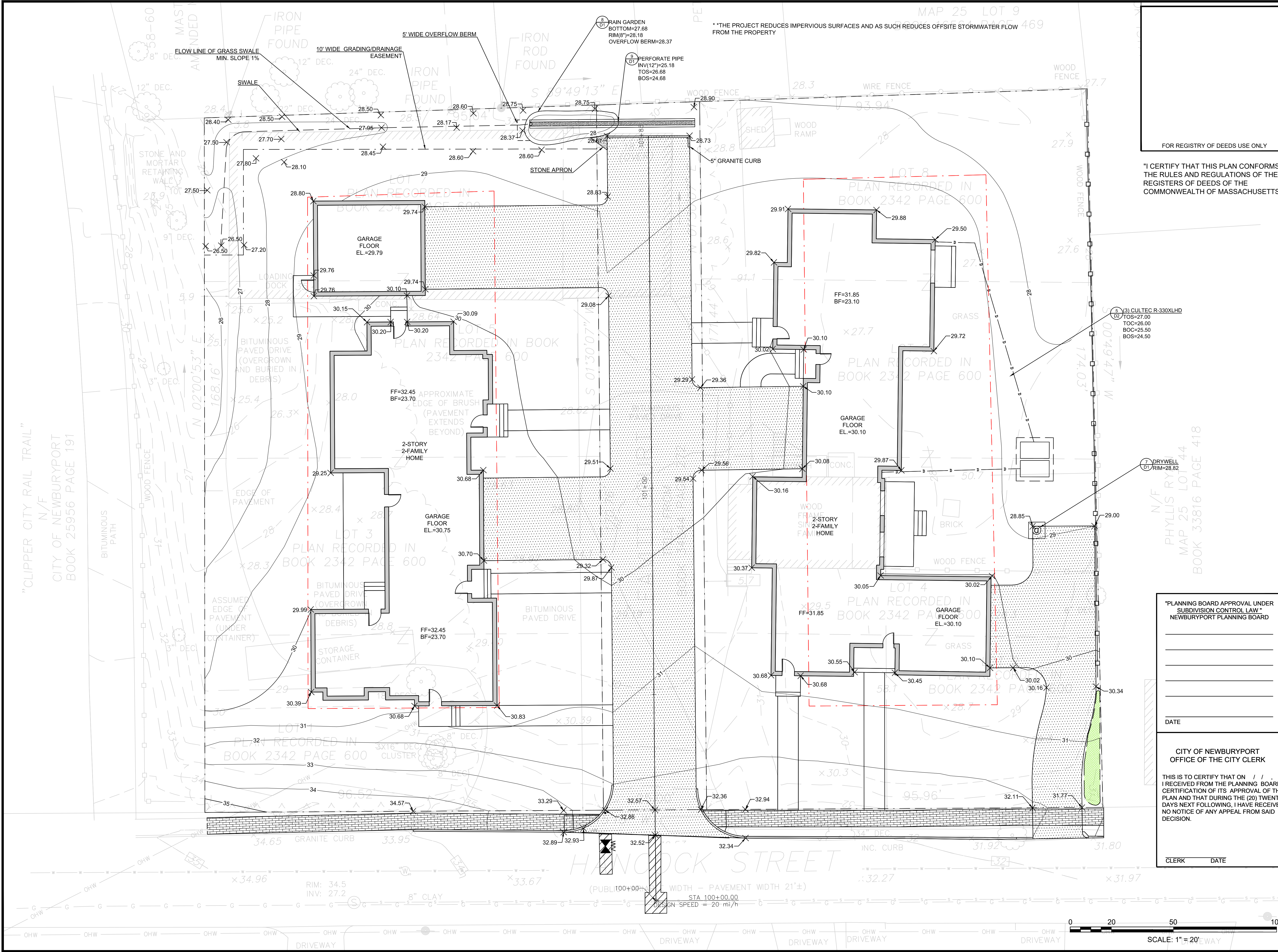
## **5.0 CONCLUSION**

Based on DCI's analysis of the existing and proposed conditions, the proposed site conditions meet the stormwater management criteria set. Design point runoff volumes have been decreased for the 2-year, 10-year, 25-year and 100-year storm events. Peak flow rates are decreased for the 2-year and 10-year, 25-year and 100-year storm event. DCI concludes that the proposed redevelopment at 21-27 Hancock Street, Newburyport, MA adheres to all applicable stormwater management policies.

## Appendix A

# SITE PLANS

P:\2020 Projects\2020-087 Leavitt Ct Newburyport\Eng\20-087\_GRAD\_DRAIN.dwg



MAP 25 LOT 9

\*\*THE PROJECT REDUCES IMPERVIOUS SURFACES AND AS SUCH REDUCES OFFSITE STORMWATER FLOW 469 FROM THE PROPERTY

NORTH

**DCI**  
Design Consultants Inc.  
Somerville - Quincy - Newburyport  
www.dci-ma.com

FOR REGISTRY OF DEEDS USE ONLY

"I CERTIFY THAT THIS PLAN CONFORMS TO THE RULES AND REGULATIONS OF THE REGISTERS OF DEEDS OF THE COMMONWEALTH OF MASSACHUSETTS."

DEVELOPER:  
CASWELL DEVELOPMENT  
24 GRAF ROAD  
NEWBURYPORT MA

ARCHITECT:  
GRAF ARCHITECTS  
2 LIBERTY STREET  
NEWBURYPORT MA

SURVEYOR  
WINTER GEC  
44 MERRIMAC ST. UNIT 312  
NEWBURYPORT, MA

PROJECT TEAM

21-27 HANCOCK NEWBURYPORT, MA.

PROJECT INFO

REV	DESCRIPTION	DATE
2	PEER REVIEW	03/31/2021
1	PLAN UPDATE	03/19/2021

"PLANNING BOARD APPROVAL UNDER SUBDIVISION CONTROL LAW" NEWBURYPORT PLANNING BOARD

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
DATE

CITY OF NEWBURYPORT  
OFFICE OF THE CITY CLERK

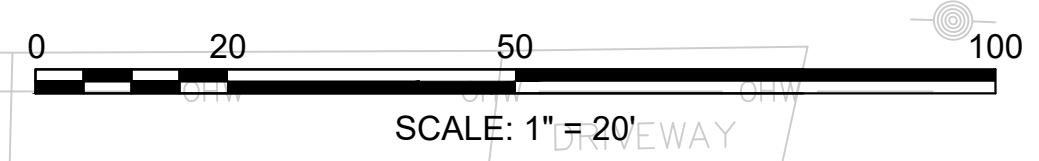
THIS IS TO CERTIFY THAT ON / / I RECEIVED FROM THE PLANNING BOARD CERTIFICATION OF ITS APPROVAL OF THIS PLAN AND THAT DURING THE (20) TWENTY DAYS NEXT FOLLOWING, I HAVE RECEIVED NO NOTICE OF ANY APPEAL FROM SAID DECISION.

CLERK \_\_\_\_\_ DATE \_\_\_\_\_

# GRADING & DRAINAGE PLAN

SHEET NAME:  
**C2**

SHT NO:  
DR BY: GS  
CHK BY: SS  
PROJ NO: 20-087  
DATE: 02/17/2021  
SCALE: 1"=10'



"CLIPPER CITY RAIL TRAIL"  
N/F  
CITY OF NEWBURYPORT  
BOOK 25956 PAGE 191

BITUMINOUS PAVED DRIVE  
(OVERGROWN AND BURIED IN DEBRIS)  
N 02°00'53" E  
168.16'

DEBRIS  
STORAGE CONTAINER  
FF=32.45  
BF=23.70

LOT 31  
PLAN RECORDED IN BOOK 2342 PAGE 600

LOT 5  
PLAN RECORDED IN BOOK 2342 PAGE 600

LOT 3  
PLAN RECORDED IN BOOK 2342 PAGE 600

LOT 8  
PLAN RECORDED IN BOOK 2342 PAGE 600

LOT 4  
PLAN RECORDED IN BOOK 2342 PAGE 600

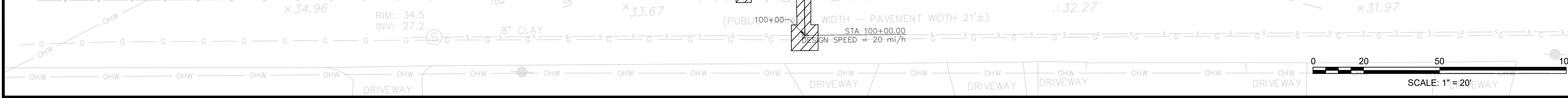
LOT 2  
PLAN RECORDED IN BOOK 2342 PAGE 600

LOT 1  
PLAN RECORDED IN BOOK 2342 PAGE 600

LOT 6  
PLAN RECORDED IN BOOK 2342 PAGE 600

LOT 7  
PLAN RECORDED IN BOOK 2342 PAGE 600

N/F  
PHYLLIS RYAN  
MAP 25 LOT 144  
BOOK 33816 PAGE 418





## Appendix B

# EXISTING & PROPOSED DRAINAGE AREAS

**DEVELOPER:**  
CASWELL DEVELOPMENT  
24 GRAF ROAD  
NEWBURYPORT MA

**ARCHITECT:**  
GRAF ARCHITECTS  
2 LIBERTY STREET  
NEWBURYPORT MA

**SURVEYOR:**  
WINTER GEC  
44 MERRIMAC ST. UNIT 312  
NEWBURYPORT, MA

PROJECT TEAM

**21-27 HANCOCK  
NEWBURYPORT, MA.**

PROJECT INFO

REV	DESCRIPTION	DATE
2	PEER REVIEW	03/31/2021
1	PLAN UPDATE	03/19/2021

STAMP:

## DRAINAGE AREA PLAN

SHEET NAME:

# C401

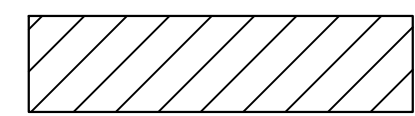


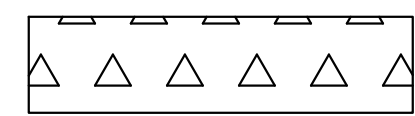


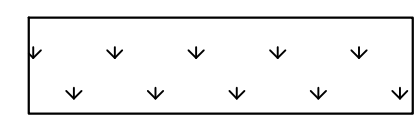

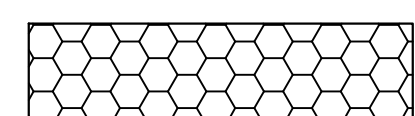
SHT NO:  
DR BY: MCH  
CHK BY: SBS  
PROJ NO: 20-067  
DATE: 12/9/2020  
SCALE: 1"=20'



### EXISTING

### PROPOSED

### LEGEND

- |   |                  |   |              |   |                        |
|---|------------------|---|--------------|---|------------------------|
|  | IMPERVIOUS AREA  |  | SUBCATCHMENT |  | DRAINAGE AREA BOUNDARY |
|  | WOODED AREA      |  | POND         |  | TIME OF CONCENTRATION  |
|  | LANDSCAPE        |  | DESIGN POINT |   |                        |
|  | PERMEABLE PAVERS |   |              |   |                        |

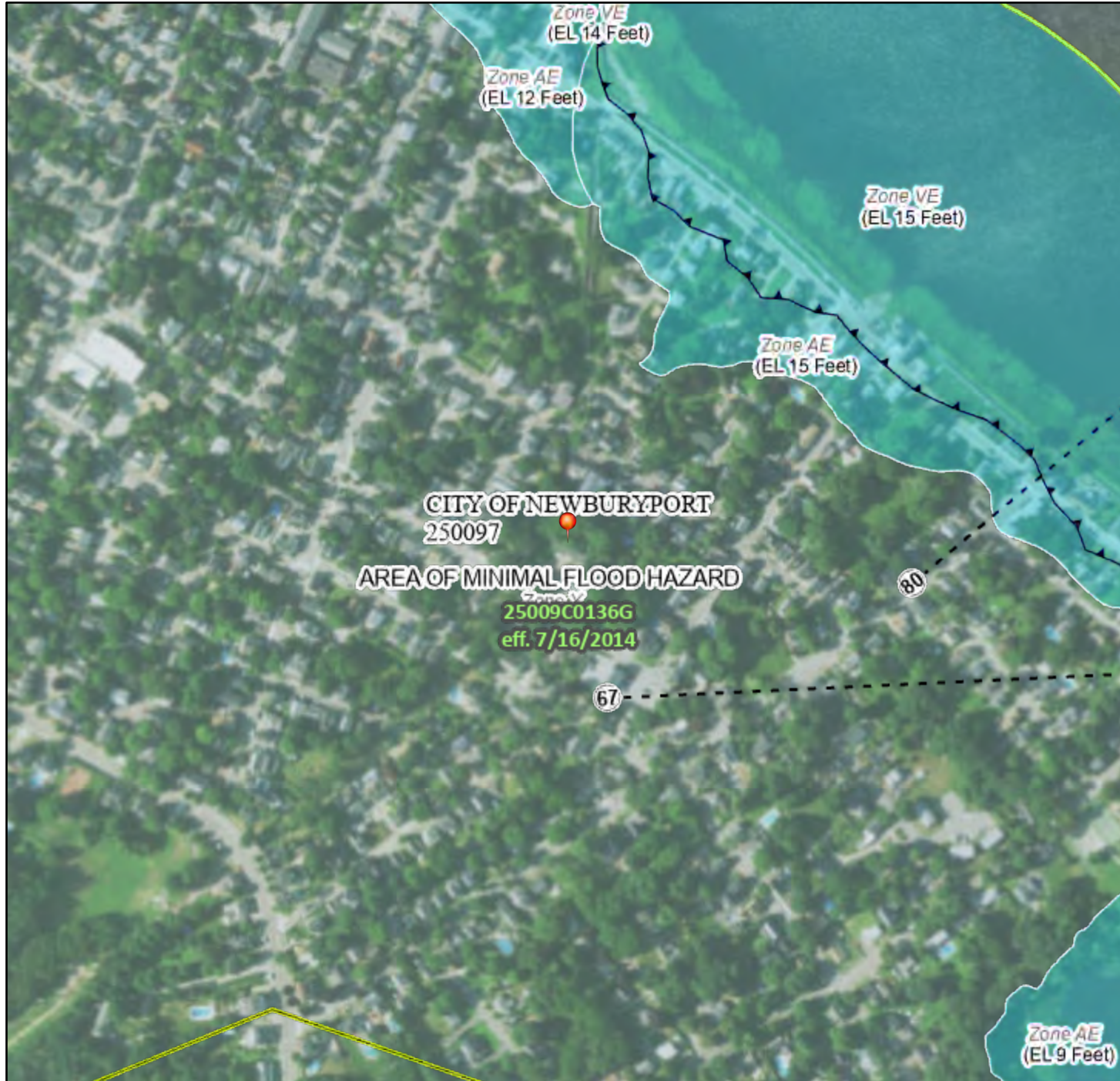
## Appendix C

# FEMA FLOOD INSURANCE RATE MAP

# National Flood Hazard Layer FIRMMette



70°51'56"W 42°48'30"N



## Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) <i>Zone A, V, A99</i>
		With BFE or Depth <i>Zone AE, AO, AH, VE, AR</i>
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile <i>Zone X</i>
		Future Conditions 1% Annual Chance Flood Hazard <i>Zone X</i>
		Area with Reduced Flood Risk due to Levee. See Notes. <i>Zone X</i>
		Area with Flood Risk due to Levee <i>Zone D</i>
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard <i>Zone X</i>
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard <i>Zone D</i>
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance
		17.5 Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
MAP PANELS		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
		Digital Data Available
		No Digital Data Available
		Unmapped
		The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.



This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **1/29/2021 at 2:47 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

0 250 500 1,000 1,500 2,000 Feet 1:6,000

70°51'19"W 42°48'4"N

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

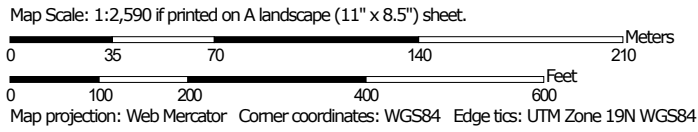
## Appendix D

# SOILS INFORMATION

Soil Map—Essex County, Massachusetts, Northern Part



Soil Map may not be valid at this scale.




## MAP LEGEND

### Area of Interest (AOI)

 Area of Interest (AOI)

### Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

### Special Point Features



Blowout



Borrow Pit



Clay Spot



Closed Depression



Gravel Pit



Gravelly Spot



Landfill



Lava Flow



Marsh or swamp



Mine or Quarry



Miscellaneous Water



Perennial Water



Rock Outcrop



Saline Spot



Sandy Spot



Severely Eroded Spot



Sinkhole



Slide or Slip



Sodic Spot



Spoil Area



Stony Spot



Very Stony Spot



Wet Spot



Other



Special Line Features

### Water Features



Streams and Canals

### Transportation



Rails



Interstate Highways



US Routes



Major Roads



Local Roads

### Background



Aerial Photography

## MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

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: Essex County, Massachusetts, Northern Part

Survey Area Data: Version 16, Jun 9, 2020

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

Date(s) aerial images were photographed: Dec 31, 2009—Sep 12, 2016

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
254A	Merrimac fine sandy loam, 0 to 3 percent slopes	32.9	99.4%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	0.2	0.6%
<b>Totals for Area of Interest</b>		<b>33.1</b>	<b>100.0%</b>



# DOUBLE RING INFILTROMETER TEST

## NEWBURYPORT, MASSACHUSETTS

21-27 Hancock Street, Massachusetts

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<u>Percolation Test</u>	<u>Dbl ring inf.test</u> (TP-1)	<u>Dbl ring inf. test</u> (TP-2)
Depth of test:	30"	30"
Start presoak:	5 min	5 min
Time at 4"→	0:00	0:00
Time at 3"→	01:38	1:25
Time at 2"→	3:30	3:20
Time at 1"→	5:20	5:00
Total time 4" to 1"→	5.33 minutes	5.00 minutes
Rate (inch/hr)	1.77min/inch or 33.8"/hr use half measured rate 17"/Hr.	1.67min/inch or 35.9"/hr use half measured rate 18"/Hr

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4/2/2021

Date of soil testing



# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

## C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-1 4/2/21 8:10am sunny 55 deg  
Hole # Date Time Weather Latitude Longitude

1. Land Use: Residential Lawn lawn/loam 0.5%  
(e.g., woodland, agricultural field, vacant lot, etc.) Vegetation Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)

Description of Location: Next to garage at rain garden location

2. Soil Parent Material: \_\_\_\_\_  
Landform Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body n/a feet Drainage Way n/a feet Wetlands n/a feet  
Property Line 15 feet Drinking Water Well n/a feet Other n/a feet

4. Unsuitable

Materials Present:  Yes  No If Yes:  Disturbed Soil  Fill Material  Weathered/Fractured Rock  Bedrock

5. Groundwater Observed:  Yes  No If yes: Depth Weeping from Pit \_\_\_\_\_ Depth Standing Water in Hole \_\_\_\_\_

### Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-8	A	FSL	10 YR 3/2								
18	B	FLS	10YR 5/6								
92	C	LS	2.5Y 5/4								

Additional Notes: Soil testing for drainage (no mottling observed)



# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

## C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-2 Hole #      4/2/21 Date      8:30am Time      sunny 55 deg Weather      \_\_\_\_\_ Latitude      \_\_\_\_\_ Longitude: 0.5% Slope (%)

1. Land Use: Residential (e.g., woodland, agricultural field, vacant lot, etc.)      Lawn Vegetation      lawn/loam Surface Stones (e.g., cobbles, stones, boulders, etc.)

Description of Location: Back yard at drywell/cultec location

2. Soil Parent Material: \_\_\_\_\_ Landform \_\_\_\_\_ Position on Landscape (SU, SH, BS, FS, TS) \_\_\_\_\_

3. Distances from: Open Water Body n/a feet      Drainage Way n/a feet      Wetlands n/a feet  
Property Line 20 feet      Drinking Water Well n/a feet      Other n/a feet

4. Unsuitable Materials Present:  Yes  No      If Yes:  Disturbed Soil       Fill Material       Weathered/Fractured Rock       Bedrock

5. Groundwater Observed:  Yes  No      If yes:      Depth Weeping from Pit      Depth Standing Water in Hole

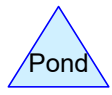
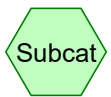
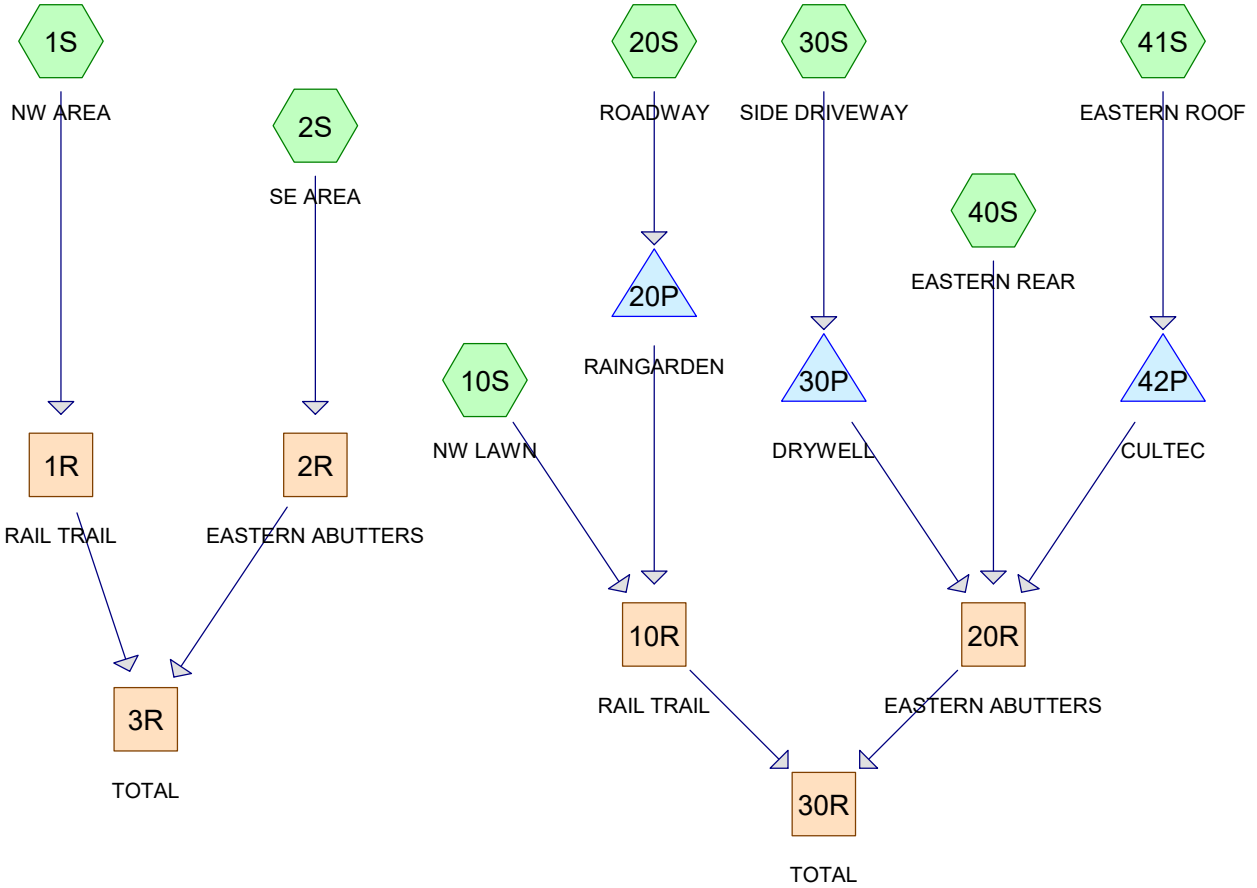
### Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-14	A	FSL	10 YR 3/2								
22	B	FLS	10YR 5/6								
94	C	S	2.5Y 5/4								Fine/Med Sand

Additional Notes: Soil testing for drainage (no mottling observed)

## Appendix E

# EXISTING AND PROPOSED HYDROLOGY



**Routing Diagram for 20-087 DR**  
 Prepared by Design Consultants, Inc., Printed 4/14/2021  
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**Area Listing (all nodes)**

Area (sq-ft)	CN	Description (subcatchment-numbers)
35,546	39	>75% Grass cover, Good, HSG A (1S, 2S, 10S, 20S, 30S, 40S)
18,653	98	Paved parking, HSG A (1S, 2S, 20S, 30S)
167	55	Permeable pavers (10S)
654	55	Permeable pavers (20S)
166	55	Permeable pavers (30S)
13,049	98	Roofs, HSG A (1S, 2S, 10S, 20S, 41S)
229	98	Unconnected pavement, HSG A (20S)
5,391	43	Woods/grass comb., Fair, HSG A (1S, 2S)

**Soil Listing (all nodes)**

Area (sq-ft)	Soil Group	Subcatchment Numbers
72,868	HSG A	1S, 2S, 10S, 20S, 30S, 40S, 41S
0	HSG B	
0	HSG C	
0	HSG D	
987	Other	10S, 20S, 30S

**20-087 DR**

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**Ground Covers (all nodes)**

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
35,546	0	0	0	0	35,546	>75% Grass cover, Good
18,653	0	0	0	0	18,653	Paved parking
0	0	0	0	167	167	Permeable pavers
0	0	0	0	654	654	Permeable pavers
0	0	0	0	166	166	Permeable pavers
13,049	0	0	0	0	13,049	Roofs
229	0	0	0	0	229	Unconnected pavement
5,391	0	0	0	0	5,391	Woods/grass comb., Fair



**20-087 DR**

Type III 24-hr 2-Year Rainfall=3.15"

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Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

**Subcatchment 1S: NW AREA** Runoff Area=19,862 sf 76.17% Impervious Runoff Depth>1.71"  
 Flow Length=191' Tc=0.9 min CN=85 Runoff=1.10 cfs 2,838 cf

**Subcatchment 2S: SE AREA** Runoff Area=17,081 sf 13.91% Impervious Runoff Depth>0.08"  
 Flow Length=201' Slope=0.0210 '/ Tc=3.3 min CN=48 Runoff=0.00 cfs 116 cf

**Subcatchment 10S: NW LAWN** Runoff Area=8,766 sf 18.24% Impervious Runoff Depth>0.12"  
 Flow Length=143' Slope=0.0560 '/ Tc=1.4 min CN=50 Runoff=0.00 cfs 87 cf

**Subcatchment 20S: ROADWAY** Runoff Area=16,917 sf 59.05% Impervious Runoff Depth>1.00"  
 Flow Length=179' Tc=1.3 min CN=74 Runoff=0.51 cfs 1,416 cf

**Subcatchment 30S: SIDE DRIVEWAY** Runoff Area=3,030 sf 37.76% Impervious Runoff Depth>0.46"  
 Flow Length=82' Tc=0.7 min CN=62 Runoff=0.03 cfs 116 cf

**Subcatchment 40S: EASTERN REAR** Runoff Area=6,505 sf 0.00% Impervious Runoff Depth>0.00"  
 Flow Length=110' Slope=0.0230 '/ Tc=1.7 min CN=39 Runoff=0.00 cfs 0 cf

**Subcatchment 41S: EASTERN ROOF** Runoff Area=1,694 sf 100.00% Impervious Runoff Depth>2.92"  
 Tc=1.0 min CN=98 Runoff=0.14 cfs 412 cf

**Reach 1R: RAIL TRAIL** Inflow=1.10 cfs 2,838 cf  
 Outflow=1.10 cfs 2,838 cf

**Reach 2R: EASTERN ABUTTERS** Inflow=0.00 cfs 116 cf  
 Outflow=0.00 cfs 116 cf

**Reach 3R: TOTAL** Inflow=1.10 cfs 2,955 cf  
 Outflow=1.10 cfs 2,955 cf

**Reach 10R: RAIL TRAIL** Inflow=0.55 cfs 1,326 cf  
 Outflow=0.55 cfs 1,326 cf

**Reach 20R: EASTERN ABUTTERS** Inflow=0.00 cfs 0 cf  
 Outflow=0.00 cfs 0 cf

**Reach 30R: TOTAL** Inflow=0.55 cfs 1,326 cf  
 Outflow=0.55 cfs 1,326 cf

**Pond 20P: RAINGARDEN** Peak Elev=28.60' Storage=93 cf Inflow=0.51 cfs 1,416 cf  
 Discarded=0.00 cfs 87 cf Primary=0.55 cfs 1,239 cf Outflow=0.55 cfs 1,326 cf

**Pond 30P: DRYWELL** Peak Elev=26.36' Storage=22 cf Inflow=0.03 cfs 116 cf  
 Discarded=0.01 cfs 116 cf Primary=0.00 cfs 0 cf Outflow=0.01 cfs 116 cf

**Pond 42P: CULTEC** Peak Elev=25.42' Storage=43 cf Inflow=0.14 cfs 412 cf  
 Discarded=0.05 cfs 412 cf Primary=0.00 cfs 0 cf Outflow=0.05 cfs 412 cf

**Summary for Subcatchment 1S: NW AREA**

Runoff = 1.10 cfs @ 12.01 hrs, Volume= 2,838 cf, Depth> 1.71"

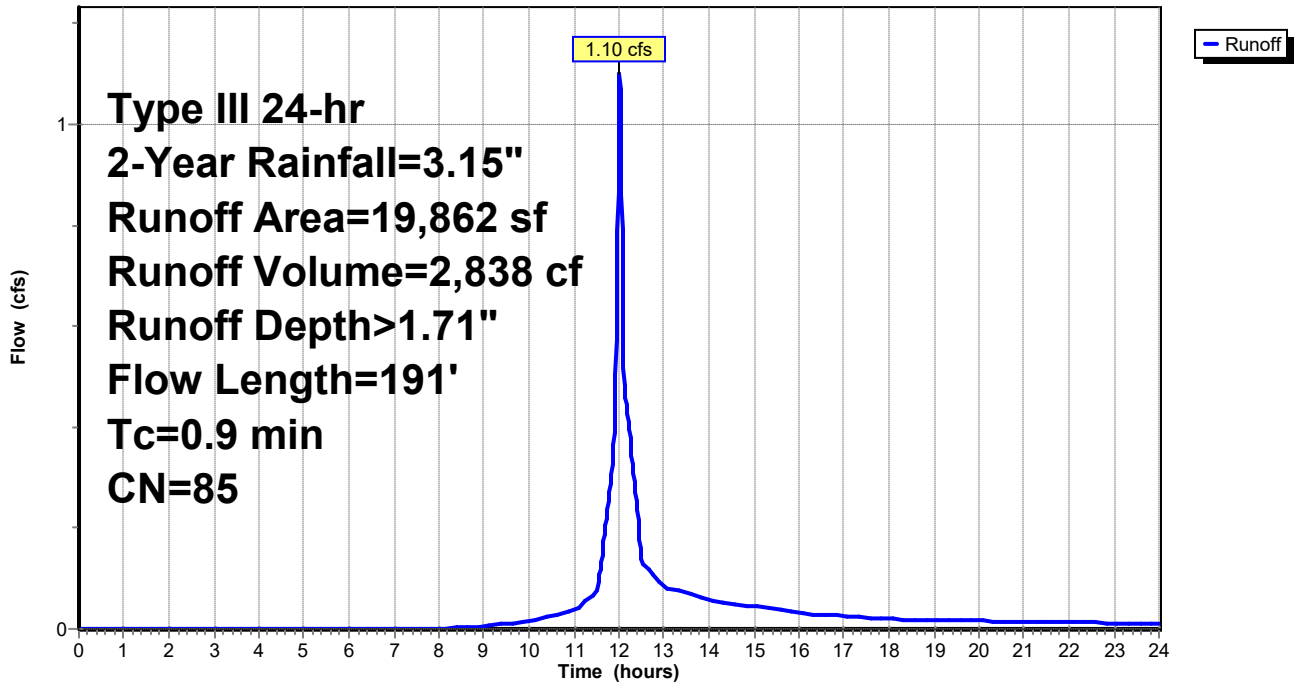
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 2-Year Rainfall=3.15"

Area (sf)	CN	Description
12,146	98	Paved parking, HSG A
2,982	98	Roofs, HSG A
3,870	43	Woods/grass comb., Fair, HSG A
864	39	>75% Grass cover, Good, HSG A
19,862	85	Weighted Average
4,734		23.83% Pervious Area
15,128		76.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	176	0.0340	3.74		<b>Shallow Concentrated Flow, Pavement</b>
					Paved Kv= 20.3 fps
0.1	15	0.0670	1.81		<b>Shallow Concentrated Flow, Grass</b>
					Short Grass Pasture Kv= 7.0 fps
0.9	191	Total			

**Subcatchment 1S: NW AREA**

Hydrograph



**Summary for Subcatchment 2S: SE AREA**

Runoff = 0.00 cfs @ 14.60 hrs, Volume= 116 cf, Depth> 0.08"

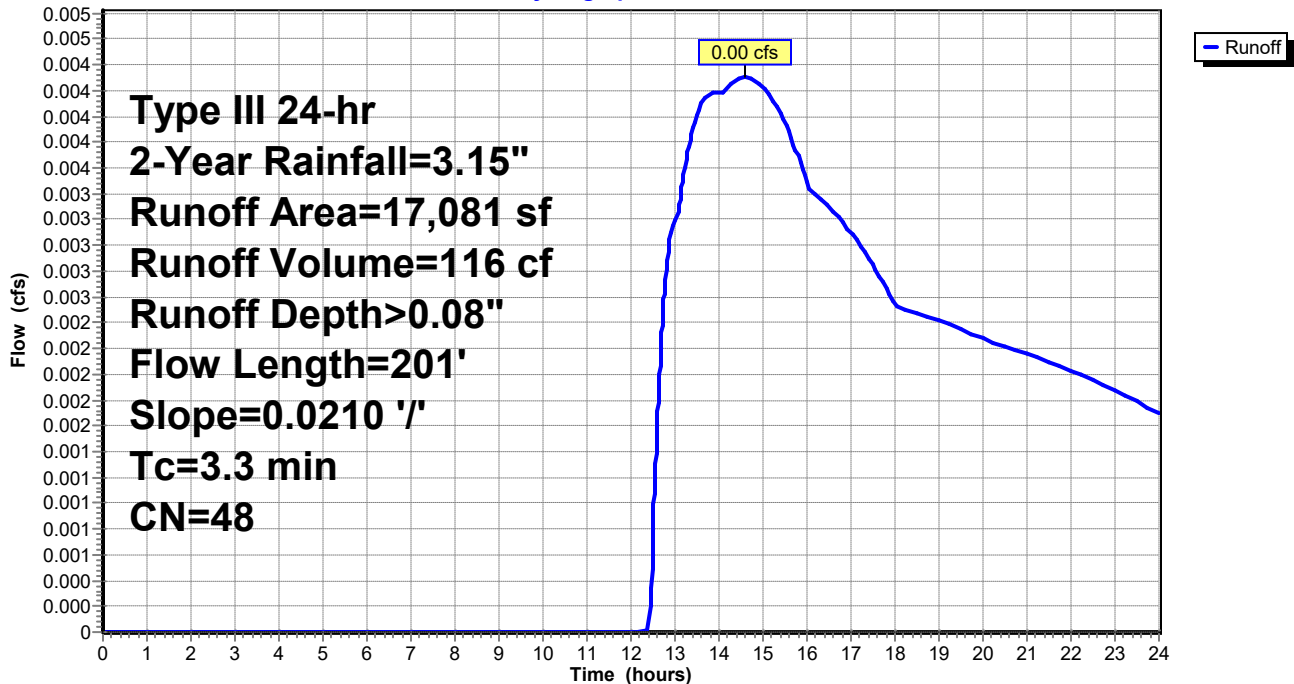
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2-Year Rainfall=3.15"

Area (sf)	CN	Description
52	98	Paved parking, HSG A
2,324	98	Roofs, HSG A
1,521	43	Woods/grass comb., Fair, HSG A
13,184	39	>75% Grass cover, Good, HSG A
17,081	48	Weighted Average
14,705		86.09% Pervious Area
2,376		13.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	201	0.0210	1.01		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps

**Subcatchment 2S: SE AREA**

Hydrograph



**Summary for Subcatchment 10S: NW LAWN**

Runoff = 0.00 cfs @ 12.42 hrs, Volume= 87 cf, Depth> 0.12"

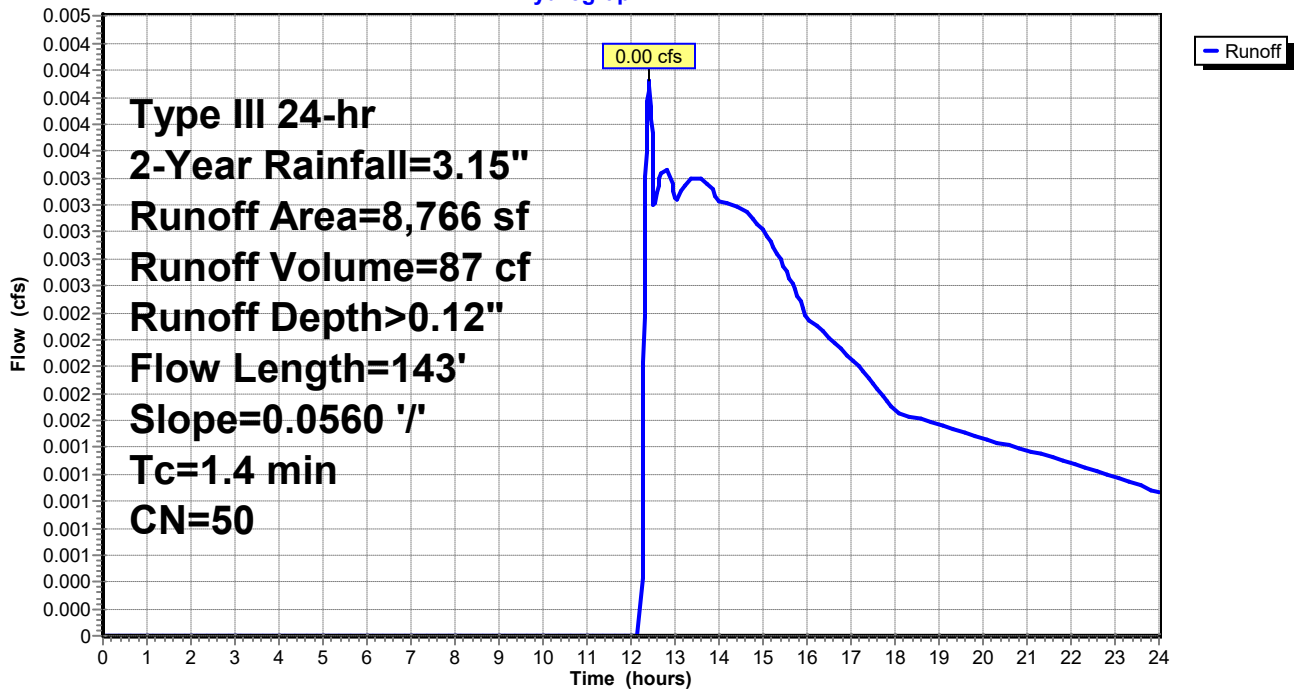
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2-Year Rainfall=3.15"

Area (sf)	CN	Description
7,000	39	>75% Grass cover, Good, HSG A
1,599	98	Roofs, HSG A
* 167	55	Permeable pavers
8,766	50	Weighted Average
7,167		81.76% Pervious Area
1,599		18.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	143	0.0560	1.66		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps

**Subcatchment 10S: NW LAWN**

Hydrograph



**Summary for Subcatchment 20S: ROADWAY**

Runoff = 0.51 cfs @ 12.02 hrs, Volume= 1,416 cf, Depth> 1.00"

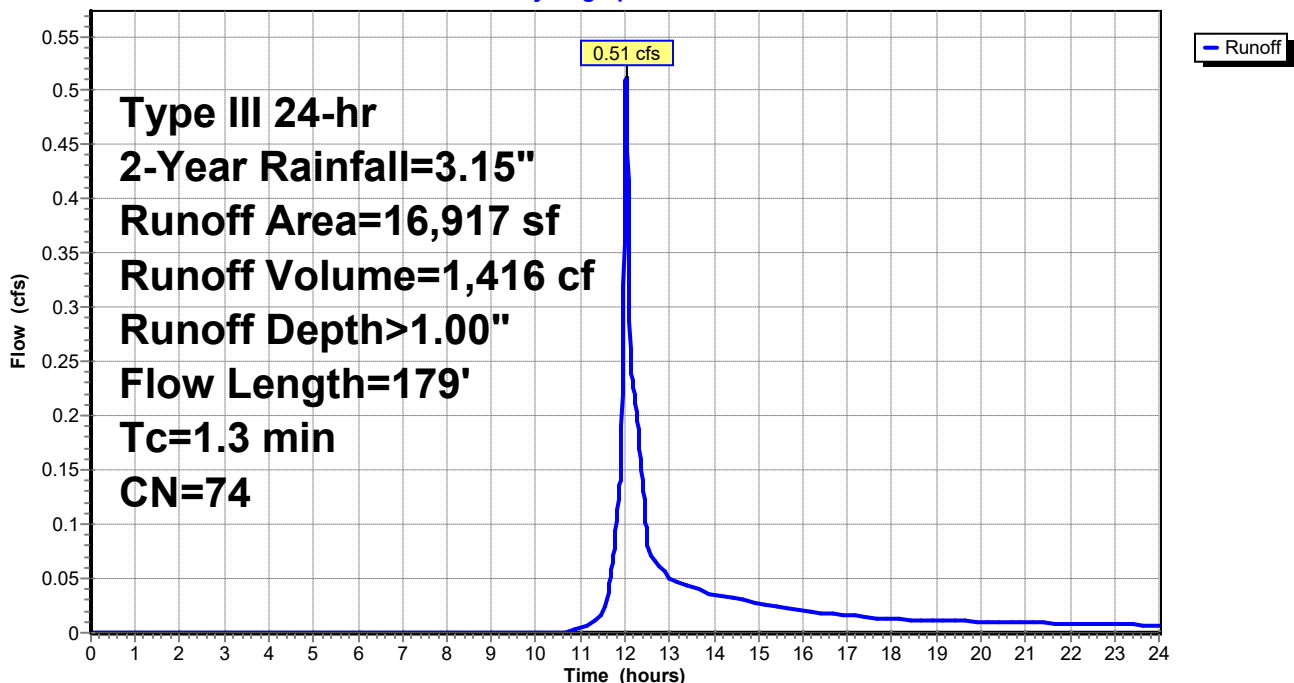
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2-Year Rainfall=3.15"

Area (sf)	CN	Description
5,311	98	Paved parking, HSG A
229	98	Unconnected pavement, HSG A
6,273	39	>75% Grass cover, Good, HSG A
4,450	98	Roofs, HSG A
* 654	55	Permeable pavers
16,917	74	Weighted Average
6,927		40.95% Pervious Area
9,990		59.05% Impervious Area
229		2.29% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	67	0.0670	1.81		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
0.7	112	0.0160	2.57		<b>Shallow Concentrated Flow, Road</b> Paved Kv= 20.3 fps
1.3	179	Total			

**Subcatchment 20S: ROADWAY**

Hydrograph



**Summary for Subcatchment 30S: SIDE DRIVEWAY**

Runoff = 0.03 cfs @ 12.03 hrs, Volume= 116 cf, Depth> 0.46"

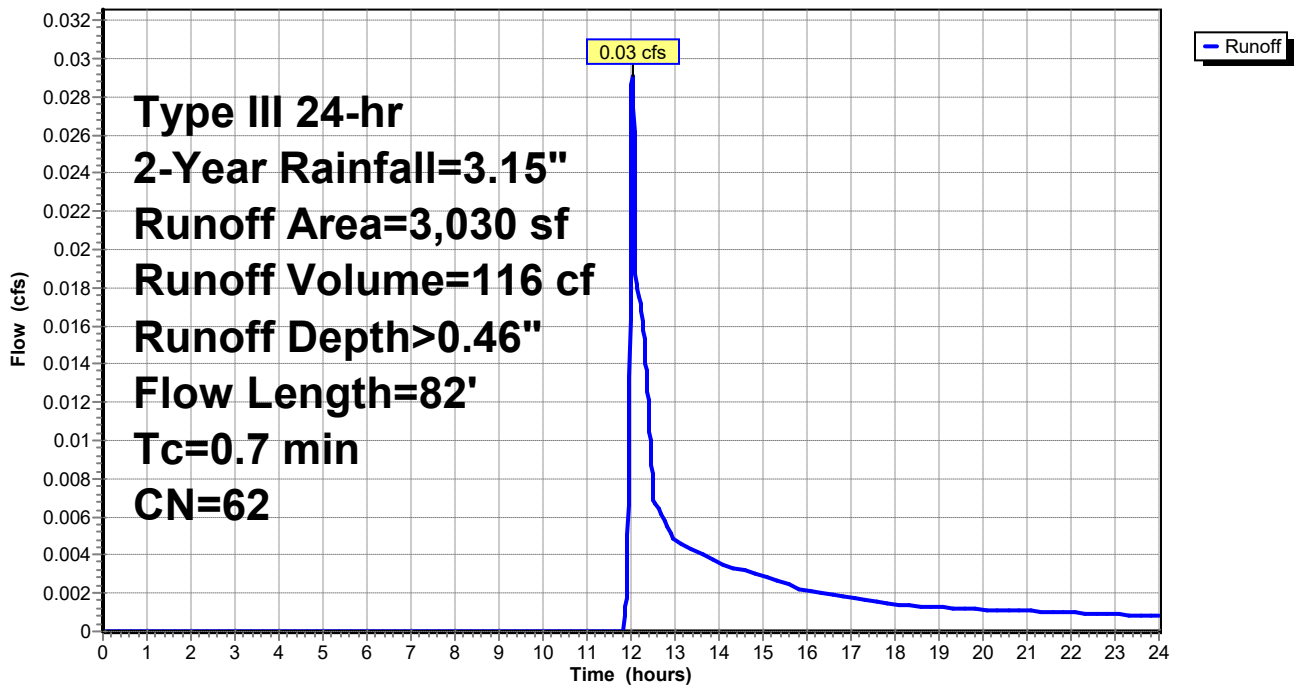
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2-Year Rainfall=3.15"

Area (sf)	CN	Description
1,144	98	Paved parking, HSG A
1,720	39	>75% Grass cover, Good, HSG A
* 166	55	Permeable pavers
3,030	62	Weighted Average
1,886		62.24% Pervious Area
1,144		37.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	48	0.0520	1.60		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
0.2	34	0.0290	3.46		<b>Shallow Concentrated Flow, Driveway</b> Paved Kv= 20.3 fps
0.7	82	Total			

**Subcatchment 30S: SIDE DRIVEWAY**

Hydrograph



**Summary for Subcatchment 40S: EASTERN REAR**

Runoff = 0.00 cfs @ 24.00 hrs, Volume= 0 cf, Depth> 0.00"

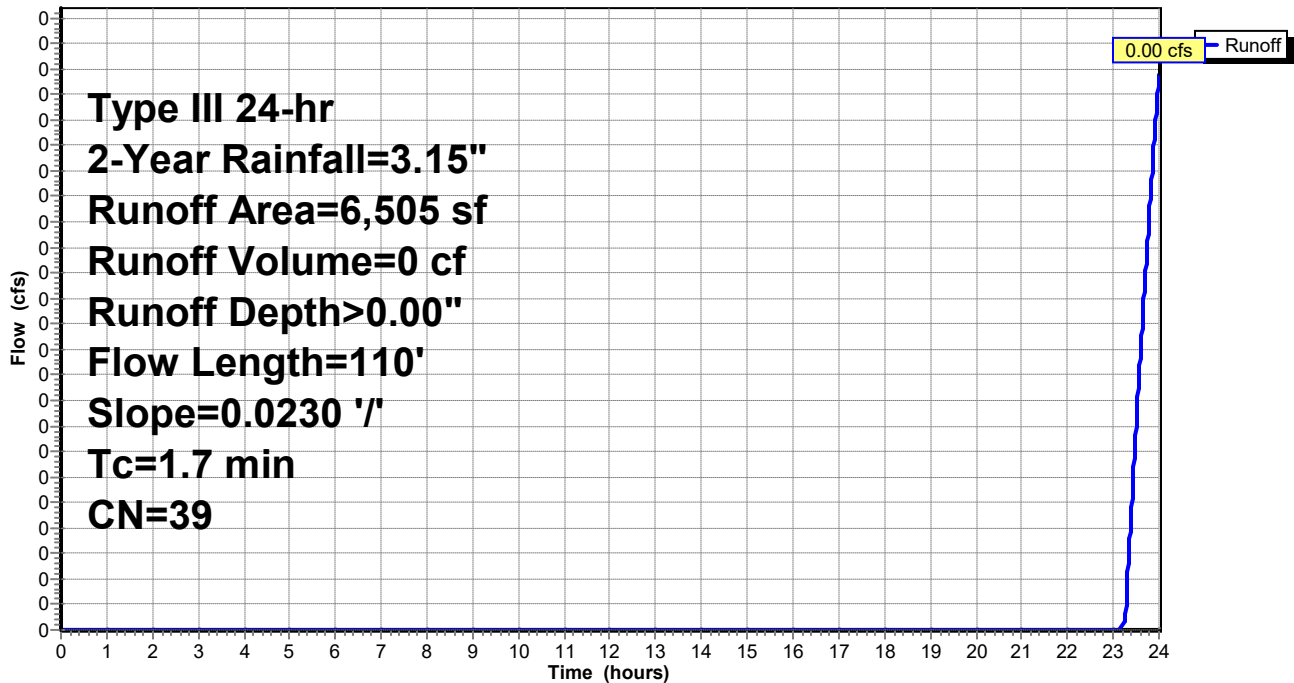
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 2-Year Rainfall=3.15"

Area (sf)	CN	Description
6,505	39	>75% Grass cover, Good, HSG A
6,505		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	110	0.0230	1.06		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps

**Subcatchment 40S: EASTERN REAR**

Hydrograph



### Summary for Subcatchment 41S: EASTERN ROOF

Runoff = 0.14 cfs @ 12.01 hrs, Volume= 412 cf, Depth> 2.92"

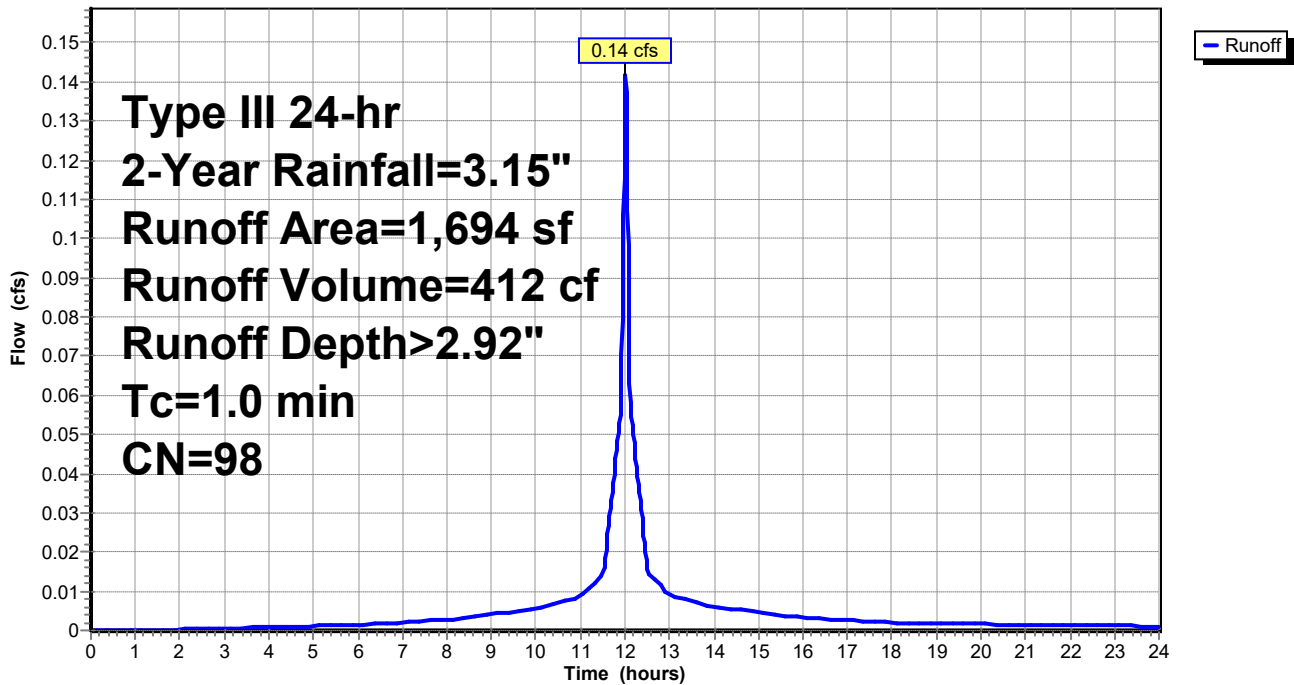
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2-Year Rainfall=3.15"

Area (sf)	CN	Description
1,694	98	Roofs, HSG A
1,694		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0					Direct Entry,

### Subcatchment 41S: EASTERN ROOF

Hydrograph





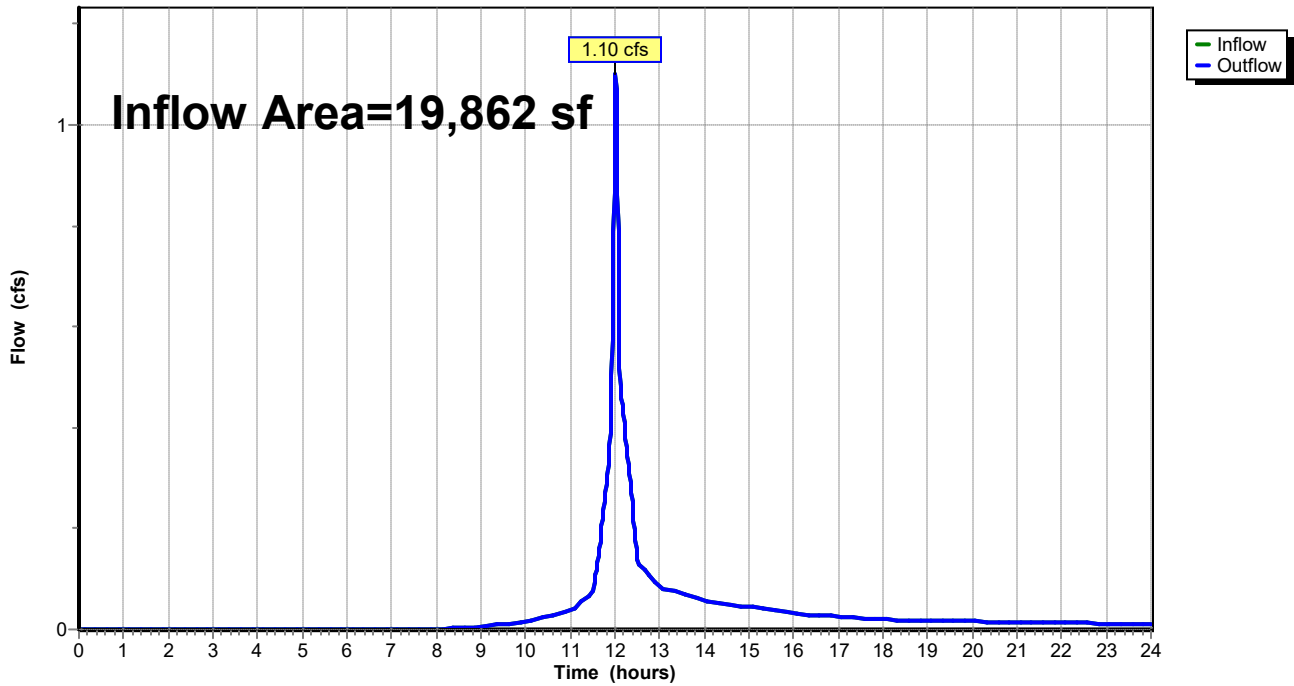
### Summary for Reach 1R: RAIL TRAIL

Inflow Area = 19,862 sf, 76.17% Impervious, Inflow Depth > 1.71" for 2-Year event  
Inflow = 1.10 cfs @ 12.01 hrs, Volume= 2,838 cf  
Outflow = 1.10 cfs @ 12.01 hrs, Volume= 2,838 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 1R: RAIL TRAIL

Hydrograph



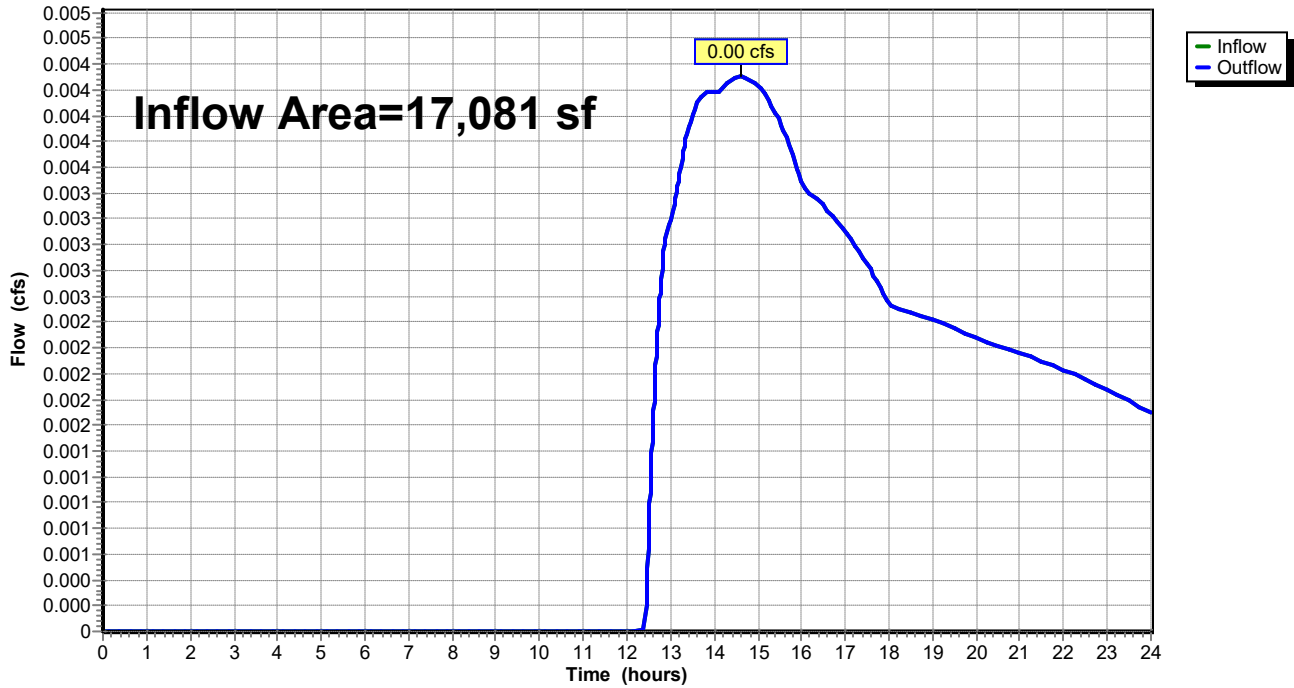
### Summary for Reach 2R: EASTERN ABUTTERS

Inflow Area = 17,081 sf, 13.91% Impervious, Inflow Depth > 0.08" for 2-Year event  
Inflow = 0.00 cfs @ 14.60 hrs, Volume= 116 cf  
Outflow = 0.00 cfs @ 14.60 hrs, Volume= 116 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 2R: EASTERN ABUTTERS

Hydrograph



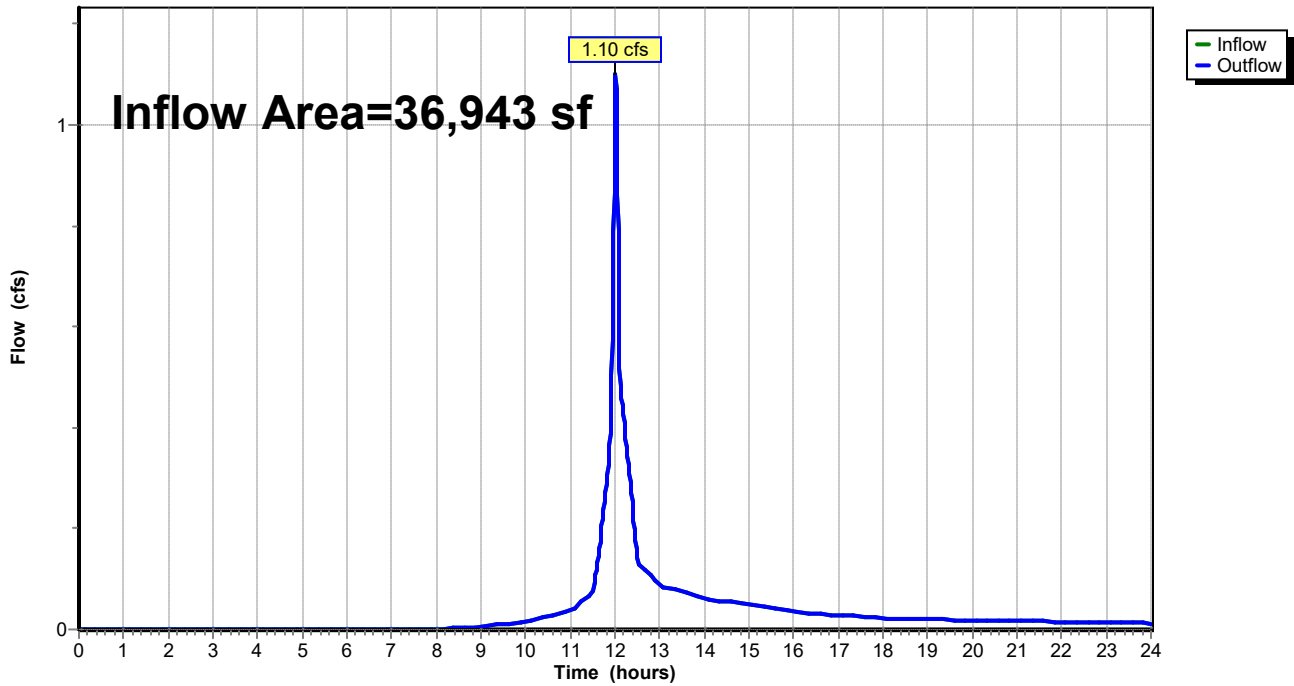
### Summary for Reach 3R: TOTAL

Inflow Area = 36,943 sf, 47.38% Impervious, Inflow Depth > 0.96" for 2-Year event  
Inflow = 1.10 cfs @ 12.01 hrs, Volume= 2,955 cf  
Outflow = 1.10 cfs @ 12.01 hrs, Volume= 2,955 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 3R: TOTAL

Hydrograph



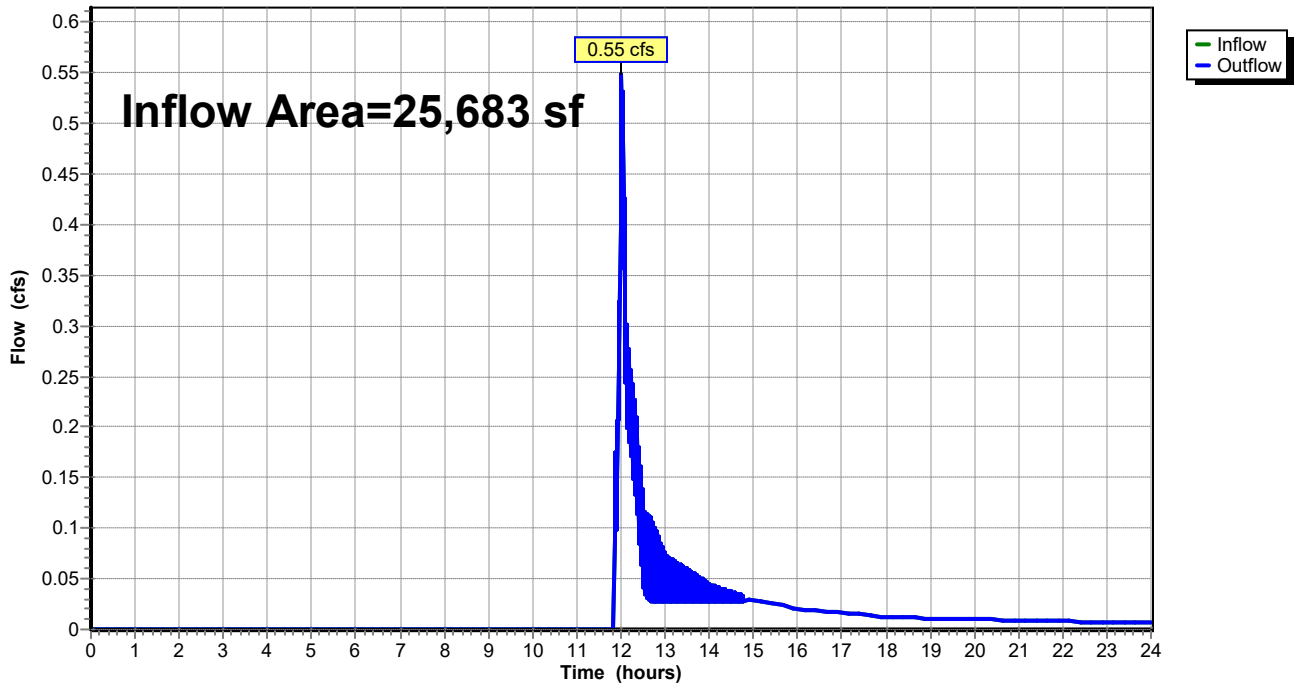
### Summary for Reach 10R: RAIL TRAIL

Inflow Area = 25,683 sf, 45.12% Impervious, Inflow Depth > 0.62" for 2-Year event  
Inflow = 0.55 cfs @ 12.02 hrs, Volume= 1,326 cf  
Outflow = 0.55 cfs @ 12.02 hrs, Volume= 1,326 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 10R: RAIL TRAIL

Hydrograph



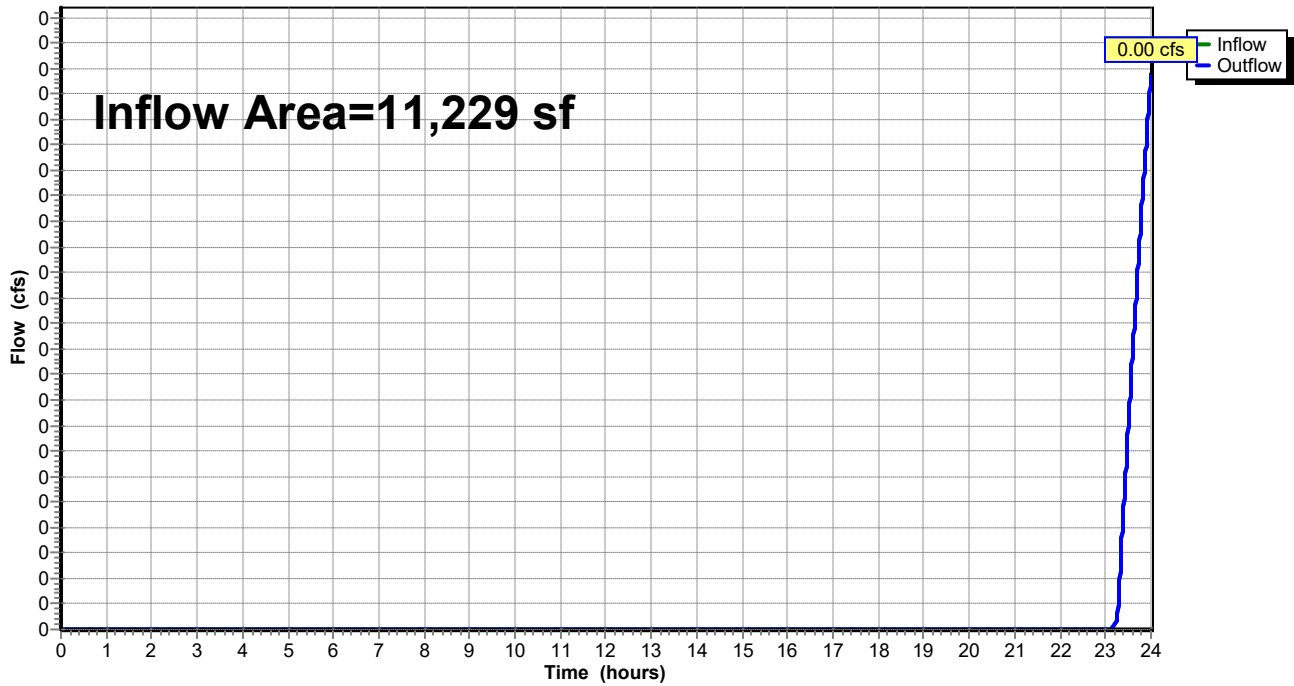
### Summary for Reach 20R: EASTERN ABUTTERS

Inflow Area = 11,229 sf, 25.27% Impervious, Inflow Depth > 0.00" for 2-Year event  
Inflow = 0.00 cfs @ 24.00 hrs, Volume= 0 cf  
Outflow = 0.00 cfs @ 24.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 20R: EASTERN ABUTTERS

Hydrograph



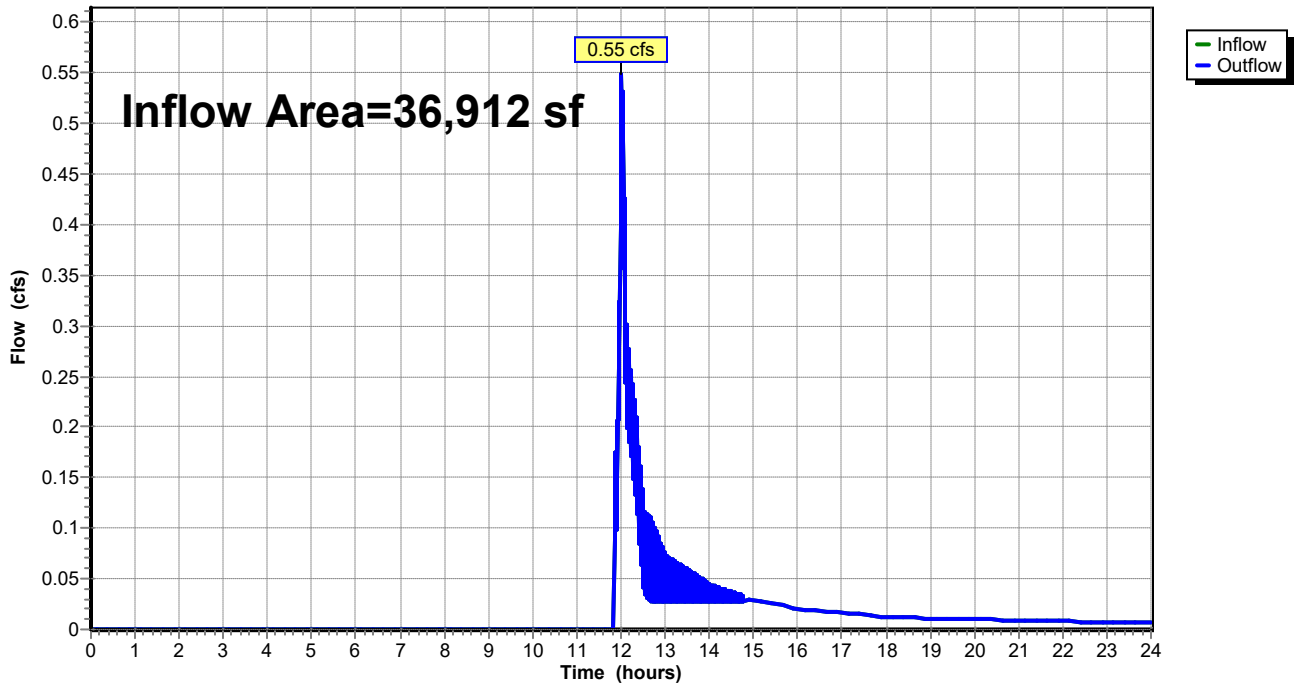
### Summary for Reach 30R: TOTAL

Inflow Area = 36,912 sf, 39.08% Impervious, Inflow Depth > 0.43" for 2-Year event  
Inflow = 0.55 cfs @ 12.02 hrs, Volume= 1,326 cf  
Outflow = 0.55 cfs @ 12.02 hrs, Volume= 1,326 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 30R: TOTAL

Hydrograph



**Summary for Pond 20P: RAINGARDEN**

Inflow Area = 16,917 sf, 59.05% Impervious, Inflow Depth > 1.00" for 2-Year event  
 Inflow = 0.51 cfs @ 12.02 hrs, Volume= 1,416 cf  
 Outflow = 0.55 cfs @ 12.02 hrs, Volume= 1,326 cf, Atten= 0%, Lag= 0.0 min  
 Discarded = 0.00 cfs @ 11.87 hrs, Volume= 87 cf  
 Primary = 0.55 cfs @ 12.02 hrs, Volume= 1,239 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 28.60' @ 12.02 hrs Surf.Area= 155 sf Storage= 93 cf

Plug-Flow detention time= 44.7 min calculated for 1,326 cf (94% of inflow)  
 Center-of-Mass det. time= 11.7 min ( 870.3 - 858.6 )

Volume	Invert	Avail.Storage	Storage Description
#1	27.68'	93 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
27.68	104	0	0
28.40	155	93	93

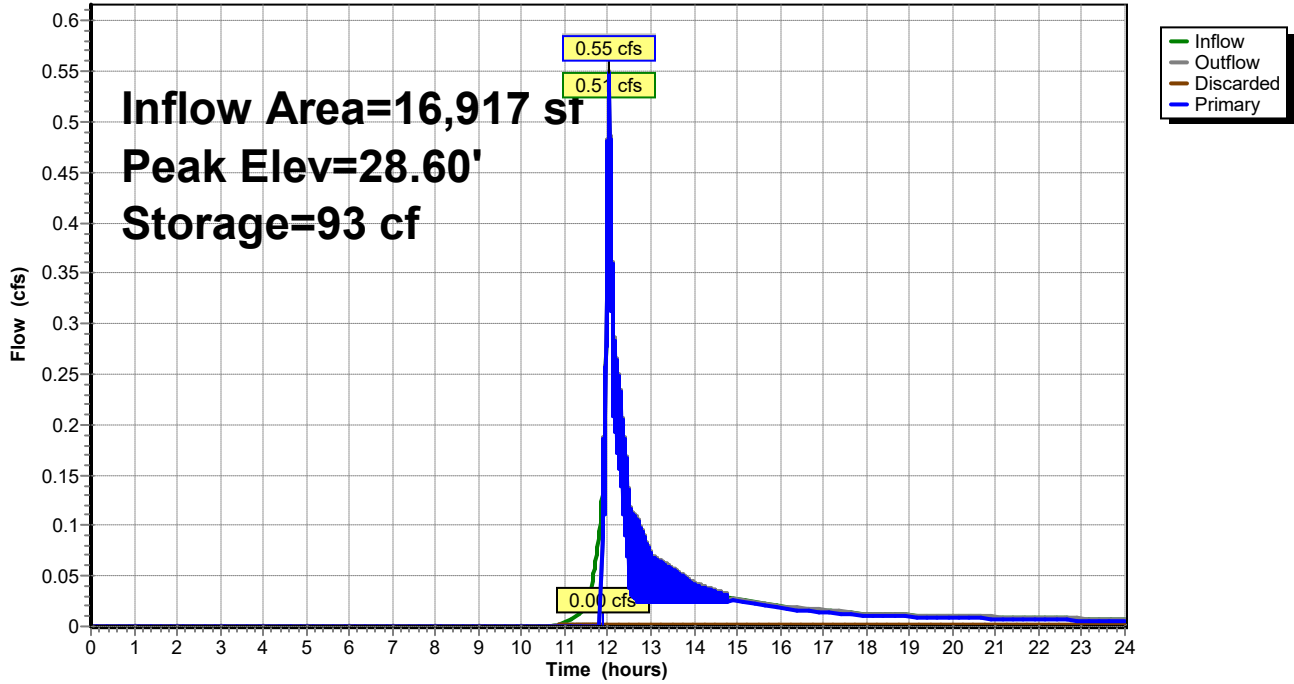
Device	Routing	Invert	Outlet Devices
#1	Discarded	27.68'	<b>0.520 in/hr Exfiltration over Surface area</b>
#2	Primary	28.37'	<b>2.0' long x 4.0' breadth Broad-Crested Rectangular Weir</b>
Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00			
2.50 3.00 3.50 4.00 4.50 5.00 5.50			
Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66			
2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32			

**Discarded OutFlow** Max=0.00 cfs @ 11.87 hrs HW=28.44' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.00 cfs)

**Primary OutFlow** Max=0.54 cfs @ 12.02 hrs HW=28.60' (Free Discharge)  
 ↑2=Broad-Crested Rectangular Weir (Weir Controls 0.54 cfs @ 1.16 fps)

### Pond 20P: RAINGARDEN

Hydrograph





**Summary for Pond 30P: DRYWELL**

Inflow Area = 3,030 sf, 37.76% Impervious, Inflow Depth > 0.46" for 2-Year event  
 Inflow = 0.03 cfs @ 12.03 hrs, Volume= 116 cf  
 Outflow = 0.01 cfs @ 11.96 hrs, Volume= 116 cf, Atten= 79%, Lag= 0.0 min  
 Discarded = 0.01 cfs @ 11.96 hrs, Volume= 116 cf  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 26.36' @ 12.72 hrs Surf.Area= 14 sf Storage= 22 cf

Plug-Flow detention time= 25.4 min calculated for 116 cf (100% of inflow)  
 Center-of-Mass det. time= 25.0 min ( 931.5 - 906.4 )

Volume	Invert	Avail.Storage	Storage Description
#1	24.82'	58 cf	<b>3.60'W x 4.00'L x 4.00'H Prismatic</b>

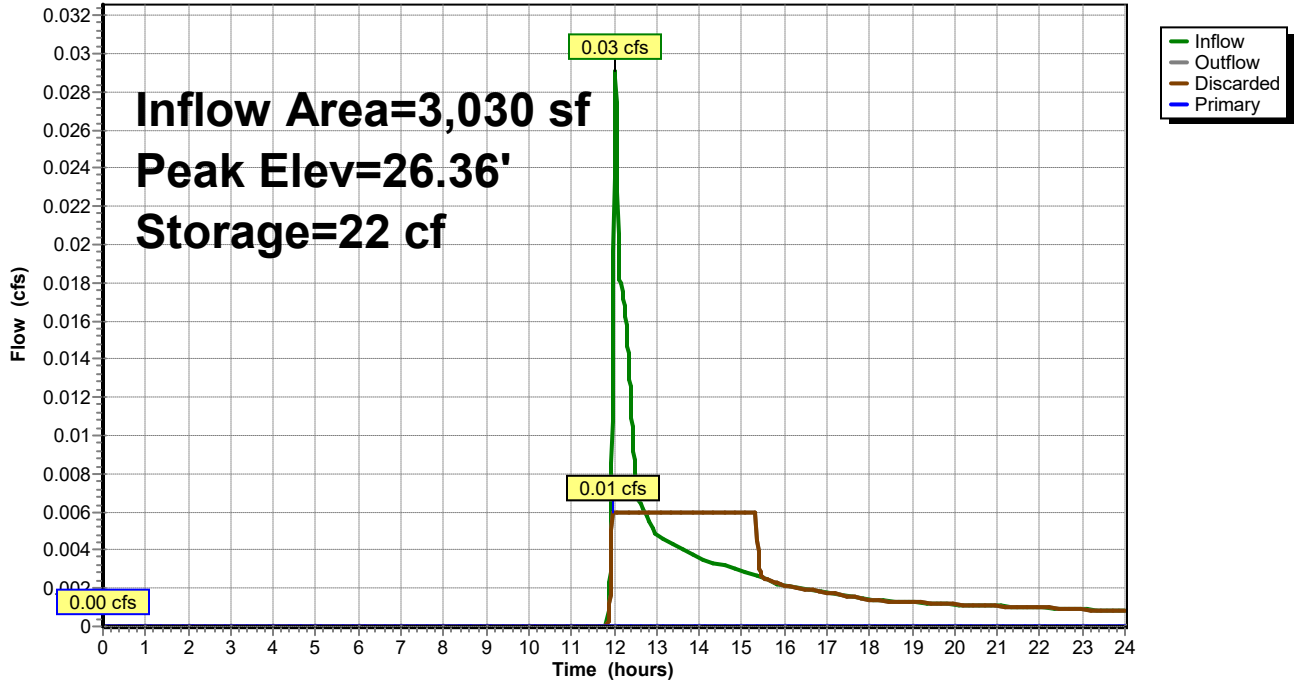
Device	Routing	Invert	Outlet Devices
#1	Discarded	24.82'	<b>18.000 in/hr Exfiltration over Surface area</b>
#2	Primary	27.82'	<b>5.0" Vert. Orifice/Grate</b> C= 0.600
#3	Primary	28.00'	<b>10.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Discarded OutFlow** Max=0.01 cfs @ 11.96 hrs HW=24.86' (Free Discharge)  
 ↖1=Exfiltration (Exfiltration Controls 0.01 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=24.82' (Free Discharge)  
 ↖2=Orifice/Grate ( Controls 0.00 cfs)  
 ↖3=Orifice/Grate ( Controls 0.00 cfs)

### Pond 30P: DRYWELL

Hydrograph



**Summary for Pond 42P: CULTEC**

Inflow Area = 1,694 sf, 100.00% Impervious, Inflow Depth > 2.92" for 2-Year event  
 Inflow = 0.14 cfs @ 12.01 hrs, Volume= 412 cf  
 Outflow = 0.05 cfs @ 11.86 hrs, Volume= 412 cf, Atten= 66%, Lag= 0.0 min  
 Discarded = 0.05 cfs @ 11.86 hrs, Volume= 412 cf  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 25.42' @ 12.20 hrs Surf.Area= 117 sf Storage= 43 cf

Plug-Flow detention time= 3.7 min calculated for 412 cf (100% of inflow)  
 Center-of-Mass det. time= 3.6 min ( 755.6 - 752.0 )

Volume	Invert	Avail.Storage	Storage Description
#1A	24.50'	162 cf	<b>11.17'W x 10.50'L x 4.54'H Field A</b> 533 cf Overall - 127 cf Embedded = 406 cf x 40.0% Voids
#2A	25.50'	127 cf	<b>Cultec R-330XLHD x 2 Inside #1</b> Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 2 rows
		289 cf	Total Available Storage

Storage Group A created with Chamber Wizard

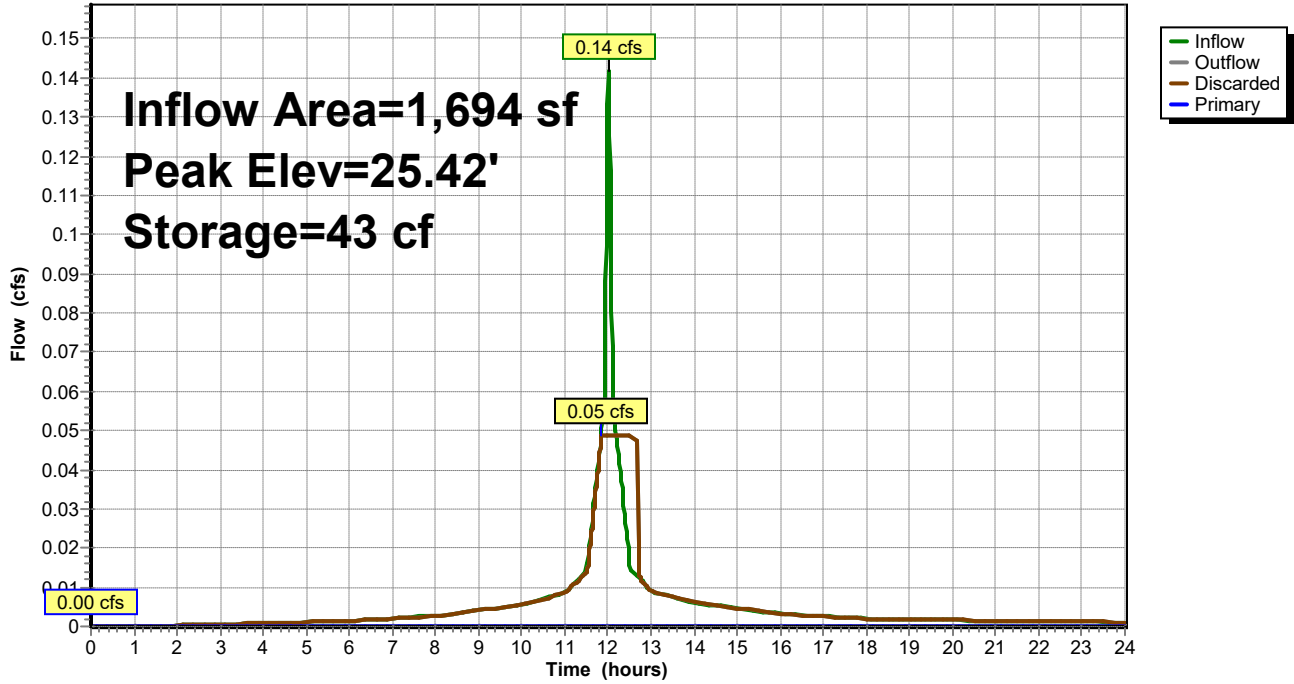
Device	Routing	Invert	Outlet Devices
#1	Primary	26.99'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 0 End Contraction(s)
#2	Discarded	24.50'	<b>18.000 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.05 cfs @ 11.86 hrs HW=24.55' (Free Discharge)  
 ↑**2=Exfiltration** (Exfiltration Controls 0.05 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=24.50' (Free Discharge)  
 ↑**1=Sharp-Crested Rectangular Weir** ( Controls 0.00 cfs)

### Pond 42P: CULTEC

#### Hydrograph



**20-087 DR**

Type III 24-hr 10-Year Rainfall=4.83"

Prepared by Design Consultants, Inc.

Printed 4/14/2021

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Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

**Subcatchment 1S: NW AREA** Runoff Area=19,862 sf 76.17% Impervious Runoff Depth>3.21"  
 Flow Length=191' Tc=0.9 min CN=85 Runoff=2.04 cfs 5,315 cf

**Subcatchment 2S: SE AREA** Runoff Area=17,081 sf 13.91% Impervious Runoff Depth>0.52"  
 Flow Length=201' Slope=0.0210 '/ Slope=0.0210 '/ Tc=3.3 min CN=48 Runoff=0.13 cfs 747 cf

**Subcatchment 10S: NW LAWN** Runoff Area=8,766 sf 18.24% Impervious Runoff Depth>0.62"  
 Flow Length=143' Slope=0.0560 '/ Slope=0.0560 '/ Tc=1.4 min CN=50 Runoff=0.10 cfs 456 cf

**Subcatchment 20S: ROADWAY** Runoff Area=16,917 sf 59.05% Impervious Runoff Depth>2.23"  
 Flow Length=179' Tc=1.3 min CN=74 Runoff=1.20 cfs 3,142 cf

**Subcatchment 30S: SIDE DRIVEWAY** Runoff Area=3,030 sf 37.76% Impervious Runoff Depth>1.33"  
 Flow Length=82' Tc=0.7 min CN=62 Runoff=0.12 cfs 337 cf

**Subcatchment 40S: EASTERN REAR** Runoff Area=6,505 sf 0.00% Impervious Runoff Depth>0.17"  
 Flow Length=110' Slope=0.0230 '/ Slope=0.0230 '/ Tc=1.7 min CN=39 Runoff=0.00 cfs 90 cf

**Subcatchment 41S: EASTERN ROOF** Runoff Area=1,694 sf 100.00% Impervious Runoff Depth>4.59"  
 Tc=1.0 min CN=98 Runoff=0.22 cfs 648 cf

**Reach 1R: RAIL TRAIL** Inflow=2.04 cfs 5,315 cf  
 Outflow=2.04 cfs 5,315 cf

**Reach 2R: EASTERN ABUTTERS** Inflow=0.13 cfs 747 cf  
 Outflow=0.13 cfs 747 cf

**Reach 3R: TOTAL** Inflow=2.07 cfs 6,062 cf  
 Outflow=2.07 cfs 6,062 cf

**Reach 10R: RAIL TRAIL** Inflow=1.28 cfs 3,410 cf  
 Outflow=1.28 cfs 3,410 cf

**Reach 20R: EASTERN ABUTTERS** Inflow=0.12 cfs 207 cf  
 Outflow=0.12 cfs 207 cf

**Reach 30R: TOTAL** Inflow=1.34 cfs 3,617 cf  
 Outflow=1.34 cfs 3,617 cf

**Pond 20P: RAINGARDEN** Peak Elev=28.75' Storage=93 cf Inflow=1.20 cfs 3,142 cf  
 Discarded=0.00 cfs 96 cf Primary=1.19 cfs 2,955 cf Outflow=1.19 cfs 3,051 cf

**Pond 30P: DRYWELL** Peak Elev=28.01' Storage=46 cf Inflow=0.12 cfs 337 cf  
 Discarded=0.01 cfs 220 cf Primary=0.12 cfs 116 cf Outflow=0.12 cfs 337 cf

**Pond 42P: CULTEC** Peak Elev=26.29' Storage=115 cf Inflow=0.22 cfs 648 cf  
 Discarded=0.05 cfs 648 cf Primary=0.00 cfs 0 cf Outflow=0.05 cfs 648 cf

**Summary for Subcatchment 1S: NW AREA**

Runoff = 2.04 cfs @ 12.01 hrs, Volume= 5,315 cf, Depth> 3.21"

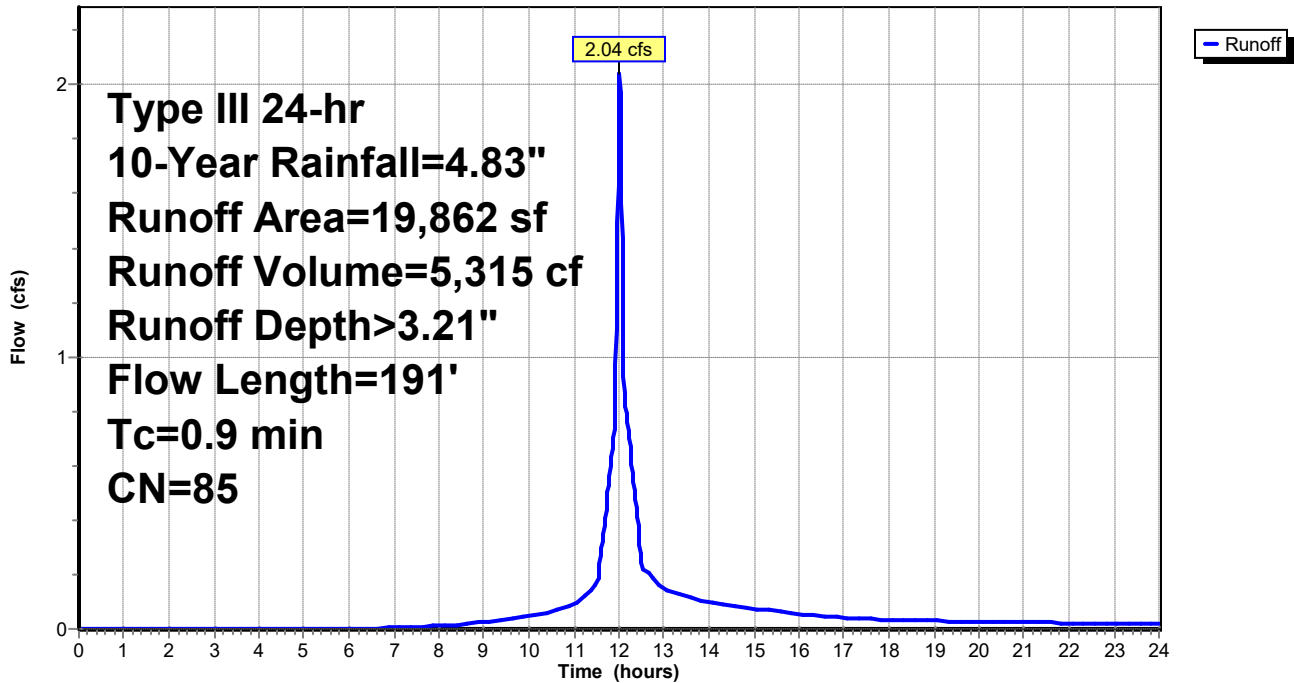
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 10-Year Rainfall=4.83"

Area (sf)	CN	Description
12,146	98	Paved parking, HSG A
2,982	98	Roofs, HSG A
3,870	43	Woods/grass comb., Fair, HSG A
864	39	>75% Grass cover, Good, HSG A
19,862	85	Weighted Average
4,734		23.83% Pervious Area
15,128		76.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	176	0.0340	3.74		<b>Shallow Concentrated Flow, Pavement</b>
					Paved Kv= 20.3 fps
0.1	15	0.0670	1.81		<b>Shallow Concentrated Flow, Grass</b>
					Short Grass Pasture Kv= 7.0 fps
0.9	191	Total			

**Subcatchment 1S: NW AREA**

Hydrograph



### Summary for Subcatchment 2S: SE AREA

Runoff = 0.13 cfs @ 12.10 hrs, Volume= 747 cf, Depth> 0.52"

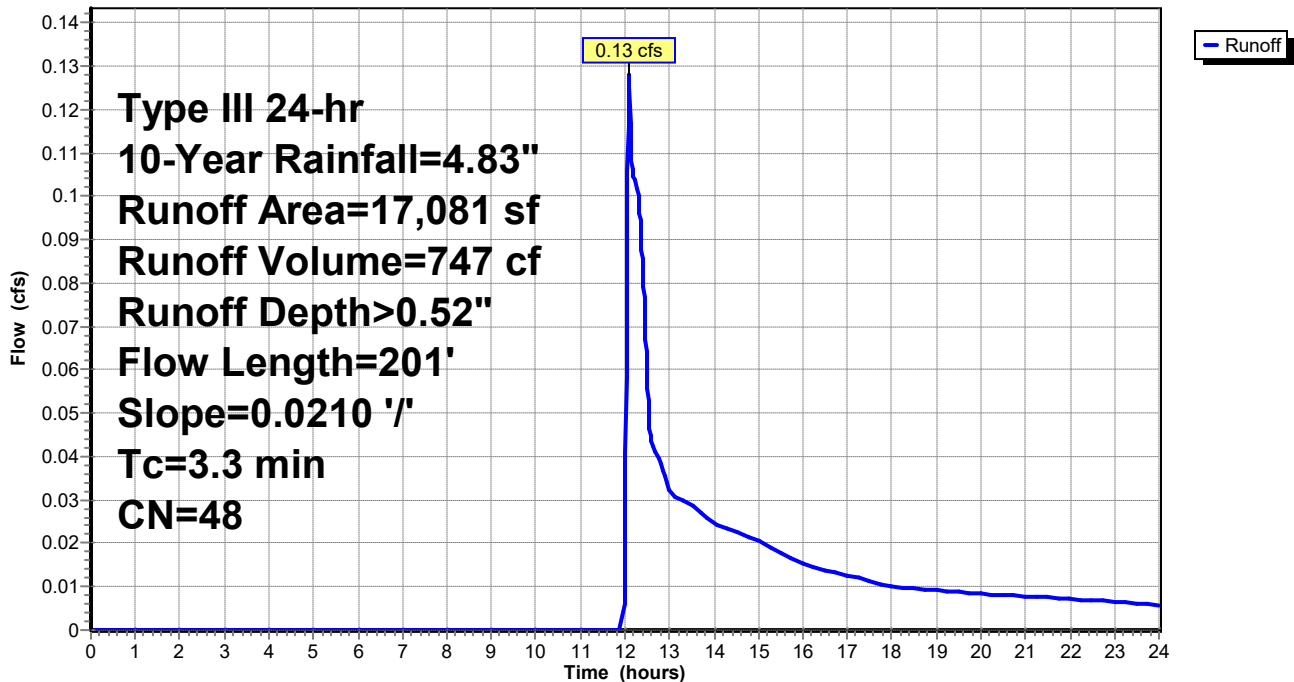
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 10-Year Rainfall=4.83"

Area (sf)	CN	Description
52	98	Paved parking, HSG A
2,324	98	Roofs, HSG A
1,521	43	Woods/grass comb., Fair, HSG A
13,184	39	>75% Grass cover, Good, HSG A
17,081	48	Weighted Average
14,705		86.09% Pervious Area
2,376		13.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	201	0.0210	1.01		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps

### Subcatchment 2S: SE AREA

Hydrograph



**Summary for Subcatchment 10S: NW LAWN**

Runoff = 0.10 cfs @ 12.05 hrs, Volume= 456 cf, Depth> 0.62"

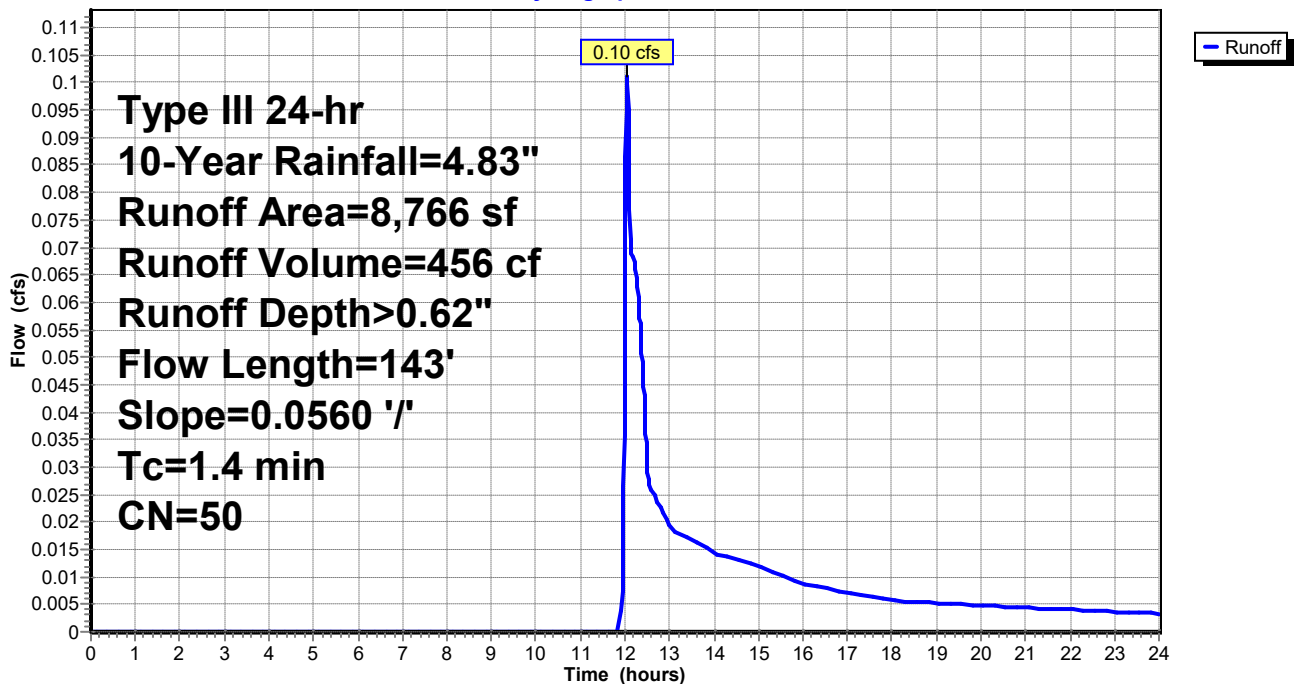
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 10-Year Rainfall=4.83"

Area (sf)	CN	Description
7,000	39	>75% Grass cover, Good, HSG A
1,599	98	Roofs, HSG A
* 167	55	Permeable pavers
8,766	50	Weighted Average
7,167		81.76% Pervious Area
1,599		18.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	143	0.0560	1.66		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps

**Subcatchment 10S: NW LAWN**

Hydrograph





**Summary for Subcatchment 20S: ROADWAY**

Runoff = 1.20 cfs @ 12.02 hrs, Volume= 3,142 cf, Depth> 2.23"

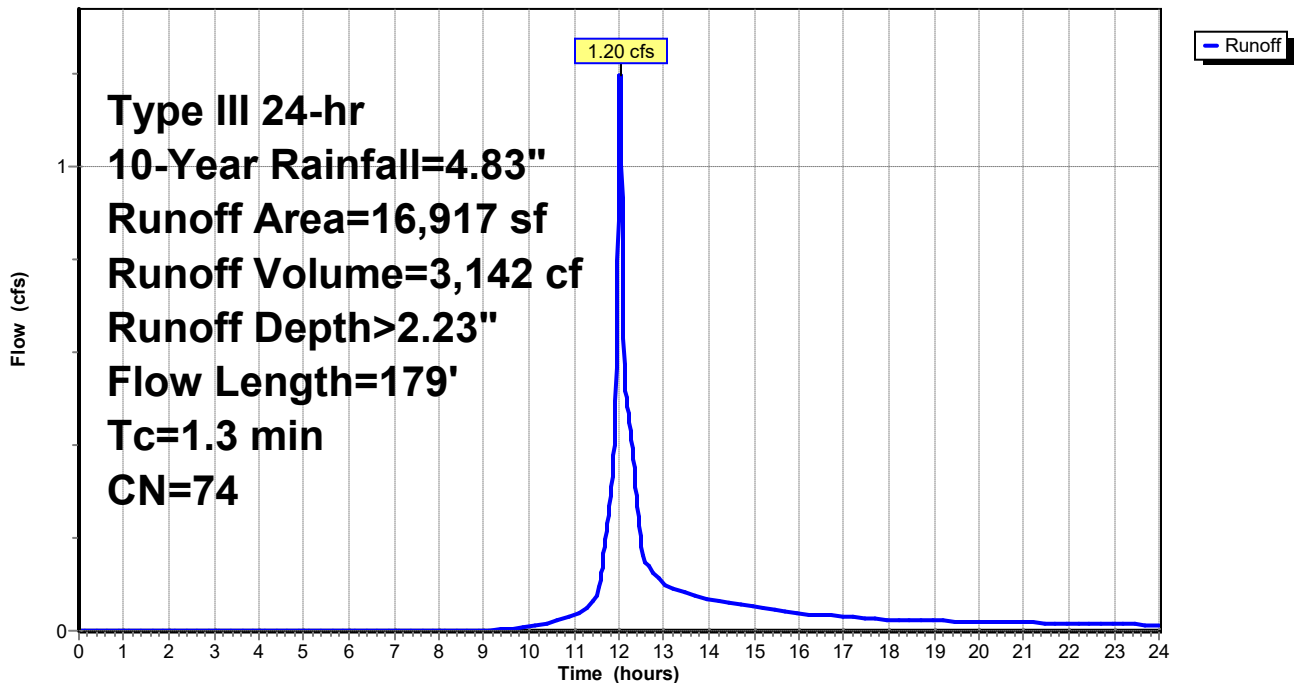
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 10-Year Rainfall=4.83"

Area (sf)	CN	Description
5,311	98	Paved parking, HSG A
229	98	Unconnected pavement, HSG A
6,273	39	>75% Grass cover, Good, HSG A
4,450	98	Roofs, HSG A
* 654	55	Permeable pavers
16,917	74	Weighted Average
6,927		40.95% Pervious Area
9,990		59.05% Impervious Area
229		2.29% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	67	0.0670	1.81		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
0.7	112	0.0160	2.57		<b>Shallow Concentrated Flow, Road</b> Paved Kv= 20.3 fps
1.3	179	Total			

**Subcatchment 20S: ROADWAY**

Hydrograph



**Summary for Subcatchment 30S: SIDE DRIVEWAY**

Runoff = 0.12 cfs @ 12.02 hrs, Volume= 337 cf, Depth> 1.33"

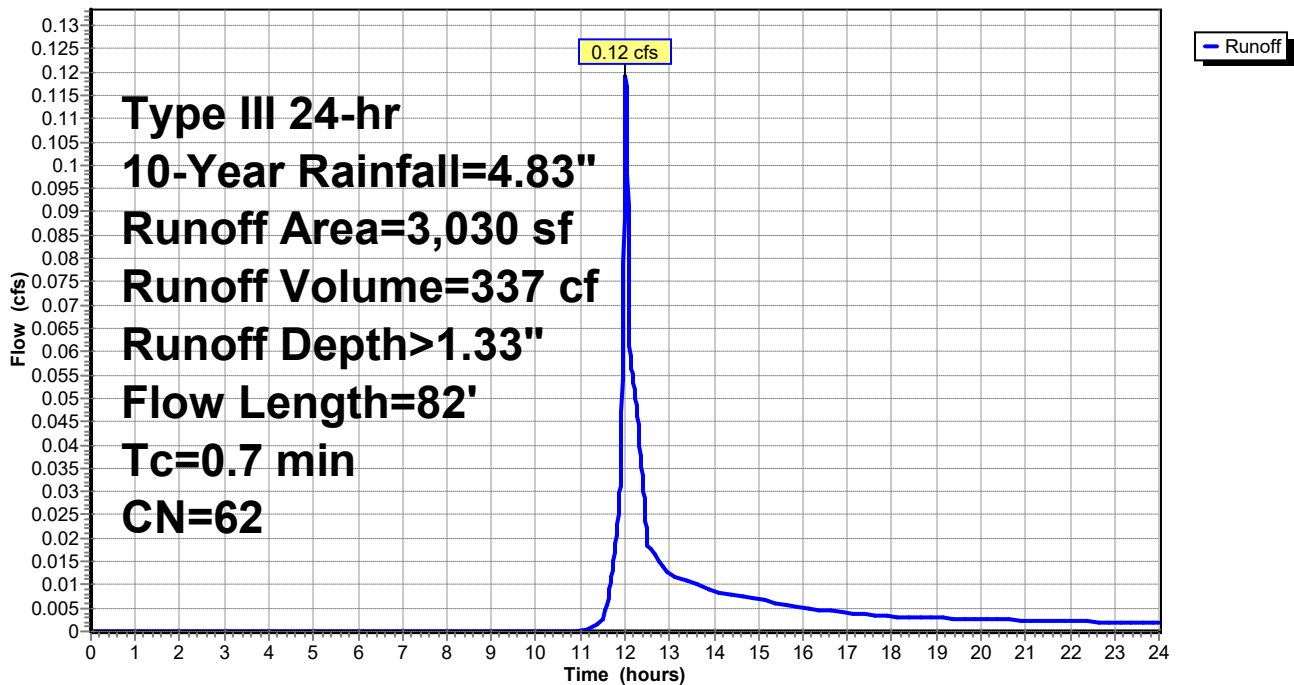
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10-Year Rainfall=4.83"

Area (sf)	CN	Description
1,144	98	Paved parking, HSG A
1,720	39	>75% Grass cover, Good, HSG A
* 166	55	Permeable pavers
3,030	62	Weighted Average
1,886		62.24% Pervious Area
1,144		37.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	48	0.0520	1.60		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
0.2	34	0.0290	3.46		<b>Shallow Concentrated Flow, Driveway</b> Paved Kv= 20.3 fps
0.7	82	Total			

**Subcatchment 30S: SIDE DRIVEWAY**

Hydrograph



**Summary for Subcatchment 40S: EASTERN REAR**

Runoff = 0.00 cfs @ 13.59 hrs, Volume= 90 cf, Depth> 0.17"

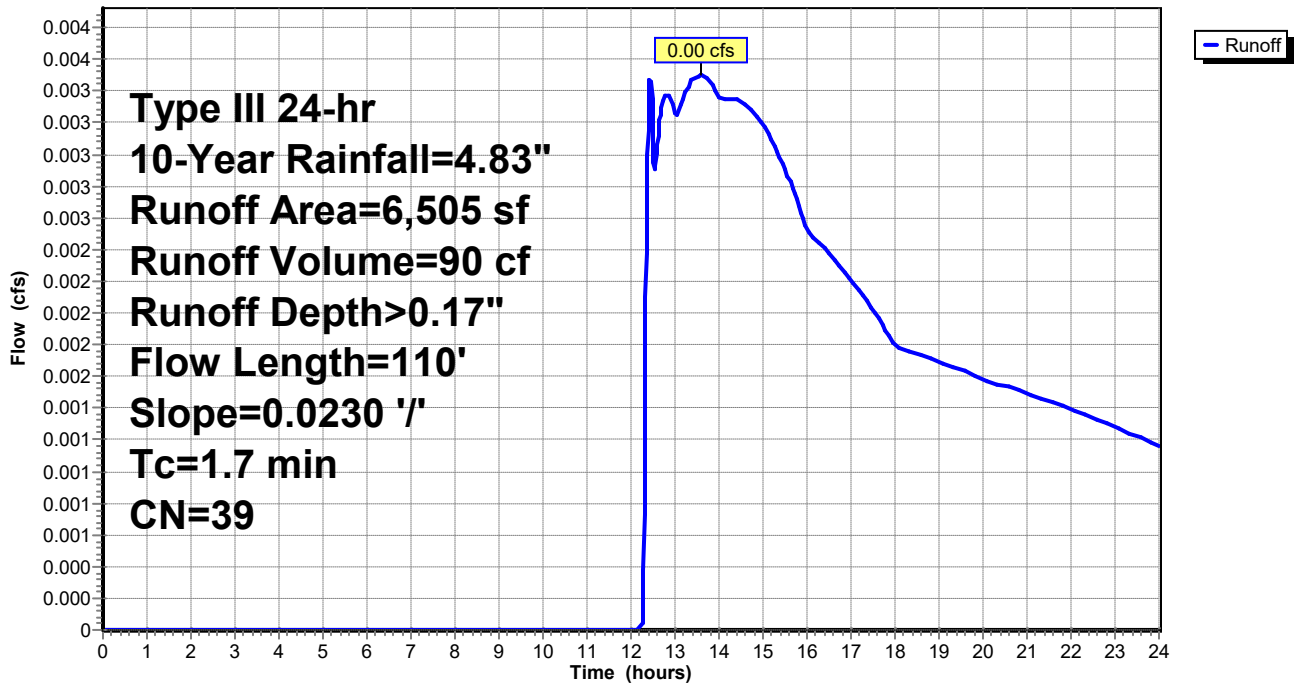
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 10-Year Rainfall=4.83"

Area (sf)	CN	Description
6,505	39	>75% Grass cover, Good, HSG A
6,505		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	110	0.0230	1.06		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps

**Subcatchment 40S: EASTERN REAR**

Hydrograph



### Summary for Subcatchment 41S: EASTERN ROOF

Runoff = 0.22 cfs @ 12.01 hrs, Volume= 648 cf, Depth> 4.59"

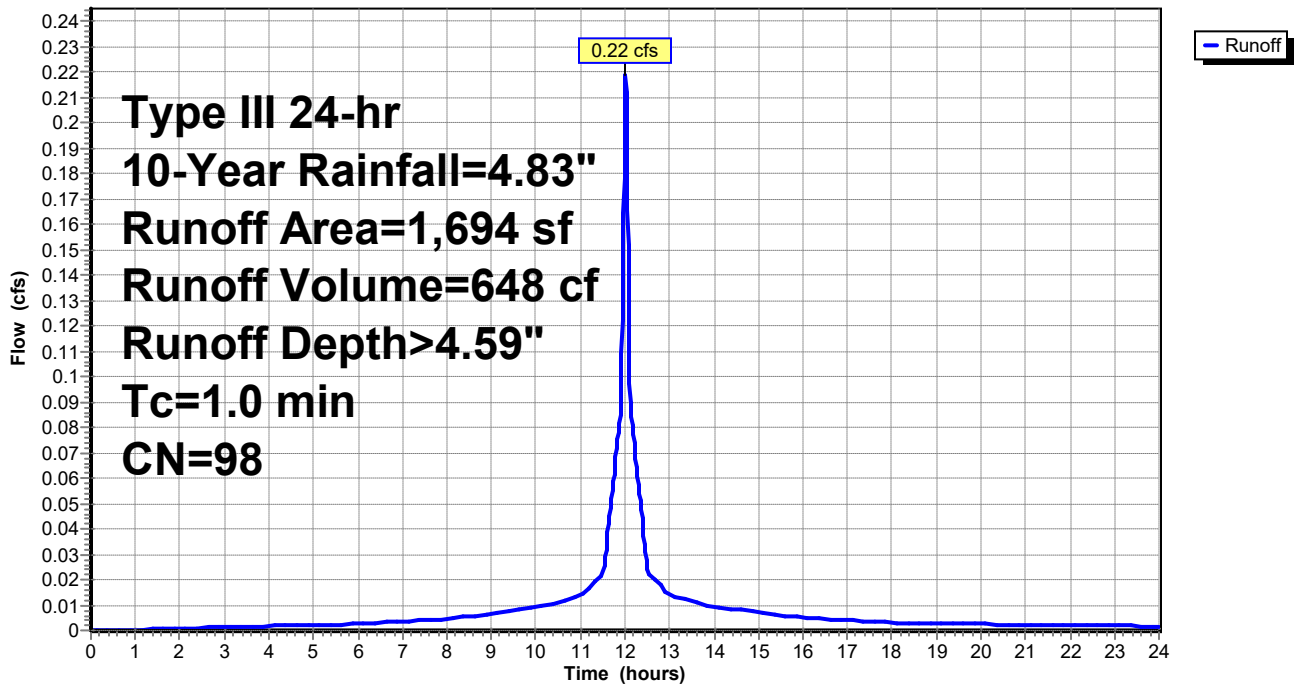
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10-Year Rainfall=4.83"

Area (sf)	CN	Description
1,694	98	Roofs, HSG A
1,694		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0					Direct Entry,

### Subcatchment 41S: EASTERN ROOF

Hydrograph



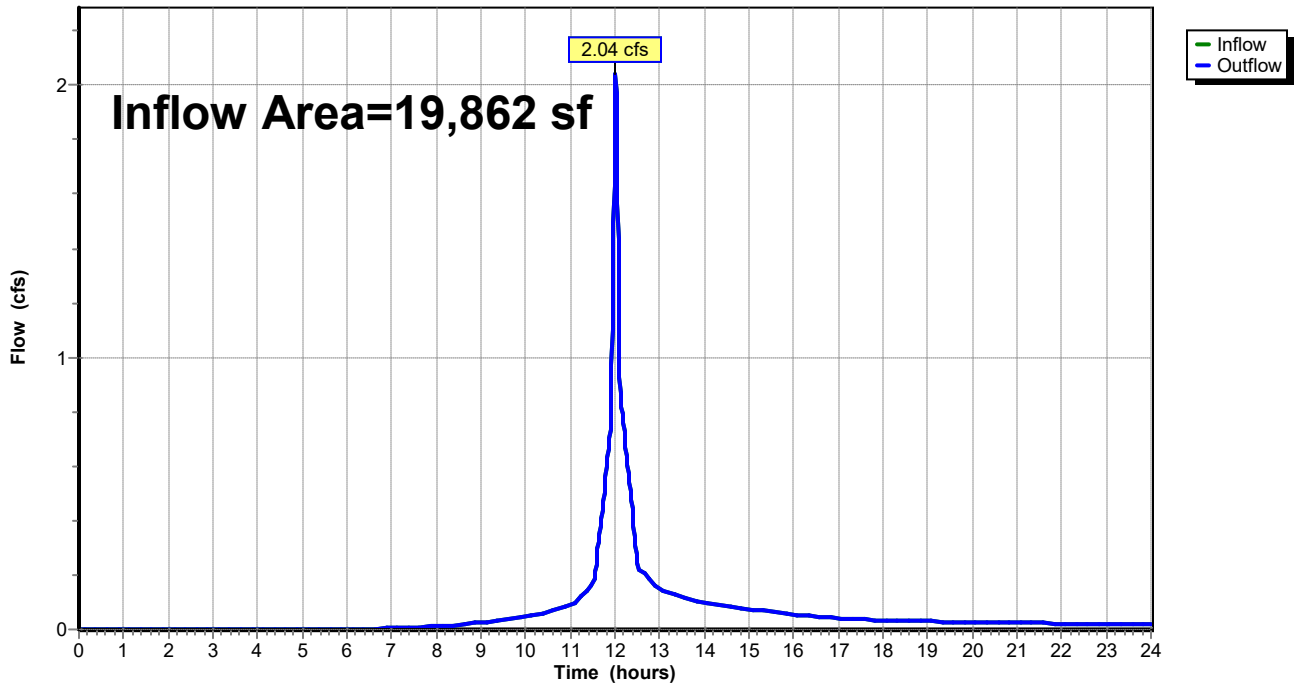
### Summary for Reach 1R: RAIL TRAIL

Inflow Area = 19,862 sf, 76.17% Impervious, Inflow Depth > 3.21" for 10-Year event  
Inflow = 2.04 cfs @ 12.01 hrs, Volume= 5,315 cf  
Outflow = 2.04 cfs @ 12.01 hrs, Volume= 5,315 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 1R: RAIL TRAIL

Hydrograph



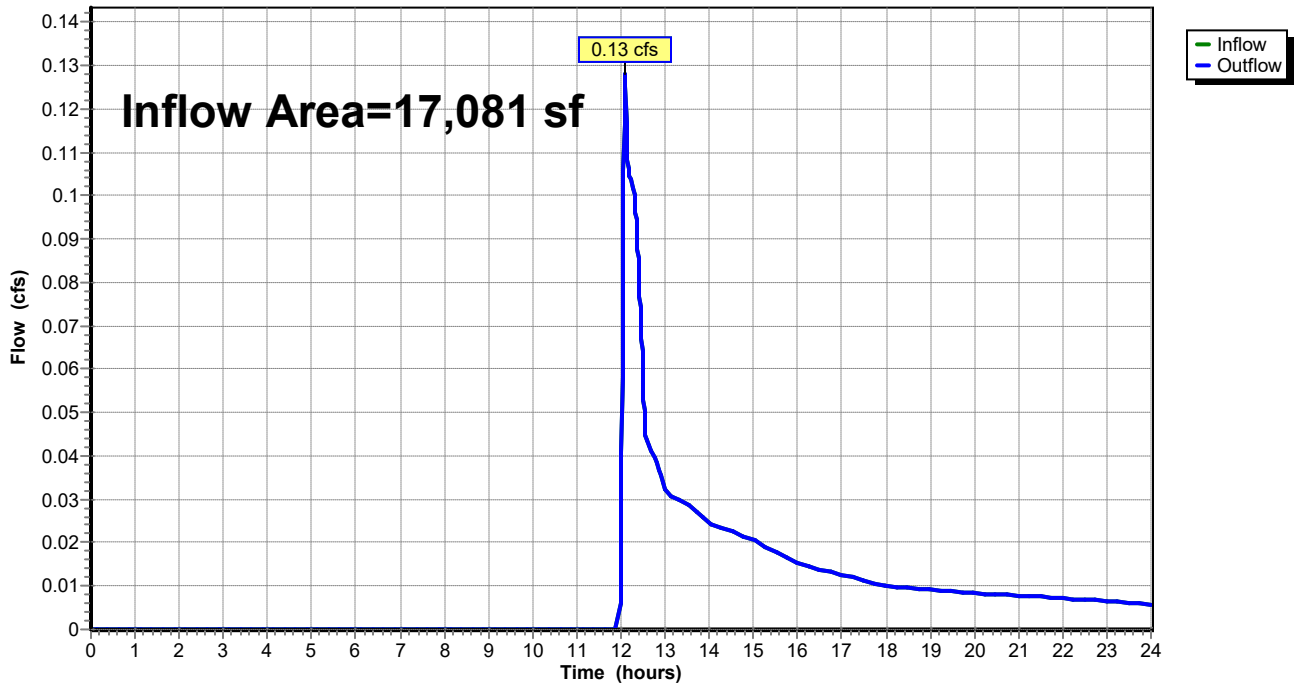
### Summary for Reach 2R: EASTERN ABUTTERS

Inflow Area = 17,081 sf, 13.91% Impervious, Inflow Depth > 0.52" for 10-Year event  
Inflow = 0.13 cfs @ 12.10 hrs, Volume= 747 cf  
Outflow = 0.13 cfs @ 12.10 hrs, Volume= 747 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 2R: EASTERN ABUTTERS

Hydrograph



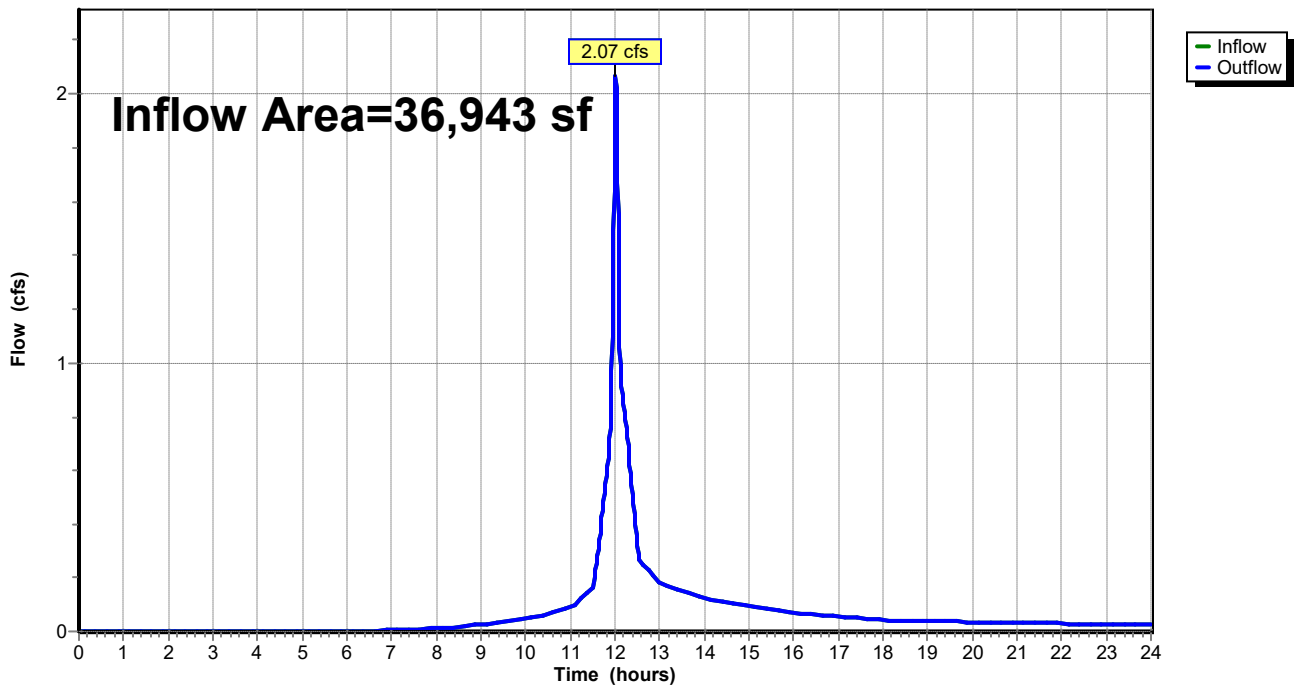
### Summary for Reach 3R: TOTAL

Inflow Area = 36,943 sf, 47.38% Impervious, Inflow Depth > 1.97" for 10-Year event  
Inflow = 2.07 cfs @ 12.02 hrs, Volume= 6,062 cf  
Outflow = 2.07 cfs @ 12.02 hrs, Volume= 6,062 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 3R: TOTAL

Hydrograph



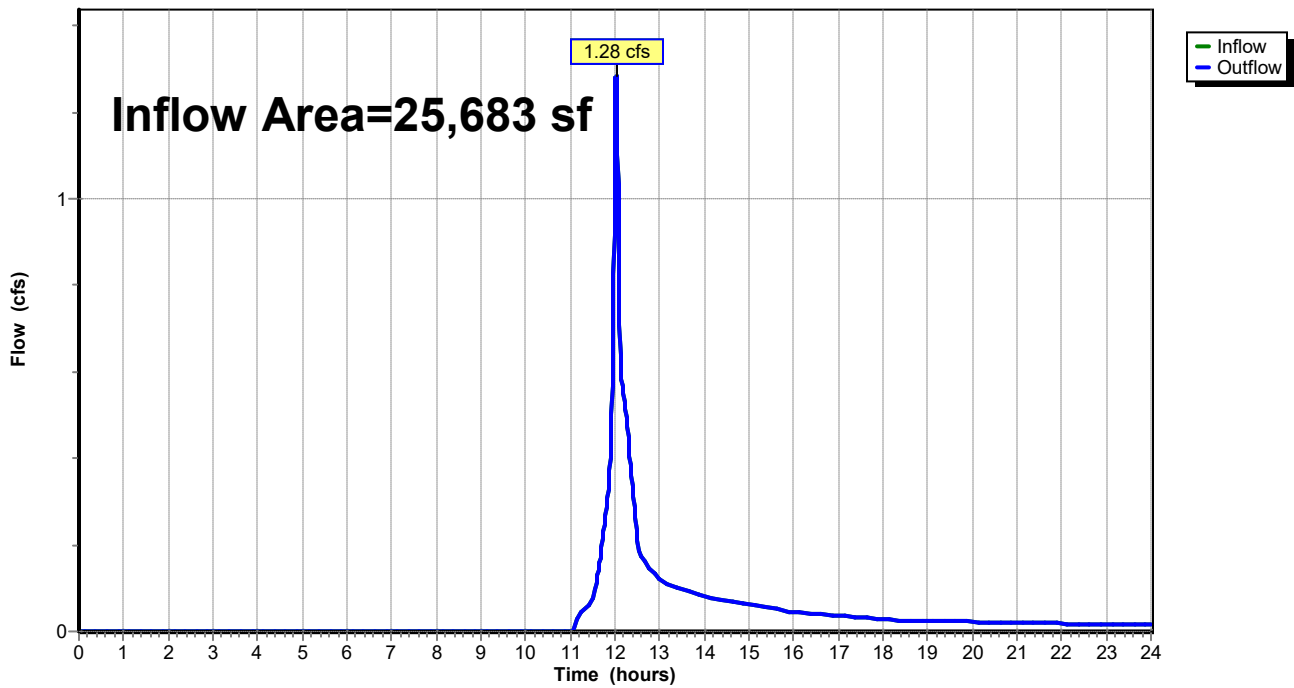
### Summary for Reach 10R: RAIL TRAIL

Inflow Area = 25,683 sf, 45.12% Impervious, Inflow Depth > 1.59" for 10-Year event  
Inflow = 1.28 cfs @ 12.02 hrs, Volume= 3,410 cf  
Outflow = 1.28 cfs @ 12.02 hrs, Volume= 3,410 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 10R: RAIL TRAIL

Hydrograph





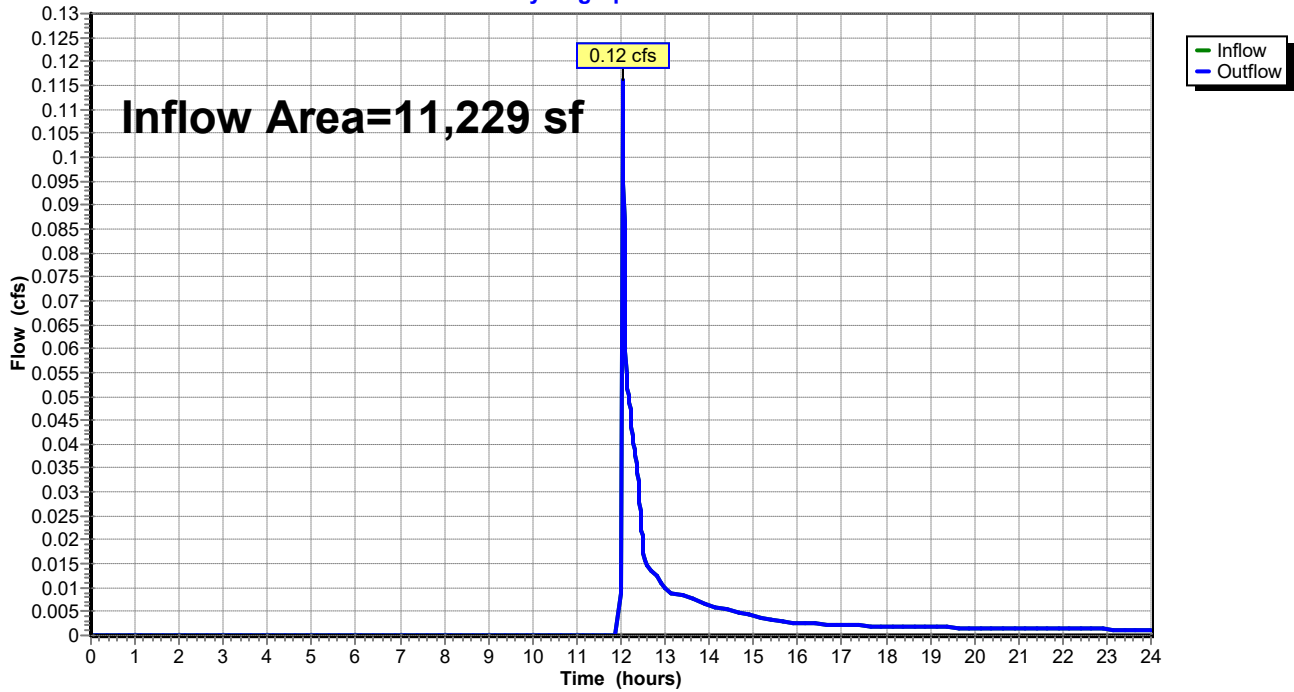
### Summary for Reach 20R: EASTERN ABUTTERS

Inflow Area = 11,229 sf, 25.27% Impervious, Inflow Depth > 0.22" for 10-Year event  
Inflow = 0.12 cfs @ 12.04 hrs, Volume= 207 cf  
Outflow = 0.12 cfs @ 12.04 hrs, Volume= 207 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 20R: EASTERN ABUTTERS

Hydrograph



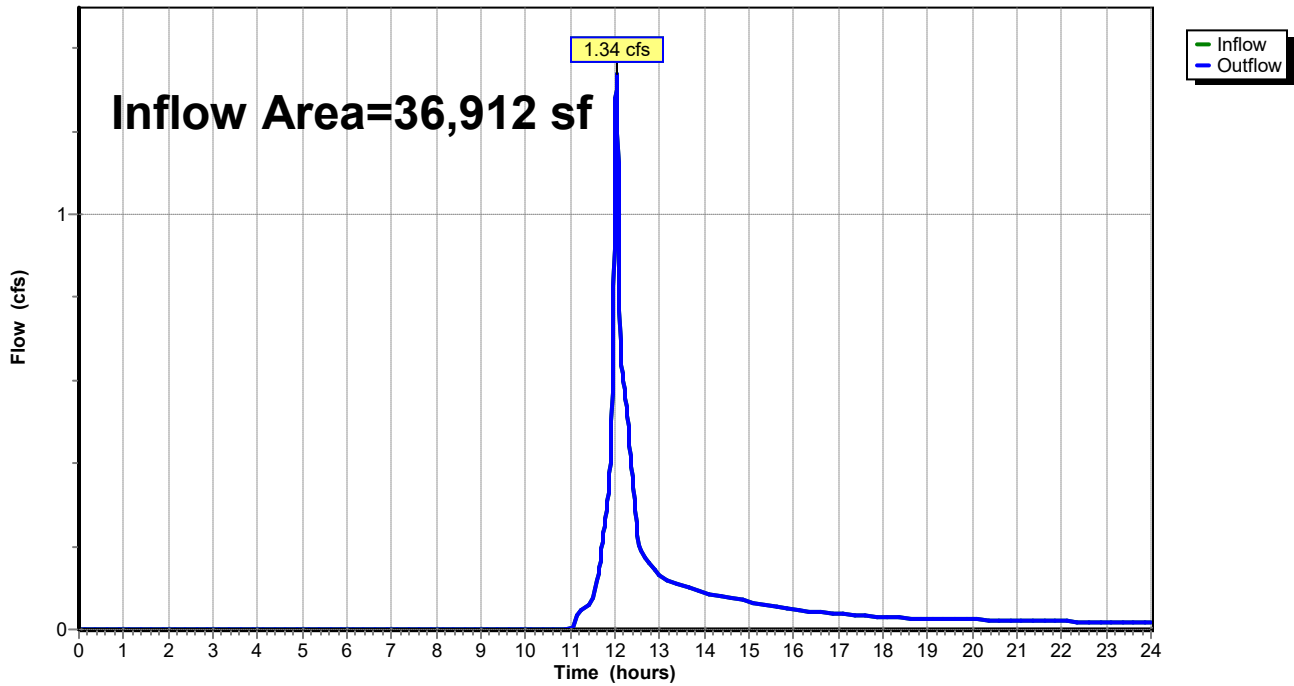
### Summary for Reach 30R: TOTAL

Inflow Area = 36,912 sf, 39.08% Impervious, Inflow Depth > 1.18" for 10-Year event  
Inflow = 1.34 cfs @ 12.04 hrs, Volume= 3,617 cf  
Outflow = 1.34 cfs @ 12.04 hrs, Volume= 3,617 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 30R: TOTAL

Hydrograph



**Summary for Pond 20P: RAINGARDEN**

Inflow Area = 16,917 sf, 59.05% Impervious, Inflow Depth > 2.23" for 10-Year event  
 Inflow = 1.20 cfs @ 12.02 hrs, Volume= 3,142 cf  
 Outflow = 1.19 cfs @ 12.02 hrs, Volume= 3,051 cf, Atten= 0%, Lag= 0.0 min  
 Discarded = 0.00 cfs @ 11.15 hrs, Volume= 96 cf  
 Primary = 1.19 cfs @ 12.02 hrs, Volume= 2,955 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 28.75' @ 12.02 hrs Surf.Area= 155 sf Storage= 93 cf

Plug-Flow detention time= 22.8 min calculated for 3,050 cf (97% of inflow)  
 Center-of-Mass det. time= 6.4 min ( 841.0 - 834.7 )

Volume	Invert	Avail.Storage	Storage Description
#1	27.68'	93 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
27.68	104	0	0
28.40	155	93	93

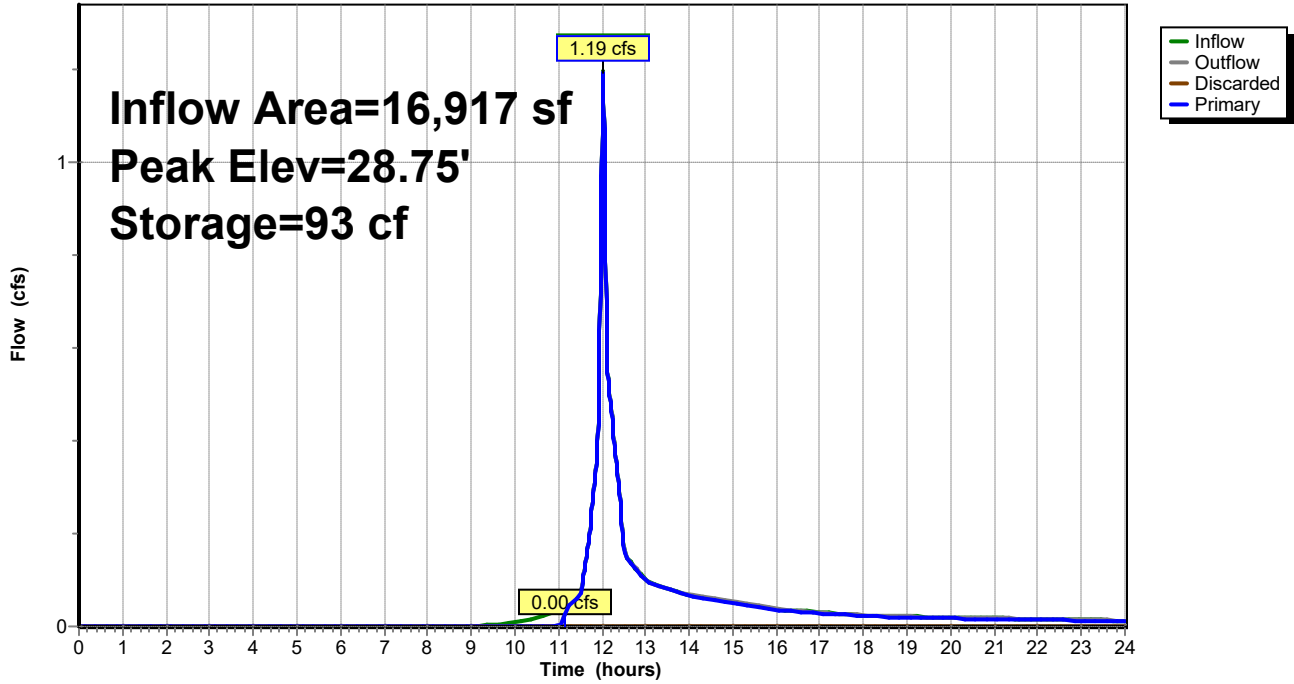
Device	Routing	Invert	Outlet Devices
#1	Discarded	27.68'	<b>0.520 in/hr Exfiltration over Surface area</b>
#2	Primary	28.37'	<b>2.0' long x 4.0' breadth Broad-Crested Rectangular Weir</b>
Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00			
2.50 3.00 3.50 4.00 4.50 5.00 5.50			
Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66			
2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32			

**Discarded OutFlow** Max=0.00 cfs @ 11.15 hrs HW=28.41' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.00 cfs)

**Primary OutFlow** Max=1.19 cfs @ 12.02 hrs HW=28.75' (Free Discharge)  
 ↑2=Broad-Crested Rectangular Weir (Weir Controls 1.19 cfs @ 1.56 fps)

### Pond 20P: RAINGARDEN

Hydrograph



**Summary for Pond 30P: DRYWELL**

Inflow Area = 3,030 sf, 37.76% Impervious, Inflow Depth > 1.33" for 10-Year event  
 Inflow = 0.12 cfs @ 12.02 hrs, Volume= 337 cf  
 Outflow = 0.12 cfs @ 12.04 hrs, Volume= 337 cf, Atten= 0%, Lag= 1.7 min  
 Discarded = 0.01 cfs @ 11.64 hrs, Volume= 220 cf  
 Primary = 0.12 cfs @ 12.04 hrs, Volume= 116 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 28.01' @ 12.04 hrs Surf.Area= 14 sf Storage= 46 cf

Plug-Flow detention time= 50.9 min calculated for 337 cf (100% of inflow)  
 Center-of-Mass det. time= 50.6 min ( 917.4 - 866.8 )

Volume	Invert	Avail.Storage	Storage Description
#1	24.82'	58 cf	<b>3.60'W x 4.00'L x 4.00'H Prismatic</b>

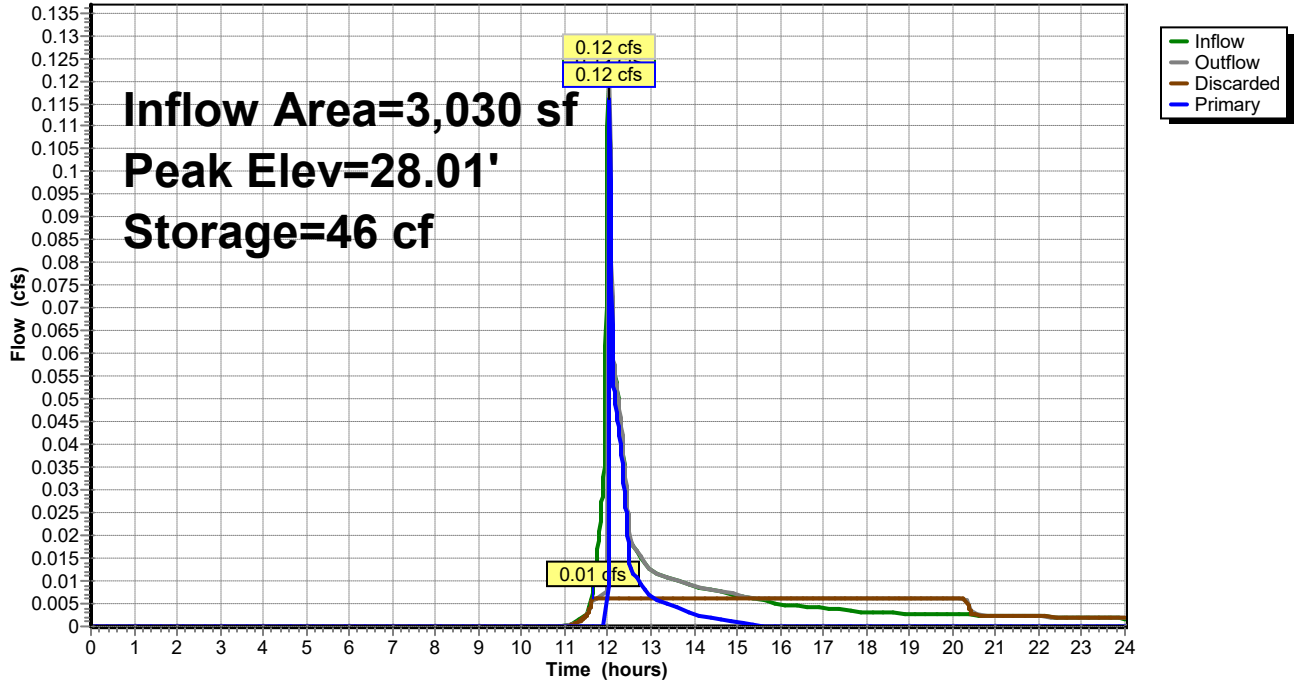
Device	Routing	Invert	Outlet Devices
#1	Discarded	24.82'	<b>18.000 in/hr Exfiltration over Surface area</b>
#2	Primary	27.82'	<b>5.0" Vert. Orifice/Grate</b> C= 0.600
#3	Primary	28.00'	<b>10.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Discarded OutFlow** Max=0.01 cfs @ 11.64 hrs HW=24.86' (Free Discharge)  
 ↖ **1=Exfiltration** (Exfiltration Controls 0.01 cfs)

**Primary OutFlow** Max=0.10 cfs @ 12.04 hrs HW=28.01' (Free Discharge)  
 ↖ **2=Orifice/Grate** (Orifice Controls 0.09 cfs @ 1.49 fps)  
 ↖ **3=Orifice/Grate** (Weir Controls 0.01 cfs @ 0.35 fps)

### Pond 30P: DRYWELL

Hydrograph



**Summary for Pond 42P: CULTEC**

Inflow Area = 1,694 sf, 100.00% Impervious, Inflow Depth > 4.59" for 10-Year event  
 Inflow = 0.22 cfs @ 12.01 hrs, Volume= 648 cf  
 Outflow = 0.05 cfs @ 11.69 hrs, Volume= 648 cf, Atten= 78%, Lag= 0.0 min  
 Discarded = 0.05 cfs @ 11.69 hrs, Volume= 648 cf  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 26.29' @ 12.36 hrs Surf.Area= 117 sf Storage= 115 cf

Plug-Flow detention time= 10.5 min calculated for 648 cf (100% of inflow)  
 Center-of-Mass det. time= 10.4 min ( 754.3 - 743.9 )

Volume	Invert	Avail.Storage	Storage Description
#1A	24.50'	162 cf	<b>11.17'W x 10.50'L x 4.54'H Field A</b> 533 cf Overall - 127 cf Embedded = 406 cf x 40.0% Voids
#2A	25.50'	127 cf	<b>Cultec R-330XLHD x 2 Inside #1</b> Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 2 rows
		289 cf	Total Available Storage

Storage Group A created with Chamber Wizard

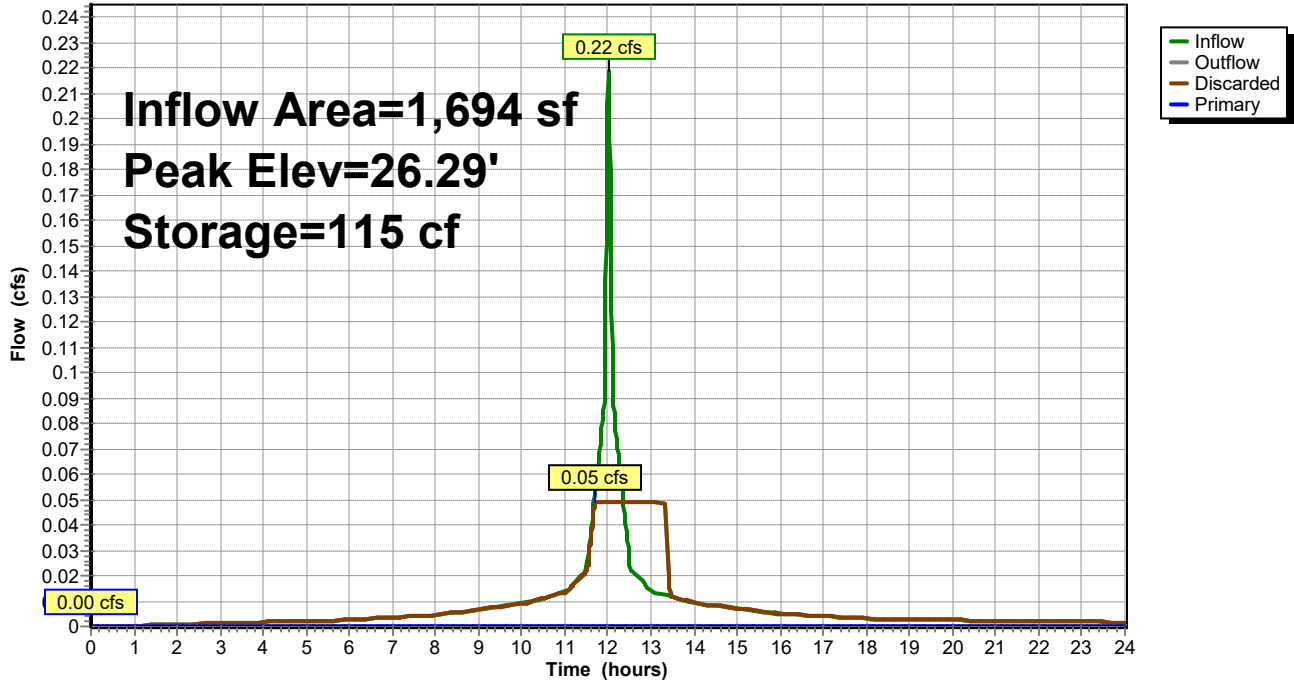
Device	Routing	Invert	Outlet Devices
#1	Primary	26.99'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 0 End Contraction(s)
#2	Discarded	24.50'	<b>18.000 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.05 cfs @ 11.69 hrs HW=24.55' (Free Discharge)  
 ↑**2=Exfiltration** (Exfiltration Controls 0.05 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=24.50' (Free Discharge)  
 ↑**1=Sharp-Crested Rectangular Weir** ( Controls 0.00 cfs)

### Pond 42P: CULTEC

#### Hydrograph





**20-087 DR**

Type III 24-hr 25-Year Rainfall=6.16"

Prepared by Design Consultants, Inc.

Printed 4/14/2021

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Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

<b>Subcatchment 1S: NW AREA</b>	Runoff Area=19,862 sf 76.17% Impervious Flow Length=191' Tc=0.9 min CN=85	Runoff Depth>4.45" Runoff=2.80 cfs 7,371 cf
<b>Subcatchment 2S: SE AREA</b>	Runoff Area=17,081 sf 13.91% Impervious Flow Length=201' Slope=0.0210 '/' Tc=3.3 min CN=48	Runoff Depth>1.07" Runoff=0.41 cfs 1,529 cf
<b>Subcatchment 10S: NW LAWN</b>	Runoff Area=8,766 sf 18.24% Impervious Flow Length=143' Slope=0.0560 '/' Tc=1.4 min CN=50	Runoff Depth>1.22" Runoff=0.27 cfs 892 cf
<b>Subcatchment 20S: ROADWAY</b>	Runoff Area=16,917 sf 59.05% Impervious Flow Length=179' Tc=1.3 min CN=74	Runoff Depth>3.32" Runoff=1.79 cfs 4,679 cf
<b>Subcatchment 30S: SIDE DRIVEWAY</b>	Runoff Area=3,030 sf 37.76% Impervious Flow Length=82' Tc=0.7 min CN=62	Runoff Depth>2.20" Runoff=0.21 cfs 556 cf
<b>Subcatchment 40S: EASTERN REAR</b>	Runoff Area=6,505 sf 0.00% Impervious Flow Length=110' Slope=0.0230 '/' Tc=1.7 min CN=39	Runoff Depth>0.49" Runoff=0.03 cfs 267 cf
<b>Subcatchment 41S: EASTERN ROOF</b>	Runoff Area=1,694 sf 100.00% Impervious Tc=1.0 min CN=98	Runoff Depth>5.92" Runoff=0.28 cfs 836 cf
<b>Reach 1R: RAIL TRAIL</b>		Inflow=2.80 cfs 7,371 cf Outflow=2.80 cfs 7,371 cf
<b>Reach 2R: EASTERN ABUTTERS</b>		Inflow=0.41 cfs 1,529 cf Outflow=0.41 cfs 1,529 cf
<b>Reach 3R: TOTAL</b>		Inflow=3.06 cfs 8,900 cf Outflow=3.06 cfs 8,900 cf
<b>Reach 10R: RAIL TRAIL</b>		Inflow=2.06 cfs 5,377 cf Outflow=2.06 cfs 5,377 cf
<b>Reach 20R: EASTERN ABUTTERS</b>		Inflow=0.20 cfs 563 cf Outflow=0.20 cfs 563 cf
<b>Reach 30R: TOTAL</b>		Inflow=2.26 cfs 5,940 cf Outflow=2.26 cfs 5,940 cf
<b>Pond 20P: RAINGARDEN</b>	Peak Elev=28.86' Storage=93 cf Discarded=0.00 cfs 103 cf Primary=1.79 cfs 4,484 cf	Inflow=1.79 cfs 4,679 cf Outflow=1.79 cfs 4,587 cf
<b>Pond 30P: DRYWELL</b>	Peak Elev=28.04' Storage=46 cf Discarded=0.01 cfs 269 cf Primary=0.20 cfs 286 cf	Inflow=0.21 cfs 556 cf Outflow=0.21 cfs 555 cf
<b>Pond 42P: CULTEC</b>	Peak Elev=27.01' Storage=174 cf Discarded=0.05 cfs 826 cf Primary=0.03 cfs 10 cf	Inflow=0.28 cfs 836 cf Outflow=0.08 cfs 836 cf

**Summary for Subcatchment 1S: NW AREA**

Runoff = 2.80 cfs @ 12.01 hrs, Volume= 7,371 cf, Depth> 4.45"

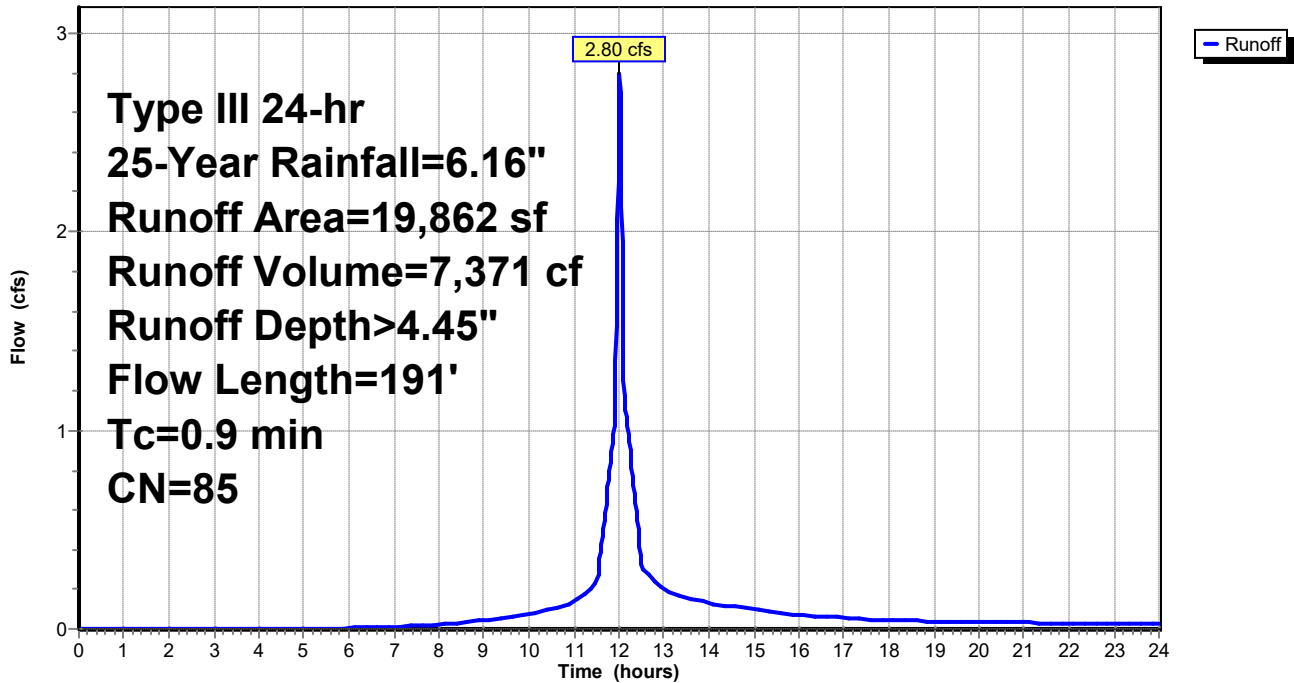
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 25-Year Rainfall=6.16"

Area (sf)	CN	Description
12,146	98	Paved parking, HSG A
2,982	98	Roofs, HSG A
3,870	43	Woods/grass comb., Fair, HSG A
864	39	>75% Grass cover, Good, HSG A
19,862	85	Weighted Average
4,734		23.83% Pervious Area
15,128		76.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	176	0.0340	3.74		<b>Shallow Concentrated Flow, Pavement</b>
					Paved Kv= 20.3 fps
0.1	15	0.0670	1.81		<b>Shallow Concentrated Flow, Grass</b>
					Short Grass Pasture Kv= 7.0 fps
0.9	191	Total			

**Subcatchment 1S: NW AREA**

Hydrograph



### Summary for Subcatchment 2S: SE AREA

Runoff = 0.41 cfs @ 12.07 hrs, Volume= 1,529 cf, Depth> 1.07"

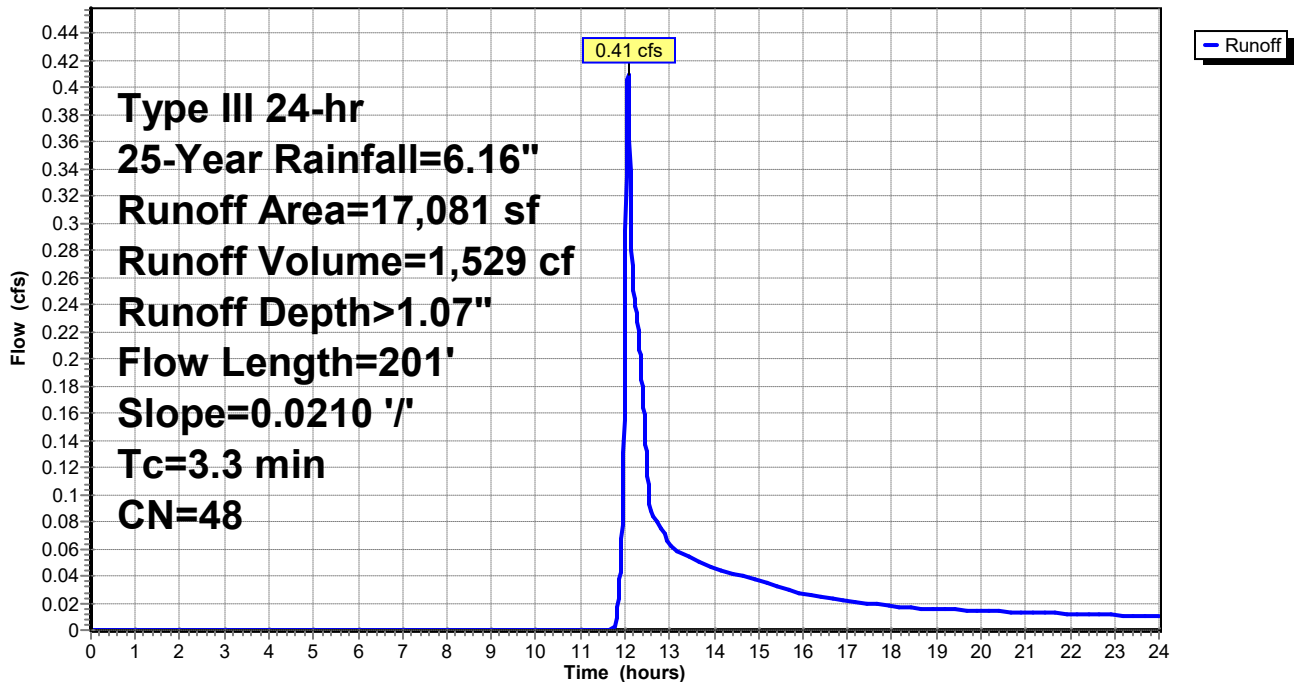
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 25-Year Rainfall=6.16"

Area (sf)	CN	Description
52	98	Paved parking, HSG A
2,324	98	Roofs, HSG A
1,521	43	Woods/grass comb., Fair, HSG A
13,184	39	>75% Grass cover, Good, HSG A
17,081	48	Weighted Average
14,705		86.09% Pervious Area
2,376		13.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	201	0.0210	1.01		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps

### Subcatchment 2S: SE AREA

Hydrograph



**Summary for Subcatchment 10S: NW LAWN**

Runoff = 0.27 cfs @ 12.03 hrs, Volume= 892 cf, Depth> 1.22"

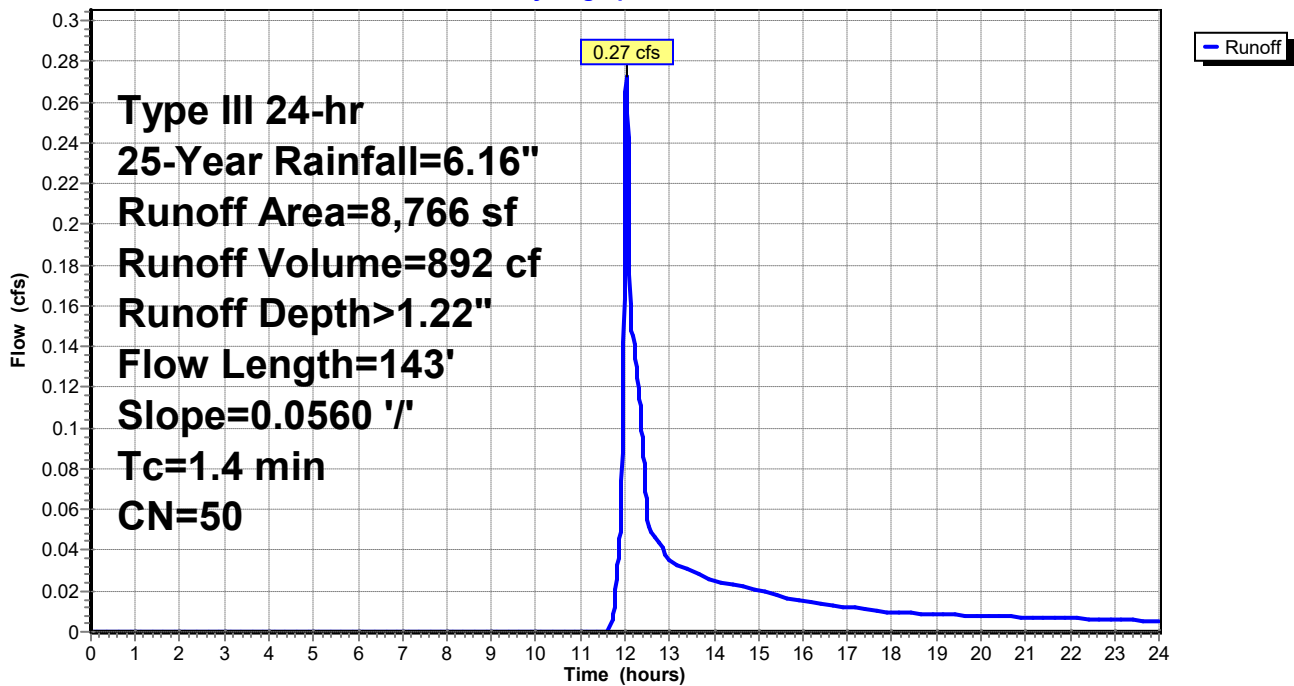
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 25-Year Rainfall=6.16"

Area (sf)	CN	Description
7,000	39	>75% Grass cover, Good, HSG A
1,599	98	Roofs, HSG A
* 167	55	Permeable pavers
8,766	50	Weighted Average
7,167		81.76% Pervious Area
1,599		18.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	143	0.0560	1.66		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps

**Subcatchment 10S: NW LAWN**

Hydrograph



**Summary for Subcatchment 20S: ROADWAY**

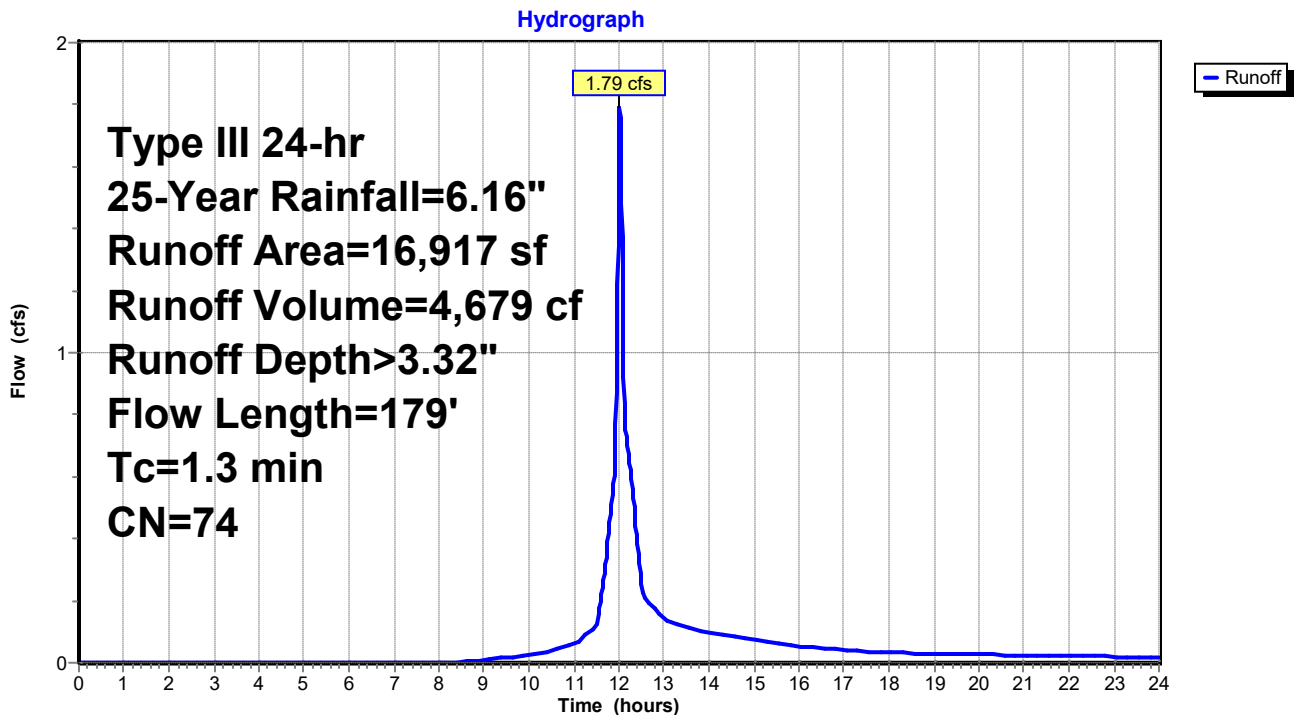
Runoff = 1.79 cfs @ 12.02 hrs, Volume= 4,679 cf, Depth> 3.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 25-Year Rainfall=6.16"

Area (sf)	CN	Description
5,311	98	Paved parking, HSG A
229	98	Unconnected pavement, HSG A
6,273	39	>75% Grass cover, Good, HSG A
4,450	98	Roofs, HSG A
* 654	55	Permeable pavers
16,917	74	Weighted Average
6,927		40.95% Pervious Area
9,990		59.05% Impervious Area
229		2.29% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	67	0.0670	1.81		<b>Shallow Concentrated Flow, Grass</b>
					Short Grass Pasture Kv= 7.0 fps
0.7	112	0.0160	2.57		<b>Shallow Concentrated Flow, Road</b>
					Paved Kv= 20.3 fps
1.3	179	Total			

**Subcatchment 20S: ROADWAY**



**Summary for Subcatchment 30S: SIDE DRIVEWAY**

Runoff = 0.21 cfs @ 12.01 hrs, Volume= 556 cf, Depth> 2.20"

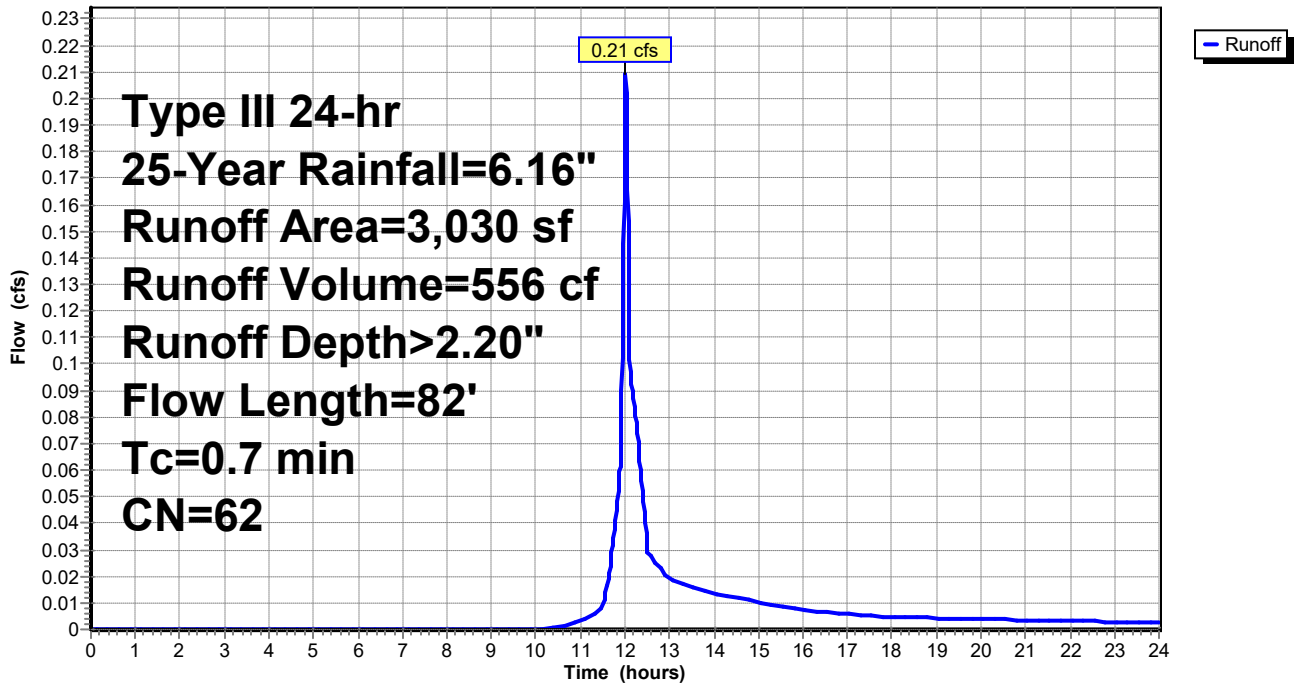
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 25-Year Rainfall=6.16"

Area (sf)	CN	Description
1,144	98	Paved parking, HSG A
1,720	39	>75% Grass cover, Good, HSG A
* 166	55	Permeable pavers
3,030	62	Weighted Average
1,886		62.24% Pervious Area
1,144		37.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	48	0.0520	1.60		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
0.2	34	0.0290	3.46		<b>Shallow Concentrated Flow, Driveway</b> Paved Kv= 20.3 fps
0.7	82	Total			

**Subcatchment 30S: SIDE DRIVEWAY**

Hydrograph



**Summary for Subcatchment 40S: EASTERN REAR**

Runoff = 0.03 cfs @ 12.26 hrs, Volume= 267 cf, Depth> 0.49"

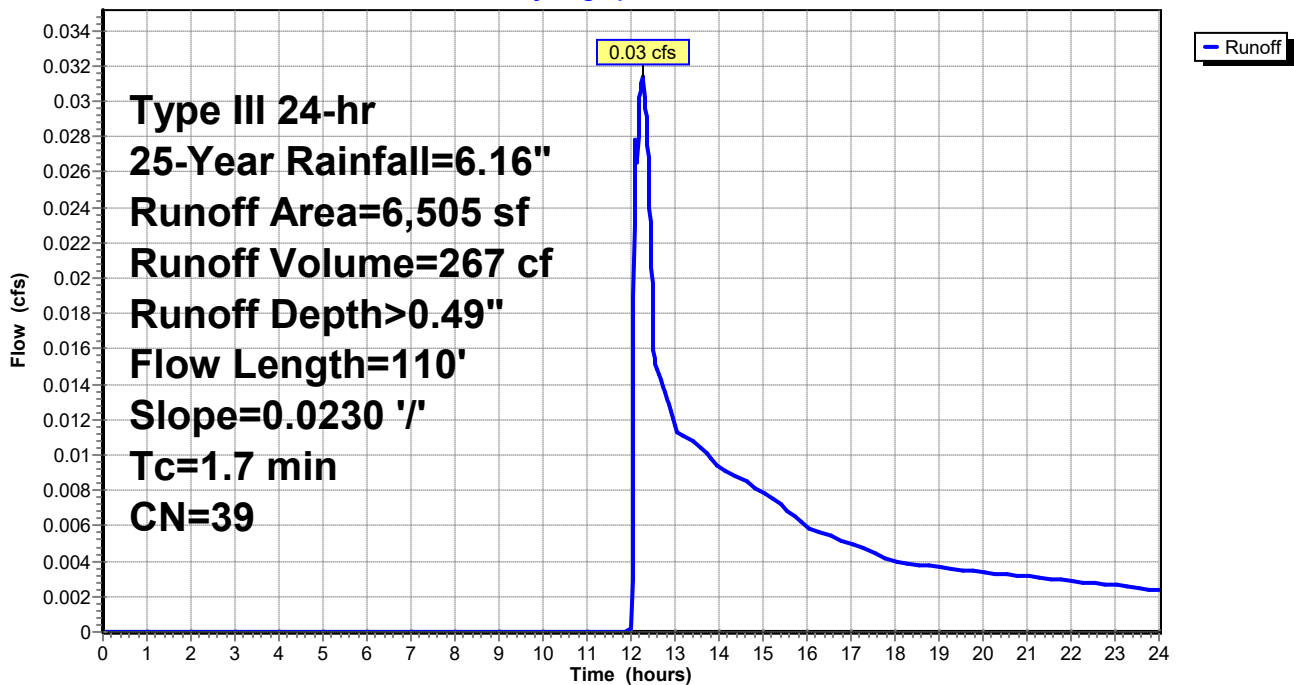
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 25-Year Rainfall=6.16"

Area (sf)	CN	Description
6,505	39	>75% Grass cover, Good, HSG A
6,505		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	110	0.0230	1.06		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps

**Subcatchment 40S: EASTERN REAR**

Hydrograph



### Summary for Subcatchment 41S: EASTERN ROOF

Runoff = 0.28 cfs @ 12.01 hrs, Volume= 836 cf, Depth> 5.92"

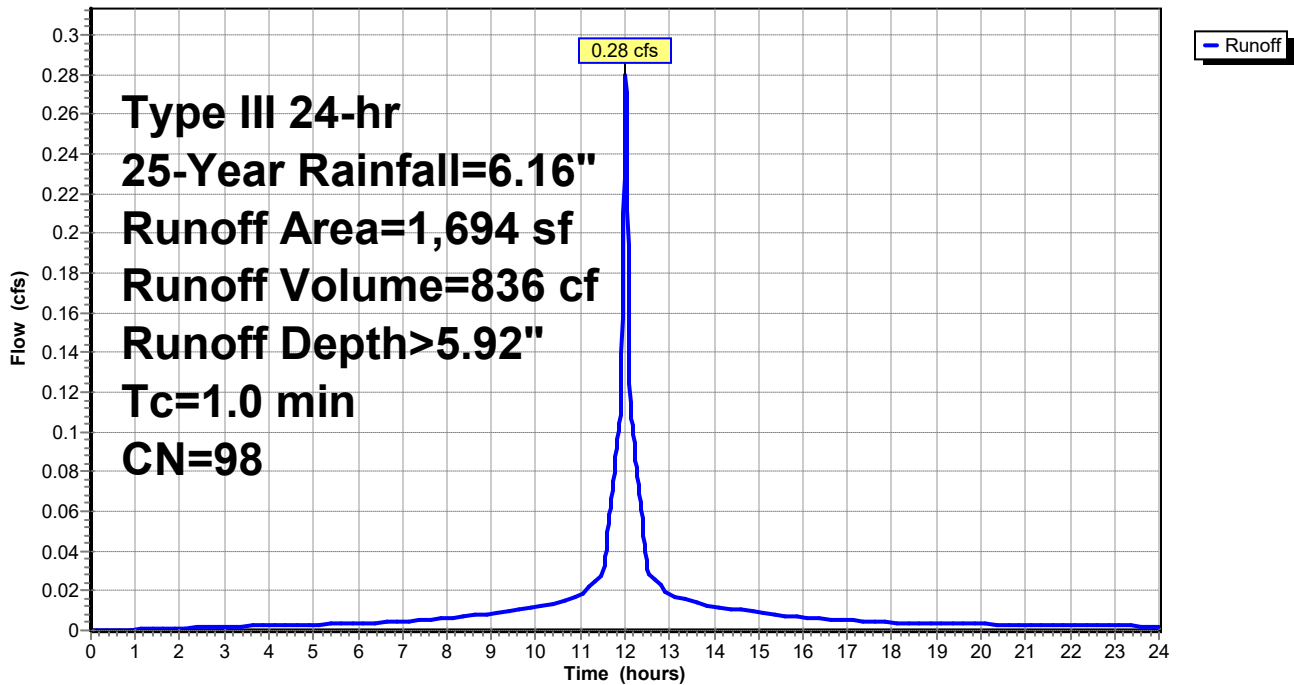
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 25-Year Rainfall=6.16"

Area (sf)	CN	Description
1,694	98	Roofs, HSG A
1,694		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0					Direct Entry,

### Subcatchment 41S: EASTERN ROOF

Hydrograph





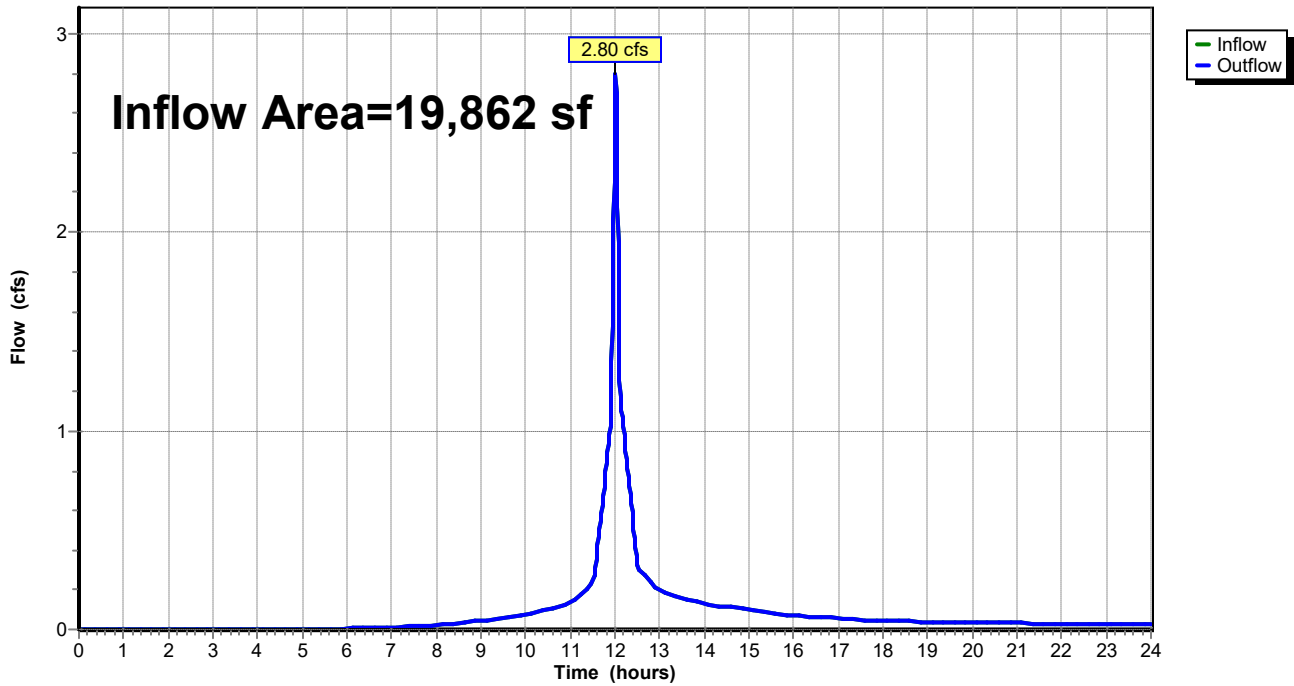
### Summary for Reach 1R: RAIL TRAIL

Inflow Area = 19,862 sf, 76.17% Impervious, Inflow Depth > 4.45" for 25-Year event  
Inflow = 2.80 cfs @ 12.01 hrs, Volume= 7,371 cf  
Outflow = 2.80 cfs @ 12.01 hrs, Volume= 7,371 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 1R: RAIL TRAIL

Hydrograph



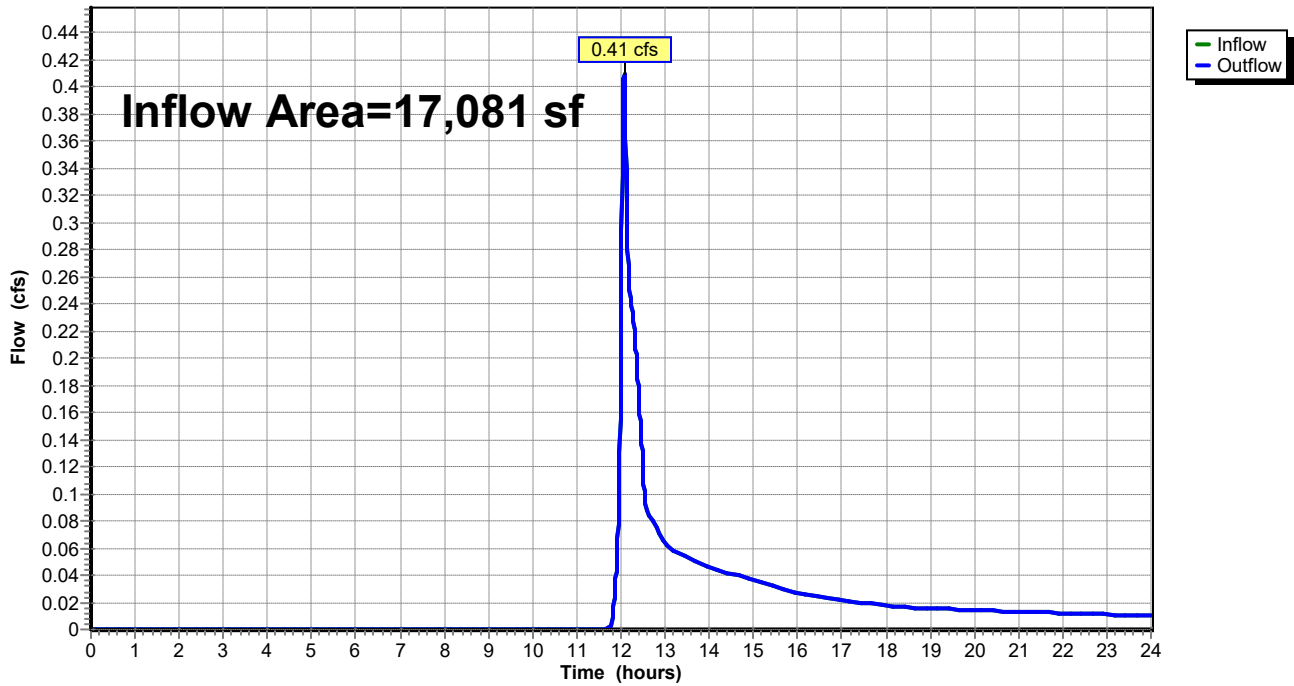
### Summary for Reach 2R: EASTERN ABUTTERS

Inflow Area = 17,081 sf, 13.91% Impervious, Inflow Depth > 1.07" for 25-Year event  
Inflow = 0.41 cfs @ 12.07 hrs, Volume= 1,529 cf  
Outflow = 0.41 cfs @ 12.07 hrs, Volume= 1,529 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 2R: EASTERN ABUTTERS

Hydrograph



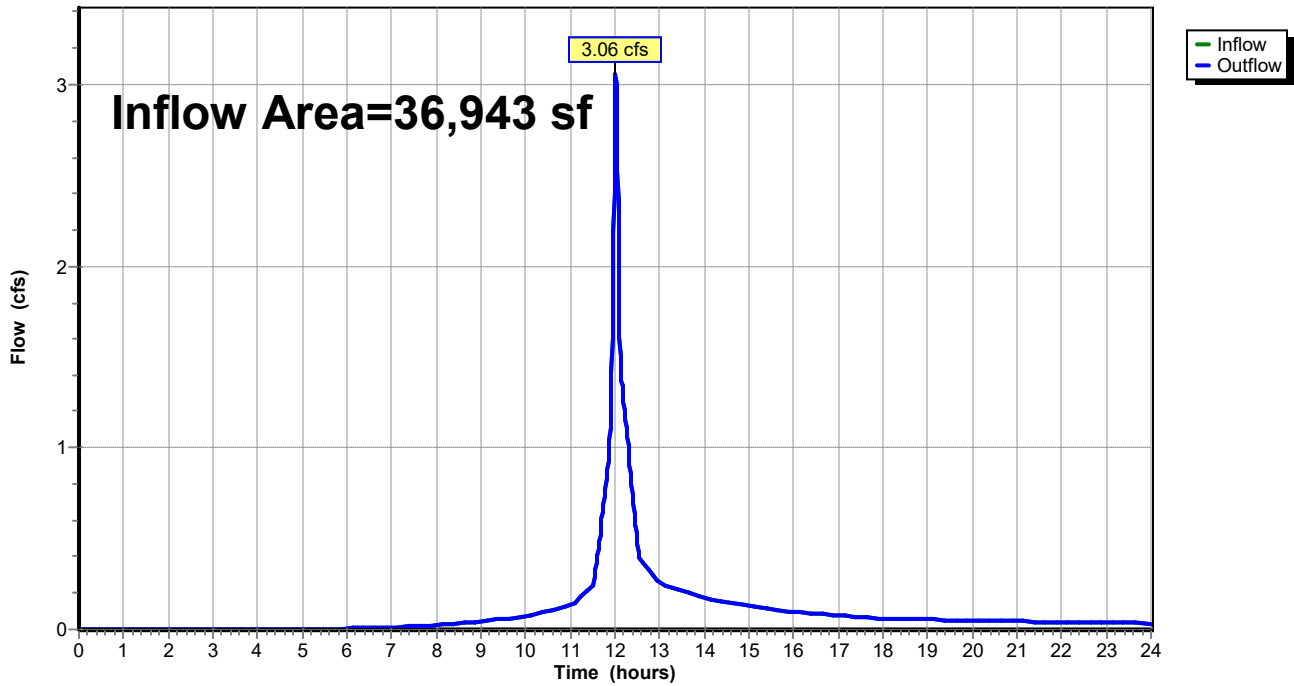
### Summary for Reach 3R: TOTAL

Inflow Area = 36,943 sf, 47.38% Impervious, Inflow Depth > 2.89" for 25-Year event  
Inflow = 3.06 cfs @ 12.02 hrs, Volume= 8,900 cf  
Outflow = 3.06 cfs @ 12.02 hrs, Volume= 8,900 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 3R: TOTAL

Hydrograph



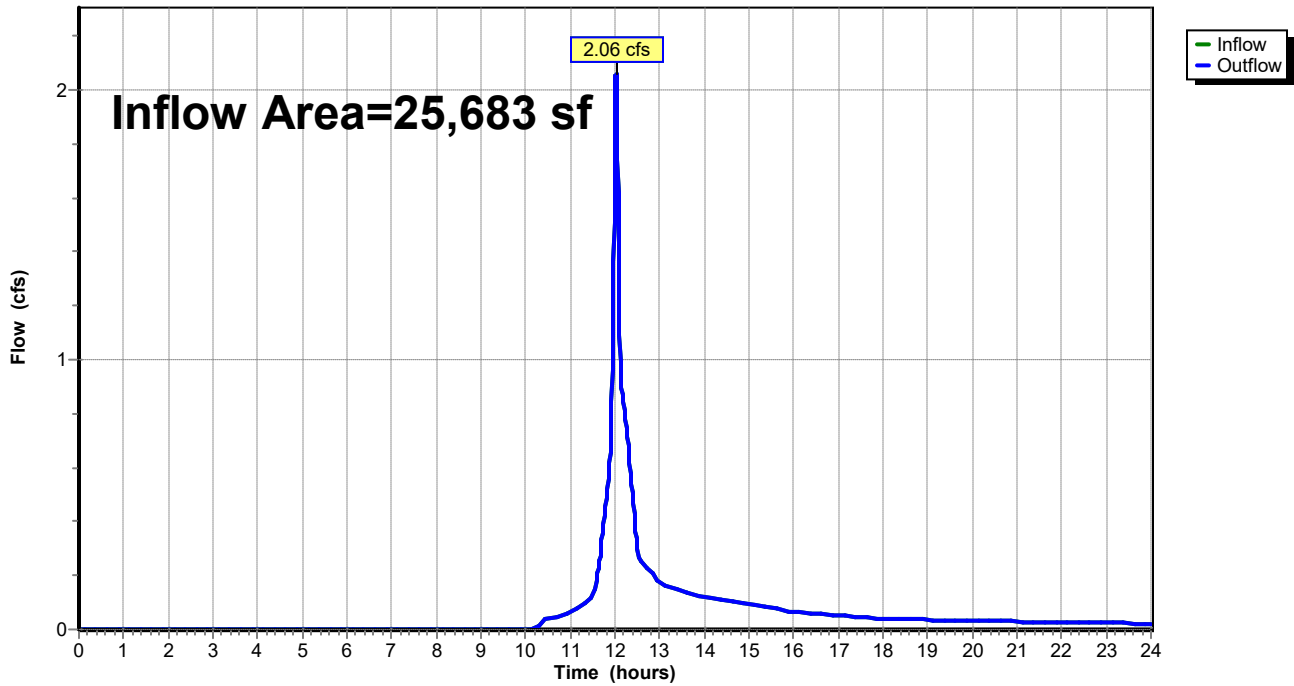
### Summary for Reach 10R: RAIL TRAIL

Inflow Area = 25,683 sf, 45.12% Impervious, Inflow Depth > 2.51" for 25-Year event  
Inflow = 2.06 cfs @ 12.02 hrs, Volume= 5,377 cf  
Outflow = 2.06 cfs @ 12.02 hrs, Volume= 5,377 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 10R: RAIL TRAIL

Hydrograph



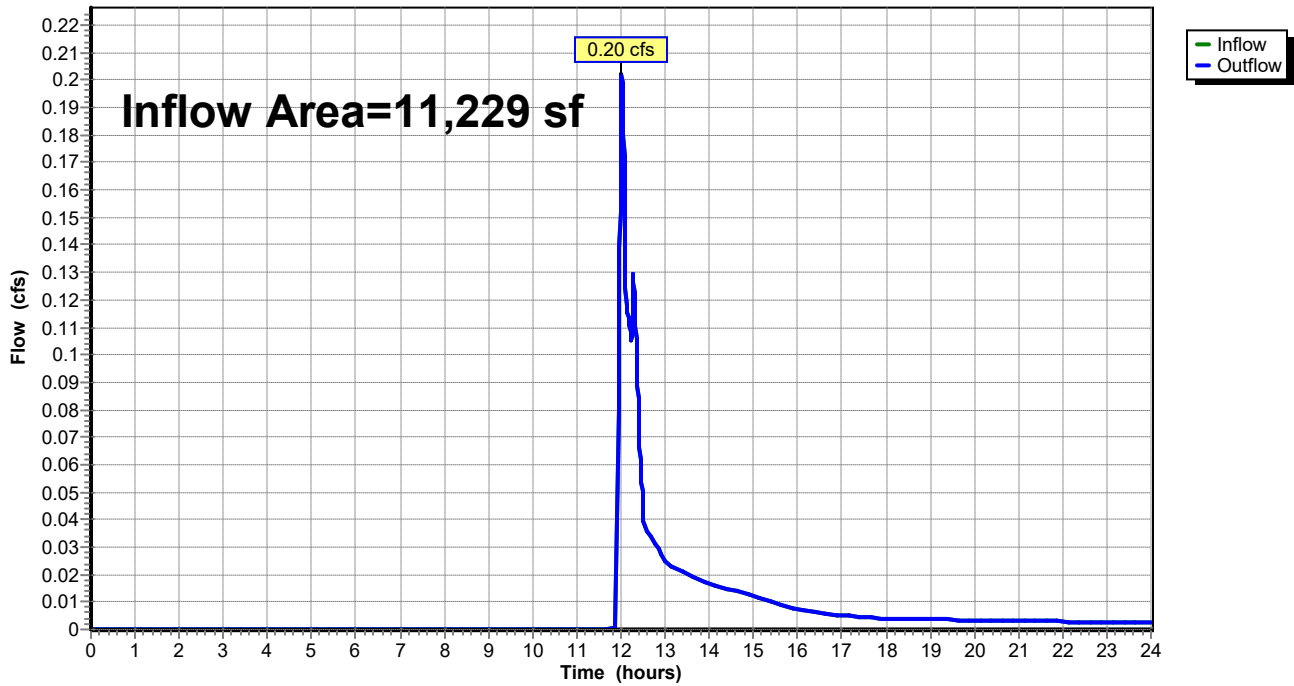
### Summary for Reach 20R: EASTERN ABUTTERS

Inflow Area = 11,229 sf, 25.27% Impervious, Inflow Depth > 0.60" for 25-Year event  
Inflow = 0.20 cfs @ 12.02 hrs, Volume= 563 cf  
Outflow = 0.20 cfs @ 12.02 hrs, Volume= 563 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 20R: EASTERN ABUTTERS

Hydrograph



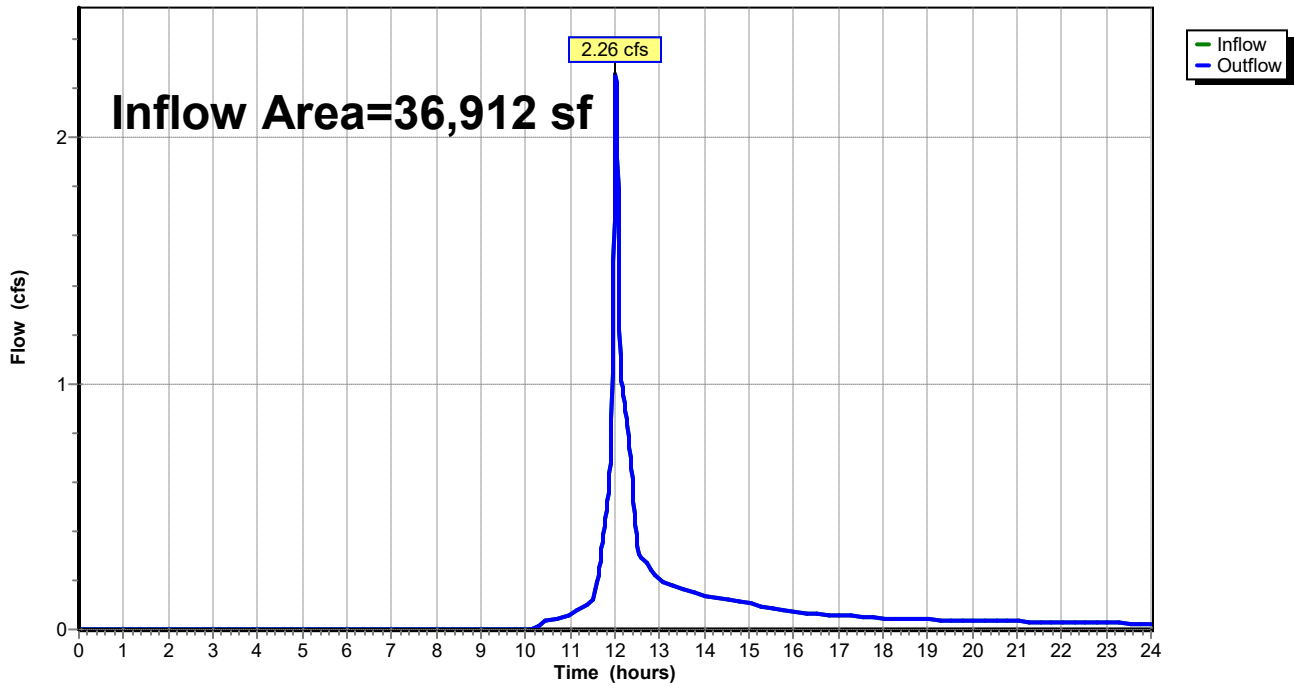
### Summary for Reach 30R: TOTAL

Inflow Area = 36,912 sf, 39.08% Impervious, Inflow Depth > 1.93" for 25-Year event  
Inflow = 2.26 cfs @ 12.02 hrs, Volume= 5,940 cf  
Outflow = 2.26 cfs @ 12.02 hrs, Volume= 5,940 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 30R: TOTAL

Hydrograph



**Summary for Pond 20P: RAINGARDEN**

Inflow Area = 16,917 sf, 59.05% Impervious, Inflow Depth > 3.32" for 25-Year event  
 Inflow = 1.79 cfs @ 12.02 hrs, Volume= 4,679 cf  
 Outflow = 1.79 cfs @ 12.02 hrs, Volume= 4,587 cf, Atten= 0%, Lag= 0.0 min  
 Discarded = 0.00 cfs @ 10.32 hrs, Volume= 103 cf  
 Primary = 1.79 cfs @ 12.02 hrs, Volume= 4,484 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 28.86' @ 12.02 hrs Surf.Area= 155 sf Storage= 93 cf

Plug-Flow detention time= 16.6 min calculated for 4,585 cf (98% of inflow)  
 Center-of-Mass det. time= 5.1 min ( 828.2 - 823.1 )

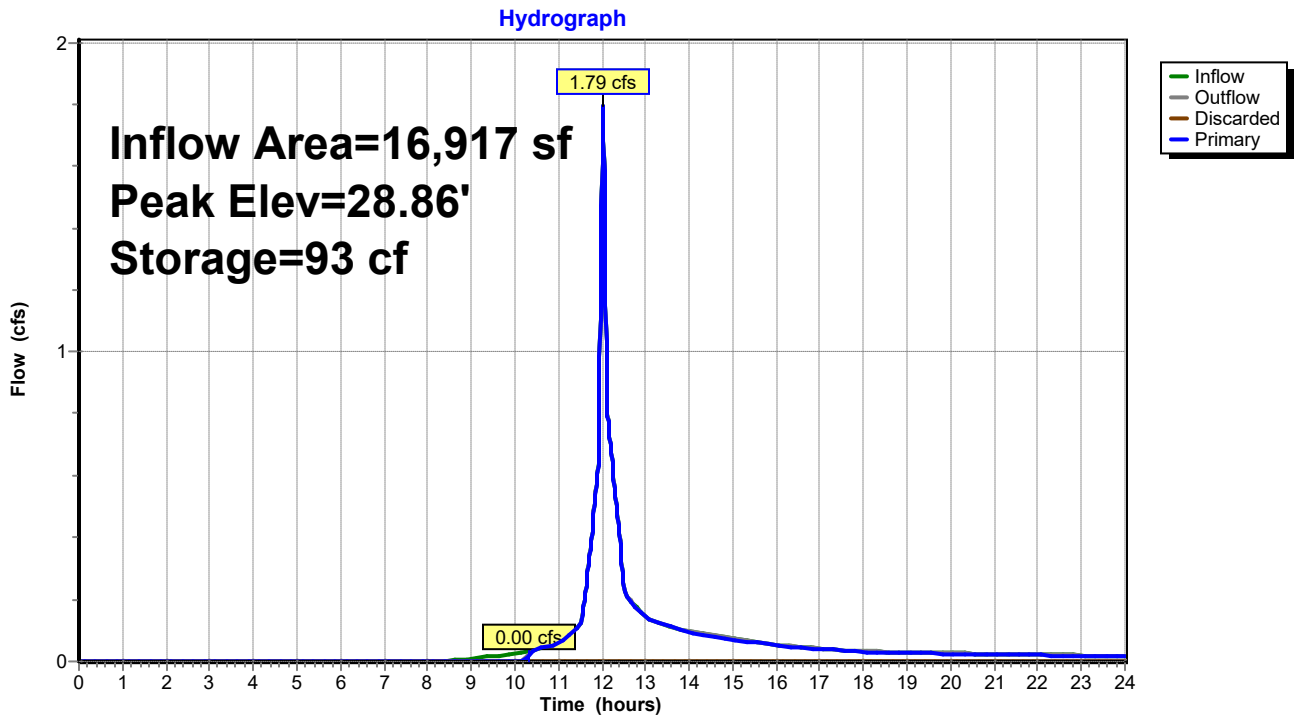
Volume	Invert	Avail.Storage	Storage Description
#1	27.68'	93 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
27.68	104	0	0
28.40	155	93	93

Device	Routing	Invert	Outlet Devices
#1	Discarded	27.68'	<b>0.520 in/hr Exfiltration over Surface area</b>
#2	Primary	28.37'	<b>2.0' long x 4.0' breadth Broad-Crested Rectangular Weir</b>
Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00			
2.50 3.00 3.50 4.00 4.50 5.00 5.50			
Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66			
2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32			

**Discarded OutFlow** Max=0.00 cfs @ 10.32 hrs HW=28.41' (Free Discharge)  
 ↑1=**Exfiltration** (Exfiltration Controls 0.00 cfs)

**Primary OutFlow** Max=1.79 cfs @ 12.02 hrs HW=28.86' (Free Discharge)  
 ↑2=**Broad-Crested Rectangular Weir** (Weir Controls 1.79 cfs @ 1.82 fps)

### Pond 20P: RAINGARDEN





**Summary for Pond 30P: DRYWELL**

Inflow Area = 3,030 sf, 37.76% Impervious, Inflow Depth > 2.20" for 25-Year event  
 Inflow = 0.21 cfs @ 12.01 hrs, Volume= 556 cf  
 Outflow = 0.21 cfs @ 12.02 hrs, Volume= 555 cf, Atten= 0%, Lag= 0.1 min  
 Discarded = 0.01 cfs @ 11.34 hrs, Volume= 269 cf  
 Primary = 0.20 cfs @ 12.02 hrs, Volume= 286 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 28.04' @ 12.02 hrs Surf.Area= 14 sf Storage= 46 cf

Plug-Flow detention time= 41.6 min calculated for 555 cf (100% of inflow)  
 Center-of-Mass det. time= 41.4 min ( 892.4 - 851.1 )

Volume	Invert	Avail.Storage	Storage Description
#1	24.82'	58 cf	<b>3.60'W x 4.00'L x 4.00'H Prismatic</b>

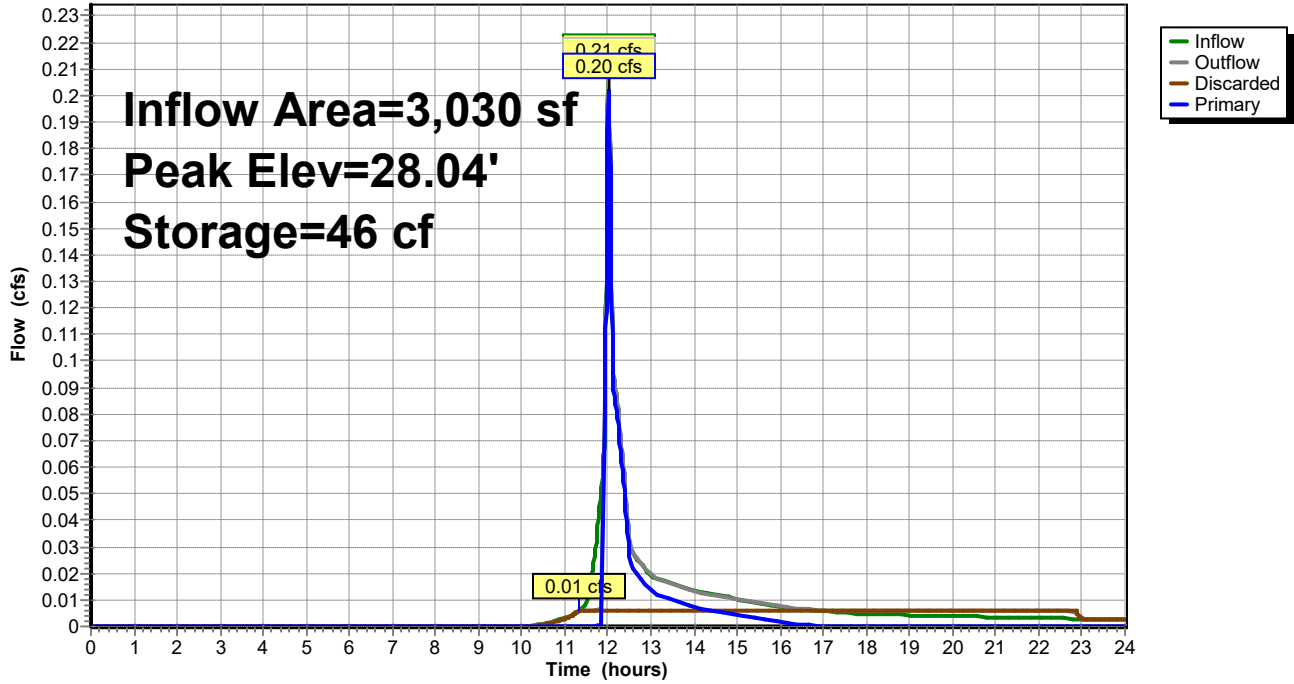
Device	Routing	Invert	Outlet Devices
#1	Discarded	24.82'	<b>18.000 in/hr Exfiltration over Surface area</b>
#2	Primary	27.82'	<b>5.0" Vert. Orifice/Grate</b> C= 0.600
#3	Primary	28.00'	<b>10.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Discarded OutFlow** Max=0.01 cfs @ 11.34 hrs HW=24.86' (Free Discharge)  
 ↖ **1=Exfiltration** (Exfiltration Controls 0.01 cfs)

**Primary OutFlow** Max=0.19 cfs @ 12.02 hrs HW=28.04' (Free Discharge)  
 ↖ **2=Orifice/Grate** (Orifice Controls 0.12 cfs @ 1.61 fps)  
 ↖ **3=Orifice/Grate** (Weir Controls 0.08 cfs @ 0.68 fps)

### Pond 30P: DRYWELL

Hydrograph



**Summary for Pond 42P: CULTEC**

Inflow Area = 1,694 sf, 100.00% Impervious, Inflow Depth > 5.92" for 25-Year event  
 Inflow = 0.28 cfs @ 12.01 hrs, Volume= 836 cf  
 Outflow = 0.08 cfs @ 12.28 hrs, Volume= 836 cf, Atten= 72%, Lag= 16.2 min  
 Discarded = 0.05 cfs @ 11.63 hrs, Volume= 826 cf  
 Primary = 0.03 cfs @ 12.28 hrs, Volume= 10 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 27.01' @ 12.28 hrs Surf.Area= 117 sf Storage= 174 cf

Plug-Flow detention time= 16.7 min calculated for 836 cf (100% of inflow)  
 Center-of-Mass det. time= 16.6 min ( 756.7 - 740.1 )

Volume	Invert	Avail.Storage	Storage Description
#1A	24.50'	162 cf	<b>11.17'W x 10.50'L x 4.54'H Field A</b> 533 cf Overall - 127 cf Embedded = 406 cf x 40.0% Voids
#2A	25.50'	127 cf	<b>Cultec R-330XLHD x 2 Inside #1</b> Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 2 rows
		289 cf	Total Available Storage

Storage Group A created with Chamber Wizard

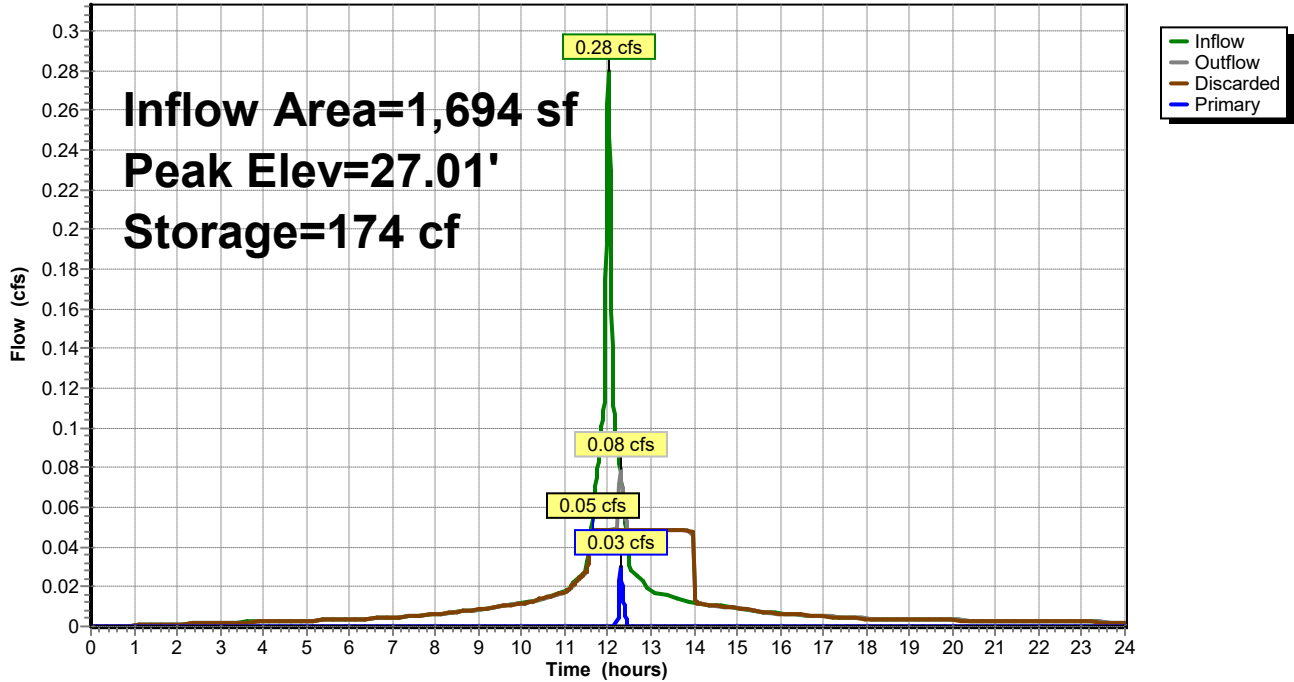
Device	Routing	Invert	Outlet Devices
#1	Primary	26.99'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 0 End Contraction(s)
#2	Discarded	24.50'	<b>18.000 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.05 cfs @ 11.63 hrs HW=24.55' (Free Discharge)  
 ↑**2=Exfiltration** (Exfiltration Controls 0.05 cfs)

**Primary OutFlow** Max=0.02 cfs @ 12.28 hrs HW=27.00' (Free Discharge)  
 ↑**1=Sharp-Crested Rectangular Weir** (Weir Controls 0.02 cfs @ 0.40 fps)

### Pond 42P: CULTEC

#### Hydrograph



**20-087 DR**

Type III 24-hr 100-Year Rainfall=8.94"

Prepared by Design Consultants, Inc.

Printed 4/14/2021

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Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

<b>Subcatchment 1S: NW AREA</b>	Runoff Area=19,862 sf 76.17% Impervious Runoff Depth>7.12" Flow Length=191' Tc=0.9 min CN=85 Runoff=4.37 cfs 11,789 cf
<b>Subcatchment 2S: SE AREA</b>	Runoff Area=17,081 sf 13.91% Impervious Runoff Depth>2.60" Flow Length=201' Slope=0.0210 '/' Tc=3.3 min CN=48 Runoff=1.22 cfs 3,706 cf
<b>Subcatchment 10S: NW LAWN</b>	Runoff Area=8,766 sf 18.24% Impervious Runoff Depth>2.84" Flow Length=143' Slope=0.0560 '/' Tc=1.4 min CN=50 Runoff=0.75 cfs 2,076 cf
<b>Subcatchment 20S: ROADWAY</b>	Runoff Area=16,917 sf 59.05% Impervious Runoff Depth>5.77" Flow Length=179' Tc=1.3 min CN=74 Runoff=3.10 cfs 8,139 cf
<b>Subcatchment 30S: SIDE DRIVEWAY</b>	Runoff Area=3,030 sf 37.76% Impervious Runoff Depth>4.30" Flow Length=82' Tc=0.7 min CN=62 Runoff=0.42 cfs 1,085 cf
<b>Subcatchment 40S: EASTERN REAR</b>	Runoff Area=6,505 sf 0.00% Impervious Runoff Depth>1.57" Flow Length=110' Slope=0.0230 '/' Tc=1.7 min CN=39 Runoff=0.24 cfs 853 cf
<b>Subcatchment 41S: EASTERN ROOF</b>	Runoff Area=1,694 sf 100.00% Impervious Runoff Depth>8.70" Tc=1.0 min CN=98 Runoff=0.41 cfs 1,228 cf
<b>Reach 1R: RAIL TRAIL</b>	Inflow=4.37 cfs 11,789 cf Outflow=4.37 cfs 11,789 cf
<b>Reach 2R: EASTERN ABUTTERS</b>	Inflow=1.22 cfs 3,706 cf Outflow=1.22 cfs 3,706 cf
<b>Reach 3R: TOTAL</b>	Inflow=5.32 cfs 15,495 cf Outflow=5.32 cfs 15,495 cf
<b>Reach 10R: RAIL TRAIL</b>	Inflow=3.83 cfs 10,009 cf Outflow=3.83 cfs 10,009 cf
<b>Reach 20R: EASTERN ABUTTERS</b>	Inflow=1.00 cfs 1,758 cf Outflow=1.00 cfs 1,758 cf
<b>Reach 30R: TOTAL</b>	Inflow=4.74 cfs 11,767 cf Outflow=4.74 cfs 11,767 cf
<b>Pond 20P: RAINGARDEN</b>	Peak Elev=29.06' Storage=93 cf Inflow=3.10 cfs 8,139 cf Discarded=0.00 cfs 113 cf Primary=3.09 cfs 7,932 cf Outflow=3.09 cfs 8,046 cf
<b>Pond 30P: DRYWELL</b>	Peak Elev=28.09' Storage=47 cf Inflow=0.42 cfs 1,085 cf Discarded=0.01 cfs 309 cf Primary=0.42 cfs 743 cf Outflow=0.42 cfs 1,052 cf
<b>Pond 42P: CULTEC</b>	Peak Elev=27.08' Storage=179 cf Inflow=0.41 cfs 1,228 cf Discarded=0.05 cfs 1,065 cf Primary=0.38 cfs 163 cf Outflow=0.42 cfs 1,228 cf

**Summary for Subcatchment 1S: NW AREA**

Runoff = 4.37 cfs @ 12.01 hrs, Volume= 11,789 cf, Depth> 7.12"

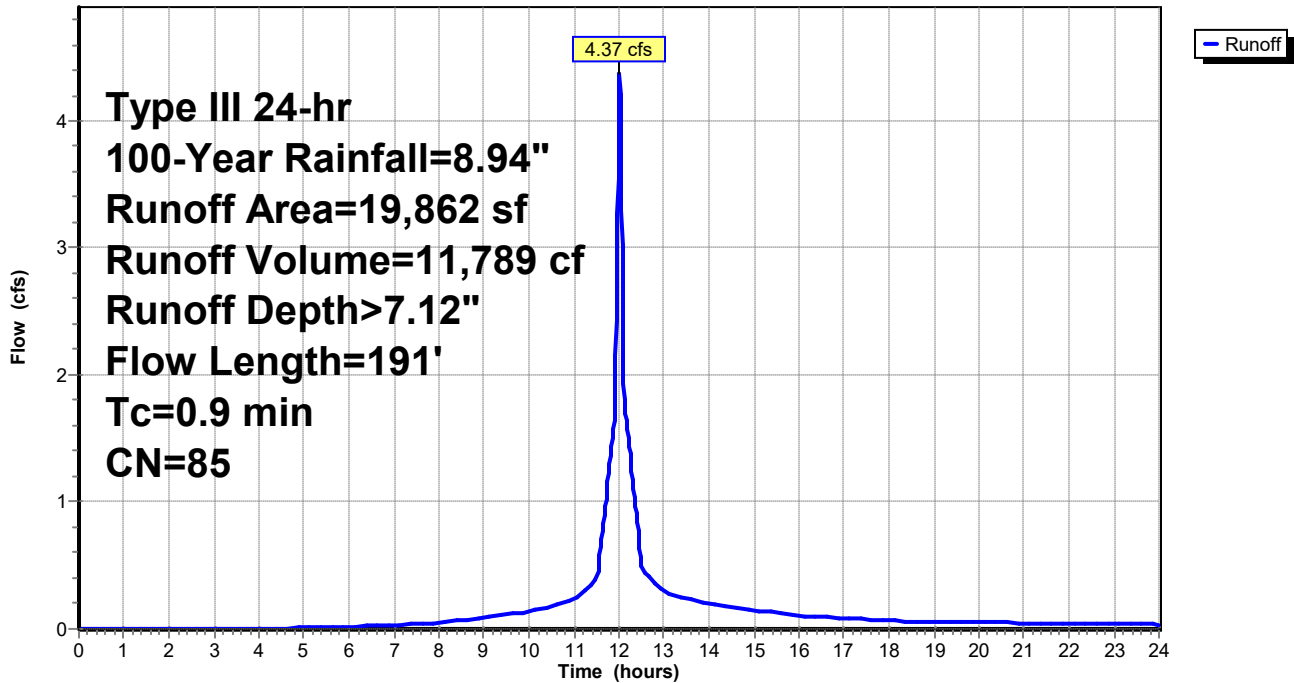
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 100-Year Rainfall=8.94"

Area (sf)	CN	Description
12,146	98	Paved parking, HSG A
2,982	98	Roofs, HSG A
3,870	43	Woods/grass comb., Fair, HSG A
864	39	>75% Grass cover, Good, HSG A
19,862	85	Weighted Average
4,734		23.83% Pervious Area
15,128		76.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	176	0.0340	3.74		<b>Shallow Concentrated Flow, Pavement</b>
					Paved Kv= 20.3 fps
0.1	15	0.0670	1.81		<b>Shallow Concentrated Flow, Grass</b>
					Short Grass Pasture Kv= 7.0 fps
0.9	191	Total			

**Subcatchment 1S: NW AREA**

Hydrograph



**Summary for Subcatchment 2S: SE AREA**

Runoff = 1.22 cfs @ 12.06 hrs, Volume= 3,706 cf, Depth> 2.60"

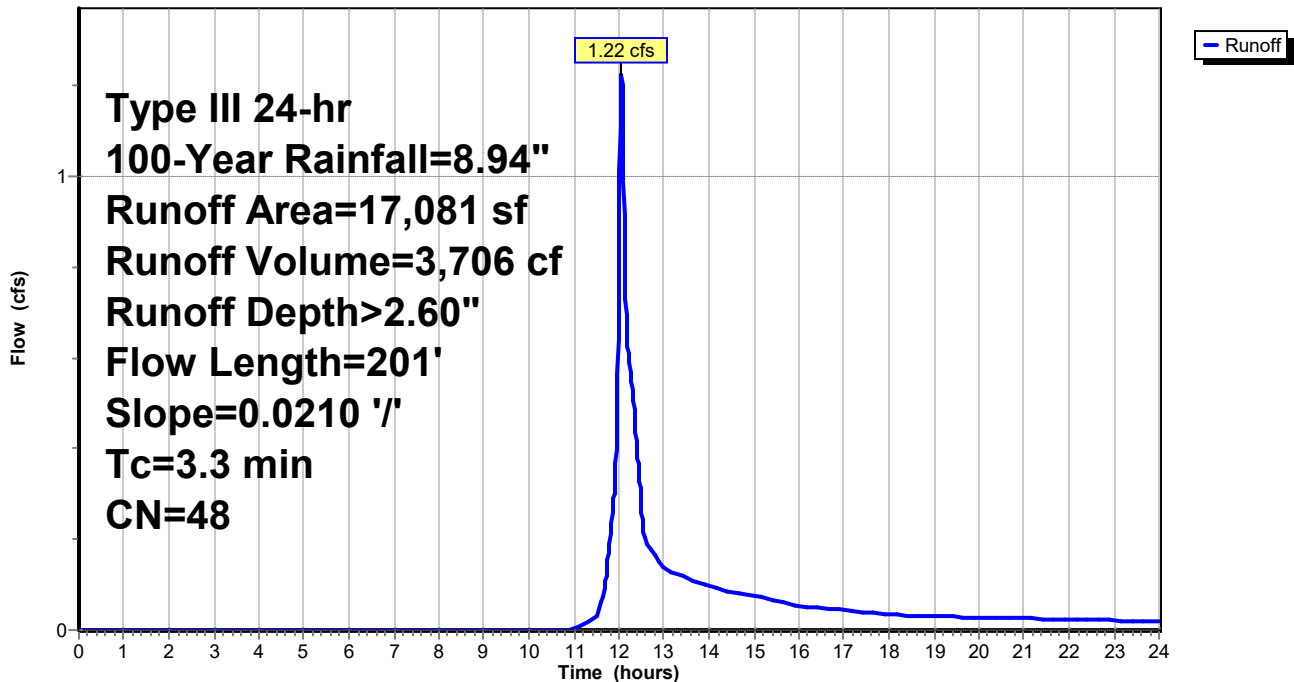
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 100-Year Rainfall=8.94"

Area (sf)	CN	Description
52	98	Paved parking, HSG A
2,324	98	Roofs, HSG A
1,521	43	Woods/grass comb., Fair, HSG A
13,184	39	>75% Grass cover, Good, HSG A
17,081	48	Weighted Average
14,705		86.09% Pervious Area
2,376		13.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	201	0.0210	1.01		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps

**Subcatchment 2S: SE AREA**

Hydrograph



**Summary for Subcatchment 10S: NW LAWN**

Runoff = 0.75 cfs @ 12.03 hrs, Volume= 2,076 cf, Depth> 2.84"

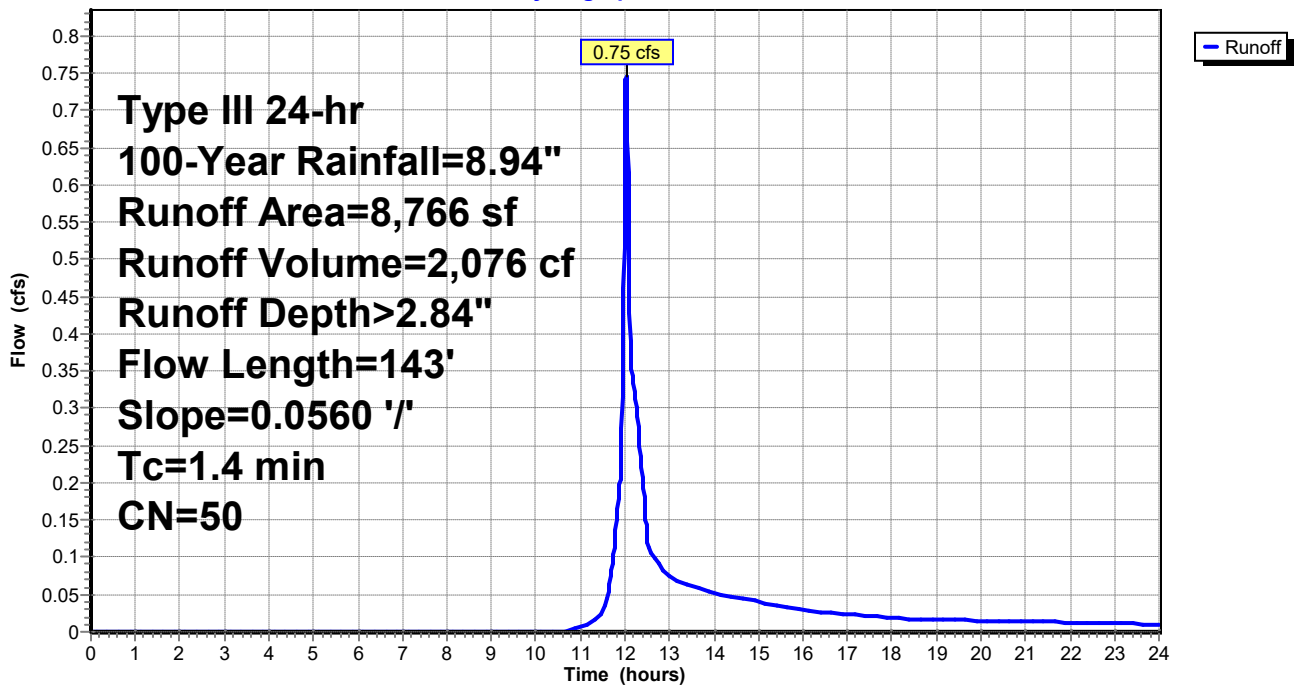
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 100-Year Rainfall=8.94"

Area (sf)	CN	Description
7,000	39	>75% Grass cover, Good, HSG A
1,599	98	Roofs, HSG A
* 167	55	Permeable pavers
8,766	50	Weighted Average
7,167		81.76% Pervious Area
1,599		18.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	143	0.0560	1.66		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps

**Subcatchment 10S: NW LAWN**

Hydrograph





**Summary for Subcatchment 20S: ROADWAY**

Runoff = 3.10 cfs @ 12.02 hrs, Volume= 8,139 cf, Depth> 5.77"

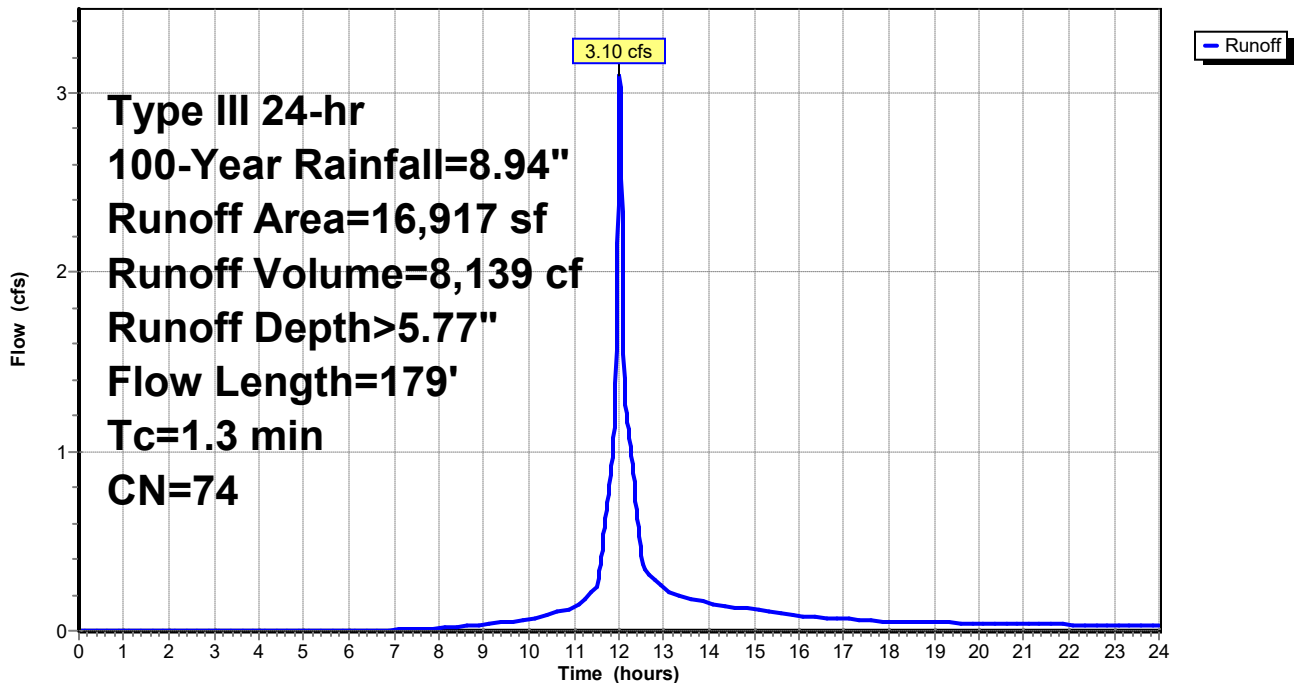
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 100-Year Rainfall=8.94"

Area (sf)	CN	Description
5,311	98	Paved parking, HSG A
229	98	Unconnected pavement, HSG A
6,273	39	>75% Grass cover, Good, HSG A
4,450	98	Roofs, HSG A
* 654	55	Permeable pavers
16,917	74	Weighted Average
6,927		40.95% Pervious Area
9,990		59.05% Impervious Area
229		2.29% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	67	0.0670	1.81		<b>Shallow Concentrated Flow, Grass</b>
					Short Grass Pasture Kv= 7.0 fps
0.7	112	0.0160	2.57		<b>Shallow Concentrated Flow, Road</b>
					Paved Kv= 20.3 fps
1.3	179	Total			

**Subcatchment 20S: ROADWAY**

Hydrograph



**Summary for Subcatchment 30S: SIDE DRIVEWAY**

Runoff = 0.42 cfs @ 12.01 hrs, Volume= 1,085 cf, Depth> 4.30"

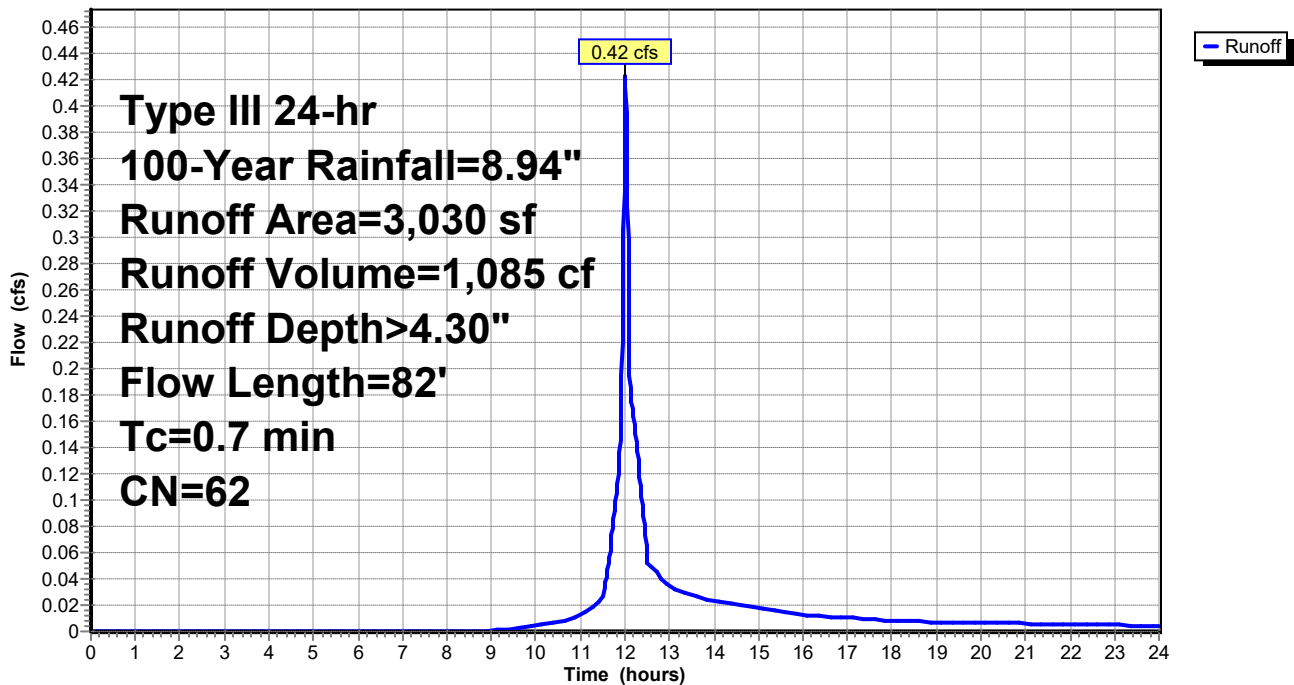
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100-Year Rainfall=8.94"

Area (sf)	CN	Description
1,144	98	Paved parking, HSG A
1,720	39	>75% Grass cover, Good, HSG A
* 166	55	Permeable pavers
3,030	62	Weighted Average
1,886		62.24% Pervious Area
1,144		37.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	48	0.0520	1.60		<b>Shallow Concentrated Flow, Grass</b>
					Short Grass Pasture Kv= 7.0 fps
0.2	34	0.0290	3.46		<b>Shallow Concentrated Flow, Driveway</b>
					Paved Kv= 20.3 fps
0.7	82	Total			

**Subcatchment 30S: SIDE DRIVEWAY**

Hydrograph



**Summary for Subcatchment 40S: EASTERN REAR**

Runoff = 0.24 cfs @ 12.04 hrs, Volume= 853 cf, Depth> 1.57"

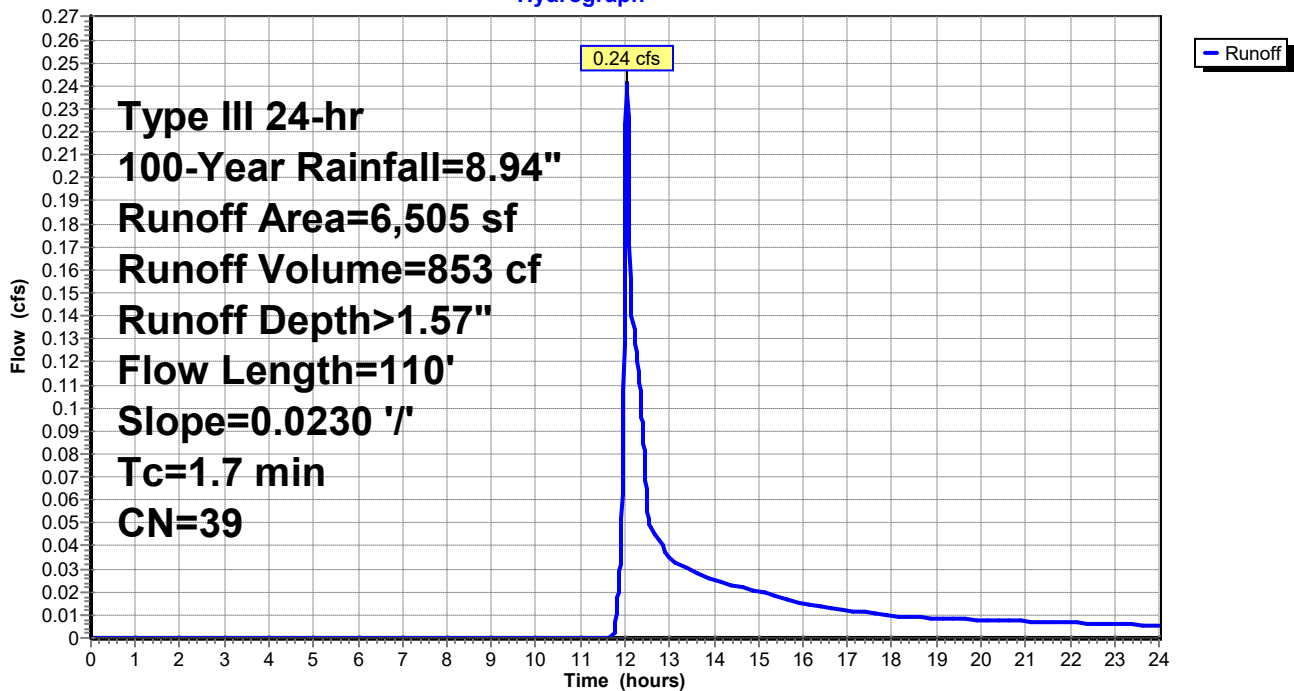
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 100-Year Rainfall=8.94"

Area (sf)	CN	Description
6,505	39	>75% Grass cover, Good, HSG A
6,505		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	110	0.0230	1.06		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps

**Subcatchment 40S: EASTERN REAR**

Hydrograph



### Summary for Subcatchment 41S: EASTERN ROOF

Runoff = 0.41 cfs @ 12.01 hrs, Volume= 1,228 cf, Depth> 8.70"

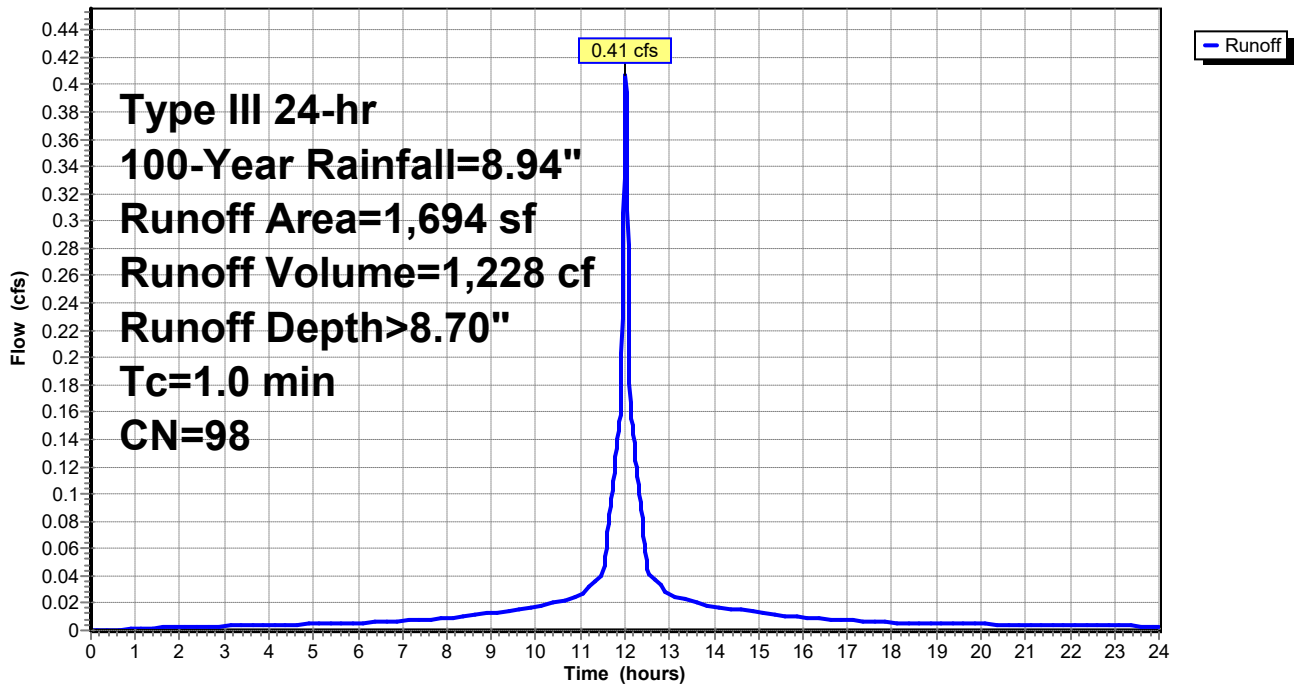
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 100-Year Rainfall=8.94"

Area (sf)	CN	Description
1,694	98	Roofs, HSG A
1,694		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0					Direct Entry,

### Subcatchment 41S: EASTERN ROOF

Hydrograph



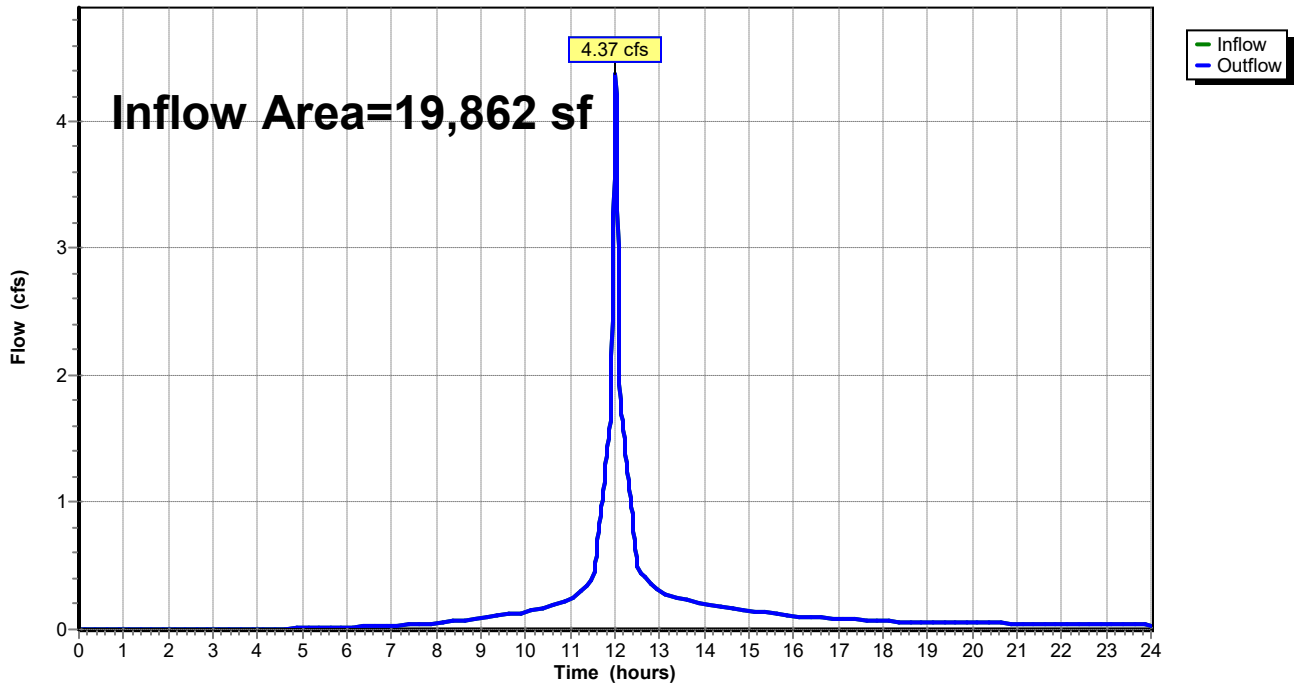
### Summary for Reach 1R: RAIL TRAIL

Inflow Area = 19,862 sf, 76.17% Impervious, Inflow Depth > 7.12" for 100-Year event  
Inflow = 4.37 cfs @ 12.01 hrs, Volume= 11,789 cf  
Outflow = 4.37 cfs @ 12.01 hrs, Volume= 11,789 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 1R: RAIL TRAIL

Hydrograph

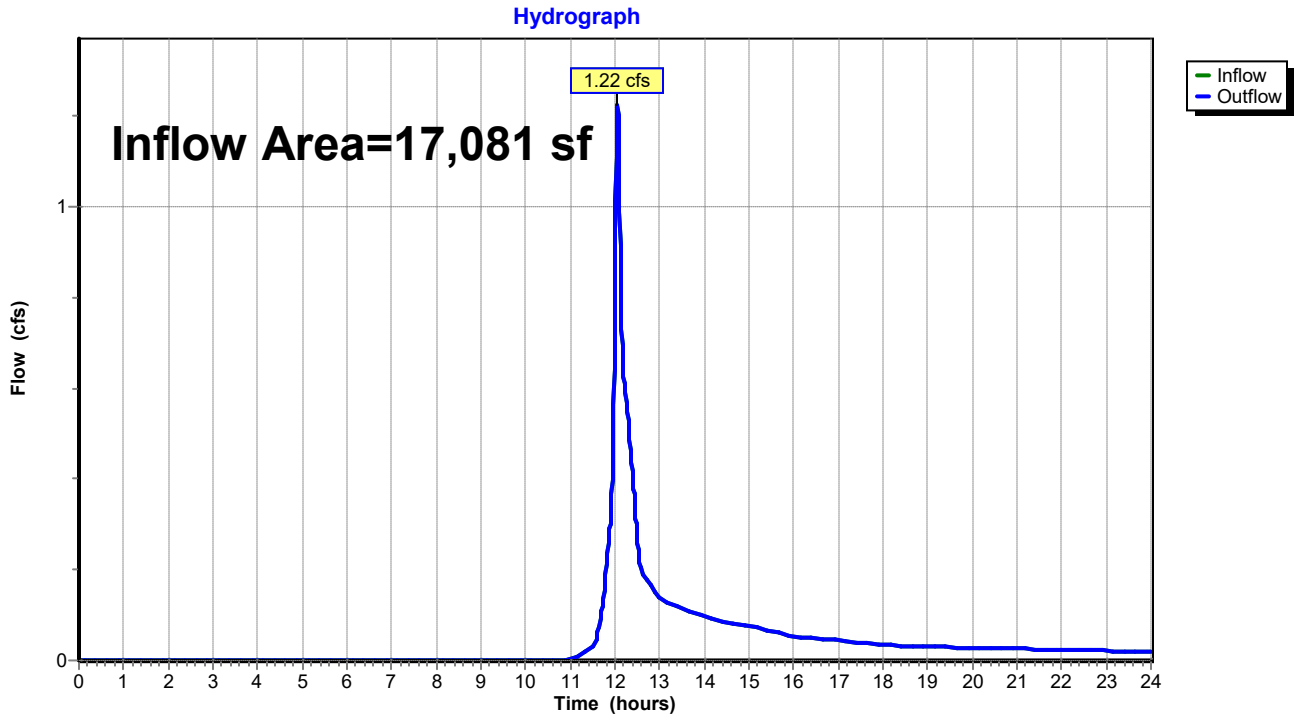


### Summary for Reach 2R: EASTERN ABUTTERS

Inflow Area = 17,081 sf, 13.91% Impervious, Inflow Depth > 2.60" for 100-Year event  
Inflow = 1.22 cfs @ 12.06 hrs, Volume= 3,706 cf  
Outflow = 1.22 cfs @ 12.06 hrs, Volume= 3,706 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 2R: EASTERN ABUTTERS



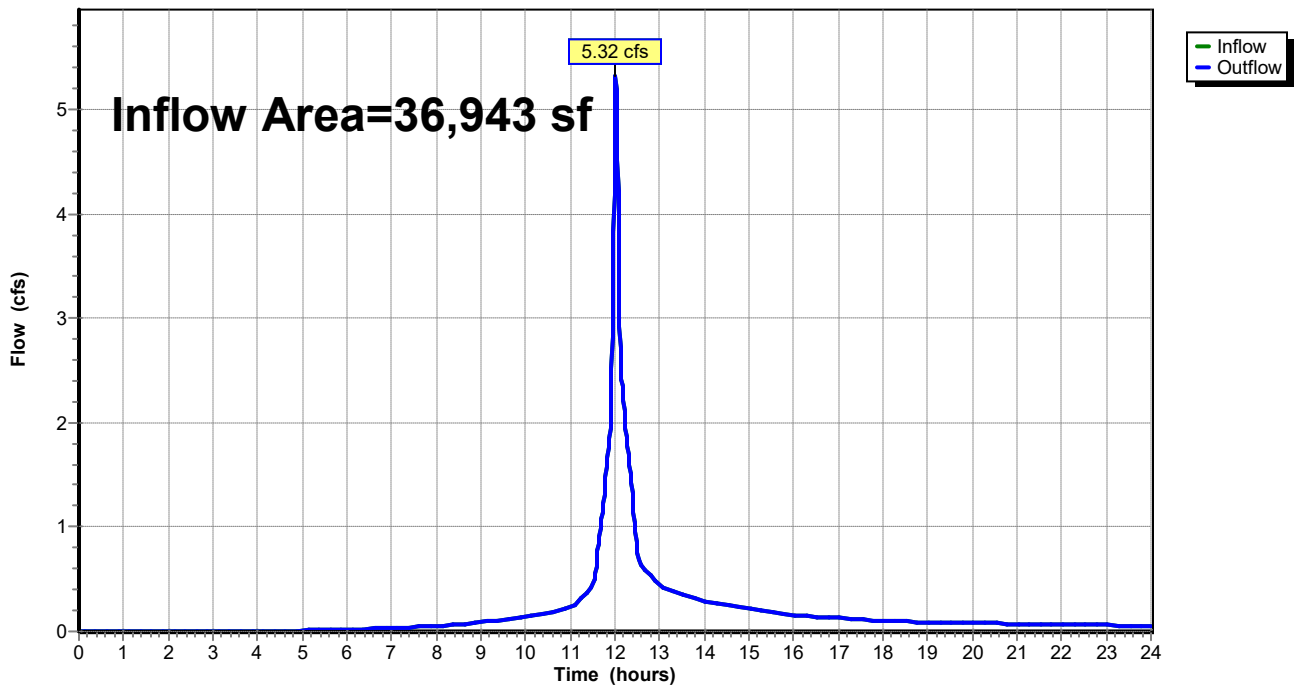
### Summary for Reach 3R: TOTAL

Inflow Area = 36,943 sf, 47.38% Impervious, Inflow Depth > 5.03" for 100-Year event  
Inflow = 5.32 cfs @ 12.02 hrs, Volume= 15,495 cf  
Outflow = 5.32 cfs @ 12.02 hrs, Volume= 15,495 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 3R: TOTAL

Hydrograph



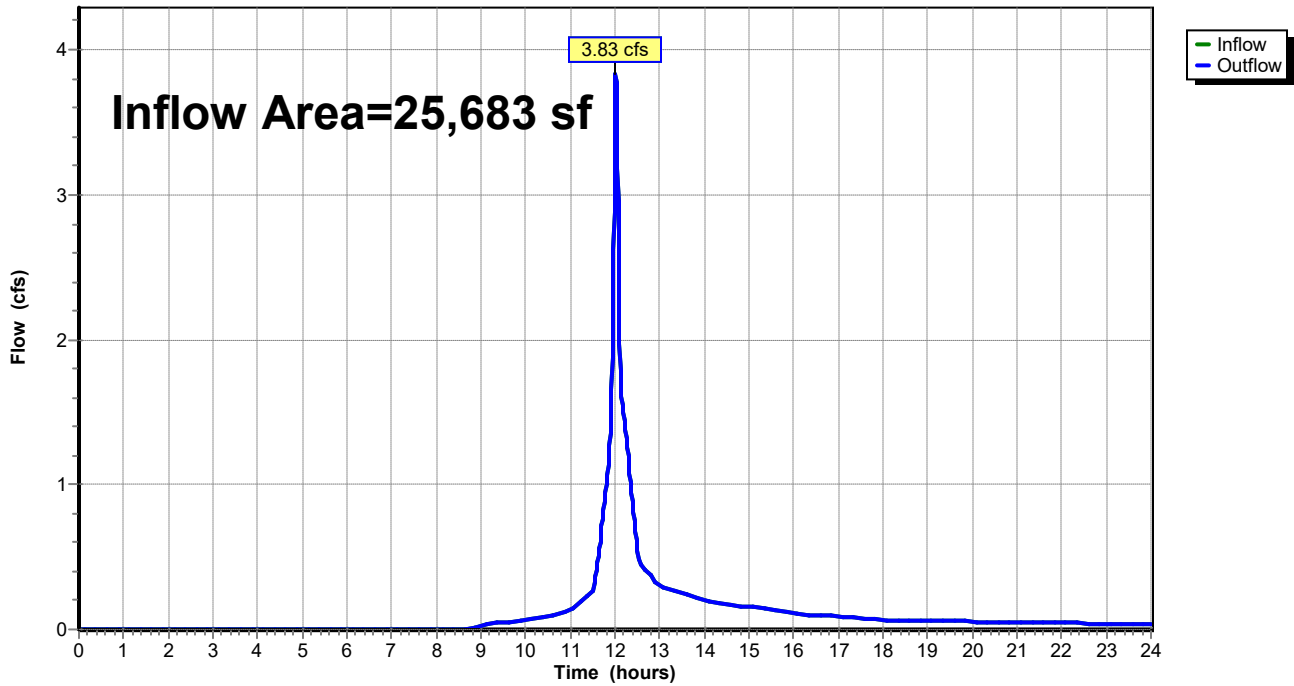
### Summary for Reach 10R: RAIL TRAIL

Inflow Area = 25,683 sf, 45.12% Impervious, Inflow Depth > 4.68" for 100-Year event  
Inflow = 3.83 cfs @ 12.02 hrs, Volume= 10,009 cf  
Outflow = 3.83 cfs @ 12.02 hrs, Volume= 10,009 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 10R: RAIL TRAIL

Hydrograph





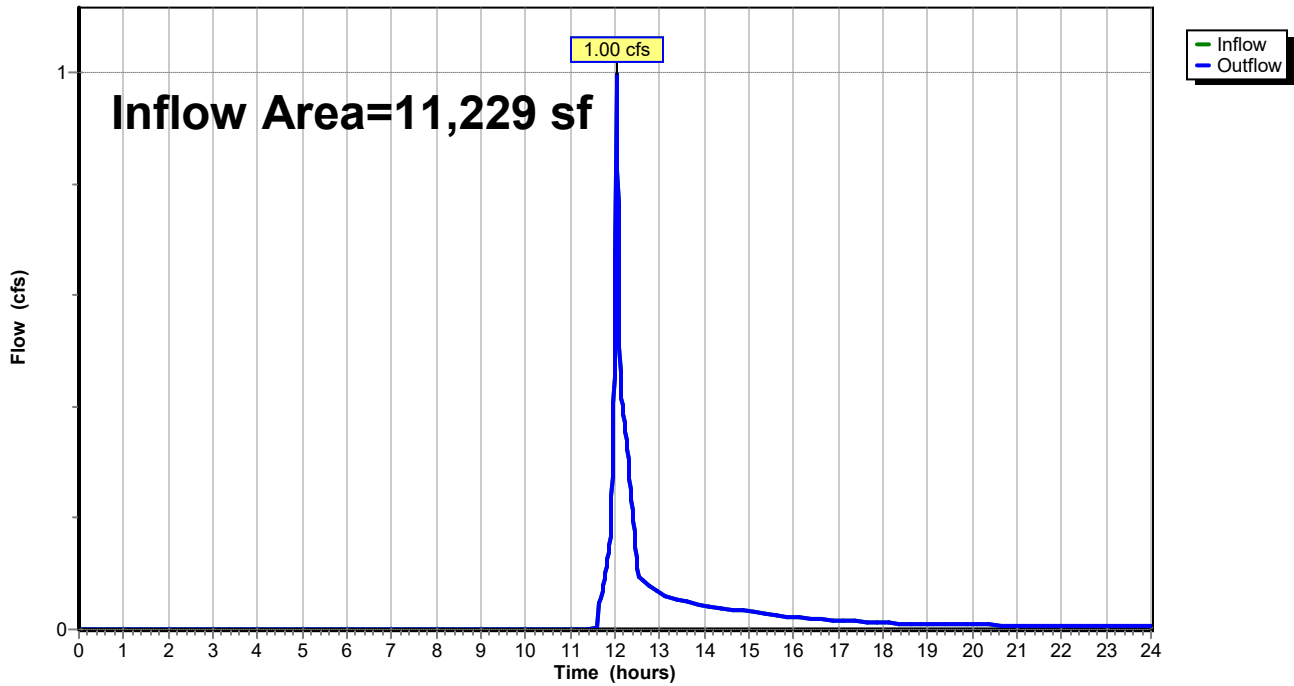
### Summary for Reach 20R: EASTERN ABUTTERS

Inflow Area = 11,229 sf, 25.27% Impervious, Inflow Depth > 1.88" for 100-Year event  
Inflow = 1.00 cfs @ 12.03 hrs, Volume= 1,758 cf  
Outflow = 1.00 cfs @ 12.03 hrs, Volume= 1,758 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 20R: EASTERN ABUTTERS

Hydrograph



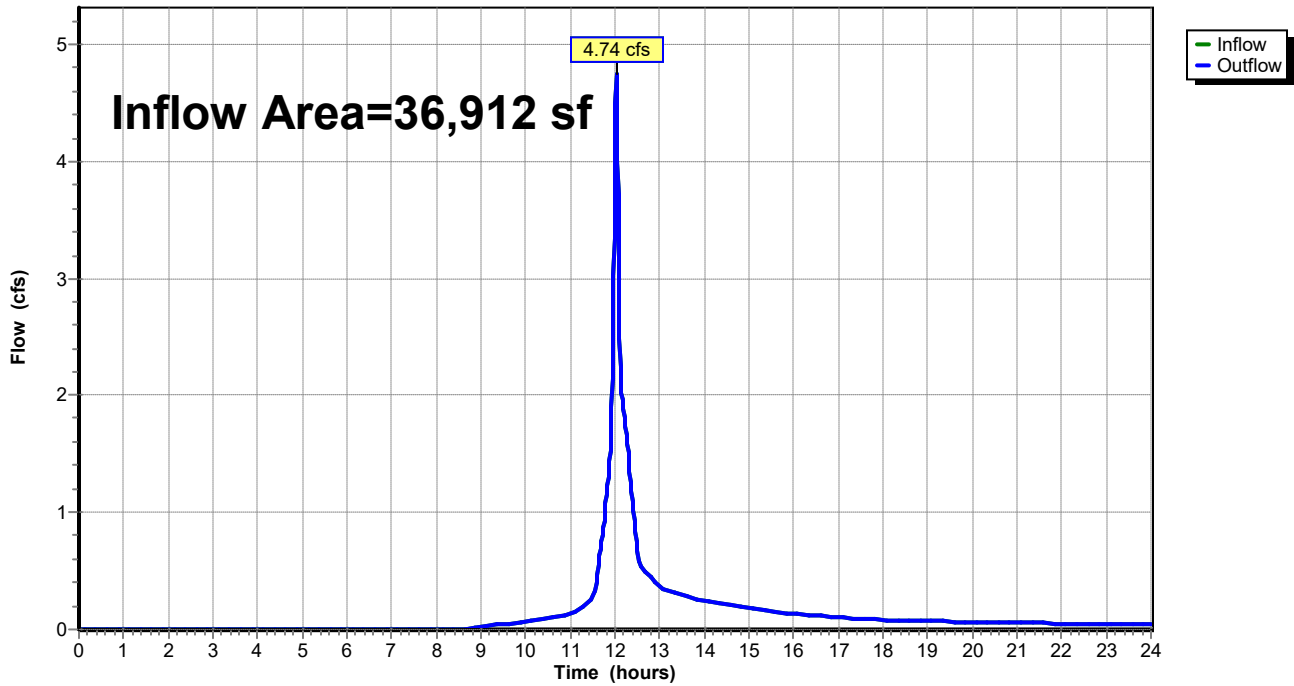
### Summary for Reach 30R: TOTAL

Inflow Area = 36,912 sf, 39.08% Impervious, Inflow Depth > 3.83" for 100-Year event  
Inflow = 4.74 cfs @ 12.03 hrs, Volume= 11,767 cf  
Outflow = 4.74 cfs @ 12.03 hrs, Volume= 11,767 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Reach 30R: TOTAL

Hydrograph



**Summary for Pond 20P: RAINGARDEN**

Inflow Area = 16,917 sf, 59.05% Impervious, Inflow Depth > 5.77" for 100-Year event  
 Inflow = 3.10 cfs @ 12.02 hrs, Volume= 8,139 cf  
 Outflow = 3.09 cfs @ 12.02 hrs, Volume= 8,046 cf, Atten= 0%, Lag= 0.0 min  
 Discarded = 0.00 cfs @ 8.91 hrs, Volume= 113 cf  
 Primary = 3.09 cfs @ 12.02 hrs, Volume= 7,932 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 29.06' @ 12.02 hrs Surf.Area= 155 sf Storage= 93 cf

Plug-Flow detention time= 10.7 min calculated for 8,042 cf (99% of inflow)  
 Center-of-Mass det. time= 3.7 min ( 811.0 - 807.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	27.68'	93 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
27.68	104	0	0
28.40	155	93	93

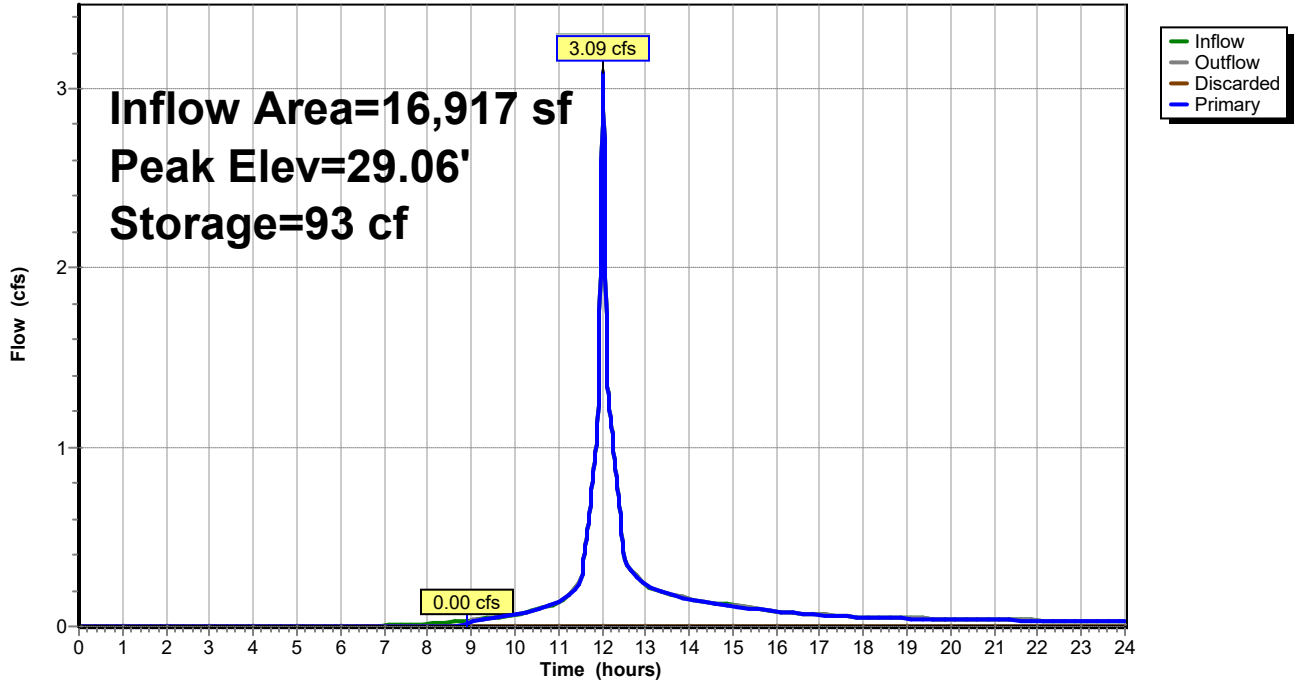
Device	Routing	Invert	Outlet Devices
#1	Discarded	27.68'	<b>0.520 in/hr Exfiltration over Surface area</b>
#2	Primary	28.37'	<b>2.0' long x 4.0' breadth Broad-Crested Rectangular Weir</b>
Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00			
2.50 3.00 3.50 4.00 4.50 5.00 5.50			
Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66			
2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32			

**Discarded OutFlow** Max=0.00 cfs @ 8.91 hrs HW=28.41' (Free Discharge)  
 ↑1=**Exfiltration** (Exfiltration Controls 0.00 cfs)

**Primary OutFlow** Max=3.09 cfs @ 12.02 hrs HW=29.06' (Free Discharge)  
 ↑2=**Broad-Crested Rectangular Weir** (Weir Controls 3.09 cfs @ 2.23 fps)

### Pond 20P: RAINGARDEN

Hydrograph



**Summary for Pond 30P: DRYWELL**

Inflow Area = 3,030 sf, 37.76% Impervious, Inflow Depth > 4.30" for 100-Year event  
 Inflow = 0.42 cfs @ 12.01 hrs, Volume= 1,085 cf  
 Outflow = 0.42 cfs @ 12.01 hrs, Volume= 1,052 cf, Atten= 0%, Lag= 0.1 min  
 Discarded = 0.01 cfs @ 10.34 hrs, Volume= 309 cf  
 Primary = 0.42 cfs @ 12.01 hrs, Volume= 743 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 28.09' @ 12.01 hrs Surf.Area= 14 sf Storage= 47 cf

Plug-Flow detention time= 29.3 min calculated for 1,052 cf (97% of inflow)  
 Center-of-Mass det. time= 11.8 min ( 843.0 - 831.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	24.82'	58 cf	<b>3.60'W x 4.00'L x 4.00'H Prismatic</b>

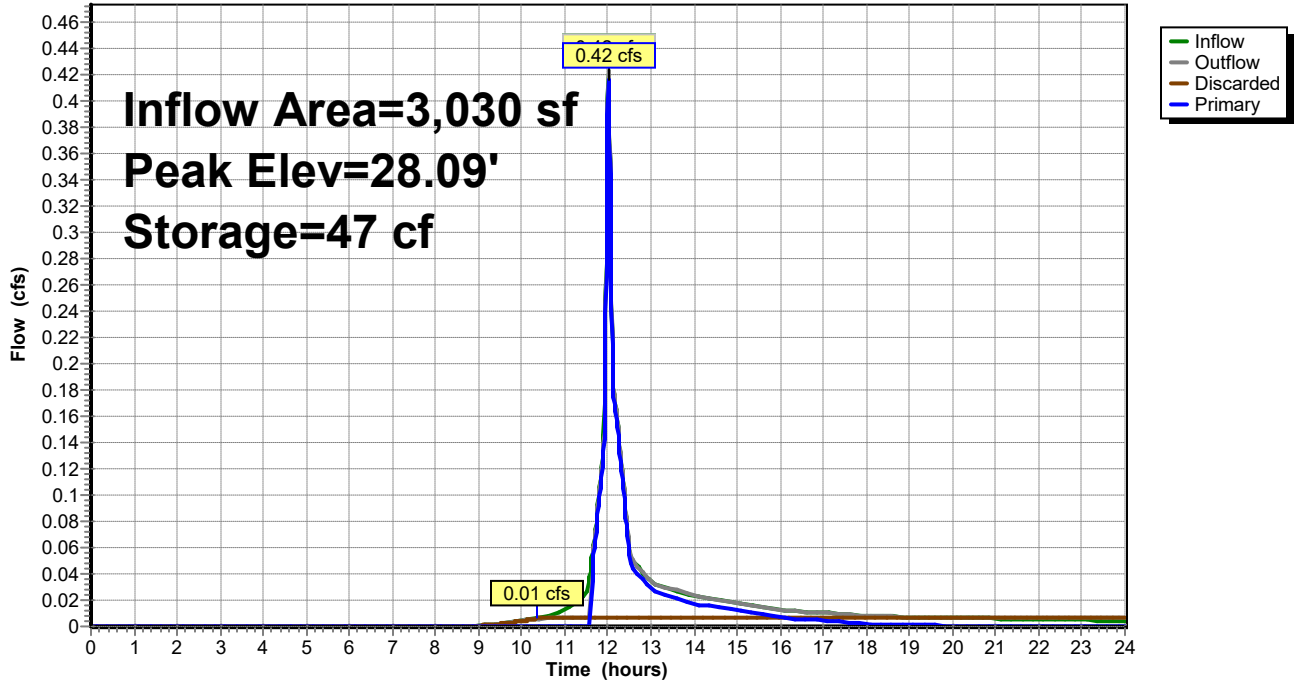
Device	Routing	Invert	Outlet Devices
#1	Discarded	24.82'	<b>18.000 in/hr Exfiltration over Surface area</b>
#2	Primary	27.82'	<b>5.0" Vert. Orifice/Grate</b> C= 0.600
#3	Primary	28.00'	<b>10.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Discarded OutFlow** Max=0.01 cfs @ 10.34 hrs HW=24.86' (Free Discharge)  
 ↑**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

**Primary OutFlow** Max=0.41 cfs @ 12.01 hrs HW=28.09' (Free Discharge)  
 ↑**2=Orifice/Grate** (Orifice Controls 0.17 cfs @ 1.78 fps)  
 ↑**3=Orifice/Grate** (Weir Controls 0.24 cfs @ 1.00 fps)

### Pond 30P: DRYWELL

Hydrograph



**Summary for Pond 42P: CULTEC**

Inflow Area = 1,694 sf, 100.00% Impervious, Inflow Depth > 8.70" for 100-Year event  
 Inflow = 0.41 cfs @ 12.01 hrs, Volume= 1,228 cf  
 Outflow = 0.42 cfs @ 12.03 hrs, Volume= 1,228 cf, Atten= 0%, Lag= 1.2 min  
 Discarded = 0.05 cfs @ 11.56 hrs, Volume= 1,065 cf  
 Primary = 0.38 cfs @ 12.03 hrs, Volume= 163 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 27.08' @ 12.03 hrs Surf.Area= 117 sf Storage= 179 cf

Plug-Flow detention time= 14.9 min calculated for 1,228 cf (100% of inflow)  
 Center-of-Mass det. time= 14.8 min ( 750.0 - 735.2 )

Volume	Invert	Avail.Storage	Storage Description
#1A	24.50'	162 cf	<b>11.17'W x 10.50'L x 4.54'H Field A</b> 533 cf Overall - 127 cf Embedded = 406 cf x 40.0% Voids
#2A	25.50'	127 cf	<b>Cultec R-330XLHD x 2 Inside #1</b> Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 2 rows
		289 cf	Total Available Storage

Storage Group A created with Chamber Wizard

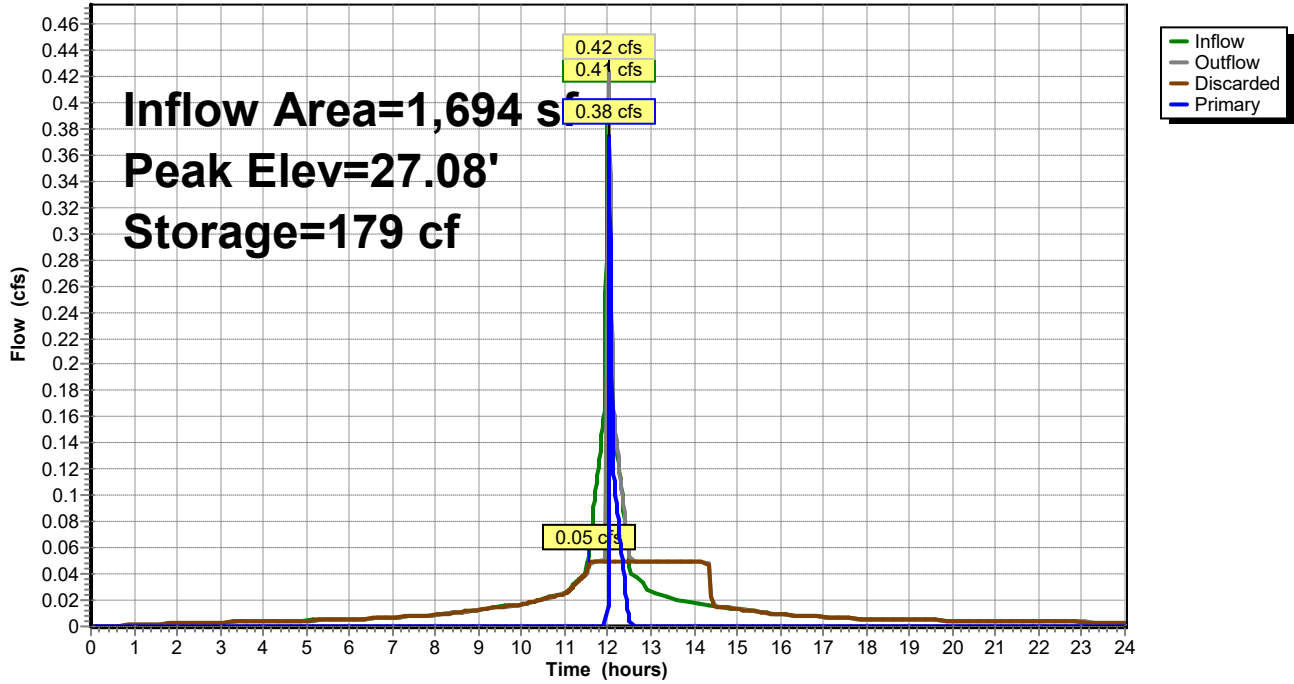
Device	Routing	Invert	Outlet Devices
#1	Primary	26.99'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 0 End Contraction(s)
#2	Discarded	24.50'	<b>18.000 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.05 cfs @ 11.56 hrs HW=24.55' (Free Discharge)  
 ↑**2=Exfiltration** (Exfiltration Controls 0.05 cfs)

**Primary OutFlow** Max=0.33 cfs @ 12.03 hrs HW=27.08' (Free Discharge)  
 ↑**1=Sharp-Crested Rectangular Weir** (Weir Controls 0.33 cfs @ 0.96 fps)

### Pond 42P: CULTEC

#### Hydrograph





**Appendix F**

**OPERATION & MAINTENANCE  
PLAN**

# Operation & Maintenance Plan (Permanent BMPs)

FOR

**21-27 Hancock Street,  
Newburyport, MA**

Date: February, 2021  
Rev. April 14, 2021

Owner/Operator: Jay Caswell  
Caswell Development  
24 Graf Road  
Newburyport, MA

## **Inspection and Maintenance Schedule**

Facility personnel will inspect the stormwater management system on a routine basis not less than once per month for the first six (6) months of operation and annually thereafter. The estimated cost for this inspection and maintenance schedule is \$800/yr. Refer to project design and as-built plans for stormwater systems and landscaped area locations. Inspection and maintenance shall be performed as follows:

### **1. Landscaped Areas:**

Landscaped areas shall be inspected and maintained on a regular basis. Areas that may be subject to erosion will be stabilized and reseeded immediately. Inspect soil and repair eroded areas monthly. Re-plant void areas as needed. Remove litter and debris monthly. Remove and replace dead vegetation twice per year in spring and fall. Replace soil media if ponding is witnessed more than 48 hours after rainfall event.

### **2. Roof Drains:**

*Inspections:* The downspout inlets on the roof of the building will need periodic maintenance to ensure proper function. The required interval for this maintenance will vary by season; however, downspout inlets should be inspected for debris before the rainy season. When trees and other deciduous vegetation shed leaves that drop into the gutters, this will inhibit the flow of water and possibly clog downspouts. The leaves and/or debris must be removed in order for the system to work as designed.

*Maintenance:* Debris, such as leaves and trash, shall be removed by hand. Sediments shall be swept and collected or vacuumed.

### **3. Infiltration Chambers:**

*Inspections:* During first year visually inspect after each major storm (>1.5") and again 72 hours later to verify exfiltration is occurring as designed. Note if water remains in basin after 72 hours. After first year visually inspect twice per year. Infiltration Systems shall be inspected for accumulation of silt, sediment, standing water, or debris on an annual basis. Debris and sediment shall be removed. Inspect overflow outlet of chambers and level spreader at gravel basin. Basin should be inspected for excessive erosion or any additional necessary changes. Down gradient of gravel basin and level spreader should also be inspected for excess erosion.

*Inspection & Maintenance procedure is as follows:* The inspection port is an 8" bolted plastic cover. Removing the inspection cover will provide access to the Chamber below. From the surface, confirm the chamber is drained to stone bottom. The chambers should drain with 48 hours of any rain event. If water evident after 48 hours the stone base and any surrounding clogged soil should be replaced and the chambers reinstalled.

### **Rain Garden**

#### *Inspections & Maintenance:*

Following construction, inspect site following rain events. Add/replace vegetation in any eroded areas. Water to promote plant growth and survival, especially during the first two years and during dry spells.

#### Monthly:

- prune and weed swale to maintain appearance
- remove accumulated trash and debris
- replace mulch as needed

#### Annually:

- Inspect inflow area for sediment accumulation. Remove accumulated sediment or debris.
- Inspect site for erosion as well as sediment and mulch which have been moved around in the garden. Add/replace vegetation in any eroded areas.
- Inspect rain garden for dead or dying vegetation. Replace vegetation as needed.
- Test planting bed for pH. If the pH is below 5.2, limestone should be applied. If the pH is above 8.0, iron sulfate and sulfur should be applied.

#### Every 2 to 3 years:

- Remove and replace mulch

### **4. Dry Well:**

*Inspections:* During first year visually inspect after each major storm (>1.5") and again 72 hours later to verify exfiltration is occurring as designed. Note if water remains in basin after 72 hours. After first year visually inspect twice per year. Infiltration Systems shall be inspected for

accumulation of silt, sediment, standing water, or debris on an annual basis. Debris and sediment shall be removed.

*Inspection & Maintenance procedure is as follows:*

The inspection port is a 24" by 24" grate and frame. When the grate is removed, this will provide access to the inside of the dry well below. From the surface, through this access, the sediment may be measured at this location. A stadia rod may be used to measure the depth of sediment, if any, in this infiltration chamber. If the depth of sediment is in excess of 3 inches (76 mm), then this chamber should be cleaned with a vacuum truck, or by hand if possible.

Stormwater System Inspection Report

General Information	
Location: <b>21-27 Hancock Street, Newburyport</b>	
Date of Inspection	Start/End Time
Inspector's Name(s)	
Inspector's Title(s)	
Inspector's Contact Information	
Purpose of Inspection	
Weather Information	
Has it rained since the last inspection? <input type="checkbox"/> Yes <input type="checkbox"/> No	
Weather at time of this inspection?	

Site-Specific Stormwater Devices: (See above for inspection frequency)

	Description	Installed and Operating Properly?	Corrective Action Needed	Date for Corrective Action/Responsible Person
1		<input type="checkbox"/> Yes <input type="checkbox"/> No		
2		<input type="checkbox"/> Yes <input type="checkbox"/> No		
3		<input type="checkbox"/> Yes <input type="checkbox"/> No		
4		<input type="checkbox"/> Yes <input type="checkbox"/> No		
5		<input type="checkbox"/> Yes <input type="checkbox"/> No		
6		<input type="checkbox"/> Yes <input type="checkbox"/> No		
7		<input type="checkbox"/> Yes <input type="checkbox"/> No		
8		<input type="checkbox"/> Yes <input type="checkbox"/> No		

Overall Site Issues

	Description		Corrective Action	Date for Corrective Action/Responsible Person
1	Are all slopes properly stabilized?	<input type="checkbox"/> Yes <input type="checkbox"/> No		
2	Are natural resource areas (e.g., streams, wetlands, etc.) being subjected to erosion?	<input type="checkbox"/> Yes <input type="checkbox"/> No		
3	Are discharge points free of sediment deposits?	<input type="checkbox"/> Yes <input type="checkbox"/> No		

**Certification Statement:**

“I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.”

Print name:

Signature:

Date: