

**DRAINAGE COMPUTATIONS FOR  
PROPOSED BOX CULVERT**

*Prepared for*

**SINGLE-FAMILY DEVELOPMENT  
350 BREAKNECK HILL ROAD  
KILLINGLY, CT**

**November 2023**

**Revised to January 2024**

*Prepared for*

Gavin Sheehan

*Prepared by*

Killingly Engineering Associates

Civil Engineering & Surveying



Normand Thibeault Jr., P.E.

CT License #22834

## ***Introduction***

Gavin Sheehan. has submitted a proposal to the Town of Killingly to develop a 20-acre parcel of land with access from Breakneck Hill Road. The portion of the property to be developed is currently wooded and undeveloped and drainage from the site sheet flows down gradient to a linear wetland system and perennial stream. The project proposes to utilize an existing gravel drive that crosses the wetlands. The design calls for installation of a 5x2 open bottomed box culvert to preserve the stream bed bottom and reduce the overall wetland impact footprint.

## ***Summary***

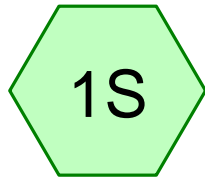
According to the USDA-SCS Soil Survey, approximately 30% of the soils in the watershed consist of excessively drained Hinckley sands and gravels which are associated with hydrologic soil group *oAö*. The remainder of the site consists of Sudbury and Canton/Charlton fine sandy loams and wetlands soils which we have defined as *öB/Cö*. The bulk of the 89-acre watershed that drains to the proposed crossing point is undeveloped.

The calculations utilized HydroCAD® Stormwater Modeling System, a computer model, to analyze pre-and post-development drainage conditions, and to aid in the design of the stormwater detention system. The model used the Soil Conservation Service TR-20 method with a Type III 24-hour rainfall to calculate the runoff. The 2 through 100-year frequency storms were analyzed to evaluate peak runoff to the proposed culvert. Our computations demonstrate that the proposed 5ø wide x 2ø deep open bottomed box culvert will convey flow from a 100-year storm.

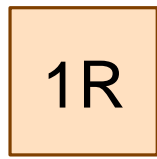
**Table 1. Existing & Proposed Peak Flows from Watershed**

Design Storm	Depth (in)	Peak Runoff Rate
2-Year	3.37	2.15 CFS
5-Year	4.28	7.80 CFS
10-Year	5.04	15.34 CFS
25-Year	6.09	29.19 CFS
50-Year	6.87	41.50 CFS
100-Year	7.70	56.26 CFS

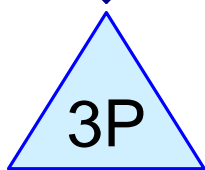
## **HYDROCAD COMPUTATIONS**



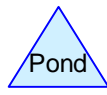
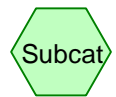
Watershed



Stream



Wetlands prior to  
Culvert



# Watershed

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Breakneck Hill Road  
Type III 24-hr 2-year Rainfall=3.41"  
Printed 1/8/2024  
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## Summary for Subcatchment 1S: Watershed

Runoff = 2.18 cfs @ 14.63 hrs, Volume= 1.209 af, Depth> 0.16"

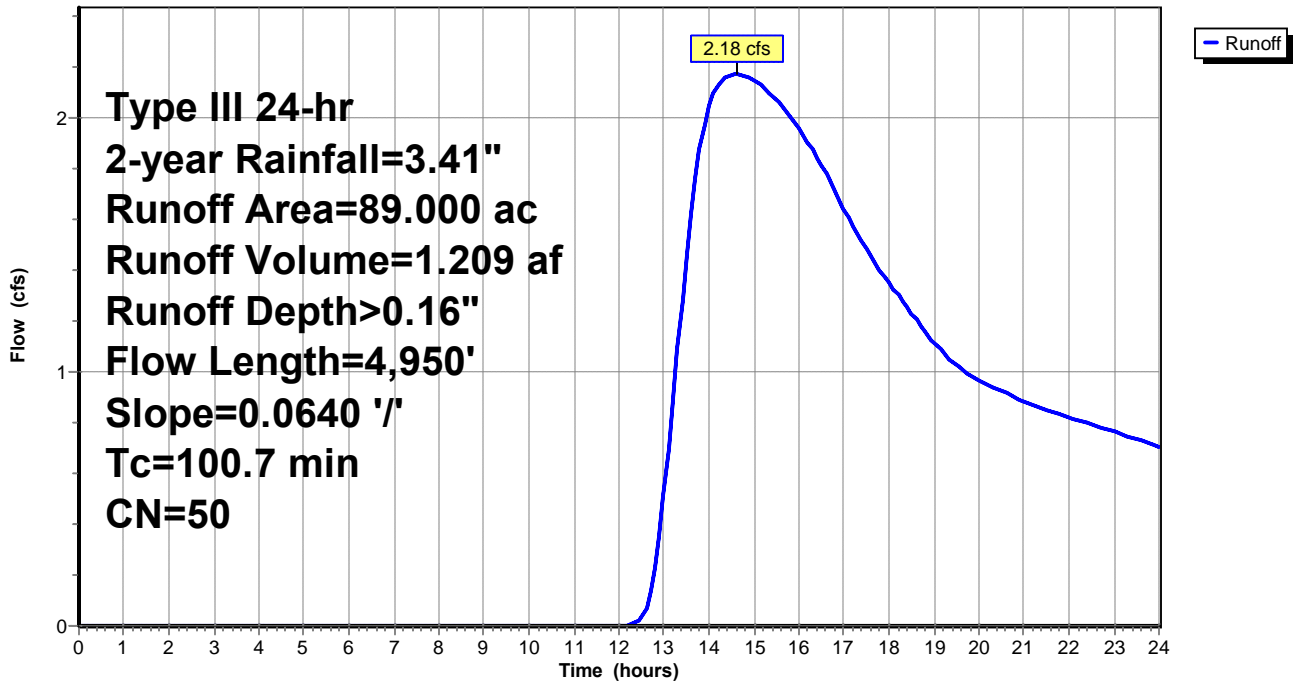
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs  
Type III 24-hr 2-year Rainfall=3.41"

Area (ac)	CN	Description
31.000	30	Woods, Good, HSG A
* 20.000	58	Brush/Grass, Good, HSG B/C
* 38.000	61	Woods, Good, HSG B/C
89.000	50	Weighted Average
89.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
100.7	4,950	0.0640	0.82		Lag/CN Method, Tc-1

## Subcatchment 1S: Watershed

Hydrograph



# Watershed

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Breakneck Hill Road  
Type III 24-hr 2-year Rainfall=3.41"  
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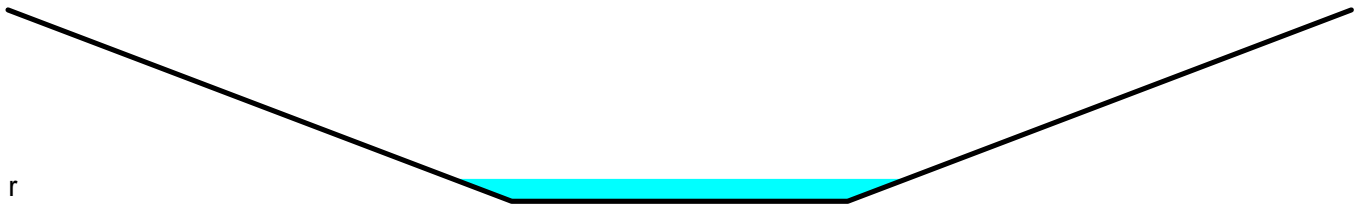
## Summary for Reach 1R: Stream

Inflow Area = 89.000 ac, 0.00% Impervious, Inflow Depth > 0.16" for 2-year event  
Inflow = 2.18 cfs @ 14.63 hrs, Volume= 1.209 af  
Outflow = 2.15 cfs @ 15.38 hrs, Volume= 1.152 af, Atten= 1%, Lag= 45.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs  
Max. Velocity= 3.53 fps, Min. Travel Time= 23.4 min  
Avg. Velocity = 2.77 fps, Avg. Travel Time= 29.8 min

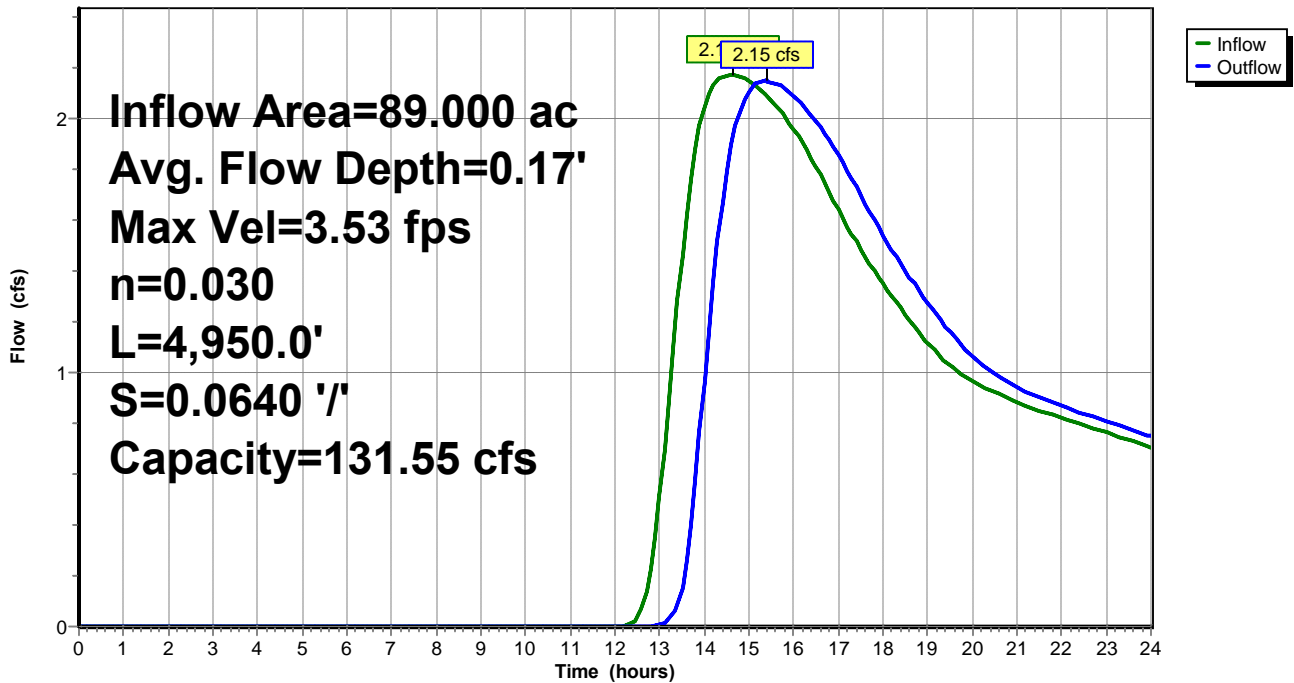
Peak Storage= 3,022 cf @ 14.99 hrs  
Average Depth at Peak Storage= 0.17'  
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 131.55 cfs

3.00' x 1.50' deep channel, n= 0.030  
Side Slope Z-value= 3.0 ' / ' Top Width= 12.00'  
Length= 4,950.0' Slope= 0.0640 ' / '  
Inlet Invert= 664.00', Outlet Invert= 347.00'



Reach 1R: Stream

Hydrograph



## Watershed

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Breakneck Hill Road  
Type III 24-hr 2-year Rainfall=3.41"  
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### Summary for Pond 3P: Wetlands prior to Culvert

Inflow Area = 89.000 ac, 0.00% Impervious, Inflow Depth > 0.16" for 2-year event  
Inflow = 2.15 cfs @ 15.38 hrs, Volume= 1.152 af  
Outflow = 2.16 cfs @ 15.32 hrs, Volume= 1.150 af, Atten= 0%, Lag= 0.0 min  
Primary = 2.16 cfs @ 15.32 hrs, Volume= 1.150 af  
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs  
Peak Elev= 346.78' @ 15.32 hrs Surf.Area= 109 sf Storage= 66 cf

Plug-Flow detention time= 0.7 min calculated for 1.146 af (99% of inflow)  
Center-of-Mass det. time= 0.4 min ( 1,080.7 - 1,080.4 )

Volume	Invert	Avail.Storage	Storage Description
#1	346.00'	4,860 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
346.00	58	0	0
348.00	188	246	246
350.00	2,650	2,838	3,084
350.60	3,270	1,776	4,860

Device	Routing	Invert	Outlet Devices
#1	Primary	346.50'	<b>60.0" W x 30.0" H Box Culvert</b> L= 30.0' Box, 0° wingwalls, square crown edge, Ke= 0.700 Inlet / Outlet Invert= 346.50' / 346.00' S= 0.0167 '/' Cc= 0.900 n= 0.030, Flow Area= 12.50 sf
#2	Secondary	350.40'	<b>16.0' long x 60.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

**Primary OutFlow** Max=2.15 cfs @ 15.32 hrs HW=346.78' (Free Discharge)

↑**1=Culvert** (Inlet Controls 2.15 cfs @ 1.51 fps)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=346.00' (Free Discharge)

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

**Watershed**

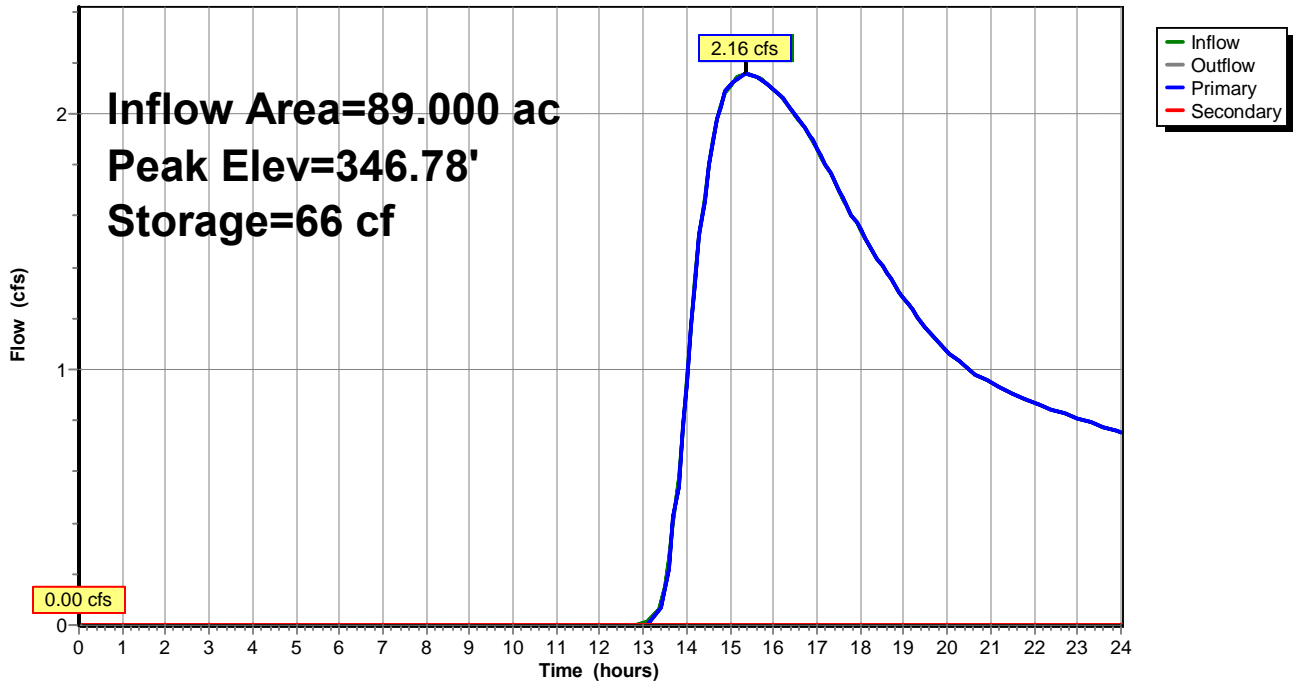
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Breakneck Hill Road  
Type III 24-hr 2-year Rainfall=3.41"

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**Pond 3P: Wetlands prior to Culvert**

Hydrograph





# Watershed

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Breakneck Hill Road  
Type III 24-hr 5-year Rainfall=4.36"  
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Page 6

## Summary for Subcatchment 1S: Watershed

Runoff = 8.01 cfs @ 13.78 hrs, Volume= 3.183 af, Depth> 0.43"

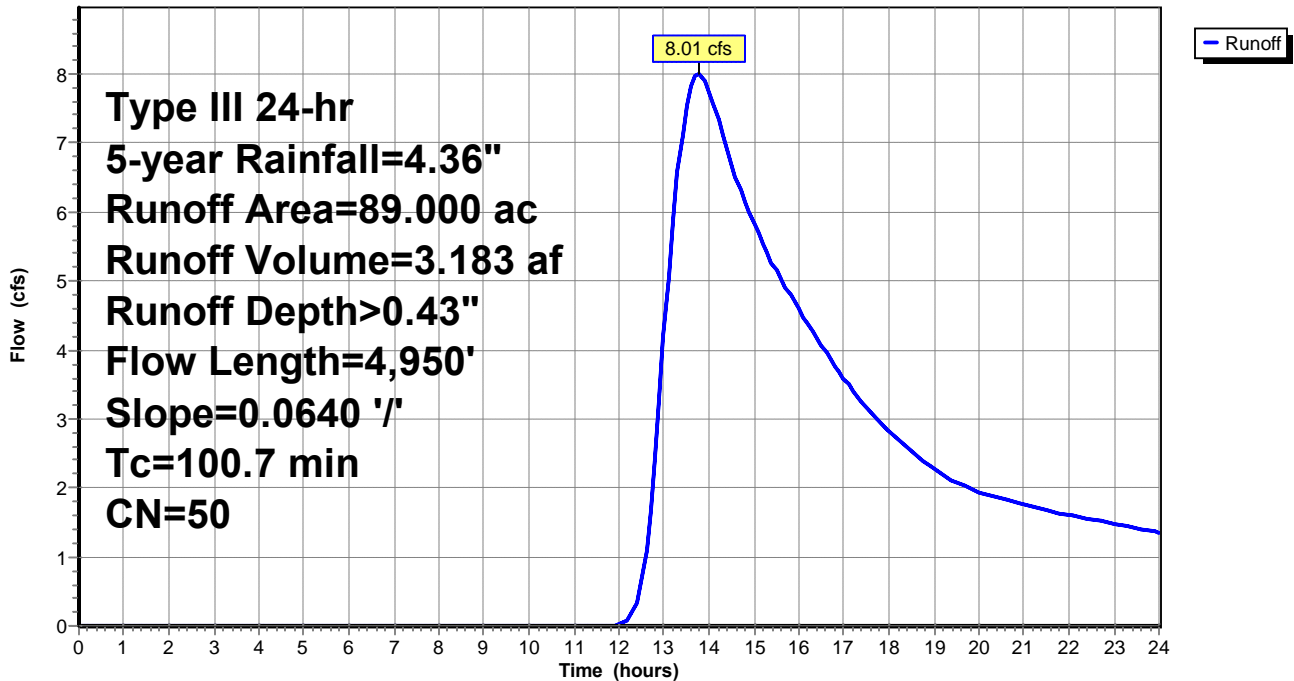
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs  
Type III 24-hr 5-year Rainfall=4.36"

Area (ac)	CN	Description
31.000	30	Woods, Good, HSG A
* 20.000	58	Brush/Grass, Good, HSG B/C
* 38.000	61	Woods, Good, HSG B/C
89.000	50	Weighted Average
89.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
100.7	4,950	0.0640	0.82		Lag/CN Method, Tc-1

## Subcatchment 1S: Watershed

Hydrograph



# Watershed

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Breakneck Hill Road  
Type III 24-hr 5-year Rainfall=4.36"  
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## Summary for Reach 1R: Stream

Inflow Area = 89.000 ac, 0.00% Impervious, Inflow Depth > 0.43" for 5-year event  
Inflow = 8.01 cfs @ 13.78 hrs, Volume= 3.183 af  
Outflow = 7.79 cfs @ 14.25 hrs, Volume= 3.101 af, Atten= 3%, Lag= 28.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs  
Max. Velocity= 5.33 fps, Min. Travel Time= 15.5 min  
Avg. Velocity = 3.76 fps, Avg. Travel Time= 22.0 min

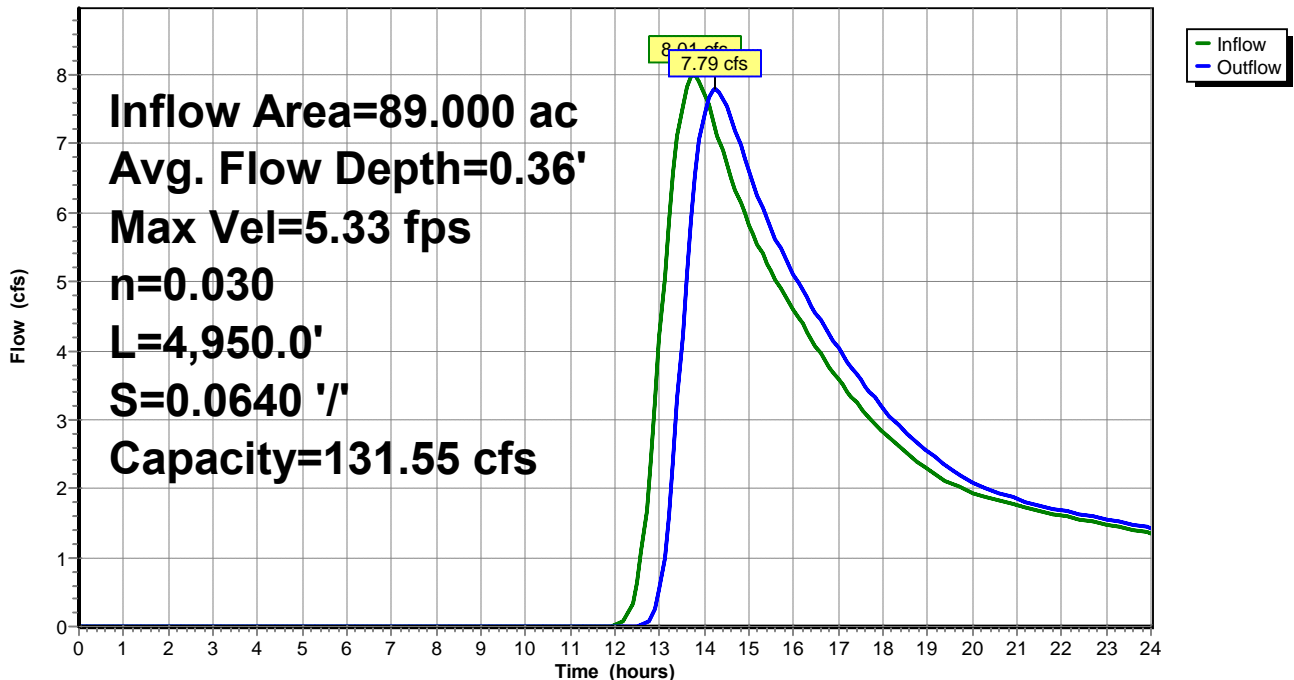
Peak Storage= 7,241 cf @ 13.99 hrs  
Average Depth at Peak Storage= 0.36'  
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 131.55 cfs

3.00' x 1.50' deep channel, n= 0.030  
Side Slope Z-value= 3.0 ' / ' Top Width= 12.00'  
Length= 4,950.0' Slope= 0.0640 ' / '  
Inlet Invert= 664.00', Outlet Invert= 347.00'



### Reach 1R: Stream

#### Hydrograph



**Watershed**

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Breakneck Hill Road  
 Type III 24-hr 5-year Rainfall=4.36"  
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 Page 8

**Summary for Pond 3P: Wetlands prior to Culvert**

Inflow Area = 89.000 ac, 0.00% Impervious, Inflow Depth > 0.42" for 5-year event  
 Inflow = 7.79 cfs @ 14.25 hrs, Volume= 3.101 af  
 Outflow = 7.80 cfs @ 14.27 hrs, Volume= 3.100 af, Atten= 0%, Lag= 1.4 min  
 Primary = 7.80 cfs @ 14.27 hrs, Volume= 3.100 af  
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs  
 Peak Elev= 347.17' @ 14.27 hrs Surf.Area= 134 sf Storage= 113 cf

Plug-Flow detention time= 0.4 min calculated for 3.100 af (100% of inflow)  
 Center-of-Mass det. time= 0.2 min ( 1,022.9 - 1,022.7 )

Volume	Invert	Avail.Storage	Storage Description
#1	346.00'	4,860 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
346.00	58	0	0
348.00	188	246	246
350.00	2,650	2,838	3,084
350.60	3,270	1,776	4,860

Device	Routing	Invert	Outlet Devices
#1	Primary	346.50'	<b>60.0" W x 30.0" H Box Culvert</b> L= 30.0' Box, 0° wingwalls, square crown edge, Ke= 0.700 Inlet / Outlet Invert= 346.50' / 346.00' S= 0.0167 '/' Cc= 0.900 n= 0.030, Flow Area= 12.50 sf
#2	Secondary	350.40'	<b>16.0' long x 60.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

**Primary OutFlow** Max=7.78 cfs @ 14.27 hrs HW=347.17' (Free Discharge)

↑1=Culvert (Inlet Controls 7.78 cfs @ 2.32 fps)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=346.00' (Free Discharge)

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

**Watershed**

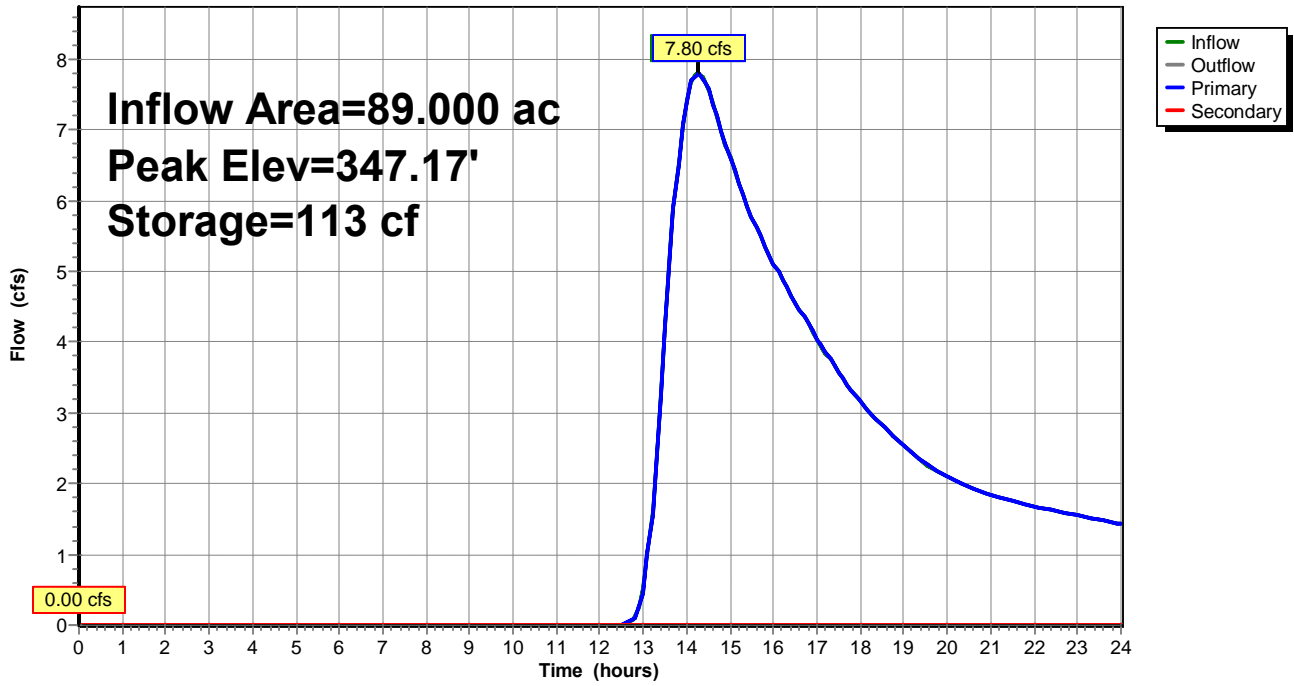
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Breakneck Hill Road  
Type III 24-hr 5-year Rainfall=4.36"

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**Pond 3P: Wetlands prior to Culvert**

Hydrograph



# Watershed

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Breakneck Hill Road  
Type III 24-hr 10-year Rainfall=5.14"  
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Page 10

## Summary for Subcatchment 1S: Watershed

Runoff = 15.67 cfs @ 13.64 hrs, Volume= 5.337 af, Depth> 0.72"

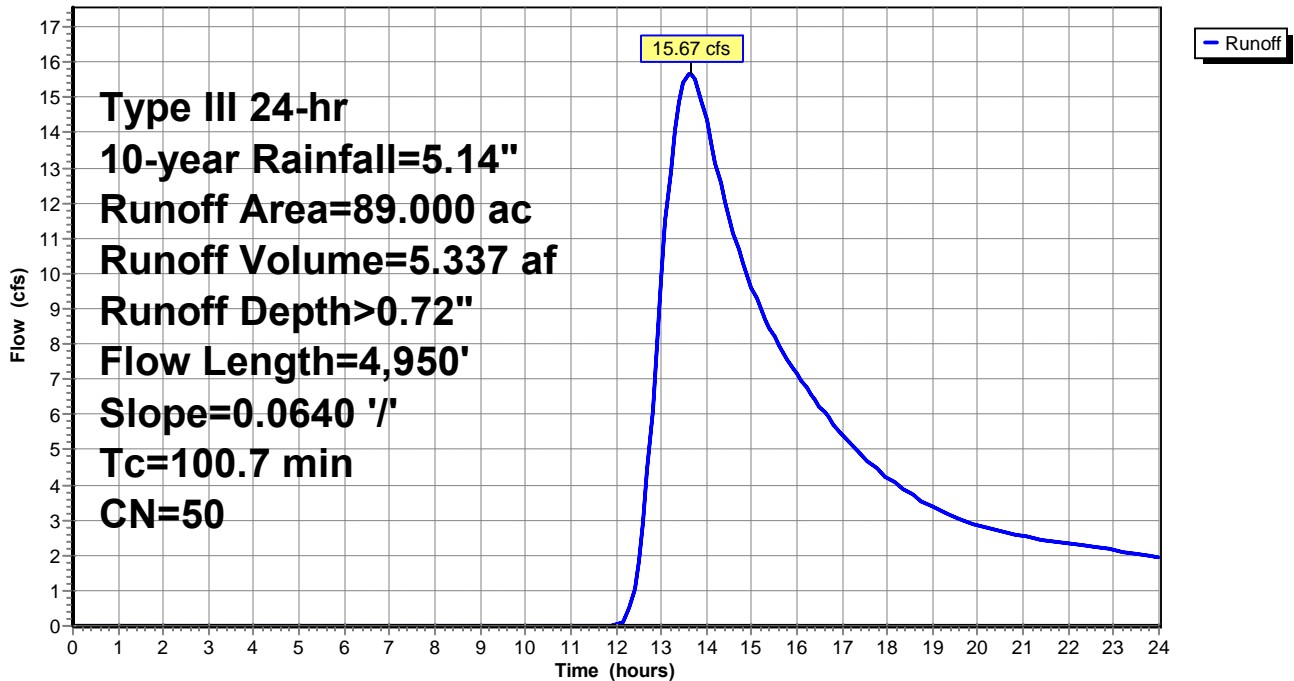
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs  
Type III 24-hr 10-year Rainfall=5.14"

Area (ac)	CN	Description
31.000	30	Woods, Good, HSG A
* 20.000	58	Brush/Grass, Good, HSG B/C
* 38.000	61	Woods, Good, HSG B/C
89.000	50	Weighted Average
89.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
100.7	4,950	0.0640	0.82		Lag/CN Method, Tc-1

## Subcatchment 1S: Watershed

Hydrograph



# Watershed

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Breakneck Hill Road  
Type III 24-hr 10-year Rainfall=5.14"  
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## Summary for Reach 1R: Stream

Inflow Area = 89.000 ac, 0.00% Impervious, Inflow Depth > 0.72" for 10-year event  
Inflow = 15.67 cfs @ 13.64 hrs, Volume= 5.337 af  
Outflow = 15.34 cfs @ 14.02 hrs, Volume= 5.235 af, Atten= 2%, Lag= 22.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs  
Max. Velocity= 6.52 fps, Min. Travel Time= 12.6 min  
Avg. Velocity = 4.40 fps, Avg. Travel Time= 18.8 min

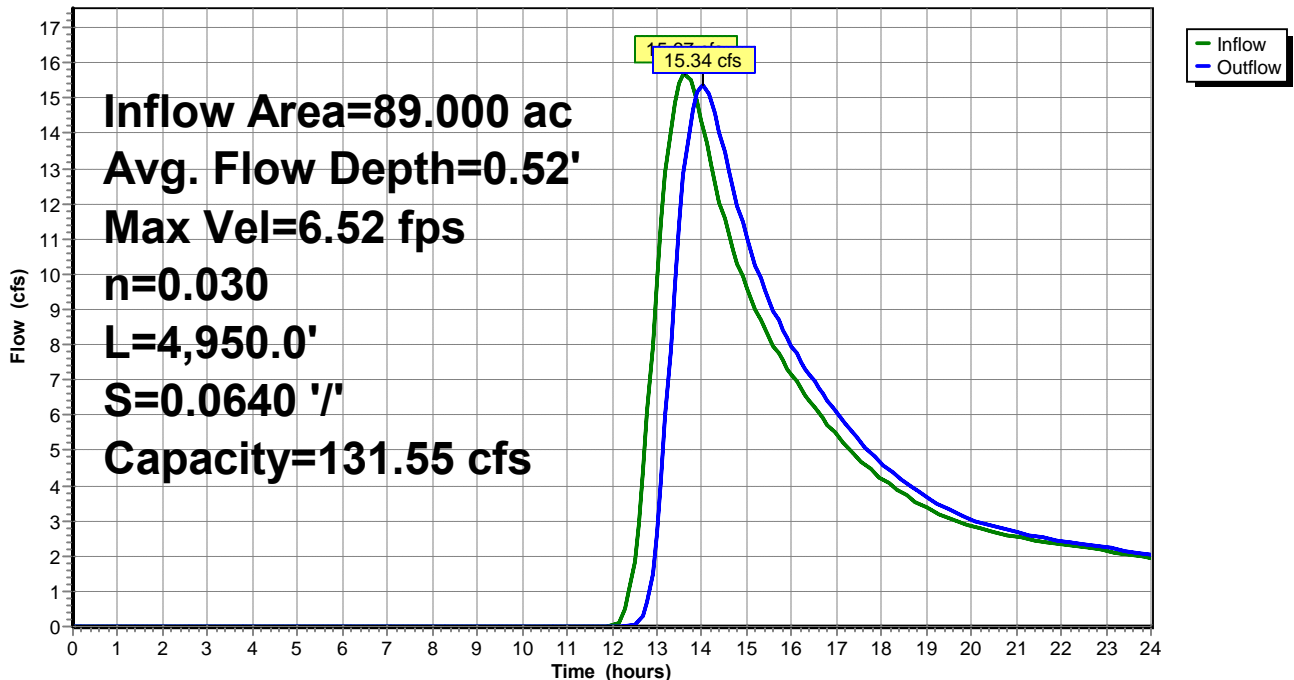
Peak Storage= 11,652 cf @ 13.81 hrs  
Average Depth at Peak Storage= 0.52'  
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 131.55 cfs

3.00' x 1.50' deep channel, n= 0.030  
Side Slope Z-value= 3.0 ' / ' Top Width= 12.00'  
Length= 4,950.0' Slope= 0.0640 ' / '  
Inlet Invert= 664.00', Outlet Invert= 347.00'



### Reach 1R: Stream

#### Hydrograph



## Watershed

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Breakneck Hill Road  
Type III 24-hr 10-year Rainfall=5.14"  
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### Summary for Pond 3P: Wetlands prior to Culvert

Inflow Area = 89.000 ac, 0.00% Impervious, Inflow Depth > 0.71" for 10-year event  
Inflow = 15.34 cfs @ 14.02 hrs, Volume= 5.235 af  
Outflow = 15.34 cfs @ 14.02 hrs, Volume= 5.234 af, Atten= 0%, Lag= 0.1 min  
Primary = 15.34 cfs @ 14.02 hrs, Volume= 5.234 af  
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs  
Peak Elev= 347.55' @ 14.02 hrs Surf.Area= 159 sf Storage= 169 cf

Plug-Flow detention time= 0.3 min calculated for 5.212 af (100% of inflow)  
Center-of-Mass det. time= 0.2 min ( 998.2 - 998.1 )

Volume	Invert	Avail.Storage	Storage Description
#1	346.00'	4,860 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
346.00	58	0	0
348.00	188	246	246
350.00	2,650	2,838	3,084
350.60	3,270	1,776	4,860

Device	Routing	Invert	Outlet Devices
#1	Primary	346.50'	<b>60.0" W x 30.0" H Box Culvert</b> L= 30.0' Box, 0° wingwalls, square crown edge, Ke= 0.700 Inlet / Outlet Invert= 346.50' / 346.00' S= 0.0167 '/' Cc= 0.900 n= 0.030, Flow Area= 12.50 sf
#2	Secondary	350.40'	<b>16.0' long x 60.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

**Primary OutFlow** Max=15.32 cfs @ 14.02 hrs HW=347.55' (Free Discharge)

↑**1=Culvert** (Inlet Controls 15.32 cfs @ 2.91 fps)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=346.00' (Free Discharge)

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

**Watershed**

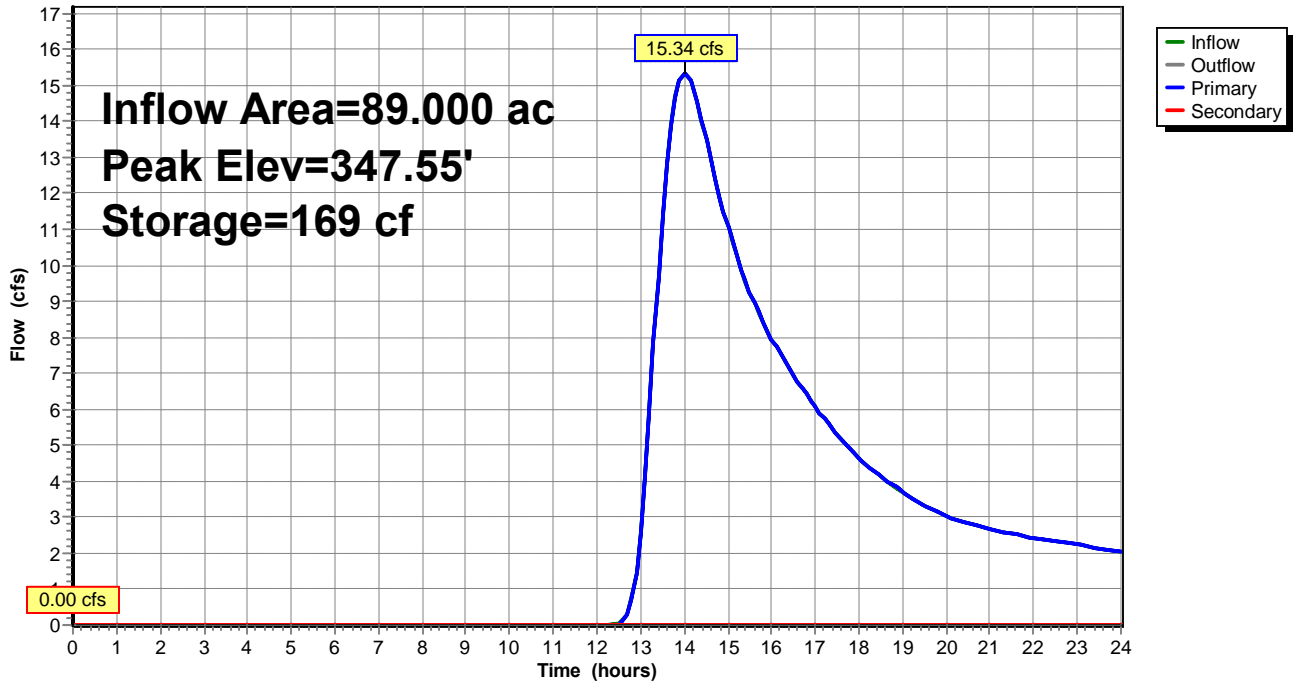
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Breakneck Hill Road  
Type III 24-hr 10-year Rainfall=5.14"

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**Pond 3P: Wetlands prior to Culvert**

Hydrograph





# Watershed

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Breakneck Hill Road  
Type III 24-hr 25-year Rainfall=6.22"  
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Page 14

## Summary for Subcatchment 1S: Watershed

Runoff = 29.71 cfs @ 13.55 hrs, Volume= 8.955 af, Depth> 1.21"

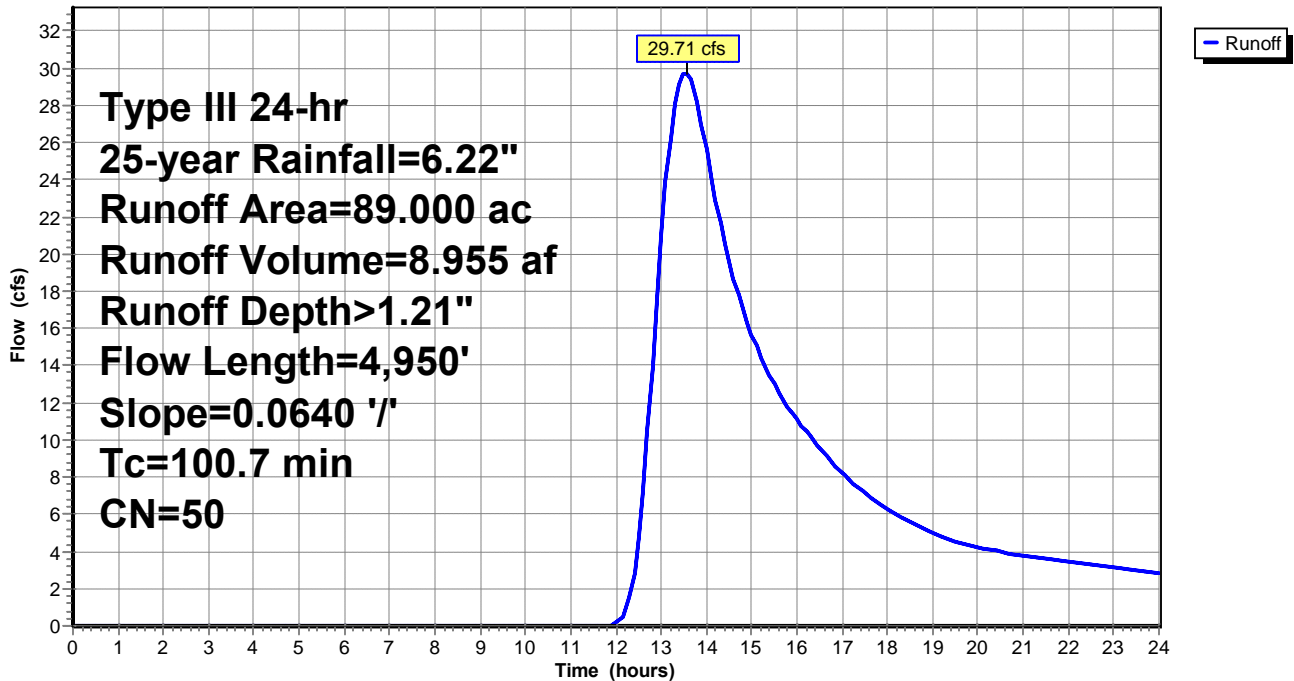
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs  
Type III 24-hr 25-year Rainfall=6.22"

Area (ac)	CN	Description
31.000	30	Woods, Good, HSG A
* 20.000	58	Brush/Grass, Good, HSG B/C
* 38.000	61	Woods, Good, HSG B/C
89.000	50	Weighted Average
89.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
100.7	4,950	0.0640	0.82		Lag/CN Method, Tc-1

## Subcatchment 1S: Watershed

Hydrograph



# Watershed

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Breakneck Hill Road  
Type III 24-hr 25-year Rainfall=6.22"  
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## Summary for Reach 1R: Stream

Inflow Area = 89.000 ac, 0.00% Impervious, Inflow Depth > 1.21" for 25-year event  
Inflow = 29.71 cfs @ 13.55 hrs, Volume= 8.955 af  
Outflow = 29.19 cfs @ 13.86 hrs, Volume= 8.828 af, Atten= 2%, Lag= 19.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs  
Max. Velocity= 7.83 fps, Min. Travel Time= 10.5 min  
Avg. Velocity = 5.05 fps, Avg. Travel Time= 16.3 min

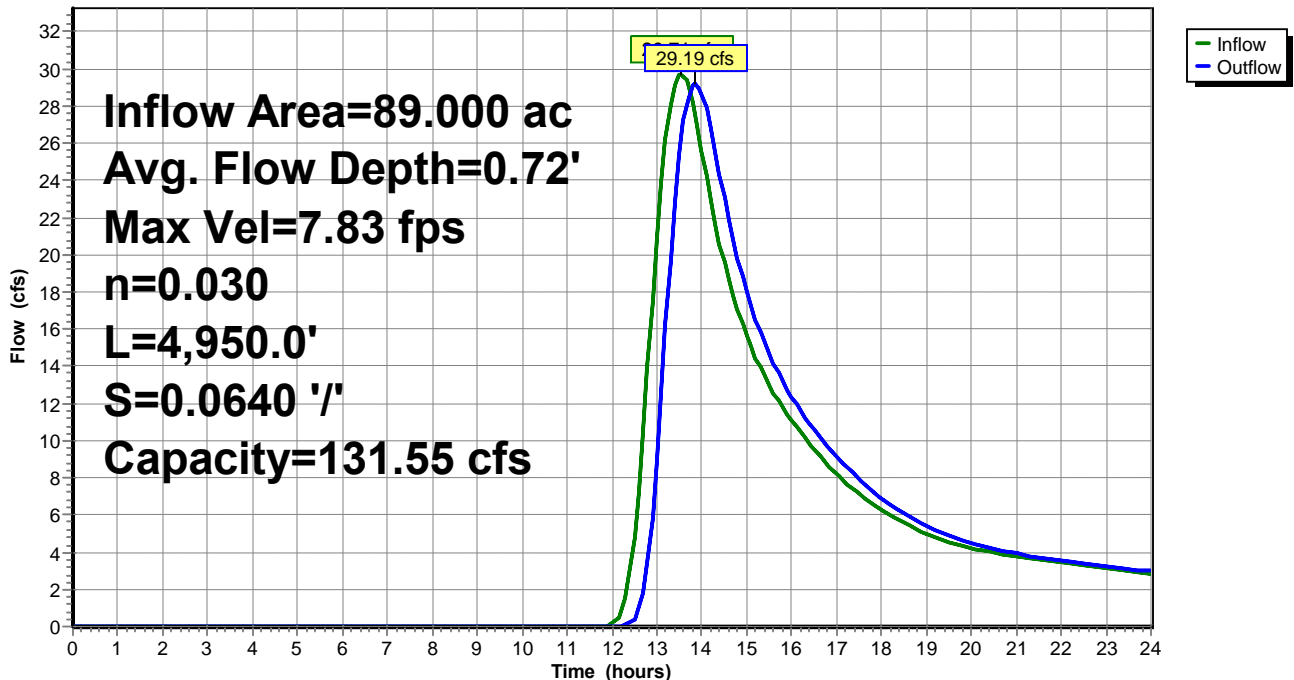
Peak Storage= 18,492 cf @ 13.69 hrs  
Average Depth at Peak Storage= 0.72'  
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 131.55 cfs

3.00' x 1.50' deep channel, n= 0.030  
Side Slope Z-value= 3.0 ' / ' Top Width= 12.00'  
Length= 4,950.0' Slope= 0.0640 ' / '  
Inlet Invert= 664.00', Outlet Invert= 347.00'



Reach 1R: Stream

Hydrograph



**Watershed**

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Breakneck Hill Road  
 Type III 24-hr 25-year Rainfall=6.22"  
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 Page 16

**Summary for Pond 3P: Wetlands prior to Culvert**

Inflow Area = 89.000 ac, 0.00% Impervious, Inflow Depth > 1.19" for 25-year event  
 Inflow = 29.19 cfs @ 13.86 hrs, Volume= 8.828 af  
 Outflow = 29.18 cfs @ 13.86 hrs, Volume= 8.826 af, Atten= 0%, Lag= 0.1 min  
 Primary = 29.18 cfs @ 13.86 hrs, Volume= 8.826 af  
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs  
 Peak Elev= 348.17' @ 13.86 hrs Surf.Area= 393 sf Storage= 294 cf

Plug-Flow detention time= 0.2 min calculated for 8.790 af (100% of inflow)  
 Center-of-Mass det. time= 0.1 min ( 977.1 - 977.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	346.00'	4,860 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
346.00	58	0	0
348.00	188	246	246
350.00	2,650	2,838	3,084
350.60	3,270	1,776	4,860

Device	Routing	Invert	Outlet Devices
#1	Primary	346.50'	<b>60.0" W x 30.0" H Box Culvert</b> L= 30.0' Box, 0° wingwalls, square crown edge, Ke= 0.700 Inlet / Outlet Invert= 346.50' / 346.00' S= 0.0167 '/' Cc= 0.900 n= 0.030, Flow Area= 12.50 sf
#2	Secondary	350.40'	<b>16.0' long x 60.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

**Primary OutFlow** Max=29.13 cfs @ 13.86 hrs HW=348.16' (Free Discharge)

↑**1=Culvert** (Barrel Controls 29.13 cfs @ 4.67 fps)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=346.00' (Free Discharge)

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

**Watershed**

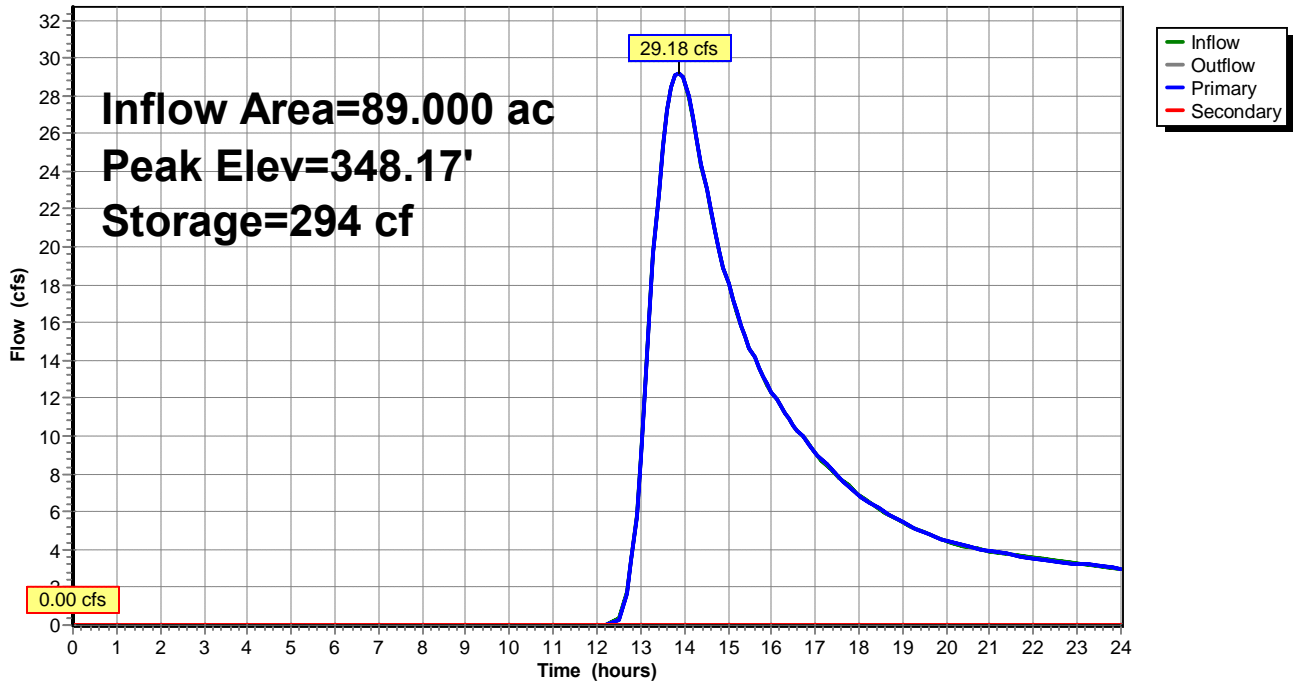
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Breakneck Hill Road  
Type III 24-hr 25-year Rainfall=6.22"

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**Pond 3P: Wetlands prior to Culvert**

Hydrograph



# Watershed

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Breakneck Hill Road  
Type III 24-hr 50-year Rainfall=7.02"  
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## Summary for Subcatchment 1S: Watershed

Runoff = 42.16 cfs @ 13.51 hrs, Volume= 12.029 af, Depth> 1.62"

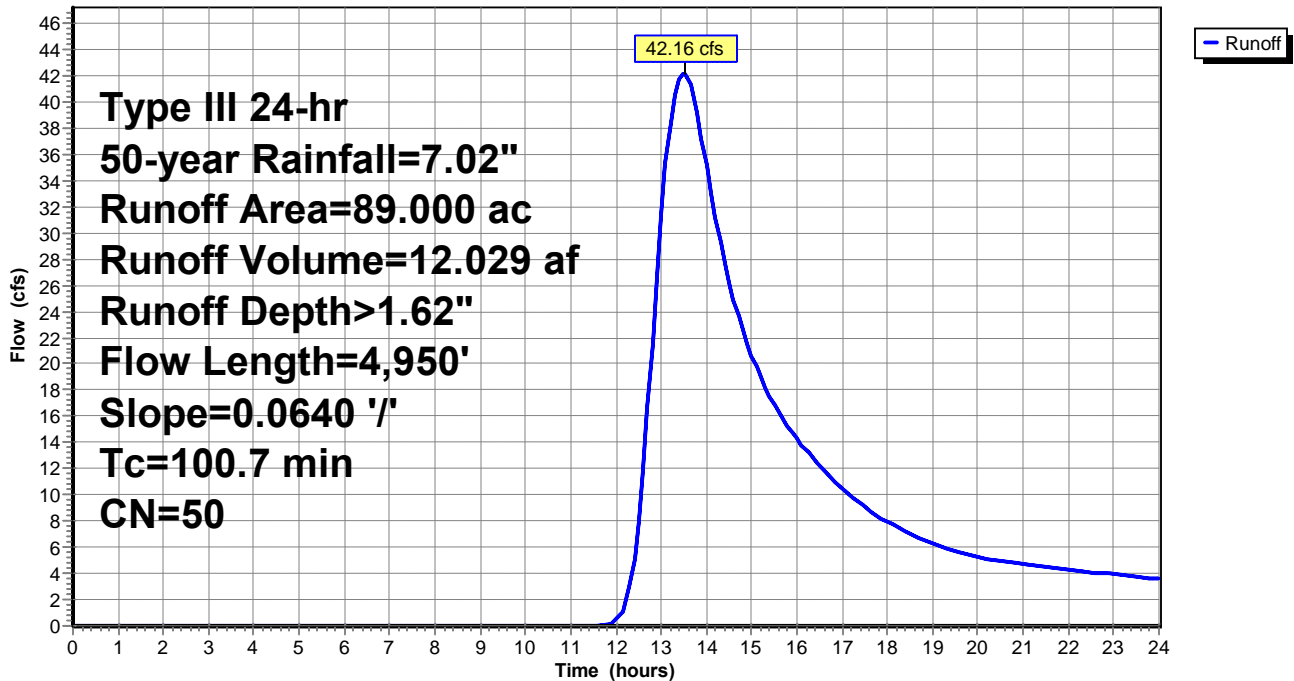
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs  
Type III 24-hr 50-year Rainfall=7.02"

Area (ac)	CN	Description
31.000	30	Woods, Good, HSG A
* 20.000	58	Brush/Grass, Good, HSG B/C
* 38.000	61	Woods, Good, HSG B/C
89.000	50	Weighted Average
89.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
100.7	4,950	0.0640	0.82		Lag/CN Method, Tc-1

## Subcatchment 1S: Watershed

Hydrograph



# Watershed

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Breakneck Hill Road  
Type III 24-hr 50-year Rainfall=7.02"  
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## Summary for Reach 1R: Stream

Inflow Area = 89.000 ac, 0.00% Impervious, Inflow Depth > 1.62" for 50-year event  
Inflow = 42.16 cfs @ 13.51 hrs, Volume= 12.029 af  
Outflow = 41.51 cfs @ 13.79 hrs, Volume= 11.883 af, Atten= 2%, Lag= 17.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs  
Max. Velocity= 8.62 fps, Min. Travel Time= 9.6 min  
Avg. Velocity = 5.42 fps, Avg. Travel Time= 15.2 min

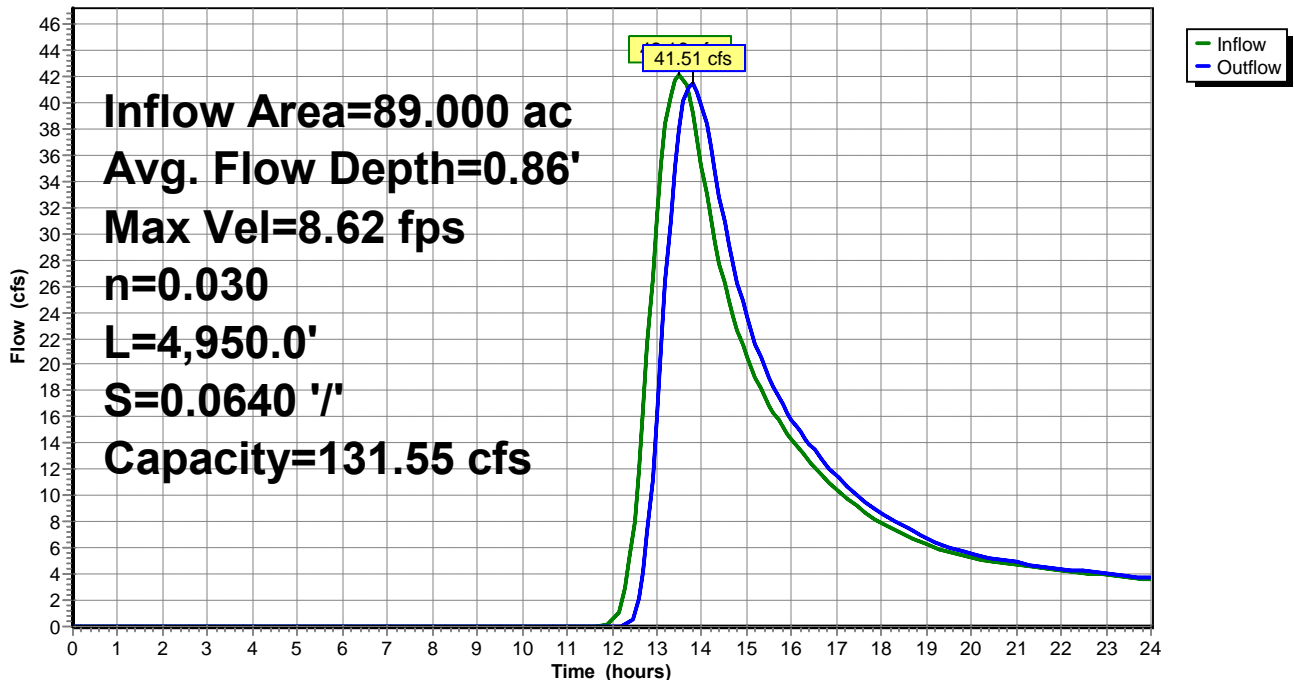
Peak Storage= 23,887 cf @ 13.63 hrs  
Average Depth at Peak Storage= 0.86'  
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 131.55 cfs

3.00' x 1.50' deep channel, n= 0.030  
Side Slope Z-value= 3.0 '/' Top Width= 12.00'  
Length= 4,950.0' Slope= 0.0640 '/'  
Inlet Invert= 664.00', Outlet Invert= 347.00'



### Reach 1R: Stream

#### Hydrograph



**Watershed**

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Breakneck Hill Road  
 Type III 24-hr 50-year Rainfall=7.02"  
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**Summary for Pond 3P: Wetlands prior to Culvert**

Inflow Area = 89.000 ac, 0.00% Impervious, Inflow Depth > 1.60" for 50-year event  
 Inflow = 41.51 cfs @ 13.79 hrs, Volume= 11.883 af  
 Outflow = 41.51 cfs @ 13.80 hrs, Volume= 11.881 af, Atten= 0%, Lag= 0.6 min  
 Primary = 41.51 cfs @ 13.80 hrs, Volume= 11.881 af  
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs  
 Peak Elev= 348.65' @ 13.80 hrs Surf.Area= 985 sf Storage= 626 cf

Plug-Flow detention time= 0.2 min calculated for 11.832 af (100% of inflow)  
 Center-of-Mass det. time= 0.1 min ( 966.4 - 966.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	346.00'	4,860 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
346.00	58	0	0
348.00	188	246	246
350.00	2,650	2,838	3,084
350.60	3,270	1,776	4,860

Device	Routing	Invert	Outlet Devices
#1	Primary	346.50'	<b>60.0" W x 30.0" H Box Culvert</b> L= 30.0' Box, 0° wingwalls, square crown edge, Ke= 0.700 Inlet / Outlet Invert= 346.50' / 346.00' S= 0.0167 '/' Cc= 0.900 n= 0.030, Flow Area= 12.50 sf
#2	Secondary	350.40'	<b>16.0' long x 60.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

**Primary OutFlow** Max=41.51 cfs @ 13.80 hrs HW=348.65' (Free Discharge)

↑1=Culvert (Barrel Controls 41.51 cfs @ 5.15 fps)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=346.00' (Free Discharge)

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

**Watershed**

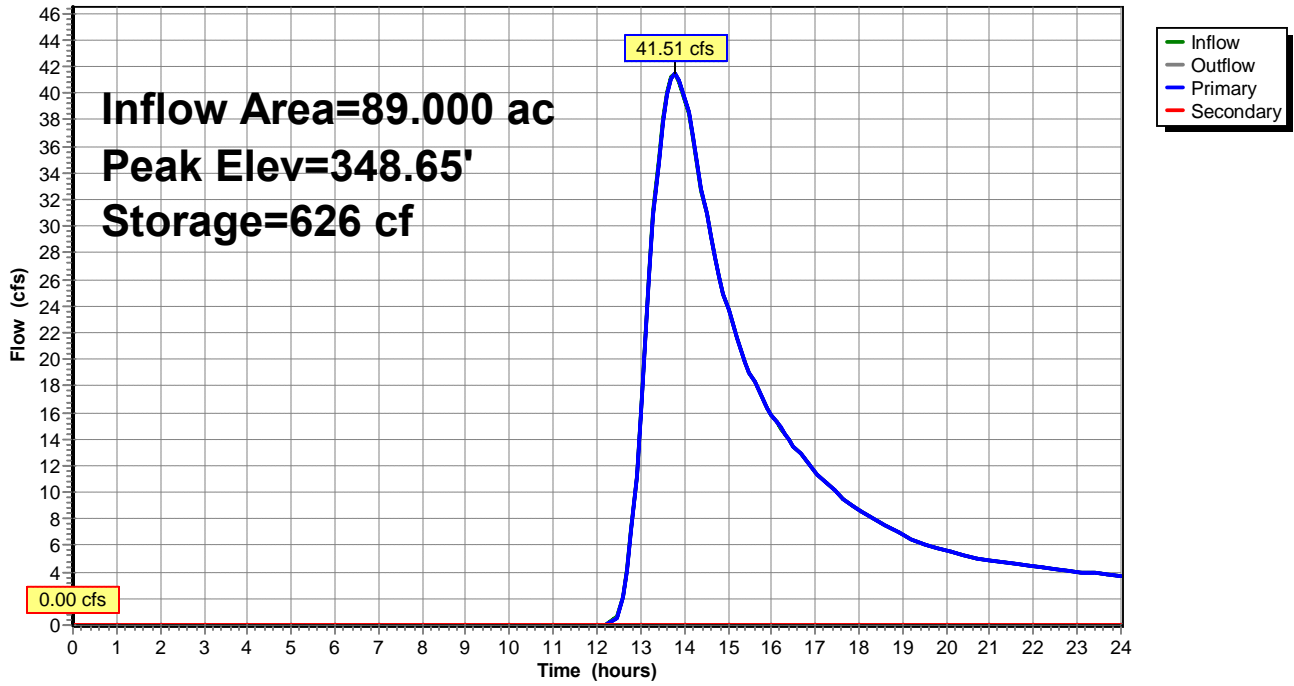
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Breakneck Hill Road  
Type III 24-hr 50-year Rainfall=7.02"

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**Pond 3P: Wetlands prior to Culvert**

Hydrograph





**Watershed**

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Breakneck Hill Road  
 Type III 24-hr 100-year Rainfall=7.88"  
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**Summary for Subcatchment 1S: Watershed**

Runoff = 57.06 cfs @ 13.47 hrs, Volume= 15.643 af, Depth> 2.11"

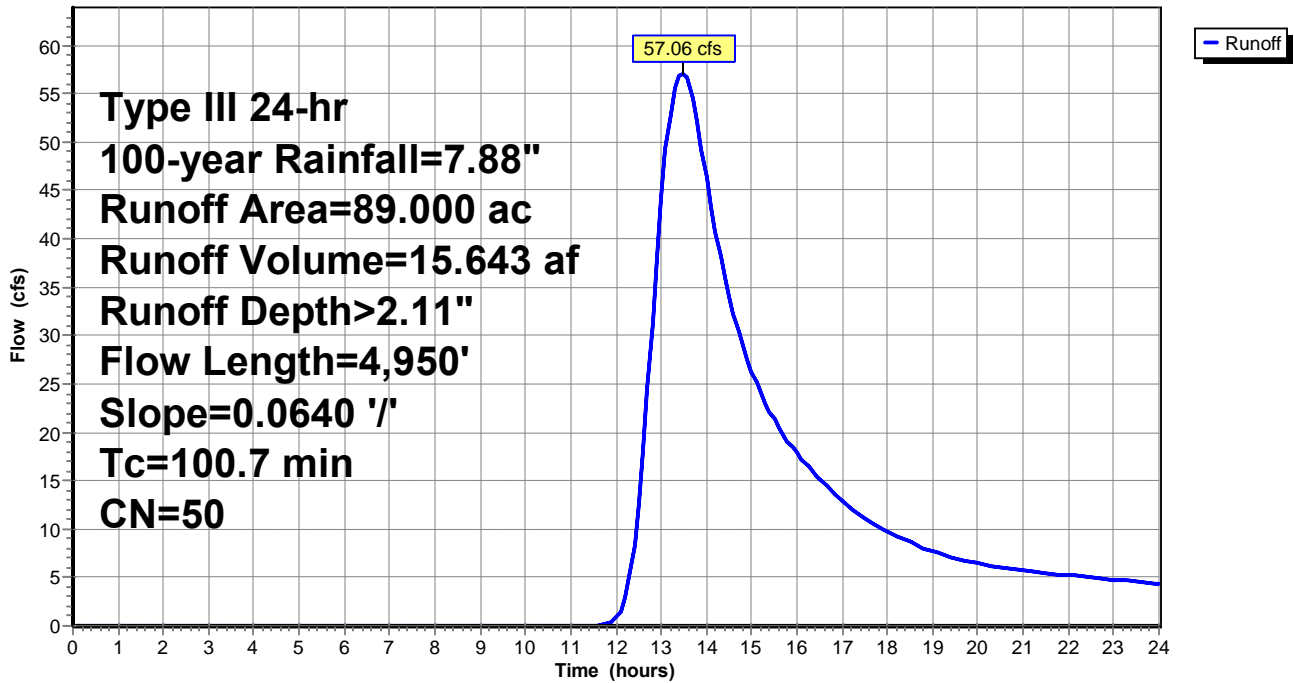
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs  
 Type III 24-hr 100-year Rainfall=7.88"

Area (ac)	CN	Description
31.000	30	Woods, Good, HSG A
* 20.000	58	Brush/Grass, Good, HSG B/C
* 38.000	61	Woods, Good, HSG B/C
89.000	50	Weighted Average
89.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
100.7	4,950	0.0640	0.82		Lag/CN Method, Tc-1

**Subcatchment 1S: Watershed**

Hydrograph



# Watershed

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Breakneck Hill Road  
Type III 24-hr 100-year Rainfall=7.88"  
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## Summary for Reach 1R: Stream

Inflow Area = 89.000 ac, 0.00% Impervious, Inflow Depth > 2.11" for 100-year event  
Inflow = 57.06 cfs @ 13.47 hrs, Volume= 15.643 af  
Outflow = 56.30 cfs @ 13.73 hrs, Volume= 15.477 af, Atten= 1%, Lag= 15.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs  
Max. Velocity= 9.36 fps, Min. Travel Time= 8.8 min  
Avg. Velocity = 5.72 fps, Avg. Travel Time= 14.4 min

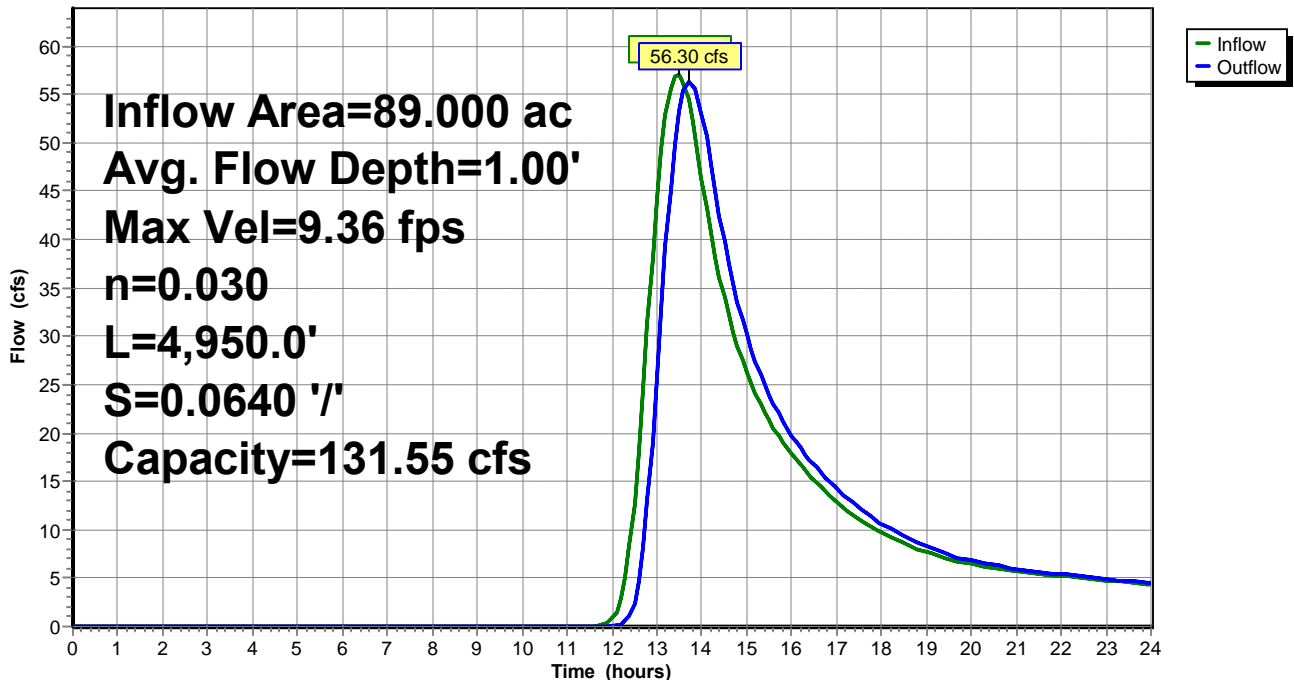
Peak Storage= 29,840 cf @ 13.59 hrs  
Average Depth at Peak Storage= 1.00'  
Bank-Full Depth= 1.50' Flow Area= 11.3 sf, Capacity= 131.55 cfs

3.00' x 1.50' deep channel, n= 0.030  
Side Slope Z-value= 3.0 ' / ' Top Width= 12.00'  
Length= 4,950.0' Slope= 0.0640 ' / '  
Inlet Invert= 664.00', Outlet Invert= 347.00'



### Reach 1R: Stream

#### Hydrograph



**Watershed**

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Breakneck Hill Road  
Type III 24-hr 100-year Rainfall=7.88"  
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**Summary for Pond 3P: Wetlands prior to Culvert**

Inflow Area = 89.000 ac, 0.00% Impervious, Inflow Depth > 2.09" for 100-year event  
Inflow = 56.30 cfs @ 13.73 hrs, Volume= 15.477 af  
Outflow = 56.29 cfs @ 13.75 hrs, Volume= 15.475 af, Atten= 0%, Lag= 0.9 min  
Primary = 56.29 cfs @ 13.75 hrs, Volume= 15.475 af  
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs  
Peak Elev= 349.17' @ 13.75 hrs Surf.Area= 1,632 sf Storage= 1,313 cf

Plug-Flow detention time= 0.3 min calculated for 15.475 af (100% of inflow)  
Center-of-Mass det. time= 0.2 min ( 957.5 - 957.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	346.00'	4,860 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
346.00	58	0	0
348.00	188	246	246
350.00	2,650	2,838	3,084
350.60	3,270	1,776	4,860

Device	Routing	Invert	Outlet Devices
#1	Primary	346.50'	<b>60.0" W x 30.0" H Box Culvert</b> L= 30.0' Box, 0° wingwalls, square crown edge, Ke= 0.700 Inlet / Outlet Invert= 346.50' / 346.00' S= 0.0167 '/' Cc= 0.900 n= 0.030, Flow Area= 12.50 sf
#2	Secondary	350.40'	<b>16.0' long x 60.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

**Primary OutFlow** Max=56.16 cfs @ 13.75 hrs HW=349.17' (Free Discharge)  
↑**1=Culvert** (Barrel Controls 56.16 cfs @ 5.61 fps)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=346.00' (Free Discharge)  
↑**2=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

**Watershed**

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Type III 24-hr 100-year Rainfall=7.88"

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**Pond 3P: Wetlands prior to Culvert**

Hydrograph

