

# **STORMWATER** **CALCULATIONS & REPORT**

## **Project**

50 Mattakeesett Street,  
Pembroke, MA 02359  
Assessor's Parcel C9-23E  
Proposed Warehouse Building

## **Owner**

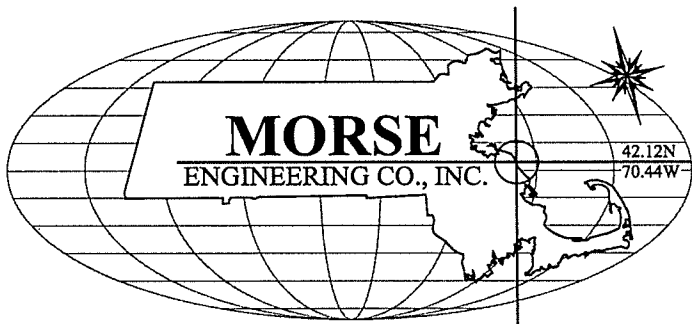
JPC / Pembroke Realty Trust  
137 Washington Street  
Norwell, MA 02061

## **Applicant**

Mike Bulman  
P.O. Box 20  
Scituate, MA 02066

***Date: February 7, 2020***

***Prepared by:***



*Registered Professional Engineers,  
Project Managers & Environmental Consultants*

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### APPENDIX A

- Construction Phase Stormwater Management Plan
- Construction Phase Erosion Control Maintenance Schedule & Checklist
- Post-Development Operation & Maintenance Plan & Long-Term Operation & Maintenance
- Stormceptor Owner's Manual
- Illicit Discharge Compliance Statement
- Storage Volume Calculation

### APPENDIX B

- Pre-Development HydroCAD Analysis
- Post-Development HydroCAD Analysis

### PLANS

- Watershed Delineation Plans (WS-1 & WS-2)

# **Project Narrative**

## **50 Mattakeesett Street**

## **Pembroke, Massachusetts**

### **Project Summary**

The project proponent proposes to construct one new warehouse building at 50 Mattakeesett Street, Pembroke, MA. The property is shown as Pembroke Assessor's Parcel C9-23E and is approximately 1.5 acres. The property has frontage on Mattakeesett Street and is abutted by developed residential properties. The property slopes to the southwest, northwest, and northeast towards the abutting residential properties.

The proposed stormwater system is comprised of a stormwater basin and a roof drywell system. The systems will provide groundwater recharge of stormwater roof runoff and control the rates and volumes of runoff.

### **Pre-Development Condition**

The site is currently comprised of an office building, paved parking lot, concrete walkway, woods, lawn and landscaped areas. The property currently has a stormwater system consisting of catch basins and leaching pits located in corners of the parking lot.

Soil information was obtained from the Soils Conservation Services (SCS) Survey of Plymouth County, Massachusetts and on-site soil testing. Based on SCS Soils Mapping the soils are classified as "427B – Newfields fine sandy loam, 3 to 8 percent slopes" (Hydrologic Soil Group B).

### **Post-Development Condition**

In the post-development condition stormwater analysis, the same watershed areas were analyzed for the purpose of analyzing the rates and volumes of runoff from the proposed new storage unit buildings, and driveways. The proposed stormwater system is comprised of a roof drywell system with an overflow to an infiltration basin. The system will provide groundwater recharge, treatment of driveway runoff and control the rates and volumes of runoff. Refer to Watershed Delineation Plan WS-2 for a delineation of post-development drainage subareas. The design points for the post-development design condition correspond to the design points for the pre-development design condition and are shown on Plans WS-1 and WS-2.

The stormwater management system was designed to be in compliance with the DEP Stormwater Management Policy to the extent practicable.

## **Erosion and Siltation Control**

The potential for temporary impacts to downgradient properties and/or wetlands due to erosion and migration of sediments will be mitigated by adherence to basic erosion control practices. These include:

1. Install staked mulch sock and/or silt fence (as directed by Conservation Agent) at the upland edge of the limit of work as shown on the Site Plan. This erosion control barrier shall be installed prior to earthwork at the site. An additional stockpile of siltation fence, and stakes will be stored on site for use in repairing the erosion control barrier as needed. Inspections of the erosion control barrier shall be made weekly and after all significant rainfall events.
2. Clearly define the limits of work in the field in order to minimize the extent of clearing and soil disturbance.
3. Regrade, loam and seed exposed soil areas immediately following construction.

**SUMMARY OF STORMWATER STANDARDS 1 – 10**  
**(50 Mattakeesett Street, Pembroke, MA)**

**Standard #1: No new stormwater conveyances (i.e. outfalls)...**

The project complies as it does not propose any new stormwater outfalls. Stormwater in the existing and proposed conditions flows overland in a southwesterly direction towards the abutting properties. It is the intent of the proposed design to follow the natural/existing conditions stormwater flow paths to the extent practicable. Proposed roof runoff will be directed to a roof drywell system and the driveway runoff will be directed to an infiltration basin.

**Standard #2: Post-Development peak discharge rates do not exceed pre-development rates...**

The project has been designed to mitigate peak rates and volumes of runoff. See below for calculations of the runoff discharges and volumes for the 2, 10 and 100-yr. storm events.

**Peak Discharge Rates (cfs):**

**Design Point #1:**

	<u>2-Yr.</u>	<u>10-Yr.</u>	<u>100-Yr.</u>
Pre-Development	0.65	1.72	4.78
Post-Development	0.45	1.05	4.59

**Design Point #3:**

	<u>2-Yr.</u>	<u>10-Yr.</u>	<u>100-Yr.</u>
Pre-Development	0.35	0.82	2.11
Post-Development	0.35	0.81	2.04

**Volume of Runoff (ac-ft.):**

**Design Point #1:**

	<u>2-Yr.</u>	<u>10-Yr.</u>	<u>100-Yr.</u>
Pre-Development	0.060	0.141	0.379
Post-Development	0.039	0.086	0.288

**Design Point #3:**

	<u>2-Yr.</u>	<u>10-Yr.</u>	<u>100-Yr.</u>
Pre-Development	0.034	0.075	0.190
Post-Development	0.034	0.074	0.184

**Standard #3: Loss of annual recharge to groundwater shall be eliminated...**

There is no loss of annual recharge to groundwater because the project proposes an infiltration basin and system of roof drywell chambers designed to infiltrate runoff.

Recharge Volume = 0.35 inches of runoff X Increased Impervious Area\*\* (Hydrologic Soil Group B)

The redevelopment results in an increase of 4,000 s.f. of impervious roof area, all of which is directed to an infiltration BMP.

Therefore Minimum Recharge Volume = 0.35 in. x 4,000 s.f. X (1 ft./12 in.) = 117 c.f. (min.)

PROVIDED RECHARGE = 513.6 c.f.  
(Provided within 48 ADS Arc-36HC Chambers, at 10.7 c.f./chamber)

**Standard #4: Stormwater management systems...shall remove 80% of the average... TSS....**

Requirement: Provide 80% TSS Removal of the Water Quality Volume.

Water Quality Volume (WQV) = 0.5 inches of runoff X new driveway impervious areas\*

Therefore: Minimum WQV = 0.5 inches X 0 s.f. X (1 ft./12 in.) = 0 c.f. (min.)

PROVIDED = 0.f.

*\*Total impervious area for Std. 4 Calculation is not required to include roof runoff, as roof runoff is considered clean and free of suspended solids (non-metal roof is proposed).*

**Standard #5: Stormwater discharges from Land Uses with Higher Potential Pollutant Loads**

Not applicable. An office building is not a land use with higher potential pollutant loads.

**Standard #6: Stormwater discharges to critical areas...**

Not applicable. The property is not an ACEC.

**Standard #7: A redevelopment project is required to meet standards....only to the extent practicable**

The project is considered to be a partial redevelopment. The project has been designed to comply with all standards.

**Standard #8: Erosion & Sedimental Control Plan**

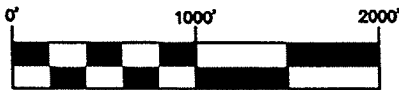
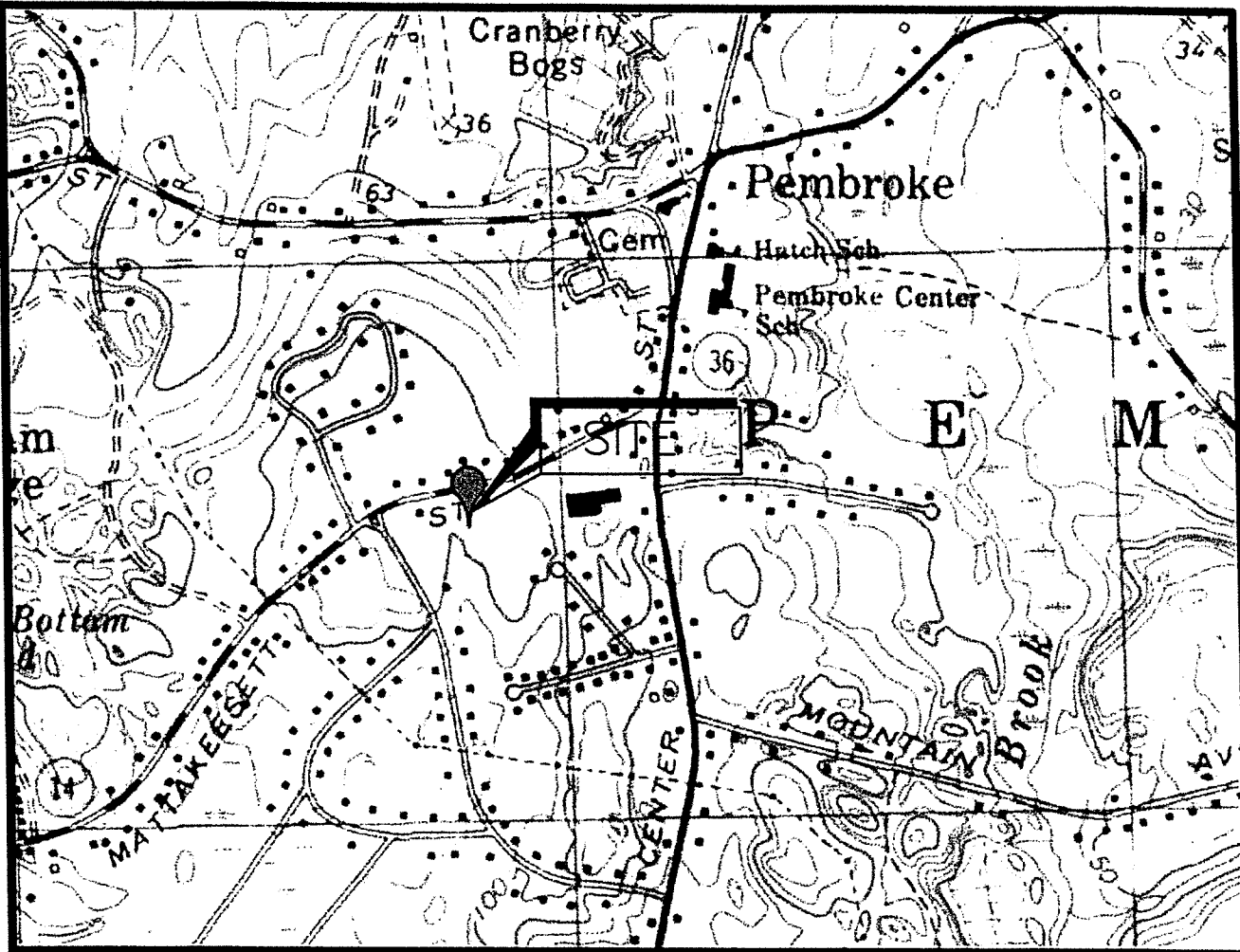
An Erosion & Sedimentation Control plan is submitted in Appendix A of this report.

**Standard #9: A Long Term Operation & Maintenance Plan shall be developed...**

A Post-Construction Operation & Maintenance Plan is submitted in Appendix A of this report.

**Standard #10: All illicit discharges to the stormwater management system are prohibited.**

An illicit discharge compliance statement is submitted in Appendix A of this report.



SCALE: 1" = 1000'

U.S. GEOLOGICAL SURVEY  
7.5 X 15 MINUTE SERIES

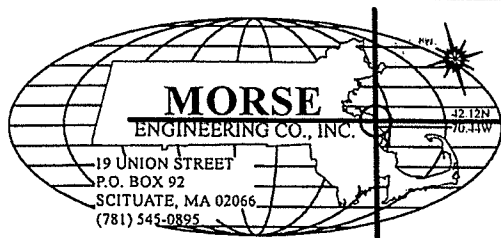
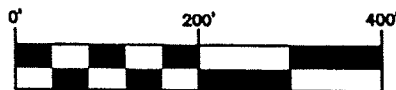


FIGURE - 1

USGS LOCUS MAP  
50 MATTAKEESETT STREET  
PEMBROKE, MASSACHUSETTS



SCALE: 1" = 200'

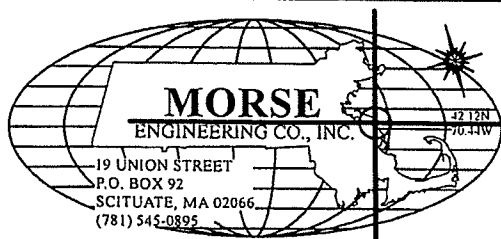
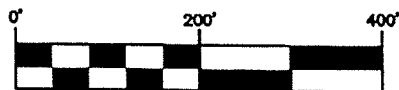
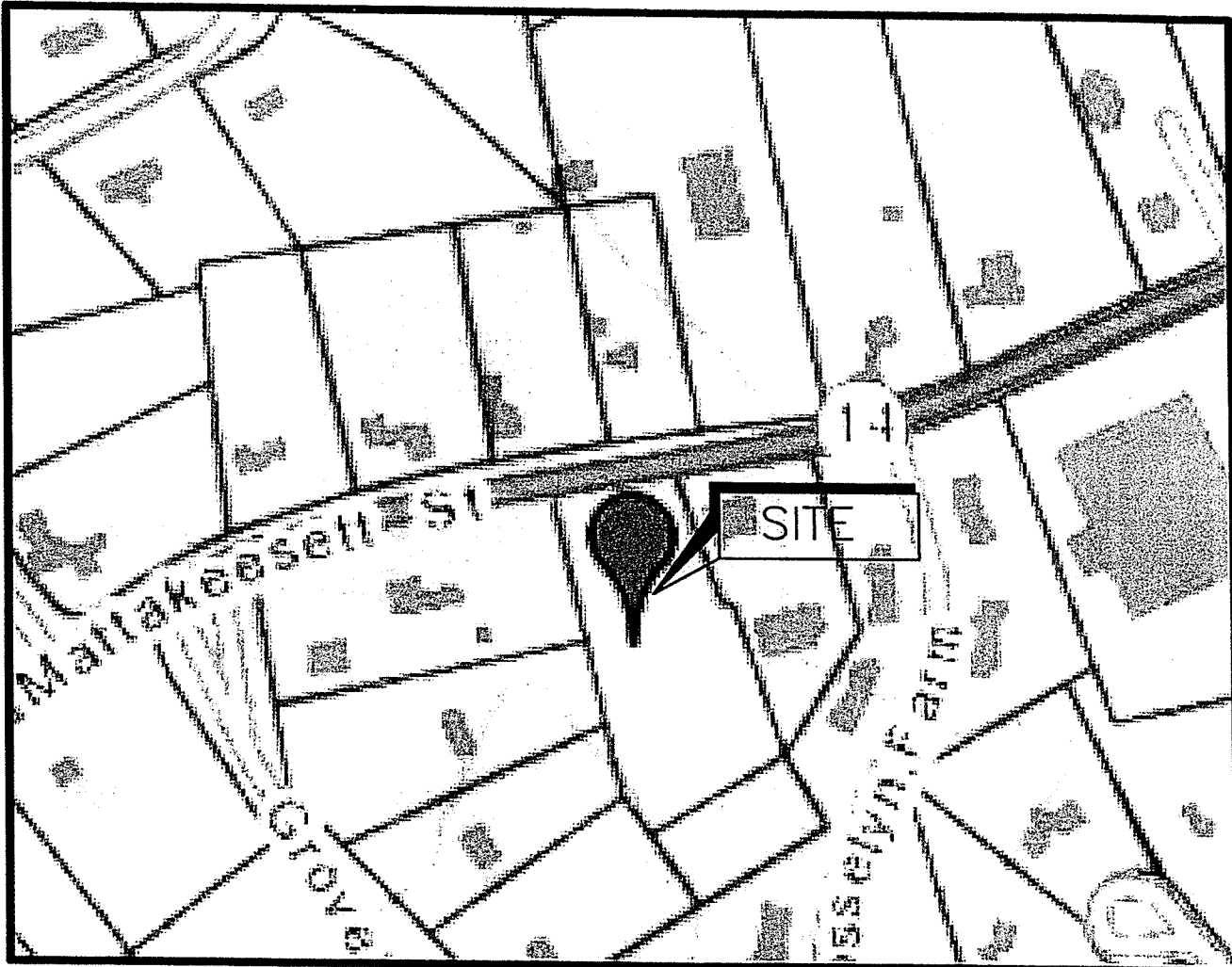


FIGURE - 2

FEMA FLOOD MAP  
50 MATTAKEESETT STREET  
PEMBROKE, MASSACHUSETTS





SCALE: 1" = 200'

NATURAL HERITAGE & ENDANGERED SPECIES ATLAS  
MASS GIS

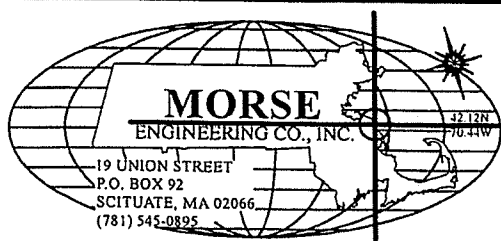


FIGURE - 3

NHESP MAP  
50 MATTAKEESETT STREET  
PEMBROKE, MASSACHUSETTS



SCALE: 1" = 200'

SCS SOILS MAP

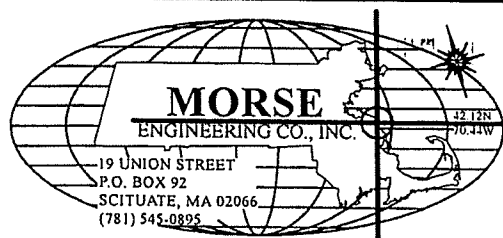


FIGURE — 4

SCS SOILS MAP  
50 MATTAKEESETT STREET  
PEMBROKE, MASSACHUSETTS

## **APPENDIX A**

- Const. Phase Stormwater Management Plan
- Construction Phase Erosion Control  
Maintenance Schedule & Checklist
- Post-Development Operation & Maintenance  
Plan & Long-Term Operation & Maintenance
- Stormceptor Owner's Manual
- Illicit Discharge Compliance Statement
- Storage Volume Calculation

**Construction Phase Operation & Maintenance Plan**  
**Best Management Practices**  
50 Mattakeesett Street  
Pembroke, MA

**Responsible Parties & Contact Information:**

Owner:

JPC / Pembroke Realty Trust  
137 Washington Street  
Norwell, MA 02061  
781-659-7273

Contractor:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Inspection & Record Keeping:**

The responsible party shall maintain an operation and maintenance log during construction to control construction-related impacts, including erosion, sedimentation and other pollutant sources and land disturbance activities.

The anticipated time to complete this project is twelve months. The responsible party shall inspect the construction site at least once every 14 calendar days and within 24 hours of a storm event of ½ inch or greater. Inspections shall be performed until the site is fully stabilized and the temporary sedimentation controls have been removed. The inspector shall inspect each measure to determine if it was installed/performed correctly. The inspector shall also determine if the measures have been damaged and if so the corrective action.

The log shall kept on-site at all times and shall be made available to MassDEP and the Conservation Commission upon request. Member and agents of MassDEP and the Conservation Commission shall be allowed to enter and inspect the premises to evaluate and ensure that the responsible party complies with the Operation and Maintenance Plan requirements for each BMP.

### **Operation & Maintenance:**

Land disturbance activities for this project include constructing the proposed storage unit buildings and associated driveways, grading, lawn, landscaping and stormwater systems. During land disturbance and construction activities, project proponents must implement controls that prevent erosion, control sediment movement, and stabilize exposed soils to prevent pollutants from moving offsite. Construction activities increase the potential for erosion and sedimentation at a site which may adversely impact wetland resource areas. To prevent this impact, the following conditions shall be imposed to control erosion and sedimentation:

**Stabilization Practices:** Disturbed areas shall be stabilized and protected as soon as practicable. Disturbed areas shall be stabilized when construction activity in the area has ceased for more than 14 days unless not feasible due to snow cover or if construction activities will resume within 21 days after construction temporarily ceased. Stabilization measures include the following:

- Temporary seeding
- Geotextiles
- Mulching and Netting
- Permanent seeding

## Construction Phase: Erosion Control Maintenance Schedule & Checklist

### Construction Practices

Best Management Practice	Inspection Frequency (1)	Date Inspected	Inspector	Minimum Maintenance and Key Items to Check (1)	Cleaning/Repair Needed: <input type="checkbox"/> yes <input type="checkbox"/> no (List Items)	Date of Cleaning/Repair	Performed by
Construction Site Stabilization	Weekly			1. Construction Site Stabilization Inspection/ Maintenance, temporary seeding, mulching etc.  Disturbed areas shall be stabilized when construction activity in the area has ceased for more than 14 days 1 Remove accumulated silt. 2 Repair rips / bulges.			
Erosion Barrier	Bi-Weekly			1. Mulch Maintenance			
Mulching & Netting	Bi-Weekly			1. Check for washouts and/or gullies. 2. Check for accumulated silt.			
Land Grading	Weekly			1. Permanent Seeding Inspection/ Maintenance			
Permanent Seeding	Bi-Weekly						

Stormwater Control Manager \_\_\_\_\_

**Long-Term Operation & Maintenance Plan**  
**Best Management Practices**  
50 Mattakeesett Street  
Pembroke, MA

**Responsible Parties & Contact Information:**

**Owner:**

JPC/Pembroke Realty Trust  
137 Washington Street  
Norwell, MA 02061  
781-659-7273

**Record Keeping:**

The responsible party shall maintain an operation and maintenance log for a minimum of three years prior including inspections, repairs, replacement and disposal. The log shall be kept on-site at all times.

The log shall be made available to MassDEP and the Conservation Commission upon request. Members and agents of MassDEP and the Town shall be allowed to enter and inspect the premises to evaluate and ensure that the responsible party complies with the Operation and Maintenance Plan requirements for each BMP.

**Operation & Maintenance:**

In order to maintain the integrity of the stormwater management system, frequent inspections and maintenance shall be performed by the owner. The BMPs require continuous inspections and maintenance in order to function properly. The BMPs should be inspected and maintained as specified and after all major storm events.

**Gutter & Downspout Systems** shall be inspected quarterly. Material observed within any gutter or downspout shall be removed and disposed of in accordance with all applicable local, state and federal regulations. Inspect for signs of overflow to the surcharge pipe. It is recommended that "gutter guards" be installed on the roof gutter system to prevent leaves and tree debris from entering the subsurface system.

**Infiltration Basin** shall be checked for infiltrative capacity on a quarterly basis and after any significant rainfall event. Trash, leaves, branches, etc. shall be removed from basin and channel areas. Silt, sand and sediment, if significant accumulation occurs, shall be removed by hand annually. Material shall be removed and disposed of in accordance with all applicable local, states and federal regulations. Care shall be taken to maintain vegetation growth within a basin. Grass shall be cut and weeds and brush removed or trimmed at regular intervals during the growing season. Reseeding and weed control may need to be performed periodically to maintain healthy, dense vegetation and maintain the pollutant removal efficiency of the basin. Any slope erosion within the basins shall be stabilized and repaired as soon as practical. Mowing shall be performed frequently enough to keep the vegetation in vigorous condition and to control encroachment of weeds and woody vegetation, however it should not be mowed too closely so as to reduce the filtering effect. Mowing shall be performed with a bag attachment to prevent the

compaction of cut grass and occur at a minimum of two times per year. The basins shall be monitored immediately after each two year storm event to verify that they fully drain within a 72-hour period. If it is found that the basin is not sufficiently drained, the basin shall be inspected by a Professional Engineer and the underlying gravel layer should be removed and replaced as overseen by a Professional Engineer.

Important items to check during inspection include: signs of differential settlement, cracking, erosion, leakage in the embankments, tree growth on the embankments, condition of riprap, sediment accumulation and the health of the turf.

**Roof Drywells** shall be checked for infiltrative capacity on a quarterly basis and after any significant rainfall event. Additional inspections should be scheduled during the first few months to make sure that the chambers are exfiltrating within 72 hours of all storms. It is recommended that "gutter guards" be installed on the roof gutter system to prevent leaves and tree debris from entering the subsurface system. Material observed within any roof drywell shall be removed and disposed of in accordance with all applicable local, states and federal regulations.

A maintenance manual is attached to this report.

**Anticipated Operation and Maintenance Cost:**

The annual anticipated operation and maintenance cost is approximately \$1,500.00.



**Project Location: 50 Mattakesett Street, Pembroke, MA**  
**Stormwater Management – Post Construction Phase**  
**Best Management Practices – Inspection Schedule and Evaluation Checklist**

**Long Term Practices**

Best Management Practice	Inspection Frequency (1)	Date Inspected	Inspector	Minimum Maintenance and Key Items to Check (1)	Cleaning/Repair Needed: <input type="checkbox"/> yes <input type="checkbox"/> no (List Items)	Date of Cleaning/Repair	Performed by
Driveway Sweeping	Monthly			Sweep & Remove any accumulated sediment			
Gutter and Downspout System	Quarterly			Remove material in gutters and downspouts. Install gutter guards. Inspect for signs of overflow to surcharge.			
Infiltration Basin	Quarterly			Check infiltrative capacity. Remove sediment, trash and debris. Repair erosion and scour. Mow Grass			
Roof Drywell System	Quarterly			Inspect for infiltrative capacity Repair erosion or scour			
				Check for debris in catchment area - remove sediment, trash and debris from catchment area.			

December 26, 2018

TO: Town of Pembroke  
Conservation Commission  
100 Center Street, Town Hall  
Pembroke, MA 02359

RE: 50 Mattakeesett Street, Pembroke, MA

To Members of the Commission:

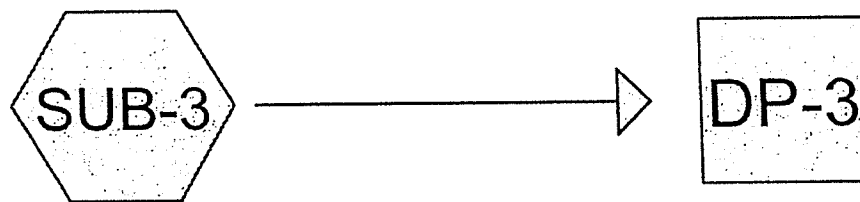
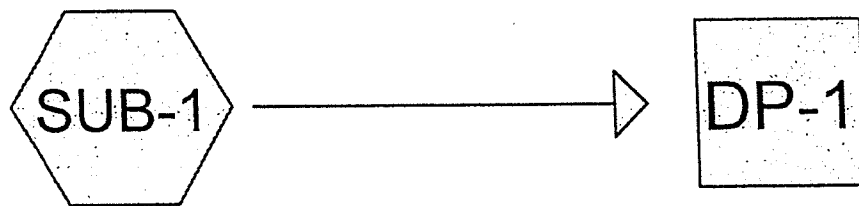
This letter is a statement that to the best of my knowledge, no illicit discharges currently exist or are being considered by me to the stormwater management system. An illicit discharge is any discharge that is not composed entirely of stormwater.

A handwritten signature in black ink, appearing to be 'J. B. Mc...', written over a dotted line.

Applicant's Representative

## **APPENDIX B**

- Pre-Development HydroCAD Analysis
- Post-Development HydroCAD Analysis



**Pre-Cornell**

Prepared by Microsoft

Printed 12/26/2018

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Page 2

**Area Listing (all nodes)**

Area (acres)	CN	Description (subcatchment-numbers)
0.825	60	Woods, Fair, HSG B (SUB-1, SUB-3)
0.207	61	>75% Grass cover, Good, HSG B (SUB-1, SUB-3)
0.024	98	Concrete (SUB-1, SUB-3)
0.222	98	Pavement (SUB-1, SUB-3)
0.052	98	Roof (SUB-1, SUB-3)
1.329	69	TOTAL AREA

**Pre-Cornell**

Prepared by Microsoft

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Printed 12/26/2018

Page 3

**Soil Listing (all nodes)**

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
1.032	HSG B	SUB-1, SUB-3
0.000	HSG C	
0.000	HSG D	
0.297	Other	SUB-1, SUB-3
1.329		TOTAL AREA

**Pre-Cornell**

Prepared by Microsoft

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*Type III 24-hr 2-Yr. Event Rainfall=3.39"*

Printed 12/26/2018

Page 4

Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment SUB-1:**

Runoff Area=39,737 sf 19.43% Impervious Runoff Depth>0.79"  
Flow Length=180' Tc=9.2 min CN=67 Runoff=0.65 cfs 0.060 af

**Subcatchment SUB-3:**

Runoff Area=18,134 sf 28.77% Impervious Runoff Depth>0.99"  
Flow Length=190' Tc=13.5 min CN=71 Runoff=0.35 cfs 0.034 af

**Reach DP-1:**

Inflow=0.65 cfs 0.060 af  
Outflow=0.65 cfs 0.060 af

**Reach DP-3:**

Inflow=0.35 cfs 0.034 af  
Outflow=0.35 cfs 0.034 af

**Total Runoff Area = 1.329 ac Runoff Volume = 0.094 af Average Runoff Depth = 0.85"**  
**77.65% Pervious = 1.032 ac 22.35% Impervious = 0.297 ac**

**Pre-Cornell**

Prepared by Microsoft

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Type III 24-hr 2-Yr. Event Rainfall=3.39"

Printed 12/26/2018

Page 5

**Summary for Subcatchment SUB-1:**

Runoff = 0.65 cfs @ 12.15 hrs, Volume= 0.060 af, Depth&gt; 0.79"

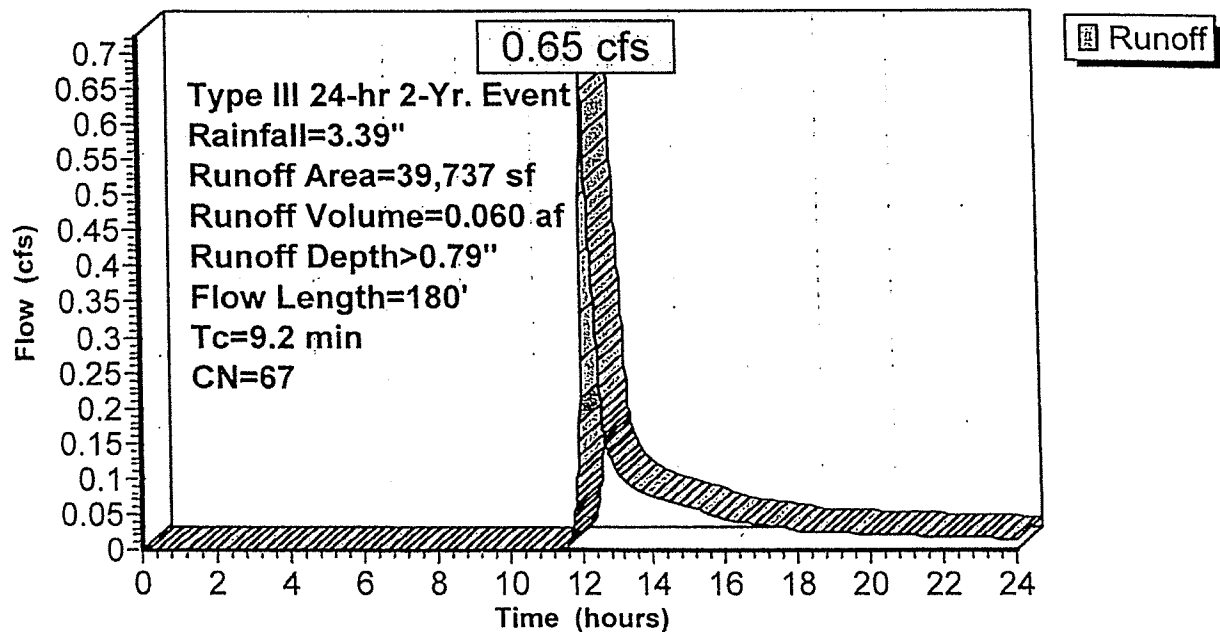
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Type III 24-hr 2-Yr. Event Rainfall=3.39"

Area (sf)	CN	Description
30,309	60	Woods, Fair, HSG B
* 6,468	98	Pavement
* 462	98	Concrete
1,709	61	>75% Grass cover, Good, HSG B
* 789	98	Roof
39,737	67	Weighted Average
32,018		80.57% Pervious Area
7,719		19.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
0.7	130	0.0347	3.00		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
9.2	180	Total			

**Subcatchment SUB-1:****Hydrograph**



**Summary for Subcatchment SUB-3:**

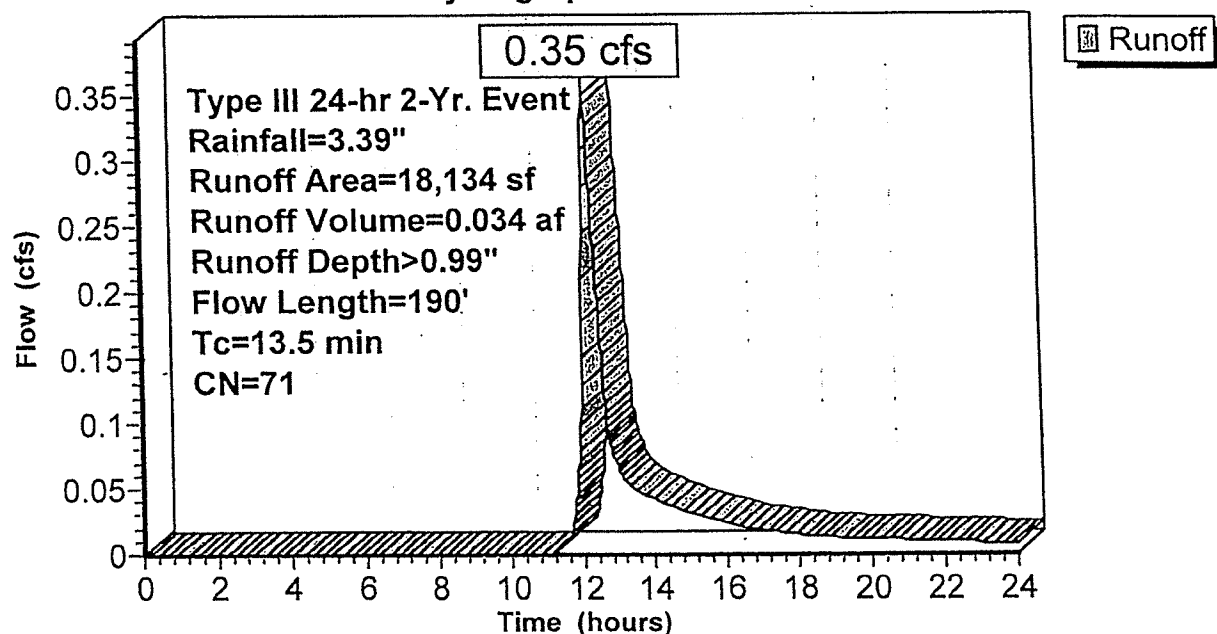
Runoff = 0.35 cfs @ 12.20 hrs, Volume= 0.034 af, Depth> 0.99"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs  
Type III 24-hr 2-Yr. Event Rainfall=3.39"

Area (sf)	CN	Description
5,621	60	Woods, Fair, HSG B
* 3,184	98	Pavement
* 567	98	Concrete
7,296	61	>75% Grass cover, Good, HSG B
* 1,466	98	Roof
18,134	71	Weighted Average
12,917		71.23% Pervious Area
5,217		28.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
1.2	140	0.0140	1.90		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
13.5	190	Total			

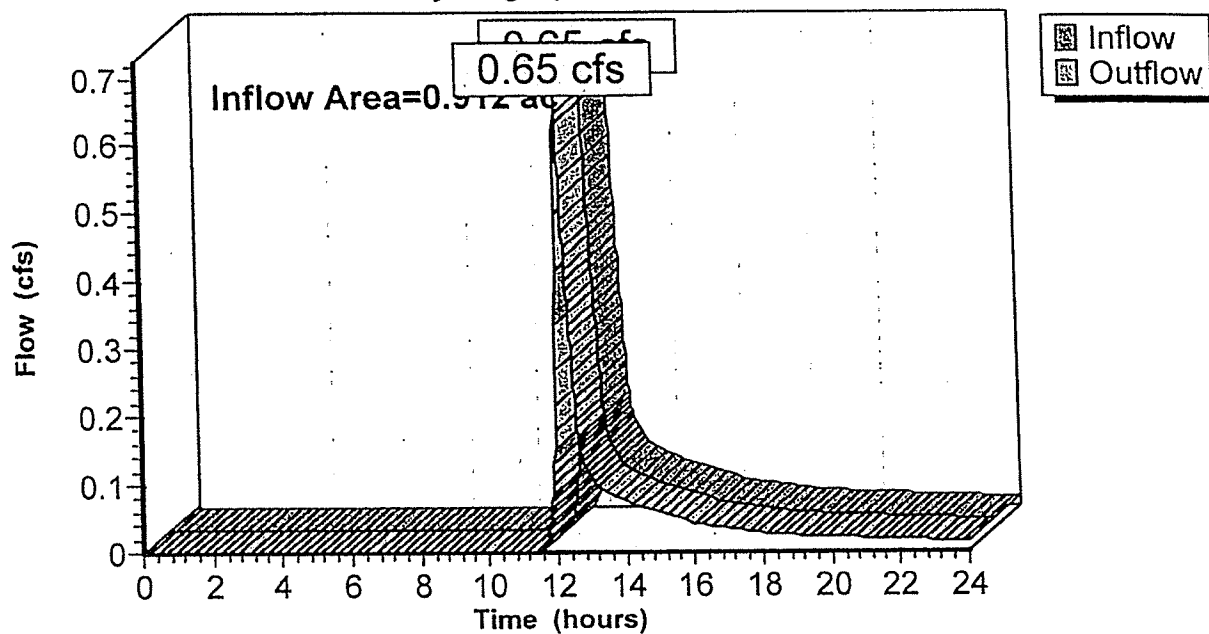
**Subcatchment SUB-3:****Hydrograph**

**Summary for Reach DP-1:**

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

Inflow Area = 0.912 ac, 19.43% Impervious, Inflow Depth > 0.79" for 2-Yr. Event event  
Inflow = 0.65 cfs @ 12.15 hrs, Volume= 0.060 af  
Outflow = 0.65 cfs @ 12.15 hrs, Volume= 0.060 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

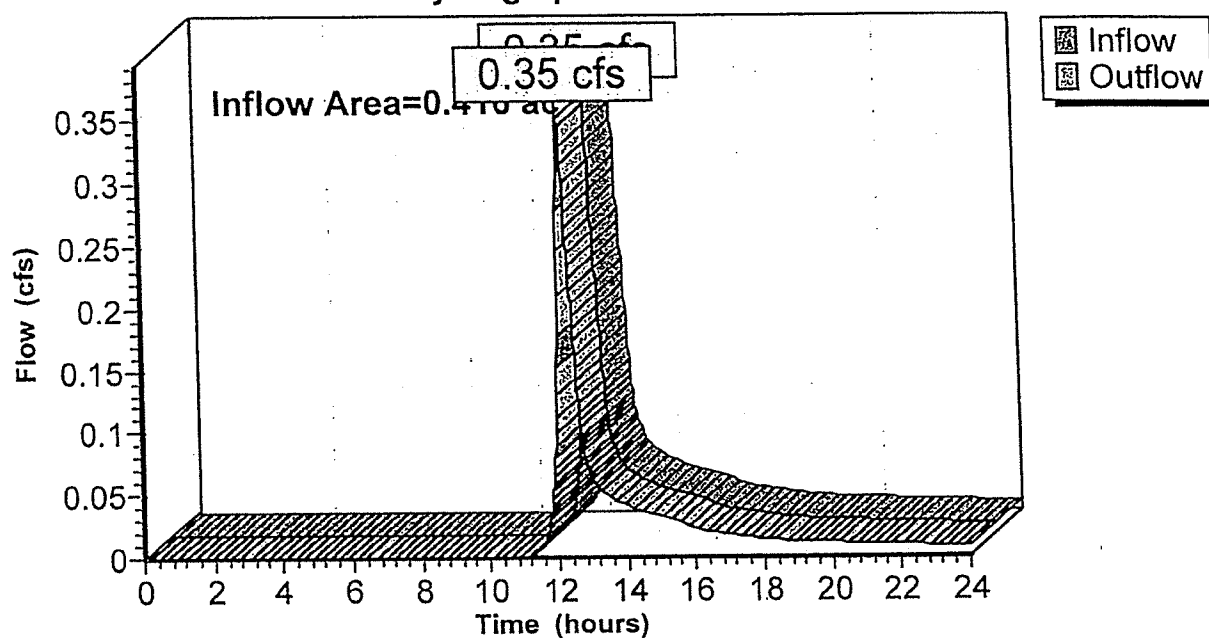
**Reach DP-1:****Hydrograph**

**Summary for Reach DP-3:**

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

Inflow Area = 0.416 ac, 28.77% Impervious, Inflow Depth > 0.99" for 2-Yr. Event event  
Inflow = 0.35 cfs @ 12.20 hrs, Volume= 0.034 af  
Outflow = 0.35 cfs @ 12.20 hrs, Volume= 0.034 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

**Reach DP-3:****Hydrograph**

**Pre-Cornell**

Type III 24-hr 10-Yr. Event Rainfall=5.08"

Prepared by Microsoft

Printed 12/26/2018

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Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment SUB-1:**

Runoff Area=39,737 sf 19.43% Impervious Runoff Depth>1.85"  
Flow Length=180' Tc=9.2 min CN=67 Runoff=1.72 cfs 0.141 af

**Subcatchment SUB-3:**

Runoff Area=18,134 sf 28.77% Impervious Runoff Depth>2.17"  
Flow Length=190' Tc=13.5 min CN=71 Runoff=0.82 cfs 0.075 af

**Reach DP-1:**

Inflow=1.72 cfs 0.141 af  
Outflow=1.72 cfs 0.141 af

**Reach DP-3:**

Inflow=0.82 cfs 0.075 af  
Outflow=0.82 cfs 0.075 af

Total Runoff Area = 1.329 ac Runoff Volume = 0.216 af Average Runoff Depth = 1.95"  
77.65% Pervious = 1.032 ac 22.35% Impervious = 0.297 ac

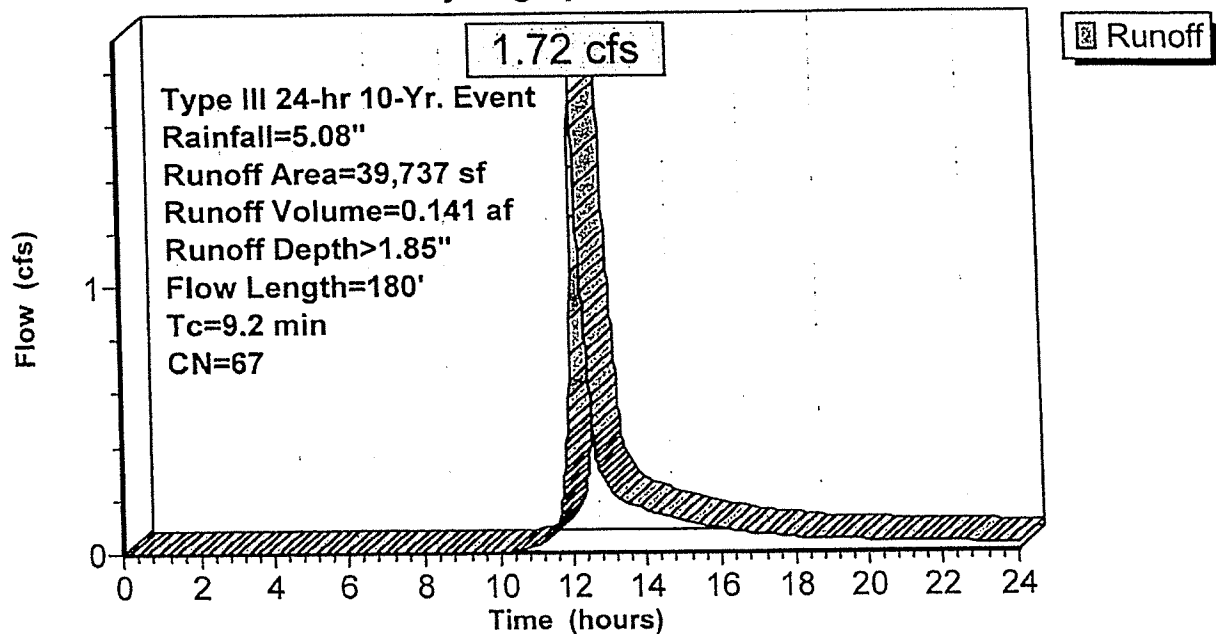
**Summary for Subcatchment SUB-1:**

Runoff = 1.72 cfs @ 12.14 hrs, Volume= 0.141 af, Depth> 1.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs  
Type III 24-hr 10-Yr. Event Rainfall=5.08"

Area (sf)	CN	Description
30,309	60	Woods, Fair, HSG B
* 6,468	98	Pavement
* 462	98	Concrete
1,709	61	>75% Grass cover, Good, HSG B
* 789	98	Roof
39,737	67	Weighted Average
32,018		80.57% Pervious Area
7,719		19.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
0.7	130	0.0347	3.00		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
9.2	180	Total			

**Subcatchment SUB-1:****Hydrograph**

**Pre-Cornell**

Prepared by Microsoft

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Type III 24-hr 10-Yr. Event Rainfall=5.08"

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**Summary for Subcatchment SUB-3:**

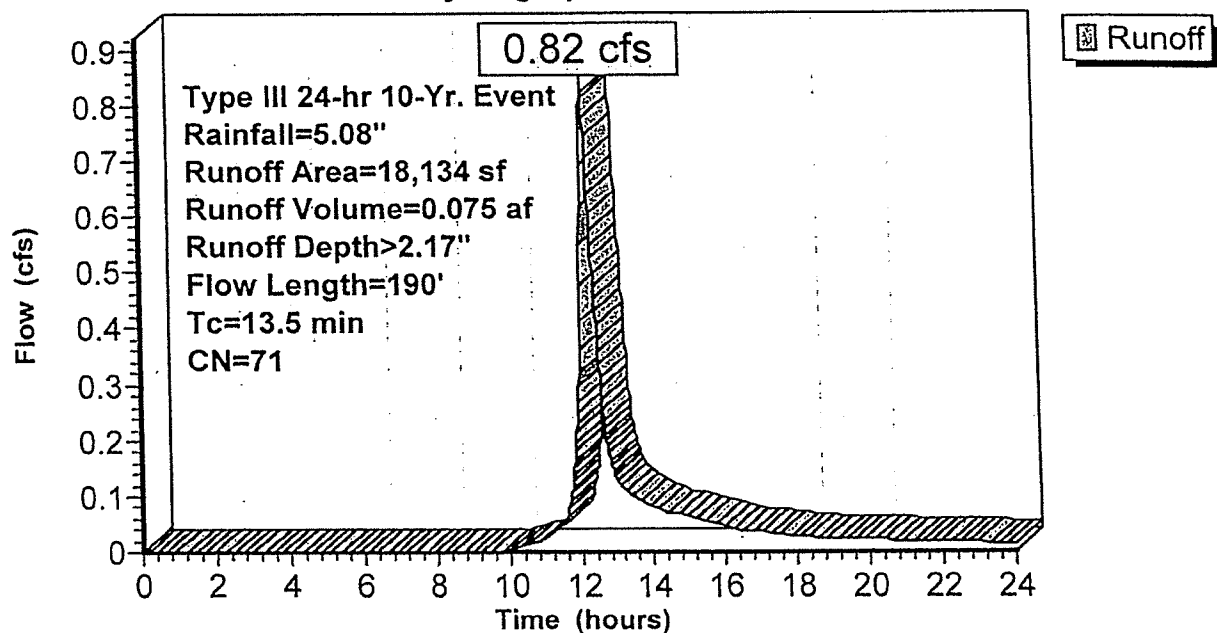
Runoff = 0.82 cfs @ 12.19 hrs, Volume= 0.075 af, Depth&gt; 2.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs  
Type III 24-hr 10-Yr. Event Rainfall=5.08"

Area (sf)	CN	Description
5,621	60	Woods, Fair, HSG B
* 3,184	98	Pavement
* 567	98	Concrete
7,296	61	>75% Grass cover, Good, HSG B
* 1,466	98	Roof
18,134	71	Weighted Average
12,917		71.23% Pervious Area
5,217		28.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
1.2	140	0.0140	1.90		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
13.5	190	Total			

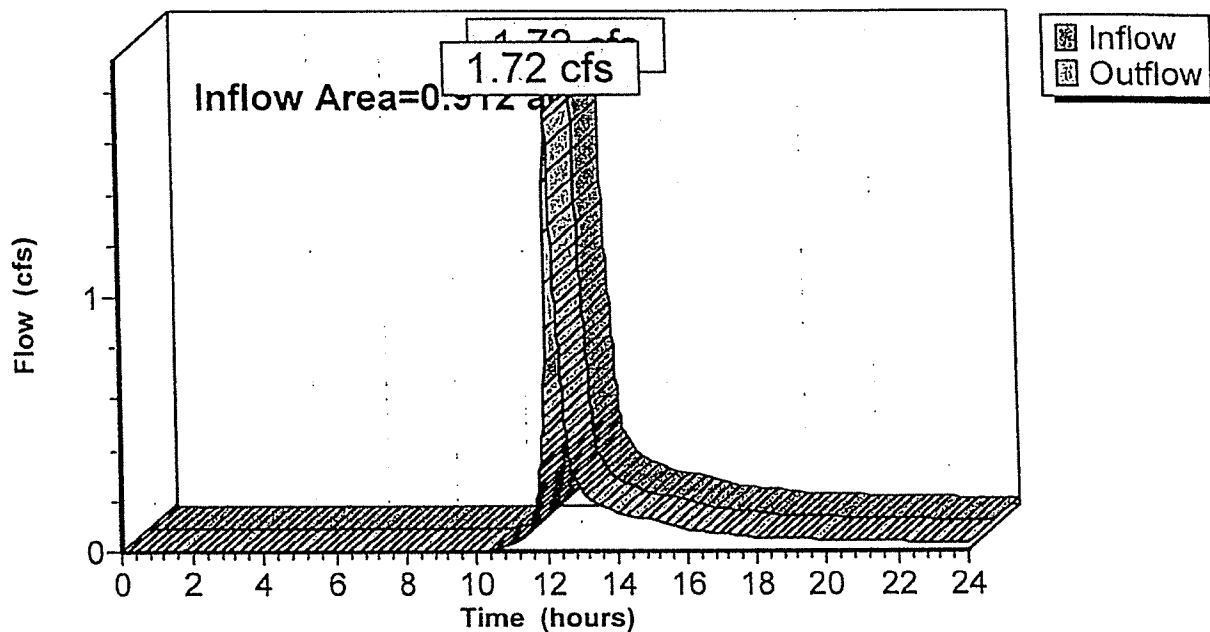
**Subcatchment SUB-3:****Hydrograph**

**Summary for Reach DP-1:**

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

Inflow Area = 0.912 ac, 19.43% Impervious, Inflow Depth > 1.85" for 10-Yr. Event event  
Inflow = 1.72 cfs @ 12.14 hrs, Volume= 0.141 af  
Outflow = 1.72 cfs @ 12.14 hrs, Volume= 0.141 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

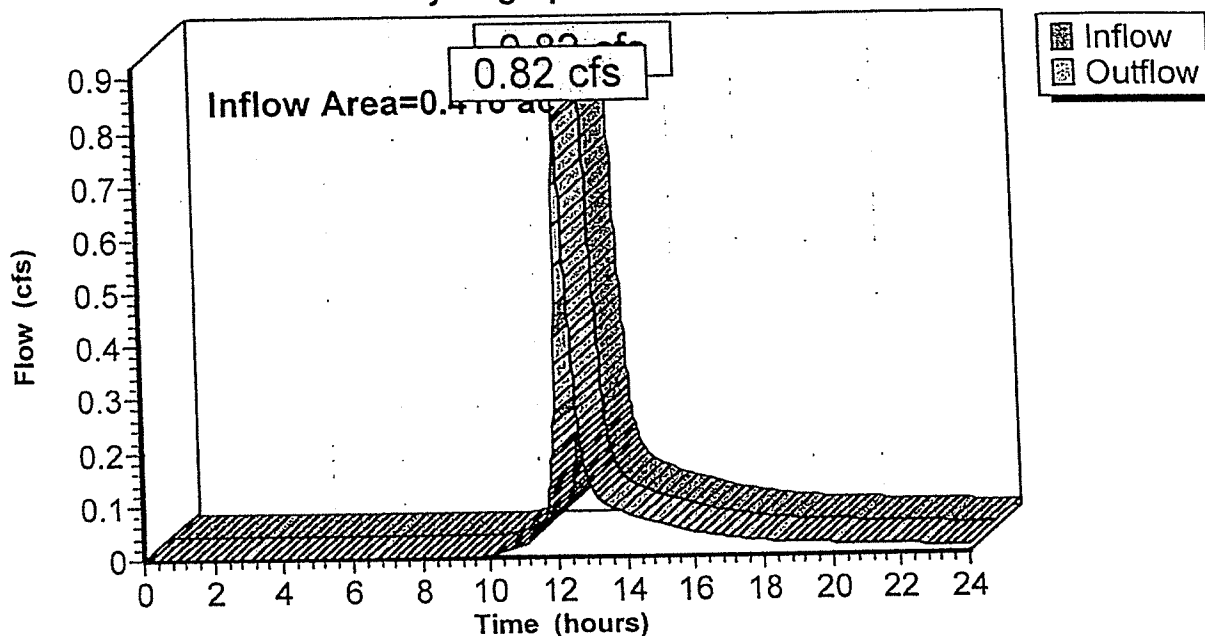
**Reach DP-1:****Hydrograph**

**Summary for Reach DP-3:**

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

Inflow Area = 0.416 ac, 28.77% Impervious, Inflow Depth > 2.17" for 10-Yr. Event event  
Inflow = 0.82 cfs @ 12.19 hrs, Volume= 0.075 af  
Outflow = 0.82 cfs @ 12.19 hrs, Volume= 0.075 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

**Reach DP-3:****Hydrograph**



**Pre-Cornell**

Prepared by Microsoft

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Type III 24-hr 100-Yr. Event Rainfall=9.04"

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Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment SUB-1:**

Runoff Area=39,737 sf 19.43% Impervious Runoff Depth>4.99"  
Flow Length=180' Tc=9.2 min CN=67 Runoff=4.78 cfs 0.379 af

**Subcatchment SUB-3:**

Runoff Area=18,134 sf 28.77% Impervious Runoff Depth>5.48"  
Flow Length=190' Tc=13.5 min CN=71 Runoff=2.11 cfs 0.190 af

**Reach DP-1:**

Inflow=4.78 cfs 0.379 af  
Outflow=4.78 cfs 0.379 af

**Reach DP-3:**

Inflow=2.11 cfs 0.190 af  
Outflow=2.11 cfs 0.190 af

Total Runoff Area = 1.329 ac Runoff Volume = 0.569 af Average Runoff Depth = 5.14"  
77.65% Pervious = 1.032 ac 22.35% Impervious = 0.297 ac

**Summary for Subcatchment SUB-1:**

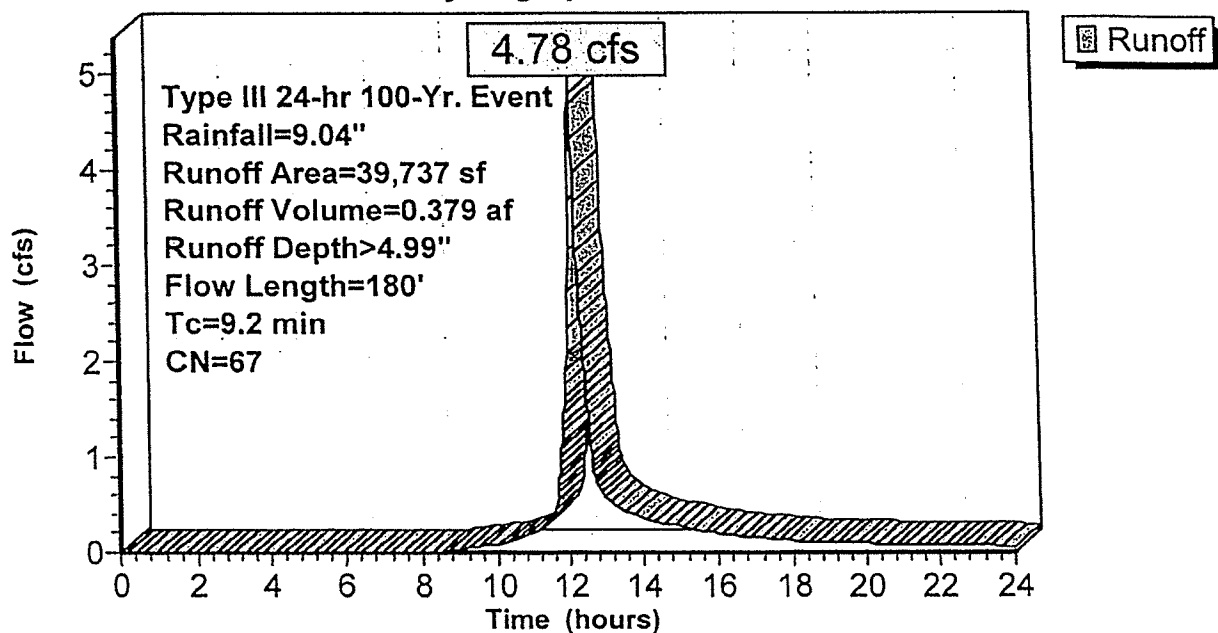
Runoff = 4.78 cfs @ 12.13 hrs, Volume= 0.379 af, Depth> 4.99"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs  
Type III 24-hr 100-Yr. Event Rainfall=9.04"

Area (sf)	CN	Description
30,309	60	Woods, Fair, HSG B
* 6,468	98	Pavement
* 462	98	Concrete
1,709	61	>75% Grass cover, Good, HSG B
* 789	98	Roof
39,737	67	Weighted Average
32,018		80.57% Pervious Area
7,719		19.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
0.7	130	0.0347	3.00		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
9.2	180	Total			

**Subcatchment SUB-1:****Hydrograph**

**Summary for Subcatchment SUB-3:**

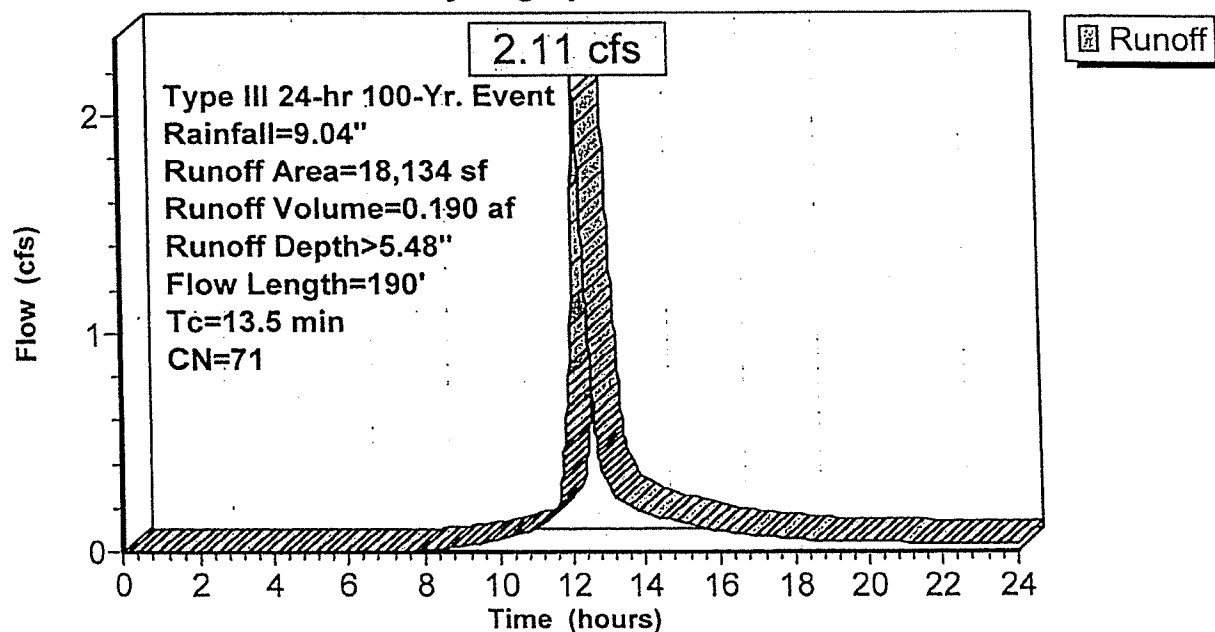
Runoff = 2.11 cfs @ 12.18 hrs, Volume= 0.190 af, Depth> 5.48"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Type III 24-hr 100-Yr. Event Rainfall=9.04"

Area (sf)	CN	Description
5,621	60	Woods, Fair, HSG B
* 3,184	98	Pavement
* 567	98	Concrete
7,296	61	>75% Grass cover, Good, HSG B
* 1,466	98	Roof
18,134	71	Weighted Average
12,917		71.23% Pervious Area
5,217		28.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
1.2	140	0.0140	1.90		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
13.5	190	Total			

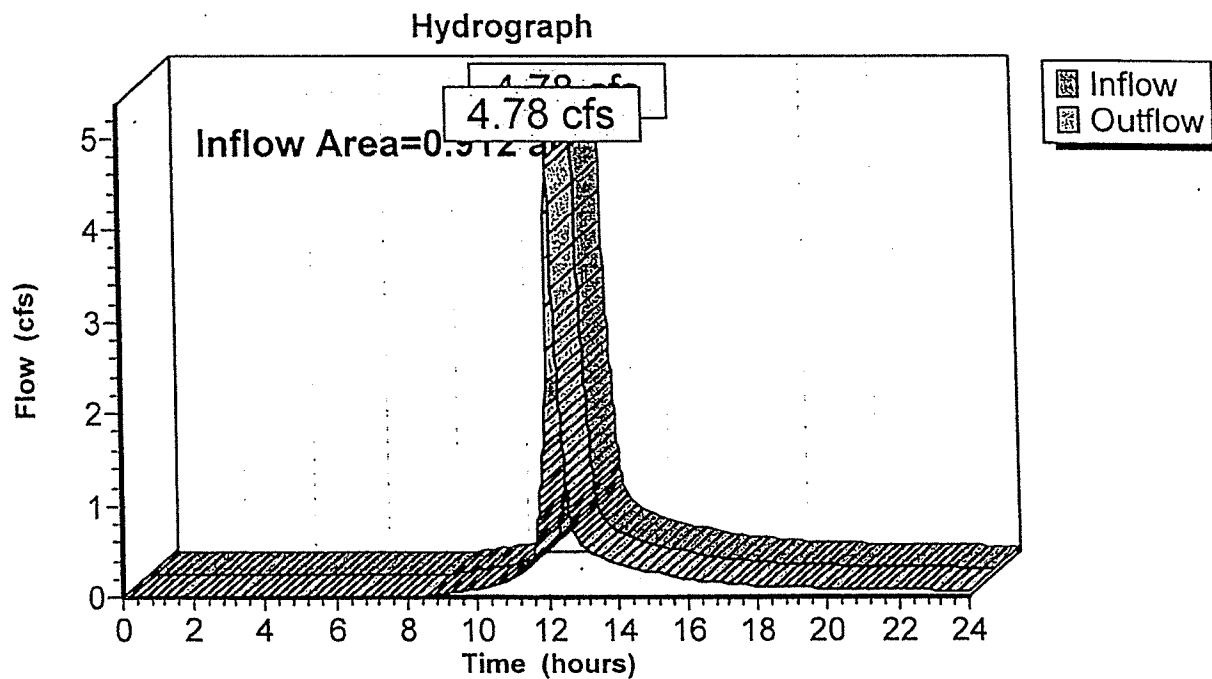
**Subcatchment SUB-3:****Hydrograph**

**Summary for Reach DP-1:**

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

Inflow Area = 0.912 ac, 19.43% Impervious, Inflow Depth > 4.99" for 100-Yr. Event event  
Inflow = 4.78 cfs @ 12.13 hrs, Volume= 0.379 af  
Outflow = 4.78 cfs @ 12.13 hrs, Volume= 0.379 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

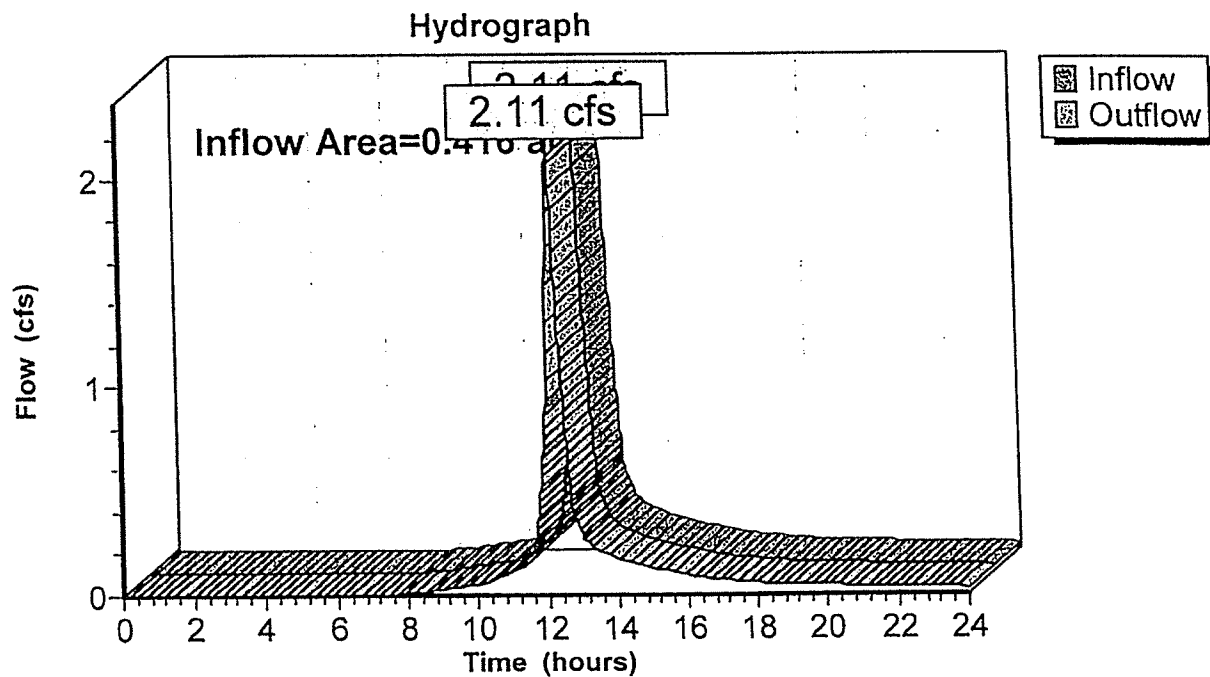
**Reach DP-1:**

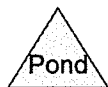
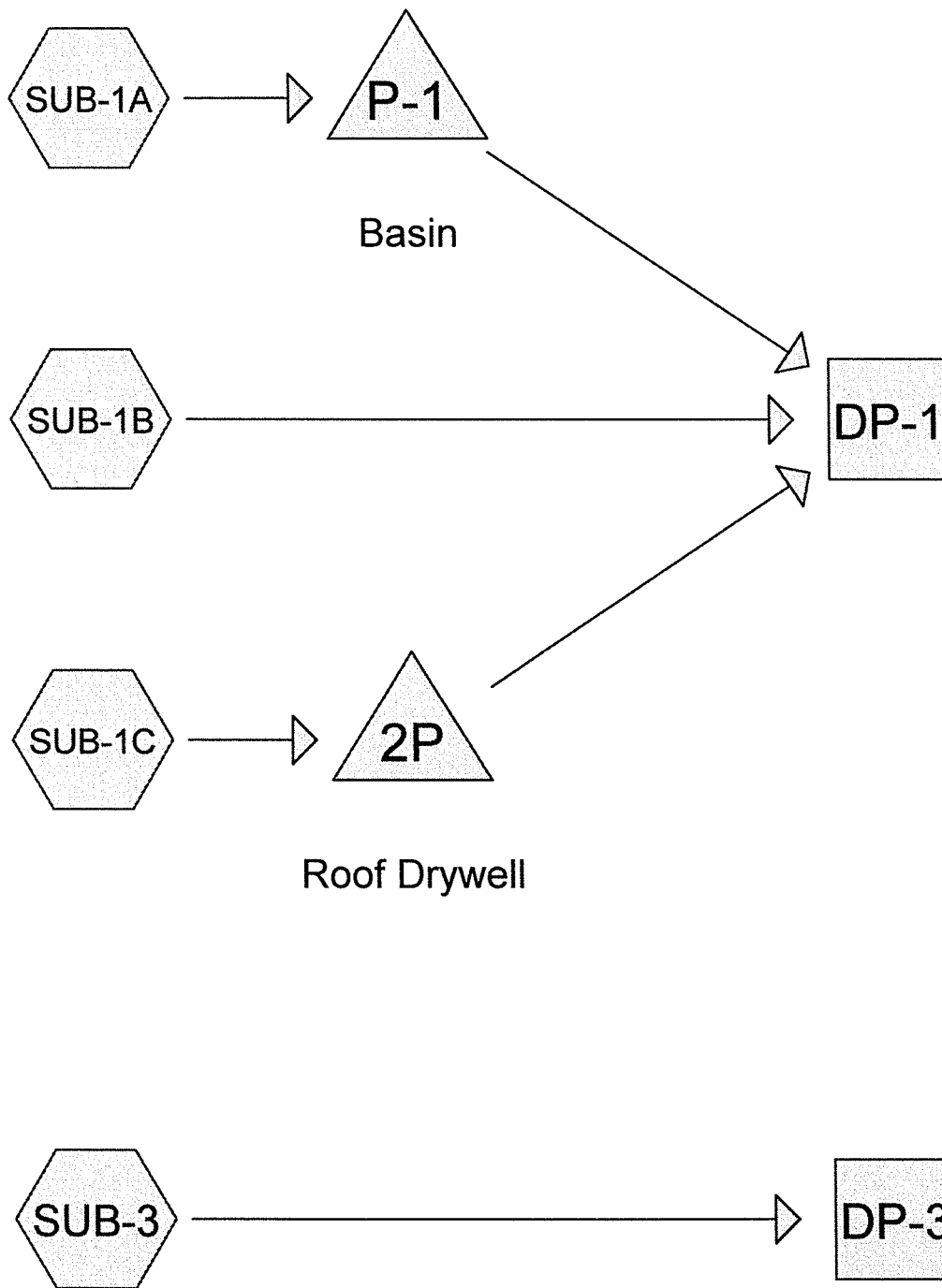
**Summary for Reach DP-3:**

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

Inflow Area = 0.416 ac, 28.77% Impervious, Inflow Depth > 5.48" for 100-Yr. Event event  
Inflow = 2.11 cfs @ 12.18 hrs, Volume= 0.190 af  
Outflow = 2.11 cfs @ 12.18 hrs, Volume= 0.190 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

**Reach DP-3:**



**Area Listing (all nodes)**

Area (acres)	CN	Description (subcatchment-numbers)
0.525	60	Woods, Fair, HSG B (SUB-1A, SUB-1B, SUB-3)
0.361	61	>75% Grass cover, Good, HSG B (SUB-1A, SUB-1B, SUB-3)
0.058	82	Gravel (SUB-1A)
0.024	98	Concrete (SUB-1B, SUB-3)
0.218	98	Pavement (SUB-1A, SUB-1B, SUB-3)
0.144	98	Roof (SUB-1B, SUB-1C, SUB-3)
<b>1.329</b>	<b>72</b>	<b>TOTAL AREA</b>

**Soil Listing (all nodes)**

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.885	HSG B	SUB-1A, SUB-1B, SUB-3
0.000	HSG C	
0.000	HSG D	
0.443	Other	SUB-1A, SUB-1B, SUB-1C, SUB-3
<b>1.329</b>		<b>TOTAL AREA</b>



Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment SUB-1A:** Runoff Area=16,412 sf 11.92% Impervious Runoff Depth>0.84"  
Flow Length=180' Tc=9.2 min CN=68 Runoff=0.29 cfs 0.026 af

**Subcatchment SUB-1B:** Runoff Area=20,308 sf 27.67% Impervious Runoff Depth>0.99"  
Flow Length=180' Tc=9.2 min CN=71 Runoff=0.45 cfs 0.039 af

**Subcatchment SUB-1C:** Runoff Area=4,000 sf 100.00% Impervious Runoff Depth>3.15"  
Tc=6.0 min CN=98 Runoff=0.30 cfs 0.024 af

**Subcatchment SUB-3:** Runoff Area=17,151 sf 30.42% Impervious Runoff Depth>1.05"  
Flow Length=190' Tc=13.5 min CN=72 Runoff=0.35 cfs 0.034 af

**Reach DP-1:** Inflow=0.45 cfs 0.039 af  
Outflow=0.45 cfs 0.039 af

**Reach DP-3:** Inflow=0.35 cfs 0.034 af  
Outflow=0.35 cfs 0.034 af

**Pond 2P: Roof Drywell** Peak Elev=93.59' Storage=278 cf Inflow=0.30 cfs 0.024 af  
Discarded=0.05 cfs 0.024 af Primary=0.00 cfs 0.000 af Outflow=0.05 cfs 0.024 af

**Pond P-1: Basin** Peak Elev=92.35' Storage=289 cf Inflow=0.29 cfs 0.026 af  
Discarded=0.06 cfs 0.026 af Primary=0.00 cfs 0.000 af Outflow=0.06 cfs 0.026 af

**Total Runoff Area = 1.329 ac Runoff Volume = 0.123 af Average Runoff Depth = 1.11"**  
**70.98% Pervious = 0.943 ac 29.02% Impervious = 0.386 ac**

**Summary for Subcatchment SUB-1A:**

Runoff = 0.29 cfs @ 12.15 hrs, Volume= 0.026 af, Depth> 0.84"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

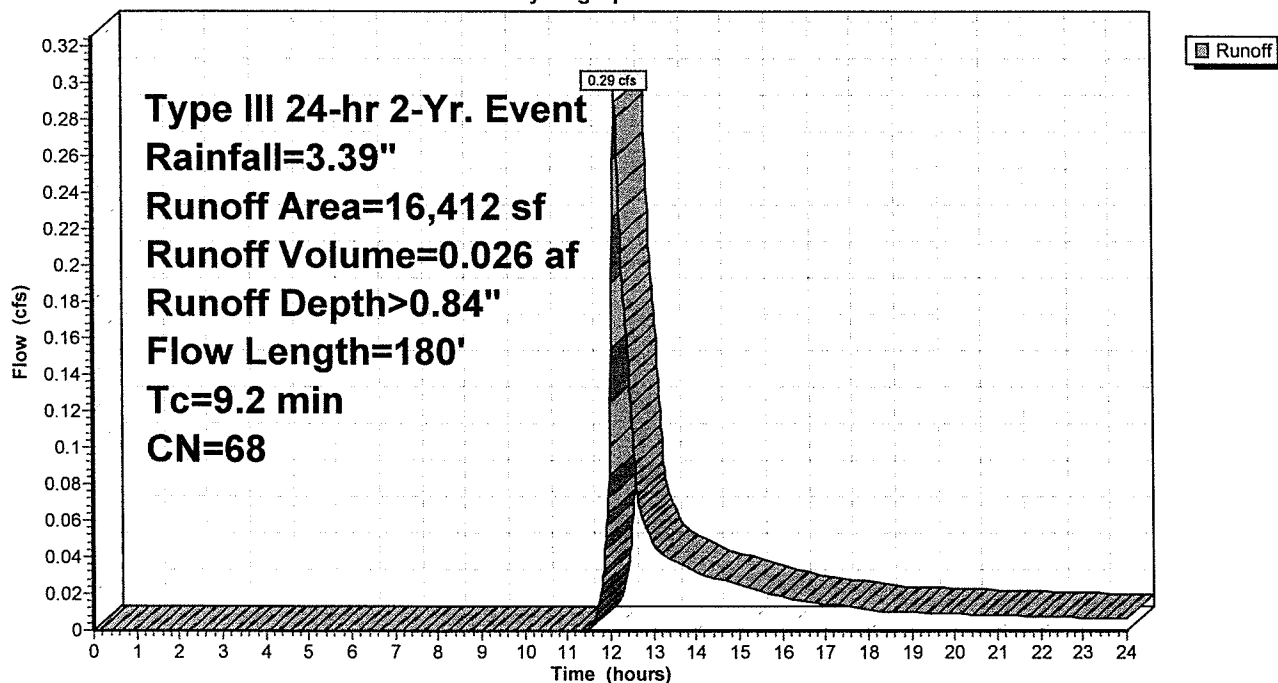
Type III 24-hr 2-Yr. Event Rainfall=3.39"

	Area (sf)	CN	Description
*	1,957	98	Pavement
	6,284	61	>75% Grass cover, Good, HSG B
	5,659	60	Woods, Fair, HSG B
*	2,512	82	Gravel
	16,412	68	Weighted Average
	14,455		88.08% Pervious Area
	1,957		11.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
0.7	130	0.0347	3.00		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
9.2	180	Total			

**Subcatchment SUB-1A:**

Hydrograph



**Summary for Subcatchment SUB-1B:**

Runoff = 0.45 cfs @ 12.14 hrs, Volume= 0.039 af, Depth> 0.99"

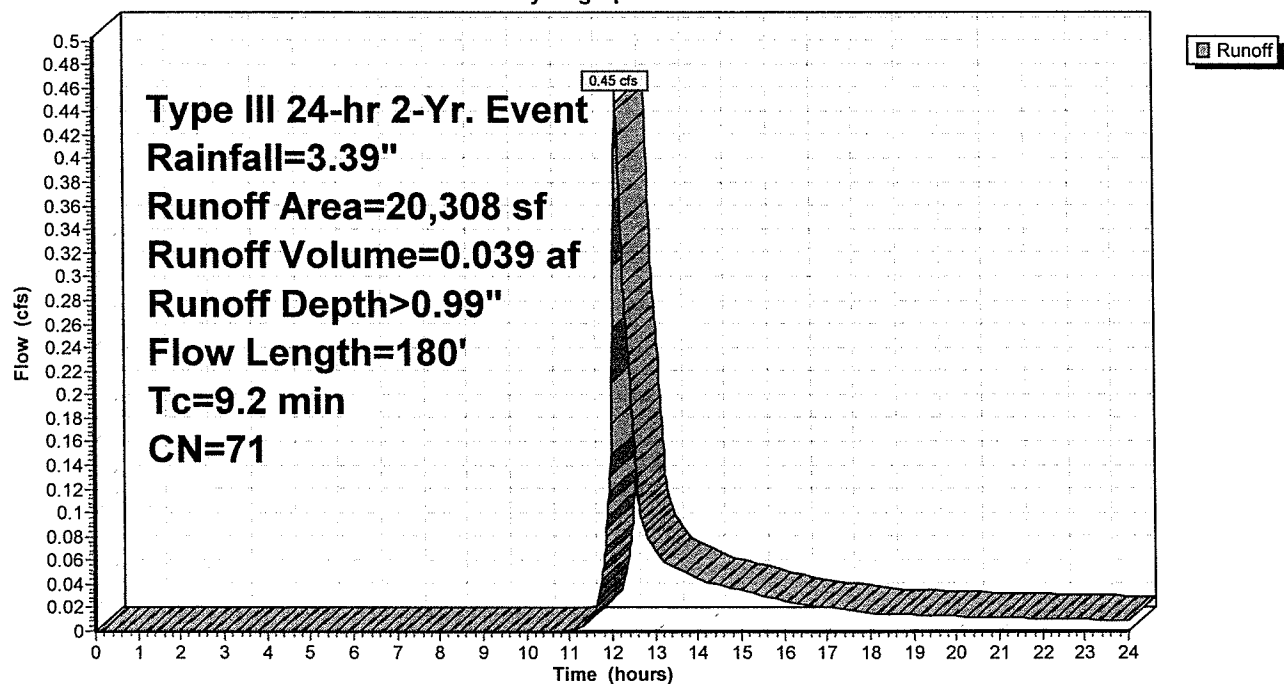
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs  
Type III 24-hr 2-Yr. Event Rainfall=3.39"

	Area (sf)	CN	Description
*	789	98	Roof
*	4,368	98	Pavement
*	462	98	Concrete
	2,128	61	>75% Grass cover, Good, HSG B
	12,561	60	Woods, Fair, HSG B
	20,308	71	Weighted Average
	14,689		72.33% Pervious Area
	5,619		27.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.20"
0.7	130	0.0347	3.00		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
9.2	180	Total			

**Subcatchment SUB-1B:**

Hydrograph



### Summary for Subcatchment SUB-1C:

Runoff = 0.30 cfs @ 12.08 hrs, Volume= 0.024 af, Depth> 3.15"

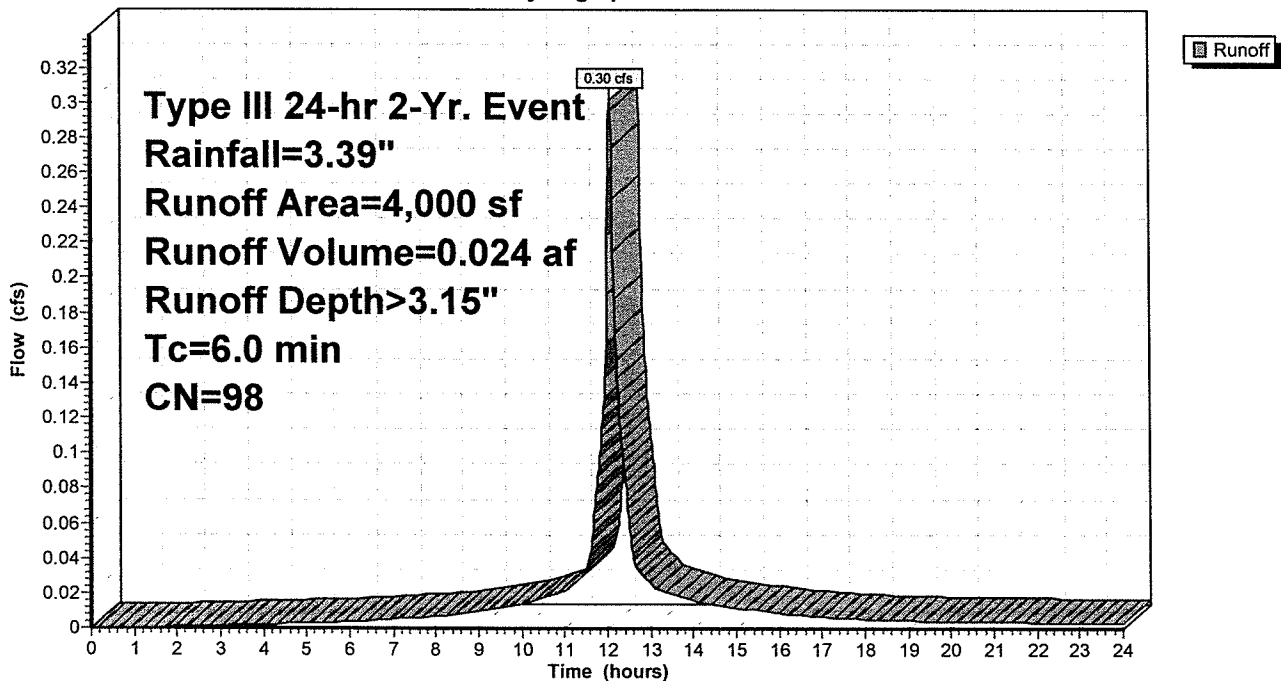
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs  
Type III 24-hr 2-Yr. Event Rainfall=3.39"

Area (sf)	CN	Description
* 4,000	98	Roof
4,000		100.00% Impervious Area

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

### Subcatchment SUB-1C:

Hydrograph



**Summary for Subcatchment SUB-3:**

Runoff = 0.35 cfs @ 12.20 hrs, Volume= 0.034 af, Depth> 1.05"

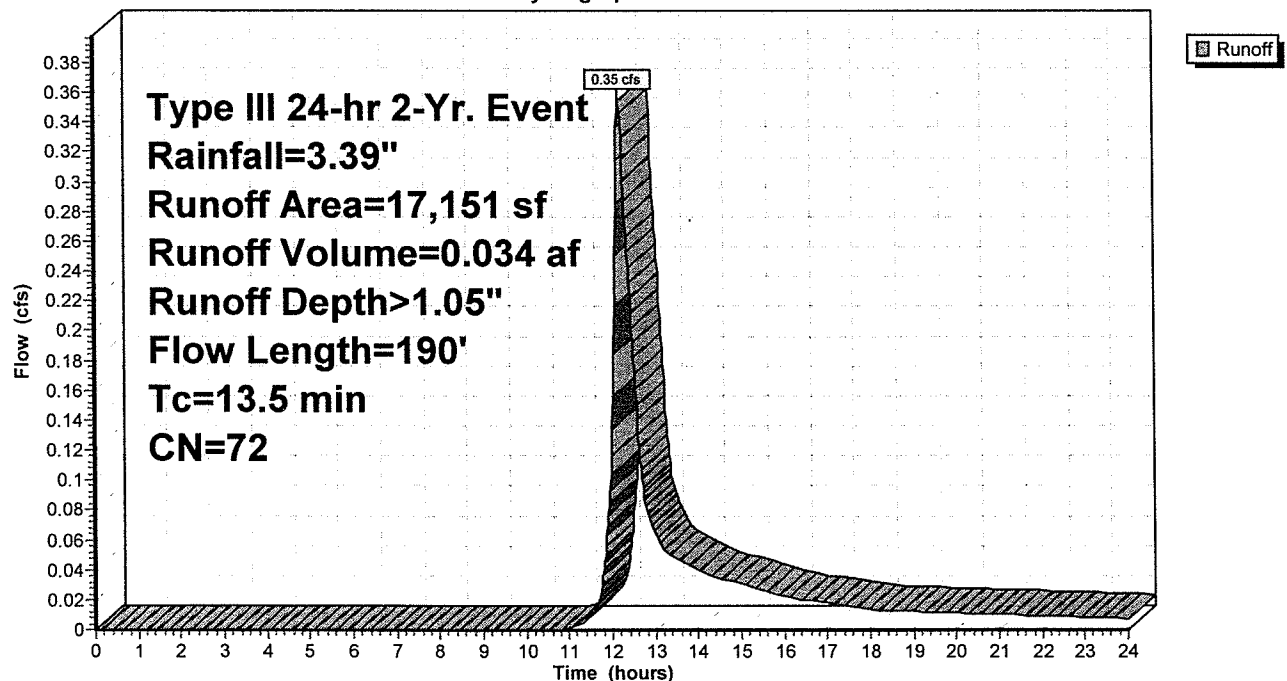
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs  
Type III 24-hr 2-Yr. Event Rainfall=3.39"

	Area (sf)	CN	Description
	4,638	60	Woods, Fair, HSG B
*	3,184	98	Pavement
*	567	98	Concrete
	7,296	61	>75% Grass cover, Good, HSG B
*	1,466	98	Roof
	17,151	72	Weighted Average
	11,934		69.58% Pervious Area
	5,217		30.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		<b>Sheet Flow,</b>
					Woods: Light underbrush n= 0.400 P2= 3.20"
1.2	140	0.0140	1.90		<b>Shallow Concentrated Flow,</b>
					Unpaved Kv= 16.1 fps
13.5	190	Total			

**Subcatchment SUB-3:**

Hydrograph

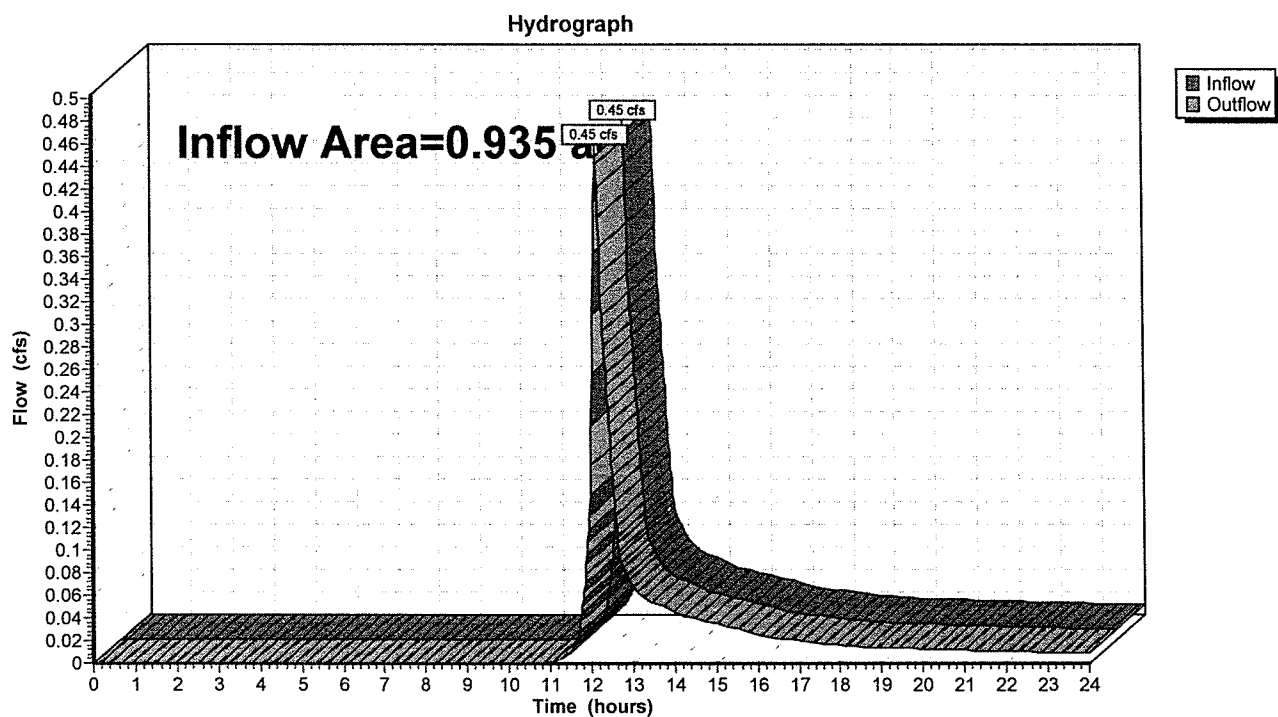


**Summary for Reach DP-1:**

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

Inflow Area = 0.935 ac, 28.43% Impervious, Inflow Depth > 0.49" for 2-Yr. Event event  
Inflow = 0.45 cfs @ 12.14 hrs, Volume= 0.039 af  
Outflow = 0.45 cfs @ 12.14 hrs, Volume= 0.039 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

**Reach DP-1:**

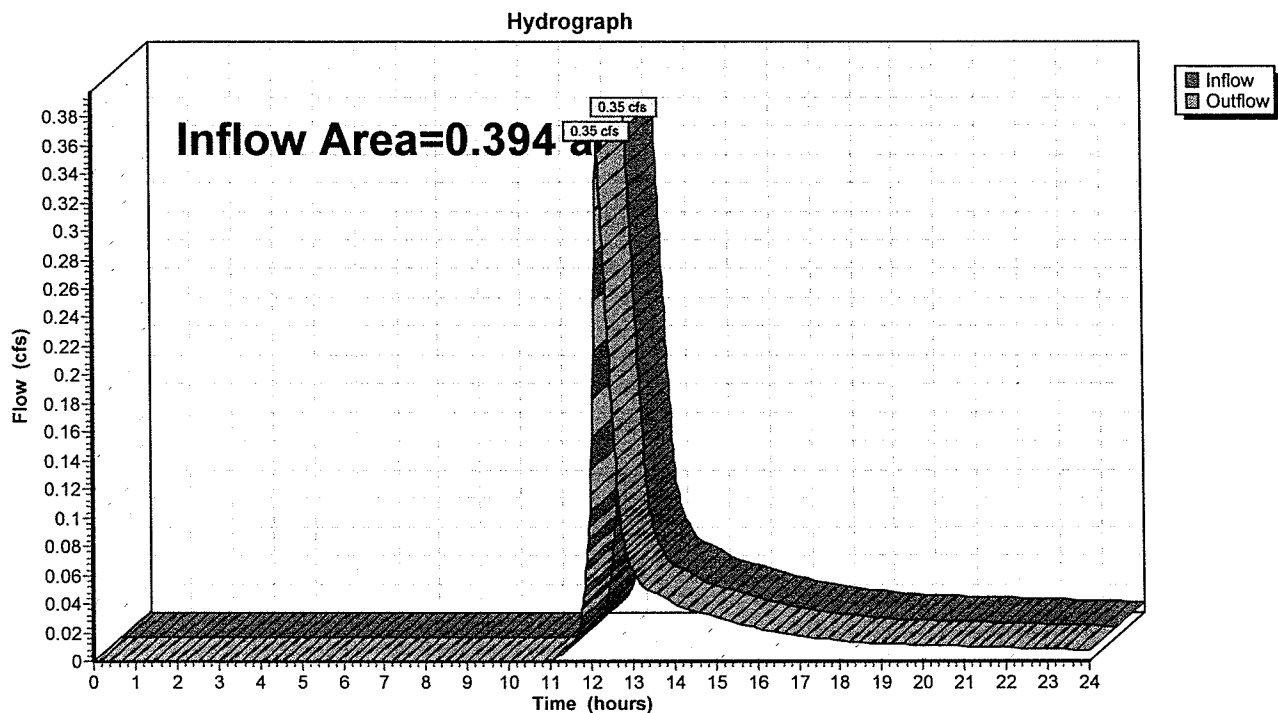
### Summary for Reach DP-3:

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

Inflow Area = 0.394 ac, 30.42% Impervious, Inflow Depth > 1.05" for 2-Yr. Event event  
 Inflow = 0.35 cfs @ 12.20 hrs, Volume= 0.034 af  
 Outflow = 0.35 cfs @ 12.20 hrs, Volume= 0.034 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

### Reach DP-3:



**Summary for Pond 2P: Roof Drywell**

[87] Warning: Oscillations may require Finer Routing or smaller dt

Inflow Area = 0.092 ac, 100.00% Impervious, Inflow Depth > 3.15" for 2-Yr. Event event  
 Inflow = 0.30 cfs @ 12.08 hrs, Volume= 0.024 af  
 Outflow = 0.05 cfs @ 11.78 hrs, Volume= 0.024 af, Atten= 84%, Lag= 0.0 min  
 Discarded = 0.05 cfs @ 11.78 hrs, Volume= 0.024 af  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs  
 Peak Elev= 93.59' @ 12.56 hrs Surf.Area= 859 sf Storage= 278 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)  
 Center-of-Mass det. time= 31.3 min ( 786.0 - 754.7 )

Volume	Invert	Avail.Storage	Storage Description
#1	93.40'	513 cf	<b>Chambers</b> Listed below Inside #2
#2	92.90'	654 cf	<b>Stone Backfill (Prismatic)</b> Listed below (Recalc)
			2,148 cf Overall - 513 cf Embedded = 1,635 cf x 40.0% Voids
		1,167 cf	Total Available Storage

Elevation (feet)	Cum.Store (cubic-feet)
93.40	0
94.80	513

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
92.90	859	0	0
93.90	859	859	859
95.40	859	1,289	2,148

Device	Routing	Invert	Outlet Devices
#1	Discarded	92.90'	<b>2.410 in/hr Exfiltration over Surface area</b>
#2	Primary	94.75'	<b>4.0" Horiz. Orifice/Grate X 2.00</b> C= 0.600 Limited to weir flow at low heads

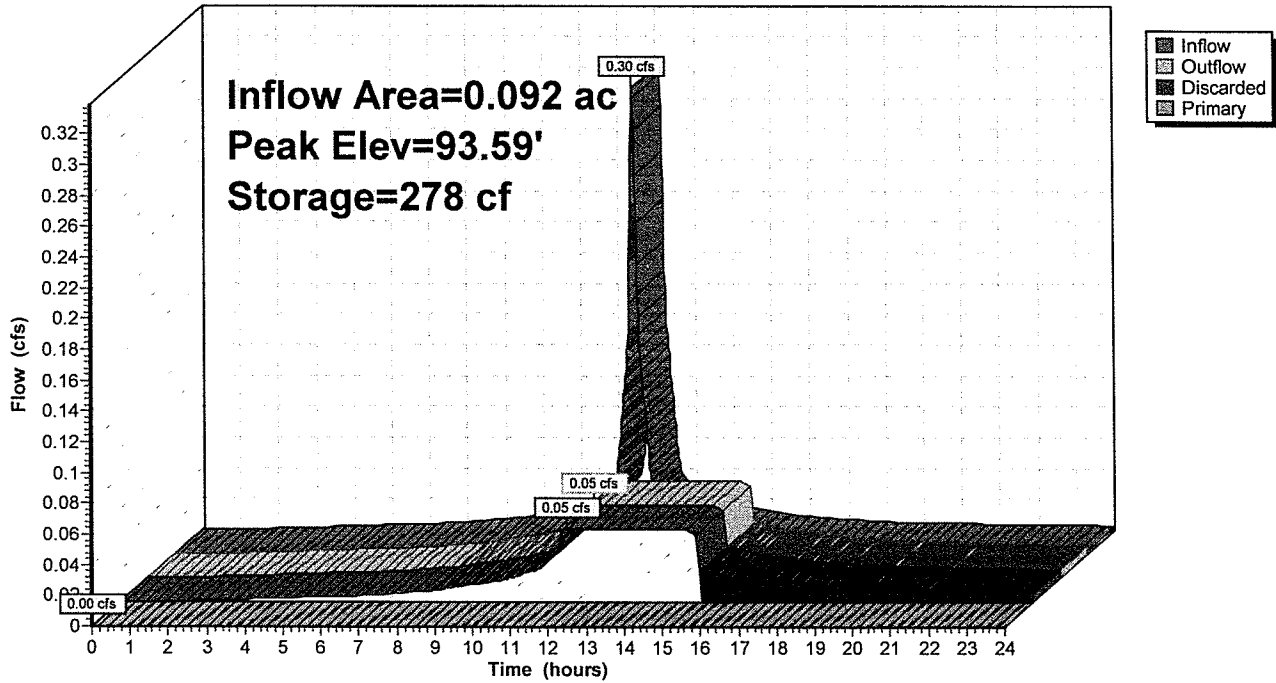
**Discarded OutFlow** Max=0.05 cfs @ 11.78 hrs HW=92.93' (Free Discharge)  
 ↑ **1=Exfiltration** (Exfiltration Controls 0.05 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=92.90' TW=0.00' (Dynamic Tailwater)  
 ↑ **2=Orifice/Grate** ( Controls 0.00 cfs)



### Pond 2P: Roof Drywell

#### Hydrograph



**Summary for Pond P-1: Basin**

[87] Warning: Oscillations may require Finer Routing or smaller dt

Inflow Area = 0.377 ac, 11.92% Impervious, Inflow Depth > 0.84" for 2-Yr. Event event  
 Inflow = 0.29 cfs @ 12.15 hrs, Volume= 0.026 af  
 Outflow = 0.06 cfs @ 12.70 hrs, Volume= 0.026 af, Atten= 78%, Lag= 33.4 min  
 Discarded = 0.06 cfs @ 12.70 hrs, Volume= 0.026 af  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs  
 Peak Elev= 92.35' @ 12.70 hrs Surf.Area= 1,163 sf Storage= 289 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)  
 Center-of-Mass det. time= 33.9 min ( 913.9 - 880.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	91.60'	1,285 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) 3,211 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
91.60	688	0	0
92.00	1,026	343	343
93.00	1,420	1,223	1,566
94.00	1,871	1,646	3,211

Device	Routing	Invert	Outlet Devices
#1	Discarded	91.60'	<b>2.410 in/hr Exfiltration over Surface area</b>
#2	Primary	93.50'	<b>10.0' long x 3.0' 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 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

**Discarded OutFlow** Max=0.06 cfs @ 12.70 hrs HW=92.35' (Free Discharge)

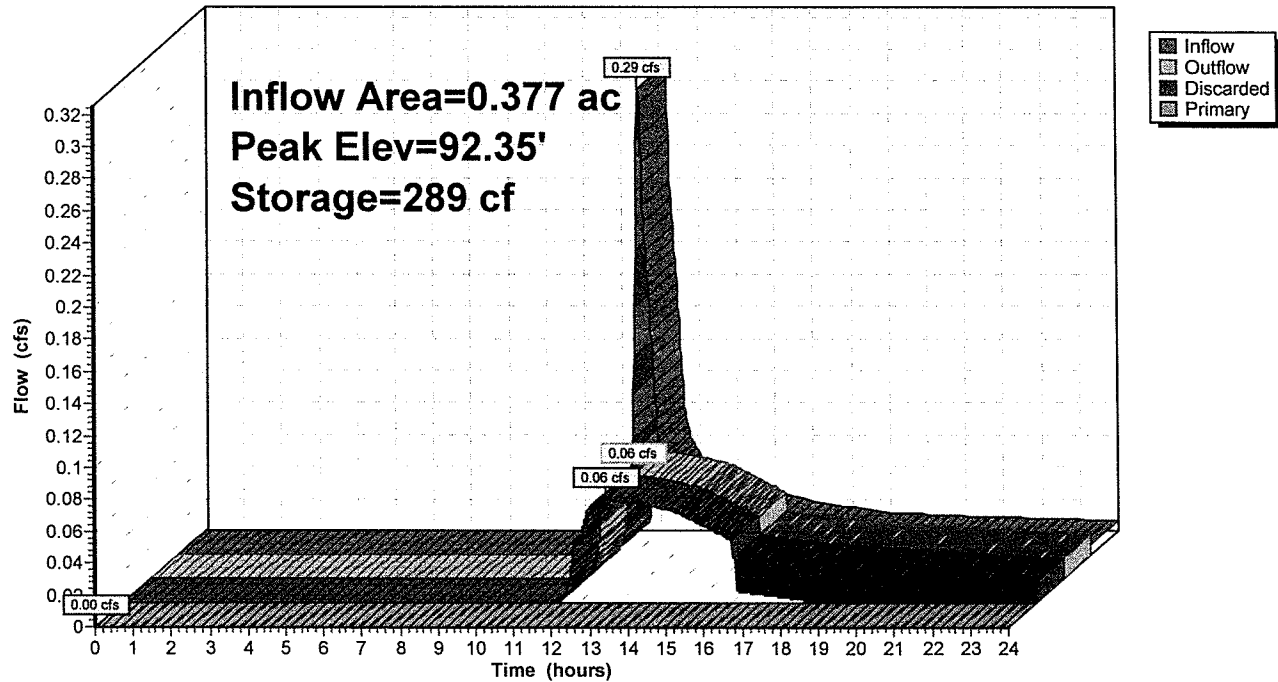
↑1=Exfiltration (Exfiltration Controls 0.06 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=91.60' TW=0.00' (Dynamic Tailwater)

↑2=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

# Pond P-1: Basin

## Hydrograph



Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

<b>Subcatchment SUB-1A:</b>	Runoff Area=16,412 sf 11.92% Impervious Runoff Depth>1.93" Flow Length=180' Tc=9.2 min CN=68 Runoff=0.74 cfs 0.061 af
<b>Subcatchment SUB-1B:</b>	Runoff Area=20,308 sf 27.67% Impervious Runoff Depth>2.17" Flow Length=180' Tc=9.2 min CN=71 Runoff=1.05 cfs 0.084 af
<b>Subcatchment SUB-1C:</b>	Runoff Area=4,000 sf 100.00% Impervious Runoff Depth>4.84" Tc=6.0 min CN=98 Runoff=0.46 cfs 0.037 af
<b>Subcatchment SUB-3:</b>	Runoff Area=17,151 sf 30.42% Impervious Runoff Depth>2.25" Flow Length=190' Tc=13.5 min CN=72 Runoff=0.81 cfs 0.074 af
<b>Reach DP-1:</b>	Inflow=1.05 cfs 0.086 af Outflow=1.05 cfs 0.086 af
<b>Reach DP-3:</b>	Inflow=0.81 cfs 0.074 af Outflow=0.81 cfs 0.074 af
<b>Pond 2P: Roof Drywell</b>	Peak Elev=94.00' Storage=512 cf Inflow=0.46 cfs 0.037 af Discarded=0.05 cfs 0.037 af Primary=0.00 cfs 0.000 af Outflow=0.05 cfs 0.037 af
<b>Pond P-1: Basin</b>	Peak Elev=93.52' Storage=945 cf Inflow=0.74 cfs 0.061 af Discarded=0.09 cfs 0.059 af Primary=0.06 cfs 0.001 af Outflow=0.15 cfs 0.061 af
<b>Total Runoff Area = 1.329 ac Runoff Volume = 0.256 af Average Runoff Depth = 2.31"</b>	
<b>70.98% Pervious = 0.943 ac 29.02% Impervious = 0.386 ac</b>	

**Summary for Subcatchment SUB-1A:**

Runoff = 0.74 cfs @ 12.14 hrs, Volume= 0.061 af, Depth> 1.93"

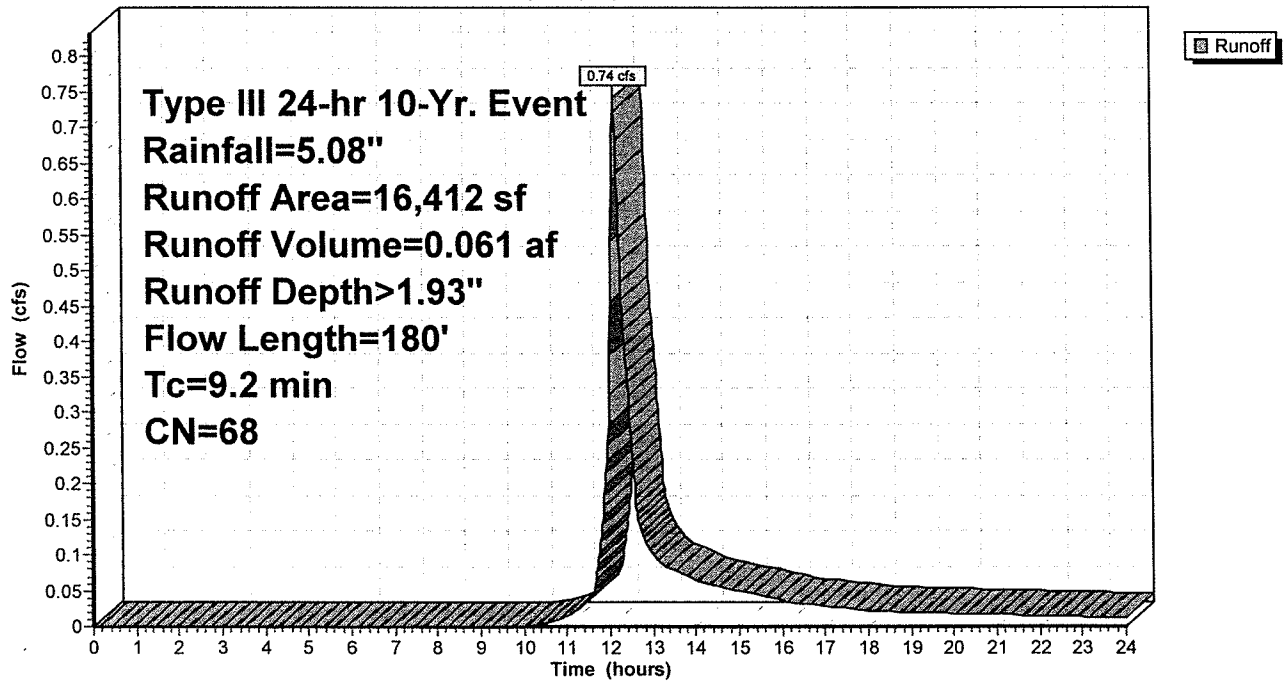
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs  
Type III 24-hr 10-Yr. Event Rainfall=5.08"

	Area (sf)	CN	Description
*	1,957	98	Pavement
	6,284	61	>75% Grass cover, Good, HSG B
	5,659	60	Woods, Fair, HSG B
*	2,512	82	Gravel
	16,412	68	Weighted Average
	14,455		88.08% Pervious Area
	1,957		11.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.20"
0.7	130	0.0347	3.00		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
9.2	180	Total			

**Subcatchment SUB-1A:**

Hydrograph



**Summary for Subcatchment SUB-1B:**

Runoff = 1.05 cfs @ 12.13 hrs, Volume= 0.084 af, Depth> 2.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Type III 24-hr 10-Yr. Event Rainfall=5.08"

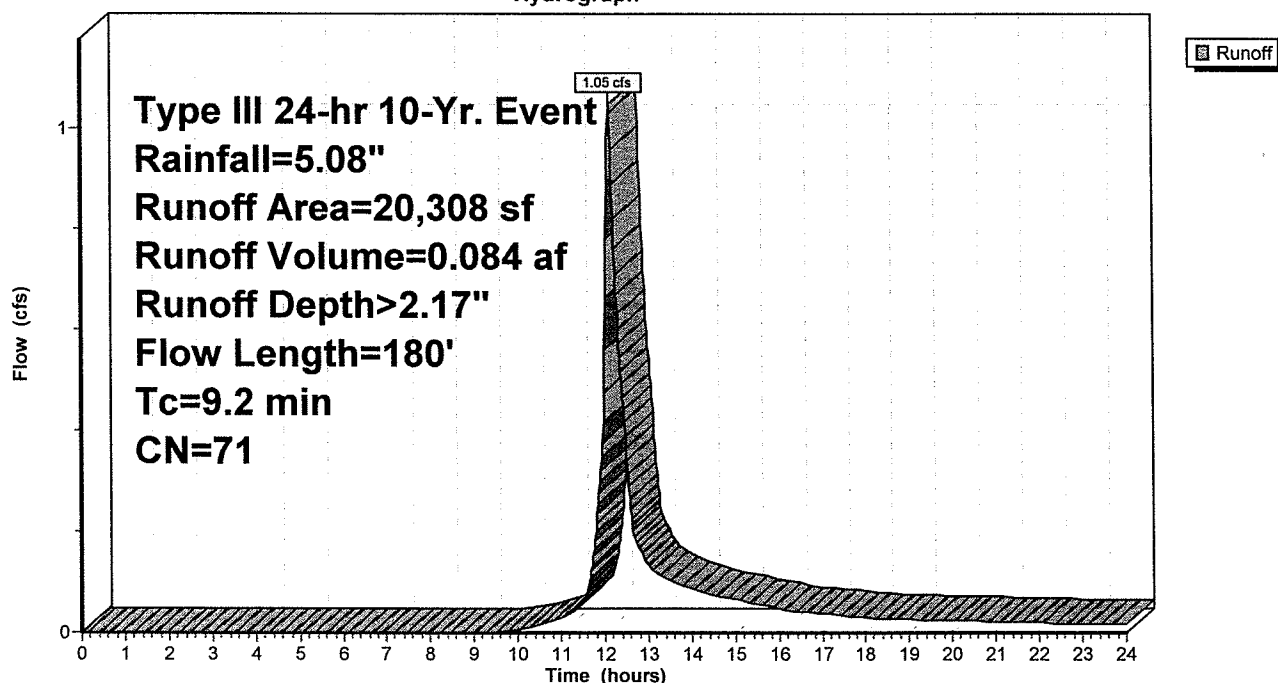
Area (sf)	CN	Description
* 789	98	Roof
* 4,368	98	Pavement
* 462	98	Concrete
2,128	61	>75% Grass cover, Good, HSG B
12,561	60	Woods, Fair, HSG B
20,308	71	Weighted Average
14,689		72.33% Pervious Area
5,619		27.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		<b>Sheet Flow,</b>
					Woods: Light underbrush n= 0.400 P2= 3.20"
0.7	130	0.0347	3.00		<b>Shallow Concentrated Flow,</b>
					Unpaved Kv= 16.1 fps
9.2	180	Total			

**Subcatchment SUB-1B:**

Hydrograph



### Summary for Subcatchment SUB-1C:

Runoff = 0.46 cfs @ 12.08 hrs, Volume= 0.037 af, Depth> 4.84"

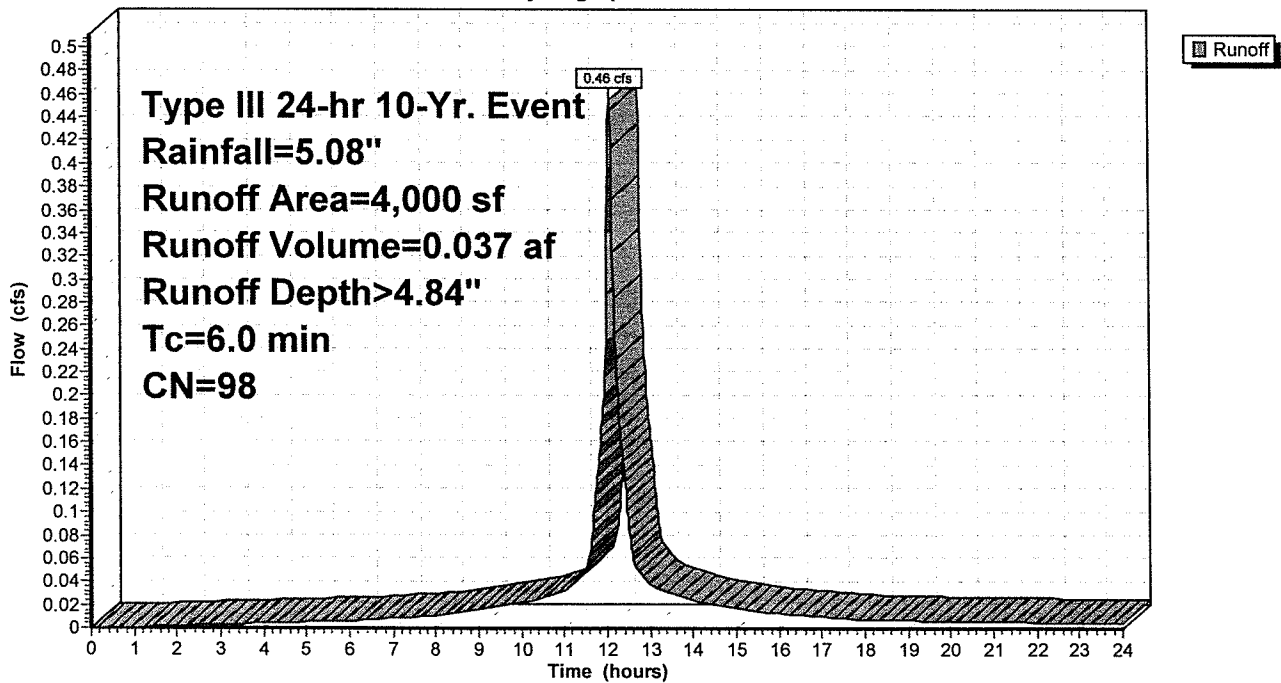
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs  
Type III 24-hr 10-Yr. Event Rainfall=5.08"

Area (sf)	CN	Description
* 4,000	98	Roof
4,000		100.00% Impervious Area

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

### Subcatchment SUB-1C:

Hydrograph



**Summary for Subcatchment SUB-3:**

Runoff = 0.81 cfs @ 12.19 hrs, Volume= 0.074 af, Depth> 2.25"

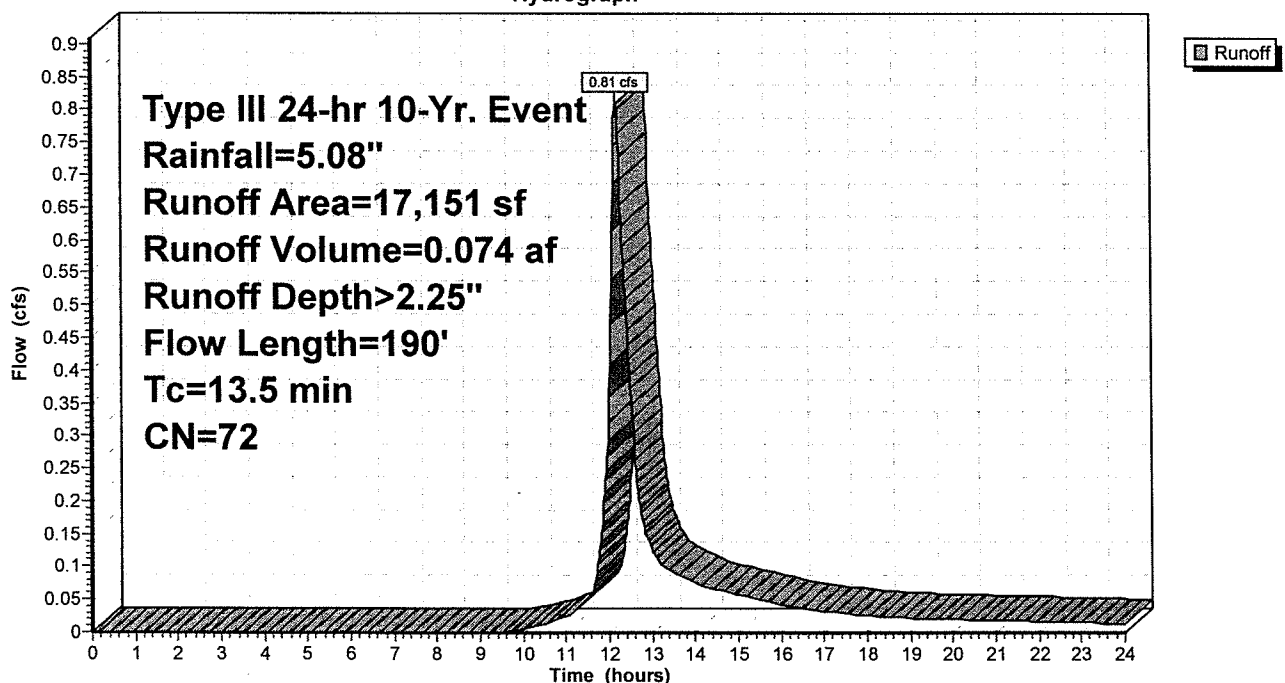
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs  
Type III 24-hr 10-Yr. Event Rainfall=5.08"

Area (sf)	CN	Description
4,638	60	Woods, Fair, HSG B
* 3,184	98	Pavement
* 567	98	Concrete
7,296	61	>75% Grass cover, Good, HSG B
* 1,466	98	Roof
17,151	72	Weighted Average
11,934		69.58% Pervious Area
5,217		30.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		<b>Sheet Flow,</b>
					Woods: Light underbrush n= 0.400 P2= 3.20"
1.2	140	0.0140	1.90		<b>Shallow Concentrated Flow,</b>
					Unpaved Kv= 16.1 fps
13.5	190	Total			

**Subcatchment SUB-3:**

Hydrograph



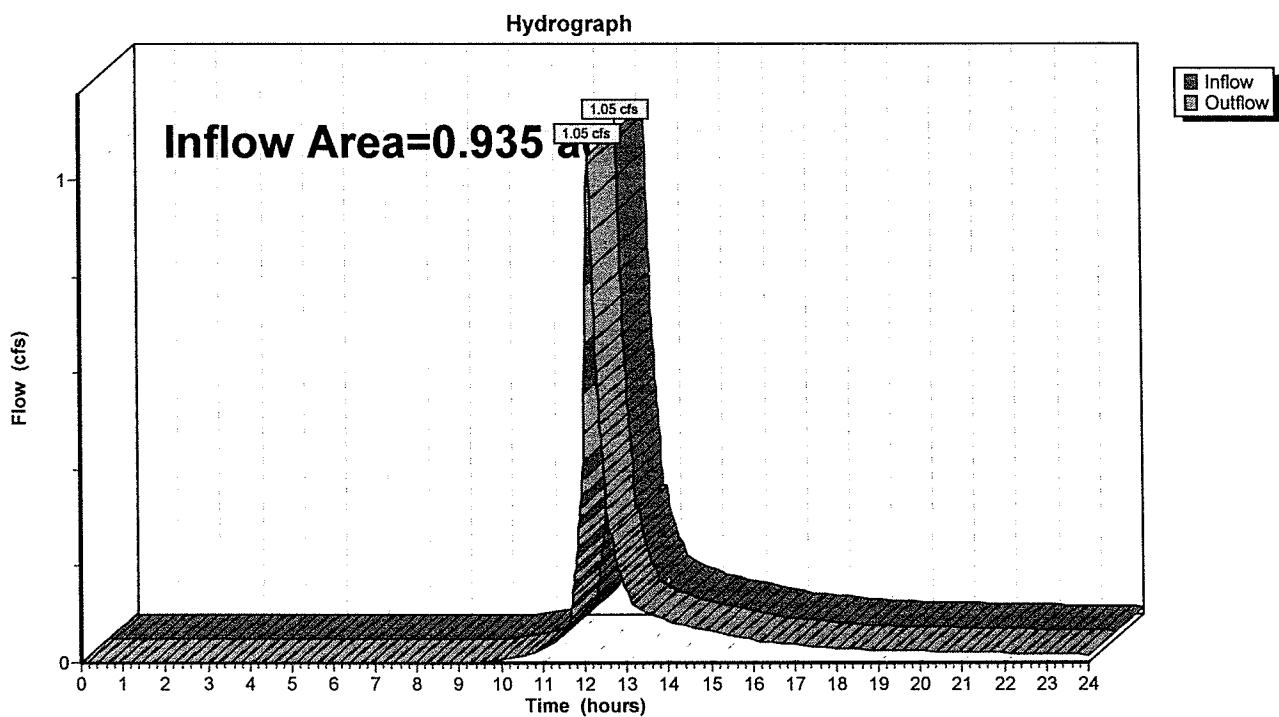


**Summary for Reach DP-1:**

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

Inflow Area = 0.935 ac, 28.43% Impervious, Inflow Depth > 1.10" for 10-Yr. Event event  
Inflow = 1.05 cfs @ 12.13 hrs, Volume= 0.086 af  
Outflow = 1.05 cfs @ 12.13 hrs, Volume= 0.086 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

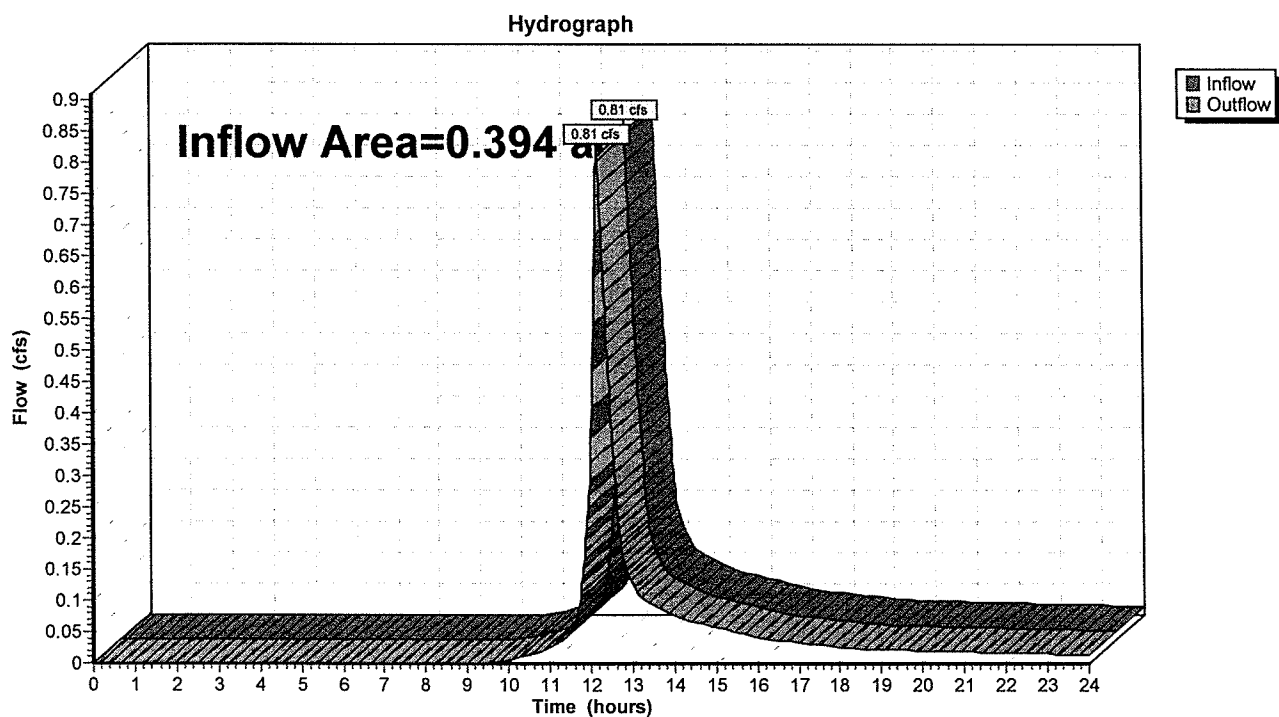
**Reach DP-1:**

**Summary for Reach DP-3:**

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

Inflow Area = 0.394 ac, 30.42% Impervious, Inflow Depth > 2.25" for 10-Yr. Event event  
Inflow = 0.81 cfs @ 12.19 hrs, Volume= 0.074 af  
Outflow = 0.81 cfs @ 12.19 hrs, Volume= 0.074 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

**Reach DP-3:**

**Summary for Pond 2P: Roof Drywell**

[87] Warning: Oscillations may require Finer Routing or smaller dt

Inflow Area = 0.092 ac, 100.00% Impervious, Inflow Depth > 4.84" for 10-Yr. Event event  
 Inflow = 0.46 cfs @ 12.08 hrs, Volume= 0.037 af  
 Outflow = 0.05 cfs @ 11.66 hrs, Volume= 0.037 af, Atten= 89%, Lag= 0.0 min  
 Discarded = 0.05 cfs @ 11.66 hrs, Volume= 0.037 af  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs  
 Peak Elev= 94.00' @ 12.78 hrs Surf.Area= 859 sf Storage= 512 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)  
 Center-of-Mass det. time= 67.7 min ( 815.0 - 747.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	93.40'	513 cf	<b>Chambers</b> Listed below Inside #2
#2	92.90'	654 cf	<b>Stone Backfill (Prismatic)</b> Listed below (Recalc)
			2,148 cf Overall - 513 cf Embedded = 1,635 cf x 40.0% Voids
			1,167 cf Total Available Storage

Elevation (feet)	Cum.Store (cubic-feet)
93.40	0
94.80	513

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
92.90	859	0	0
93.90	859	859	859
95.40	859	1,289	2,148

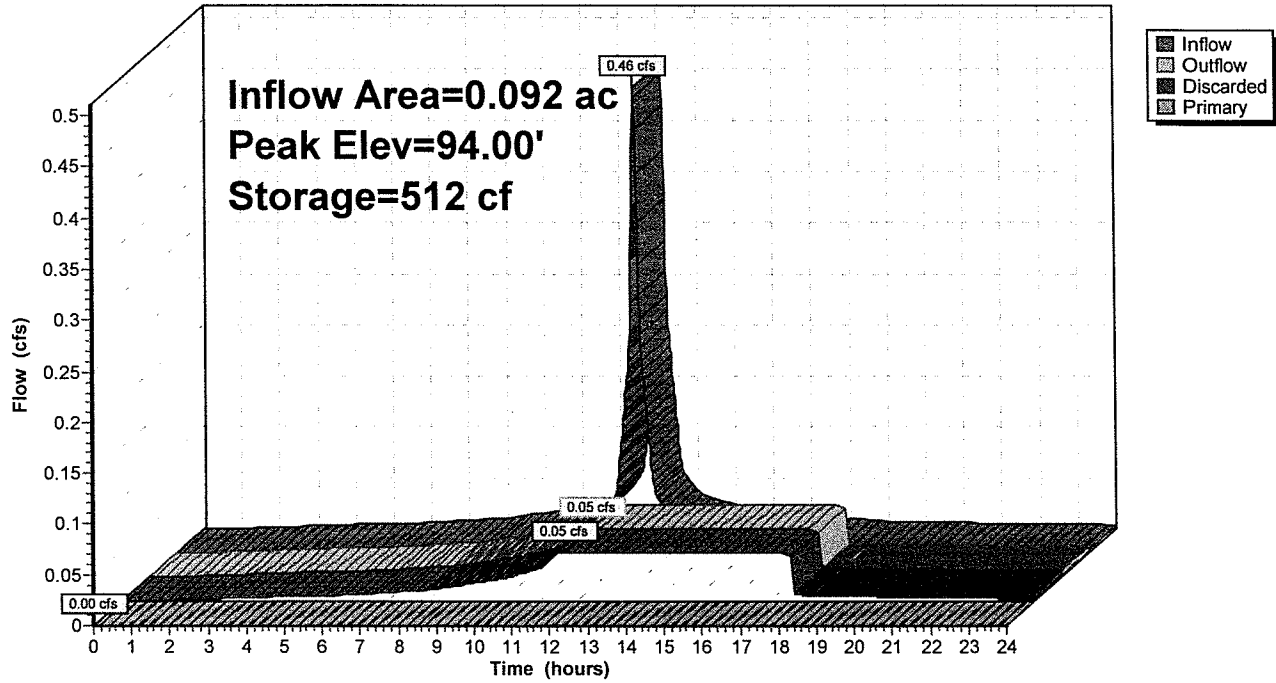
Device	Routing	Invert	Outlet Devices
#1	Discarded	92.90'	<b>2.410 in/hr Exfiltration over Surface area</b>
#2	Primary	94.75'	<b>4.0" Horiz. Orifice/Grate X 2.00</b> C= 0.600 Limited to weir flow at low heads

**Discarded OutFlow** Max=0.05 cfs @ 11.66 hrs HW=92.93' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.05 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=92.90' TW=0.00' (Dynamic Tailwater)  
 ↑2=Orifice/Grate ( Controls 0.00 cfs)

# Pond 2P: Roof Drywell

## Hydrograph



**Summary for Pond P-1: Basin**

[87] Warning: Oscillations may require Finer Routing or smaller dt

Inflow Area = 0.377 ac, 11.92% Impervious, Inflow Depth > 1.93" for 10-Yr. Event event  
 Inflow = 0.74 cfs @ 12.14 hrs, Volume= 0.061 af  
 Outflow = 0.15 cfs @ 12.66 hrs, Volume= 0.061 af, Atten= 80%, Lag= 31.4 min  
 Discarded = 0.09 cfs @ 12.66 hrs, Volume= 0.059 af  
 Primary = 0.06 cfs @ 12.66 hrs, Volume= 0.001 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs  
 Peak Elev= 93.52' @ 12.66 hrs Surf.Area= 1,654 sf Storage= 945 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)  
 Center-of-Mass det. time= 102.6 min ( 956.3 - 853.6 )

Volume	Invert	Avail.Storage	Storage Description
#1	91.60'	1,285 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) 3,211 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
91.60	688	0	0
92.00	1,026	343	343
93.00	1,420	1,223	1,566
94.00	1,871	1,646	3,211

Device	Routing	Invert	Outlet Devices
#1	Discarded	91.60'	<b>2.410 in/hr Exfiltration over Surface area</b>
#2	Primary	93.50'	<b>10.0' long x 3.0' 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 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

**Discarded OutFlow** Max=0.09 cfs @ 12.66 hrs HW=93.52' (Free Discharge)

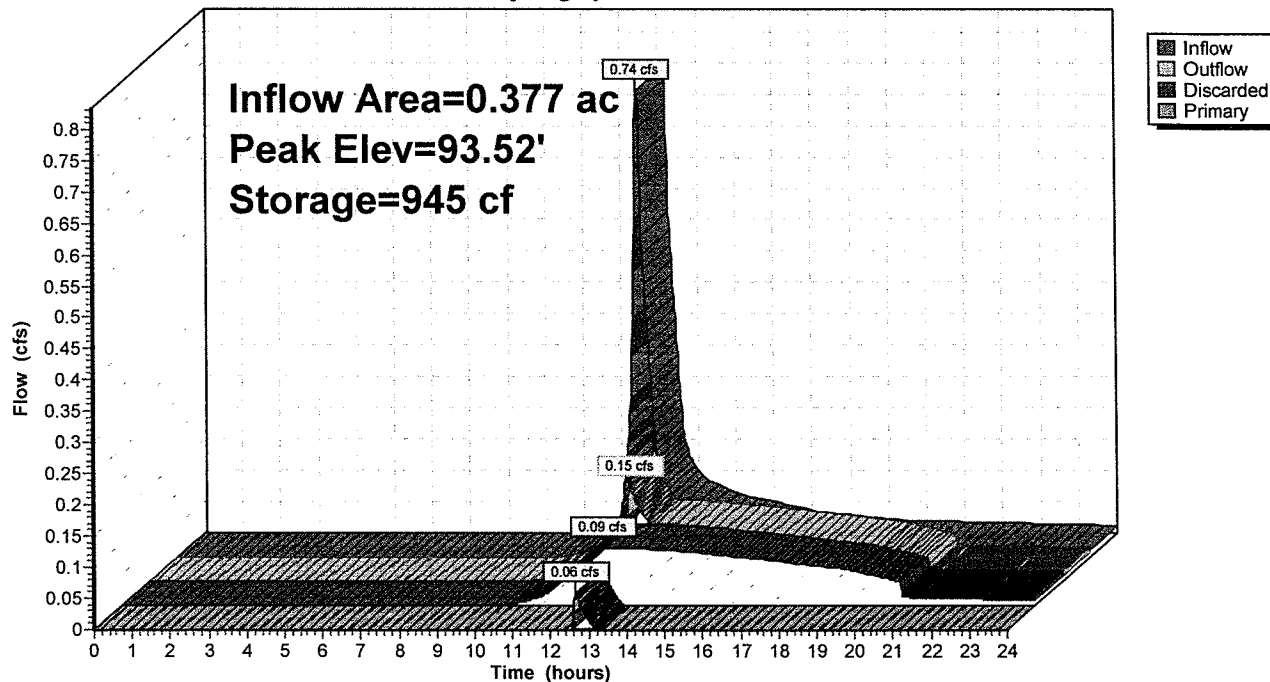
↑ **1=Exfiltration** (Exfiltration Controls 0.09 cfs)

**Primary OutFlow** Max=0.06 cfs @ 12.66 hrs HW=93.52' TW=0.00' (Dynamic Tailwater)

↑ **2=Broad-Crested Rectangular Weir** (Weir Controls 0.06 cfs @ 0.33 fps)

# Pond P-1: Basin

## Hydrograph



Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

<b>Subcatchment SUB-1A:</b>	Runoff Area=16,412 sf 11.92% Impervious Runoff Depth>5.11" Flow Length=180' Tc=9.2 min CN=68 Runoff=2.03 cfs 0.161 af
<b>Subcatchment SUB-1B:</b>	Runoff Area=20,308 sf 27.67% Impervious Runoff Depth>5.48" Flow Length=180' Tc=9.2 min CN=71 Runoff=2.68 cfs 0.213 af
<b>Subcatchment SUB-1C:</b>	Runoff Area=4,000 sf 100.00% Impervious Runoff Depth>8.79" Tc=6.0 min CN=98 Runoff=0.81 cfs 0.067 af
<b>Subcatchment SUB-3:</b>	Runoff Area=17,151 sf 30.42% Impervious Runoff Depth>5.60" Flow Length=190' Tc=13.5 min CN=72 Runoff=2.04 cfs 0.184 af
<b>Reach DP-1:</b>	Inflow=4.59 cfs 0.288 af Outflow=4.59 cfs 0.288 af
<b>Reach DP-3:</b>	Inflow=2.04 cfs 0.184 af Outflow=2.04 cfs 0.184 af
<b>Pond 2P: Roof Drywell</b>	Peak Elev=94.84' Storage=976 cf Inflow=0.81 cfs 0.067 af Discarded=0.05 cfs 0.061 af Primary=0.20 cfs 0.006 af Outflow=0.25 cfs 0.067 af
<b>Pond P-1: Basin</b>	Peak Elev=93.68' Storage=1,057 cf Inflow=2.03 cfs 0.161 af Discarded=0.10 cfs 0.090 af Primary=1.91 cfs 0.069 af Outflow=2.01 cfs 0.159 af
<b>Total Runoff Area = 1.329 ac Runoff Volume = 0.625 af Average Runoff Depth = 5.64"</b>	
<b>70.98% Pervious = 0.943 ac 29.02% Impervious = 0.386 ac</b>	

**Summary for Subcatchment SUB-1A:**

Runoff = 2.03 cfs @ 12.13 hrs, Volume= 0.161 af, Depth> 5.11"

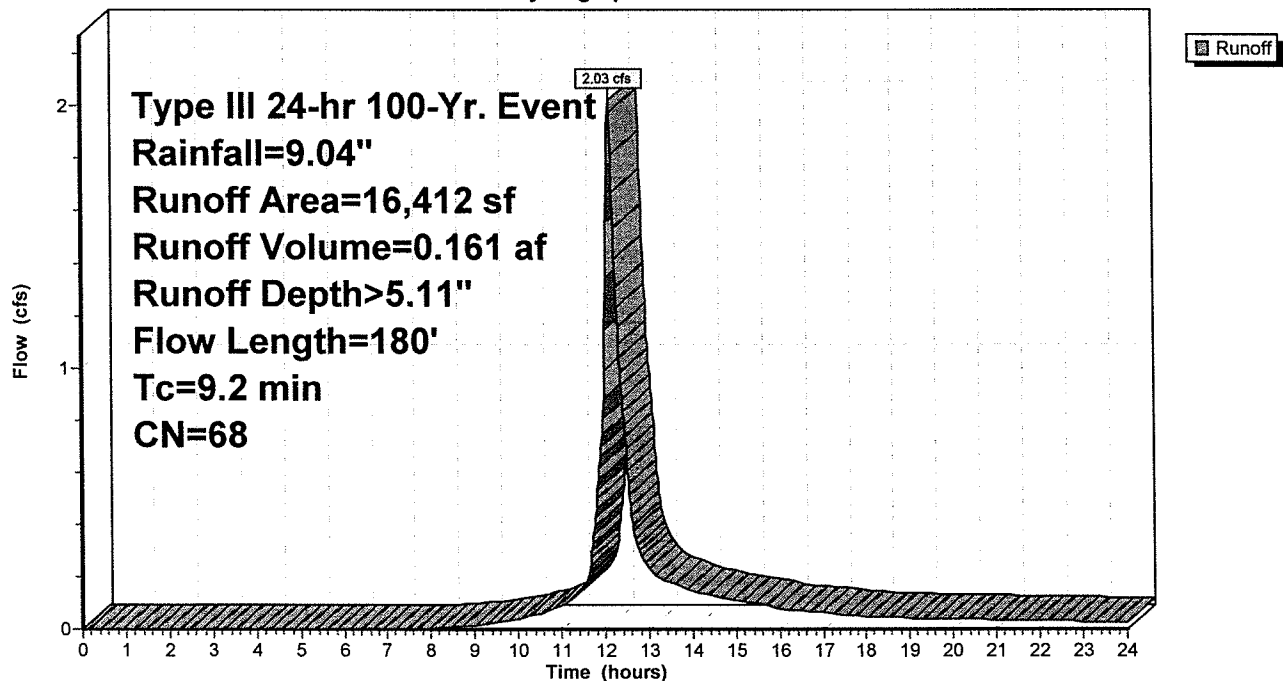
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs  
Type III 24-hr 100-Yr. Event Rainfall=9.04"

	Area (sf)	CN	Description
*	1,957	98	Pavement
	6,284	61	>75% Grass cover, Good, HSG B
	5,659	60	Woods, Fair, HSG B
*	2,512	82	Gravel
	16,412	68	Weighted Average
	14,455		88.08% Pervious Area
	1,957		11.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.20"
0.7	130	0.0347	3.00		<b>Shallow Concentrated Flow,</b> Unpaved Kv= 16.1 fps
9.2	180	Total			

**Subcatchment SUB-1A:**

Hydrograph





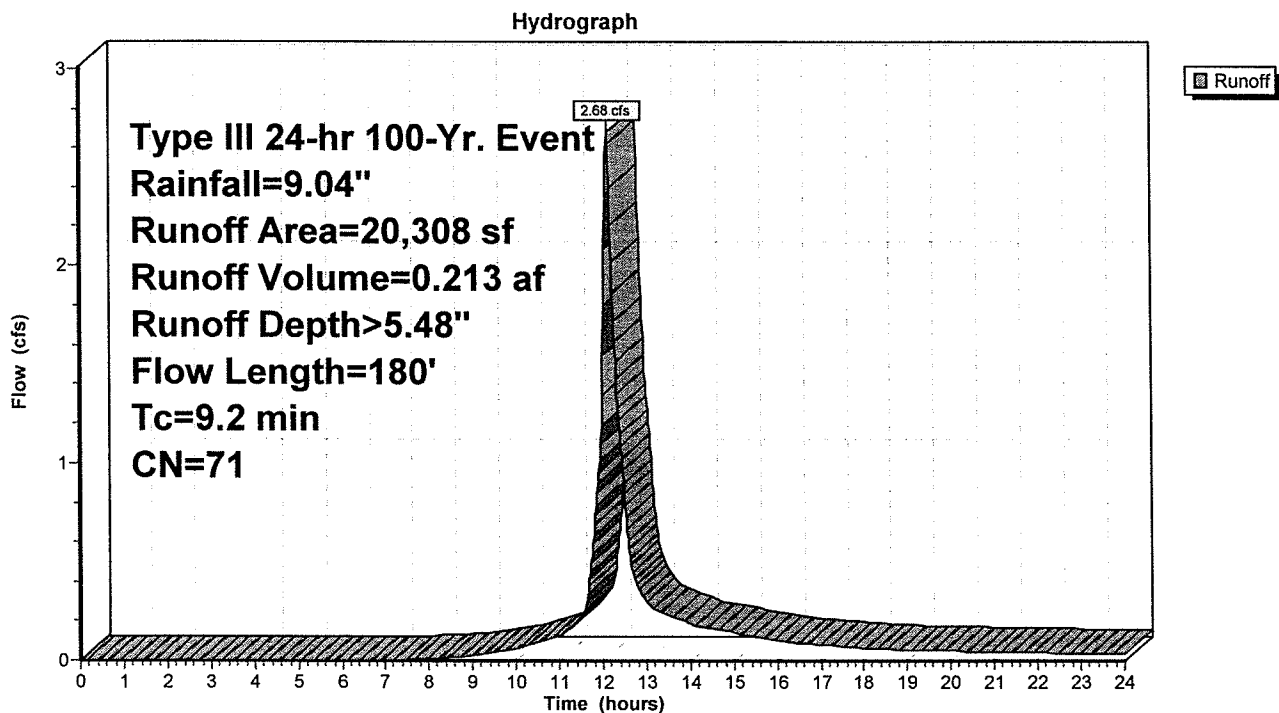
**Summary for Subcatchment SUB-1B:**

Runoff = 2.68 cfs @ 12.13 hrs, Volume= 0.213 af, Depth> 5.48"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs  
Type III 24-hr 100-Yr. Event Rainfall=9.04"

Area (sf)	CN	Description
* 789	98	Roof
* 4,368	98	Pavement
* 462	98	Concrete
2,128	61	>75% Grass cover, Good, HSG B
12,561	60	Woods, Fair, HSG B
20,308	71	Weighted Average
14,689		72.33% Pervious Area
5,619		27.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.20"
0.7	130	0.0347	3.00		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
9.2	180	Total			

**Subcatchment SUB-1B:**

**Summary for Subcatchment SUB-1C:**

Runoff = 0.81 cfs @ 12.08 hrs, Volume= 0.067 af, Depth> 8.79"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs  
Type III 24-hr 100-Yr. Event Rainfall=9.04"

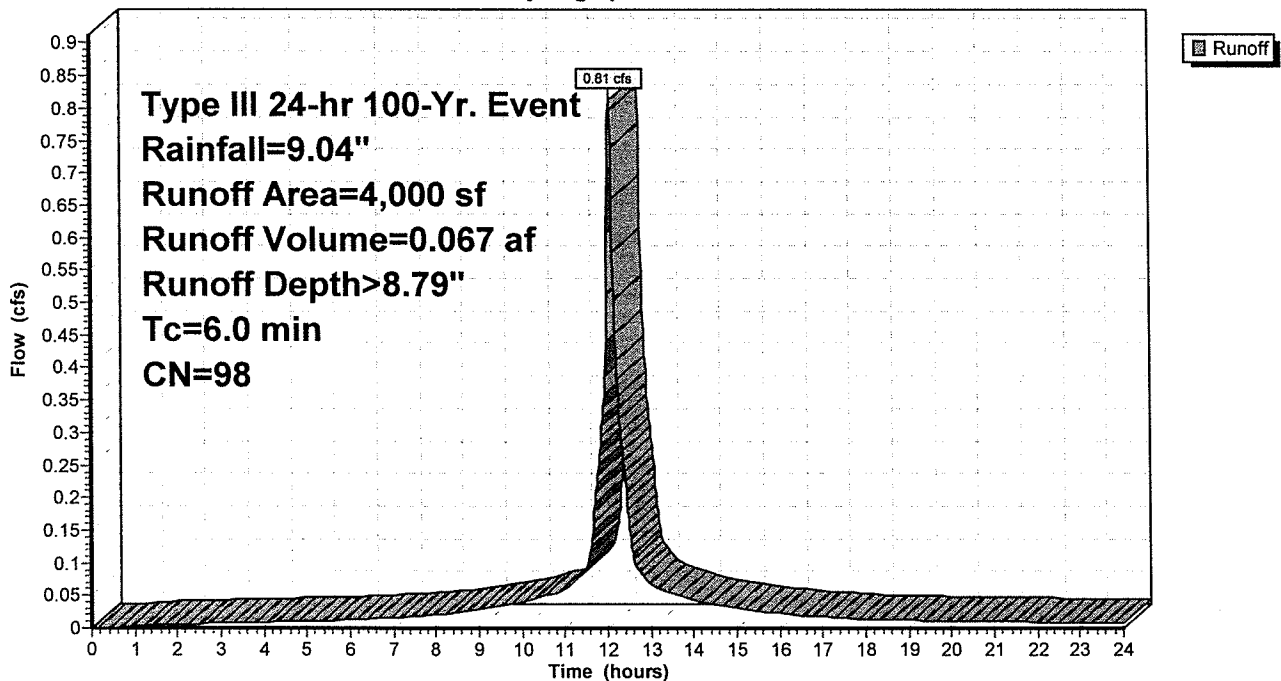
Area (sf)	CN	Description
* 4,000	98	Roof
4,000		100.00% Impervious Area

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

**Subcatchment SUB-1C:**

Hydrograph



**Summary for Subcatchment SUB-3:**

Runoff = 2.04 cfs @ 12.18 hrs, Volume= 0.184 af, Depth> 5.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs  
Type III 24-hr 100-Yr. Event Rainfall=9.04"

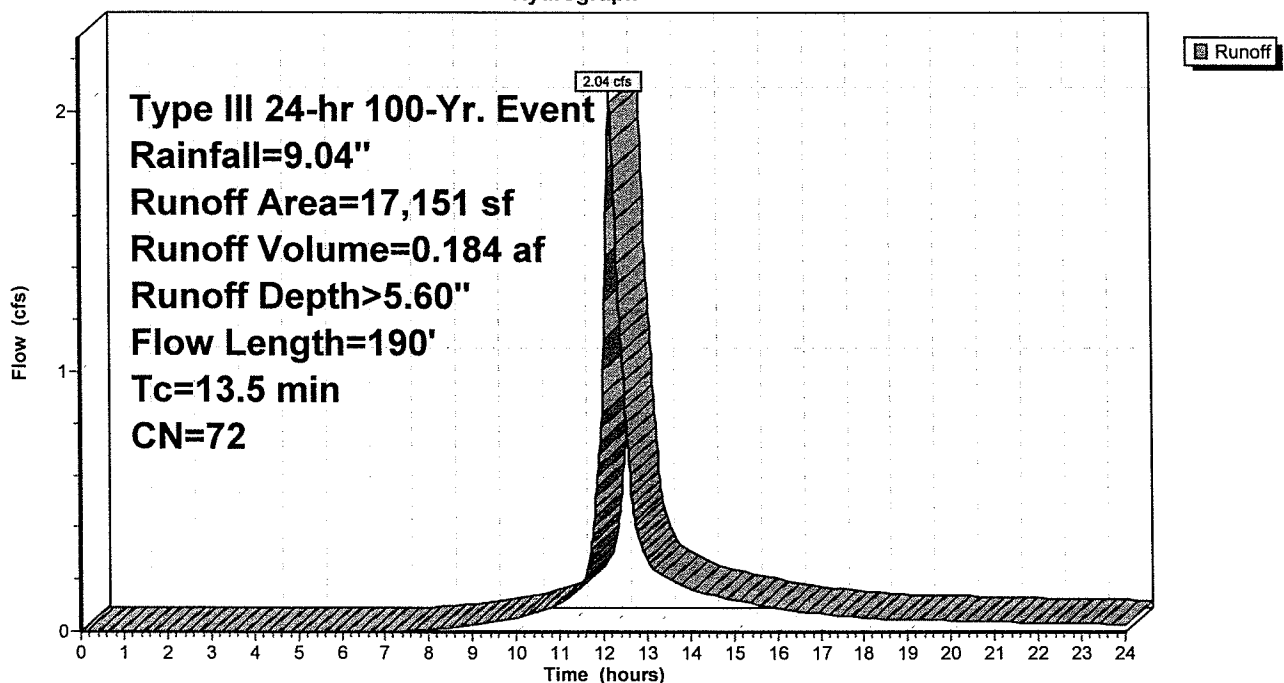
Area (sf)	CN	Description
4,638	60	Woods, Fair, HSG B
* 3,184	98	Pavement
* 567	98	Concrete
7,296	61	>75% Grass cover, Good, HSG B
* 1,466	98	Roof
17,151	72	Weighted Average
11,934		69.58% Pervious Area
5,217		30.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		<b>Sheet Flow,</b>
					Woods: Light underbrush n= 0.400 P2= 3.20"
1.2	140	0.0140	1.90		<b>Shallow Concentrated Flow,</b>
					Unpaved Kv= 16.1 fps
13.5	190	Total			

**Subcatchment SUB-3:**

Hydrograph



**Summary for Reach DP-1:**

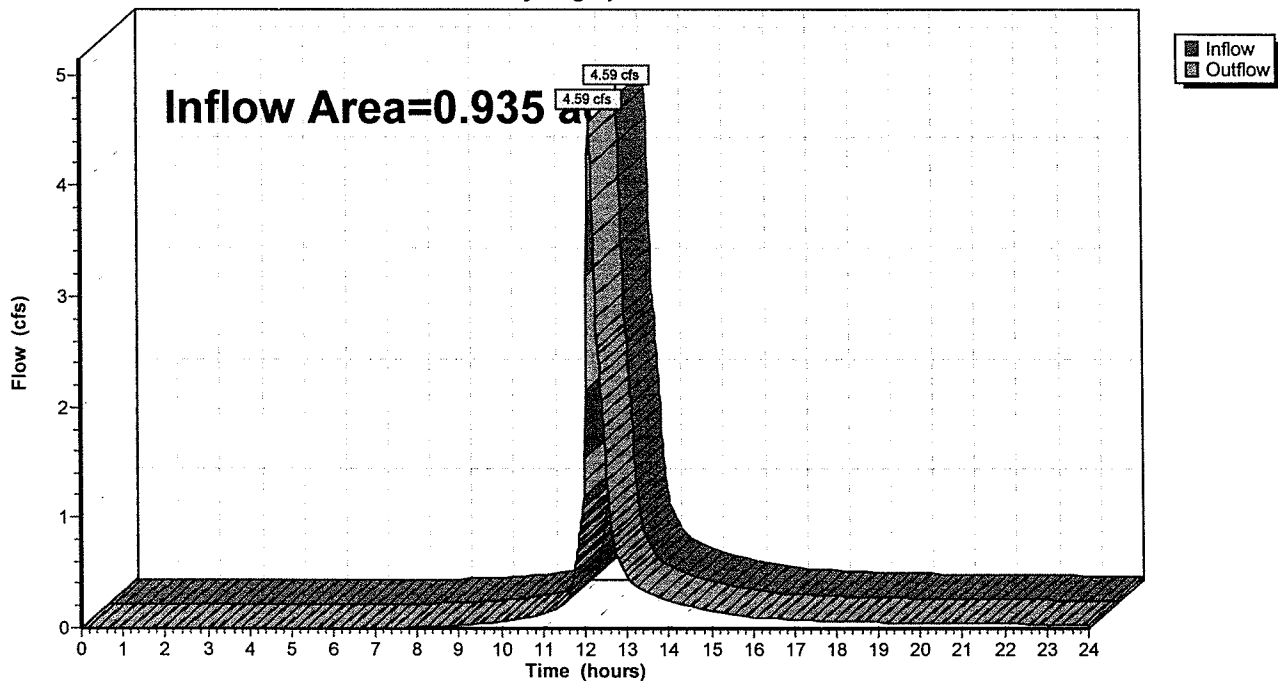
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.935 ac, 28.43% Impervious, Inflow Depth > 3.70" for 100-Yr. Event event  
Inflow = 4.59 cfs @ 12.14 hrs, Volume= 0.288 af  
Outflow = 4.59 cfs @ 12.14 hrs, Volume= 0.288 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

**Reach DP-1:**

Hydrograph



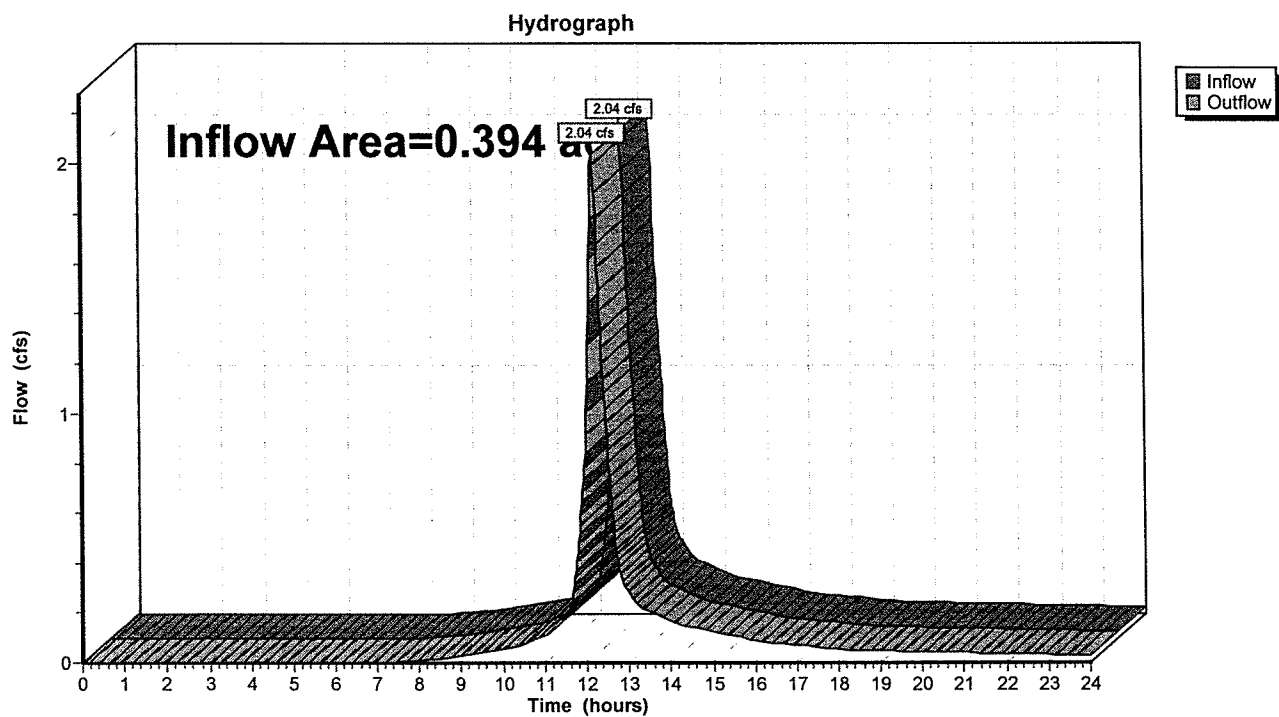
### Summary for Reach DP-3:

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

Inflow Area = 0.394 ac, 30.42% Impervious, Inflow Depth > 5.60" for 100-Yr. Event event  
 Inflow = 2.04 cfs @ 12.18 hrs, Volume= 0.184 af  
 Outflow = 2.04 cfs @ 12.18 hrs, Volume= 0.184 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

### Reach DP-3:



**Summary for Pond 2P: Roof Drywell**

[87] Warning: Oscillations may require Finer Routing or smaller dt

Inflow Area = 0.092 ac, 100.00% Impervious, Inflow Depth > 8.79" for 100-Yr. Event event  
 Inflow = 0.81 cfs @ 12.08 hrs, Volume= 0.067 af  
 Outflow = 0.25 cfs @ 12.39 hrs, Volume= 0.067 af, Atten= 70%, Lag= 18.6 min  
 Discarded = 0.05 cfs @ 10.96 hrs, Volume= 0.061 af  
 Primary = 0.20 cfs @ 12.39 hrs, Volume= 0.006 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs  
 Peak Elev= 94.84' @ 12.39 hrs Surf.Area= 859 sf Storage= 976 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)  
 Center-of-Mass det. time= 133.6 min ( 872.9 - 739.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	93.40'	513 cf	<b>Chambers</b> Listed below Inside #2
#2	92.90'	654 cf	<b>Stone Backfill (Prismatic)</b> Listed below (Recalc)
			2,148 cf Overall - 513 cf Embedded = 1,635 cf x 40.0% Voids
			1,167 cf Total Available Storage

Elevation (feet)	Cum.Store (cubic-feet)
93.40	0
94.80	513

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
92.90	859	0	0
93.90	859	859	859
95.40	859	1,289	2,148

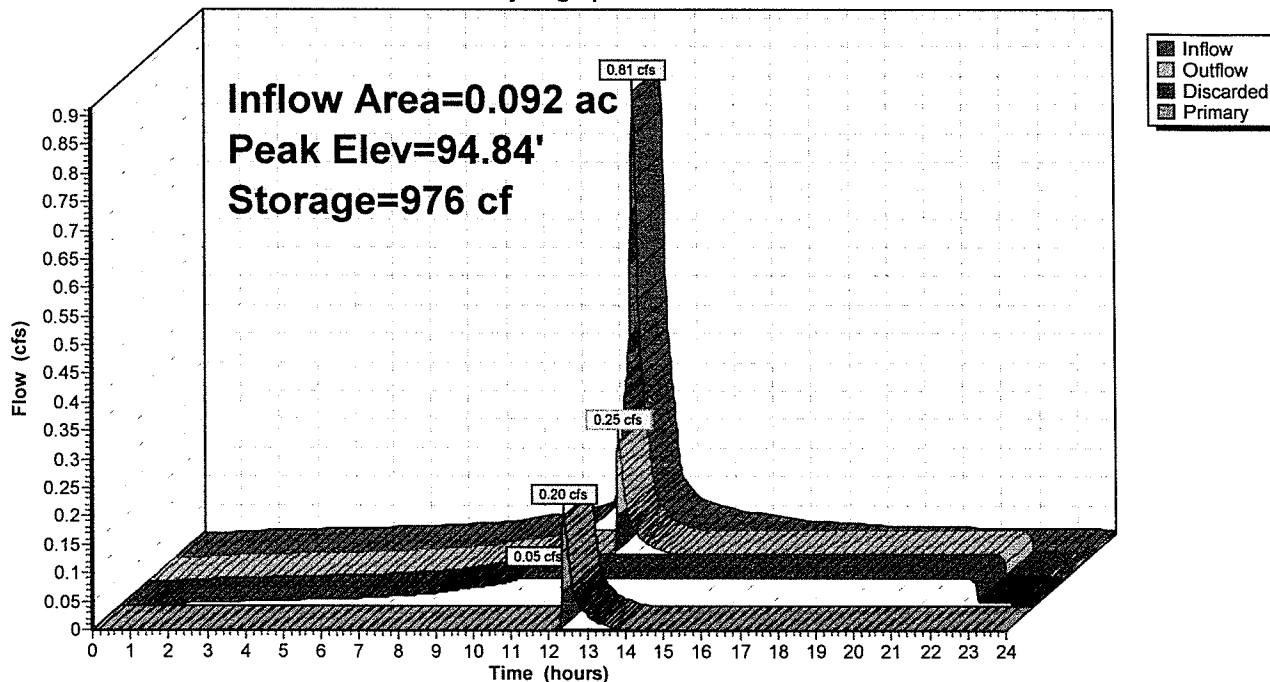
Device	Routing	Invert	Outlet Devices
#1	Discarded	92.90'	<b>2.410 in/hr Exfiltration over Surface area</b>
#2	Primary	94.75'	<b>4.0" Horiz. Orifice/Grate X 2.00</b> C= 0.600 Limited to weir flow at low heads

**Discarded OutFlow** Max=0.05 cfs @ 10.96 hrs HW=92.93' (Free Discharge)  
 ↳1=Exfiltration (Exfiltration Controls 0.05 cfs)

**Primary OutFlow** Max=0.20 cfs @ 12.39 hrs HW=94.84' TW=0.00' (Dynamic Tailwater)  
 ↳2=Orifice/Grate (Weir Controls 0.20 cfs @ 1.01 fps)

# Pond 2P: Roof Drywell

Hydrograph



**Summary for Pond P-1: Basin**

Inflow Area = 0.377 ac, 11.92% Impervious, Inflow Depth > 5.11" for 100-Yr. Event event  
 Inflow = 2.03 cfs @ 12.13 hrs, Volume= 0.161 af  
 Outflow = 2.01 cfs @ 12.14 hrs, Volume= 0.159 af, Atten= 1%, Lag= 0.8 min  
 Discarded = 0.10 cfs @ 12.14 hrs, Volume= 0.090 af  
 Primary = 1.91 cfs @ 12.14 hrs, Volume= 0.069 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

Peak Elev= 93.68' @ 12.14 hrs Surf.Area= 1,728 sf Storage= 1,057 cf

Plug-Flow detention time= 69.4 min calculated for 0.159 af (99% of inflow)

Center-of-Mass det. time= 64.8 min ( 890.2 - 825.4 )

Volume	Invert	Avail.Storage	Storage Description
#1	91.60'	1,285 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) 3,211 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
91.60	688	0	0
92.00	1,026	343	343
93.00	1,420	1,223	1,566
94.00	1,871	1,646	3,211

Device	Routing	Invert	Outlet Devices
#1	Discarded	91.60'	<b>2.410 in/hr Exfiltration over Surface area</b>
#2	Primary	93.50'	<b>10.0' long x 3.0' 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
			Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68
			2.72 2.81 2.92 2.97 3.07 3.32

**Discarded OutFlow** Max=0.10 cfs @ 12.14 hrs HW=93.68' (Free Discharge)

↑ **1=Exfiltration** (Exfiltration Controls 0.10 cfs)

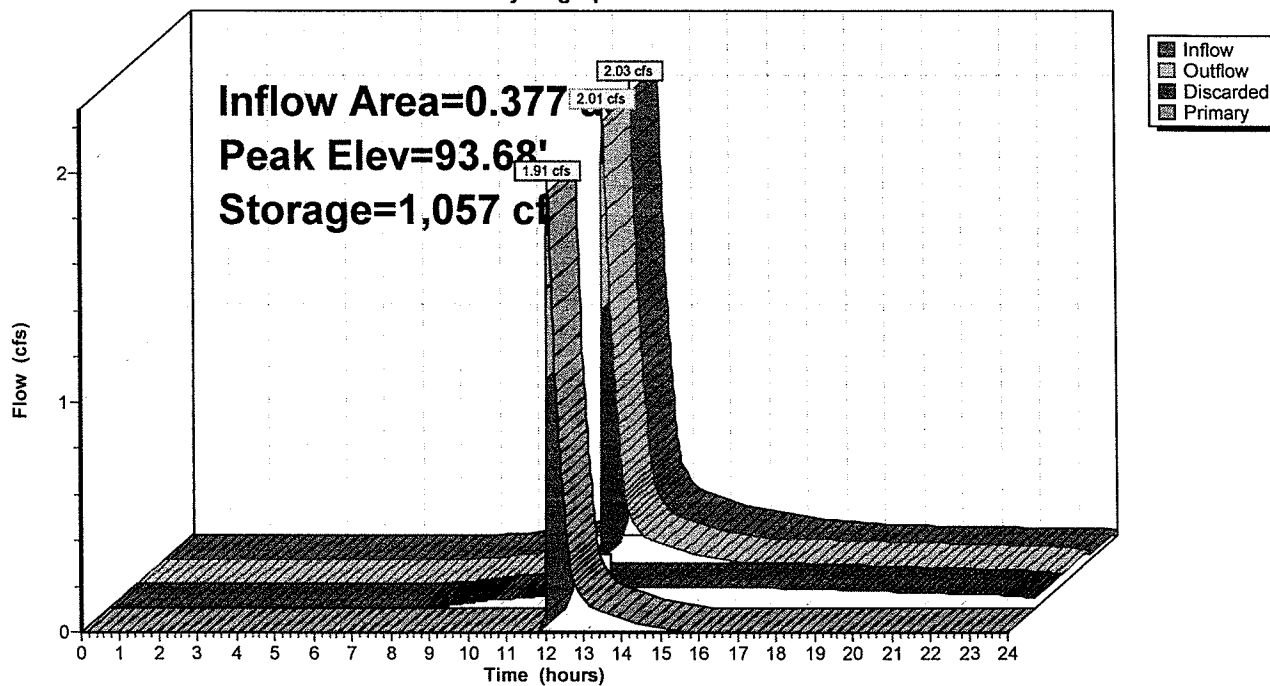
**Primary OutFlow** Max=1.91 cfs @ 12.14 hrs HW=93.68' TW=0.00' (Dynamic Tailwater)

↑ **2=Broad-Crested Rectangular Weir** (Weir Controls 1.91 cfs @ 1.04 fps)



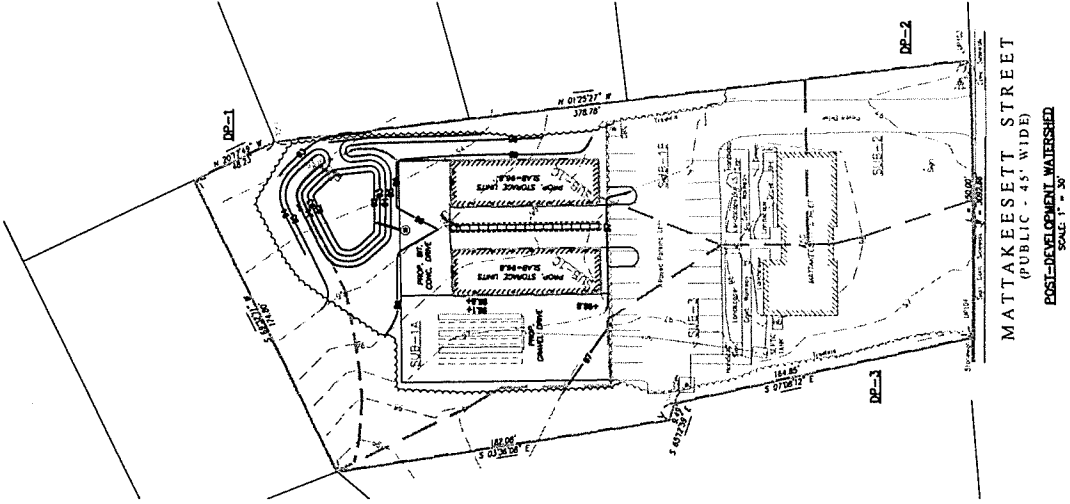
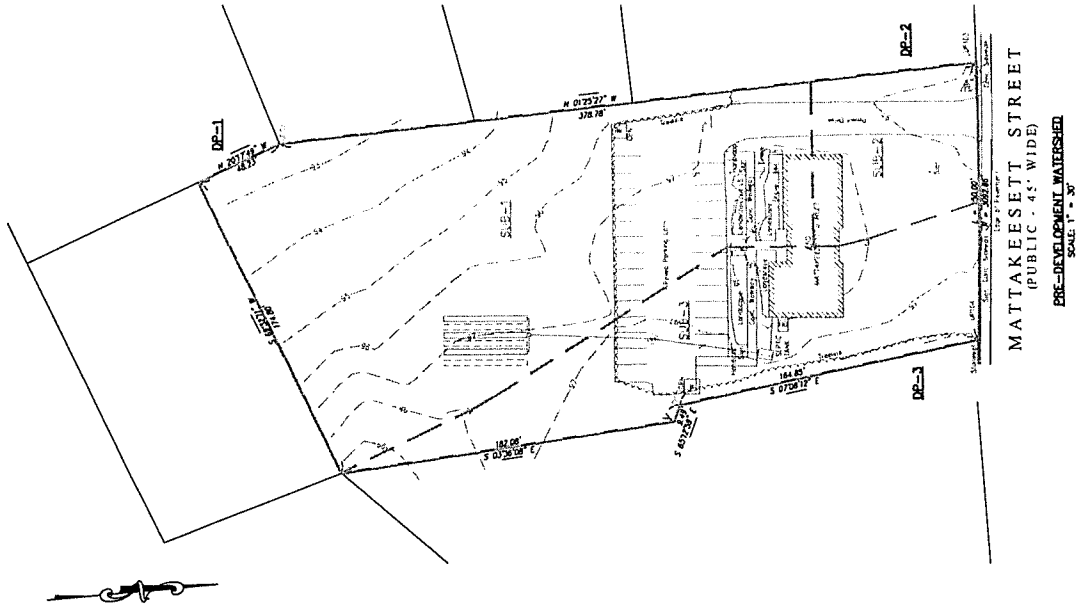
# Pond P-1: Basin


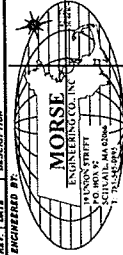
Hydrograph

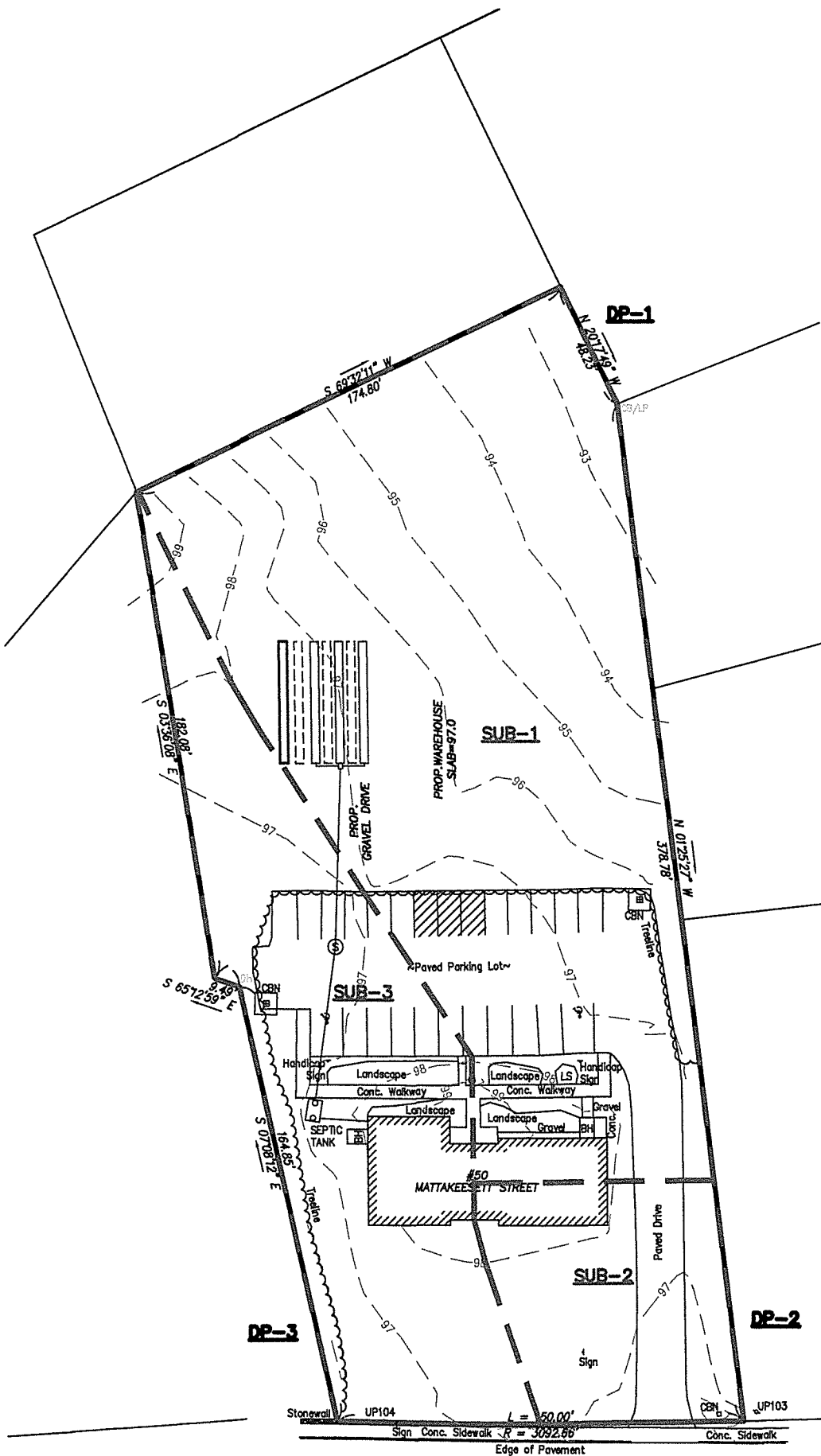


**PLANS**

- Watershed Delineation Plan (WS-1 & WS-2)

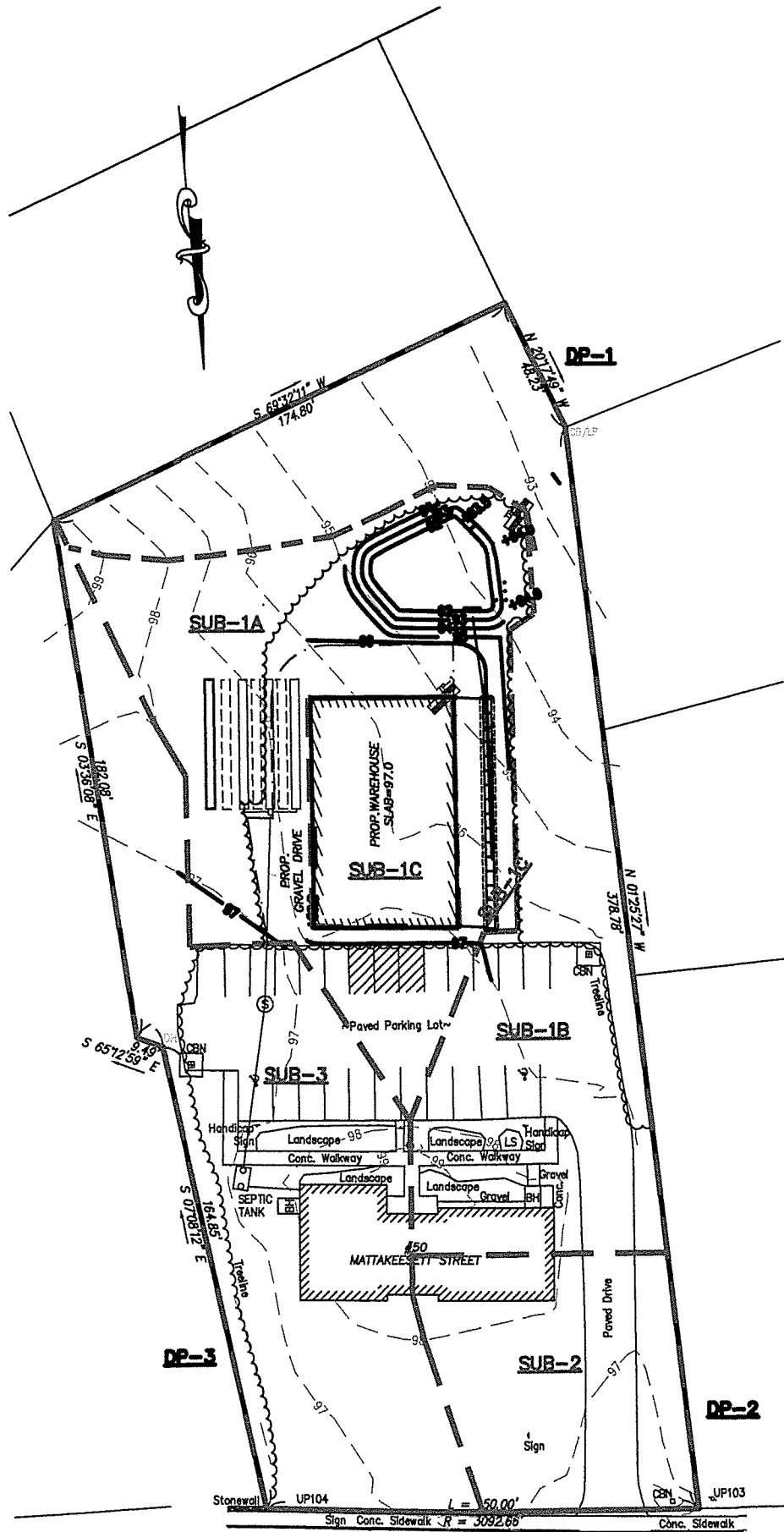


REF. DATE	DESCRIPTION	BY
ENGINEERED BY:		
		
		
PROJECT:	PROPOSED SITE PLAN 50 MATTAKEESSETT STREET ASSESSOR'S PARCEL: 02359 PEMBROKE, MASSACHUSETTS 02359	PERSON: JSC 18-768 DATE: 03/26/10 REV:
PREPARED FOR:	NIKE BULMAN P.O. BOX 20 SCITUATE, MA 02066	SHEET: 1 OF 1
PLAN TITLE: WATERSHED PLANS		



MATTAKEESETT STREET  
(PUBLIC - 45' WIDE)

PRE-DEVELOPMENT WATERSHED



**MATTAKEESETT STREET**  
(PUBLIC - 45' WIDE)

POST-DEVELOPMENT WATERSHED