Stormwater Addendum 3
for
Fearing Hill Road Solar Project
Wareham, Massachusetts

Prepared for:
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September 2, 2022
Atlantic Project No. 3055.02

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UNDER SEPARATE COVER

Copy of plans entitled "Site Development Plans for Fearing Hill Road Solar Project, Wareham Massachusetts" (Sheets 1 - 9) prepared by Atlantic Design Engineers, Inc., Revised date September 2, 2022

I. INTRODUCTION

This addendum to the 5/17/2021 Stormwater Drainage Analysis for the Proposed Fearing Hill Road Solar Project in Wareham, MA has been prepared to address follow-up e-mail comments received from the Town's consulting hydrogeo engineer Horsley Witten Group, as well as items discussed at the 8/16/22 meeting with Horsley Witten Group and the Town's reviewing consultant Charles Rowley.

II. SUMMARY OF REVISIONS AND RESULTS

The following is a summary of the revisions made since the last submittal. They are as follows:

- Revisions to the railroad grade/ditch in Pre-Development HydroCAD calculations to consider only storage on the culvert side of the raised railroad bed, until water levels exceed the height of the bed

  Due to the minimal elevation difference between the bottom of the trench and the raised railroad bed (±1.5 ft.), the results of the revised HydroCAD modelling showed no difference in the calculated pre/post runoff amounts or water levels.

- Revised capacity calculations for the conveyance swale, using the different slope stages throughout the length of swale. The berm height for the swales was increased from 12" to 18".

  The results show that the conveyance swale still has adequate capacity to convey the 100-year storm.

- Completion of revised sizing calculations for the rip-rap aprons, impact basins and level spreaders.

  The sizes of rip-rap aprons and impact basins are now revised on the plans, based upon these calculations. The level spreader sizes as proposed were found to be more than adequate. The Rip Rap calculations were adjusted to use the Vpeak from HydroCAD and the provided Rip Rap size was adjusted from 6" to a minimum of 8".

- An alternate HydroCAD analysis was developed for Post-Development conditions using "Fair" Grass designation in order to assess runoff and items prior to full complete establishment of the grass within the array.

Table 1: Pre- vs. post-development flows vs. Change in Grass Type to All Fair Grass

DP1	Northeast Wetland					
Event	***Pre-development (HW)***		***Post-development (SW)***		**W/ Fair Grass**	
	Flow, *cfs*	Volume, *a-f*	Flow, *cfs*	Volume, *a-f*	Flow, *cfs*	Volume, *a-f*
2-yr	14.02	1.8	13.38	2.4	14.84	2.7
10-yr	30.64	3.8	26.00	4.8	27.64	5.2
25-yr	43.84	5.4	34.98	6.6	36.45	7.1
100-yr	66.37	8.2	48.58	9.8	49.89	10.3

DP2	Southwest Wetland/Railroad Ditch					
Event	***Pre-development (HW)***		***Post-development (SW)***		**W/ Fair Grass**	
	Flow, *cfs*	Volume, *a-f*	Flow, *cfs*	Volume, *a-f*	Flow, *cfs*	Volume, *a-f*
2-yr	8.77	1.32*	7.26	1.39*	7.35	1.4
10-yr	23.31	3.1	17.22	3.1	17.28	3.1
25-yr	35.55	4.6	25.45	4.5	25.50	4.6
100-yr	57.28	7.3	39.93	6.9	39.98	7.1

*In CF, Pre-Volume = 57,339 CF. Post Volume = 59,665 CF. A negligible increase of 2,326 CF.

As shown in the tables above, the peak rates and volumes of stormwater runoff generated under Post-Development conditions using "Fair" Grass will still be under pre-development conditions for most storm events and are not substantially higher than the numbers using "good" grass. It is still the intent of the applicant and the design to establish a "good" healthy field within the array by utilizing 6" of loam maintaining 50% openness and a special seed mix.

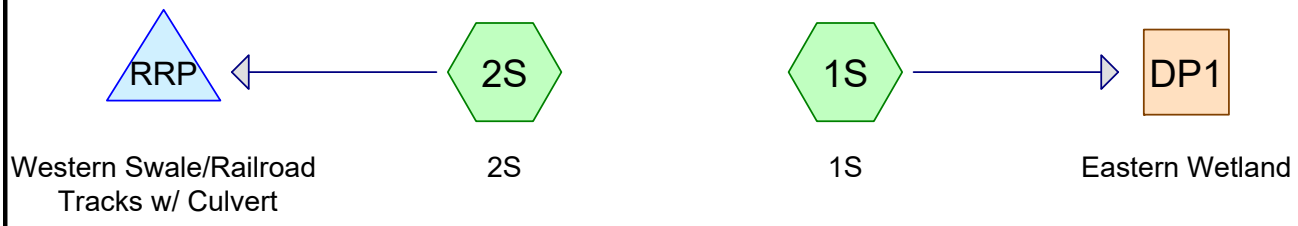
- Pos-Development HydroCAD analysis was developed to analysis the portion stormwater runoff generated and contributing the proposed swale at project site entrance.

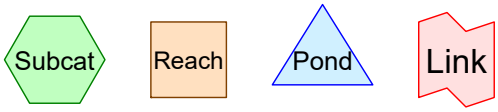
  Calculations show that the swale designed at the entrance of the site will maintain all generated runoff in the 100-year storm without overtopping to Fearing Hill Road. The rip rap swale will convey all stormwater along the natural channel along the northern side of Fearing Hill Road ultimately leading to the Railroad Bed design point.

Appendix A

Pre-Development HydroCAD Stormwater Analysis – 2nd Revision

PRE-DEVELOPMENT





Routing Diagram for 3055.01- FEARING HILL RD - PRE-REV2
Prepared by Atlantic Design Engineers, Inc., Printed 8/31/2022
HydroCAD® 10.00-25 s/n 00480 © 2019 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.123	74	>75% Grass cover, Good, HSG C (2S)
8.854	55	Woods, Good, HSG B (1S, 2S)
25.513	70	Woods, Good, HSG C (1S, 2S)
3.899	77	Woods, Good, HSG D (1S)
38.390	**67**	**TOTAL AREA**

Time span=1.00-36.00 hrs, dt=0.05 hrs, 701 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: 1S Runoff Area=809,848 sf 0.00% Impervious Runoff Depth=1.18"
Flow Length=463' Tc=28.4 min CN=71 Runoff=14.02 cfs 1.8 af

Subcatchment 2S: 2S Runoff Area=862,401 sf 0.00% Impervious Runoff Depth=0.80"
Flow Length=850' Tc=30.4 min CN=64 Runoff=8.77 cfs 1.3 af

Reach DP1: Eastern Wetland Inflow=14.02 cfs 1.8 af
Outflow=14.02 cfs 1.8 af

Pond RRP: Western Swale/Railroad Tracks w/ Peak Elev=58.77' Storage=5,767 cf Inflow=8.77 cfs 1.3 af
Outflow=8.41 cfs 1.3 af

Total Runoff Area = 38.390 ac Runoff Volume = 3.1 af Average Runoff Depth = 0.98"
100.00% Pervious = 38.390 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: 1S

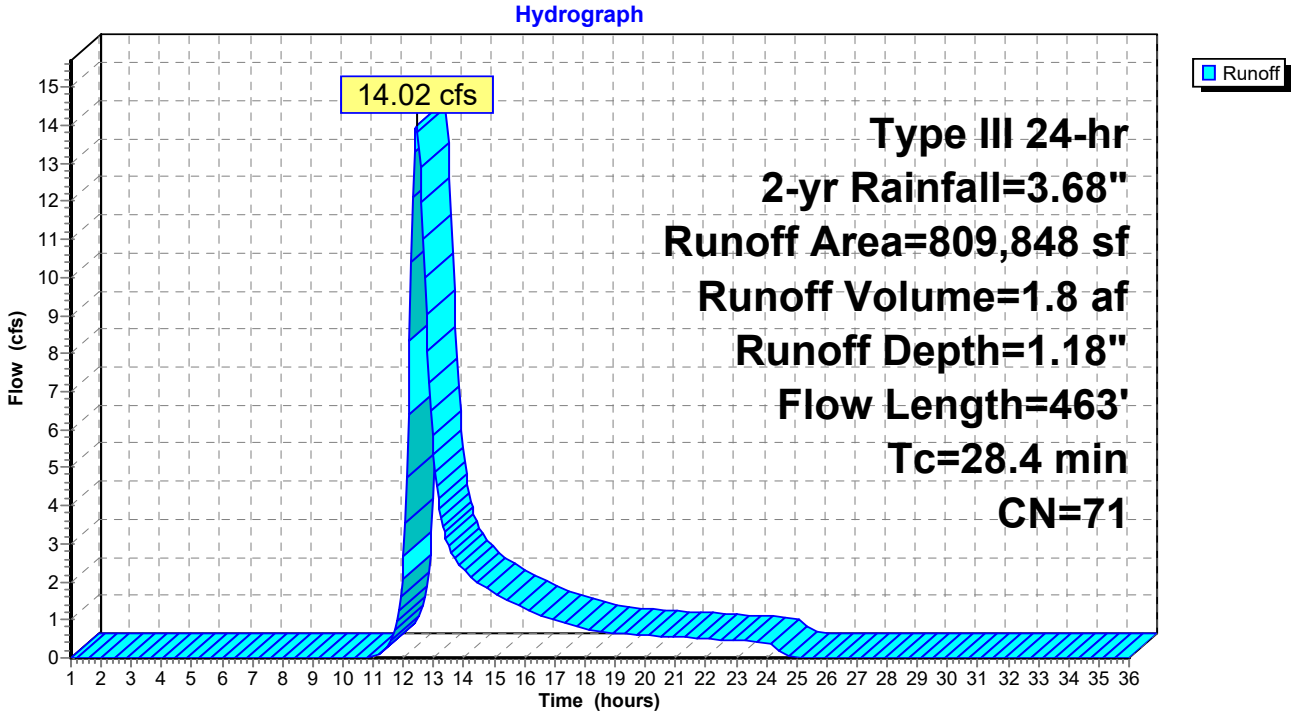
Runoff = 14.02 cfs @ 12.43 hrs, Volume= 1.8 af, Depth= 1.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.68"

Area (sf)	CN	Description
41,299	55	Woods, Good, HSG B
598,726	70	Woods, Good, HSG C
169,823	77	Woods, Good, HSG D
809,848	71	Weighted Average
809,848		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.7	50	0.0100	0.03		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.60"
1.7	413	0.0670	4.17		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
28.4	463	Total			

Subcatchment 1S: 1S



Summary for Subcatchment 2S: 2S

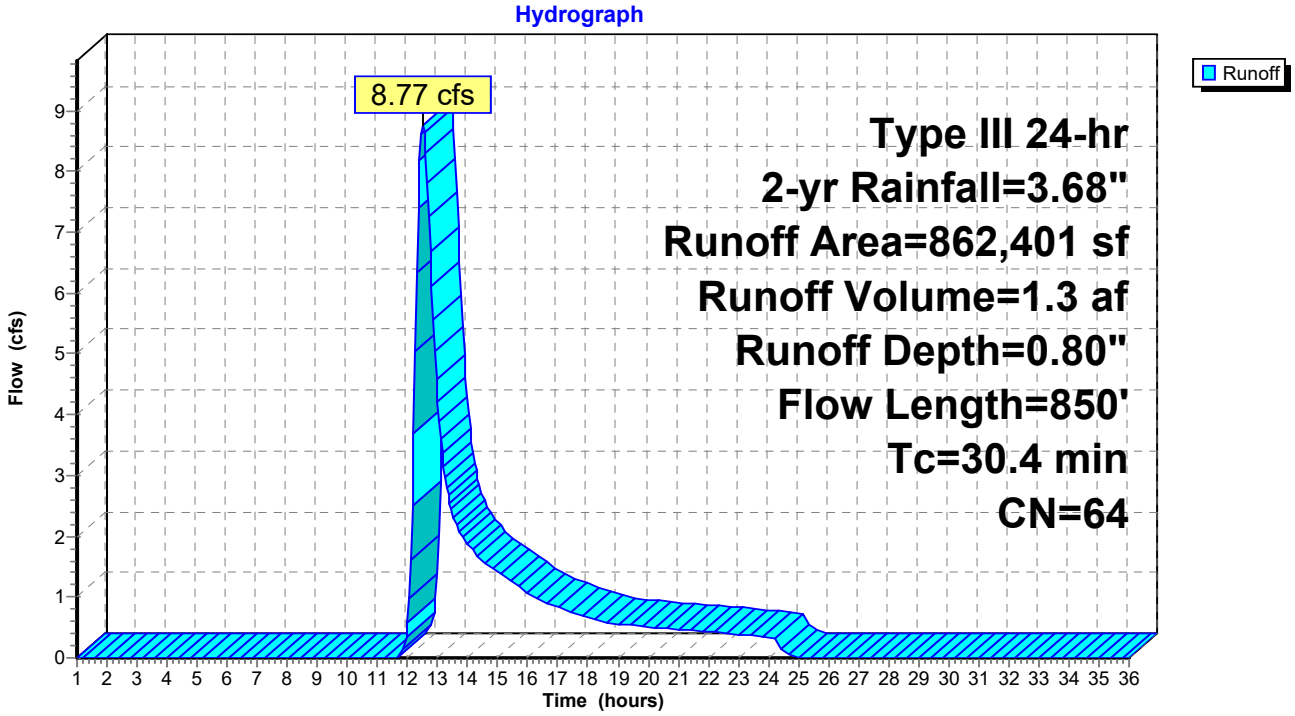
Runoff = 8.77 cfs @ 12.50 hrs, Volume= 1.3 af, Depth= 0.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.68"

Area (sf)	CN	Description
344,400	55	Woods, Good, HSG B
512,627	70	Woods, Good, HSG C
5,374	74	>75% Grass cover, Good, HSG C
862,401	64	Weighted Average
862,401		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.7	50	0.0100	0.03		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.60"
3.7	800	0.0500	3.60		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
30.4	850	Total			

Subcatchment 2S: 2S

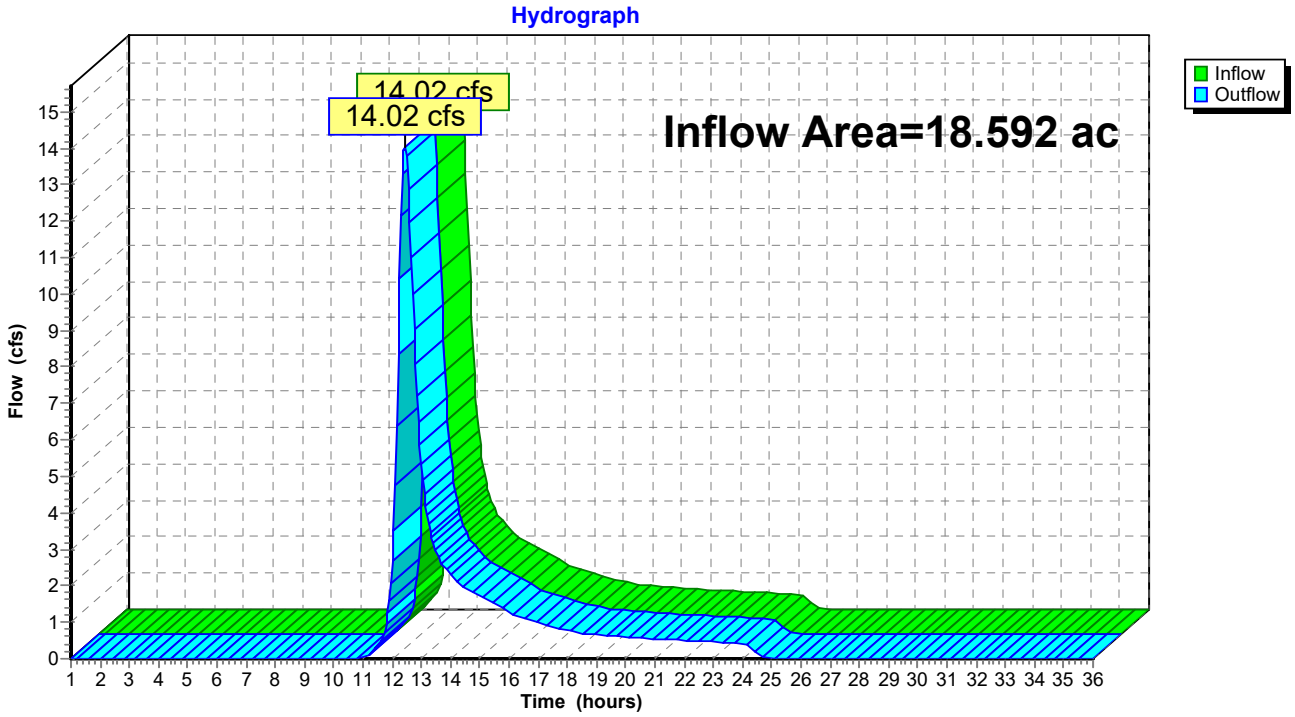


Summary for Reach DP1: Eastern Wetland

Inflow Area = 18.592 ac, 0.00% Impervious, Inflow Depth = 1.18" for 2-yr event
Inflow = 14.02 cfs @ 12.43 hrs, Volume= 1.8 af
Outflow = 14.02 cfs @ 12.43 hrs, Volume= 1.8 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs

Reach DP1: Eastern Wetland



Summary for Pond RRP: Western Swale/Railroad Tracks w/ Culvert

Inflow Area = 19.798 ac, 0.00% Impervious, Inflow Depth = 0.80" for 2-yr event
Inflow = 8.77 cfs @ 12.50 hrs, Volume= 1.3 af
Outflow = 8.41 cfs @ 12.60 hrs, Volume= 1.3 af, Atten= 4%, Lag= 6.1 min
Primary = 8.41 cfs @ 12.60 hrs, Volume= 1.3 af

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 58.77' @ 12.60 hrs Surf.Area= 8,332 sf Storage= 5,767 cf

Plug-Flow detention time= 12.7 min calculated for 1.3 af (100% of inflow)
Center-of-Mass det. time= 12.1 min (921.2 - 909.1)

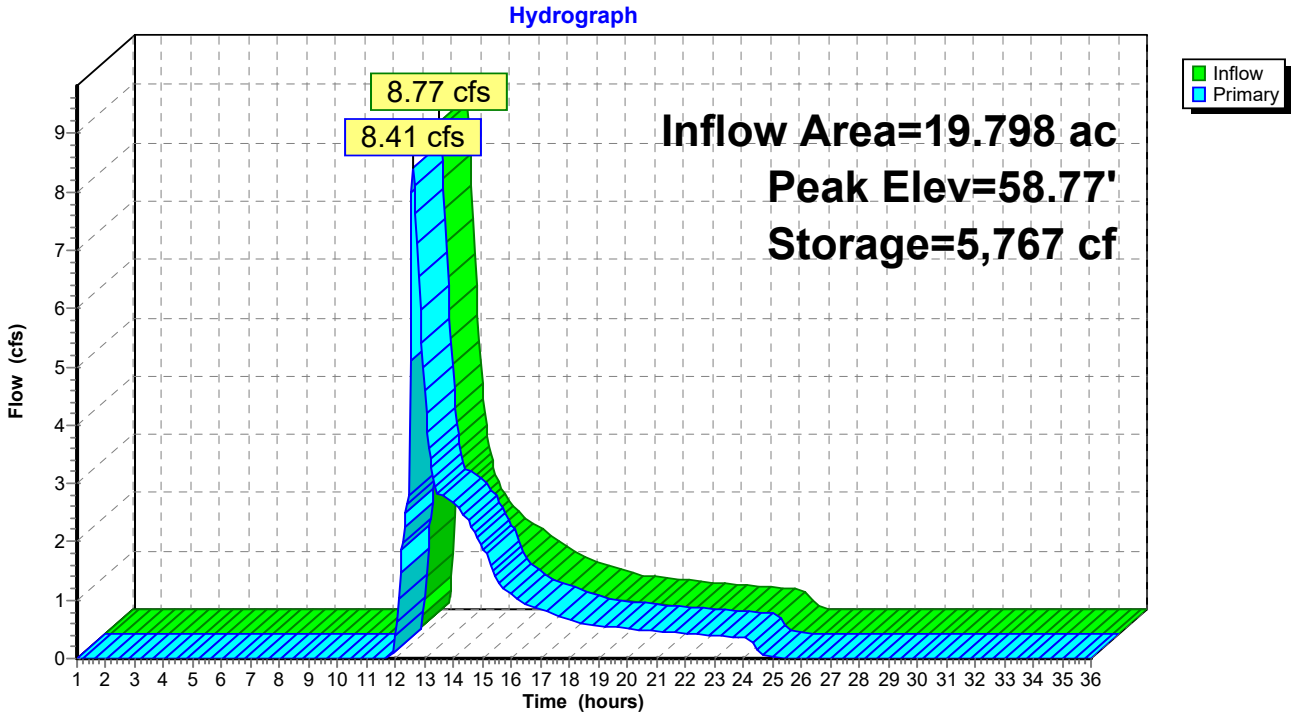
Volume	Invert	Avail.Storage	Storage Description
#1	56.00'	22,365 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
56.00	13	26.5	0	0	13
57.00	505	195.7	200	200	3,007
58.00	2,779	348.1	1,490	1,689	9,607
59.00	10,591	884.0	6,265	7,954	62,155
60.00	18,605	1,253.7	14,411	22,365	125,054

Device	Routing	Invert	Outlet Devices
#1	Primary	56.26'	**12.0" Round CMP_Round 12"** L= 60.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 56.26' / 55.86' S= 0.0067 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#2	Primary	58.65'	**50.0' long x 35.0' breadth Broad-Crested Rectangular Weir** 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=8.35 cfs @ 12.60 hrs HW=58.77' (Free Discharge)
└─**1=CMP_Round 12"** (Barrel Controls 2.92 cfs @ 3.72 fps)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 5.43 cfs @ 0.92 fps)

Pond RRP: Western Swale/Railroad Tracks w/ Culvert



Time span=1.00-36.00 hrs, dt=0.05 hrs, 701 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: 1S Runoff Area=809,848 sf 0.00% Impervious Runoff Depth=2.45"
Flow Length=463' Tc=28.4 min CN=71 Runoff=30.64 cfs 3.8 af

Subcatchment 2S: 2S Runoff Area=862,401 sf 0.00% Impervious Runoff Depth=1.87"
Flow Length=850' Tc=30.4 min CN=64 Runoff=23.31 cfs 3.1 af

Reach DP1: Eastern Wetland Inflow=30.64 cfs 3.8 af
Outflow=30.64 cfs 3.8 af

Pond RRP: Western Swale/Railroad Tracks w/ Peak Elev=58.93' Storage=7,257 cf Inflow=23.31 cfs 3.1 af
Outflow=23.20 cfs 3.1 af

Total Runoff Area = 38.390 ac Runoff Volume = 6.9 af Average Runoff Depth = 2.15"
100.00% Pervious = 38.390 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: 1S

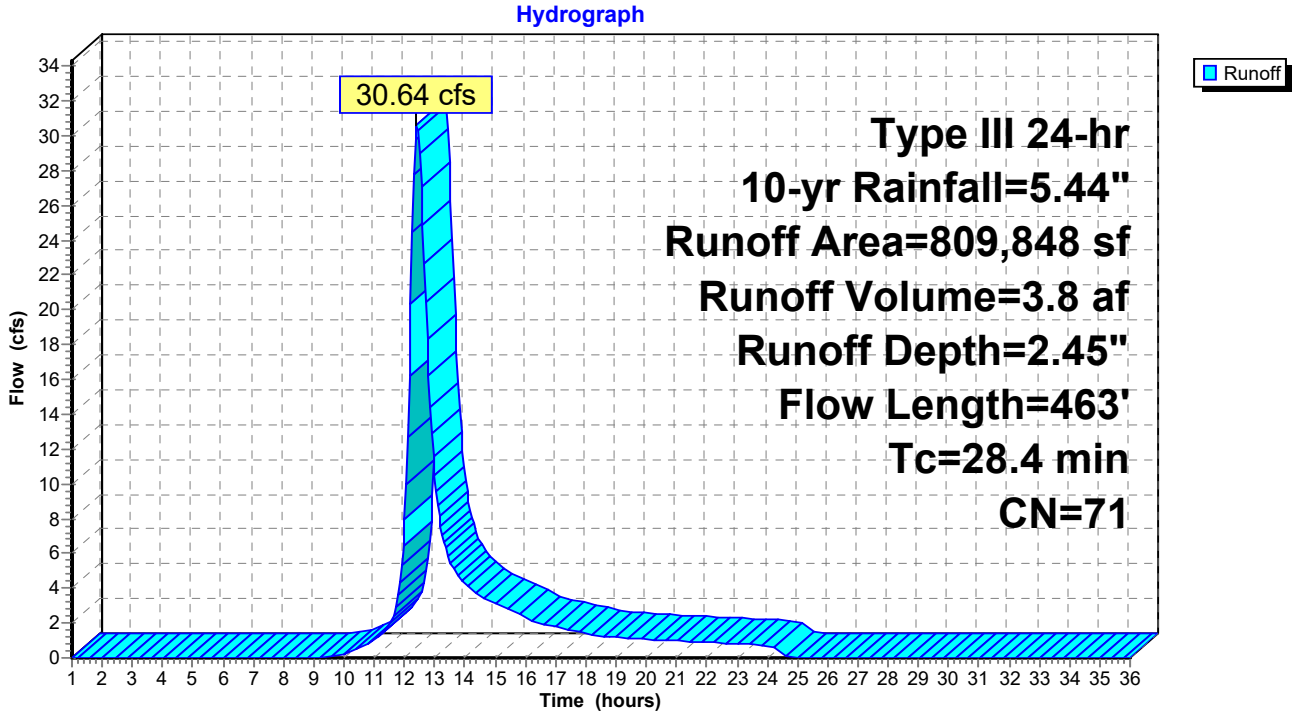
Runoff = 30.64 cfs @ 12.41 hrs, Volume= 3.8 af, Depth= 2.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=5.44"

Area (sf)	CN	Description
41,299	55	Woods, Good, HSG B
598,726	70	Woods, Good, HSG C
169,823	77	Woods, Good, HSG D
809,848	71	Weighted Average
809,848		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.7	50	0.0100	0.03		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.60"
1.7	413	0.0670	4.17		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
28.4	463	Total			

Subcatchment 1S: 1S



Summary for Subcatchment 2S: 2S

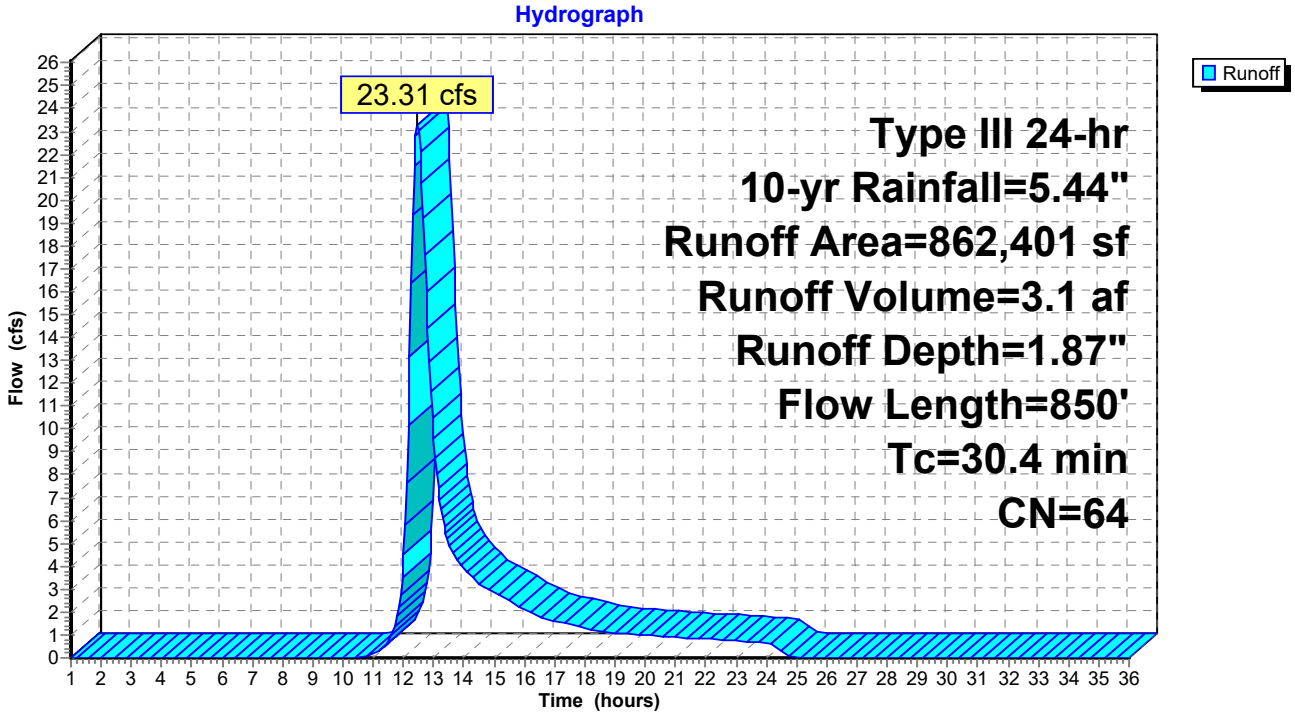
Runoff = 23.31 cfs @ 12.46 hrs, Volume= 3.1 af, Depth= 1.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=5.44"

Area (sf)	CN	Description
344,400	55	Woods, Good, HSG B
512,627	70	Woods, Good, HSG C
5,374	74	>75% Grass cover, Good, HSG C
862,401	64	Weighted Average
862,401		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.7	50	0.0100	0.03		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.60"
3.7	800	0.0500	3.60		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
30.4	850	Total			

Subcatchment 2S: 2S

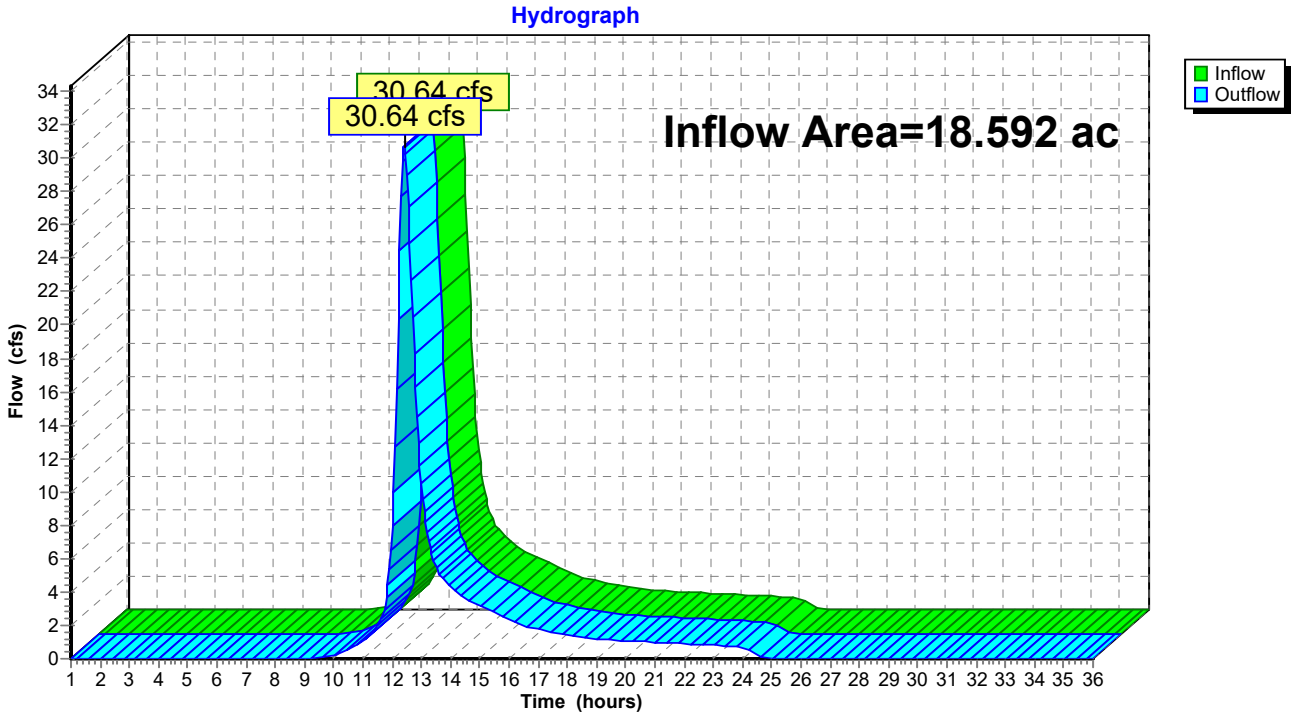


Summary for Reach DP1: Eastern Wetland

Inflow Area = 18.592 ac, 0.00% Impervious, Inflow Depth = 2.45" for 10-yr event
Inflow = 30.64 cfs @ 12.41 hrs, Volume= 3.8 af
Outflow = 30.64 cfs @ 12.41 hrs, Volume= 3.8 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs

Reach DP1: Eastern Wetland



Summary for Pond RRP: Western Swale/Railroad Tracks w/ Culvert

Inflow Area = 19.798 ac, 0.00% Impervious, Inflow Depth = 1.87" for 10-yr event
Inflow = 23.31 cfs @ 12.46 hrs, Volume= 3.1 af
Outflow = 23.20 cfs @ 12.48 hrs, Volume= 3.1 af, Atten= 0%, Lag= 1.5 min
Primary = 23.20 cfs @ 12.48 hrs, Volume= 3.1 af

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 58.93' @ 12.48 hrs Surf.Area= 9,900 sf Storage= 7,257 cf

Plug-Flow detention time= 11.9 min calculated for 3.1 af (100% of inflow)
Center-of-Mass det. time= 11.4 min (892.4 - 881.0)

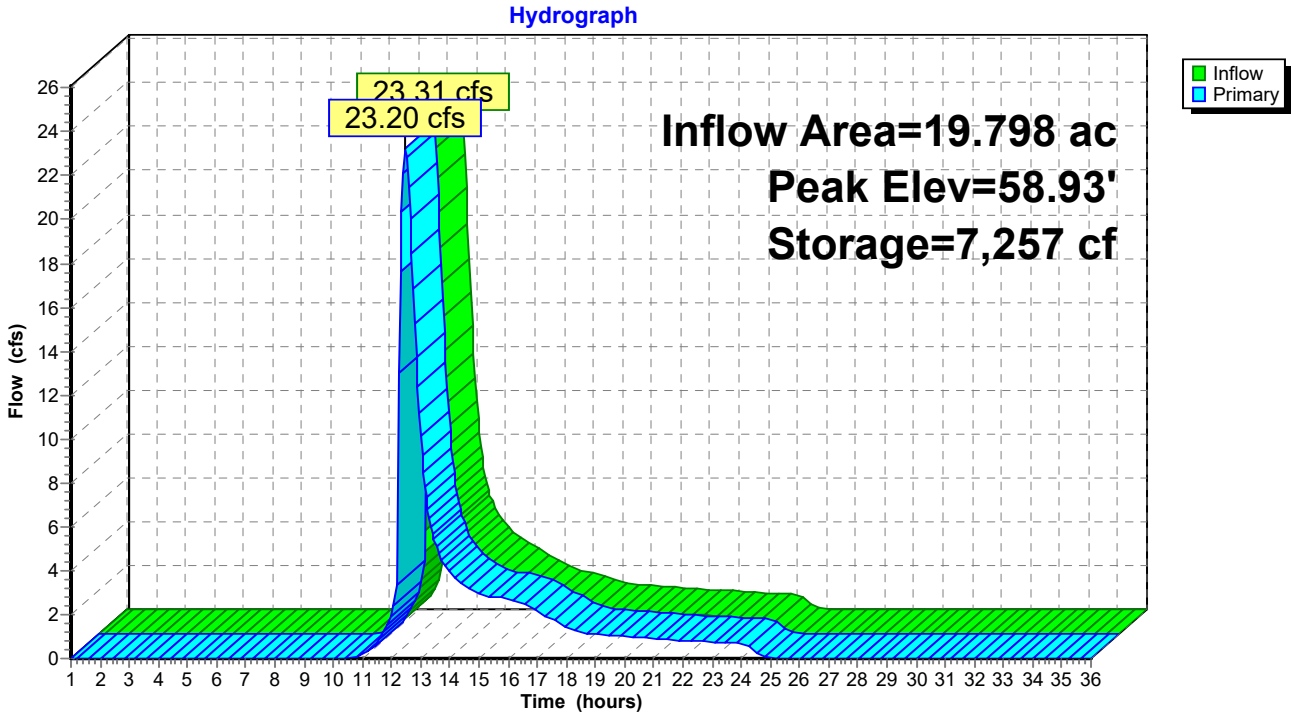
Volume	Invert	Avail.Storage	Storage Description
#1	56.00'	22,365 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
56.00	13	26.5	0	0	13
57.00	505	195.7	200	200	3,007
58.00	2,779	348.1	1,490	1,689	9,607
59.00	10,591	884.0	6,265	7,954	62,155
60.00	18,605	1,253.7	14,411	22,365	125,054

Device	Routing	Invert	Outlet Devices
#1	Primary	56.26'	**12.0" Round CMP_Round 12"** L= 60.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 56.26' / 55.86' S= 0.0067 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#2	Primary	58.65'	**50.0' long x 35.0' breadth Broad-Crested Rectangular Weir** 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=23.09 cfs @ 12.48 hrs HW=58.93' (Free Discharge)
└─**1=CMP_Round 12"** (Barrel Controls 3.05 cfs @ 3.88 fps)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 20.05 cfs @ 1.43 fps)

Pond RRP: Western Swale/Railroad Tracks w/ Culvert



Time span=1.00-36.00 hrs, dt=0.05 hrs, 701 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: 1S Runoff Area=809,848 sf 0.00% Impervious Runoff Depth=3.48"
Flow Length=463' Tc=28.4 min CN=71 Runoff=43.84 cfs 5.4 af

Subcatchment 2S: 2S Runoff Area=862,401 sf 0.00% Impervious Runoff Depth=2.78"
Flow Length=850' Tc=30.4 min CN=64 Runoff=35.55 cfs 4.6 af

Reach DP1: Eastern Wetland Inflow=43.84 cfs 5.4 af
Outflow=43.84 cfs 5.4 af

Pond RRP: Western Swale/Railroad Tracks w/ Peak Elev=59.04' Storage=8,335 cf Inflow=35.55 cfs 4.6 af
Outflow=35.44 cfs 4.6 af

Total Runoff Area = 38.390 ac Runoff Volume = 10.0 af Average Runoff Depth = 3.12"
100.00% Pervious = 38.390 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: 1S

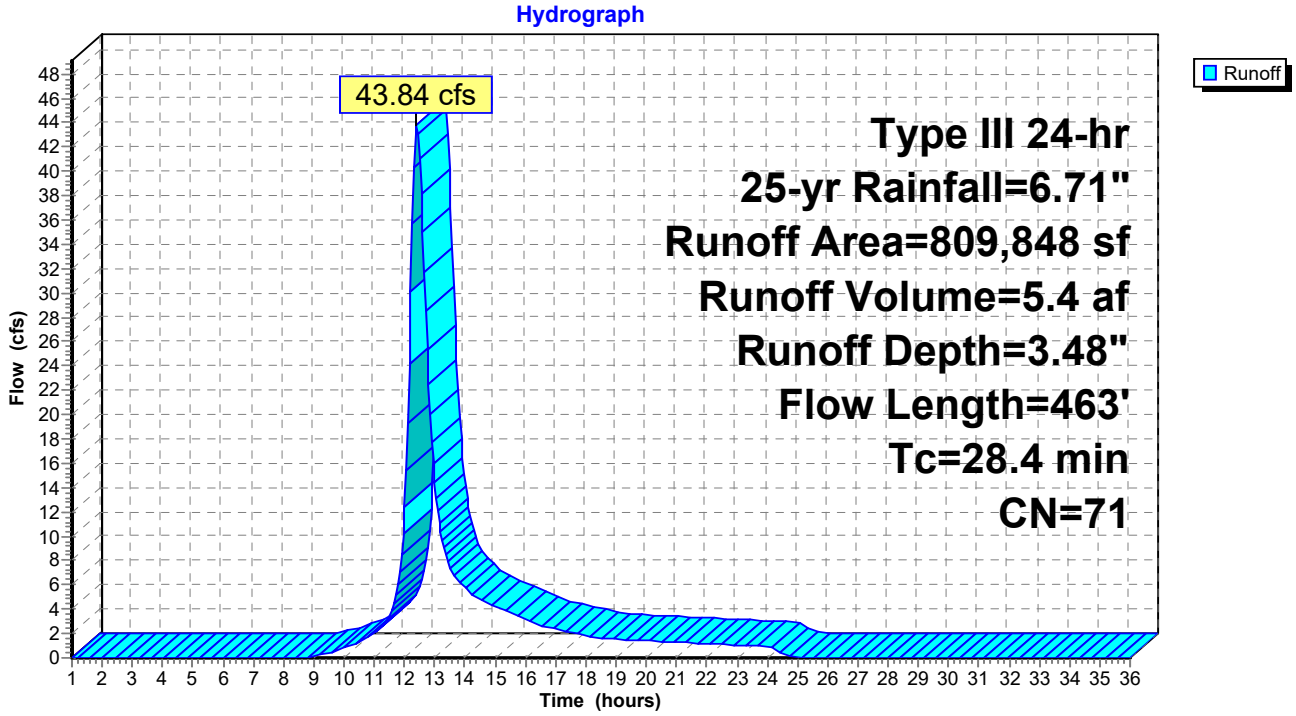
Runoff = 43.84 cfs @ 12.40 hrs, Volume= 5.4 af, Depth= 3.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.71"

Area (sf)	CN	Description
41,299	55	Woods, Good, HSG B
598,726	70	Woods, Good, HSG C
169,823	77	Woods, Good, HSG D
809,848	71	Weighted Average
809,848		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.7	50	0.0100	0.03		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.60"
1.7	413	0.0670	4.17		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
28.4	463	Total			

Subcatchment 1S: 1S



Summary for Subcatchment 2S: 2S

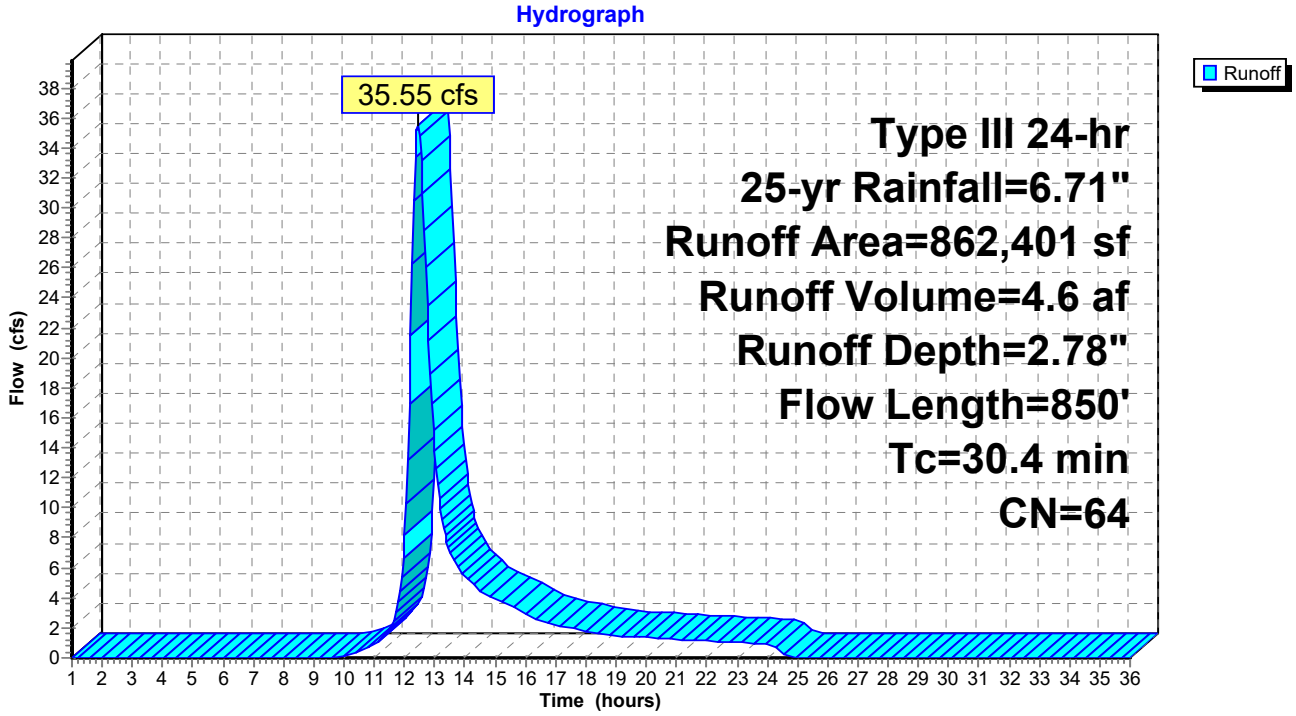
Runoff = 35.55 cfs @ 12.44 hrs, Volume= 4.6 af, Depth= 2.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.71"

Area (sf)	CN	Description
344,400	55	Woods, Good, HSG B
512,627	70	Woods, Good, HSG C
5,374	74	>75% Grass cover, Good, HSG C
862,401	64	Weighted Average
862,401		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.7	50	0.0100	0.03		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.60"
3.7	800	0.0500	3.60		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
30.4	850	Total			

Subcatchment 2S: 2S

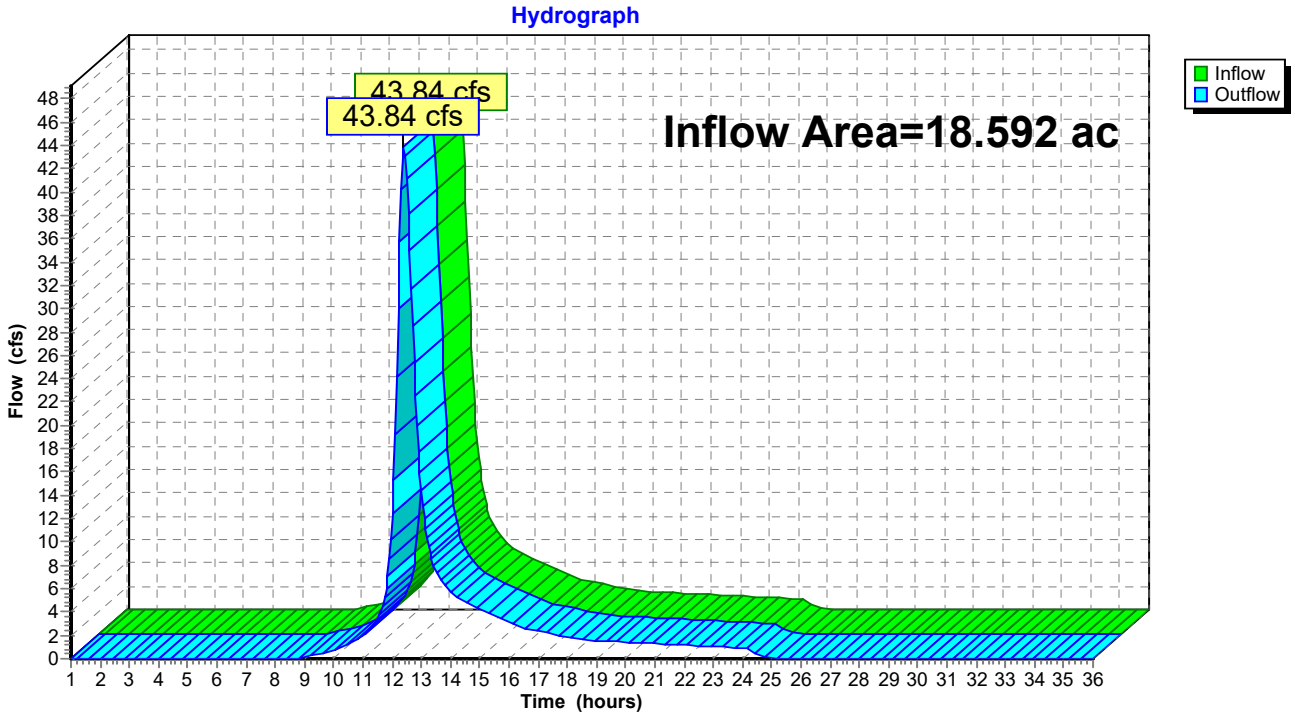


Summary for Reach DP1: Eastern Wetland

Inflow Area = 18.592 ac, 0.00% Impervious, Inflow Depth = 3.48" for 25-yr event
Inflow = 43.84 cfs @ 12.40 hrs, Volume= 5.4 af
Outflow = 43.84 cfs @ 12.40 hrs, Volume= 5.4 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs

Reach DP1: Eastern Wetland



Summary for Pond RRP: Western Swale/Railroad Tracks w/ Culvert

Inflow Area = 19.798 ac, 0.00% Impervious, Inflow Depth = 2.78" for 25-yr event
Inflow = 35.55 cfs @ 12.44 hrs, Volume= 4.6 af
Outflow = 35.44 cfs @ 12.47 hrs, Volume= 4.6 af, Atten= 0%, Lag= 1.5 min
Primary = 35.44 cfs @ 12.47 hrs, Volume= 4.6 af

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 59.04' @ 12.47 hrs Surf.Area= 10,837 sf Storage= 8,335 cf

Plug-Flow detention time= 10.2 min calculated for 4.6 af (100% of inflow)
Center-of-Mass det. time= 10.2 min (879.3 - 869.1)

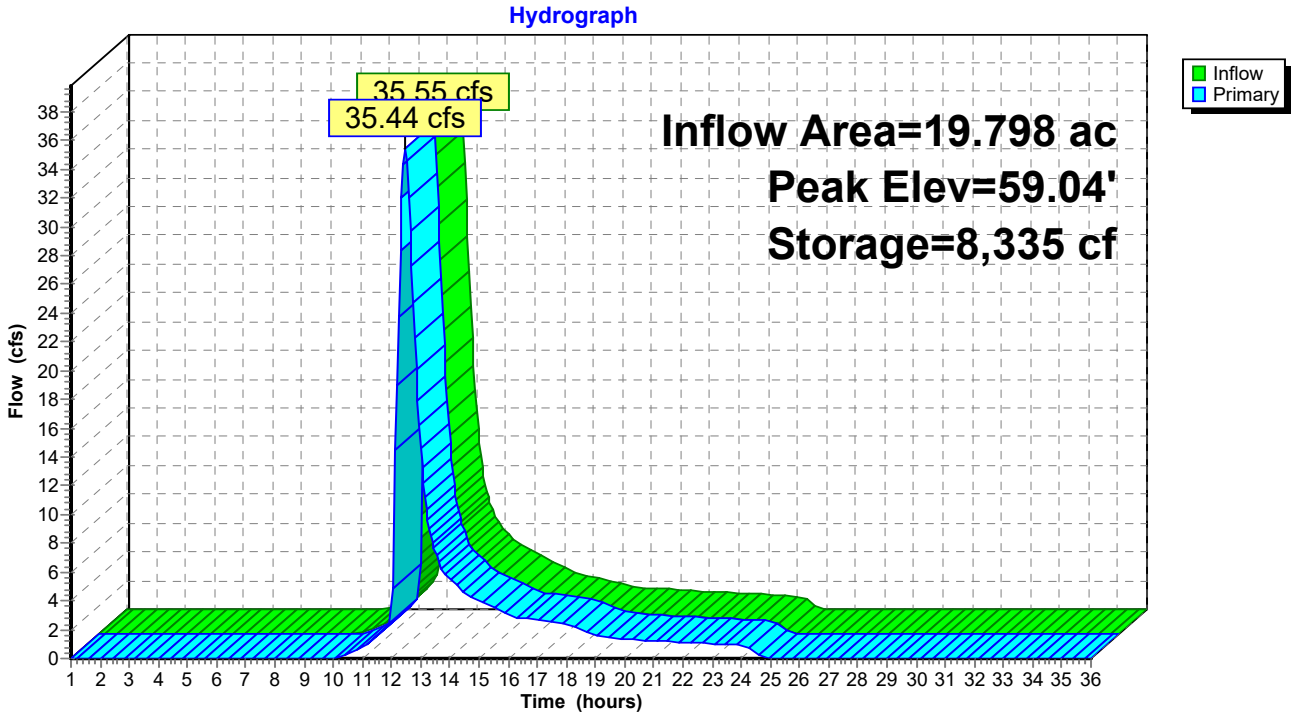
Volume	Invert	Avail.Storage	Storage Description
#1	56.00'	22,365 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
56.00	13	26.5	0	0	13
57.00	505	195.7	200	200	3,007
58.00	2,779	348.1	1,490	1,689	9,607
59.00	10,591	884.0	6,265	7,954	62,155
60.00	18,605	1,253.7	14,411	22,365	125,054

Device	Routing	Invert	Outlet Devices
#1	Primary	56.26'	**12.0" Round CMP_Round 12"** L= 60.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 56.26' / 55.86' S= 0.0067 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#2	Primary	58.65'	**50.0' long x 35.0' breadth Broad-Crested Rectangular Weir** 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=35.29 cfs @ 12.47 hrs HW=59.03' (Free Discharge)
└─**1=CMP_Round 12"** (Barrel Controls 3.12 cfs @ 3.97 fps)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 32.16 cfs @ 1.67 fps)

Pond RRP: Western Swale/Railroad Tracks w/ Culvert



Time span=1.00-36.00 hrs, dt=0.05 hrs, 701 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: 1S Runoff Area=809,848 sf 0.00% Impervious Runoff Depth=5.26"
Flow Length=463' Tc=28.4 min CN=71 Runoff=66.37 cfs 8.2 af

Subcatchment 2S: 2S Runoff Area=862,401 sf 0.00% Impervious Runoff Depth=4.41"
Flow Length=850' Tc=30.4 min CN=64 Runoff=57.28 cfs 7.3 af

Reach DP1: Eastern Wetland Inflow=66.37 cfs 8.2 af
Outflow=66.37 cfs 8.2 af

Pond RRP: Western Swale/Railroad Tracks w/ Peak Elev=59.19' Storage=10,117 cf Inflow=57.28 cfs 7.3 af
Outflow=57.12 cfs 7.3 af

Total Runoff Area = 38.390 ac Runoff Volume = 15.4 af Average Runoff Depth = 4.82"
100.00% Pervious = 38.390 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: 1S

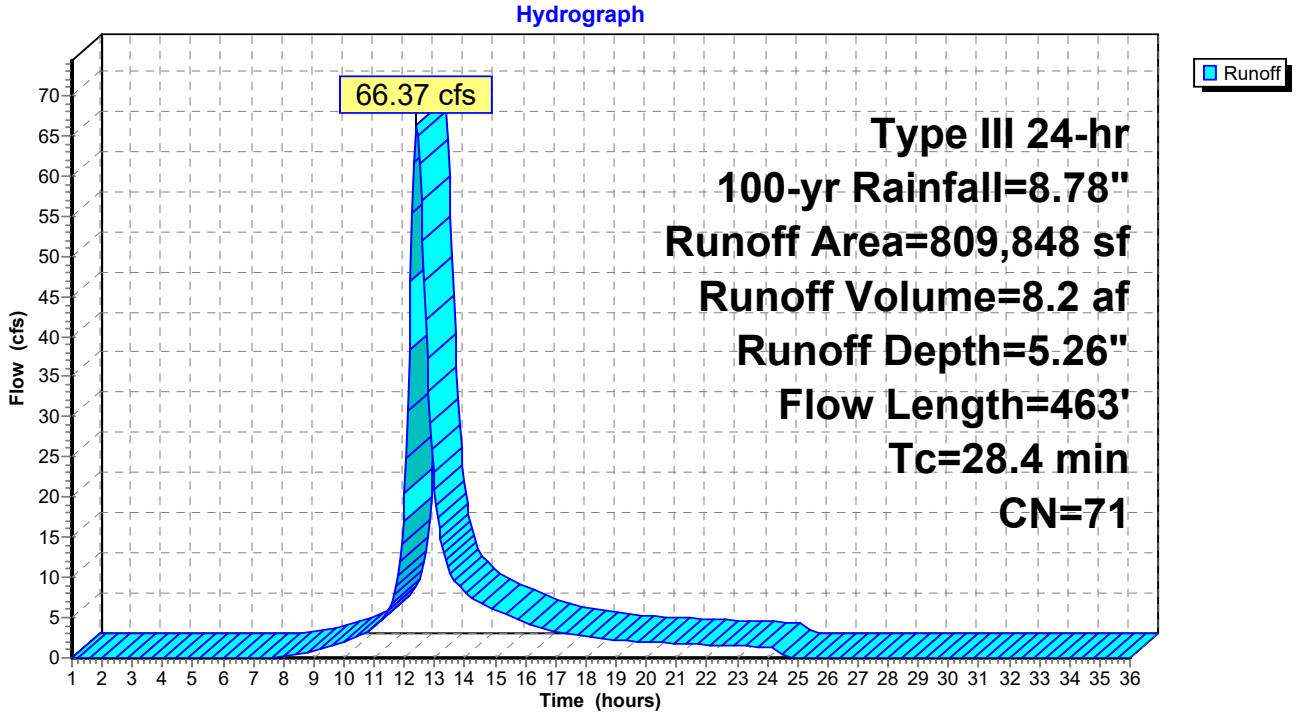
Runoff = 66.37 cfs @ 12.39 hrs, Volume= 8.2 af, Depth= 5.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.78"

Area (sf)	CN	Description
41,299	55	Woods, Good, HSG B
598,726	70	Woods, Good, HSG C
169,823	77	Woods, Good, HSG D
809,848	71	Weighted Average
809,848		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.7	50	0.0100	0.03		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.60"
1.7	413	0.0670	4.17		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
28.4	463	Total			

Subcatchment 1S: 1S



Summary for Subcatchment 2S: 2S

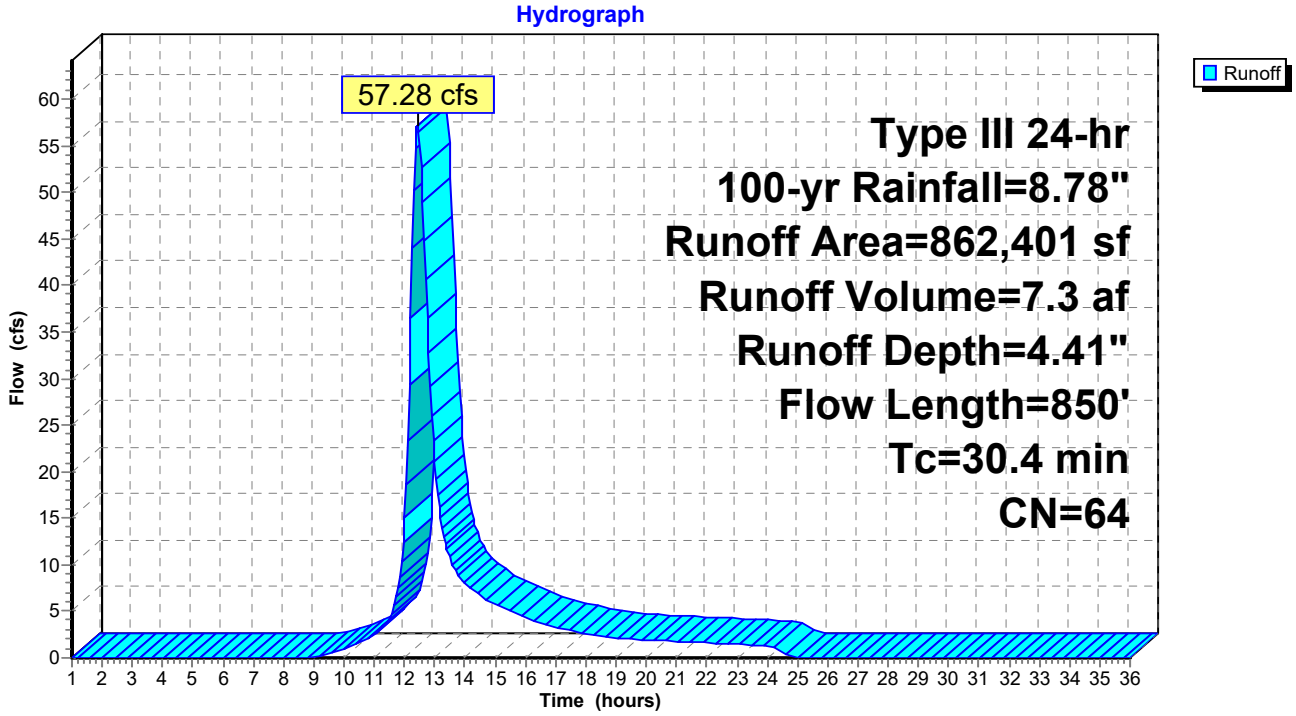
Runoff = 57.28 cfs @ 12.43 hrs, Volume= 7.3 af, Depth= 4.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.78"

Area (sf)	CN	Description
344,400	55	Woods, Good, HSG B
512,627	70	Woods, Good, HSG C
5,374	74	>75% Grass cover, Good, HSG C
862,401	64	Weighted Average
862,401		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.7	50	0.0100	0.03		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.60"
3.7	800	0.0500	3.60		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
30.4	850	Total			

Subcatchment 2S: 2S

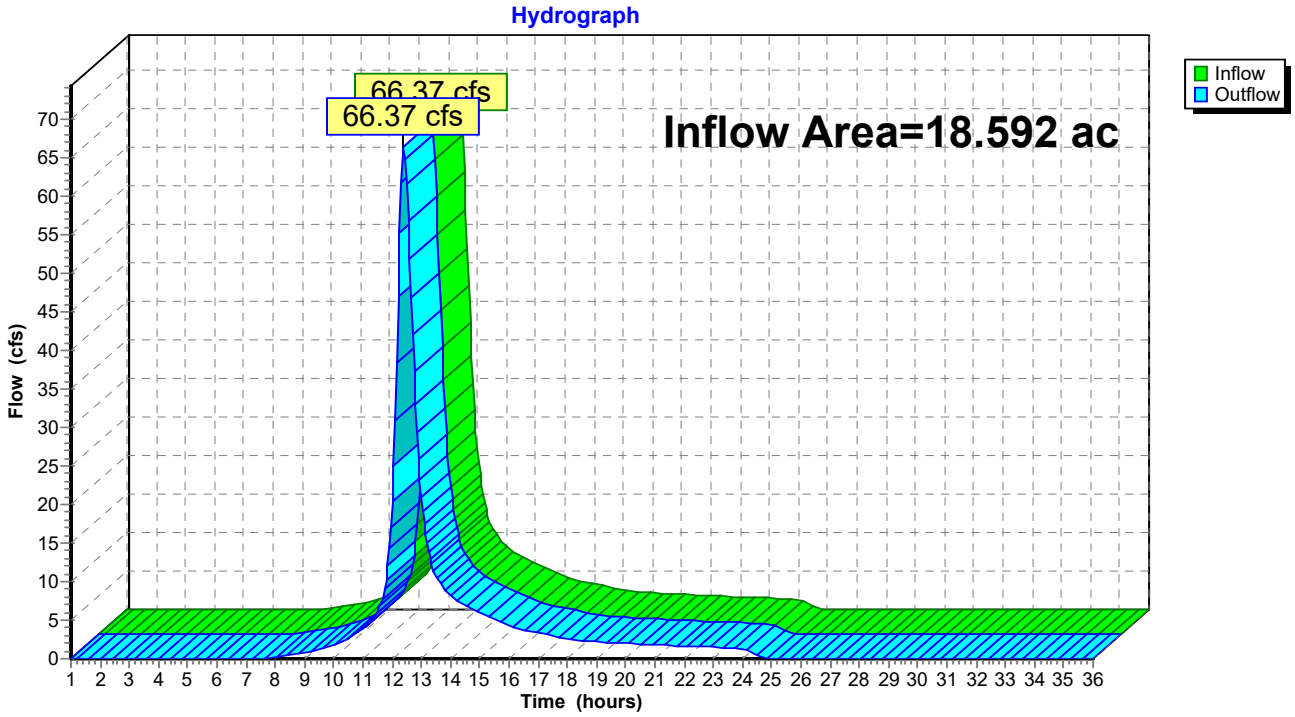


Summary for Reach DP1: Eastern Wetland

Inflow Area = 18.592 ac, 0.00% Impervious, Inflow Depth = 5.26" for 100-yr event
Inflow = 66.37 cfs @ 12.39 hrs, Volume= 8.2 af
Outflow = 66.37 cfs @ 12.39 hrs, Volume= 8.2 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs

Reach DP1: Eastern Wetland



Summary for Pond RRP: Western Swale/Railroad Tracks w/ Culvert

Inflow Area = 19.798 ac, 0.00% Impervious, Inflow Depth = 4.41" for 100-yr event
Inflow = 57.28 cfs @ 12.43 hrs, Volume= 7.3 af
Outflow = 57.12 cfs @ 12.45 hrs, Volume= 7.3 af, Atten= 0%, Lag= 1.4 min
Primary = 57.12 cfs @ 12.45 hrs, Volume= 7.3 af

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 59.19' @ 12.45 hrs Surf.Area= 11,956 sf Storage= 10,117 cf

Plug-Flow detention time= 9.2 min calculated for 7.3 af (100% of inflow)
Center-of-Mass det. time= 9.2 min (864.8 - 855.6)

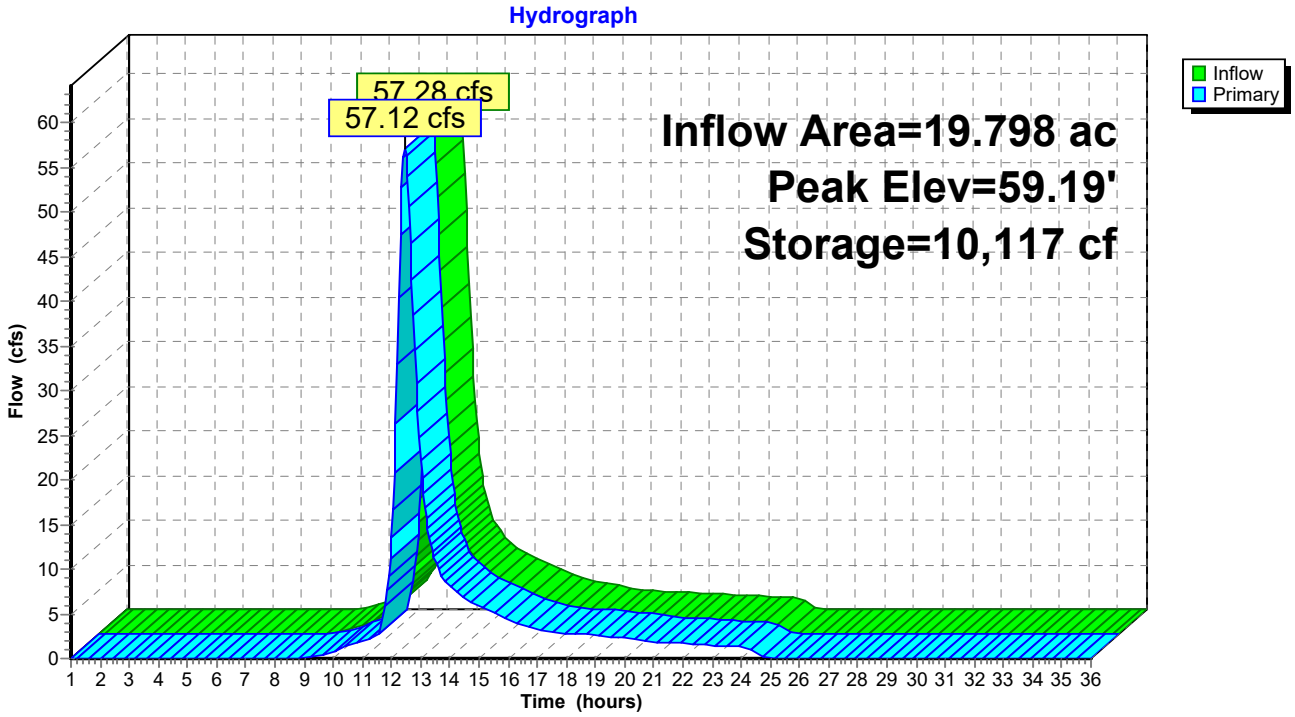
Volume	Invert	Avail.Storage	Storage Description
#1	56.00'	22,365 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
56.00	13	26.5	0	0	13
57.00	505	195.7	200	200	3,007
58.00	2,779	348.1	1,490	1,689	9,607
59.00	10,591	884.0	6,265	7,954	62,155
60.00	18,605	1,253.7	14,411	22,365	125,054

Device	Routing	Invert	Outlet Devices
#1	Primary	56.26'	**12.0" Round CMP_Round 12"** L= 60.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 56.26' / 55.86' S= 0.0067 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#2	Primary	58.65'	**50.0' long x 35.0' breadth Broad-Crested Rectangular Weir** 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=57.03 cfs @ 12.45 hrs HW=59.19' (Free Discharge)
└─**1=CMP_Round 12"** (Barrel Controls 3.23 cfs @ 4.12 fps)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 53.80 cfs @ 1.99 fps)

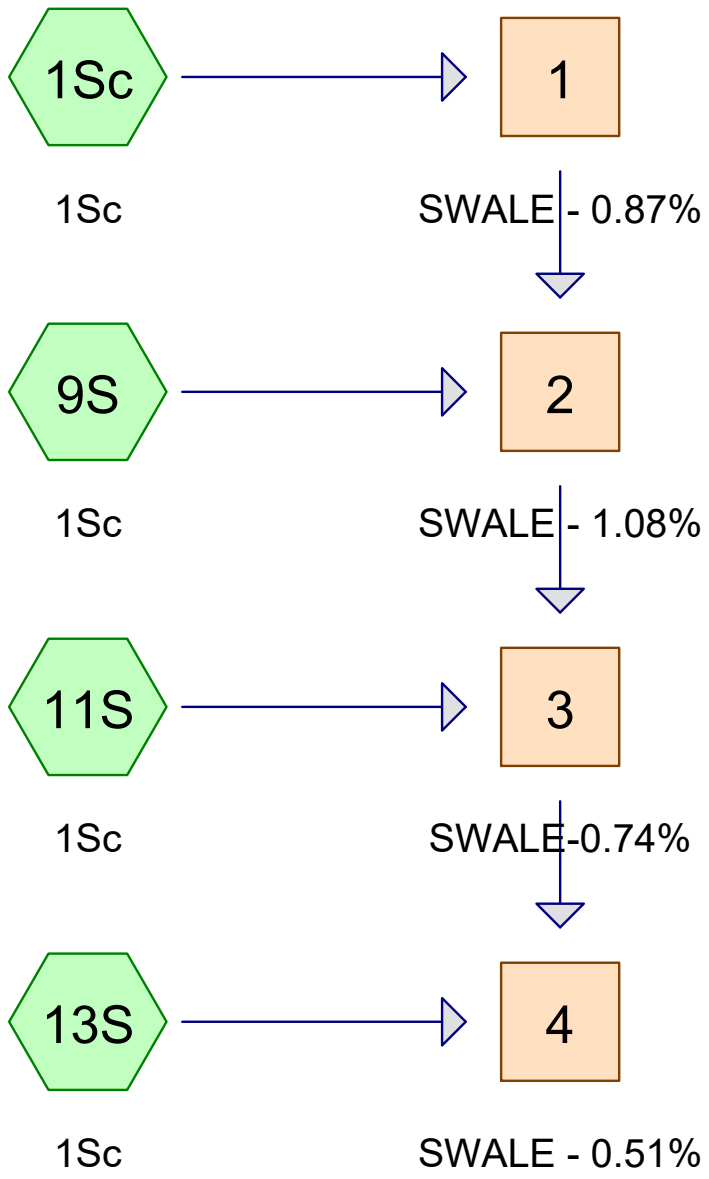
Pond RRP: Western Swale/Railroad Tracks w/ Culvert

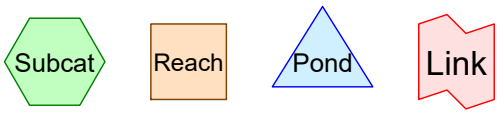


Appendix B

Revised Diversion Trench/Conveyance Swale Capacity Calculation – 1st Revision

DIVERSION SWALE





Routing Diagram for 3055.02 - FEARING HILL RD - DIVERSION SWALE-REVI
Prepared by Atlantic Design Engineers, Inc., Printed 8/31/2022
HydroCAD® 10.00-25 s/n 00480 © 2019 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
100,300	74	>75% Grass cover, Good, HSG C (1Sc, 9S, 11S, 13S)
4,401	96	Gravel surface, HSG C (13S)
104,701	**75**	**TOTAL AREA**

Time span=1.00-36.00 hrs, dt=0.05 hrs, 701 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1Sc: 1Sc Runoff Area=16,341 sf 0.00% Impervious Runoff Depth=1.37"
Flow Length=155' Tc=18.2 min CN=74 Runoff=0.41 cfs 1,860 cf

Subcatchment 9S: 1Sc Runoff Area=10,919 sf 0.00% Impervious Runoff Depth=1.37"
Flow Length=155' Tc=18.2 min CN=74 Runoff=0.27 cfs 1,243 cf

Subcatchment 11S: 1Sc Runoff Area=47,118 sf 0.00% Impervious Runoff Depth=1.37"
Flow Length=155' Tc=18.2 min CN=74 Runoff=1.17 cfs 5,362 cf

Subcatchment 13S: 1Sc Runoff Area=30,323 sf 0.00% Impervious Runoff Depth=1.57"
Flow Length=155' Tc=18.2 min CN=77 Runoff=0.88 cfs 3,956 cf

Reach 1: SWALE - 0.87% Avg. Flow Depth=0.16' Max Vel=0.83 fps Inflow=0.41 cfs 1,860 cf
n=0.040 L=228.2' S=0.0087 '/' Capacity=49.64 cfs Outflow=0.39 cfs 1,860 cf

Reach 2: SWALE - 1.08% Avg. Flow Depth=0.19' Max Vel=1.04 fps Inflow=0.65 cfs 3,102 cf
n=0.040 L=90.3' S=0.0109 '/' Capacity=55.38 cfs Outflow=0.65 cfs 3,102 cf

Reach 3: SWALE-0.74% Avg. Flow Depth=0.35' Max Vel=1.18 fps Inflow=1.79 cfs 8,465 cf
n=0.040 L=402.0' S=0.0074 '/' Capacity=45.69 cfs Outflow=1.68 cfs 8,465 cf

Reach 4: SWALE - 0.51% Avg. Flow Depth=0.44' Max Vel=1.13 fps Inflow=2.48 cfs 12,421 cf
n=0.040 L=408.0' S=0.0051 '/' Capacity=37.96 cfs Outflow=2.34 cfs 12,421 cf

Total Runoff Area = 104,701 sf Runoff Volume = 12,421 cf Average Runoff Depth = 1.42"
100.00% Pervious = 104,701 sf 0.00% Impervious = 0 sf

Summary for Subcatchment 1Sc: 1Sc

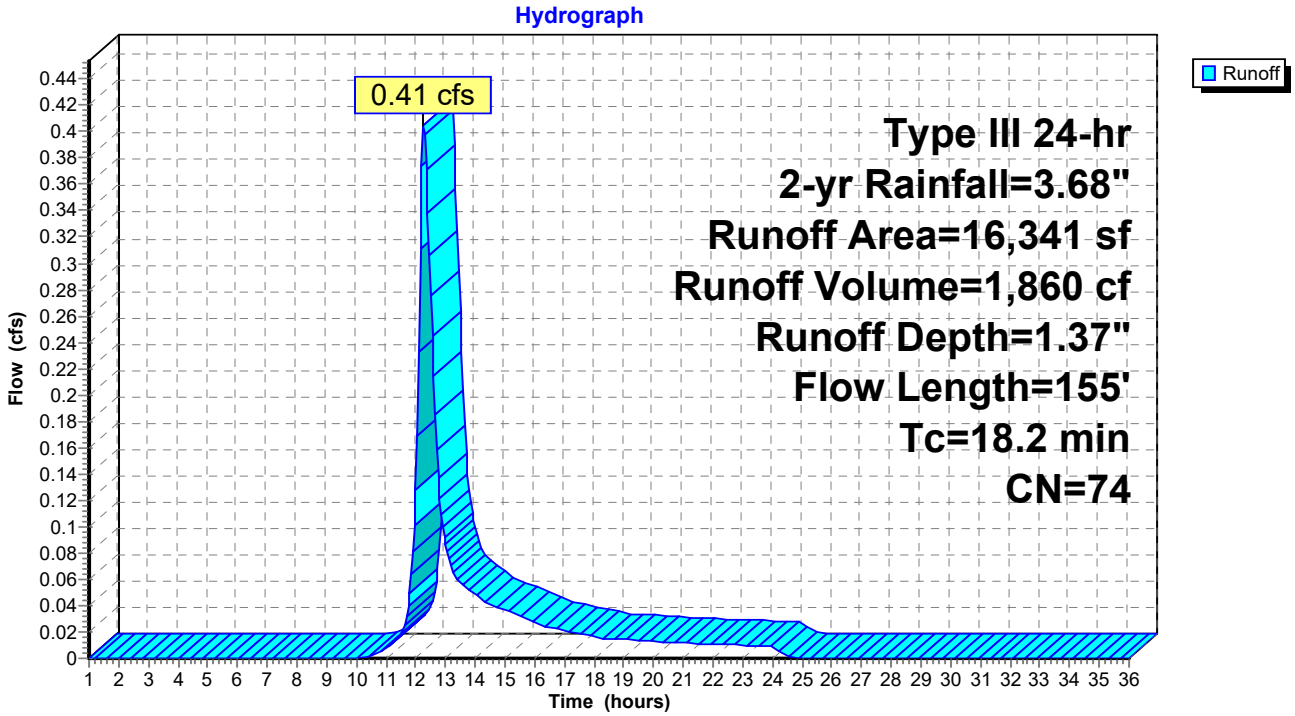
Runoff = 0.41 cfs @ 12.27 hrs, Volume= 1,860 cf, Depth= 1.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.68"

Area (sf)	CN	Description
16,341	74	>75% Grass cover, Good, HSG C
16,341		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.6	50	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.6	105	0.0330	2.92		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
18.2	155	Total			

Subcatchment 1Sc: 1Sc



Summary for Subcatchment 9S: 1Sc

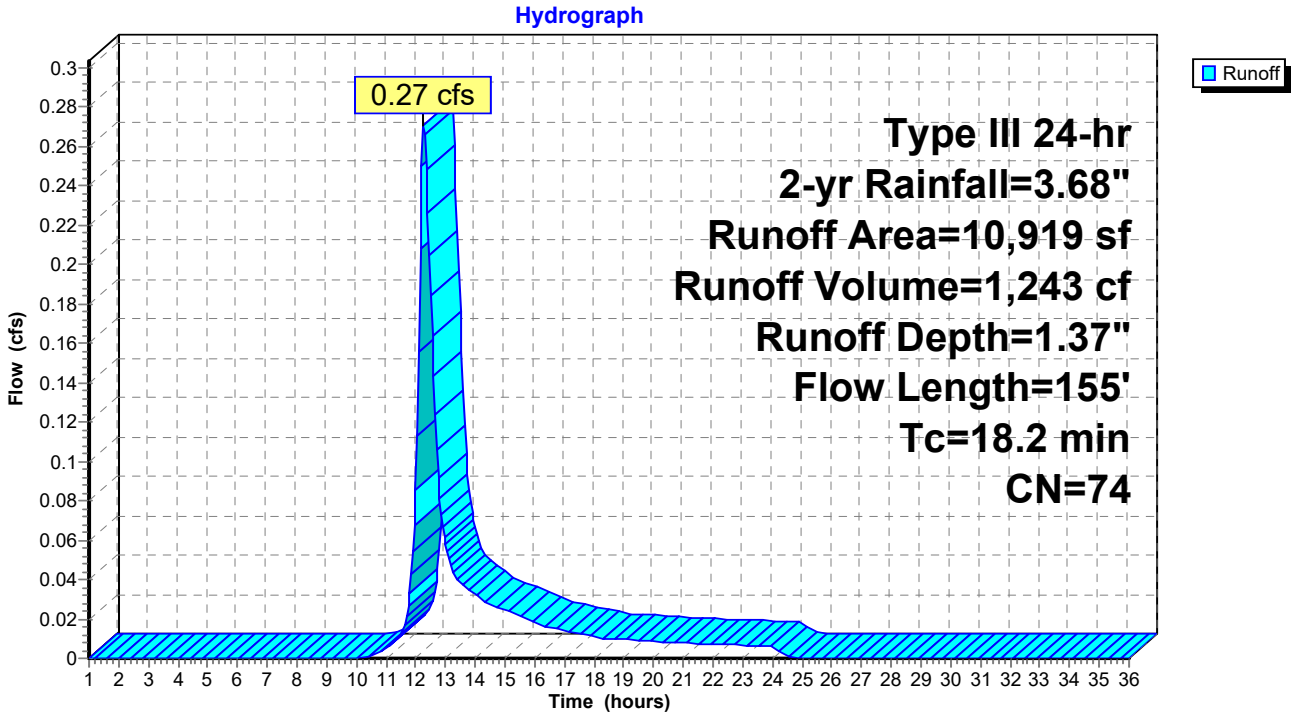
Runoff = 0.27 cfs @ 12.27 hrs, Volume= 1,243 cf, Depth= 1.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.68"

Area (sf)	CN	Description
10,919	74	>75% Grass cover, Good, HSG C
10,919		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.6	50	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.6	105	0.0330	2.92		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
18.2	155	Total			

Subcatchment 9S: 1Sc



Summary for Subcatchment 11S: 1Sc

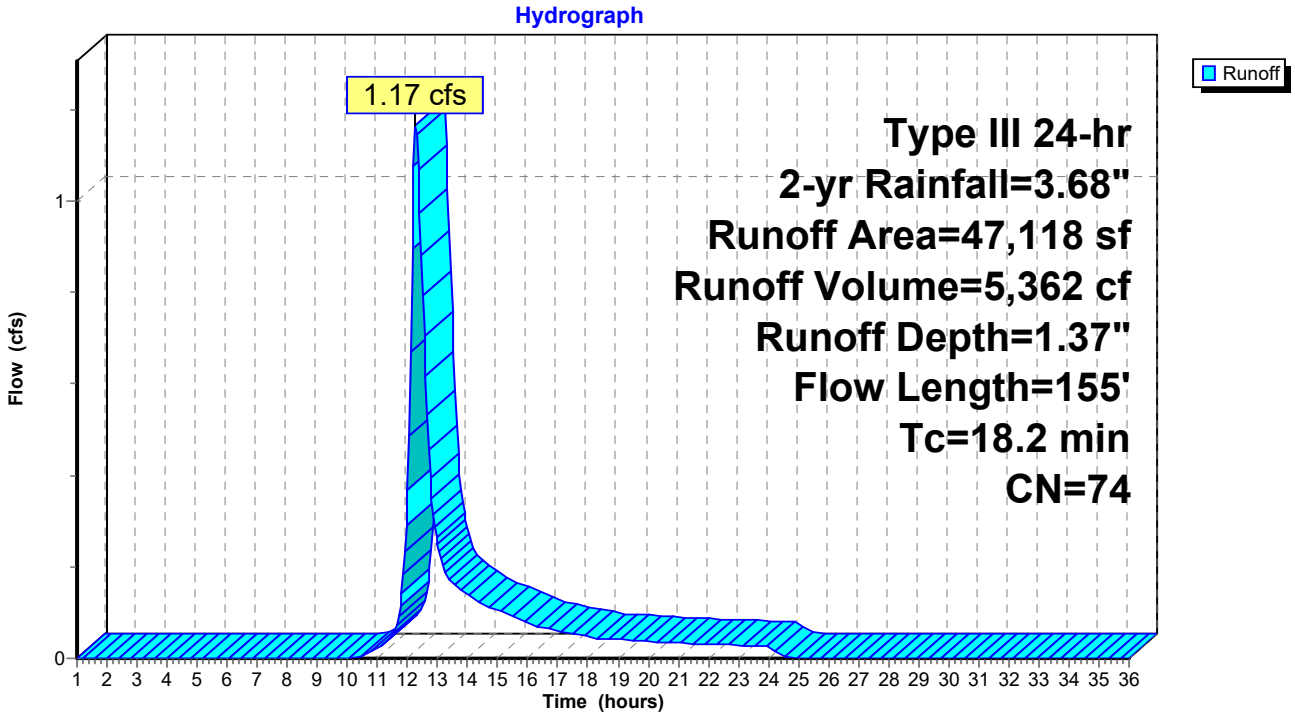
Runoff = 1.17 cfs @ 12.27 hrs, Volume= 5,362 cf, Depth= 1.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.68"

Area (sf)	CN	Description
47,118	74	>75% Grass cover, Good, HSG C
47,118		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.6	50	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.6	105	0.0330	2.92		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
18.2	155	Total			

Subcatchment 11S: 1Sc



Summary for Subcatchment 13S: 1Sc

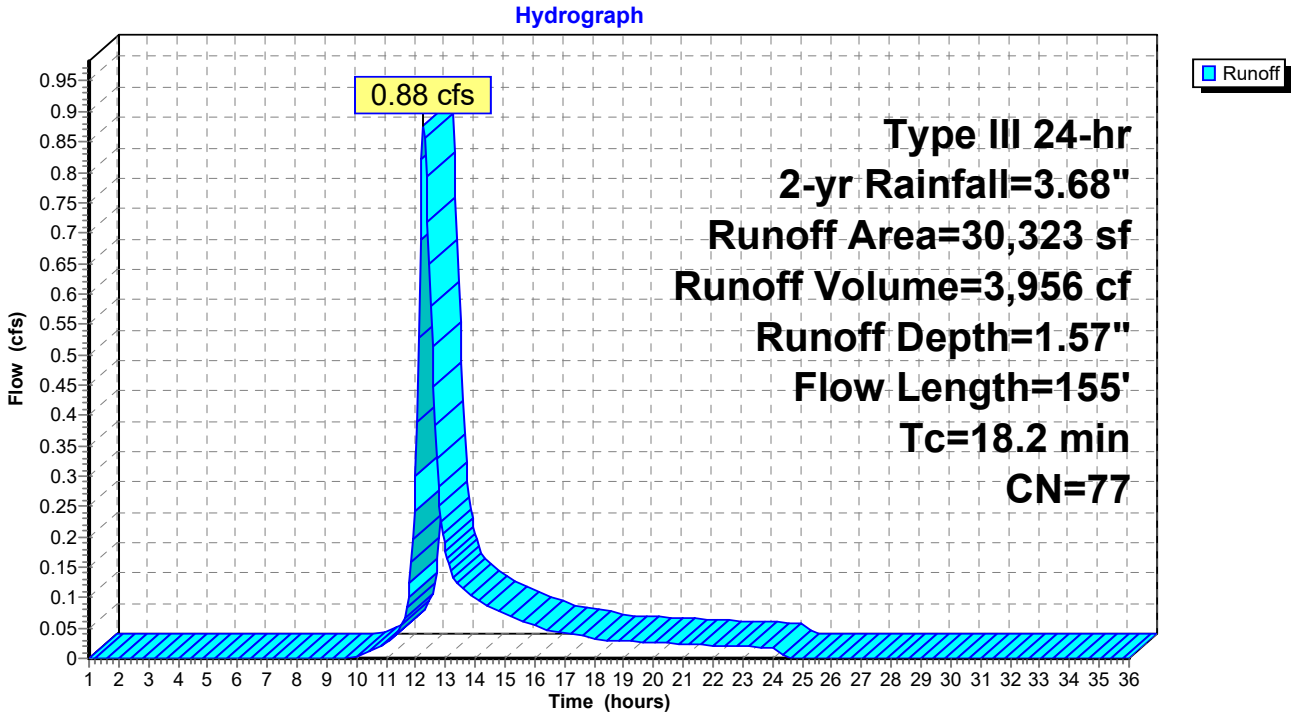
Runoff = 0.88 cfs @ 12.26 hrs, Volume= 3,956 cf, Depth= 1.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.68"

Area (sf)	CN	Description
4,401	96	Gravel surface, HSG C
25,922	74	>75% Grass cover, Good, HSG C
30,323	77	Weighted Average
30,323		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.6	50	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.6	105	0.0330	2.92		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
18.2	155	Total			

Subcatchment 13S: 1Sc



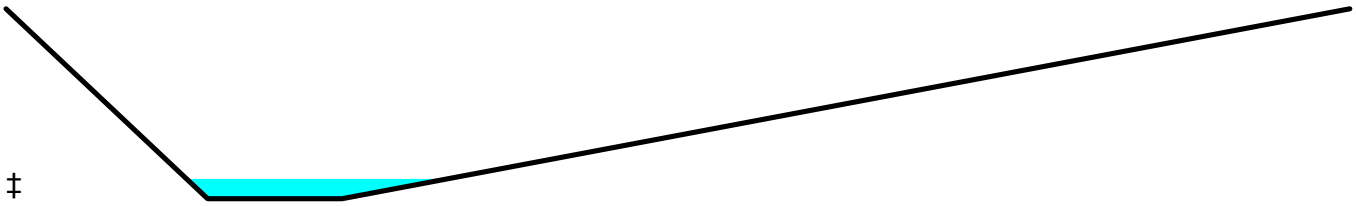
Summary for Reach 1: SWALE - 0.87%

Inflow Area = 16,341 sf, 0.00% Impervious, Inflow Depth = 1.37" for 2-yr event
Inflow = 0.41 cfs @ 12.27 hrs, Volume= 1,860 cf
Outflow = 0.39 cfs @ 12.33 hrs, Volume= 1,860 cf, Atten= 5%, Lag= 3.6 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.83 fps, Min. Travel Time= 4.6 min
Avg. Velocity = 0.32 fps, Avg. Travel Time= 11.8 min

Peak Storage= 106 cf @ 12.33 hrs
Average Depth at Peak Storage= 0.16'
Bank-Full Depth= 1.50' Flow Area= 16.5 sf, Capacity= 49.64 cfs

2.00' x 1.50' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 10.0 '/' Top Width= 20.00'
Length= 228.2' Slope= 0.0087 '/'
Inlet Invert= 91.00', Outlet Invert= 89.01'



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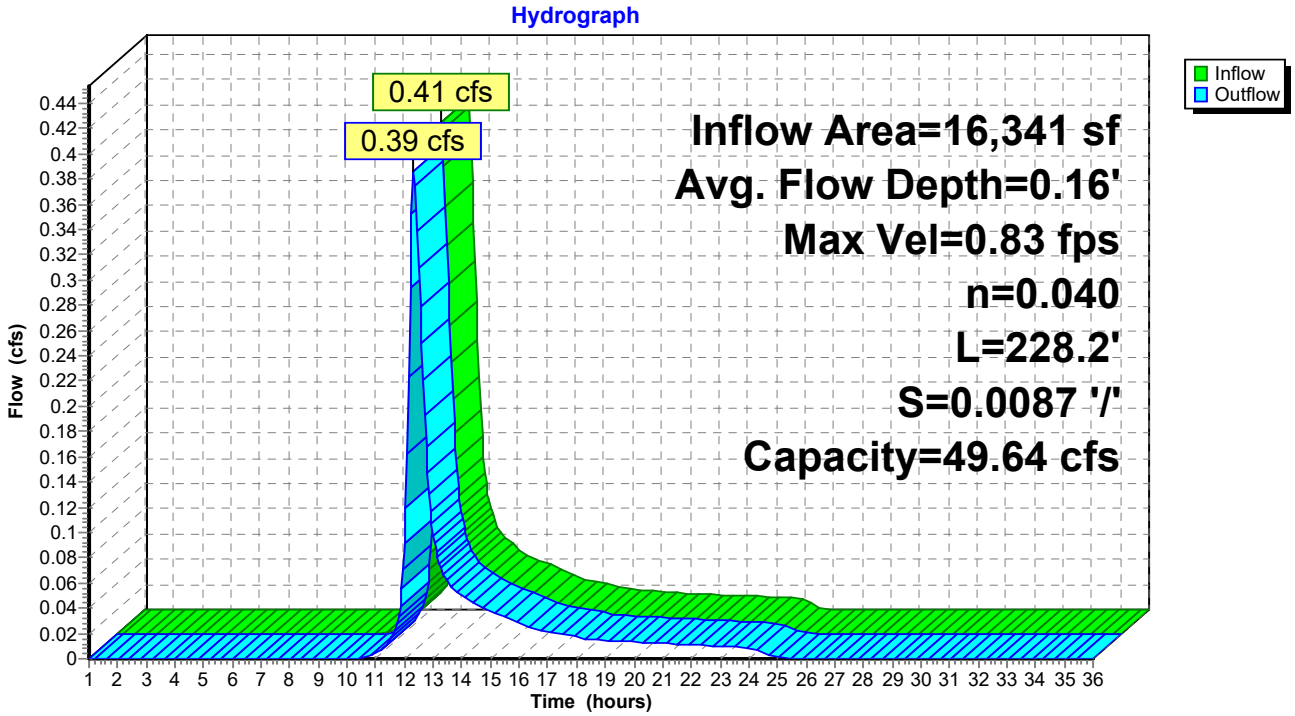
Reach 1: SWALE - 0.87%



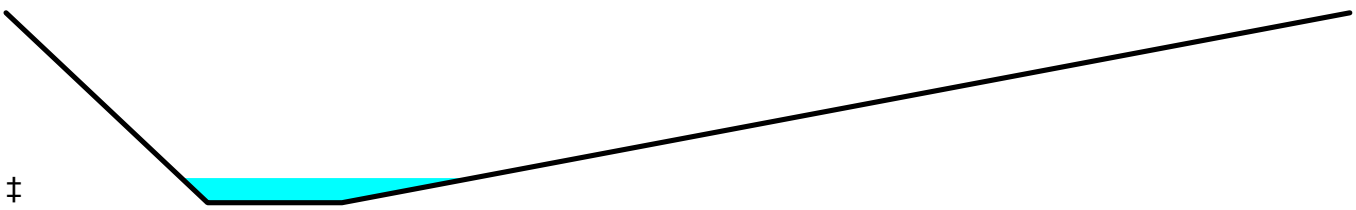
Summary for Reach 2: SWALE - 1.08%

Inflow Area = 27,260 sf, 0.00% Impervious, Inflow Depth = 1.37" for 2-yr event
Inflow = 0.65 cfs @ 12.31 hrs, Volume= 3,102 cf
Outflow = 0.65 cfs @ 12.32 hrs, Volume= 3,102 cf, Atten= 0%, Lag= 1.0 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.04 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 0.40 fps, Avg. Travel Time= 3.7 min

Peak Storage= 56 cf @ 12.32 hrs
Average Depth at Peak Storage= 0.19'
Bank-Full Depth= 1.50' Flow Area= 16.5 sf, Capacity= 55.38 cfs

2.00' x 1.50' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 10.0 '/' Top Width= 20.00'
Length= 90.3' Slope= 0.0109 '/'
Inlet Invert= 89.00', Outlet Invert= 88.02'



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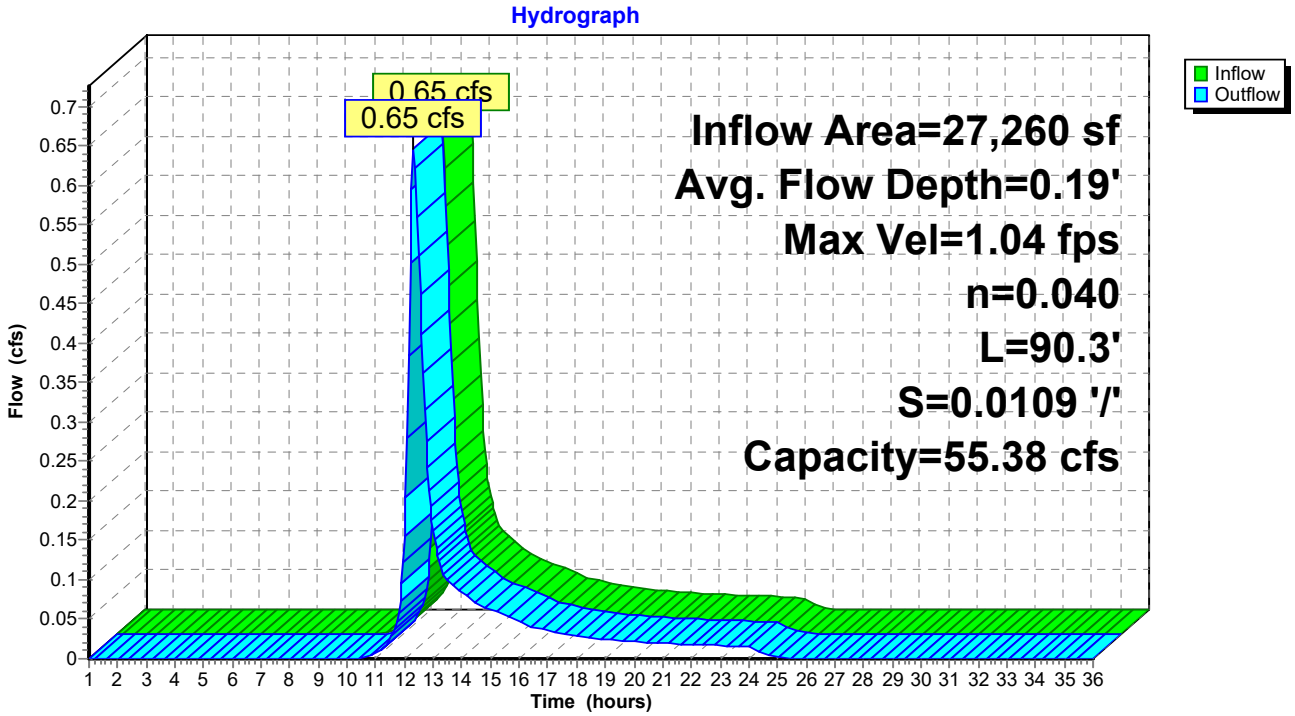
Reach 2: SWALE - 1.08%



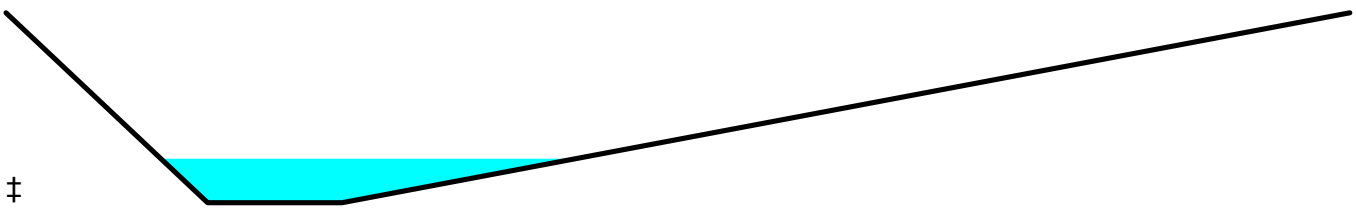
Summary for Reach 3: SWALE-0.74%

Inflow Area = 74,378 sf, 0.00% Impervious, Inflow Depth = 1.37" for 2-yr event
Inflow = 1.79 cfs @ 12.29 hrs, Volume= 8,465 cf
Outflow = 1.68 cfs @ 12.37 hrs, Volume= 8,465 cf, Atten= 6%, Lag= 4.7 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.18 fps, Min. Travel Time= 5.7 min
Avg. Velocity = 0.45 fps, Avg. Travel Time= 15.0 min

Peak Storage= 570 cf @ 12.37 hrs
Average Depth at Peak Storage= 0.35'
Bank-Full Depth= 1.50' Flow Area= 16.5 sf, Capacity= 45.69 cfs

2.00' x 1.50' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 10.0 '/' Top Width= 20.00'
Length= 402.0' Slope= 0.0074 '/'
Inlet Invert= 88.00', Outlet Invert= 85.03'



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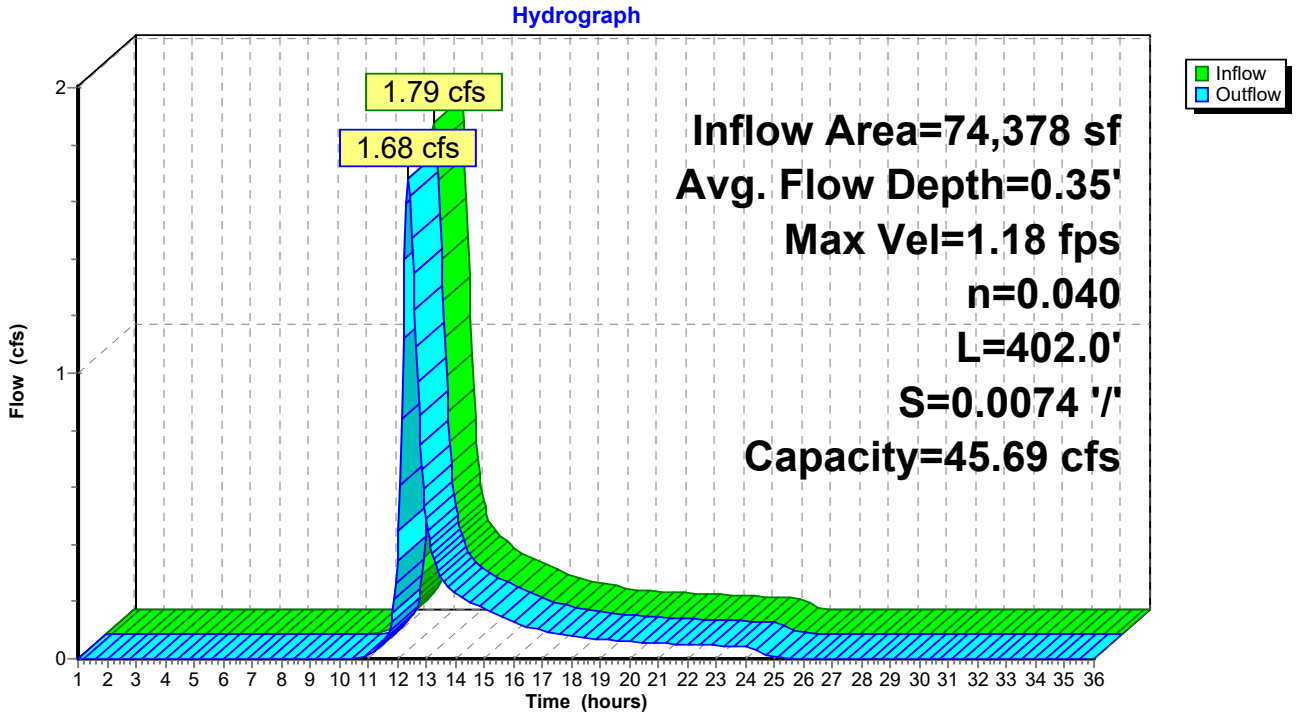
Reach 3: SWALE-0.74%



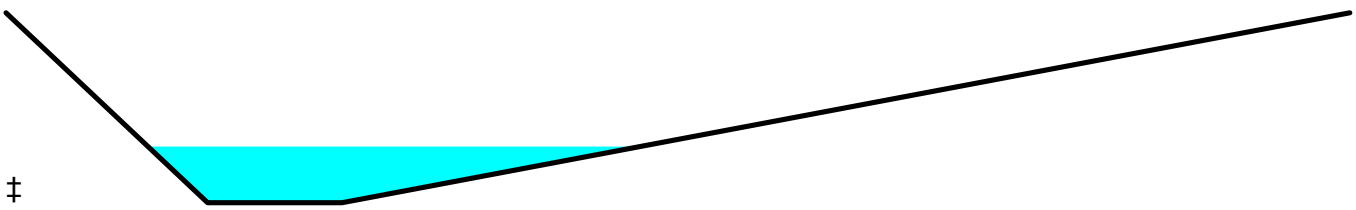
Summary for Reach 4: SWALE - 0.51%

Inflow Area = 104,701 sf, 0.00% Impervious, Inflow Depth = 1.42" for 2-yr event
Inflow = 2.48 cfs @ 12.33 hrs, Volume= 12,421 cf
Outflow = 2.34 cfs @ 12.42 hrs, Volume= 12,421 cf, Atten= 6%, Lag= 5.1 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.13 fps, Min. Travel Time= 6.0 min
Avg. Velocity = 0.40 fps, Avg. Travel Time= 16.9 min

Peak Storage= 844 cf @ 12.42 hrs
Average Depth at Peak Storage= 0.44'
Bank-Full Depth= 1.50' Flow Area= 16.5 sf, Capacity= 37.96 cfs

2.00' x 1.50' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 10.0 '/' Top Width= 20.00'
Length= 408.0' Slope= 0.0051 '/'
Inlet Invert= 85.00', Outlet Invert= 82.92'



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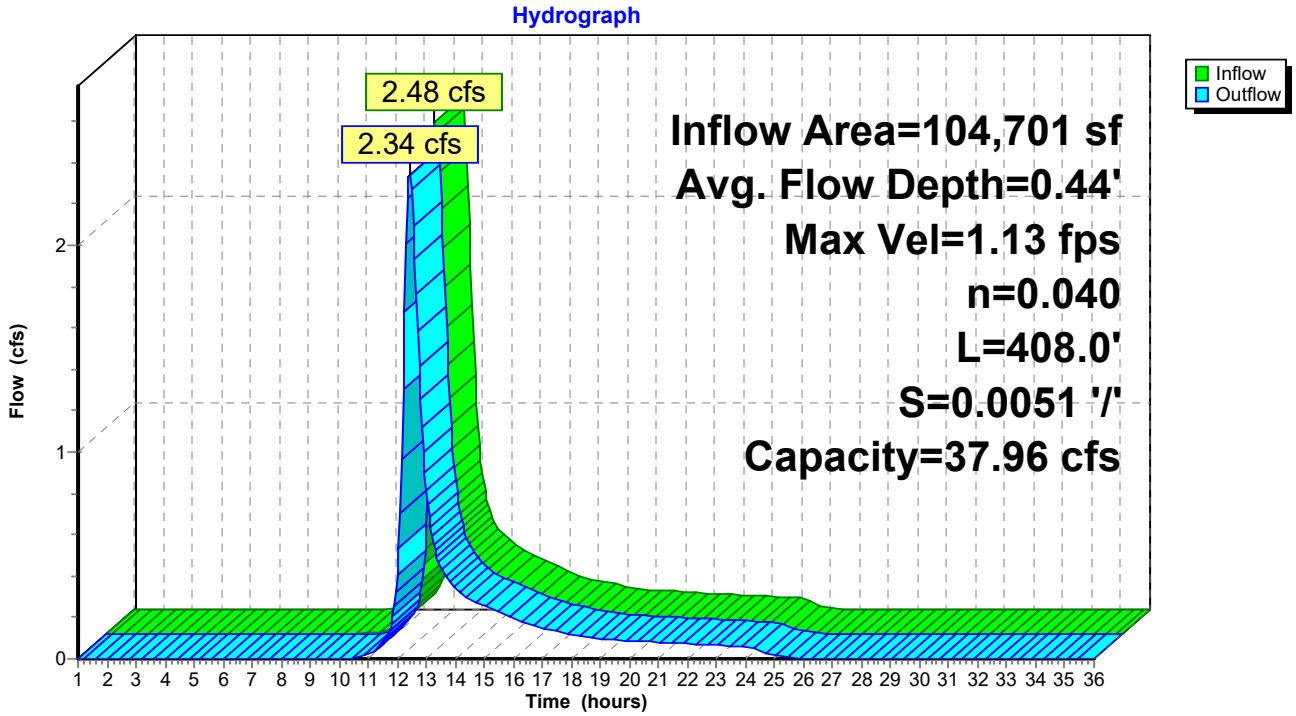
Reach 4: SWALE - 0.51%



Time span=1.00-36.00 hrs, dt=0.05 hrs, 701 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1Sc: 1Sc Runoff Area=16,341 sf 0.00% Impervious Runoff Depth=2.72"
Flow Length=155' Tc=18.2 min CN=74 Runoff=0.83 cfs 3,704 cf

Subcatchment 9S: 1Sc Runoff Area=10,919 sf 0.00% Impervious Runoff Depth=2.72"
Flow Length=155' Tc=18.2 min CN=74 Runoff=0.56 cfs 2,475 cf

Subcatchment 11S: 1Sc Runoff Area=47,118 sf 0.00% Impervious Runoff Depth=2.72"
Flow Length=155' Tc=18.2 min CN=74 Runoff=2.40 cfs 10,680 cf

Subcatchment 13S: 1Sc Runoff Area=30,323 sf 0.00% Impervious Runoff Depth=3.00"
Flow Length=155' Tc=18.2 min CN=77 Runoff=1.71 cfs 7,568 cf

Reach 1: SWALE - 0.87% Avg. Flow Depth=0.23' Max Vel=1.03 fps Inflow=0.83 cfs 3,704 cf
n=0.040 L=228.2' S=0.0087 '/' Capacity=49.64 cfs Outflow=0.81 cfs 3,704 cf

Reach 2: SWALE - 1.08% Avg. Flow Depth=0.28' Max Vel=1.28 fps Inflow=1.35 cfs 6,179 cf
n=0.040 L=90.3' S=0.0109 '/' Capacity=55.38 cfs Outflow=1.35 cfs 6,179 cf

Reach 3: SWALE-0.74% Avg. Flow Depth=0.49' Max Vel=1.44 fps Inflow=3.72 cfs 16,859 cf
n=0.040 L=402.0' S=0.0074 '/' Capacity=45.69 cfs Outflow=3.54 cfs 16,859 cf

Reach 4: SWALE - 0.51% Avg. Flow Depth=0.62' Max Vel=1.37 fps Inflow=5.14 cfs 24,427 cf
n=0.040 L=408.0' S=0.0051 '/' Capacity=37.96 cfs Outflow=4.90 cfs 24,427 cf

Total Runoff Area = 104,701 sf Runoff Volume = 24,427 cf Average Runoff Depth = 2.80"
100.00% Pervious = 104,701 sf 0.00% Impervious = 0 sf

Summary for Subcatchment 1Sc: 1Sc

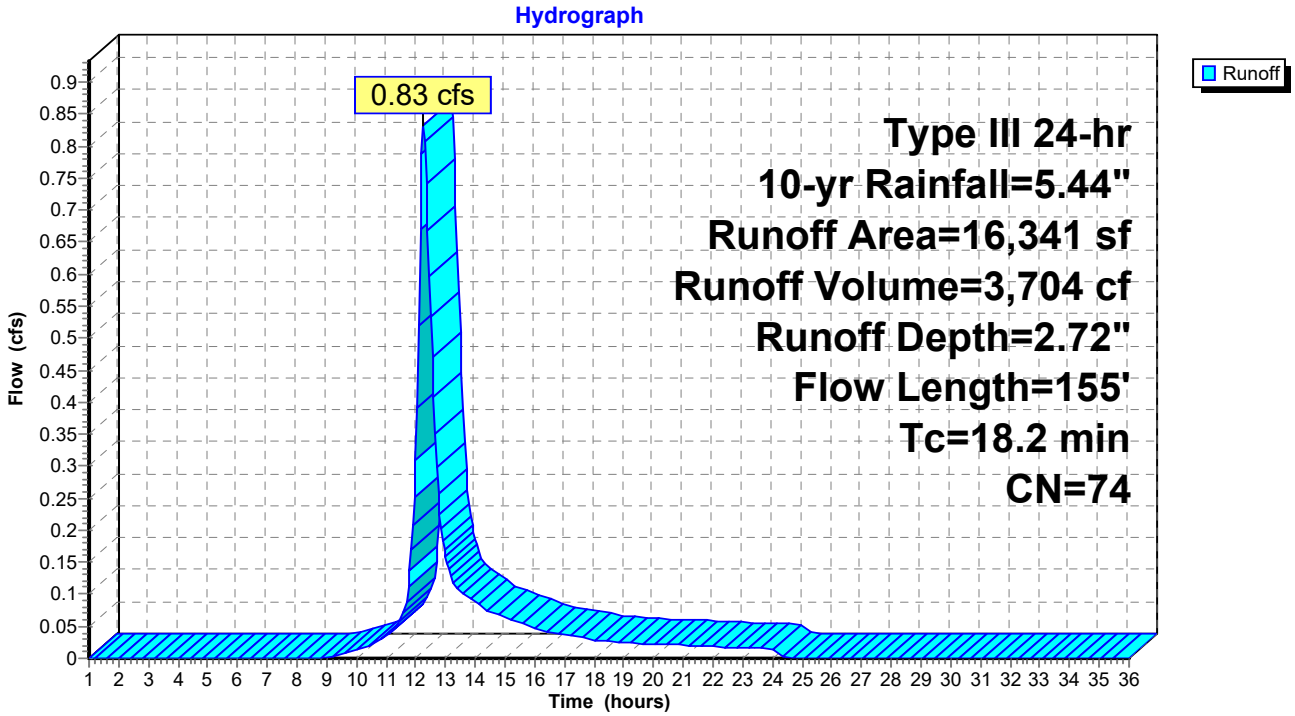
Runoff = 0.83 cfs @ 12.26 hrs, Volume= 3,704 cf, Depth= 2.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=5.44"

Area (sf)	CN	Description
16,341	74	>75% Grass cover, Good, HSG C
16,341		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.6	50	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.6	105	0.0330	2.92		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
18.2	155	Total			

Subcatchment 1Sc: 1Sc



Summary for Subcatchment 9S: 1Sc

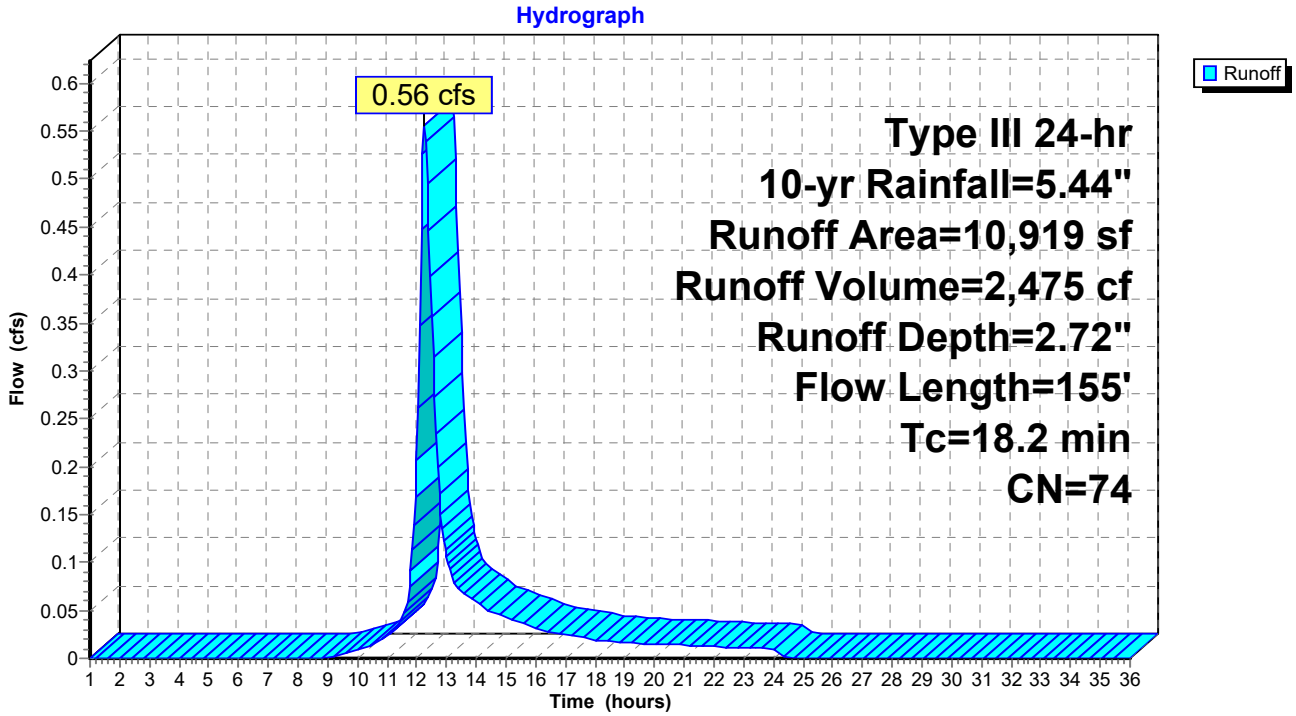
Runoff = 0.56 cfs @ 12.26 hrs, Volume= 2,475 cf, Depth= 2.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=5.44"

Area (sf)	CN	Description
10,919	74	>75% Grass cover, Good, HSG C
10,919		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.6	50	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.6	105	0.0330	2.92		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
18.2	155	Total			

Subcatchment 9S: 1Sc



Summary for Subcatchment 11S: 1Sc

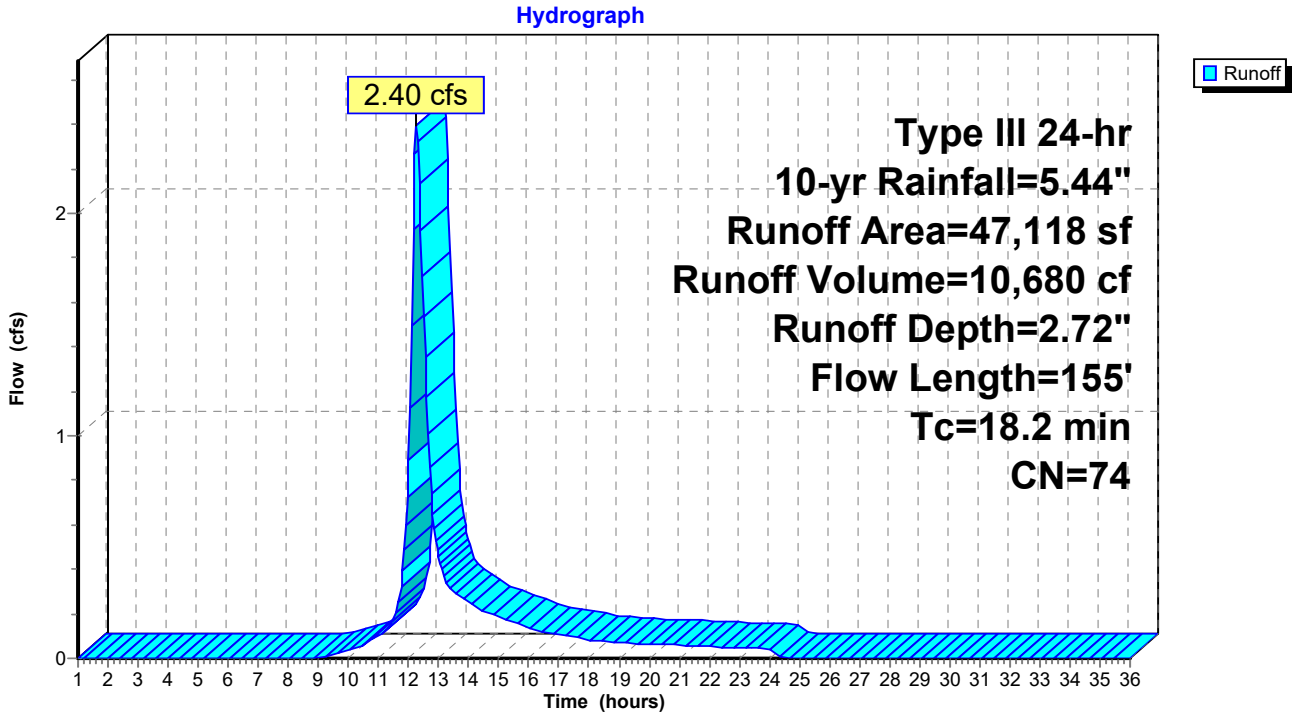
Runoff = 2.40 cfs @ 12.26 hrs, Volume= 10,680 cf, Depth= 2.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=5.44"

Area (sf)	CN	Description
47,118	74	>75% Grass cover, Good, HSG C
47,118		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.6	50	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.6	105	0.0330	2.92		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
18.2	155	Total			

Subcatchment 11S: 1Sc



Summary for Subcatchment 13S: 1Sc

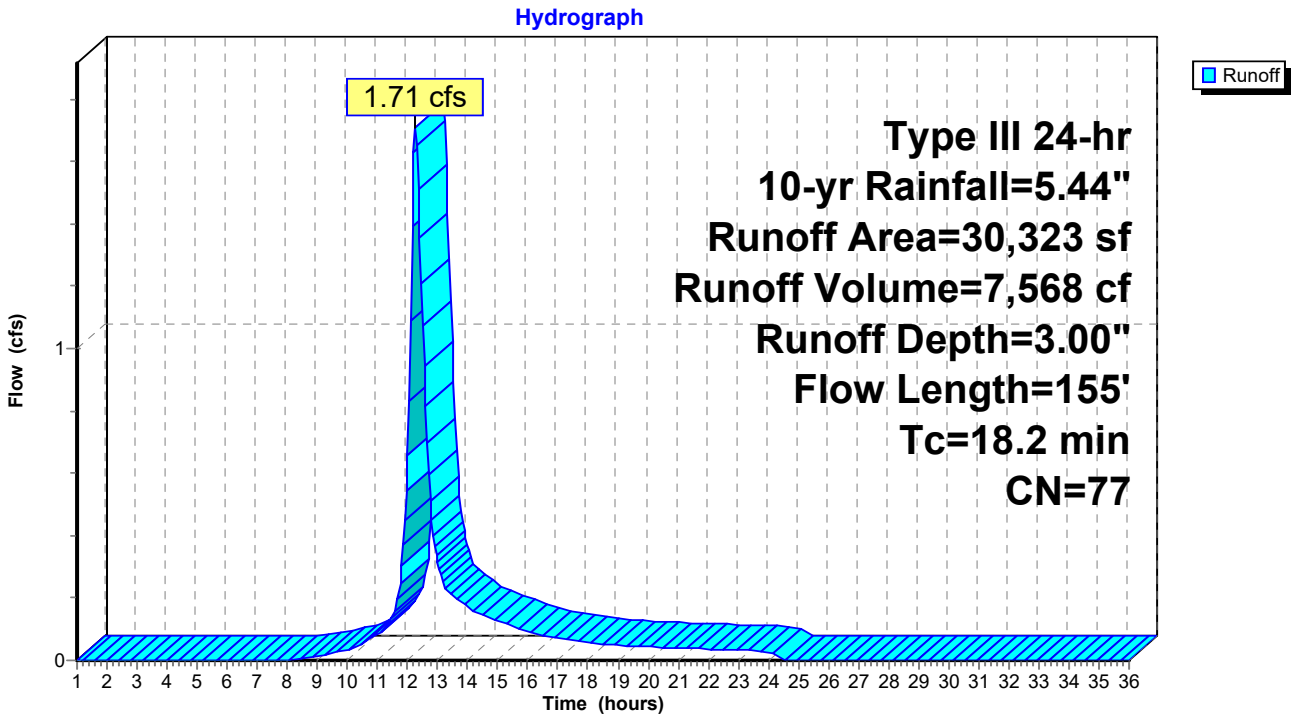
Runoff = 1.71 cfs @ 12.25 hrs, Volume= 7,568 cf, Depth= 3.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=5.44"

Area (sf)	CN	Description
4,401	96	Gravel surface, HSG C
25,922	74	>75% Grass cover, Good, HSG C
30,323	77	Weighted Average
30,323		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.6	50	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.6	105	0.0330	2.92		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
18.2	155	Total			

Subcatchment 13S: 1Sc



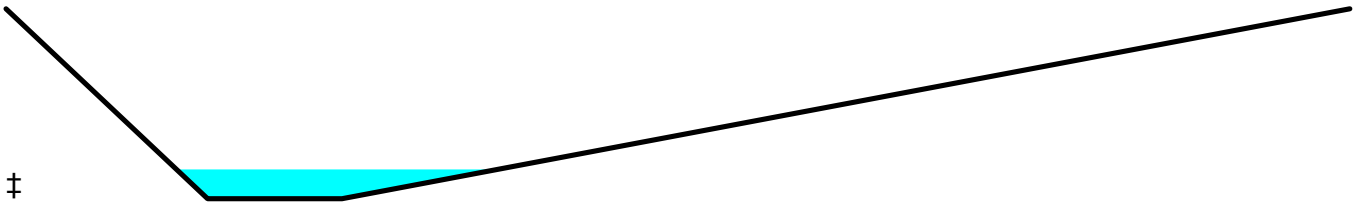
Summary for Reach 1: SWALE - 0.87%

Inflow Area = 16,341 sf, 0.00% Impervious, Inflow Depth = 2.72" for 10-yr event
Inflow = 0.83 cfs @ 12.26 hrs, Volume= 3,704 cf
Outflow = 0.81 cfs @ 12.31 hrs, Volume= 3,704 cf, Atten= 3%, Lag= 3.0 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.03 fps, Min. Travel Time= 3.7 min
Avg. Velocity = 0.38 fps, Avg. Travel Time= 10.0 min

Peak Storage= 179 cf @ 12.31 hrs
Average Depth at Peak Storage= 0.23'
Bank-Full Depth= 1.50' Flow Area= 16.5 sf, Capacity= 49.64 cfs

2.00' x 1.50' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 10.0 '/' Top Width= 20.00'
Length= 228.2' Slope= 0.0087 '/'
Inlet Invert= 91.00', Outlet Invert= 89.01'



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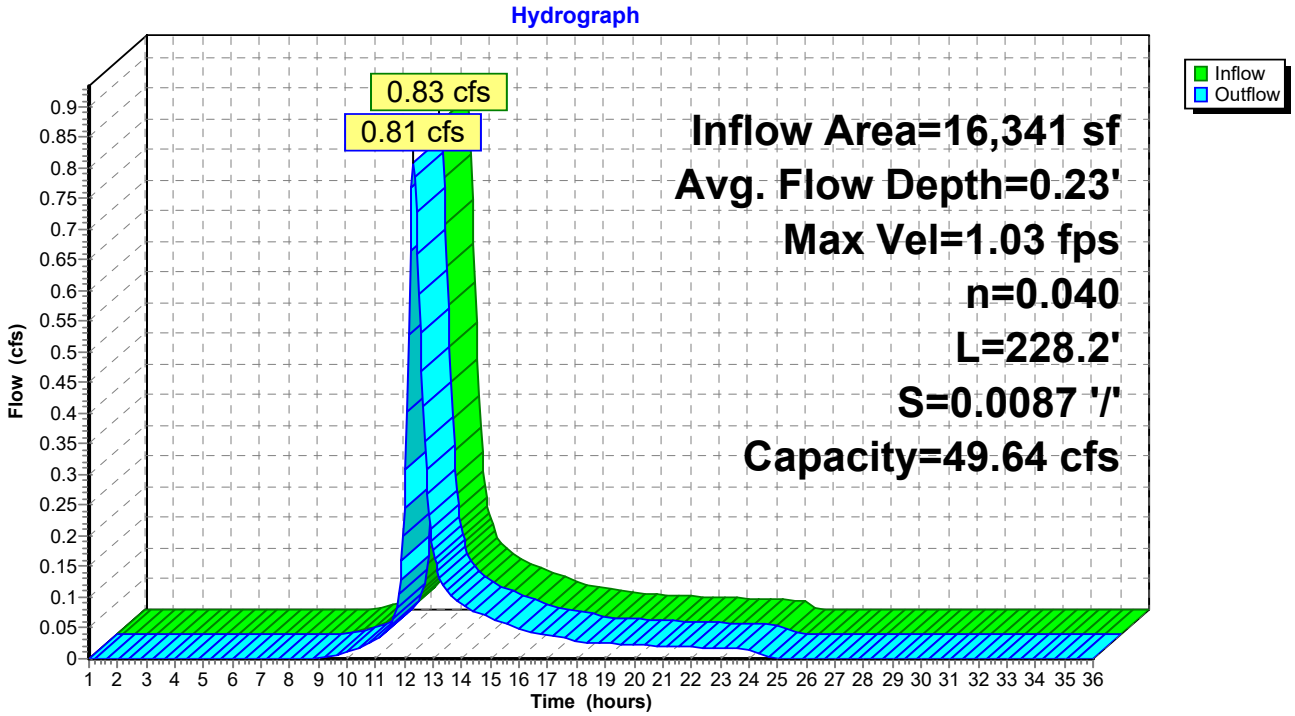
Reach 1: SWALE - 0.87%



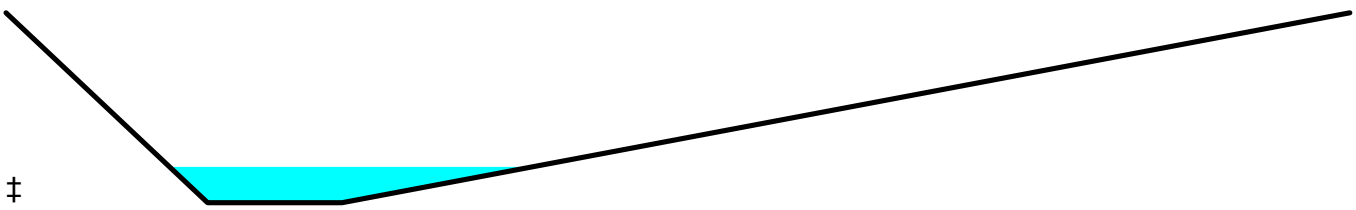
Summary for Reach 2: SWALE - 1.08%

Inflow Area = 27,260 sf, 0.00% Impervious, Inflow Depth = 2.72" for 10-yr event
Inflow = 1.35 cfs @ 12.29 hrs, Volume= 6,179 cf
Outflow = 1.35 cfs @ 12.30 hrs, Volume= 6,179 cf, Atten= 0%, Lag= 0.9 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.28 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 0.48 fps, Avg. Travel Time= 3.2 min

Peak Storage= 95 cf @ 12.30 hrs
Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 1.50' Flow Area= 16.5 sf, Capacity= 55.38 cfs

2.00' x 1.50' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 10.0 '/' Top Width= 20.00'
Length= 90.3' Slope= 0.0109 '/'
Inlet Invert= 89.00', Outlet Invert= 88.02'



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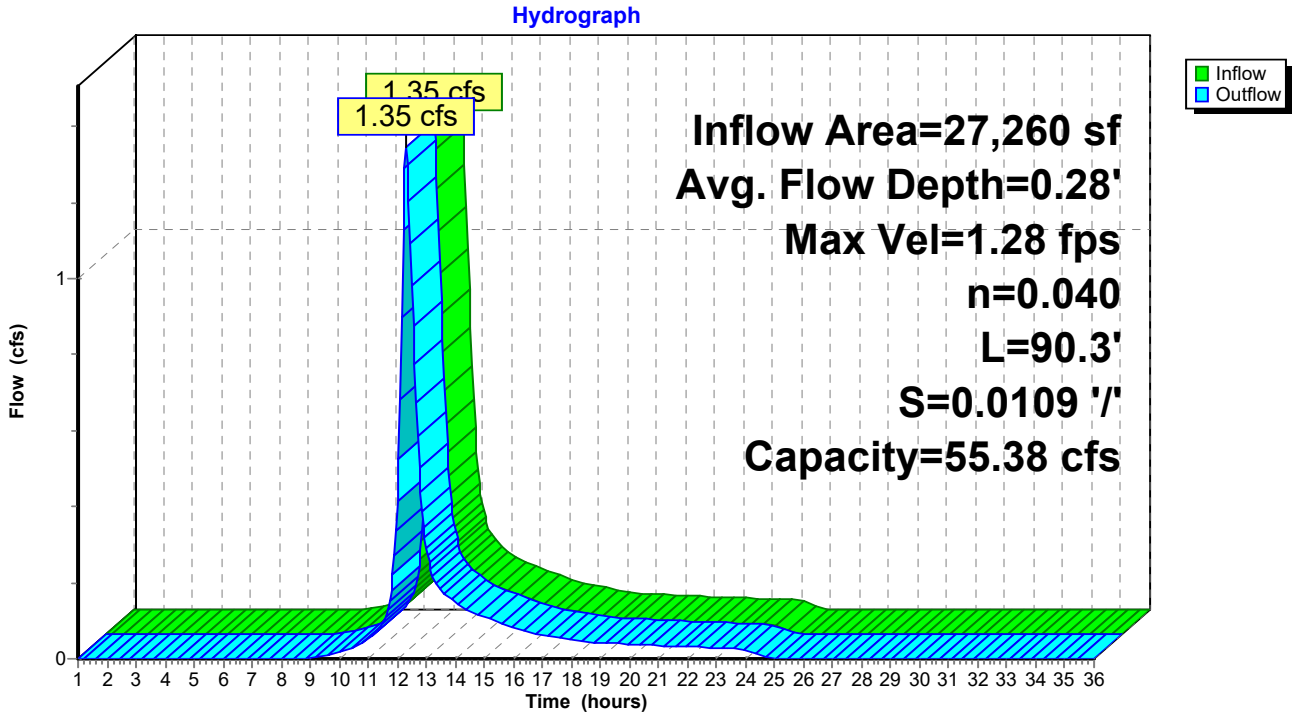
Reach 2: SWALE - 1.08%



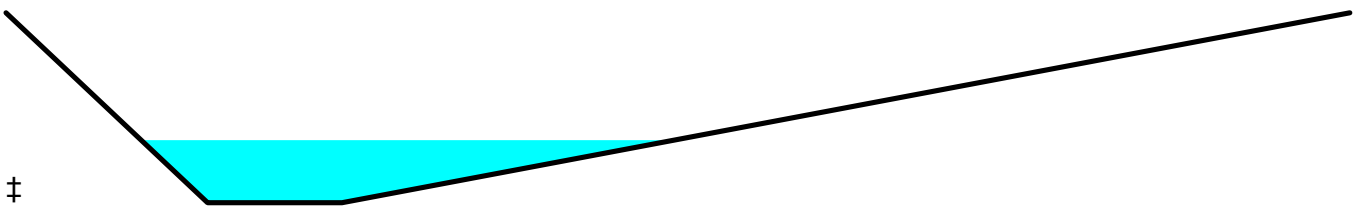
Summary for Reach 3: SWALE-0.74%

Inflow Area = 74,378 sf, 0.00% Impervious, Inflow Depth = 2.72" for 10-yr event
Inflow = 3.72 cfs @ 12.27 hrs, Volume= 16,859 cf
Outflow = 3.54 cfs @ 12.34 hrs, Volume= 16,859 cf, Atten= 5%, Lag= 3.9 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.44 fps, Min. Travel Time= 4.6 min
Avg. Velocity = 0.52 fps, Avg. Travel Time= 12.8 min

Peak Storage= 985 cf @ 12.34 hrs
Average Depth at Peak Storage= 0.49'
Bank-Full Depth= 1.50' Flow Area= 16.5 sf, Capacity= 45.69 cfs

2.00' x 1.50' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 10.0 '/' Top Width= 20.00'
Length= 402.0' Slope= 0.0074 '/'
Inlet Invert= 88.00', Outlet Invert= 85.03'



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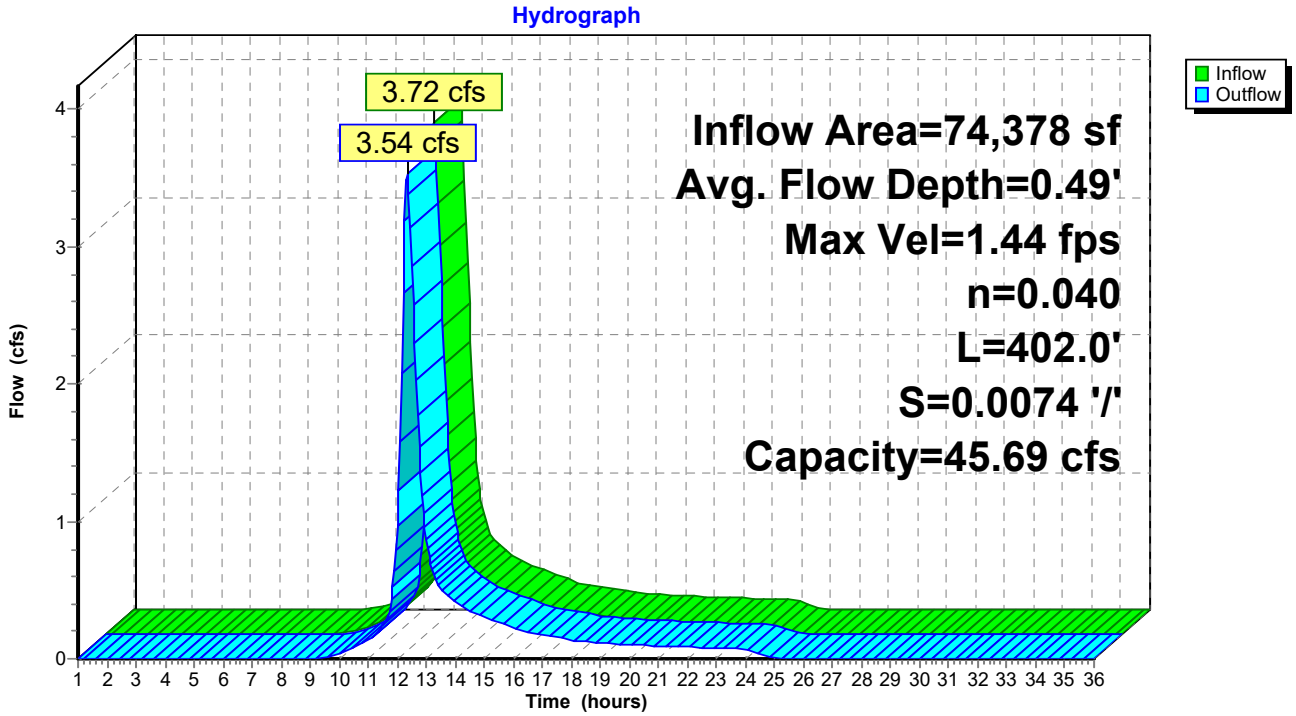
Reach 3: SWALE-0.74%



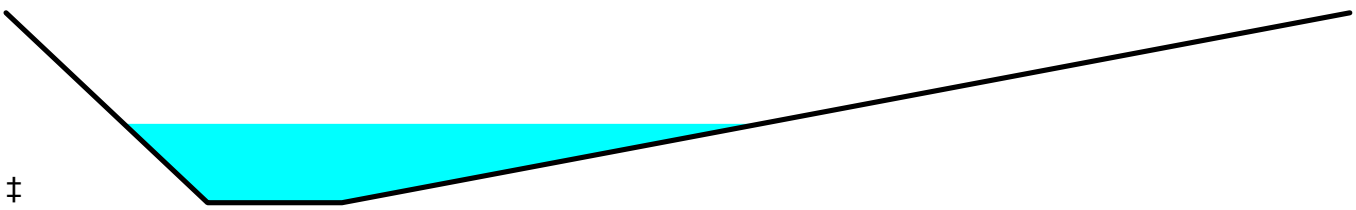
Summary for Reach 4: SWALE - 0.51%

Inflow Area = 104,701 sf, 0.00% Impervious, Inflow Depth = 2.80" for 10-yr event
Inflow = 5.14 cfs @ 12.31 hrs, Volume= 24,427 cf
Outflow = 4.90 cfs @ 12.38 hrs, Volume= 24,427 cf, Atten= 5%, Lag= 4.1 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.37 fps, Min. Travel Time= 5.0 min
Avg. Velocity = 0.47 fps, Avg. Travel Time= 14.5 min

Peak Storage= 1,460 cf @ 12.38 hrs
Average Depth at Peak Storage= 0.62'
Bank-Full Depth= 1.50' Flow Area= 16.5 sf, Capacity= 37.96 cfs

2.00' x 1.50' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 10.0 '/' Top Width= 20.00'
Length= 408.0' Slope= 0.0051 '/'
Inlet Invert= 85.00', Outlet Invert= 82.92'



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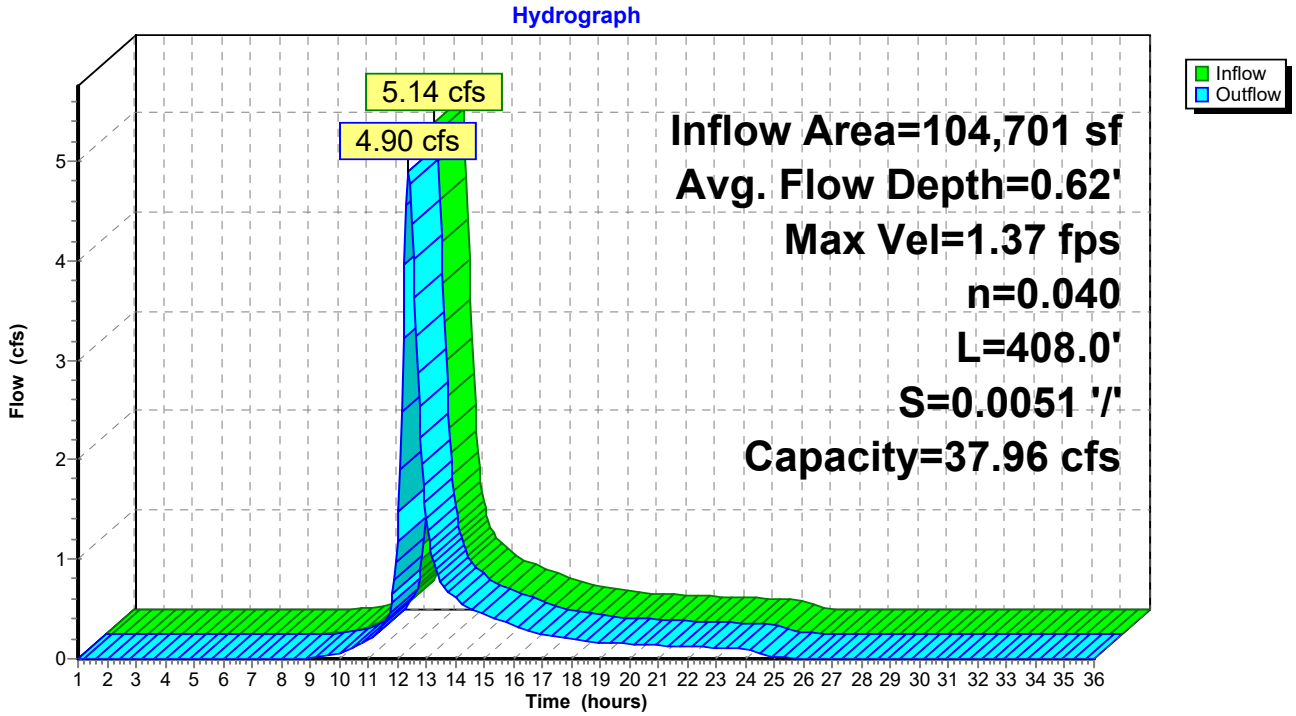
Reach 4: SWALE - 0.51%



Time span=1.00-36.00 hrs, dt=0.05 hrs, 701 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1Sc: 1Sc Runoff Area=16,341 sf 0.00% Impervious Runoff Depth=3.79"
Flow Length=155' Tc=18.2 min CN=74 Runoff=1.17 cfs 5,162 cf

Subcatchment 9S: 1Sc Runoff Area=10,919 sf 0.00% Impervious Runoff Depth=3.79"
Flow Length=155' Tc=18.2 min CN=74 Runoff=0.78 cfs 3,449 cf

Subcatchment 11S: 1Sc Runoff Area=47,118 sf 0.00% Impervious Runoff Depth=3.79"
Flow Length=155' Tc=18.2 min CN=74 Runoff=3.36 cfs 14,883 cf

Subcatchment 13S: 1Sc Runoff Area=30,323 sf 0.00% Impervious Runoff Depth=4.11"
Flow Length=155' Tc=18.2 min CN=77 Runoff=2.34 cfs 10,376 cf

Reach 1: SWALE - 0.87% Avg. Flow Depth=0.27' Max Vel=1.13 fps Inflow=1.17 cfs 5,162 cf
n=0.040 L=228.2' S=0.0087 '/' Capacity=49.64 cfs Outflow=1.13 cfs 5,162 cf

Reach 2: SWALE - 1.08% Avg. Flow Depth=0.33' Max Vel=1.41 fps Inflow=1.89 cfs 8,611 cf
n=0.040 L=90.3' S=0.0109 '/' Capacity=55.38 cfs Outflow=1.89 cfs 8,611 cf

Reach 3: SWALE-0.74% Avg. Flow Depth=0.58' Max Vel=1.58 fps Inflow=5.22 cfs 23,493 cf
n=0.040 L=402.0' S=0.0074 '/' Capacity=45.69 cfs Outflow=5.00 cfs 23,493 cf

Reach 4: SWALE - 0.51% Avg. Flow Depth=0.73' Max Vel=1.49 fps Inflow=7.21 cfs 33,869 cf
n=0.040 L=408.0' S=0.0051 '/' Capacity=37.96 cfs Outflow=6.92 cfs 33,869 cf

Total Runoff Area = 104,701 sf Runoff Volume = 33,869 cf Average Runoff Depth = 3.88"
100.00% Pervious = 104,701 sf 0.00% Impervious = 0 sf

Summary for Subcatchment 1Sc: 1Sc

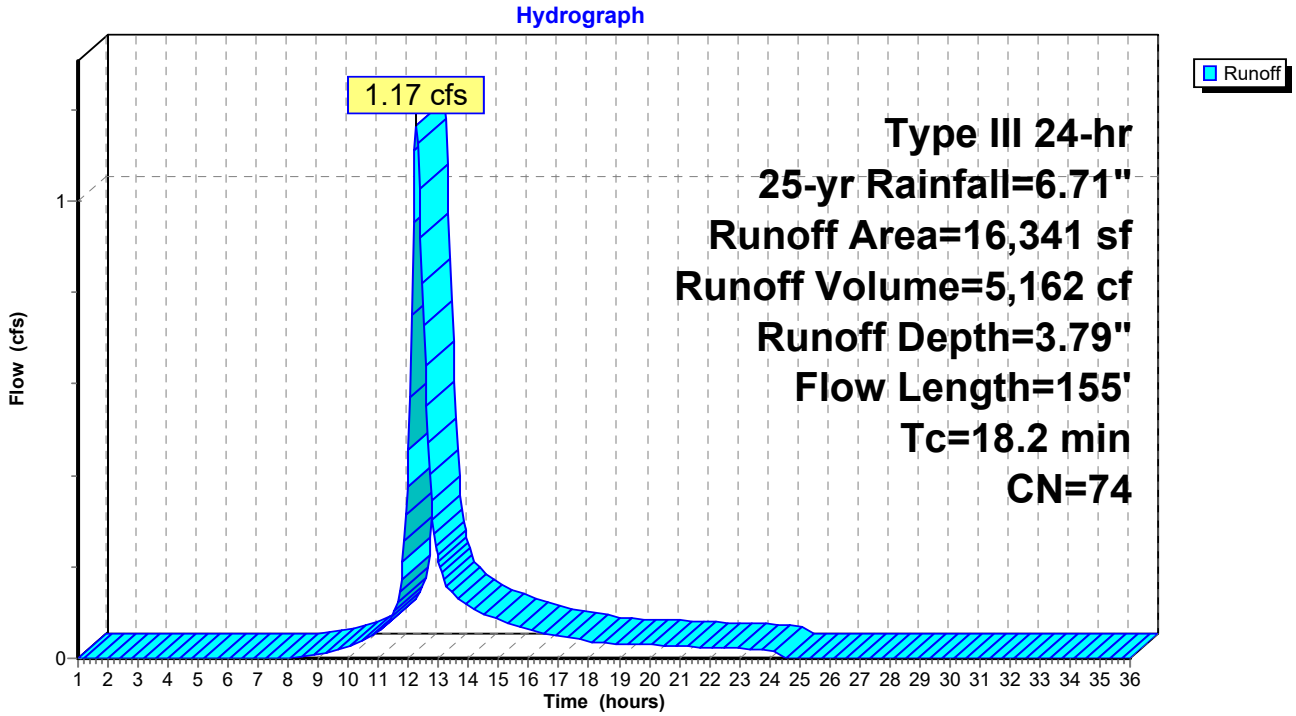
Runoff = 1.17 cfs @ 12.25 hrs, Volume= 5,162 cf, Depth= 3.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.71"

Area (sf)	CN	Description
16,341	74	>75% Grass cover, Good, HSG C
16,341		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.6	50	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.6	105	0.0330	2.92		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
18.2	155	Total			

Subcatchment 1Sc: 1Sc



Summary for Subcatchment 9S: 1Sc

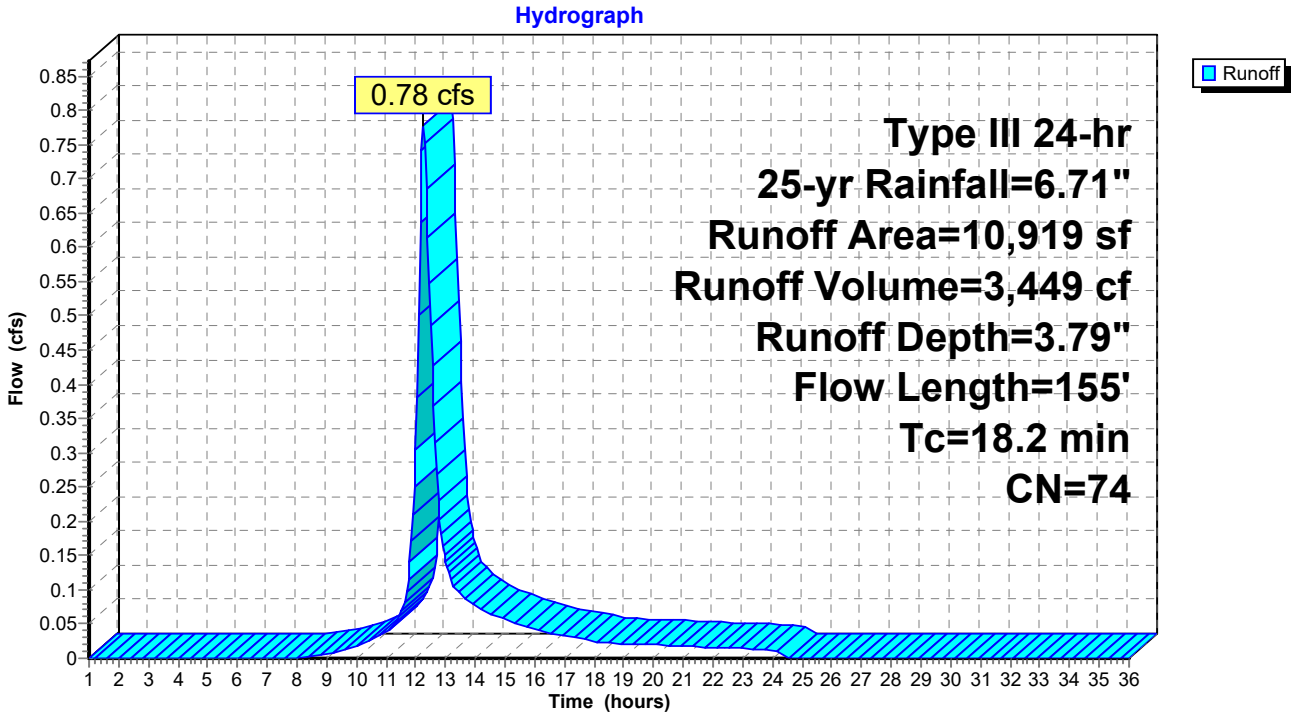
Runoff = 0.78 cfs @ 12.25 hrs, Volume= 3,449 cf, Depth= 3.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.71"

Area (sf)	CN	Description
10,919	74	>75% Grass cover, Good, HSG C
10,919		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.6	50	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.6	105	0.0330	2.92		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
18.2	155	Total			

Subcatchment 9S: 1Sc



Summary for Subcatchment 11S: 1Sc

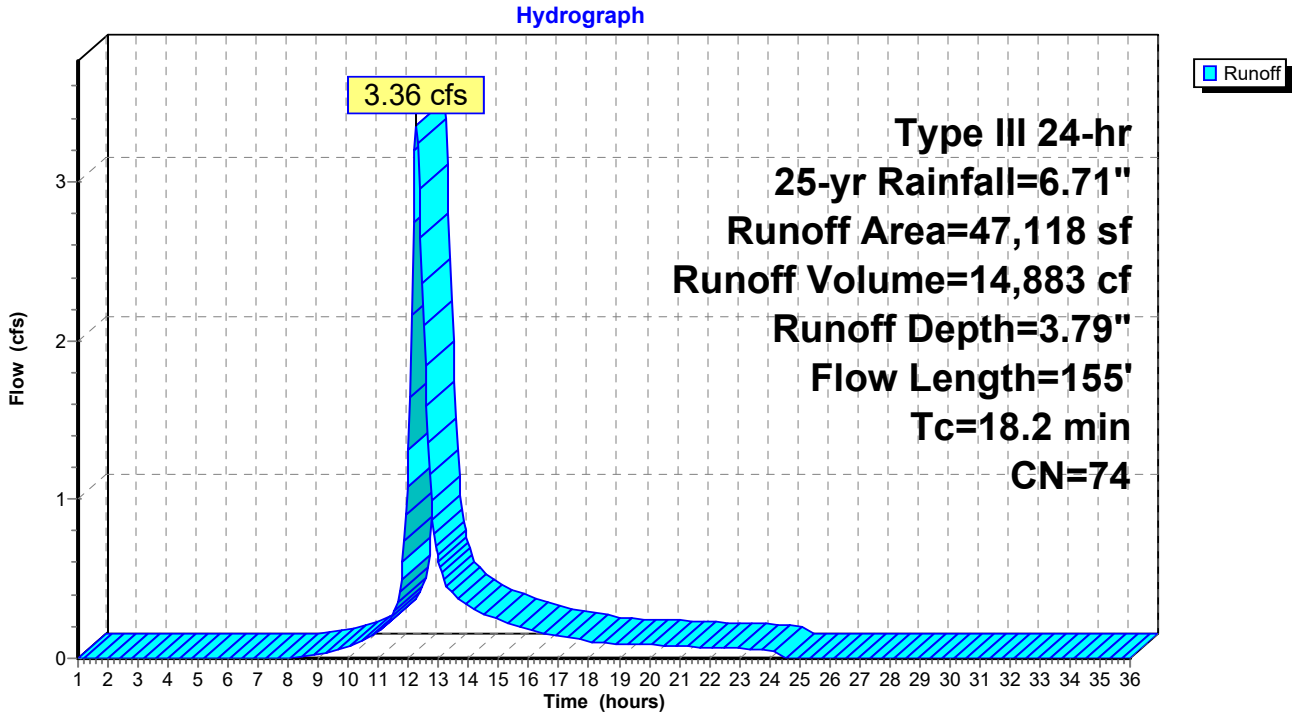
Runoff = 3.36 cfs @ 12.25 hrs, Volume= 14,883 cf, Depth= 3.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.71"

Area (sf)	CN	Description
47,118	74	>75% Grass cover, Good, HSG C
47,118		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.6	50	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.6	105	0.0330	2.92		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
18.2	155	Total			

Subcatchment 11S: 1Sc



Summary for Subcatchment 13S: 1Sc

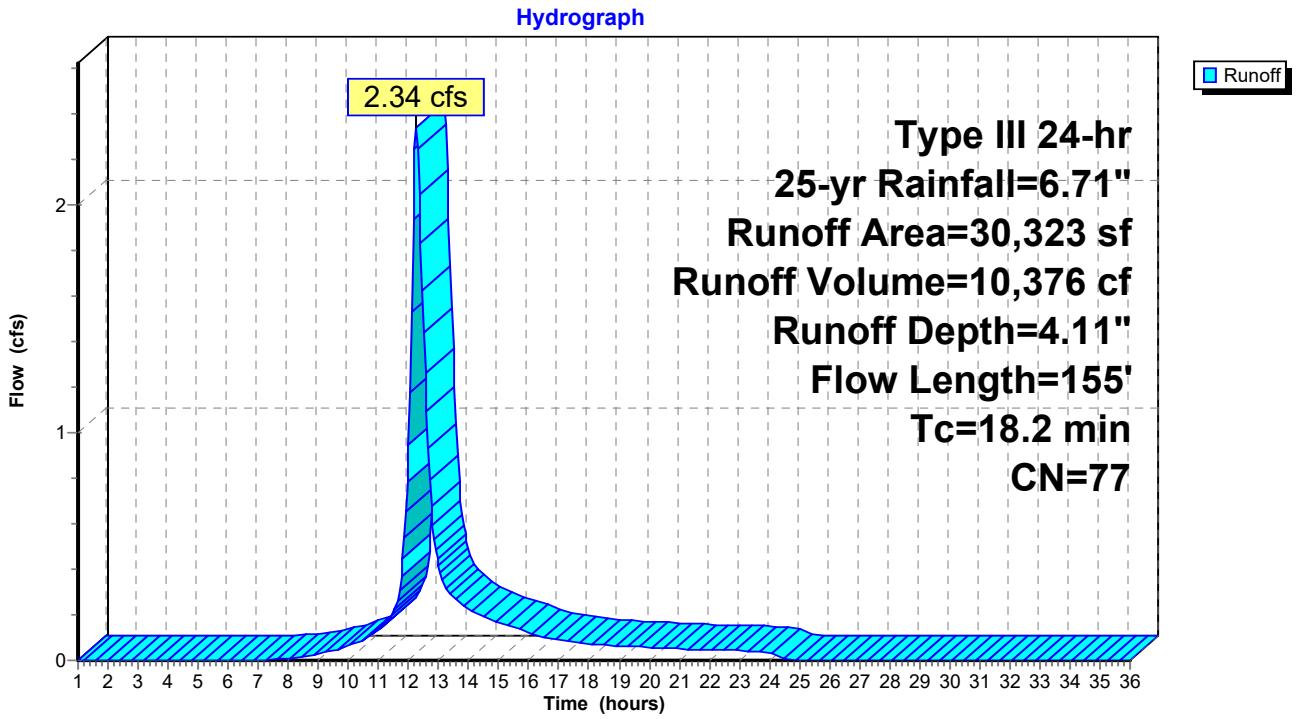
Runoff = 2.34 cfs @ 12.25 hrs, Volume= 10,376 cf, Depth= 4.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.71"

Area (sf)	CN	Description
4,401	96	Gravel surface, HSG C
25,922	74	>75% Grass cover, Good, HSG C
30,323	77	Weighted Average
30,323		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.6	50	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.6	105	0.0330	2.92		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
18.2	155	Total			

Subcatchment 13S: 1Sc



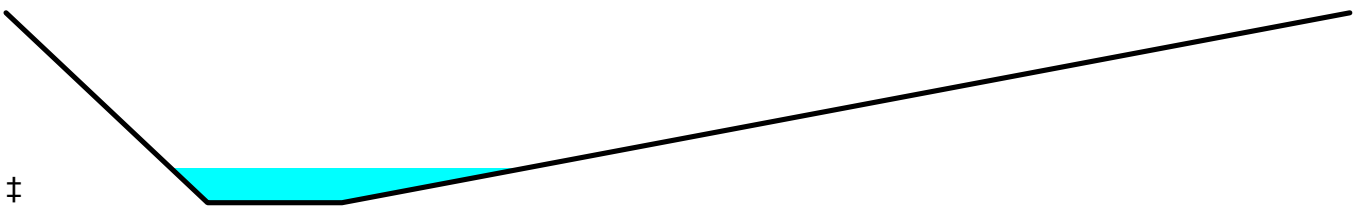
Summary for Reach 1: SWALE - 0.87%

Inflow Area = 16,341 sf, 0.00% Impervious, Inflow Depth = 3.79" for 25-yr event
Inflow = 1.17 cfs @ 12.25 hrs, Volume= 5,162 cf
Outflow = 1.13 cfs @ 12.30 hrs, Volume= 5,162 cf, Atten= 3%, Lag= 2.7 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.13 fps, Min. Travel Time= 3.4 min
Avg. Velocity = 0.41 fps, Avg. Travel Time= 9.2 min

Peak Storage= 228 cf @ 12.30 hrs
Average Depth at Peak Storage= 0.27'
Bank-Full Depth= 1.50' Flow Area= 16.5 sf, Capacity= 49.64 cfs

2.00' x 1.50' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 10.0 '/' Top Width= 20.00'
Length= 228.2' Slope= 0.0087 '/'
Inlet Invert= 91.00', Outlet Invert= 89.01'



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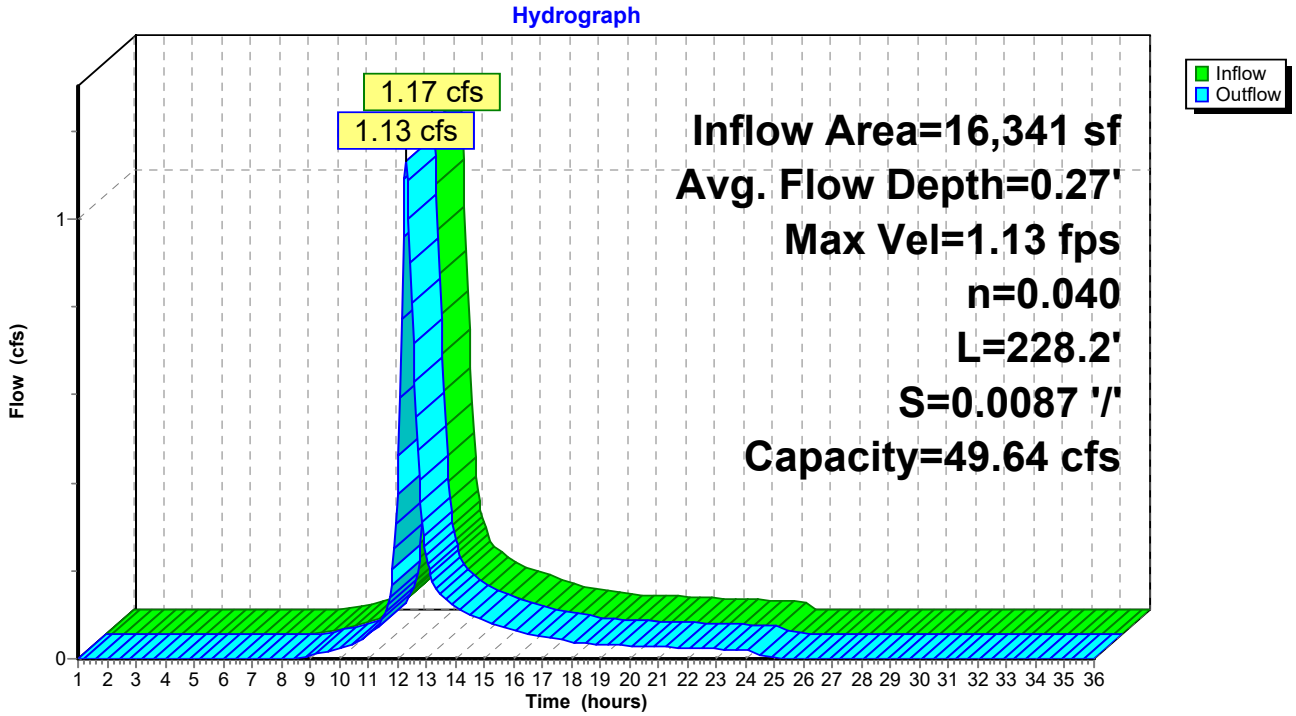
Reach 1: SWALE - 0.87%



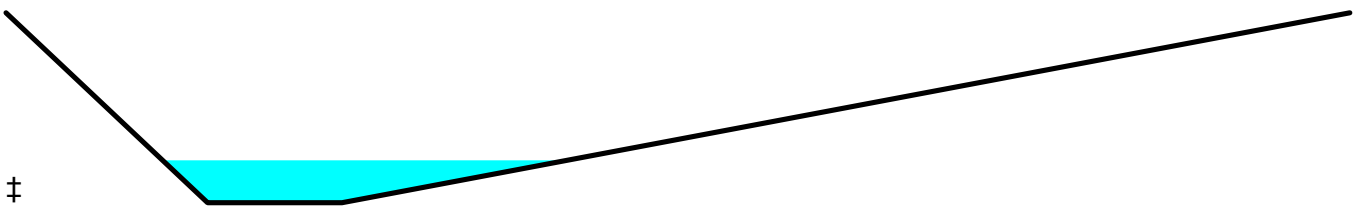
Summary for Reach 2: SWALE - 1.08%

Inflow Area = 27,260 sf, 0.00% Impervious, Inflow Depth = 3.79" for 25-yr event
Inflow = 1.89 cfs @ 12.28 hrs, Volume= 8,611 cf
Outflow = 1.89 cfs @ 12.29 hrs, Volume= 8,611 cf, Atten= 0%, Lag= 0.9 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.41 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 0.52 fps, Avg. Travel Time= 2.9 min

Peak Storage= 121 cf @ 12.29 hrs
Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 1.50' Flow Area= 16.5 sf, Capacity= 55.38 cfs

2.00' x 1.50' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 10.0 '/' Top Width= 20.00'
Length= 90.3' Slope= 0.0109 '/'
Inlet Invert= 89.00', Outlet Invert= 88.02'



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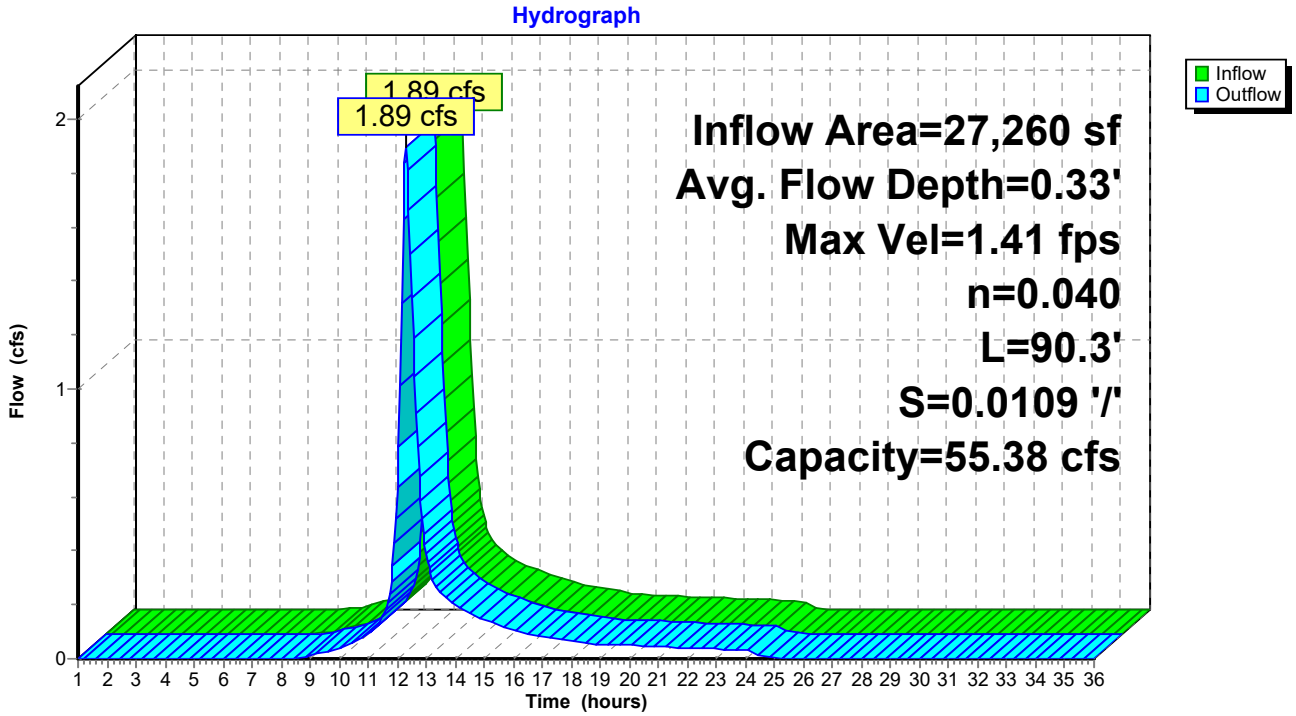
Reach 2: SWALE - 1.08%



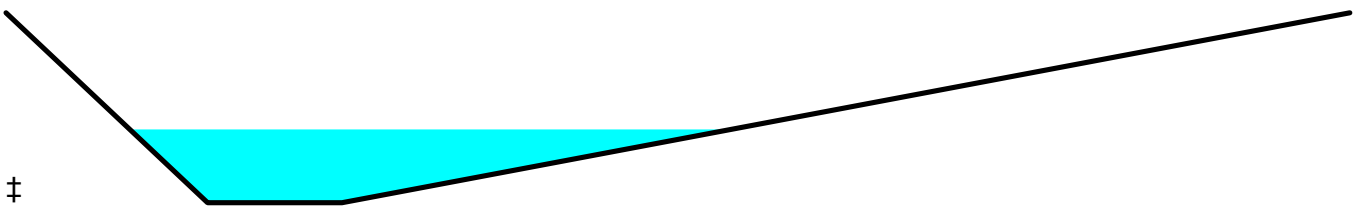
Summary for Reach 3: SWALE-0.74%

Inflow Area = 74,378 sf, 0.00% Impervious, Inflow Depth = 3.79" for 25-yr event
Inflow = 5.22 cfs @ 12.27 hrs, Volume= 23,493 cf
Outflow = 5.00 cfs @ 12.32 hrs, Volume= 23,493 cf, Atten= 4%, Lag= 3.4 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.58 fps, Min. Travel Time= 4.3 min
Avg. Velocity = 0.56 fps, Avg. Travel Time= 11.9 min

Peak Storage= 1,274 cf @ 12.32 hrs
Average Depth at Peak Storage= 0.58'
Bank-Full Depth= 1.50' Flow Area= 16.5 sf, Capacity= 45.69 cfs

2.00' x 1.50' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 10.0 '/' Top Width= 20.00'
Length= 402.0' Slope= 0.0074 '/'
Inlet Invert= 88.00', Outlet Invert= 85.03'



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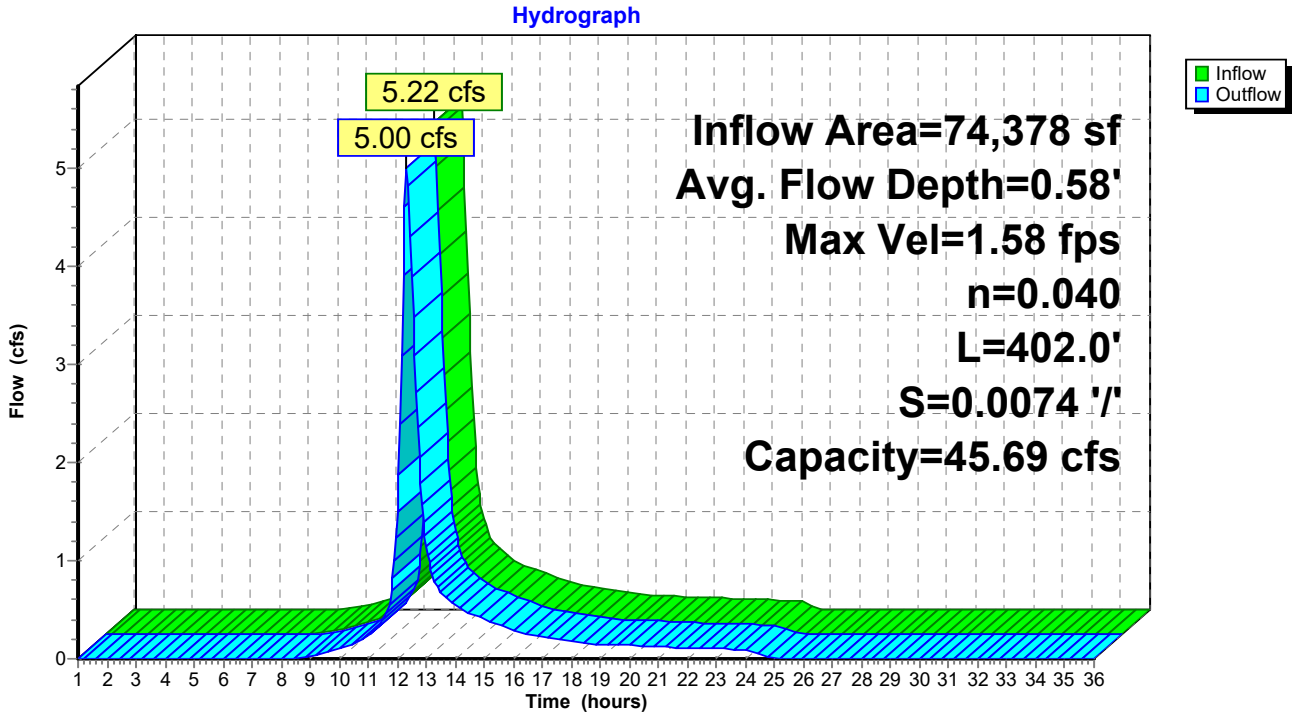
Reach 3: SWALE-0.74%



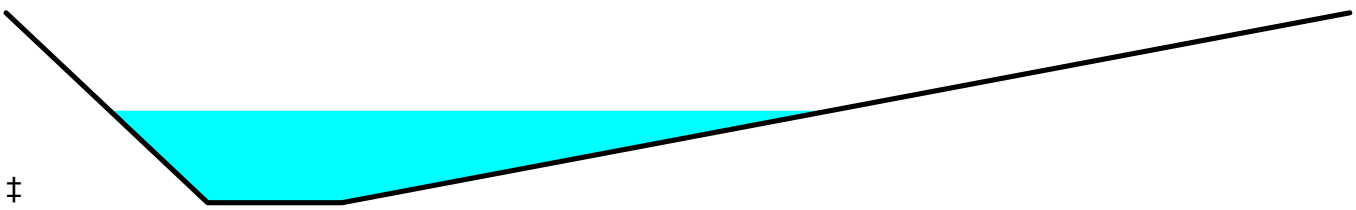
Summary for Reach 4: SWALE - 0.51%

Inflow Area = 104,701 sf, 0.00% Impervious, Inflow Depth = 3.88" for 25-yr event
Inflow = 7.21 cfs @ 12.30 hrs, Volume= 33,869 cf
Outflow = 6.92 cfs @ 12.36 hrs, Volume= 33,869 cf, Atten= 4%, Lag= 3.7 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.49 fps, Min. Travel Time= 4.6 min
Avg. Velocity = 0.51 fps, Avg. Travel Time= 13.5 min

Peak Storage= 1,888 cf @ 12.36 hrs
Average Depth at Peak Storage= 0.73'
Bank-Full Depth= 1.50' Flow Area= 16.5 sf, Capacity= 37.96 cfs

2.00' x 1.50' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 10.0 '/' Top Width= 20.00'
Length= 408.0' Slope= 0.0051 '/'
Inlet Invert= 85.00', Outlet Invert= 82.92'



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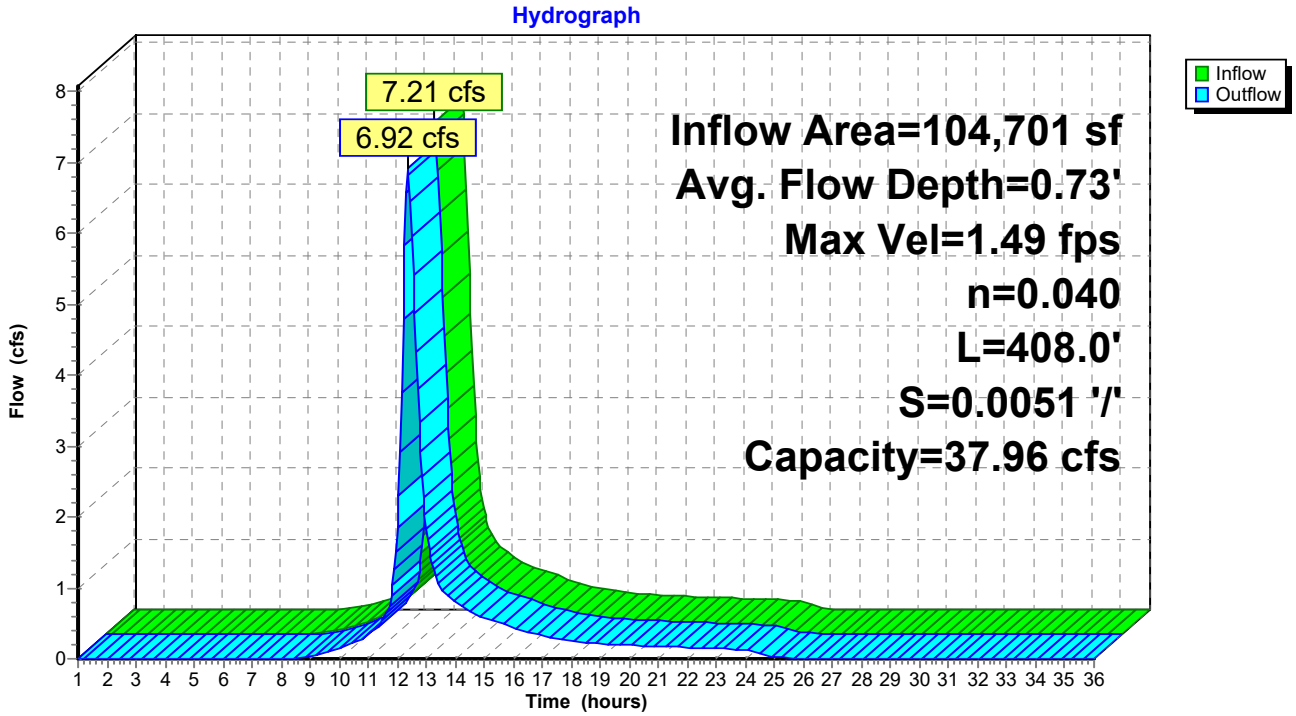
Reach 4: SWALE - 0.51%



Time span=1.00-36.00 hrs, dt=0.05 hrs, 701 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1Sc: 1Sc Runoff Area=16,341 sf 0.00% Impervious Runoff Depth=5.63"
Flow Length=155' Tc=18.2 min CN=74 Runoff=1.72 cfs 7,665 cf

Subcatchment 9S: 1Sc Runoff Area=10,919 sf 0.00% Impervious Runoff Depth=5.63"
Flow Length=155' Tc=18.2 min CN=74 Runoff=1.15 cfs 5,122 cf

Subcatchment 11S: 1Sc Runoff Area=47,118 sf 0.00% Impervious Runoff Depth=5.63"
Flow Length=155' Tc=18.2 min CN=74 Runoff=4.97 cfs 22,102 cf

Subcatchment 13S: 1Sc Runoff Area=30,323 sf 0.00% Impervious Runoff Depth=5.99"
Flow Length=155' Tc=18.2 min CN=77 Runoff=3.39 cfs 15,147 cf

Reach 1: SWALE - 0.87% Avg. Flow Depth=0.33' Max Vel=1.26 fps Inflow=1.72 cfs 7,665 cf
n=0.040 L=228.2' S=0.0087 '/' Capacity=49.64 cfs Outflow=1.68 cfs 7,665 cf

Reach 2: SWALE - 1.08% Avg. Flow Depth=0.41' Max Vel=1.56 fps Inflow=2.82 cfs 12,787 cf
n=0.040 L=90.3' S=0.0109 '/' Capacity=55.38 cfs Outflow=2.81 cfs 12,787 cf

Reach 3: SWALE-0.74% Avg. Flow Depth=0.69' Max Vel=1.75 fps Inflow=7.75 cfs 34,888 cf
n=0.040 L=402.0' S=0.0074 '/' Capacity=45.69 cfs Outflow=7.48 cfs 34,888 cf

Reach 4: SWALE - 0.51% Avg. Flow Depth=0.87' Max Vel=1.66 fps Inflow=10.70 cfs 50,036 cf
n=0.040 L=408.0' S=0.0051 '/' Capacity=37.96 cfs Outflow=10.32 cfs 50,036 cf

Total Runoff Area = 104,701 sf Runoff Volume = 50,036 cf Average Runoff Depth = 5.73"
100.00% Pervious = 104,701 sf 0.00% Impervious = 0 sf

Summary for Subcatchment 1Sc: 1Sc

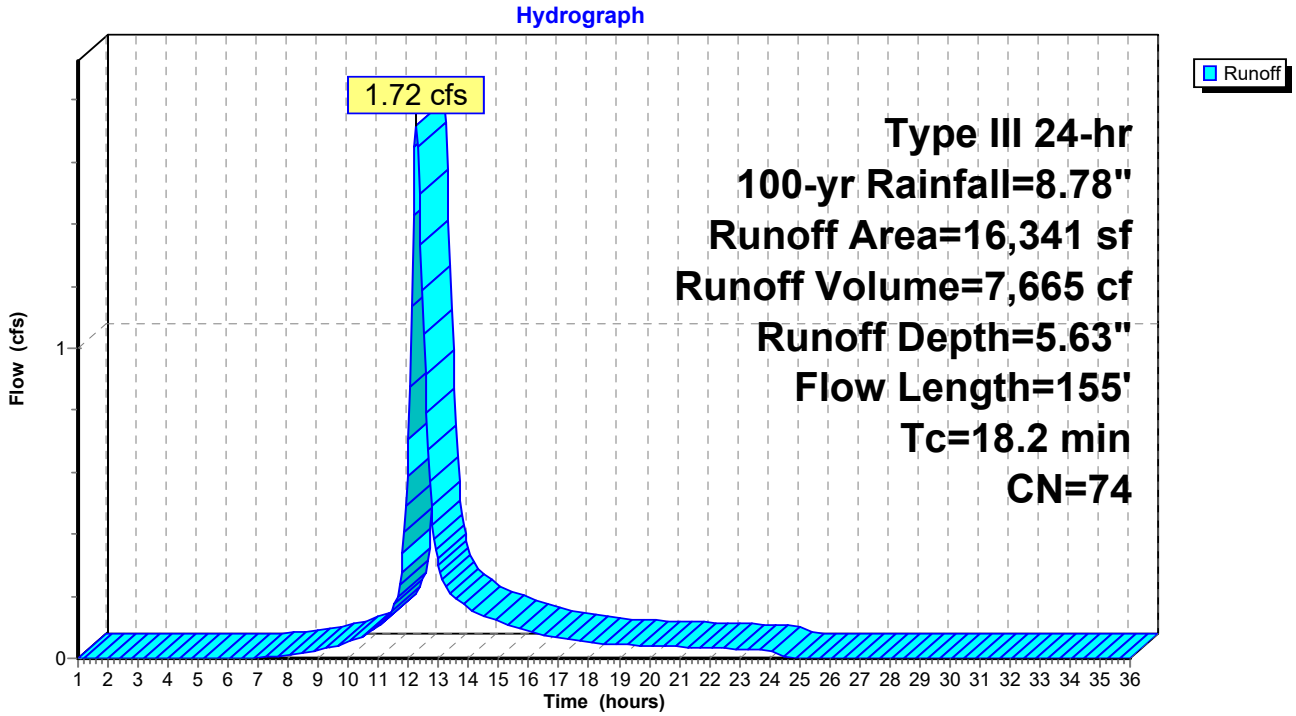
Runoff = 1.72 cfs @ 12.25 hrs, Volume= 7,665 cf, Depth= 5.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.78"

Area (sf)	CN	Description
16,341	74	>75% Grass cover, Good, HSG C
16,341		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.6	50	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.6	105	0.0330	2.92		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
18.2	155	Total			

Subcatchment 1Sc: 1Sc



Summary for Subcatchment 9S: 1Sc

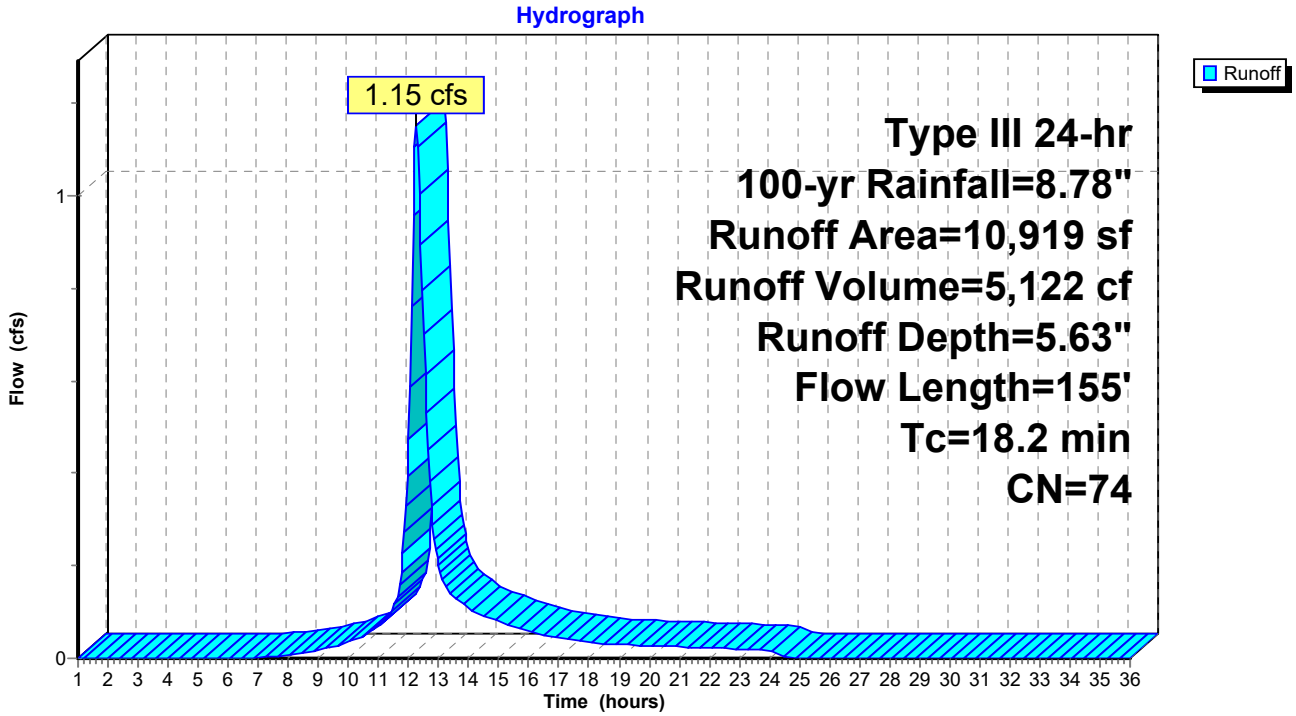
Runoff = 1.15 cfs @ 12.25 hrs, Volume= 5,122 cf, Depth= 5.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.78"

Area (sf)	CN	Description
10,919	74	>75% Grass cover, Good, HSG C
10,919		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.6	50	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.6	105	0.0330	2.92		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
18.2	155	Total			

Subcatchment 9S: 1Sc



Summary for Subcatchment 11S: 1Sc

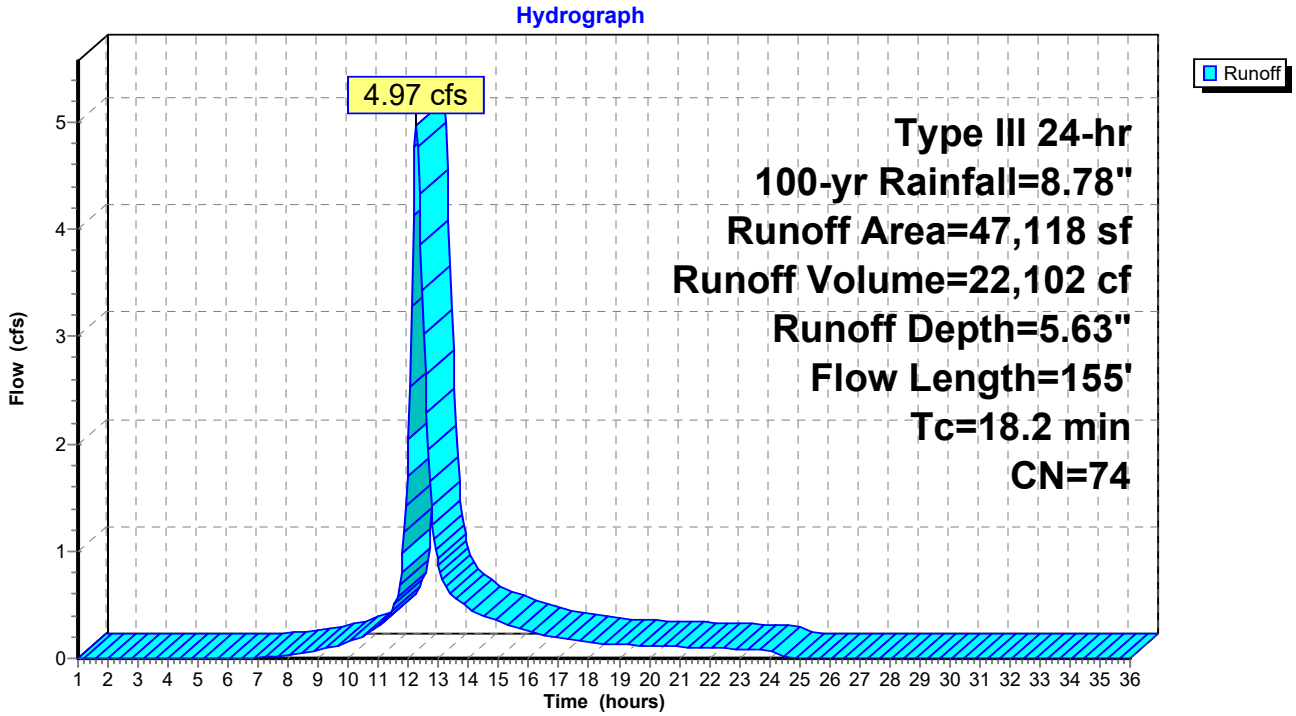
Runoff = 4.97 cfs @ 12.25 hrs, Volume= 22,102 cf, Depth= 5.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.78"

Area (sf)	CN	Description
47,118	74	>75% Grass cover, Good, HSG C
47,118		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.6	50	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.6	105	0.0330	2.92		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
18.2	155	Total			

Subcatchment 11S: 1Sc



Summary for Subcatchment 13S: 1Sc

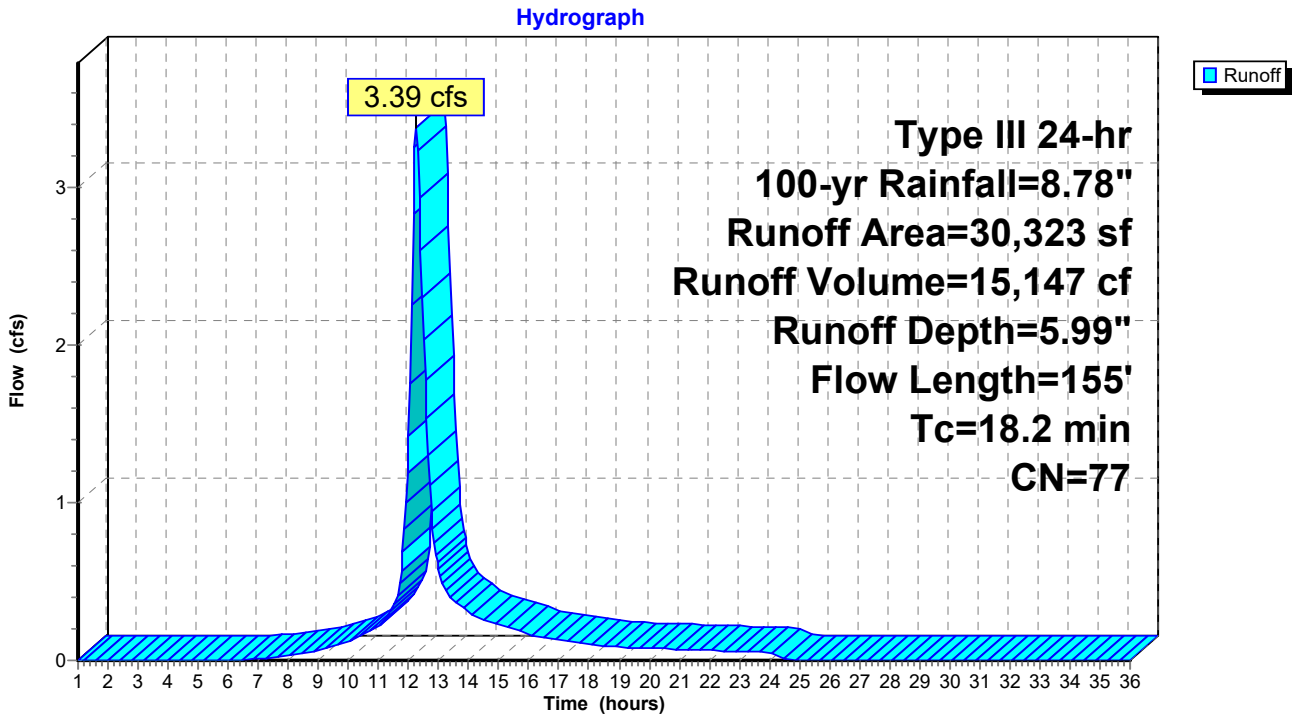
Runoff = 3.39 cfs @ 12.25 hrs, Volume= 15,147 cf, Depth= 5.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.78"

Area (sf)	CN	Description
4,401	96	Gravel surface, HSG C
25,922	74	>75% Grass cover, Good, HSG C
30,323	77	Weighted Average
30,323		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.6	50	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.6	105	0.0330	2.92		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
18.2	155	Total			

Subcatchment 13S: 1Sc



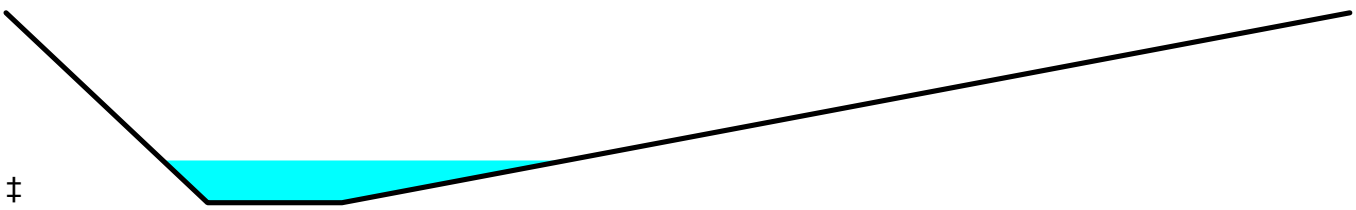
Summary for Reach 1: SWALE - 0.87%

Inflow Area = 16,341 sf, 0.00% Impervious, Inflow Depth = 5.63" for 100-yr event
Inflow = 1.72 cfs @ 12.25 hrs, Volume= 7,665 cf
Outflow = 1.68 cfs @ 12.29 hrs, Volume= 7,665 cf, Atten= 2%, Lag= 2.4 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.26 fps, Min. Travel Time= 3.0 min
Avg. Velocity = 0.45 fps, Avg. Travel Time= 8.4 min

Peak Storage= 305 cf @ 12.29 hrs
Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 1.50' Flow Area= 16.5 sf, Capacity= 49.64 cfs

2.00' x 1.50' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 10.0 '/' Top Width= 20.00'
Length= 228.2' Slope= 0.0087 '/'
Inlet Invert= 91.00', Outlet Invert= 89.01'



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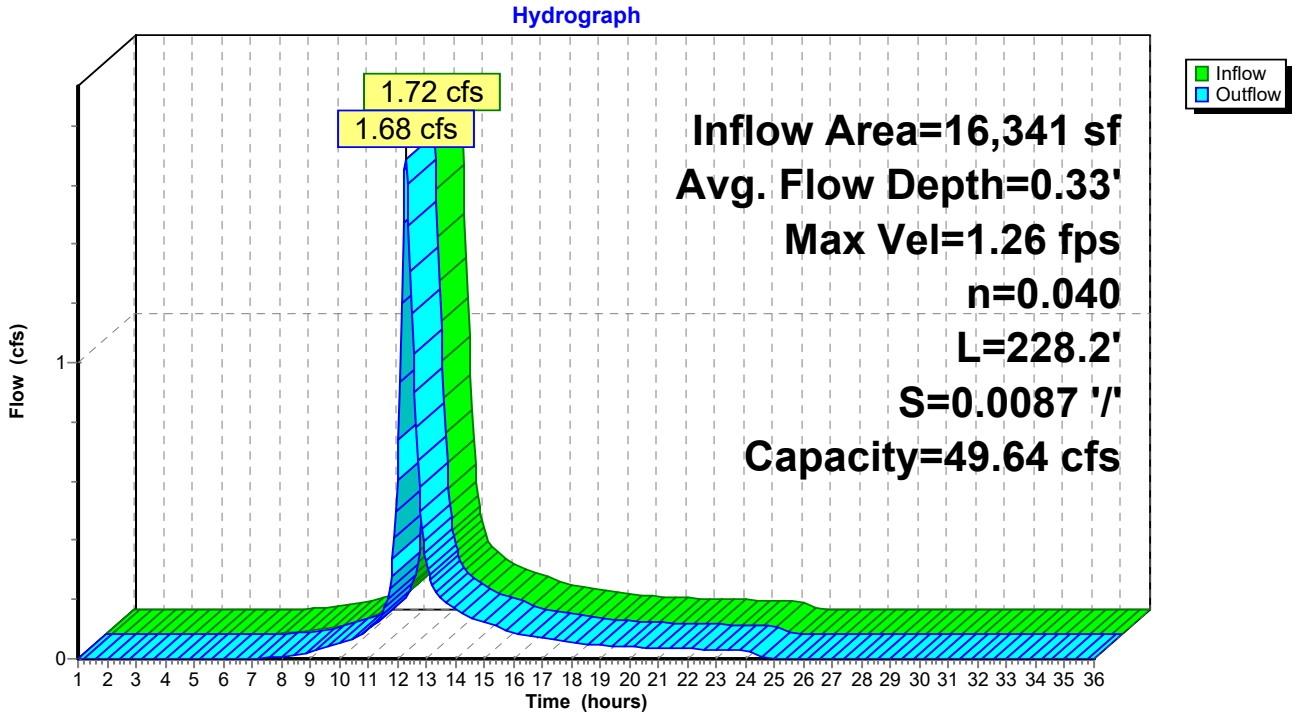
Reach 1: SWALE - 0.87%



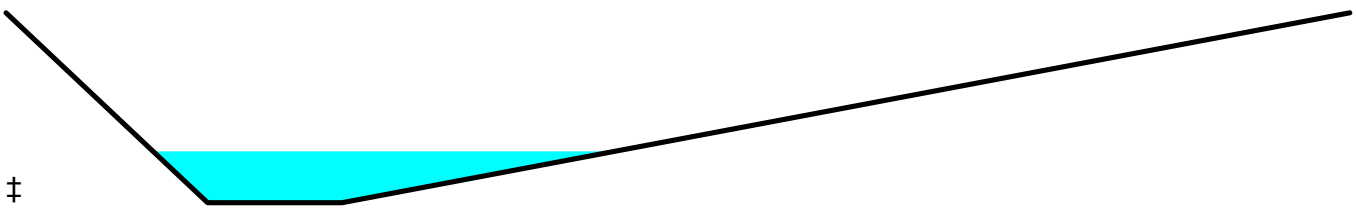
Summary for Reach 2: SWALE - 1.08%

Inflow Area = 27,260 sf, 0.00% Impervious, Inflow Depth = 5.63" for 100-yr event
Inflow = 2.82 cfs @ 12.27 hrs, Volume= 12,787 cf
Outflow = 2.81 cfs @ 12.29 hrs, Volume= 12,787 cf, Atten= 0%, Lag= 0.8 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.56 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 0.57 fps, Avg. Travel Time= 2.7 min

Peak Storage= 162 cf @ 12.29 hrs
Average Depth at Peak Storage= 0.41'
Bank-Full Depth= 1.50' Flow Area= 16.5 sf, Capacity= 55.38 cfs

2.00' x 1.50' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 10.0 '/' Top Width= 20.00'
Length= 90.3' Slope= 0.0109 '/'
Inlet Invert= 89.00', Outlet Invert= 88.02'



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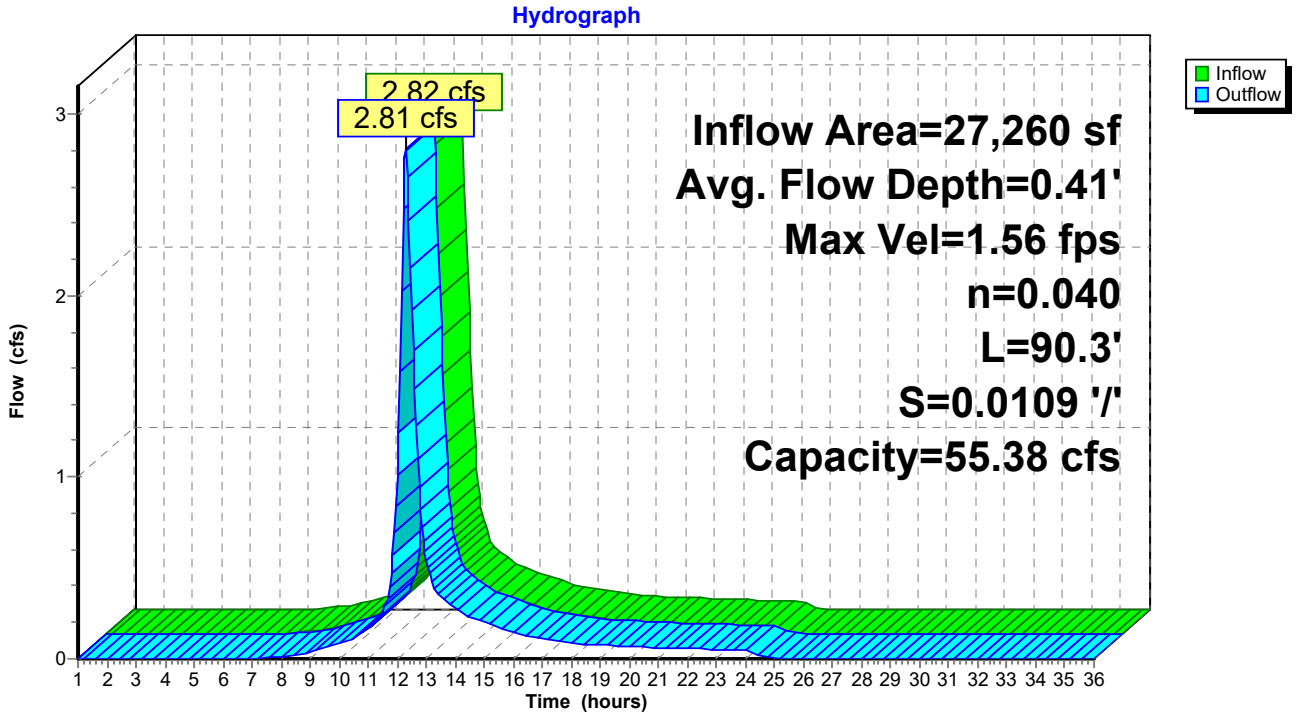
Reach 2: SWALE - 1.08%



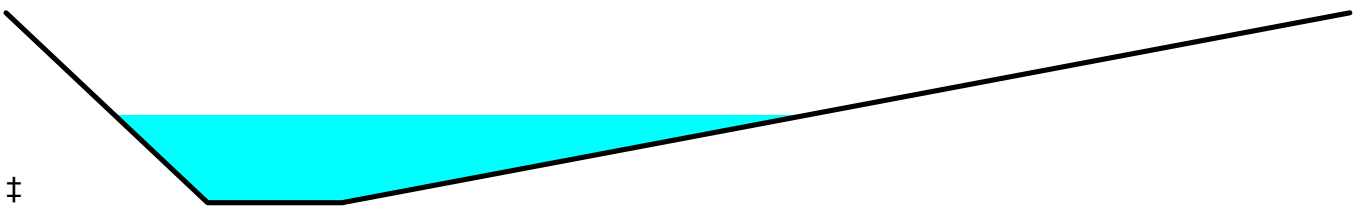
Summary for Reach 3: SWALE-0.74%

Inflow Area = 74,378 sf, 0.00% Impervious, Inflow Depth = 5.63" for 100-yr event
Inflow = 7.75 cfs @ 12.26 hrs, Volume= 34,888 cf
Outflow = 7.48 cfs @ 12.31 hrs, Volume= 34,888 cf, Atten= 4%, Lag= 3.1 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.75 fps, Min. Travel Time= 3.8 min
Avg. Velocity = 0.62 fps, Avg. Travel Time= 10.9 min

Peak Storage= 1,717 cf @ 12.31 hrs
Average Depth at Peak Storage= 0.69'
Bank-Full Depth= 1.50' Flow Area= 16.5 sf, Capacity= 45.69 cfs

2.00' x 1.50' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 10.0 '/' Top Width= 20.00'
Length= 402.0' Slope= 0.0074 '/'
Inlet Invert= 88.00', Outlet Invert= 85.03'



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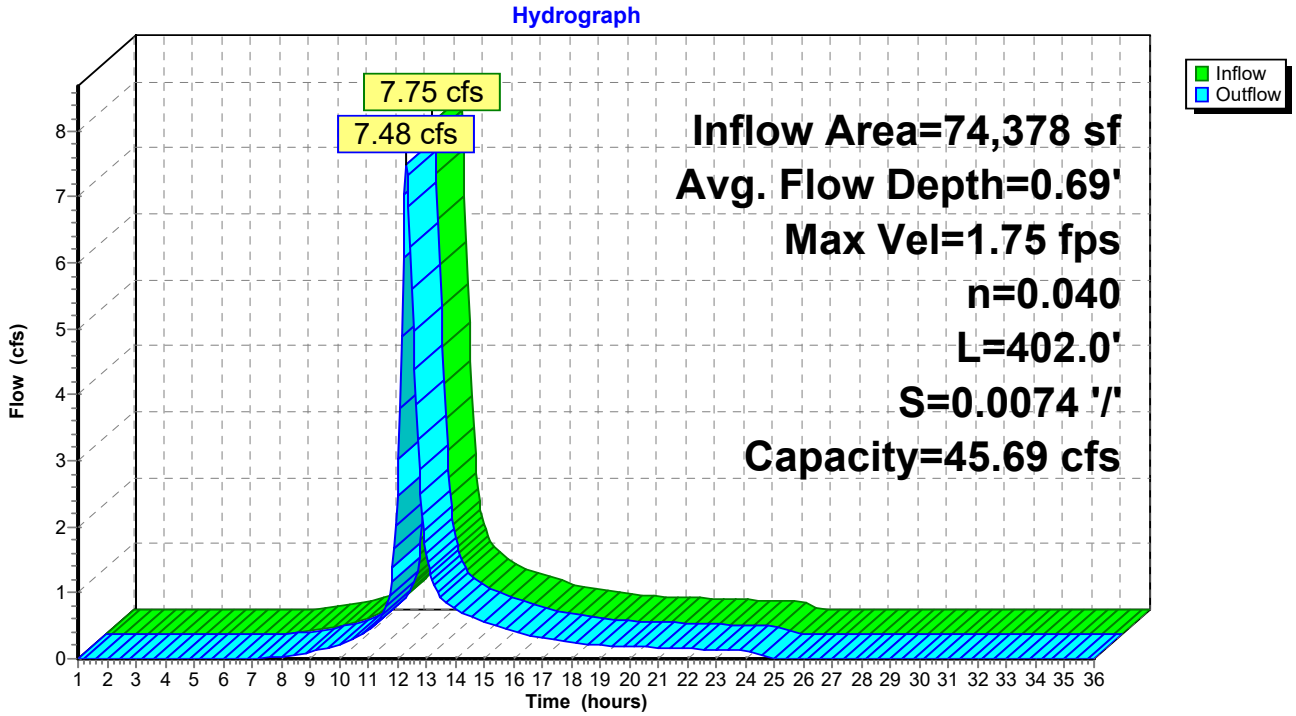
Reach 3: SWALE-0.74%



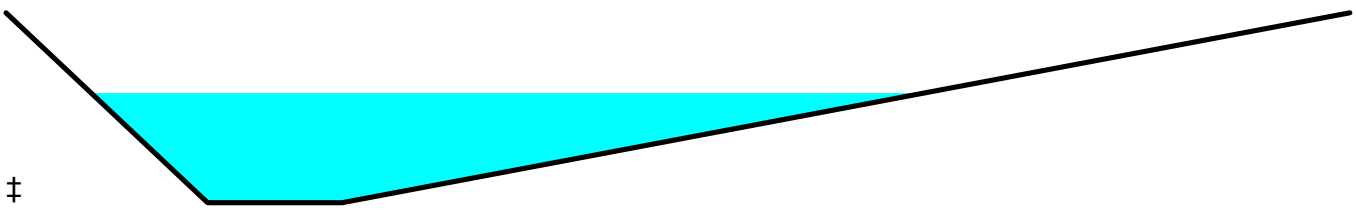
Summary for Reach 4: SWALE - 0.51%

Inflow Area = 104,701 sf, 0.00% Impervious, Inflow Depth = 5.73" for 100-yr event
Inflow = 10.70 cfs @ 12.29 hrs, Volume= 50,036 cf
Outflow = 10.32 cfs @ 12.35 hrs, Volume= 50,036 cf, Atten= 4%, Lag= 3.3 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.66 fps, Min. Travel Time= 4.1 min
Avg. Velocity = 0.55 fps, Avg. Travel Time= 12.3 min

Peak Storage= 2,544 cf @ 12.35 hrs
Average Depth at Peak Storage= 0.87'
Bank-Full Depth= 1.50' Flow Area= 16.5 sf, Capacity= 37.96 cfs

2.00' x 1.50' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.0 10.0 '/' Top Width= 20.00'
Length= 408.0' Slope= 0.0051 '/'
Inlet Invert= 85.00', Outlet Invert= 82.92'



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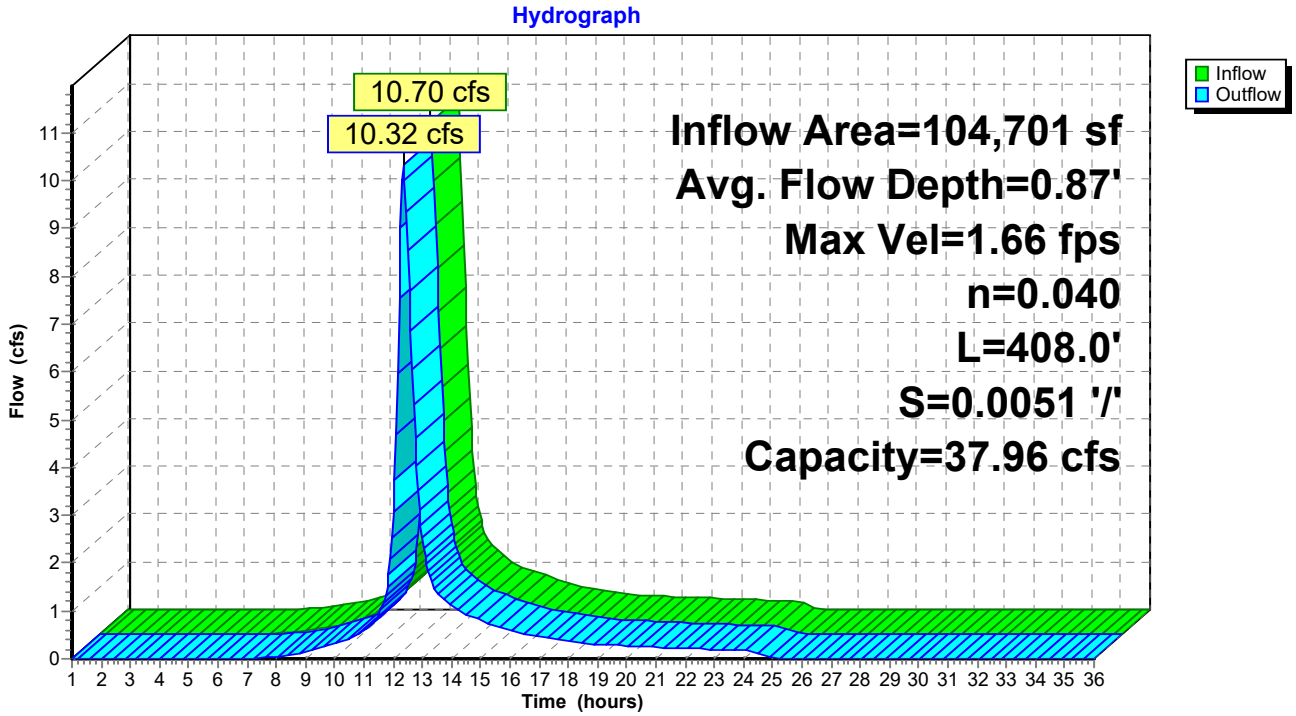
Reach 4: SWALE - 0.51%



Appendix C

Rip-Rap Apron, Impact Basin, Level Spreader Sizing, Rip-Rap Sizing Calculations

1st Revision

RIP RAP SCOUR HOLE DESIGN **Stormwater Basin 1 (1P)**

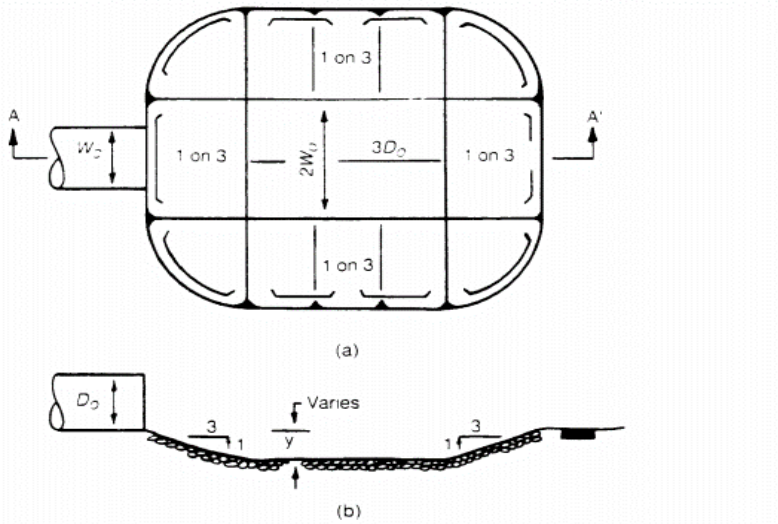


Figure 9.14—Preformed scour hole: (a) plan and (b) section (ASCE, 1975).

ASCE Manual of Practice No. 77,
" Design and Construction of Urban Stormwater Management Systems"

OUTLET #1 (EL. = 72.55')	**INPUT**	
PIPE DIAMETER (inches)	10.00	D
PIPE WIDTH (inches)	10.00	W
PIPE DESIGN DISCHARGE (cfs)	3.99	Q
SCOUR HOLE DEPTH (feet)	1.00	Y
TAILWATER DEPTH (inches)	1.00	TW

*Based on 100yr Storm

OUTLET #1 (EL. = 72.55')	**OUTPUT**		
PIPE DIAMETER (feet)	0.83	Do	
PIPE WIDTH (feet)	0.83	Wo	
SCOUR HOLE LENGTH (feet)	2.50	Ls	
SCOUR HOLE WIDTH (feet)	1.67	Ws	Provided on Plans
OVERALL LENGTH (feet)	8.50	Lt	8.5 ft length provided
OVERALL WIDTH (feet)	7.67	Wt	8 ft width provided

RIP RAP SCOUR HOLE DESIGN **Stormwater Basin 2 (2P)**

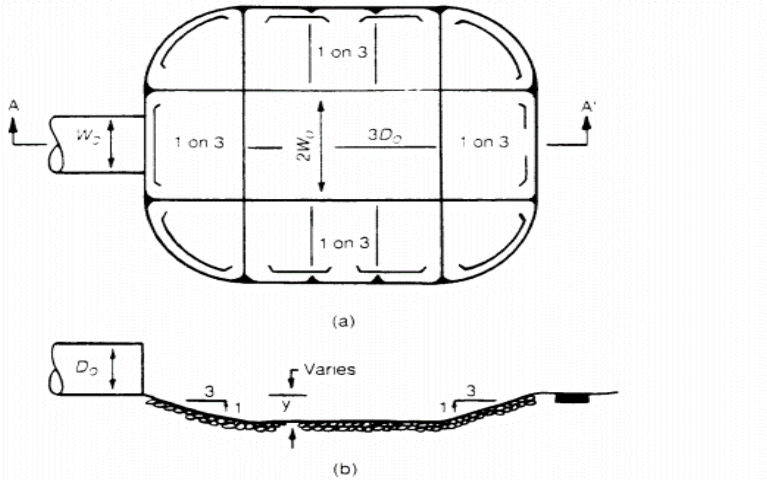


Figure 9.14—Preformed scour hole: (a) plan and (b) section (ASCE, 1975).

ASCE Manual of Practice No. 77,
" Design and Construction of Urban Stormwater Management Systems"

OUTLET #1 (EL. = 92.50')	**INPUT**	
PIPE DIAMETER (inches)	8.00	D
PIPE WIDTH (inches)	8.00	W
PIPE DESIGN DISCHARGE (cfs)	2.41	Q
SCOUR HOLE DEPTH (feet)	1.00	Y
TAILWATER DEPTH (inches)	1.00	TW

*Based on 100yr Storm

OUTLET #1 (EL. = 92.50')	**OUTPUT**	
PIPE DIAMETER (feet)	0.67	Do
PIPE WIDTH (feet)	0.67	Wo
SCOUR HOLE LENGTH (feet)	2.00	Ls
SCOUR HOLE WIDTH (feet)	1.33	Ws
OVERALL LENGTH (feet)	8.00	Lt
OVERALL WIDTH (feet)	7.33	Wt

Provided on Plans	
8	ft length provided
7.5	ft width provided

RIP RAP SCOUR HOLE DESIGN **Stormwater Basin 3 (3P)**

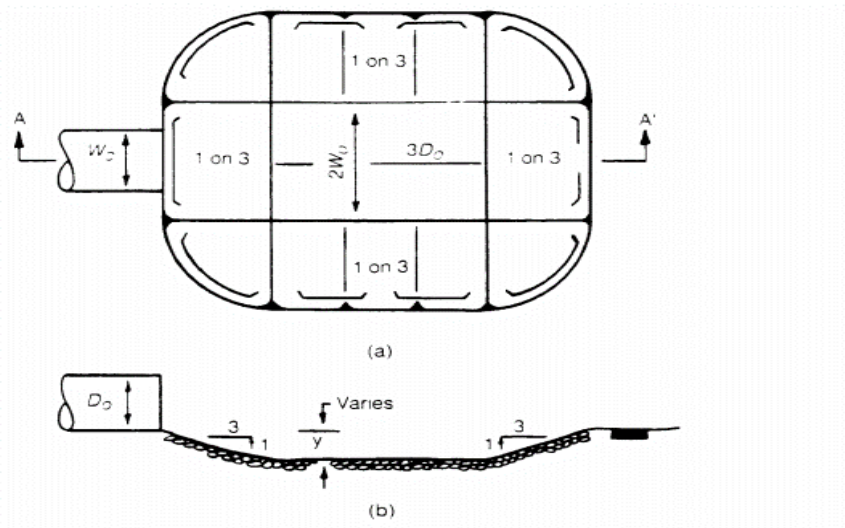


Figure 9.14—Preformed scour hole: (a) plan and (b) section (ASCE, 1975).

ASCE Manual of Practice No. 77,
" Design and Construction of Urban Stormwater Management Systems"

OUTLET #1 (EL. = 84.00')	**INPUT**	
PIPE DIAMETER (inches)	14.00	D
PIPE WIDTH (inches)	14.00	W
PIPE DESIGN DISCHARGE (cfs)	6.07	Q
SCOUR HOLE DEPTH (feet)	1.00	Y
TAILWATER DEPTH (inches)	1.00	TW

*Based on 100yr Storm

OUTLET #1 (EL. = 84.00')	**OUTPUT**		
PIPE DIAMETER (feet)	1.17	Do	
PIPE WIDTH (feet)	1.17	Wo	
SCOUR HOLE LENGTH (feet)	3.50	Ls	
SCOUR HOLE WIDTH (feet)	2.33	Ws	Provided on Plans
OVERALL LENGTH (feet)	9.50	Lt	9.5 ft length provided
OVERALL WIDTH (feet)	8.33	Wt	8.5 ft width provided

RIP RAP SCOUR HOLE DESIGN **Stormwater Basin 3 (3P)**

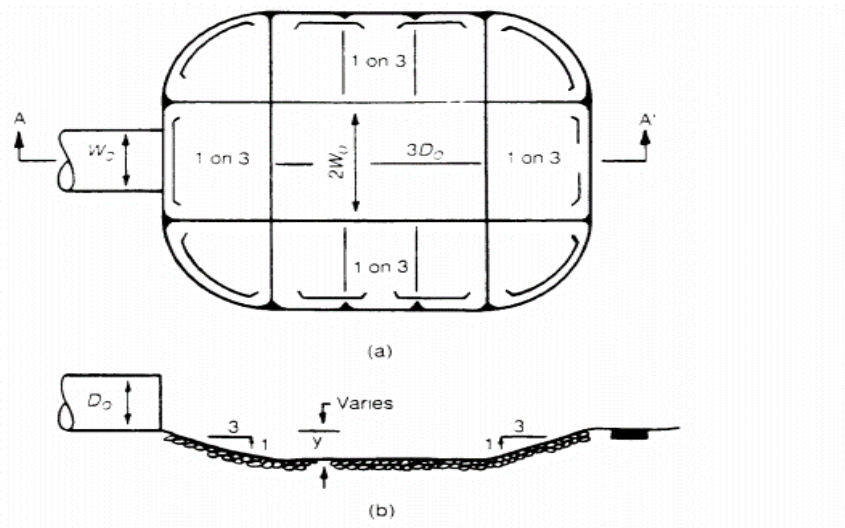


Figure 9.14—Preformed scour hole: (a) plan and (b) section (ASCE, 1975).

ASCE Manual of Practice No. 77,
" Design and Construction of Urban Stormwater Management Systems"

OUTLET #1 (EL. = 84.00')	**INPUT**		
PIPE DIAMETER (inches)	6.00	D	
PIPE WIDTH (inches)	6.00	W	
PIPE DESIGN DISCHARGE (cfs)	6.07	Q	*Based on 100yr Storm
SCOUR HOLE DEPTH (feet)	1.00	Y	
TAILWATER DEPTH (inches)	1.00	TW	

OUTLET #1 (EL. = 84.00')	**OUTPUT**		
PIPE DIAMETER (feet)	0.50	Do	
PIPE WIDTH (feet)	0.50	Wo	
SCOUR HOLE LENGTH (feet)	1.50	Ls	
SCOUR HOLE WIDTH (feet)	1.00	Ws	Provided on Plans
OVERALL LENGTH (feet)	7.50	Lt	7.5 ft length provided
OVERALL WIDTH (feet)	7.00	Wt	7 ft width provided

RIP RAP APRON DESIGN **Conveyance Swale**

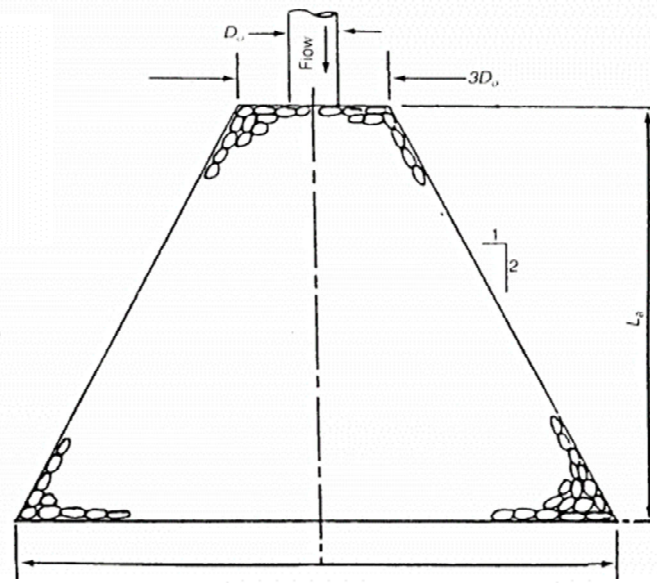
C. Riprap Protection at Outlets

If the flow velocity at a conduit outlet exceeds the maximum permissible velocity for the local soil or channel lining, channel protection is required. This protection usually consists of an erosion resistant reach, such as riprap, between the outlet and the stable downstream channel to provide a stable reach at the outlet in which the exit velocity is reduced to a velocity allowable in the downstream channel. The design of such protection is normally based on a 25-year design runoff event.

ASCE Manual of Practice No. 77,
" Design and Construction of Urban Stormwater Management Systems"

$$L_a = \frac{1.8Q}{D_0^{3/2}} + 7D_0, \text{ for } TW < \frac{D_0}{2}$$

$$W = 3D_0 + L_a, \text{ for } TW < \frac{D_0}{2}$$



$$L_a = \frac{1.8Q}{D_0^{3/2}} + 7D_0, \text{ for } TW < \frac{D_0}{2}$$

$$W = 3D_0 + L_a, \text{ for } TW < \frac{D_0}{2}$$

OUTLET #1 (EL. = 93.60')	INPUT	
PIPE DIAMETER (inches)	6.00	D
PIPE DESIGN DISCHARGE (cfs)	10.32	Q
TAILWATER DEPTH (inches)	1.00	TW

OUTLET #1 (EL. = 93.60')	OUTPUT		Provided on Plans
PIPE DIAMETER (feet)	0.50	Do	
APRON LENGTH (feet)	56.04	La	57 ft length provided
APRON BOTTOM WIDTH (feet)	57.54	W	58 ft width provided
APRON TOP WIDTH (feet)	1.50	3Do	

RIP RAP APRON DESIGN **Conveyance Pipe**

Pipe Flowing Full

v=k*C*R^(0.63)*S^(0.54) (Hazen Williams Formula)

v=velocity in ft/s			
k=1.318	**1.318**		
R=Hydraulic radius (ft) - (πr^2)/2πr	**0.125**		
C=Roughness coefficient (plastic)	**150**		
S=Slope (lowest)	**0.03**		
v=	**8.029813**	or	8.5 ft/s

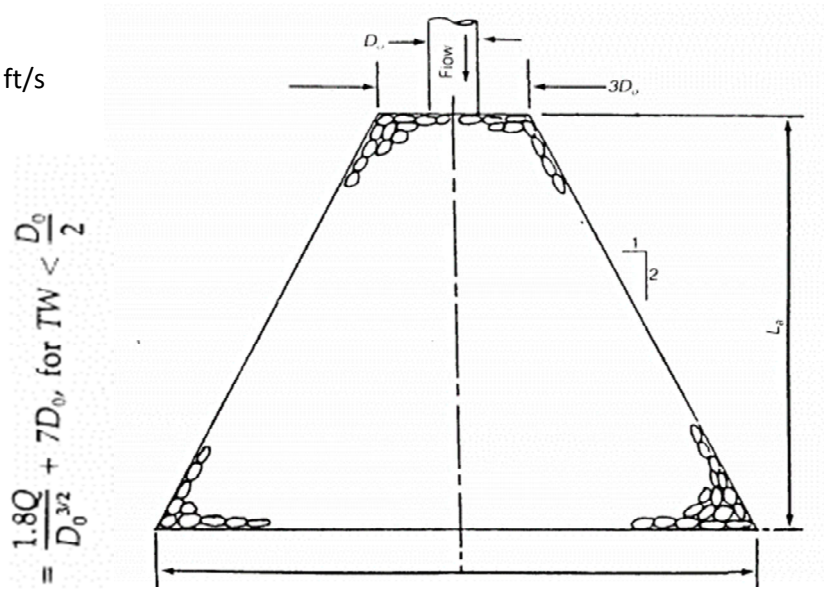
Pipe Area (A):	0.19635	sf
V:	8.5	ft/s
Q=VA	1.668975	cf/s

C. Riprap Protection at Outlets

If the flow velocity at a conduit outlet exceeds the maximum permissible velocity for the local soil or channel lining, channel protection is required. This protection usually consists of an erosion resistant reach, such as riprap, between the outlet and the stable downstream channel to provide a stable reach at the outlet in which the exit velocity is reduced to a velocity allowable in the downstream channel. The design of such protection is normally based on a 25-year design runoff event.

ASCE Manual of Practice No. 77,
" Design and Construction of Urban Stormwater Management Systems"

$$L_a = \frac{1.8Q}{D_0^{3/2}} + 7D_0, \text{ for } TW < \frac{D_0}{2} \qquad W = 3D_0 + L_a, \text{ for } TW < \frac{D_0}{2}$$



$$L_a = \frac{1.8Q}{D_0^{3/2}} + 7D_0, \text{ for } TW < \frac{D_0}{2}$$

$$W = 3D_0 + L_a, \text{ for } TW < \frac{D_0}{2}$$

OUTLET #1 (EL. = 93.60')	**INPUT**	
PIPE DIAMETER (inches)	6.00	D
PIPE DESIGN DISCHARGE (cfs)	1.67	Q
TAILWATER DEPTH (inches)	1.00	TW

OUTLET #1 (EL. = 93.60')	**OUTPUT**		Provided on Plans
PIPE DIAMETER (feet)	0.50	Do	
APRON LENGTH (feet)	12.00	La	12 ft length provided
APRON BOTTOM WIDTH (feet)	13.50	W	13.5 ft width provided
APRON TOP WIDTH (feet)	1.50	3Do	

RIP RAP SIZING CALCUALTIONS - STORMWATER BASIN 1 (1P)

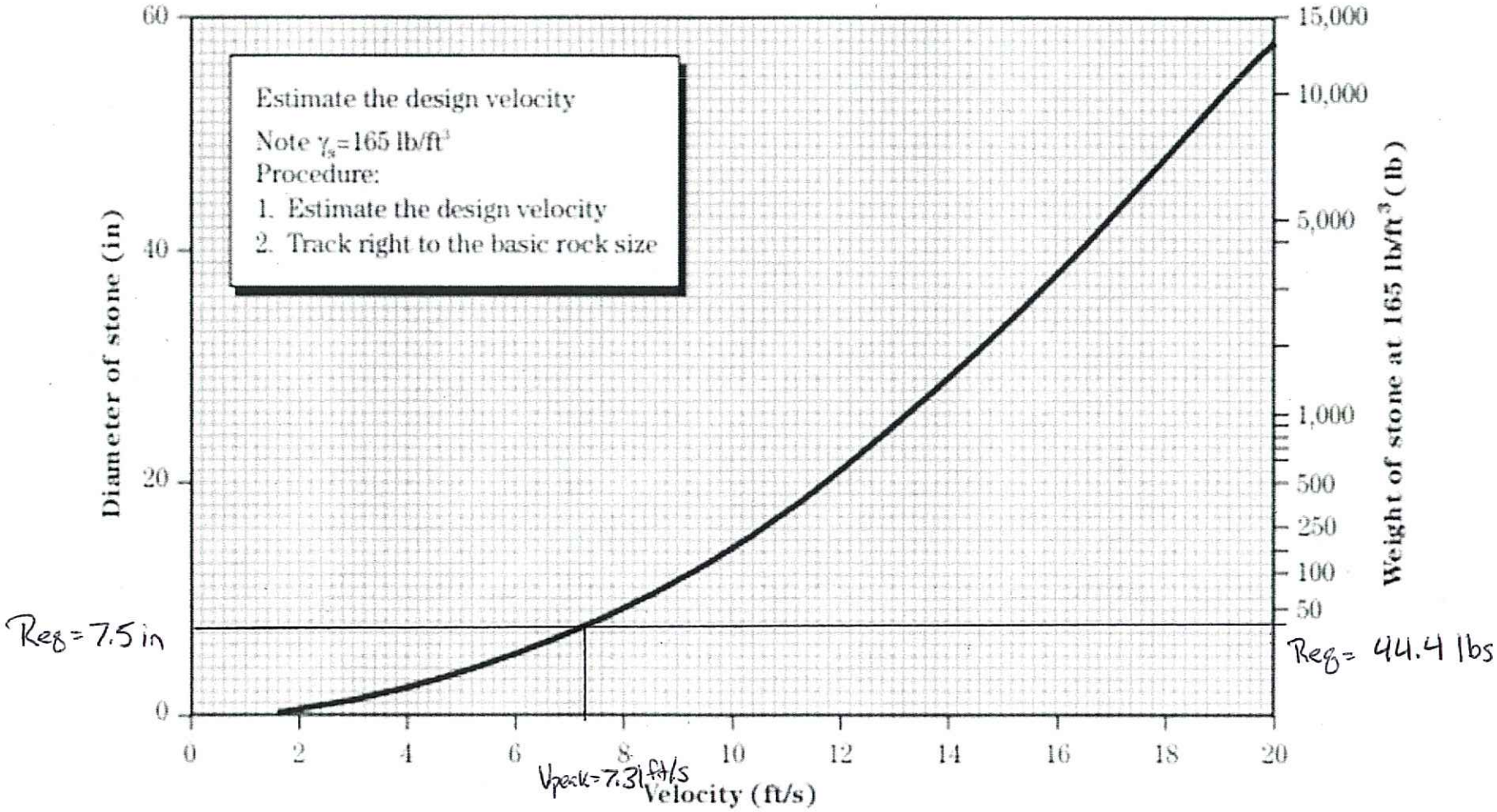
Design Engineer:	Atlantic Design Engineers, Inc.	Job No.:	3055.02
Project Name:	Fearing Hill Road Solar Project	Calc'd By:	NJC
Location:	Wareham, MA	Revised Date:	9/2/2022

SUMMARY OF DISCHARGE FROM HYDROCAD

Outlet #1 (10" culvert) - Qpeak=3.99 cfs; Vpeak=7.31 fps

Vpeak= 7.31 fps (From HydroCAD calculations-100yr storm)

From Isbash Curve; required D_{50}=	**8**	**inches**
From Isbash Curve; required D_{50}=	**44**	**lbs**
Provided D_{50}=	8	Inches
Provided Weight=	50	lbs



Stormwater Basin 1 (IP) 10" CPP

RIP RAP SIZING CALCUALTIONS - STORMWATER BASIN 2 (2P)

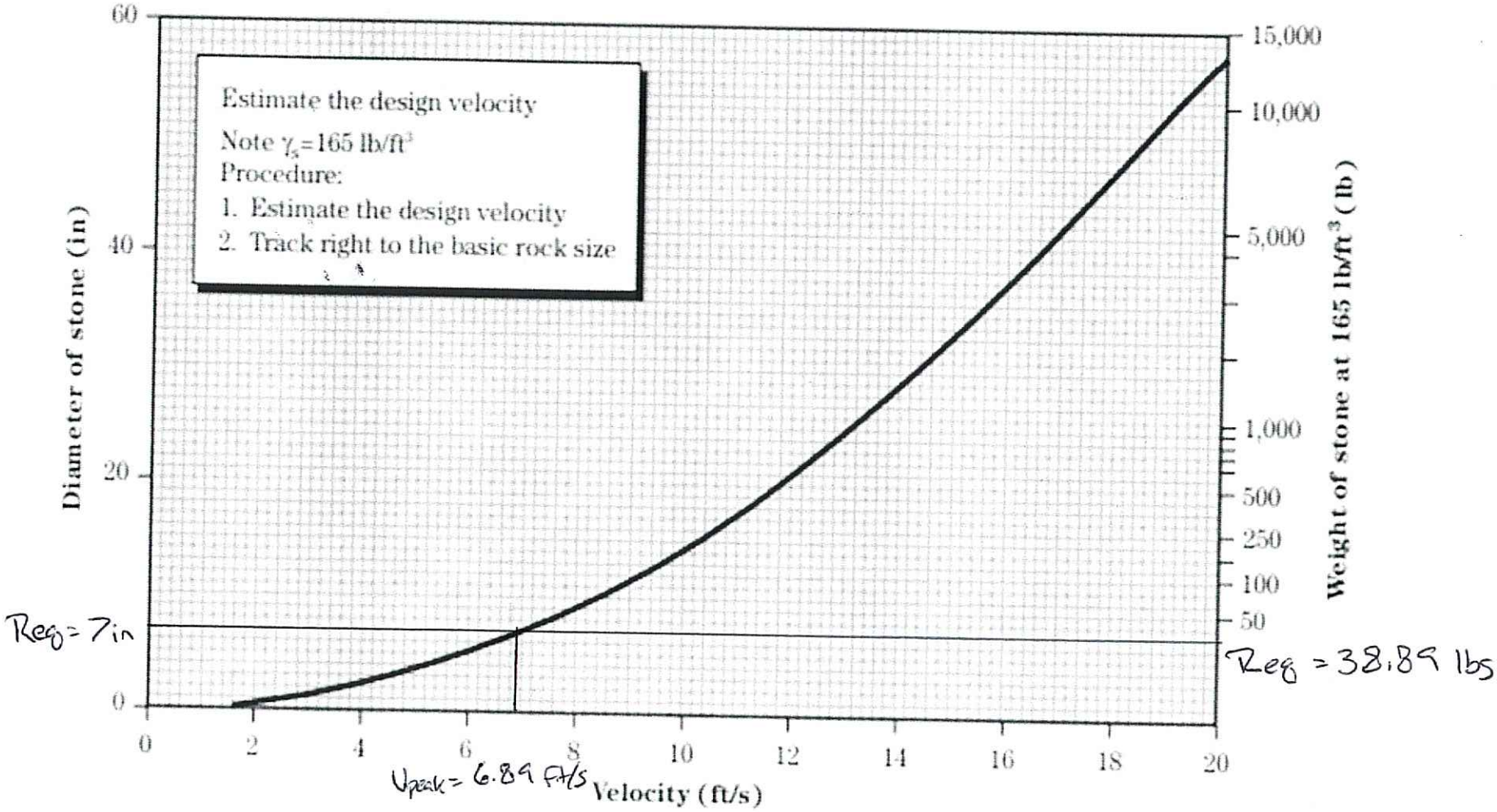
Design Engineer:	Atlantic Design Engineers, Inc.	Job No.:	3055.02
Project Name:	Fearing Hill Road Solar Project	Calc'd By:	NJC
Location:	Wareham, MA	Date:	9/2/2022

SUMMARY OF DISCHARGE FROM HYDROCAD

Outlet #1 (8" culvert) - Qpeak=2.41 cfs; Vpeak=6.89 fps

Vpeak= 6.89 fps (From HydroCAD calculations-100yr storm)

From Isbash Curve; required D_{50}=	**7**	**inches**
From Isbash Curve; required D_{50}=	**39**	**lbs**
Provided D_{50}=	8	Inches
Provided Weight=	50	lbs



Stormwater Basin 2 (2P) 8" CPP

RIP RAP SIZING CALCUALTIONS - STORMWATER BASIN 3 (3P)

Design Engineer:	Atlantic Design Engineers, Inc.	Job No.:	3055.02
Project Name:	Fearing Hill Road Solar Project	Calc'd By:	NJC
Location:	Wareham, MA	Date:	9/2/2022

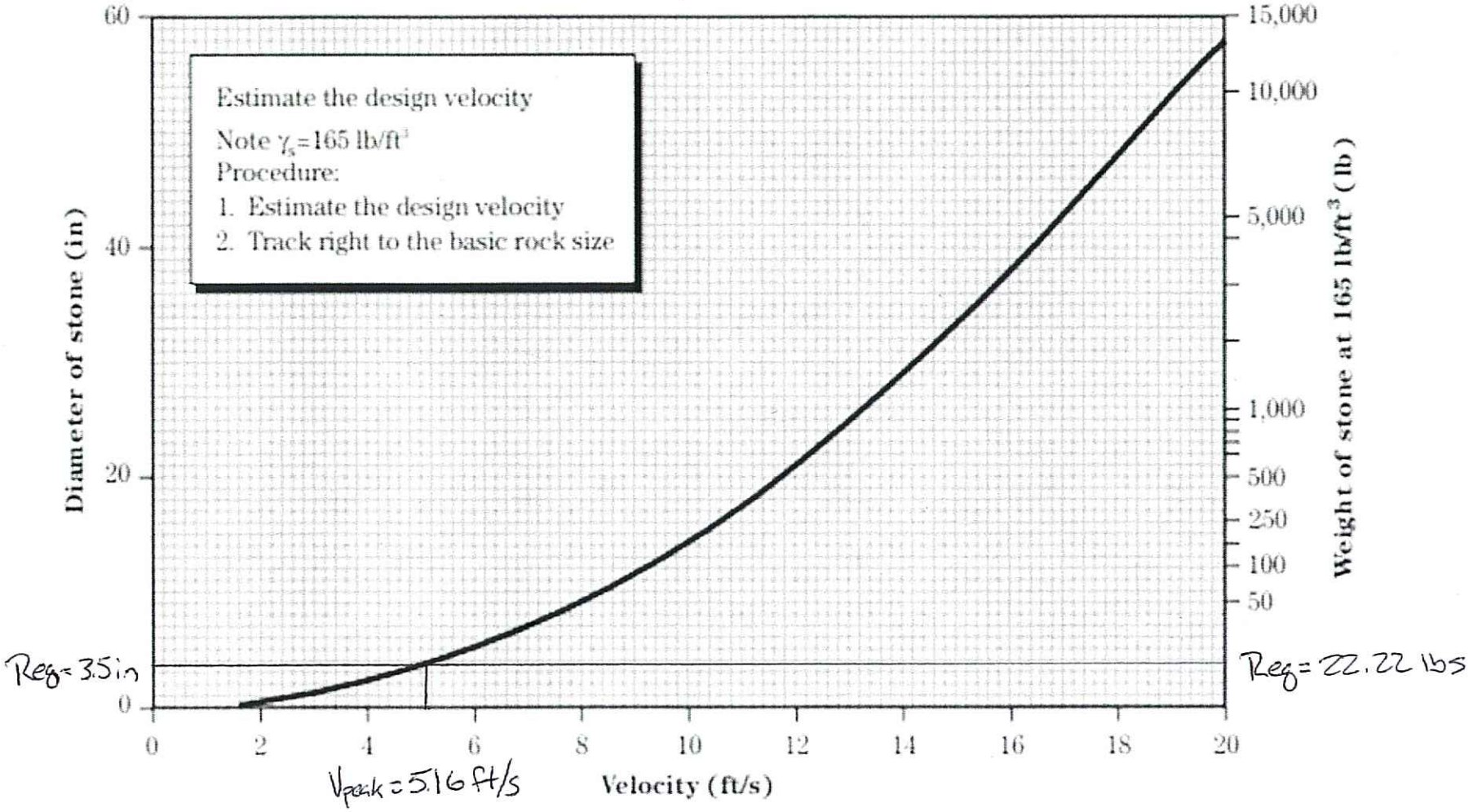
SUMMARY OF DISCHARGE FROM HYDROCAD

Outlet #1 (2x-6" culverts) - Qpeak=2.38 cfs; Vpeak=6.07 fps **Max Peak assumed**

Outlet #1 (2x-14" culvert) - Qpeak=11.04 cfs; Vpeak=5.16 fps

Vpeak= 5.16 fps (From HydroCAD calculations-100yr storm)

From Isbash Curve; required D_{50}=	**2**	**inches**
From Isbash Curve; required Weight=	**11**	**lbs**
Provided D_{50}=	8	Inches
Provided Weight=	50	lbs



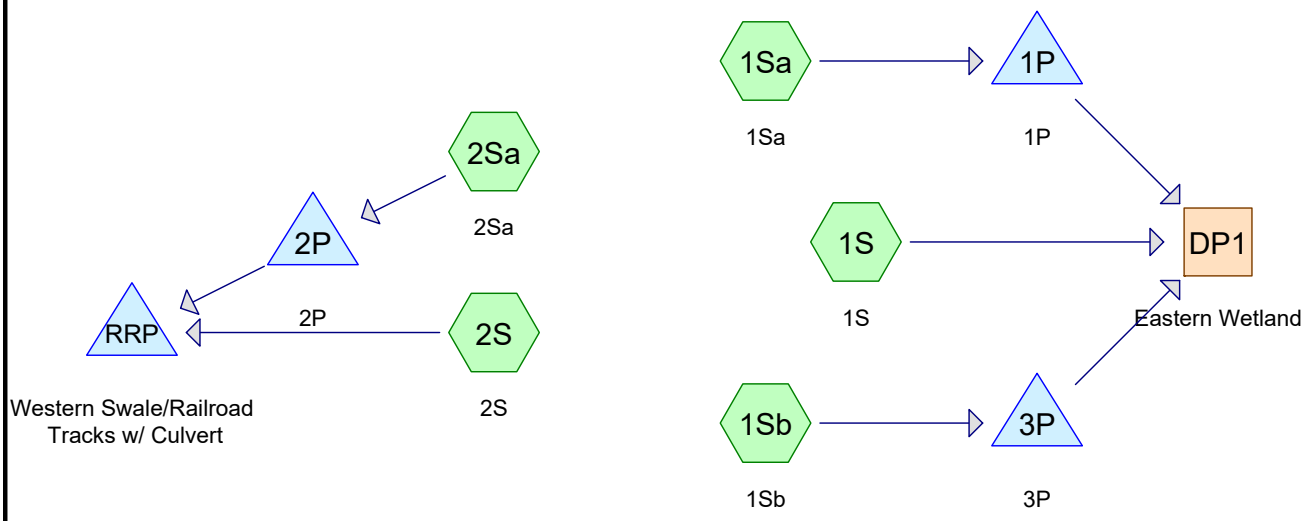
Stormwater Basin 3 (3P)

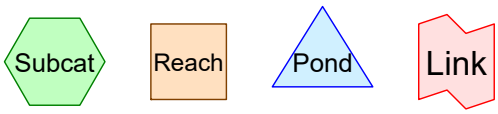
2-6" CPP + 2-14" CPP

Appendix D

Alternate Post-Development HydroCAD Stormwater Analysis – Fair Grass Analysis

POST-DEVELOPMENT





Routing Diagram for 3055.02 - WITH FAIR GRASS
Prepared by Atlantic Design Engineers, Inc., Printed 8/31/2022
HydroCAD® 10.00-25 s/n 00480 © 2019 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.327	69	50-75% Grass cover, Fair, HSG B (2S, 2Sa)
17.514	79	50-75% Grass cover, Fair, HSG C (1S, 1Sa, 1Sb, 2S, 2Sa)
1.161	84	50-75% Grass cover, Fair, HSG D (1S, 1Sa)
0.450	96	Gravel surface, HSG C (1Sa, 1Sb, 2S, 2Sa)
0.111	98	Paved parking, HSG B (2S)
0.147	98	Unconnected pavement, HSG C - EQ PADS (1Sa)
7.506	55	Woods, Good, HSG B (1S, 2S)
7.963	70	Woods, Good, HSG C (1S, 2S)
2.210	77	Woods, Good, HSG D (1S)
38.390	**72**	**TOTAL AREA**

Time span=1.00-36.00 hrs, dt=0.05 hrs, 701 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: 1S Runoff Area=386,365 sf 0.00% Impervious Runoff Depth=1.37"
Flow Length=468' Tc=32.0 min CN=74 Runoff=7.52 cfs 1.0 af

Subcatchment 1Sa: 1Sa Runoff Area=332,772 sf 1.93% Impervious Runoff Depth=1.78"
Flow Length=251' Tc=7.8 min CN=80 Runoff=14.74 cfs 1.1 af

Subcatchment 1Sb: 1Sb Runoff Area=178,528 sf 0.00% Impervious Runoff Depth=1.71"
Flow Length=221' Tc=18.4 min CN=79 Runoff=5.66 cfs 0.6 af

Subcatchment 2S: 2S Runoff Area=601,941 sf 0.80% Impervious Runoff Depth=0.80"
Flow Length=898' Tc=34.8 min CN=64 Runoff=5.76 cfs 0.9 af

Subcatchment 2Sa: 2Sa Runoff Area=172,643 sf 0.00% Impervious Runoff Depth=1.57"
Flow Length=283' Tc=8.9 min CN=77 Runoff=6.36 cfs 0.5 af

Reach DP1: Eastern Wetland Inflow=14.84 cfs 2.7 af
Outflow=14.84 cfs 2.7 af

Pond 1P: 1P Peak Elev=74.64' Storage=18,515 cf Inflow=14.74 cfs 1.1 af
Outflow=2.56 cfs 1.1 af

Pond 2P: 2P Peak Elev=70.60' Storage=6,807 cf Inflow=6.36 cfs 0.5 af
Outflow=1.59 cfs 0.5 af

Pond 3P: 3P Peak Elev=73.72' Storage=1,354 cf Inflow=5.66 cfs 0.6 af
Outflow=5.32 cfs 0.6 af

Pond RRP: Western Swale/Railroad Tracks w/ Peak Elev=58.75' Storage=5,593 cf Inflow=7.35 cfs 1.4 af
Outflow=7.03 cfs 1.4 af

Total Runoff Area = 38.390 ac Runoff Volume = 4.2 af Average Runoff Depth = 1.30"
99.33% Pervious = 38.132 ac 0.67% Impervious = 0.258 ac

Summary for Subcatchment 1S: 1S

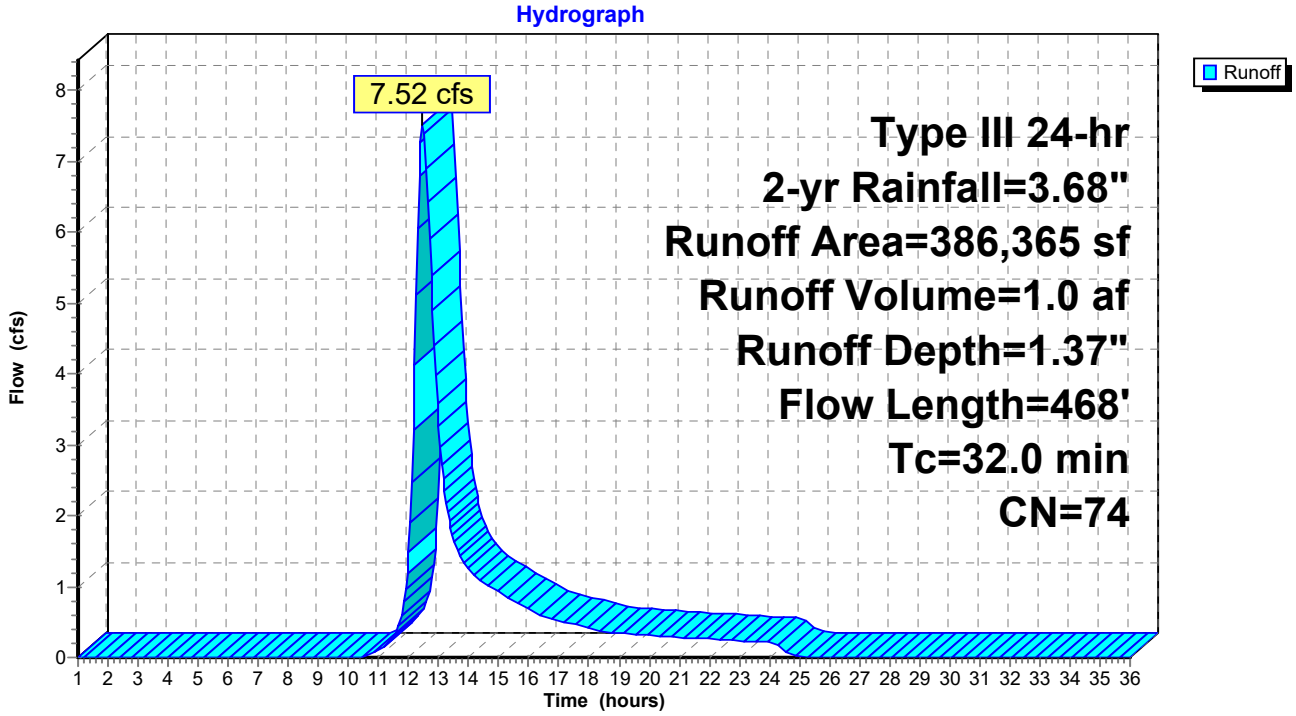
Runoff = 7.52 cfs @ 12.48 hrs, Volume= 1.0 af, Depth= 1.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.68"

Area (sf)	CN	Description
41,299	55	Woods, Good, HSG B
121,227	70	Woods, Good, HSG C
96,253	77	Woods, Good, HSG D
42,050	79	50-75% Grass cover, Fair, HSG C
44,337	79	50-75% Grass cover, Fair, HSG C
41,199	84	50-75% Grass cover, Fair, HSG D
386,365	74	Weighted Average
386,365		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.7	50	0.0100	0.03		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.60"
5.3	418	0.0681	1.30		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
32.0	468	Total			

Subcatchment 1S: 1S



Summary for Subcatchment 1Sa: 1Sa

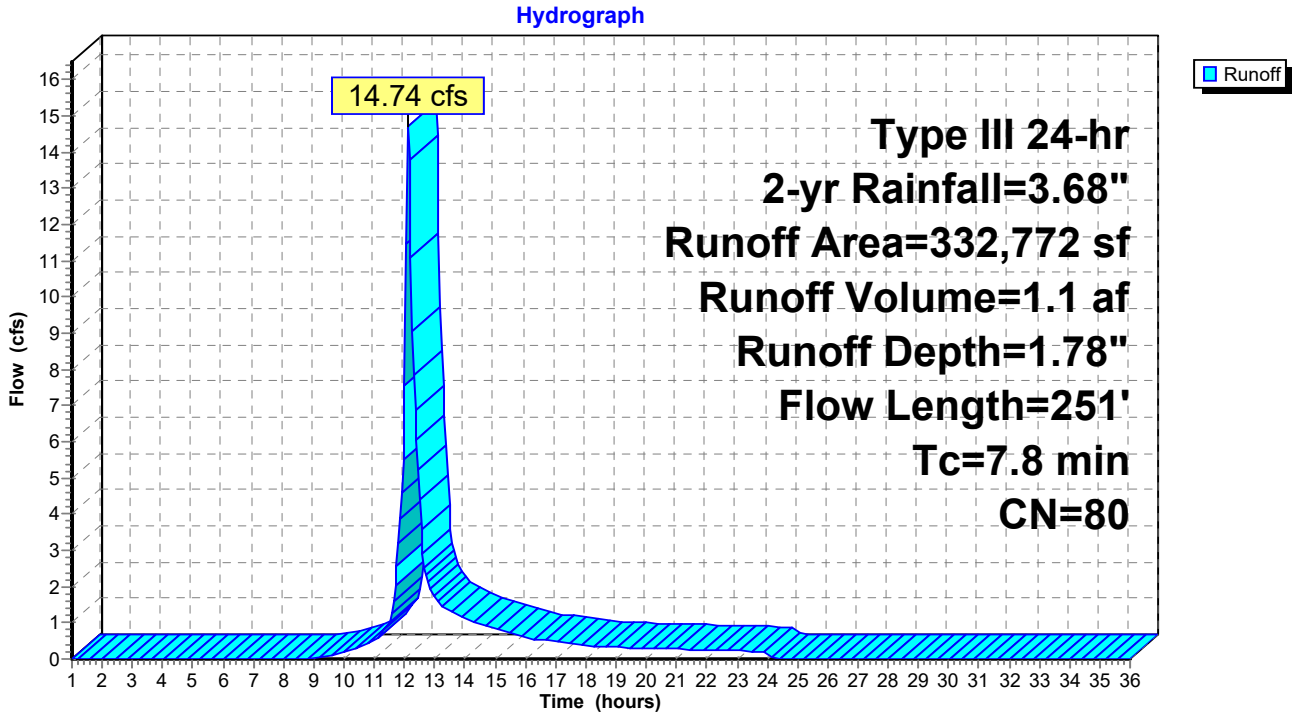
Runoff = 14.74 cfs @ 12.12 hrs, Volume= 1.1 af, Depth= 1.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.68"

	Area (sf)	CN	Description
*	6,408	98	Unconnected pavement, HSG C - EQ PADS
	5,146	96	Gravel surface, HSG C
	252,473	79	50-75% Grass cover, Fair, HSG C
	59,360	79	50-75% Grass cover, Fair, HSG C
	9,385	84	50-75% Grass cover, Fair, HSG D
	332,772	80	Weighted Average
	326,364		98.07% Pervious Area
	6,408		1.93% Impervious Area
	6,408		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0100	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.8	201	0.0640	4.07		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
7.8	251	Total			

Subcatchment 1Sa: 1Sa



Summary for Subcatchment 1Sb: 1Sb

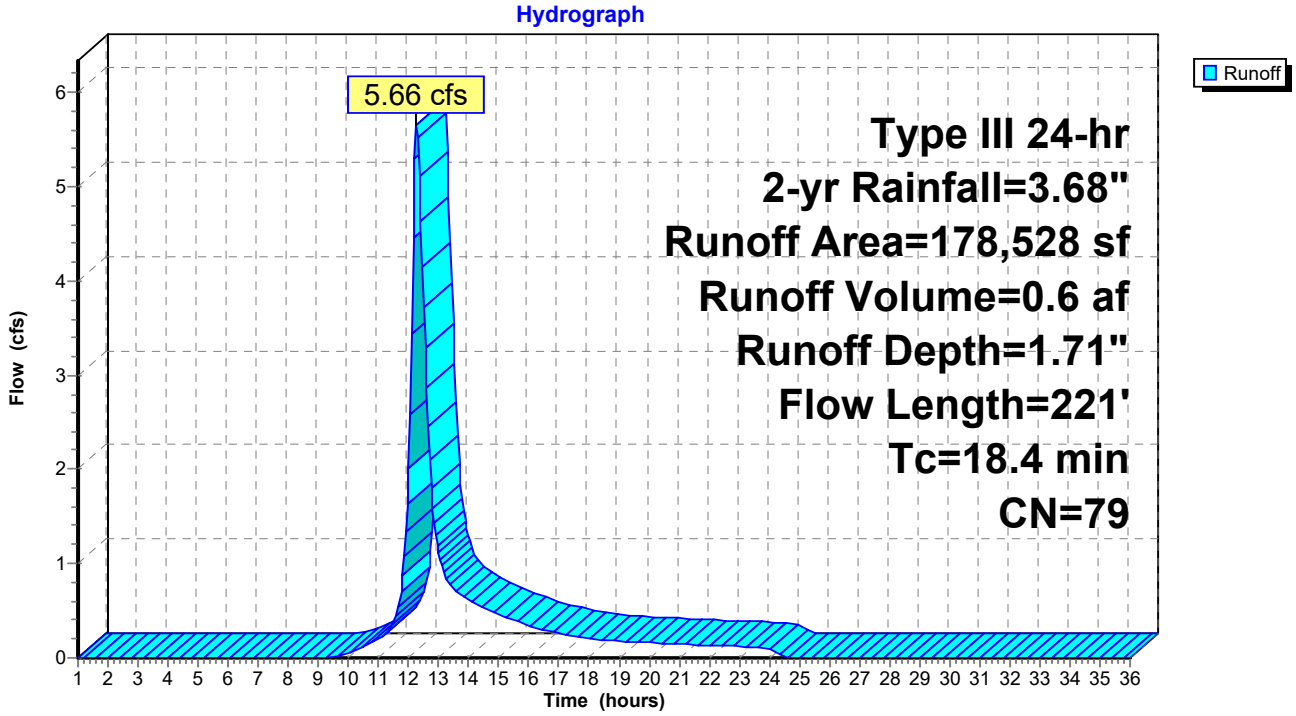
Runoff = 5.66 cfs @ 12.26 hrs, Volume= 0.6 af, Depth= 1.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.68"

Area (sf)	CN	Description
4,422	96	Gravel surface, HSG C
157,889	79	50-75% Grass cover, Fair, HSG C
16,217	79	50-75% Grass cover, Fair, HSG C
178,528	79	Weighted Average
178,528		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.6	50	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.8	171	0.0450	3.42		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
18.4	221	Total			

Subcatchment 1Sb: 1Sb



Summary for Subcatchment 2S: 2S

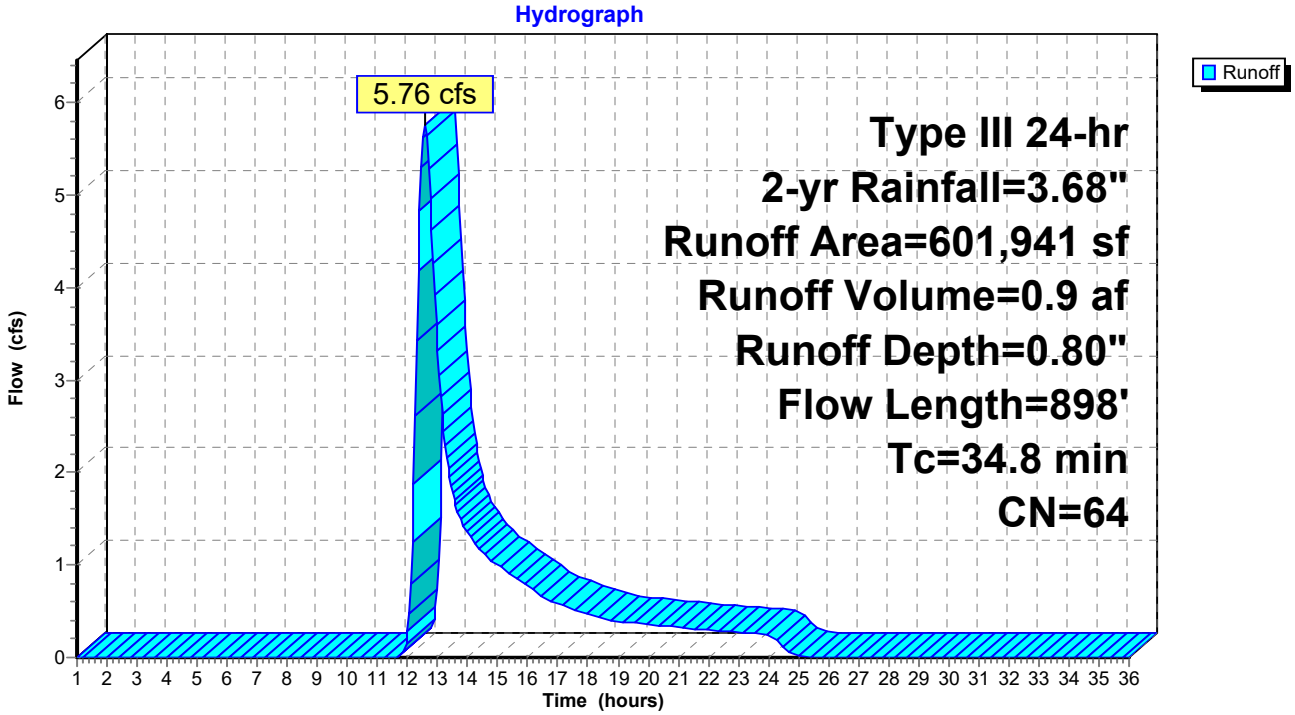
Runoff = 5.76 cfs @ 12.57 hrs, Volume= 0.9 af, Depth= 0.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.68"

Area (sf)	CN	Description
8,087	96	Gravel surface, HSG C
22,963	79	50-75% Grass cover, Fair, HSG C
285,668	55	Woods, Good, HSG B
225,635	70	Woods, Good, HSG C
15,496	69	50-75% Grass cover, Fair, HSG B
39,276	79	50-75% Grass cover, Fair, HSG C
4,816	98	Paved parking, HSG B
601,941	64	Weighted Average
597,125		99.20% Pervious Area
4,816		0.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.2	50	0.0080	0.03		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.60"
5.6	848	0.0250	2.55		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
34.8	898	Total			

Subcatchment 2S: 2S



Summary for Subcatchment 2Sa: 2Sa

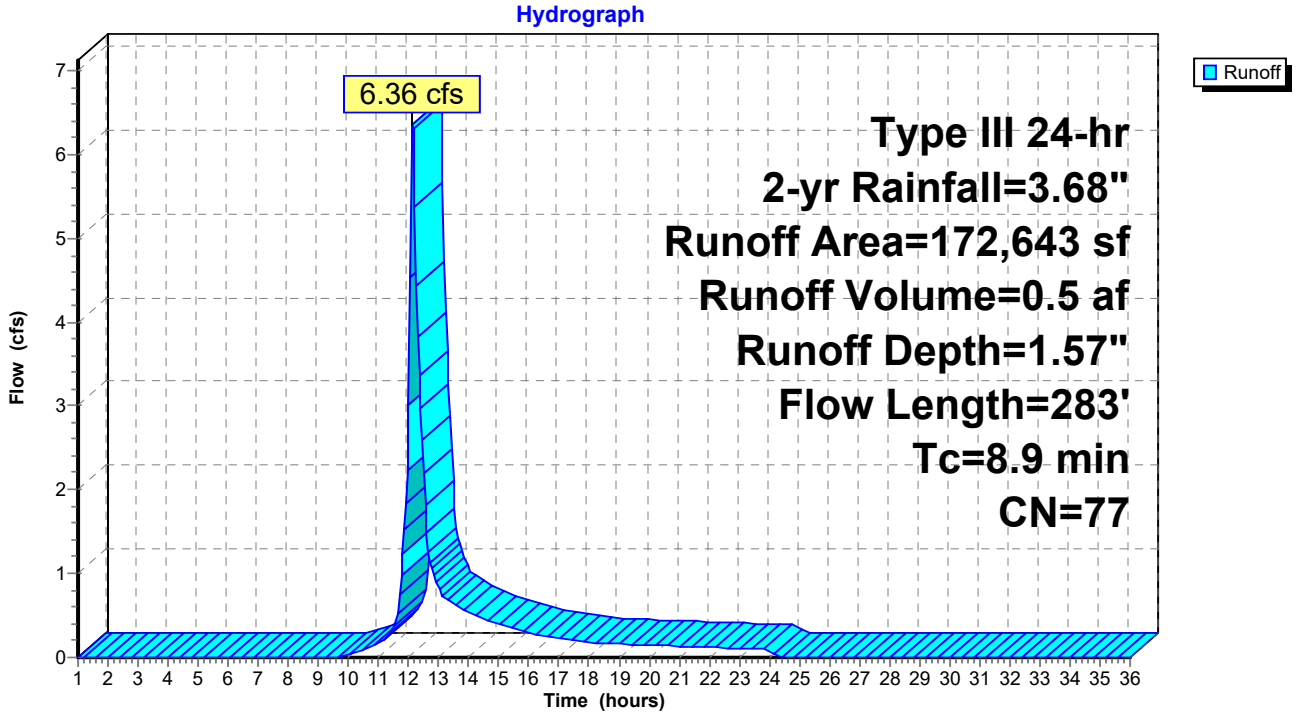
Runoff = 6.36 cfs @ 12.13 hrs, Volume= 0.5 af, Depth= 1.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.68"

Area (sf)	CN	Description
1,962	96	Gravel surface, HSG C
42,320	69	50-75% Grass cover, Fair, HSG B
98,678	79	50-75% Grass cover, Fair, HSG C
29,683	79	50-75% Grass cover, Fair, HSG C
172,643	77	Weighted Average
172,643		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	50	0.0072	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.7	184	0.0850	4.69		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	49	0.0612	3.71		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
8.9	283	Total			

Subcatchment 2Sa: 2Sa

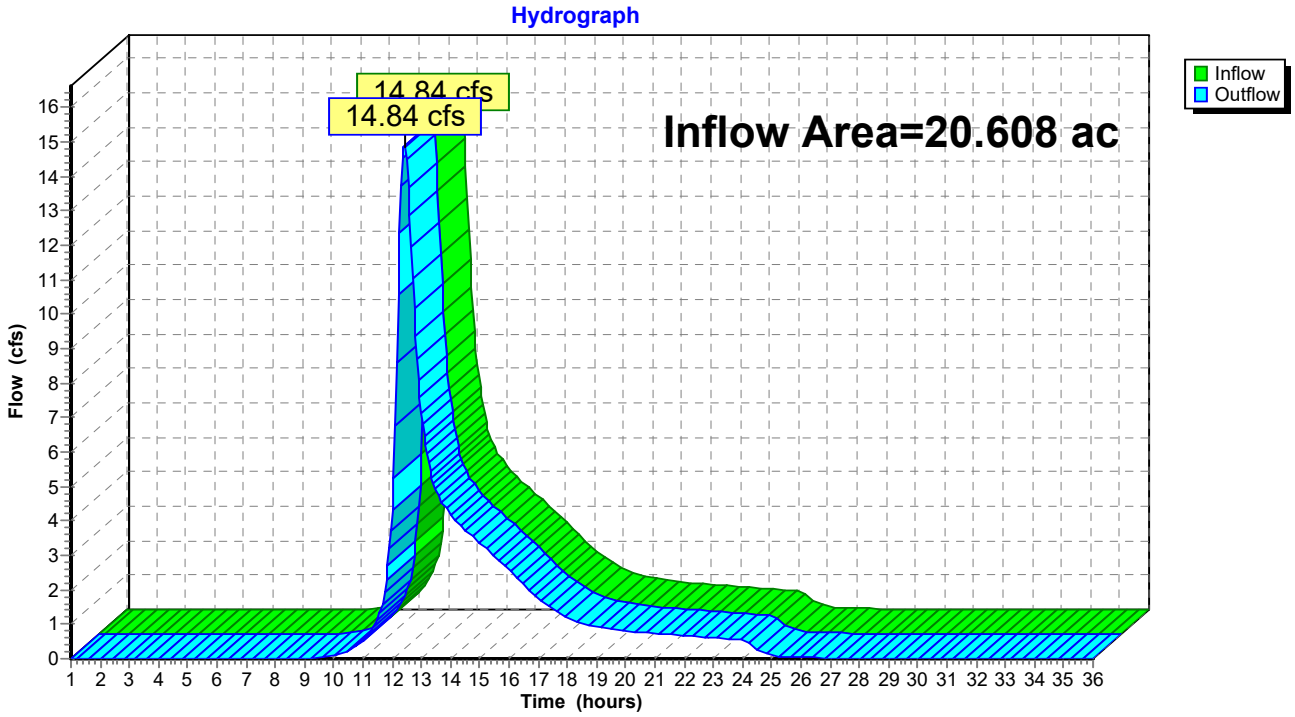


Summary for Reach DP1: Eastern Wetland

Inflow Area = 20.608 ac, 0.71% Impervious, Inflow Depth > 1.59" for 2-yr event
Inflow = 14.84 cfs @ 12.41 hrs, Volume= 2.7 af
Outflow = 14.84 cfs @ 12.41 hrs, Volume= 2.7 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs

Reach DP1: Eastern Wetland



Summary for Pond 1P: 1P

Inflow Area = 7.639 ac, 1.93% Impervious, Inflow Depth = 1.78" for 2-yr event
Inflow = 14.74 cfs @ 12.12 hrs, Volume= 1.1 af
Outflow = 2.56 cfs @ 12.65 hrs, Volume= 1.1 af, Atten= 83%, Lag= 32.1 min
Primary = 2.56 cfs @ 12.65 hrs, Volume= 1.1 af

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 74.64' @ 12.65 hrs Surf.Area= 21,288 sf Storage= 18,515 cf

Plug-Flow detention time= 85.4 min calculated for 1.1 af (100% of inflow)
Center-of-Mass det. time= 85.5 min (922.9 - 837.5)

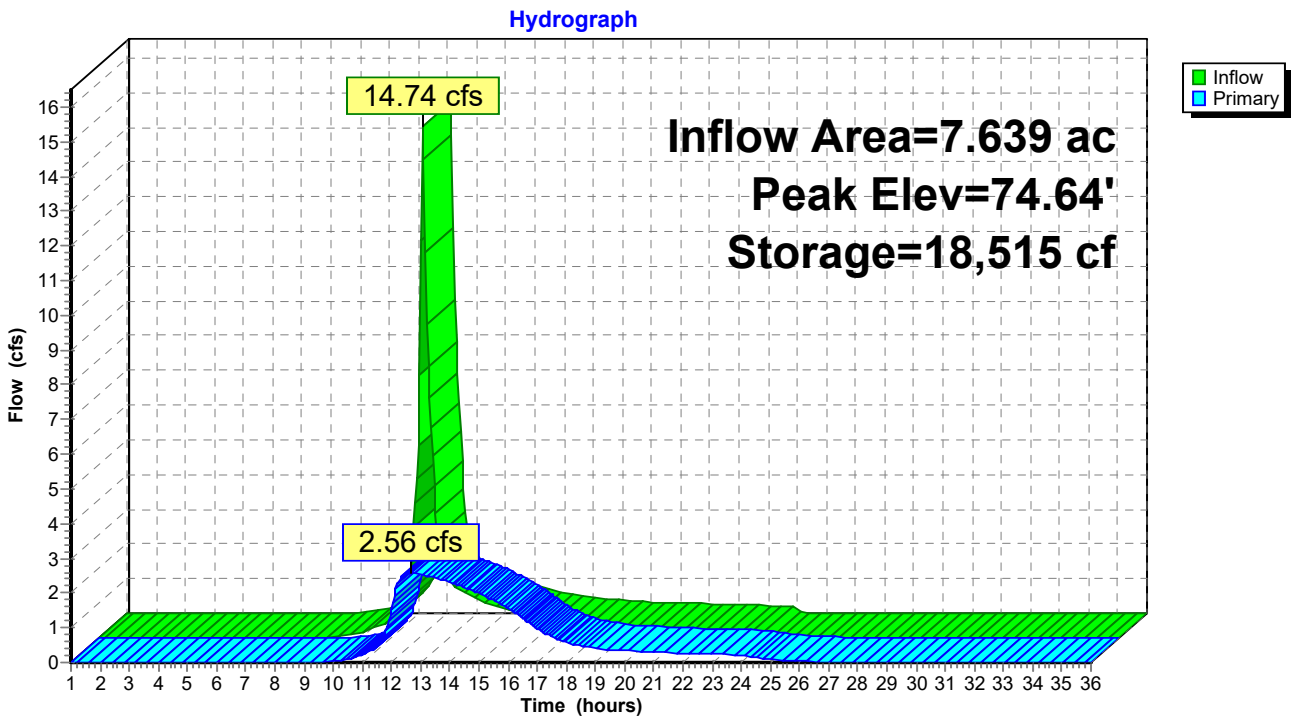
Volume	Invert	Avail.Storage	Storage Description
#1	73.00'	140,073 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
73.00	2,895	876.8	0	0	2,895
74.00	13,416	1,517.5	7,514	7,514	124,975
75.00	26,522	1,740.9	19,600	27,115	182,924
76.00	41,778	1,899.3	33,862	60,977	228,845
77.00	58,419	2,081.5	49,867	110,844	286,597
77.50	58,500	2,100.0	29,230	140,073	292,842

Device	Routing	Invert	Outlet Devices
#1	Primary	77.00'	**20.0' long x 20.0' breadth Broad-Crested Rectangular Weir** 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
#2	Primary	73.00'	**10.0" Round Culvert** L= 45.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 73.00' / 72.55' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.55 sf

Primary OutFlow Max=2.56 cfs @ 12.65 hrs HW=74.64' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└─**2=Culvert** (Inlet Controls 2.56 cfs @ 4.70 fps)

Pond 1P: 1P


Hydrograph
14.74 cfs
2.56 cfs
Inflow Area=7.639 ac
Peak Elev=74.64'
Storage=18,515 cf
Inflow
Primary
Flow (cfs)
Time (hours)

Summary for Pond 2P: 2P

Inflow Area = 3.963 ac, 0.00% Impervious, Inflow Depth = 1.57" for 2-yr event
Inflow = 6.36 cfs @ 12.13 hrs, Volume= 0.5 af
Outflow = 1.59 cfs @ 12.59 hrs, Volume= 0.5 af, Atten= 75%, Lag= 27.1 min
Primary = 1.59 cfs @ 12.59 hrs, Volume= 0.5 af

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 70.60' @ 12.59 hrs Surf.Area= 9,221 sf Storage= 6,807 cf

Plug-Flow detention time= 44.7 min calculated for 0.5 af (100% of inflow)
Center-of-Mass det. time= 45.1 min (892.5 - 847.4)

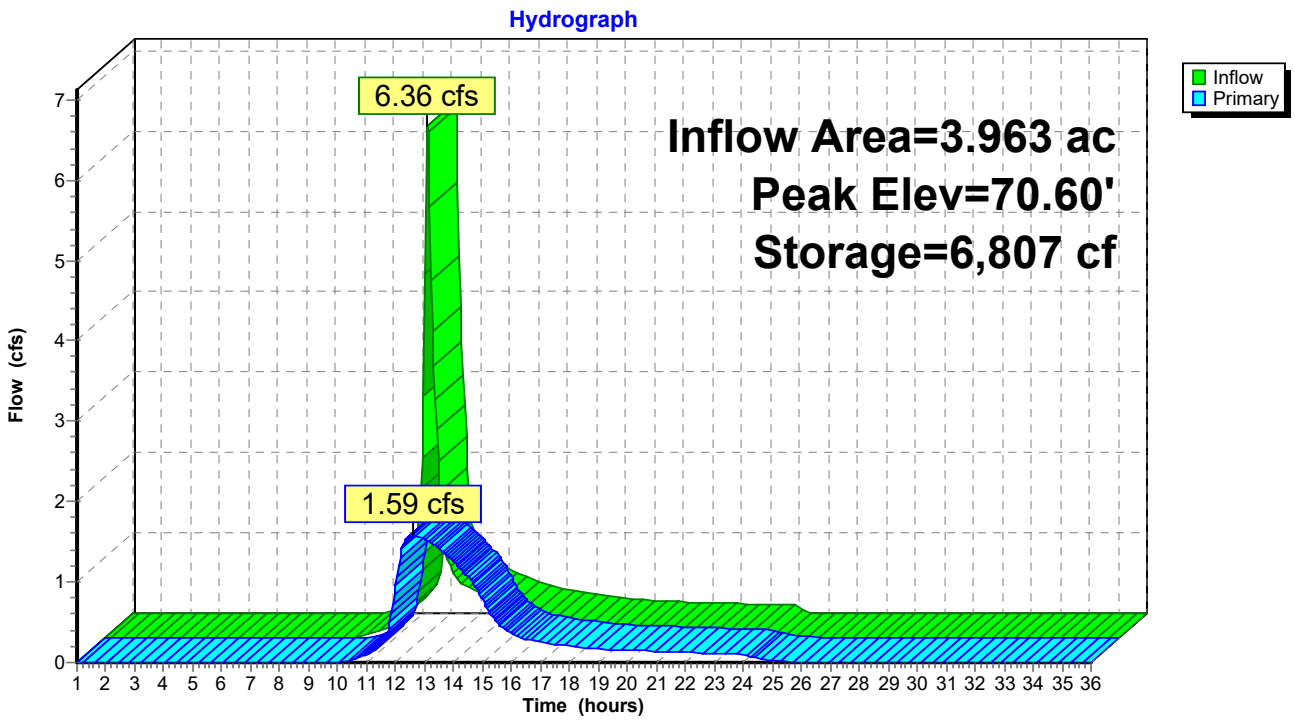
Volume	Invert	Avail.Storage	Storage Description
#1	69.00'	58,912 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
69.00	1,009	191.5	0	0	1,009
70.00	4,826	397.8	2,681	2,681	10,688
71.00	12,978	663.6	8,573	11,253	33,145
72.00	23,823	909.9	18,128	29,381	63,995
73.00	35,633	1,063.0	29,531	58,912	88,052

Device	Routing	Invert	Outlet Devices
#1	Primary	72.50'	**20.0' long x 8.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74
#2	Primary	69.00'	**8.0" Round Culvert** L= 41.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 69.00' / 68.67' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=1.59 cfs @ 12.59 hrs HW=70.60' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└─**2=Culvert** (Barrel Controls 1.59 cfs @ 4.56 fps)

Pond 2P: 2P


Hydrograph
6.36 cfs
1.59 cfs
Inflow Area=3.963 ac
Peak Elev=70.60'
Storage=6,807 cf
Inflow
Primary
Flow (cfs)
Time (hours)

Summary for Pond 3P: 3P

Inflow Area = 4.098 ac, 0.00% Impervious, Inflow Depth = 1.71" for 2-yr event
Inflow = 5.66 cfs @ 12.26 hrs, Volume= 0.6 af
Outflow = 5.32 cfs @ 12.33 hrs, Volume= 0.6 af, Atten= 6%, Lag= 4.0 min
Primary = 5.32 cfs @ 12.33 hrs, Volume= 0.6 af

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 73.72' @ 12.33 hrs Surf.Area= 2,166 sf Storage= 1,354 cf

Plug-Flow detention time= 3.8 min calculated for 0.6 af (100% of inflow)
Center-of-Mass det. time= 3.8 min (854.1 - 850.3)

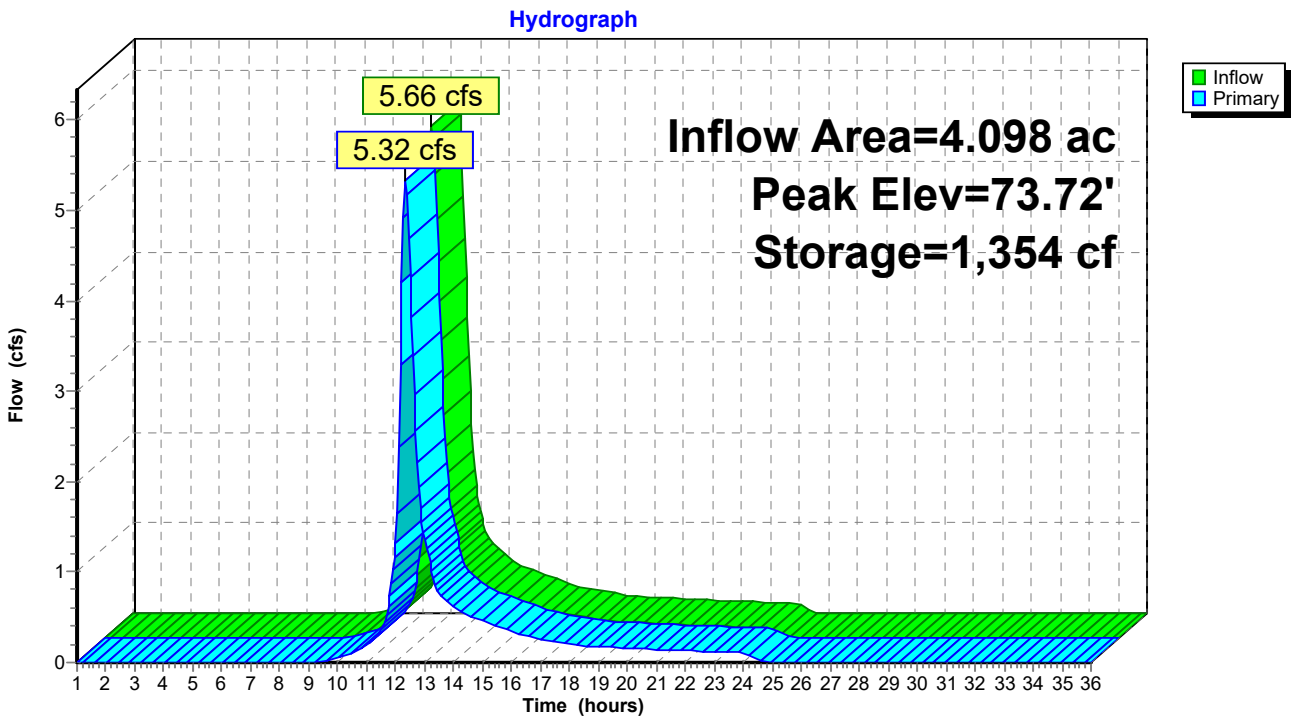
Volume	Invert	Avail.Storage	Storage Description
#1	72.00'	17,415 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
72.00	167	153.1	0	0	167
73.00	660	176.0	386	386	789
74.00	2,979	333.6	1,680	2,067	7,185
75.00	9,151	469.4	5,784	7,850	15,872
76.00	9,984	563.0	9,564	17,415	23,579

Device	Routing	Invert	Outlet Devices
#1	Primary	75.50'	**20.0' long x 20.0' breadth Broad-Crested Rectangular Weir** 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
#2	Primary	72.00'	**6.0" Round Culvert X 2.00** L= 45.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 72.00' / 71.55' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#3	Primary	73.00'	**14.0" Round Culvert X 2.00** L= 45.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 73.00' / 72.55' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.07 sf

Primary OutFlow Max=5.29 cfs @ 12.33 hrs HW=73.72' (Free Discharge)
- **1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
- **2=Culvert** (Barrel Controls 1.77 cfs @ 4.52 fps)
- **3=Culvert** (Inlet Controls 3.52 cfs @ 2.55 fps)

Pond 3P: 3P


Hydrograph
5.66 cfs
5.32 cfs
Inflow Area=4.098 ac
Peak Elev=73.72'
Storage=1,354 cf
Inflow
Primary
Flow (cfs)
Time (hours)

Summary for Pond RRP: Western Swale/Railroad Tracks w/ Culvert

Inflow Area = 17.782 ac, 0.62% Impervious, Inflow Depth = 0.97" for 2-yr event
Inflow = 7.35 cfs @ 12.57 hrs, Volume= 1.4 af
Outflow = 7.03 cfs @ 12.68 hrs, Volume= 1.4 af, Atten= 4%, Lag= 6.8 min
Primary = 7.03 cfs @ 12.68 hrs, Volume= 1.4 af

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 58.75' @ 12.68 hrs Surf.Area= 8,140 sf Storage= 5,593 cf

Plug-Flow detention time= 14.4 min calculated for 1.4 af (100% of inflow)
Center-of-Mass det. time= 14.3 min (920.0 - 905.7)

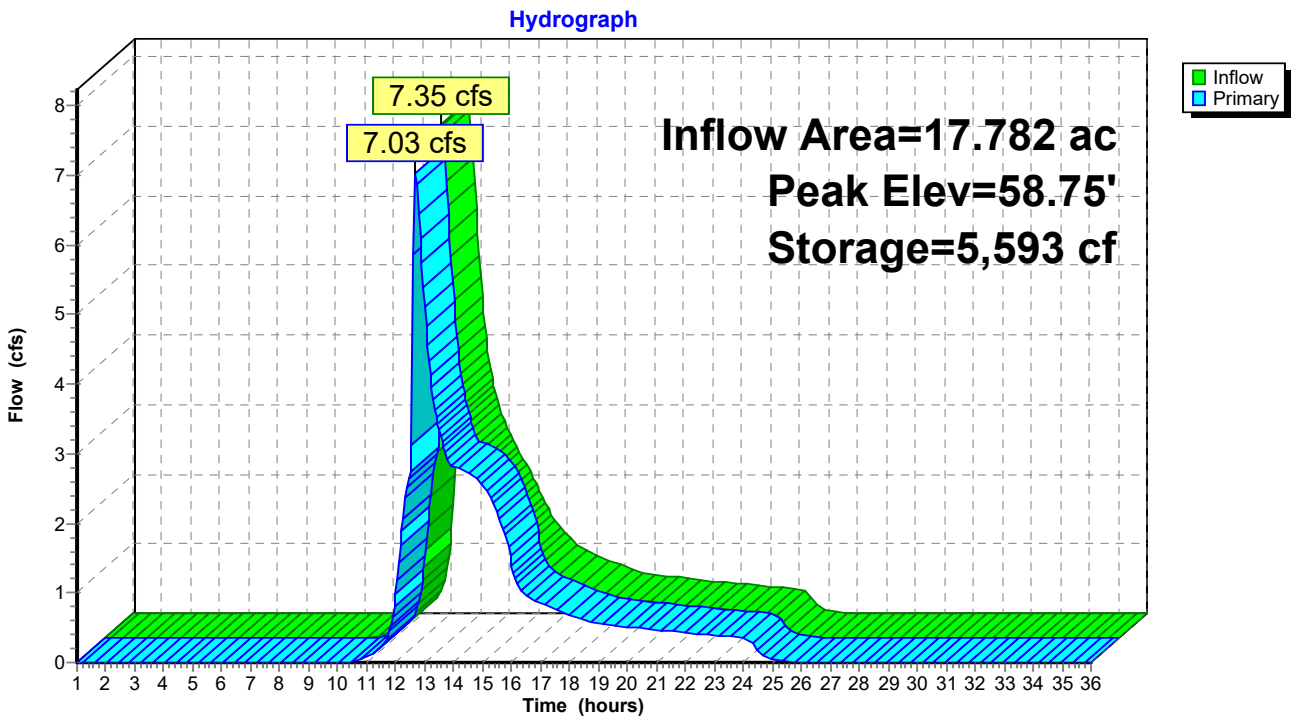
Volume	Invert	Avail.Storage	Storage Description
#1	56.00'	22,365 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
56.00	13	26.5	0	0	13
57.00	505	195.7	200	200	3,007
58.00	2,779	348.1	1,490	1,689	9,607
59.00	10,591	884.0	6,265	7,954	62,155
60.00	18,605	1,253.7	14,411	22,365	125,054

Device	Routing	Invert	Outlet Devices
#1	Primary	56.26'	**12.0" Round CMP_Round 12"** L= 60.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 56.26' / 55.86' S= 0.0067 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#2	Primary	58.65'	**50.0' long x 35.0' breadth Broad-Crested Rectangular Weir** 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=6.93 cfs @ 12.68 hrs HW=58.75' (Free Discharge)
└─**1=CMP_Round 12"** (Barrel Controls 2.91 cfs @ 3.70 fps)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 4.03 cfs @ 0.83 fps)

Pond RRP: Western Swale/Railroad Tracks w/ Culvert



Time span=1.00-36.00 hrs, dt=0.05 hrs, 701 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: 1S Runoff Area=386,365 sf 0.00% Impervious Runoff Depth=2.72"
Flow Length=468' Tc=32.0 min CN=74 Runoff=15.44 cfs 2.0 af

Subcatchment 1Sa: 1Sa Runoff Area=332,772 sf 1.93% Impervious Runoff Depth=3.28"
Flow Length=251' Tc=7.8 min CN=80 Runoff=27.23 cfs 2.1 af

Subcatchment 1Sb: 1Sb Runoff Area=178,528 sf 0.00% Impervious Runoff Depth=3.18"
Flow Length=221' Tc=18.4 min CN=79 Runoff=10.64 cfs 1.1 af

Subcatchment 2S: 2S Runoff Area=601,941 sf 0.80% Impervious Runoff Depth=1.87"
Flow Length=898' Tc=34.8 min CN=64 Runoff=15.30 cfs 2.2 af

Subcatchment 2Sa: 2Sa Runoff Area=172,643 sf 0.00% Impervious Runoff Depth=3.00"
Flow Length=283' Tc=8.9 min CN=77 Runoff=12.35 cfs 1.0 af

Reach DP1: Eastern Wetland Inflow=27.64 cfs 5.2 af
Outflow=27.64 cfs 5.2 af

Pond 1P: 1P Peak Elev=75.40' Storage=38,750 cf Inflow=27.23 cfs 2.1 af
Outflow=3.26 cfs 2.1 af

Pond 2P: 2P Peak Elev=71.32' Storage=15,854 cf Inflow=12.35 cfs 1.0 af
Outflow=1.99 cfs 1.0 af

Pond 3P: 3P Peak Elev=74.23' Storage=2,858 cf Inflow=10.64 cfs 1.1 af
Outflow=9.30 cfs 1.1 af

Pond RRP: Western Swale/Railroad Tracks w/ Peak Elev=58.87' Storage=6,696 cf Inflow=17.28 cfs 3.1 af
Outflow=17.21 cfs 3.1 af

Total Runoff Area = 38.390 ac Runoff Volume = 8.3 af Average Runoff Depth = 2.60"
99.33% Pervious = 38.132 ac 0.67% Impervious = 0.258 ac

Summary for Subcatchment 1S: 1S

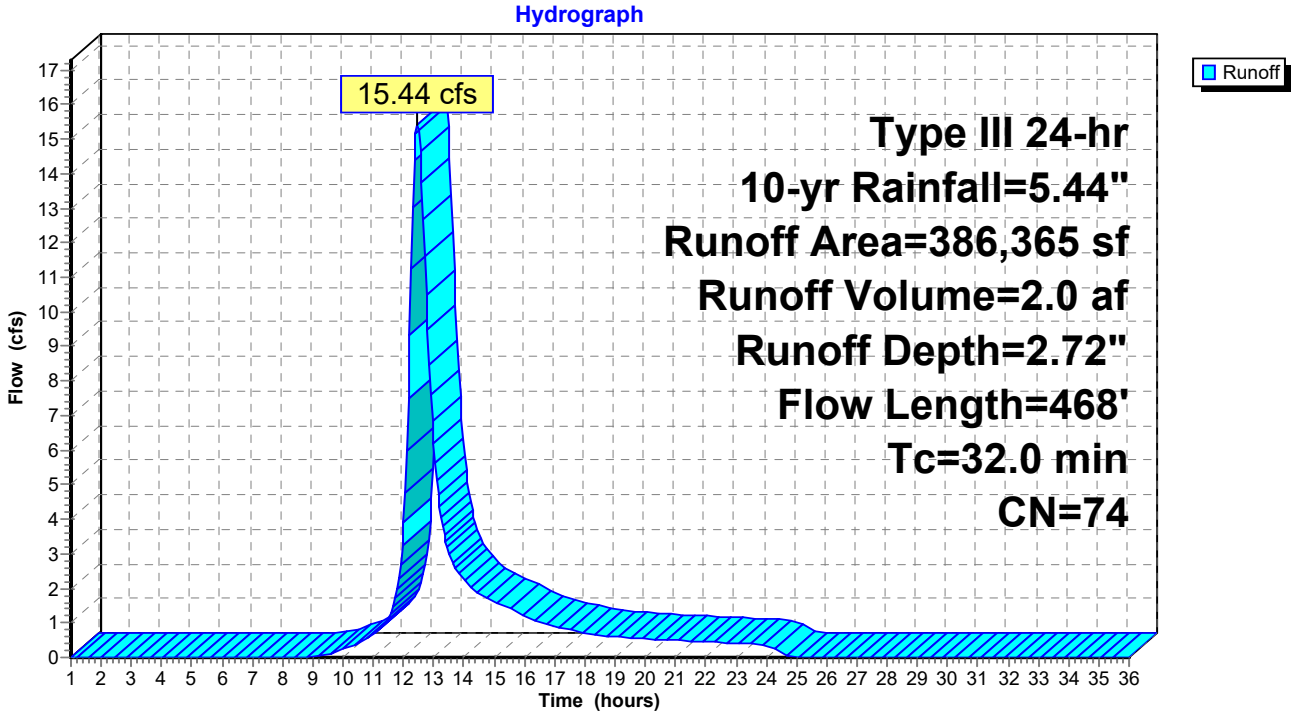
Runoff = 15.44 cfs @ 12.45 hrs, Volume= 2.0 af, Depth= 2.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=5.44"

Area (sf)	CN	Description
41,299	55	Woods, Good, HSG B
121,227	70	Woods, Good, HSG C
96,253	77	Woods, Good, HSG D
42,050	79	50-75% Grass cover, Fair, HSG C
44,337	79	50-75% Grass cover, Fair, HSG C
41,199	84	50-75% Grass cover, Fair, HSG D
386,365	74	Weighted Average
386,365		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.7	50	0.0100	0.03		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.60"
5.3	418	0.0681	1.30		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
32.0	468	Total			

Subcatchment 1S: 1S



Summary for Subcatchment 1Sa: 1Sa

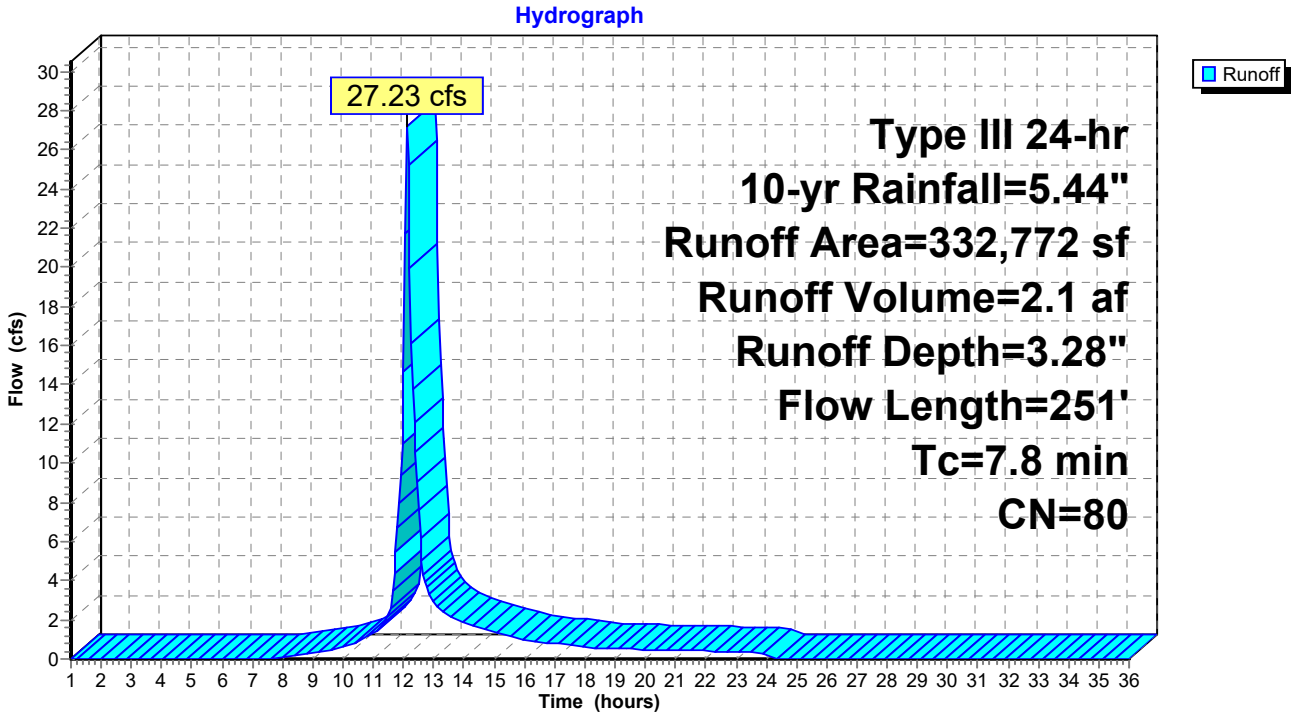
Runoff = 27.23 cfs @ 12.11 hrs, Volume= 2.1 af, Depth= 3.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=5.44"

	Area (sf)	CN	Description
*	6,408	98	Unconnected pavement, HSG C - EQ PADS
	5,146	96	Gravel surface, HSG C
	252,473	79	50-75% Grass cover, Fair, HSG C
	59,360	79	50-75% Grass cover, Fair, HSG C
	9,385	84	50-75% Grass cover, Fair, HSG D
	332,772	80	Weighted Average
	326,364		98.07% Pervious Area
	6,408		1.93% Impervious Area
	6,408		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0100	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.8	201	0.0640	4.07		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
7.8	251	Total			

Subcatchment 1Sa: 1Sa



Summary for Subcatchment 1Sb: 1Sb

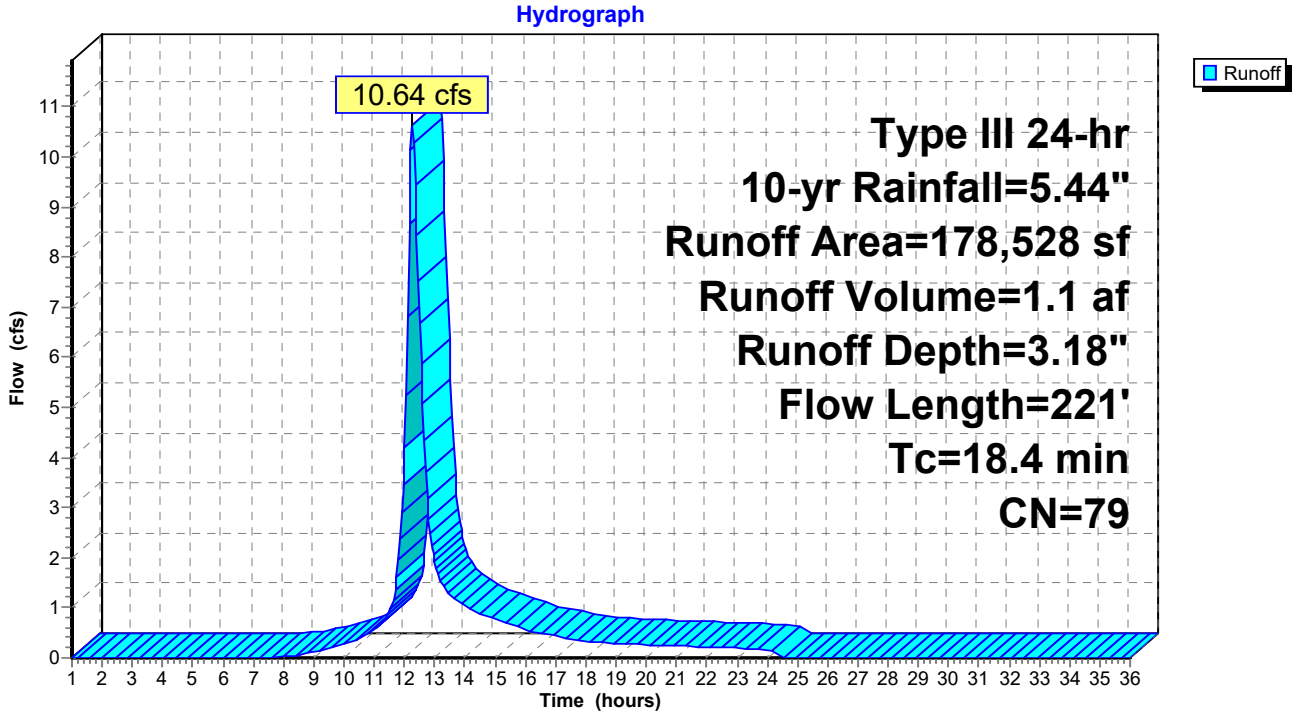
Runoff = 10.64 cfs @ 12.25 hrs, Volume= 1.1 af, Depth= 3.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=5.44"

Area (sf)	CN	Description
4,422	96	Gravel surface, HSG C
157,889	79	50-75% Grass cover, Fair, HSG C
16,217	79	50-75% Grass cover, Fair, HSG C
178,528	79	Weighted Average
178,528		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.6	50	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.8	171	0.0450	3.42		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
18.4	221	Total			

Subcatchment 1Sb: 1Sb



Summary for Subcatchment 2S: 2S

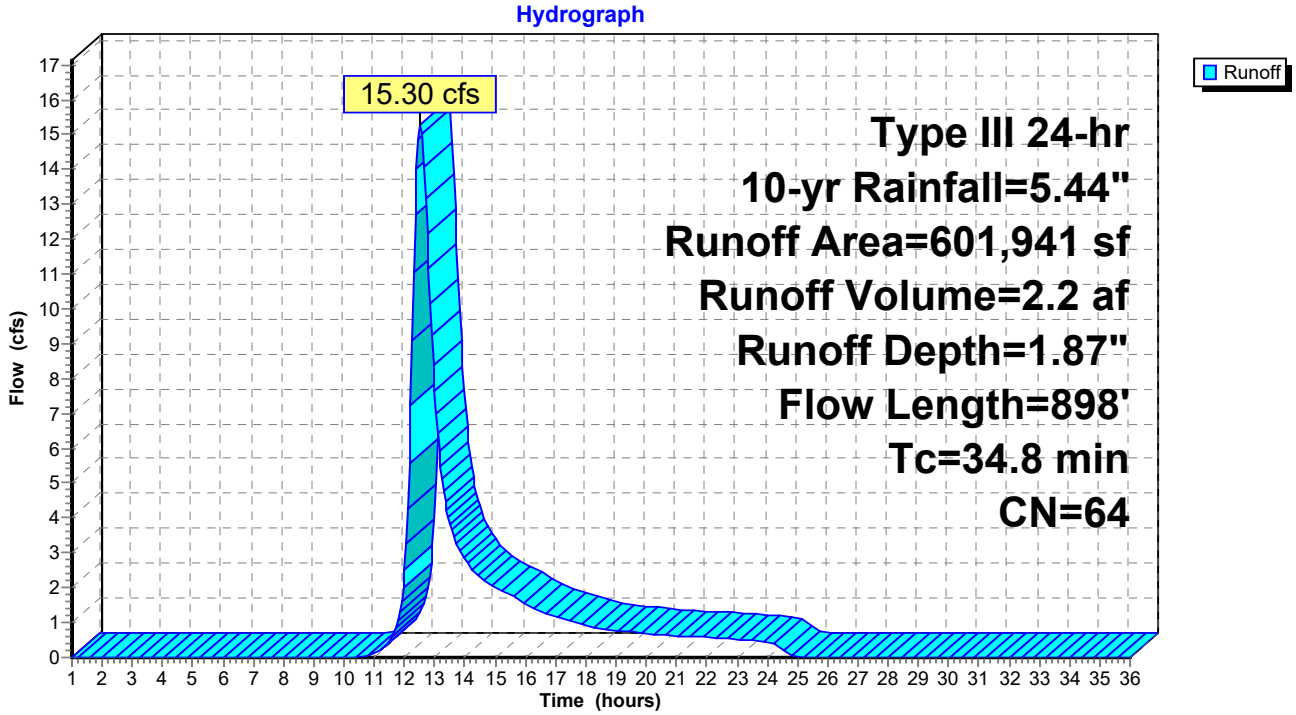
Runoff = 15.30 cfs @ 12.52 hrs, Volume= 2.2 af, Depth= 1.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=5.44"

Area (sf)	CN	Description
8,087	96	Gravel surface, HSG C
22,963	79	50-75% Grass cover, Fair, HSG C
285,668	55	Woods, Good, HSG B
225,635	70	Woods, Good, HSG C
15,496	69	50-75% Grass cover, Fair, HSG B
39,276	79	50-75% Grass cover, Fair, HSG C
4,816	98	Paved parking, HSG B
601,941	64	Weighted Average
597,125		99.20% Pervious Area
4,816		0.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.2	50	0.0080	0.03		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.60"
5.6	848	0.0250	2.55		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
34.8	898	Total			

Subcatchment 2S: 2S



Summary for Subcatchment 2Sa: 2Sa

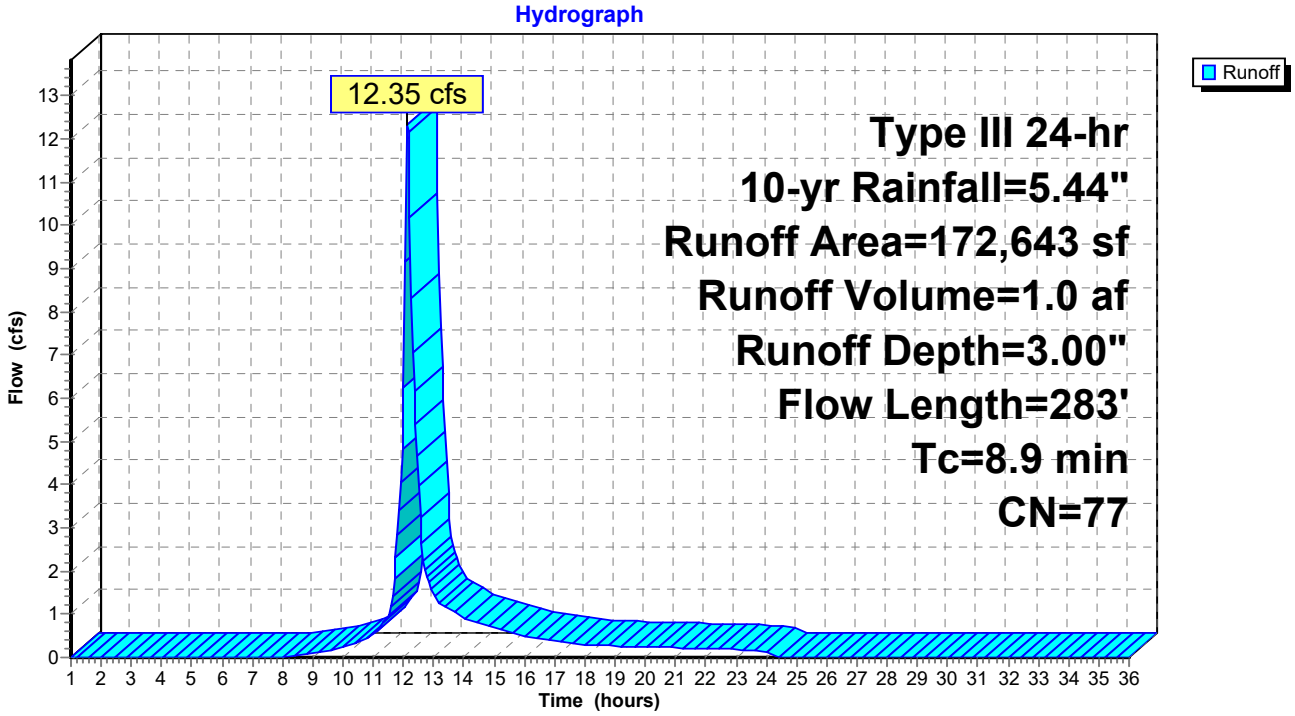
Runoff = 12.35 cfs @ 12.13 hrs, Volume= 1.0 af, Depth= 3.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=5.44"

Area (sf)	CN	Description
1,962	96	Gravel surface, HSG C
42,320	69	50-75% Grass cover, Fair, HSG B
98,678	79	50-75% Grass cover, Fair, HSG C
29,683	79	50-75% Grass cover, Fair, HSG C
172,643	77	Weighted Average
172,643		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	50	0.0072	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.7	184	0.0850	4.69		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	49	0.0612	3.71		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
8.9	283	Total			

Subcatchment 2Sa: 2Sa

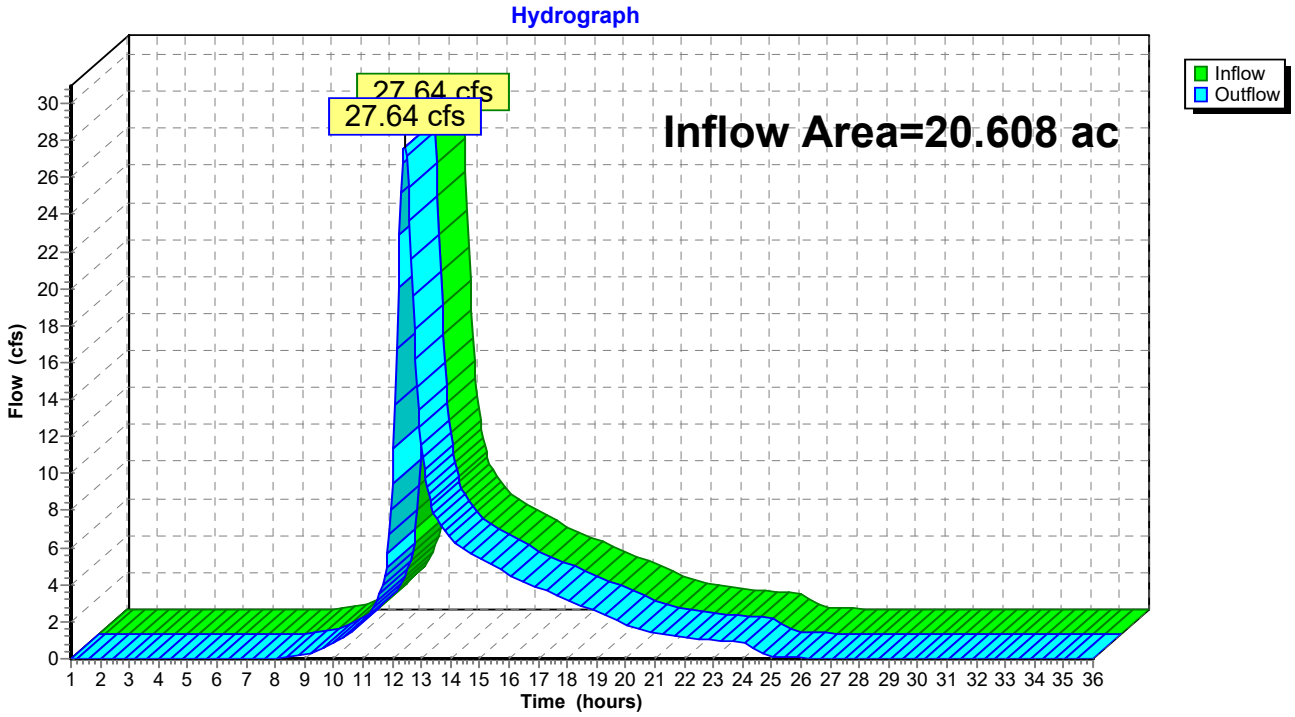


Summary for Reach DP1: Eastern Wetland

Inflow Area = 20.608 ac, 0.71% Impervious, Inflow Depth = 3.02" for 10-yr event
Inflow = 27.64 cfs @ 12.42 hrs, Volume= 5.2 af
Outflow = 27.64 cfs @ 12.42 hrs, Volume= 5.2 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs

Reach DP1: Eastern Wetland



Summary for Pond 1P: 1P

Inflow Area = 7.639 ac, 1.93% Impervious, Inflow Depth = 3.28" for 10-yr event
Inflow = 27.23 cfs @ 12.11 hrs, Volume= 2.1 af
Outflow = 3.26 cfs @ 12.89 hrs, Volume= 2.1 af, Atten= 88%, Lag= 46.6 min
Primary = 3.26 cfs @ 12.89 hrs, Volume= 2.1 af

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 75.40' @ 12.89 hrs Surf.Area= 32,167 sf Storage= 38,750 cf

Plug-Flow detention time= 129.3 min calculated for 2.1 af (100% of inflow)
Center-of-Mass det. time= 129.4 min (949.3 - 819.9)

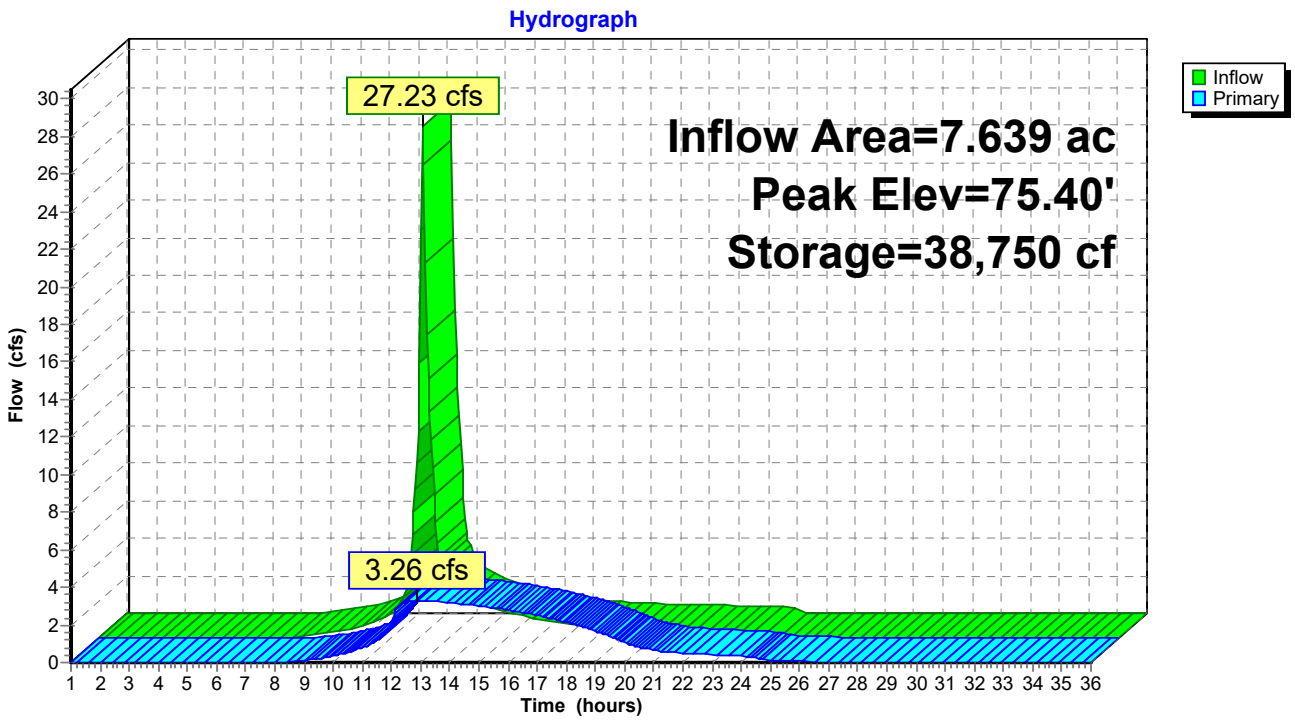
Volume	Invert	Avail.Storage	Storage Description
#1	73.00'	140,073 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
73.00	2,895	876.8	0	0	2,895
74.00	13,416	1,517.5	7,514	7,514	124,975
75.00	26,522	1,740.9	19,600	27,115	182,924
76.00	41,778	1,899.3	33,862	60,977	228,845
77.00	58,419	2,081.5	49,867	110,844	286,597
77.50	58,500	2,100.0	29,230	140,073	292,842

Device	Routing	Invert	Outlet Devices
#1	Primary	77.00'	**20.0' long x 20.0' breadth Broad-Crested Rectangular Weir** 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
#2	Primary	73.00'	**10.0" Round Culvert** L= 45.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 73.00' / 72.55' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.55 sf

Primary OutFlow Max=3.26 cfs @ 12.89 hrs HW=75.40' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└─**2=Culvert** (Inlet Controls 3.26 cfs @ 5.98 fps)

Pond 1P: 1P


Hydrograph
27.23 cfs
3.26 cfs
Inflow Area=7.639 ac
Peak Elev=75.40'
Storage=38,750 cf
Inflow
Primary
Flow (cfs)
Time (hours)

Summary for Pond 2P: 2P

Inflow Area = 3.963 ac, 0.00% Impervious, Inflow Depth = 3.00" for 10-yr event
Inflow = 12.35 cfs @ 12.13 hrs, Volume= 1.0 af
Outflow = 1.99 cfs @ 12.71 hrs, Volume= 1.0 af, Atten= 84%, Lag= 35.0 min
Primary = 1.99 cfs @ 12.71 hrs, Volume= 1.0 af

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 71.32' @ 12.71 hrs Surf.Area= 16,067 sf Storage= 15,854 cf

Plug-Flow detention time= 77.4 min calculated for 1.0 af (100% of inflow)
Center-of-Mass det. time= 77.2 min (905.7 - 828.6)

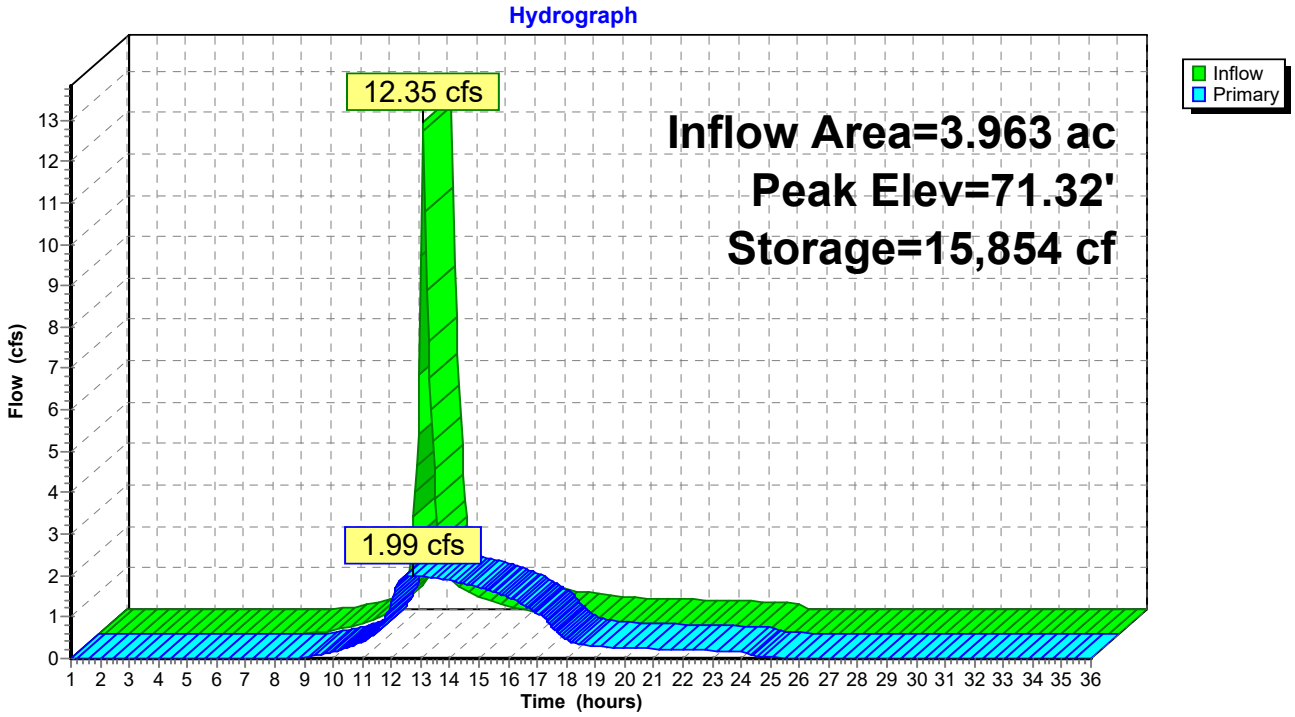
Volume	Invert	Avail.Storage	Storage Description
#1	69.00'	58,912 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
69.00	1,009	191.5	0	0	1,009
70.00	4,826	397.8	2,681	2,681	10,688
71.00	12,978	663.6	8,573	11,253	33,145
72.00	23,823	909.9	18,128	29,381	63,995
73.00	35,633	1,063.0	29,531	58,912	88,052

Device	Routing	Invert	Outlet Devices
#1	Primary	72.50'	**20.0' long x 8.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74
#2	Primary	69.00'	**8.0" Round Culvert** L= 41.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 69.00' / 68.67' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=1.99 cfs @ 12.71 hrs HW=71.32' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└─**2=Culvert** (Barrel Controls 1.99 cfs @ 5.71 fps)

Pond 2P: 2P


Hydrograph
12.35 cfs
1.99 cfs
Inflow Area=3.963 ac
Peak Elev=71.32'
Storage=15,854 cf
Inflow
Primary
Flow (cfs)
Time (hours)

Summary for Pond 3P: 3P

Inflow Area = 4.098 ac, 0.00% Impervious, Inflow Depth = 3.18" for 10-yr event
Inflow = 10.64 cfs @ 12.25 hrs, Volume= 1.1 af
Outflow = 9.30 cfs @ 12.36 hrs, Volume= 1.1 af, Atten= 13%, Lag= 6.2 min
Primary = 9.30 cfs @ 12.36 hrs, Volume= 1.1 af

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 74.23' @ 12.36 hrs Surf.Area= 4,075 sf Storage= 2,858 cf

Plug-Flow detention time= 3.9 min calculated for 1.1 af (100% of inflow)
Center-of-Mass det. time= 4.0 min (836.3 - 832.3)

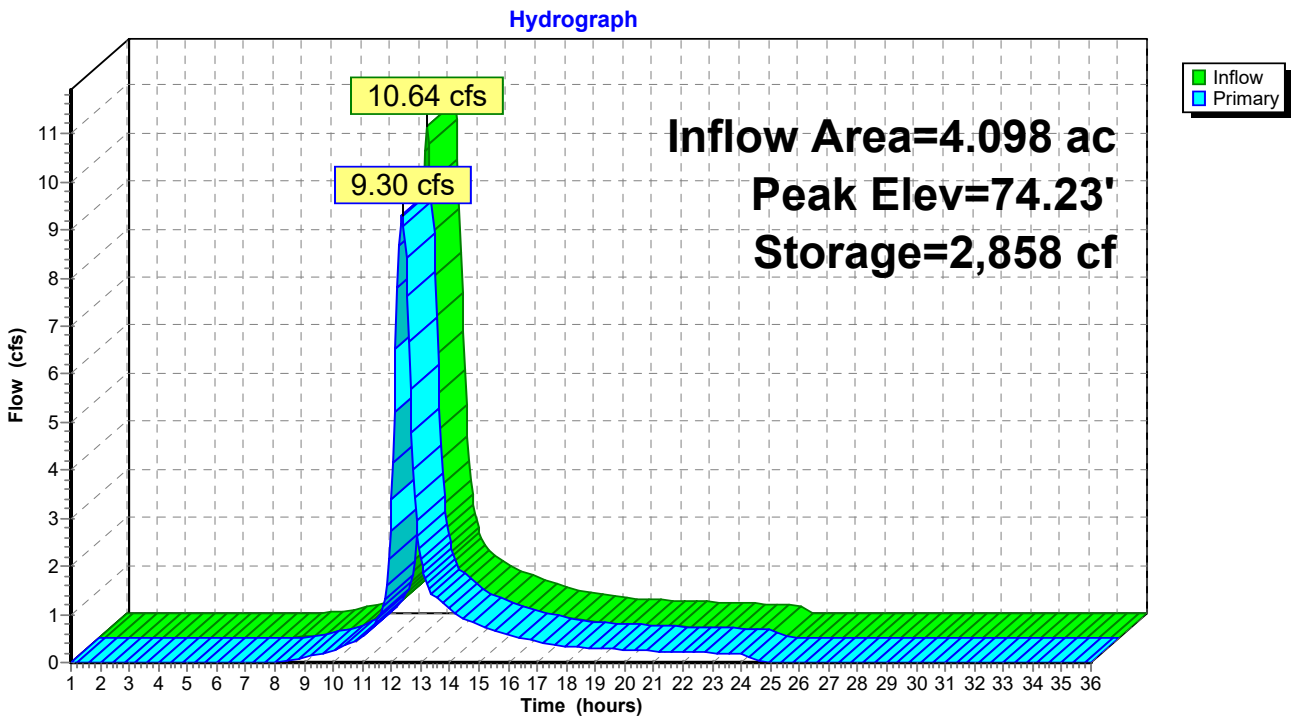
Volume	Invert	Avail.Storage	Storage Description
#1	72.00'	17,415 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
72.00	167	153.1	0	0	167
73.00	660	176.0	386	386	789
74.00	2,979	333.6	1,680	2,067	7,185
75.00	9,151	469.4	5,784	7,850	15,872
76.00	9,984	563.0	9,564	17,415	23,579

Device	Routing	Invert	Outlet Devices
#1	Primary	75.50'	**20.0' long x 20.0' breadth Broad-Crested Rectangular Weir** 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
#2	Primary	72.00'	**6.0" Round Culvert X 2.00** L= 45.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 72.00' / 71.55' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#3	Primary	73.00'	**14.0" Round Culvert X 2.00** L= 45.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 73.00' / 72.55' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.07 sf

Primary OutFlow Max=9.29 cfs @ 12.36 hrs HW=74.22' (Free Discharge)
- **1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
- **2=Culvert** (Barrel Controls 2.03 cfs @ 5.16 fps)
- **3=Culvert** (Inlet Controls 7.26 cfs @ 3.40 fps)

Pond 3P: 3P


Hydrograph
10.64 cfs
9.30 cfs
Inflow Area=4.098 ac
Peak Elev=74.23'
Storage=2,858 cf
Inflow
Primary
Flow (cfs)
Time (hours)

Summary for Pond RRP: Western Swale/Railroad Tracks w/ Culvert

Inflow Area = 17.782 ac, 0.62% Impervious, Inflow Depth = 2.12" for 10-yr event
Inflow = 17.28 cfs @ 12.52 hrs, Volume= 3.1 af
Outflow = 17.21 cfs @ 12.55 hrs, Volume= 3.1 af, Atten= 0%, Lag= 1.8 min
Primary = 17.21 cfs @ 12.55 hrs, Volume= 3.1 af

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 58.87' @ 12.55 hrs Surf.Area= 9,325 sf Storage= 6,696 cf

Plug-Flow detention time= 13.6 min calculated for 3.1 af (100% of inflow)
Center-of-Mass det. time= 13.4 min (904.9 - 891.6)

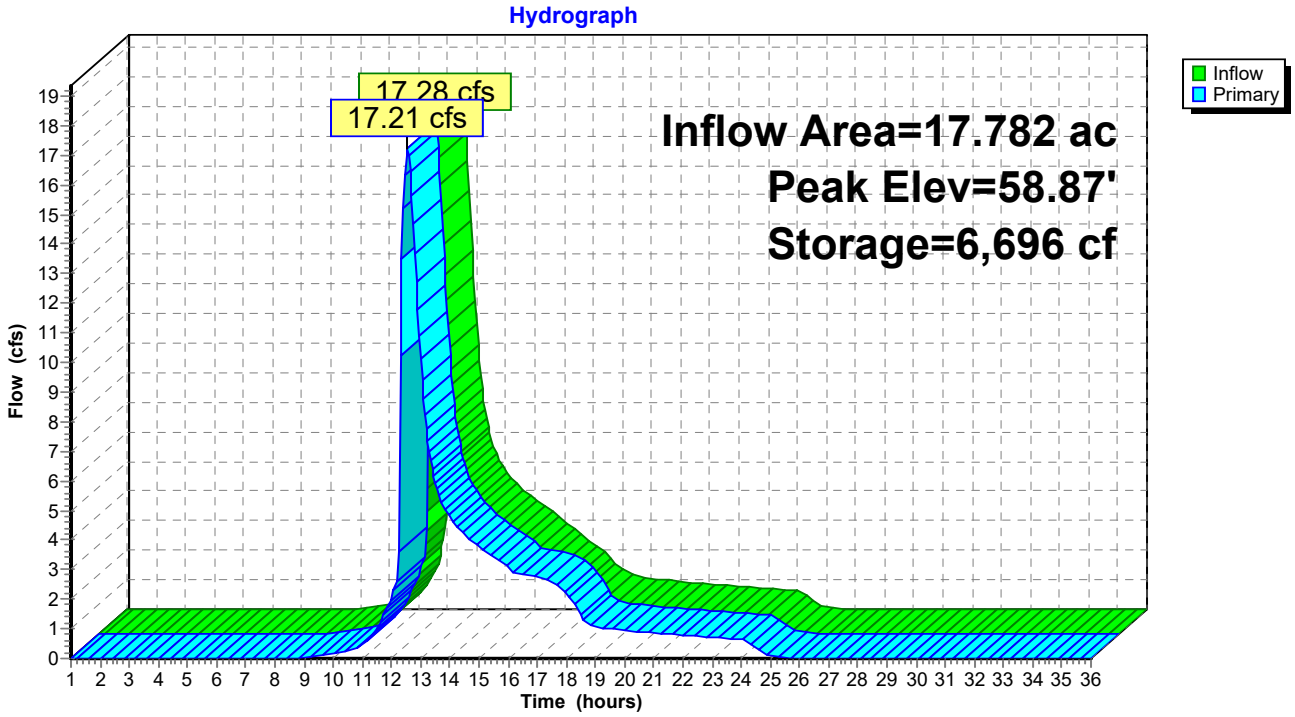
Volume	Invert	Avail.Storage	Storage Description
#1	56.00'	22,365 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
56.00	13	26.5	0	0	13
57.00	505	195.7	200	200	3,007
58.00	2,779	348.1	1,490	1,689	9,607
59.00	10,591	884.0	6,265	7,954	62,155
60.00	18,605	1,253.7	14,411	22,365	125,054

Device	Routing	Invert	Outlet Devices
#1	Primary	56.26'	**12.0" Round CMP_Round 12"** L= 60.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 56.26' / 55.86' S= 0.0067 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#2	Primary	58.65'	**50.0' long x 35.0' breadth Broad-Crested Rectangular Weir** 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=17.18 cfs @ 12.55 hrs HW=58.87' (Free Discharge)
└─**1=CMP_Round 12"** (Barrel Controls 3.00 cfs @ 3.82 fps)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 14.18 cfs @ 1.27 fps)

Pond RRP: Western Swale/Railroad Tracks w/ Culvert



Time span=1.00-36.00 hrs, dt=0.05 hrs, 701 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: 1S Runoff Area=386,365 sf 0.00% Impervious Runoff Depth=3.79"
Flow Length=468' Tc=32.0 min CN=74 Runoff=21.59 cfs 2.8 af

Subcatchment 1Sa: 1Sa Runoff Area=332,772 sf 1.93% Impervious Runoff Depth=4.43"
Flow Length=251' Tc=7.8 min CN=80 Runoff=36.53 cfs 2.8 af

Subcatchment 1Sb: 1Sb Runoff Area=178,528 sf 0.00% Impervious Runoff Depth=4.32"
Flow Length=221' Tc=18.4 min CN=79 Runoff=14.39 cfs 1.5 af

Subcatchment 2S: 2S Runoff Area=601,941 sf 0.80% Impervious Runoff Depth=2.78"
Flow Length=898' Tc=34.8 min CN=64 Runoff=23.33 cfs 3.2 af

Subcatchment 2Sa: 2Sa Runoff Area=172,643 sf 0.00% Impervious Runoff Depth=4.11"
Flow Length=283' Tc=8.9 min CN=77 Runoff=16.89 cfs 1.4 af

Reach DP1: Eastern Wetland Inflow=36.45 cfs 7.1 af
Outflow=36.45 cfs 7.1 af

Pond 1P: 1P Peak Elev=75.87' Storage=55,519 cf Inflow=36.53 cfs 2.8 af
Outflow=3.63 cfs 2.8 af

Pond 2P: 2P Peak Elev=71.74' Storage=23,565 cf Inflow=16.89 cfs 1.4 af
Outflow=2.20 cfs 1.4 af

Pond 3P: 3P Peak Elev=74.61' Storage=4,856 cf Inflow=14.39 cfs 1.5 af
Outflow=11.41 cfs 1.5 af

Pond RRP: Western Swale/Railroad Tracks w/ Peak Elev=58.95' Storage=7,458 cf Inflow=25.50 cfs 4.6 af
Outflow=25.41 cfs 4.6 af

Total Runoff Area = 38.390 ac Runoff Volume = 11.7 af Average Runoff Depth = 3.64"
99.33% Pervious = 38.132 ac 0.67% Impervious = 0.258 ac

Summary for Subcatchment 1S: 1S

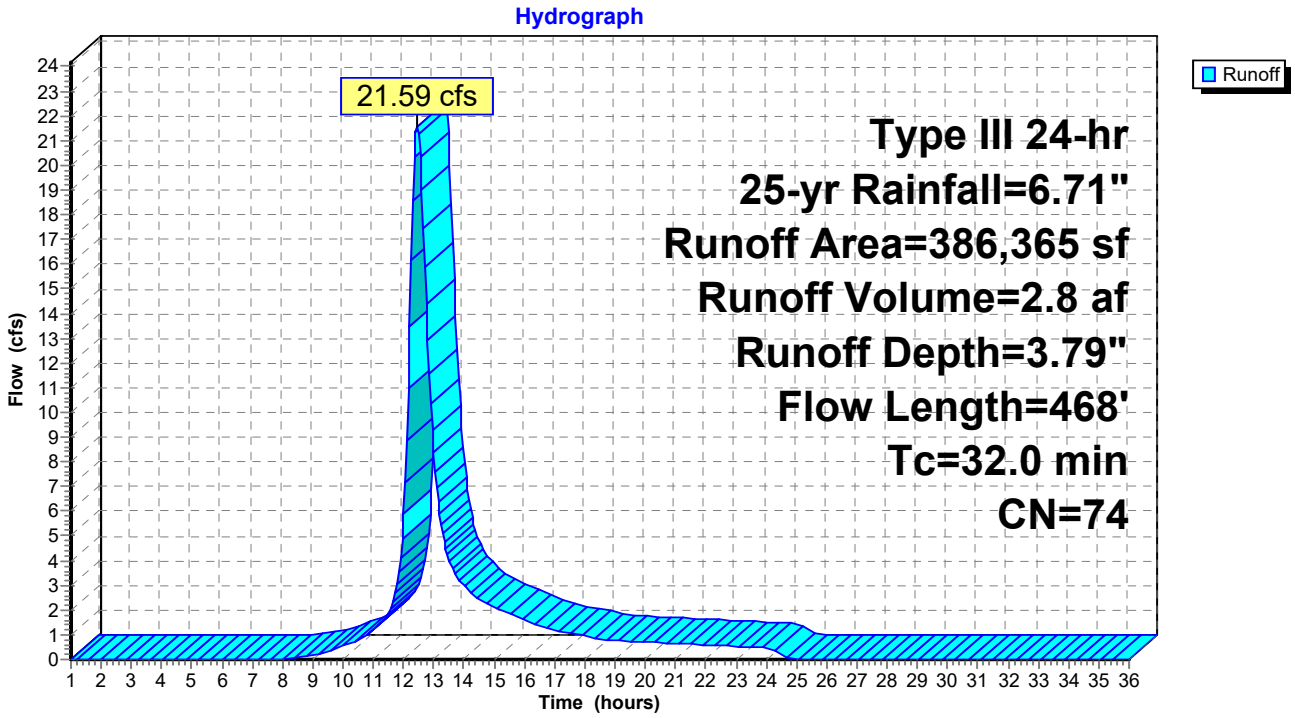
Runoff = 21.59 cfs @ 12.45 hrs, Volume= 2.8 af, Depth= 3.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.71"

Area (sf)	CN	Description
41,299	55	Woods, Good, HSG B
121,227	70	Woods, Good, HSG C
96,253	77	Woods, Good, HSG D
42,050	79	50-75% Grass cover, Fair, HSG C
44,337	79	50-75% Grass cover, Fair, HSG C
41,199	84	50-75% Grass cover, Fair, HSG D
386,365	74	Weighted Average
386,365		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.7	50	0.0100	0.03		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.60"
5.3	418	0.0681	1.30		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
32.0	468	Total			

Subcatchment 1S: 1S



Summary for Subcatchment 1Sa: 1Sa

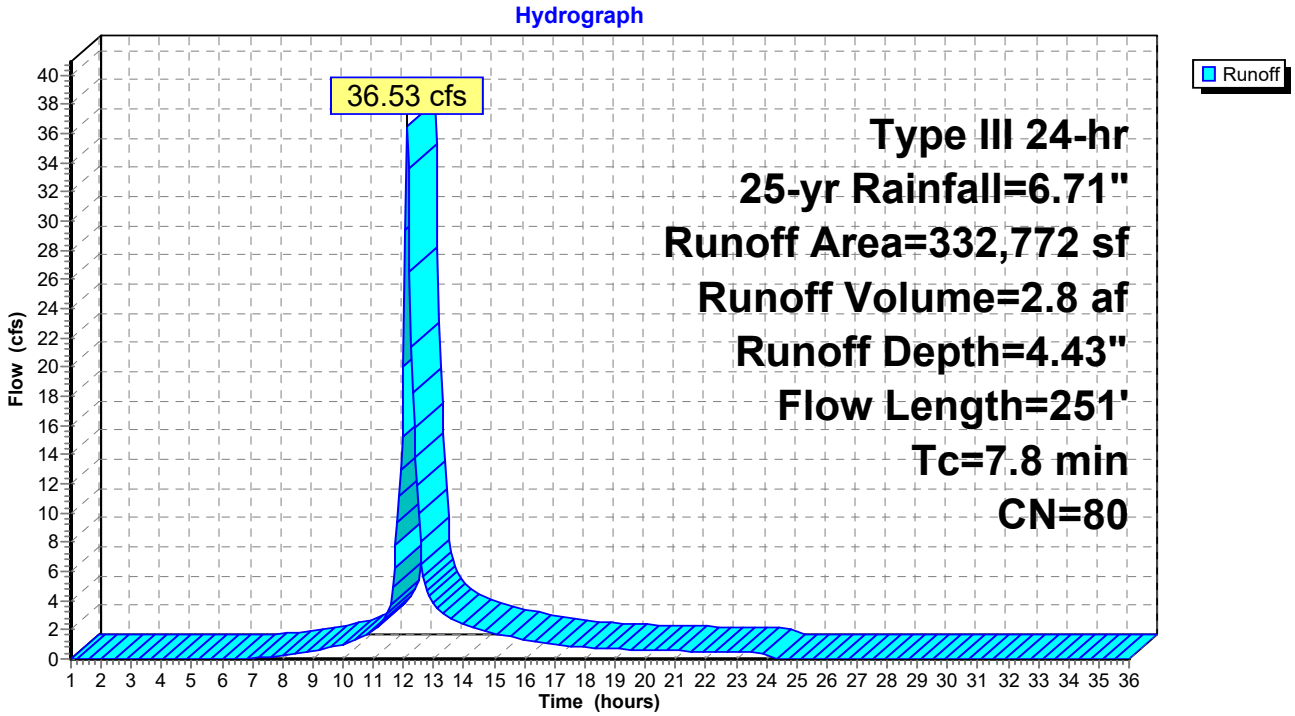
Runoff = 36.53 cfs @ 12.11 hrs, Volume= 2.8 af, Depth= 4.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.71"

	Area (sf)	CN	Description
*	6,408	98	Unconnected pavement, HSG C - EQ PADS
	5,146	96	Gravel surface, HSG C
	252,473	79	50-75% Grass cover, Fair, HSG C
	59,360	79	50-75% Grass cover, Fair, HSG C
	9,385	84	50-75% Grass cover, Fair, HSG D
	332,772	80	Weighted Average
	326,364		98.07% Pervious Area
	6,408		1.93% Impervious Area
	6,408		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0100	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.8	201	0.0640	4.07		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
7.8	251	Total			

Subcatchment 1Sa: 1Sa



Summary for Subcatchment 1Sb: 1Sb

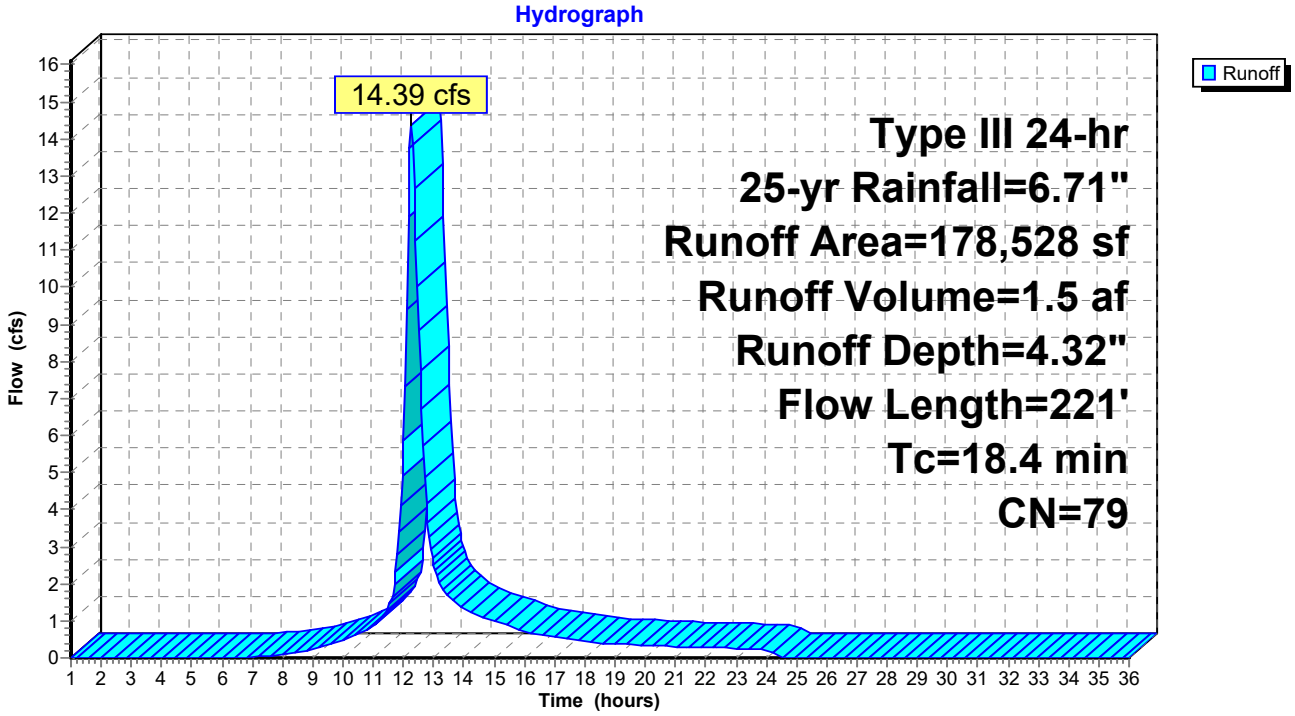
Runoff = 14.39 cfs @ 12.25 hrs, Volume= 1.5 af, Depth= 4.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.71"

Area (sf)	CN	Description
4,422	96	Gravel surface, HSG C
157,889	79	50-75% Grass cover, Fair, HSG C
16,217	79	50-75% Grass cover, Fair, HSG C
178,528	79	Weighted Average
178,528		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.6	50	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.8	171	0.0450	3.42		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
18.4	221	Total			

Subcatchment 1Sb: 1Sb



Summary for Subcatchment 2S: 2S

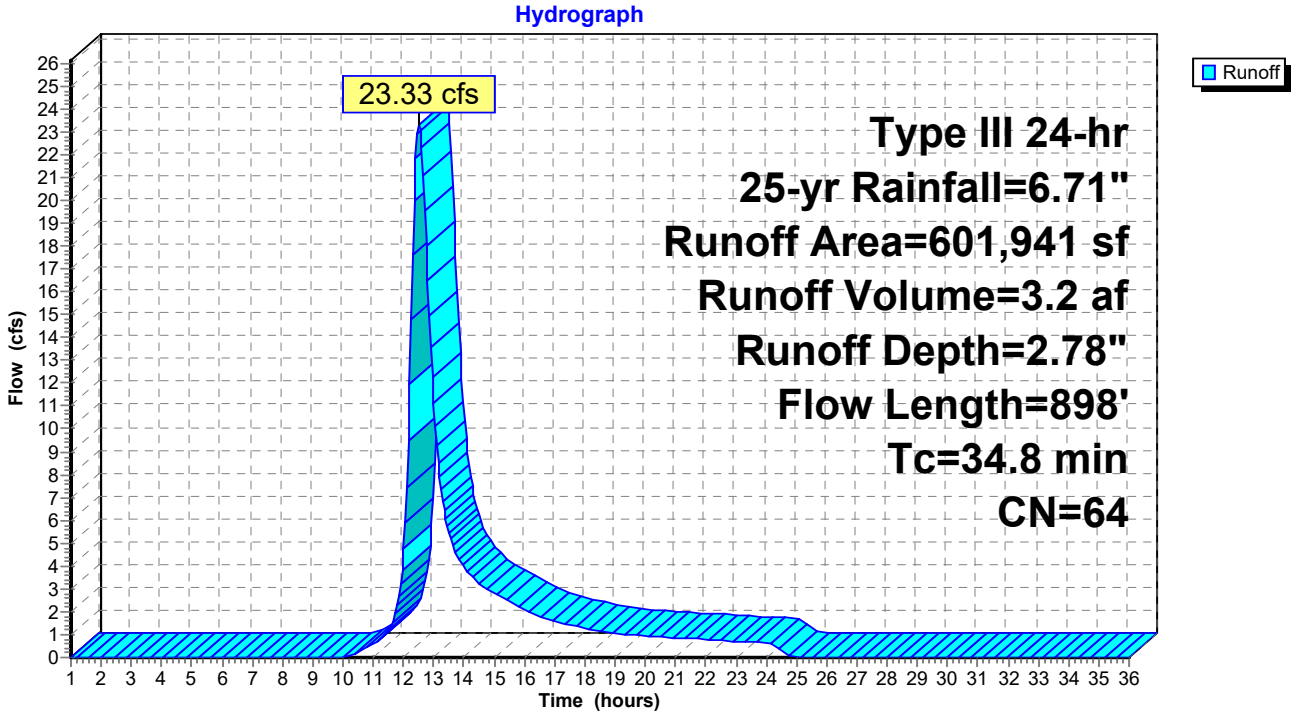
Runoff = 23.33 cfs @ 12.51 hrs, Volume= 3.2 af, Depth= 2.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.71"

Area (sf)	CN	Description
8,087	96	Gravel surface, HSG C
22,963	79	50-75% Grass cover, Fair, HSG C
285,668	55	Woods, Good, HSG B
225,635	70	Woods, Good, HSG C
15,496	69	50-75% Grass cover, Fair, HSG B
39,276	79	50-75% Grass cover, Fair, HSG C
4,816	98	Paved parking, HSG B
601,941	64	Weighted Average
597,125		99.20% Pervious Area
4,816		0.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.2	50	0.0080	0.03		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.60"
5.6	848	0.0250	2.55		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
34.8	898	Total			

Subcatchment 2S: 2S



Summary for Subcatchment 2Sa: 2Sa

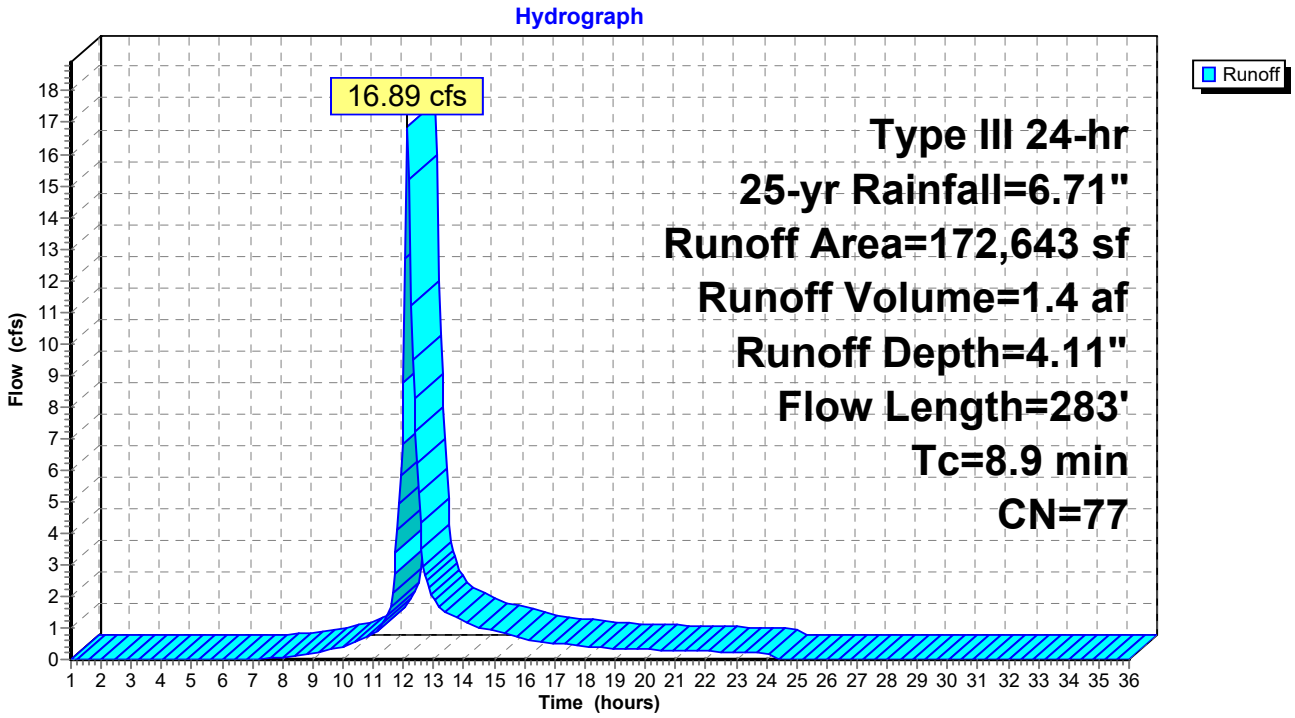
Runoff = 16.89 cfs @ 12.13 hrs, Volume= 1.4 af, Depth= 4.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.71"

Area (sf)	CN	Description
1,962	96	Gravel surface, HSG C
42,320	69	50-75% Grass cover, Fair, HSG B
98,678	79	50-75% Grass cover, Fair, HSG C
29,683	79	50-75% Grass cover, Fair, HSG C
172,643	77	Weighted Average
172,643		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	50	0.0072	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.7	184	0.0850	4.69		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	49	0.0612	3.71		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
8.9	283	Total			

Subcatchment 2Sa: 2Sa

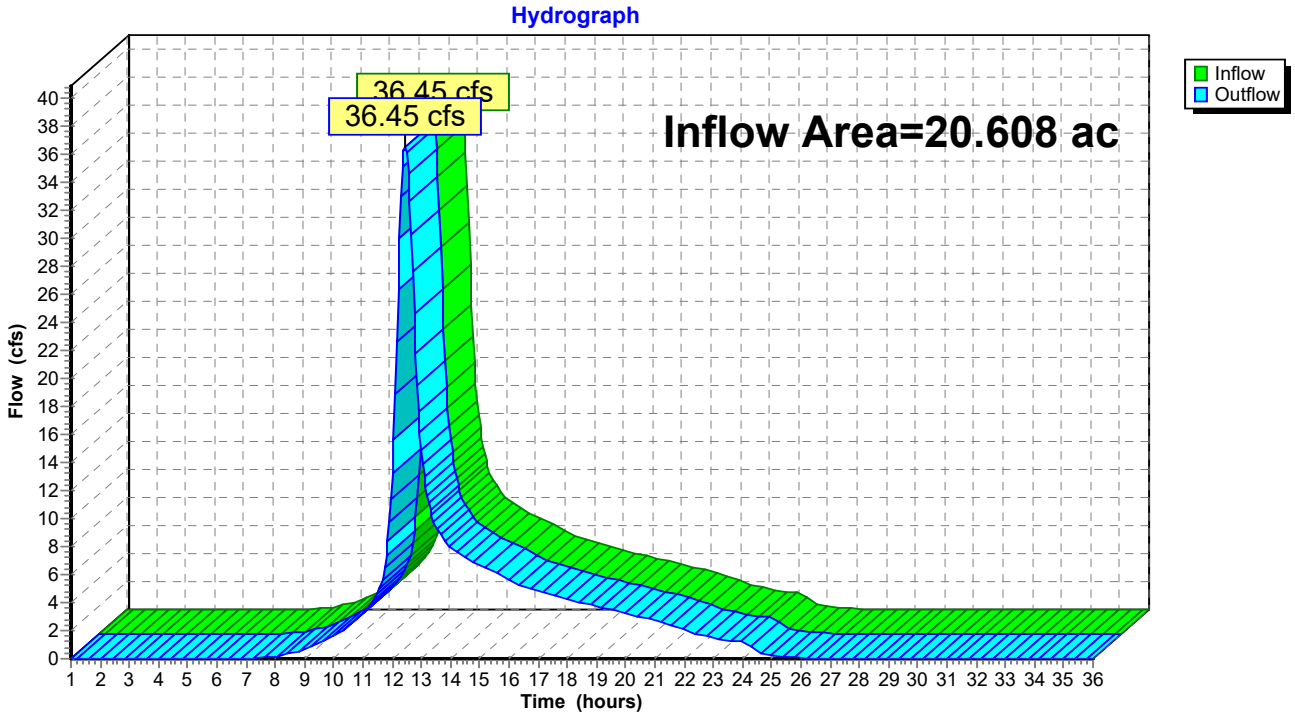


Summary for Reach DP1: Eastern Wetland

Inflow Area = 20.608 ac, 0.71% Impervious, Inflow Depth = 4.13" for 25-yr event
Inflow = 36.45 cfs @ 12.44 hrs, Volume= 7.1 af
Outflow = 36.45 cfs @ 12.44 hrs, Volume= 7.1 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs

Reach DP1: Eastern Wetland



Summary for Pond 1P: 1P

Inflow Area = 7.639 ac, 1.93% Impervious, Inflow Depth = 4.43" for 25-yr event
Inflow = 36.53 cfs @ 12.11 hrs, Volume= 2.8 af
Outflow = 3.63 cfs @ 13.04 hrs, Volume= 2.8 af, Atten= 90%, Lag= 55.8 min
Primary = 3.63 cfs @ 13.04 hrs, Volume= 2.8 af

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 75.87' @ 13.04 hrs Surf.Area= 39,529 sf Storage= 55,519 cf

Plug-Flow detention time= 164.8 min calculated for 2.8 af (100% of inflow)
Center-of-Mass det. time= 164.9 min (976.3 - 811.3)

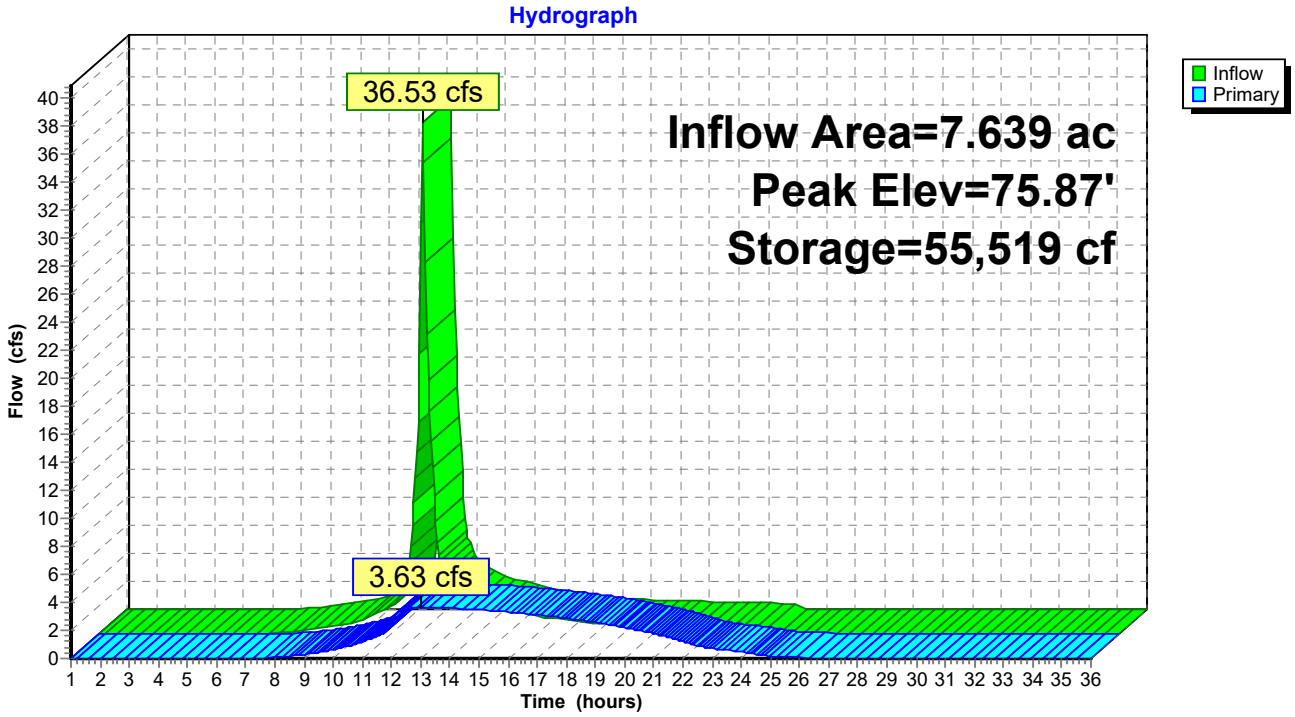
Volume	Invert	Avail.Storage	Storage Description
#1	73.00'	140,073 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
73.00	2,895	876.8	0	0	2,895
74.00	13,416	1,517.5	7,514	7,514	124,975
75.00	26,522	1,740.9	19,600	27,115	182,924
76.00	41,778	1,899.3	33,862	60,977	228,845
77.00	58,419	2,081.5	49,867	110,844	286,597
77.50	58,500	2,100.0	29,230	140,073	292,842

Device	Routing	Invert	Outlet Devices
#1	Primary	77.00'	**20.0' long x 20.0' breadth Broad-Crested Rectangular Weir** 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
#2	Primary	73.00'	**10.0" Round Culvert** L= 45.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 73.00' / 72.55' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.55 sf

Primary OutFlow Max=3.63 cfs @ 13.04 hrs HW=75.87' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└─**2=Culvert** (Inlet Controls 3.63 cfs @ 6.65 fps)

Pond 1P: 1P


Hydrograph
36.53 cfs
3.63 cfs
Inflow Area=7.639 ac
Peak Elev=75.87'
Storage=55,519 cf
Inflow
Primary
Flow (cfs)
Time (hours)

Summary for Pond 2P: 2P

Inflow Area = 3.963 ac, 0.00% Impervious, Inflow Depth = 4.11" for 25-yr event
Inflow = 16.89 cfs @ 12.13 hrs, Volume= 1.4 af
Outflow = 2.20 cfs @ 12.86 hrs, Volume= 1.4 af, Atten= 87%, Lag= 44.2 min
Primary = 2.20 cfs @ 12.86 hrs, Volume= 1.4 af

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 71.74' @ 12.86 hrs Surf.Area= 20,670 sf Storage= 23,565 cf

Plug-Flow detention time= 104.9 min calculated for 1.4 af (100% of inflow)
Center-of-Mass det. time= 104.6 min (924.2 - 819.6)

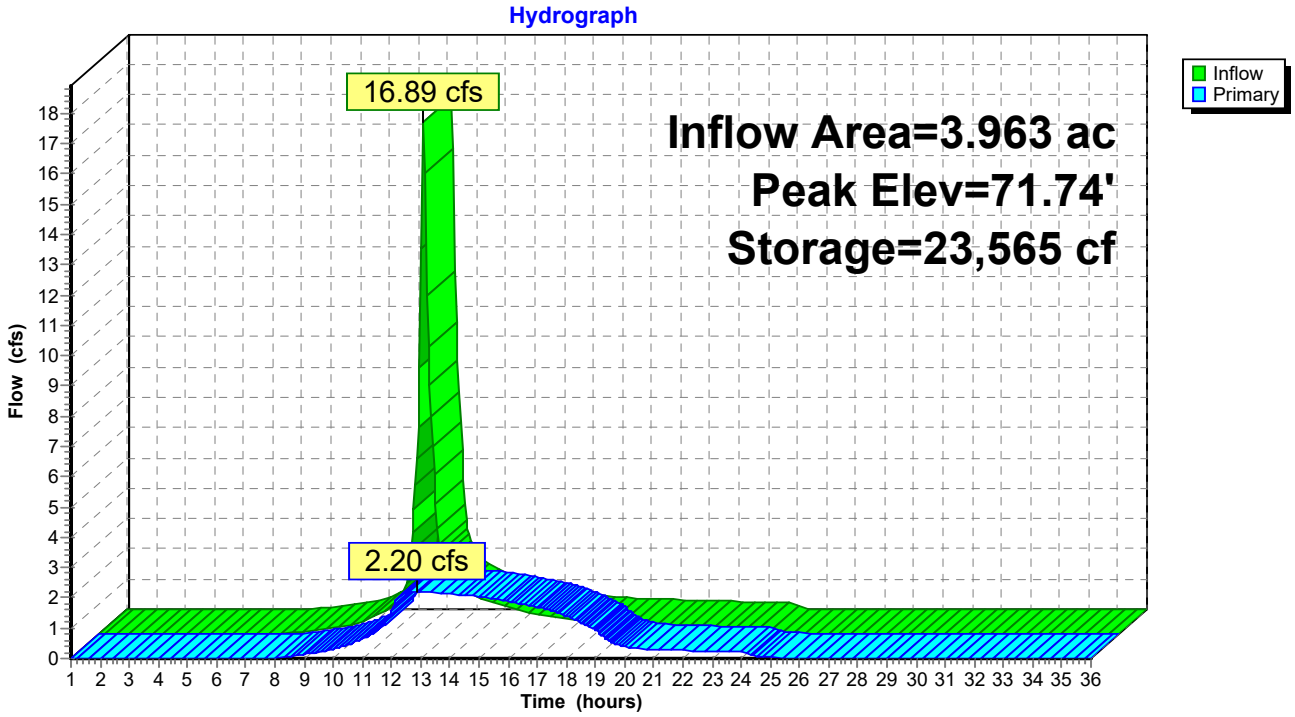
Volume	Invert	Avail.Storage	Storage Description
#1	69.00'	58,912 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
69.00	1,009	191.5	0	0	1,009
70.00	4,826	397.8	2,681	2,681	10,688
71.00	12,978	663.6	8,573	11,253	33,145
72.00	23,823	909.9	18,128	29,381	63,995
73.00	35,633	1,063.0	29,531	58,912	88,052

Device	Routing	Invert	Outlet Devices
#1	Primary	72.50'	**20.0' long x 8.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74
#2	Primary	69.00'	**8.0" Round Culvert** L= 41.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 69.00' / 68.67' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=2.20 cfs @ 12.86 hrs HW=71.74' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└─**2=Culvert** (Barrel Controls 2.20 cfs @ 6.29 fps)

Pond 2P: 2P


Hydrograph
16.89 cfs
2.20 cfs
Inflow Area=3.963 ac
Peak Elev=71.74'
Storage=23,565 cf
Inflow
Primary
Flow (cfs)
Time (hours)

Summary for Pond 3P: 3P

Inflow Area = 4.098 ac, 0.00% Impervious, Inflow Depth = 4.32" for 25-yr event
Inflow = 14.39 cfs @ 12.25 hrs, Volume= 1.5 af
Outflow = 11.41 cfs @ 12.40 hrs, Volume= 1.5 af, Atten= 21%, Lag= 8.7 min
Primary = 11.41 cfs @ 12.40 hrs, Volume= 1.5 af

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 74.61' @ 12.40 hrs Surf.Area= 6,353 sf Storage= 4,856 cf

Plug-Flow detention time= 4.7 min calculated for 1.5 af (100% of inflow)
Center-of-Mass det. time= 4.5 min (828.1 - 823.6)

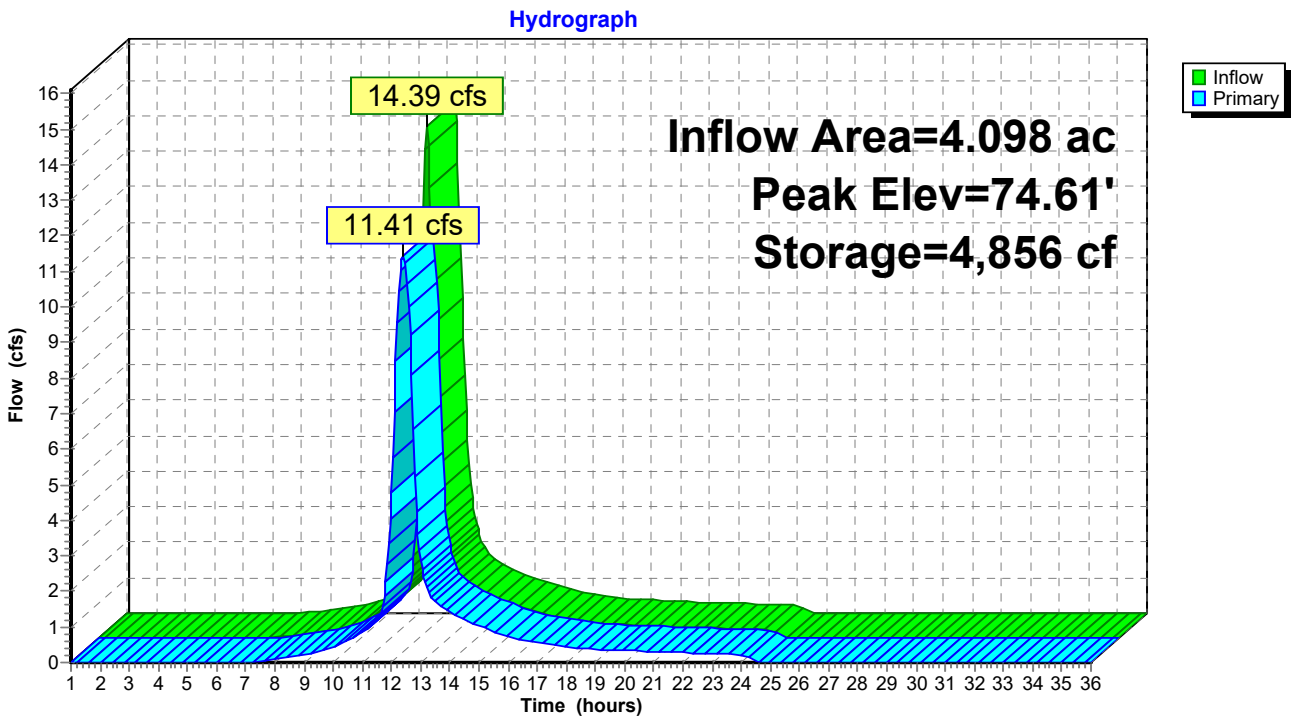
Volume	Invert	Avail.Storage	Storage Description
#1	72.00'	17,415 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
72.00	167	153.1	0	0	167
73.00	660	176.0	386	386	789
74.00	2,979	333.6	1,680	2,067	7,185
75.00	9,151	469.4	5,784	7,850	15,872
76.00	9,984	563.0	9,564	17,415	23,579

Device	Routing	Invert	Outlet Devices
#1	Primary	75.50'	**20.0' long x 20.0' breadth Broad-Crested Rectangular Weir** 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
#2	Primary	72.00'	**6.0" Round Culvert X 2.00** L= 45.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 72.00' / 71.55' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#3	Primary	73.00'	**14.0" Round Culvert X 2.00** L= 45.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 73.00' / 72.55' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.07 sf

Primary OutFlow Max=11.41 cfs @ 12.40 hrs HW=74.61' (Free Discharge)
- **1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
- **2=Culvert** (Barrel Controls 2.20 cfs @ 5.60 fps)
- **3=Culvert** (Inlet Controls 9.21 cfs @ 4.31 fps)

Pond 3P: 3P


Hydrograph
14.39 cfs
11.41 cfs
Inflow Area=4.098 ac
Peak Elev=74.61'
Storage=4,856 cf
Inflow
Primary
Flow (cfs)
Time (hours)

Summary for Pond RRP: Western Swale/Railroad Tracks w/ Culvert

Inflow Area = 17.782 ac, 0.62% Impervious, Inflow Depth = 3.08" for 25-yr event
Inflow = 25.50 cfs @ 12.51 hrs, Volume= 4.6 af
Outflow = 25.41 cfs @ 12.53 hrs, Volume= 4.6 af, Atten= 0%, Lag= 1.6 min
Primary = 25.41 cfs @ 12.53 hrs, Volume= 4.6 af

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 58.95' @ 12.53 hrs Surf.Area= 10,101 sf Storage= 7,458 cf

Plug-Flow detention time= 12.4 min calculated for 4.6 af (100% of inflow)
Center-of-Mass det. time= 12.4 min (900.7 - 888.3)

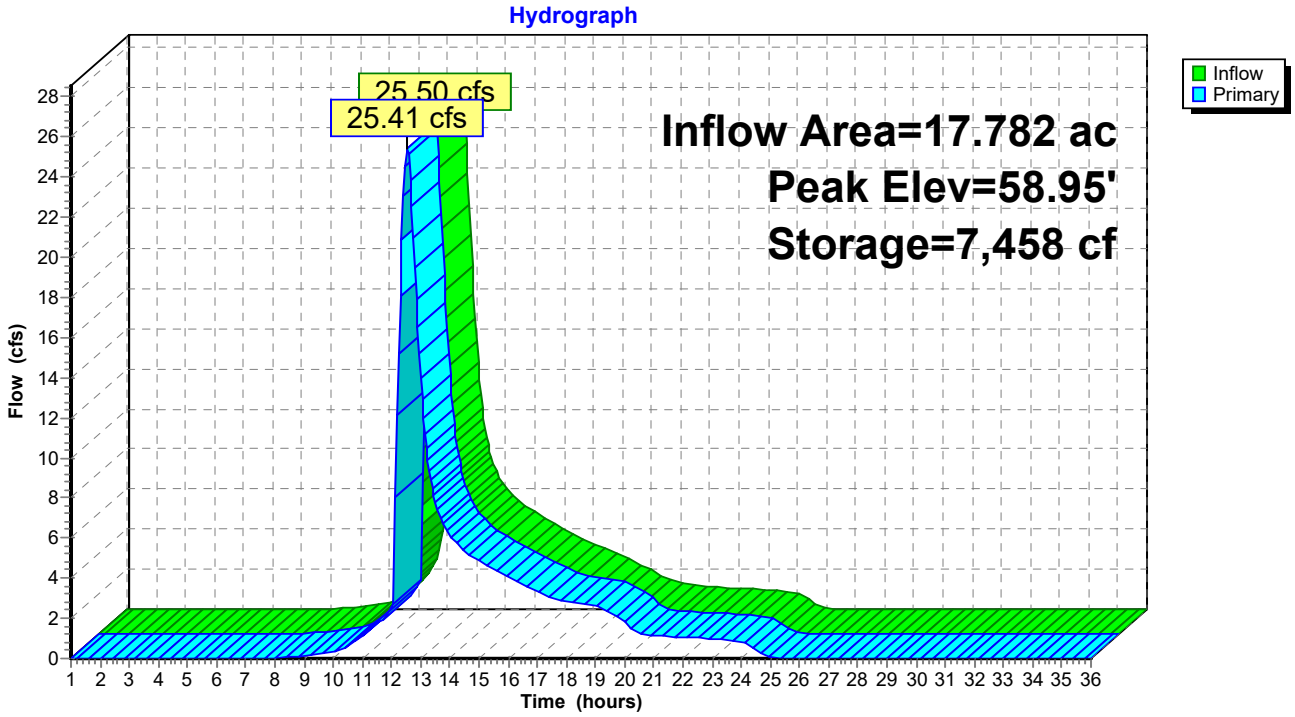
Volume	Invert	Avail.Storage	Storage Description
#1	56.00'	22,365 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
56.00	13	26.5	0	0	13
57.00	505	195.7	200	200	3,007
58.00	2,779	348.1	1,490	1,689	9,607
59.00	10,591	884.0	6,265	7,954	62,155
60.00	18,605	1,253.7	14,411	22,365	125,054

Device	Routing	Invert	Outlet Devices
#1	Primary	56.26'	**12.0" Round CMP_Round 12"** L= 60.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 56.26' / 55.86' S= 0.0067 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#2	Primary	58.65'	**50.0' long x 35.0' breadth Broad-Crested Rectangular Weir** 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=25.32 cfs @ 12.53 hrs HW=58.95' (Free Discharge)
└─**1=CMP_Round 12"** (Barrel Controls 3.06 cfs @ 3.90 fps)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 22.25 cfs @ 1.48 fps)

Pond RRP: Western Swale/Railroad Tracks w/ Culvert



Time span=1.00-36.00 hrs, dt=0.05 hrs, 701 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: 1S Runoff Area=386,365 sf 0.00% Impervious Runoff Depth=5.63"
Flow Length=468' Tc=32.0 min CN=74 Runoff=31.95 cfs 4.2 af

Subcatchment 1Sa: 1Sa Runoff Area=332,772 sf 1.93% Impervious Runoff Depth=6.36"
Flow Length=251' Tc=7.8 min CN=80 Runoff=51.82 cfs 4.0 af

Subcatchment 1Sb: 1Sb Runoff Area=178,528 sf 0.00% Impervious Runoff Depth=6.24"
Flow Length=221' Tc=18.4 min CN=79 Runoff=20.57 cfs 2.1 af

Subcatchment 2S: 2S Runoff Area=601,941 sf 0.80% Impervious Runoff Depth=4.41"
Flow Length=898' Tc=34.8 min CN=64 Runoff=37.57 cfs 5.1 af

Subcatchment 2Sa: 2Sa Runoff Area=172,643 sf 0.00% Impervious Runoff Depth=5.99"
Flow Length=283' Tc=8.9 min CN=77 Runoff=24.59 cfs 2.0 af

Reach DP1: Eastern Wetland Inflow=49.89 cfs 10.3 af
Outflow=49.89 cfs 10.3 af

Pond 1P: 1P Peak Elev=76.54' Storage=85,647 cf Inflow=51.82 cfs 4.0 af
Outflow=4.09 cfs 4.0 af

Pond 2P: 2P Peak Elev=72.33' Storage=37,749 cf Inflow=24.59 cfs 2.0 af
Outflow=2.45 cfs 2.0 af

Pond 3P: 3P Peak Elev=75.20' Storage=9,664 cf Inflow=20.57 cfs 2.1 af
Outflow=13.97 cfs 2.1 af

Pond RRP: Western Swale/Railroad Tracks w/ Peak Elev=59.07' Storage=8,708 cf Inflow=39.98 cfs 7.1 af
Outflow=39.86 cfs 7.1 af

Total Runoff Area = 38.390 ac Runoff Volume = 17.4 af Average Runoff Depth = 5.44"
99.33% Pervious = 38.132 ac 0.67% Impervious = 0.258 ac

Summary for Subcatchment 1S: 1S

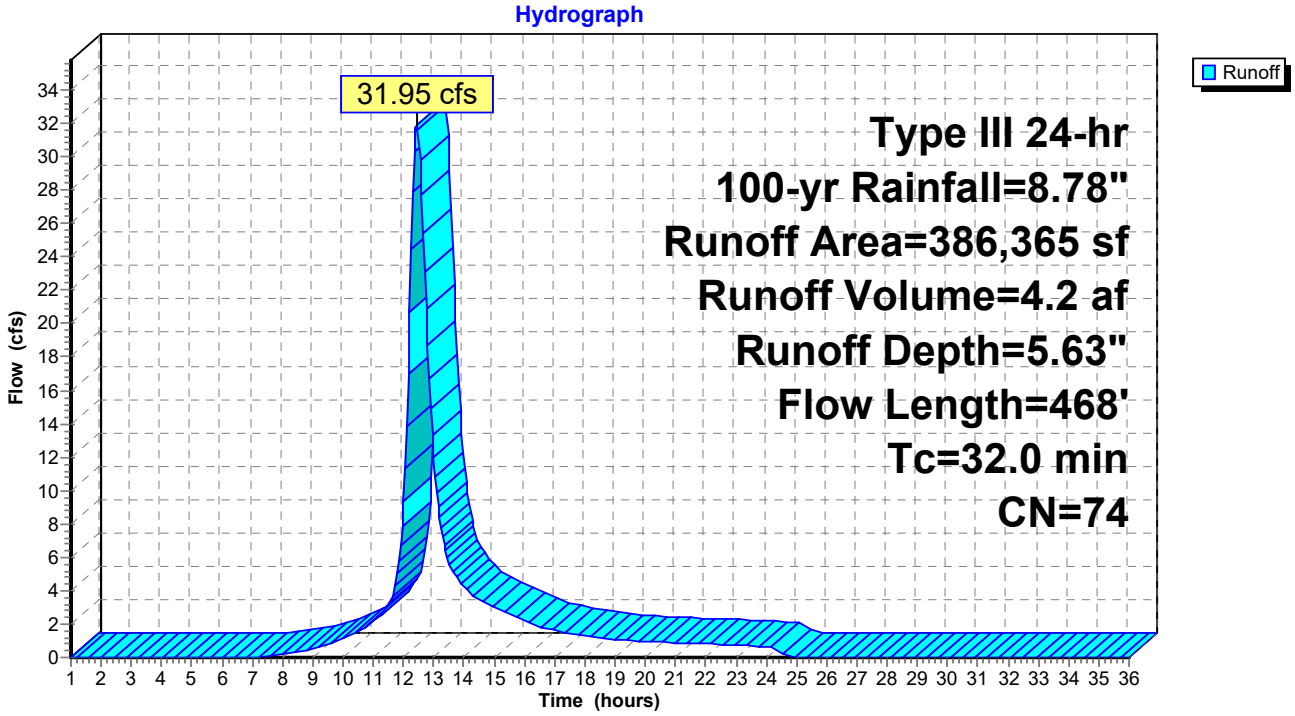
Runoff = 31.95 cfs @ 12.44 hrs, Volume= 4.2 af, Depth= 5.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.78"

Area (sf)	CN	Description
41,299	55	Woods, Good, HSG B
121,227	70	Woods, Good, HSG C
96,253	77	Woods, Good, HSG D
42,050	79	50-75% Grass cover, Fair, HSG C
44,337	79	50-75% Grass cover, Fair, HSG C
41,199	84	50-75% Grass cover, Fair, HSG D
386,365	74	Weighted Average
386,365		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.7	50	0.0100	0.03		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.60"
5.3	418	0.0681	1.30		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
32.0	468	Total			

Subcatchment 1S: 1S



Summary for Subcatchment 1Sa: 1Sa

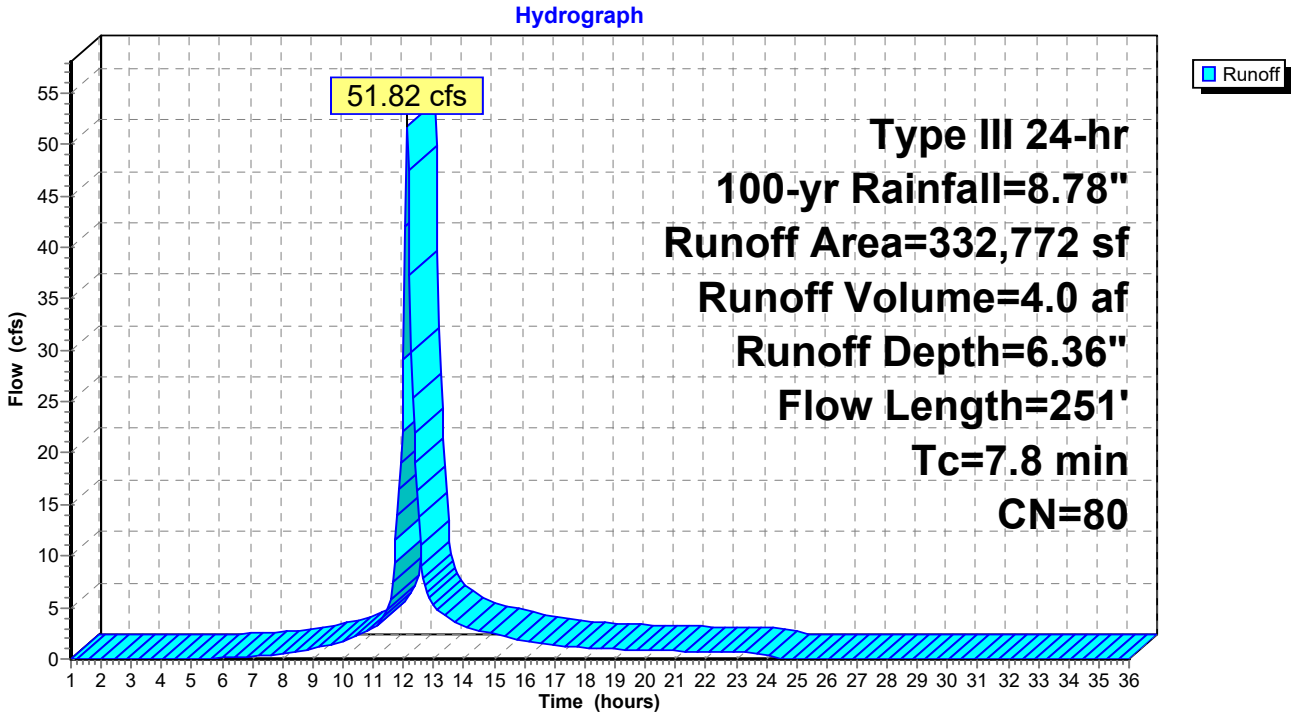
Runoff = 51.82 cfs @ 12.11 hrs, Volume= 4.0 af, Depth= 6.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.78"

	Area (sf)	CN	Description
*	6,408	98	Unconnected pavement, HSG C - EQ PADS
	5,146	96	Gravel surface, HSG C
	252,473	79	50-75% Grass cover, Fair, HSG C
	59,360	79	50-75% Grass cover, Fair, HSG C
	9,385	84	50-75% Grass cover, Fair, HSG D
	332,772	80	Weighted Average
	326,364		98.07% Pervious Area
	6,408		1.93% Impervious Area
	6,408		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	50	0.0100	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.8	201	0.0640	4.07		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
7.8	251	Total			

Subcatchment 1Sa: 1Sa



Summary for Subcatchment 1Sb: 1Sb

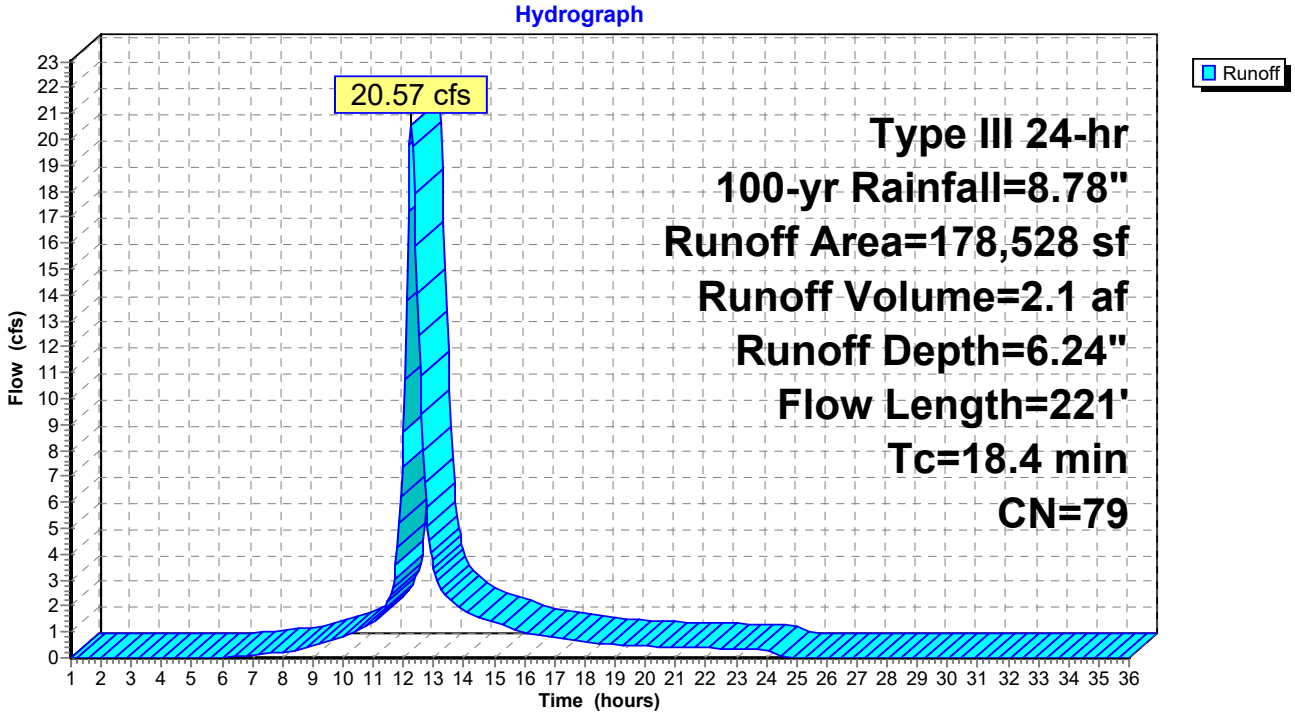
Runoff = 20.57 cfs @ 12.25 hrs, Volume= 2.1 af, Depth= 6.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.78"

Area (sf)	CN	Description
4,422	96	Gravel surface, HSG C
157,889	79	50-75% Grass cover, Fair, HSG C
16,217	79	50-75% Grass cover, Fair, HSG C
178,528	79	Weighted Average
178,528		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.6	50	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.8	171	0.0450	3.42		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
18.4	221	Total			

Subcatchment 1Sb: 1Sb



Summary for Subcatchment 2S: 2S

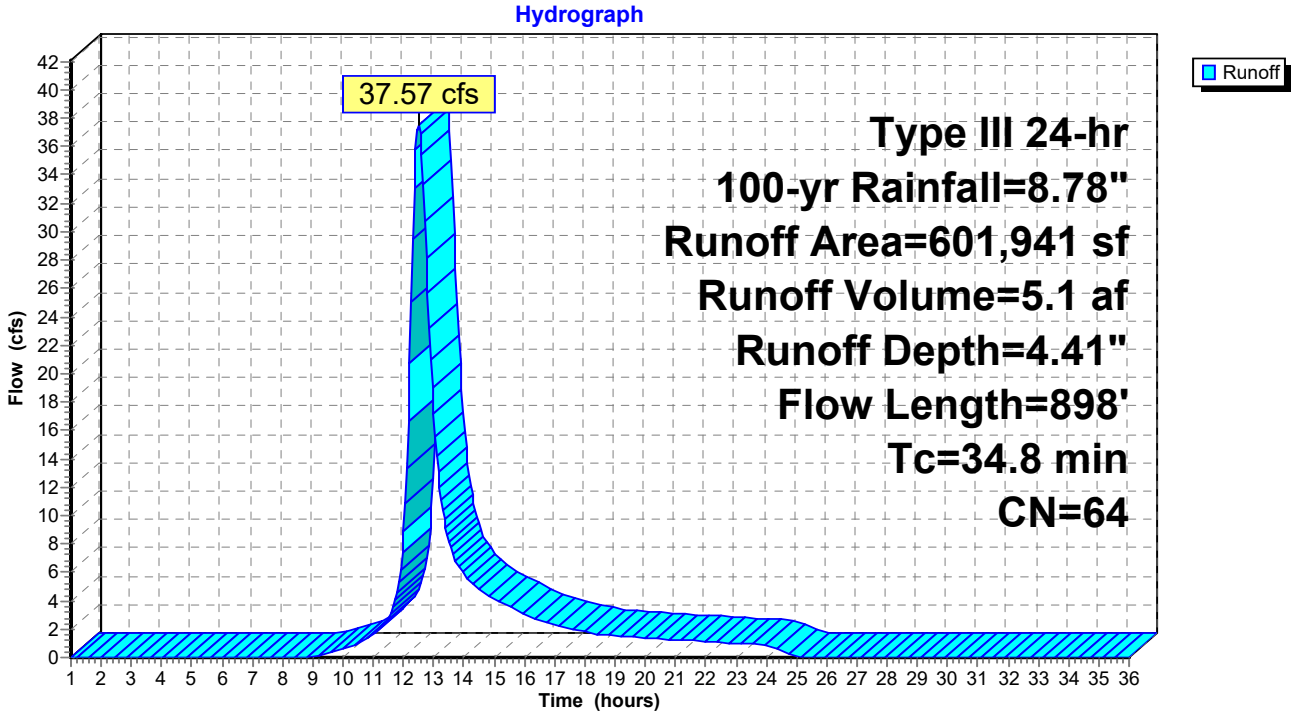
Runoff = 37.57 cfs @ 12.49 hrs, Volume= 5.1 af, Depth= 4.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.78"

Area (sf)	CN	Description
8,087	96	Gravel surface, HSG C
22,963	79	50-75% Grass cover, Fair, HSG C
285,668	55	Woods, Good, HSG B
225,635	70	Woods, Good, HSG C
15,496	69	50-75% Grass cover, Fair, HSG B
39,276	79	50-75% Grass cover, Fair, HSG C
4,816	98	Paved parking, HSG B
601,941	64	Weighted Average
597,125		99.20% Pervious Area
4,816		0.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.2	50	0.0080	0.03		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.60"
5.6	848	0.0250	2.55		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
34.8	898	Total			

Subcatchment 2S: 2S



Summary for Subcatchment 2Sa: 2Sa

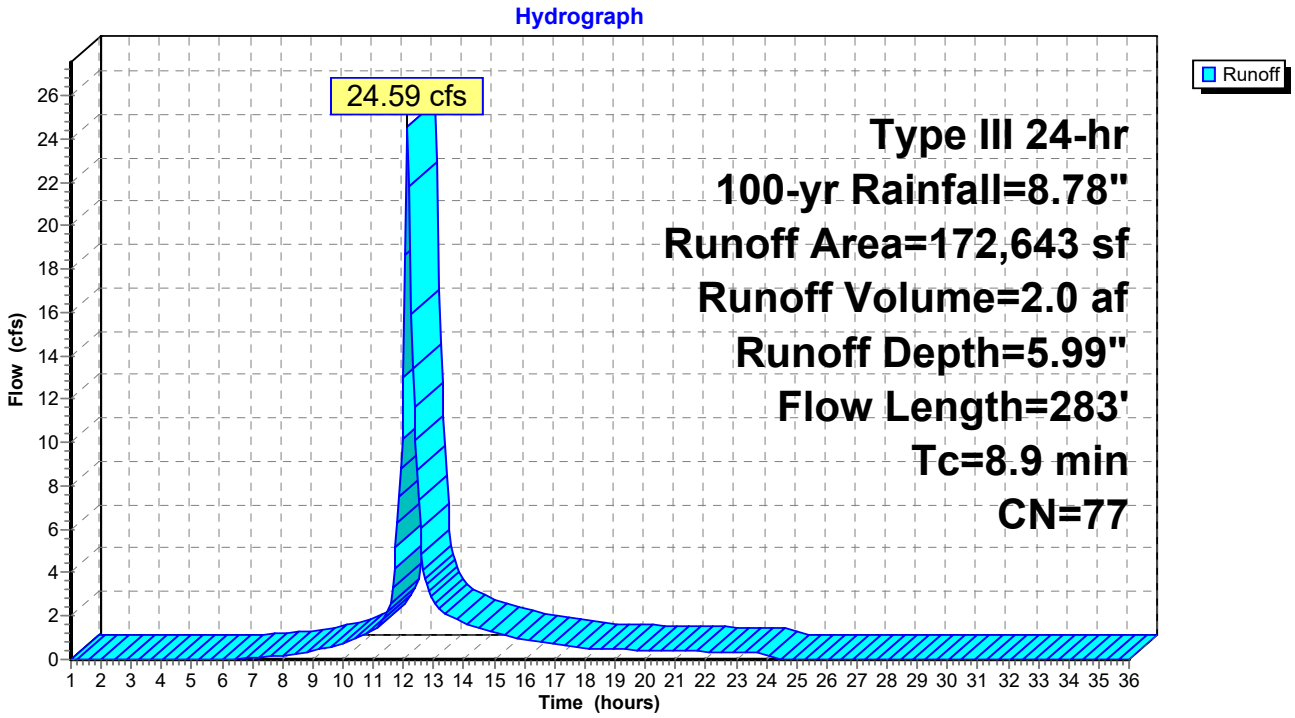
Runoff = 24.59 cfs @ 12.12 hrs, Volume= 2.0 af, Depth= 5.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.78"

Area (sf)	CN	Description
1,962	96	Gravel surface, HSG C
42,320	69	50-75% Grass cover, Fair, HSG B
98,678	79	50-75% Grass cover, Fair, HSG C
29,683	79	50-75% Grass cover, Fair, HSG C
172,643	77	Weighted Average
172,643		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	50	0.0072	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
0.7	184	0.0850	4.69		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	49	0.0612	3.71		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
8.9	283	Total			

Subcatchment 2Sa: 2Sa

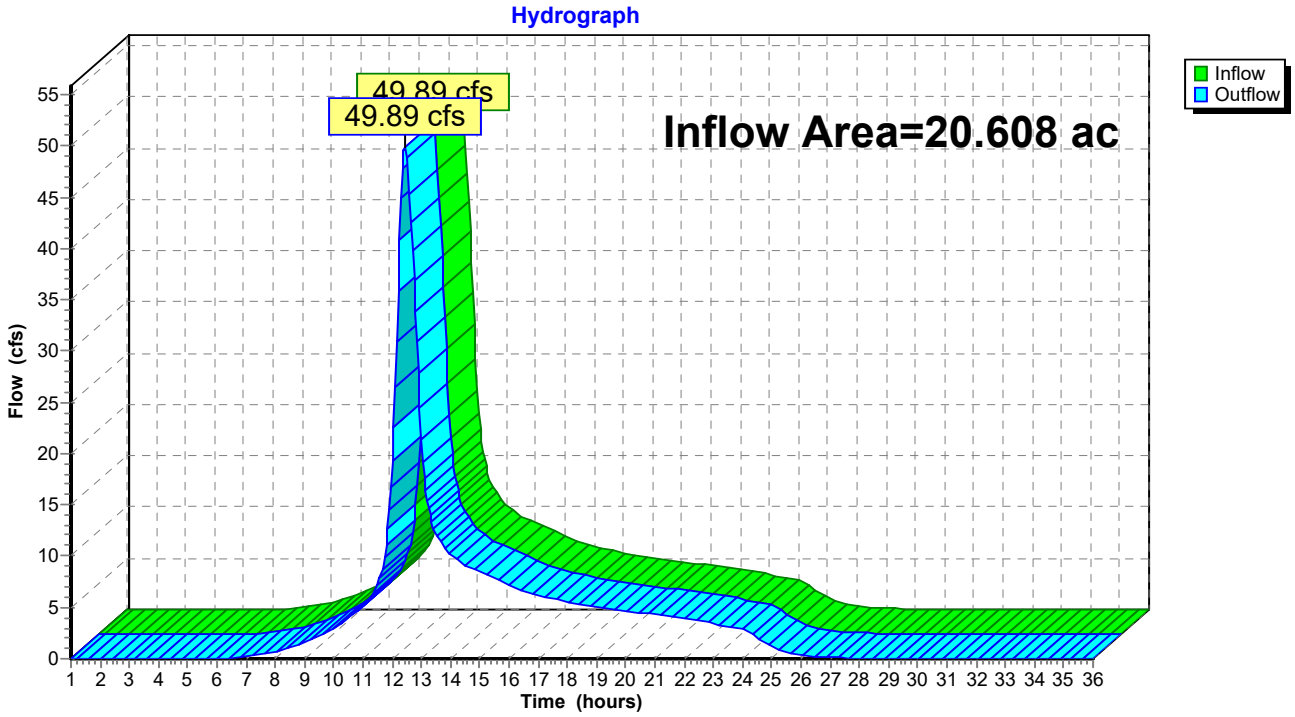


Summary for Reach DP1: Eastern Wetland

Inflow Area = 20.608 ac, 0.71% Impervious, Inflow Depth = 6.02" for 100-yr event
Inflow = 49.89 cfs @ 12.44 hrs, Volume= 10.3 af
Outflow = 49.89 cfs @ 12.44 hrs, Volume= 10.3 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs

Reach DP1: Eastern Wetland



Summary for Pond 1P: 1P

Inflow Area = 7.639 ac, 1.93% Impervious, Inflow Depth = 6.36" for 100-yr event
Inflow = 51.82 cfs @ 12.11 hrs, Volume= 4.0 af
Outflow = 4.09 cfs @ 13.42 hrs, Volume= 4.0 af, Atten= 92%, Lag= 78.5 min
Primary = 4.09 cfs @ 13.42 hrs, Volume= 4.0 af

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 76.54' @ 13.42 hrs Surf.Area= 50,356 sf Storage= 85,647 cf

Plug-Flow detention time= 226.3 min calculated for 4.0 af (100% of inflow)
Center-of-Mass det. time= 226.0 min (1,027.1 - 801.1)

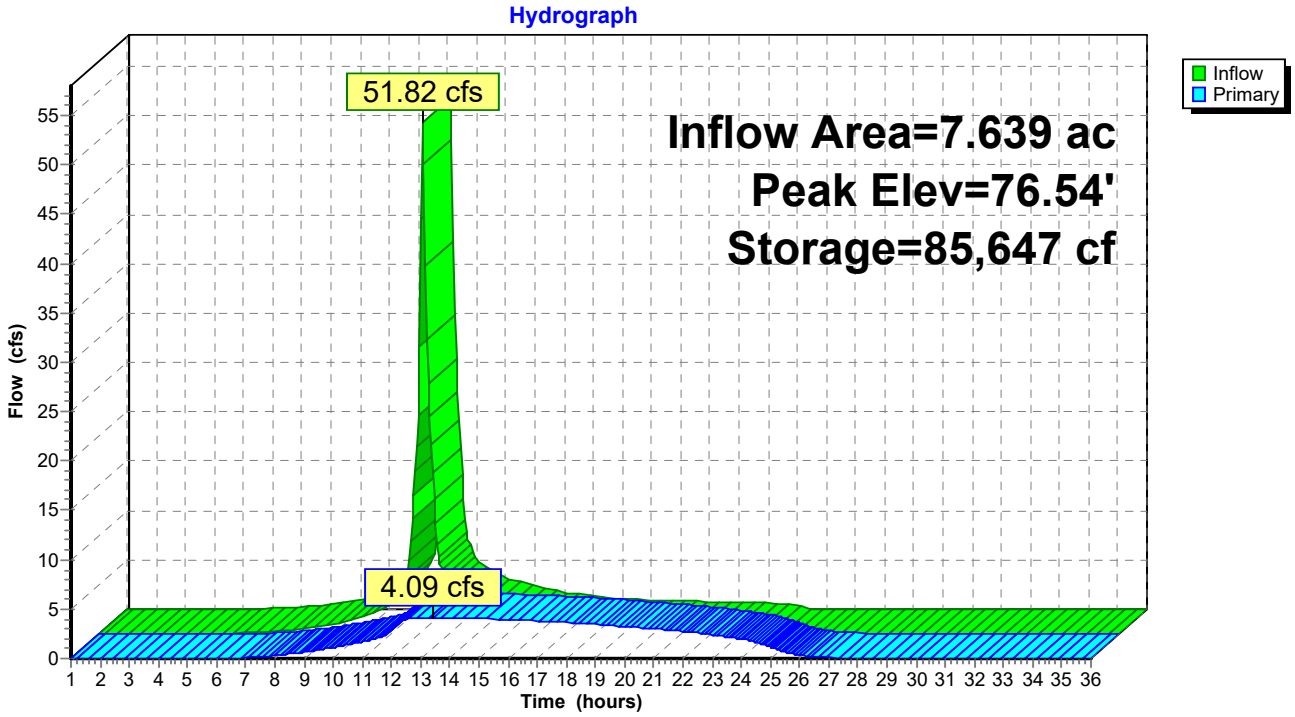
Volume	Invert	Avail.Storage	Storage Description
#1	73.00'	140,073 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
73.00	2,895	876.8	0	0	2,895
74.00	13,416	1,517.5	7,514	7,514	124,975
75.00	26,522	1,740.9	19,600	27,115	182,924
76.00	41,778	1,899.3	33,862	60,977	228,845
77.00	58,419	2,081.5	49,867	110,844	286,597
77.50	58,500	2,100.0	29,230	140,073	292,842

Device	Routing	Invert	Outlet Devices
#1	Primary	77.00'	**20.0' long x 20.0' breadth Broad-Crested Rectangular Weir** 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
#2	Primary	73.00'	**10.0" Round Culvert** L= 45.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 73.00' / 72.55' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.55 sf

Primary OutFlow Max=4.09 cfs @ 13.42 hrs HW=76.54' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└─**2=Culvert** (Inlet Controls 4.09 cfs @ 7.50 fps)

Pond 1P: 1P


Hydrograph
51.82 cfs
4.09 cfs
Inflow Area=7.639 ac
Peak Elev=76.54'
Storage=85,647 cf
Inflow
Primary
Flow (cfs)
Time (hours)

Summary for Pond 2P: 2P

Inflow Area = 3.963 ac, 0.00% Impervious, Inflow Depth = 5.99" for 100-yr event
Inflow = 24.59 cfs @ 12.12 hrs, Volume= 2.0 af
Outflow = 2.45 cfs @ 13.08 hrs, Volume= 2.0 af, Atten= 90%, Lag= 57.4 min
Primary = 2.45 cfs @ 13.08 hrs, Volume= 2.0 af

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 72.33' @ 13.08 hrs Surf.Area= 27,422 sf Storage= 37,749 cf

Plug-Flow detention time= 153.3 min calculated for 2.0 af (100% of inflow)
Center-of-Mass det. time= 153.3 min (962.1 - 808.8)

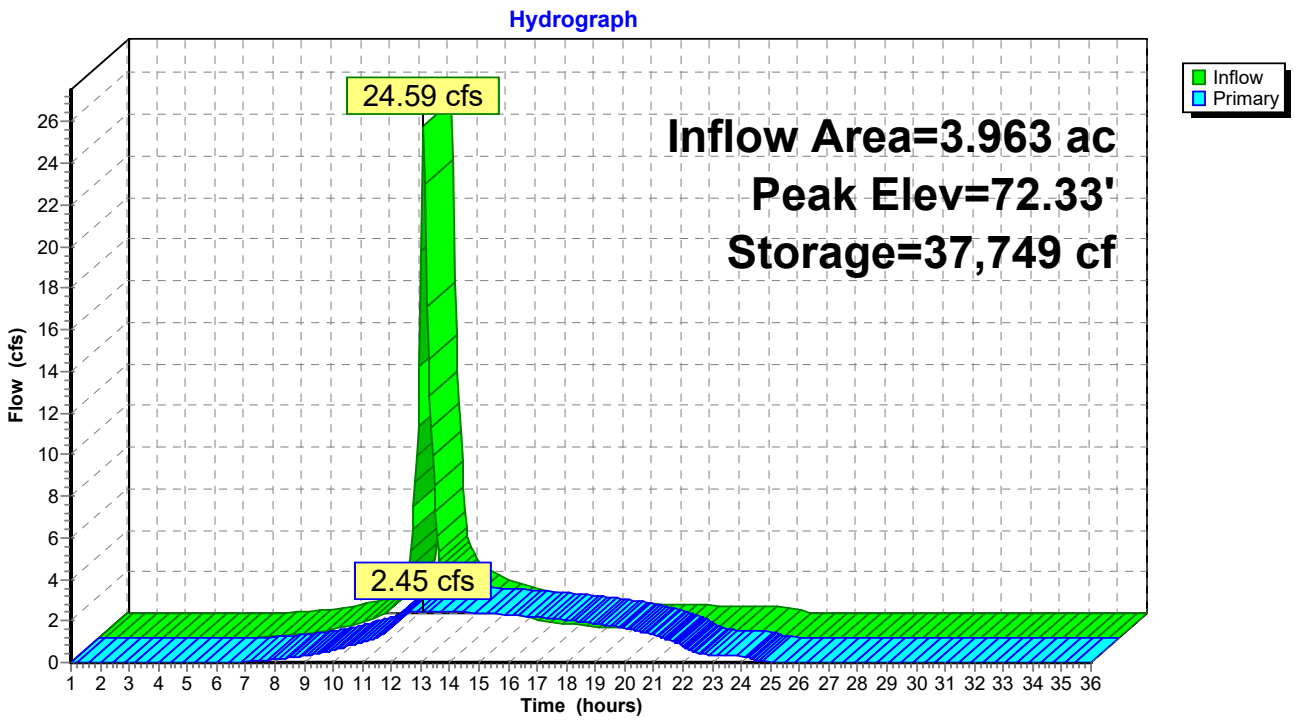
Volume	Invert	Avail.Storage	Storage Description
#1	69.00'	58,912 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
69.00	1,009	191.5	0	0	1,009
70.00	4,826	397.8	2,681	2,681	10,688
71.00	12,978	663.6	8,573	11,253	33,145
72.00	23,823	909.9	18,128	29,381	63,995
73.00	35,633	1,063.0	29,531	58,912	88,052

Device	Routing	Invert	Outlet Devices
#1	Primary	72.50'	**20.0' long x 8.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74
#2	Primary	69.00'	**8.0" Round Culvert** L= 41.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 69.00' / 68.67' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=2.45 cfs @ 13.08 hrs HW=72.33' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└─**2=Culvert** (Barrel Controls 2.45 cfs @ 7.02 fps)

Pond 2P: 2P


Hydrograph
24.59 cfs
2.45 cfs
Inflow Area=3.963 ac
Peak Elev=72.33'
Storage=37,749 cf
Inflow
Primary
Flow (cfs)
Time (hours)

Summary for Pond 3P: 3P

Inflow Area = 4.098 ac, 0.00% Impervious, Inflow Depth = 6.24" for 100-yr event
Inflow = 20.57 cfs @ 12.25 hrs, Volume= 2.1 af
Outflow = 13.97 cfs @ 12.46 hrs, Volume= 2.1 af, Atten= 32%, Lag= 12.4 min
Primary = 13.97 cfs @ 12.46 hrs, Volume= 2.1 af

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 75.20' @ 12.46 hrs Surf.Area= 9,312 sf Storage= 9,664 cf

Plug-Flow detention time= 6.2 min calculated for 2.1 af (100% of inflow)
Center-of-Mass det. time= 6.0 min (819.2 - 813.2)

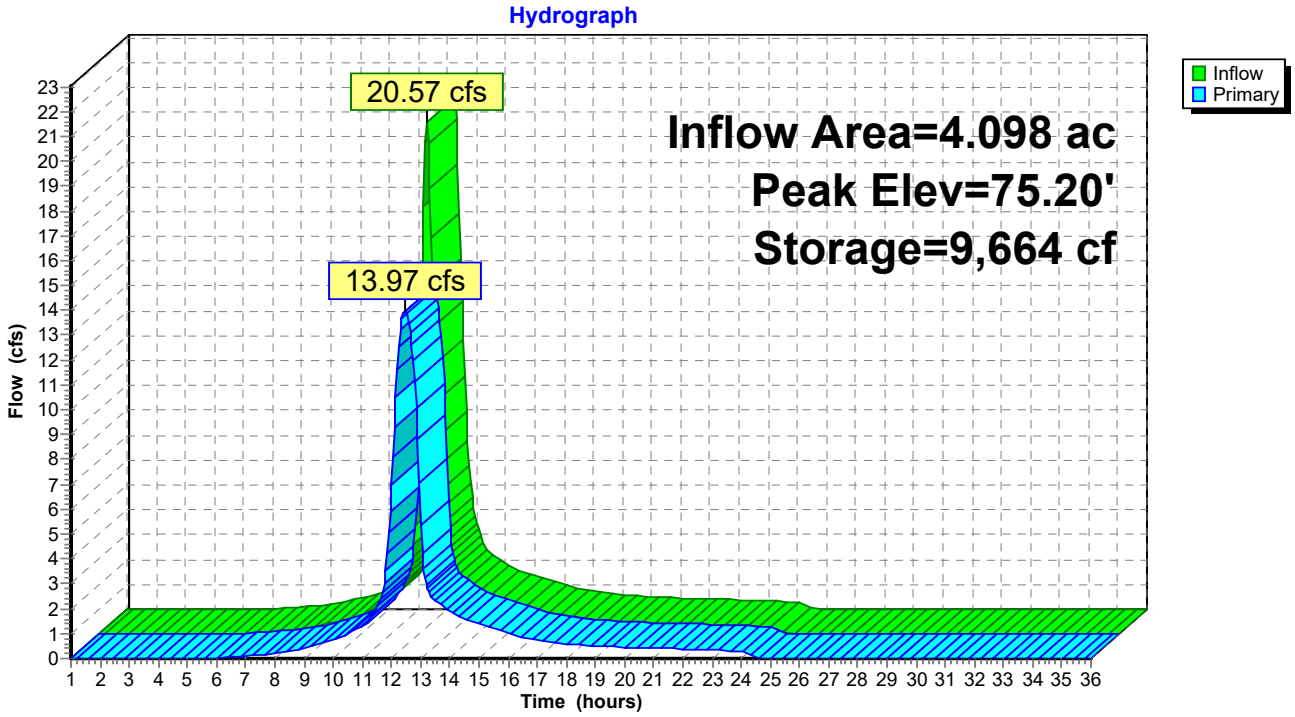
Volume	Invert	Avail.Storage	Storage Description
#1	72.00'	17,415 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
72.00	167	153.1	0	0	167
73.00	660	176.0	386	386	789
74.00	2,979	333.6	1,680	2,067	7,185
75.00	9,151	469.4	5,784	7,850	15,872
76.00	9,984	563.0	9,564	17,415	23,579

Device	Routing	Invert	Outlet Devices
#1	Primary	75.50'	**20.0' long x 20.0' breadth Broad-Crested Rectangular Weir** 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
#2	Primary	72.00'	**6.0" Round Culvert X 2.00** L= 45.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 72.00' / 71.55' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#3	Primary	73.00'	**14.0" Round Culvert X 2.00** L= 45.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 73.00' / 72.55' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.07 sf

Primary OutFlow Max=13.97 cfs @ 12.46 hrs HW=75.19' (Free Discharge)
- **1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
- **2=Culvert** (Barrel Controls 2.44 cfs @ 6.21 fps)
- **3=Culvert** (Inlet Controls 11.53 cfs @ 5.39 fps)

Pond 3P: 3P


Hydrograph
20.57 cfs
13.97 cfs
Inflow Area=4.098 ac
Peak Elev=75.20'
Storage=9,664 cf
Inflow
Primary
Flow (cfs)
Time (hours)

Summary for Pond RRP: Western Swale/Railroad Tracks w/ Culvert

Inflow Area = 17.782 ac, 0.62% Impervious, Inflow Depth = 4.77" for 100-yr event
Inflow = 39.98 cfs @ 12.50 hrs, Volume= 7.1 af
Outflow = 39.86 cfs @ 12.52 hrs, Volume= 7.1 af, Atten= 0%, Lag= 1.4 min
Primary = 39.86 cfs @ 12.52 hrs, Volume= 7.1 af

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 59.07' @ 12.52 hrs Surf.Area= 11,076 sf Storage= 8,708 cf

Plug-Flow detention time= 11.8 min calculated for 7.1 af (100% of inflow)
Center-of-Mass det. time= 11.7 min (900.2 - 888.4)

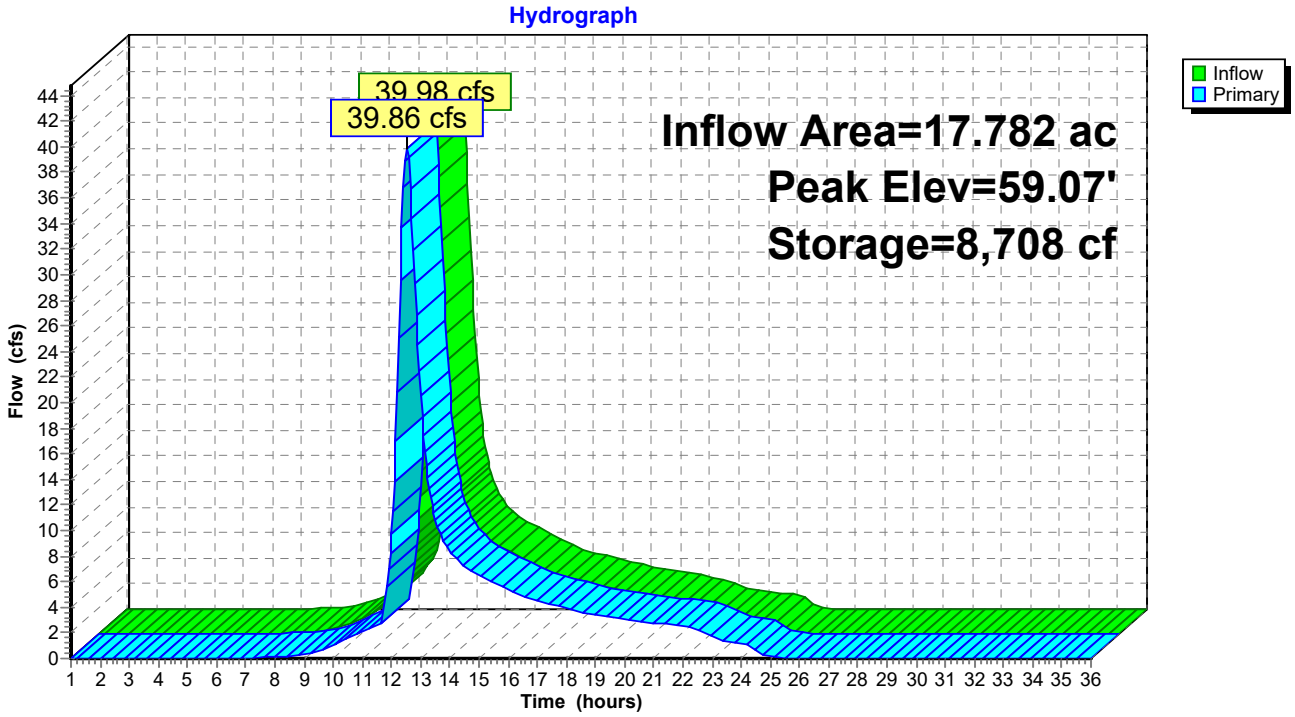
Volume	Invert	Avail.Storage	Storage Description
#1	56.00'	22,365 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
56.00	13	26.5	0	0	13
57.00	505	195.7	200	200	3,007
58.00	2,779	348.1	1,490	1,689	9,607
59.00	10,591	884.0	6,265	7,954	62,155
60.00	18,605	1,253.7	14,411	22,365	125,054

Device	Routing	Invert	Outlet Devices
#1	Primary	56.26'	**12.0" Round CMP_Round 12"** L= 60.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 56.26' / 55.86' S= 0.0067 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf
#2	Primary	58.65'	**50.0' long x 35.0' breadth Broad-Crested Rectangular Weir** 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

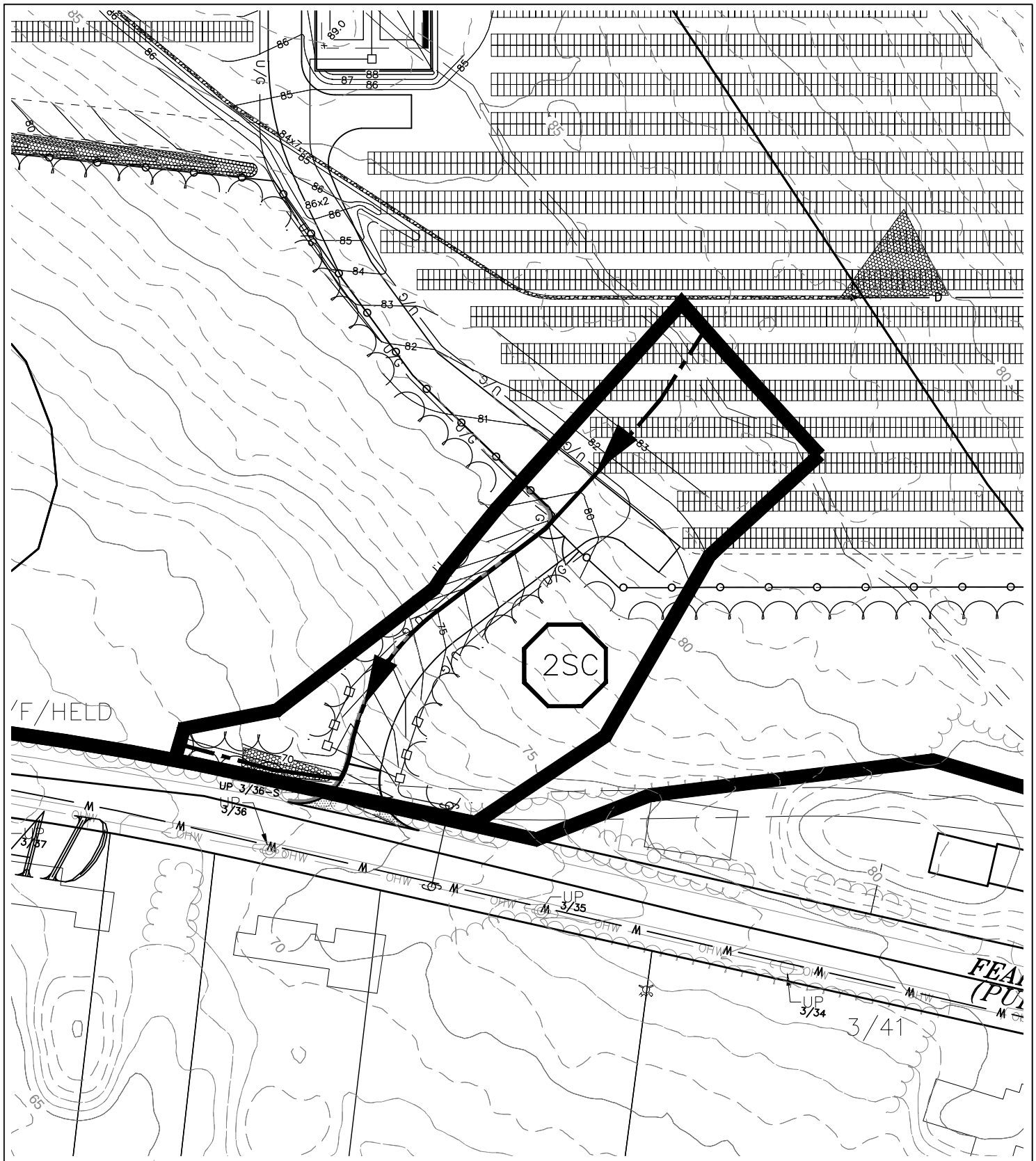
Primary OutFlow Max=39.72 cfs @ 12.52 hrs HW=59.07' (Free Discharge)
└─**1=CMP_Round 12"** (Barrel Controls 3.15 cfs @ 4.01 fps)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 36.57 cfs @ 1.75 fps)

Pond RRP: Western Swale/Railroad Tracks w/ Culvert



Appendix E

Post-Development Watershed Plan – Entrance Swale



Atlantic® DESIGN ENGINEERS, L.L.C.

P.O. Box 1051, Sandwich, MA 02563 (508) 888 – 9282

1" = 80'

0 40 80

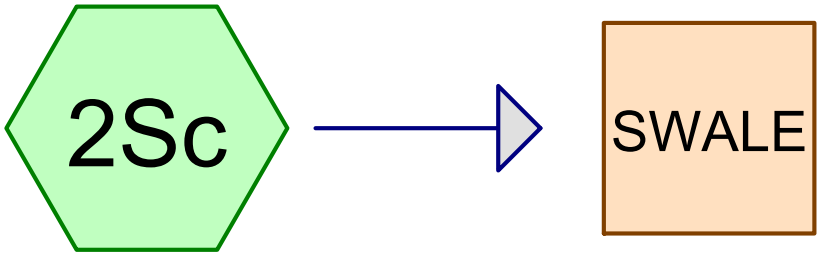
FILE : 3055.02-WSHD-POST-ENTRANCEROAD

APPLICANT:	POST DEVELOPMENT WATERSHED FOR	Sheet	of
WAREHAM MA 3, LLC	FEARING HILL ROAD SOLAR PROJECT	1	1
100 SUMMIT LAKE DRIVE, SUITE 210	WAREHAM, MA 02576	JOB NUMBER	
VALHALLA, NY 10595	SEPTEMBER 2, 2022	3055.02	

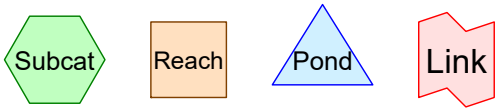
Appendix F

Post-Development HydroCAD Stormwater Analysis – Entrance Swale

ENTRANCE SWALE



2Sc ENTRANCE DRIVE SWALE



Routing Diagram for 3055.02 - FEARING HILL RD - ENTRANCE DRIVE SWALE
Prepared by Atlantic Design Engineers, Inc., Printed 8/31/2022
HydroCAD® 10.00-25 s/n 00480 © 2019 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
23,795	74	>75% Grass cover, Good, HSG C (2Sc)
7,416	96	Gravel surface, HSG C (2Sc)
983	98	Paved parking, HSG B (2Sc)
12,469	70	Woods, Good, HSG C (2Sc)
44,663	**77**	**TOTAL AREA**

Time span=1.00-36.00 hrs, dt=0.05 hrs, 701 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 2Sc: 2Sc Runoff Area=44,663 sf 2.20% Impervious Runoff Depth=1.57"
Flow Length=795' Tc=18.1 min CN=77 Runoff=1.30 cfs 5,827 cf

Reach SWALE: ENTRANCE DRIVE Avg. Flow Depth=0.22' Max Vel=0.80 fps Inflow=1.30 cfs 5,827 cf
n=0.040 L=81.3' S=0.0037 '/' Capacity=15.74 cfs Outflow=1.29 cfs 5,827 cf

Total Runoff Area = 44,663 sf Runoff Volume = 5,827 cf Average Runoff Depth = 1.57"
97.80% Pervious = 43,680 sf 2.20% Impervious = 983 sf

Summary for Subcatchment 2Sc: 2Sc

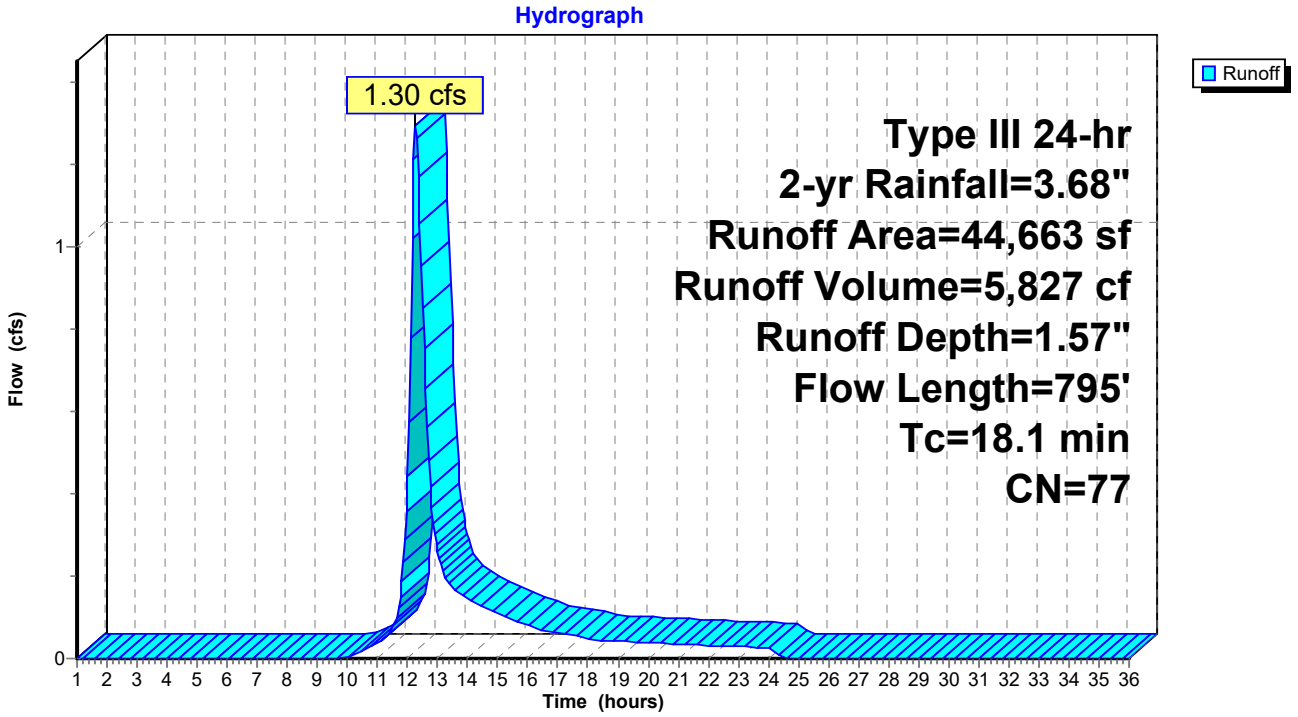
Runoff = 1.30 cfs @ 12.26 hrs, Volume= 5,827 cf, Depth= 1.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.68"

Area (sf)	CN	Description
7,416	96	Gravel surface, HSG C
23,795	74	>75% Grass cover, Good, HSG C
983	98	Paved parking, HSG B
12,469	70	Woods, Good, HSG C
44,663	77	Weighted Average
43,680		97.80% Pervious Area
983		2.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.3	50	0.0038	0.08		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
3.8	402	0.0119	1.76		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	43	0.0468	3.48		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.8	300	0.0067	1.32		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
18.1	795	Total			

Subcatchment 2Sc: 2Sc



Summary for Reach SWALE: ENTRANCE DRIVE SWALE

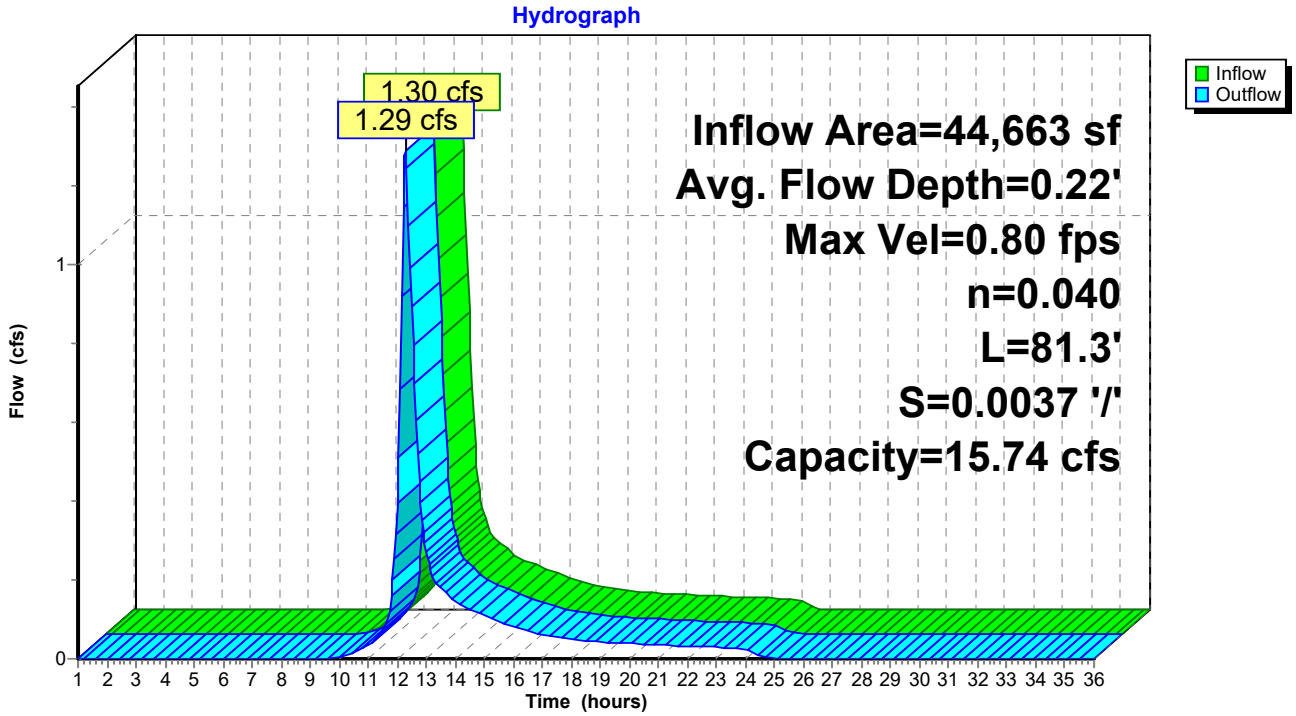
Inflow Area = 44,663 sf, 2.20% Impervious, Inflow Depth = 1.57" for 2-yr event
Inflow = 1.30 cfs @ 12.26 hrs, Volume= 5,827 cf
Outflow = 1.29 cfs @ 12.28 hrs, Volume= 5,827 cf, Atten= 1%, Lag= 1.1 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.80 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 0.24 fps, Avg. Travel Time= 5.5 min

Peak Storage= 131 cf @ 12.28 hrs
Average Depth at Peak Storage= 0.22'
Bank-Full Depth= 1.00' Flow Area= 8.0 sf, Capacity= 15.74 cfs

7.00' x 1.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 1.0 '/' Top Width= 9.00'
Length= 81.3' Slope= 0.0037 '/'
Inlet Invert= 69.00', Outlet Invert= 68.70'

Reach SWALE: ENTRANCE DRIVE SWALE



Time span=1.00-36.00 hrs, dt=0.05 hrs, 701 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 2Sc: 2Sc Runoff Area=44,663 sf 2.20% Impervious Runoff Depth=3.00"
Flow Length=795' Tc=18.1 min CN=77 Runoff=2.52 cfs 11,148 cf

Reach SWALE: ENTRANCE DRIVE Avg. Flow Depth=0.33' Max Vel=1.03 fps Inflow=2.52 cfs 11,148 cf
n=0.040 L=81.3' S=0.0037 '/' Capacity=15.74 cfs Outflow=2.52 cfs 11,148 cf

Total Runoff Area = 44,663 sf Runoff Volume = 11,148 cf Average Runoff Depth = 3.00"
97.80% Pervious = 43,680 sf 2.20% Impervious = 983 sf

Summary for Subcatchment 2Sc: 2Sc

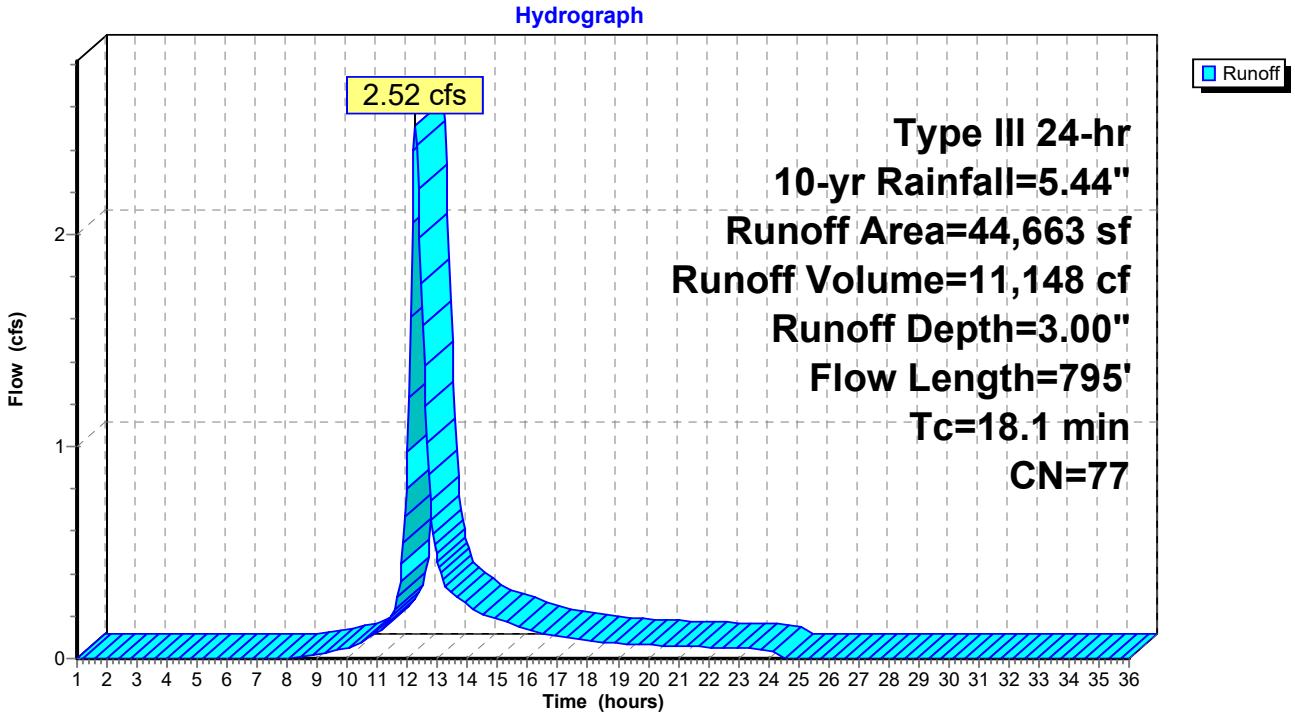
Runoff = 2.52 cfs @ 12.25 hrs, Volume= 11,148 cf, Depth= 3.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=5.44"

Area (sf)	CN	Description
7,416	96	Gravel surface, HSG C
23,795	74	>75% Grass cover, Good, HSG C
983	98	Paved parking, HSG B
12,469	70	Woods, Good, HSG C
44,663	77	Weighted Average
43,680		97.80% Pervious Area
983		2.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.3	50	0.0038	0.08		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
3.8	402	0.0119	1.76		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	43	0.0468	3.48		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.8	300	0.0067	1.32		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
18.1	795	Total			

Subcatchment 2Sc: 2Sc



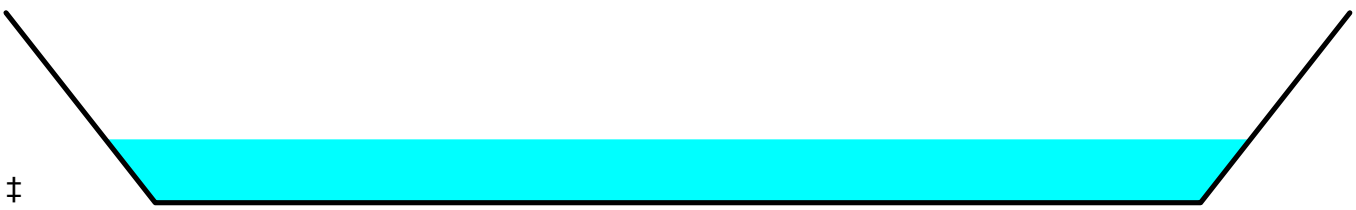
Summary for Reach SWALE: ENTRANCE DRIVE SWALE

Inflow Area = 44,663 sf, 2.20% Impervious, Inflow Depth = 3.00" for 10-yr event
Inflow = 2.52 cfs @ 12.25 hrs, Volume= 11,148 cf
Outflow = 2.52 cfs @ 12.27 hrs, Volume= 11,148 cf, Atten= 0%, Lag= 0.8 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.03 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 0.30 fps, Avg. Travel Time= 4.6 min

Peak Storage= 199 cf @ 12.27 hrs
Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 1.00' Flow Area= 8.0 sf, Capacity= 15.74 cfs

7.00' x 1.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 1.0 '/' Top Width= 9.00'
Length= 81.3' Slope= 0.0037 '/'
Inlet Invert= 69.00', Outlet Invert= 68.70'



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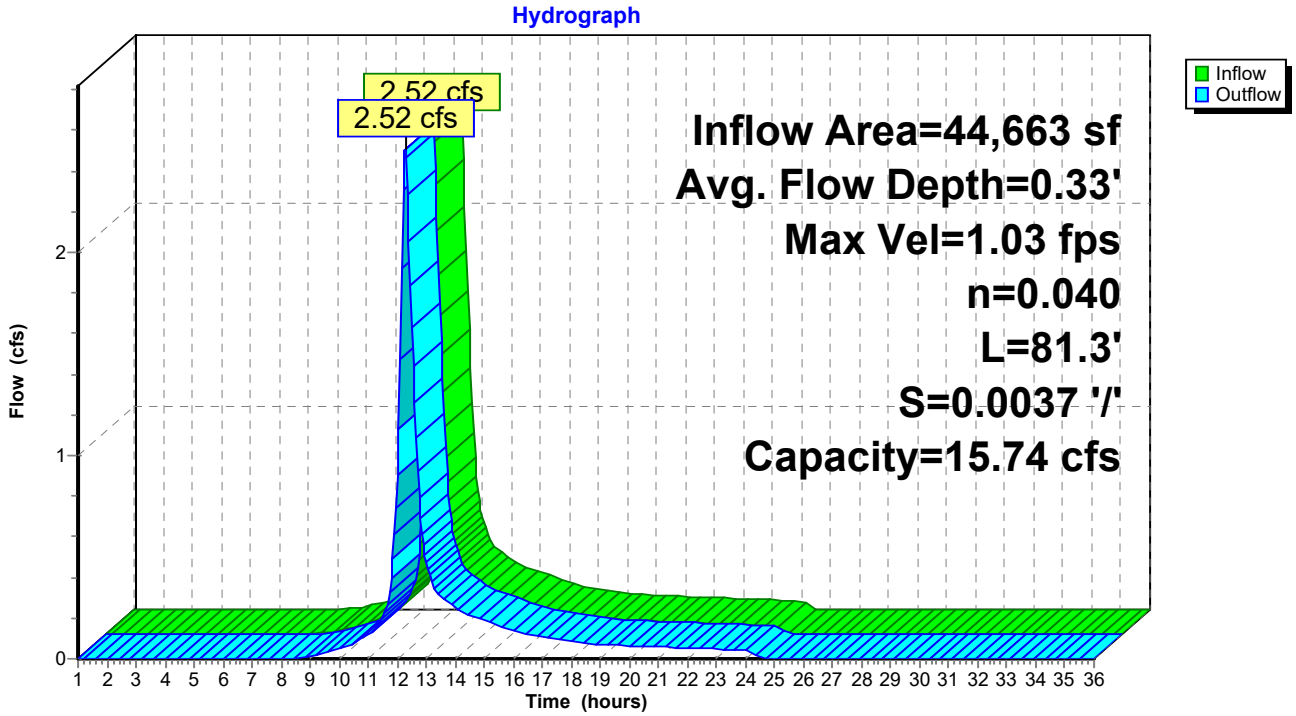
Reach SWALE: ENTRANCE DRIVE SWALE



Time span=1.00-36.00 hrs, dt=0.05 hrs, 701 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 2Sc: 2Sc Runoff Area=44,663 sf 2.20% Impervious Runoff Depth=4.11"
Flow Length=795' Tc=18.1 min CN=77 Runoff=3.45 cfs 15,283 cf

Reach SWALE: ENTRANCE DRIVE Avg. Flow Depth=0.40' Max Vel=1.15 fps Inflow=3.45 cfs 15,283 cf
n=0.040 L=81.3' S=0.0037 '/' Capacity=15.74 cfs Outflow=3.45 cfs 15,283 cf

Total Runoff Area = 44,663 sf Runoff Volume = 15,283 cf Average Runoff Depth = 4.11"
97.80% Pervious = 43,680 sf 2.20% Impervious = 983 sf

Summary for Subcatchment 2Sc: 2Sc

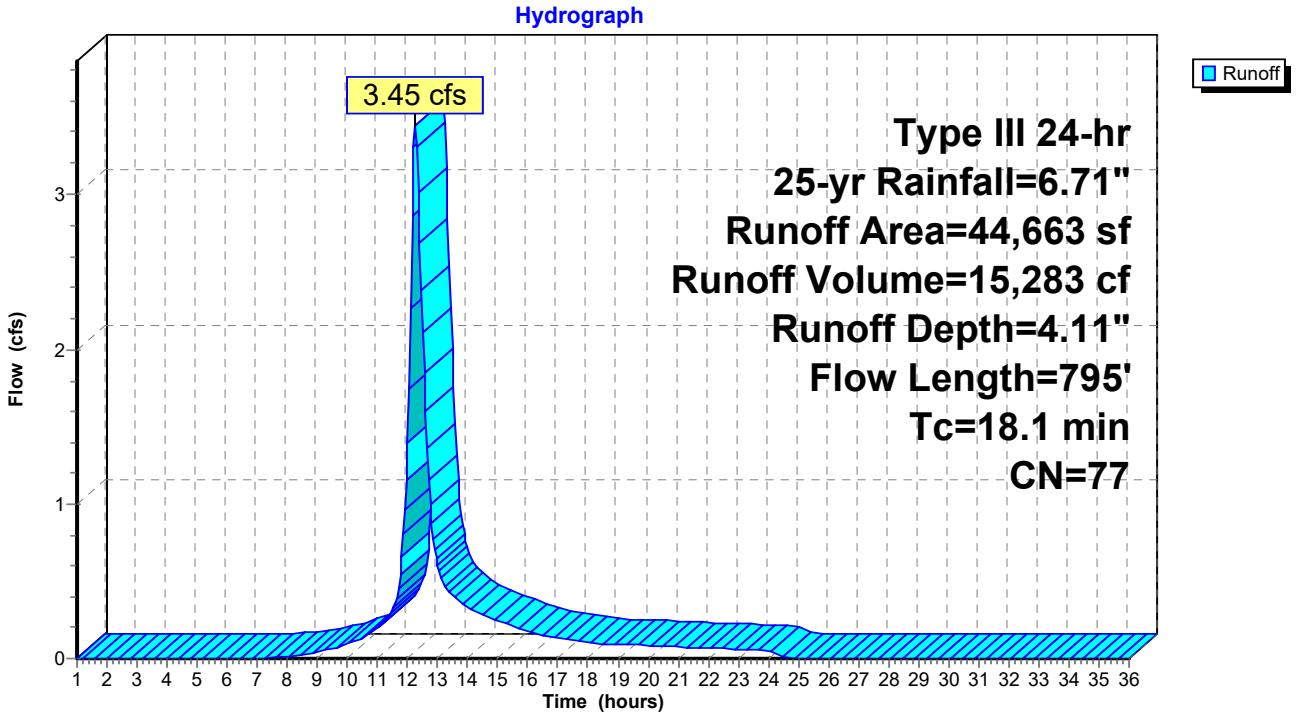
Runoff = 3.45 cfs @ 12.25 hrs, Volume= 15,283 cf, Depth= 4.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.71"

Area (sf)	CN	Description
7,416	96	Gravel surface, HSG C
23,795	74	>75% Grass cover, Good, HSG C
983	98	Paved parking, HSG B
12,469	70	Woods, Good, HSG C
44,663	77	Weighted Average
43,680		97.80% Pervious Area
983		2.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.3	50	0.0038	0.08		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
3.8	402	0.0119	1.76		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	43	0.0468	3.48		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.8	300	0.0067	1.32		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
18.1	795	Total			

Subcatchment 2Sc: 2Sc



Summary for Reach SWALE: ENTRANCE DRIVE SWALE

Inflow Area = 44,663 sf, 2.20% Impervious, Inflow Depth = 4.11" for 25-yr event
Inflow = 3.45 cfs @ 12.25 hrs, Volume= 15,283 cf
Outflow = 3.45 cfs @ 12.26 hrs, Volume= 15,283 cf, Atten= 0%, Lag= 0.8 min

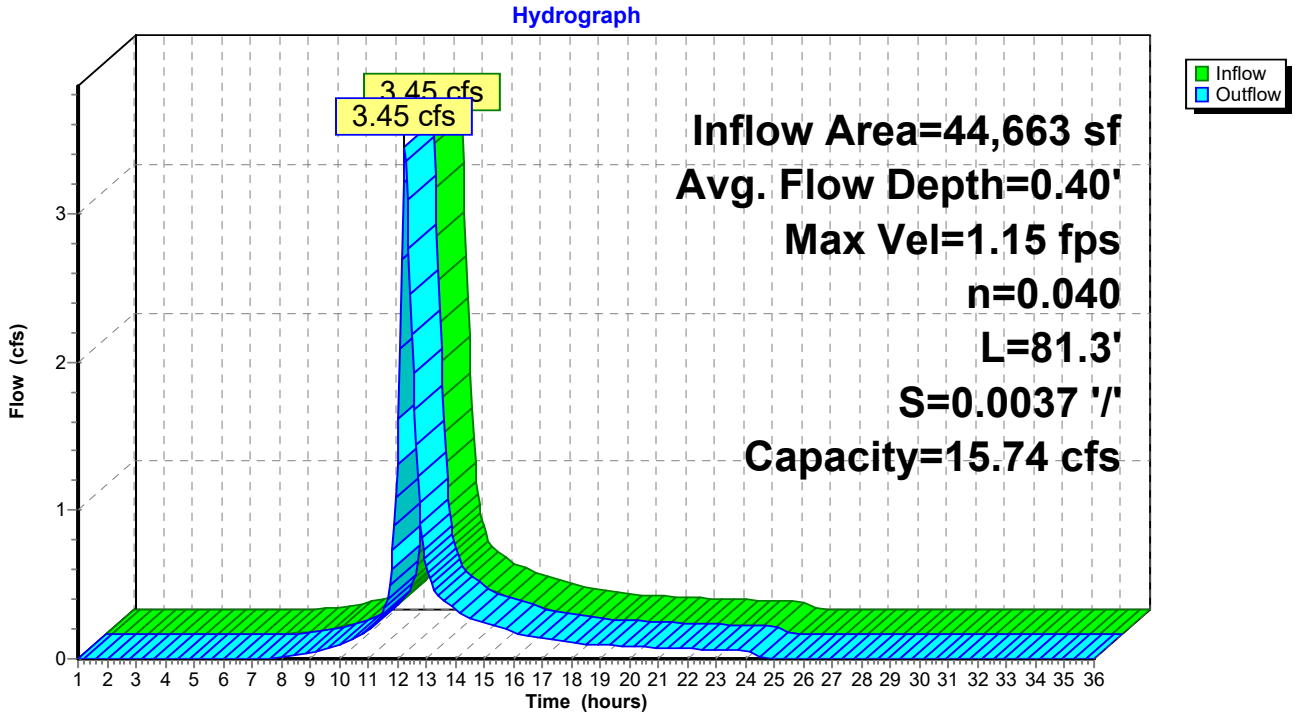
Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.15 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 0.32 fps, Avg. Travel Time= 4.2 min

Peak Storage= 243 cf @ 12.26 hrs
Average Depth at Peak Storage= 0.40'
Bank-Full Depth= 1.00' Flow Area= 8.0 sf, Capacity= 15.74 cfs

7.00' x 1.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 1.0 '/' Top Width= 9.00'
Length= 81.3' Slope= 0.0037 '/'
Inlet Invert= 69.00', Outlet Invert= 68.70'

‡

Reach SWALE: ENTRANCE DRIVE SWALE



Time span=1.00-36.00 hrs, dt=0.05 hrs, 701 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 2Sc: 2Sc Runoff Area=44,663 sf 2.20% Impervious Runoff Depth=5.99"
Flow Length=795' Tc=18.1 min CN=77 Runoff=5.00 cfs 22,311 cf

Reach SWALE: ENTRANCE DRIVE Avg. Flow Depth=0.50' Max Vel=1.32 fps Inflow=5.00 cfs 22,311 cf
n=0.040 L=81.3' S=0.0037 '/' Capacity=15.74 cfs Outflow=5.00 cfs 22,311 cf

Total Runoff Area = 44,663 sf Runoff Volume = 22,311 cf Average Runoff Depth = 5.99"
97.80% Pervious = 43,680 sf 2.20% Impervious = 983 sf

Summary for Subcatchment 2Sc: 2Sc

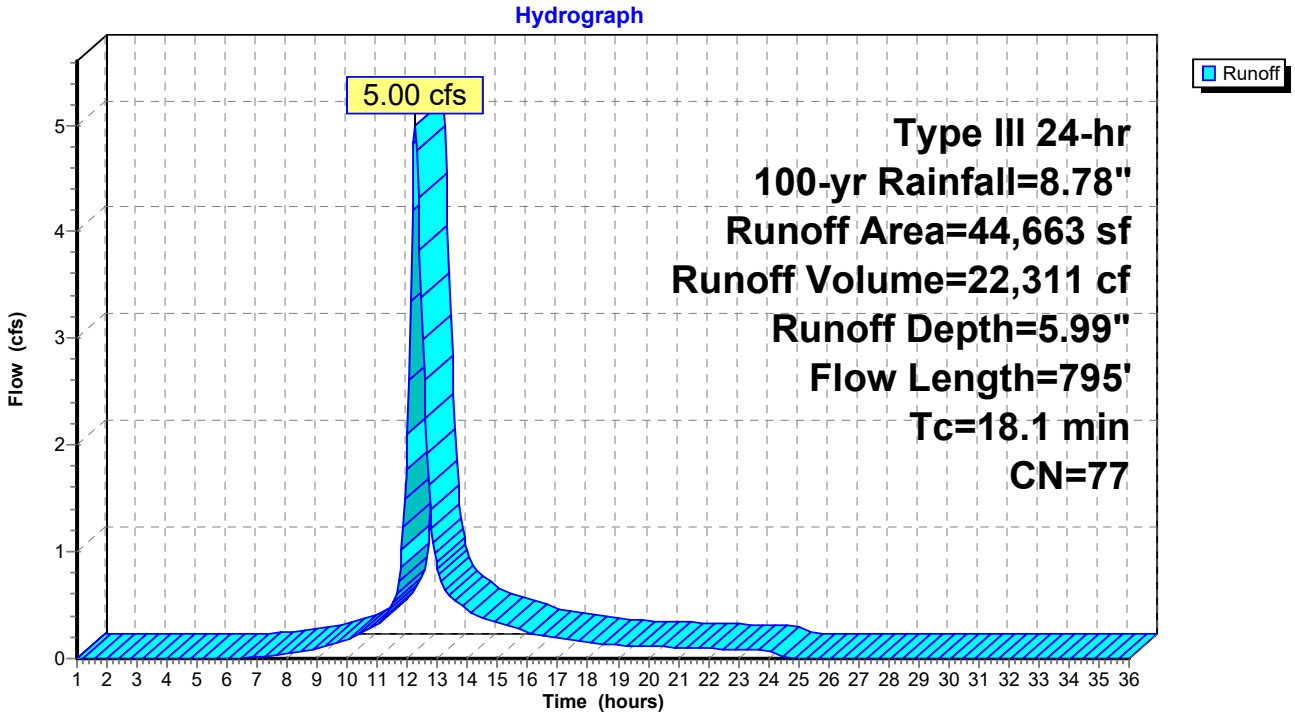
Runoff = 5.00 cfs @ 12.25 hrs, Volume= 22,311 cf, Depth= 5.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.78"

Area (sf)	CN	Description
7,416	96	Gravel surface, HSG C
23,795	74	>75% Grass cover, Good, HSG C
983	98	Paved parking, HSG B
12,469	70	Woods, Good, HSG C
44,663	77	Weighted Average
43,680		97.80% Pervious Area
983		2.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.3	50	0.0038	0.08		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.60"
3.8	402	0.0119	1.76		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	43	0.0468	3.48		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.8	300	0.0067	1.32		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
18.1	795	Total			

Subcatchment 2Sc: 2Sc



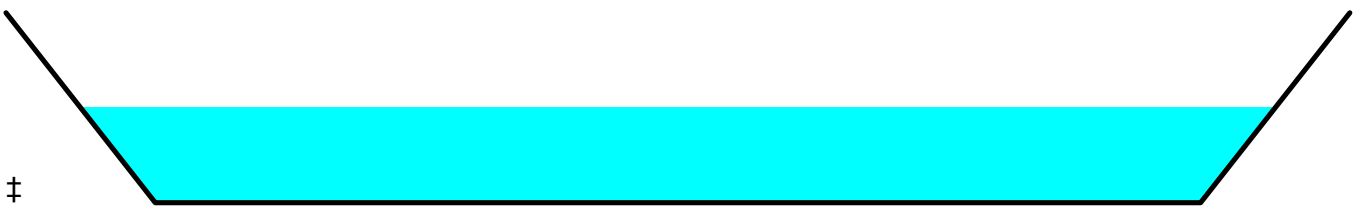
Summary for Reach SWALE: ENTRANCE DRIVE SWALE

Inflow Area = 44,663 sf, 2.20% Impervious, Inflow Depth = 5.99" for 100-yr event
Inflow = 5.00 cfs @ 12.25 hrs, Volume= 22,311 cf
Outflow = 5.00 cfs @ 12.26 hrs, Volume= 22,311 cf, Atten= 0%, Lag= 0.7 min

Routing by Stor-Ind method, Time Span= 1.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.32 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 0.36 fps, Avg. Travel Time= 3.7 min

Peak Storage= 307 cf @ 12.26 hrs
Average Depth at Peak Storage= 0.50'
Bank-Full Depth= 1.00' Flow Area= 8.0 sf, Capacity= 15.74 cfs

7.00' x 1.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 1.0 '/' Top Width= 9.00'
Length= 81.3' Slope= 0.0037 '/'
Inlet Invert= 69.00', Outlet Invert= 68.70'



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Reach SWALE: ENTRANCE DRIVE SWALE