

## **DRAINAGE ANALYSIS**

Project: Reduced Standard Subdivision  
BettyJoe Way  
84 State Road West  
Westminster, MA 01473

Applicant: Bear Investments, LLC  
6 Brooks Avenue  
Westminster, MA 01473

Date: 15 May 2020



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### **Trowbridge Engineering Company**

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*Consulting Civil/Site Engineers*  
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## **NARRATIVE**

### INTRODUCTION

Trowbridge Engineering, LLC. has prepared this Drainage Analysis as part of the submittal and design of a reduced construction standard residential subdivision serving two single family houses.

The site is located at 84 State Road West (Rte. 2A) in Westminster MA. The site currently has a single family house located on it. This house is set back approximately 100' off of State Road West. The house has a paved driveway that transitions to a gravel surface before reaching the house. The driveway connects to a walkout entrance on the east side of the house and then continues to a gravel parking area right behind the house. Another gravel road runs back from this parking area to a gravel parking / storage area located about 500' from State Road West. A new single family house is proposed in this area.

The area around the existing house is open with a lawn. The area behind the house is a mix of unmaintained grass, brush and saplings. The gravel parking / storage area was previously used by a landscaping business. There are soil stockpiles and construction materials still located onsite.

The parking / storage area represents a knoll / high spot on the lot at an elevation of 120± and there are generally moderate to shallow slopes running down toward State Road West, which is at elevation 97±. The site drainage flows toward the northeast corner of the lot to a small pond located partially on the property and extending into the State Road West ROW. The water in this pond flows northerly through a culvert under State Road West. A more complete presentation is made on the attached site plans. (TE Plan No. M19024-2 dated 15 May 2020)

### METHOD OF ANALYSIS

The attached calculations were conducted utilizing techniques development by the USDA Soil Conservation Service. The analysis was performed utilizing the HydroCAD software program developed by Applied Microcomputer Systems.

### SOILS

The soils information for this area is shown on the USDA SCS *Worcester County, MA Northwest Part Atlas, Sheet 12*. A site locus from MassGIS showing soil units has been provided in this booklet.

- The property is underlain by an Allagash (62B) soil unit.
- The Allagash series consists of nearly level to strongly sloping, deep, well drained soils on glacial outwash plains, terraces and kames. They formed in water-sorted, sandy glacial material. Allagash soils have a very friable fine sandy loam surface soils and a very friable to loose fine sandy loam to gravelly loamy fine sand subsoil with moderately rapid permeability, over a loose stratified sand substratum 28"- 32" with rapid permeability. Major limitations are related to slope.
- Allagash soils are classified in Hydrologic Group A.

### RUNOFF CURVE NUMBERS

The runoff curve numbers utilized in the calculations are from the Soil Conservation Service's "Urban Hydrology for Small Watersheds", Technical Release 55 and are incorporated into the HydroCad software.

## DESIGN CRITERIA

This analysis was conducted using Type III, 24 hour rainfall. The storm frequencies analyzed are the 2, 10 and 100 year storm events. The rainfall amounts utilized are from the maps developed by the Soil Conservation Service for Massachusetts which are based upon "Rainfall Frequency Atlas of the United States", Technical Paper 40. This information is also incorporated into the HydroCad software.

## HYDROLOGIC ANALYSIS

- To determine the pre-development runoff conditions the site was analyzed with a single subcatchment that incorporates the area to be developed including the existing house, lawn, driveways and extending up to the gravel parking / storage area. Runoff from this subcatchment is directed toward a design point located at the existing pond at the northeast corner of the lot near State Road West. (See the pre-development delineation found in the "Pre-Development Development Analysis" in this booklet.) Other areas on the lot flow in different directions and the proposed project will not affect them.
- Post-development runoff conditions were modeled using a slightly larger single subcatchment that includes part of the new house. It shows the conversion of the gravel parking / storage area to a septic system / lawn area and the abandonment of the existing gravel road to this area. It includes the construction of the new road / driveway to be used by the new house. (See the post-development delineation found in the "Post-Development Development Analysis" in this booklet.)

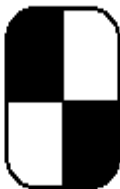
## CONCLUSION

The model indicates that the pre- and post- development peak flows are mitigated and improved upon as tabulated below:

<b><u>Storm Event</u></b>	<b><u>Pre-Development Peak Flows</u></b>	<b><u>Post-Development Peak Flows</u></b>
2 YEAR	0.26 cfs	0.03 cfs
10 YEAR	1.25 cfs	0.86 cfs
100 YEAR	3.00 cfs	2.47 cfs

## **TROWBRIDGE ENGINEERING, LLC**

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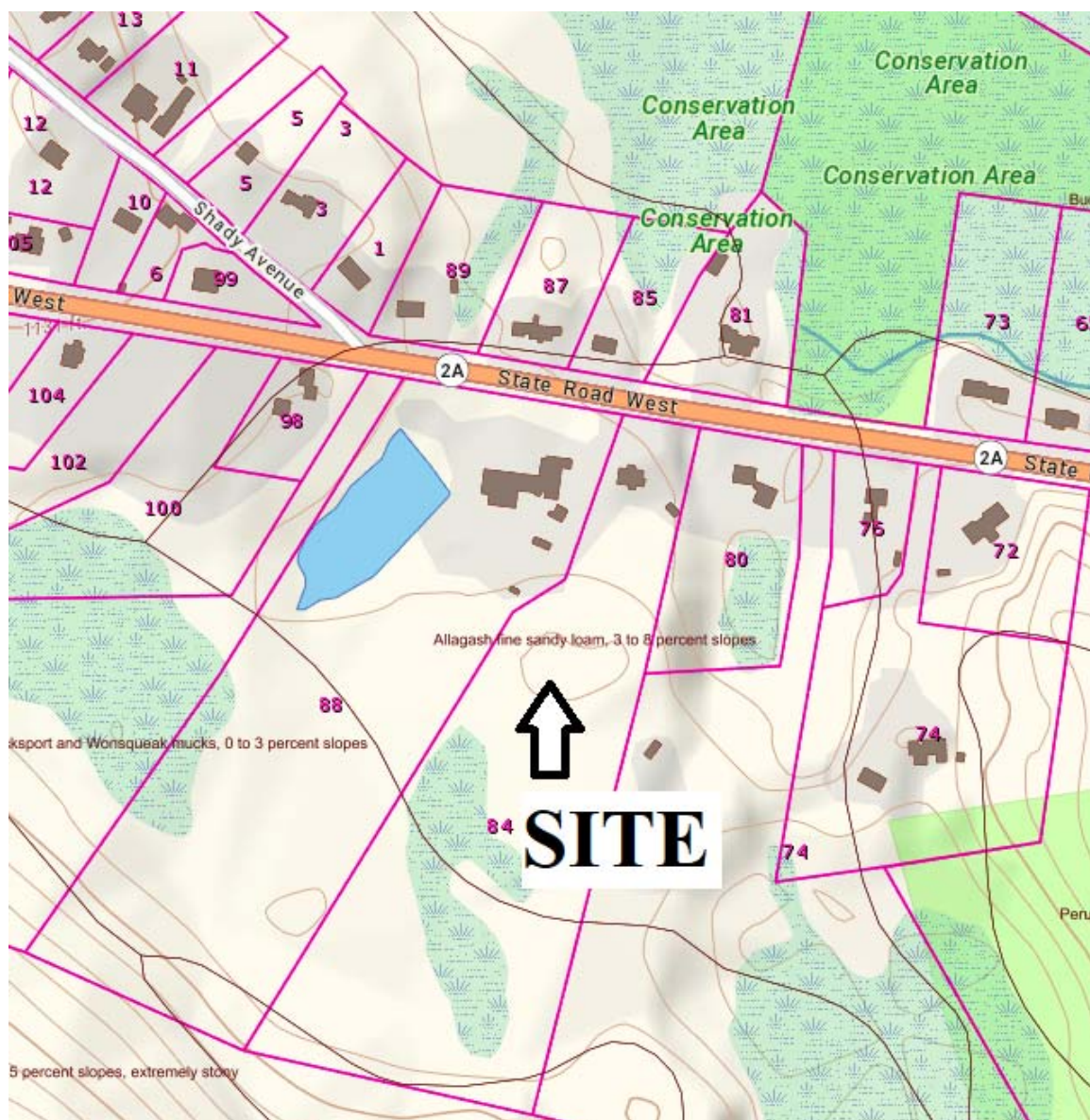


Client: Bear Investments, LLC

Site: BettyJoe Way (off State Road West) Westminster, MA

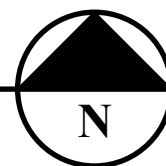
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Date 13 May 2020

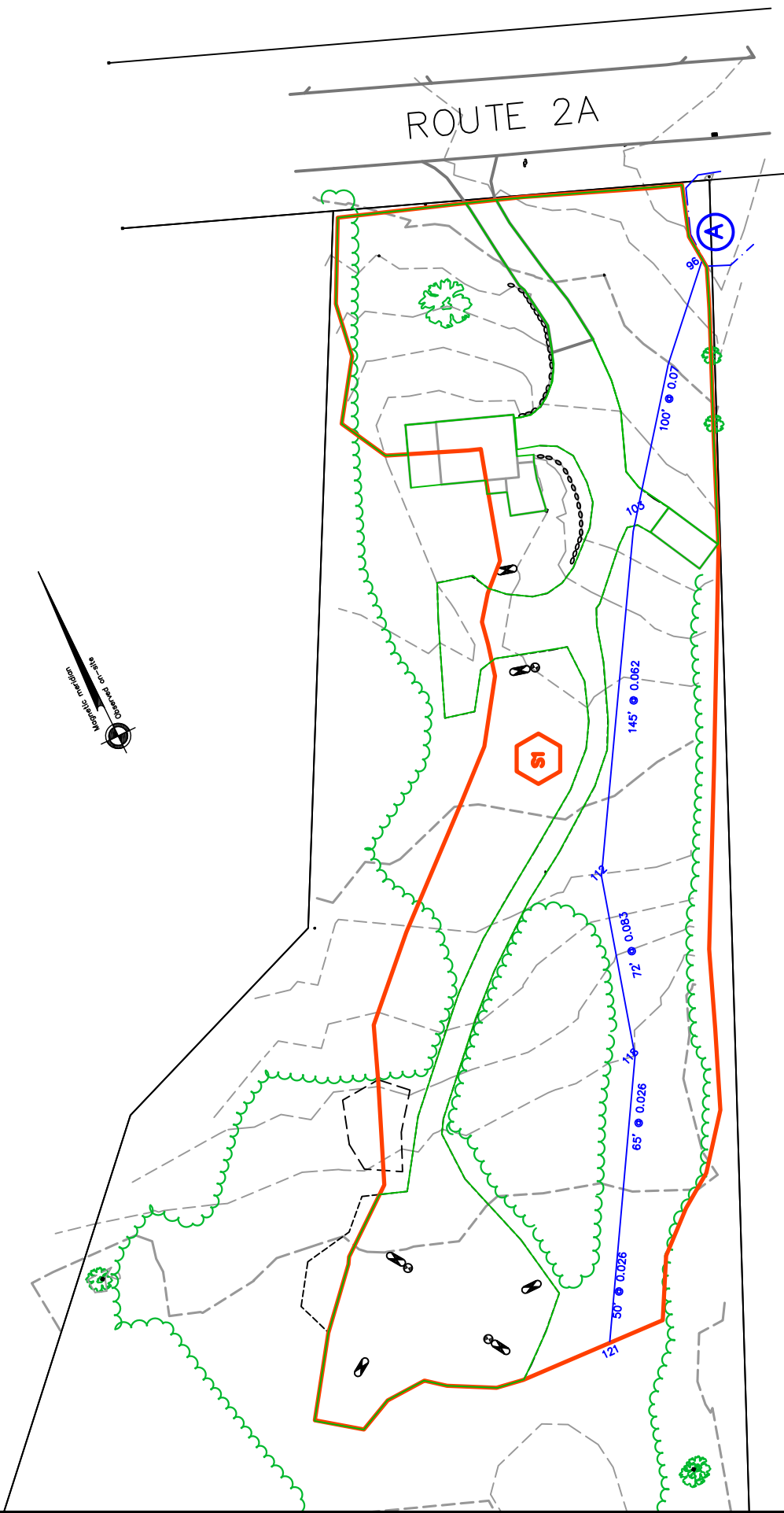
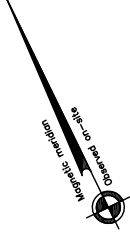


## **SITE SOILS INFORMATION**

Source: MassGIS

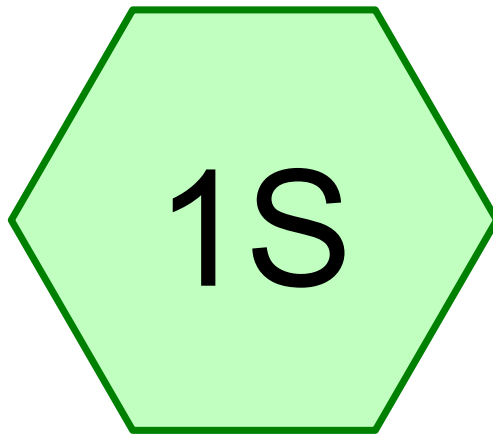


**PRE-DEVELOPMENT**  
**DRAINAGE ANALYSIS**

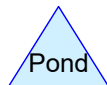
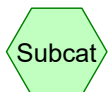


- Design Point (A)
- Subcatchment Number (S1)
- Subcatchment Boundary (Red line)
- Subcatchment Flow Route (Blue line)

# PRE DEVELOPMENT PLAN



# Current Condition



## BettyJoe Way - Pre-Development

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### Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.640	48	Brush, Poor, HSG A (1S)
0.290	49	50-75% Grass cover, Fair, HSG A (1S)
0.310	98	Paved parking, HSG A (1S)
0.040	98	Unconnected roofs, HSG A (1S)



## BettyJoe Way - Pre-Development

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### Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
1.280	HSG A	1S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	

**BettyJoe Way - Pre-Development***Type III 24-hr 2-Year Rainfall=3.00"*

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points

Runoff by SCS TR-20 method, UH=SCS

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

**Subcatchment 1S: Current Condition**

Runoff Area=1.280 ac 27.34% Impervious Runoff Depth&gt;0.32"

Flow Length=432' Tc=9.1 min UI Adjusted CN=61 Runoff=0.26 cfs 0.034 af

**BettyJoe Way - Pre-Development**

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Type III 24-hr 2-Year Rainfall=3.00"

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**Summary for Subcatchment 1S: Current Condition**

Runoff = 0.26 cfs @ 12.21 hrs, Volume= 0.034 af, Depth&gt; 0.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

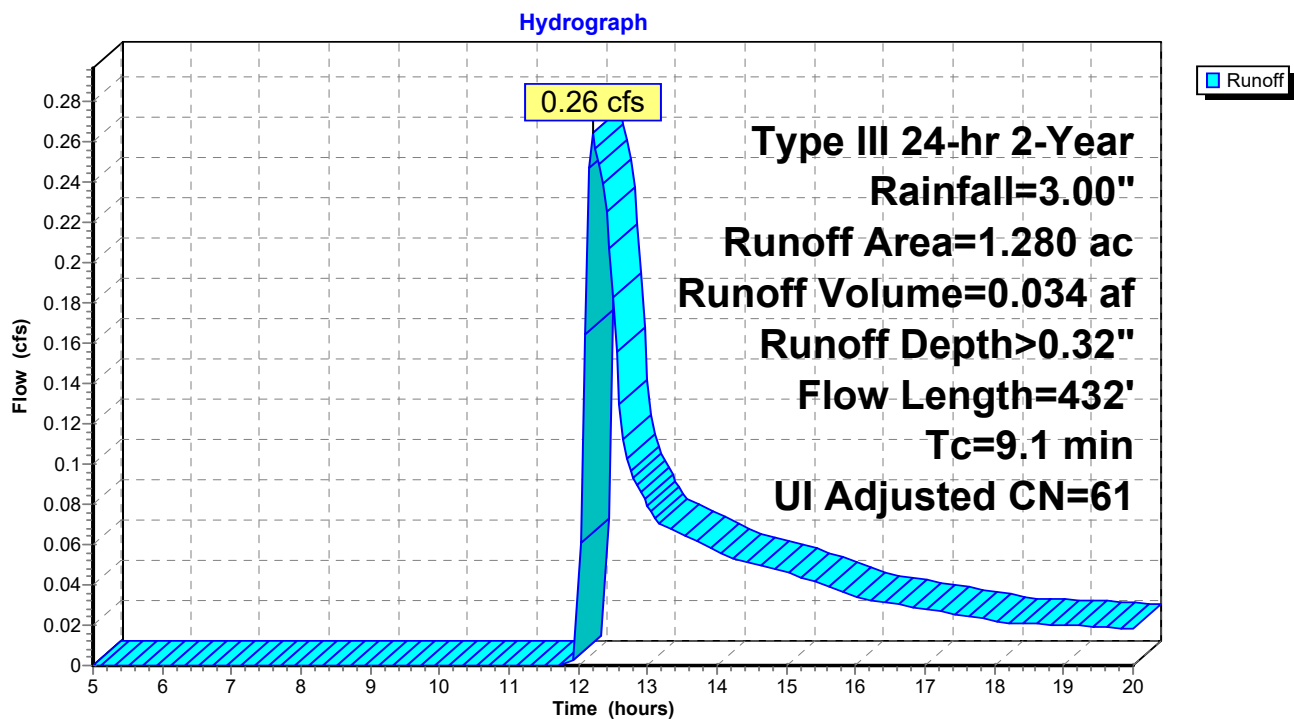
Type III 24-hr 2-Year Rainfall=3.00"

Area (ac)	CN	Description
0.310	98	Paved parking, HSG A
0.040	98	Unconnected roofs, HSG A
0.290	49	50-75% Grass cover, Fair, HSG A
0.640	48	Brush, Poor, HSG A
1.280	62	Weighted Average, UI Adjusted CN = 61
0.930		72.66% Pervious Area
0.350		27.34% Impervious Area
0.040		11.43% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	50	0.0260	0.16		<b>Sheet Flow, SF</b> Grass: Short n= 0.150 P2= 3.00"
1.0	65	0.0260	1.13		<b>Shallow Concentrated Flow, SCF</b> Short Grass Pasture Kv= 7.0 fps
0.6	72	0.0830	2.02		<b>Shallow Concentrated Flow, SCF</b> Short Grass Pasture Kv= 7.0 fps
1.4	145	0.0620	1.74		<b>Shallow Concentrated Flow, SCF</b> Short Grass Pasture Kv= 7.0 fps
0.9	100	0.0700	1.85		<b>Shallow Concentrated Flow, SCF</b> Short Grass Pasture Kv= 7.0 fps
9.1	432	Total			

**Subcatchment 1S: Current Condition**



**BettyJoe Way - Pre-Development***Type III 24-hr 10-Year Rainfall=4.50"*

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points

Runoff by SCS TR-20 method, UH=SCS

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

**Subcatchment 1S: Current Condition**

Runoff Area=1.280 ac 27.34% Impervious Runoff Depth&gt;0.97"

Flow Length=432' Tc=9.1 min UI Adjusted CN=61 Runoff=1.25 cfs 0.103 af

**BettyJoe Way - Pre-Development**

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

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**Summary for Subcatchment 1S: Current Condition**

Runoff = 1.25 cfs @ 12.15 hrs, Volume= 0.103 af, Depth&gt; 0.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

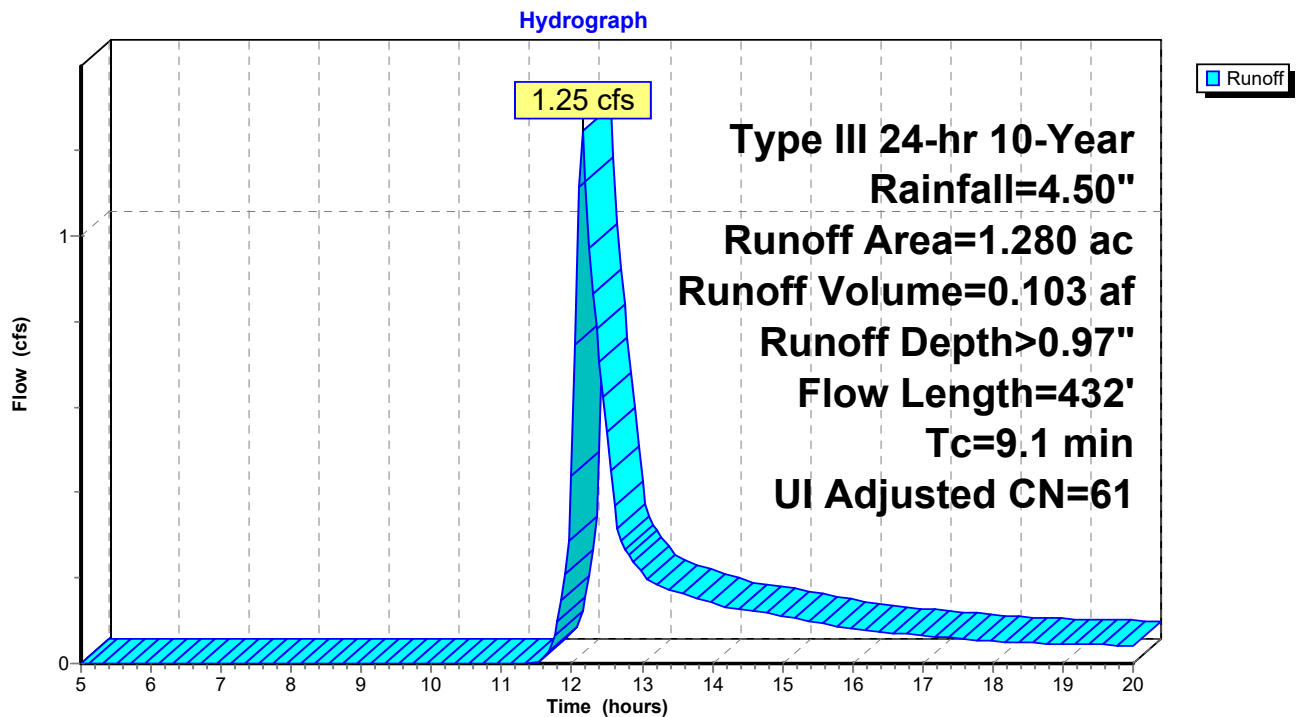
Type III 24-hr 10-Year Rainfall=4.50"

Area (ac)	CN	Description
0.310	98	Paved parking, HSG A
0.040	98	Unconnected roofs, HSG A
0.290	49	50-75% Grass cover, Fair, HSG A
0.640	48	Brush, Poor, HSG A
1.280	62	Weighted Average, UI Adjusted CN = 61
0.930		72.66% Pervious Area
0.350		27.34% Impervious Area
0.040		11.43% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	50	0.0260	0.16		<b>Sheet Flow, SF</b> Grass: Short n= 0.150 P2= 3.00"
1.0	65	0.0260	1.13		<b>Shallow Concentrated Flow, SCF</b> Short Grass Pasture Kv= 7.0 fps
0.6	72	0.0830	2.02		<b>Shallow Concentrated Flow, SCF</b> Short Grass Pasture Kv= 7.0 fps
1.4	145	0.0620	1.74		<b>Shallow Concentrated Flow, SCF</b> Short Grass Pasture Kv= 7.0 fps
0.9	100	0.0700	1.85		<b>Shallow Concentrated Flow, SCF</b> Short Grass Pasture Kv= 7.0 fps
9.1	432	Total			

**Subcatchment 1S: Current Condition**



**BettyJoe Way - Pre-Development***Type III 24-hr 100-Year Rainfall=6.50"*

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points

Runoff by SCS TR-20 method, UH=SCS

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

**Subcatchment 1S: Current Condition**

Runoff Area=1.280 ac 27.34% Impervious Runoff Depth&gt;2.15"

Flow Length=432' Tc=9.1 min UI Adjusted CN=61 Runoff=3.00 cfs 0.229 af



**BettyJoe Way - Pre-Development**

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Type III 24-hr 100-Year Rainfall=6.50"

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**Summary for Subcatchment 1S: Current Condition**

Runoff = 3.00 cfs @ 12.14 hrs, Volume= 0.229 af, Depth&gt; 2.15"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

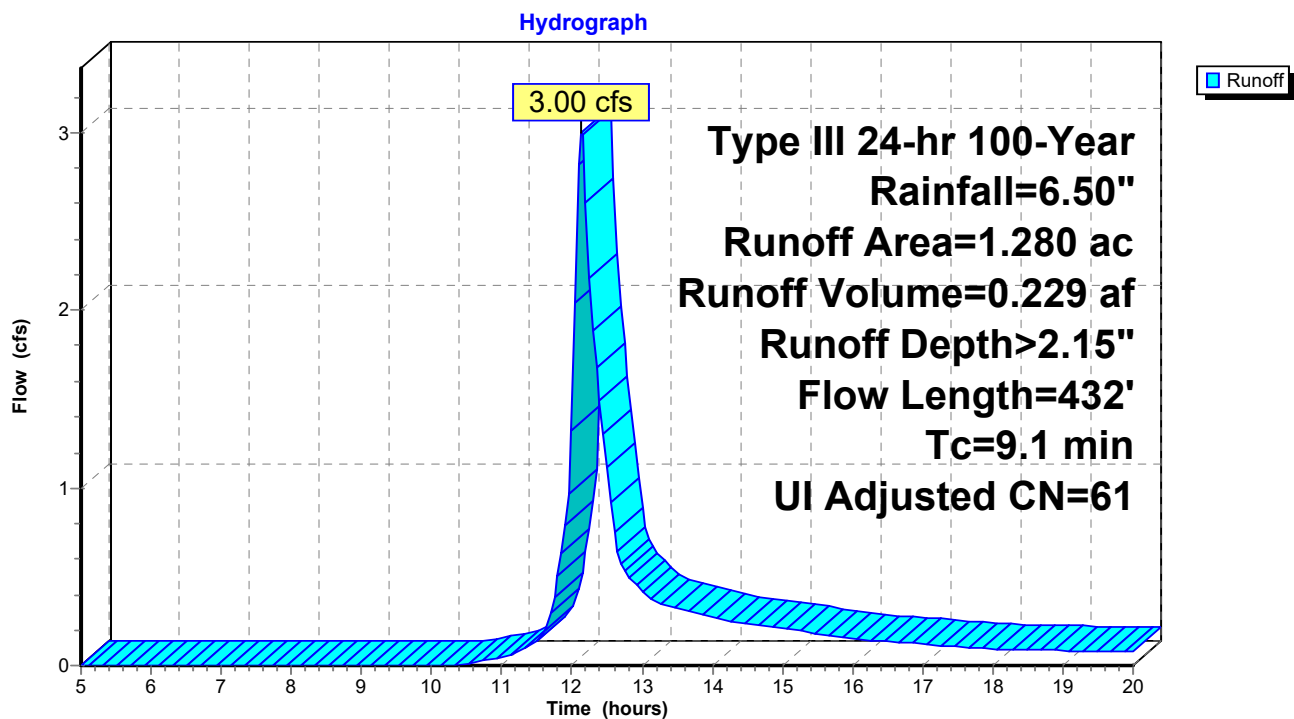
Type III 24-hr 100-Year Rainfall=6.50"

Area (ac)	CN	Description
0.310	98	Paved parking, HSG A
0.040	98	Unconnected roofs, HSG A
0.290	49	50-75% Grass cover, Fair, HSG A
0.640	48	Brush, Poor, HSG A
1.280	62	Weighted Average, UI Adjusted CN = 61
0.930		72.66% Pervious Area
0.350		27.34% Impervious Area
0.040		11.43% Unconnected

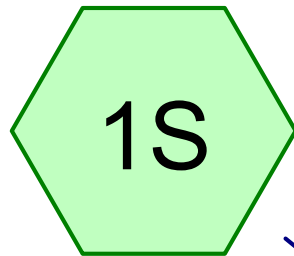
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	50	0.0260	0.16		<b>Sheet Flow, SF</b> Grass: Short n= 0.150 P2= 3.00"
1.0	65	0.0260	1.13		<b>Shallow Concentrated Flow, SCF</b> Short Grass Pasture Kv= 7.0 fps
0.6	72	0.0830	2.02		<b>Shallow Concentrated Flow, SCF</b> Short Grass Pasture Kv= 7.0 fps
1.4	145	0.0620	1.74		<b>Shallow Concentrated Flow, SCF</b> Short Grass Pasture Kv= 7.0 fps
0.9	100	0.0700	1.85		<b>Shallow Concentrated Flow, SCF</b> Short Grass Pasture Kv= 7.0 fps
9.1	432	Total			

**Subcatchment 1S: Current Condition**

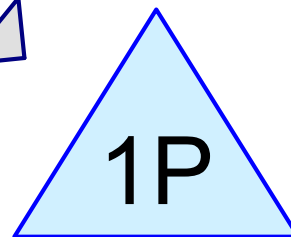
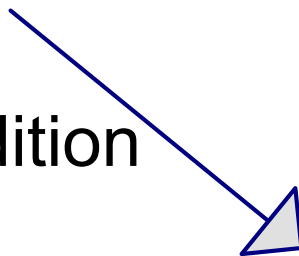


# **POST-DEVELOPMENT** **DRAINAGE ANALYSIS**

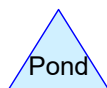
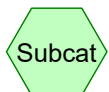




Future Condition



driveway sump



## BettyJoe Way - Post-Development

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### Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.600	48	Brush, Poor, HSG A (1S)
0.510	49	50-75% Grass cover, Fair, HSG A (1S)
0.210	98	Paved parking, HSG A (1S)
0.060	98	Unconnected roofs, HSG A (1S)

## BettyJoe Way - Post-Development

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### Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
1.380	HSG A	1S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	

**BettyJoe Way - Post-Development***Type III 24-hr 2-Year Rainfall=3.00"*

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Time span=5.00-20.00 hrs, dt=0.01 hrs, 1501 points

Runoff by SCS TR-20 method, UH=SCS

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

**Subcatchment 1S: Future Condition**

Runoff Area=1.380 ac 19.57% Impervious Runoff Depth&gt;0.21"

Flow Length=455' Tc=11.3 min UI Adjusted CN=57 Runoff=0.14 cfs 0.024 af

**Pond 1P: driveway sump**

Peak Elev=99.52' Storage=254 cf Inflow=0.14 cfs 0.024 af

Discarded=0.02 cfs 0.013 af Primary=0.03 cfs 0.005 af Outflow=0.06 cfs 0.019 af



**BettyJoe Way - Post-Development**

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Type III 24-hr 2-Year Rainfall=3.00"

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**Summary for Subcatchment 1S: Future Condition**

Runoff = 0.14 cfs @ 12.41 hrs, Volume= 0.024 af, Depth&gt; 0.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

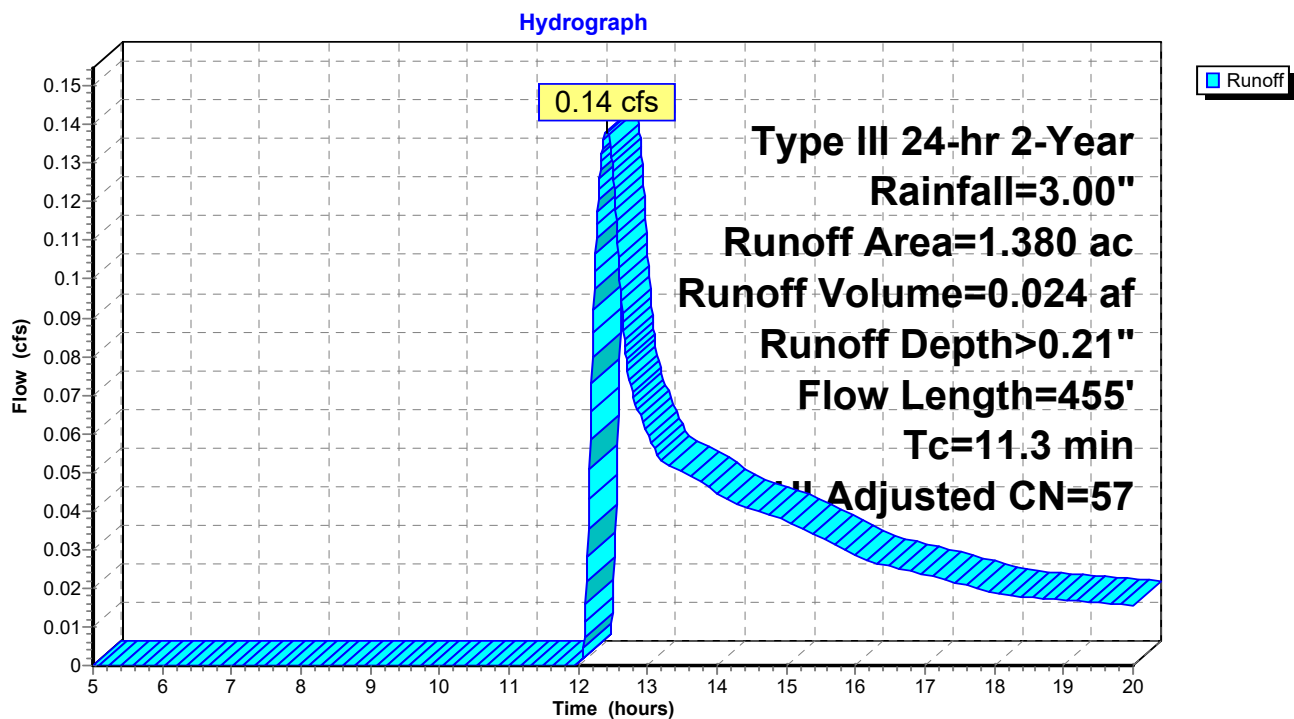
Type III 24-hr 2-Year Rainfall=3.00"

Area (ac)	CN	Description
0.210	98	Paved parking, HSG A
0.060	98	Unconnected roofs, HSG A
0.510	49	50-75% Grass cover, Fair, HSG A
0.600	48	Brush, Poor, HSG A
1.380	58	Weighted Average, UI Adjusted CN = 57
1.110		80.43% Pervious Area
0.270		19.57% Impervious Area
0.060		22.22% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	50	0.0100	0.11		<b>Sheet Flow, SF</b> Grass: Short n= 0.150 P2= 3.00"
0.9	71	0.0350	1.31		<b>Shallow Concentrated Flow, SCF</b> Short Grass Pasture Kv= 7.0 fps
0.7	83	0.0720	1.88		<b>Shallow Concentrated Flow, SCF</b> Short Grass Pasture Kv= 7.0 fps
1.5	129	0.0430	1.45		<b>Shallow Concentrated Flow, SCF</b> Short Grass Pasture Kv= 7.0 fps
0.3	72	0.0630	4.04		<b>Shallow Concentrated Flow, SCF</b> Unpaved Kv= 16.1 fps
0.2	50	0.0400	3.98	11.94	<b>Trap/Vee/Rect Channel Flow, grass swale</b> Bot.W=1.00' D=1.00' Z= 2.0 '/' Top.W=5.00' n= 0.050 Earth, long dense weeds
11.3	455	Total			

**Subcatchment 1S: Future Condition**



**BettyJoe Way - Post-Development**

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Type III 24-hr 2-Year Rainfall=3.00"

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**Summary for Pond 1P: driveway sump**

Inflow Area = 1.380 ac, 19.57% Impervious, Inflow Depth > 0.21" for 2-Year event  
 Inflow = 0.14 cfs @ 12.41 hrs, Volume= 0.024 af  
 Outflow = 0.06 cfs @ 13.11 hrs, Volume= 0.019 af, Atten= 60%, Lag= 42.1 min  
 Discarded = 0.02 cfs @ 13.11 hrs, Volume= 0.013 af  
 Primary = 0.03 cfs @ 13.11 hrs, Volume= 0.005 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs  
 Peak Elev= 99.52' @ 13.11 hrs Surf.Area= 309 sf Storage= 254 cf

Plug-Flow detention time= 107.6 min calculated for 0.019 af (79% of inflow)  
 Center-of-Mass det. time= 51.3 min ( 938.8 - 887.5 )

Volume	Invert	Avail.Storage	Storage Description
#1	97.80'	424 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

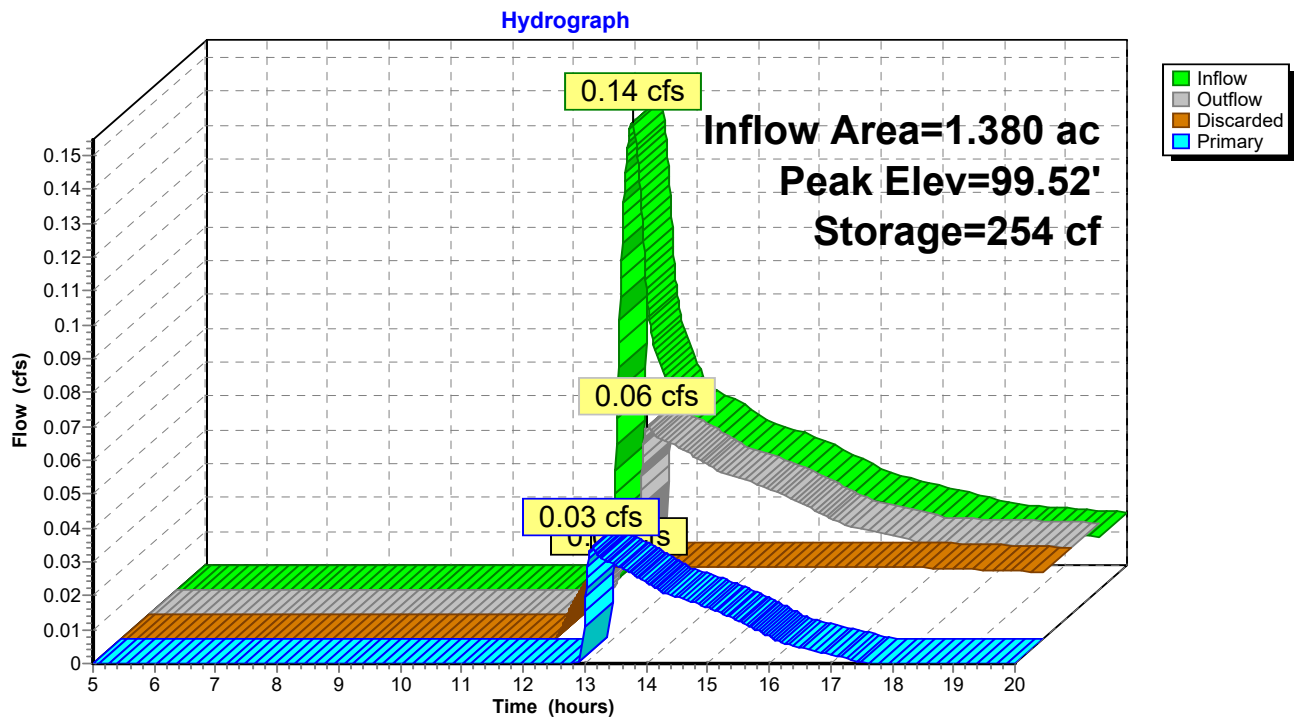
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
97.80	0	0	0
98.00	22	2	2
100.00	400	422	424

Device	Routing	Invert	Outlet Devices
#1	Primary	99.50'	<b>5.0' 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
#2	Discarded	97.80'	<b>2.410 in/hr Exfiltration over Surface area</b> Conductivity to Groundwater Elevation = 95.00'

**Discarded OutFlow** Max=0.02 cfs @ 13.11 hrs HW=99.52' (Free Discharge)  
 ↑**2=Exfiltration** ( Controls 0.02 cfs)

**Primary OutFlow** Max=0.03 cfs @ 13.11 hrs HW=99.52' (Free Discharge)  
 ↑**1=Broad-Crested Rectangular Weir** (Weir Controls 0.03 cfs @ 0.34 fps)

**Pond 1P: driveway sump**



**BettyJoe Way - Post-Development***Type III 24-hr 10-Year Rainfall=4.50"*

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Time span=5.00-20.00 hrs, dt=0.01 hrs, 1501 points

Runoff by SCS TR-20 method, UH=SCS

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

**Subcatchment 1S: Future Condition**

Runoff Area=1.380 ac 19.57% Impervious Runoff Depth&gt;0.75"

Flow Length=455' Tc=11.3 min UI Adjusted CN=57 Runoff=0.89 cfs 0.087 af

**Pond 1P: driveway sump**

Peak Elev=99.67' Storage=303 cf Inflow=0.89 cfs 0.087 af

Discarded=0.02 cfs 0.014 af Primary=0.86 cfs 0.066 af Outflow=0.88 cfs 0.081 af

**BettyJoe Way - Post-Development**

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

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**Summary for Subcatchment 1S: Future Condition**

Runoff = 0.89 cfs @ 12.19 hrs, Volume= 0.087 af, Depth&gt; 0.75"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

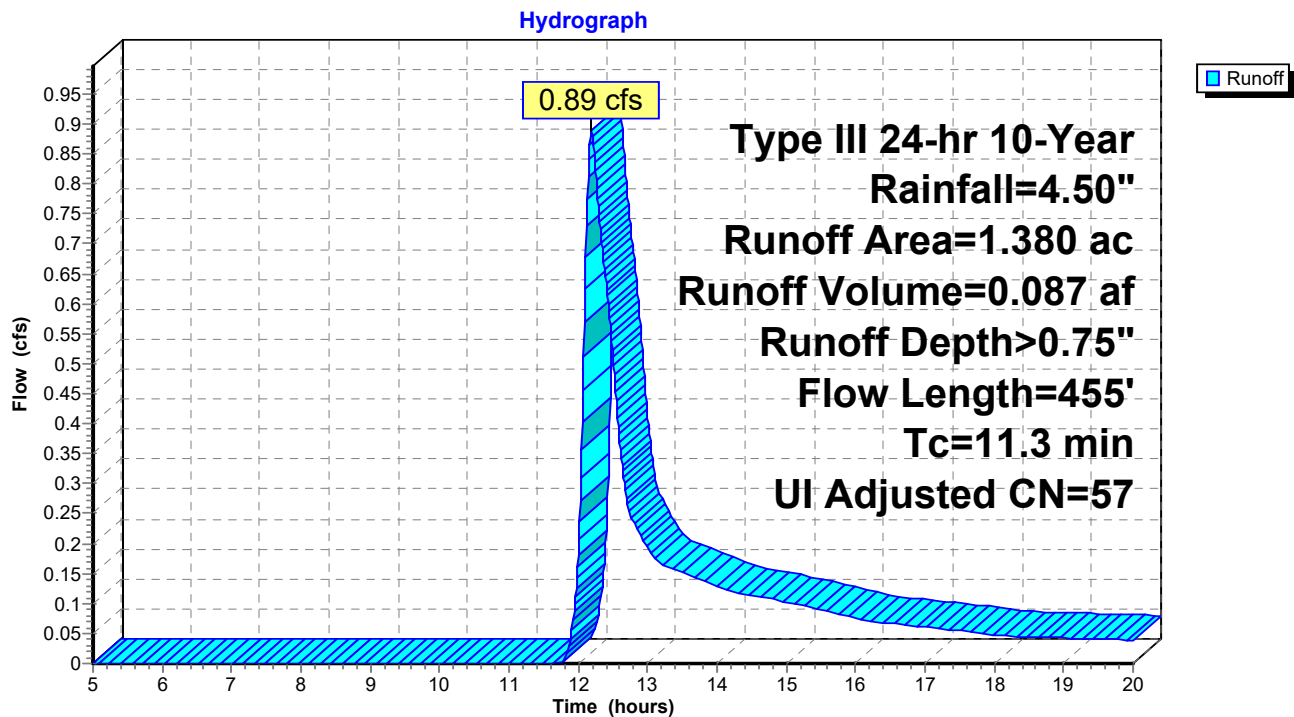
Type III 24-hr 10-Year Rainfall=4.50"

Area (ac)	CN	Description
0.210	98	Paved parking, HSG A
0.060	98	Unconnected roofs, HSG A
0.510	49	50-75% Grass cover, Fair, HSG A
0.600	48	Brush, Poor, HSG A
1.380	58	Weighted Average, UI Adjusted CN = 57
1.110		80.43% Pervious Area
0.270		19.57% Impervious Area
0.060		22.22% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	50	0.0100	0.11		<b>Sheet Flow, SF</b> Grass: Short n= 0.150 P2= 3.00"
0.9	71	0.0350	1.31		<b>Shallow Concentrated Flow, SCF</b> Short Grass Pasture Kv= 7.0 fps
0.7	83	0.0720	1.88		<b>Shallow Concentrated Flow, SCF</b> Short Grass Pasture Kv= 7.0 fps
1.5	129	0.0430	1.45		<b>Shallow Concentrated Flow, SCF</b> Short Grass Pasture Kv= 7.0 fps
0.3	72	0.0630	4.04		<b>Shallow Concentrated Flow, SCF</b> Unpaved Kv= 16.1 fps
0.2	50	0.0400	3.98	11.94	<b>Trap/Vee/Rect Channel Flow, grass swale</b> Bot.W=1.00' D=1.00' Z= 2.0 '/' Top.W=5.00' n= 0.050 Earth, long dense weeds
11.3	455	Total			

**Subcatchment 1S: Future Condition**



**BettyJoe Way - Post-Development**

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

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**Summary for Pond 1P: driveway sump**

Inflow Area = 1.380 ac, 19.57% Impervious, Inflow Depth > 0.75" for 10-Year event  
 Inflow = 0.89 cfs @ 12.19 hrs, Volume= 0.087 af  
 Outflow = 0.88 cfs @ 12.21 hrs, Volume= 0.081 af, Atten= 1%, Lag= 1.0 min  
 Discarded = 0.02 cfs @ 12.21 hrs, Volume= 0.014 af  
 Primary = 0.86 cfs @ 12.21 hrs, Volume= 0.066 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs  
 Peak Elev= 99.67' @ 12.21 hrs Surf.Area= 338 sf Storage= 303 cf

Plug-Flow detention time= 31.4 min calculated for 0.081 af (93% of inflow)  
 Center-of-Mass det. time= 9.8 min ( 855.8 - 846.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	97.80'	424 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
97.80	0	0	0
98.00	22	2	2
100.00	400	422	424

Device	Routing	Invert	Outlet Devices
#1	Primary	99.50'	<b>5.0' 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
#2	Discarded	97.80'	<b>2.410 in/hr Exfiltration over Surface area</b> Conductivity to Groundwater Elevation = 95.00'

**Discarded OutFlow** Max=0.02 cfs @ 12.21 hrs HW=99.67' (Free Discharge)  
 ↑ **2=Exfiltration** ( Controls 0.02 cfs)

**Primary OutFlow** Max=0.86 cfs @ 12.21 hrs HW=99.67' (Free Discharge)  
 ↑ **1=Broad-Crested Rectangular Weir** (Weir Controls 0.86 cfs @ 1.01 fps)



# BettyJoe Way - Post-Development

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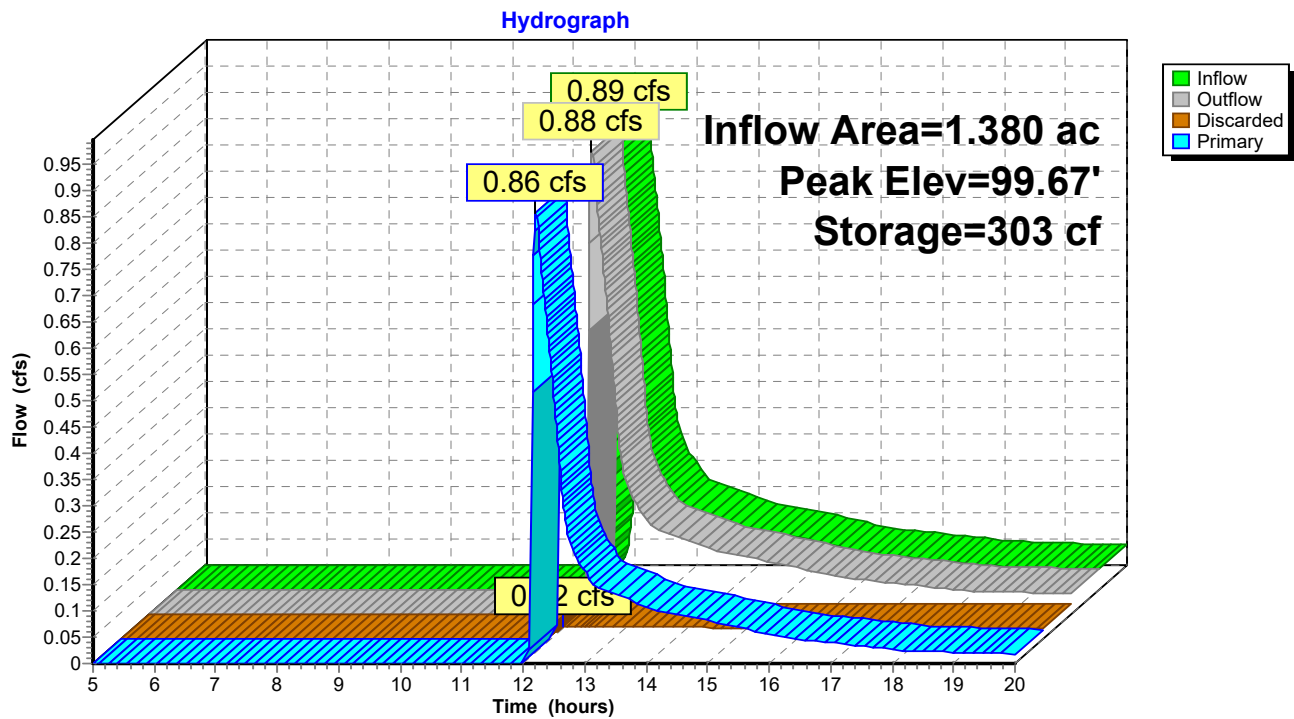
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Type III 24-hr 10-Year Rainfall=4.50"

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## Pond 1P: driveway sump



**BettyJoe Way - Post-Development***Type III 24-hr 100-Year Rainfall=6.50"*

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Time span=5.00-20.00 hrs, dt=0.01 hrs, 1501 points

Runoff by SCS TR-20 method, UH=SCS

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

**Subcatchment 1S: Future Condition**

Runoff Area=1.380 ac 19.57% Impervious Runoff Depth&gt;1.80"

Flow Length=455' Tc=11.3 min UI Adjusted CN=57 Runoff=2.51 cfs 0.207 af

**Pond 1P: driveway sump**

Peak Elev=99.84' Storage=361 cf Inflow=2.51 cfs 0.207 af

Discarded=0.03 cfs 0.016 af Primary=2.47 cfs 0.186 af Outflow=2.50 cfs 0.201 af

**BettyJoe Way - Post-Development**

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Type III 24-hr 100-Year Rainfall=6.50"

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**Summary for Subcatchment 1S: Future Condition**

Runoff = 2.51 cfs @ 12.17 hrs, Volume= 0.207 af, Depth&gt; 1.80"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

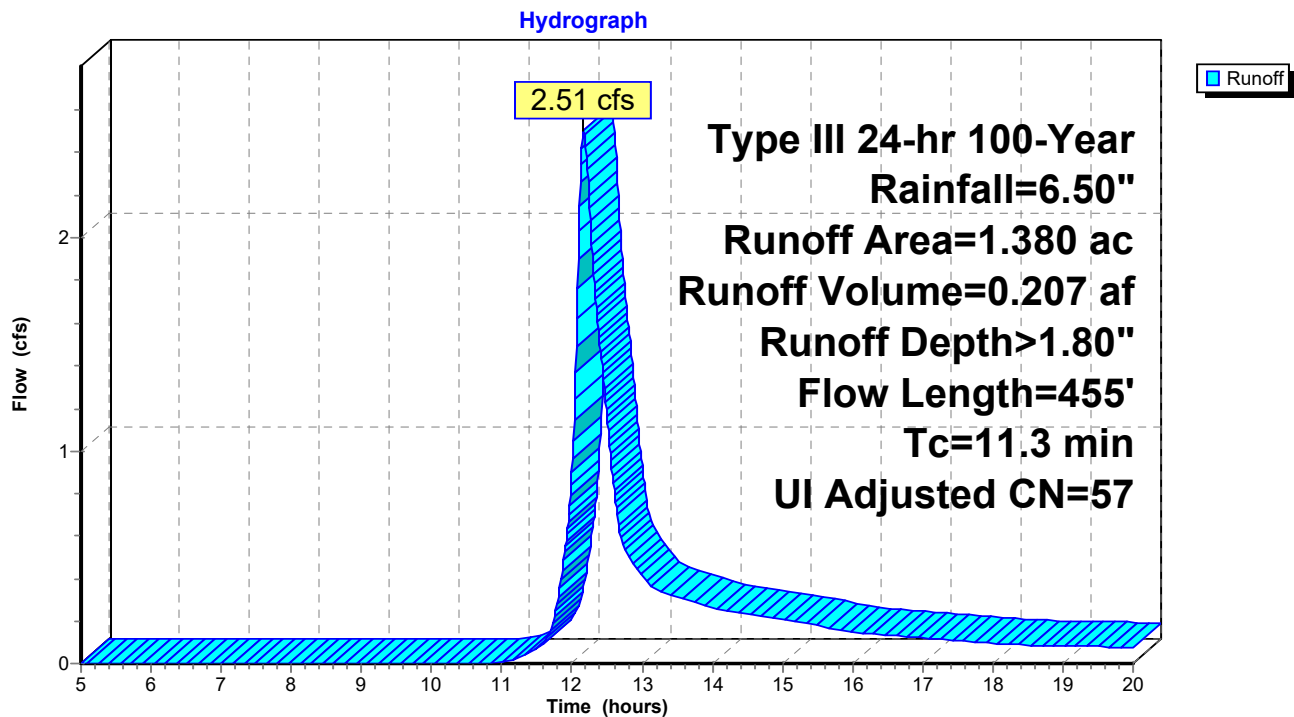
Type III 24-hr 100-Year Rainfall=6.50"

Area (ac)	CN	Description
0.210	98	Paved parking, HSG A
0.060	98	Unconnected roofs, HSG A
0.510	49	50-75% Grass cover, Fair, HSG A
0.600	48	Brush, Poor, HSG A
1.380	58	Weighted Average, UI Adjusted CN = 57
1.110		80.43% Pervious Area
0.270		19.57% Impervious Area
0.060		22.22% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	50	0.0100	0.11		<b>Sheet Flow, SF</b> Grass: Short n= 0.150 P2= 3.00"
0.9	71	0.0350	1.31		<b>Shallow Concentrated Flow, SCF</b> Short Grass Pasture Kv= 7.0 fps
0.7	83	0.0720	1.88		<b>Shallow Concentrated Flow, SCF</b> Short Grass Pasture Kv= 7.0 fps
1.5	129	0.0430	1.45		<b>Shallow Concentrated Flow, SCF</b> Short Grass Pasture Kv= 7.0 fps
0.3	72	0.0630	4.04		<b>Shallow Concentrated Flow, SCF</b> Unpaved Kv= 16.1 fps
0.2	50	0.0400	3.98	11.94	<b>Trap/Vee/Rect Channel Flow, grass swale</b> Bot.W=1.00' D=1.00' Z= 2.0 '/' Top.W=5.00' n= 0.050 Earth, long dense weeds
11.3	455	Total			

**Subcatchment 1S: Future Condition**



**BettyJoe Way - Post-Development**

Type III 24-hr 100-Year Rainfall=6.50"

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**Summary for Pond 1P: driveway sump**

Inflow Area = 1.380 ac, 19.57% Impervious, Inflow Depth > 1.80" for 100-Year event  
 Inflow = 2.51 cfs @ 12.17 hrs, Volume= 0.207 af  
 Outflow = 2.50 cfs @ 12.18 hrs, Volume= 0.201 af, Atten= 0%, Lag= 0.5 min  
 Discarded = 0.03 cfs @ 12.18 hrs, Volume= 0.016 af  
 Primary = 2.47 cfs @ 12.18 hrs, Volume= 0.186 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs  
 Peak Elev= 99.84' @ 12.18 hrs Surf.Area= 369 sf Storage= 361 cf

Plug-Flow detention time= 14.6 min calculated for 0.201 af (97% of inflow)  
 Center-of-Mass det. time= 4.4 min ( 829.2 - 824.8 )

Volume	Invert	Avail.Storage	Storage Description
#1	97.80'	424 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
97.80	0	0	0
98.00	22	2	2
100.00	400	422	424

Device	Routing	Invert	Outlet Devices
#1	Primary	99.50'	<b>5.0' 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
#2	Discarded	97.80'	<b>2.410 in/hr Exfiltration over Surface area</b> Conductivity to Groundwater Elevation = 95.00'

**Discarded OutFlow** Max=0.03 cfs @ 12.18 hrs HW=99.84' (Free Discharge)  
 ↑**2=Exfiltration** ( Controls 0.03 cfs)

**Primary OutFlow** Max=2.47 cfs @ 12.18 hrs HW=99.84' (Free Discharge)  
 ↑**1=Broad-Crested Rectangular Weir** (Weir Controls 2.47 cfs @ 1.47 fps)

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Type III 24-hr 100-Year Rainfall=6.50"

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## Pond 1P: driveway sump

