

# ***STORMWATER MANAGEMENT REPORT***

**The Governor's Academy  
1 Elm Street  
Byfield, Massachusetts**

***Parker River Environmental Studies Building***

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*Prepared for:*

**THE GOVERNOR'S ACADEMY**  
1 Elm Street  
Byfield, Massachusetts 01922

*Prepared by:*

**MERIDIAN ASSOCIATES, INC.**  
69 Milk Street, Suite 302  
Westborough, Massachusetts 01581

December 3, 2021



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## **REPORT SUMMARY:**

### **Calculation Objectives:**

The objective of these calculations is to demonstrate design compliance of the proposed building and improvements for the Parker River Environmental Studies Building at The Governor's Academy in Byfield, Massachusetts for water quantity and water quality objectives of the DEP's Stormwater Management Regulations, the Massachusetts Stormwater Handbook and the Town of Newbury Stormwater Management Rules and Regulations. The Project is an amendment of the previously approved development project but remains a new development.

The existing site consists of mostly wooded area with some ledge outcrops and slopes leading down to Parker River. The site lies to the north of the existing maintenance facility for the campus. The project area currently has no drainage improvements (beyond the existing maintenance buildings) and stormwater runoff flows to three design points. The northern portion of the site (SC1.0) flows to Parker River. The eastern portion of the site (SC2.0) flows towards an isolated (non-jurisdictional depression area. The southern portion of the site (SC3.0) flows towards an existing wetland area. The new building, parking area, and related improvements will fully comply with the ten (10) standards of the MADEP Stormwater Regulations.

Subcatchment Area Plans have been incorporated into this report to depict existing and proposed watershed areas.

### **Calculation Methods:**

- TR55/TR20 methodology utilizing HydroCAD software by Applied Microcomputer Systems.
- MADEP Stormwater Management Handbook for Water Quality Calculations / TSS Removal.

### **Sources of Data:**

- Technical Report No. 20 & No. 55
- Technical Paper No. 40
- Existing Conditions Instrument Field Survey by W.C. Cammett Engineering Inc. supplemented with Existing Conditions Field Survey by Meridian Associates, Inc.
- Soil Testing Logs by Northeast Geotechnical, Inc.
- Web Soil Survey of Essex County Massachusetts, Northern Part, by the USDA Natural Resources Conservation Service (NRCS)
- "Stormwater Management – Stormwater Policy Handbook and Stormwater Technical Handbook" by the Massachusetts DEP – February 2008

**Soil Descriptions:**

Existing soil conditions have been characterized by the Essex County, Northern Part, Soil Survey Report. The soils have been assigned a Hydrologic Soil Grouping (HSG) by NRCS. A map of the Soil Survey has been included in this report. According to the NRCS, the site consists of the follow soils:

Hydrologic Soil Group (HSG) Rating	Map Unit Symbol	NRCS Soil Map Unit Name
B/C	717E	Rock outcrop-Charlton-Hollis complex, 15 to 35 percent slopes
D	709B	Buxton-Rock outcrop complex, 3 to 8 percent slopes
C	255B	Belgrade very fine sandy loam, 3 to 8 percent slopes.

As required by Volume 3: Documenting Compliance with the Massachusetts Stormwater Management Standards, an on-site evaluation by a competent soils professional was undertaken on March 1, 2018, by Michael Clement a licensed Soil Evaluator from Northeast Geotechnical, Inc. to confirm the NRCS soil survey. The observed soil type was documented, mapped and is included in this report. The observed parent soils were found to be vary between Loamy Sand, Loam, Fine Sandy Loam, and Sandy Loam. The Estimated Seasonal High Groundwater was observed in one test pit only at elevation of 27.5'. Based on the soil field data, B soils were used to provide a conservative analysis allowing for less runoff within the existing conditions model.

A "Rawls" infiltration rate for Loam of 0.52 in/hr per the DEP Stormwater Handbook, has been utilized for the design for the two of the three infiltration areas, and a "Rawls" infiltration rate for Sandy Loam of 1.02 in/hr for the third infiltration area to east of the proposed building.

**Selection of Storm Events:**

The storm events have been compiled from the Soil Conservation Service Technical Report No. 55. The 2-year, 10-year and 100-year storm events have been utilized for hydrology calculations. There is an existing ridge or "saddle", essentially separating the project site into two areas. The northern half flows towards Parker River and the southern area flows towards the maintenance area. The rainfall data for the Type III, 24-hour storm events has been revised and taken from the U.S. Department of Commerce Technical Paper No. 40 as follows:

<u>Frequency (Years)</u>	<u>Rainfall (Inches/Hour)</u>
2	3.20
10	4.50
100	6.50

**Existing Conditions Overview:**

The project area is located beyond the existing maintenance buildings off of Middle Road. The existing site consists of mostly wooded area with some ledge outcrops and some steep slopes leading down to Parker River. The project area currently has no drainage improvements (beyond the existing structures located within the maintenance drive and in and around the maintenance buildings).

The site has been divided into four subcatchment areas which drain to four design points designated as DP-1, DP-2, DP-3 and DP-4. DP-1 is located at the Parker River which is to the North of the project site. DP-2 is located at the wetland to the East of the project site. DP-3 is located at the wetland to the Southeast of the project site. DP-4 is located at the existing infiltration basin which is West of the existing maintenance buildings. The subcatchment areas encompass the entire project site and were selected based on existing topography and natural features. Please refer to the Existing Conditions Subcatchment Area Plan that is included at the end of this report for the details pertaining to the existing drainage areas.

The following is a summary of pre-development subcatchment watershed areas from the site:

<u>Existing Subcatchments</u>	<u>Description</u>
SC1 (DP-1)	Overland Flow to the Parker River
SC2 (DP-2)	Overland Flow to Wetland
SC3 (DP-3)	Overland Flow to Wetland
SC4 (DP-4)	Overland Flow and through storm drain system to existing infiltration basin

#### **Proposed Conditions Overview:**

The Governor's Academy is proposing to develop a 7,032 SF building overlooking the Parker River to act as their Environmental Studies Building. The proposed facility will include a proposed parking area at the end of the maintenance building existing drive and a stone dust path to the new building. The proposed building will also provide a raised wooden access path leading down to Parker River that replaces the previously proposed stone dust path and stairs. This modification proposes a 200 SF increase in the building footprint, but is more than offset by a significant decrease in the length and associated disturbance for the path leading to Parker River.

The proposed stormwater management system has been carefully designed to provide peak flow reduction and substantial reduction of runoff volumes for all post development flows up to and including the 100-year storm event. DP-1 yield a slight increase in post development flows, however this is allowed over land subject to tidal/coastal flowage (Parker River). The development has been designed to meet the requirements of the DEP Stormwater Management regulations.

The proposed project has been divided into seven subcatchments which drain to the four Design Points as developed and described under the existing conditions narrative above. The following is a description of each subcatchment and the stormwater system routing for the proposed project.

SC101: This subcatchment includes the proposed building rooftop and the stormwater runoff discharges to the proposed infiltration basin area adjacent to the building. Stormwater storage and recharge will occur in the new basin.

SC102: This subcatchment includes existing woods, the proposed walkway and landscaped areas and the stormwater runoff flows overland to the Parker River.

SC102A: Small subcatchment that includes overland flows directly to Pond 2P.

SC200: This subcatchment includes existing woods, a portion of the proposed walkway and landscaped areas and the stormwater runoff flows overland to a wetland.

SC301: This subcatchment includes existing woods, a portion of the proposed access driveway and parking area and landscaped areas and the stormwater runoff flows overland and through a CDS unit to the proposed infiltration basin area adjacent to the proposed parking area. Stormwater storage and recharge will occur in the new basin. The stormwater runoff overflow discharges through a storm drain system to the existing stormwater basin.

SC302: This subcatchment includes existing woods and grass and the stormwater runoff flows overland to a wetland to the southeast.

SC400: This subcatchment includes existing woods, existing maintenance buildings and associated parking areas and driveway, existing access driveway and landscaped areas. The stormwater runoff flows overland and through a storm drain system to the existing infiltration basin to the West of the maintenance buildings.

The following is a summary of post-development subcatchment watershed areas from the site:

<b><u>Proposed</u></b>	<b><u>Description</u></b>
<b><u>Subcatchments:</u></b>	
SC101 (DP-1)	Building rooftop discharges to proposed infiltration basin
SC102 (DP-1)	Overland Flow to the Parker River
SC102A (DP-1)	Overland Flow to Pond 2P
SC200 (DP-2)	Overland Flow to Wetland
SC301 (DP-4)	Overland Flow to proposed infiltration basin
SC302 (DP-3)	Overland Flow to Wetland
SC400 (DP-4)	Overland Flow and through storm drain system to existing infiltration basin

#### **Summary of Flows at Design Point 1**

<b><u>Storm Event</u></b>	<b><u>Existing Conditions (Pre)</u></b>		<b><u>Proposed Conditions (Post)</u></b>	
	<b><u>Peak Flow</u></b> <b><u>(CFS)</u></b>	<b><u>Volume</u></b> <b><u>(CF)</u></b>	<b><u>Peak Flow (CFS)</u></b>	<b><u>Volume (CF)</u></b>
2-Year (3.20 in./hr.)	0.6	3,292	0.5	3,092
10-Year (4.50 in./hr.)	2.2	8,228	2.1	8,515
100-Year (6.50 in./hr.)	5.4	18,208	6.3	19,086

#### **Summary of Flows at Design Point 2**

<b><u>Storm Event</u></b>	<b><u>Existing Conditions (Pre)</u></b>		<b><u>Proposed Conditions (Post)</u></b>	
	<b><u>Peak Flow</u></b> <b><u>(CFS)</u></b>	<b><u>Volume</u></b> <b><u>(CF)</u></b>	<b><u>Peak Flow (CFS)</u></b>	<b><u>Volume (CF)</u></b>
2-Year (3.20 in./hr.)	0.7	3,149	0.6	2,685
10-Year (4.50 in./hr.)	1.7	6,591	1.5	5,522
100-Year (6.50 in./hr.)	3.5	12,954	3.0	10,716

### **Summary of Flows at Design Point 3**

<b><u>Storm Event</u></b>	<b><u>Existing Conditions (Pre)</u></b>		<b><u>Proposed Conditions (Post)</u></b>	
	<b><u>Peak Flow (CFS)</u></b>	<b><u>Volume (CF)</u></b>	<b><u>Peak Flow (CFS)</u></b>	<b><u>Volume (CF)</u></b>
2-Year (3.20 in./hr.)	0.2	1,496	0.1	1,064
10-Year (4.50 in./hr.)	1.0	4,432	0.8	4,036
100-Year* (6.50 in./hr.)	3.0	10,832	2.3	10,396

### **Summary of Flows at Design Point 4**

<b><u>Storm Event</u></b>	<b><u>Existing Conditions (Pre)</u></b>		<b><u>Proposed Conditions (Post)</u></b>	
	<b><u>Peak Flow (CFS)</u></b>	<b><u>Volume (CF)</u></b>	<b><u>Peak Flow (CFS)</u></b>	<b><u>Volume (CF)</u></b>
2-Year (3.20 in./hr.)	2.6	8,769	2.3	7,905
10-Year (4.50 in./hr.)	4.9	16,216	4.5	15,031
100-Year* (6.50 in./hr.)	8.8	29,054	8.6	27,787

\*Revised to be consistent with TP-40

### **Erosion Control Discussion:**

The project is subject to the NPDES Construction General Permit requirements, so a comprehensive Stormwater Pollution Prevention Plan (SWPPP) will be required, and provided, prior to construction. The SWPPP will act as the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan for the project. A site work contractor has not yet been selected for the project. We would like the selected contractor to have input into the Plan. This plan will be prepared prior to construction as allowed by DEP Stormwater Regulations. A copy of this plan can be submitted to the Town as a condition of project approvals. However, the project plans do include erosion control information in the form of details of sediment control best management practices that will be implemented. This information will be the basis of the SWPPP/CPPPESCP.

### **Conclusion:**

The calculations performed for design points 2, 3, and 4, indicate that the peak flow rates will not exceed the existing conditions peak flows. The calculations performed for design points 2, 3, and 4, indicated that the peak volumes will not exceed the existing conditions peak volumes.

The calculation performed for design point 1 indicate that the peak flow rates and volumes exceed the existing conditions for the 100-year storm and exceed the volume for the 10-year storm. However, all peak flow rates and volumes for design point 1 in this modification have *decreased* from the increases that would be realized with the previously approved design (in 2018).

Subcatchment SC#102, as described above, includes existing woods, proposed walkways, and landscaped areas. The majority of subcatchment SC#101 is the proposed roof, which is routed to a series of infiltration basins for mitigation. These basins then discharge overland towards the Parker River and the isolated non-jurisdictional depression. Splitting the spillway overflow will limit the discharge to Parker River while providing a resource to the depression with the intent to provide more favorable vernal pool characteristics.

Every effort was made to reduce the proposed flows to the Parker River (Design Point #1). Although an increase in the peak flow rate will be realized, the MassDEP Stormwater Handbook states in Volume 1, Chapter 1, Page 5 *“Where an area is within the 100-year coastal flood plain or land subject to coastal storm flowage, the control of peak discharge rates is usually unnecessary and may be waived”*. The MassDEP Parker River Watershed Water Quality Assessment Report notes that *“In Newbury, the Parker River becomes tidal with the last nine miles of the river subject to the rise of the tide”*. Therefore, the coastal flowage provisions in standard 2 for design point 1 are applicable. However, runoff will be managed such that erosion and sedimentation of this important resource area does not occur. Again, all peak flow rate and volume increases for design point 1 have been reduced from the originally approved design (in 2018).

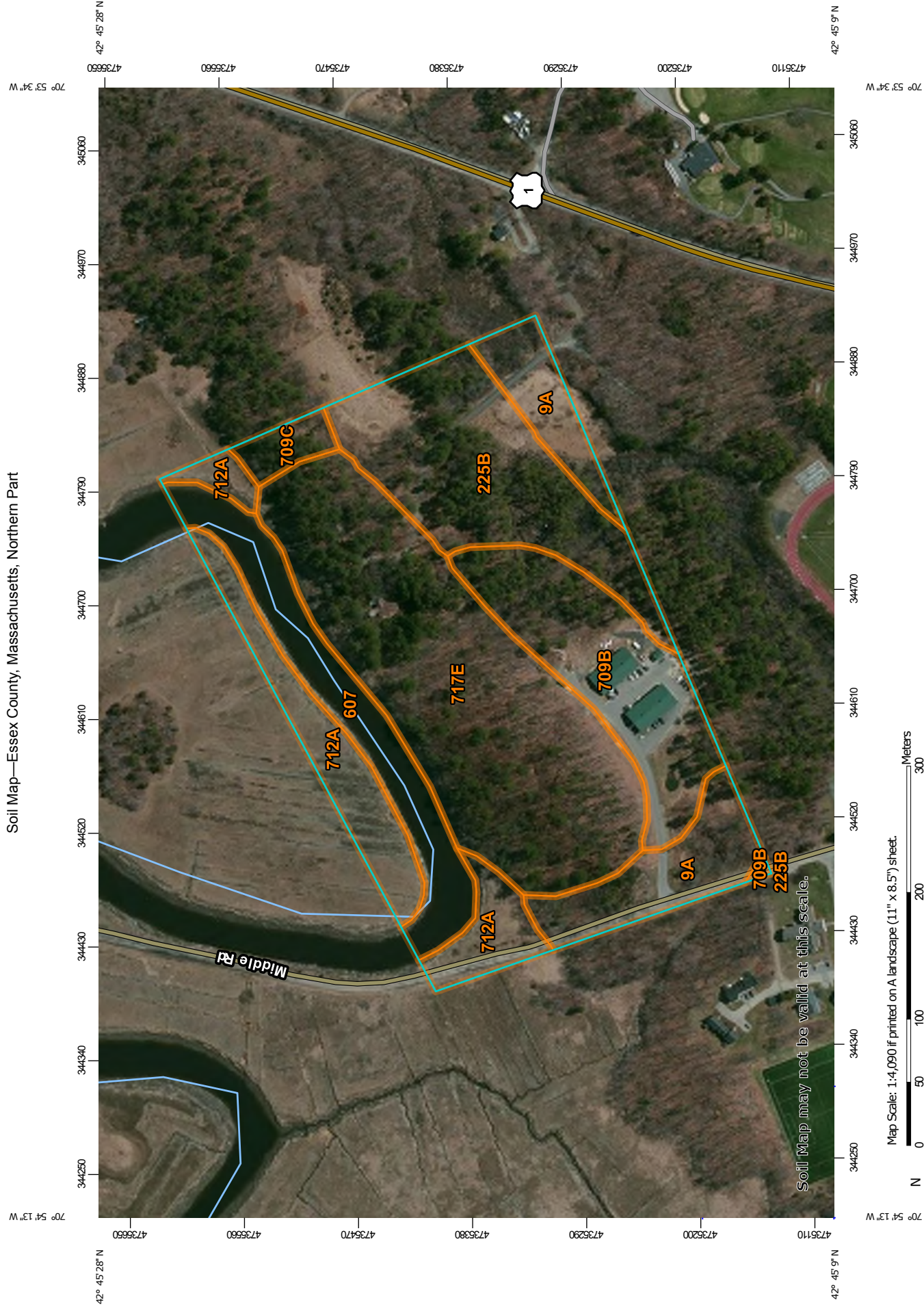
An Operation and Maintenance Plan for stormwater systems is included herein.

With implementation of the stormwater management system as designed, substantial compliance with the MADEP Stormwater Management regulations and handbook is achieved.



## **SOILS INFORMATION**

# Soil Map—Essex County, Massachusetts, Northern Part



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

Streams and Canals

**Transportation**

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

**Water Features**

Streams and Canals

**Background**

Aerial Photography

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

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 13, Oct 6, 2017

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

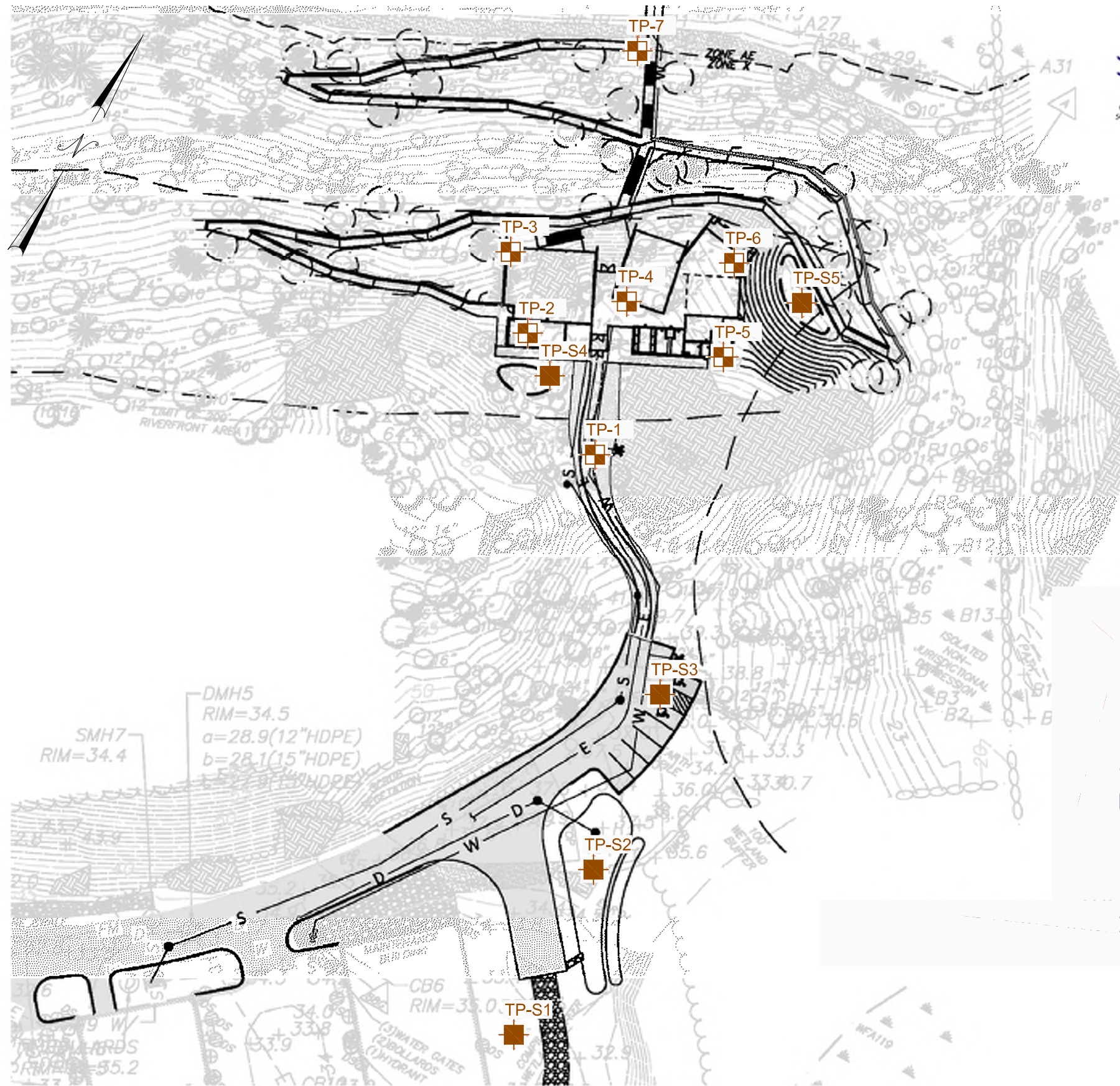
Date(s) aerial images were photographed: Dec 31, 2009—Sep 12, 2016

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
9A	Birdsall silt loam, 0 to 3 percent slopes	3.9	11.1%
225B	Belgrade very fine sandy loam, 3 to 8 percent slopes	6.0	17.1%
607	Water, saline	3.8	10.9%
709B	Buxton-Rock outcrop complex, 3 to 8 percent slopes	4.9	13.8%
709C	Buxton-Rock outcrop complex, 8 to 15 percent slopes	0.6	1.8%
712A	Ipswich and Westbrook mucky peats, 0 to 2 percent slopes, very frequently flooded	4.1	11.6%
717E	Rock outcrop-Charlton-Hollis complex, 15 to 35 percent slopes	11.8	33.8%
<b>Totals for Area of Interest</b>		<b>35.1</b>	<b>100.0%</b>





- NOTES:
- 1. BASE MAP DEVELOPED FROM PLAN BY MERIDIAN ASSOCIATES, INC. (MAI) DATED JANUARY 26, 2018, DWG NO. 8490 SITE.DWG, SHEET 1 OF 1.
  - 2. TEST PIT LOCATIONS ESTABLISHED IN THE FIELD BY MAI PRIOR TO THE SUBSURFACE EXPLORATION PROGRAM. THE TEST PITS WERE EXCAVATED AT THE APPROXIMATE LOCATIONS ESTABLISHED IN THE FIELD.
  - 3. TEST PIT LOCATIONS SHOWN ON THIS PLAN SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHODS USED.
  - 4. TEST PITS WERE EXCAVATED BY GOVERNORS ACADEMY PERSONNEL ON MARCH 1, 2018. TEST PIT EXCAVATIONS WERE OBSERVED AND LOGGED BY NORTHEAST GEOTECHNICAL, INC. PERSONNEL.

- LEGEND:
- TP-S1 APPROXIMATE TEST PIT LOCATION AND NUMBER.
  - S-3 APPROXIMATE TEST PIT WITH SOIL EVALUATION LOCATION AND NUMBER.



NORTHEAST  
GEOTECHNICAL

NORTHEAST GEOTECHNICAL, INC.

THE GOVERNOR'S ACADEMY -  
PARKER RIVER ENVIRONMENTAL SCIENCES BUILDING

1 ELM STREETBYFIELD, MA

EXPLORATION LOCATION PLAN

Project No.: O292.00	Drawn By: JJP	Reviewed By: G.OLSON, P.E.
Date: 3/11/2018	Scale: NOT TO SCALE	Figure No.: 1

JACK POWERS, 03/13/2018, 16:32:32 | FILE: C:\NORTHEAST\O292.00 BYFIELD\PLANS\O29200F01.DWG

NORTHEAST GEOTECHNICAL, INC.									
TEST PIT LOG		Project: <u>The Governor's Academy</u> <u>Parker River Environmental Sciences Building</u> <u>Byfield, MA</u>			Test Pit No.: <u>TP-1</u>				
					Page: <u>1 of 1</u>				
					File No.: <u>O292.00</u>				
					Reviewed By: <u>Glenn A. Olson, P.E.</u>				
Subcontractor: <u>The Governor's Academy</u>		Date: <u>3/1/2018</u>							
Operator: <u>David Fitzgerald</u>		Northeast Geotechnical Observer: <u>Michael Clement</u>							
Equipment: <u>Caterpillar 304C Excavator</u>		Test Pit Location: <u>See Exploration Location Plan</u>							
Capacity/Reach: <u>1/4 C.Y. / 10± feet</u>		Ground Surface Elevation: <u>51± feet</u>							
Depth	Strata Change	Soil Description (Burmister Identification System)		Excavation Effort	Boulder Count	Note No.			
1'	FOREST MAT 0.5'±	Dark brown, fine to medium SAND and SILT, trace Roots		E	10± A 1± B	1,2			
2'	SUBSOIL 2'±	Orangish brown, fine SAND and SILT, trace Roots		E					
3'	NATURAL GLACIAL TILL 5.5'±	Olive brown, fine to medium SAND and SILT, little (-) fine to coarse Gravel, trace Cobbles with Boulders		M					
4'									
5'									
6'									
7'		Refusal to excavator bucket on apparent bedrock at 5.5± feet.							
8'									
9'									
10'									
11'									
12'									
13'									
14'									
15'									
Notes: 1.The test pit terminated on apparent bedrock at a depth of about 5.5± feet below ground surface. 2.Groundwater was not observed at time of test pit.									
Test Pit Dimensions		Boulder Classification		Proportions Used		Abbreviations		Excavation Effort	
N/S =	9'±	Diameter	Class	Trace (T): 0-10% Little (Li): 10-20% Some (So): 20-35% And: 35-50%		F = Fine M = Medium C = Coarse F/M = Fine to Medium		E = Easy M = Moderate D = Difficult	
E/W =	4'±	6" - 18"	A						
		18" - 36"	B						
		>36"	C						

NORTHEAST GEOTECHNICAL, INC.									
TEST PIT LOG		Project: <u>The Governor's Academy</u> <u>Parker River Environmental Sciences Building</u> <u>Byfield, MA</u>			Test Pit No.: <u>TP-2</u>				
					Page: <u>1 of 1</u>				
					File No.: <u>O292.00</u>				
					Reviewed By: <u>Glenn A. Olson, P.E.</u>				
Subcontractor: <u>The Governor's Academy</u>		Date: <u>3/1/2018</u>							
Operator: <u>David Fitzgerald</u>		Northeast Geotechnical Observer: <u>Michael Clement</u>							
Equipment: <u>Caterpillar 304C Excavator</u>		Test Pit Location: <u>See Exploration Location Plan</u>							
Capacity/Reach: <u>1/4 C.Y. / 10± feet</u>		Ground Surface Elevation: <u>43± feet</u>							
Depth	Strata Change	Soil Description (Burmister Identification System)		Excavation Effort	Boulder Count	Note No.			
1'	FOREST MAT 0.5'±	Dark brown, fine to medium SAND and SILT, trace Roots		E	5± A	1,2			
2'	SUBSOIL 2'±	Orangish brown, fine SAND and SILT, trace Roots		E					
3'	NATURAL GLACIAL TILL 5.5'±	Olive brown, fine to medium SAND and SILT, trace fine to coarse Gravel, trace Cobbles		E					
4'									
5'									
6'									
7'									
8'		Refusal to excavator bucket on apparent bedrock at 5.5± feet.							
9'									
10'									
11'									
12'									
13'									
14'									
15'									
Notes: 1.The test pit terminated on apparent bedrock at a depth of about 5.5± feet below ground surface. 2.Groundwater was not observed at time of test pit.									
Test Pit Dimensions		Boulder Classification		Proportions Used		Abbreviations		Excavation Effort	
N/S =	8'±	Diameter	Class	Trace (T): 0-10% Little (Li): 10-20% Some (So): 20-35% And: 35-50%		F = Fine M = Medium C = Coarse F/M = Fine to Medium		E = Easy M = Moderate D = Difficult	
E/W =	4'±	6" - 18"	A						
		18" - 36"	B						
		>36"	C						

NORTHEAST GEOTECHNICAL, INC.									
TEST PIT LOG		Project: <u>The Governor's Academy</u> <u>Parker River Environmental Sciences Building</u> <u>Byfield, MA</u>			Test Pit No.: <u>TP-3</u>				
					Page: <u>1 of 1</u>				
					File No.: <u>O292.00</u>				
					Reviewed By: <u>Glenn A. Olson, P.E.</u>				
Subcontractor: <u>The Governor's Academy</u>		Date: <u>3/1/2018</u>							
Operator: <u>David Fitzgerald</u>		Northeast Geotechnical Observer: <u>Michael Clement</u>							
Equipment: <u>Caterpillar 304C Excavator</u>		Test Pit Location: <u>See Exploration Location Plan</u>							
Capacity/Reach: <u>1/4 C.Y. / 10± feet</u>		Ground Surface Elevation: <u>34± feet</u>							
Depth	Strata Change	Soil Description (Burmister Identification System)		Excavation Effort	Boulder Count	Note No.			
1'	FOREST MAT 0.5'±	Dark brown, fine to medium SAND and SILT, trace Roots		E		1,2			
	SUBSOIL 1'±	Orangish brown, fine SAND and SILT, trace Roots		E					
2'		Refusal to excavator bucket on apparent bedrock at 1± foot.							
3'									
4'									
5'									
6'									
7'									
8'									
9'									
10'									
11'									
12'									
13'									
14'									
15'									
Notes: 1.The test pit terminated on apparent bedrock at a depth of about 1± foot below ground surface. 2.Groundwater was not observed at time of test pit.									
Test Pit Dimensions		Boulder Classification		Proportions Used		Abbreviations		Excavation Effort	
N/S =	6'±	Diameter	Class	Trace (T): 0-10% Little (Li): 10-20% Some (So): 20-35% And: 35-50%		F = Fine M = Medium C = Coarse F/M = Fine to Medium		E = Easy M = Moderate D = Difficult	
E/W =	3'±	6" - 18"	A						
		18" - 36"	B						
		>36"	C						



NORTHEAST GEOTECHNICAL, INC.									
TEST PIT LOG		Project: <u>The Governor's Academy</u> <u>Parker River Environmental Sciences Building</u> <u>Byfield, MA</u>			Test Pit No.: <u>TP-4</u>				
					Page: <u>1 of 1</u>				
					File No.: <u>O292.00</u>				
					Reviewed By: <u>Glenn A. Olson, P.E.</u>				
Subcontractor: <u>The Governor's Academy</u>		Date: <u>3/1/2018</u>							
Operator: <u>David Fitzgerald</u>		Northeast Geotechnical Observer: <u>Michael Clement</u>							
Equipment: <u>Caterpillar 304C Excavator</u>		Test Pit Location: <u>See Exploration Location Plan</u>							
Capacity/Reach: <u>1/4 C.Y. / 10± feet</u>		Ground Surface Elevation: <u>43± feet</u>							
Depth	Strata Change	Soil Description (Burmister Identification System)		Excavation Effort	Boulder Count	Note No.			
1'	FOREST MAT 0.5'±	Dark brown, fine to medium SAND and SILT, trace Roots		E	8± A 1± B	1,2			
	SUBSOIL	Orangish brown, fine SAND and SILT, trace Roots		E					
2'	1.5'±								
	NATURAL GLACIAL TILL	Olive brown, fine SAND and SILT, trace fine to coarse Gravel, trace Cobbles with Boulders		M					
3'									
4'									
4'±									
5'	Refusal to excavator bucket on apparent bedrock at 4± feet.								
6'									
7'									
8'									
9'									
10'									
11'									
12'									
13'									
14'									
15'									
Notes: 1.The test pit terminated on apparent bedrock at a depth of about 4± feet below ground surface. 2.Groundwater was not observed at time of test pit.									
Test Pit Dimensions		Boulder Classification		Proportions Used		Abbreviations		Excavation Effort	
N/S =	4'±	Diameter	Class	Trace (T): 0-10% Little (Li): 10-20% Some (So): 20-35% And: 35-50%		F = Fine M = Medium C = Coarse F/M = Fine to Medium		E = Easy M = Moderate D = Difficult	
E/W =	8'±	6" - 18"	A						
		18" - 36"	B						
		>36"	C						

**NORTHEAST GEOTECHNICAL, INC.**

## TEST PIT LOG

Project: The Governor's Academy  
Parker River Environmental Sciences Building  
Byfield, MA

Test Pit No.:	TP-5
Page:	1 of 1
File No.:	O292.00
Reviewed By:	Glenn A. Olson, P.E.

Date:	3/1/2018
Northeast Geotechnical Observer:	Michael Clement
Test Pit Location:	See Exploration Location Plan
Ground Surface Elevation:	41± feet

Depth	Strata Change	Soil Description (Burmister Identification System)	Excavation Effort	Boulder Count	Note No.
1'  2'	FOREST MAT 0.5'±	Dark brown, fine to medium SAND and SILT, trace Roots	E	5± A 1± B	1,2
	SUBSOIL	Orangish brown, fine SAND and SILT, trace Roots	E		
	2'±				
3'	NATURAL GLACIAL TILL	Olive brown, fine SAND and SILT, trace fine to coarse Gravel, trace Cobbles	E		
4'					
5'					
5.5'±					
6'		Refusal to excavator bucket on apparent bedrock at 5.5± feet.			
7'					
8'					
9'					
10'					
11'					
12'					
13'					
14'					
15'					

Notes:
1.The test pit terminated on apparent bedrock at a depth of about 5.5± feet below ground surface.
2.Groundwater was not observed at time of test pit.

1. The test pit terminated on apparent bedrock at a depth of about 5.5± feet below ground surface.
2. Groundwater was not observed at time of test pit.

Test Pit Dimensions		Boulder Classification		Proportions Used	Abbreviations	Excavation Effort
N/S =	4'±	Diameter	Class	Trace (T): 0-10%	F = Fine	E = Easy
		6" - 18"	A	Little (Li): 10-20%	M = Medium	M = Moderate
E/W =	7'±	18" - 36"	B	Some (So): 20-35%	C = Coarse	D = Difficult
		>36"	C	And: 35-50%	F/M = Fine to Medium	

NORTHEAST GEOTECHNICAL, INC.						
TEST PIT LOG		Project: <u>The Governor's Academy</u> <u>Parker River Environmental Sciences Building</u> <u>Byfield, MA</u>			Test Pit No.: <u>TP-6</u>	
					Page: <u>1 of 1</u>	
					File No.: <u>O292.00</u>	
					Reviewed By: <u>Glenn A. Olson, P.E.</u>	
Subcontractor: <u>The Governor's Academy</u>		Date: <u>3/1/2018</u>				
Operator: <u>David Fitzgerald</u>		Northeast Geotechnical Observer: <u>Michael Clement</u>				
Equipment: <u>Caterpillar 304C Excavator</u>		Test Pit Location: <u>See Exploration Location Plan</u>				
Capacity/Reach: <u>1/4 C.Y. / 10± feet</u>		Ground Surface Elevation: <u>39± feet</u>				
Depth	Strata Change	Soil Description (Burmister Identification System)		Excavation Effort	Boulder Count	Note No.
1'	FOREST MAT 0.5'±	Dark brown, fine to medium SAND and SILT, trace Roots		E	5± A	1,2
	SUBSOIL	Orangish brown, fine SAND and SILT, trace Roots		E		
2'	1.5'±					
	NATURAL GLACIAL TILL	Brown, fine SAND and SILT, trace fine to coarse Gravel, trace Cobbles with Boulders		M		
3'	3'±					
4'		Refusal to excavator bucket on apparent bedrock at 3± feet.				
5'						
6'						
7'						
8'						
9'						
10'						
11'						
12'						
13'						
14'						
15'						
Notes: 1.The test pit terminated on apparent bedrock at a depth of about 4± feet below ground surface. 2.Groundwater was not observed at time of test pit.						
Test Pit Dimensions		Boulder Classification		Proportions Used	Abbreviations	Excavation Effort
N/S =	4'±	Diameter	Class	Trace (T): 0-10% Little (Li): 10-20% Some (So): 20-35% And: 35-50%	F = Fine M = Medium C = Coarse F/M = Fine to Medium	E = Easy M = Moderate D = Difficult
E/W =	6'±	6" - 18" 18" - 36" >36"	A B C			

NORTHEAST GEOTECHNICAL, INC.									
TEST PIT LOG		Project: <u>The Governor's Academy</u> <u>Parker River Environmental Sciences Building</u> <u>Byfield, MA</u>			Test Pit No.: <u>TP-7</u>				
					Page: <u>1 of 1</u>				
					File No.: <u>O292.00</u>				
					Reviewed By: <u>Glenn A. Olson, P.E.</u>				
Subcontractor: <u>The Governor's Academy</u>		Date: <u>3/1/2018</u>							
Operator: <u>David Fitzgerald</u>		Northeast Geotechnical Observer: <u>Michael Clement</u>							
Equipment: <u>Caterpillar 304C Excavator</u>		Test Pit Location: <u>See Exploration Location Plan</u>							
Capacity/Reach: <u>1/4 C.Y. / 10± feet</u>		Ground Surface Elevation: <u>8± feet</u>							
Depth	Strata Change	Soil Description (Burmister Identification System)		Excavation Effort	Boulder Count	Note No.			
1'	FOREST MAT 0.5'±	Dark brown, fine to medium SAND and SILT, trace Roots		E	4± A	1 2			
	SUBSOIL 1'±	Orangish brown, fine SAND and SILT, trace Roots		E					
2'	NATURAL GLACIAL TILL	Olive brown, fine SAND and SILT, trace fine to coarse Gravel, trace Cobbles		M					
3'									
4'									
5'									
6'									
7'									
8'									
9'							8.5'±	Refusal to excavator bucket on apparent bedrock at 8.5± feet.	
10'									
11'									
12'									
13'									
14'									
15'									
Notes: 1. Groundwater was encountered at 7.8± feet below ground surface at time of test pit. 2. The test pit terminated on apparent bedrock at a depth of about 8.5± feet below ground surface.									
Test Pit Dimensions		Boulder Classification		Proportions Used		Abbreviations		Excavation Effort	
N/S =	12'±	Diameter	Class	Trace (T): 0-10% Little (Li): 10-20% Some (So): 20-35% And: 35-50%		F = Fine M = Medium C = Coarse F/M = Fine to Medium		E = Easy M = Moderate D = Difficult	
E/W =	4'±	6" - 18"	A						
		18" - 36"	B						
		>36"	C						

NORTHEAST GEOTECHNICAL, INC.											
TEST PIT LOG		Project: <u>The Governor's Academy</u> <u>Parker River Environmental Sciences Building</u> <u>Byfield, MA</u>				Test Pit/Deep Observation Hole Number: <u>TP-S1</u>					
Subcontractor: <u>The Governor's Academy</u>		Date/Weather: <u>3-1-2018 / Partly Sunny, 40's °F</u>		Page: <u>1 of 1</u>							
Operator: <u>David Fitzgerald</u>		Northeast Geotechnical Observer: <u>Michael Clement</u>		File No. <u>0292.00</u>							
Equipment: <u>Caterpillar 304C Excavator</u>		Test Pit Location: <u>See Exploration Location Plan</u>		Reviewed By: <u>Glenn Olson, P.E.</u>							
Capacity/Reach: <u>1/4 C.Y. / 10± feet</u>		Ground Surface Elevation: <u>33.5± feet</u>									
Depth (in.)	Soil Horizon/Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments		Soil Structure	Soil Consistence (Moist)	Other
			Depth (in.)	Color	Percent		Gravel	Cobbles & Stones			
0-96±	C	2.5Y 5/4	See Note 3	---	---	Loamy Sand	30±%	20±%	Massive	Friable	
Groundwater Observed: <u>No</u> Depth Weeping from Pit: <u>Not Observed</u> Depth Standing Water in Hole: <u>Not Observed</u>											
Estimated Depth (Elevation) to High Groundwater: <u>Not Observed</u>											
Notes: 1. Sample collected from about 36± to 60± inches below ground surface. 2. Test pit terminated in glacial till (USDA Soil Texture: Loamy Sand) at 96± inches (8± feet) below ground surface. 3. Redoximorphic features were not observed nor apparent to the depth of the test pit.											

NORTHEAST GEOTECHNICAL, INC.												
TEST PIT LOG			Project: <u>The Governor's Academy</u> <u>Parker River Environmental Sciences Building</u> <u>Byfield, MA</u>					Test Pit/Deep Observation Hole Number: <u>TP-S2</u>				
Subcontractor: <u>The Governor's Academy</u>			Date/Weather: <u>3-1-2018 / Partly Sunny, 40's °F</u>		Page: <u>1 of 1</u>							
Operator: <u>David Fitzgerald</u>			Northeast Geotechnical Observer: <u>Michael Clement</u>		File No. <u>0292.00</u>							
Equipment: <u>Caterpillar 304C Excavator</u>			Test Pit Location: <u>See Exploration Location Plan</u>		Reviewed By: <u>Glenn Olson, P.E.</u>							
Capacity/Reach: <u>1/4 C.Y. / 10± feet</u>			Ground Surface Elevation: <u>38± feet</u>									
Depth (in.)	Soil Horizon/Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments		Soil Structure	Soil Consistence (Moist)	Other	
			Depth (in.)	Color	Percent		Gravel	Cobbles & Stones				
0-16±	FILL	---	---	---	---	---	---	---	---	---		
16-40±	C	10YR 5/4	See Note 3	---	---	Loam	20±%	5±%	Massive	Friable		
Groundwater Observed: <u>No</u> Depth Weeping from Pit: <u>Not Observed</u> Depth Standing Water in Hole: <u>Not Observed</u>												
Estimated Depth (Elevation) to High Groundwater: <u>Not Observed</u>												
Notes: 1. Sample collected from about 24± to 36± inches below ground surface. 2. Test pit terminated on apparent bedrock at 40± inches (3.3± feet) below ground surface. 3. Redoximorphic features were not observed nor apparent to the depth of the test pit.												

NORTHEAST GEOTECHNICAL, INC.											
TEST PIT LOG		Project: <u>The Governor's Academy</u> <u>Parker River Environmental Sciences Building</u> <u>Byfield, MA</u>				Test Pit/Deep Observation Hole Number: <u>TP-S3</u>					
Subcontractor: <u>The Governor's Academy</u>		Date/Weather: <u>3-1-2018 / Partly Sunny, 40's °F</u>		Page: <u>1 of 1</u>							
Operator: <u>David Fitzgerald</u>		Northeast Geotechnical Observer: <u>Michael Clement</u>		File No. <u>0292.00</u>							
Equipment: <u>Caterpillar 304C Excavator</u>		Test Pit Location: <u>See Exploration Location Plan</u>		Reviewed By: <u>Glenn Olson, P.E.</u>							
Capacity/Reach: <u>1/4 C.Y. / 10± feet</u>		Ground Surface Elevation: <u>36± feet</u>									
Depth (in.)	Soil Horizon/Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments		Soil Structure	Soil Consistence (Moist)	Other
			Depth (in.)	Color	Percent		Gravel	Cobbles & Stones			
0-22±	FILL	---	---	---	---	---	---	---	---	---	
22-90±	C	2.5Y 5/3	See Note 4	---	---	Loam	10±%	10±%	Massive	Friable	
Groundwater Observed: <u>No</u> Depth Weeping from Pit: <u>Not Observed</u> Depth Standing Water in Hole: <u>Not Observed</u>											
Estimated Depth (Elevation) to High Groundwater: <u>Not Observed</u>											
Notes: 1. Sample collected from about 60± to 72± inches below ground surface. 2. Test pit terminated in glacial till (USDA Soil Texture: Loam) at 90± inches (7.5± feet) below ground surface. 3. Fine Roots were observed to extend to a depth of about 7± feet. 4. Redoximorphic features were not observed nor apparent to the depth of the test pit.											

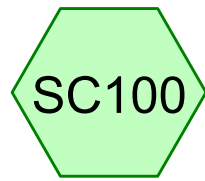
NORTHEAST GEOTECHNICAL, INC.												
TEST PIT LOG			Project: <u>The Governor's Academy</u> <u>Parker River Environmental Sciences Building</u> <u>Byfield, MA</u>					Test Pit/Deep Observation Hole Number: <u>TP-S4</u>				
Subcontractor: <u>The Governor's Academy</u>			Date/Weather: <u>3-1-2018 / Partly Sunny, 40's °F</u>		Page: <u>1 of 1</u>							
Operator: <u>David Fitzgerald</u>			Northeast Geotechnical Observer: <u>Michael Clement</u>		File No. <u>0292.00</u>							
Equipment: <u>Caterpillar 304C Excavator</u>			Test Pit Location: <u>See Exploration Location Plan</u>		Reviewed By: <u>Glenn Olson, P.E.</u>							
Capacity/Reach: <u>1/4 C.Y. / 10± feet</u>			Ground Surface Elevation: <u>43.5± feet</u>									
Depth (in.)	Soil Horizon/Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments		Soil Structure	Soil Consistence (Moist)	Other	
			Depth (in.)	Color	Percent		Gravel	Cobbles & Stones				
0-6±	A	10YR 3/3	---	---	---	Fine Sandy Loam	---	---	Massive	Friable		
6-14±	B	7.5YR 4/4	---	---	---	Fine Sandy Loam	---	---	Massive	Friable		
14-46±	C <sub>1</sub>	2.5Y 5/3	---	---	---	Fine Sandy Loam	---	---	Massive	Friable		
46-66±	C <sub>2</sub>	2.5Y 4/4	See Note 3	---	---	Loam	25±%	5±%	Massive	Friable		
Groundwater Observed: <u>No</u> Depth Weeping from Pit: <u>Not Observed</u> Depth Standing Water in Hole: <u>Not Observed</u>												
Estimated Depth (Elevation) to High Groundwater: <u>Not Observed</u>												
Notes: 1. Sample collected from about 48± to 60± inches below ground surface. 2. Test pit terminated on apparent bedrock at 66± inches (5.5± feet) below ground surface. 3. Redoximorphic features were not observed nor apparent to the depth of the test pit.												



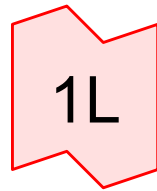
NORTHEAST GEOTECHNICAL, INC.												
TEST PIT LOG			Project: <u>The Governor's Academy</u> <u>Parker River Environmental Sciences Building</u> <u>Byfield, MA</u>					Test Pit/Deep Observation Hole Number: <u>TP-S5</u>				
Subcontractor: <u>The Governor's Academy</u>		Date/Weather: <u>3-1-2018 / Partly Sunny, 40's °F</u>		Page: <u>1 of 1</u>								
Operator: <u>David Fitzgerald</u>		Northeast Geotechnical Observer: <u>Michael Clement</u>		File No. <u>0292.00</u>								
Equipment: <u>Caterpillar 304C Excavator</u>		Test Pit Location: <u>See Exploration Location Plan</u>		Reviewed By: <u>Glenn Olson, P.E.</u>								
Capacity/Reach: <u>1/4 C.Y. / 10± feet</u>		Ground Surface Elevation: <u>32.5± feet</u>										
Depth (in.)	Soil Horizon/Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments		Soil Structure	Soil Consistence (Moist)	Other	
			Depth (in.)	Color	Percent		Gravel	Cobbles & Stones				
0-7±	A	10YR 3/2	---	---	---	Sandy Loam	---	---	Massive	Friable		
7-15±	B	7.5YR 4/4	---	---	---	Fine Loam	---	---	Massive	Friable		
15-84±	C	2.5Y 5/3	58±	---	5±%	Sandy Loam	5±%	5±%	Massive	Friable		
Groundwater Observed: <u>YES</u> Depth Weeping from Pit: <u>76± inches</u> Depth Standing Water in Hole: <u>76± inches</u>												
Estimated Depth (Elevation) to High Groundwater: <u>58± inches (Elevation 27.5± feet)</u>												
Notes: 1. Sample collected from about 60± to 72± inches below ground surface. 2. Test pit terminated in glacial till (USDA Soil Texture: Sandy Loam) at 84± inches (7± feet) below ground surface.												

## **HYDROLOGICAL ANALYSIS**





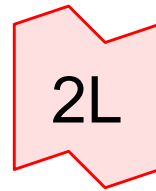
Parker River



Parker River



Islolated Wetland



BVW



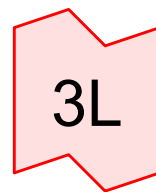
Basin



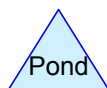
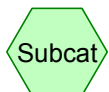
Existing Basin



Wetland



IVW



**8490-Existing**

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*Type III 24-hr 2-Year Rainfall=3.20"*

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Page 2

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**SubcatchmentSC100: Parker River**Runoff Area=97,036 sf 7.18% Impervious Runoff Depth>0.41"  
Flow Length=308' Tc=7.4 min CN=60 Runoff=0.6 cfs 3,292 cf**SubcatchmentSC200: Isolated Wetland**Runoff Area=51,765 sf 20.75% Impervious Runoff Depth>0.73"  
Flow Length=371' Tc=11.3 min CN=68 Runoff=0.7 cfs 3,149 cf**SubcatchmentSC300: Wetland**Runoff Area=71,840 sf 9.70% Impervious Runoff Depth>0.25"  
Flow Length=483' Tc=7.9 min CN=55 Runoff=0.2 cfs 1,496 cf**SubcatchmentSC400: Basin**Runoff Area=91,517 sf 53.93% Impervious Runoff Depth>1.15"  
Flow Length=653' Tc=7.8 min CN=76 Runoff=2.6 cfs 8,769 cf**Link 1L: Parker River**Inflow=0.6 cfs 3,292 cf  
Primary=0.6 cfs 3,292 cf**Link 2L: BVW**Inflow=0.7 cfs 3,149 cf  
Primary=0.7 cfs 3,149 cf**Link 3L: IVW**Inflow=0.2 cfs 1,496 cf  
Primary=0.2 cfs 1,496 cf**Link 4L: Existing Basin**Inflow=2.6 cfs 8,769 cf  
Primary=2.6 cfs 8,769 cf

**8490-Existing**

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Type III 24-hr 2-Year Rainfall=3.20"

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Page 3

**Summary for Subcatchment SC100: Parker River**

Runoff = 0.6 cfs @ 12.15 hrs, Volume= 3,292 cf, Depth&gt; 0.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 2-Year Rainfall=3.20"

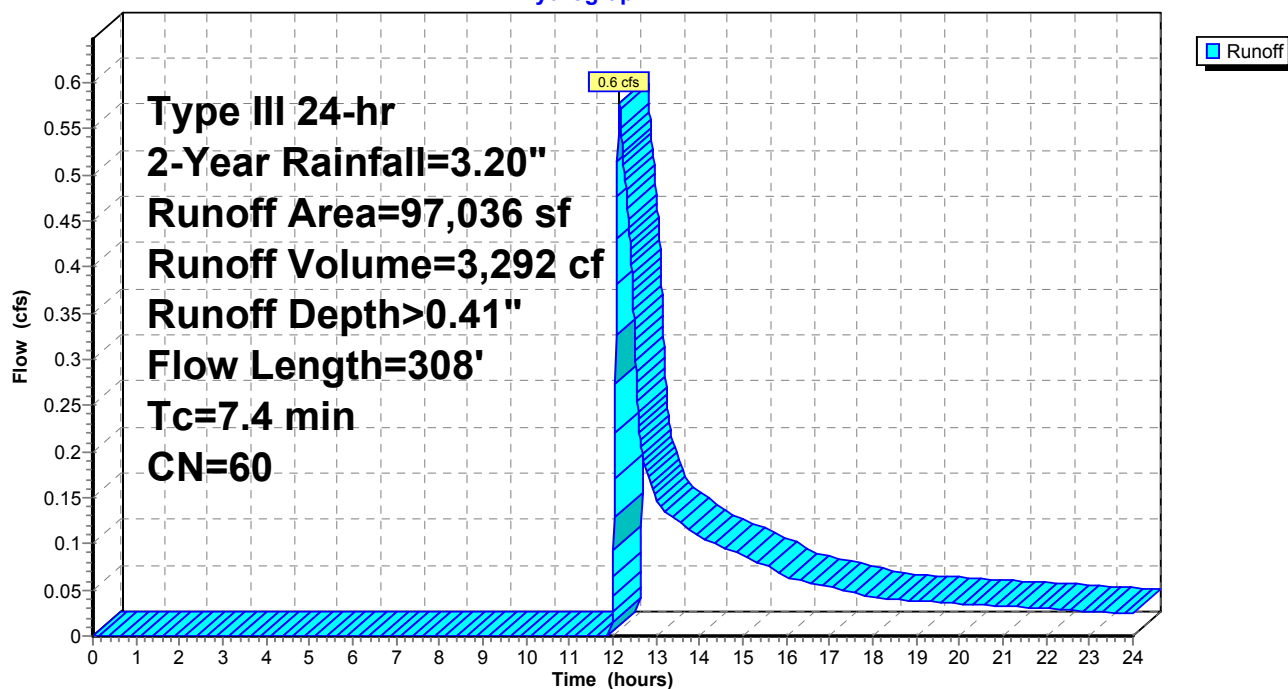
	Area (sf)	CN	Description
*	6,970	98	Ledge
	3,901	96	Gravel surface, HSG B
	86,165	55	Woods, Good, HSG B
	97,036	60	Weighted Average
	90,066		92.82% Pervious Area
	6,970		7.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.1600	0.2		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
1.9	245	0.1940	2.2		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.0	8	0.0500	3.6		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.0	5	0.1750	2.1		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
7.4	308	Total			

**Subcatchment SC100: Parker River**

Hydrograph



**8490-Existing**

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Type III 24-hr 2-Year Rainfall=3.20"

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**Summary for Subcatchment SC200: Isolated Wetland**

Runoff = 0.7 cfs @ 12.18 hrs, Volume= 3,149 cf, Depth&gt; 0.73"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

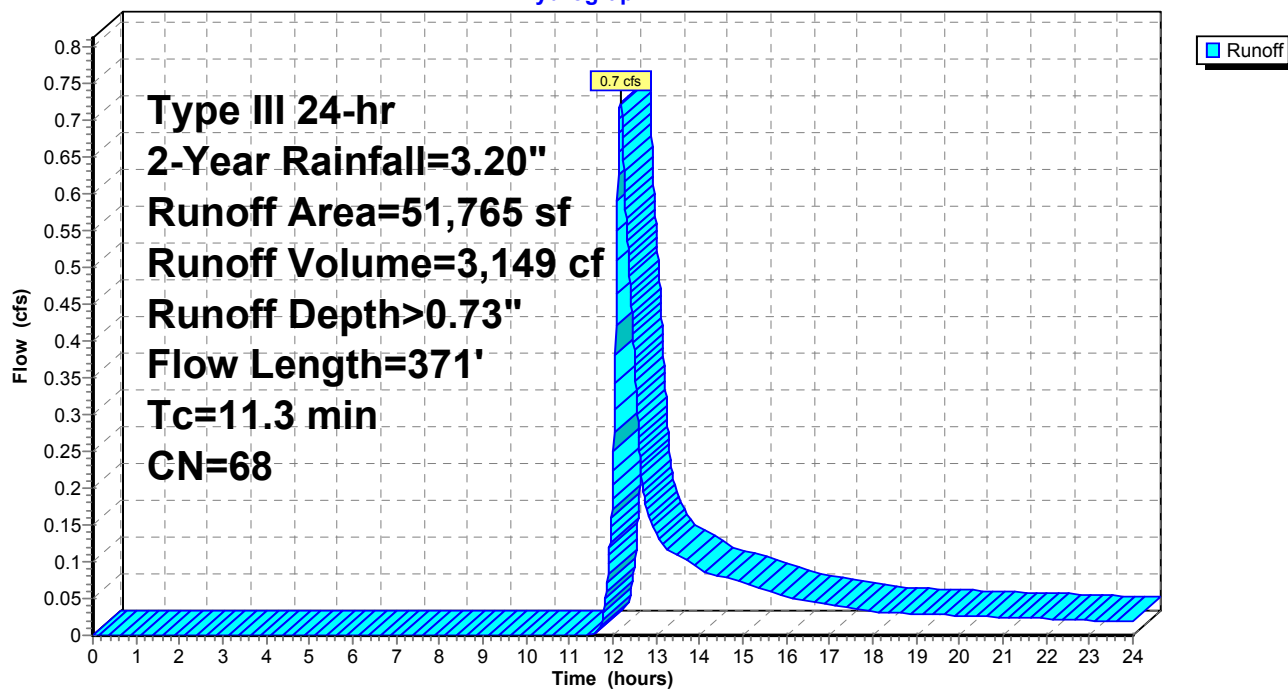
Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
	6,429	82	Dirt roads, HSG B
*	5,164	98	Ledge
	1,127	96	Gravel surface, HSG B
*	5,579	100	Wetland
	33,466	55	Woods, Good, HSG B
	51,765	68	Weighted Average
	41,022		79.25% Pervious Area
	10,743		20.75% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.1		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.0	9	0.3800	12.5		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.7	100	0.2000	2.2		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.5	78	0.0600	2.4		<b>Shallow Concentrated Flow,</b> Nearly Bare & Untilled Kv= 10.0 fps
1.4	134	0.1000	1.6		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
11.3	371	Total			

## Subcatchment SC200: Isolated Wetland

Hydrograph





**8490-Existing**

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Type III 24-hr 2-Year Rainfall=3.20"

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**Summary for Subcatchment SC300: Wetland**

Runoff = 0.2 cfs @ 12.37 hrs, Volume= 1,496 cf, Depth&gt; 0.25"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
	3,732	98	Roofs, HSG A
	15,273	72	Dirt roads, HSG A
	184	87	Dirt roads, HSG C
	273	61	>75% Grass cover, Good, HSG B
	2,047	96	Gravel surface, HSG A
*	69	98	Ledge
*	150	98	Ledge
	632	98	Paved parking, HSG B
	2,112	98	Water Surface, HSG A
	824	48	Brush, Good, HSG B
	9,777	30	Brush, Good, HSG A
	2,157	72	Woods/grass comb., Good, HSG C
*	274	100	Wetland
	14,316	55	Woods, Good, HSG B
	18,995	30	Woods, Good, HSG A
	1,025	70	Woods, Good, HSG C
	71,840	55	Weighted Average
	64,871		90.30% Pervious Area
	6,969		9.70% Impervious Area

**8490-Existing**

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Type III 24-hr 2-Year Rainfall=3.20"

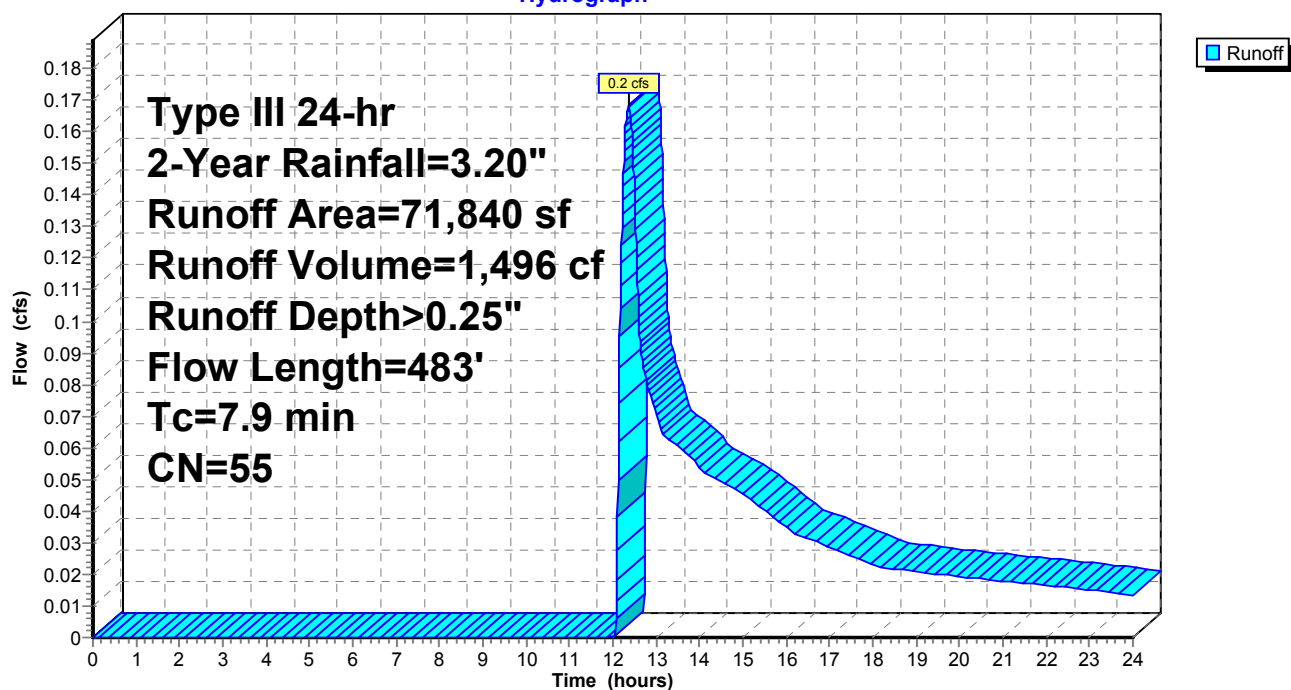
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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	50	0.2600	0.2		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	41	0.2400	2.4		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
1.3	125	0.1100	1.7		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.1	21	0.3500	4.1		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.0	4	0.1100	5.3		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.3	45	0.0118	2.2		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.0	12	0.1300	5.8		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.0	24	0.9000	15.3		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.6	47	0.0077	1.4		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.2	56	0.3300	4.0		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.6	58	0.1000	1.6		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
7.9	483	Total			

**Subcatchment SC300: Wetland**

Hydrograph



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Type III 24-hr 2-Year Rainfall=3.20"

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**Summary for Subcatchment SC400: Basin**

Runoff = 2.6 cfs @ 12.12 hrs, Volume= 8,769 cf, Depth&gt; 1.15"

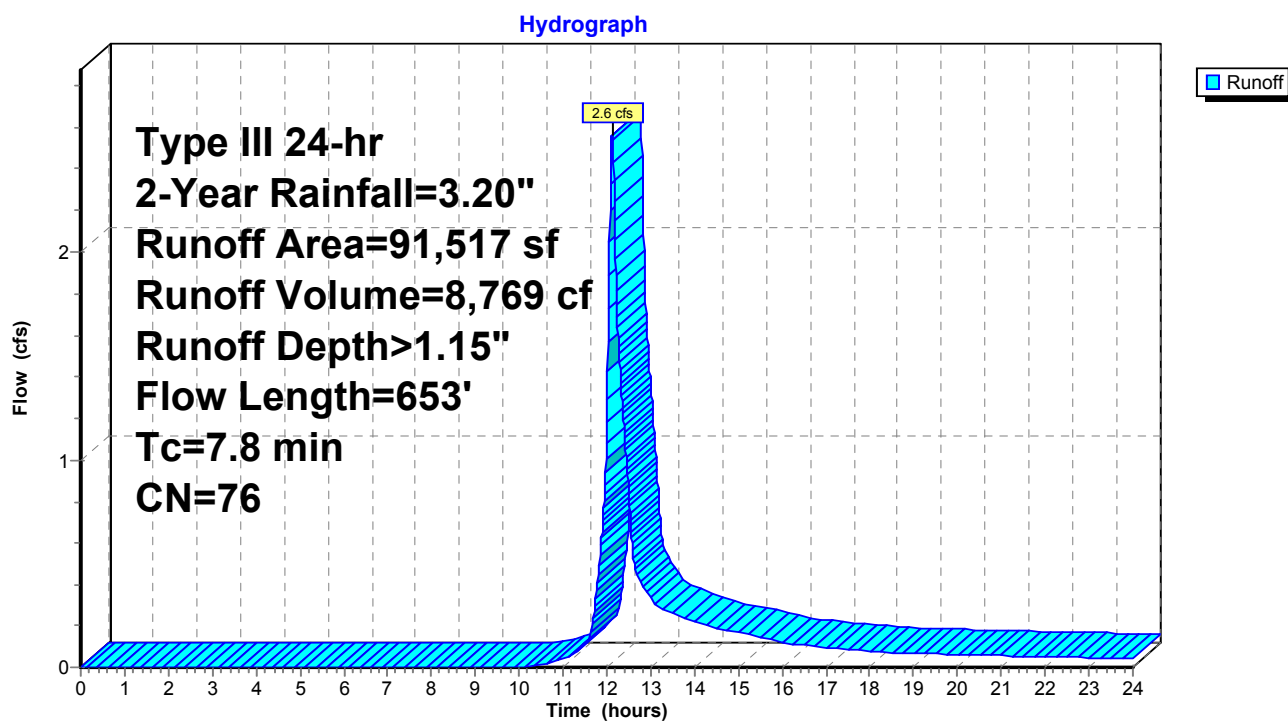
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
11,003	98	Roofs, HSG A
696	61	>75% Grass cover, Good, HSG B
12,993	39	>75% Grass cover, Good, HSG A
425	96	Gravel surface, HSG B
1,854	96	Gravel surface, HSG A
* 1,186	98	Ledge
* 187	98	Ledge
143	98	Paved parking, HSG B
36,767	98	Paved parking, HSG A
66	98	Paved parking, HSG C
11,459	48	Brush, Good, HSG B
100	30	Brush, Good, HSG A
14,638	55	Woods, Good, HSG B
91,517	76	Weighted Average
42,165		46.07% Pervious Area
49,352		53.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.1500	0.1		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.8	114	0.2500	2.5		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.1	24	0.3100	3.9		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.0	4	0.0450	3.4		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.4	80	0.0330	3.7		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.2	54	0.0100	4.5	3.56	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
0.3	130	0.0270	8.6	10.61	<b>Pipe Channel,</b> 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013 Corrugated PE, smooth interior
0.2	94	0.0270	9.8	17.26	<b>Pipe Channel,</b> 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Corrugated PE, smooth interior
0.2	103	0.0330	10.8	19.08	<b>Pipe Channel,</b> 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Corrugated PE, smooth interior
7.8	653	Total			

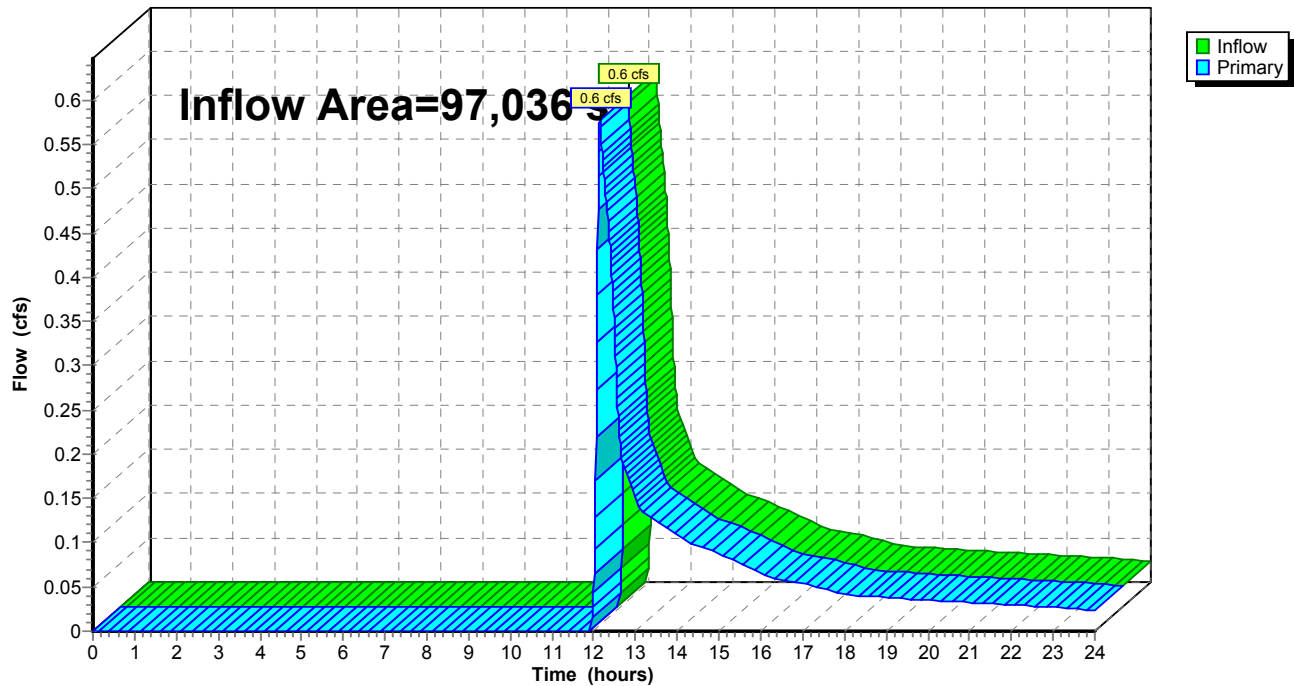
## Subcatchment SC400: Basin



**Summary for Link 1L: Parker River**

Inflow Area = 97,036 sf, 7.18% Impervious, Inflow Depth > 0.41" for 2-Year event  
Inflow = 0.6 cfs @ 12.15 hrs, Volume= 3,292 cf  
Primary = 0.6 cfs @ 12.15 hrs, Volume= 3,292 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Link 1L: Parker River****Hydrograph**

## 8490-Existing

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Type III 24-hr 2-Year Rainfall=3.20"

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### Summary for Link 2L: BVW

Inflow Area = 51,765 sf, 20.75% Impervious, Inflow Depth > 0.73" for 2-Year event

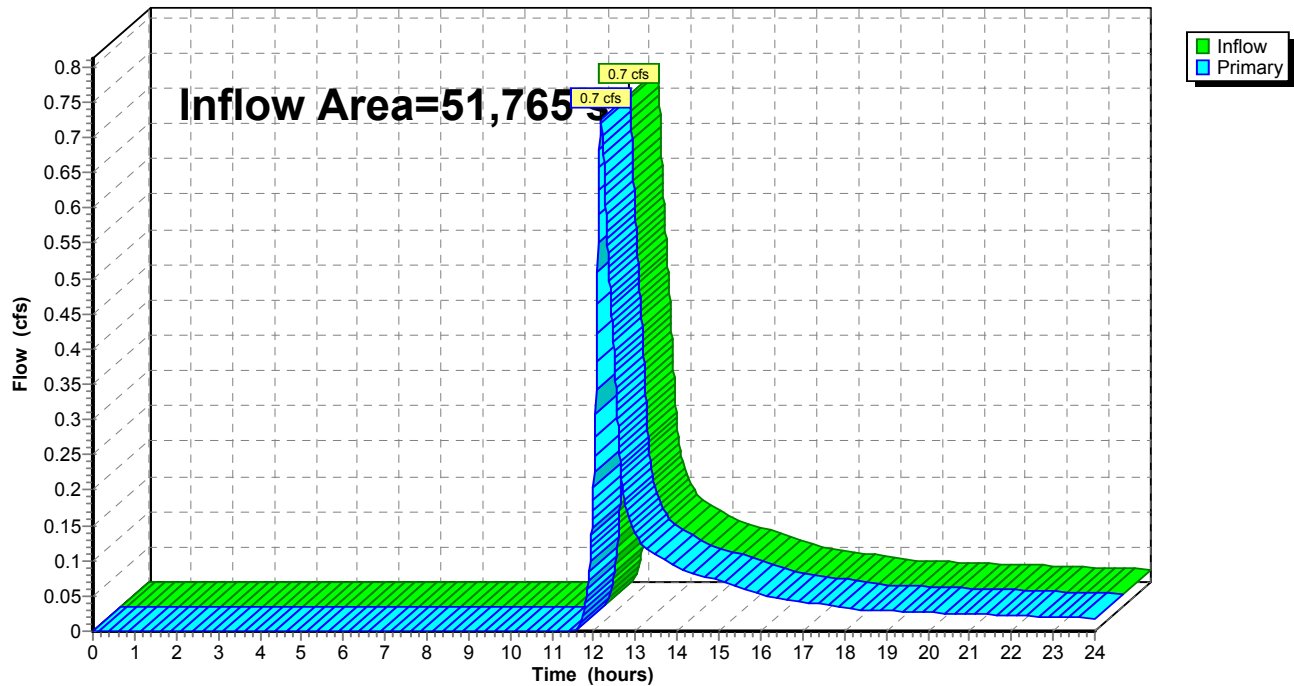
Inflow = 0.7 cfs @ 12.18 hrs, Volume= 3,149 cf

Primary = 0.7 cfs @ 12.18 hrs, Volume= 3,149 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Link 2L: BVW

Hydrograph



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Type III 24-hr 2-Year Rainfall=3.20"

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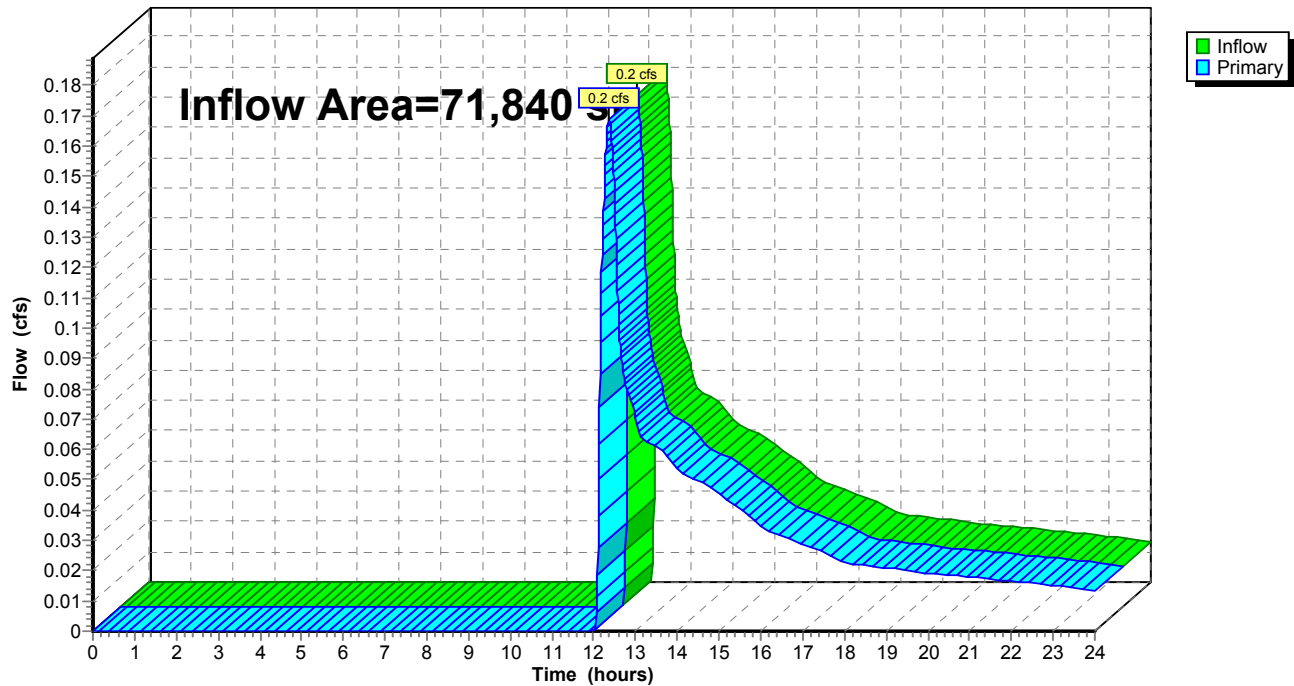
### Summary for Link 3L: IVW

Inflow Area = 71,840 sf, 9.70% Impervious, Inflow Depth > 0.25" for 2-Year event  
Inflow = 0.2 cfs @ 12.37 hrs, Volume= 1,496 cf  
Primary = 0.2 cfs @ 12.37 hrs, Volume= 1,496 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Link 3L: IVW

Hydrograph



## 8490-Existing

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Type III 24-hr 2-Year Rainfall=3.20"

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### Summary for Link 4L: Existing Basin

Inflow Area = 91,517 sf, 53.93% Impervious, Inflow Depth > 1.15" for 2-Year event

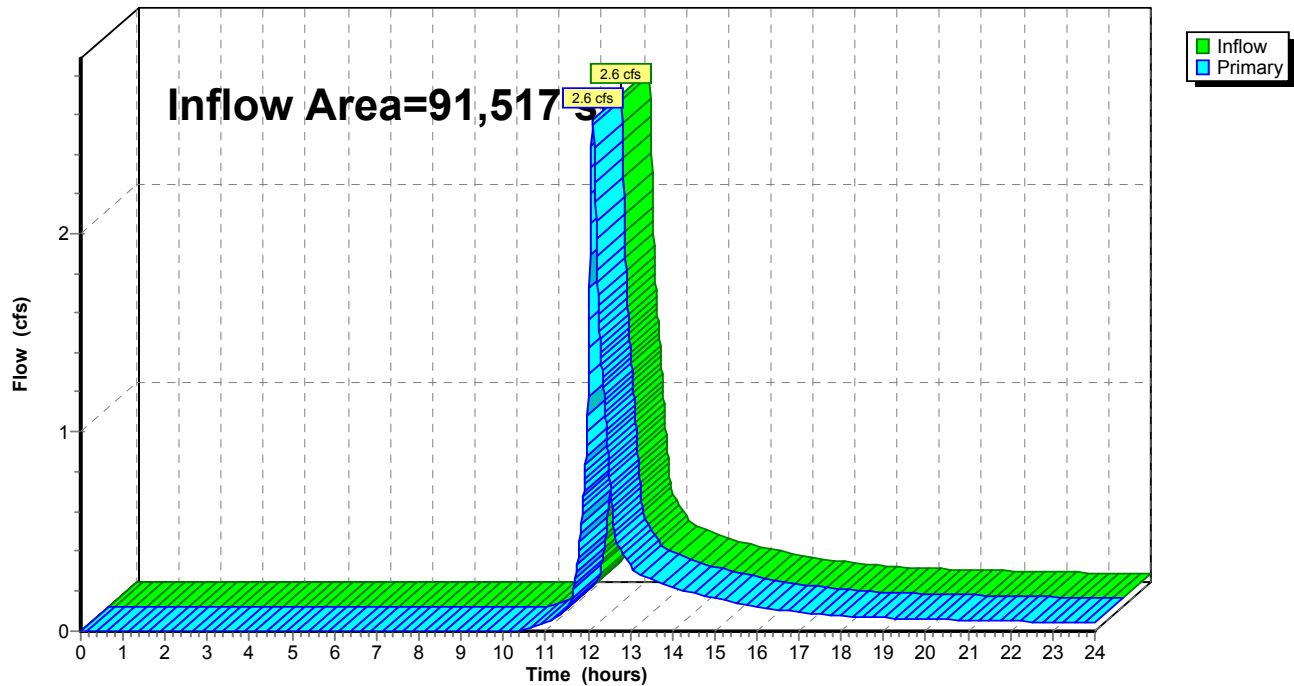
Inflow = 2.6 cfs @ 12.12 hrs, Volume= 8,769 cf

Primary = 2.6 cfs @ 12.12 hrs, Volume= 8,769 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Link 4L: Existing Basin

Hydrograph





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*Type III 24-hr 10-Year Rainfall=4.50"*

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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

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**SubcatchmentSC100: Parker River**Runoff Area=97,036 sf 7.18% Impervious Runoff Depth>1.02"  
Flow Length=308' Tc=7.4 min CN=60 Runoff=2.2 cfs 8,228 cf**SubcatchmentSC200: Isolated Wetland**Runoff Area=51,765 sf 20.75% Impervious Runoff Depth>1.53"  
Flow Length=371' Tc=11.3 min CN=68 Runoff=1.7 cfs 6,591 cf**SubcatchmentSC300: Wetland**Runoff Area=71,840 sf 9.70% Impervious Runoff Depth>0.74"  
Flow Length=483' Tc=7.9 min CN=55 Runoff=1.0 cfs 4,432 cf**SubcatchmentSC400: Basin**Runoff Area=91,517 sf 53.93% Impervious Runoff Depth>2.13"  
Flow Length=653' Tc=7.8 min CN=76 Runoff=4.9 cfs 16,216 cf**Link 1L: Parker River**Inflow=2.2 cfs 8,228 cf  
Primary=2.2 cfs 8,228 cf**Link 2L: BVW**Inflow=1.7 cfs 6,591 cf  
Primary=1.7 cfs 6,591 cf**Link 3L: IVW**Inflow=1.0 cfs 4,432 cf  
Primary=1.0 cfs 4,432 cf**Link 4L: Existing Basin**Inflow=4.9 cfs 16,216 cf  
Primary=4.9 cfs 16,216 cf

**8490-Existing**

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Type III 24-hr 10-Year Rainfall=4.50"

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**Summary for Subcatchment SC100: Parker River**

Runoff = 2.2 cfs @ 12.12 hrs, Volume= 8,228 cf, Depth&gt; 1.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 10-Year Rainfall=4.50"

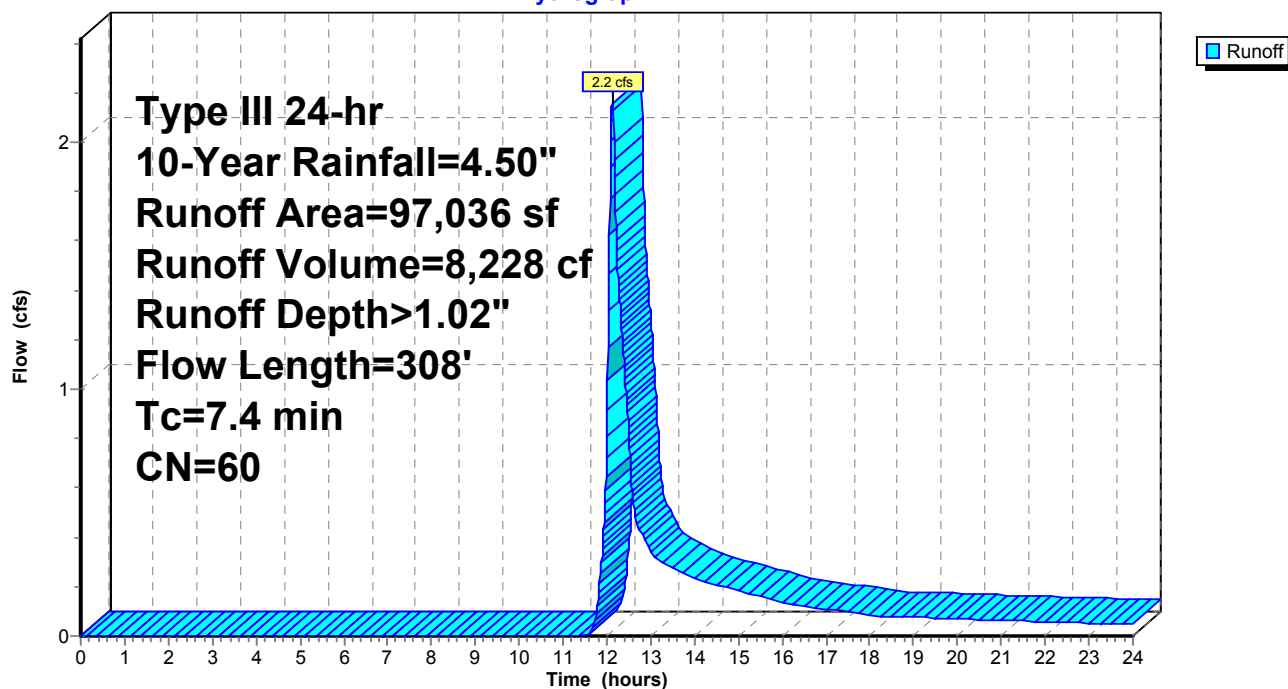
Area (sf)	CN	Description
* 6,970	98	Ledge
3,901	96	Gravel surface, HSG B
86,165	55	Woods, Good, HSG B
97,036	60	Weighted Average
90,066		92.82% Pervious Area
6,970		7.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.1600	0.2		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
1.9	245	0.1940	2.2		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.0	8	0.0500	3.6		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.0	5	0.1750	2.1		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
7.4	308	Total			

**Subcatchment SC100: Parker River**

Hydrograph



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Type III 24-hr 10-Year Rainfall=4.50"

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**Summary for Subcatchment SC200: Isolated Wetland**

Runoff = 1.7 cfs @ 12.17 hrs, Volume= 6,591 cf, Depth&gt; 1.53"

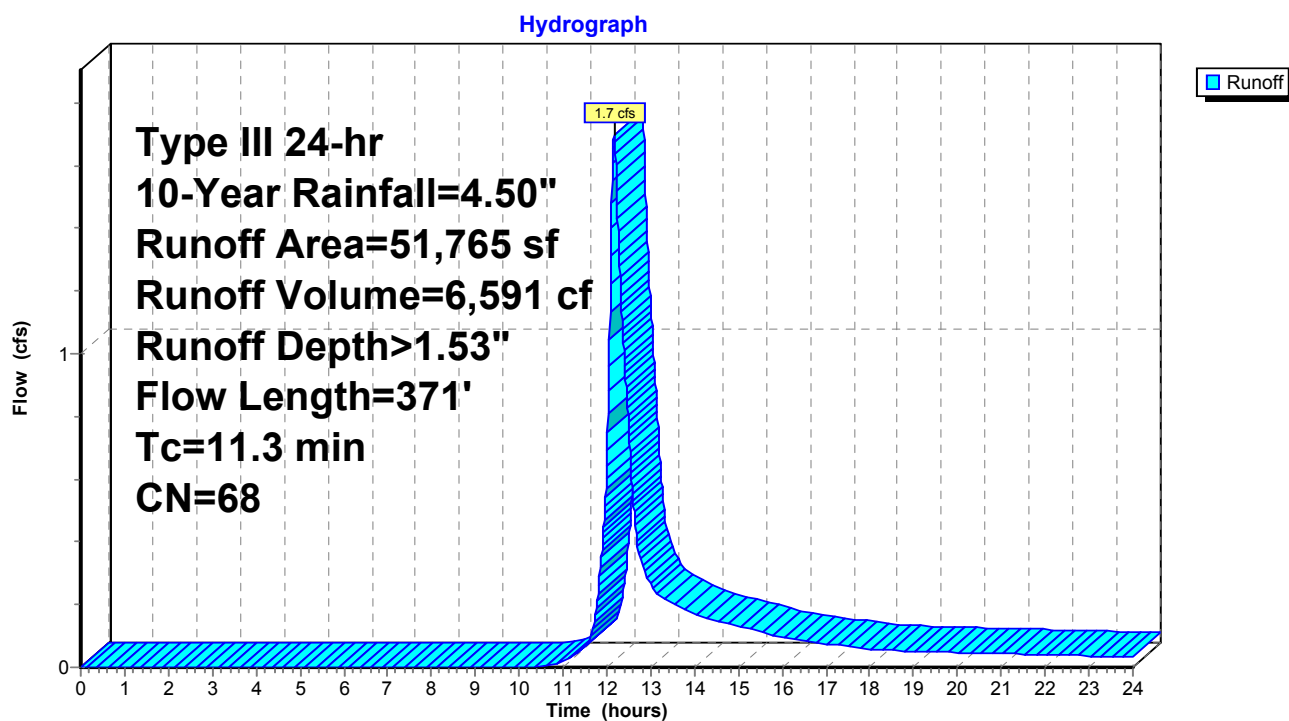
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
	6,429	82	Dirt roads, HSG B
*	5,164	98	Ledge
	1,127	96	Gravel surface, HSG B
*	5,579	100	Wetland
	33,466	55	Woods, Good, HSG B
	51,765	68	Weighted Average
	41,022		79.25% Pervious Area
	10,743		20.75% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.1		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.0	9	0.3800	12.5		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.7	100	0.2000	2.2		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.5	78	0.0600	2.4		<b>Shallow Concentrated Flow,</b> Nearly Bare & Untilled Kv= 10.0 fps
1.4	134	0.1000	1.6		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
11.3	371	Total			

## Subcatchment SC200: Isolated Wetland



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Type III 24-hr 10-Year Rainfall=4.50"

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**Summary for Subcatchment SC300: Wetland**

Runoff = 1.0 cfs @ 12.14 hrs, Volume= 4,432 cf, Depth&gt; 0.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
	3,732	98	Roofs, HSG A
	15,273	72	Dirt roads, HSG A
	184	87	Dirt roads, HSG C
	273	61	>75% Grass cover, Good, HSG B
	2,047	96	Gravel surface, HSG A
*	69	98	Ledge
*	150	98	Ledge
	632	98	Paved parking, HSG B
	2,112	98	Water Surface, HSG A
	824	48	Brush, Good, HSG B
	9,777	30	Brush, Good, HSG A
	2,157	72	Woods/grass comb., Good, HSG C
*	274	100	Wetland
	14,316	55	Woods, Good, HSG B
	18,995	30	Woods, Good, HSG A
	1,025	70	Woods, Good, HSG C
	71,840	55	Weighted Average
	64,871		90.30% Pervious Area
	6,969		9.70% Impervious Area

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Type III 24-hr 10-Year Rainfall=4.50"

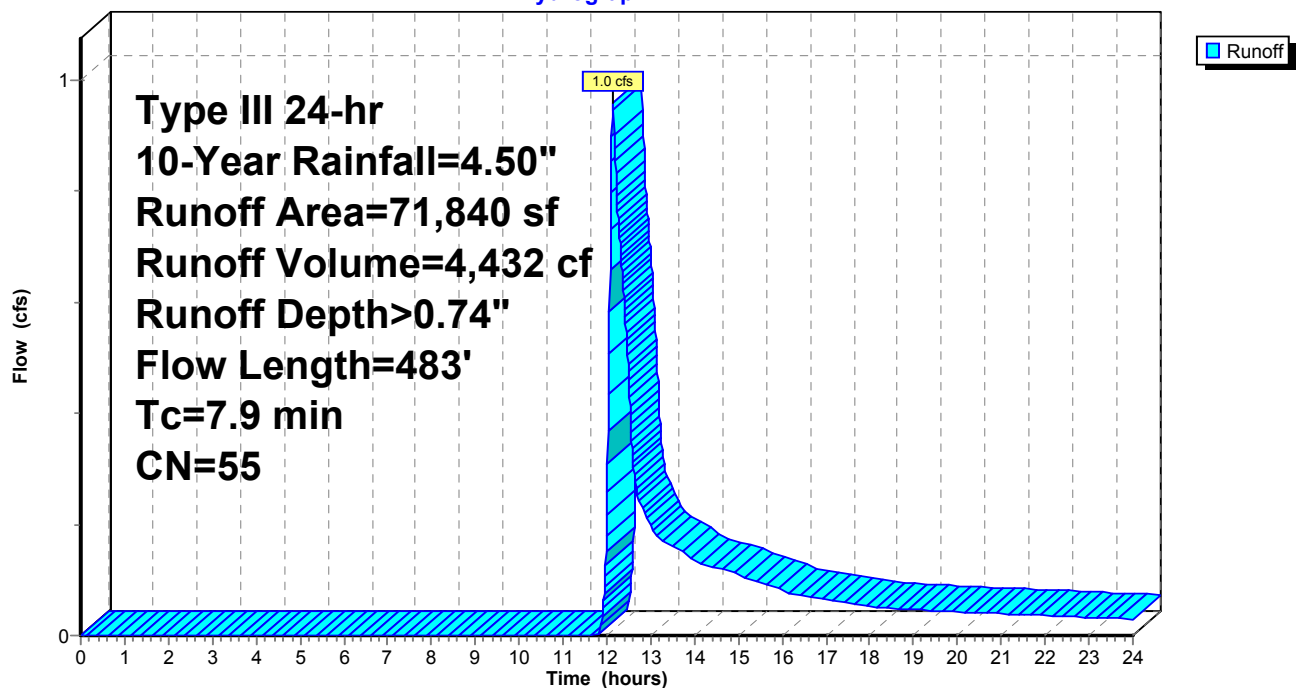
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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	50	0.2600	0.2		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	41	0.2400	2.4		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
1.3	125	0.1100	1.7		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.1	21	0.3500	4.1		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.0	4	0.1100	5.3		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.3	45	0.0118	2.2		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.0	12	0.1300	5.8		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.0	24	0.9000	15.3		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.6	47	0.0077	1.4		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.2	56	0.3300	4.0		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.6	58	0.1000	1.6		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
7.9	483	Total			

**Subcatchment SC300: Wetland**

Hydrograph



**8490-Existing**

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Type III 24-hr 10-Year Rainfall=4.50"

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**Summary for Subcatchment SC400: Basin**

Runoff = 4.9 cfs @ 12.11 hrs, Volume= 16,216 cf, Depth&gt; 2.13"

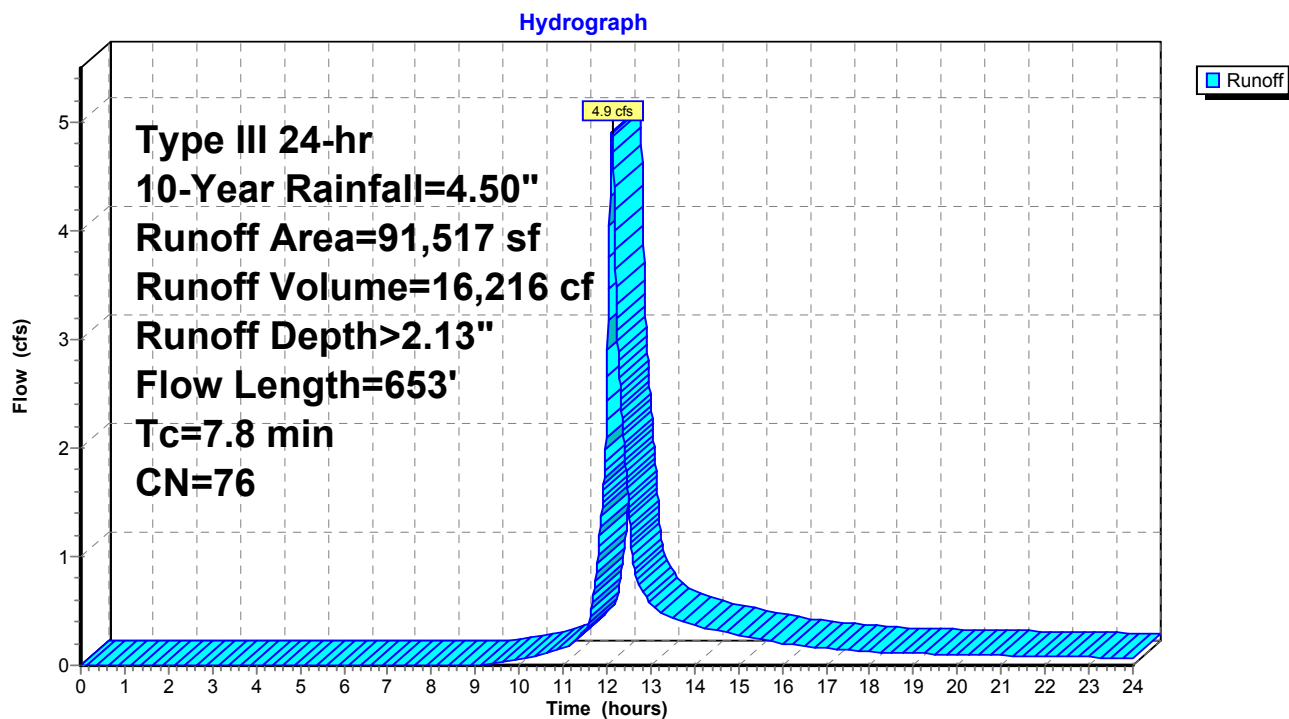
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
11,003	98	Roofs, HSG A
696	61	>75% Grass cover, Good, HSG B
12,993	39	>75% Grass cover, Good, HSG A
425	96	Gravel surface, HSG B
1,854	96	Gravel surface, HSG A
* 1,186	98	Ledge
* 187	98	Ledge
143	98	Paved parking, HSG B
36,767	98	Paved parking, HSG A
66	98	Paved parking, HSG C
11,459	48	Brush, Good, HSG B
100	30	Brush, Good, HSG A
14,638	55	Woods, Good, HSG B
91,517	76	Weighted Average
42,165		46.07% Pervious Area
49,352		53.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.1500	0.1		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.8	114	0.2500	2.5		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.1	24	0.3100	3.9		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.0	4	0.0450	3.4		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.4	80	0.0330	3.7		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.2	54	0.0100	4.5	3.56	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
0.3	130	0.0270	8.6	10.61	<b>Pipe Channel,</b> 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013 Corrugated PE, smooth interior
0.2	94	0.0270	9.8	17.26	<b>Pipe Channel,</b> 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Corrugated PE, smooth interior
0.2	103	0.0330	10.8	19.08	<b>Pipe Channel,</b> 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Corrugated PE, smooth interior
7.8	653	Total			

## Subcatchment SC400: Basin

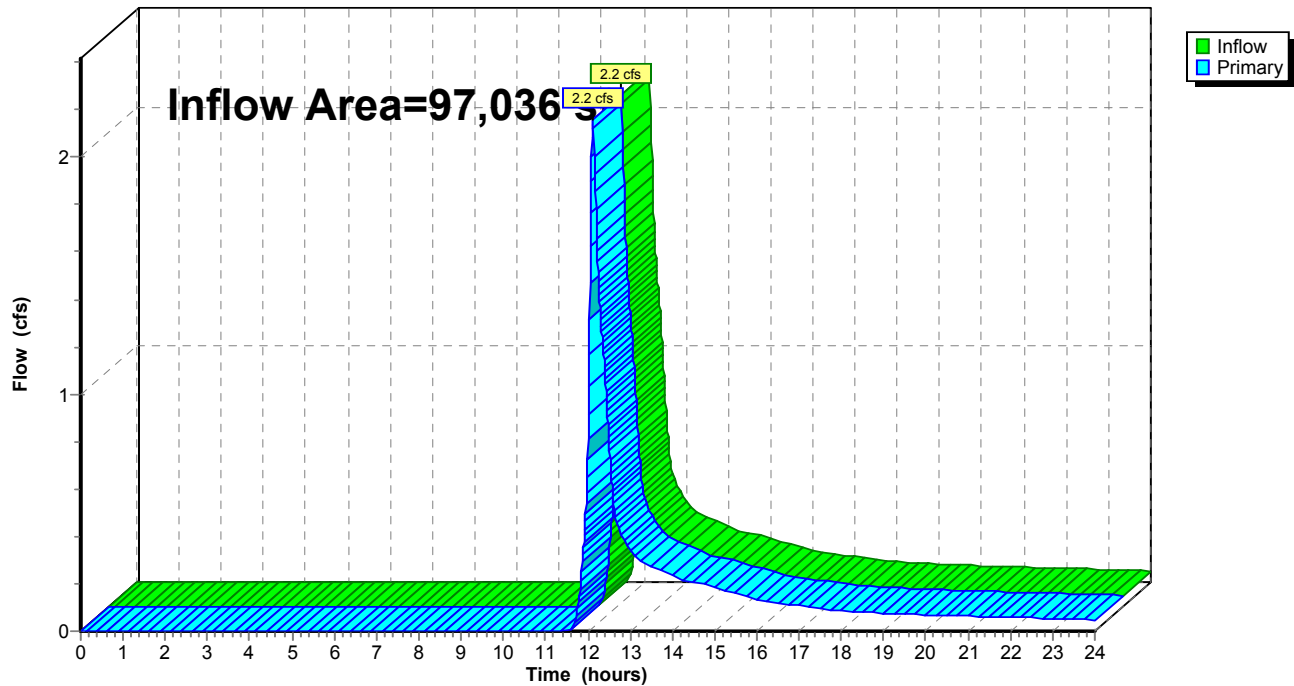




**Summary for Link 1L: Parker River**

Inflow Area = 97,036 sf, 7.18% Impervious, Inflow Depth > 1.02" for 10-Year event  
Inflow = 2.2 cfs @ 12.12 hrs, Volume= 8,228 cf  
Primary = 2.2 cfs @ 12.12 hrs, Volume= 8,228 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Link 1L: Parker River****Hydrograph**

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Type III 24-hr 10-Year Rainfall=4.50"

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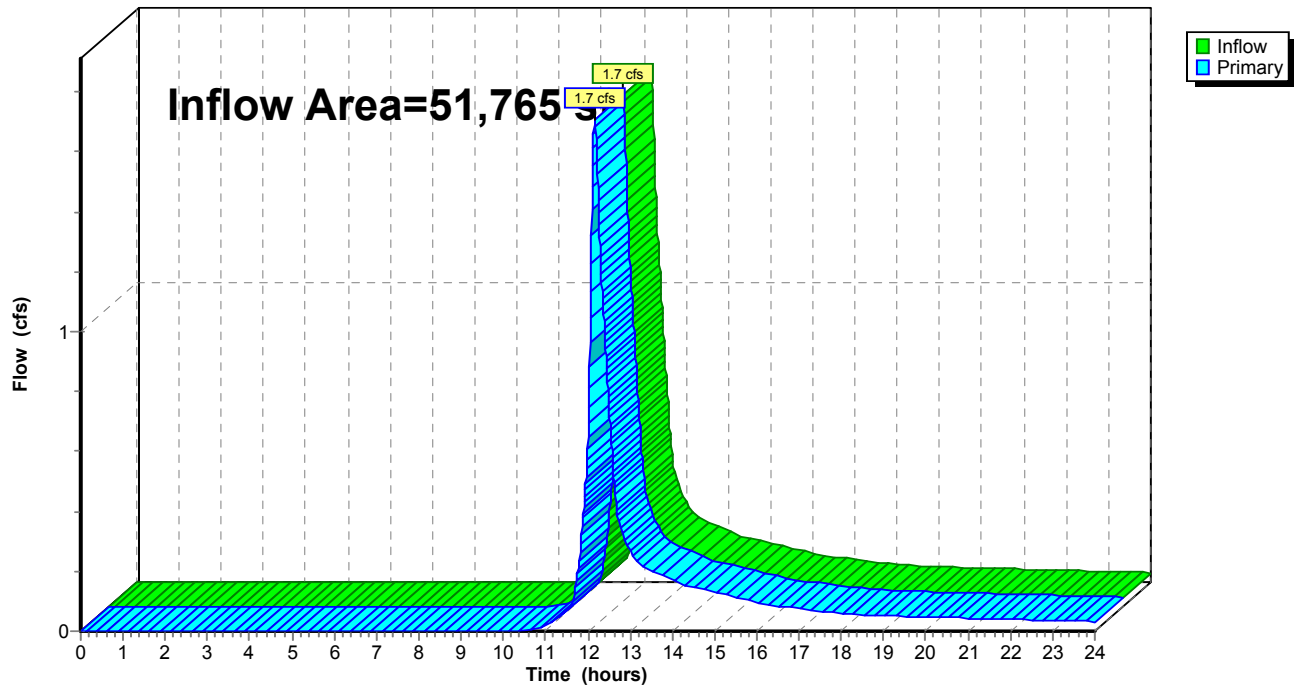
### Summary for Link 2L: BVW

Inflow Area = 51,765 sf, 20.75% Impervious, Inflow Depth > 1.53" for 10-Year event  
Inflow = 1.7 cfs @ 12.17 hrs, Volume= 6,591 cf  
Primary = 1.7 cfs @ 12.17 hrs, Volume= 6,591 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Link 2L: BVW

Hydrograph



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Type III 24-hr 10-Year Rainfall=4.50"

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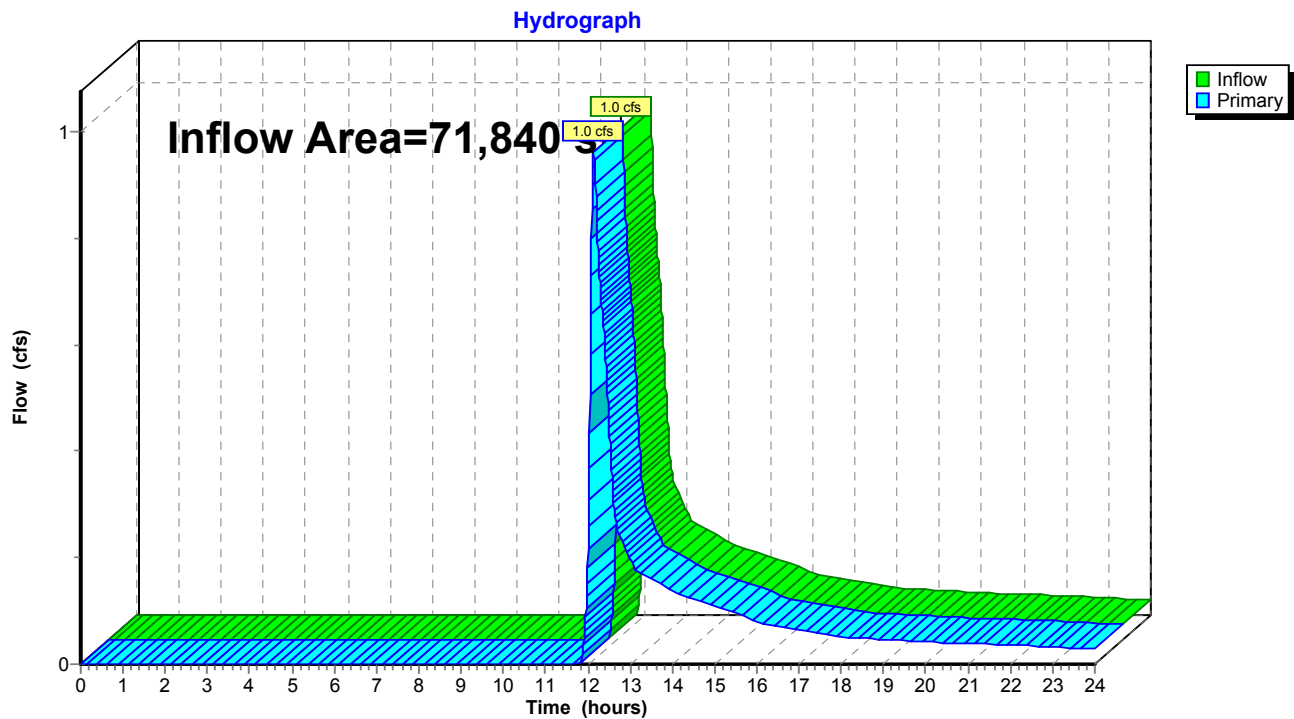
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### Summary for Link 3L: IVW

Inflow Area = 71,840 sf, 9.70% Impervious, Inflow Depth > 0.74" for 10-Year event  
Inflow = 1.0 cfs @ 12.14 hrs, Volume= 4,432 cf  
Primary = 1.0 cfs @ 12.14 hrs, Volume= 4,432 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Link 3L: IVW



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Type III 24-hr 10-Year Rainfall=4.50"

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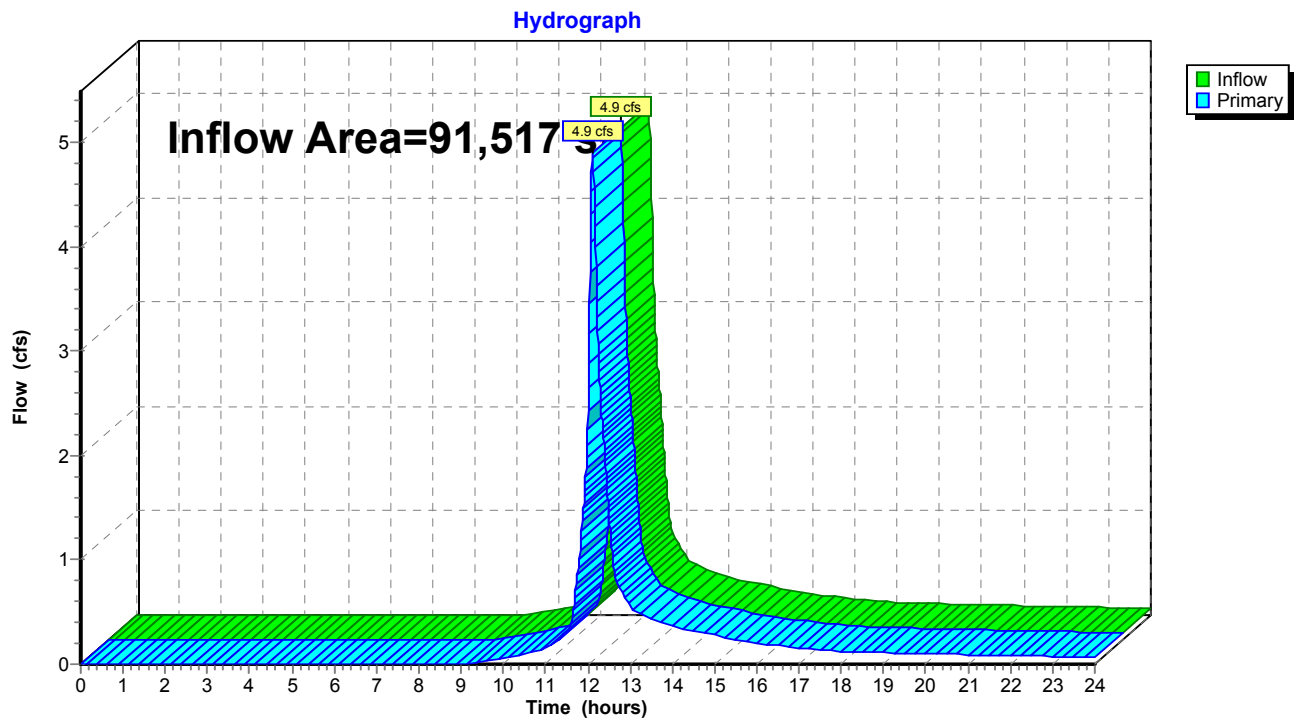
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### Summary for Link 4L: Existing Basin

Inflow Area = 91,517 sf, 53.93% Impervious, Inflow Depth > 2.13" for 10-Year event  
Inflow = 4.9 cfs @ 12.11 hrs, Volume= 16,216 cf  
Primary = 4.9 cfs @ 12.11 hrs, Volume= 16,216 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Link 4L: Existing Basin



**8490-Existing***Type III 24-hr 100-yr (tp-40) Rainfall=6.50"*

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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

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**SubcatchmentSC100: Parker River**Runoff Area=97,036 sf 7.18% Impervious Runoff Depth>2.25"  
Flow Length=308' Tc=7.4 min CN=60 Runoff=5.4 cfs 18,208 cf**SubcatchmentSC200: Isolated Wetland**Runoff Area=51,765 sf 20.75% Impervious Runoff Depth>3.00"  
Flow Length=371' Tc=11.3 min CN=68 Runoff=3.5 cfs 12,954 cf**SubcatchmentSC300: Wetland**Runoff Area=71,840 sf 9.70% Impervious Runoff Depth>1.81"  
Flow Length=483' Tc=7.9 min CN=55 Runoff=3.0 cfs 10,832 cf**SubcatchmentSC400: Basin**Runoff Area=91,517 sf 53.93% Impervious Runoff Depth>3.81"  
Flow Length=653' Tc=7.8 min CN=76 Runoff=8.8 cfs 29,054 cf**Link 1L: Parker River**Inflow=5.4 cfs 18,208 cf  
Primary=5.4 cfs 18,208 cf**Link 2L: BVW**Inflow=3.5 cfs 12,954 cf  
Primary=3.5 cfs 12,954 cf**Link 3L: IVW**Inflow=3.0 cfs 10,832 cf  
Primary=3.0 cfs 10,832 cf**Link 4L: Existing Basin**Inflow=8.8 cfs 29,054 cf  
Primary=8.8 cfs 29,054 cf

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Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

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**Summary for Subcatchment SC100: Parker River**

Runoff = 5.4 cfs @ 12.11 hrs, Volume= 18,208 cf, Depth&gt; 2.25"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

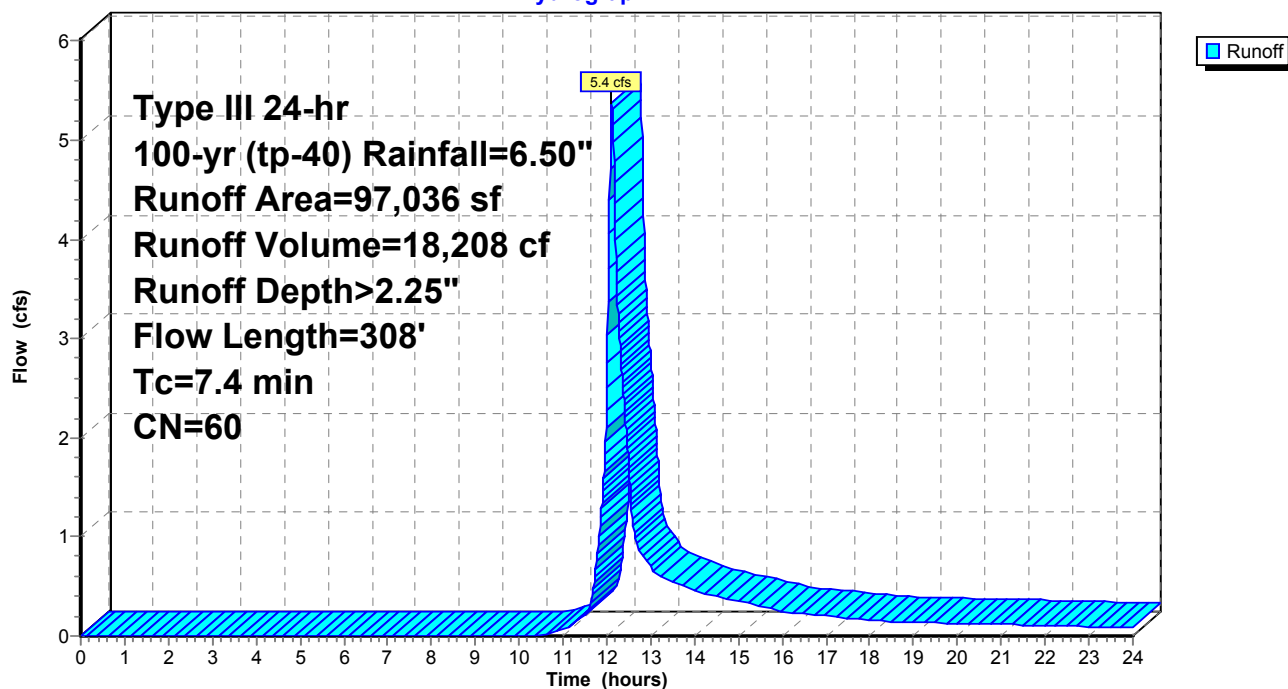
	Area (sf)	CN	Description
*	6,970	98	Ledge
	3,901	96	Gravel surface, HSG B
	86,165	55	Woods, Good, HSG B
	97,036	60	Weighted Average
	90,066		92.82% Pervious Area
	6,970		7.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.1600	0.2		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
1.9	245	0.1940	2.2		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.0	8	0.0500	3.6		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.0	5	0.1750	2.1		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
7.4	308	Total			

**Subcatchment SC100: Parker River**

Hydrograph



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Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

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**Summary for Subcatchment SC200: Isolated Wetland**

Runoff = 3.5 cfs @ 12.16 hrs, Volume= 12,954 cf, Depth&gt; 3.00"

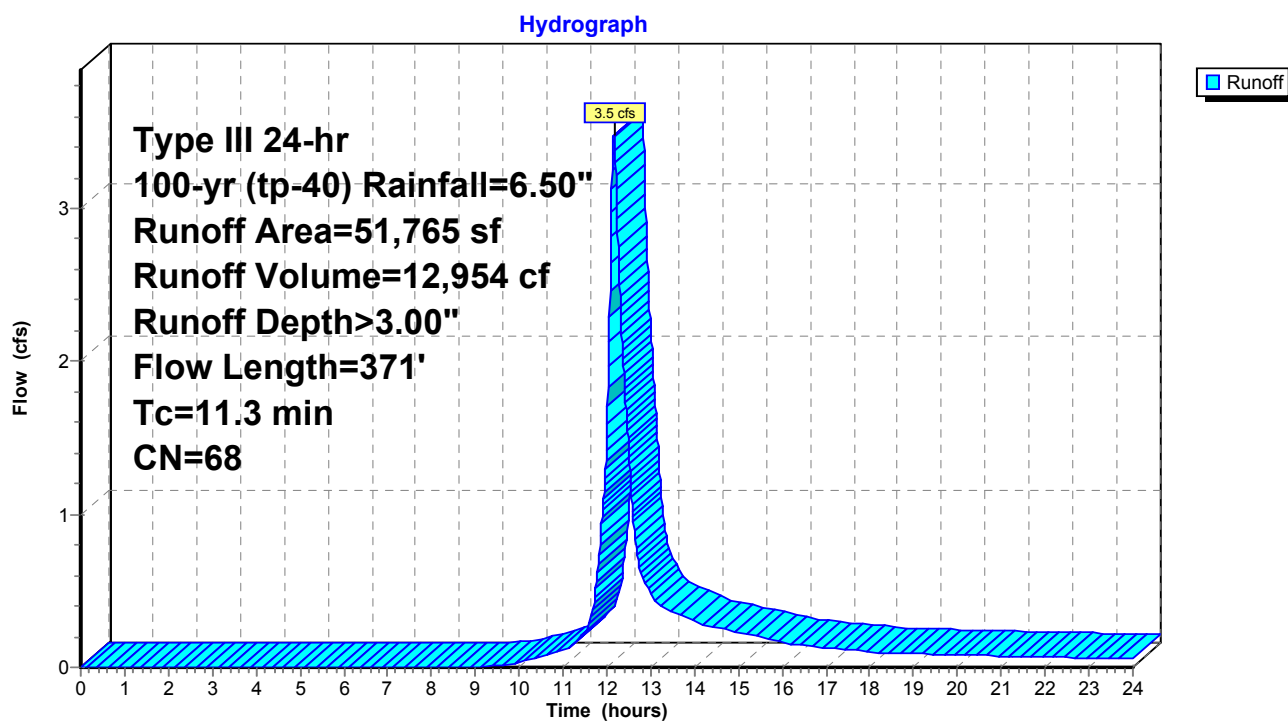
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

	Area (sf)	CN	Description
	6,429	82	Dirt roads, HSG B
*	5,164	98	Ledge
	1,127	96	Gravel surface, HSG B
*	5,579	100	Wetland
	33,466	55	Woods, Good, HSG B
	51,765	68	Weighted Average
	41,022		79.25% Pervious Area
	10,743		20.75% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.1		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.0	9	0.3800	12.5		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.7	100	0.2000	2.2		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.5	78	0.0600	2.4		<b>Shallow Concentrated Flow,</b> Nearly Bare & Untilled Kv= 10.0 fps
1.4	134	0.1000	1.6		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
11.3	371	Total			

## Subcatchment SC200: Isolated Wetland





**8490-Existing**

Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

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**Summary for Subcatchment SC300: Wetland**

Runoff = 3.0 cfs @ 12.12 hrs, Volume= 10,832 cf, Depth&gt; 1.81"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

	Area (sf)	CN	Description
	3,732	98	Roofs, HSG A
	15,273	72	Dirt roads, HSG A
	184	87	Dirt roads, HSG C
	273	61	>75% Grass cover, Good, HSG B
	2,047	96	Gravel surface, HSG A
*	69	98	Ledge
*	150	98	Ledge
	632	98	Paved parking, HSG B
	2,112	98	Water Surface, HSG A
	824	48	Brush, Good, HSG B
	9,777	30	Brush, Good, HSG A
	2,157	72	Woods/grass comb., Good, HSG C
*	274	100	Wetland
	14,316	55	Woods, Good, HSG B
	18,995	30	Woods, Good, HSG A
	1,025	70	Woods, Good, HSG C
	71,840	55	Weighted Average
	64,871		90.30% Pervious Area
	6,969		9.70% Impervious Area

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Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

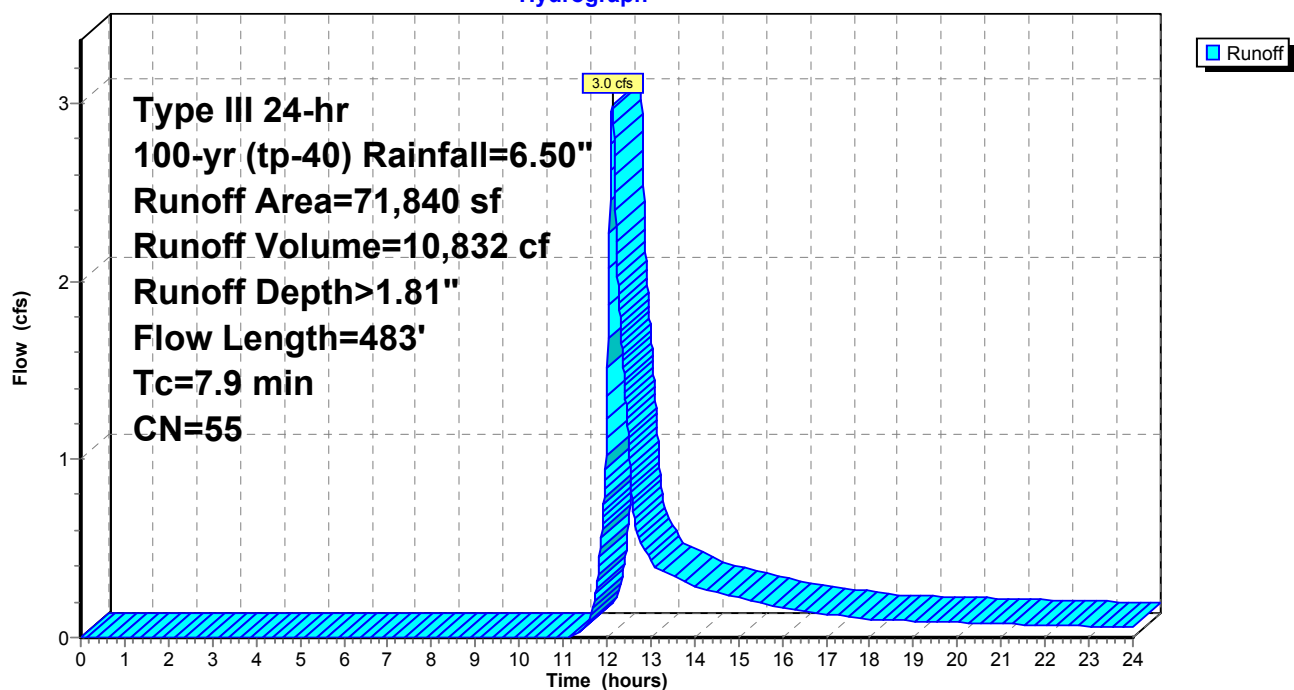
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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	50	0.2600	0.2		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	41	0.2400	2.4		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
1.3	125	0.1100	1.7		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.1	21	0.3500	4.1		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.0	4	0.1100	5.3		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.3	45	0.0118	2.2		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.0	12	0.1300	5.8		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.0	24	0.9000	15.3		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.6	47	0.0077	1.4		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.2	56	0.3300	4.0		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.6	58	0.1000	1.6		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
7.9	483	Total			

**Subcatchment SC300: Wetland**

Hydrograph



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Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

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**Summary for Subcatchment SC400: Basin**

Runoff = 8.8 cfs @ 12.11 hrs, Volume= 29,054 cf, Depth&gt; 3.81"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

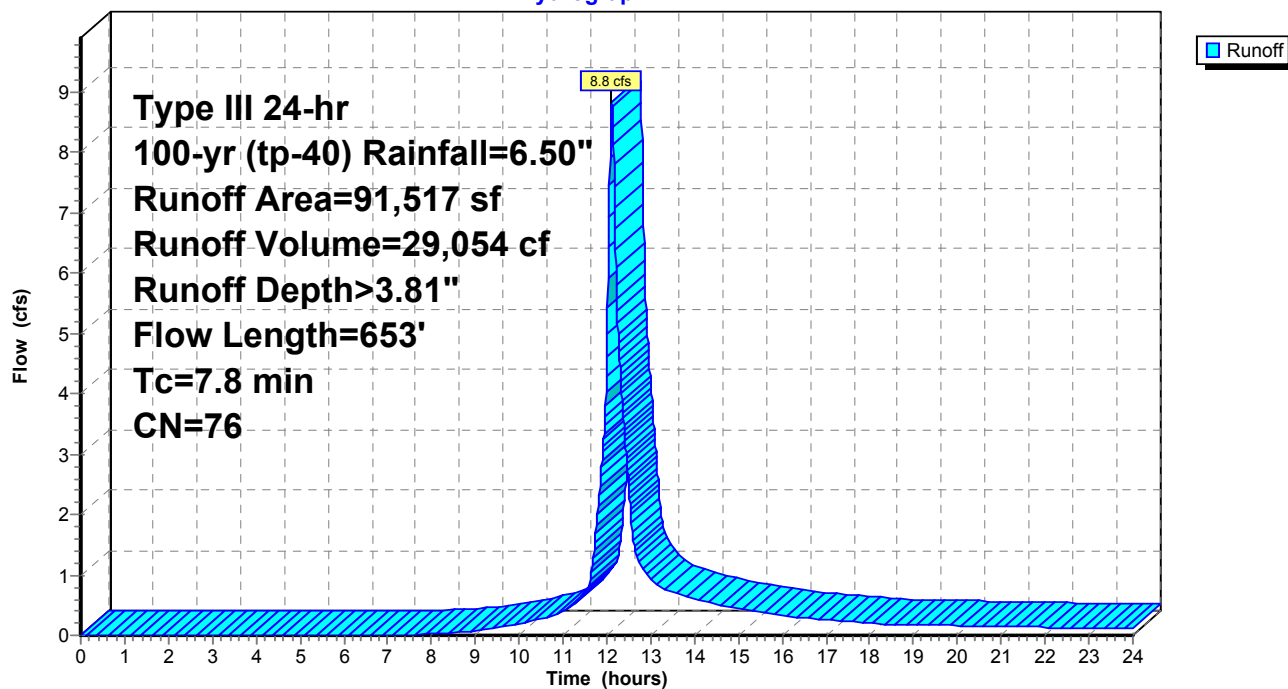
Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

Area (sf)	CN	Description
11,003	98	Roofs, HSG A
696	61	>75% Grass cover, Good, HSG B
12,993	39	>75% Grass cover, Good, HSG A
425	96	Gravel surface, HSG B
1,854	96	Gravel surface, HSG A
* 1,186	98	Ledge
* 187	98	Ledge
143	98	Paved parking, HSG B
36,767	98	Paved parking, HSG A
66	98	Paved parking, HSG C
11,459	48	Brush, Good, HSG B
100	30	Brush, Good, HSG A
14,638	55	Woods, Good, HSG B
91,517	76	Weighted Average
42,165		46.07% Pervious Area
49,352		53.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.1500	0.1		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.8	114	0.2500	2.5		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.1	24	0.3100	3.9		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.0	4	0.0450	3.4		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.4	80	0.0330	3.7		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.2	54	0.0100	4.5	3.56	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
0.3	130	0.0270	8.6	10.61	<b>Pipe Channel,</b> 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013 Corrugated PE, smooth interior
0.2	94	0.0270	9.8	17.26	<b>Pipe Channel,</b> 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Corrugated PE, smooth interior
0.2	103	0.0330	10.8	19.08	<b>Pipe Channel,</b> 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Corrugated PE, smooth interior
7.8	653	Total			

## Subcatchment SC400: Basin

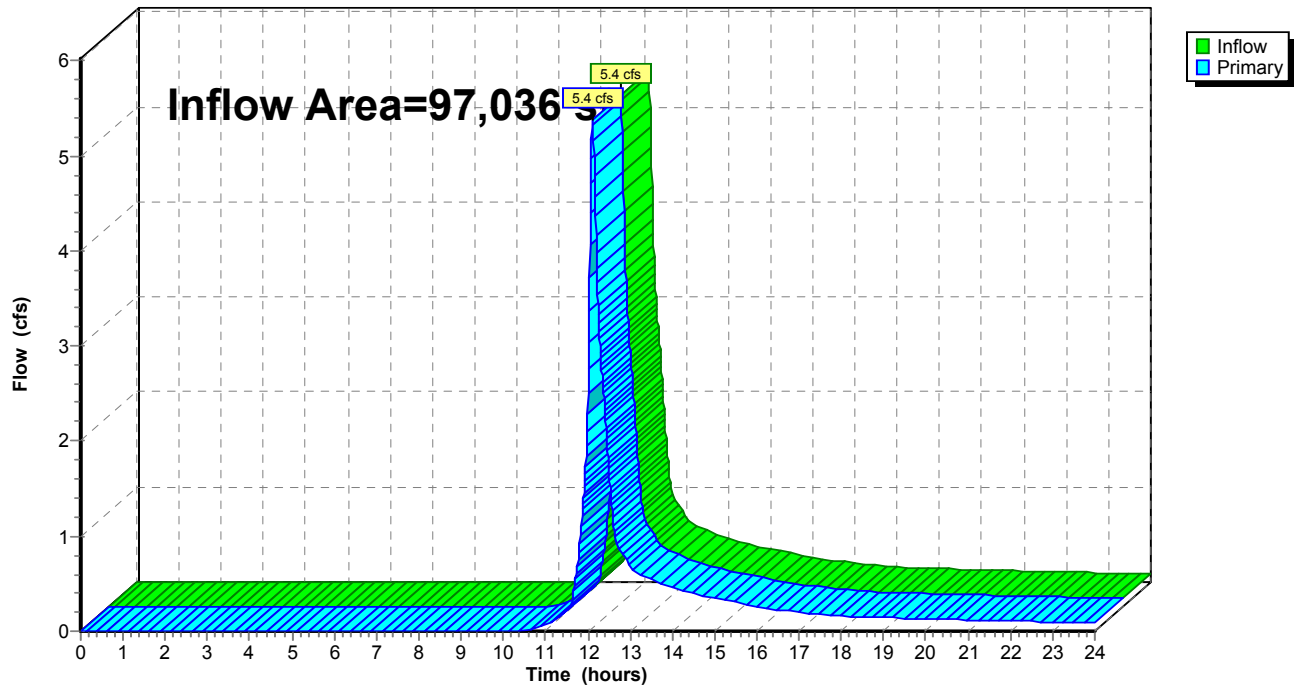
Hydrograph



**Summary for Link 1L: Parker River**

Inflow Area = 97,036 sf, 7.18% Impervious, Inflow Depth > 2.25" for 100-yr (tp-40) event  
Inflow = 5.4 cfs @ 12.11 hrs, Volume= 18,208 cf  
Primary = 5.4 cfs @ 12.11 hrs, Volume= 18,208 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Link 1L: Parker River****Hydrograph**

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Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

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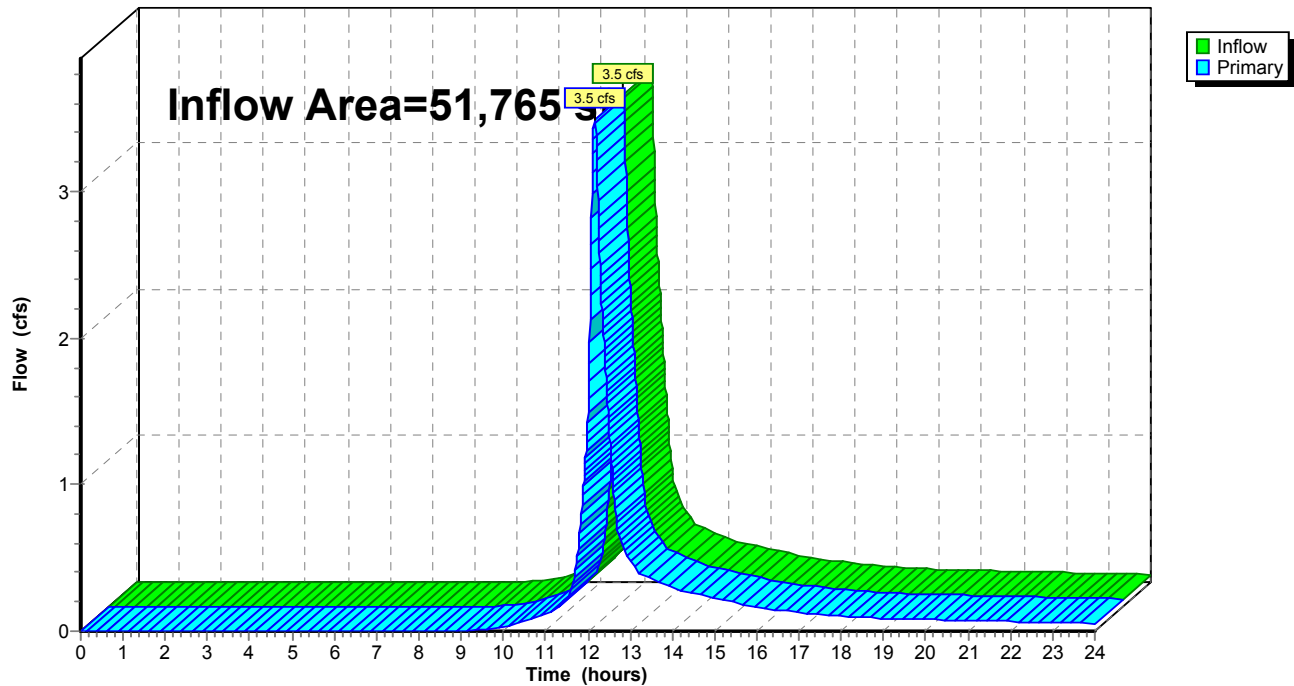
### Summary for Link 2L: BVW

Inflow Area = 51,765 sf, 20.75% Impervious, Inflow Depth > 3.00" for 100-yr (tp-40) event  
Inflow = 3.5 cfs @ 12.16 hrs, Volume= 12,954 cf  
Primary = 3.5 cfs @ 12.16 hrs, Volume= 12,954 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Link 2L: BVW

Hydrograph



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Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

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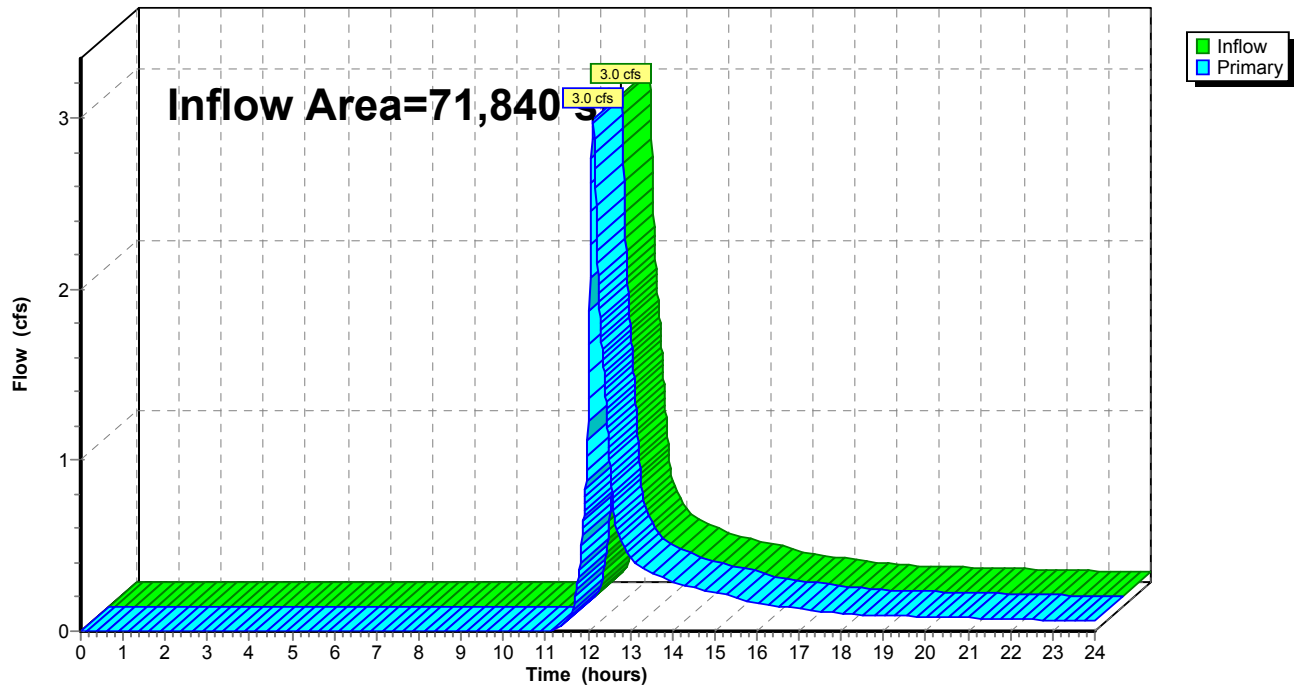
### Summary for Link 3L: IVW

Inflow Area = 71,840 sf, 9.70% Impervious, Inflow Depth > 1.81" for 100-yr (tp-40) event  
Inflow = 3.0 cfs @ 12.12 hrs, Volume= 10,832 cf  
Primary = 3.0 cfs @ 12.12 hrs, Volume= 10,832 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Link 3L: IVW

Hydrograph



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Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

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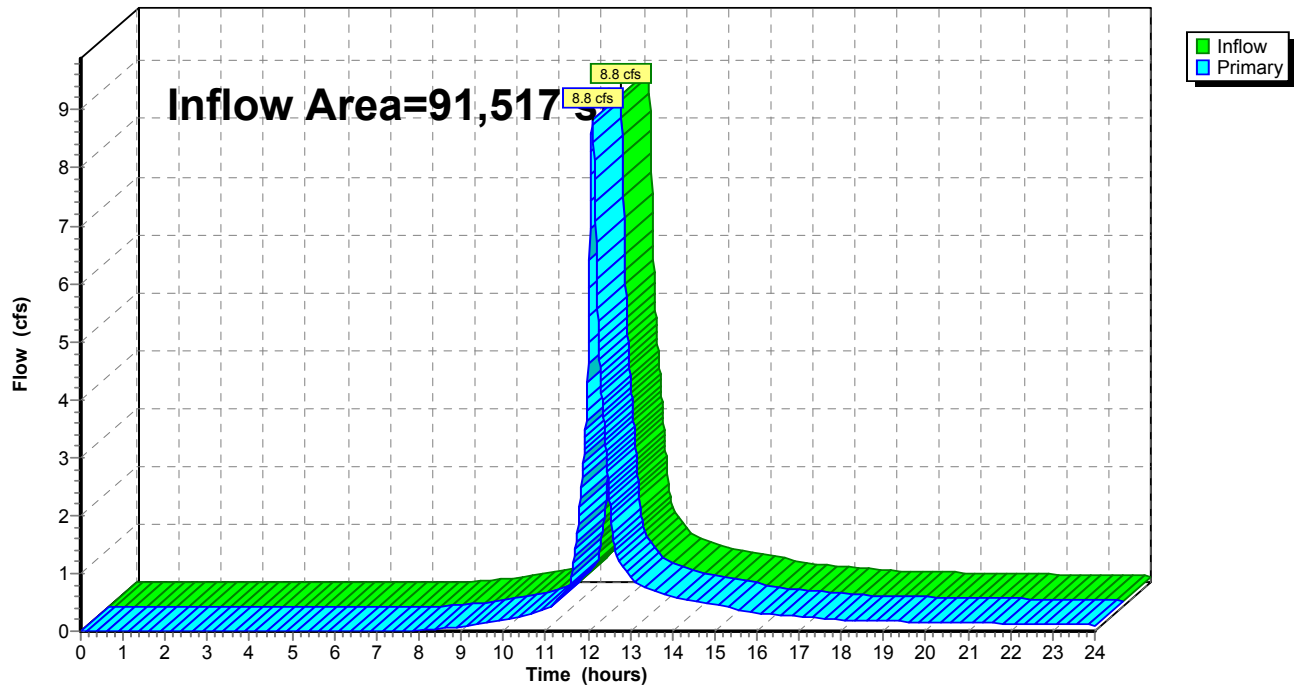
### Summary for Link 4L: Existing Basin

Inflow Area = 91,517 sf, 53.93% Impervious, Inflow Depth > 3.81" for 100-yr (tp-40) event  
Inflow = 8.8 cfs @ 12.11 hrs, Volume= 29,054 cf  
Primary = 8.8 cfs @ 12.11 hrs, Volume= 29,054 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Link 4L: Existing Basin

Hydrograph







**SOIL NOTE**  
THE SOIL DESIGNATIONS WITHIN THE LOCUS PROPERTY SUBCATCHMENT LIMITS HAVE BEEN DELINEATED BY USDA NATURAL RESOURCES CONSERVATION SERVICE. THE PROPERTY HAS BEEN DELINEATED AS SOIL TYPE 225B-BELGRADE VERY FINE SANDY LOAM, 709B-BUXTON-ROCK OUTCROP COMPLEX, AND 717E-ROCK OUTCROP-CHARLTON COMPLEX. THIS SOIL IS RATED AS A HYDROLOGIC SOIL GROUP C, D, AND UNKNOWN RESPECTIVELY.

- LEGEND**
- SC#1 — SUBCATCHMENT AREA
  - DP#1 — DESIGN POINT
  - OVERLAND FLOW LINE
  - OVERLAND FLOW DIRECTION
  - 220C — SOIL TYPE DELINEATION
  - LIMIT OF SOIL TYPE

**SOILS INFORMATION**  
TEST PITS WERE PERFORMED ON MARCH 1, 2018 BY MICHAEL CLEMENT (CERTIFIED SOIL EVALUATOR #14027)

TEST PIT: TP-S1 (ELEV.=33.5±)  
0"-96" C: LOAMY SAND

TEST PIT: TP-S2 (ELEV.=38±)  
0"-16" HTM  
16"-40" C: LOAM  
BEDROCK @ 40"

TEST PIT: TP-S3 (ELEV.=36±)  
0"-22" HTM  
22"-90" C: LOAM

TEST PIT: TP-S4 (ELEV.=43.5±)  
0"-6" A: FINE SANDY LOAM  
6"-14" B: FINE SANDY LOAM  
14"-46" C1: FINE SANDY LOAM  
46"-66" C2: LOAM  
BEDROCK @ 66"

TEST PIT: TP-S5 (ELEV.=32.5±)  
0"-7" A: SANDY LOAM  
7"-15" B: FINE LOAM  
15"-84" C: SANDY LOAM  
E.S.H.G.W. @ 58" REDOX  
WEeping/STANDING WATER OBSERVED @ 76"

REVISIONS		DATE	BY

PROPOSED CONDITIONS WATERSHED PLAN  
LOCATED IN  
BYFIELD, MASSACHUSETTS  
1 ELM STREET  
PREPARED FOR  
THE GOVERNOR'S ACADEMY

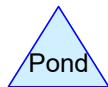
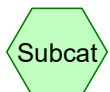
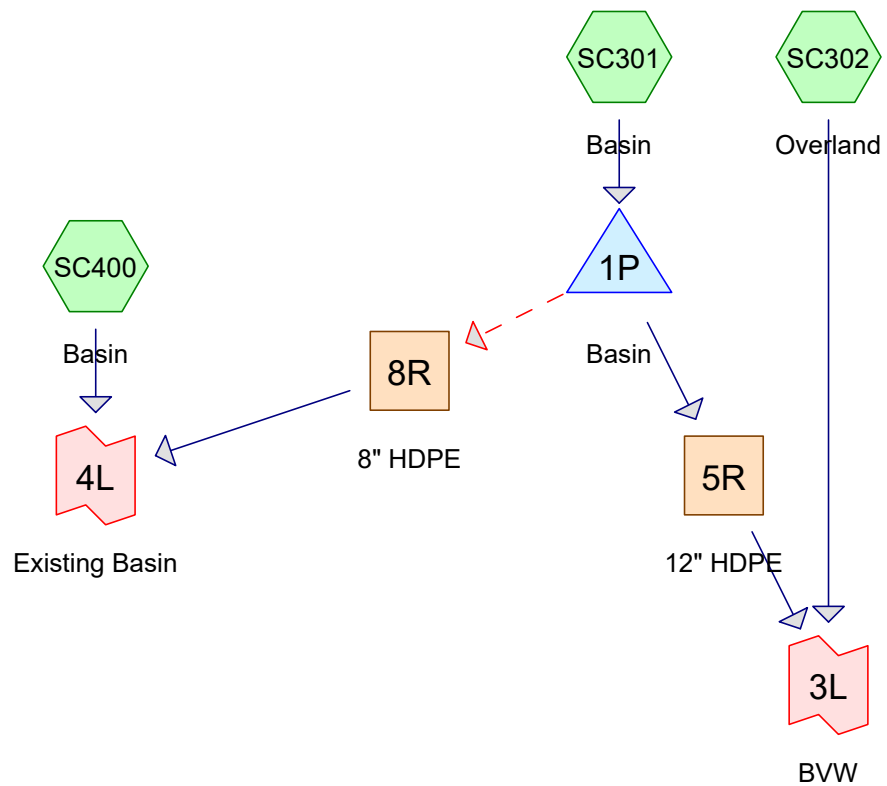
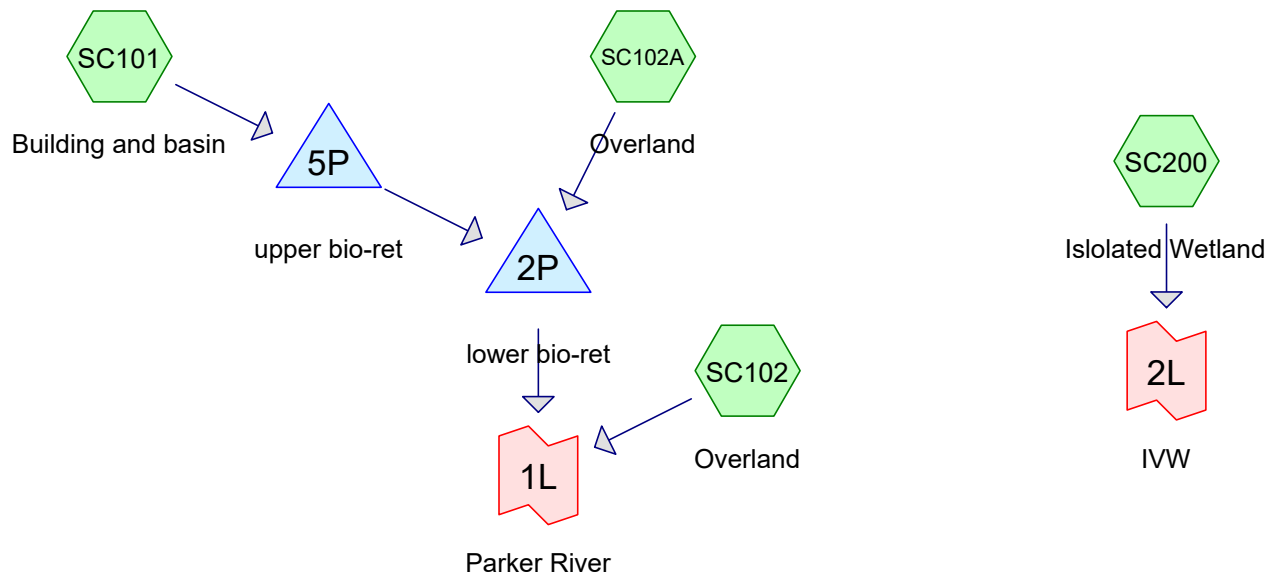
**MERIDIAN ASSOCIATES**  
580 CUMMINGS CENTER SUITE 550  
BOSTON, MA 02115  
TELEPHONE: (617) 299-4441  
WWW.MERIDIANASSOCIATES.COM

DESIGNED BY: CSB  
CHECKED BY: CSB

DATE: APRIL 30, 2018  
SCALE: 1"=40'  
SHEET No. 2 OF 2  
PROJECT No. 8490

DWG. No. 8490 POST





**Routing Diagram for 8490-Proposed**  
 Prepared by {enter your company name here}, Printed 12/6/2021  
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**8490-Proposed**

Type III 24-hr 2-Year Rainfall=3.20"

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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

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

<b>SubcatchmentSC101: Building and basin</b>	Runoff Area=13,212 sf 72.31% Impervious Runoff Depth>1.91" Flow Length=94' Tc=6.0 min CN=87 Runoff=0.7 cfs 2,106 cf
<b>SubcatchmentSC102: Overland</b>	Runoff Area=77,770 sf 3.80% Impervious Runoff Depth>0.41" Flow Length=422' Tc=7.4 min CN=60 Runoff=0.5 cfs 2,639 cf
<b>SubcatchmentSC102A: Overland</b>	Runoff Area=5,065 sf 19.01% Impervious Runoff Depth>0.73" Flow Length=83' Tc=6.0 min CN=68 Runoff=0.1 cfs 309 cf
<b>SubcatchmentSC200: Isolated Wetland</b>	Runoff Area=41,464 sf 25.87% Impervious Runoff Depth>0.78" Flow Length=328' Tc=10.6 min CN=69 Runoff=0.6 cfs 2,685 cf
<b>SubcatchmentSC301: Basin</b>	Runoff Area=45,668 sf 23.80% Impervious Runoff Depth>0.52" Flow Length=359' Tc=6.6 min CN=63 Runoff=0.4 cfs 1,972 cf
<b>SubcatchmentSC302: Overland</b>	Runoff Area=37,667 sf 0.73% Impervious Runoff Depth>0.00" Flow Length=75' Slope=0.3300 '/' Tc=6.0 min CN=40 Runoff=0.0 cfs 8 cf
<b>SubcatchmentSC400: Basin</b>	Runoff Area=91,609 sf 51.31% Impervious Runoff Depth>1.04" Tc=7.8 min CN=74 Runoff=2.3 cfs 7,905 cf
<b>Reach 5R: 12" HDPE</b>	Avg. Flow Depth=0.06' Max Vel=5.2 fps Inflow=0.1 cfs 1,056 cf 12.0" Round Pipe n=0.013 L=25.0' S=0.1600 '/' Capacity=14.3 cfs Outflow=0.1 cfs 1,056 cf
<b>Reach 8R: 8" HDPE</b>	Avg. Flow Depth=0.00' Max Vel=0.0 fps Inflow=0.0 cfs 0 cf 8.0" Round Pipe n=0.013 L=140.0' S=0.0214 '/' Capacity=1.8 cfs Outflow=0.0 cfs 0 cf
<b>Pond 1P: Basin</b>	Peak Elev=36.10' Storage=579 cf Inflow=0.4 cfs 1,972 cf Discarded=0.0 cfs 408 cf Primary=0.1 cfs 1,056 cf Secondary=0.0 cfs 0 cf Outflow=0.1 cfs 1,464 cf
<b>Pond 2P: lower bio-ret</b>	Peak Elev=22.53' Storage=658 cf Inflow=0.4 cfs 1,093 cf Outflow=0.1 cfs 453 cf
<b>Pond 5P: upper bio-ret</b>	Peak Elev=30.60' Storage=675 cf Inflow=0.7 cfs 2,106 cf Discarded=0.0 cfs 862 cf Primary=0.4 cfs 785 cf Outflow=0.4 cfs 1,647 cf
<b>Link 1L: Parker River</b>	Inflow=0.5 cfs 3,092 cf Primary=0.5 cfs 3,092 cf
<b>Link 2L: IVW</b>	Inflow=0.6 cfs 2,685 cf Primary=0.6 cfs 2,685 cf
<b>Link 3L: BVW</b>	Inflow=0.1 cfs 1,064 cf Primary=0.1 cfs 1,064 cf
<b>Link 4L: Existing Basin</b>	Inflow=2.3 cfs 7,905 cf Primary=2.3 cfs 7,905 cf

**8490-Proposed***Type III 24-hr 2-Year Rainfall=3.20"*

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**Total Runoff Area = 312,455 sf   Runoff Volume = 17,623 cf   Average Runoff Depth = 0.68"**  
**73.65% Pervious = 230,108 sf   26.35% Impervious = 82,347 sf**

**8490-Proposed**

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Type III 24-hr 2-Year Rainfall=3.20"

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**Summary for Subcatchment SC101: Building and basin**

Runoff = 0.7 cfs @ 12.09 hrs, Volume= 2,106 cf, Depth&gt; 1.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

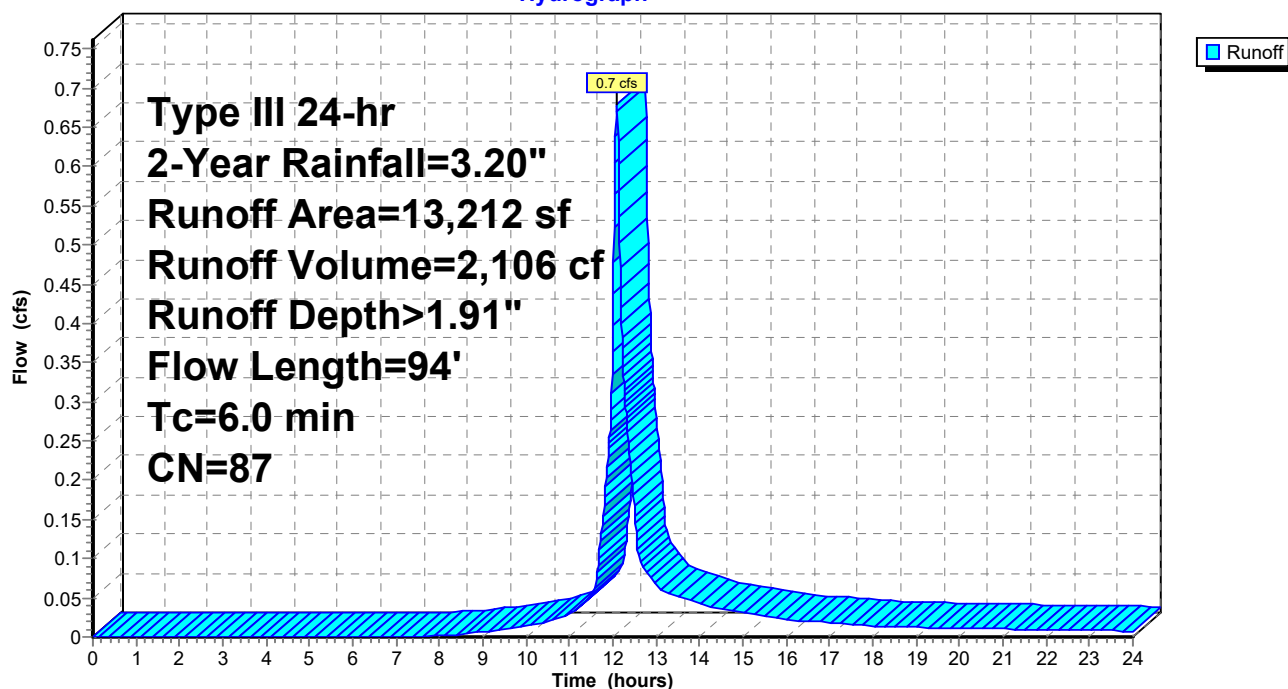
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
7,032	98	Roofs, HSG B
769	98	Paved parking, HSG B
2,777	61	>75% Grass cover, Good, HSG B
* 1,753	98	Ledge
881	55	Woods, Good, HSG B
13,212	87	Weighted Average
3,658		27.69% Pervious Area
9,554		72.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	42	0.3300	3.5		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 3.10"
0.3	52	0.1875	3.0		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.5	94	Total, Increased to minimum Tc = 6.0 min			

**Subcatchment SC101: Building and basin**

Hydrograph



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Type III 24-hr 2-Year Rainfall=3.20"

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**Summary for Subcatchment SC102: Overland**

Runoff = 0.5 cfs @ 12.15 hrs, Volume= 2,639 cf, Depth&gt; 0.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2-Year Rainfall=3.20"

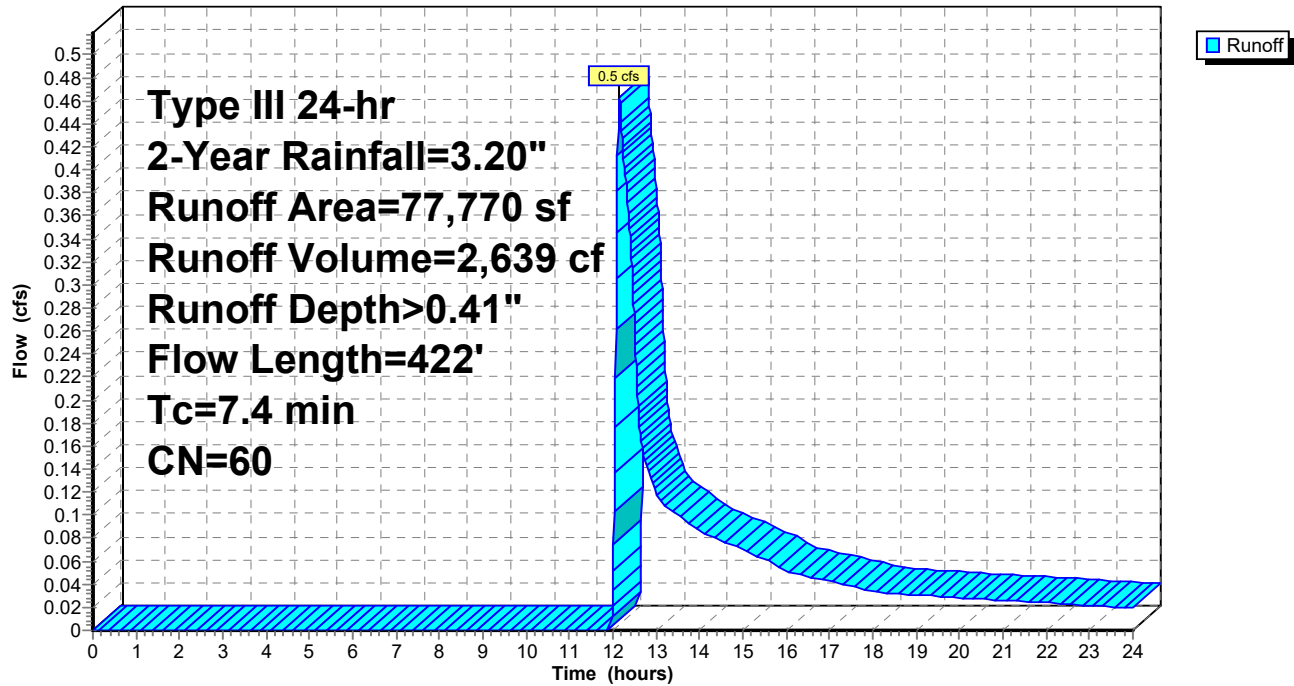
Area (sf)	CN	Description
2,469	61	>75% Grass cover, Good, HSG B
446	61	>75% Grass cover, Good, HSG B
* 2,957	98	Ledge
3,901	96	Gravel surface, HSG B
2,862	96	Gravel surface, HSG B
65,135	55	Woods, Good, HSG B
77,770	60	Weighted Average
74,813		96.20% Pervious Area
2,957		3.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.1600	0.2		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.2	30	0.3000	2.7		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.2	21	0.1000	1.6		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.1	20	0.2800	2.6		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.6	170	0.0450	4.9	3.07	<b>Trap/Vee/Rect Channel Flow,</b> Bot.W=2.00' D=0.25' Z= 2.0 '/' Top.W=3.00' n= 0.022 Earth, clean & straight
0.8	118	0.2300	2.4		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.0	8	0.0500	3.6		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.0	5	0.1750	2.1		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
7.4	422	Total			

## Subcatchment SC102: Overland

Hydrograph



**8490-Proposed**

Type III 24-hr 2-Year Rainfall=3.20"

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**Summary for Subcatchment SC102A: Overland**

Runoff = 0.1 cfs @ 12.10 hrs, Volume= 309 cf, Depth&gt; 0.73"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 2-Year Rainfall=3.20"

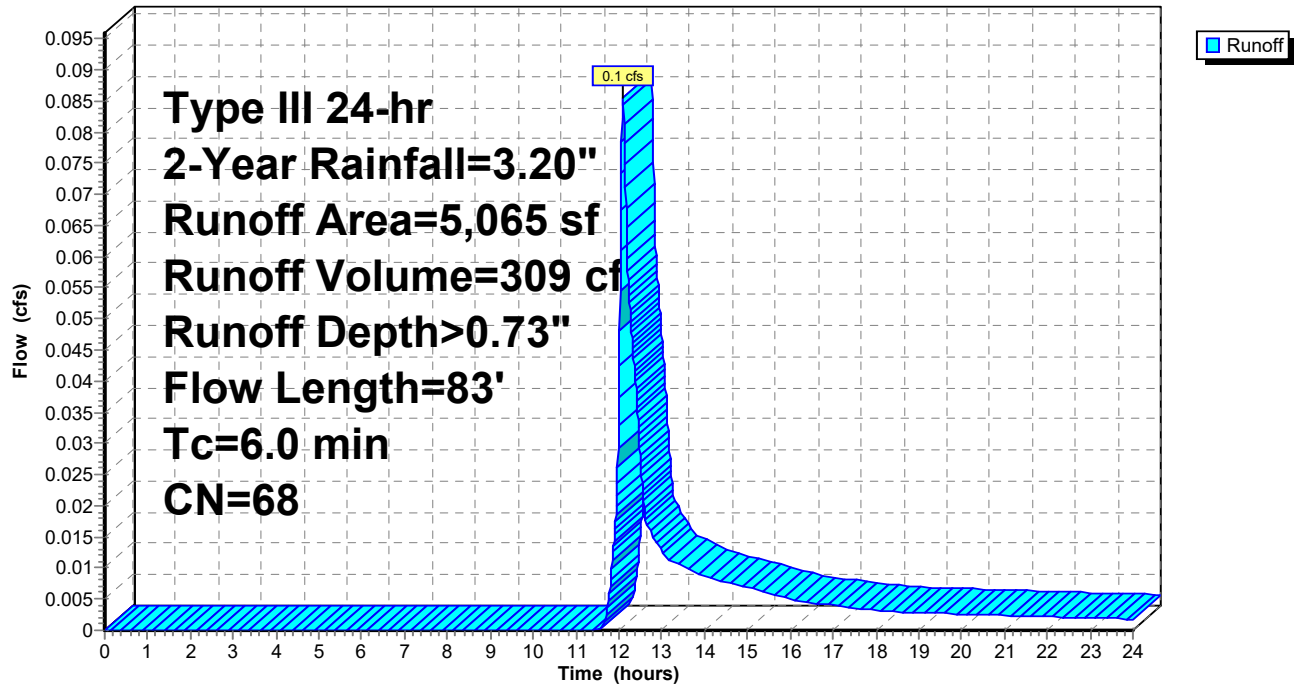
Area (sf)	CN	Description
247	61	>75% Grass cover, Good, HSG B
299	61	>75% Grass cover, Good, HSG B
106	96	Gravel surface, HSG B
* 963	98	Ledge
342	96	Gravel surface, HSG B
52	96	Gravel surface, HSG B
3,056	55	Woods, Good, HSG B
5,065	68	Weighted Average
4,102		80.99% Pervious Area
963		19.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	20	0.2500	2.7		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 3.10"
0.1	28	0.2500	3.5		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.3	35	0.2000	2.2		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.5	83	Total, Increased to minimum Tc = 6.0 min			



## Subcatchment SC102A: Overland

Hydrograph



**8490-Proposed**

Type III 24-hr 2-Year Rainfall=3.20"

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**Summary for Subcatchment SC200: Isolated Wetland**

Runoff = 0.6 cfs @ 12.17 hrs, Volume= 2,685 cf, Depth&gt; 0.78"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

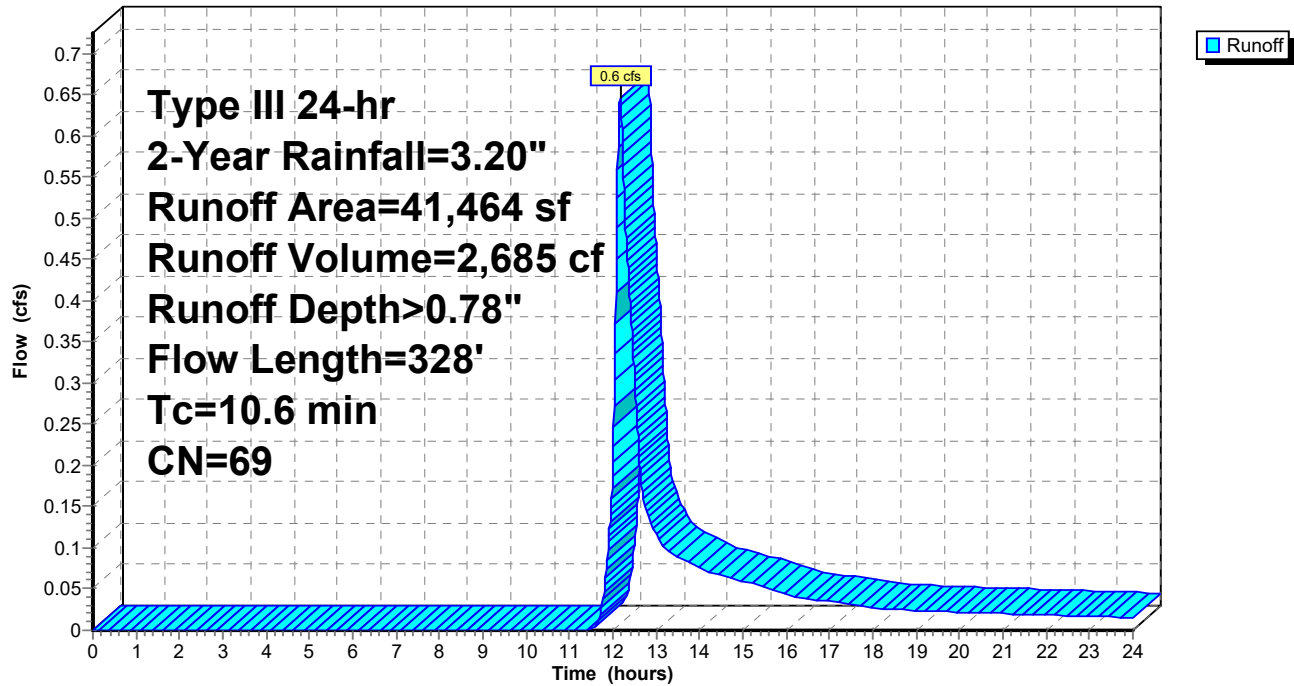
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
1,062	82	Dirt roads, HSG B
721	61	>75% Grass cover, Good, HSG B
2,106	61	>75% Grass cover, Good, HSG B
* 5,148	98	Ledge
1,127	96	Gravel surface, HSG B
532	96	Gravel surface, HSG B
* 5,579	100	Wetland
25,189	55	Woods, Good, HSG B
41,464	69	Weighted Average
30,737		74.13% Pervious Area
10,727		25.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.1		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.0	11	0.4000	12.8		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.3	38	0.1670	2.0		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.1	16	0.0150	2.0		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.4	82	0.0450	3.4		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.1	131	0.1500	1.9		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
10.6	328	Total			

**Subcatchment SC200: Isolated Wetland**

Hydrograph



**8490-Proposed**

Type III 24-hr 2-Year Rainfall=3.20"

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**Summary for Subcatchment SC301: Basin**

Runoff = 0.4 cfs @ 12.12 hrs, Volume= 1,972 cf, Depth&gt; 0.52"

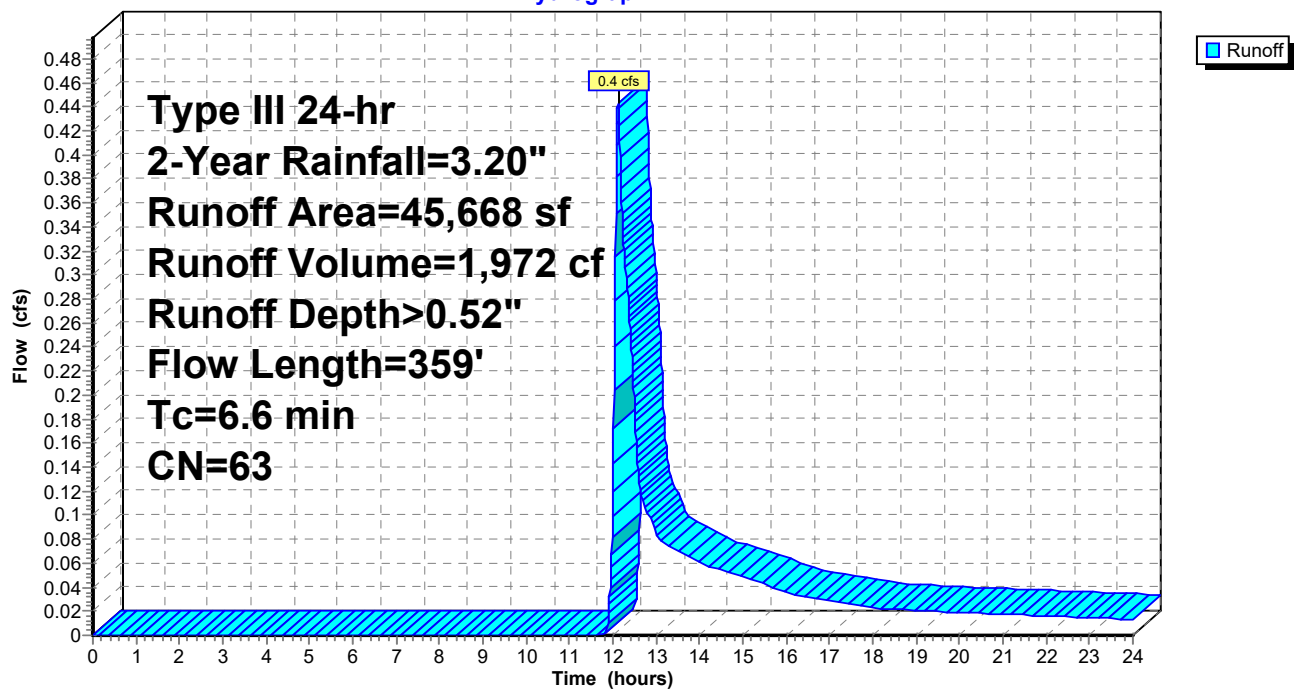
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
3,732	98	Roofs, HSG A
1,752	39	>75% Grass cover, Good, HSG A
6,950	39	>75% Grass cover, Good, HSG A
208	61	>75% Grass cover, Good, HSG B
2,246	96	Gravel surface, HSG A
2,256	39	>75% Grass cover, Good, HSG A
* 220	98	Ledge
3,255	98	Paved parking, HSG A
3,664	98	Paved parking, HSG B
824	48	Brush, Good, HSG B
20,561	55	Woods, Good, HSG B
45,668	63	Weighted Average
34,797		76.20% Pervious Area
10,871		23.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	50	0.2600	0.2		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	41	0.2400	2.4		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
1.3	125	0.1100	1.7		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.1	21	0.3500	4.1		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.0	4	0.1100	5.3		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.3	83	0.0420	4.2		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.1	22	0.0150	2.5		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.0	13	0.3300	11.7		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
6.6	359	Total			

## Subcatchment SC301: Basin

Hydrograph



**8490-Proposed**

Type III 24-hr 2-Year Rainfall=3.20"

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**Summary for Subcatchment SC302: Overland**

Runoff = 0.0 cfs @ 23.98 hrs, Volume= 8 cf, Depth&gt; 0.00"

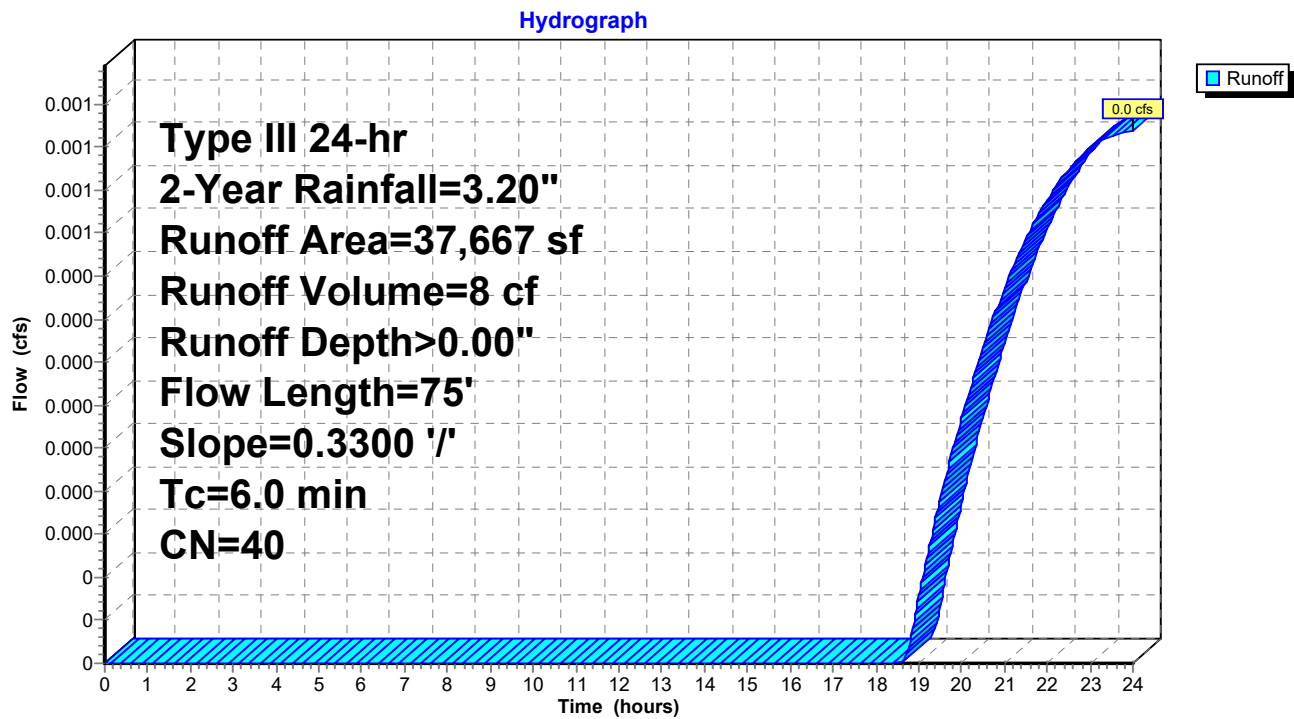
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
5,498	72	Dirt roads, HSG A
184	87	Dirt roads, HSG C
9,499	30	Brush, Good, HSG A
2,157	65	Brush, Good, HSG C
* 274	100	Wetlands
18,985	30	Woods, Good, HSG A
1,070	70	Woods, Good, HSG C
37,667	40	Weighted Average
37,393		99.27% Pervious Area
274		0.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	50	0.3300	0.4		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.10"
0.0	10	0.3300	4.0		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.1	15	0.3300	2.9		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
2.0	75	Total, Increased to minimum Tc = 6.0 min			

## Subcatchment SC302: Overland



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Type III 24-hr 2-Year Rainfall=3.20"

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**Summary for Subcatchment SC400: Basin**

Runoff = 2.3 cfs @ 12.12 hrs, Volume= 7,905 cf, Depth&gt; 1.04"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

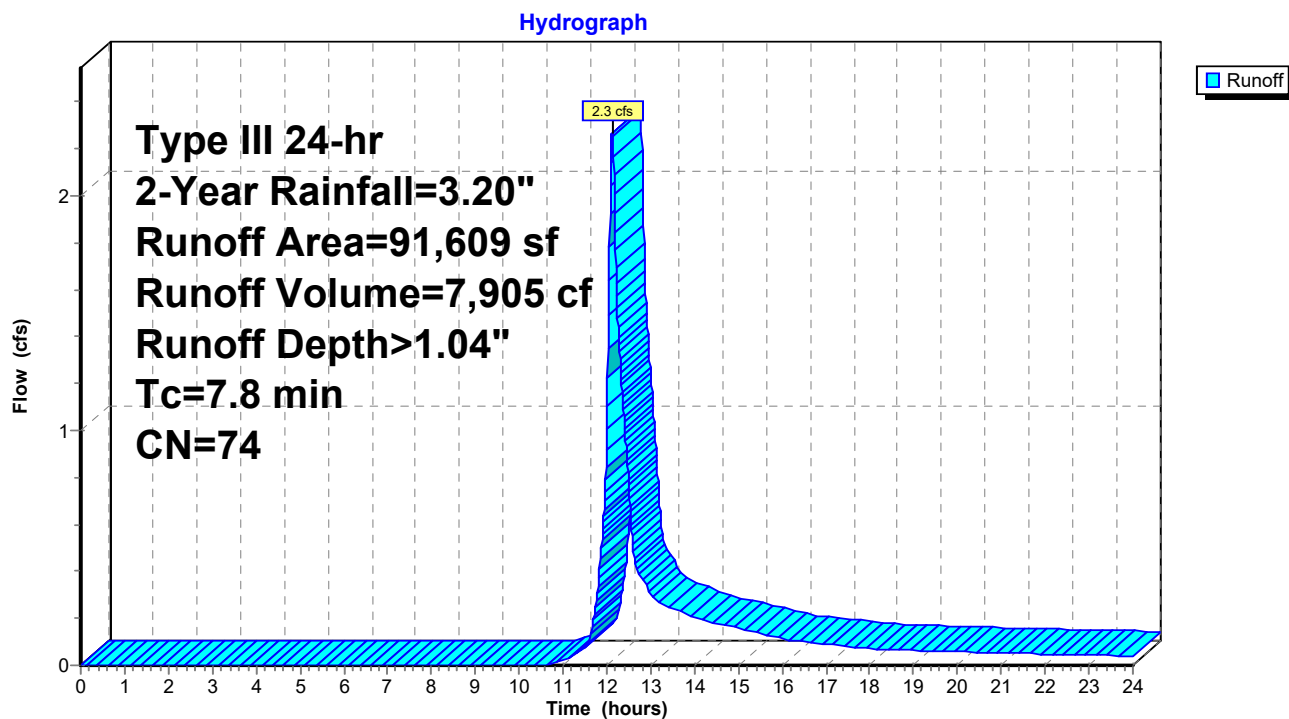
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
11,003	98	Roofs, HSG A
11,291	39	>75% Grass cover, Good, HSG A
894	61	>75% Grass cover, Good, HSG B
1,479	96	Gravel surface, HSG A
425	96	Gravel surface, HSG B
4,285	39	>75% Grass cover, Good, HSG A
38	61	>75% Grass cover, Good, HSG B
* 187	98	Ledge
* 1,186	98	Ledge
34,405	98	Paved parking, HSG A
153	98	Paved parking, HSG B
67	98	Paved parking, HSG C
100	30	Brush, Good, HSG A
11,459	48	Brush, Good, HSG B
14,637	55	Woods, Good, HSG B
91,609	74	Weighted Average
44,608		48.69% Pervious Area
47,001		51.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8					<b>Direct Entry,</b>



## Subcatchment SC400: Basin



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Type III 24-hr 2-Year Rainfall=3.20"

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### Summary for Reach 5R: 12" HDPE

Inflow Area = 45,668 sf, 23.80% Impervious, Inflow Depth > 0.28" for 2-Year event  
Inflow = 0.1 cfs @ 12.73 hrs, Volume= 1,056 cf  
Outflow = 0.1 cfs @ 12.73 hrs, Volume= 1,056 cf, Atten= 0%, Lag= 0.2 min

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

Max. Velocity= 5.2 fps, Min. Travel Time= 0.1 min

Avg. Velocity= 3.2 fps, Avg. Travel Time= 0.1 min

Peak Storage= 0 cf @ 12.73 hrs

Average Depth at Peak Storage= 0.06'

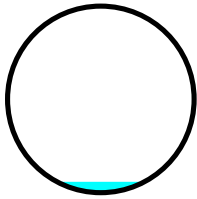
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 14.3 cfs

12.0" Round Pipe

n= 0.013 Corrugated PE, smooth interior

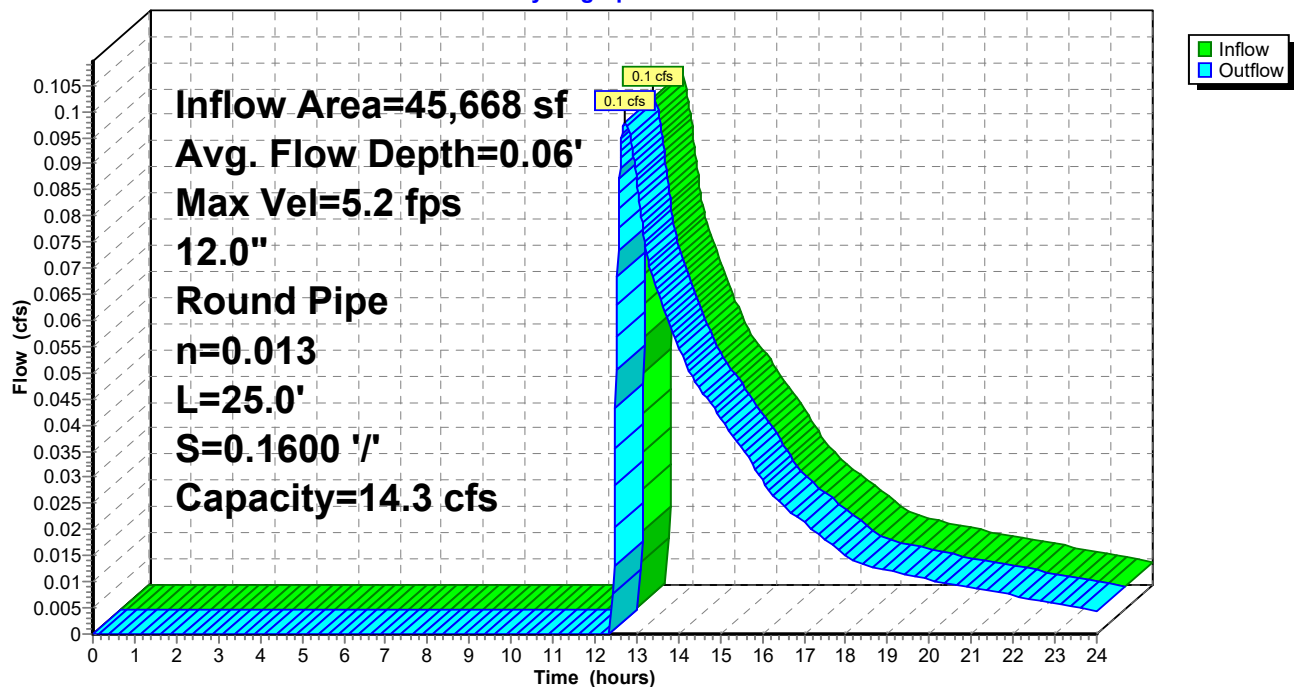
Length= 25.0' Slope= 0.1600 '/'

Inlet Invert= 34.00', Outlet Invert= 30.00'



### Reach 5R: 12" HDPE

#### Hydrograph



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Type III 24-hr 2-Year Rainfall=3.20"

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### Summary for Reach 8R: 8" HDPE

Inflow = 0.0 cfs @ 0.00 hrs, Volume= 0 cf  
Outflow = 0.0 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

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

Max. Velocity= 0.0 fps, Min. Travel Time= 0.0 min

Avg. Velocity = 0.0 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs

Average Depth at Peak Storage= 0.00'

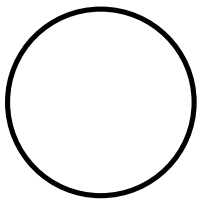
Bank-Full Depth= 0.67' Flow Area= 0.3 sf, Capacity= 1.8 cfs

8.0" Round Pipe

n= 0.013 Corrugated PE, smooth interior

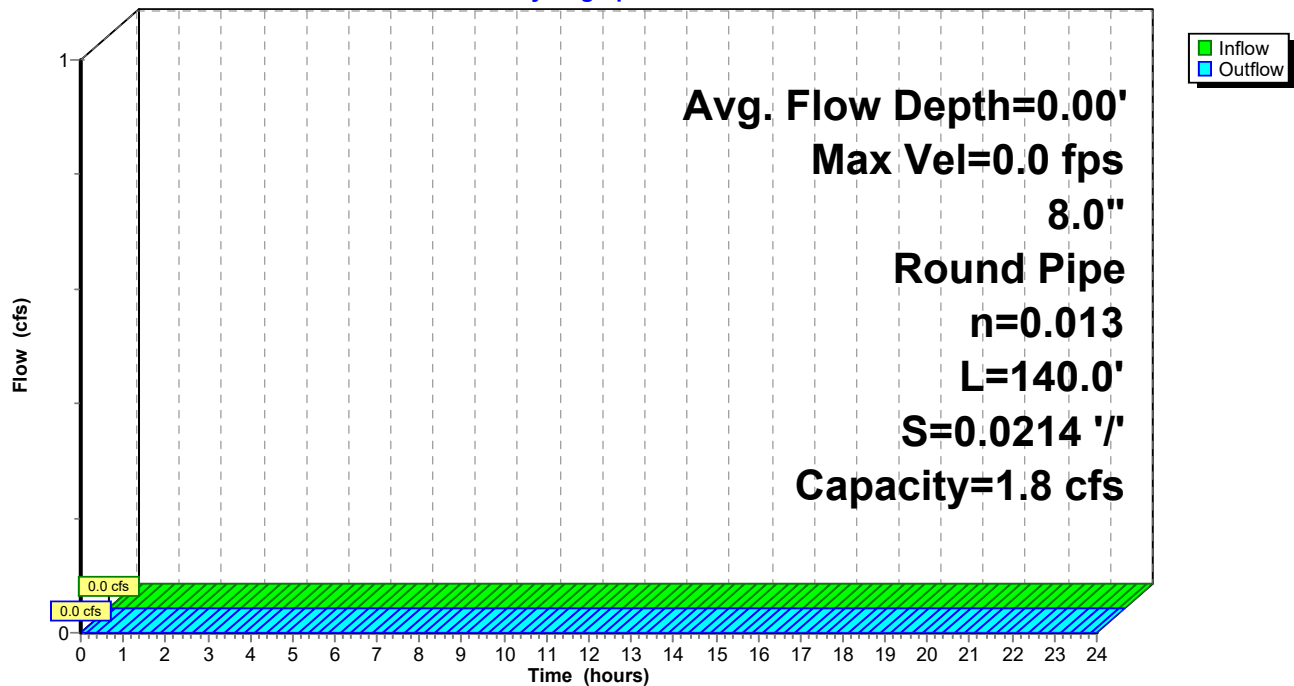
Length= 140.0' Slope= 0.0214 '/'

Inlet Invert= 34.00', Outlet Invert= 31.00'



### Reach 8R: 8" HDPE

#### Hydrograph



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**Summary for Pond 1P: Basin**

Inflow Area = 45,668 sf, 23.80% Impervious, Inflow Depth > 0.52" for 2-Year event  
 Inflow = 0.4 cfs @ 12.12 hrs, Volume= 1,972 cf  
 Outflow = 0.1 cfs @ 12.73 hrs, Volume= 1,464 cf, Atten= 76%, Lag= 36.2 min  
 Discarded = 0.0 cfs @ 12.73 hrs, Volume= 408 cf  
 Primary = 0.1 cfs @ 12.73 hrs, Volume= 1,056 cf  
 Secondary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 2

Peak Elev= 36.10' @ 12.73 hrs Surf.Area= 811 sf Storage= 579 cf

Plug-Flow detention time= 169.8 min calculated for 1,463 cf (74% of inflow)

Center-of-Mass det. time= 69.5 min ( 973.3 - 903.9 )

Volume	Invert	Avail.Storage	Storage Description
#1	35.00'	2,091 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) 2,391 cf Overall - 300 cf Embedded = 2,091 cf
#2	35.00'	120 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) Inside #1 300 cf Overall x 40.0% Voids
		2,211 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
35.00	600	131.0	0	0	600
36.00	767	123.0	682	682	806
37.00	1,274	165.0	1,010	1,692	1,779
37.50	1,529	174.0	700	2,391	2,036

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
35.00	600	131.0	0	0	600
35.50	600	131.0	300	300	666

Device	Routing	Invert	Outlet Devices
#1	Primary	37.00'	<b>9.0' 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
#2	Discarded	35.00'	<b>0.520 in/hr Exfiltration over Surface area</b>
#3	Secondary	36.85'	<b>24.0" x 24.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#4	Primary	36.85'	<b>24.0" x 24.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#5	Primary	36.00'	<b>12.0" W x 4.0" H Vert. Orifice/Grate</b> C= 0.600

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**Discarded OutFlow** Max=0.0 cfs @ 12.73 hrs HW=36.10' (Free Discharge)

↑ **2=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.1 cfs @ 12.73 hrs HW=36.10' (Free Discharge)

↑ **1=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)

↑ **4=Orifice/Grate** (Controls 0.0 cfs)

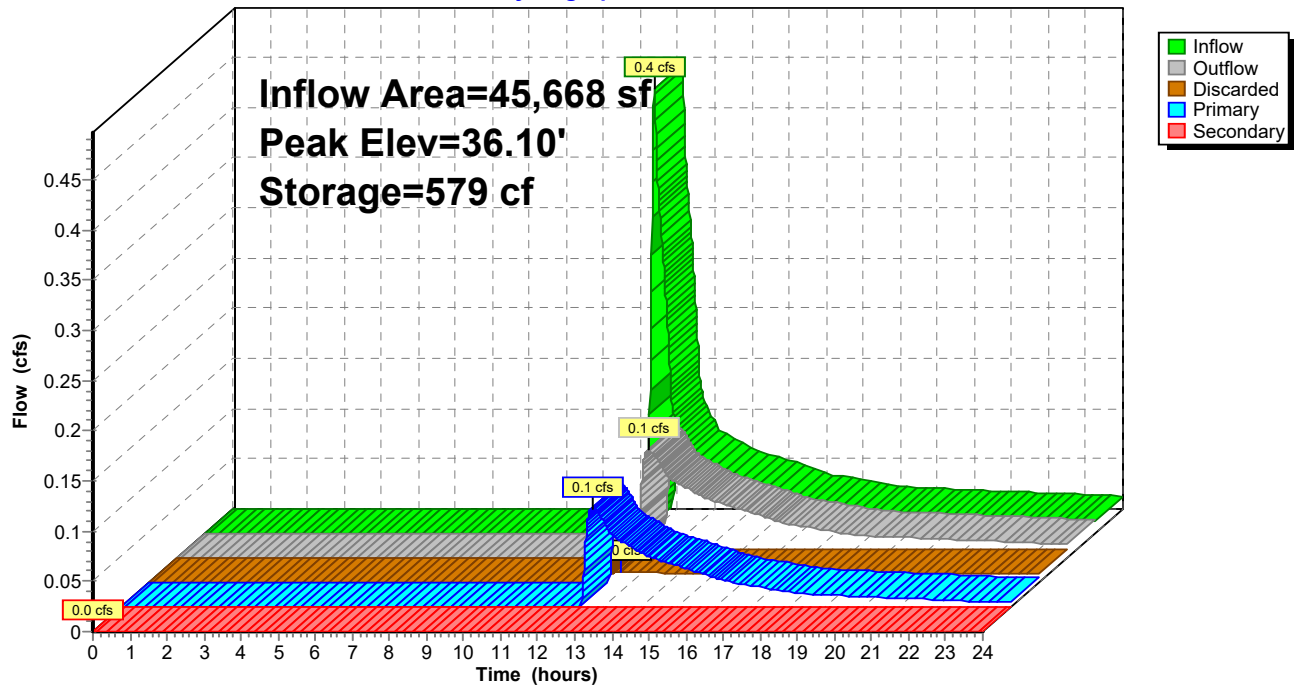
↑ **5=Orifice/Grate** (Orifice Controls 0.1 cfs @ 1.0 fps)

**Secondary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=35.00' (Free Discharge)

↑ **3=Orifice/Grate** (Controls 0.0 cfs)

### Pond 1P: Basin

Hydrograph



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Type III 24-hr 2-Year Rainfall=3.20"

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**Summary for Pond 2P: lower bio-ret**

Inflow Area = 18,277 sf, 57.54% Impervious, Inflow Depth > 0.72" for 2-Year event  
 Inflow = 0.4 cfs @ 12.20 hrs, Volume= 1,093 cf  
 Outflow = 0.1 cfs @ 13.10 hrs, Volume= 453 cf, Atten= 87%, Lag= 54.0 min  
 Primary = 0.1 cfs @ 13.10 hrs, Volume= 453 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 22.53' @ 13.10 hrs Surf.Area= 638 sf Storage= 658 cf

Plug-Flow detention time= 175.0 min calculated for 453 cf (41% of inflow)  
 Center-of-Mass det. time= 100.6 min ( 910.4 - 809.8 )

Volume	Invert	Avail.Storage	Storage Description
#1	21.00'	993 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc)

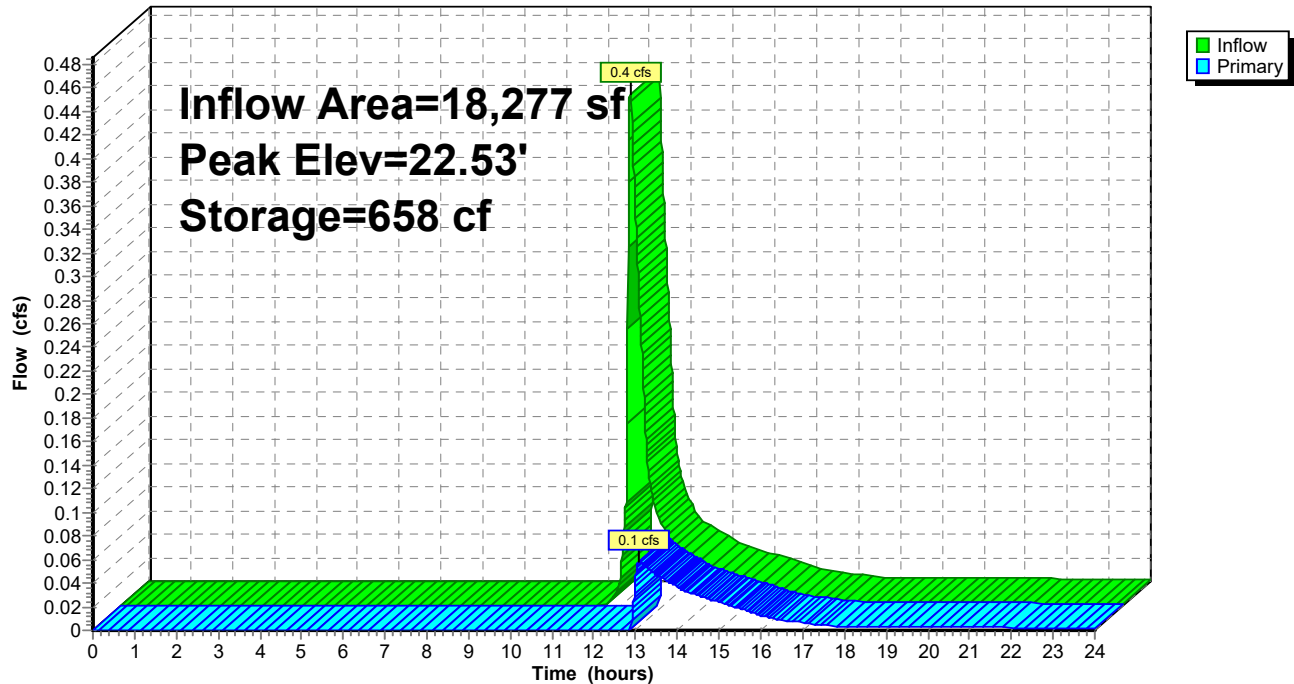
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
21.00	247	71.0	0	0	247
22.00	489	89.9	361	361	502
23.00	787	108.7	632	993	815

Device	Routing	Invert	Outlet Devices
#1	Primary	22.50'	<b>5.0' long x 5.0' 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) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

**Primary OutFlow** Max=0.1 cfs @ 13.10 hrs HW=22.53' (Free Discharge)  
 ↑1=**Broad-Crested Rectangular Weir**(Weir Controls 0.1 cfs @ 0.4 fps)

## Pond 2P: lower bio-ret

Hydrograph



**8490-Proposed**

Type III 24-hr 2-Year Rainfall=3.20"

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**Summary for Pond 5P: upper bio-ret**

Inflow Area = 13,212 sf, 72.31% Impervious, Inflow Depth > 1.91" for 2-Year event  
 Inflow = 0.7 cfs @ 12.09 hrs, Volume= 2,106 cf  
 Outflow = 0.4 cfs @ 12.20 hrs, Volume= 1,647 cf, Atten= 42%, Lag= 7.0 min  
 Discarded = 0.0 cfs @ 12.20 hrs, Volume= 862 cf  
 Primary = 0.4 cfs @ 12.20 hrs, Volume= 785 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 30.60' @ 12.20 hrs Surf.Area= 751 sf Storage= 675 cf

Plug-Flow detention time= 163.5 min calculated for 1,646 cf (78% of inflow)  
 Center-of-Mass det. time= 83.2 min ( 901.4 - 818.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	29.50'	992 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
29.50	425	0	0
30.00	624	262	262
31.00	835	730	992

Device	Routing	Invert	Outlet Devices
#1	Primary	30.50'	<b>5.0' long x 5.0' 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) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	29.50'	<b>1.020 in/hr Exfiltration over Surface area</b>

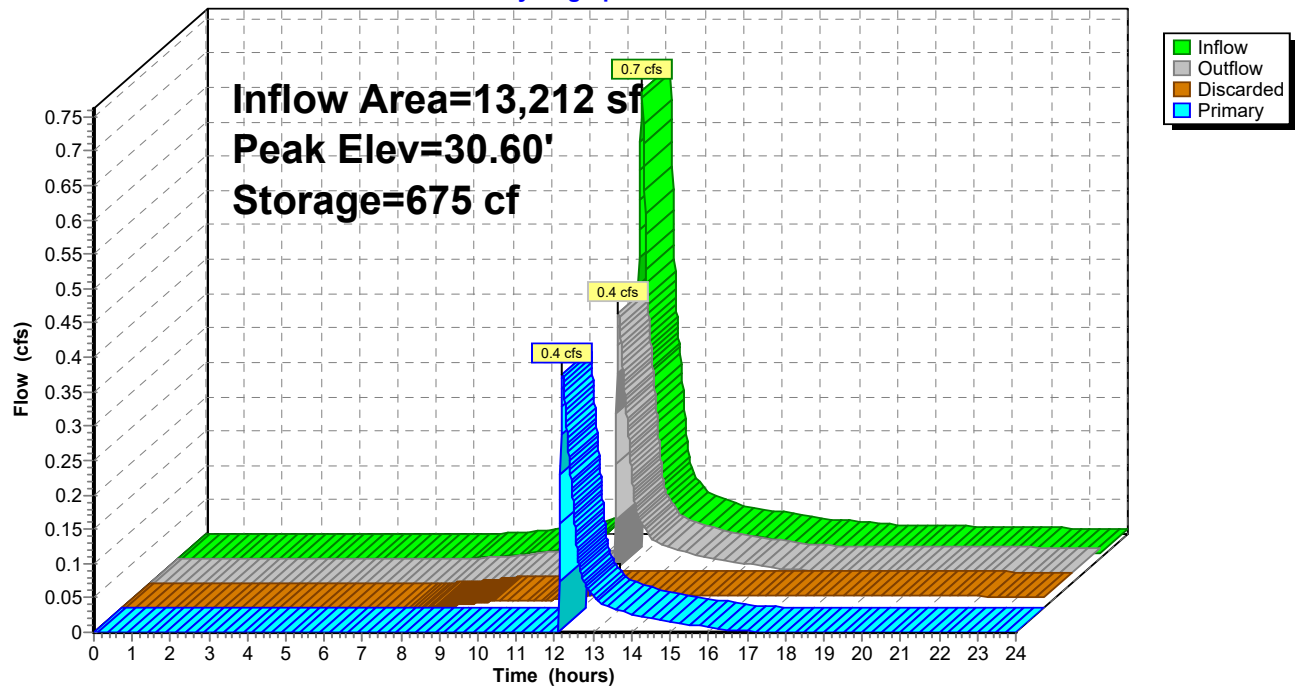
**Discarded OutFlow** Max=0.0 cfs @ 12.20 hrs HW=30.60' (Free Discharge)  
 ↑ **2=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.4 cfs @ 12.20 hrs HW=30.60' (Free Discharge)  
 ↑ **1=Broad-Crested Rectangular Weir** (Weir Controls 0.4 cfs @ 0.7 fps)



## Pond 5P: upper bio-ret

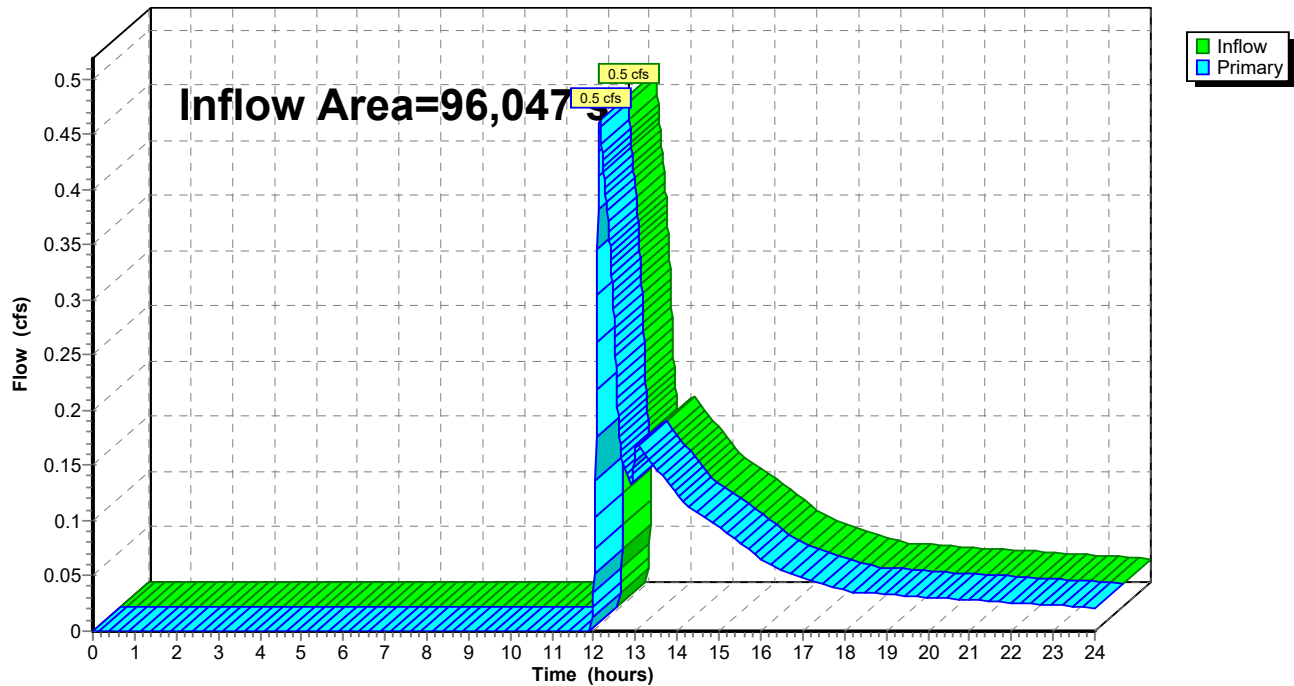
Hydrograph



**Summary for Link 1L: Parker River**

Inflow Area = 96,047 sf, 14.03% Impervious, Inflow Depth > 0.39" for 2-Year event  
Inflow = 0.5 cfs @ 12.15 hrs, Volume= 3,092 cf  
Primary = 0.5 cfs @ 12.15 hrs, Volume= 3,092 cf, Atten= 0%, Lag= 0.0 min

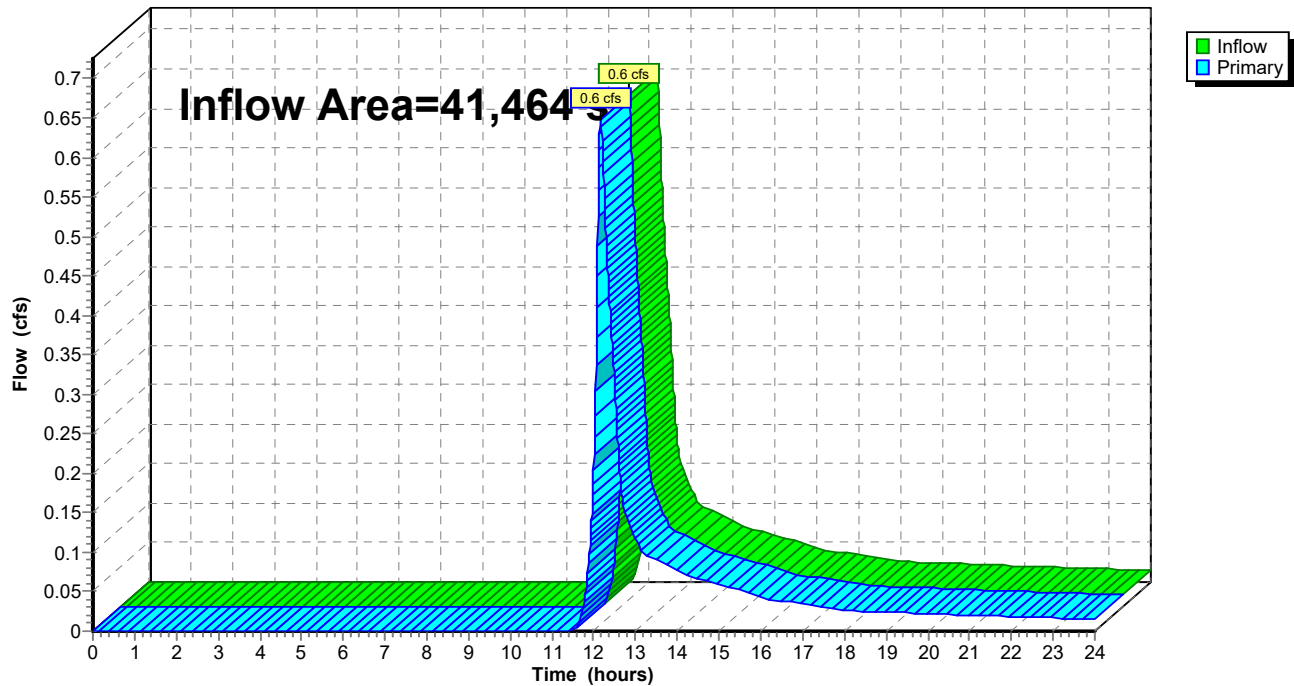
Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Link 1L: Parker River****Hydrograph**

**Summary for Link 2L: IVW**

Inflow Area = 41,464 sf, 25.87% Impervious, Inflow Depth > 0.78" for 2-Year event  
Inflow = 0.6 cfs @ 12.17 hrs, Volume= 2,685 cf  
Primary = 0.6 cfs @ 12.17 hrs, Volume= 2,685 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Link 2L: IVW****Hydrograph**

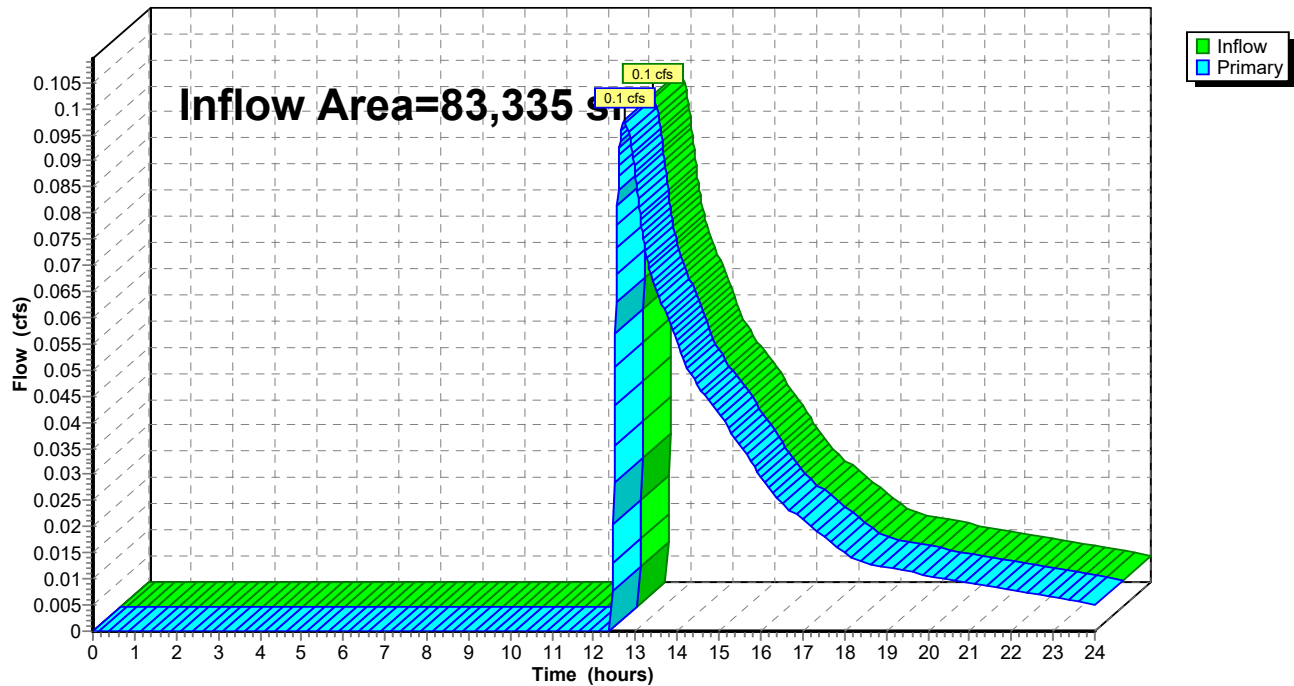
**Summary for Link 3L: BVW**

Inflow Area = 83,335 sf, 13.37% Impervious, Inflow Depth > 0.15" for 2-Year event

Inflow = 0.1 cfs @ 12.73 hrs, Volume= 1,064 cf

Primary = 0.1 cfs @ 12.73 hrs, Volume= 1,064 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Link 3L: BVW****Hydrograph**

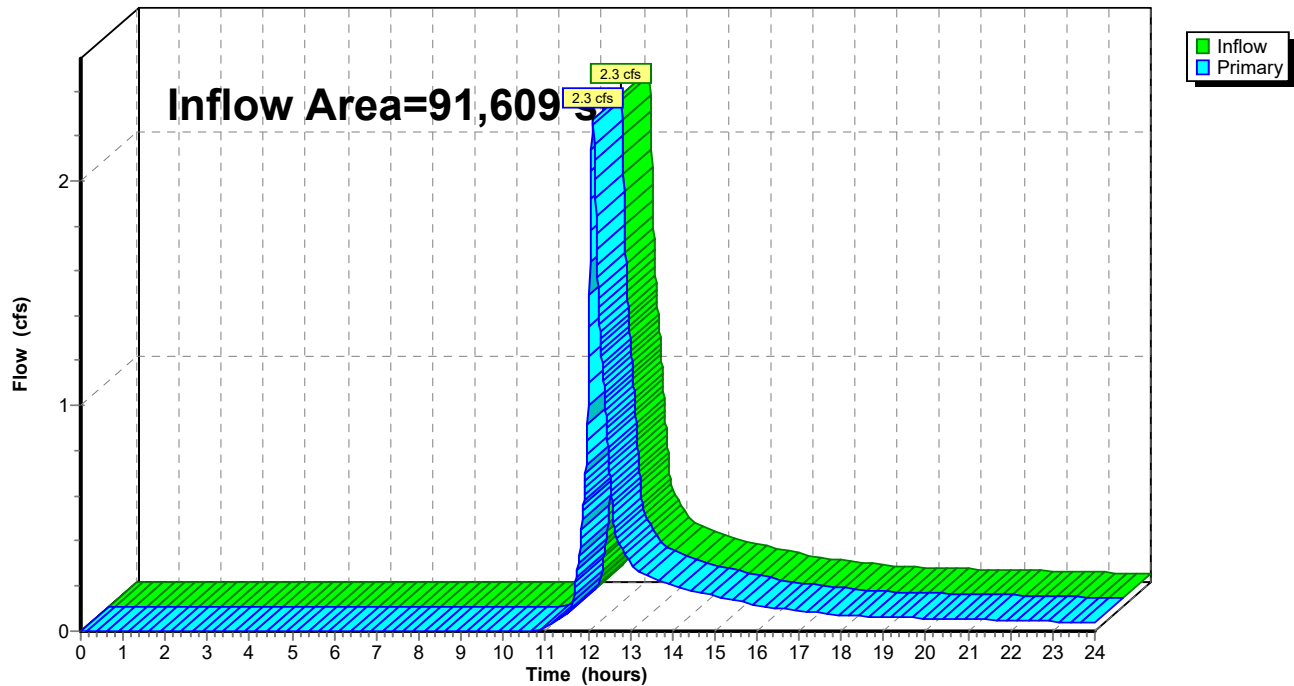
**Summary for Link 4L: Existing Basin**

Inflow Area = 91,609 sf, 51.31% Impervious, Inflow Depth > 1.04" for 2-Year event

Inflow = 2.3 cfs @ 12.12 hrs, Volume= 7,905 cf

Primary = 2.3 cfs @ 12.12 hrs, Volume= 7,905 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Link 4L: Existing Basin****Hydrograph**

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Type III 24-hr 10-Year Rainfall=4.50"

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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

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

<b>SubcatchmentSC101: Building and basin</b>	Runoff Area=13,212 sf 72.31% Impervious Runoff Depth>3.10" Flow Length=94' Tc=6.0 min CN=87 Runoff=1.1 cfs 3,408 cf
<b>SubcatchmentSC102: Overland</b>	Runoff Area=77,770 sf 3.80% Impervious Runoff Depth>1.02" Flow Length=422' Tc=7.4 min CN=60 Runoff=1.7 cfs 6,594 cf
<b>SubcatchmentSC102A: Overland</b>	Runoff Area=5,065 sf 19.01% Impervious Runoff Depth>1.53" Flow Length=83' Tc=6.0 min CN=68 Runoff=0.2 cfs 646 cf
<b>SubcatchmentSC200: Isolated Wetland</b>	Runoff Area=41,464 sf 25.87% Impervious Runoff Depth>1.60" Flow Length=328' Tc=10.6 min CN=69 Runoff=1.5 cfs 5,522 cf
<b>SubcatchmentSC301: Basin</b>	Runoff Area=45,668 sf 23.80% Impervious Runoff Depth>1.20" Flow Length=359' Tc=6.6 min CN=63 Runoff=1.3 cfs 4,567 cf
<b>SubcatchmentSC302: Overland</b>	Runoff Area=37,667 sf 0.73% Impervious Runoff Depth>0.14" Flow Length=75' Slope=0.3300 '/' Tc=6.0 min CN=40 Runoff=0.0 cfs 426 cf
<b>SubcatchmentSC400: Basin</b>	Runoff Area=91,609 sf 51.31% Impervious Runoff Depth>1.97" Tc=7.8 min CN=74 Runoff=4.5 cfs 15,031 cf
<b>Reach 5R: 12" HDPE</b>	Avg. Flow Depth=0.16' Max Vel=9.7 fps Inflow=0.8 cfs 3,610 cf 12.0" Round Pipe n=0.013 L=25.0' S=0.1600 '/' Capacity=14.3 cfs Outflow=0.8 cfs 3,610 cf
<b>Reach 8R: 8" HDPE</b>	Avg. Flow Depth=0.00' Max Vel=0.0 fps Inflow=0.0 cfs 0 cf 8.0" Round Pipe n=0.013 L=140.0' S=0.0214 '/' Capacity=1.8 cfs Outflow=0.0 cfs 0 cf
<b>Pond 1P: Basin</b>	Peak Elev=36.41' Storage=854 cf Inflow=1.3 cfs 4,567 cf Discarded=0.0 cfs 433 cf Primary=0.8 cfs 3,610 cf Secondary=0.0 cfs 0 cf Outflow=0.8 cfs 4,043 cf
<b>Pond 2P: lower bio-ret</b>	Peak Elev=22.66' Storage=747 cf Inflow=1.2 cfs 2,562 cf Outflow=0.8 cfs 1,921 cf
<b>Pond 5P: upper bio-ret</b>	Peak Elev=30.70' Storage=747 cf Inflow=1.1 cfs 3,408 cf Discarded=0.0 cfs 938 cf Primary=1.0 cfs 1,916 cf Outflow=1.0 cfs 2,855 cf
<b>Link 1L: Parker River</b>	Inflow=2.1 cfs 8,515 cf Primary=2.1 cfs 8,515 cf
<b>Link 2L: IVW</b>	Inflow=1.5 cfs 5,522 cf Primary=1.5 cfs 5,522 cf
<b>Link 3L: BVW</b>	Inflow=0.8 cfs 4,036 cf Primary=0.8 cfs 4,036 cf
<b>Link 4L: Existing Basin</b>	Inflow=4.5 cfs 15,031 cf Primary=4.5 cfs 15,031 cf

**8490-Proposed***Type III 24-hr 10-Year Rainfall=4.50"*

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**Total Runoff Area = 312,455 sf   Runoff Volume = 36,195 cf   Average Runoff Depth = 1.39"**  
**73.65% Pervious = 230,108 sf   26.35% Impervious = 82,347 sf**

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Type III 24-hr 10-Year Rainfall=4.50"

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**Summary for Subcatchment SC101: Building and basin**

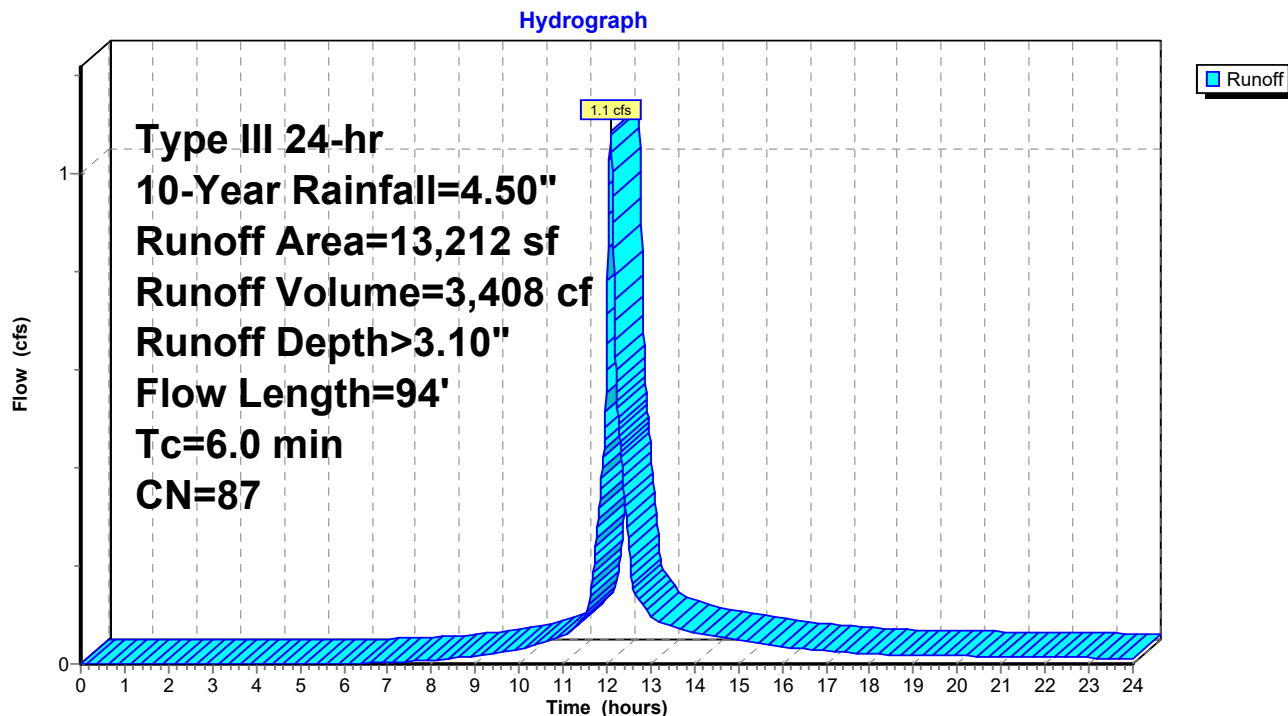
Runoff = 1.1 cfs @ 12.09 hrs, Volume= 3,408 cf, Depth&gt; 3.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
7,032	98	Roofs, HSG B
769	98	Paved parking, HSG B
2,777	61	>75% Grass cover, Good, HSG B
* 1,753	98	Ledge
881	55	Woods, Good, HSG B
13,212	87	Weighted Average
3,658		27.69% Pervious Area
9,554		72.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	42	0.3300	3.5		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 3.10"
0.3	52	0.1875	3.0		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.5	94	Total, Increased to minimum Tc = 6.0 min			

**Subcatchment SC101: Building and basin**



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Type III 24-hr 10-Year Rainfall=4.50"

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**Summary for Subcatchment SC102: Overland**

Runoff = 1.7 cfs @ 12.12 hrs, Volume= 6,594 cf, Depth&gt; 1.02"

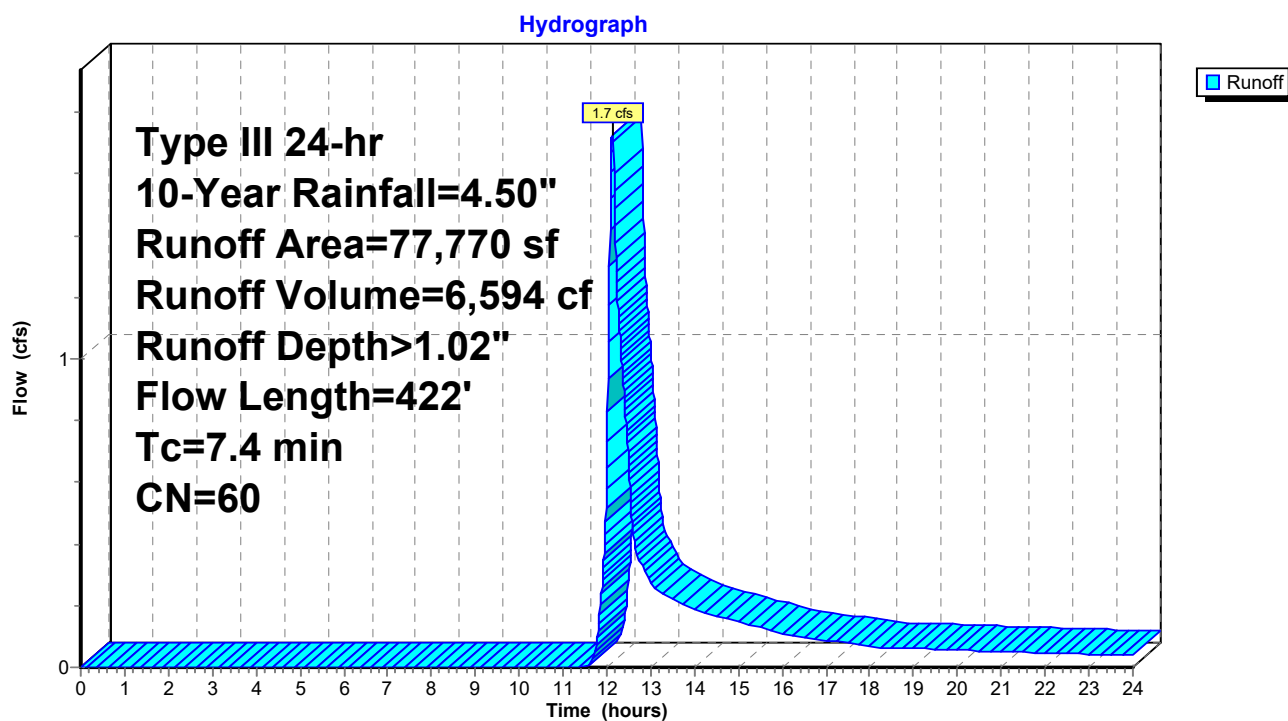
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
2,469	61	>75% Grass cover, Good, HSG B
446	61	>75% Grass cover, Good, HSG B
* 2,957	98	Ledge
3,901	96	Gravel surface, HSG B
2,862	96	Gravel surface, HSG B
65,135	55	Woods, Good, HSG B
77,770	60	Weighted Average
74,813		96.20% Pervious Area
2,957		3.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.1600	0.2		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.2	30	0.3000	2.7		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.2	21	0.1000	1.6		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.1	20	0.2800	2.6		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.6	170	0.0450	4.9	3.07	<b>Trap/Vee/Rect Channel Flow,</b> Bot.W=2.00' D=0.25' Z= 2.0 '/' Top.W=3.00' n= 0.022 Earth, clean & straight
0.8	118	0.2300	2.4		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.0	8	0.0500	3.6		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.0	5	0.1750	2.1		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
7.4	422	Total			

## Subcatchment SC102: Overland



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Type III 24-hr 10-Year Rainfall=4.50"

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**Summary for Subcatchment SC102A: Overland**

Runoff = 0.2 cfs @ 12.09 hrs, Volume= 646 cf, Depth&gt; 1.53"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

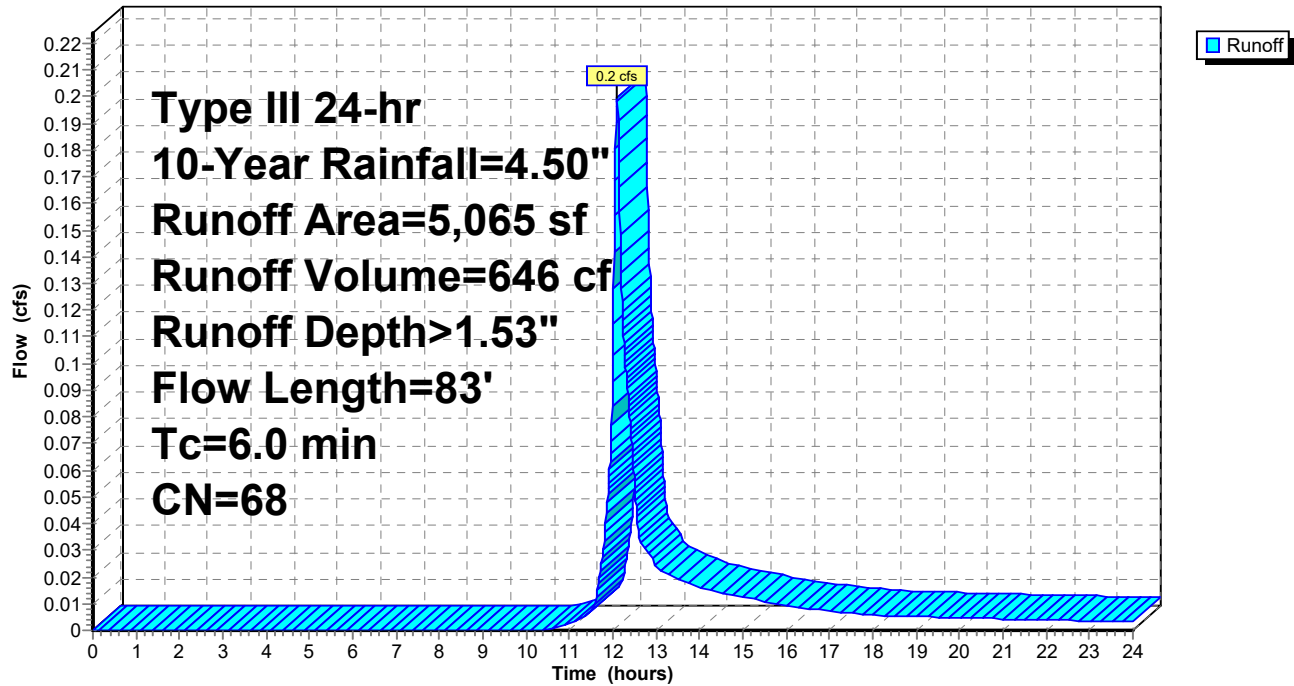
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
247	61	>75% Grass cover, Good, HSG B
299	61	>75% Grass cover, Good, HSG B
106	96	Gravel surface, HSG B
* 963	98	Ledge
342	96	Gravel surface, HSG B
52	96	Gravel surface, HSG B
3,056	55	Woods, Good, HSG B
5,065	68	Weighted Average
4,102		80.99% Pervious Area
963		19.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	20	0.2500	2.7		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 3.10"
0.1	28	0.2500	3.5		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.3	35	0.2000	2.2		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.5	83	Total, Increased to minimum Tc = 6.0 min			

## Subcatchment SC102A: Overland

Hydrograph



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Type III 24-hr 10-Year Rainfall=4.50"

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**Summary for Subcatchment SC200: Isolated Wetland**

Runoff = 1.5 cfs @ 12.16 hrs, Volume= 5,522 cf, Depth&gt; 1.60"

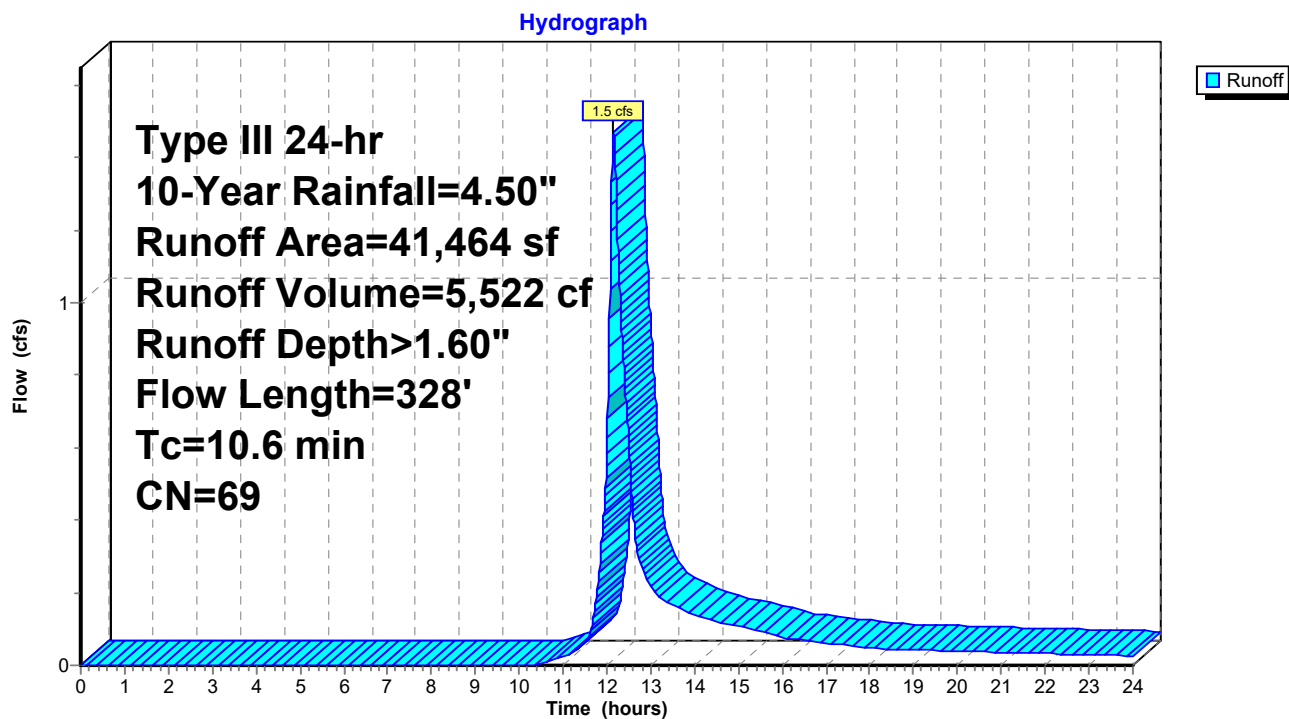
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
1,062	82	Dirt roads, HSG B
721	61	>75% Grass cover, Good, HSG B
2,106	61	>75% Grass cover, Good, HSG B
* 5,148	98	Ledge
1,127	96	Gravel surface, HSG B
532	96	Gravel surface, HSG B
* 5,579	100	Wetland
25,189	55	Woods, Good, HSG B
41,464	69	Weighted Average
30,737		74.13% Pervious Area
10,727		25.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.1		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.0	11	0.4000	12.8		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.3	38	0.1670	2.0		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.1	16	0.0150	2.0		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.4	82	0.0450	3.4		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.1	131	0.1500	1.9		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
10.6	328	Total			

## Subcatchment SC200: Isolated Wetland



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Type III 24-hr 10-Year Rainfall=4.50"

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**Summary for Subcatchment SC301: Basin**

Runoff = 1.3 cfs @ 12.11 hrs, Volume= 4,567 cf, Depth&gt; 1.20"

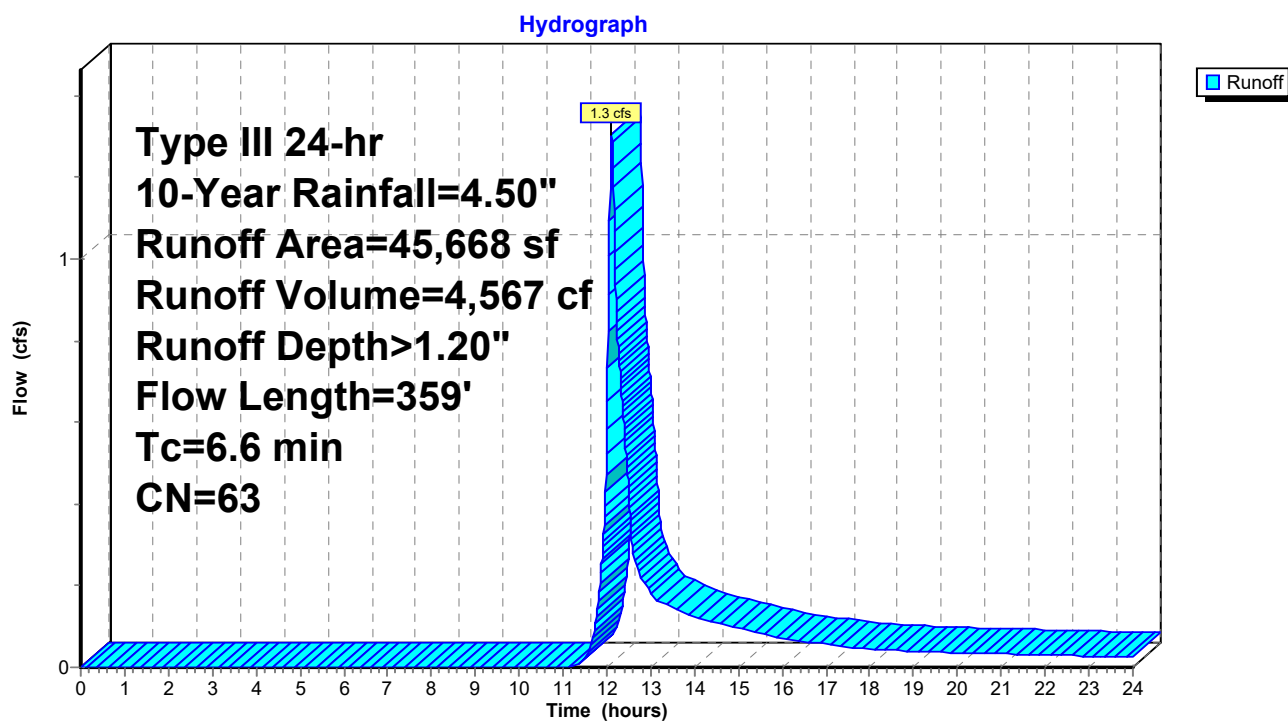
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
3,732	98	Roofs, HSG A
1,752	39	>75% Grass cover, Good, HSG A
6,950	39	>75% Grass cover, Good, HSG A
208	61	>75% Grass cover, Good, HSG B
2,246	96	Gravel surface, HSG A
2,256	39	>75% Grass cover, Good, HSG A
* 220	98	Ledge
3,255	98	Paved parking, HSG A
3,664	98	Paved parking, HSG B
824	48	Brush, Good, HSG B
20,561	55	Woods, Good, HSG B
45,668	63	Weighted Average
34,797		76.20% Pervious Area
10,871		23.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	50	0.2600	0.2		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	41	0.2400	2.4		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
1.3	125	0.1100	1.7		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.1	21	0.3500	4.1		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.0	4	0.1100	5.3		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.3	83	0.0420	4.2		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.1	22	0.0150	2.5		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.0	13	0.3300	11.7		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
6.6	359	Total			

## Subcatchment SC301: Basin





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Type III 24-hr 10-Year Rainfall=4.50"

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**Summary for Subcatchment SC302: Overland**

Runoff = 0.0 cfs @ 13.78 hrs, Volume= 426 cf, Depth&gt; 0.14"

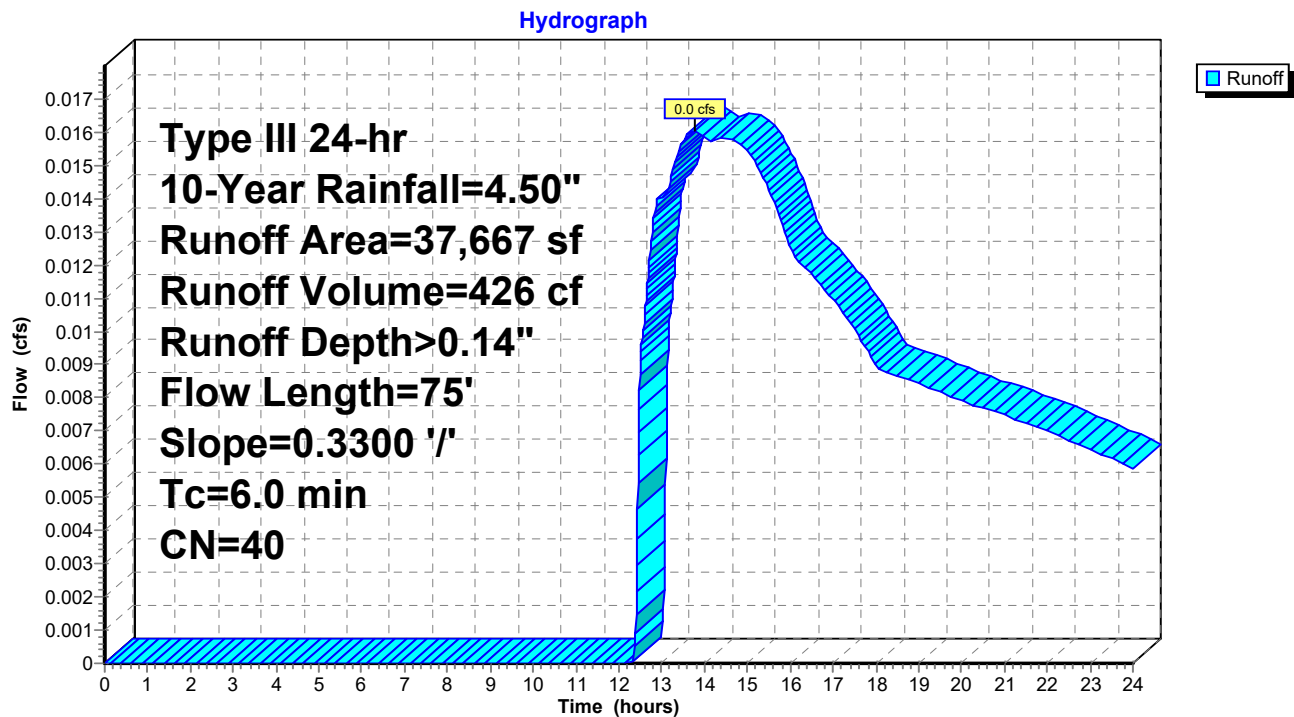
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
5,498	72	Dirt roads, HSG A
184	87	Dirt roads, HSG C
9,499	30	Brush, Good, HSG A
2,157	65	Brush, Good, HSG C
* 274	100	Wetlands
18,985	30	Woods, Good, HSG A
1,070	70	Woods, Good, HSG C
37,667	40	Weighted Average
37,393		99.27% Pervious Area
274		0.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	50	0.3300	0.4		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.10"
0.0	10	0.3300	4.0		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.1	15	0.3300	2.9		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
2.0	75	Total, Increased to minimum Tc = 6.0 min			

## Subcatchment SC302: Overland



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Type III 24-hr 10-Year Rainfall=4.50"

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**Summary for Subcatchment SC400: Basin**

Runoff = 4.5 cfs @ 12.12 hrs, Volume= 15,031 cf, Depth&gt; 1.97"

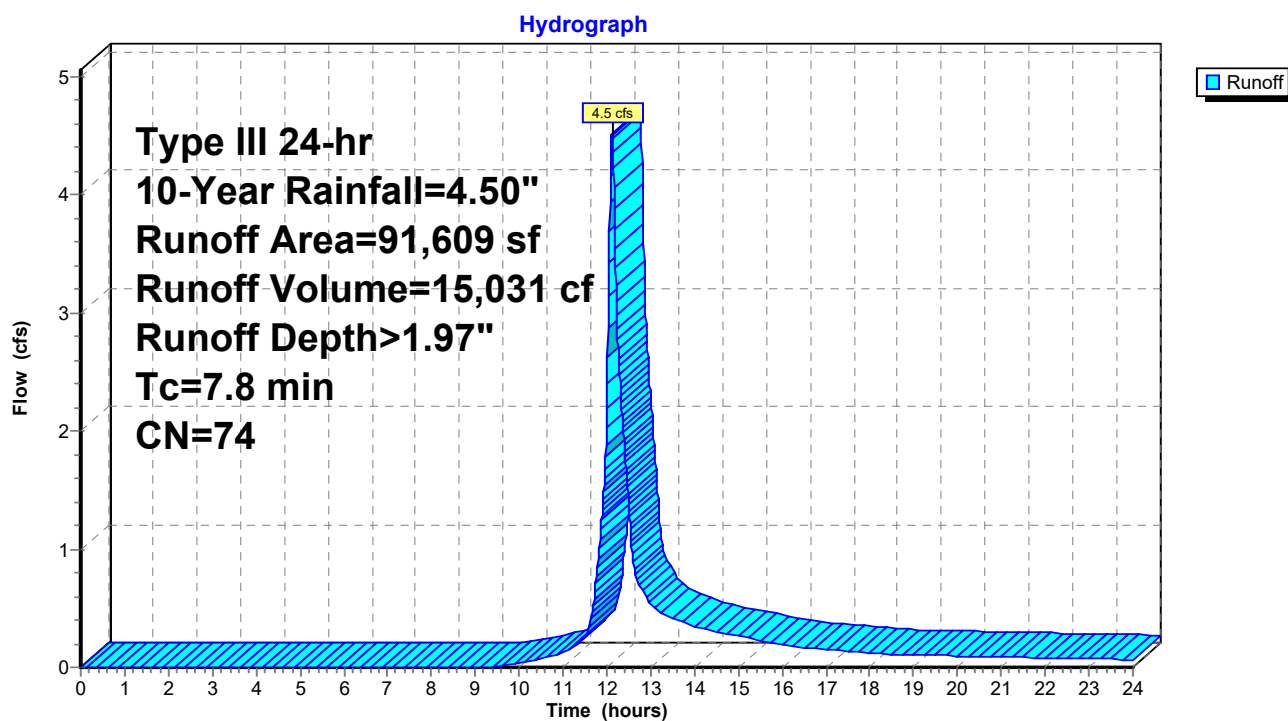
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
11,003	98	Roofs, HSG A
11,291	39	>75% Grass cover, Good, HSG A
894	61	>75% Grass cover, Good, HSG B
1,479	96	Gravel surface, HSG A
425	96	Gravel surface, HSG B
4,285	39	>75% Grass cover, Good, HSG A
38	61	>75% Grass cover, Good, HSG B
* 187	98	Ledge
* 1,186	98	Ledge
34,405	98	Paved parking, HSG A
153	98	Paved parking, HSG B
67	98	Paved parking, HSG C
100	30	Brush, Good, HSG A
11,459	48	Brush, Good, HSG B
14,637	55	Woods, Good, HSG B
91,609	74	Weighted Average
44,608		48.69% Pervious Area
47,001		51.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8					<b>Direct Entry,</b>

## Subcatchment SC400: Basin



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Type III 24-hr 10-Year Rainfall=4.50"

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### Summary for Reach 5R: 12" HDPE

Inflow Area = 45,668 sf, 23.80% Impervious, Inflow Depth > 0.95" for 10-Year event  
Inflow = 0.8 cfs @ 12.26 hrs, Volume= 3,610 cf  
Outflow = 0.8 cfs @ 12.26 hrs, Volume= 3,610 cf, Atten= 0%, Lag= 0.1 min

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

Max. Velocity= 9.7 fps, Min. Travel Time= 0.0 min

Avg. Velocity= 4.4 fps, Avg. Travel Time= 0.1 min

Peak Storage= 2 cf @ 12.26 hrs

Average Depth at Peak Storage= 0.16'

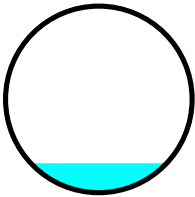
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 14.3 cfs

12.0" Round Pipe

n= 0.013 Corrugated PE, smooth interior

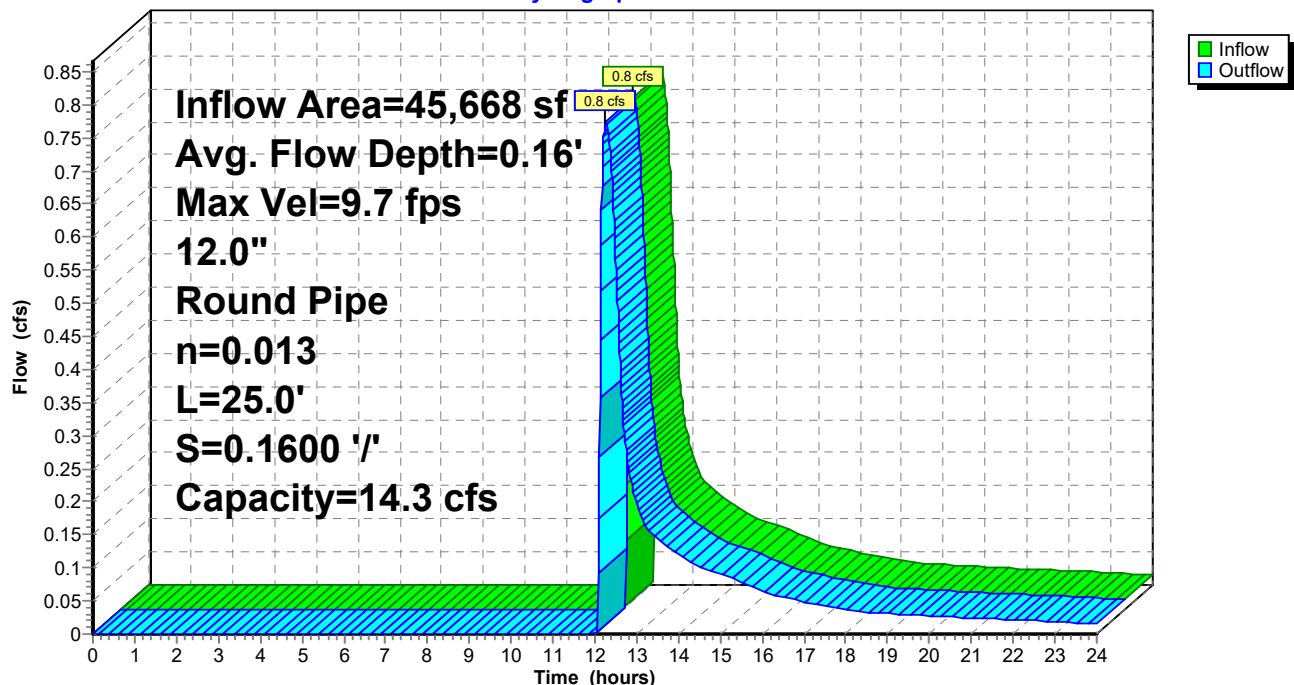
Length= 25.0' Slope= 0.1600 '/'

Inlet Invert= 34.00', Outlet Invert= 30.00'



### Reach 5R: 12" HDPE

#### Hydrograph



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Type III 24-hr 10-Year Rainfall=4.50"

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### Summary for Reach 8R: 8" HDPE

Inflow = 0.0 cfs @ 0.00 hrs, Volume= 0 cf  
Outflow = 0.0 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

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

Max. Velocity= 0.0 fps, Min. Travel Time= 0.0 min

Avg. Velocity = 0.0 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs

Average Depth at Peak Storage= 0.00'

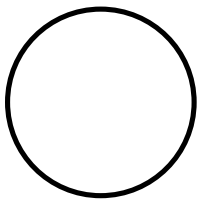
Bank-Full Depth= 0.67' Flow Area= 0.3 sf, Capacity= 1.8 cfs

8.0" Round Pipe

n= 0.013 Corrugated PE, smooth interior

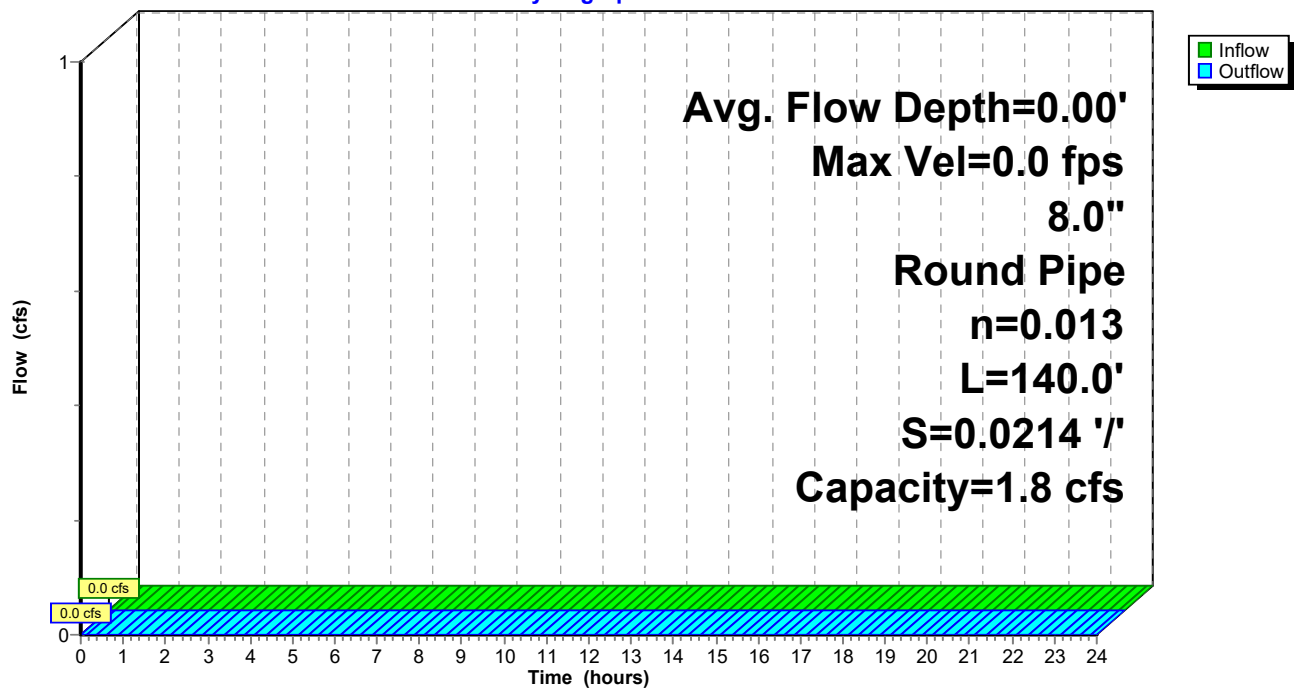
Length= 140.0' Slope= 0.0214 '/'

Inlet Invert= 34.00', Outlet Invert= 31.00'



### Reach 8R: 8" HDPE

Hydrograph



**8490-Proposed**

Type III 24-hr 10-Year Rainfall=4.50"

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**Summary for Pond 1P: Basin**

Inflow Area = 45,668 sf, 23.80% Impervious, Inflow Depth > 1.20" for 10-Year event  
 Inflow = 1.3 cfs @ 12.11 hrs, Volume= 4,567 cf  
 Outflow = 0.8 cfs @ 12.26 hrs, Volume= 4,043 cf, Atten= 40%, Lag= 9.2 min  
 Discarded = 0.0 cfs @ 12.26 hrs, Volume= 433 cf  
 Primary = 0.8 cfs @ 12.26 hrs, Volume= 3,610 cf  
 Secondary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 2

Peak Elev= 36.41' @ 12.26 hrs Surf.Area= 959 sf Storage= 854 cf

Plug-Flow detention time= 81.2 min calculated for 4,043 cf (89% of inflow)

Center-of-Mass det. time= 27.3 min ( 900.6 - 873.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	35.00'	2,091 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) 2,391 cf Overall - 300 cf Embedded = 2,091 cf
#2	35.00'	120 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) Inside #1 300 cf Overall x 40.0% Voids
		2,211 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
35.00	600	131.0	0	0	600
36.00	767	123.0	682	682	806
37.00	1,274	165.0	1,010	1,692	1,779
37.50	1,529	174.0	700	2,391	2,036

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
35.00	600	131.0	0	0	600
35.50	600	131.0	300	300	666

Device	Routing	Invert	Outlet Devices
#1	Primary	37.00'	<b>9.0' 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
#2	Discarded	35.00'	<b>0.520 in/hr Exfiltration over Surface area</b>
#3	Secondary	36.85'	<b>24.0" x 24.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#4	Primary	36.85'	<b>24.0" x 24.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#5	Primary	36.00'	<b>12.0" W x 4.0" H Vert. Orifice/Grate</b> C= 0.600

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Type III 24-hr 10-Year Rainfall=4.50"

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**Discarded OutFlow** Max=0.0 cfs @ 12.26 hrs HW=36.41' (Free Discharge)

↑ **2=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=0.8 cfs @ 12.26 hrs HW=36.41' (Free Discharge)

↑ **1=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)

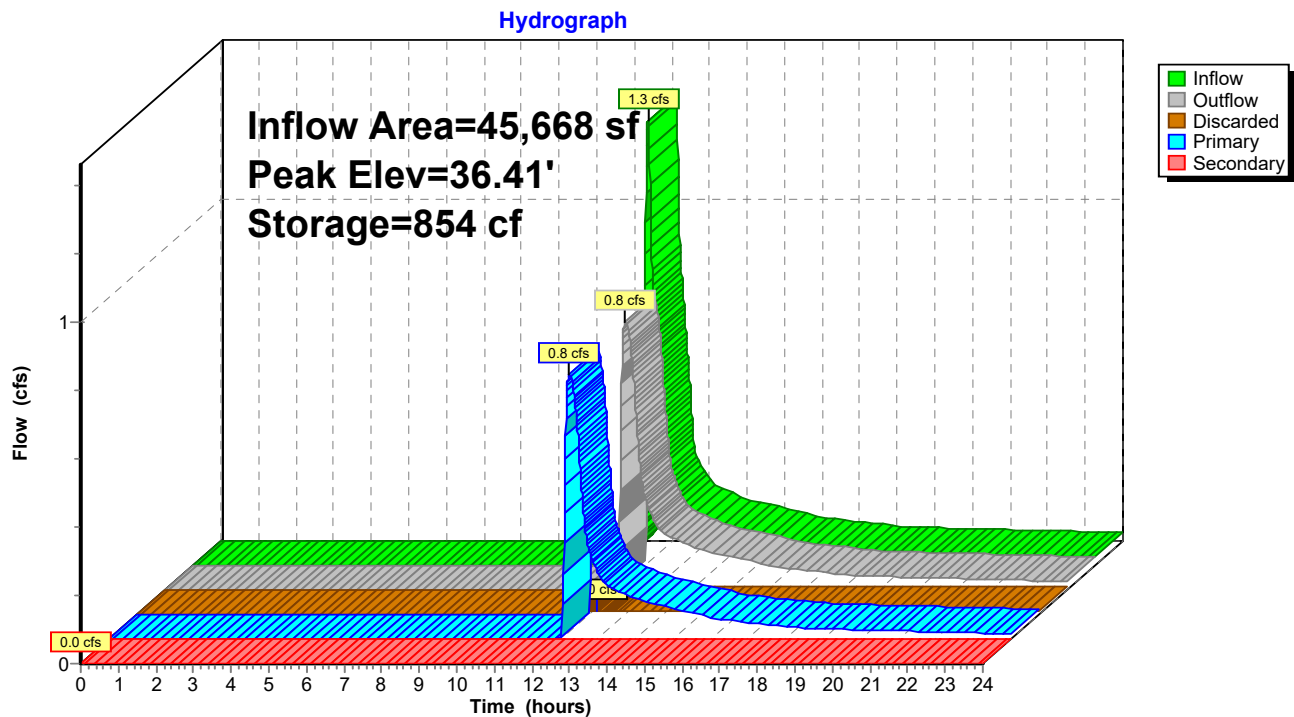
↑ **4=Orifice/Grate** (Controls 0.0 cfs)

↑ **5=Orifice/Grate** (Orifice Controls 0.8 cfs @ 2.3 fps)

**Secondary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=35.00' (Free Discharge)

↑ **3=Orifice/Grate** (Controls 0.0 cfs)

### Pond 1P: Basin





**8490-Proposed**

Type III 24-hr 10-Year Rainfall=4.50"

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**Summary for Pond 2P: lower bio-ret**

Inflow Area = 18,277 sf, 57.54% Impervious, Inflow Depth > 1.68" for 10-Year event  
 Inflow = 1.2 cfs @ 12.11 hrs, Volume= 2,562 cf  
 Outflow = 0.8 cfs @ 12.22 hrs, Volume= 1,921 cf, Atten= 36%, Lag= 6.6 min  
 Primary = 0.8 cfs @ 12.22 hrs, Volume= 1,921 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 22.66' @ 12.22 hrs Surf.Area= 679 sf Storage= 747 cf

Plug-Flow detention time= 83.7 min calculated for 1,920 cf (75% of inflow)  
 Center-of-Mass det. time= 28.9 min ( 827.2 - 798.2 )

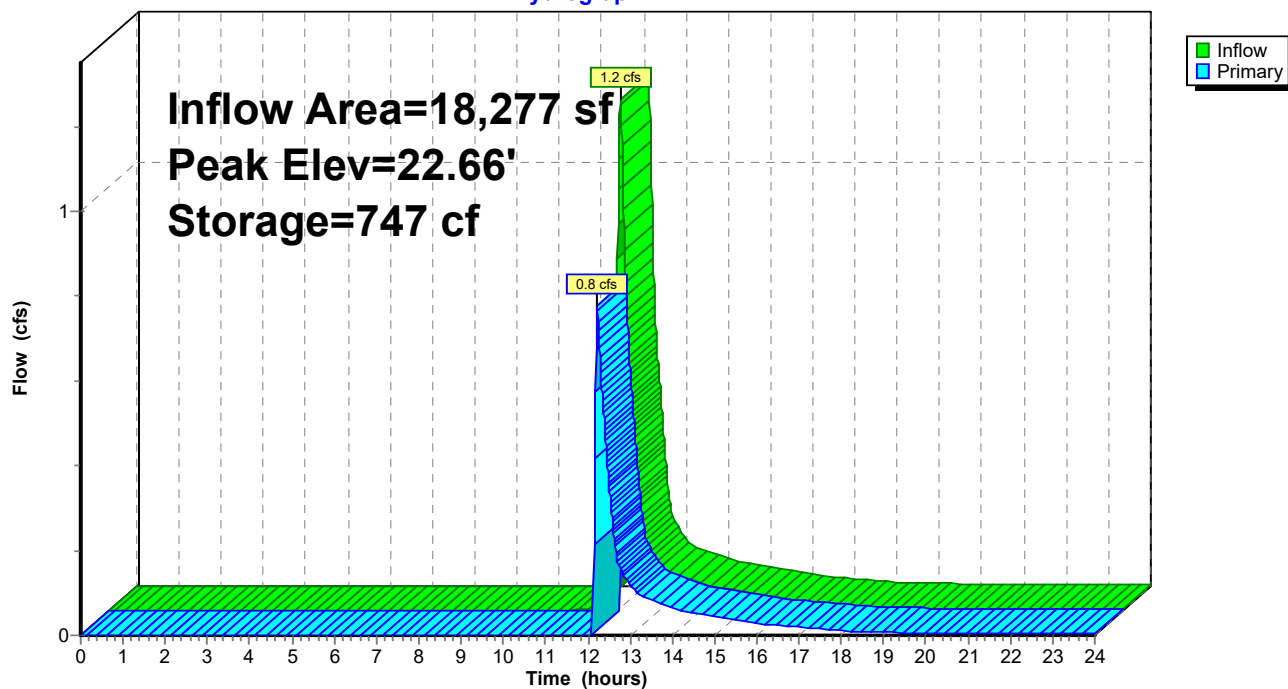
Volume	Invert	Avail.Storage	Storage Description		
#1	21.00'	993 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc)		
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
21.00	247	71.0	0	0	247
22.00	489	89.9	361	361	502
23.00	787	108.7	632	993	815

Device	Routing	Invert	Outlet Devices											
#1	Primary	22.50'	<b>5.0' long x 5.0' 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)	2.34	2.50	2.70	2.68	2.68	2.66	2.65	2.65	2.65		
				2.65	2.67	2.66	2.68	2.70	2.74	2.79	2.88			

**Primary OutFlow** Max=0.8 cfs @ 12.22 hrs HW=22.66' (Free Discharge)  
 ↑1=**Broad-Crested Rectangular Weir**(Weir Controls 0.8 cfs @ 0.9 fps)

## Pond 2P: lower bio-ret

Hydrograph



**8490-Proposed**

Type III 24-hr 10-Year Rainfall=4.50"

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**Summary for Pond 5P: upper bio-ret**

Inflow Area = 13,212 sf, 72.31% Impervious, Inflow Depth > 3.10" for 10-Year event  
 Inflow = 1.1 cfs @ 12.09 hrs, Volume= 3,408 cf  
 Outflow = 1.0 cfs @ 12.11 hrs, Volume= 2,855 cf, Atten= 5%, Lag= 1.6 min  
 Discarded = 0.0 cfs @ 12.11 hrs, Volume= 938 cf  
 Primary = 1.0 cfs @ 12.11 hrs, Volume= 1,916 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 30.70' @ 12.11 hrs Surf.Area= 771 sf Storage= 747 cf

Plug-Flow detention time= 106.4 min calculated for 2,855 cf (84% of inflow)  
 Center-of-Mass det. time= 39.5 min ( 844.0 - 804.5 )

Volume	Invert	Avail.Storage	Storage Description
#1	29.50'	992 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
29.50	425	0	0
30.00	624	262	262
31.00	835	730	992

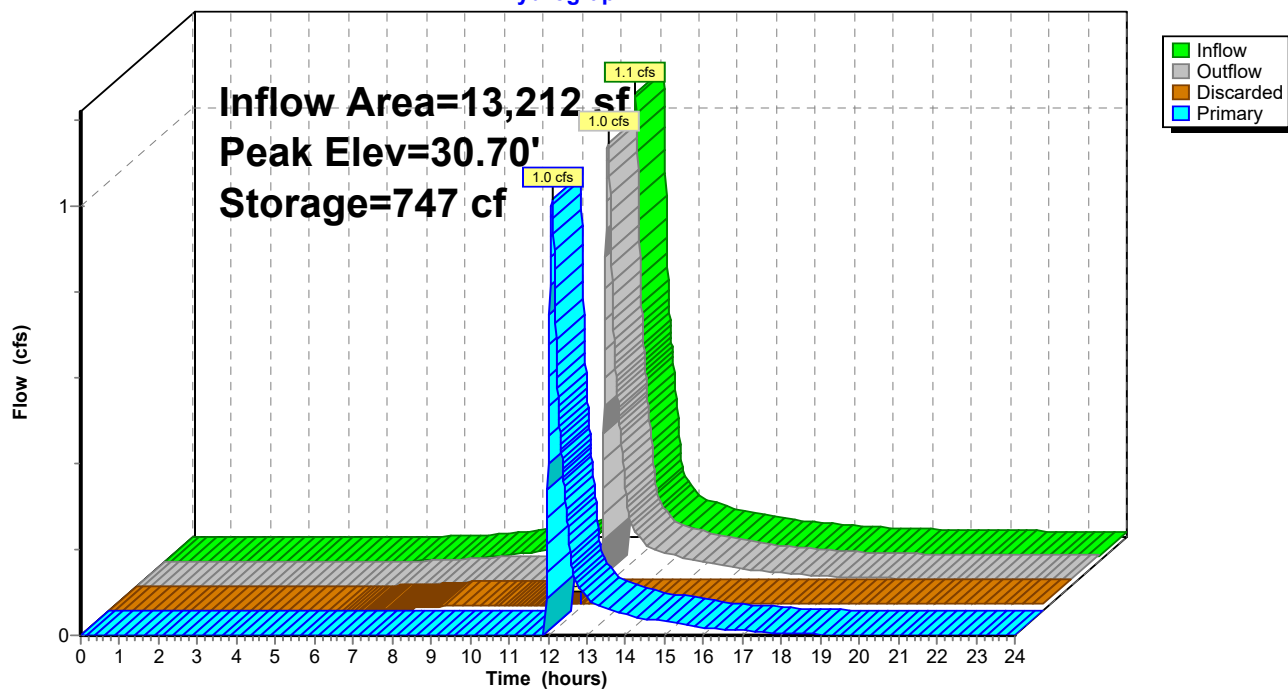
Device	Routing	Invert	Outlet Devices
#1	Primary	30.50'	<b>5.0' long x 5.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	29.50'	<b>1.020 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.0 cfs @ 12.11 hrs HW=30.70' (Free Discharge)  
 ↑ **2=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=1.0 cfs @ 12.11 hrs HW=30.70' (Free Discharge)  
 ↑ **1=Broad-Crested Rectangular Weir** (Weir Controls 1.0 cfs @ 1.0 fps)

## Pond 5P: upper bio-ret

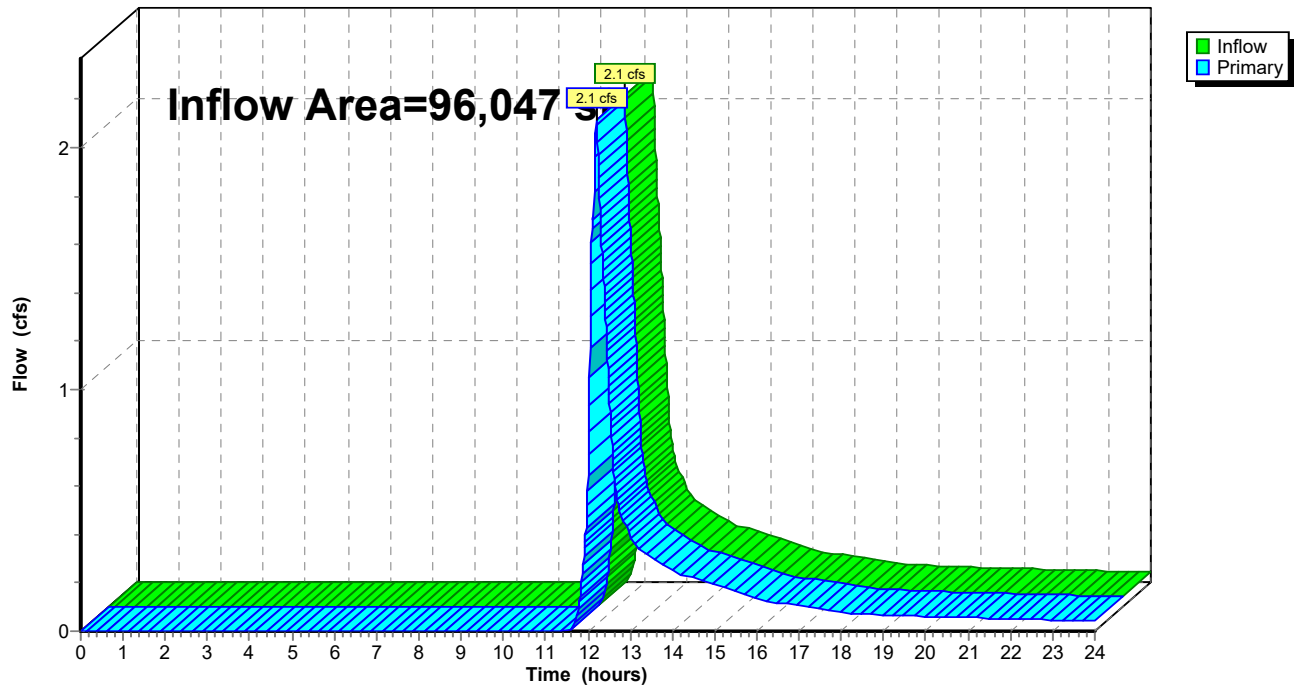
Hydrograph



**Summary for Link 1L: Parker River**

Inflow Area = 96,047 sf, 14.03% Impervious, Inflow Depth > 1.06" for 10-Year event  
Inflow = 2.1 cfs @ 12.20 hrs, Volume= 8,515 cf  
Primary = 2.1 cfs @ 12.20 hrs, Volume= 8,515 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Link 1L: Parker River****Hydrograph**

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Type III 24-hr 10-Year Rainfall=4.50"

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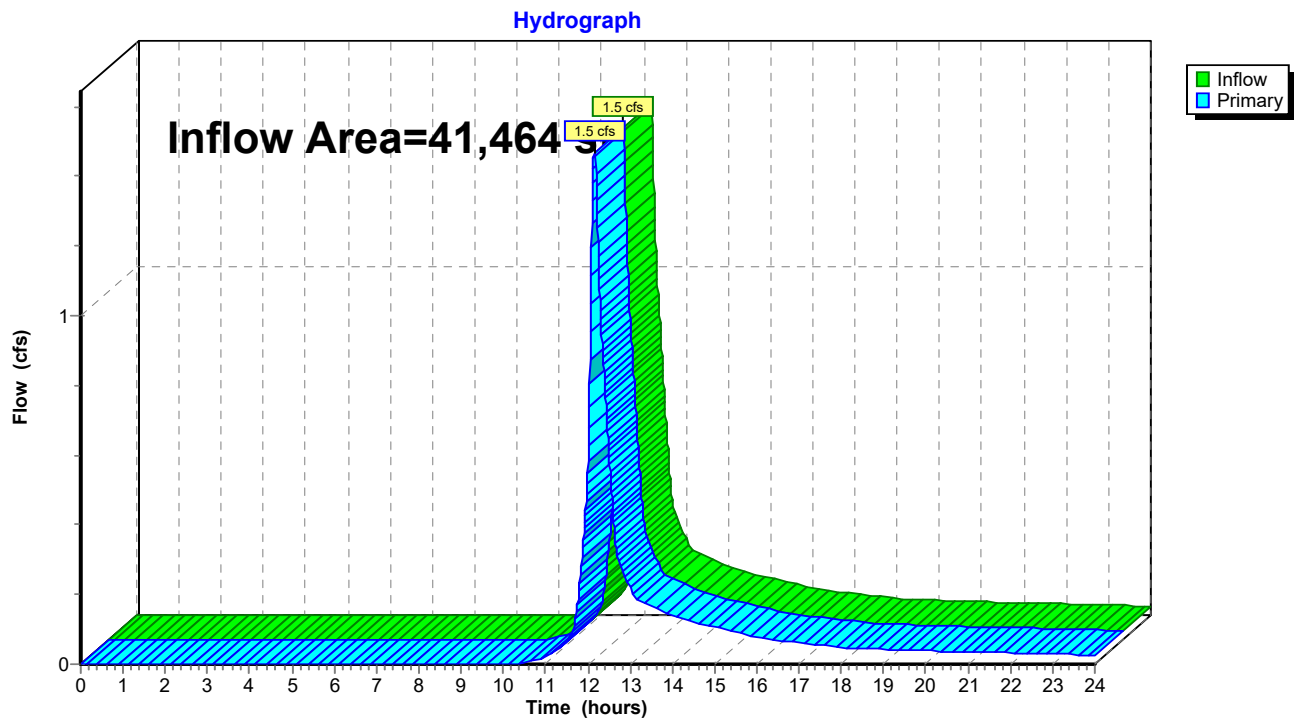
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### Summary for Link 2L: IVW

Inflow Area = 41,464 sf, 25.87% Impervious, Inflow Depth > 1.60" for 10-Year event  
Inflow = 1.5 cfs @ 12.16 hrs, Volume= 5,522 cf  
Primary = 1.5 cfs @ 12.16 hrs, Volume= 5,522 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Link 2L: IVW



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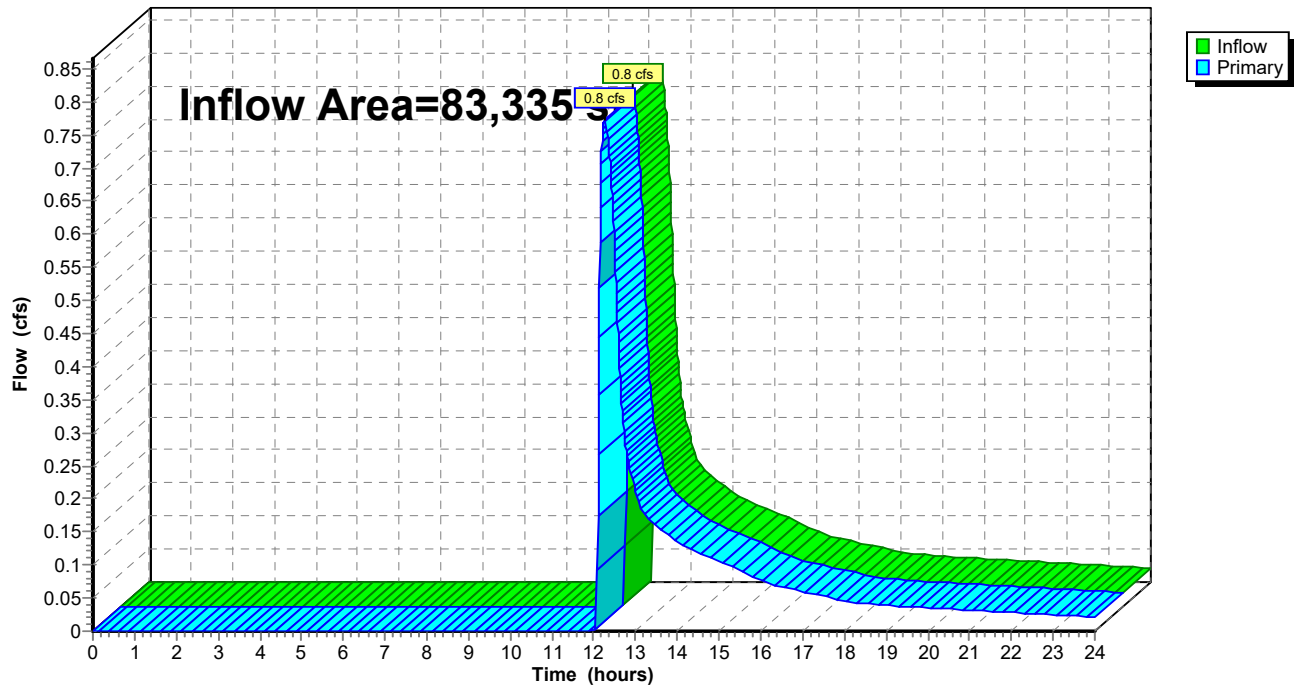
### Summary for Link 3L: BVW

Inflow Area = 83,335 sf, 13.37% Impervious, Inflow Depth > 0.58" for 10-Year event  
Inflow = 0.8 cfs @ 12.26 hrs, Volume= 4,036 cf  
Primary = 0.8 cfs @ 12.26 hrs, Volume= 4,036 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Link 3L: BVW

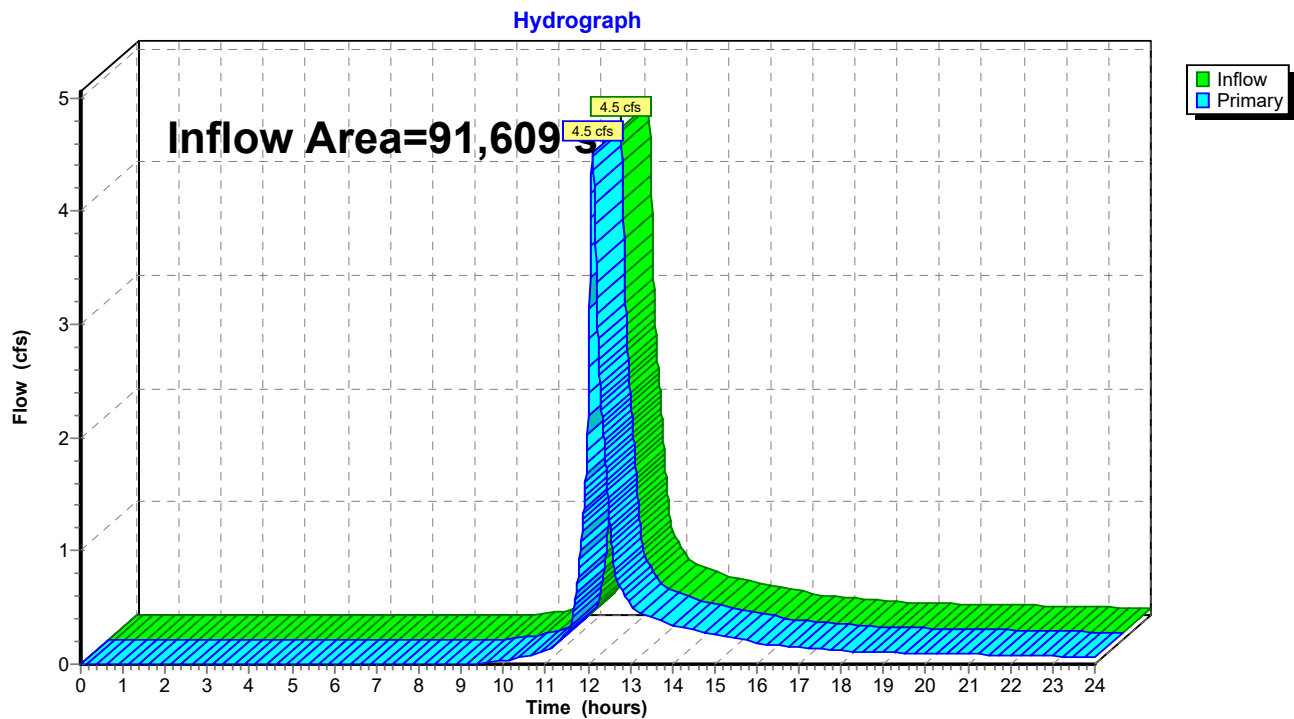
Hydrograph



**Summary for Link 4L: Existing Basin**

Inflow Area = 91,609 sf, 51.31% Impervious, Inflow Depth > 1.97" for 10-Year event  
Inflow = 4.5 cfs @ 12.12 hrs, Volume= 15,031 cf  
Primary = 4.5 cfs @ 12.12 hrs, Volume= 15,031 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Link 4L: Existing Basin**



**8490-Proposed***Type III 24-hr 100-yr (tp-40) Rainfall=6.50"*

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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

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**SubcatchmentSC101: Building and basin** Runoff Area=13,212 sf 72.31% Impervious Runoff Depth>4.99"  
Flow Length=94' Tc=6.0 min CN=87 Runoff=1.7 cfs 5,497 cf

**SubcatchmentSC102: Overland** Runoff Area=77,770 sf 3.80% Impervious Runoff Depth>2.25"  
Flow Length=422' Tc=7.4 min CN=60 Runoff=4.3 cfs 14,593 cf

**SubcatchmentSC102A: Overland** Runoff Area=5,065 sf 19.01% Impervious Runoff Depth>3.01"  
Flow Length=83' Tc=6.0 min CN=68 Runoff=0.4 cfs 1,269 cf

**SubcatchmentSC200: Isolated Wetland** Runoff Area=41,464 sf 25.87% Impervious Runoff Depth>3.10"  
Flow Length=328' Tc=10.6 min CN=69 Runoff=3.0 cfs 10,716 cf

**SubcatchmentSC301: Basin** Runoff Area=45,668 sf 23.80% Impervious Runoff Depth>2.53"  
Flow Length=359' Tc=6.6 min CN=63 Runoff=3.0 cfs 9,623 cf

**SubcatchmentSC302: Overland** Runoff Area=37,667 sf 0.73% Impervious Runoff Depth>0.66"  
Flow Length=75' Slope=0.3300 '/' Tc=6.0 min CN=40 Runoff=0.3 cfs 2,073 cf

**SubcatchmentSC400: Basin** Runoff Area=91,609 sf 51.31% Impervious Runoff Depth>3.60"  
Tc=7.8 min CN=74 Runoff=8.4 cfs 27,514 cf

**Reach 5R: 12" HDPE** Avg. Flow Depth=0.26' Max Vel=12.9 fps Inflow=2.0 cfs 8,323 cf  
12.0" Round Pipe n=0.013 L=25.0' S=0.1600 '/' Capacity=14.3 cfs Outflow=2.0 cfs 8,323 cf

**Reach 8R: 8" HDPE** Avg. Flow Depth=0.27' Max Vel=4.6 fps Inflow=0.6 cfs 273 cf  
8.0" Round Pipe n=0.013 L=140.0' S=0.0214 '/' Capacity=1.8 cfs Outflow=0.6 cfs 273 cf

**Pond 1P: Basin** Peak Elev=36.93' Storage=1,428 cf Inflow=3.0 cfs 9,623 cf  
Discarded=0.0 cfs 487 cf Primary=2.0 cfs 8,323 cf Secondary=0.6 cfs 273 cf Outflow=2.7 cfs 9,083 cf

**Pond 2P: lower bio-ret** Peak Elev=22.80' Storage=843 cf Inflow=2.0 cfs 5,135 cf  
Outflow=2.0 cfs 4,493 cf

**Pond 5P: upper bio-ret** Peak Elev=30.77' Storage=802 cf Inflow=1.7 cfs 5,497 cf  
Discarded=0.0 cfs 1,030 cf Primary=1.6 cfs 3,866 cf Outflow=1.7 cfs 4,896 cf

**Link 1L: Parker River** Inflow=6.3 cfs 19,086 cf  
Primary=6.3 cfs 19,086 cf

**Link 2L: IVW** Inflow=3.0 cfs 10,716 cf  
Primary=3.0 cfs 10,716 cf

**Link 3L: BVW** Inflow=2.3 cfs 10,396 cf  
Primary=2.3 cfs 10,396 cf

**Link 4L: Existing Basin** Inflow=8.6 cfs 27,787 cf  
Primary=8.6 cfs 27,787 cf

**8490-Proposed***Type III 24-hr 100-yr (tp-40) Rainfall=6.50"*

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**Total Runoff Area = 312,455 sf   Runoff Volume = 71,284 cf   Average Runoff Depth = 2.74"**  
**73.65% Pervious = 230,108 sf   26.35% Impervious = 82,347 sf**

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Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

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**Summary for Subcatchment SC101: Building and basin**

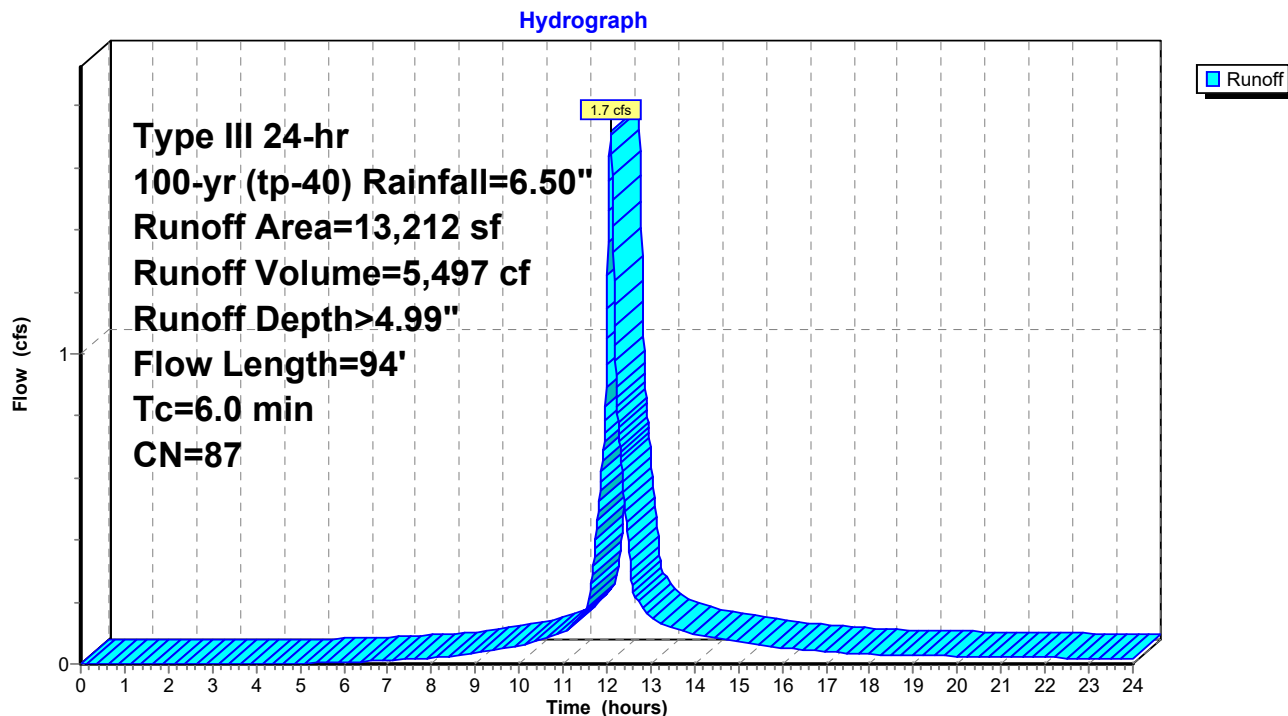
Runoff = 1.7 cfs @ 12.09 hrs, Volume= 5,497 cf, Depth&gt; 4.99"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

Area (sf)	CN	Description
7,032	98	Roofs, HSG B
769	98	Paved parking, HSG B
2,777	61	>75% Grass cover, Good, HSG B
* 1,753	98	Ledge
881	55	Woods, Good, HSG B
13,212	87	Weighted Average
3,658		27.69% Pervious Area
9,554		72.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	42	0.3300	3.5		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 3.10"
0.3	52	0.1875	3.0		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.5	94	Total, Increased to minimum Tc = 6.0 min			

**Subcatchment SC101: Building and basin**

**8490-Proposed**

Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

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**Summary for Subcatchment SC102: Overland**

Runoff = 4.3 cfs @ 12.11 hrs, Volume= 14,593 cf, Depth&gt; 2.25"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

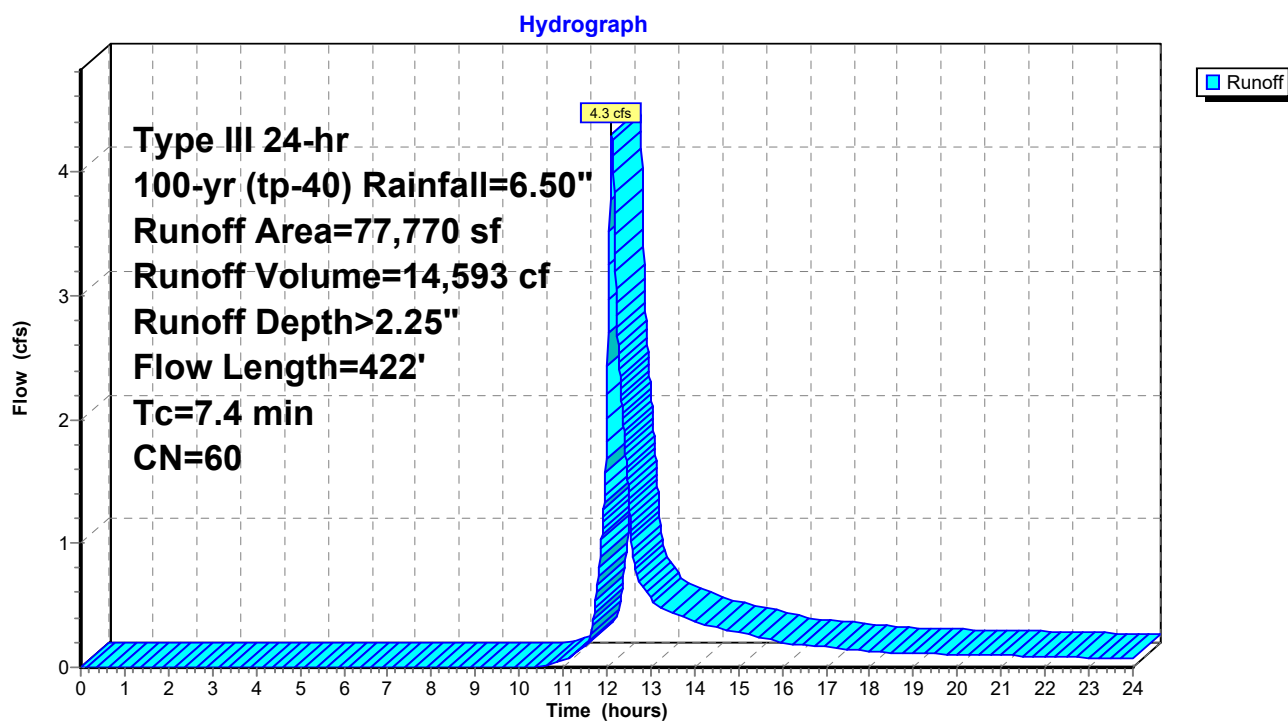
Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

Area (sf)	CN	Description
2,469	61	>75% Grass cover, Good, HSG B
446	61	>75% Grass cover, Good, HSG B
* 2,957	98	Ledge
3,901	96	Gravel surface, HSG B
2,862	96	Gravel surface, HSG B
65,135	55	Woods, Good, HSG B
77,770	60	Weighted Average
74,813		96.20% Pervious Area
2,957		3.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.1600	0.2		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.2	30	0.3000	2.7		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.2	21	0.1000	1.6		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.1	20	0.2800	2.6		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.6	170	0.0450	4.9	3.07	<b>Trap/Vee/Rect Channel Flow,</b> Bot.W=2.00' D=0.25' Z= 2.0 '/' Top.W=3.00' n= 0.022 Earth, clean & straight
0.8	118	0.2300	2.4		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.0	8	0.0500	3.6		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.0	5	0.1750	2.1		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
7.4	422	Total			

## Subcatchment SC102: Overland



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Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

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**Summary for Subcatchment SC102A: Overland**

Runoff = 0.4 cfs @ 12.09 hrs, Volume= 1,269 cf, Depth&gt; 3.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

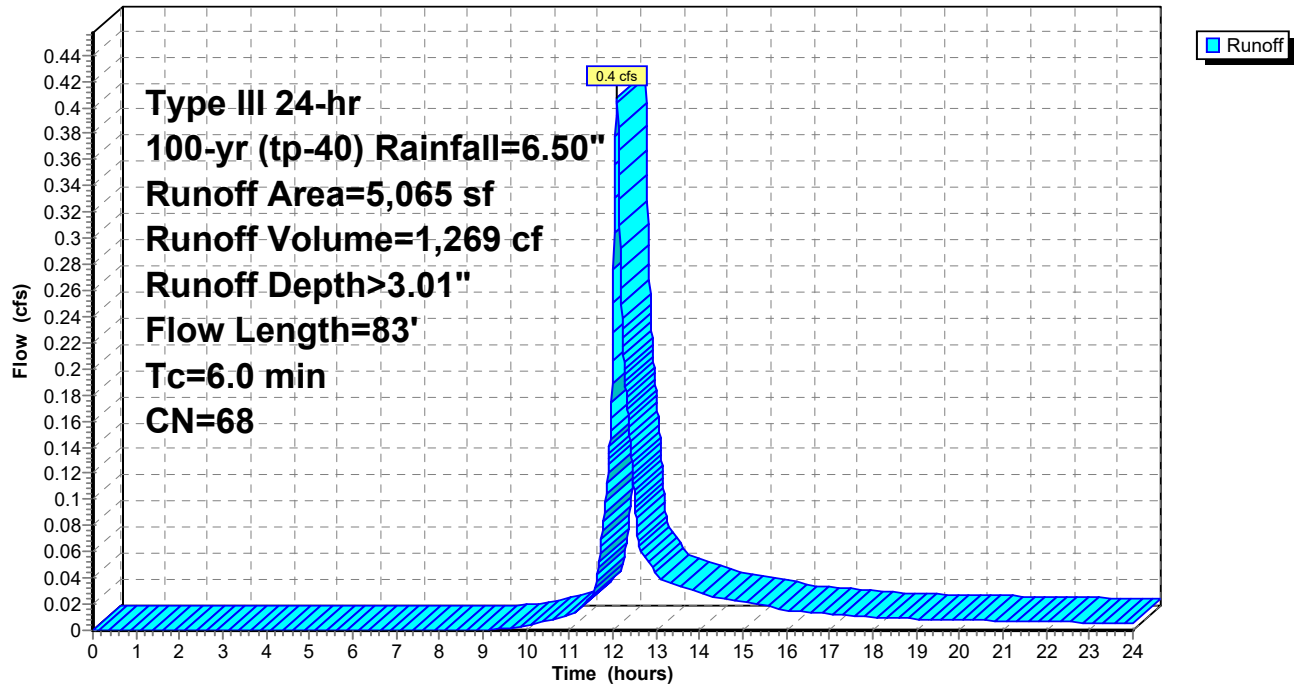
Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

Area (sf)	CN	Description
247	61	>75% Grass cover, Good, HSG B
299	61	>75% Grass cover, Good, HSG B
106	96	Gravel surface, HSG B
* 963	98	Ledge
342	96	Gravel surface, HSG B
52	96	Gravel surface, HSG B
3,056	55	Woods, Good, HSG B
5,065	68	Weighted Average
4,102		80.99% Pervious Area
963		19.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	20	0.2500	2.7		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 3.10"
0.1	28	0.2500	3.5		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.3	35	0.2000	2.2		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.5	83	Total, Increased to minimum Tc = 6.0 min			

## Subcatchment SC102A: Overland

Hydrograph



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Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

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**Summary for Subcatchment SC200: Isolated Wetland**

Runoff = 3.0 cfs @ 12.15 hrs, Volume= 10,716 cf, Depth&gt; 3.10"

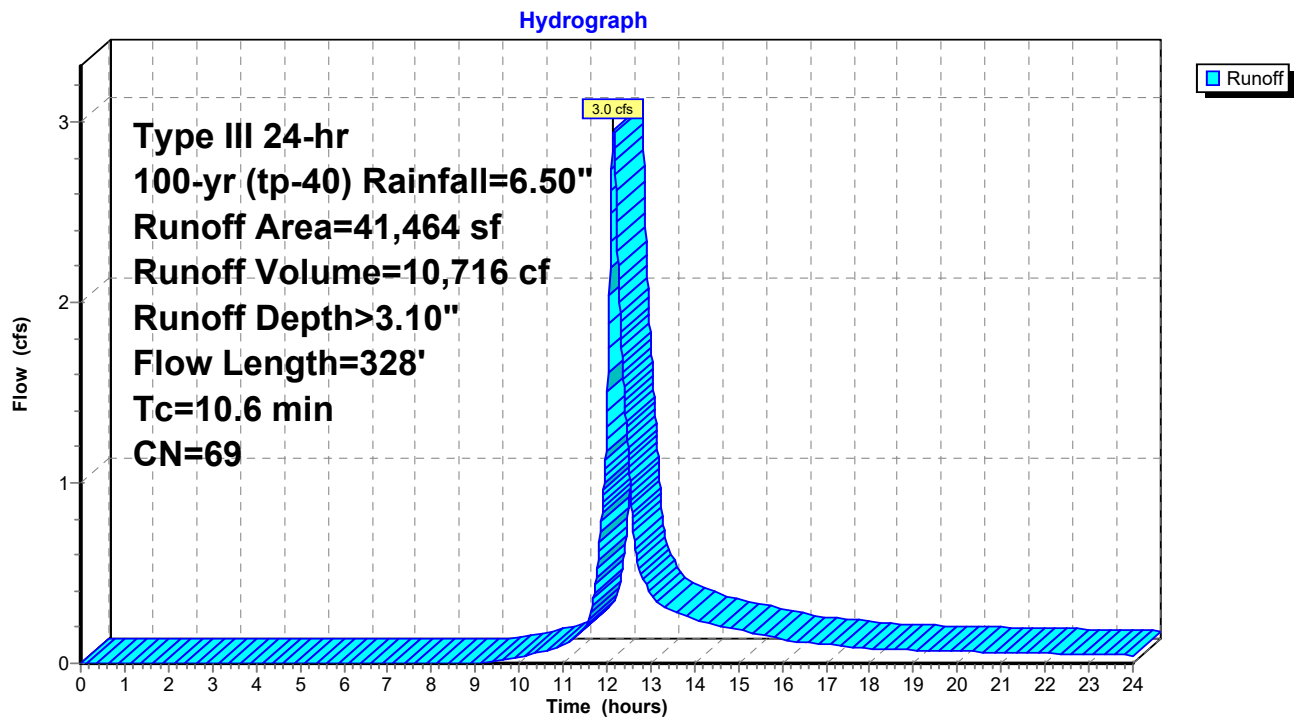
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

Area (sf)	CN	Description
1,062	82	Dirt roads, HSG B
721	61	>75% Grass cover, Good, HSG B
2,106	61	>75% Grass cover, Good, HSG B
* 5,148	98	Ledge
1,127	96	Gravel surface, HSG B
532	96	Gravel surface, HSG B
* 5,579	100	Wetland
25,189	55	Woods, Good, HSG B
41,464	69	Weighted Average
30,737		74.13% Pervious Area
10,727		25.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.1		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.0	11	0.4000	12.8		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.3	38	0.1670	2.0		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.1	16	0.0150	2.0		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.4	82	0.0450	3.4		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
1.1	131	0.1500	1.9		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
10.6	328	Total			



**Subcatchment SC200: Isolated Wetland**

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Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

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**Summary for Subcatchment SC301: Basin**

Runoff = 3.0 cfs @ 12.10 hrs, Volume= 9,623 cf, Depth&gt; 2.53"

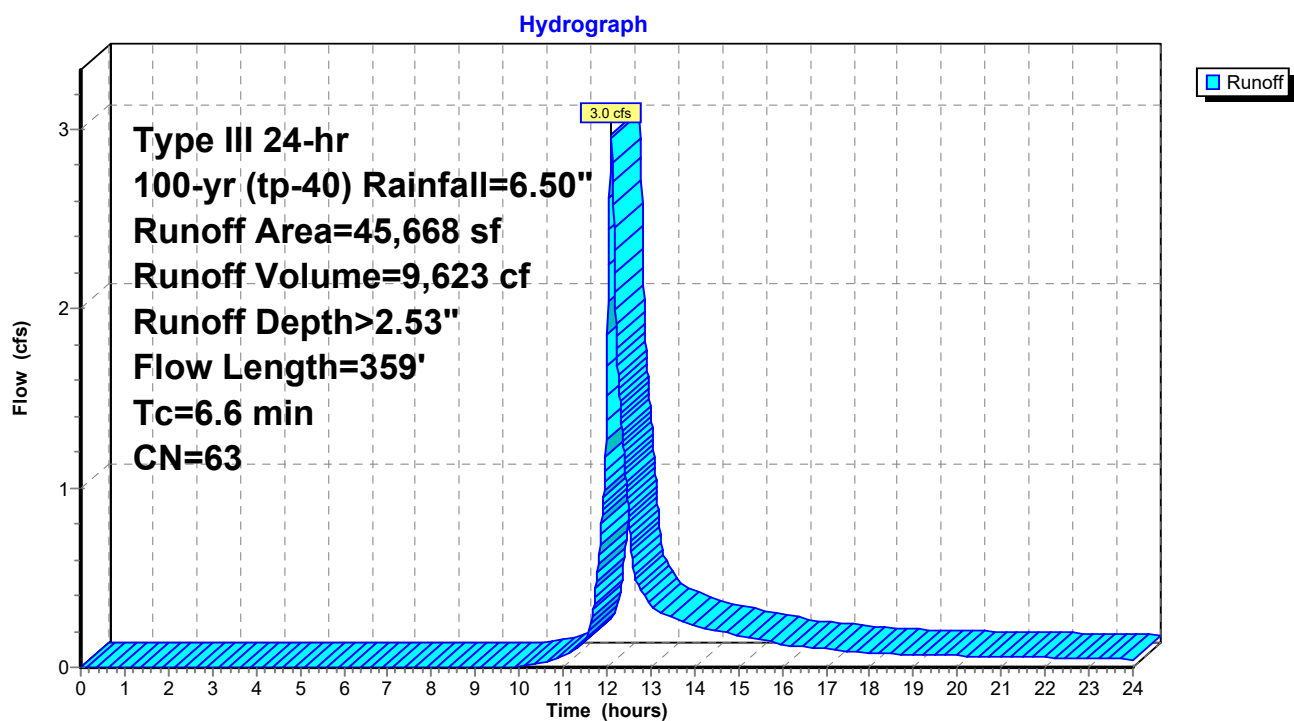
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

Area (sf)	CN	Description
3,732	98	Roofs, HSG A
1,752	39	>75% Grass cover, Good, HSG A
6,950	39	>75% Grass cover, Good, HSG A
208	61	>75% Grass cover, Good, HSG B
2,246	96	Gravel surface, HSG A
2,256	39	>75% Grass cover, Good, HSG A
* 220	98	Ledge
3,255	98	Paved parking, HSG A
3,664	98	Paved parking, HSG B
824	48	Brush, Good, HSG B
20,561	55	Woods, Good, HSG B
45,668	63	Weighted Average
34,797		76.20% Pervious Area
10,871		23.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	50	0.2600	0.2		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	41	0.2400	2.4		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
1.3	125	0.1100	1.7		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.1	21	0.3500	4.1		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.0	4	0.1100	5.3		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
0.3	83	0.0420	4.2		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.1	22	0.0150	2.5		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.0	13	0.3300	11.7		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
6.6	359	Total			

## Subcatchment SC301: Basin



**8490-Proposed**

Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

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**Summary for Subcatchment SC302: Overland**

Runoff = 0.3 cfs @ 12.15 hrs, Volume= 2,073 cf, Depth&gt; 0.66"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

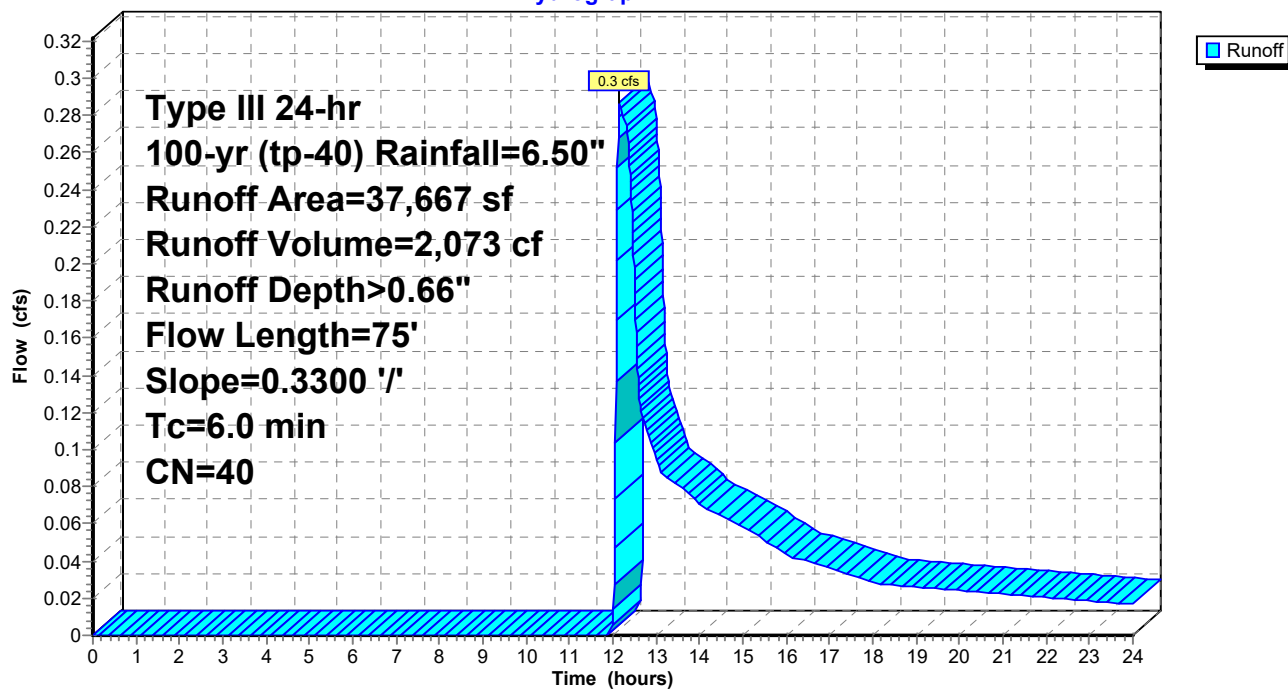
Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

Area (sf)	CN	Description
5,498	72	Dirt roads, HSG A
184	87	Dirt roads, HSG C
9,499	30	Brush, Good, HSG A
2,157	65	Brush, Good, HSG C
* 274	100	Wetlands
18,985	30	Woods, Good, HSG A
1,070	70	Woods, Good, HSG C
37,667	40	Weighted Average
37,393		99.27% Pervious Area
274		0.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	50	0.3300	0.4		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.10"
0.0	10	0.3300	4.0		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
0.1	15	0.3300	2.9		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
2.0	75	Total, Increased to minimum Tc = 6.0 min			

## Subcatchment SC302: Overland

Hydrograph



**8490-Proposed**

Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

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**Summary for Subcatchment SC400: Basin**

Runoff = 8.4 cfs @ 12.11 hrs, Volume= 27,514 cf, Depth&gt; 3.60"

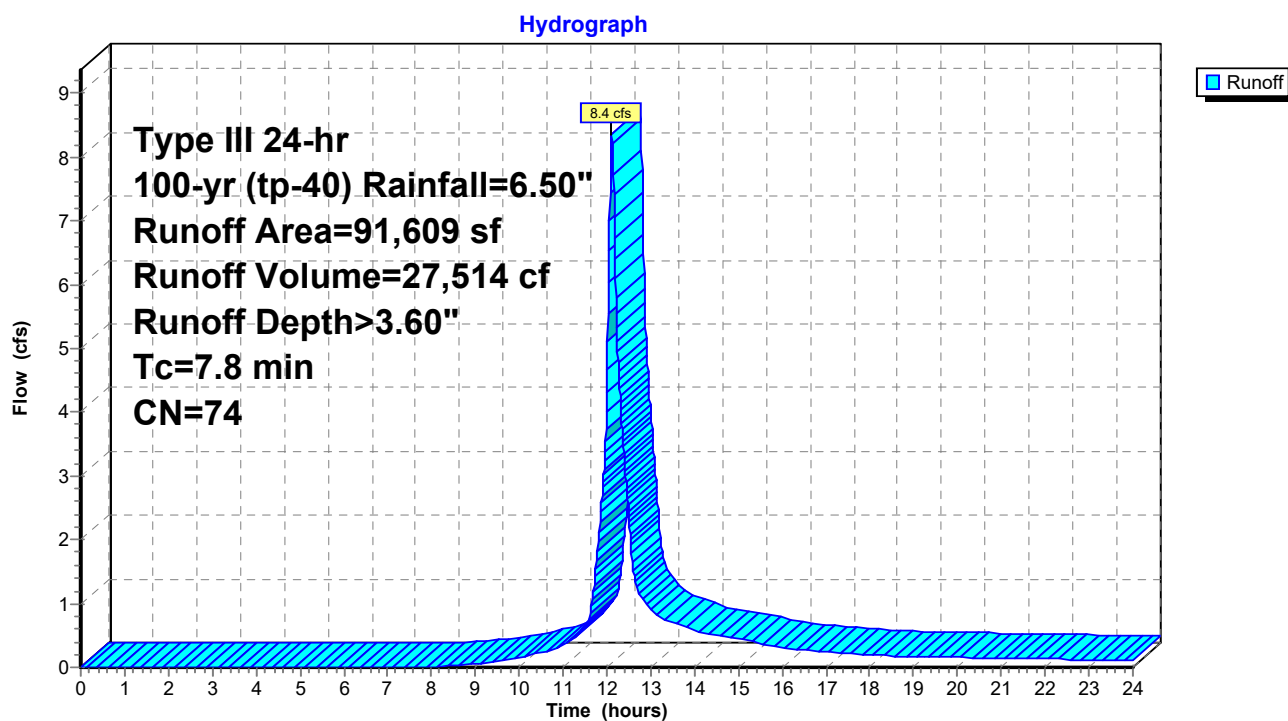
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

Area (sf)	CN	Description
11,003	98	Roofs, HSG A
11,291	39	>75% Grass cover, Good, HSG A
894	61	>75% Grass cover, Good, HSG B
1,479	96	Gravel surface, HSG A
425	96	Gravel surface, HSG B
4,285	39	>75% Grass cover, Good, HSG A
38	61	>75% Grass cover, Good, HSG B
* 187	98	Ledge
* 1,186	98	Ledge
34,405	98	Paved parking, HSG A
153	98	Paved parking, HSG B
67	98	Paved parking, HSG C
100	30	Brush, Good, HSG A
11,459	48	Brush, Good, HSG B
14,637	55	Woods, Good, HSG B
91,609	74	Weighted Average
44,608		48.69% Pervious Area
47,001		51.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8					<b>Direct Entry,</b>

## Subcatchment SC400: Basin



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Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

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### Summary for Reach 5R: 12" HDPE

Inflow Area = 45,668 sf, 23.80% Impervious, Inflow Depth > 2.19" for 100-yr (tp-40) event  
Inflow = 2.0 cfs @ 12.14 hrs, Volume= 8,323 cf  
Outflow = 2.0 cfs @ 12.14 hrs, Volume= 8,323 cf, Atten= 0%, Lag= 0.0 min

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

Max. Velocity= 12.9 fps, Min. Travel Time= 0.0 min

Avg. Velocity= 5.5 fps, Avg. Travel Time= 0.1 min

Peak Storage= 4 cf @ 12.14 hrs

Average Depth at Peak Storage= 0.26'

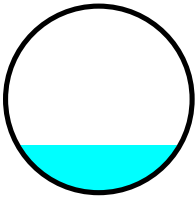
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 14.3 cfs

12.0" Round Pipe

n= 0.013 Corrugated PE, smooth interior

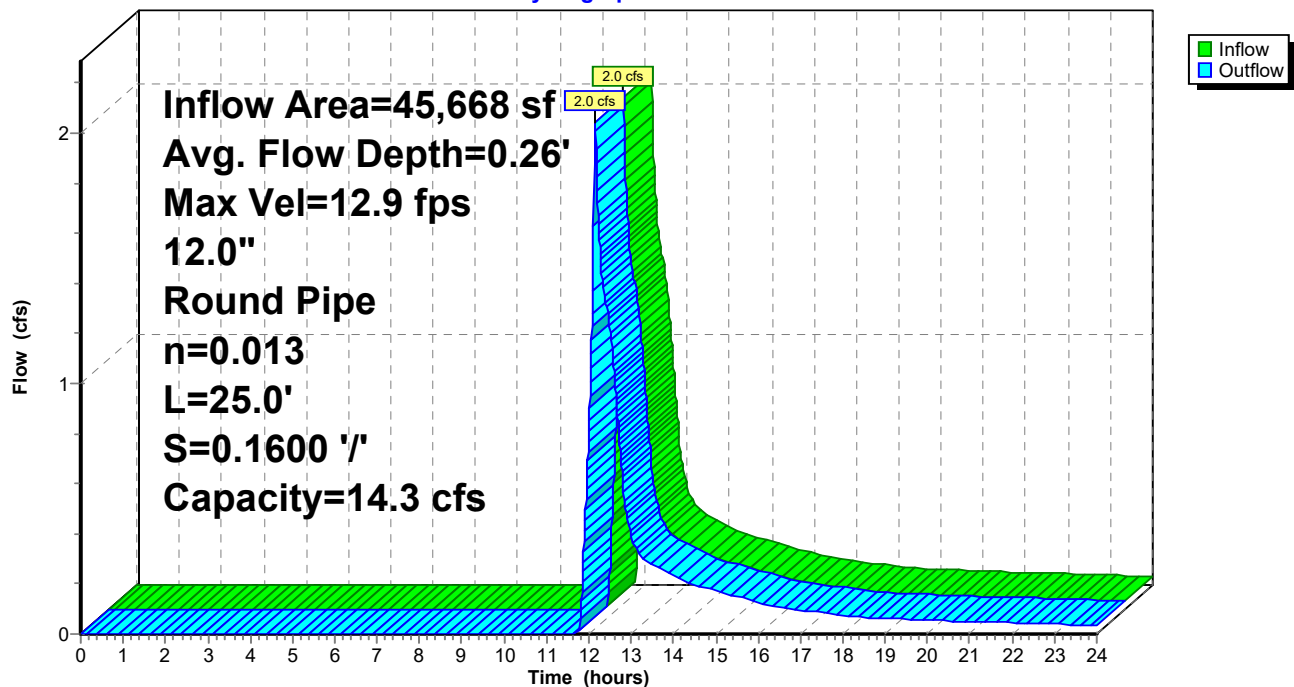
Length= 25.0' Slope= 0.1600 '/'

Inlet Invert= 34.00', Outlet Invert= 30.00'



### Reach 5R: 12" HDPE

#### Hydrograph





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Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

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### Summary for Reach 8R: 8" HDPE

Inflow = 0.6 cfs @ 12.14 hrs, Volume= 273 cf  
Outflow = 0.6 cfs @ 12.16 hrs, Volume= 273 cf, Atten= 2%, Lag= 1.0 min

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

Max. Velocity= 4.6 fps, Min. Travel Time= 0.5 min

Avg. Velocity = 2.0 fps, Avg. Travel Time= 1.2 min

Peak Storage= 19 cf @ 12.15 hrs

Average Depth at Peak Storage= 0.27'

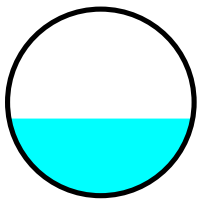
Bank-Full Depth= 0.67' Flow Area= 0.3 sf, Capacity= 1.8 cfs

8.0" Round Pipe

n= 0.013 Corrugated PE, smooth interior

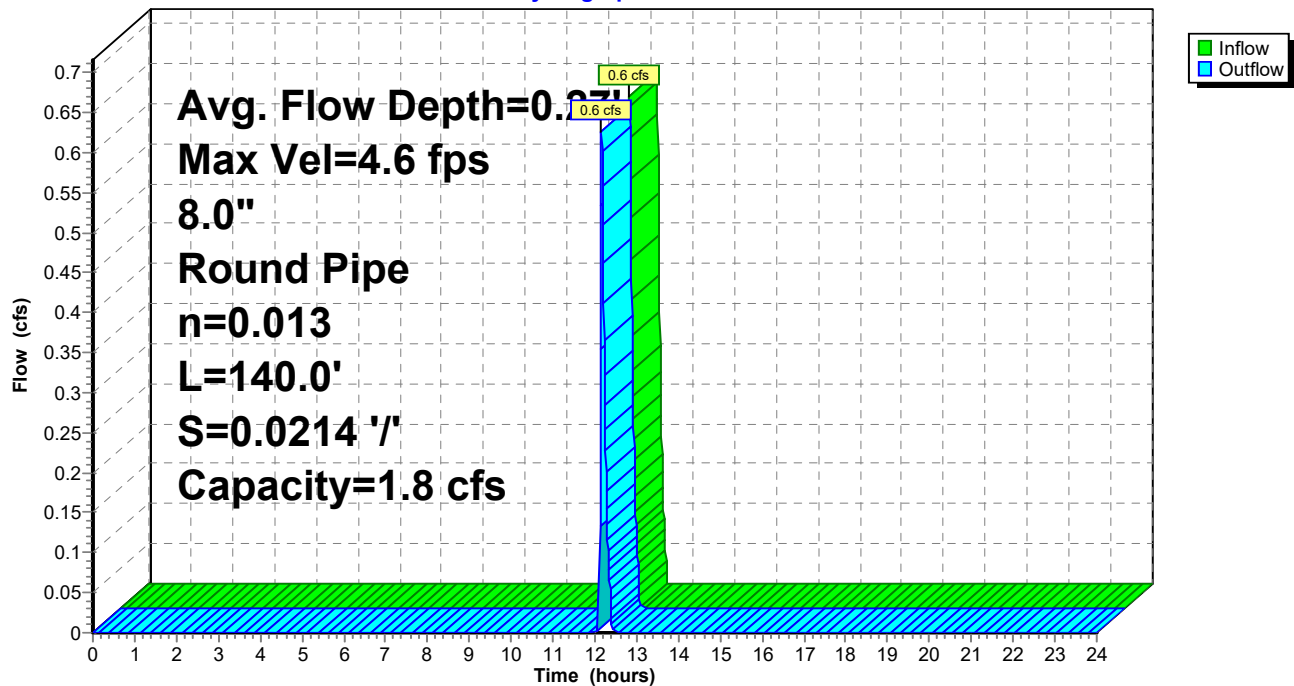
Length= 140.0' Slope= 0.0214 '/'

Inlet Invert= 34.00', Outlet Invert= 31.00'



### Reach 8R: 8" HDPE

#### Hydrograph



**8490-Proposed**

Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

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**Summary for Pond 1P: Basin**

Inflow Area = 45,668 sf, 23.80% Impervious, Inflow Depth > 2.53" for 100-yr (tp-40) event  
 Inflow = 3.0 cfs @ 12.10 hrs, Volume= 9,623 cf  
 Outflow = 2.7 cfs @ 12.14 hrs, Volume= 9,083 cf, Atten= 9%, Lag= 2.4 min  
 Discarded = 0.0 cfs @ 12.14 hrs, Volume= 487 cf  
 Primary = 2.0 cfs @ 12.14 hrs, Volume= 8,323 cf  
 Secondary = 0.6 cfs @ 12.14 hrs, Volume= 273 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 2  
 Peak Elev= 36.93' @ 12.14 hrs Surf.Area= 1,236 sf Storage= 1,428 cf

Plug-Flow detention time= 45.9 min calculated for 9,083 cf (94% of inflow)  
 Center-of-Mass det. time= 16.4 min ( 866.6 - 850.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	35.00'	2,091 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) 2,391 cf Overall - 300 cf Embedded = 2,091 cf
#2	35.00'	120 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc) Inside #1 300 cf Overall x 40.0% Voids
		2,211 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
35.00	600	131.0	0	0	600
36.00	767	123.0	682	682	806
37.00	1,274	165.0	1,010	1,692	1,779
37.50	1,529	174.0	700	2,391	2,036

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
35.00	600	131.0	0	0	600
35.50	600	131.0	300	300	666

Device	Routing	Invert	Outlet Devices
#1	Primary	37.00'	<b>9.0' 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
#2	Discarded	35.00'	<b>0.520 in/hr Exfiltration over Surface area</b>
#3	Secondary	36.85'	<b>24.0" x 24.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#4	Primary	36.85'	<b>24.0" x 24.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#5	Primary	36.00'	<b>12.0" W x 4.0" H Vert. Orifice/Grate</b> C= 0.600

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**Discarded OutFlow** Max=0.0 cfs @ 12.14 hrs HW=36.93' (Free Discharge)

↑ **2=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=2.0 cfs @ 12.14 hrs HW=36.93' (Free Discharge)

↑ **1=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)

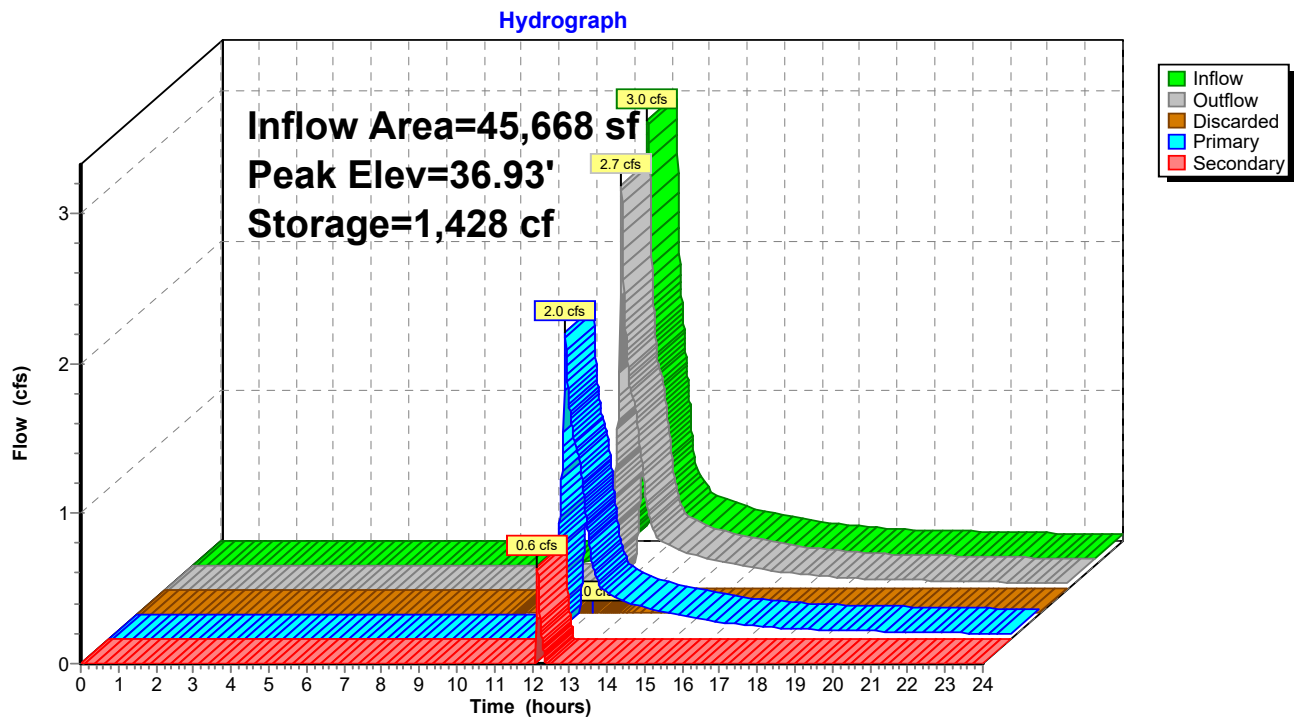
↑ **4=Orifice/Grate** (Weir Controls 0.6 cfs @ 0.9 fps)

↑ **5=Orifice/Grate** (Orifice Controls 1.4 cfs @ 4.2 fps)

**Secondary OutFlow** Max=0.6 cfs @ 12.14 hrs HW=36.93' (Free Discharge)

↑ **3=Orifice/Grate** (Weir Controls 0.6 cfs @ 0.9 fps)

### Pond 1P: Basin



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**Summary for Pond 2P: lower bio-ret**

Inflow Area = 18,277 sf, 57.54% Impervious, Inflow Depth > 3.37" for 100-yr (tp-40) event  
 Inflow = 2.0 cfs @ 12.10 hrs, Volume= 5,135 cf  
 Outflow = 2.0 cfs @ 12.12 hrs, Volume= 4,493 cf, Atten= 2%, Lag= 1.2 min  
 Primary = 2.0 cfs @ 12.12 hrs, Volume= 4,493 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 22.80' @ 12.12 hrs Surf.Area= 722 sf Storage= 843 cf

Plug-Flow detention time= 59.5 min calculated for 4,492 cf (87% of inflow)  
 Center-of-Mass det. time= 16.8 min ( 814.5 - 797.7 )

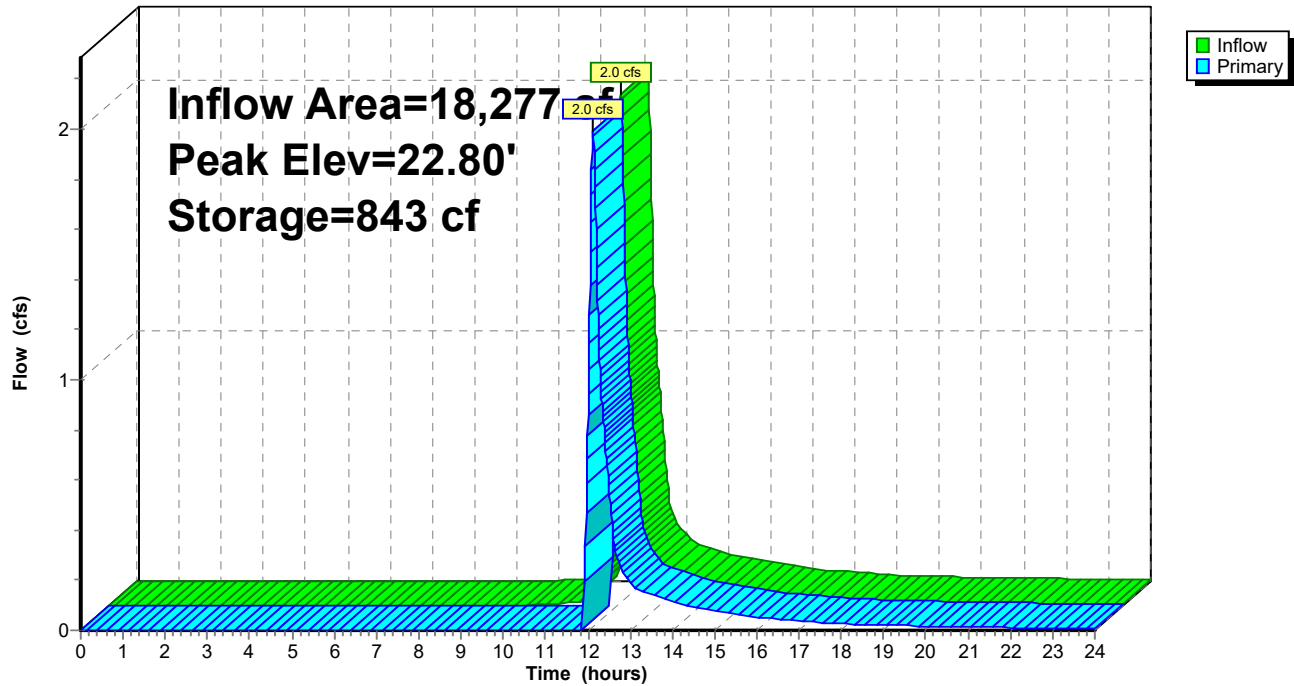
Volume	Invert	Avail.Storage	Storage Description		
#1	21.00'	993 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc)		
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
21.00	247	71.0	0	0	247
22.00	489	89.9	361	361	502
23.00	787	108.7	632	993	815

Device	Routing	Invert	Outlet Devices											
#1	Primary	22.50'	<b>5.0' long x 5.0' 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)	2.34	2.50	2.70	2.68	2.68	2.66	2.65	2.65	2.65		
				2.65	2.67	2.66	2.68	2.70	2.74	2.79	2.88			

**Primary OutFlow** Max=2.0 cfs @ 12.12 hrs HW=22.80' (Free Discharge)  
 ↑1=**Broad-Crested Rectangular Weir**(Weir Controls 2.0 cfs @ 1.3 fps)

## Pond 2P: lower bio-ret

Hydrograph



**8490-Proposed**

Type III 24-hr 100-yr (tp-40) Rainfall=6.50"

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**Summary for Pond 5P: upper bio-ret**

Inflow Area = 13,212 sf, 72.31% Impervious, Inflow Depth > 4.99" for 100-yr (tp-40) event  
 Inflow = 1.7 cfs @ 12.09 hrs, Volume= 5,497 cf  
 Outflow = 1.7 cfs @ 12.11 hrs, Volume= 4,896 cf, Atten= 3%, Lag= 1.3 min  
 Discarded = 0.0 cfs @ 12.11 hrs, Volume= 1,030 cf  
 Primary = 1.6 cfs @ 12.11 hrs, Volume= 3,866 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 30.77' @ 12.11 hrs Surf.Area= 786 sf Storage= 802 cf

Plug-Flow detention time= 76.6 min calculated for 4,896 cf (89% of inflow)  
 Center-of-Mass det. time= 25.1 min ( 816.4 - 791.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	29.50'	992 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
29.50	425	0	0
30.00	624	262	262
31.00	835	730	992

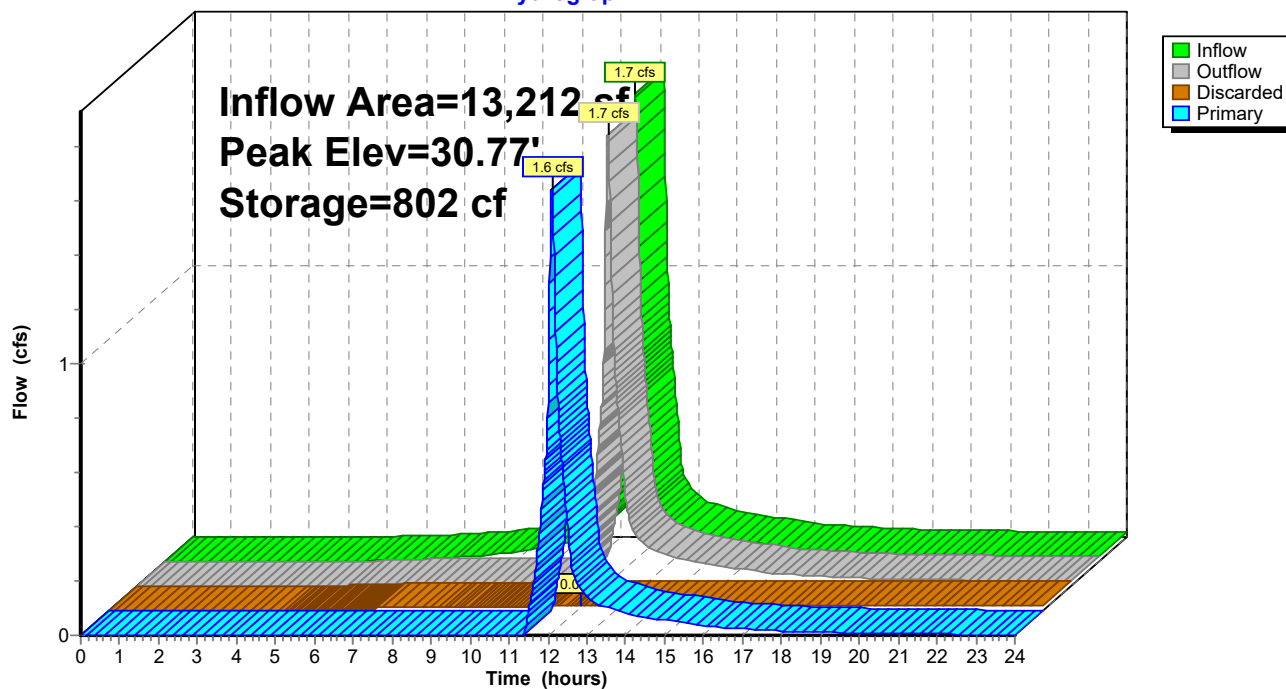
Device	Routing	Invert	Outlet Devices
#1	Primary	30.50'	<b>5.0' long x 5.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	29.50'	<b>1.020 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.0 cfs @ 12.11 hrs HW=30.77' (Free Discharge)  
 ↑ **2=Exfiltration** (Exfiltration Controls 0.0 cfs)

**Primary OutFlow** Max=1.6 cfs @ 12.11 hrs HW=30.77' (Free Discharge)  
 ↑ **1=Broad-Crested Rectangular Weir** (Weir Controls 1.6 cfs @ 1.2 fps)

## Pond 5P: upper bio-ret

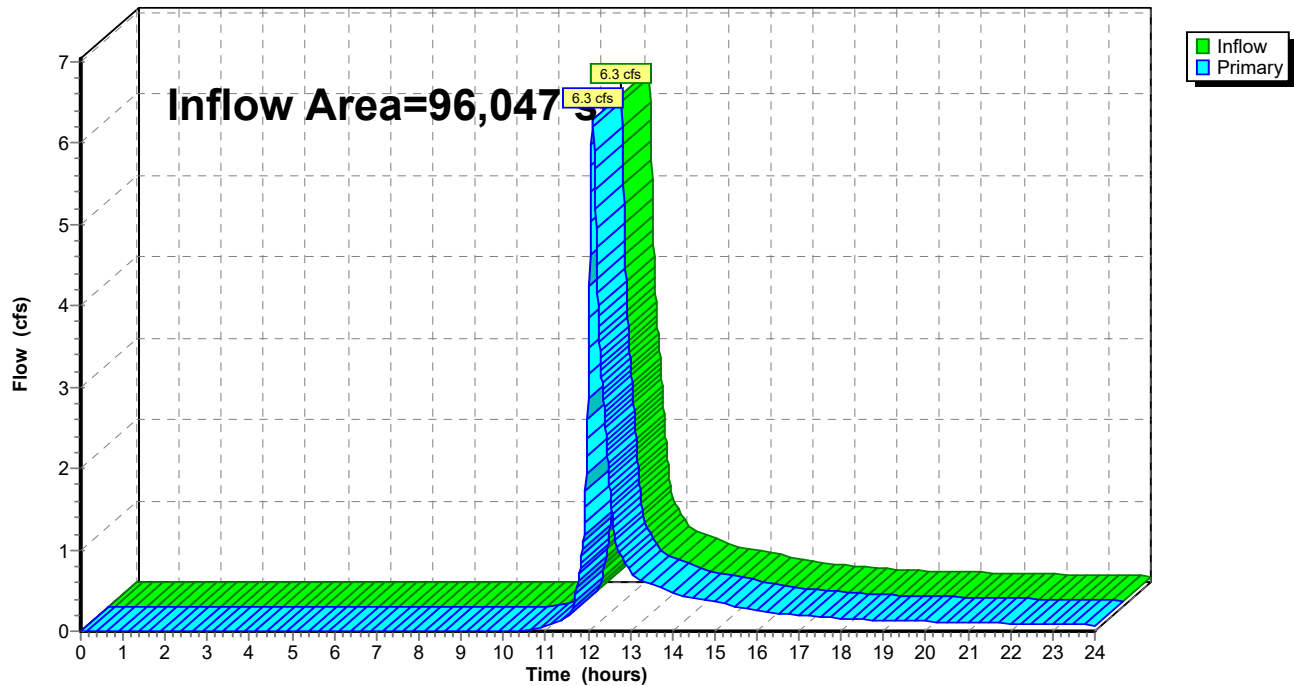
Hydrograph



**Summary for Link 1L: Parker River**

Inflow Area = 96,047 sf, 14.03% Impervious, Inflow Depth > 2.38" for 100-yr (tp-40) event  
Inflow = 6.3 cfs @ 12.12 hrs, Volume= 19,086 cf  
Primary = 6.3 cfs @ 12.12 hrs, Volume= 19,086 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Link 1L: Parker River****Hydrograph**



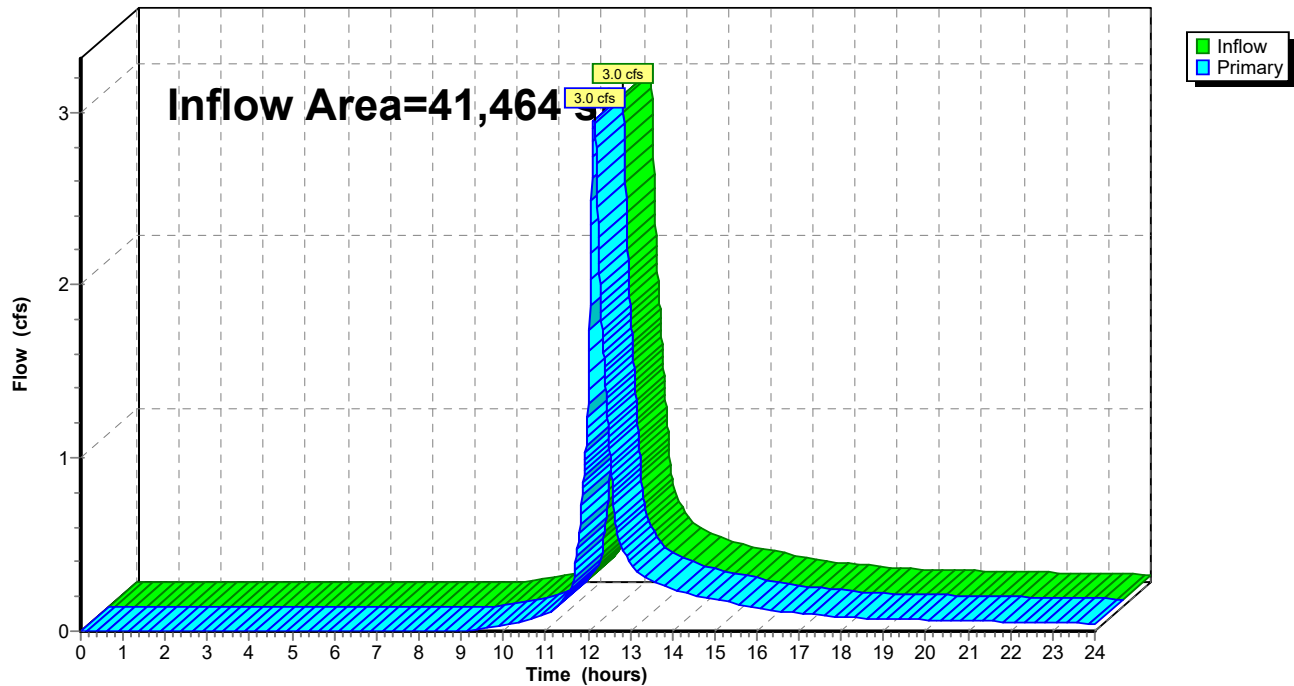
**Summary for Link 2L: IVW**

Inflow Area = 41,464 sf, 25.87% Impervious, Inflow Depth > 3.10" for 100-yr (tp-40) event  
Inflow = 3.0 cfs @ 12.15 hrs, Volume= 10,716 cf  
Primary = 3.0 cfs @ 12.15 hrs, Volume= 10,716 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Link 2L: IVW**

Hydrograph



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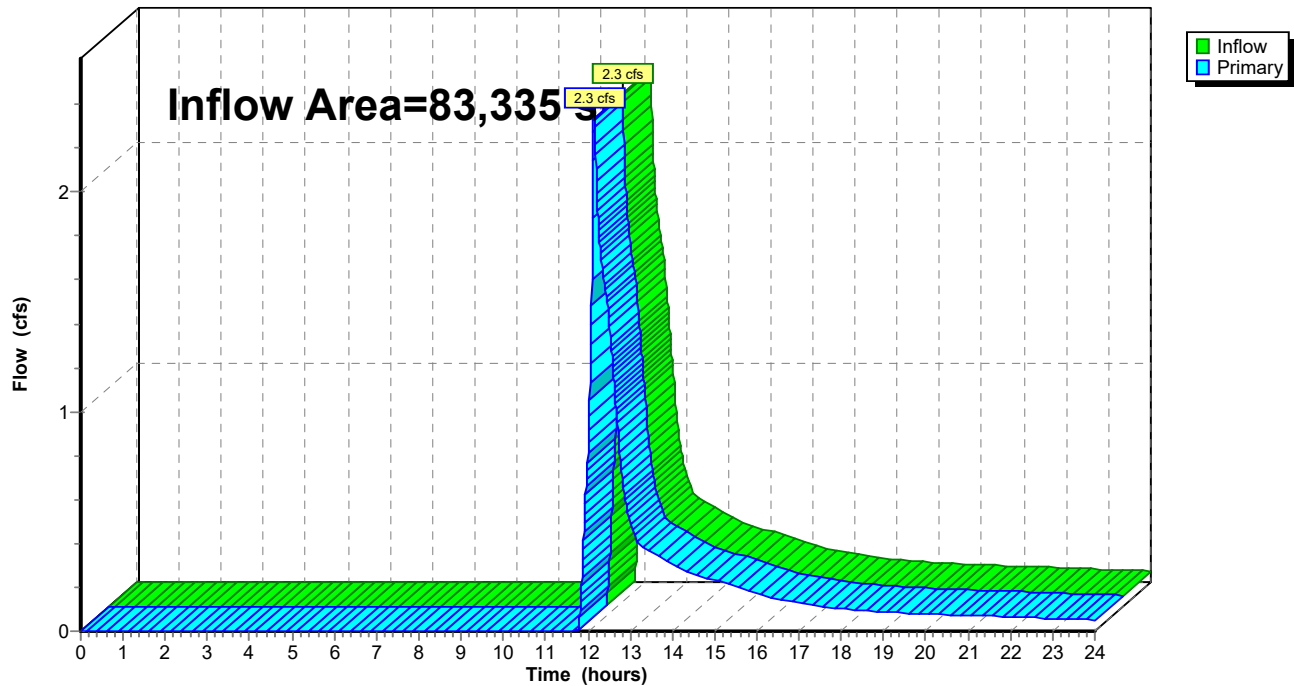
### Summary for Link 3L: BVW

Inflow Area = 83,335 sf, 13.37% Impervious, Inflow Depth > 1.50" for 100-yr (tp-40) event  
Inflow = 2.3 cfs @ 12.14 hrs, Volume= 10,396 cf  
Primary = 2.3 cfs @ 12.14 hrs, Volume= 10,396 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Link 3L: BVW

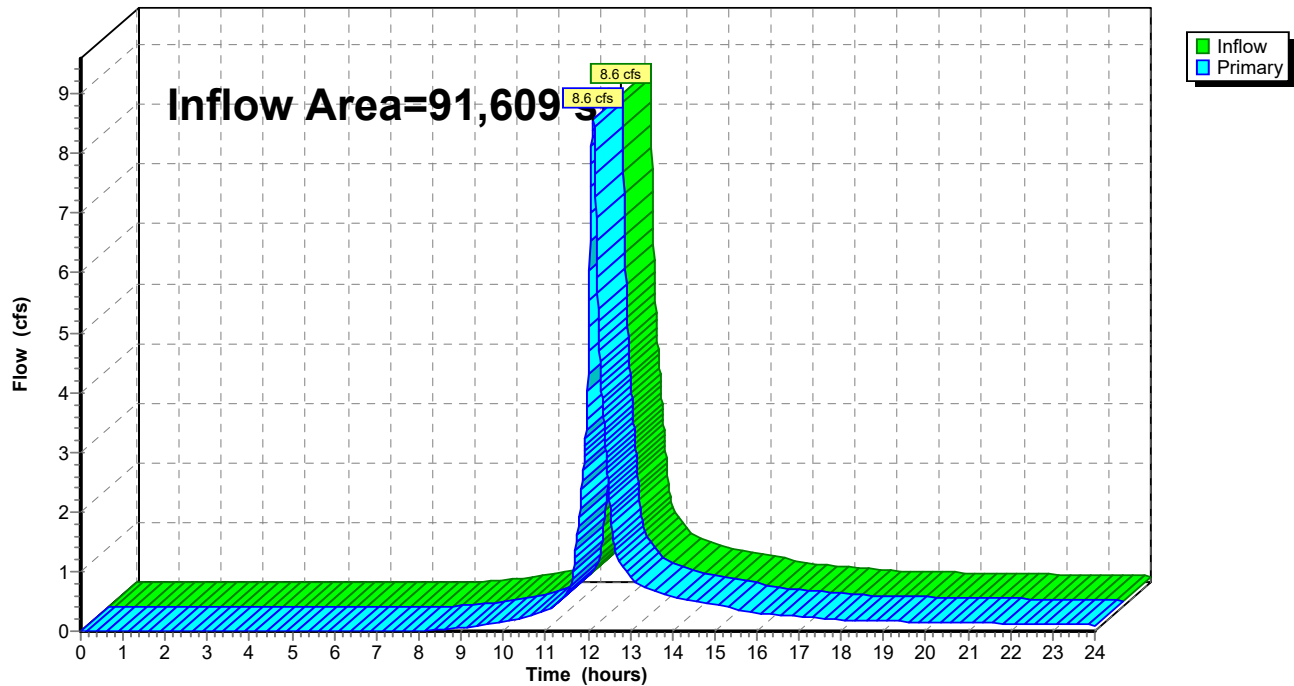
Hydrograph



**Summary for Link 4L: Existing Basin**

Inflow Area = 91,609 sf, 51.31% Impervious, Inflow Depth > 3.64" for 100-yr (tp-40) event  
Inflow = 8.6 cfs @ 12.13 hrs, Volume= 27,787 cf  
Primary = 8.6 cfs @ 12.13 hrs, Volume= 27,787 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

**Link 4L: Existing Basin****Hydrograph**

## **WATER QUALITY**

### ***Recharge Calculations-Standard 3***

The “Rawls” infiltration rate for Sandy Loam of 1.02 in/hr per the DEP Stormwater Handbook, has been utilized for the proposed infiltration area to the East of the building. The “Rawls” infiltration rate for Loam of 0.52 in/hr per the DEP Stormwater Handbook, has been utilized for the proposed infiltration areas to the West of the building and adjacent to the proposed parking area. The NRCS Hydrologic Soil Group rating for these soil types is “B”.

#### **The Required Recharge Volume (Rv):**

##### Design Point 1 (DP-1)

The increase in impervious area is:

- 7,032 sf

$R_v = F * \text{Impervious Area}$

F = Target Depth Factor associated with Hydrological Soil Group; HSG B = 0.35 inches

$$R_v = [(0.35 \text{ in})(7,032 \text{ sf})]/(12 \text{ in/ft}) = 205 \text{ ft}^3$$

##### Design Point 3 (DP-3)

The increase in impervious area for Hydrologic Soil Group A is:

- 1,329 sf

$R_v = F * \text{Impervious Area}$

F = Target Depth Factor associated with Hydrological Soil Group; HSG A = 0.6 inches

$$R_v = [(0.6 \text{ in})(1,329 \text{ sf})]/(12 \text{ in/ft}) = 67 \text{ ft}^3$$

The increase in impervious area for Hydrologic Soil Group B is:

- 3,183 sf

$R_v = F * \text{Impervious Area}$

F = Target Depth Factor associated with Hydrological Soil Group; HSG B = 0.35 inches

$$R_v = [(0.35 \text{ in})(3,183 \text{ sf})]/(12 \text{ in/ft}) = 93 \text{ ft}^3$$

Total Required Recharge Volume for Design Point 3 = 160 ft<sup>3</sup>

Total Required Recharge Volume for Design Points 1 & 3 = 365 ft<sup>3</sup>

The provided recharge volume:

- Upper infiltration Basin for SC101  
The storage volume below the weir is 830 ft<sup>3</sup>
- Infiltration Basin for SC301  
The storage volume below the weir 1,014 ft<sup>3</sup>

Therefore, the total recharge volume provided is 1,844 ft<sup>3</sup> > 365 ft<sup>3</sup> required. OKAY

### **Drawdown Calculations-Standard 3**

The Stormwater Handbook also requires recharge facilities be installed in soils capable of absorbing the recharge volume with the ability to drain within 72 hours. The formula for time drawdown is as follows:

**General Formula:**

$$T_{DR} = \frac{\text{required storage volume}^*}{(\text{Rawls Rate})(\text{Bottom Surface Area of System})}$$

(\*Required storage volume is equal to the larger of the calculated required recharge or treatment volumes. In this case, water quality volume is greater as indicated in Standard 4).

**Upper Infiltration area West of building:**

Volume to Treat = 830 cf

$$T_{DR} = 830 \text{ cf} / (((1.02 \text{ in/hr}) / (12 \text{ in/ft})) (446 \text{ sf})) = 22 \text{ hrs}$$

22 hrs < 72 hrs

**Infiltration area adjacent to parking area:**

Volume to Treat = 1014 cf

$$T_{DR} = 1014 \text{ cf} / (((0.52 \text{ in/hr}) / (12 \text{ in/ft})) (739 \text{ sf})) = 32 \text{ hrs}$$

32 hrs < 72 hrs

## ***Water Quality Volume Calculations-Standard 4***

The Project will be treating the total impervious areas. It is assumed all flows are eventually going to Parker River and wetlands areas so a 1" water quality volume is used.

### **The Water Quality Treatment Volume ( $V_{WQ}$ ):**

Design Point 1 (DP-1)

$$V_{WQ} = (D_{WQ}/12 \text{ inches/foot}) (A_{IMP})$$

$$D_{WQ} = 1 \text{ inches (required water quality volume)}$$

$$A_{IMP} = 7,707 \text{ sf (building rooftop)}$$

$$V_{WQ}(\text{Proposed}) = (1 \text{ inches}/12 \text{ inches/foot}) (7,707 \text{ sf}) = \boxed{642 \text{ ft}^3}$$

Design Point 3 (DP-3)

$$V_{WQ} = (D_{WQ}/12 \text{ inches/foot}) (A_{IMP})$$

$$D_{WQ} = 1 \text{ inches (required water quality volume)}$$

$$A_{IMP} = 10,651 \text{ sf (driveway and parking area)}$$

$$V_{WQ}(\text{Proposed}) = (1 \text{ inches}/12 \text{ inches/foot}) (10,651 \text{ sf}) = 888 \text{ ft}^3$$

➔ *Therefore the total water quality volume provided is  $2,484 \text{ ft}^3 > 1,530 \text{ ft}^3$  required -OKAY*

**INSTRUCTIONS:**

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: SC101 (DP-1) Overland Flow to the Parker River

B	C	D	E	F
BMP <sup>1</sup>	TSS Removal Rate <sup>1</sup>	Starting TSS Load*	Amount Removed (C*D)	Remaining Load (D-E)
Infiltration Basin	0.80	1.00	0.80	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20

Separate Form Needs to be Completed for Each Outlet or BMP Train

**Total TSS Removal =**

80%

Project:	8490
Prepared By:	CSB
Date:	4/30/2018

\*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed  
 1. From MassDEP Stormwater Handbook Vol. 1



**INSTRUCTIONS:**

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: SC301 (DP-3) Overland Flow to Wetland

B	C	D	E	F
BMP <sup>1</sup>	TSS Removal Rate <sup>1</sup>	Starting TSS Load*	Amount Removed (C*D)	Remaining Load (D-E)
Infiltration Basin	0.80	1.00	0.80	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20

Separate Form Needs to be Completed for Each Outlet or BMP Train

**Total TSS Removal =**

80%

Project:	8490
Prepared By:	CSB
Date:	4/30/2018

\*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed  
 1. From MassDEP Stormwater Handbook Vol. 1

## **OPERATION AND MAINTENANCE PLAN**

**Stormwater Management Operation and Maintenance Plan**  
***Parker River Environmental Studies Center***  
***The Governor's Academy - Byfield, Massachusetts***

In accordance with Standard 9 of the Massachusetts Department of Environmental Protection (MassDEP) Stormwater Handbook, the attached on-site maintenance program for the proposed stormwater management system has been developed to ensure the Best Management Practices (BMP's) in place will remain functioning as designed. The Plan contains both construction period operations and maintenance as well as post construction responsibilities that shall "run" with the property if ownership is transferred.

All stormwater management-related records shall be retained for a minimum of three (3) years. These records shall be available for inspection during normal business hours upon request by City or MassDEP personnel.

**Owner/Operator:**

**The Governor's Academy**  
1 Elm Street  
Byfield, Massachusetts 02052  
(978) 499-3105

**Construction Period Operation and Maintenance**

**Erosion Control Barrier:**

Compost filter socks ("Filtrexx Soxx"), or approved equal, shall be installed where indicated on the plans and in other appropriate locations where warranted. These barriers shall be installed prior to the commencement of any work on site and in accordance with the construction plans. A supply of erosion control barrier materials shall be kept on site to replace and/or repair barriers that are damaged or degraded. The barriers shall be observed and maintained as necessary on a weekly basis and after every rainfall event of 0.25 inches or more during construction.

**Deep Sump Catch Basin Protection:**

Temporary catch basin protection barriers consisting of compost filter socks and a Silt Sack will be placed around and in all constructed inlets to prevent inflow of sediment into the constructed drainage systems. The barriers shall remain in place until a permanent cover is established or diversions away from the catch basin are constructed. The barrier shall be observed and maintained as necessary on a weekly basis and after every rainfall event of 0.25 inches or more. If inspection identifies the presence of hydrocarbons, these materials shall be immediately removed and disposed of in accordance with applicable local, state and federal guidelines and regulations.

**Diversions:**

Temporary diversion swales and mounds will be constructed to divert stormwater away from areas under construction to limit sediment transport. These diversions will be relocated as construction progresses. Compost filter socks shall be installed in the centerline of swales where necessary to reduce storm velocities and soil erosion.

**Sediment Traps:**

Temporary sediment traps shall be utilized to limit sediment transport off-site. These traps will be sized according to Massachusetts DEP and US EPA guidelines and will be relocated as construction progresses. No sediment shall be allowed to enter the infiltration components of the stormwater system.

**Surface Stabilization:**

The surface of all disturbed areas shall be stabilized during and after construction. Temporary measures shall be taken during construction to prevent erosion and siltation. All finished surfaces shall be stabilized with finish materials or permanent vegetative cover. Some or all of the following measures will be utilized on this project as conditions may warrant.

- Temporary Seeding
- Temporary Mulching
- Permanent Seeding
- Placement of Sod
- Hydroseeding
- Placement of Hay
- Placement of Jute Netting

**Spill Control:**

A contingency plan to address the spillage/release of petroleum products and any hazardous materials will be implemented for the site during construction. The plan will include the following measures:

- Equipment necessary to quickly attend to inadvertent spills or leaks shall be maintained on-site in a secure but accessible location. Such equipment will include, but not be limited to, the following: urethane drain cover seals (mats), a spill containment kit which includes sand and shovels, suitable absorbent materials, storage containers, safety goggles, chemically resistant gloves and overshoe boots, water and chemical fire extinguishers, and first aid equipment.
- Spills or leaks will be treated properly according to material type, volume of spillage and location of spill. Mitigation will include preventing further spillage, containing the spilled material in the smallest practical area, removing spilled material in a safe and environmentally friendly manner, and remediating any damage to the environment.

- The contractor shall be familiar with the reporting requirements of the Massachusetts Contingency Plan (310 CMR 40.00) as issued by the Massachusetts Department of Environmental Protection (DEP); specifically Subpart C Notification of Releases and Threats of Release of Oil and Hazardous Materials and Subpart D Preliminary Response Activities and Risk Reduction Measures.
- For any large spills, Massachusetts DEP Hazardous Waste Incident Response Group will be notified immediately at (617) 792-7653 and an emergency response contractor will be called in.

### **Long-Term Operation and Maintenance**

#### **Deep Sump Catch Basins:**

Deep Sump Drain Basins shall be inspected at least four times per year. Accumulated sediment in drain basins shall be removed when sediment accumulates to 24 inches below the invert of the outlet pipe of the drain basins; but should be removed during late winter / early spring at a minimum. Sediment shall be transported off site and disposed of in accordance with applicable local, state and federal guidelines and regulations.

#### **CDS® Treatment Units:**

CDS treatment units shall be inspected a minimum of four times per year until the site reaches "equilibrium"; after which time annual inspections are typically sufficient. Accumulated sediment shall be removed via a vacuum truck when it reaches a depth of 1.5 feet. Any accumulated hydrocarbons shall be removed via the inspection / cleanout port. Refer to spill control section below in the event of any hazardous material spill. Transport and dispose of sediment and hydrocarbons off site in accordance with applicable local, state and federal guidelines and regulations. See the attached CDS Inspection and Maintenance Guide/Log as provided by Contech Construction Products, Inc.

#### **Infiltration Basin, Outlet Control Structure, Flared End Inlets:**

The open storage/recharge basin, outlet control structure, and flared end inlets shall be inspected annually to ensure basin is operating properly. Inlet and outlets shall be examined for clogging. Sediment accumulation shall be removed from inlets, outlet control structure and rip-rap areas as required to maintain free flow. Sediment accumulation shall be removed from the basin at least once every five (5) years or when it accumulates over twelve (12) inches above pretreatment sediment forebay.

Vegetation in basin shall not be mowed but woody growth shall be removed on a regular basis so that trees and large scrub brush does not grow in the basin.

**Snow Removal:**

Snow that is removed from paved surfaces shall not be stored over catch basins.

**De-icing:**

The use of Sodium Chloride ("rock salt") for de-icing of paved surfaces will be limited. Sand will be the primary icing control agent.

**Fertilizer:**

Slow release organic fertilizers will be used in landscape areas to limit nutrient transport to groundwater and any offsite wetland areas. Application will be limited to 3 lbs. per 1000 square feet of lawn area.

**Waste Management:**

Solid waste will be contained within dumpsters for pick up by a privately contracted waste hauler. Waste deposition in these dumpsters will be consistent with state and local permits. The covers of the dumpster and doors of the dumpster enclosure will be kept closed to limit rainwater and pest intrusion.

**Spill Control:**

A contingency plan to address the spillage/release of petroleum products and any hazardous materials will be implemented for the facility. The plan will include the following measures:

- Spills or leaks will be treated properly according to material type, volume of spillage and location of spill. Mitigation will include preventing further spillage, containing the spilled material in the smallest practical area, removing spilled material in a safe and environmentally friendly manner, and remediating any damage to the environment.
- The catch basins have a specific internal storage capacity that will be available in the event of any hazardous material spill. However, for added security, urethane drain cover seals ("mats") will be kept on-site to be placed over the grate of the catch basin to assist with the prevention of flow from entering the drainage system in the event of a spill. These should be kept in an easily accessible on-site location.
- The owner shall be familiar with the reporting requirements of the Massachusetts Contingency Plan (310 CMR 40.00) as issued by the Massachusetts Department of Environmental Protection (DEP); specifically Subpart C Notification of Releases and Threats of Release of Oil and Hazardous Materials and Subpart D Preliminary Response Activities and Risk Reduction Measures.
- For any large spills, Massachusetts DEP Hazardous Waste Incident Response Group will be notified immediately at (617) 792-7653 and an emergency response contractor will be called in.

### **Prohibition of Illicit Discharges**

All illicit discharges to the stormwater management system are prohibited. Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater.

An Illicit discharge does not include allowable non-stormwater discharges from the following activities or facilities: firefighting, water line flushing, landscape irrigation, uncontaminated groundwater, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, dechlorinated water from swimming pools, water used for street washing and water used to clean residential building without detergents.

### **Long-Term Operation and Maintenance Budget**

Consistent with Standard 9 of the Massachusetts Department of Environmental Protection Stormwater Handbook (February 2008) the approximate cost of inspections and maintenance based on the abovementioned post-construction activities and frequencies is as follows;

- **Stormwater Quality Units (CDS)** – inspection/cleaning - \$500.00 per year based on quarterly inspections (or per manufacturer's guidelines) and sediment removal for one unit.
- **Infiltration Basin** – inspection/cleaning - \$500 per year (as required based upon yearly inspection).

Additional costs may be incurred if it is determined during routine inspections of the BMP's that further corrective actions are necessary.

# Inspection Report

## Operation and Maintenance Log

General Information			
Project Name	Parker River Environmental Studies Center		
MAI Project No.	8490	Location	The Governor's Academy Byfield, MA
Date of Inspection		Start/End Time	
Inspector's Name(s)			
Inspector's Title(s)			
Inspector's Contact Information			
Inspector's Qualifications			
Describe present phase of construction			
<b>Type of Inspection:</b> <input type="checkbox"/> Regular <input type="checkbox"/> Pre-storm event <input type="checkbox"/> During storm event <input type="checkbox"/> Post-storm event			
Weather Information			
<b>Has there been a storm event since the last inspection?</b> <input type="checkbox"/> Yes <input type="checkbox"/> No <b>If yes, provide:</b> Storm Start Date & Time:                      Storm Duration (hrs):                      Approximate Amount of Precipitation (in):			
<b>Weather at time of this inspection?</b> <input type="checkbox"/> Clear <input type="checkbox"/> Cloudy <input type="checkbox"/> Rain <input type="checkbox"/> Sleet <input type="checkbox"/> Fog <input type="checkbox"/> Snowing <input type="checkbox"/> High Winds <input type="checkbox"/> Other:    Temperature:			
<b>Have any discharges occurred since the last inspection?</b> <input type="checkbox"/> Yes <input type="checkbox"/> No <b>If yes, describe:</b>			
<b>Are there any discharges at the time of inspection?</b> <input type="checkbox"/> Yes <input type="checkbox"/> No <b>If yes, describe:</b>			



#### Site-specific BMPs

- Number the structural and non-structural BMPs identified in your O&M Plan on your site map and list them below (add as many BMPs as necessary). Carry a copy of the numbered site map with you during your inspections. This list will ensure that you are inspecting all required BMPs at your site.
- Describe corrective actions initiated, date completed, and note the person that completed the work in the Corrective Action Log.

	BMP	BMP Installed?	BMP Maintenance Required?	Corrective Action Needed and Notes
1		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
2		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
3		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
4		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
5		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
6		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
7		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
8		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
9		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
10		<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	

#### Overall Site Issues

Below are some general site issues that should be assessed during inspections. Customize this list as needed for conditions at your site.

	BMP/activity	Implemented?	Maintenance Required?	Corrective Action Needed and Notes
1	Are all slopes and disturbed areas not actively being worked properly stabilized?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
2	Are natural resource areas (e.g., streams, wetlands, mature trees, etc.) protected with barriers or similar BMPs?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
3	Are perimeter controls and sediment barriers adequately installed (keyed into substrate) and maintained?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
4	Are discharge points and receiving waters free of any sediment deposits?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
5	Are storm drain inlets properly protected?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
6	Is the construction exit preventing sediment from being tracked into the street?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	

	BMP/activity	Implemented?	Maintenance Required?	Corrective Action Needed and Notes
7	Is trash/litter from work areas collected and placed in covered dumpsters?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
8	Are washout facilities (e.g., paint, stucco, concrete) available, clearly marked, and maintained?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
9	Are vehicle and equipment fueling, cleaning, and maintenance areas free of spills, leaks, or any other deleterious material?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
10	Are materials that are potential stormwater contaminants stored inside or under cover?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
11	Are non-stormwater discharges (e.g., wash water, dewatering) properly controlled?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	
12	(Other)	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	

**Non-Compliance**

Describe any incidents of non-compliance not described above:

**MADEP STORMWATER MANAGEMENT CHECKLIST**



# Checklist for Stormwater Report

## A. Introduction

**Important:** When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the [Massachusetts Stormwater Handbook](#). The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.<sup>1</sup> This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8<sup>2</sup>
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

<sup>1</sup> The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

<sup>2</sup> For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.



# Checklist for Stormwater Report

## B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

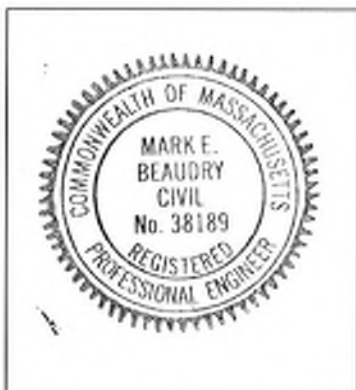
*Note:* Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

### Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature



*WFB* 4/30/18  
Signature and Date

## Checklist

**Project Type:** Is the application for new development, redevelopment, or a mix of new and redevelopment?

- ☒ New development  
☐ Redevelopment  
☐ Mix of New Development and Redevelopment



# Checklist for Stormwater Report

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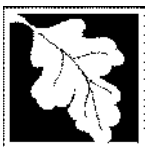
## Checklist (continued)

**LID Measures:** Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☐ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☐ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☐ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☐ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☐ Other (describe): \_\_\_\_\_

## Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☐ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.



# Checklist for Stormwater Report

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## Checklist (continued)

### Standard 2: Peak Rate Attenuation

- ☒ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.
- ☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.
- ☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

### Standard 3: Recharge

- ☒ Soil Analysis provided.
- ☒ Required Recharge Volume calculation provided.
- ☐ Required Recharge volume reduced through use of the LID site Design Credits.
- ☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.
  - ☒ Static
  - ☐ Simple Dynamic
  - ☐ Dynamic Field<sup>1</sup>
- ☒ Runoff from all impervious areas at the site discharging to the infiltration BMP.
- ☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.
- ☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.
- ☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:
  - ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
  - ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
  - ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
  - ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.
- ☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.
- ☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

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<sup>1</sup> 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.



# Checklist for Stormwater Report

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## Checklist (continued)

### Standard 3: Recharge (continued)

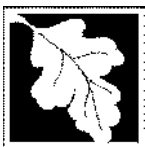
- ☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.
- ☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

### Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
  - Provisions for storing materials and waste products inside or under cover;
  - Vehicle washing controls;
  - Requirements for routine inspections and maintenance of stormwater BMPs;
  - Spill prevention and response plans;
  - Provisions for maintenance of lawns, gardens, and other landscaped areas;
  - Requirements for storage and use of fertilizers, herbicides, and pesticides;
  - Pet waste management provisions;
  - Provisions for operation and management of septic systems;
  - Provisions for solid waste management;
  - Snow disposal and plowing plans relative to Wetland Resource Areas;
  - Winter Road Salt and/or Sand Use and Storage restrictions;
  - Street sweeping schedules;
  - Provisions for prevention of illicit discharges to the stormwater management system;
  - Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
  - Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
  - List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.
- ☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.
  - ☐ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:
    - ☐ is within the Zone II or Interim Wellhead Protection Area
    - ☐ is near or to other critical areas
    - ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
    - ☐ involves runoff from land uses with higher potential pollutant loads.
  - ☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.
  - ☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.





# Checklist for Stormwater Report

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## Checklist (continued)

### Standard 4: Water Quality (continued)

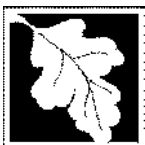
- ☒ The BMP is sized (and calculations provided) based on:
  - ☒ The ½" or 1" Water Quality Volume or
  - ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.
- ☒ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.
- ☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

### Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

- ☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.
- ☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted **prior to** the discharge of stormwater to the post-construction stormwater BMPs.
- ☒ The NPDES Multi-Sector General Permit does **not** cover the land use.
- ☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.
- ☐ All exposure has been eliminated.
- ☐ All exposure has **not** been eliminated and all BMPs selected are on MassDEP LUHPPL list.
- ☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

### Standard 6: Critical Areas

- ☒ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.
- ☒ Critical areas and BMPs are identified in the Stormwater Report.



# Checklist for Stormwater Report

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## Checklist (continued)

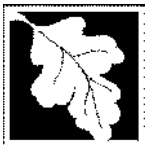
### Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

- ☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:
  - ☐ Limited Project
  - ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
  - ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
  - ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
  - ☐ Bike Path and/or Foot Path
  - ☐ Redevelopment Project
  - ☐ Redevelopment portion of mix of new and redevelopment.
- ☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.
- ☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

### Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
  - Construction Period Operation and Maintenance Plan;
  - Names of Persons or Entity Responsible for Plan Compliance;
  - Construction Period Pollution Prevention Measures;
  - Erosion and Sedimentation Control Plan Drawings;
  - Detail drawings and specifications for erosion control BMPs, including sizing calculations;
  - Vegetation Planning;
  - Site Development Plan;
  - Construction Sequencing Plan;
  - Sequencing of Erosion and Sedimentation Controls;
  - Operation and Maintenance of Erosion and Sedimentation Controls;
  - Inspection Schedule;
  - Maintenance Schedule;
  - Inspection and Maintenance Log Form.
- ☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.



# Checklist for Stormwater Report

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## Checklist (continued)

### Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

- ☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has **not** been included in the Stormwater Report but will be submitted **before** land disturbance begins.
- ☐ The project is **not** covered by a NPDES Construction General Permit.
- ☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.
- ☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

### Standard 9: Operation and Maintenance Plan

- ☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:
  - ☒ Name of the stormwater management system owners;
  - ☒ Party responsible for operation and maintenance;
  - ☒ Schedule for implementation of routine and non-routine maintenance tasks;
  - ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
  - ☒ Description and delineation of public safety features;
  - ☒ Estimated operation and maintenance budget; and
  - ☒ Operation and Maintenance Log Form.
- ☐ The responsible party is **not** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:
  - ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
  - ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

### Standard 10: Prohibition of Illicit Discharges

- ☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;
- ☒ An Illicit Discharge Compliance Statement is attached;
- ☐ NO Illicit Discharge Compliance Statement is attached but will be submitted **prior to** the discharge of any stormwater to post-construction BMPs.