Stormwater Management System Report
Addendum 3

CEC SOLAR #1056 LLC

PROPOSED SOLAR PANEL ARRAY INSTALLATION

207 PROVIDENCE ROAD
GRAFTON, MASSACHUSETTS

Prepared for:

Clean Energy Collective, LLC
146 W Boylston Drive
Worcester, Massachusetts 01606

Prepared by:

Field Engineering Co., Inc.
11D Industrial Drive
PO Box 1178
Mattapoisett, Massachusetts 02739

July 22, 2016
Project No. 2035

FIELD ENGINEERING CO., INC.
CONSULTING ENGINEERS

TABLE OF CONTENTS

Section 1 Hydrologic Overview

1.0 Purpose of Addendum
1.1 Revised Pre-Development Hydrologic Summary
1.2 Revised Post-Development Hydrologic Summary

Section 2 Revised Pre Development Hydrologic Analysis

2-Year Storm Event
10-Year Storm Event
25-Year Storm Event
100-Year Storm Event

Section 3 Revised Post Development Hydrologic Analysis

2-Year Storm Event
10-Year Storm Event
25-Year Storm Event
100-Year Storm Event

Section 4 Supplemental Data

Water Quality Volume Calculations
Recharge Calculations

Appendix A – Revised Pre Development Watershed Plan

Appendix A – Revised Pre Development Watershed Plan

Section 1

Hydrologic Overview

1.0 Purpose of Addendum

The purpose of this Addendum is to address modifications to the stormwater management system design and hydrologic analysis as a result of the relocation of the proposed access driveway from the existing National Grid power line easement further north along Providence Road to a route around the existing land-owner's house to the array location. The relocation of the access driveway has required us to now pave a portion of the driveway to comply with Fire Department requirements due to the slope of the drive. Following discussions with the Planning Board/Conservation Commission Consultant, we have modified both the Pre Development and Post Development hydrologic models to account for the all of the runoff contributing flow to the subject analysis point which is the Providence Road drainage system in front of 207 Providence Road. The drainage system within Providence Road is now taken as Analysis Point 1 in the hydrologic calculations present below an in the following sections.

1.1 Revised Pre-Development Hydrologic Summary

A summary of the revised pre development hydrologic conditions for the 2, 10, 25, and 100-year storm events is submitted in Table 1.1 below. The areas contributing flows to the new Analysis Point 1 include the existing properties at 207 and 211 Providence Road as well as an off-site detention basin which discharges over the subject parcels as shown on the updated Pre-Development Watershed Plan in Appendix 1.

Table 1.1 – Revised Pre Development Hydrologic Summary

Storm Event	Analysis Point AP-1 Rate of Flow (c.f.s.)	Analysis Point AP-2 Rate of Flow (c.f.s.)
2-year storm	6.89	3.66
10-year storm	15.90	9.22
25-year storm	26.46	14.18
100-year storm	85.62	25.16

1.2 Revised Post Development Hydrologic Summary

A summary of the revised post-development hydrologic conditions for the 2, 10, 25 and 100-year storm events is submitted in Table 1.2 below.

Table 1.2 – Post Development Hydrologic Summary

Storm Event	Analysis Point AP-1 Rate of Flow (c.f.s.)	Analysis Point AP-2 Rate of Flow (c.f.s.)
2-year storm	6.87	2.08
10-year storm	15.11	7.38
25-year storm	22.11	12.91
100-year storm	78.95	22.17

A summary of the pre and post-development hydrologic conditions for the 2, 10, 25, and 100-year storm events is submitted in Table 1.3 below. Results shown as a "negative" represent a decrease in post development condition rates of runoff.

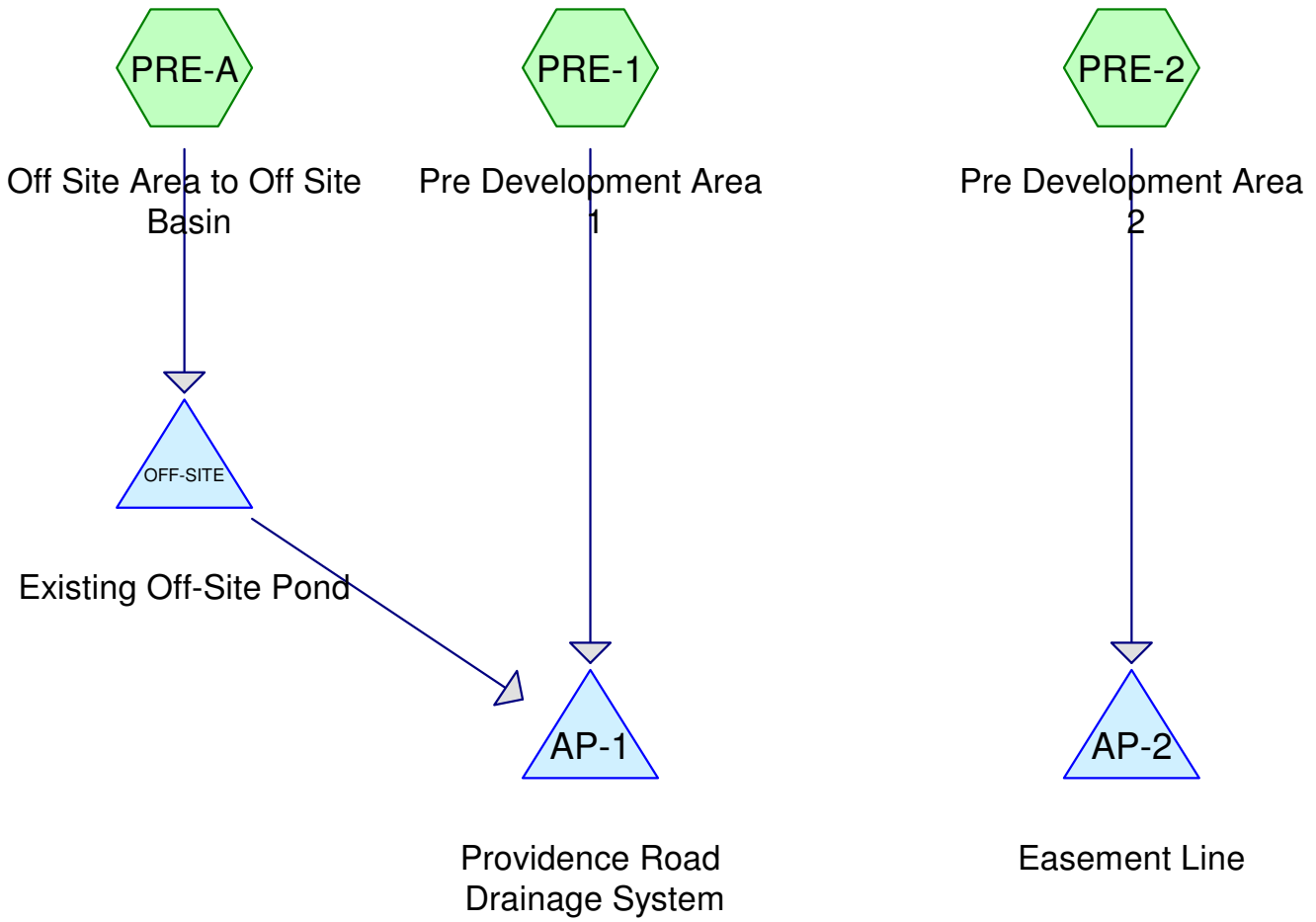
Table 1.3 – Pre-Post Development Hydrologic Results

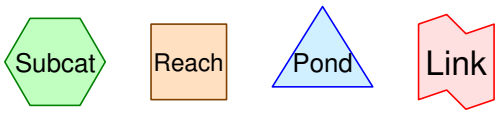
Storm Event	Analysis Point AP-1 Rate of Flow	Analysis Point AP-2 Rate of Flow
2-year storm	-0.0%	-43.2%
10-year storm	-5.0%	-20.0%
25-year storm	-16.4%	-9.0%
100-year storm	-7.8%	-11.9%

The hydrologic analysis indicates that the stormwater management system design for the site meets or reduces peak runoff rates for the 2, 10, 25, and 100 year, 24 hour, Type III storm events from the pre developed levels at the subject analysis points. The analysis shows the proposed development of this project area, even with the proposed pavement now required for the access drive, will not result in an increase in the rates of runoff from the project site to the Providence Road drainage system or the existing National Grid Easement.

Section 2

Revised Pre Development Hydrologic Analysis





Routing Diagram for 2035-PreDevelopmentAnalysis-R1
Prepared by Field Engineering Co. Inc.
HydroCAD® 10.00-12 s/n 01897 © 2014 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.075	74	>75% Grass cover, Good, HSG C (Lots) (PRE-1)
0.213	89	Gravel roads, HSG C (PRE-1, PRE-2)
0.525	98	Paved parking, HSG C (Lots) (PRE-1)
9.880	74	Taken from Record Calculations (PRE-A)
7.875	70	Woods, Good, HSG C (PRE-1, PRE-2)
3.683	70	Woods, Good, HSG C (Lots) (PRE-1)
24.250	**73**	**TOTAL AREA**

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PRE-1: Pre Development Runoff Area=378,354 sf 6.04% Impervious Runoff Depth>1.00"
Flow Length=1,440' Tc=17.0 min CN=73 Runoff=6.89 cfs 0.727 af

Subcatchment PRE-2: Pre Development Runoff Area=247,604 sf 0.00% Impervious Runoff Depth>0.85"
Flow Length=760' Tc=16.7 min CN=70 Runoff=3.66 cfs 0.401 af

Subcatchment PRE-A: Off Site Area to Off Runoff Area=9.880 ac 0.00% Impervious Runoff Depth>1.06"
Tc=18.0 min CN=74 Runoff=8.18 cfs 0.872 af

Pond AP-1: Providence Road Drainage System Inflow=6.89 cfs 0.727 af
Primary=6.89 cfs 0.727 af

Pond AP-2: Easement Line Inflow=3.66 cfs 0.401 af
Primary=3.66 cfs 0.401 af

Pond OFF-SITE: Existing Off-Site Pond Peak Elev=436.29' Storage=27,286 cf Inflow=8.18 cfs 0.872 af
Discarded=0.27 cfs 0.258 af Primary=0.00 cfs 0.000 af Outflow=0.27 cfs 0.258 af

Total Runoff Area = 24.250 ac Runoff Volume = 2.000 af Average Runoff Depth = 0.99"
97.84% Pervious = 23.725 ac 2.16% Impervious = 0.525 ac

Summary for Subcatchment PRE-1: Pre Development Area 1

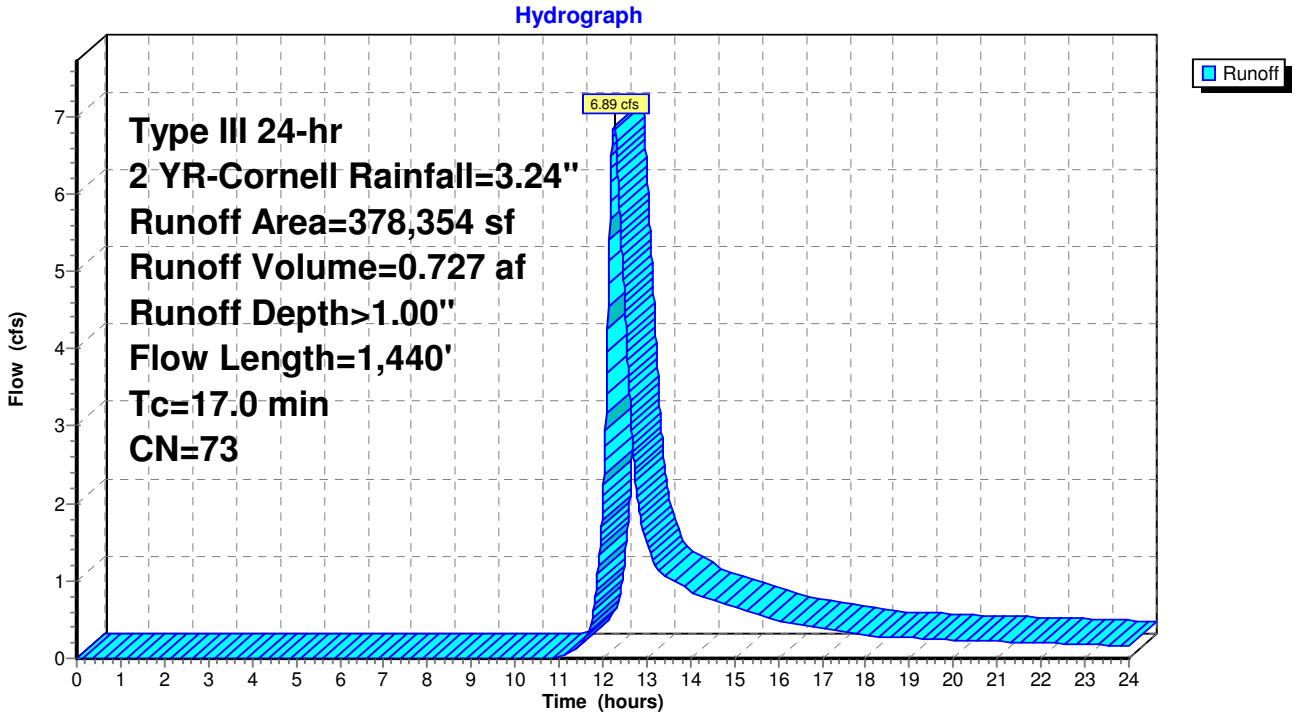
Runoff = 6.89 cfs @ 12.26 hrs, Volume= 0.727 af, Depth> 1.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YR-Cornell Rainfall=3.24"

	Area (sf)	CN	Description
	99,084	70	Woods, Good, HSG C
	5,622	89	Gravel roads, HSG C
*	90,371	74	>75% Grass cover, Good, HSG C (Lots)
*	22,849	98	Paved parking, HSG C (Lots)
*	160,428	70	Woods, Good, HSG C (Lots)
	378,354	73	Weighted Average
	355,505		93.96% Pervious Area
	22,849		6.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0900	0.12		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.24"
1.2	120	0.1100	1.66		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
1.3	460	0.1300	5.80		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
7.8	810	0.1200	1.73		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
17.0	1,440	Total			

Subcatchment PRE-1: Pre Development Area 1



Summary for Subcatchment PRE-2: Pre Development Area 2

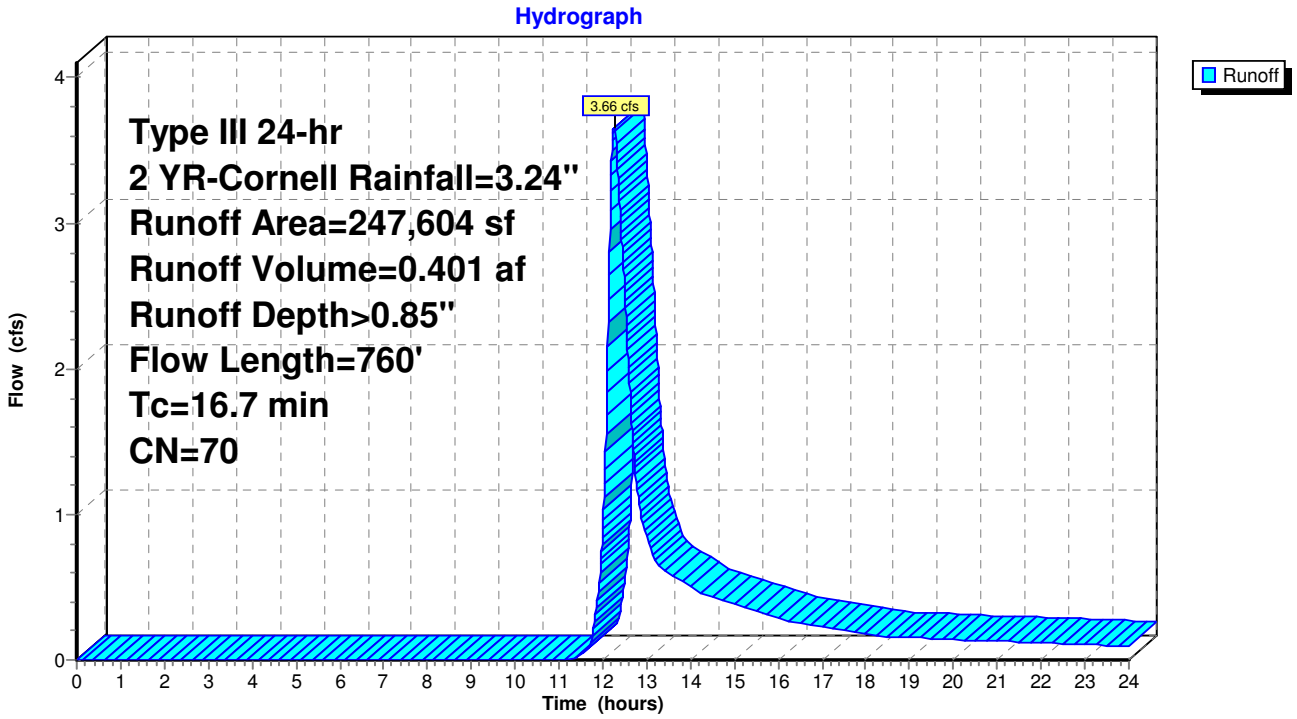
Runoff = 3.66 cfs @ 12.26 hrs, Volume= 0.401 af, Depth> 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YR-Cornell Rainfall=3.24"

Area (sf)	CN	Description
243,947	70	Woods, Good, HSG C
3,657	89	Gravel roads, HSG C
247,604	70	Weighted Average
247,604		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.24"
3.6	337	0.0949	1.54		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.9	126	0.2380	2.44		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
2.9	247	0.0810	1.42		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
16.7	760	Total			

Subcatchment PRE-2: Pre Development Area 2



Summary for Subcatchment PRE-A: Off Site Area to Off Site Basin

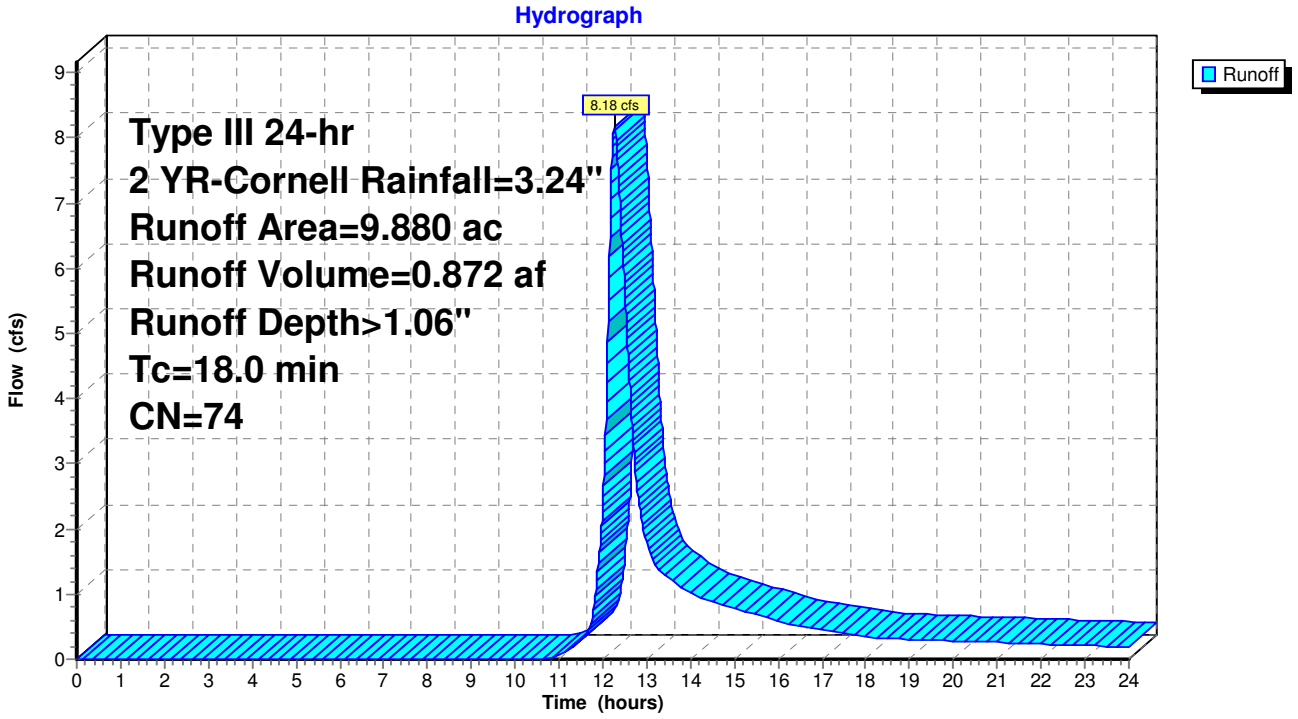
Runoff = 8.18 cfs @ 12.26 hrs, Volume= 0.872 af, Depth> 1.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YR-Cornell Rainfall=3.24"

	Area (ac)	CN	Description
*	9.880	74	Taken from Record Calculations
	9.880		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.0					**Direct Entry, Taken from Record Calculations**

Subcatchment PRE-A: Off Site Area to Off Site Basin



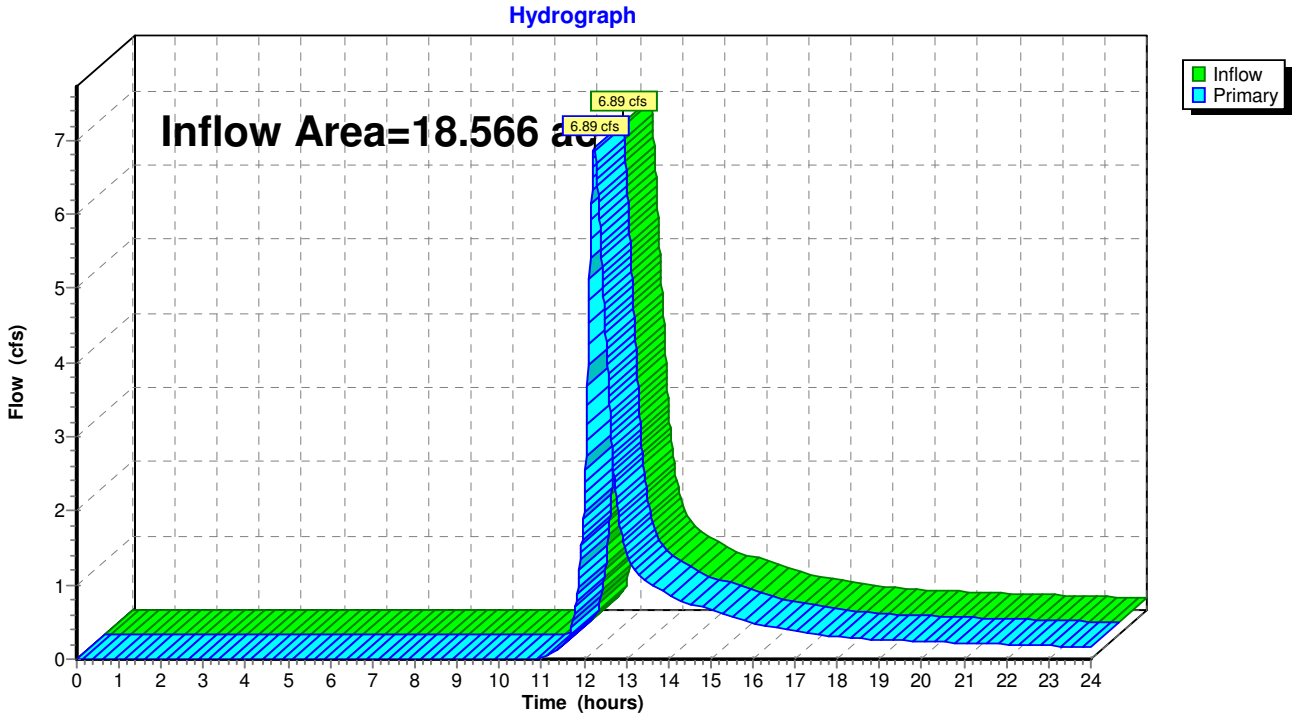
Summary for Pond AP-1: Providence Road Drainage System

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

Inflow Area = 18.566 ac, 2.83% Impervious, Inflow Depth > 0.47" for 2 YR-Cornell event
Inflow = 6.89 cfs @ 12.26 hrs, Volume= 0.727 af
Primary = 6.89 cfs @ 12.26 hrs, Volume= 0.727 af, Atten= 0%, Lag= 0.0 min

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

Pond AP-1: Providence Road Drainage System



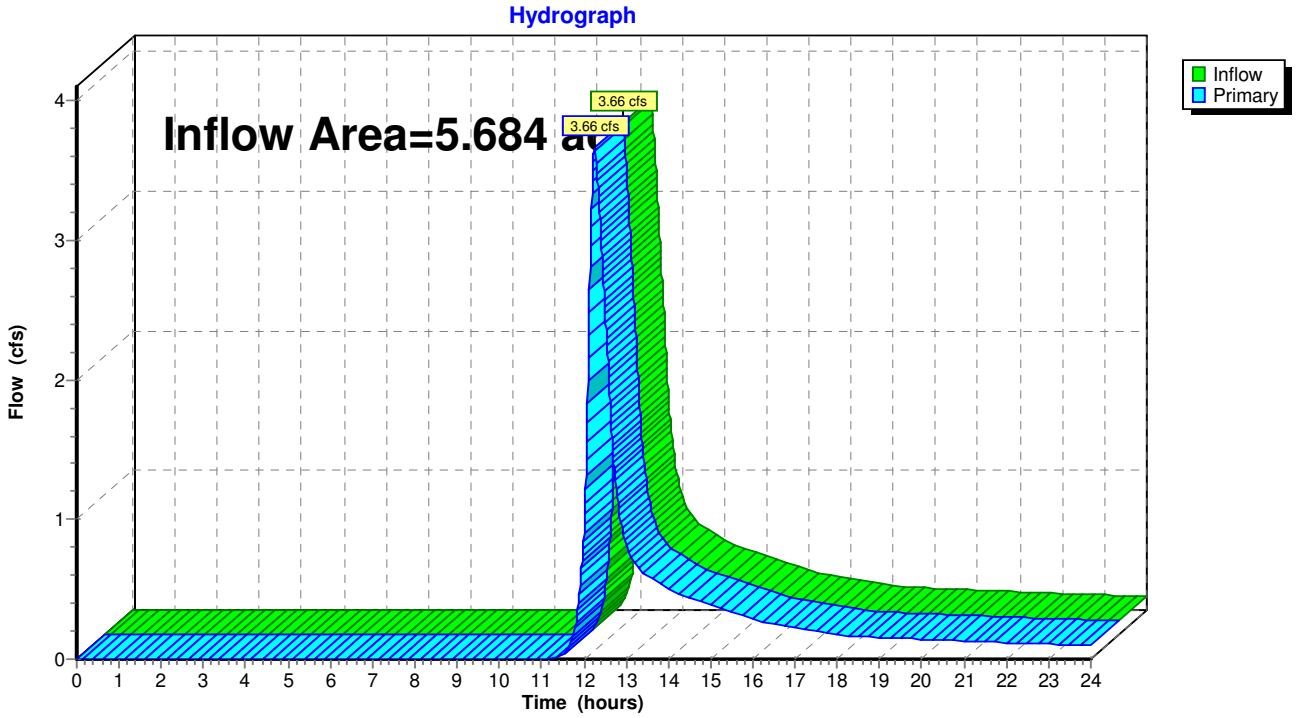
Summary for Pond AP-2: Easement Line

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

Inflow Area =	5.684 ac,	0.00% Impervious,	Inflow Depth >	0.85"	for 2 YR-Cornell event
Inflow =	3.66 cfs @	12.26 hrs,	Volume=	0.401 af	
Primary =	3.66 cfs @	12.26 hrs,	Volume=	0.401 af,	Atten= 0%, Lag= 0.0 min

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

Pond AP-2: Easement Line



Summary for Pond OFF-SITE: Existing Off-Site Pond

Inflow Area =	9.880 ac,	0.00% Impervious,	Inflow Depth >	1.06"	for 2 YR-Cornell event
Inflow =	8.18 cfs @	12.26 hrs,	Volume=	0.872 af	
Outflow =	0.27 cfs @	20.23 hrs,	Volume=	0.258 af,	Atten= 97%, Lag= 478.2 min
Discarded =	0.27 cfs @	20.23 hrs,	Volume=	0.258 af	
Primary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 436.29' @ 20.23 hrs Surf.Area= 11,555 sf Storage= 27,286 cf

Plug-Flow detention time= 362.0 min calculated for 0.258 af (30% of inflow)
Center-of-Mass det. time= 221.8 min (1,091.5 - 869.6)

Volume	Invert	Avail.Storage	Storage Description
#1	432.00'	66,840 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

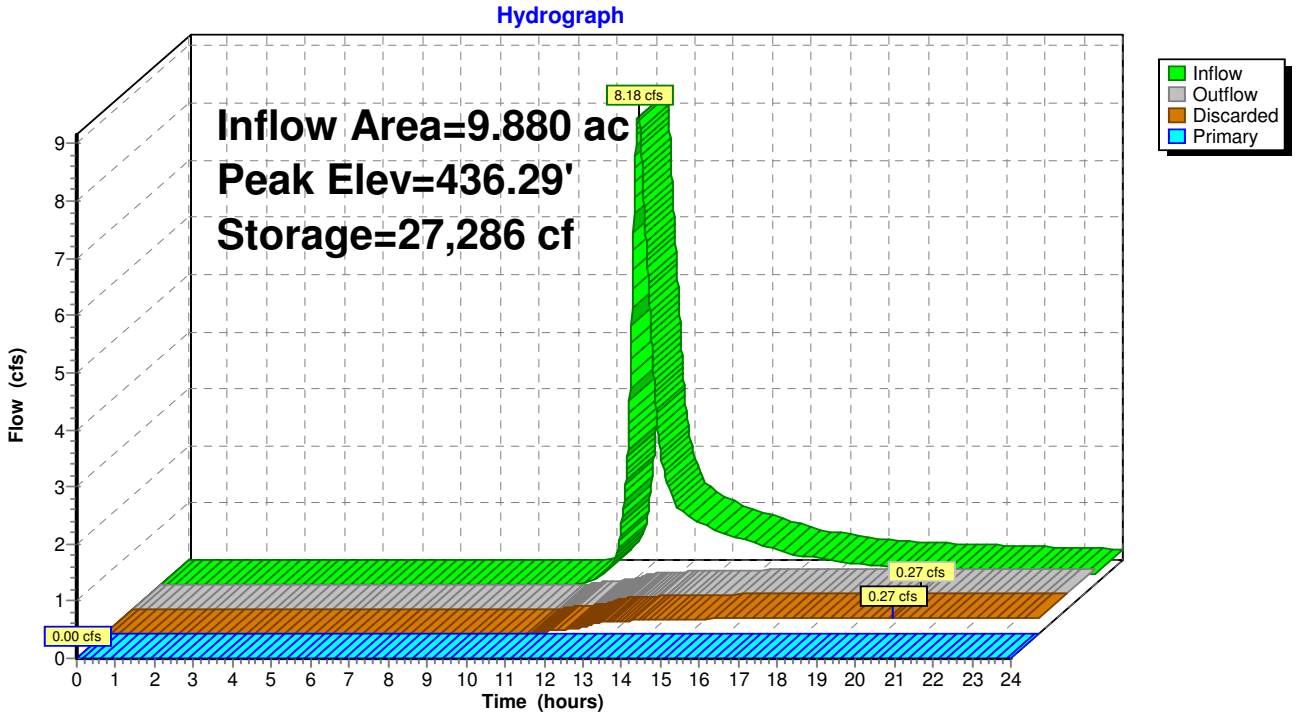
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
432.00	3,000	0	0
434.00	5,120	8,120	8,120
436.00	10,800	15,920	24,040
438.00	16,000	26,800	50,840
439.00	16,000	16,000	66,840

Device	Routing	Invert	Outlet Devices
#1	Primary	438.00'	**160.0' long x 10.0' 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) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Discarded	432.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.27 cfs @ 20.23 hrs HW=436.29' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.27 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=432.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond OFF-SITE: Existing Off-Site Pond



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PRE-1: Pre Development Runoff Area=378,354 sf 6.04% Impervious Runoff Depth>2.19"
Flow Length=1,440' Tc=17.0 min CN=73 Runoff=15.90 cfs 1.582 af

Subcatchment PRE-2: Pre Development Runoff Area=247,604 sf 0.00% Impervious Runoff Depth>1.95"
Flow Length=760' Tc=16.7 min CN=70 Runoff=9.22 cfs 0.922 af

Subcatchment PRE-A: Off Site Area to Off Runoff Area=9.880 ac 0.00% Impervious Runoff Depth>2.27"
Tc=18.0 min CN=74 Runoff=18.42 cfs 1.867 af

Pond AP-1: Providence Road Drainage System Inflow=15.90 cfs 1.903 af
Primary=15.90 cfs 1.903 af

Pond AP-2: Easement Line Inflow=9.22 cfs 0.922 af
Primary=9.22 cfs 0.922 af

Pond OFF-SITE: Existing Off-Site Pond Peak Elev=438.02' Storage=51,207 cf Inflow=18.42 cfs 1.867 af
Discarded=0.38 cfs 0.381 af Primary=1.53 cfs 0.321 af Outflow=1.91 cfs 0.701 af

Total Runoff Area = 24.250 ac Runoff Volume = 4.372 af Average Runoff Depth = 2.16"
97.84% Pervious = 23.725 ac 2.16% Impervious = 0.525 ac

Summary for Subcatchment PRE-1: Pre Development Area 1

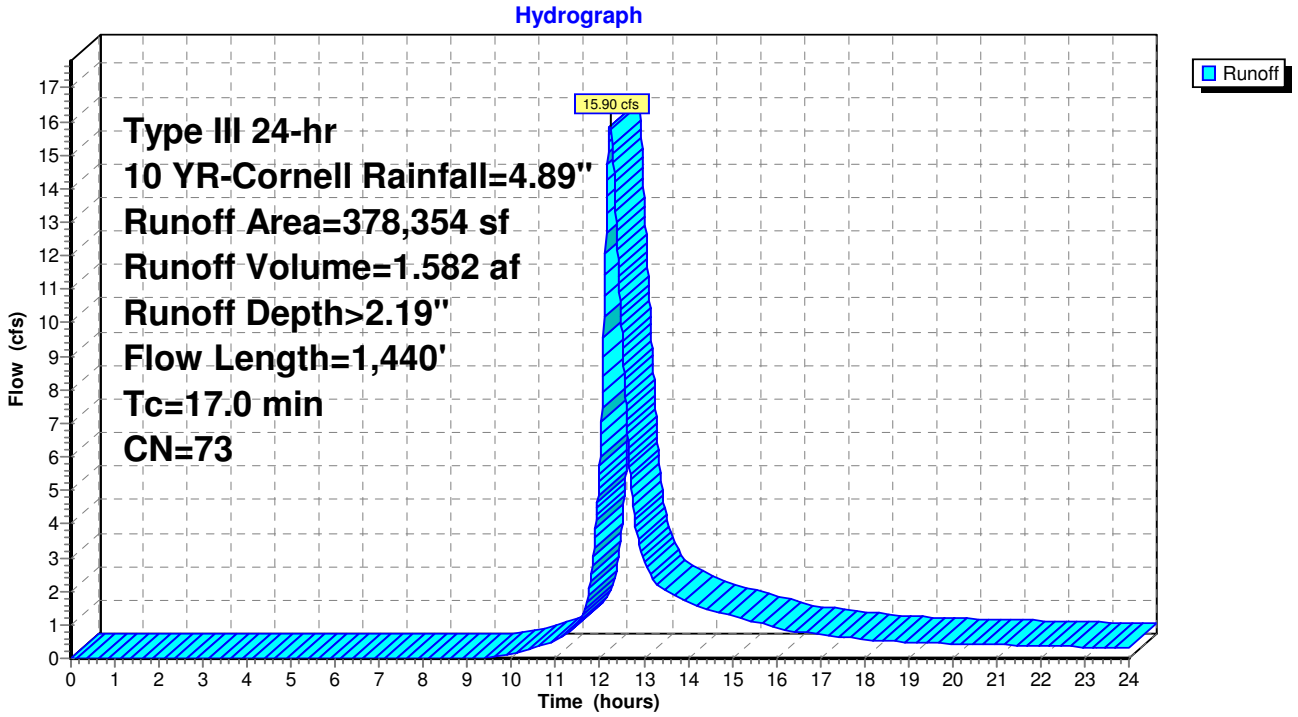
Runoff = 15.90 cfs @ 12.24 hrs, Volume= 1.582 af, Depth> 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YR-Cornell Rainfall=4.89"

	Area (sf)	CN	Description
	99,084	70	Woods, Good, HSG C
	5,622	89	Gravel roads, HSG C
*	90,371	74	>75% Grass cover, Good, HSG C (Lots)
*	22,849	98	Paved parking, HSG C (Lots)
*	160,428	70	Woods, Good, HSG C (Lots)
	378,354	73	Weighted Average
	355,505		93.96% Pervious Area
	22,849		6.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0900	0.12		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.24"
1.2	120	0.1100	1.66		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
1.3	460	0.1300	5.80		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
7.8	810	0.1200	1.73		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
17.0	1,440	Total			

Subcatchment PRE-1: Pre Development Area 1



Summary for Subcatchment PRE-2: Pre Development Area 2

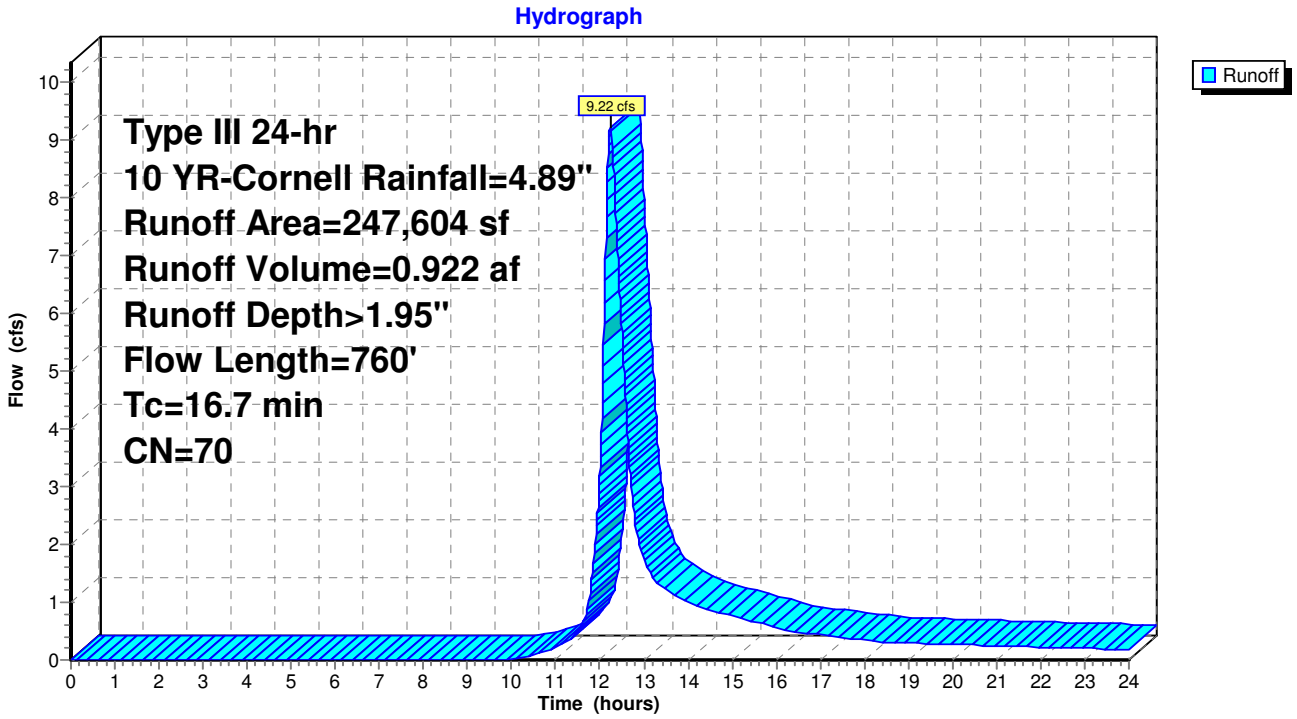
Runoff = 9.22 cfs @ 12.23 hrs, Volume= 0.922 af, Depth> 1.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YR-Cornell Rainfall=4.89"

Area (sf)	CN	Description
243,947	70	Woods, Good, HSG C
3,657	89	Gravel roads, HSG C
247,604	70	Weighted Average
247,604		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.24"
3.6	337	0.0949	1.54		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.9	126	0.2380	2.44		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
2.9	247	0.0810	1.42		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
16.7	760	Total			

Subcatchment PRE-2: Pre Development Area 2



Summary for Subcatchment PRE-A: Off Site Area to Off Site Basin

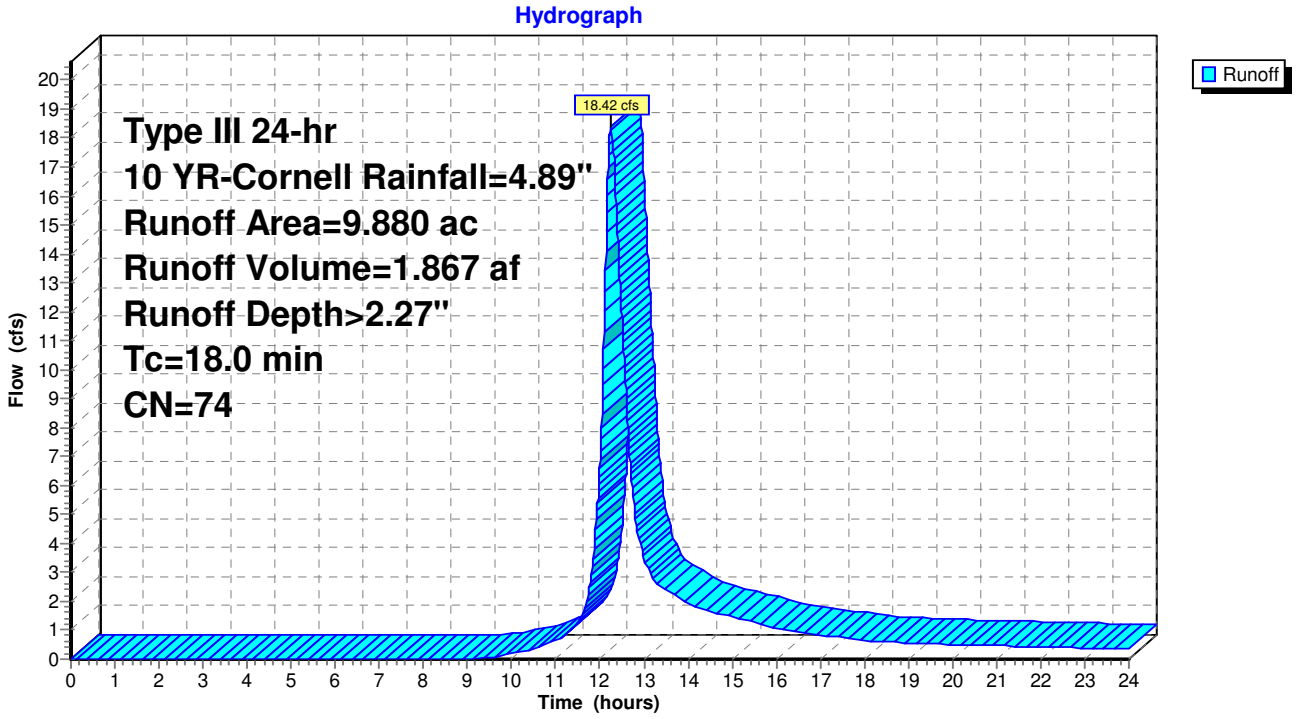
Runoff = 18.42 cfs @ 12.26 hrs, Volume= 1.867 af, Depth> 2.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YR-Cornell Rainfall=4.89"

	Area (ac)	CN	Description
*	9.880	74	Taken from Record Calculations
	9.880		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.0					**Direct Entry, Taken from Record Calculations**

Subcatchment PRE-A: Off Site Area to Off Site Basin



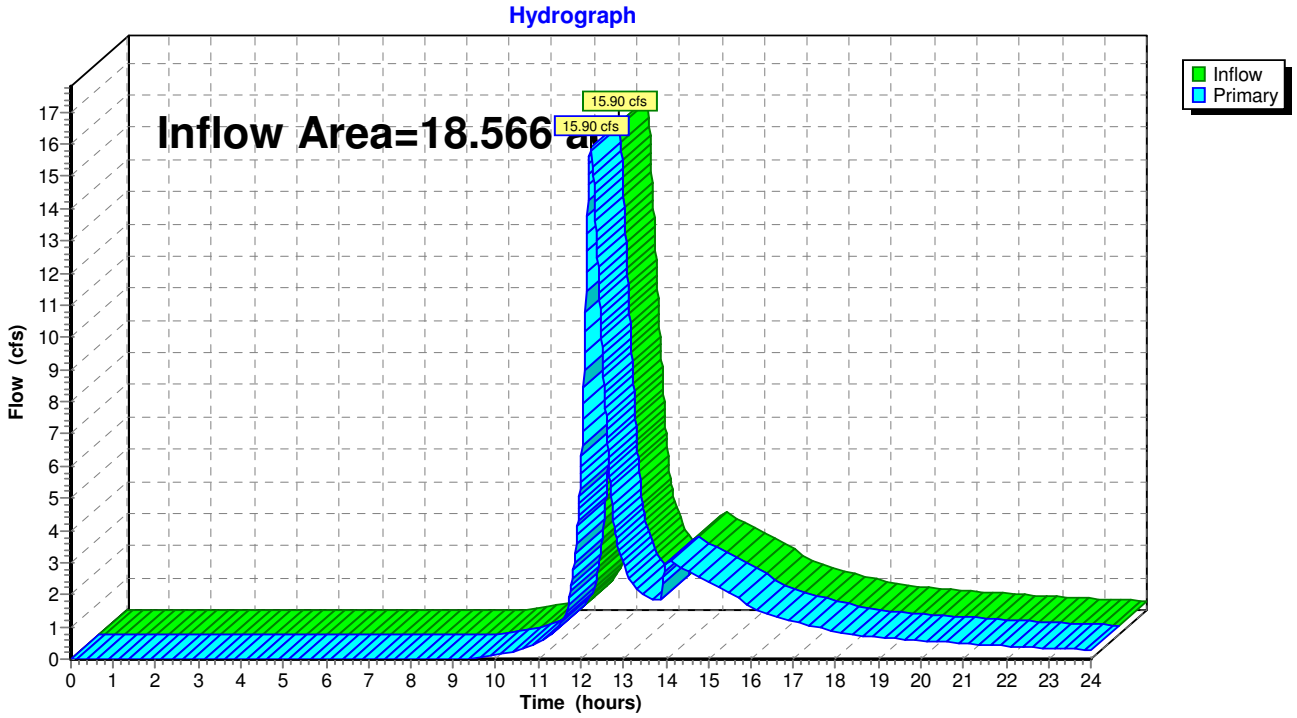
Summary for Pond AP-1: Providence Road Drainage System

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

Inflow Area = 18.566 ac, 2.83% Impervious, Inflow Depth > 1.23" for 10 YR-Cornell event
Inflow = 15.90 cfs @ 12.24 hrs, Volume= 1.903 af
Primary = 15.90 cfs @ 12.24 hrs, Volume= 1.903 af, Atten= 0%, Lag= 0.0 min

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

Pond AP-1: Providence Road Drainage System



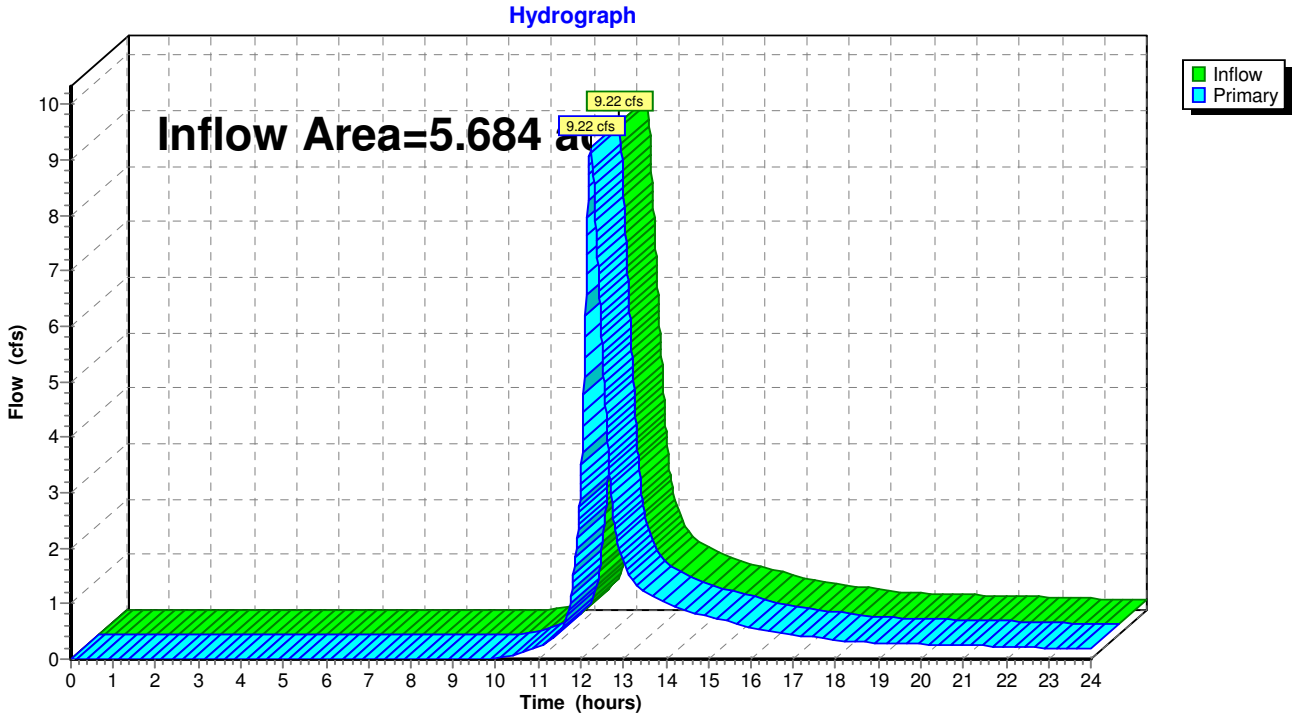
Summary for Pond AP-2: Easement Line

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

Inflow Area =	5.684 ac,	0.00% Impervious,	Inflow Depth >	1.95"	for 10 YR-Cornell event
Inflow =	9.22 cfs @	12.23 hrs,	Volume=	0.922 af	
Primary =	9.22 cfs @	12.23 hrs,	Volume=	0.922 af,	Atten= 0%, Lag= 0.0 min

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

Pond AP-2: Easement Line



Summary for Pond OFF-SITE: Existing Off-Site Pond

Inflow Area =	9.880 ac,	0.00% Impervious,	Inflow Depth >	2.27"	for 10 YR-Cornell event
Inflow =	18.42 cfs @	12.26 hrs,	Volume=	1.867 af	
Outflow =	1.91 cfs @	14.08 hrs,	Volume=	0.701 af,	Atten= 90%, Lag= 109.3 min
Discarded =	0.38 cfs @	13.90 hrs,	Volume=	0.381 af	
Primary =	1.53 cfs @	14.08 hrs,	Volume=	0.321 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 438.02' @ 14.08 hrs Surf.Area= 16,000 sf Storage= 51,207 cf

Plug-Flow detention time= 301.7 min calculated for 0.701 af (38% of inflow)
Center-of-Mass det. time= 175.6 min (1,022.8 - 847.2)

Volume	Invert	Avail.Storage	Storage Description
#1	432.00'	66,840 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

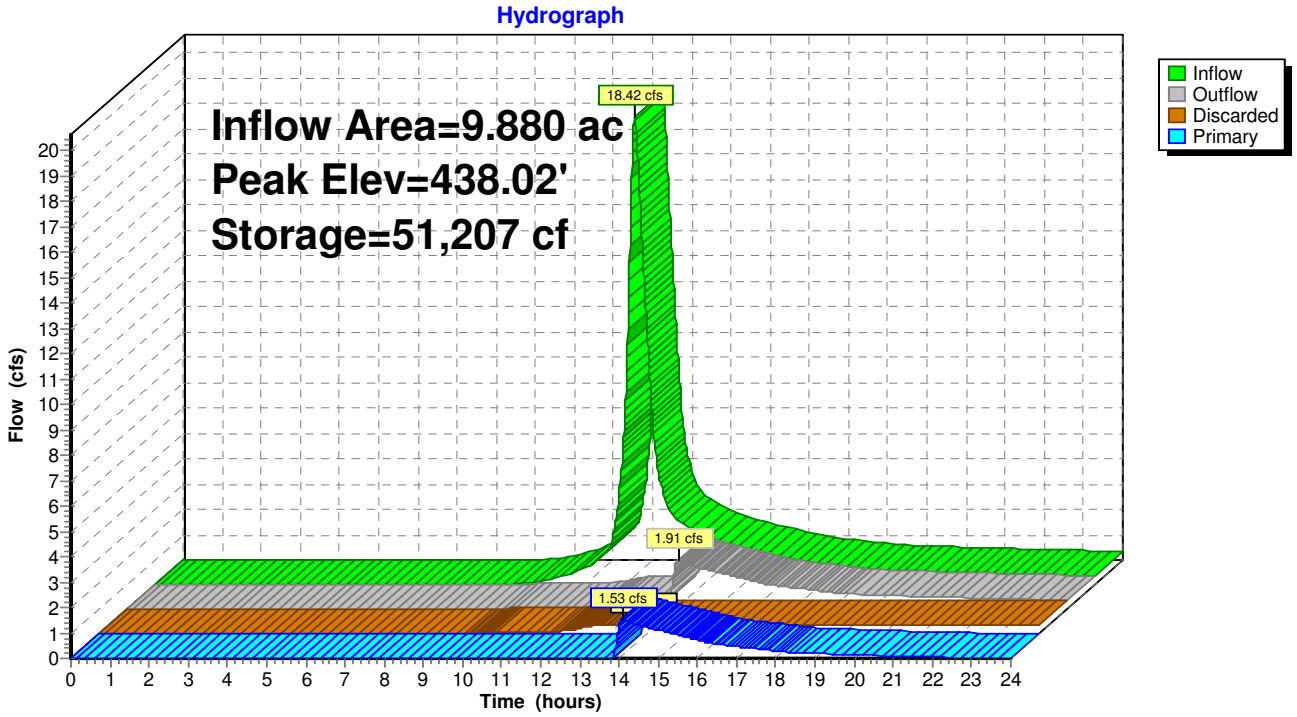
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
432.00	3,000	0	0
434.00	5,120	8,120	8,120
436.00	10,800	15,920	24,040
438.00	16,000	26,800	50,840
439.00	16,000	16,000	66,840

Device	Routing	Invert	Outlet Devices
#1	Primary	438.00'	**160.0' long x 10.0' 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) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Discarded	432.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.38 cfs @ 13.90 hrs HW=438.00' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.38 cfs)

Primary OutFlow Max=1.38 cfs @ 14.08 hrs HW=438.02' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 1.38 cfs @ 0.38 fps)

Pond OFF-SITE: Existing Off-Site Pond



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PRE-1: Pre Development Runoff Area=378,354 sf 6.04% Impervious Runoff Depth>3.23"
Flow Length=1,440' Tc=17.0 min CN=73 Runoff=23.71 cfs 2.336 af

Subcatchment PRE-2: Pre Development Runoff Area=247,604 sf 0.00% Impervious Runoff Depth>2.94"
Flow Length=760' Tc=16.7 min CN=70 Runoff=14.18 cfs 1.392 af

Subcatchment PRE-A: Off Site Area to Off Runoff Area=9.880 ac 0.00% Impervious Runoff Depth>3.32"
Tc=18.0 min CN=74 Runoff=27.18 cfs 2.737 af

Pond AP-1: Providence Road Drainage System Inflow=26.46 cfs 3.509 af
Primary=26.46 cfs 3.509 af

Pond AP-2: Easement Line Inflow=14.18 cfs 1.392 af
Primary=14.18 cfs 1.392 af

Pond OFF-SITE: Existing Off-Site Pond Peak Elev=438.11' Storage=52,542 cf Inflow=27.18 cfs 2.737 af
Discarded=0.38 cfs 0.396 af Primary=14.21 cfs 1.174 af Outflow=14.59 cfs 1.569 af

Total Runoff Area = 24.250 ac Runoff Volume = 6.464 af Average Runoff Depth = 3.20"
97.84% Pervious = 23.725 ac 2.16% Impervious = 0.525 ac

Summary for Subcatchment PRE-1: Pre Development Area 1

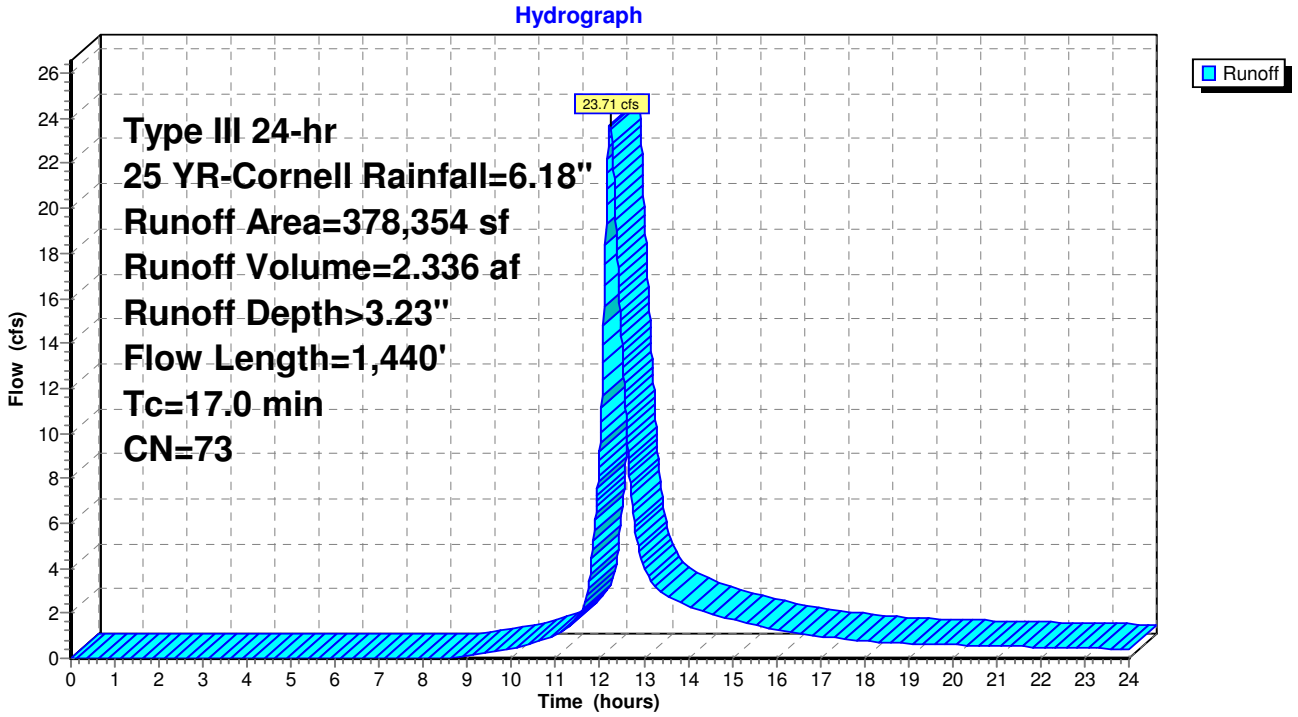
Runoff = 23.71 cfs @ 12.23 hrs, Volume= 2.336 af, Depth> 3.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YR-Cornell Rainfall=6.18"

	Area (sf)	CN	Description
	99,084	70	Woods, Good, HSG C
	5,622	89	Gravel roads, HSG C
*	90,371	74	>75% Grass cover, Good, HSG C (Lots)
*	22,849	98	Paved parking, HSG C (Lots)
*	160,428	70	Woods, Good, HSG C (Lots)
	378,354	73	Weighted Average
	355,505		93.96% Pervious Area
	22,849		6.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0900	0.12		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.24"
1.2	120	0.1100	1.66		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
1.3	460	0.1300	5.80		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
7.8	810	0.1200	1.73		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
17.0	1,440	Total			

Subcatchment PRE-1: Pre Development Area 1



Summary for Subcatchment PRE-2: Pre Development Area 2

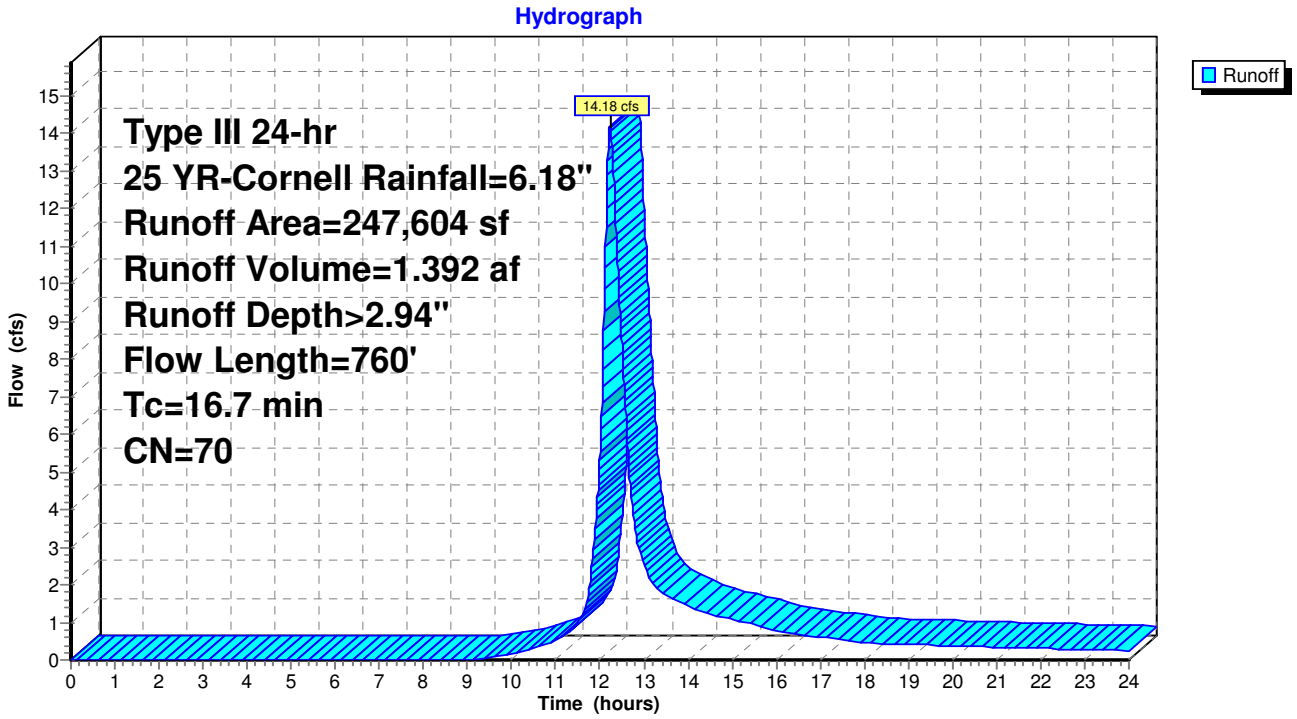
Runoff = 14.18 cfs @ 12.23 hrs, Volume= 1.392 af, Depth> 2.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YR-Cornell Rainfall=6.18"

Area (sf)	CN	Description
243,947	70	Woods, Good, HSG C
3,657	89	Gravel roads, HSG C
247,604	70	Weighted Average
247,604		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.24"
3.6	337	0.0949	1.54		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.9	126	0.2380	2.44		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
2.9	247	0.0810	1.42		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
16.7	760	Total			

Subcatchment PRE-2: Pre Development Area 2



Summary for Subcatchment PRE-A: Off Site Area to Off Site Basin

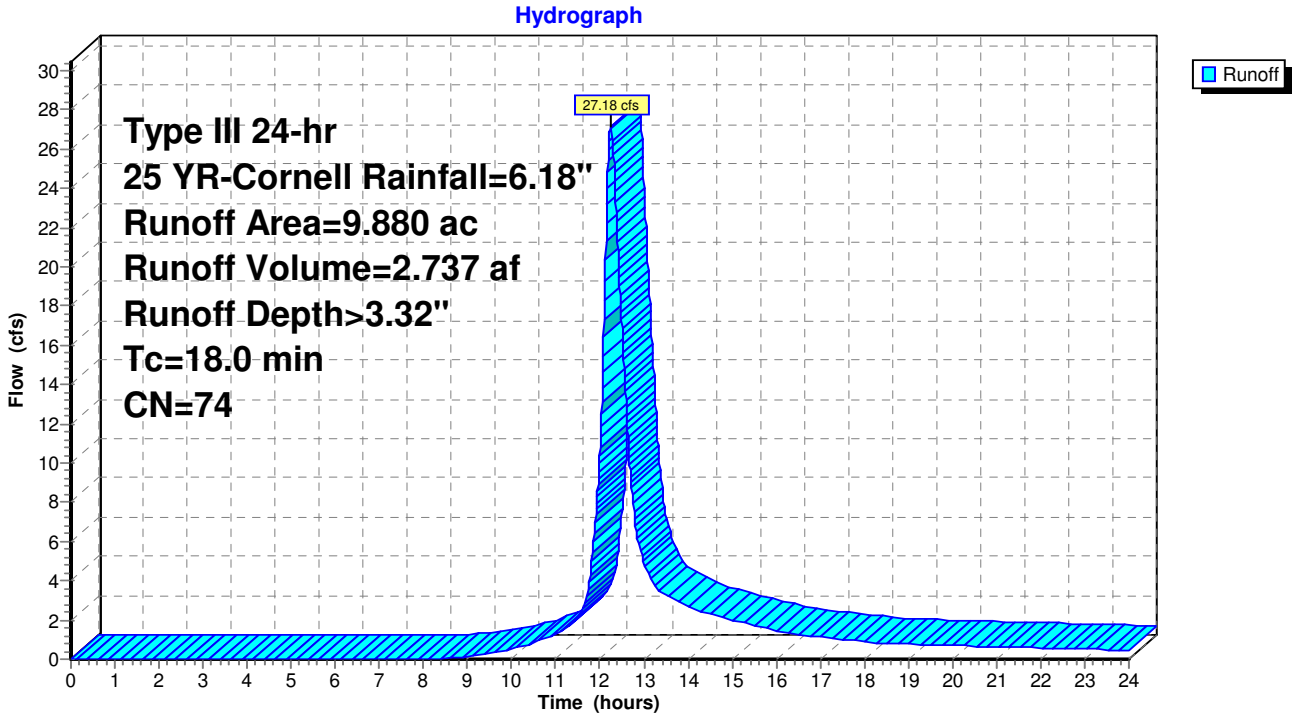
Runoff = 27.18 cfs @ 12.25 hrs, Volume= 2.737 af, Depth> 3.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YR-Cornell Rainfall=6.18"

	Area (ac)	CN	Description
*	9.880	74	Taken from Record Calculations
	9.880		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.0					**Direct Entry, Taken from Record Calculations**

Subcatchment PRE-A: Off Site Area to Off Site Basin



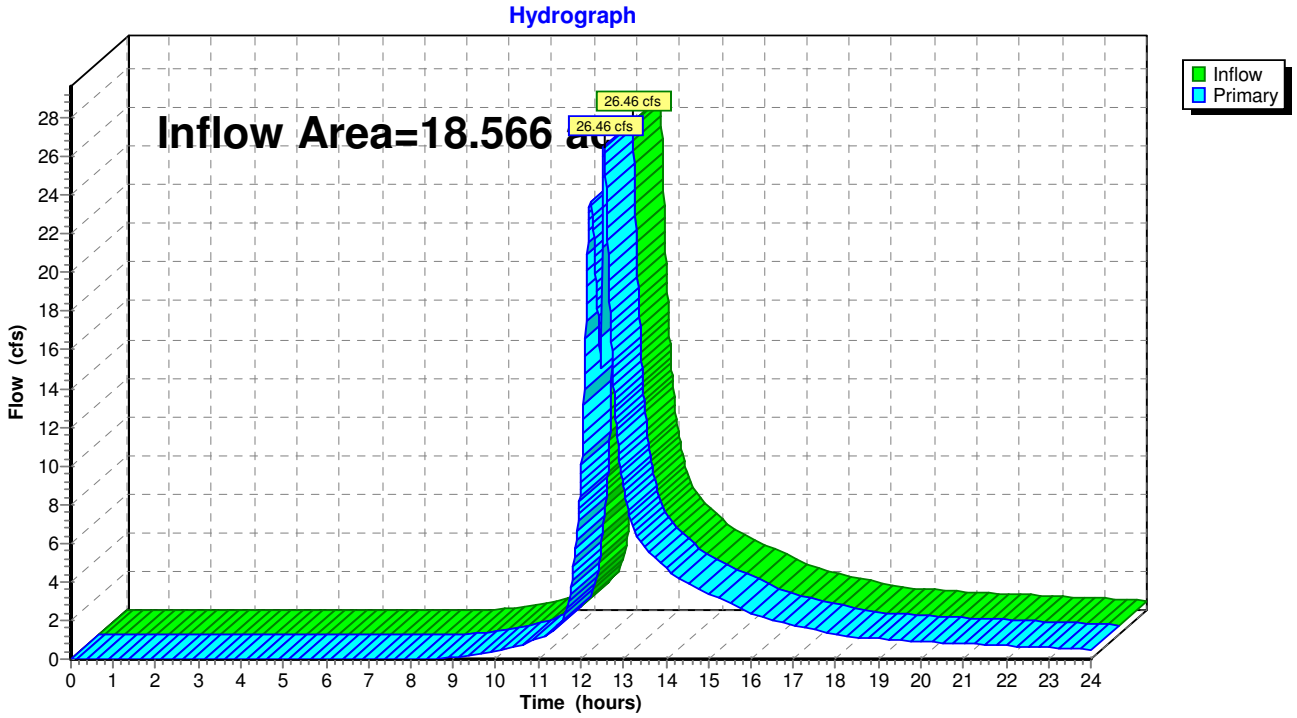
Summary for Pond AP-1: Providence Road Drainage System

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

Inflow Area = 18.566 ac, 2.83% Impervious, Inflow Depth > 2.27" for 25 YR-Cornell event
Inflow = 26.46 cfs @ 12.54 hrs, Volume= 3.509 af
Primary = 26.46 cfs @ 12.54 hrs, Volume= 3.509 af, Atten= 0%, Lag= 0.0 min

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

Pond AP-1: Providence Road Drainage System



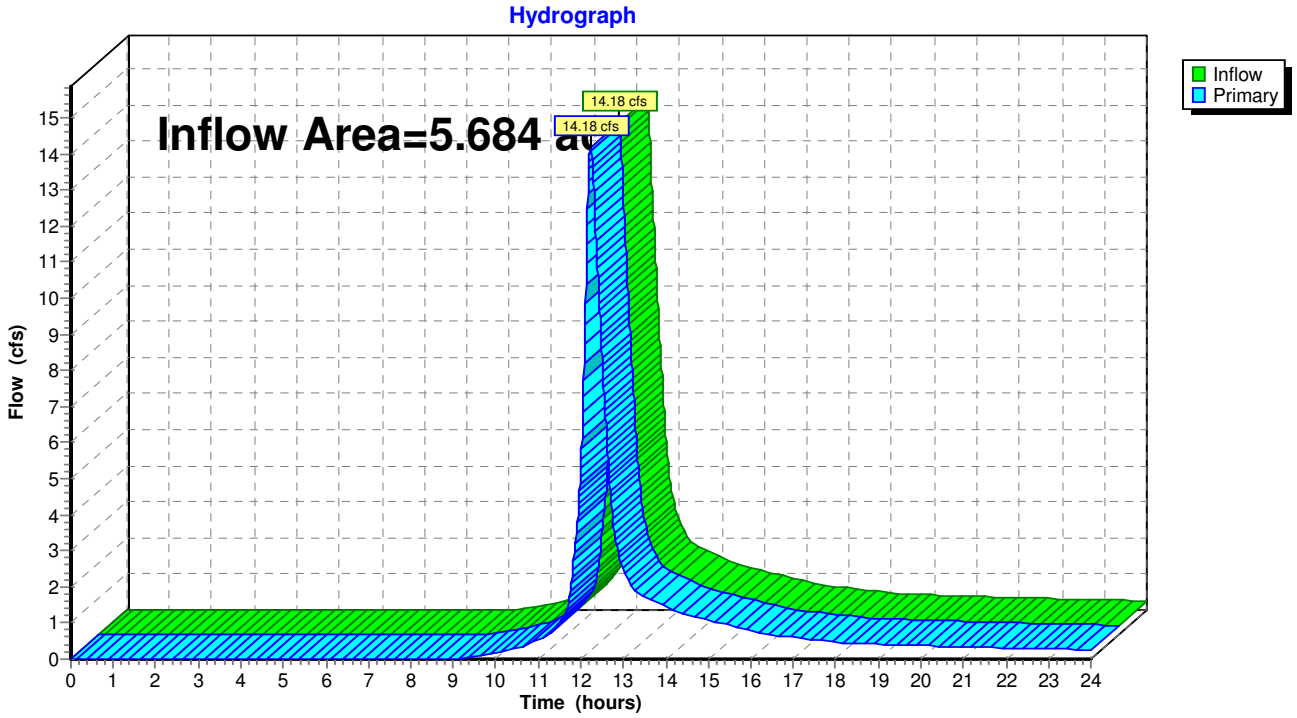
Summary for Pond AP-2: Easement Line

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

Inflow Area = 5.684 ac, 0.00% Impervious, Inflow Depth > 2.94" for 25 YR-Cornell event
Inflow = 14.18 cfs @ 12.23 hrs, Volume= 1.392 af
Primary = 14.18 cfs @ 12.23 hrs, Volume= 1.392 af, Atten= 0%, Lag= 0.0 min

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

Pond AP-2: Easement Line



Summary for Pond OFF-SITE: Existing Off-Site Pond

Inflow Area =	9.880 ac,	0.00% Impervious,	Inflow Depth >	3.32"	for 25 YR-Cornell event
Inflow =	27.18 cfs @	12.25 hrs,	Volume=	2.737 af	
Outflow =	14.59 cfs @	12.56 hrs,	Volume=	1.569 af,	Atten= 46%, Lag= 18.2 min
Discarded =	0.38 cfs @	12.48 hrs,	Volume=	0.396 af	
Primary =	14.21 cfs @	12.56 hrs,	Volume=	1.174 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 438.11' @ 12.56 hrs Surf.Area= 16,000 sf Storage= 52,542 cf

Plug-Flow detention time= 198.8 min calculated for 1.569 af (57% of inflow)
Center-of-Mass det. time= 89.6 min (925.9 - 836.3)

Volume	Invert	Avail.Storage	Storage Description
#1	432.00'	66,840 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

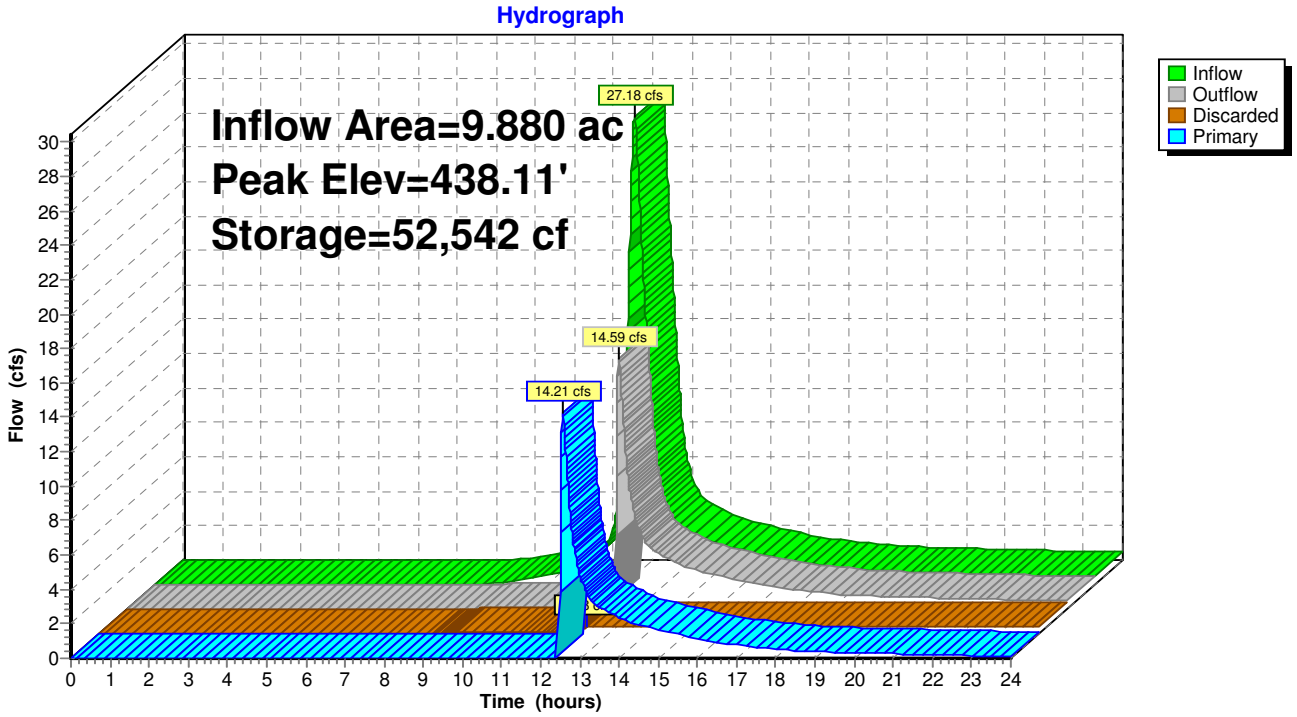
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
432.00	3,000	0	0
434.00	5,120	8,120	8,120
436.00	10,800	15,920	24,040
438.00	16,000	26,800	50,840
439.00	16,000	16,000	66,840

Device	Routing	Invert	Outlet Devices
#1	Primary	438.00'	**160.0' long x 10.0' 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) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Discarded	432.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.38 cfs @ 12.48 hrs HW=438.01' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.38 cfs)

Primary OutFlow Max=13.81 cfs @ 12.56 hrs HW=438.11' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 13.81 cfs @ 0.81 fps)

Pond OFF-SITE: Existing Off-Site Pond



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PRE-1: Pre Development Runoff Area=378,354 sf 6.04% Impervious Runoff Depth>5.54"
Flow Length=1,440' Tc=17.0 min CN=73 Runoff=40.72 cfs 4.012 af

Subcatchment PRE-2: Pre Development Runoff Area=247,604 sf 0.00% Impervious Runoff Depth>5.18"
Flow Length=760' Tc=16.7 min CN=70 Runoff=25.16 cfs 2.452 af

Subcatchment PRE-A: Off Site Area to Off Runoff Area=9.880 ac 0.00% Impervious Runoff Depth>5.66"
Tc=18.0 min CN=74 Runoff=46.18 cfs 4.664 af

Pond AP-1: Providence Road Drainage System Inflow=85.62 cfs 7.085 af
Primary=85.62 cfs 7.085 af

Pond AP-2: Easement Line Inflow=25.16 cfs 2.452 af
Primary=25.16 cfs 2.452 af

Pond OFF-SITE: Existing Off-Site Pond Peak Elev=438.23' Storage=54,588 cf Inflow=46.18 cfs 4.664 af
Discarded=0.38 cfs 0.421 af Primary=45.48 cfs 3.073 af Outflow=45.86 cfs 3.494 af

Total Runoff Area = 24.250 ac Runoff Volume = 11.128 af Average Runoff Depth = 5.51"
97.84% Pervious = 23.725 ac 2.16% Impervious = 0.525 ac

Summary for Subcatchment PRE-1: Pre Development Area 1

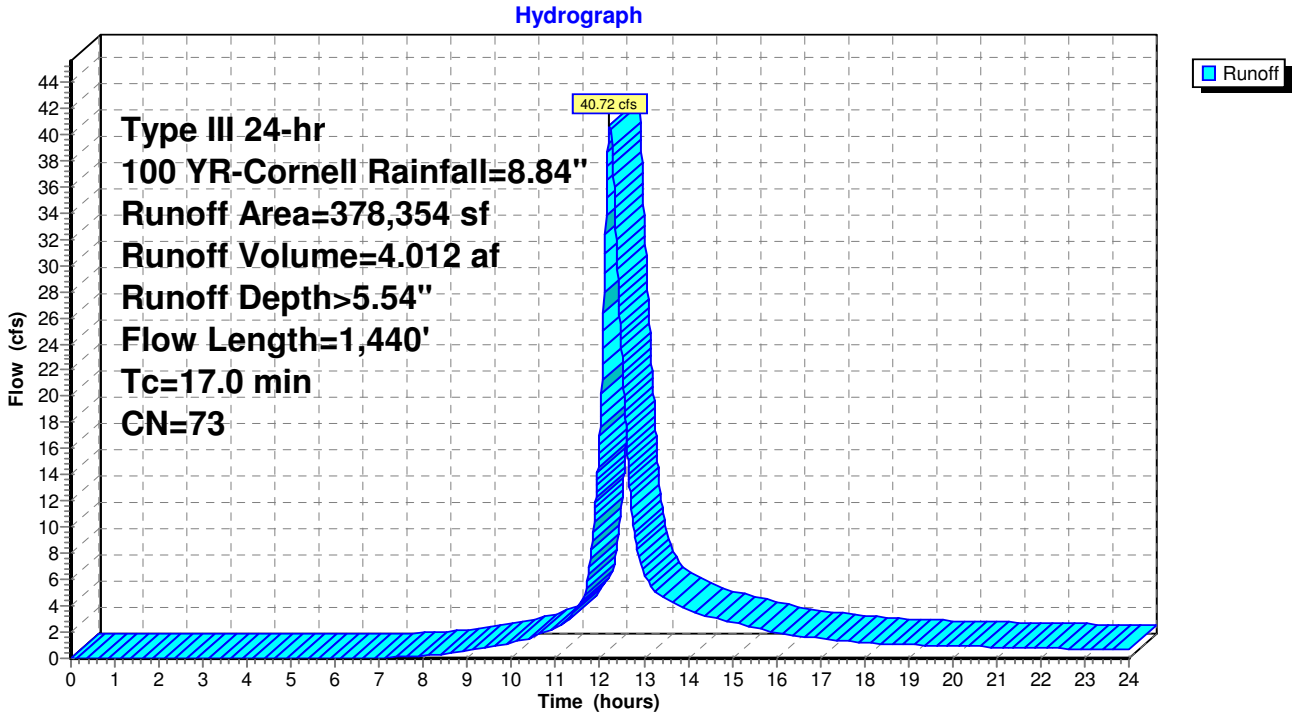
Runoff = 40.72 cfs @ 12.23 hrs, Volume= 4.012 af, Depth> 5.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YR-Cornell Rainfall=8.84"

	Area (sf)	CN	Description
	99,084	70	Woods, Good, HSG C
	5,622	89	Gravel roads, HSG C
*	90,371	74	>75% Grass cover, Good, HSG C (Lots)
*	22,849	98	Paved parking, HSG C (Lots)
*	160,428	70	Woods, Good, HSG C (Lots)
	378,354	73	Weighted Average
	355,505		93.96% Pervious Area
	22,849		6.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0900	0.12		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.24"
1.2	120	0.1100	1.66		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
1.3	460	0.1300	5.80		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
7.8	810	0.1200	1.73		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
17.0	1,440	Total			

Subcatchment PRE-1: Pre Development Area 1



Summary for Subcatchment PRE-2: Pre Development Area 2

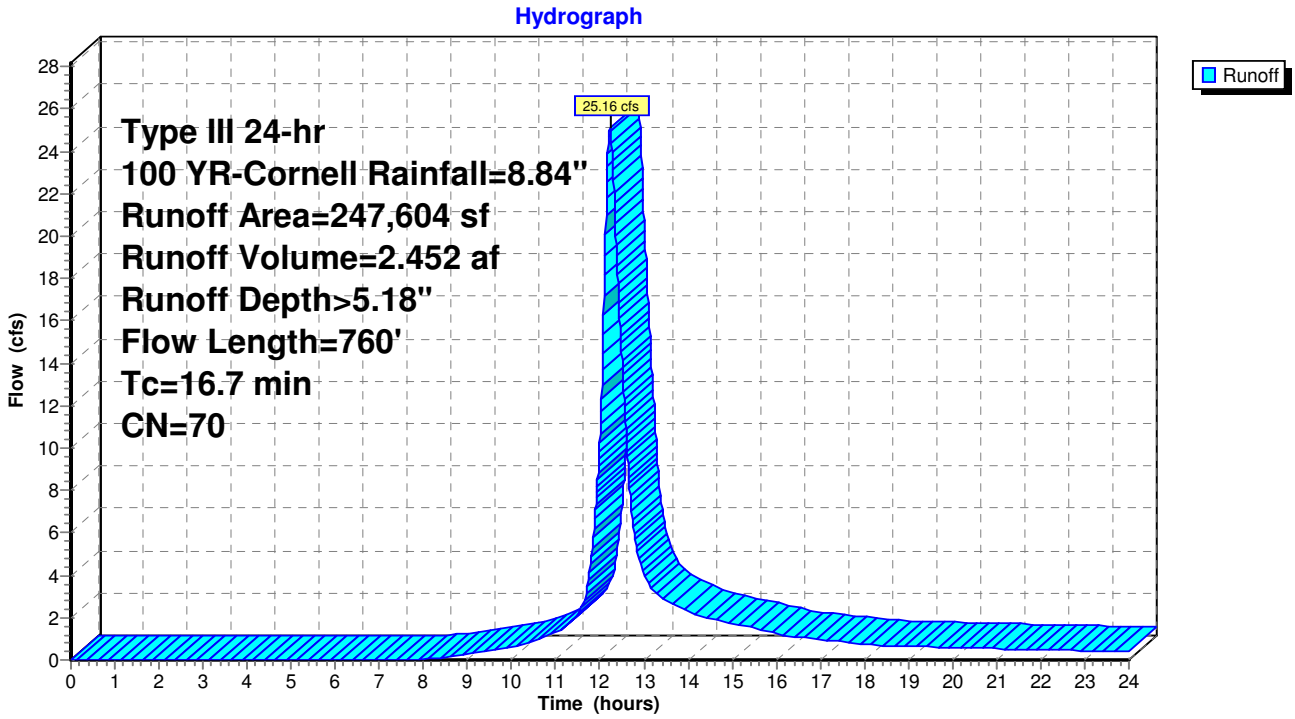
Runoff = 25.16 cfs @ 12.23 hrs, Volume= 2.452 af, Depth> 5.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YR-Cornell Rainfall=8.84"

Area (sf)	CN	Description
243,947	70	Woods, Good, HSG C
3,657	89	Gravel roads, HSG C
247,604	70	Weighted Average
247,604		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.24"
3.6	337	0.0949	1.54		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.9	126	0.2380	2.44		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
2.9	247	0.0810	1.42		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
16.7	760	Total			

Subcatchment PRE-2: Pre Development Area 2



Summary for Subcatchment PRE-A: Off Site Area to Off Site Basin

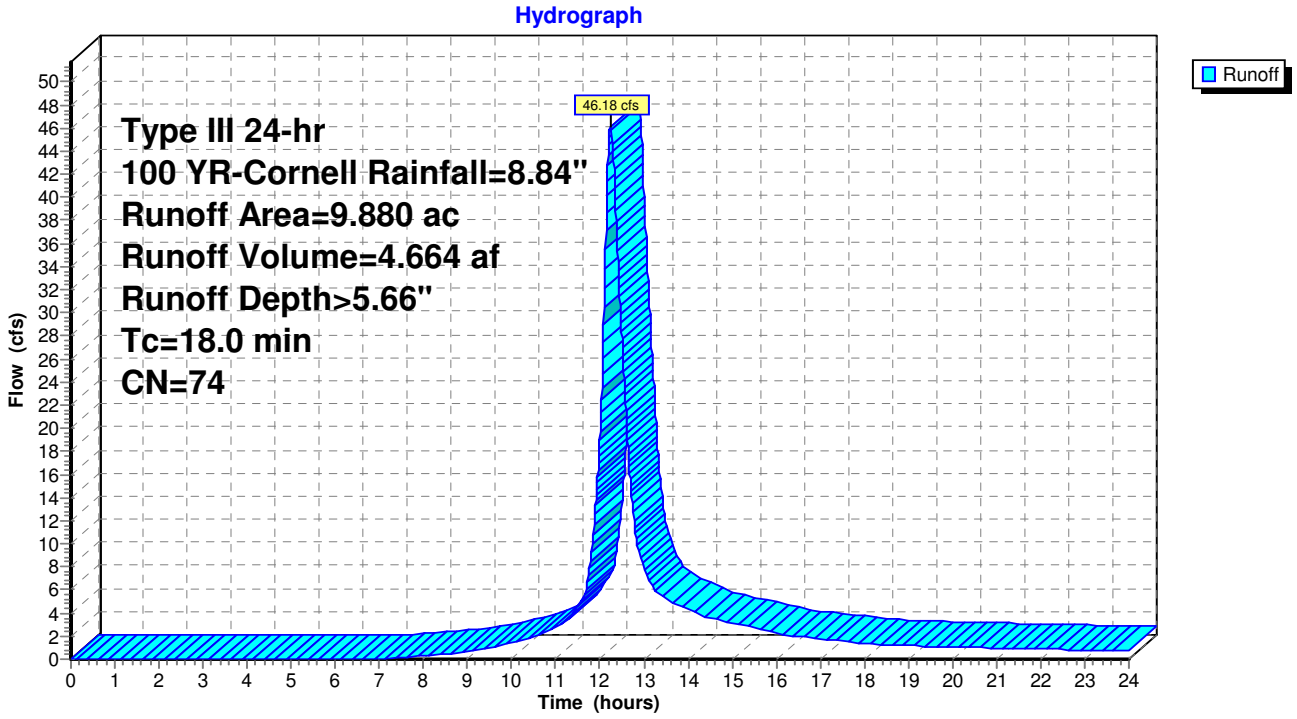
Runoff = 46.18 cfs @ 12.24 hrs, Volume= 4.664 af, Depth> 5.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YR-Cornell Rainfall=8.84"

	Area (ac)	CN	Description
*	9.880	74	Taken from Record Calculations
	9.880		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.0					**Direct Entry, Taken from Record Calculations**

Subcatchment PRE-A: Off Site Area to Off Site Basin



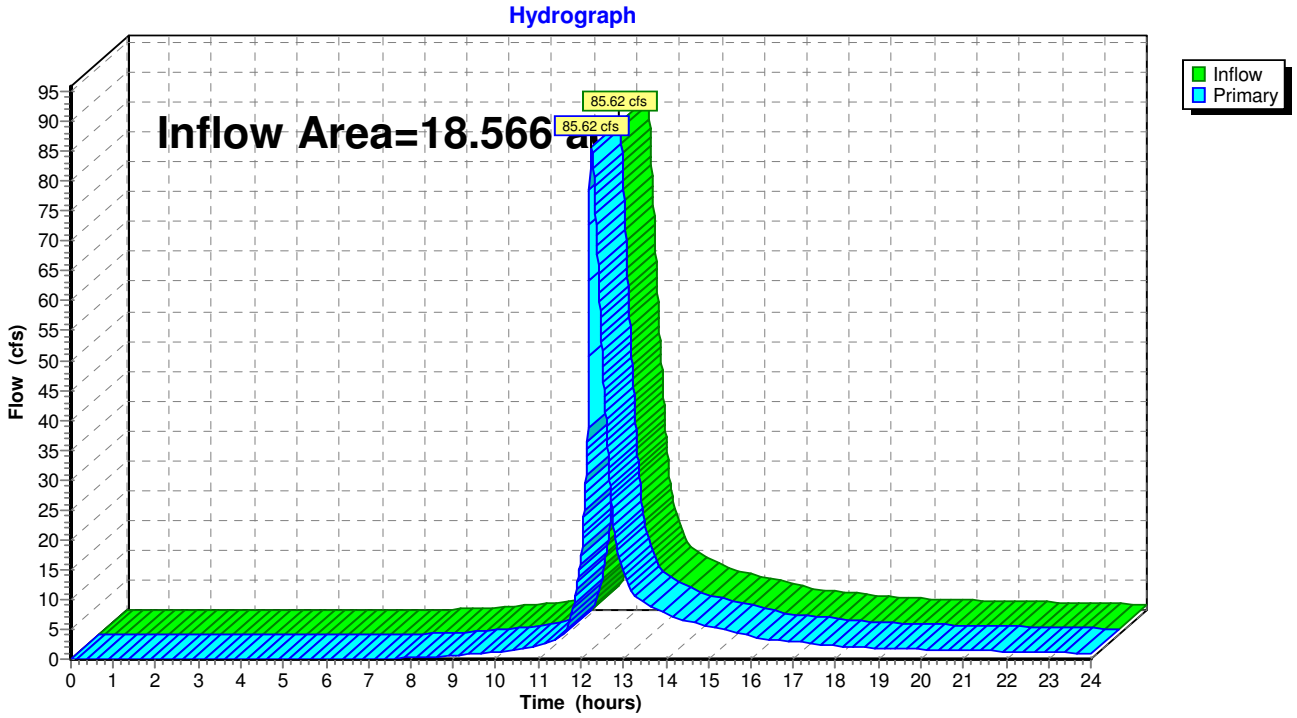
Summary for Pond AP-1: Providence Road Drainage System

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

Inflow Area = 18.566 ac, 2.83% Impervious, Inflow Depth > 4.58" for 100 YR-Cornell event
Inflow = 85.62 cfs @ 12.26 hrs, Volume= 7.085 af
Primary = 85.62 cfs @ 12.26 hrs, Volume= 7.085 af, Atten= 0%, Lag= 0.0 min

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

Pond AP-1: Providence Road Drainage System



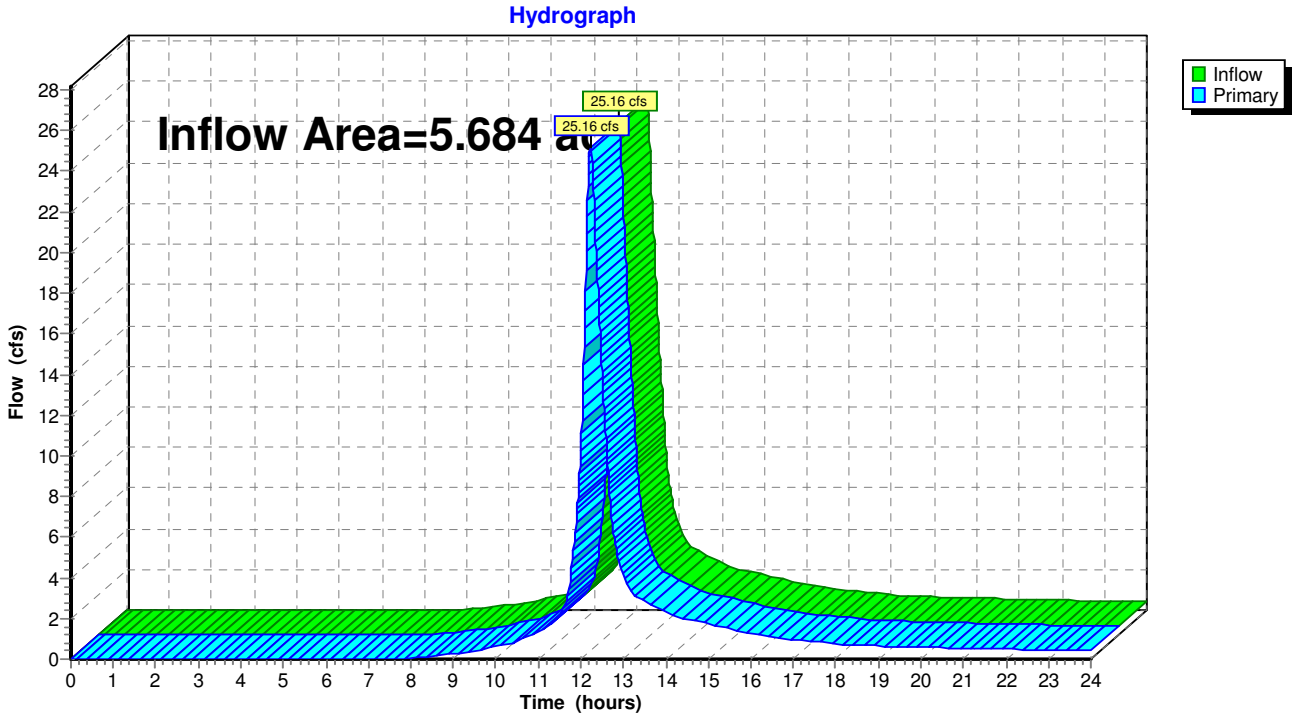
Summary for Pond AP-2: Easement Line

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

Inflow Area = 5.684 ac, 0.00% Impervious, Inflow Depth > 5.18" for 100 YR-Cornell event
Inflow = 25.16 cfs @ 12.23 hrs, Volume= 2.452 af
Primary = 25.16 cfs @ 12.23 hrs, Volume= 2.452 af, Atten= 0%, Lag= 0.0 min

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

Pond AP-2: Easement Line



Summary for Pond OFF-SITE: Existing Off-Site Pond

Inflow Area =	9.880 ac,	0.00% Impervious,	Inflow Depth >	5.66"	for 100 YR-Cornell event
Inflow =	46.18 cfs @	12.24 hrs,	Volume=	4.664 af	
Outflow =	45.86 cfs @	12.27 hrs,	Volume=	3.494 af,	Atten= 1%, Lag= 1.3 min
Discarded =	0.38 cfs @	12.17 hrs,	Volume=	0.421 af	
Primary =	45.48 cfs @	12.27 hrs,	Volume=	3.073 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 438.23' @ 12.27 hrs Surf.Area= 16,000 sf Storage= 54,588 cf

Plug-Flow detention time= 132.3 min calculated for 3.494 af (75% of inflow)
Center-of-Mass det. time= 47.5 min (868.7 - 821.2)

Volume	Invert	Avail.Storage	Storage Description
#1	432.00'	66,840 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

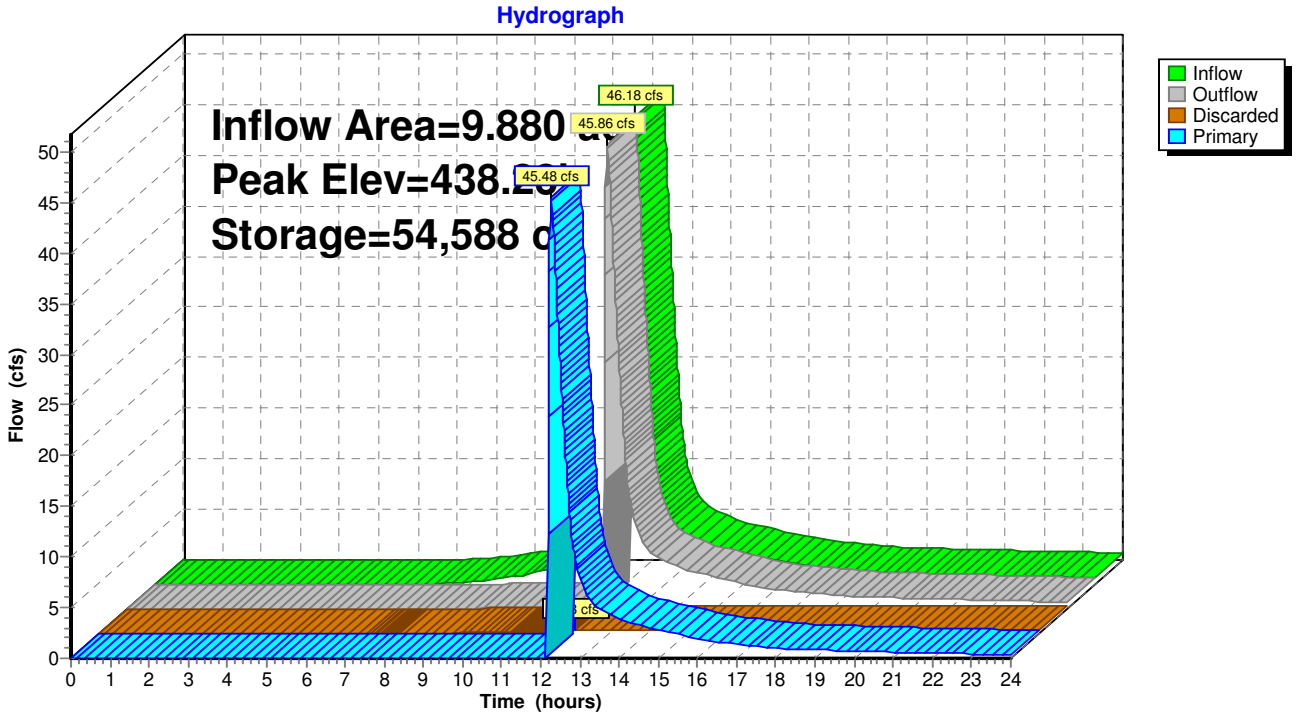
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
432.00	3,000	0	0
434.00	5,120	8,120	8,120
436.00	10,800	15,920	24,040
438.00	16,000	26,800	50,840
439.00	16,000	16,000	66,840

Device	Routing	Invert	Outlet Devices
#1	Primary	438.00'	**160.0' long x 10.0' 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) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Discarded	432.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.38 cfs @ 12.17 hrs HW=438.02' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.38 cfs)

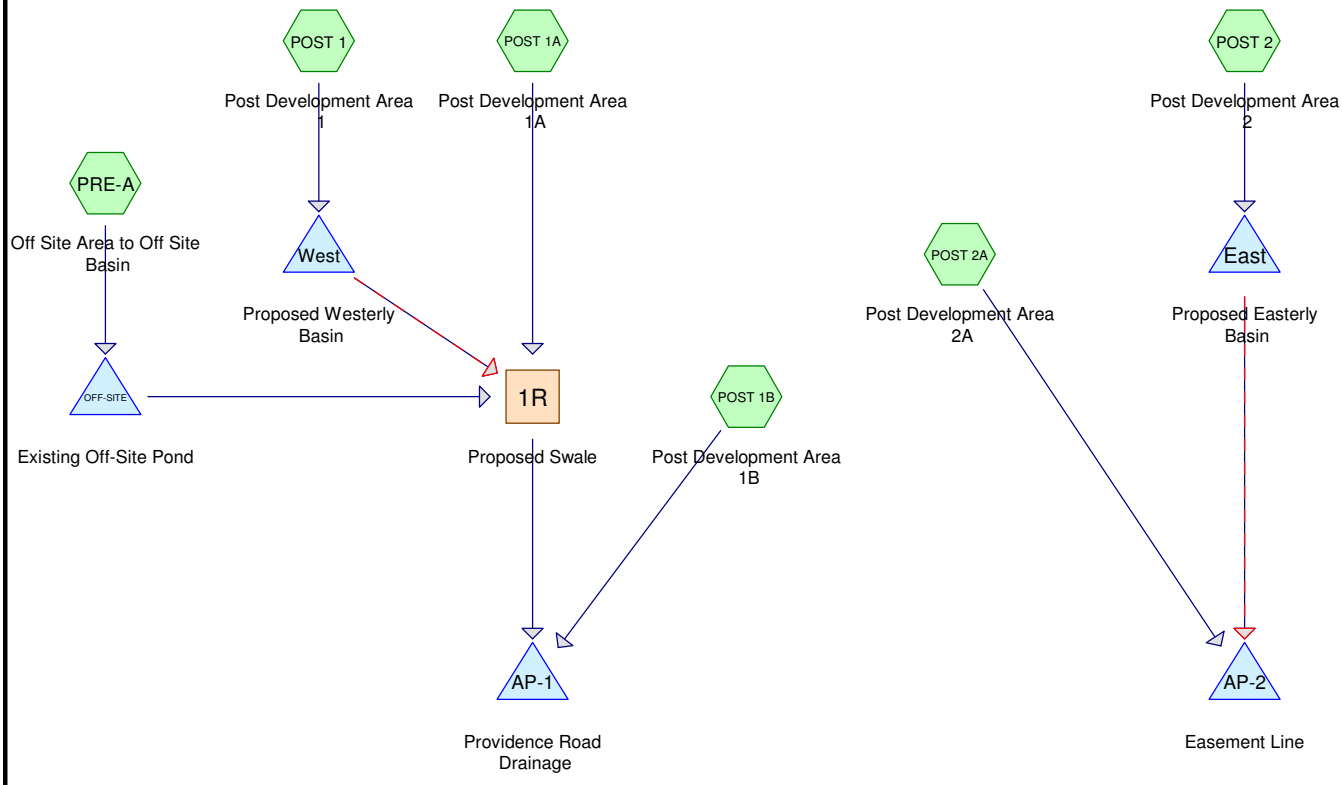
Primary OutFlow Max=45.36 cfs @ 12.27 hrs HW=438.23' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 45.36 cfs @ 1.21 fps)

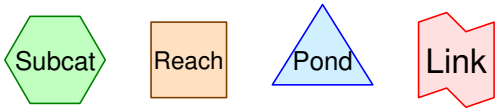
Pond OFF-SITE: Existing Off-Site Pond



Section 3

Revised Post Development Hydrologic Analysis





Routing Diagram for 2035-PostDevelopmentAnalysis-R3
Prepared by Field Engineering Co. Inc.
HydroCAD® 10.00-12 s/n 01897 © 2014 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.188	74	>75% Grass cover, Good, HSG C (POST 1A, POST 2A)
0.172	74	>75% Grass cover, Good, HSG C (Access) (POST 1A)
2.075	74	>75% Grass cover, Good, HSG C (Lots) (POST 1B)
0.019	98	Concrete Equipment Pads (POST 1)
0.655	89	Gravel roads, HSG C (POST 1, POST 1A, POST 2)
0.122	89	Gravel roads, HSG C (Access) (POST 1A)
3.953	74	Pasture/grassland/range, Good, HSG C (POST 1, POST 2)
0.223	98	Paved parking, HSG C (Access) (POST 1A)
0.525	98	Paved parking, HSG C (Lots) (POST 1B)
9.880	74	Taken from Record Calculations (PRE-A)
0.586	98	Unconnected pavement, HSG C (POST 1)
0.954	98	Unconnected pavement, HSG C (Panels) (POST 2)
0.391	98	Unconnected roofs, HSG C (POST 2A)
0.141	70	Woods, Good, HSG C (POST 2)
3.179	70	Woods, Good, HSG C (Lots) (POST 1A, POST 1B)
0.188	72	Woods/grass comb., Good, HSG C (POST 1)
24.250	**77**	**TOTAL AREA**

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment POST 1: Post Runoff Area=134,109 sf 19.66% Impervious Runoff Depth>1.30"
Flow Length=850' Tc=12.6 min UI Adjusted CN=78 Runoff=3.71 cfs 0.333 af

Subcatchment POST 1A: Post Runoff Area=67,090 sf 14.46% Impervious Runoff Depth>1.24"
Flow Length=160' Tc=9.9 min CN=77 Runoff=1.91 cfs 0.159 af

Subcatchment POST 1B: Post Runoff Area=218,556 sf 10.45% Impervious Runoff Depth>1.12"
Flow Length=700' Tc=14.7 min CN=75 Runoff=4.79 cfs 0.467 af

Subcatchment POST 2: Post Runoff Area=148,565 sf 27.98% Impervious Runoff Depth>1.36"
Flow Length=600' Tc=12.5 min UI Adjusted CN=79 Runoff=4.35 cfs 0.387 af

Subcatchment POST 2A: Post Runoff Area=57,638 sf 29.54% Impervious Runoff Depth>1.30"
Tc=10.0 min UI Adjusted CN=78 Runoff=1.73 cfs 0.143 af

Subcatchment PRE-A: Off Site Area to Off Runoff Area=9.880 ac 0.00% Impervious Runoff Depth>1.06"
Tc=18.0 min CN=74 Runoff=8.18 cfs 0.872 af

Reach 1R: Proposed Swale Avg. Flow Depth=0.15' Max Vel=3.70 fps Inflow=2.25 cfs 0.466 af
n=0.030 L=750.0' S=0.0773 '/' Capacity=59.15 cfs Outflow=2.15 cfs 0.464 af

Pond AP-1: Providence Road Drainage Inflow=6.87 cfs 0.931 af
Primary=6.87 cfs 0.931 af

Pond AP-2: Easement Line Inflow=2.08 cfs 0.520 af
Primary=2.08 cfs 0.520 af

Pond East: Proposed Easterly Basin Peak Elev=187.59' Storage=6,905 cf Inflow=4.35 cfs 0.387 af
Primary=0.87 cfs 0.377 af Secondary=0.00 cfs 0.000 af Outflow=0.87 cfs 0.377 af

Pond OFF-SITE: Existing Off-Site Pond Peak Elev=436.29' Storage=27,286 cf Inflow=8.18 cfs 0.872 af
Discarded=0.27 cfs 0.258 af Primary=0.00 cfs 0.000 af Outflow=0.27 cfs 0.258 af

Pond West: Proposed Westerly Basin Peak Elev=161.82' Storage=5,799 cf Inflow=3.71 cfs 0.333 af
Primary=0.72 cfs 0.307 af Secondary=0.00 cfs 0.000 af Outflow=0.72 cfs 0.307 af

Total Runoff Area = 24.250 ac Runoff Volume = 2.361 af Average Runoff Depth = 1.17"
88.88% Pervious = 21.552 ac 11.12% Impervious = 2.698 ac

Summary for Subcatchment POST 1: Post Development Area 1

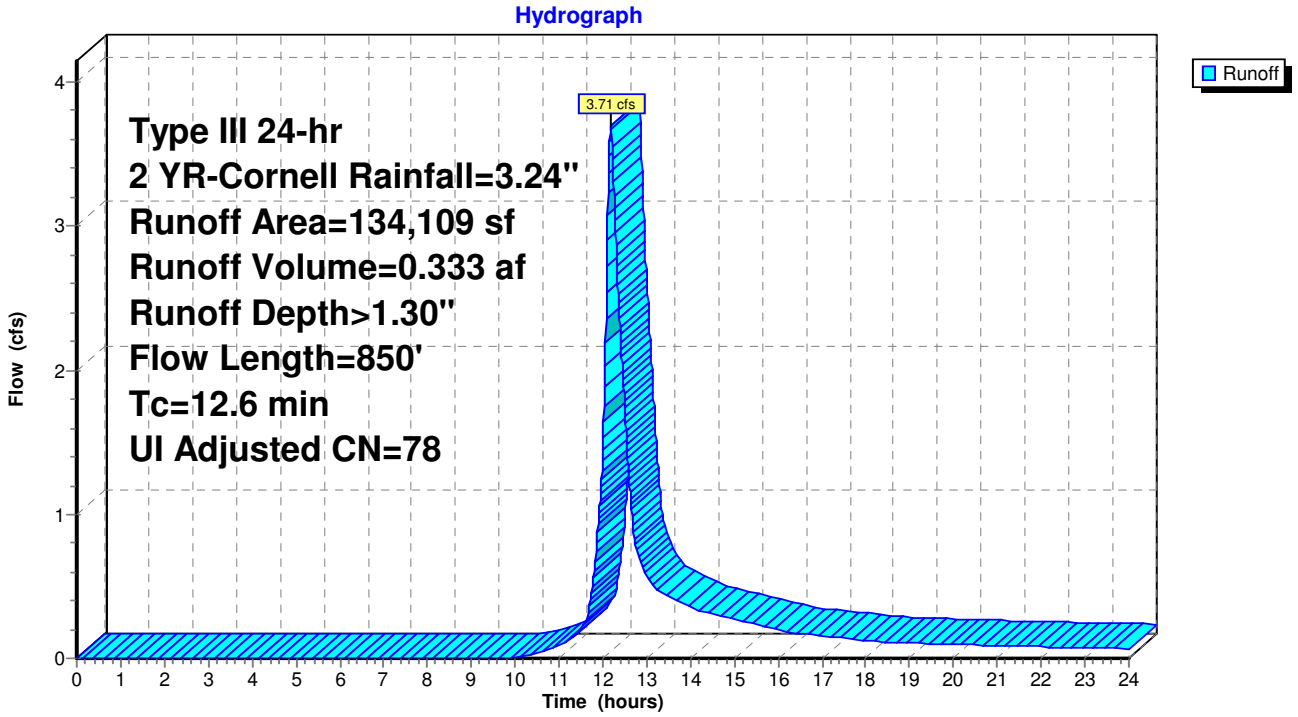
Runoff = 3.71 cfs @ 12.18 hrs, Volume= 0.333 af, Depth> 1.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YR-Cornell Rainfall=3.24"

	Area (sf)	CN	Adj	Description
	11,462	89		Gravel roads, HSG C
	8,168	72		Woods/grass comb., Good, HSG C
	88,115	74		Pasture/grassland/range, Good, HSG C
	25,536	98		Unconnected pavement, HSG C
*	828	98		Concrete Equipment Pads
	134,109	80	78	Weighted Average, UI Adjusted
	107,745			80.34% Pervious Area
	26,364			19.66% Impervious Area
	25,536			96.86% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.24"
2.5	350	0.1100	2.32		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.8	450	0.1200	9.90	1.94	**Pipe Channel, C-D** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.013 Corrugated PE, smooth interior
12.6	850	Total			

Subcatchment POST 1: Post Development Area 1



Summary for Subcatchment POST 1A: Post Development Area 1A

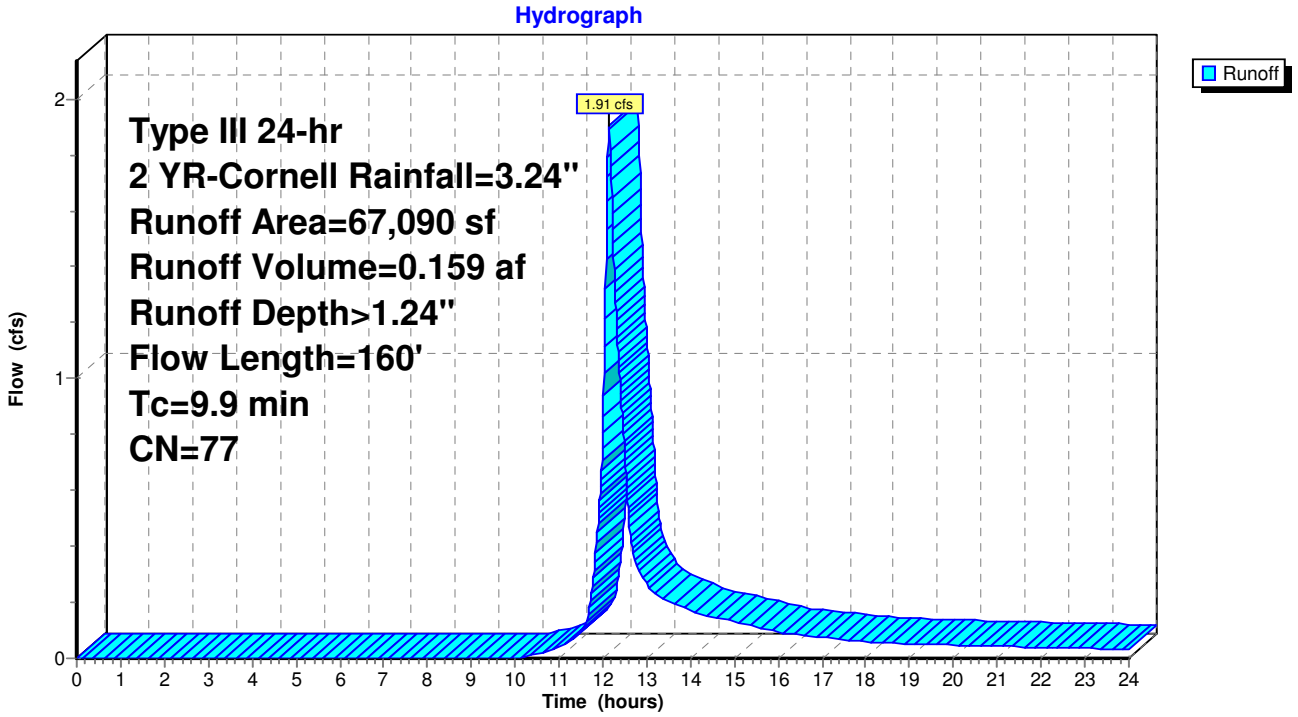
Runoff = 1.91 cfs @ 12.15 hrs, Volume= 0.159 af, Depth> 1.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YR-Cornell Rainfall=3.24"

	Area (sf)	CN	Description
	285	89	Gravel roads, HSG C
	11,155	74	>75% Grass cover, Good, HSG C
*	9,700	98	Paved parking, HSG C (Access)
*	5,300	89	Gravel roads, HSG C (Access)
*	7,500	74	>75% Grass cover, Good, HSG C (Access)
*	33,150	70	Woods, Good, HSG C (Lots)
	67,090	77	Weighted Average
	57,390		85.54% Pervious Area
	9,700		14.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.24"
1.3	85	0.0500	1.12		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.1	25	0.0300	3.52		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
9.9	160	Total			

Subcatchment POST 1A: Post Development Area 1A



Summary for Subcatchment POST 1B: Post Development Area 1B

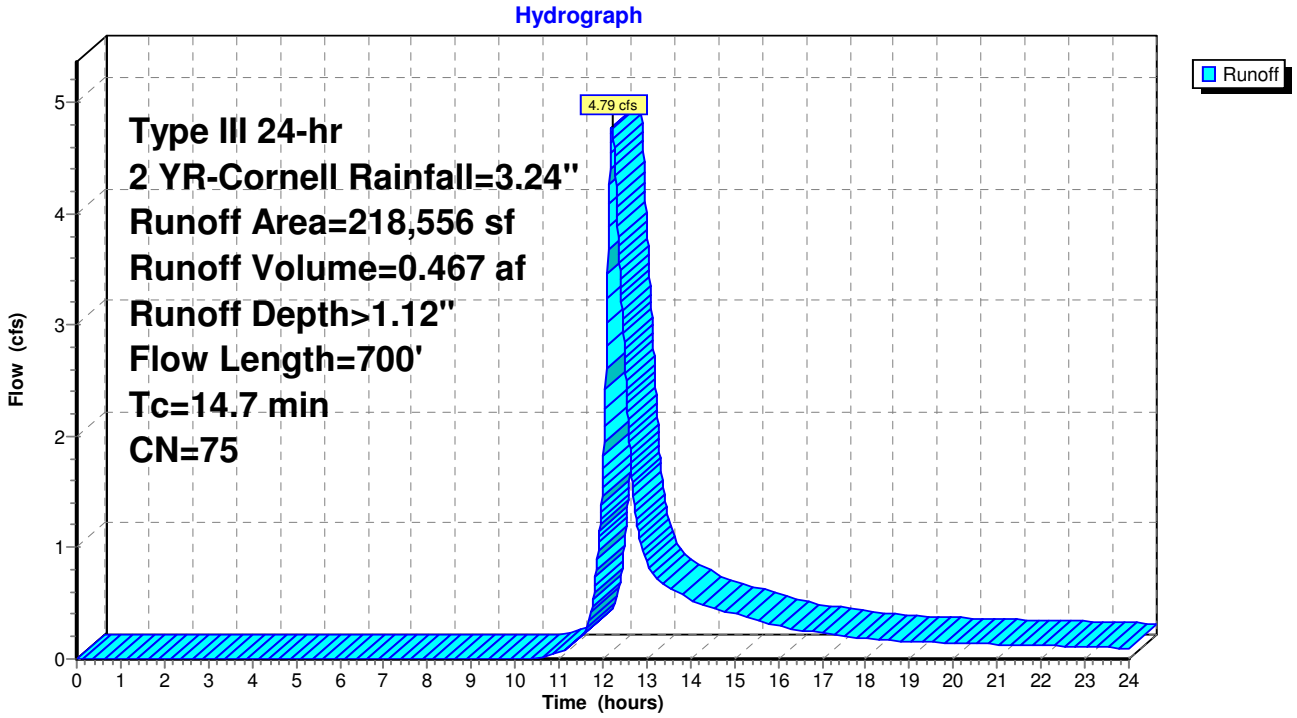
Runoff = 4.79 cfs @ 12.21 hrs, Volume= 0.467 af, Depth> 1.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YR-Cornell Rainfall=3.24"

	Area (sf)	CN	Description
*	22,849	98	Paved parking, HSG C (Lots)
*	90,371	74	>75% Grass cover, Good, HSG C (Lots)
*	105,336	70	Woods, Good, HSG C (Lots)
	218,556	75	Weighted Average
	195,707		89.55% Pervious Area
	22,849		10.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	50	0.0600	0.11		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.24"
5.7	485	0.0800	1.41		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.0	20	0.1500	7.86		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
1.1	145	0.1030	2.25		**Shallow Concentrated Flow, D-E** Short Grass Pasture Kv= 7.0 fps
14.7	700	Total			

Subcatchment POST 1B: Post Development Area 1B



Summary for Subcatchment POST 2: Post Development Area 2

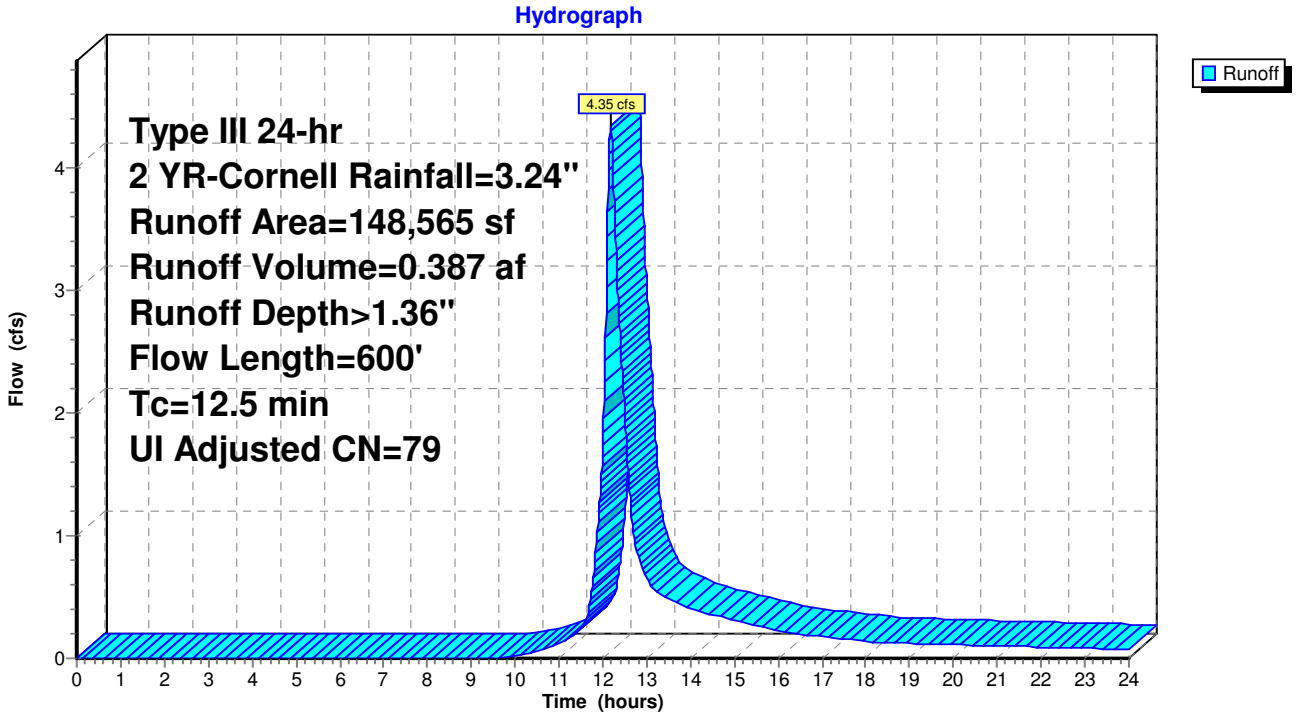
Runoff = 4.35 cfs @ 12.18 hrs, Volume= 0.387 af, Depth> 1.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YR-Cornell Rainfall=3.24"

	Area (sf)	CN	Adj	Description
	84,058	74		Pasture/grassland/range, Good, HSG C
*	41,571	98		Unconnected pavement, HSG C (Panels)
	16,786	89		Gravel roads, HSG C
	6,150	70		Woods, Good, HSG C
	148,565	82	79	Weighted Average, UI Adjusted
	106,994			72.02% Pervious Area
	41,571			27.98% Impervious Area
	41,571			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.24"
2.9	350	0.0850	2.04		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.3	200	0.1400	12.95	4.52	**Pipe Channel, C-D** 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.013 Corrugated PE, smooth interior
12.5	600	Total			

Subcatchment POST 2: Post Development Area 2



Summary for Subcatchment POST 2A: Post Development Area 2A

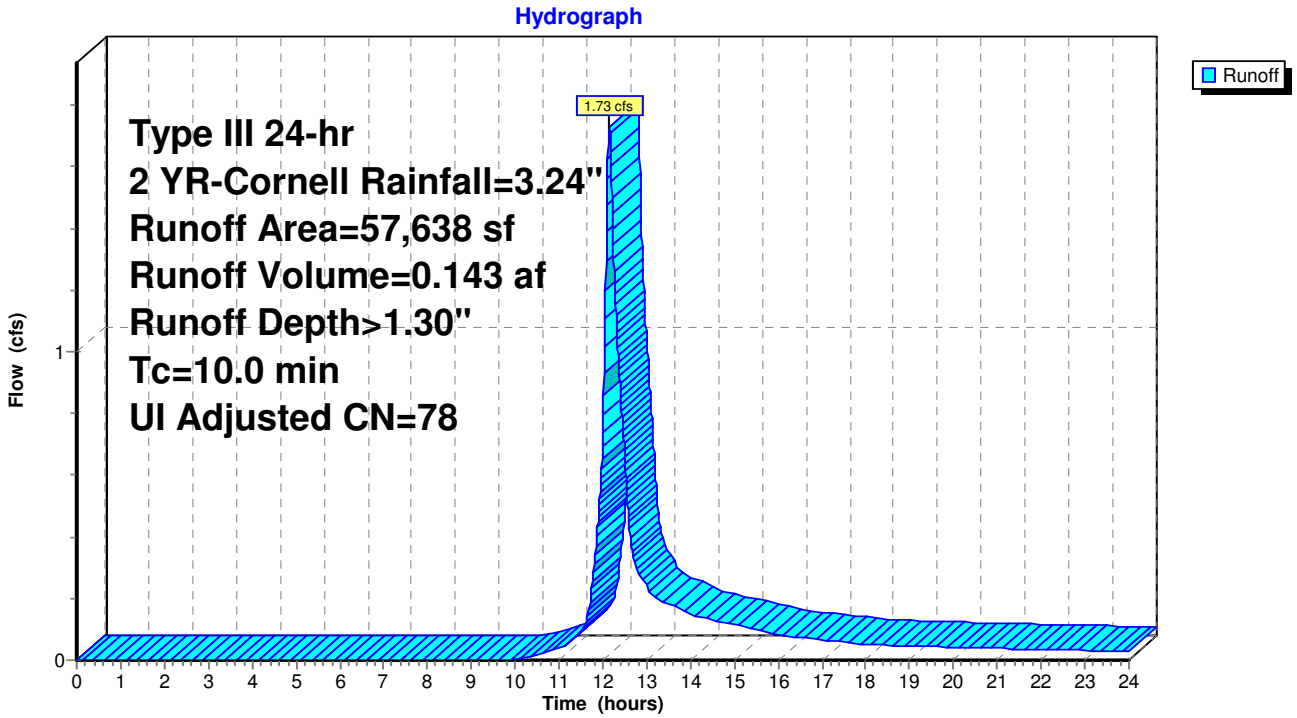
Runoff = 1.73 cfs @ 12.15 hrs, Volume= 0.143 af, Depth> 1.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YR-Cornell Rainfall=3.24"

Area (sf)	CN	Adj	Description
40,614	74		>75% Grass cover, Good, HSG C
17,024	98		Unconnected roofs, HSG C
57,638	81	78	Weighted Average, UI Adjusted
40,614			70.46% Pervious Area
17,024			29.54% Impervious Area
17,024			100.00% Unconnected

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

Subcatchment POST 2A: Post Development Area 2A



Summary for Subcatchment PRE-A: Off Site Area to Off Site Basin

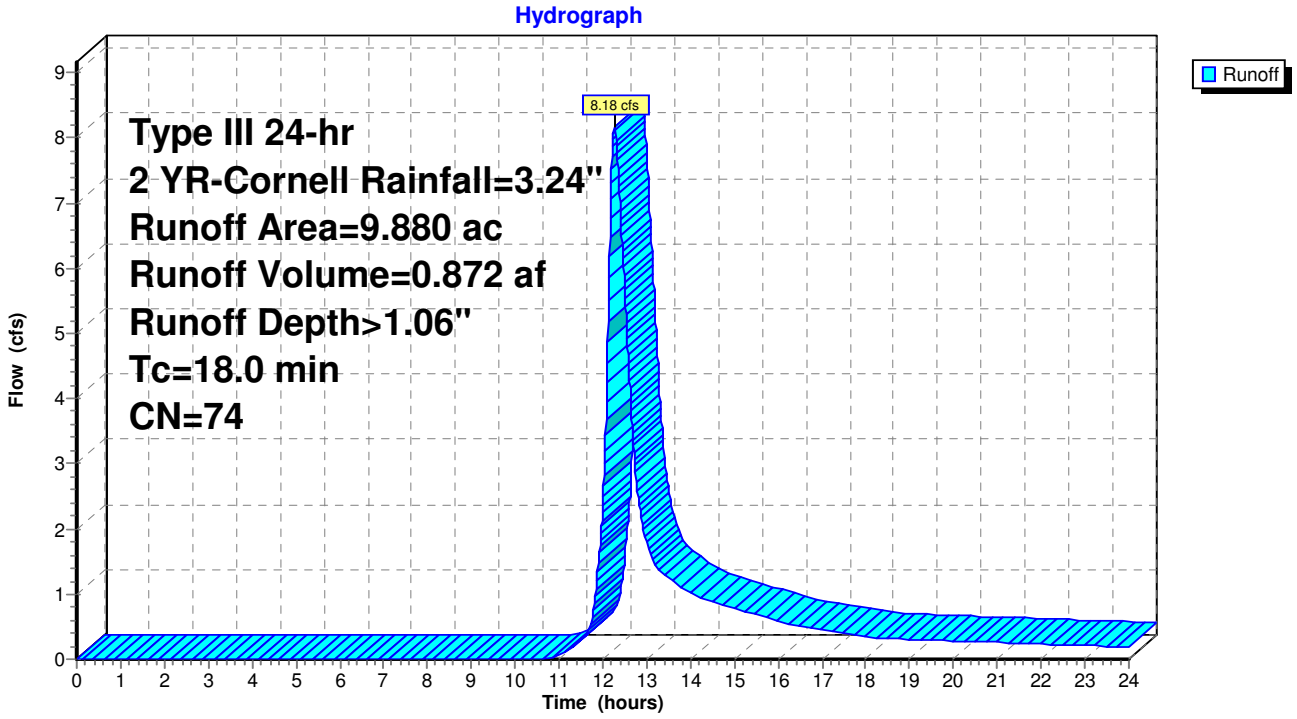
Runoff = 8.18 cfs @ 12.26 hrs, Volume= 0.872 af, Depth> 1.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YR-Cornell Rainfall=3.24"

	Area (ac)	CN	Description
*	9.880	74	Taken from Record Calculations
	9.880		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.0					**Direct Entry, Taken from Record Calculations**

Subcatchment PRE-A: Off Site Area to Off Site Basin



Summary for Reach 1R: Proposed Swale

Inflow Area = 14.499 ac, 5.71% Impervious, Inflow Depth > 0.39" for 2 YR-Cornell event
Inflow = 2.25 cfs @ 12.16 hrs, Volume= 0.466 af
Outflow = 2.15 cfs @ 12.26 hrs, Volume= 0.464 af, Atten= 4%, Lag= 5.9 min

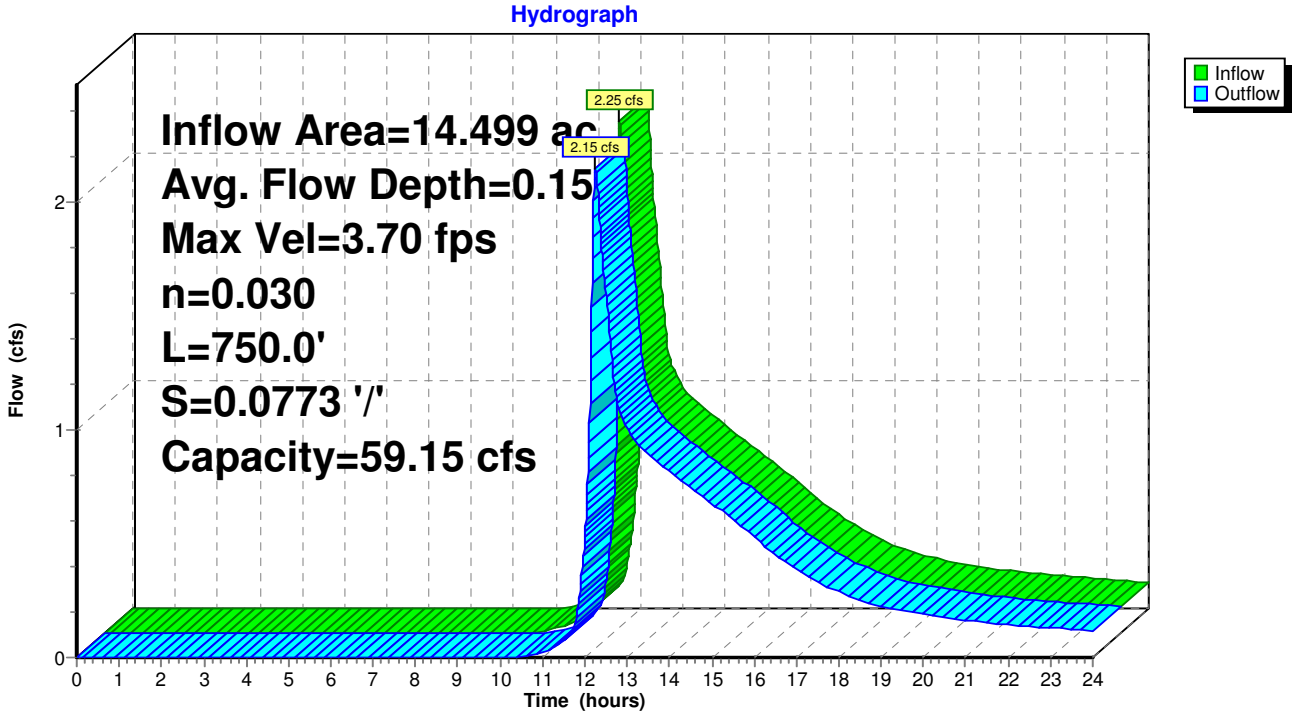
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.70 fps, Min. Travel Time= 3.4 min
Avg. Velocity = 1.78 fps, Avg. Travel Time= 7.0 min

Peak Storage= 436 cf @ 12.20 hrs
Average Depth at Peak Storage= 0.15'
Bank-Full Depth= 1.00' Flow Area= 5.5 sf, Capacity= 59.15 cfs

3.50' x 1.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 7.50'
Length= 750.0' Slope= 0.0773 '/'
Inlet Invert= 153.00', Outlet Invert= 95.00'

‡

Reach 1R: Proposed Swale



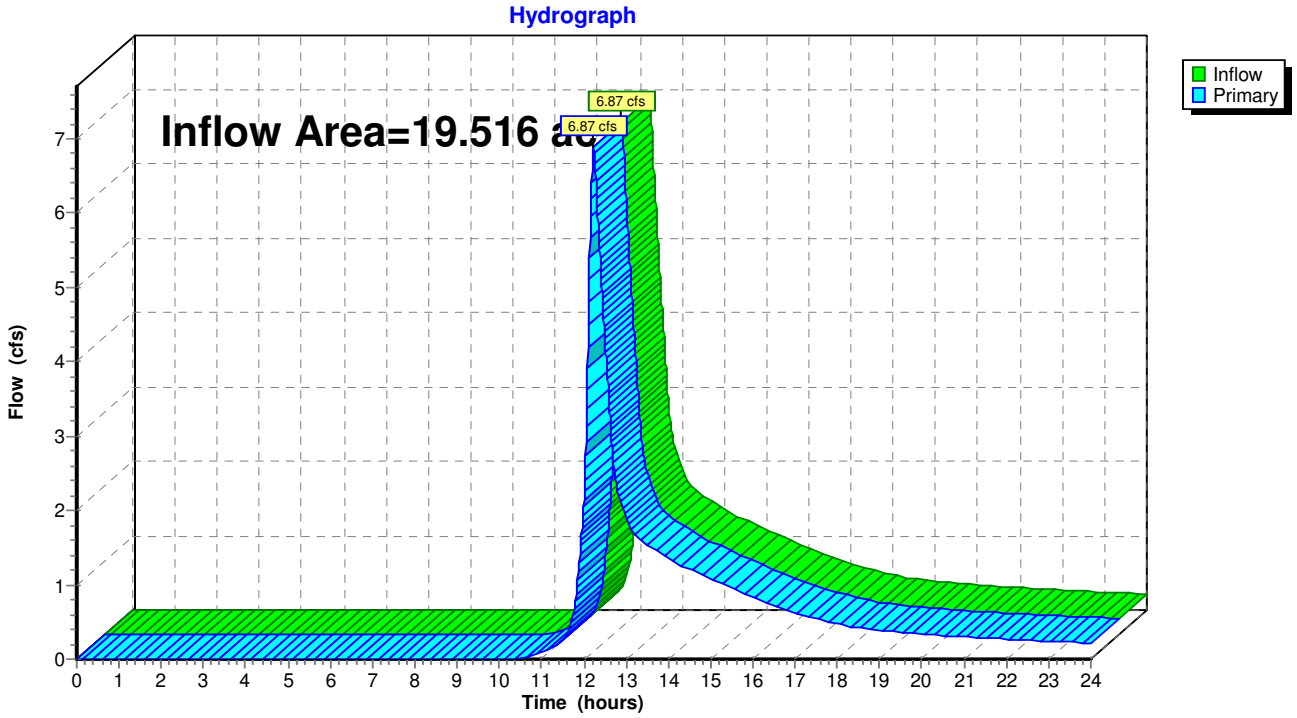
Summary for Pond AP-1: Providence Road Drainage

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

Inflow Area =	19.516 ac,	6.93% Impervious,	Inflow Depth >	0.57"	for 2 YR-Cornell event
Inflow =	6.87 cfs @	12.23 hrs,	Volume=	0.931 af	
Primary =	6.87 cfs @	12.23 hrs,	Volume=	0.931 af,	Atten= 0%, Lag= 0.0 min

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

Pond AP-1: Providence Road Drainage



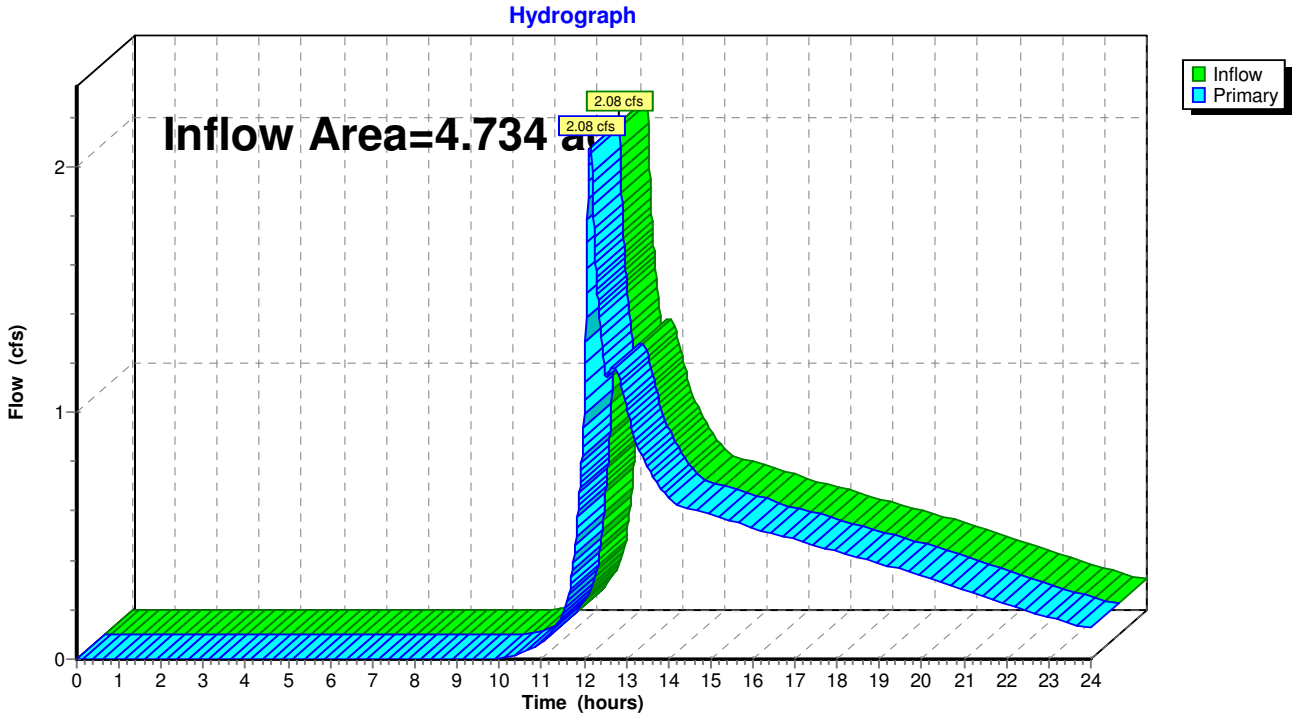
Summary for Pond AP-2: Easement Line

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

Inflow Area =	4.734 ac,	28.42% Impervious,	Inflow Depth >	1.32"	for 2 YR-Cornell event
Inflow =	2.08 cfs @	12.15 hrs,	Volume=	0.520 af	
Primary =	2.08 cfs @	12.15 hrs,	Volume=	0.520 af,	Atten= 0%, Lag= 0.0 min

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

Pond AP-2: Easement Line



Summary for Pond East: Proposed Easterly Basin

Inflow Area =	3.411 ac, 27.98% Impervious, Inflow Depth > 1.36" for 2 YR-Cornell event				
Inflow =	4.35 cfs @	12.18 hrs,	Volume=	0.387 af	
Outflow =	0.87 cfs @	12.77 hrs,	Volume=	0.377 af,	Atten= 80%, Lag= 35.6 min
Primary =	0.87 cfs @	12.77 hrs,	Volume=	0.377 af	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 187.59' @ 12.77 hrs Surf.Area= 5,992 sf Storage= 6,905 cf

Plug-Flow detention time= 154.6 min calculated for 0.377 af (97% of inflow)
Center-of-Mass det. time= 139.2 min (988.8 - 849.6)

Volume	Invert	Avail.Storage	Storage Description
#1	186.00'	24,433 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

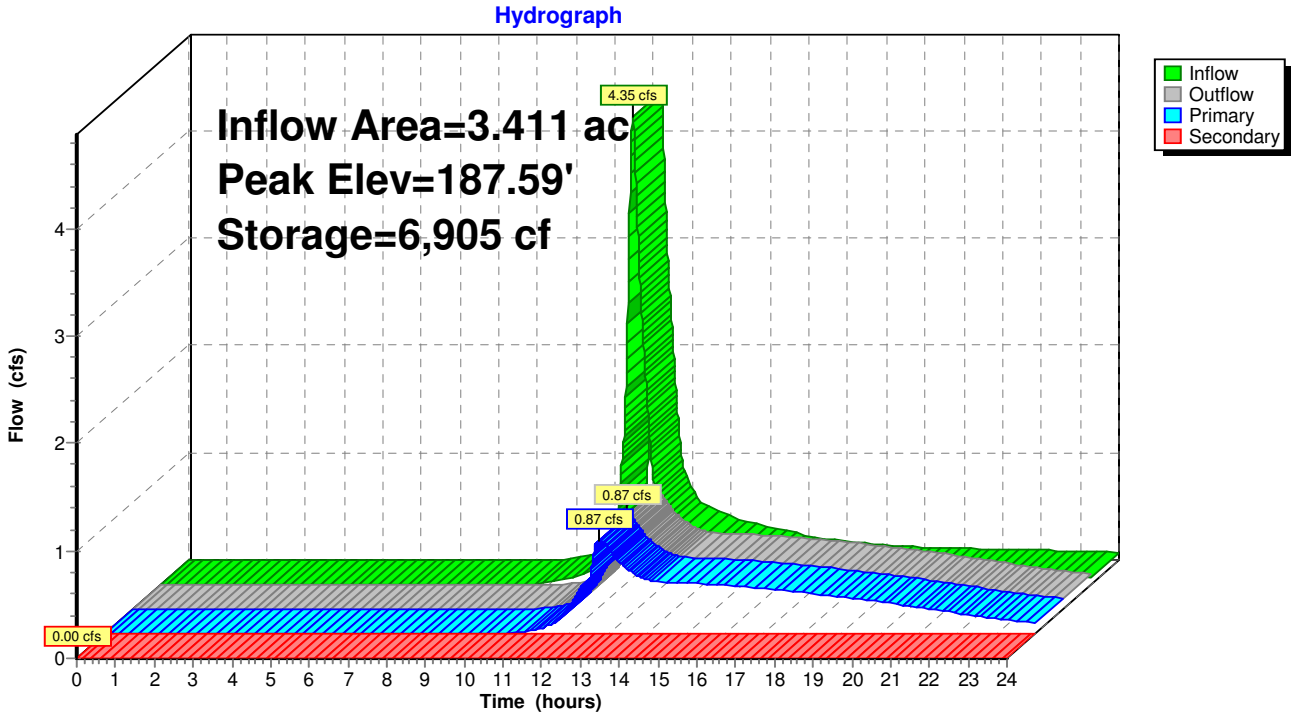
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
186.00	1,685	0	0
187.00	5,388	3,537	3,537
188.00	6,408	5,898	9,435
189.00	7,485	6,947	16,381
190.00	8,618	8,052	24,433

Device	Routing	Invert	Outlet Devices
#1	Primary	185.00'	**18.0" Round Culvert** L= 26.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 185.00' / 184.75' S= 0.0096 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	186.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	187.50'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Secondary	189.00'	**15.0' long x 5.0' 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) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=0.86 cfs @ 12.77 hrs HW=187.59' (Free Discharge)
└─**1=Culvert** (Passes 0.86 cfs of 11.55 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.50 cfs @ 5.75 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 0.36 cfs @ 0.99 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=186.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond East: Proposed Easterly Basin



Summary for Pond OFF-SITE: Existing Off-Site Pond

Inflow Area =	9.880 ac,	0.00% Impervious,	Inflow Depth >	1.06"	for 2 YR-Cornell event
Inflow =	8.18 cfs @	12.26 hrs,	Volume=	0.872 af	
Outflow =	0.27 cfs @	20.23 hrs,	Volume=	0.258 af,	Atten= 97%, Lag= 478.2 min
Discarded =	0.27 cfs @	20.23 hrs,	Volume=	0.258 af	
Primary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 436.29' @ 20.23 hrs Surf.Area= 11,555 sf Storage= 27,286 cf

Plug-Flow detention time= 362.0 min calculated for 0.258 af (30% of inflow)
Center-of-Mass det. time= 221.8 min (1,091.5 - 869.6)

Volume	Invert	Avail.Storage	Storage Description
#1	432.00'	66,840 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

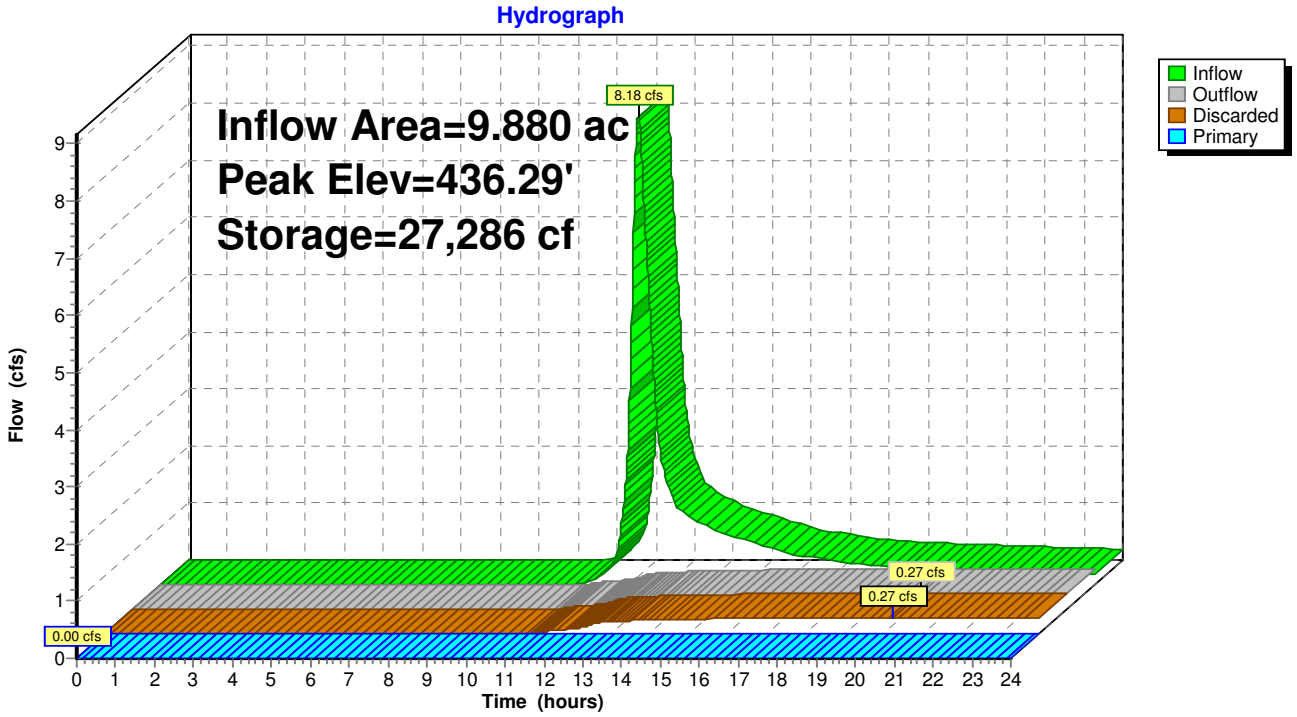
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
432.00	3,000	0	0
434.00	5,120	8,120	8,120
436.00	10,800	15,920	24,040
438.00	16,000	26,800	50,840
439.00	16,000	16,000	66,840

Device	Routing	Invert	Outlet Devices
#1	Primary	438.00'	**160.0' long x 10.0' 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) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Discarded	432.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.27 cfs @ 20.23 hrs HW=436.29' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.27 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=432.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond OFF-SITE: Existing Off-Site Pond



Summary for Pond West: Proposed Westerly Basin

Inflow Area =	3.079 ac, 19.66% Impervious, Inflow Depth > 1.30" for 2 YR-Cornell event				
Inflow =	3.71 cfs @	12.18 hrs,	Volume=	0.333 af	
Outflow =	0.72 cfs @	12.81 hrs,	Volume=	0.307 af,	Atten= 81%, Lag= 37.8 min
Primary =	0.72 cfs @	12.81 hrs,	Volume=	0.307 af	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 161.82' @ 12.81 hrs Surf.Area= 7,572 sf Storage= 5,799 cf

Plug-Flow detention time= 131.6 min calculated for 0.307 af (92% of inflow)
Center-of-Mass det. time= 92.7 min (945.5 - 852.8)

Volume	Invert	Avail.Storage	Storage Description
#1	161.00'	36,536 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

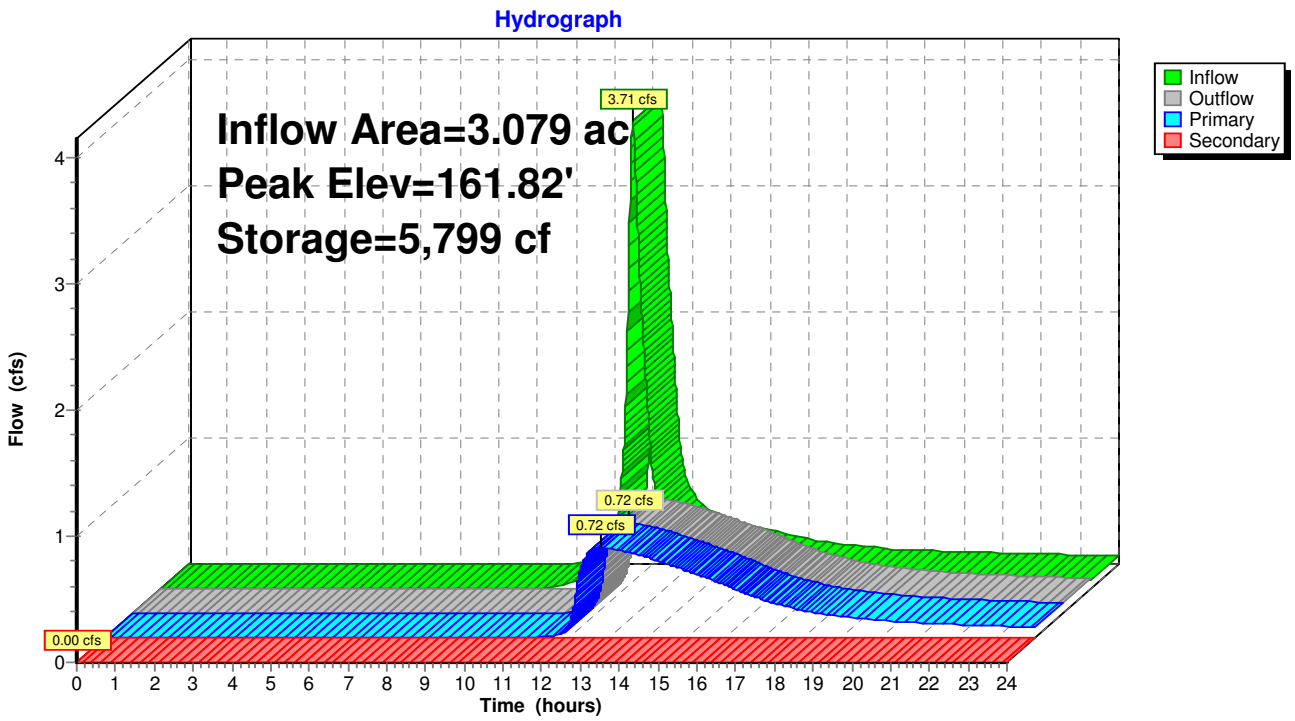
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
161.00	6,535	0	0
162.00	7,796	7,166	7,166
163.00	9,096	8,446	15,612
164.00	10,447	9,772	25,383
165.00	11,858	11,153	36,536

Device	Routing	Invert	Outlet Devices
#1	Primary	160.00'	**15.0" Round Culvert** L= 37.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 160.00' / 159.50' S= 0.0135 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.23 sf
#2	Device 1	161.00'	**6.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	163.25'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Secondary	164.00'	**15.0' long x 5.0' 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) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=0.72 cfs @ 12.81 hrs HW=161.82' (Free Discharge)
└─**1=Culvert** (Passes 0.72 cfs of 5.10 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.72 cfs @ 3.64 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=161.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond West: Proposed Westerly Basin



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment POST 1: Post Runoff Area=134,109 sf 19.66% Impervious Runoff Depth>2.61"
Flow Length=850' Tc=12.6 min UI Adjusted CN=78 Runoff=7.63 cfs 0.670 af

Subcatchment POST 1A: Post Runoff Area=67,090 sf 14.46% Impervious Runoff Depth>2.53"
Flow Length=160' Tc=9.9 min CN=77 Runoff=4.00 cfs 0.324 af

Subcatchment POST 1B: Post Runoff Area=218,556 sf 10.45% Impervious Runoff Depth>2.35"
Flow Length=700' Tc=14.7 min CN=75 Runoff=10.54 cfs 0.984 af

Subcatchment POST 2: Post Runoff Area=148,565 sf 27.98% Impervious Runoff Depth>2.70"
Flow Length=600' Tc=12.5 min UI Adjusted CN=79 Runoff=8.77 cfs 0.767 af

Subcatchment POST 2A: Post Runoff Area=57,638 sf 29.54% Impervious Runoff Depth>2.61"
Tc=10.0 min UI Adjusted CN=78 Runoff=3.55 cfs 0.288 af

Subcatchment PRE-A: Off Site Area to Off Runoff Area=9.880 ac 0.00% Impervious Runoff Depth>2.27"
Tc=18.0 min CN=74 Runoff=18.42 cfs 1.867 af

Reach 1R: Proposed Swale Avg. Flow Depth=0.24' Max Vel=4.84 fps Inflow=4.74 cfs 1.279 af
n=0.030 L=750.0' S=0.0773 '/' Capacity=59.15 cfs Outflow=4.60 cfs 1.276 af

Pond AP-1: Providence Road Drainage Inflow=15.11 cfs 2.260 af
Primary=15.11 cfs 2.260 af

Pond AP-2: Easement Line Inflow=7.38 cfs 1.025 af
Primary=7.38 cfs 1.025 af

Pond East: Proposed Easterly Basin Peak Elev=188.03' Storage=9,602 cf Inflow=8.77 cfs 0.767 af
Primary=5.43 cfs 0.737 af Secondary=0.00 cfs 0.000 af Outflow=5.43 cfs 0.737 af

Pond OFF-SITE: Existing Off-Site Pond Peak Elev=438.02' Storage=51,207 cf Inflow=18.42 cfs 1.867 af
Discarded=0.38 cfs 0.381 af Primary=1.53 cfs 0.321 af Outflow=1.91 cfs 0.701 af

Pond West: Proposed Westerly Basin Peak Elev=162.71' Storage=13,057 cf Inflow=7.63 cfs 0.670 af
Primary=1.14 cfs 0.635 af Secondary=0.00 cfs 0.000 af Outflow=1.14 cfs 0.635 af

Total Runoff Area = 24.250 ac Runoff Volume = 4.901 af Average Runoff Depth = 2.43"
88.88% Pervious = 21.552 ac 11.12% Impervious = 2.698 ac

Summary for Subcatchment POST 1: Post Development Area 1

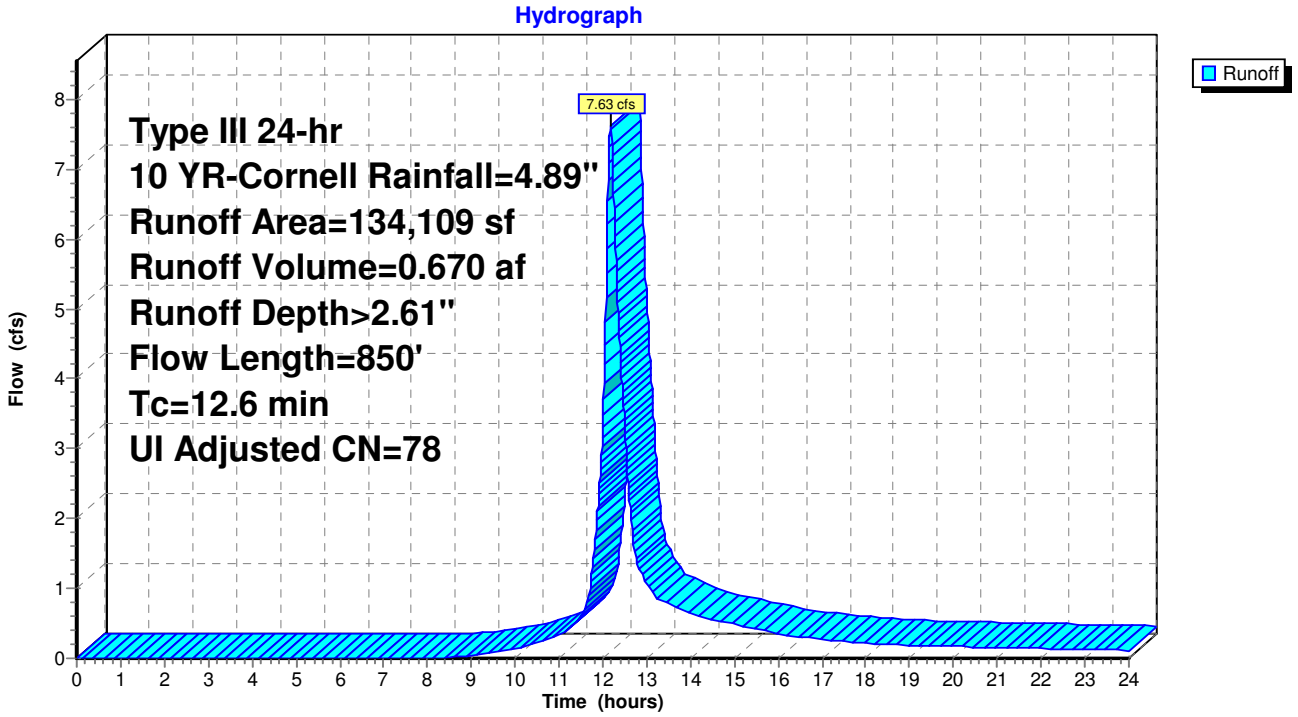
Runoff = 7.63 cfs @ 12.17 hrs, Volume= 0.670 af, Depth> 2.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YR-Cornell Rainfall=4.89"

	Area (sf)	CN	Adj	Description
	11,462	89		Gravel roads, HSG C
	8,168	72		Woods/grass comb., Good, HSG C
	88,115	74		Pasture/grassland/range, Good, HSG C
	25,536	98		Unconnected pavement, HSG C
*	828	98		Concrete Equipment Pads
	134,109	80	78	Weighted Average, UI Adjusted
	107,745			80.34% Pervious Area
	26,364			19.66% Impervious Area
	25,536			96.86% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.24"
2.5	350	0.1100	2.32		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.8	450	0.1200	9.90	1.94	**Pipe Channel, C-D** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.013 Corrugated PE, smooth interior
12.6	850	Total			

Subcatchment POST 1: Post Development Area 1



Summary for Subcatchment POST 1A: Post Development Area 1A

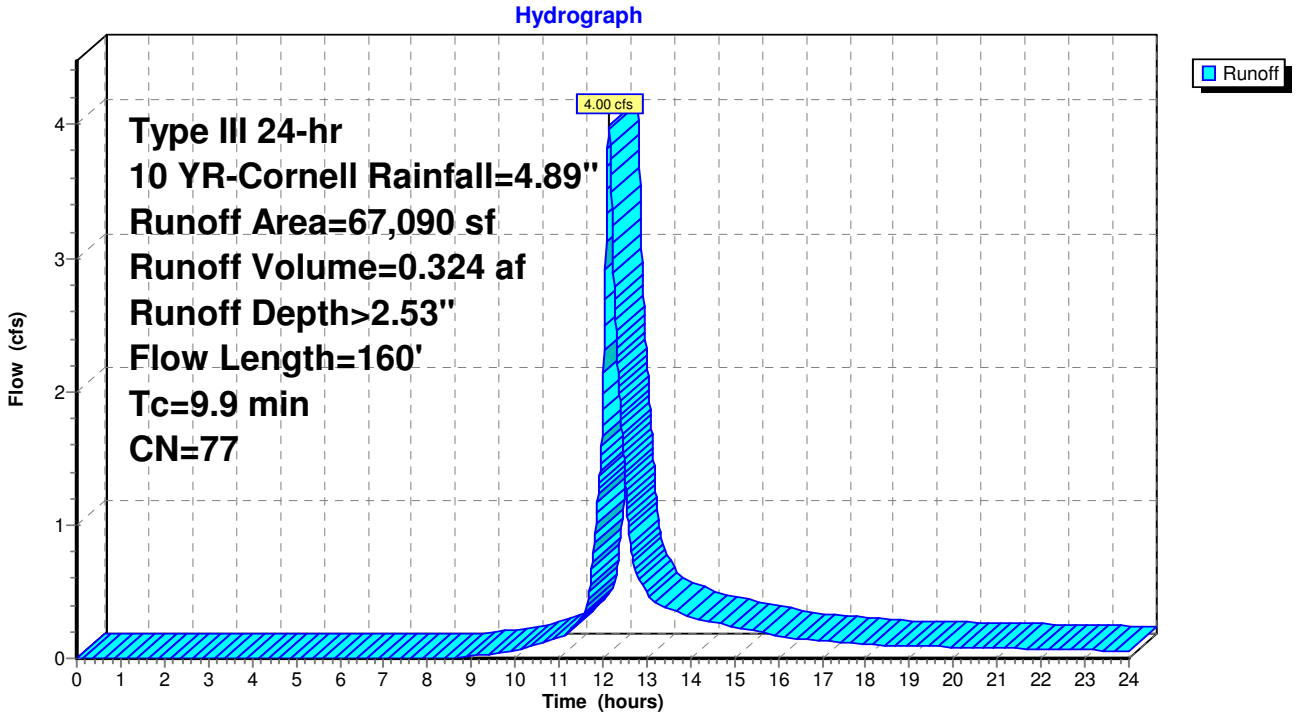
Runoff = 4.00 cfs @ 12.14 hrs, Volume= 0.324 af, Depth> 2.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YR-Cornell Rainfall=4.89"

	Area (sf)	CN	Description
	285	89	Gravel roads, HSG C
	11,155	74	>75% Grass cover, Good, HSG C
*	9,700	98	Paved parking, HSG C (Access)
*	5,300	89	Gravel roads, HSG C (Access)
*	7,500	74	>75% Grass cover, Good, HSG C (Access)
*	33,150	70	Woods, Good, HSG C (Lots)
	67,090	77	Weighted Average
	57,390		85.54% Pervious Area
	9,700		14.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.24"
1.3	85	0.0500	1.12		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.1	25	0.0300	3.52		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
9.9	160	Total			

Subcatchment POST 1A: Post Development Area 1A



Summary for Subcatchment POST 1B: Post Development Area 1B

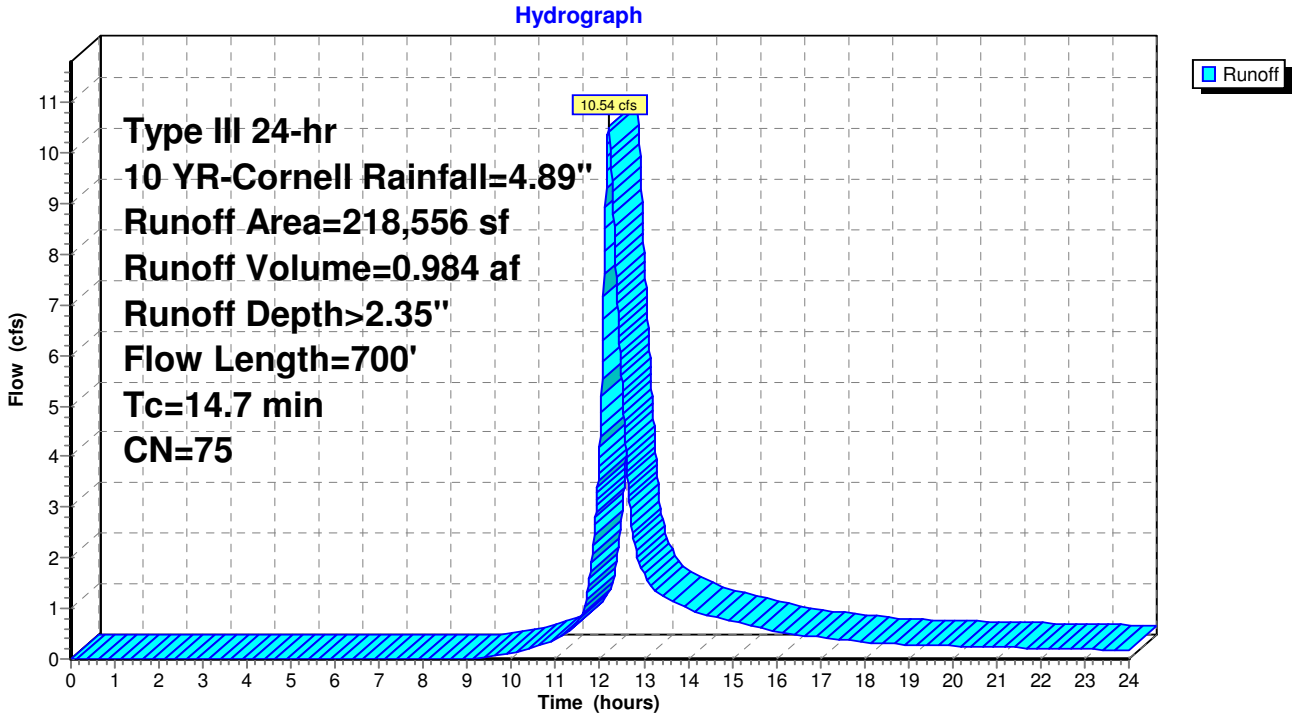
Runoff = 10.54 cfs @ 12.20 hrs, Volume= 0.984 af, Depth> 2.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YR-Cornell Rainfall=4.89"

	Area (sf)	CN	Description
*	22,849	98	Paved parking, HSG C (Lots)
*	90,371	74	>75% Grass cover, Good, HSG C (Lots)
*	105,336	70	Woods, Good, HSG C (Lots)
	218,556	75	Weighted Average
	195,707		89.55% Pervious Area
	22,849		10.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	50	0.0600	0.11		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.24"
5.7	485	0.0800	1.41		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.0	20	0.1500	7.86		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
1.1	145	0.1030	2.25		**Shallow Concentrated Flow, D-E** Short Grass Pasture Kv= 7.0 fps
14.7	700	Total			

Subcatchment POST 1B: Post Development Area 1B



Summary for Subcatchment POST 2: Post Development Area 2

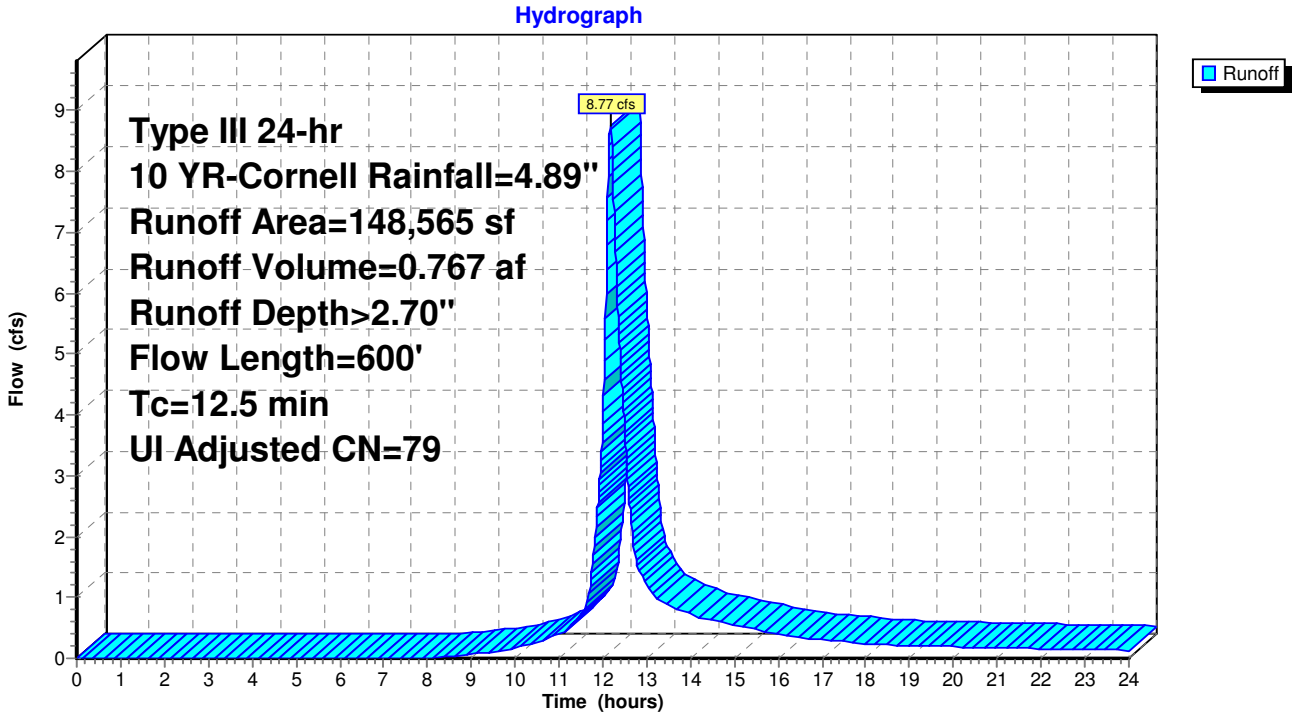
Runoff = 8.77 cfs @ 12.17 hrs, Volume= 0.767 af, Depth> 2.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YR-Cornell Rainfall=4.89"

	Area (sf)	CN	Adj	Description
	84,058	74		Pasture/grassland/range, Good, HSG C
*	41,571	98		Unconnected pavement, HSG C (Panels)
	16,786	89		Gravel roads, HSG C
	6,150	70		Woods, Good, HSG C
	148,565	82	79	Weighted Average, UI Adjusted
	106,994			72.02% Pervious Area
	41,571			27.98% Impervious Area
	41,571			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.24"
2.9	350	0.0850	2.04		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.3	200	0.1400	12.95	4.52	**Pipe Channel, C-D** 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.013 Corrugated PE, smooth interior
12.5	600	Total			

Subcatchment POST 2: Post Development Area 2



Summary for Subcatchment POST 2A: Post Development Area 2A

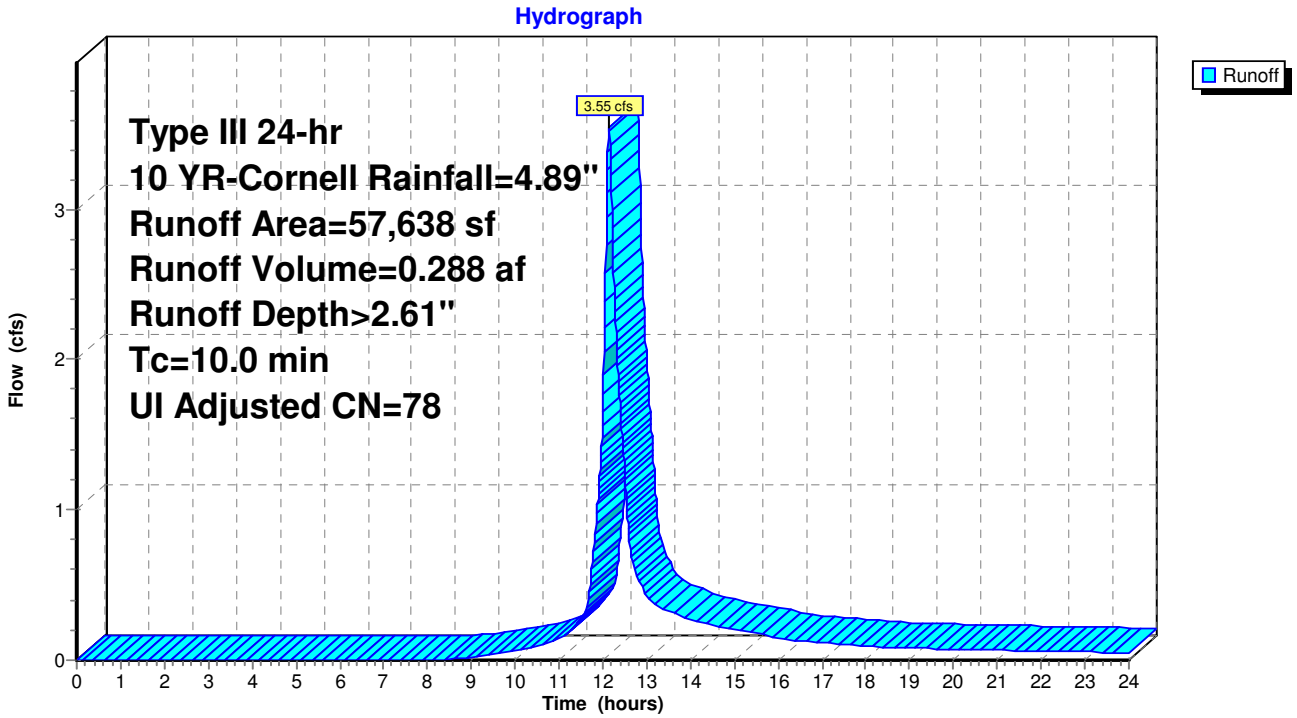
Runoff = 3.55 cfs @ 12.14 hrs, Volume= 0.288 af, Depth> 2.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YR-Cornell Rainfall=4.89"

Area (sf)	CN	Adj	Description
40,614	74		>75% Grass cover, Good, HSG C
17,024	98		Unconnected roofs, HSG C
57,638	81	78	Weighted Average, UI Adjusted
40,614			70.46% Pervious Area
17,024			29.54% Impervious Area
17,024			100.00% Unconnected

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

Subcatchment POST 2A: Post Development Area 2A



Summary for Subcatchment PRE-A: Off Site Area to Off Site Basin

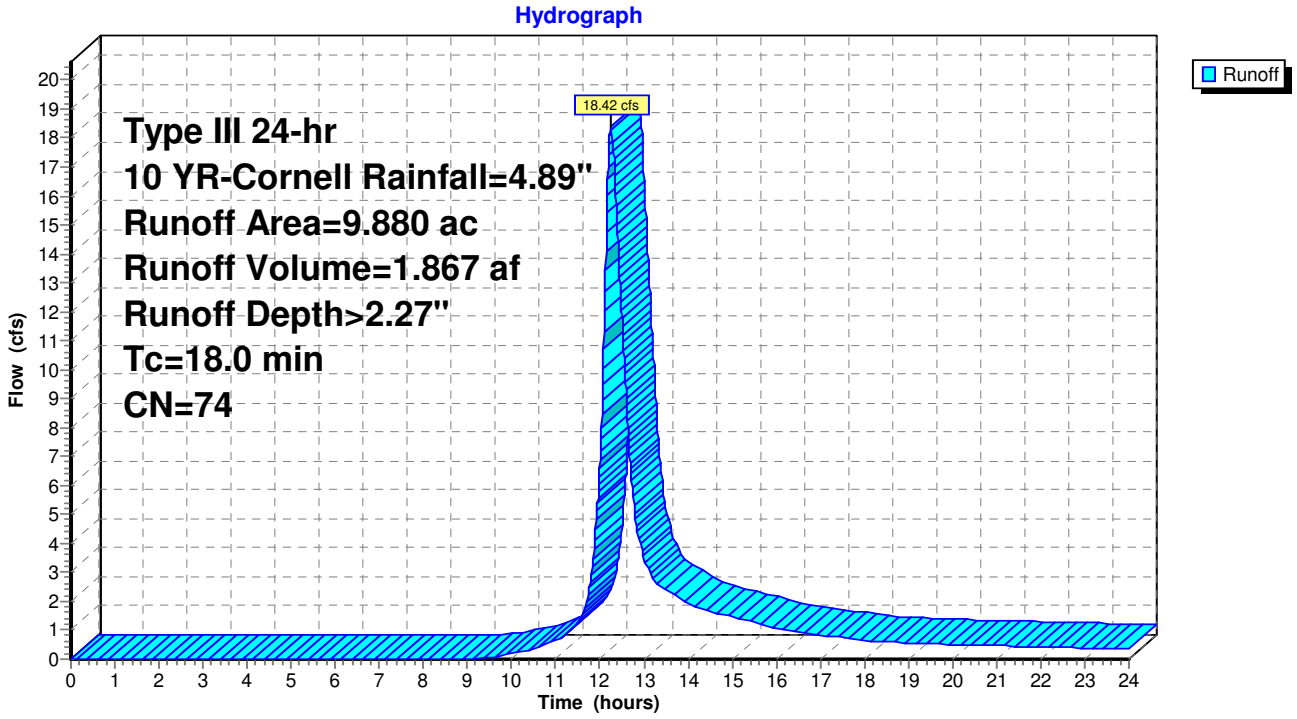
Runoff = 18.42 cfs @ 12.26 hrs, Volume= 1.867 af, Depth> 2.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YR-Cornell Rainfall=4.89"

	Area (ac)	CN	Description
*	9.880	74	Taken from Record Calculations
	9.880		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.0					**Direct Entry, Taken from Record Calculations**

Subcatchment PRE-A: Off Site Area to Off Site Basin



Summary for Reach 1R: Proposed Swale

Inflow Area = 14.499 ac, 5.71% Impervious, Inflow Depth > 1.06" for 10 YR-Cornell event
Inflow = 4.74 cfs @ 12.15 hrs, Volume= 1.279 af
Outflow = 4.60 cfs @ 12.22 hrs, Volume= 1.276 af, Atten= 3%, Lag= 4.4 min

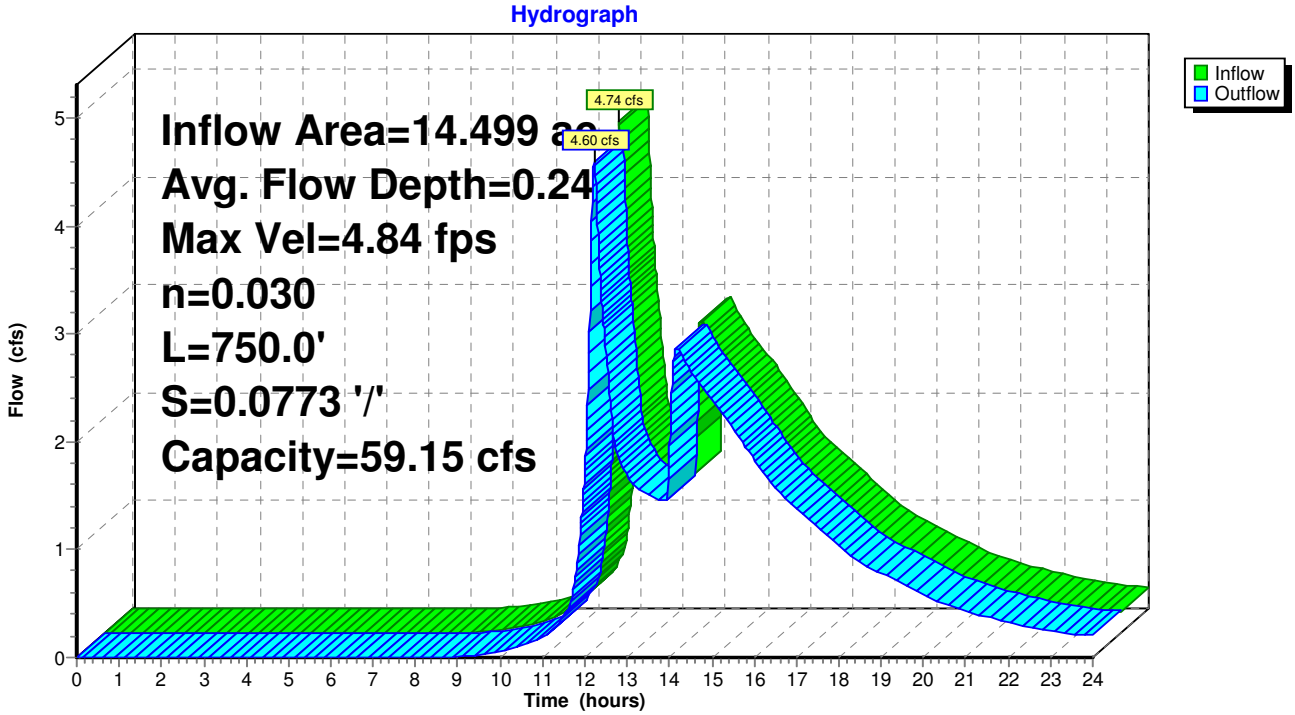
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.84 fps, Min. Travel Time= 2.6 min
Avg. Velocity = 2.45 fps, Avg. Travel Time= 5.1 min

Peak Storage= 713 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.24'
Bank-Full Depth= 1.00' Flow Area= 5.5 sf, Capacity= 59.15 cfs

3.50' x 1.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 7.50'
Length= 750.0' Slope= 0.0773 '/'
Inlet Invert= 153.00', Outlet Invert= 95.00'

‡

Reach 1R: Proposed Swale



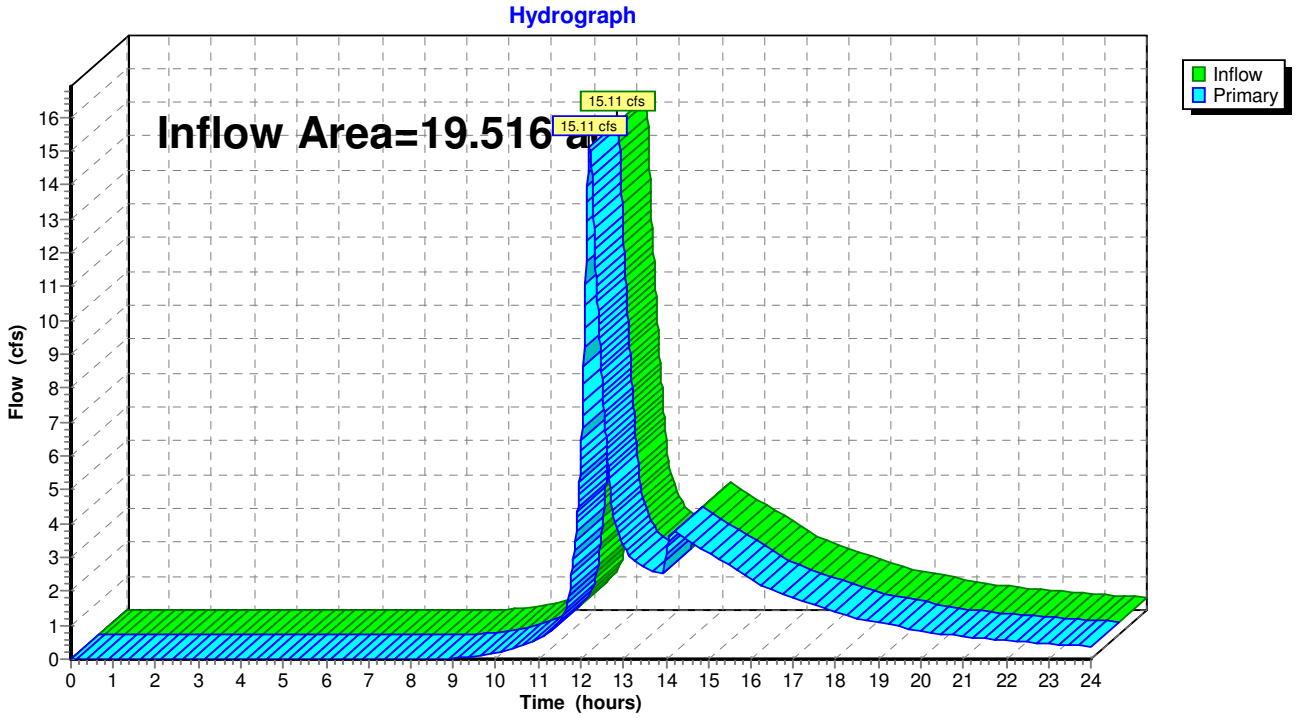
Summary for Pond AP-1: Providence Road Drainage

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

Inflow Area = 19.516 ac, 6.93% Impervious, Inflow Depth > 1.39" for 10 YR-Cornell event
Inflow = 15.11 cfs @ 12.21 hrs, Volume= 2.260 af
Primary = 15.11 cfs @ 12.21 hrs, Volume= 2.260 af, Atten= 0%, Lag= 0.0 min

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

Pond AP-1: Providence Road Drainage



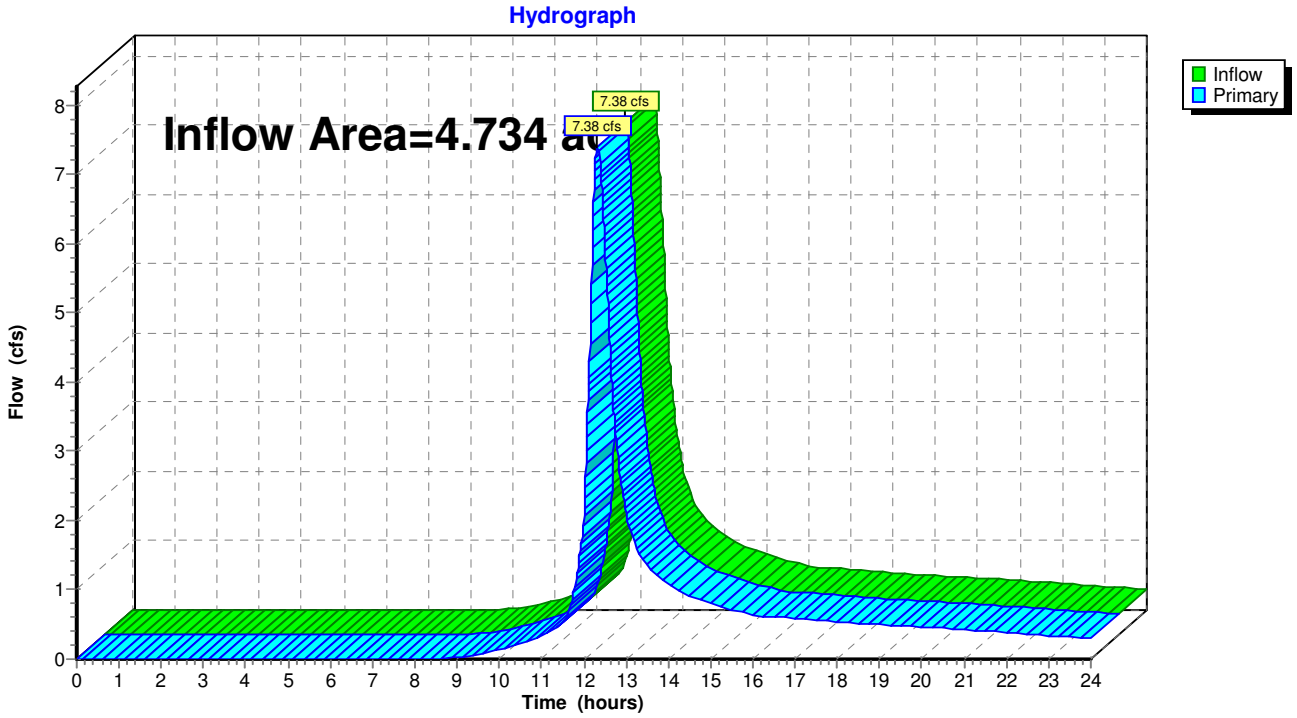
Summary for Pond AP-2: Easement Line

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

Inflow Area = 4.734 ac, 28.42% Impervious, Inflow Depth > 2.60" for 10 YR-Cornell event
Inflow = 7.38 cfs @ 12.32 hrs, Volume= 1.025 af
Primary = 7.38 cfs @ 12.32 hrs, Volume= 1.025 af, Atten= 0%, Lag= 0.0 min

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

Pond AP-2: Easement Line



Summary for Pond East: Proposed Easterly Basin

Inflow Area =	3.411 ac, 27.98% Impervious, Inflow Depth > 2.70" for 10 YR-Cornell event				
Inflow =	8.77 cfs @	12.17 hrs,	Volume=	0.767 af	
Outflow =	5.43 cfs @	12.36 hrs,	Volume=	0.737 af,	Atten= 38%, Lag= 11.3 min
Primary =	5.43 cfs @	12.36 hrs,	Volume=	0.737 af	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 188.03' @ 12.36 hrs Surf.Area= 6,436 sf Storage= 9,602 cf

Plug-Flow detention time= 111.0 min calculated for 0.737 af (96% of inflow)
Center-of-Mass det. time= 89.2 min (919.1 - 829.9)

Volume	Invert	Avail.Storage	Storage Description
#1	186.00'	24,433 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

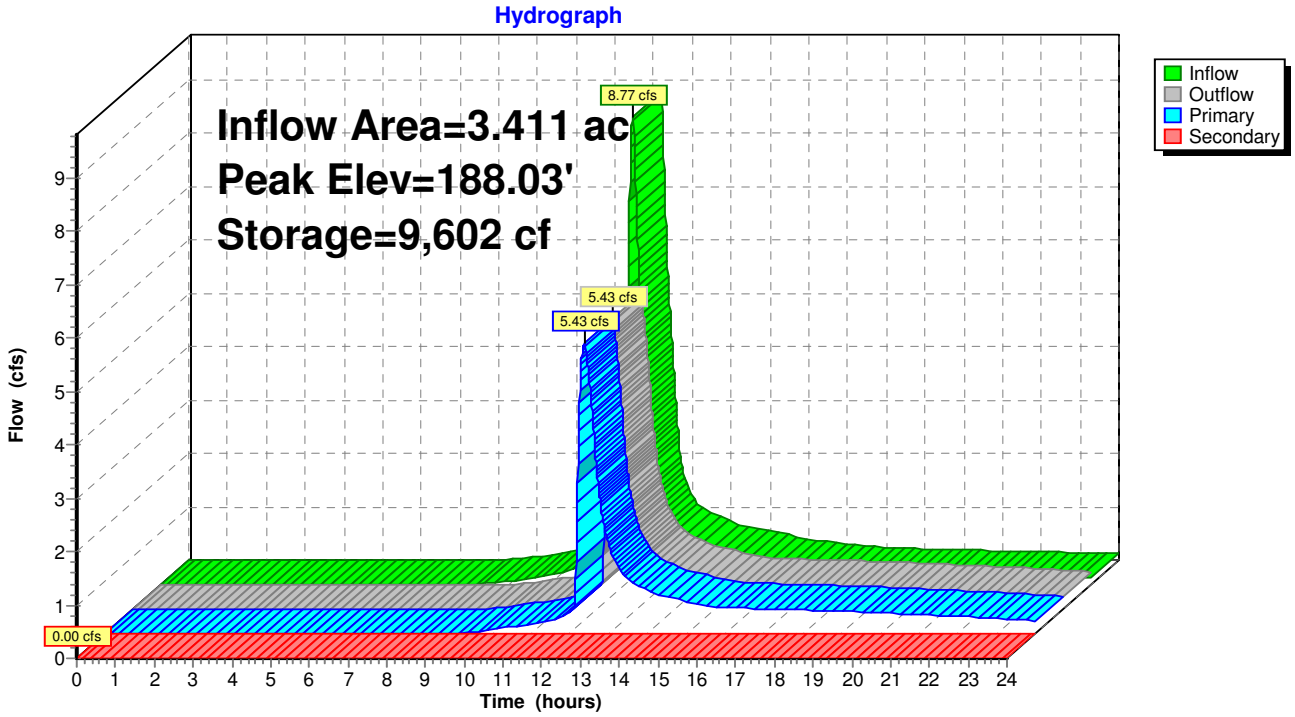
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
186.00	1,685	0	0
187.00	5,388	3,537	3,537
188.00	6,408	5,898	9,435
189.00	7,485	6,947	16,381
190.00	8,618	8,052	24,433

Device	Routing	Invert	Outlet Devices
#1	Primary	185.00'	**18.0" Round Culvert** L= 26.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 185.00' / 184.75' S= 0.0096 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	186.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	187.50'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Secondary	189.00'	**15.0' long x 5.0' 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) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=5.43 cfs @ 12.36 hrs HW=188.03' (Free Discharge)
└─**1=Culvert** (Passes 5.43 cfs of 12.84 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.57 cfs @ 6.57 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 4.86 cfs @ 2.37 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=186.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond East: Proposed Easterly Basin



Summary for Pond OFF-SITE: Existing Off-Site Pond

Inflow Area =	9.880 ac,	0.00% Impervious,	Inflow Depth >	2.27"	for 10 YR-Cornell event
Inflow =	18.42 cfs @	12.26 hrs,	Volume=	1.867 af	
Outflow =	1.91 cfs @	14.08 hrs,	Volume=	0.701 af,	Atten= 90%, Lag= 109.3 min
Discarded =	0.38 cfs @	13.90 hrs,	Volume=	0.381 af	
Primary =	1.53 cfs @	14.08 hrs,	Volume=	0.321 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 438.02' @ 14.08 hrs Surf.Area= 16,000 sf Storage= 51,207 cf

Plug-Flow detention time= 301.7 min calculated for 0.701 af (38% of inflow)
Center-of-Mass det. time= 175.6 min (1,022.8 - 847.2)

Volume	Invert	Avail.Storage	Storage Description
#1	432.00'	66,840 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

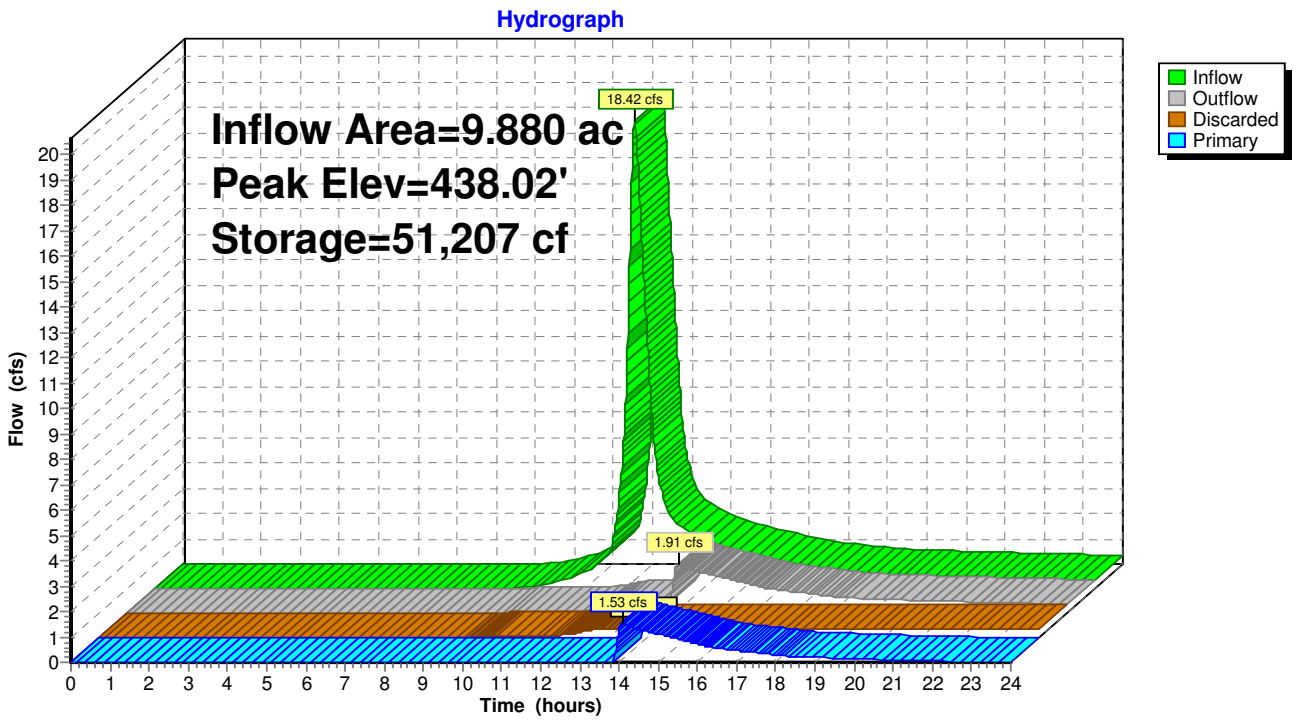
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
432.00	3,000	0	0
434.00	5,120	8,120	8,120
436.00	10,800	15,920	24,040
438.00	16,000	26,800	50,840
439.00	16,000	16,000	66,840

Device	Routing	Invert	Outlet Devices
#1	Primary	438.00'	**160.0' long x 10.0' 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) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Discarded	432.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.38 cfs @ 13.90 hrs HW=438.00' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.38 cfs)

Primary OutFlow Max=1.38 cfs @ 14.08 hrs HW=438.02' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 1.38 cfs @ 0.38 fps)

Pond OFF-SITE: Existing Off-Site Pond



Summary for Pond West: Proposed Westerly Basin

Inflow Area =	3.079 ac,	19.66% Impervious,	Inflow Depth >	2.61"	for 10 YR-Cornell event
Inflow =	7.63 cfs @	12.17 hrs,	Volume=	0.670 af	
Outflow =	1.14 cfs @	12.93 hrs,	Volume=	0.635 af,	Atten= 85%, Lag= 45.5 min
Primary =	1.14 cfs @	12.93 hrs,	Volume=	0.635 af	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 162.71' @ 12.93 hrs Surf.Area= 8,723 sf Storage= 13,057 cf

Plug-Flow detention time= 153.8 min calculated for 0.634 af (95% of inflow)
Center-of-Mass det. time= 125.6 min (958.2 - 832.6)

Volume	Invert	Avail.Storage	Storage Description
#1	161.00'	36,536 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

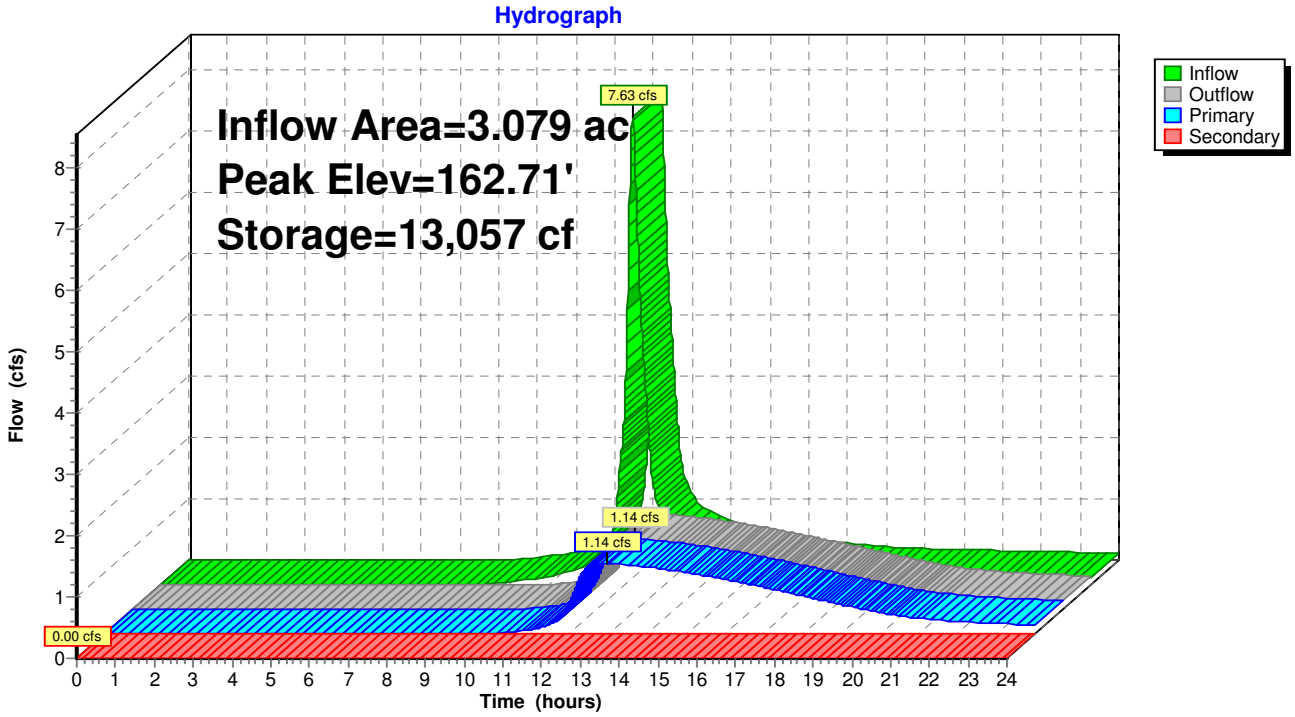
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
161.00	6,535	0	0
162.00	7,796	7,166	7,166
163.00	9,096	8,446	15,612
164.00	10,447	9,772	25,383
165.00	11,858	11,153	36,536

Device	Routing	Invert	Outlet Devices
#1	Primary	160.00'	**15.0" Round Culvert** L= 37.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 160.00' / 159.50' S= 0.0135 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.23 sf
#2	Device 1	161.00'	**6.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	163.25'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Secondary	164.00'	**15.0' long x 5.0' 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) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=1.14 cfs @ 12.93 hrs HW=162.71' (Free Discharge)
└─**1=Culvert** (Passes 1.14 cfs of 6.74 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.14 cfs @ 5.82 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=161.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond West: Proposed Westerly Basin



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment POST 1: Post Runoff Area=134,109 sf 19.66% Impervious Runoff Depth>3.73"
Flow Length=850' Tc=12.6 min UI Adjusted CN=78 Runoff=10.90 cfs 0.957 af

Subcatchment POST 1A: Post Runoff Area=67,090 sf 14.46% Impervious Runoff Depth>3.63"
Flow Length=160' Tc=9.9 min CN=77 Runoff=5.75 cfs 0.466 af

Subcatchment POST 1B: Post Runoff Area=218,556 sf 10.45% Impervious Runoff Depth>3.43"
Flow Length=700' Tc=14.7 min CN=75 Runoff=15.44 cfs 1.432 af

Subcatchment POST 2: Post Runoff Area=148,565 sf 27.98% Impervious Runoff Depth>3.83"
Flow Length=600' Tc=12.5 min UI Adjusted CN=79 Runoff=12.41 cfs 1.089 af

Subcatchment POST 2A: Post Runoff Area=57,638 sf 29.54% Impervious Runoff Depth>3.73"
Tc=10.0 min UI Adjusted CN=78 Runoff=5.06 cfs 0.411 af

Subcatchment PRE-A: Off Site Area to Off Runoff Area=9.880 ac 0.00% Impervious Runoff Depth>3.32"
Tc=18.0 min CN=74 Runoff=27.18 cfs 2.737 af

Reach 1R: Proposed Swale Avg. Flow Depth=0.50' Max Vel=7.39 fps Inflow=17.26 cfs 2.552 af
n=0.030 L=750.0' S=0.0773 '/' Capacity=59.15 cfs Outflow=16.67 cfs 2.548 af

Pond AP-1: Providence Road Drainage Inflow=22.11 cfs 3.980 af
Primary=22.11 cfs 3.980 af

Pond AP-2: Easement Line Inflow=12.91 cfs 1.449 af
Primary=12.91 cfs 1.449 af

Pond East: Proposed Easterly Basin Peak Elev=188.29' Storage=11,355 cf Inflow=12.41 cfs 1.089 af
Primary=9.48 cfs 1.037 af Secondary=0.00 cfs 0.000 af Outflow=9.48 cfs 1.037 af

Pond OFF-SITE: Existing Off-Site Pond Peak Elev=438.11' Storage=52,542 cf Inflow=27.18 cfs 2.737 af
Discarded=0.38 cfs 0.396 af Primary=14.21 cfs 1.174 af Outflow=14.59 cfs 1.569 af

Pond West: Proposed Westerly Basin Peak Elev=163.37' Storage=19,040 cf Inflow=10.90 cfs 0.957 af
Primary=1.90 cfs 0.912 af Secondary=0.00 cfs 0.000 af Outflow=1.90 cfs 0.912 af

Total Runoff Area = 24.250 ac Runoff Volume = 7.093 af Average Runoff Depth = 3.51"
88.88% Pervious = 21.552 ac 11.12% Impervious = 2.698 ac

Summary for Subcatchment POST 1: Post Development Area 1

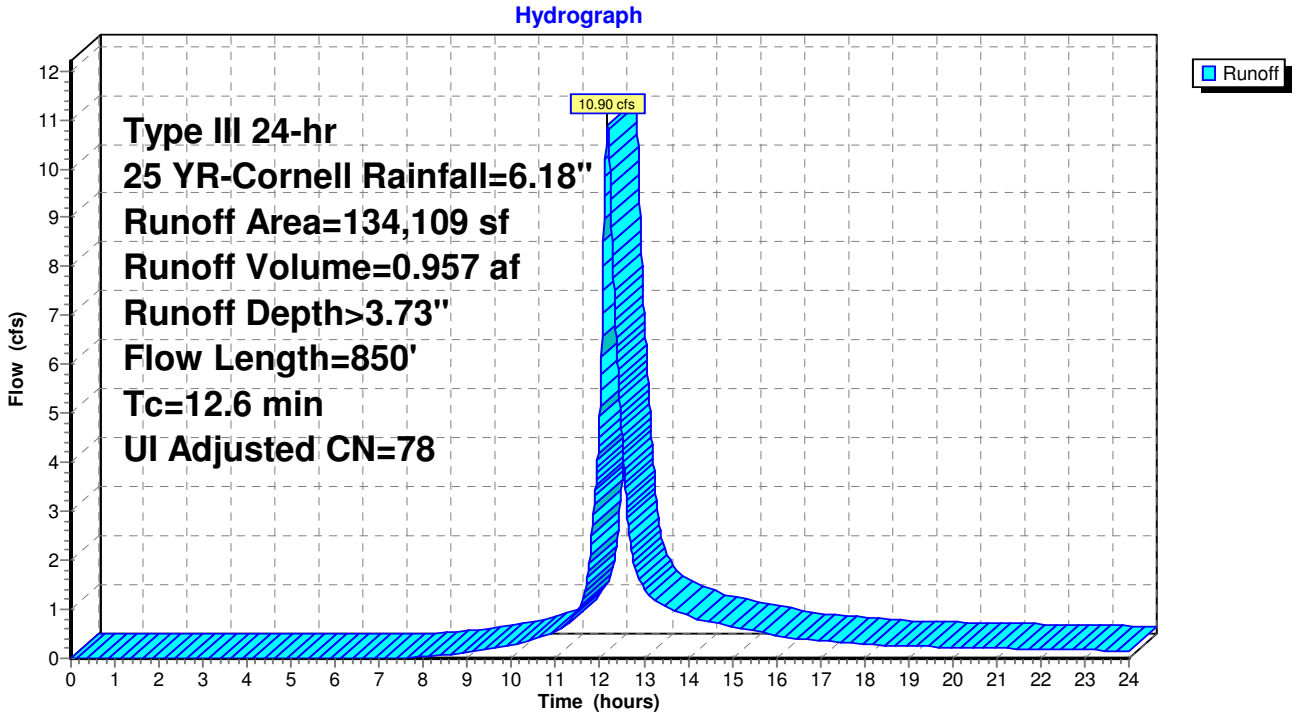
Runoff = 10.90 cfs @ 12.17 hrs, Volume= 0.957 af, Depth> 3.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YR-Cornell Rainfall=6.18"

	Area (sf)	CN	Adj	Description
	11,462	89		Gravel roads, HSG C
	8,168	72		Woods/grass comb., Good, HSG C
	88,115	74		Pasture/grassland/range, Good, HSG C
	25,536	98		Unconnected pavement, HSG C
*	828	98		Concrete Equipment Pads
	134,109	80	78	Weighted Average, UI Adjusted
	107,745			80.34% Pervious Area
	26,364			19.66% Impervious Area
	25,536			96.86% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.24"
2.5	350	0.1100	2.32		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.8	450	0.1200	9.90	1.94	**Pipe Channel, C-D** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.013 Corrugated PE, smooth interior
12.6	850	Total			

Subcatchment POST 1: Post Development Area 1



Summary for Subcatchment POST 1A: Post Development Area 1A

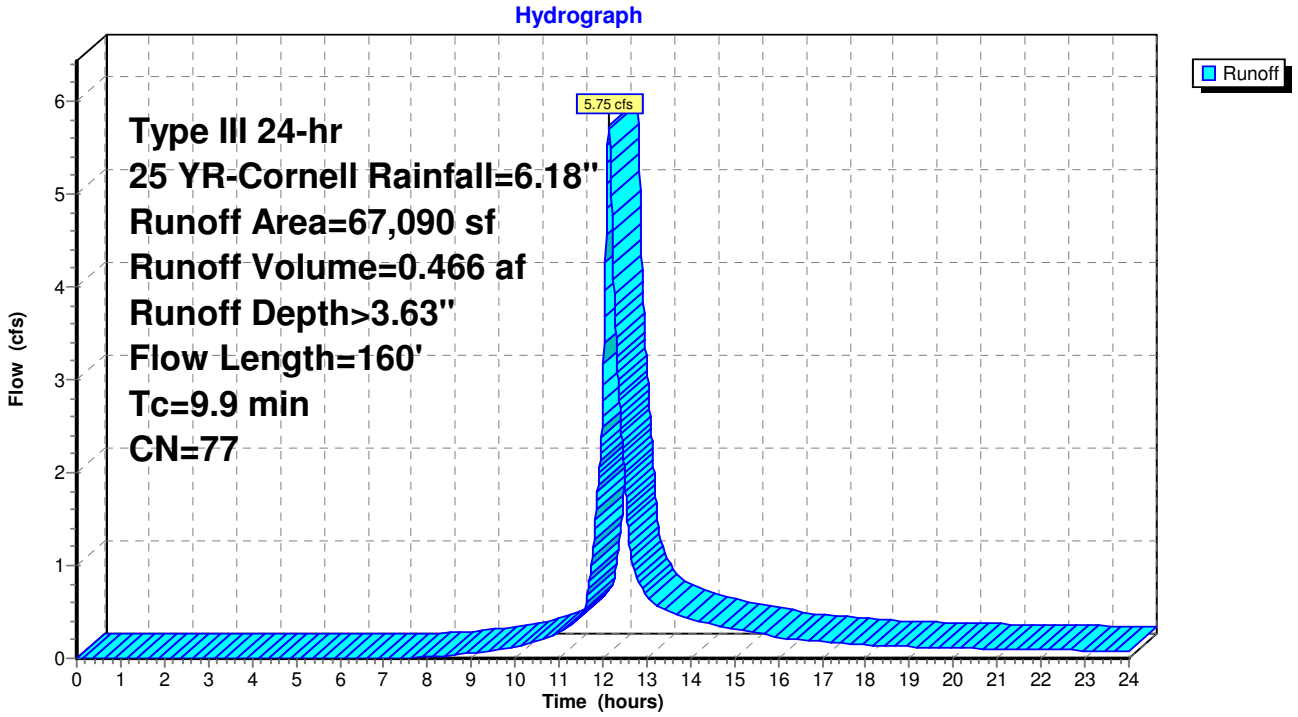
Runoff = 5.75 cfs @ 12.14 hrs, Volume= 0.466 af, Depth> 3.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YR-Cornell Rainfall=6.18"

	Area (sf)	CN	Description
	285	89	Gravel roads, HSG C
	11,155	74	>75% Grass cover, Good, HSG C
*	9,700	98	Paved parking, HSG C (Access)
*	5,300	89	Gravel roads, HSG C (Access)
*	7,500	74	>75% Grass cover, Good, HSG C (Access)
*	33,150	70	Woods, Good, HSG C (Lots)
	67,090	77	Weighted Average
	57,390		85.54% Pervious Area
	9,700		14.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.24"
1.3	85	0.0500	1.12		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.1	25	0.0300	3.52		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
9.9	160	Total			

Subcatchment POST 1A: Post Development Area 1A



Summary for Subcatchment POST 1B: Post Development Area 1B

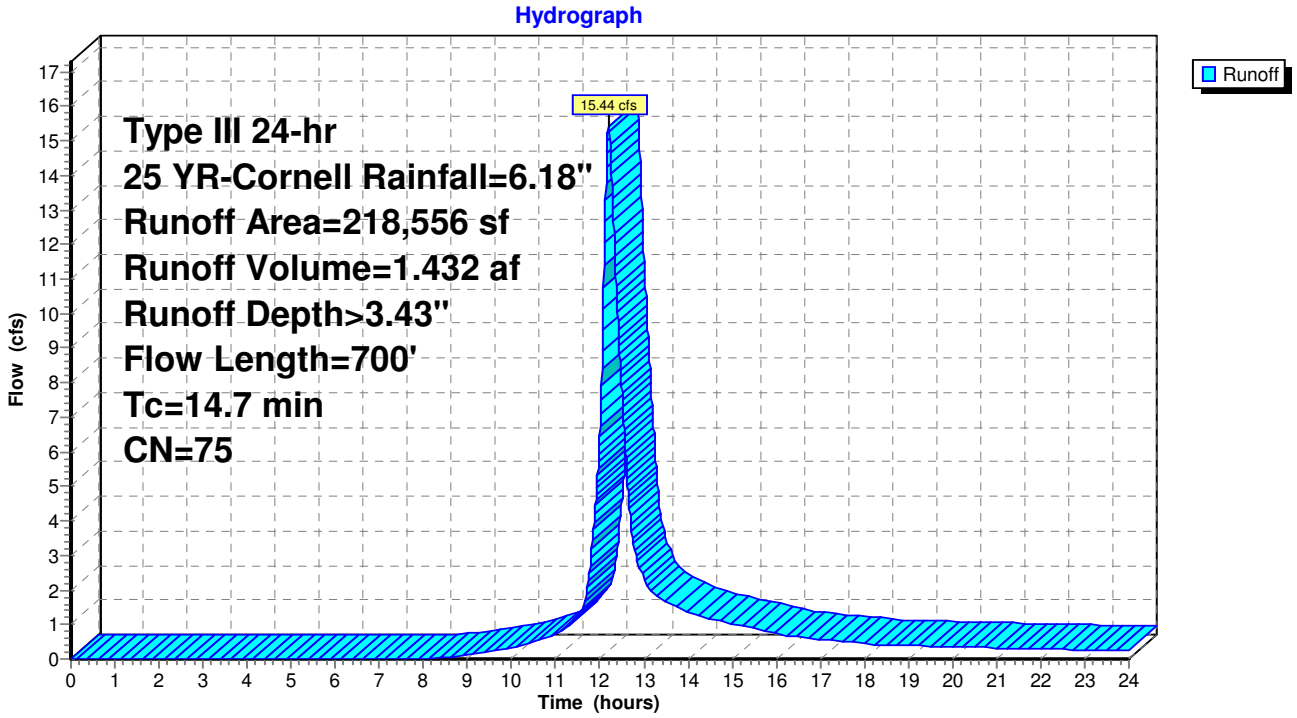
Runoff = 15.44 cfs @ 12.20 hrs, Volume= 1.432 af, Depth> 3.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YR-Cornell Rainfall=6.18"

	Area (sf)	CN	Description
*	22,849	98	Paved parking, HSG C (Lots)
*	90,371	74	>75% Grass cover, Good, HSG C (Lots)
*	105,336	70	Woods, Good, HSG C (Lots)
	218,556	75	Weighted Average
	195,707		89.55% Pervious Area
	22,849		10.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	50	0.0600	0.11		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.24"
5.7	485	0.0800	1.41		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.0	20	0.1500	7.86		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
1.1	145	0.1030	2.25		**Shallow Concentrated Flow, D-E** Short Grass Pasture Kv= 7.0 fps
14.7	700	Total			

Subcatchment POST 1B: Post Development Area 1B



Summary for Subcatchment POST 2: Post Development Area 2

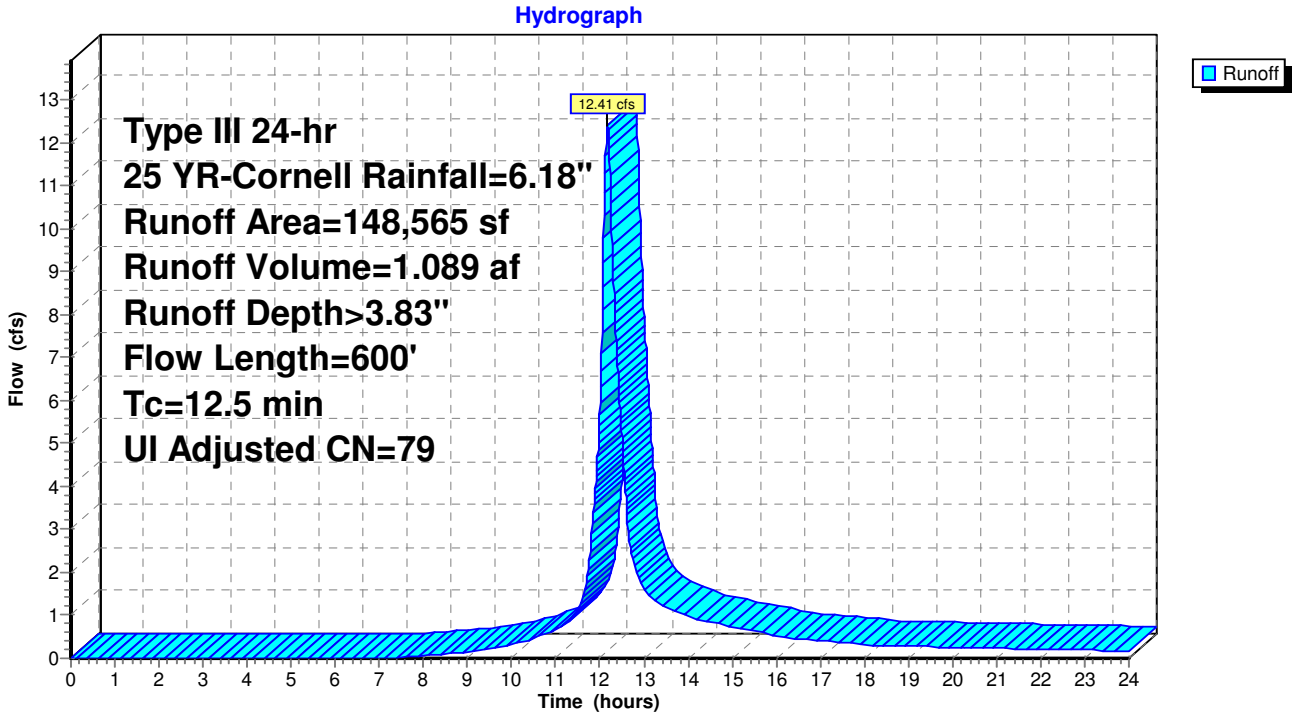
Runoff = 12.41 cfs @ 12.17 hrs, Volume= 1.089 af, Depth> 3.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YR-Cornell Rainfall=6.18"

	Area (sf)	CN	Adj	Description
	84,058	74		Pasture/grassland/range, Good, HSG C
*	41,571	98		Unconnected pavement, HSG C (Panels)
	16,786	89		Gravel roads, HSG C
	6,150	70		Woods, Good, HSG C
	148,565	82	79	Weighted Average, UI Adjusted
	106,994			72.02% Pervious Area
	41,571			27.98% Impervious Area
	41,571			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.24"
2.9	350	0.0850	2.04		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.3	200	0.1400	12.95	4.52	**Pipe Channel, C-D** 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.013 Corrugated PE, smooth interior
12.5	600	Total			

Subcatchment POST 2: Post Development Area 2



Summary for Subcatchment POST 2A: Post Development Area 2A

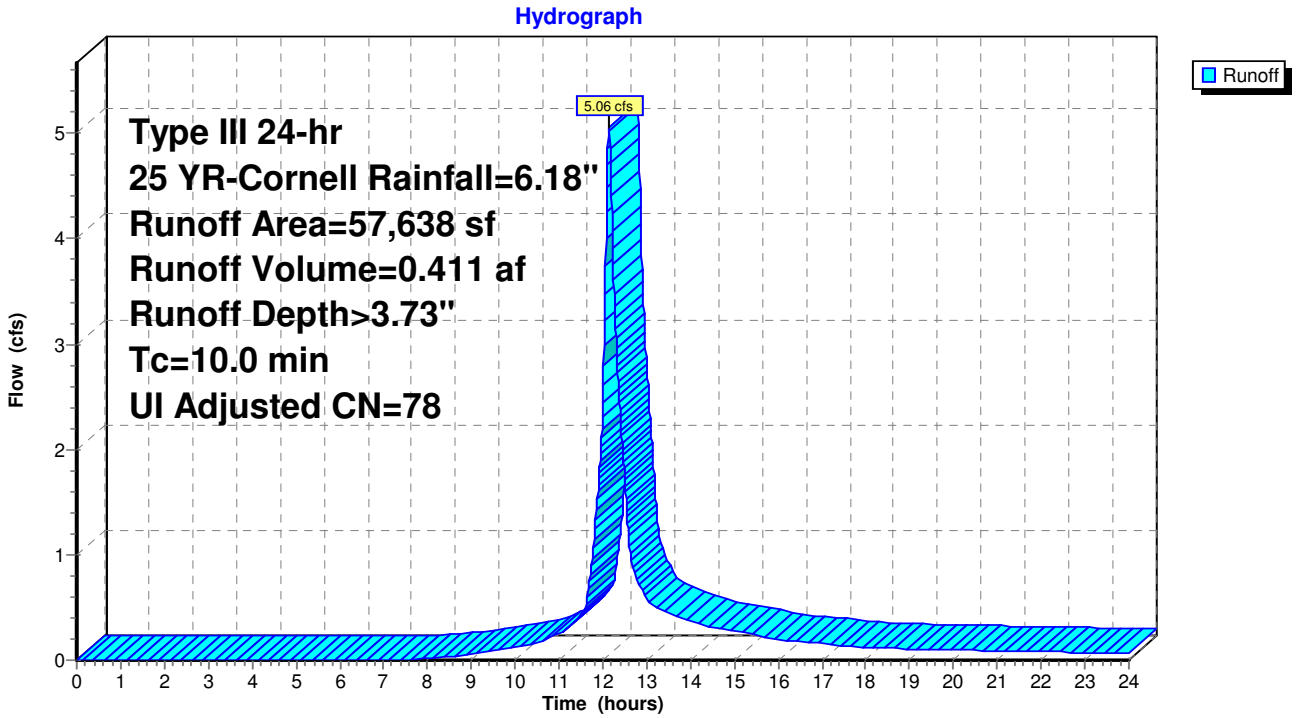
Runoff = 5.06 cfs @ 12.14 hrs, Volume= 0.411 af, Depth> 3.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YR-Cornell Rainfall=6.18"

Area (sf)	CN	Adj	Description
40,614	74		>75% Grass cover, Good, HSG C
17,024	98		Unconnected roofs, HSG C
57,638	81	78	Weighted Average, UI Adjusted
40,614			70.46% Pervious Area
17,024			29.54% Impervious Area
17,024			100.00% Unconnected

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

Subcatchment POST 2A: Post Development Area 2A



Summary for Subcatchment PRE-A: Off Site Area to Off Site Basin

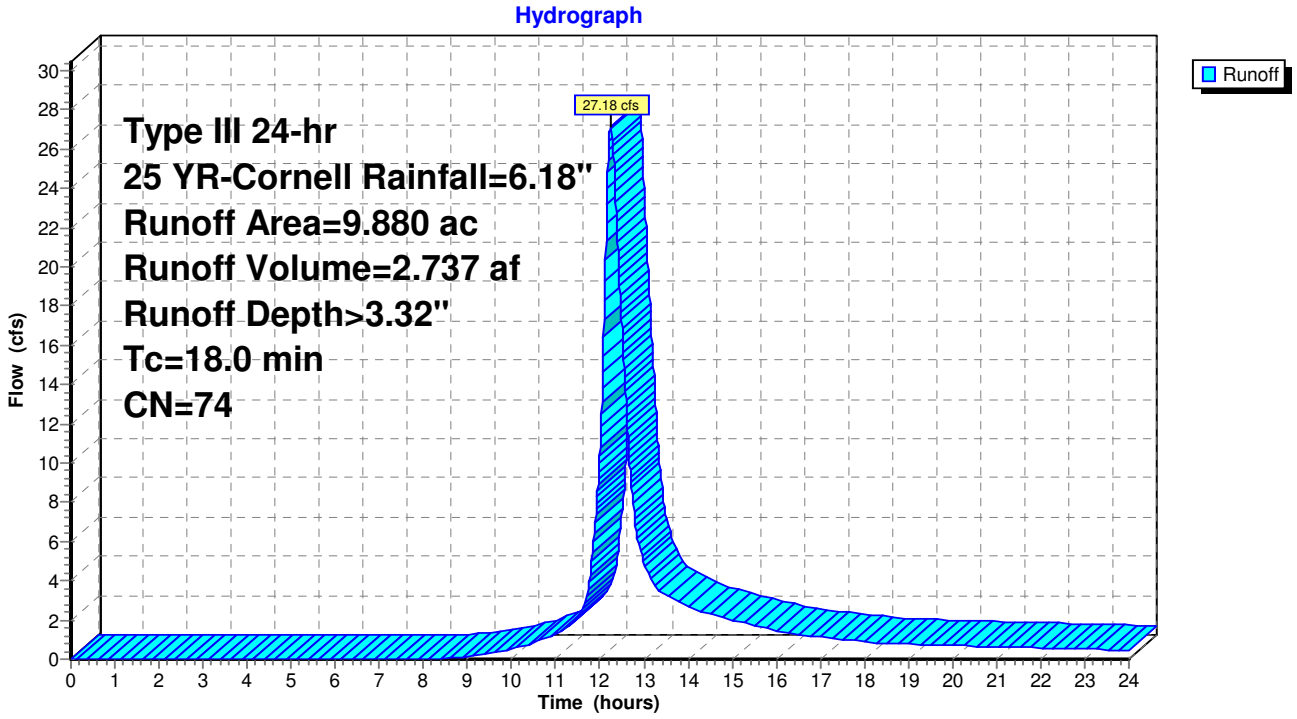
Runoff = 27.18 cfs @ 12.25 hrs, Volume= 2.737 af, Depth> 3.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YR-Cornell Rainfall=6.18"

	Area (ac)	CN	Description
*	9.880	74	Taken from Record Calculations
	9.880		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.0					**Direct Entry, Taken from Record Calculations**

Subcatchment PRE-A: Off Site Area to Off Site Basin



Summary for Reach 1R: Proposed Swale

Inflow Area = 14.499 ac, 5.71% Impervious, Inflow Depth > 2.11" for 25 YR-Cornell event
Inflow = 17.26 cfs @ 12.56 hrs, Volume= 2.552 af
Outflow = 16.67 cfs @ 12.61 hrs, Volume= 2.548 af, Atten= 3%, Lag= 3.5 min

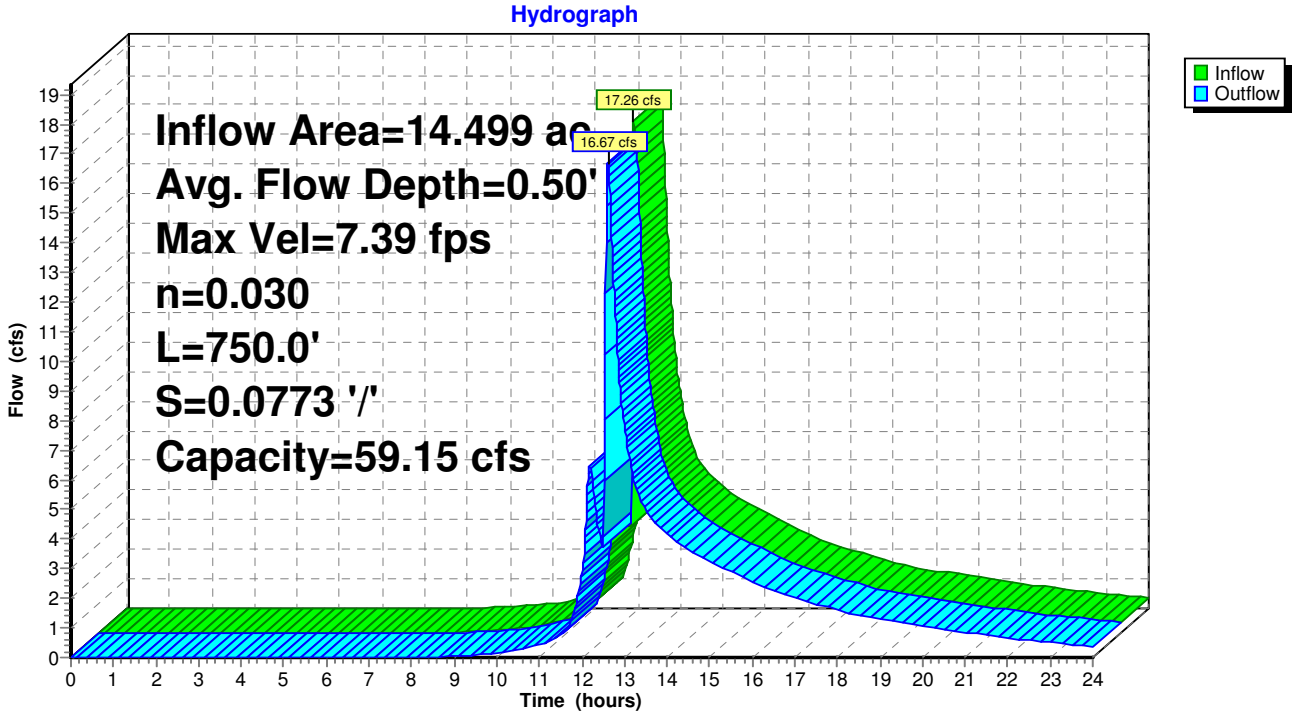
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.39 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 2.95 fps, Avg. Travel Time= 4.2 min

Peak Storage= 1,692 cf @ 12.59 hrs
Average Depth at Peak Storage= 0.50'
Bank-Full Depth= 1.00' Flow Area= 5.5 sf, Capacity= 59.15 cfs

3.50' x 1.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 7.50'
Length= 750.0' Slope= 0.0773 '/'
Inlet Invert= 153.00', Outlet Invert= 95.00'

‡

Reach 1R: Proposed Swale



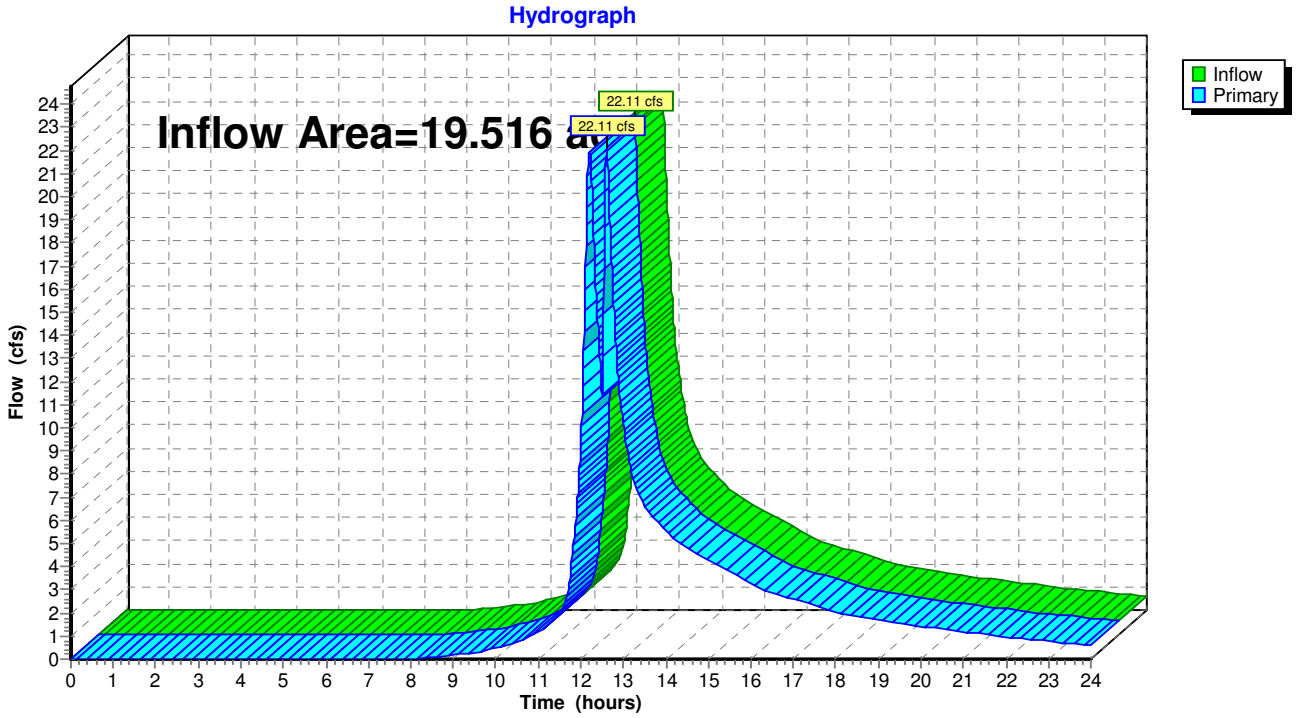
Summary for Pond AP-1: Providence Road Drainage

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

Inflow Area = 19.516 ac, 6.93% Impervious, Inflow Depth > 2.45" for 25 YR-Cornell event
Inflow = 22.11 cfs @ 12.60 hrs, Volume= 3.980 af
Primary = 22.11 cfs @ 12.60 hrs, Volume= 3.980 af, Atten= 0%, Lag= 0.0 min

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

Pond AP-1: Providence Road Drainage



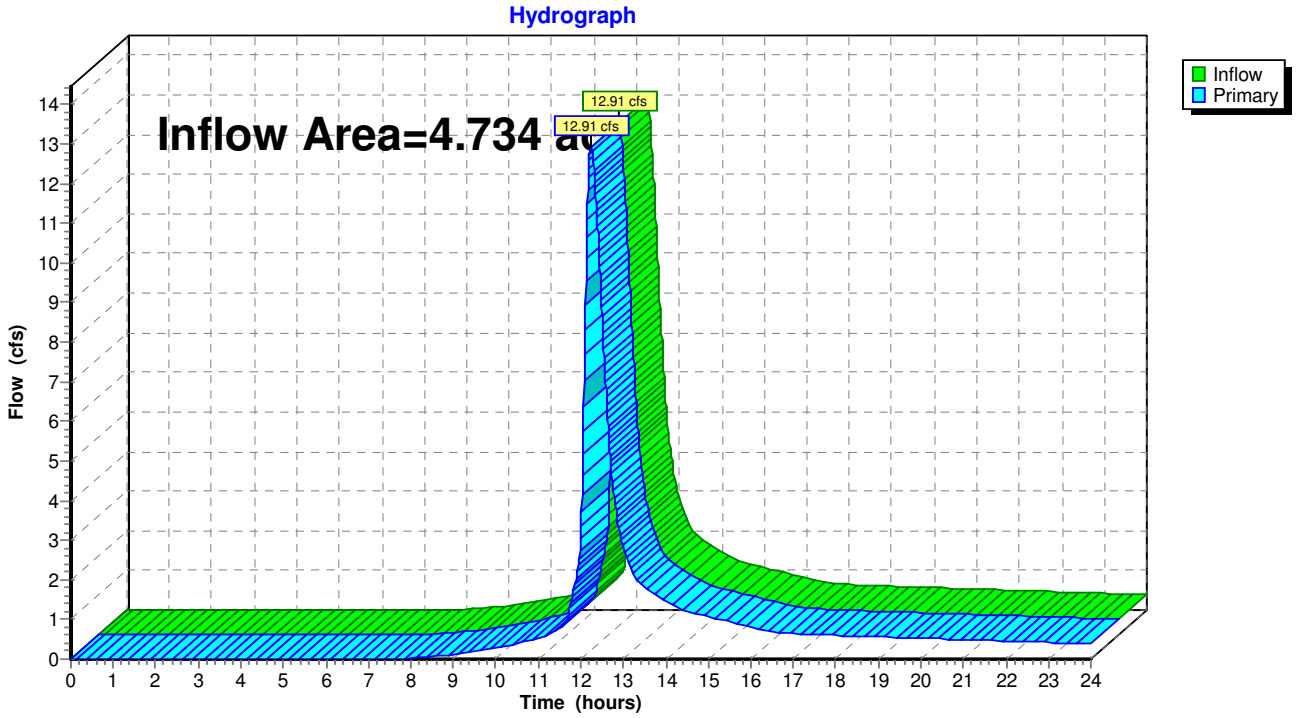
Summary for Pond AP-2: Easement Line

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

Inflow Area = 4.734 ac, 28.42% Impervious, Inflow Depth > 3.67" for 25 YR-Cornell event
Inflow = 12.91 cfs @ 12.24 hrs, Volume= 1.449 af
Primary = 12.91 cfs @ 12.24 hrs, Volume= 1.449 af, Atten= 0%, Lag= 0.0 min

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

Pond AP-2: Easement Line



Summary for Pond East: Proposed Easterly Basin

Inflow Area = 3.411 ac, 27.98% Impervious, Inflow Depth > 3.83" for 25 YR-Cornell event
Inflow = 12.41 cfs @ 12.17 hrs, Volume= 1.089 af
Outflow = 9.48 cfs @ 12.28 hrs, Volume= 1.037 af, Atten= 24%, Lag= 6.7 min
Primary = 9.48 cfs @ 12.28 hrs, Volume= 1.037 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 188.29' @ 12.28 hrs Surf.Area= 6,723 sf Storage= 11,355 cf

Plug-Flow detention time= 91.3 min calculated for 1.037 af (95% of inflow)
Center-of-Mass det. time= 65.3 min (885.3 - 820.0)

Volume	Invert	Avail.Storage	Storage Description
#1	186.00'	24,433 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

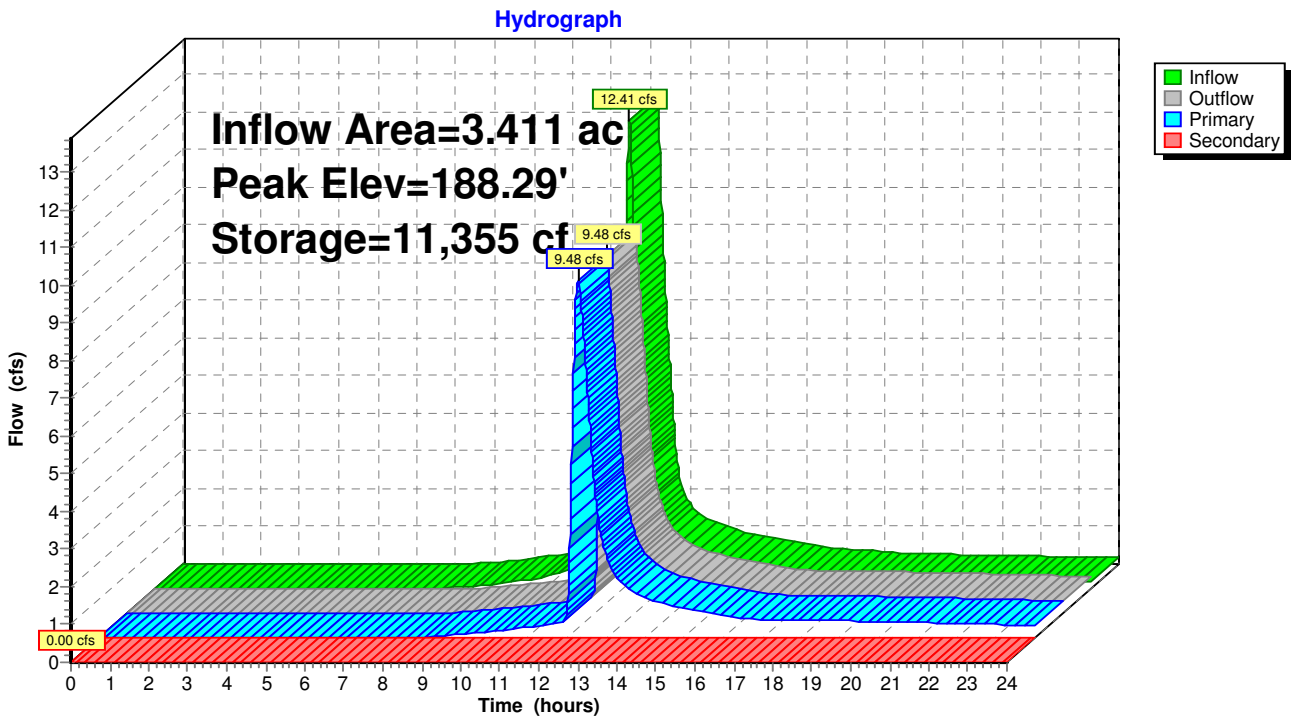
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
186.00	1,685	0	0
187.00	5,388	3,537	3,537
188.00	6,408	5,898	9,435
189.00	7,485	6,947	16,381
190.00	8,618	8,052	24,433

Device	Routing	Invert	Outlet Devices
#1	Primary	185.00'	**18.0" Round Culvert** L= 26.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 185.00' / 184.75' S= 0.0096 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	186.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	187.50'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Secondary	189.00'	**15.0' long x 5.0' 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) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=9.47 cfs @ 12.28 hrs HW=188.29' (Free Discharge)
└─**1=Culvert** (Passes 9.47 cfs of 13.57 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.61 cfs @ 7.02 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 8.86 cfs @ 2.91 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=186.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond East: Proposed Easterly Basin



Summary for Pond OFF-SITE: Existing Off-Site Pond

Inflow Area =	9.880 ac,	0.00% Impervious,	Inflow Depth >	3.32"	for 25 YR-Cornell event
Inflow =	27.18 cfs @	12.25 hrs,	Volume=	2.737 af	
Outflow =	14.59 cfs @	12.56 hrs,	Volume=	1.569 af,	Atten= 46%, Lag= 18.2 min
Discarded =	0.38 cfs @	12.48 hrs,	Volume=	0.396 af	
Primary =	14.21 cfs @	12.56 hrs,	Volume=	1.174 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 438.11' @ 12.56 hrs Surf.Area= 16,000 sf Storage= 52,542 cf

Plug-Flow detention time= 198.8 min calculated for 1.569 af (57% of inflow)
Center-of-Mass det. time= 89.6 min (925.9 - 836.3)

Volume	Invert	Avail.Storage	Storage Description
#1	432.00'	66,840 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

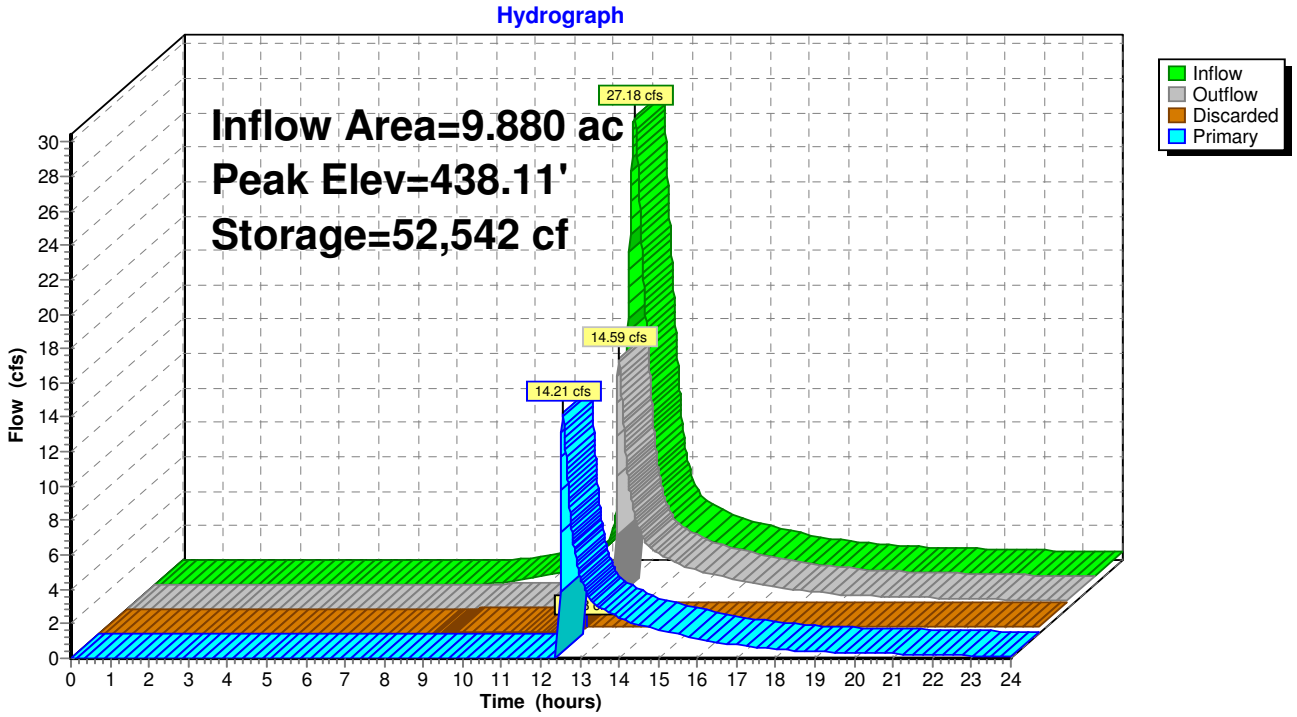
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
432.00	3,000	0	0
434.00	5,120	8,120	8,120
436.00	10,800	15,920	24,040
438.00	16,000	26,800	50,840
439.00	16,000	16,000	66,840

Device	Routing	Invert	Outlet Devices
#1	Primary	438.00'	**160.0' long x 10.0' 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) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Discarded	432.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.38 cfs @ 12.48 hrs HW=438.01' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.38 cfs)

Primary OutFlow Max=13.81 cfs @ 12.56 hrs HW=438.11' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 13.81 cfs @ 0.81 fps)

Pond OFF-SITE: Existing Off-Site Pond



Summary for Pond West: Proposed Westerly Basin

Inflow Area =	3.079 ac,	19.66% Impervious,	Inflow Depth >	3.73"	for 25 YR-Cornell event
Inflow =	10.90 cfs @	12.17 hrs,	Volume=	0.957 af	
Outflow =	1.90 cfs @	12.78 hrs,	Volume=	0.912 af,	Atten= 83%, Lag= 36.6 min
Primary =	1.90 cfs @	12.78 hrs,	Volume=	0.912 af	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 163.37' @ 12.78 hrs Surf.Area= 9,592 sf Storage= 19,040 cf

Plug-Flow detention time= 170.7 min calculated for 0.912 af (95% of inflow)
Center-of-Mass det. time= 145.4 min (967.9 - 822.5)

Volume	Invert	Avail.Storage	Storage Description
#1	161.00'	36,536 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

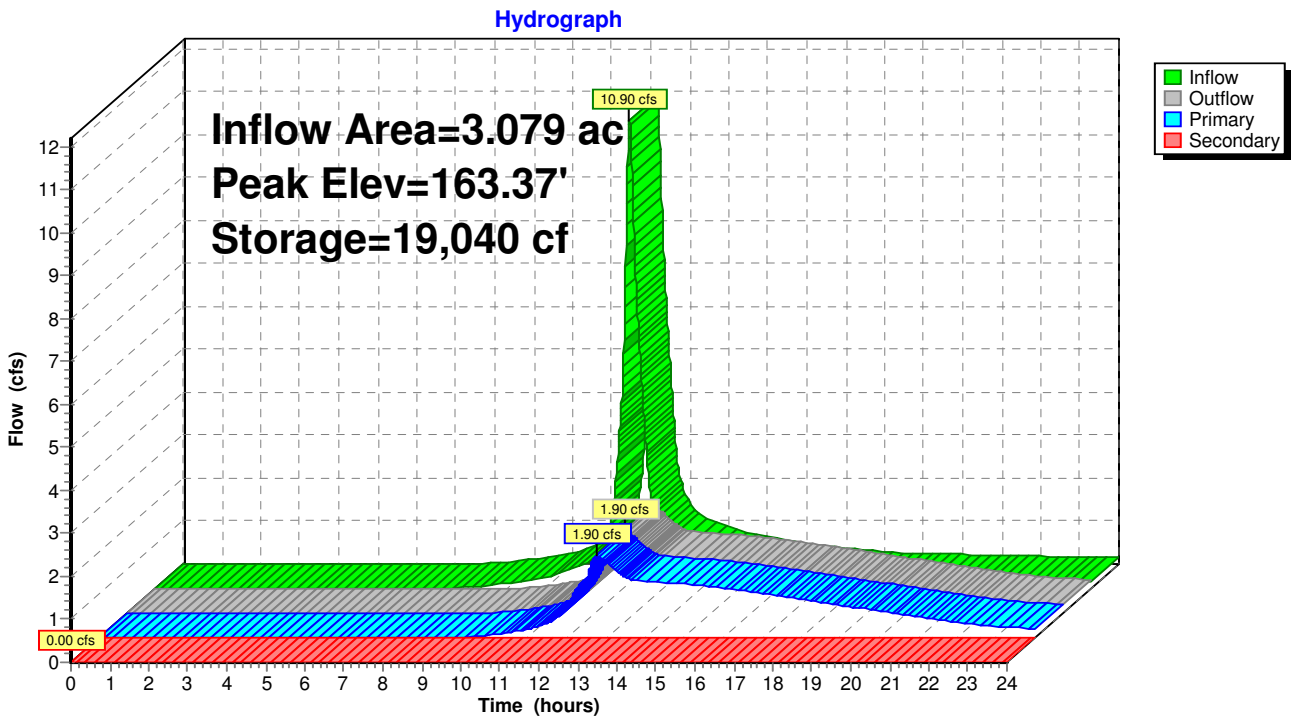
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
161.00	6,535	0	0
162.00	7,796	7,166	7,166
163.00	9,096	8,446	15,612
164.00	10,447	9,772	25,383
165.00	11,858	11,153	36,536

Device	Routing	Invert	Outlet Devices
#1	Primary	160.00'	**15.0" Round Culvert** L= 37.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 160.00' / 159.50' S= 0.0135 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.23 sf
#2	Device 1	161.00'	**6.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	163.25'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Secondary	164.00'	**15.0' long x 5.0' 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) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=1.90 cfs @ 12.78 hrs HW=163.37' (Free Discharge)
└─**1=Culvert** (Passes 1.90 cfs of 7.72 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.38 cfs @ 7.01 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 0.52 cfs @ 1.12 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=161.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond West: Proposed Westerly Basin



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment POST 1: Post Runoff Area=134,109 sf 19.66% Impervious Runoff Depth>6.16"
Flow Length=850' Tc=12.6 min UI Adjusted CN=78 Runoff=17.79 cfs 1.580 af

Subcatchment POST 1A: Post Runoff Area=67,090 sf 14.46% Impervious Runoff Depth>6.04"
Flow Length=160' Tc=9.9 min CN=77 Runoff=9.47 cfs 0.775 af

Subcatchment POST 1B: Post Runoff Area=218,556 sf 10.45% Impervious Runoff Depth>5.79"
Flow Length=700' Tc=14.7 min CN=75 Runoff=25.95 cfs 2.421 af

Subcatchment POST 2: Post Runoff Area=148,565 sf 27.98% Impervious Runoff Depth>6.28"
Flow Length=600' Tc=12.5 min UI Adjusted CN=79 Runoff=20.07 cfs 1.785 af

Subcatchment POST 2A: Post Runoff Area=57,638 sf 29.54% Impervious Runoff Depth>6.16"
Tc=10.0 min UI Adjusted CN=78 Runoff=8.26 cfs 0.679 af

Subcatchment PRE-A: Off Site Area to Off Runoff Area=9.880 ac 0.00% Impervious Runoff Depth>5.66"
Tc=18.0 min CN=74 Runoff=46.18 cfs 4.664 af

Reach 1R: Proposed Swale Avg. Flow Depth=0.98' Max Vel=10.66 fps Inflow=57.72 cfs 5.364 af
n=0.030 L=750.0' S=0.0773 '/' Capacity=59.15 cfs Outflow=57.41 cfs 5.357 af

Pond AP-1: Providence Road Drainage Inflow=78.95 cfs 7.778 af
Primary=78.95 cfs 7.778 af

Pond AP-2: Easement Line Inflow=22.17 cfs 2.370 af
Primary=22.17 cfs 2.370 af

Pond East: Proposed Easterly Basin Peak Elev=188.78' Storage=14,753 cf Inflow=20.07 cfs 1.785 af
Primary=14.81 cfs 1.691 af Secondary=0.00 cfs 0.000 af Outflow=14.81 cfs 1.691 af

Pond OFF-SITE: Existing Off-Site Pond Peak Elev=438.23' Storage=54,588 cf Inflow=46.18 cfs 4.664 af
Discarded=0.38 cfs 0.421 af Primary=45.48 cfs 3.073 af Outflow=45.86 cfs 3.494 af

Pond West: Proposed Westerly Basin Peak Elev=163.94' Storage=24,803 cf Inflow=17.79 cfs 1.580 af
Primary=8.50 cfs 1.516 af Secondary=0.00 cfs 0.000 af Outflow=8.50 cfs 1.516 af

Total Runoff Area = 24.250 ac Runoff Volume = 11.904 af Average Runoff Depth = 5.89"
88.88% Pervious = 21.552 ac 11.12% Impervious = 2.698 ac

Summary for Subcatchment POST 1: Post Development Area 1

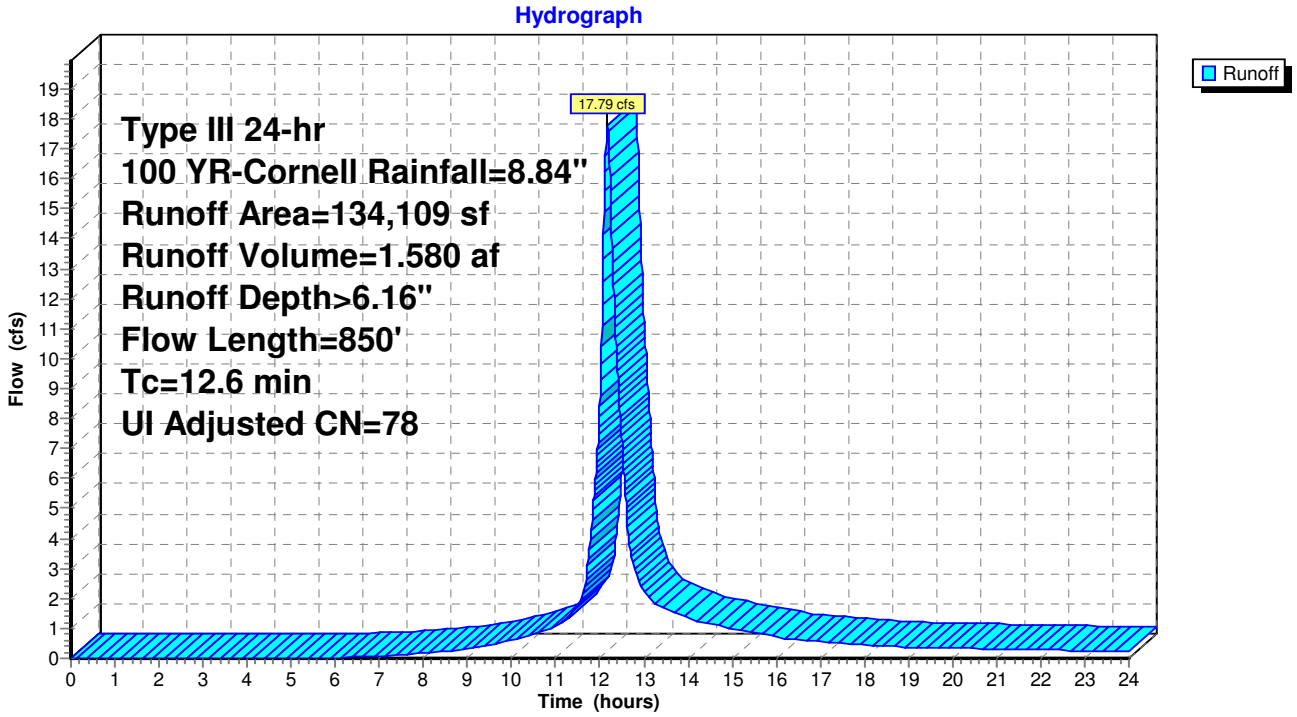
Runoff = 17.79 cfs @ 12.17 hrs, Volume= 1.580 af, Depth> 6.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YR-Cornell Rainfall=8.84"

	Area (sf)	CN	Adj	Description
	11,462	89		Gravel roads, HSG C
	8,168	72		Woods/grass comb., Good, HSG C
	88,115	74		Pasture/grassland/range, Good, HSG C
	25,536	98		Unconnected pavement, HSG C
*	828	98		Concrete Equipment Pads
	134,109	80	78	Weighted Average, UI Adjusted
	107,745			80.34% Pervious Area
	26,364			19.66% Impervious Area
	25,536			96.86% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.24"
2.5	350	0.1100	2.32		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.8	450	0.1200	9.90	1.94	**Pipe Channel, C-D** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.013 Corrugated PE, smooth interior
12.6	850	Total			

Subcatchment POST 1: Post Development Area 1



Summary for Subcatchment POST 1A: Post Development Area 1A

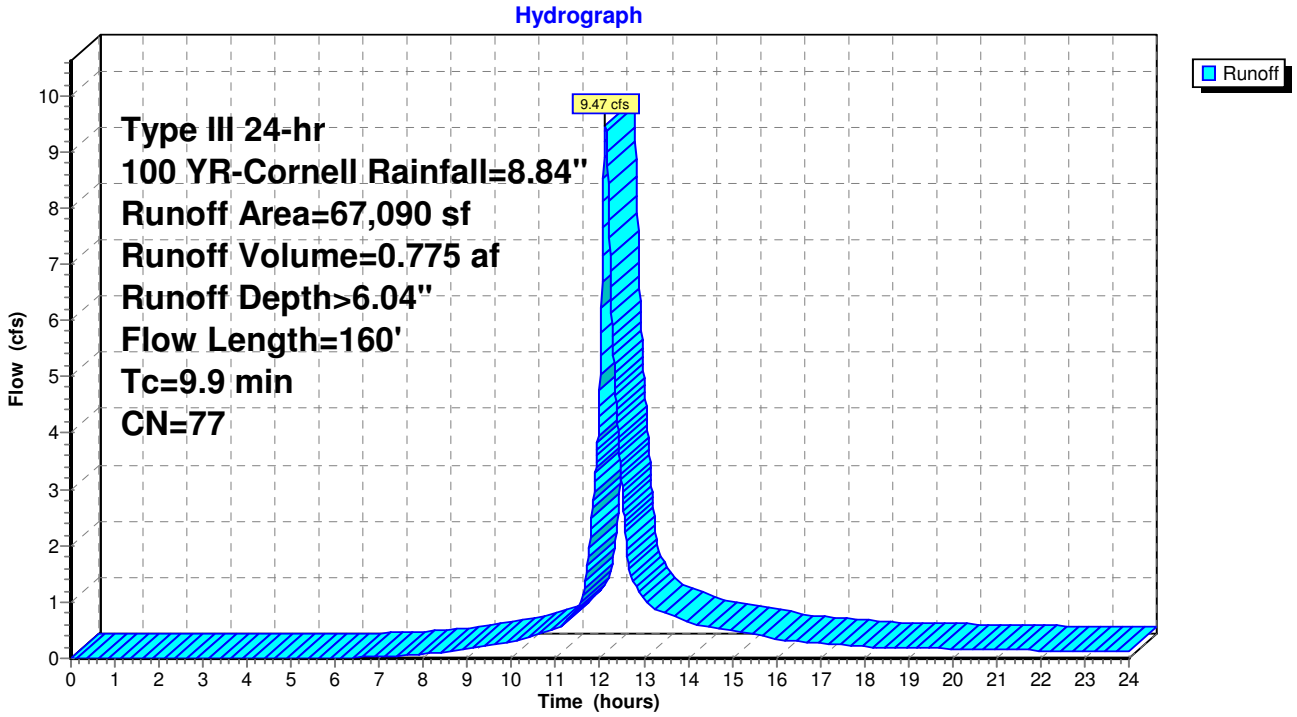
Runoff = 9.47 cfs @ 12.14 hrs, Volume= 0.775 af, Depth> 6.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YR-Cornell Rainfall=8.84"

	Area (sf)	CN	Description
	285	89	Gravel roads, HSG C
	11,155	74	>75% Grass cover, Good, HSG C
*	9,700	98	Paved parking, HSG C (Access)
*	5,300	89	Gravel roads, HSG C (Access)
*	7,500	74	>75% Grass cover, Good, HSG C (Access)
*	33,150	70	Woods, Good, HSG C (Lots)
	67,090	77	Weighted Average
	57,390		85.54% Pervious Area
	9,700		14.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.10		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.24"
1.3	85	0.0500	1.12		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.1	25	0.0300	3.52		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
9.9	160	Total			

Subcatchment POST 1A: Post Development Area 1A



Summary for Subcatchment POST 1B: Post Development Area 1B

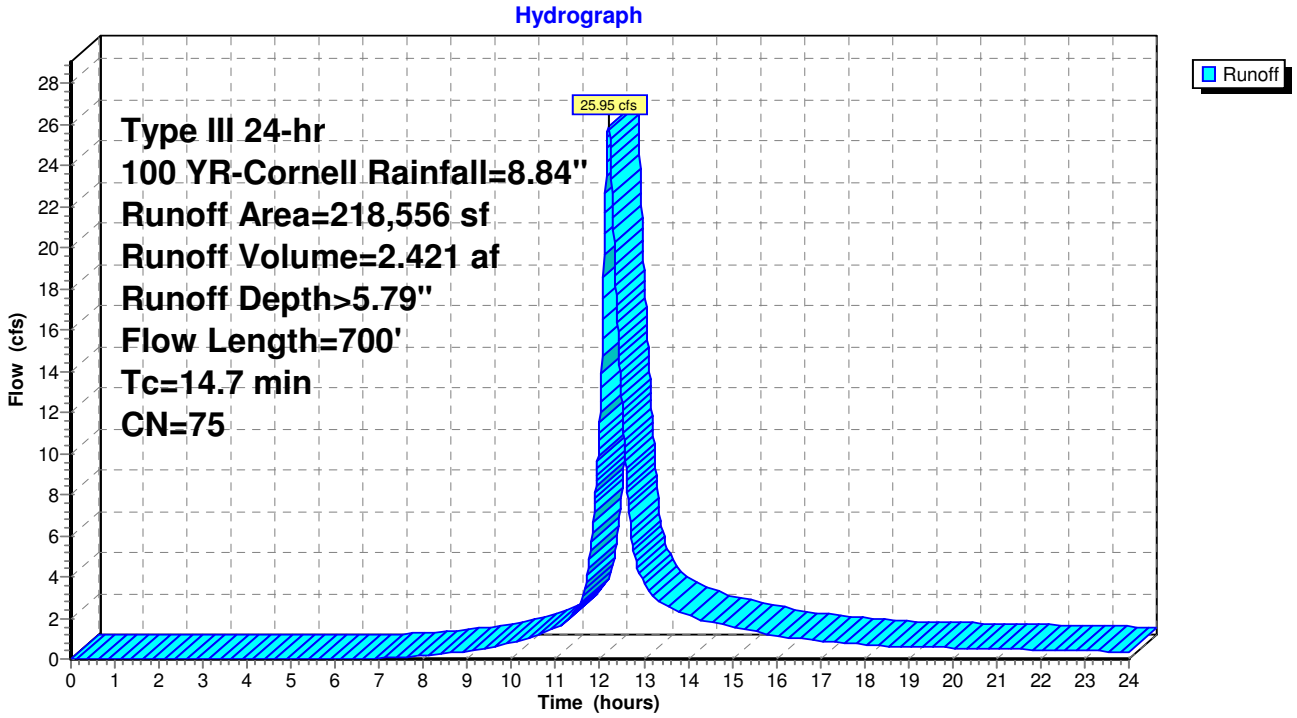
Runoff = 25.95 cfs @ 12.20 hrs, Volume= 2.421 af, Depth> 5.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YR-Cornell Rainfall=8.84"

	Area (sf)	CN	Description
*	22,849	98	Paved parking, HSG C (Lots)
*	90,371	74	>75% Grass cover, Good, HSG C (Lots)
*	105,336	70	Woods, Good, HSG C (Lots)
	218,556	75	Weighted Average
	195,707		89.55% Pervious Area
	22,849		10.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	50	0.0600	0.11		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.24"
5.7	485	0.0800	1.41		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.0	20	0.1500	7.86		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
1.1	145	0.1030	2.25		**Shallow Concentrated Flow, D-E** Short Grass Pasture Kv= 7.0 fps
14.7	700	Total			

Subcatchment POST 1B: Post Development Area 1B



Summary for Subcatchment POST 2: Post Development Area 2

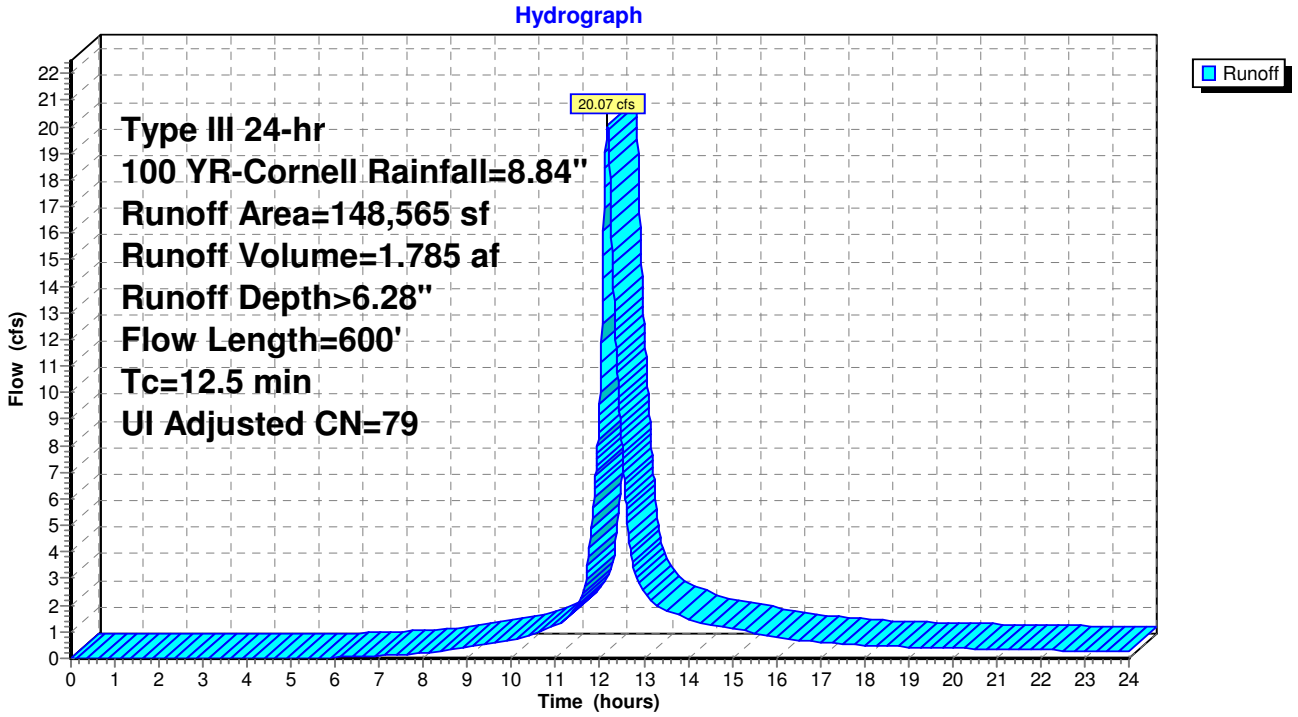
Runoff = 20.07 cfs @ 12.17 hrs, Volume= 1.785 af, Depth> 6.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YR-Cornell Rainfall=8.84"

	Area (sf)	CN	Adj	Description
	84,058	74		Pasture/grassland/range, Good, HSG C
*	41,571	98		Unconnected pavement, HSG C (Panels)
	16,786	89		Gravel roads, HSG C
	6,150	70		Woods, Good, HSG C
	148,565	82	79	Weighted Average, UI Adjusted
	106,994			72.02% Pervious Area
	41,571			27.98% Impervious Area
	41,571			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.24"
2.9	350	0.0850	2.04		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.3	200	0.1400	12.95	4.52	**Pipe Channel, C-D** 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.013 Corrugated PE, smooth interior
12.5	600	Total			

Subcatchment POST 2: Post Development Area 2



Summary for Subcatchment POST 2A: Post Development Area 2A

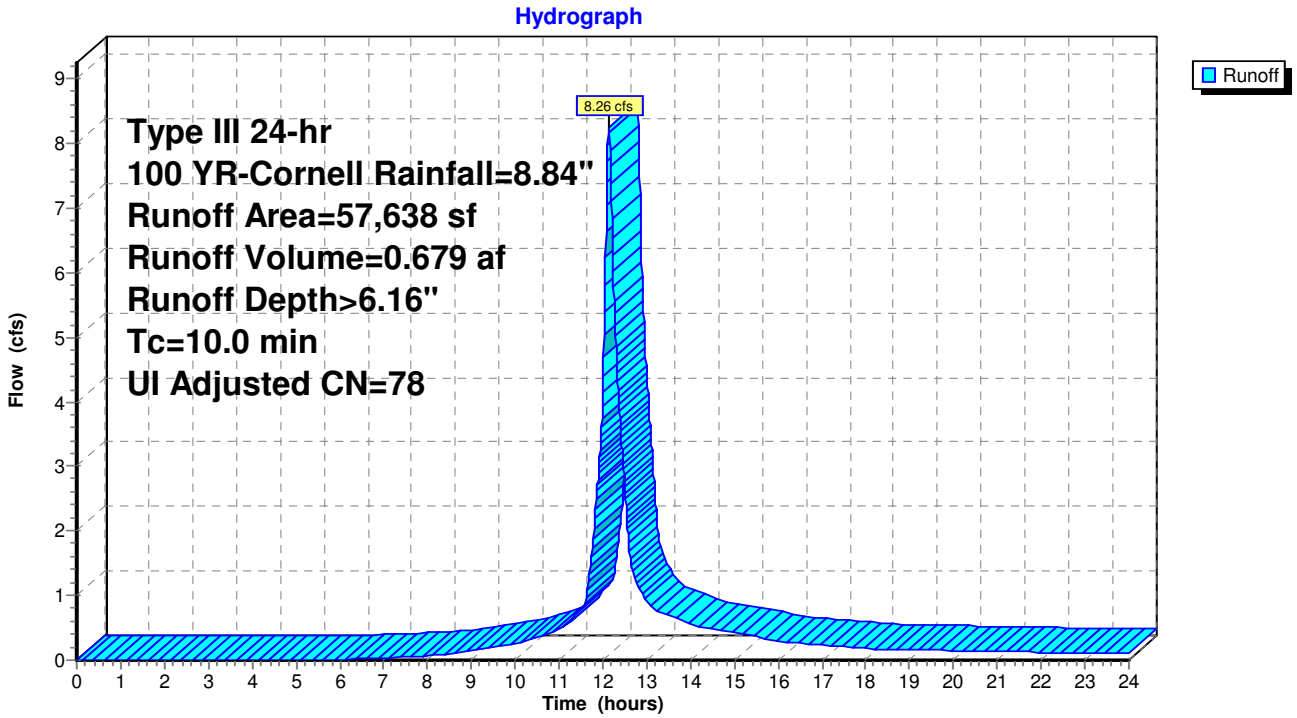
Runoff = 8.26 cfs @ 12.14 hrs, Volume= 0.679 af, Depth> 6.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YR-Cornell Rainfall=8.84"

Area (sf)	CN	Adj	Description
40,614	74		>75% Grass cover, Good, HSG C
17,024	98		Unconnected roofs, HSG C
57,638	81	78	Weighted Average, UI Adjusted
40,614			70.46% Pervious Area
17,024			29.54% Impervious Area
17,024			100.00% Unconnected

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

Subcatchment POST 2A: Post Development Area 2A



Summary for Subcatchment PRE-A: Off Site Area to Off Site Basin

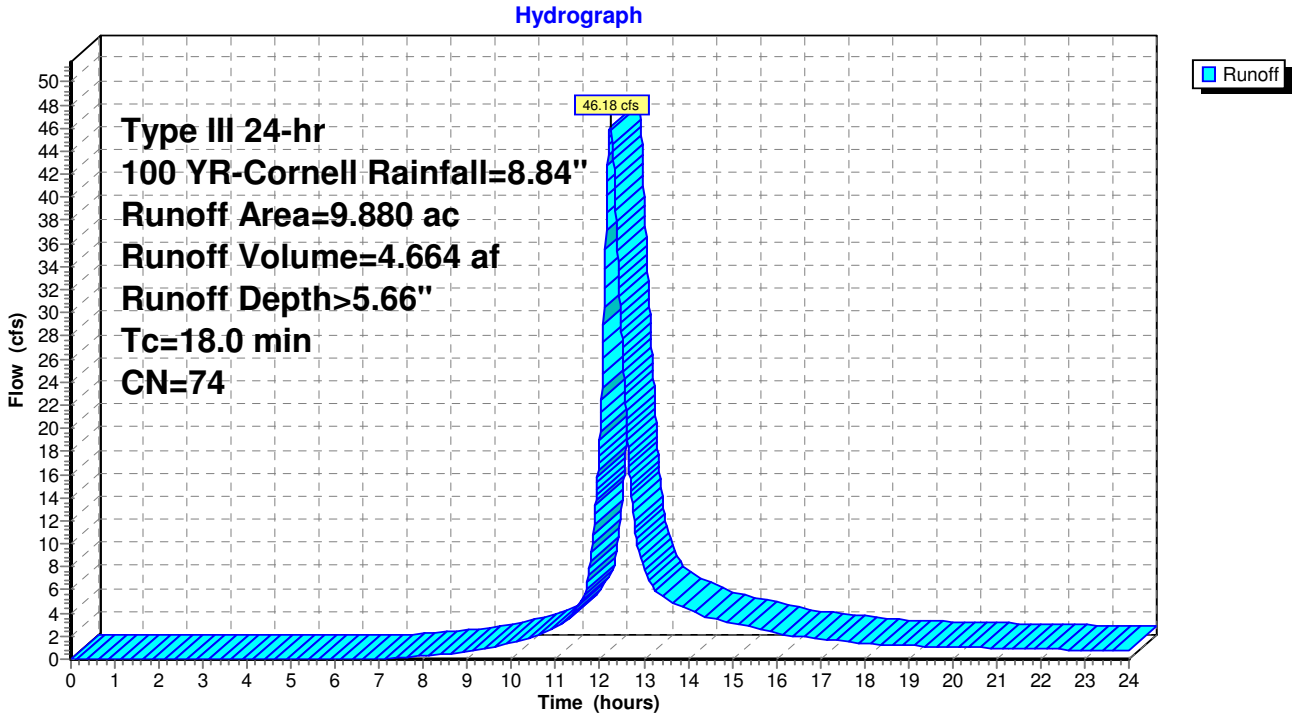
Runoff = 46.18 cfs @ 12.24 hrs, Volume= 4.664 af, Depth> 5.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YR-Cornell Rainfall=8.84"

	Area (ac)	CN	Description
*	9.880	74	Taken from Record Calculations
	9.880		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.0					**Direct Entry, Taken from Record Calculations**

Subcatchment PRE-A: Off Site Area to Off Site Basin



Summary for Reach 1R: Proposed Swale

Inflow Area = 14.499 ac, 5.71% Impervious, Inflow Depth > 4.44" for 100 YR-Cornell event
Inflow = 57.72 cfs @ 12.27 hrs, Volume= 5.364 af
Outflow = 57.41 cfs @ 12.31 hrs, Volume= 5.357 af, Atten= 1%, Lag= 2.3 min

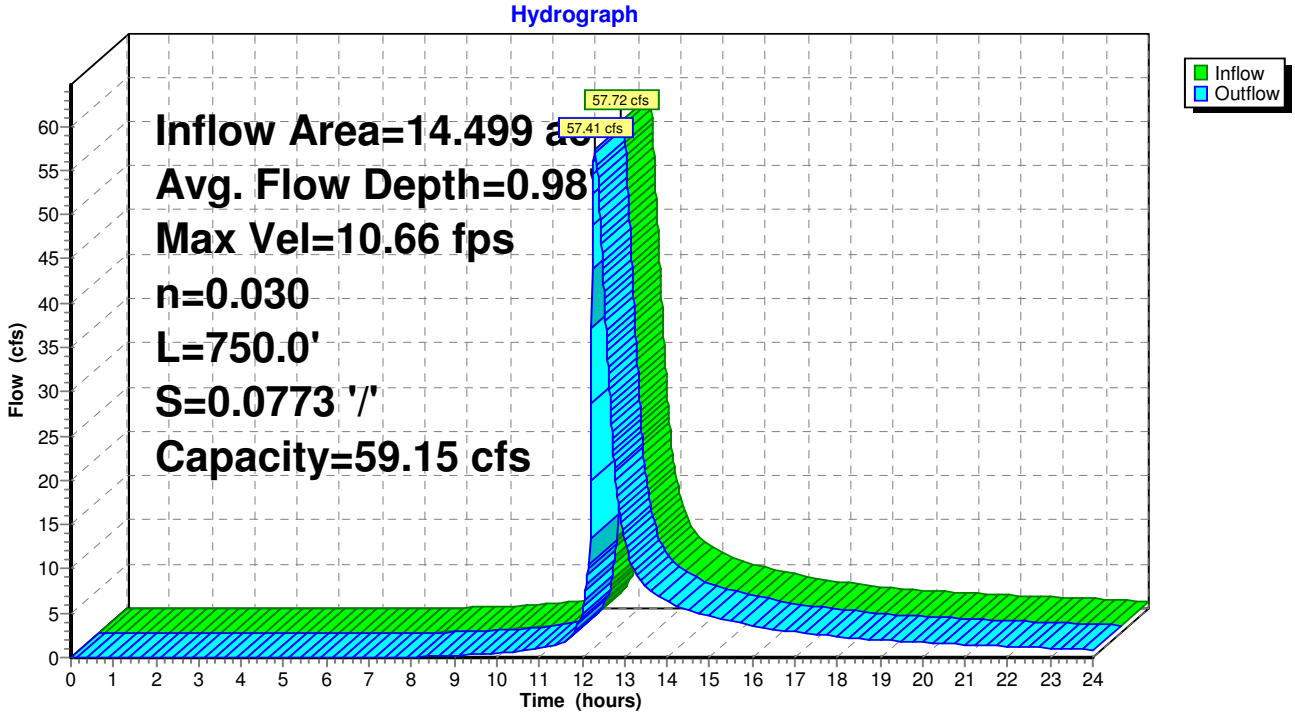
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 10.66 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 3.44 fps, Avg. Travel Time= 3.6 min

Peak Storage= 4,038 cf @ 12.29 hrs
Average Depth at Peak Storage= 0.98'
Bank-Full Depth= 1.00' Flow Area= 5.5 sf, Capacity= 59.15 cfs

3.50' x 1.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 7.50'
Length= 750.0' Slope= 0.0773 '/'
Inlet Invert= 153.00', Outlet Invert= 95.00'

‡

Reach 1R: Proposed Swale



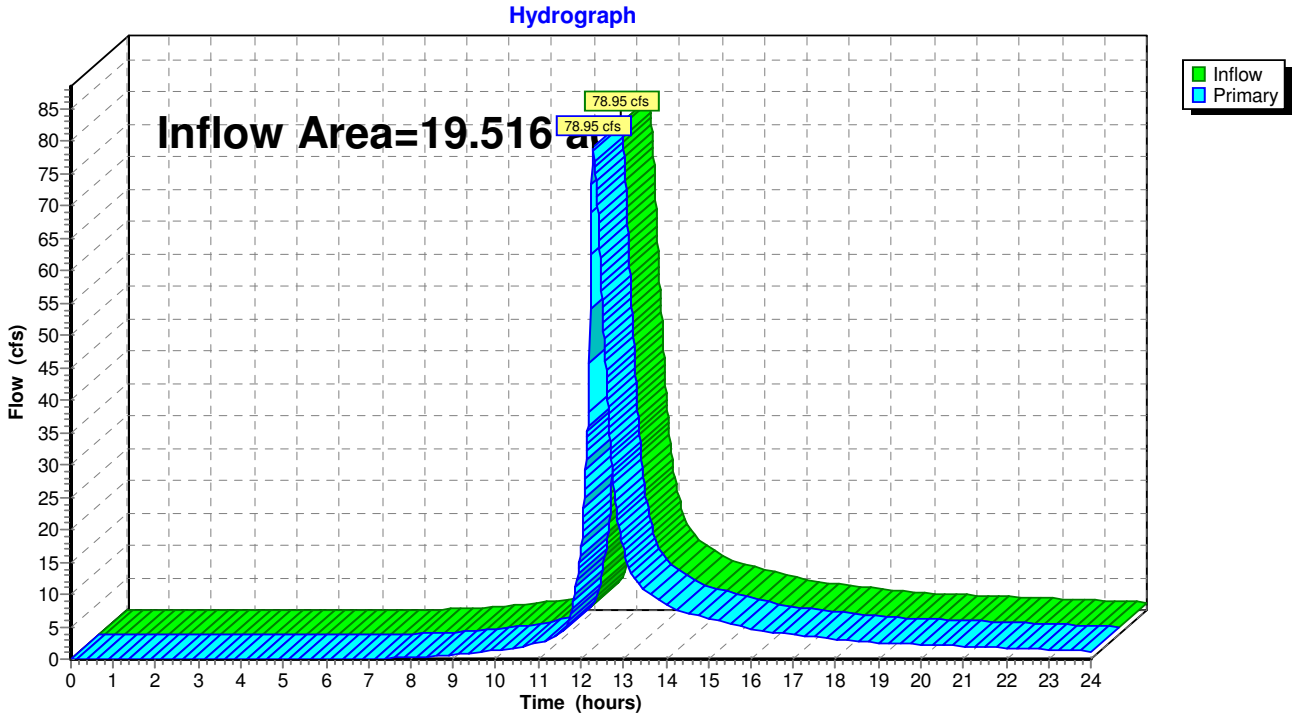
Summary for Pond AP-1: Providence Road Drainage

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

Inflow Area = 19.516 ac, 6.93% Impervious, Inflow Depth > 4.78" for 100 YR-Cornell event
Inflow = 78.95 cfs @ 12.29 hrs, Volume= 7.778 af
Primary = 78.95 cfs @ 12.29 hrs, Volume= 7.778 af, Atten= 0%, Lag= 0.0 min

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

Pond AP-1: Providence Road Drainage



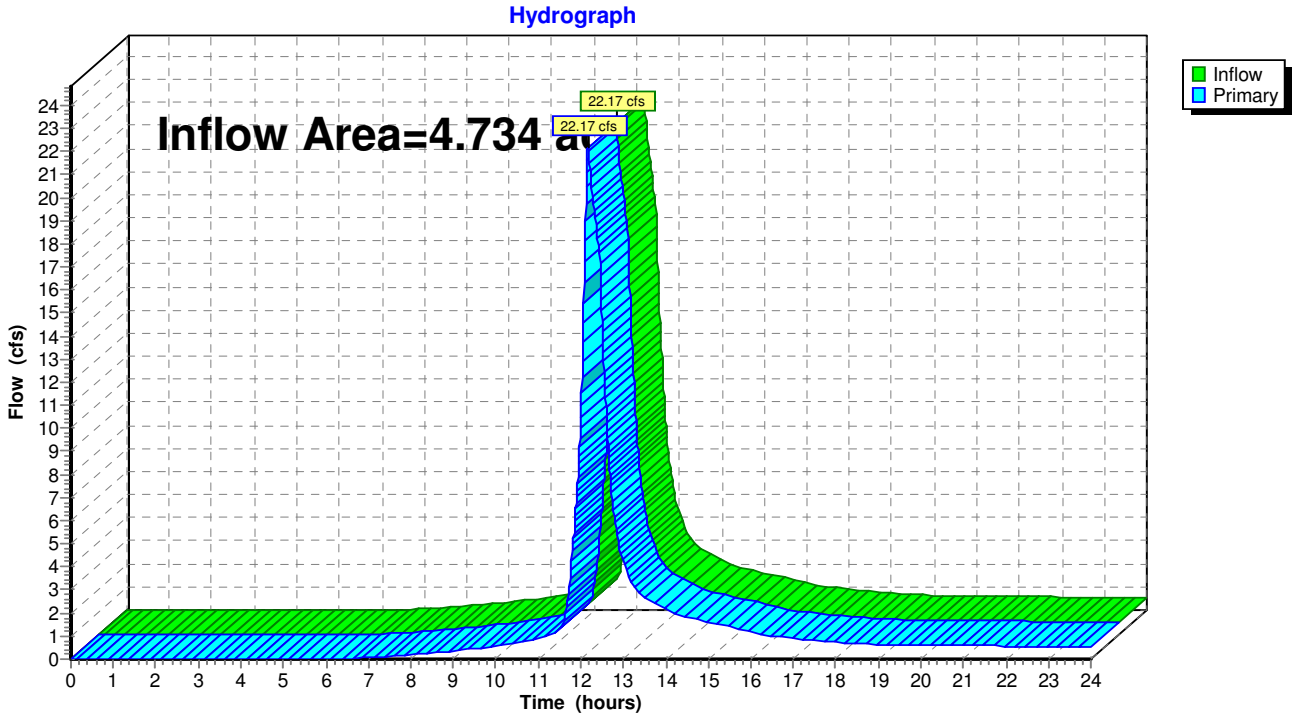
Summary for Pond AP-2: Easement Line

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

Inflow Area =	4.734 ac,	28.42% Impervious,	Inflow Depth >	6.01"	for	100 YR-Cornell event
Inflow =	22.17 cfs @	12.17 hrs,	Volume=	2.370 af		
Primary =	22.17 cfs @	12.17 hrs,	Volume=	2.370 af,	Atten= 0%,	Lag= 0.0 min

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

Pond AP-2: Easement Line



Summary for Pond East: Proposed Easterly Basin

Inflow Area = 3.411 ac, 27.98% Impervious, Inflow Depth > 6.28" for 100 YR-Cornell event
Inflow = 20.07 cfs @ 12.17 hrs, Volume= 1.785 af
Outflow = 14.81 cfs @ 12.29 hrs, Volume= 1.691 af, Atten= 26%, Lag= 7.3 min
Primary = 14.81 cfs @ 12.29 hrs, Volume= 1.691 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 188.78' @ 12.29 hrs Surf.Area= 7,247 sf Storage= 14,753 cf

Plug-Flow detention time= 68.5 min calculated for 1.691 af (95% of inflow)
Center-of-Mass det. time= 39.7 min (845.8 - 806.1)

Volume	Invert	Avail.Storage	Storage Description
#1	186.00'	24,433 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

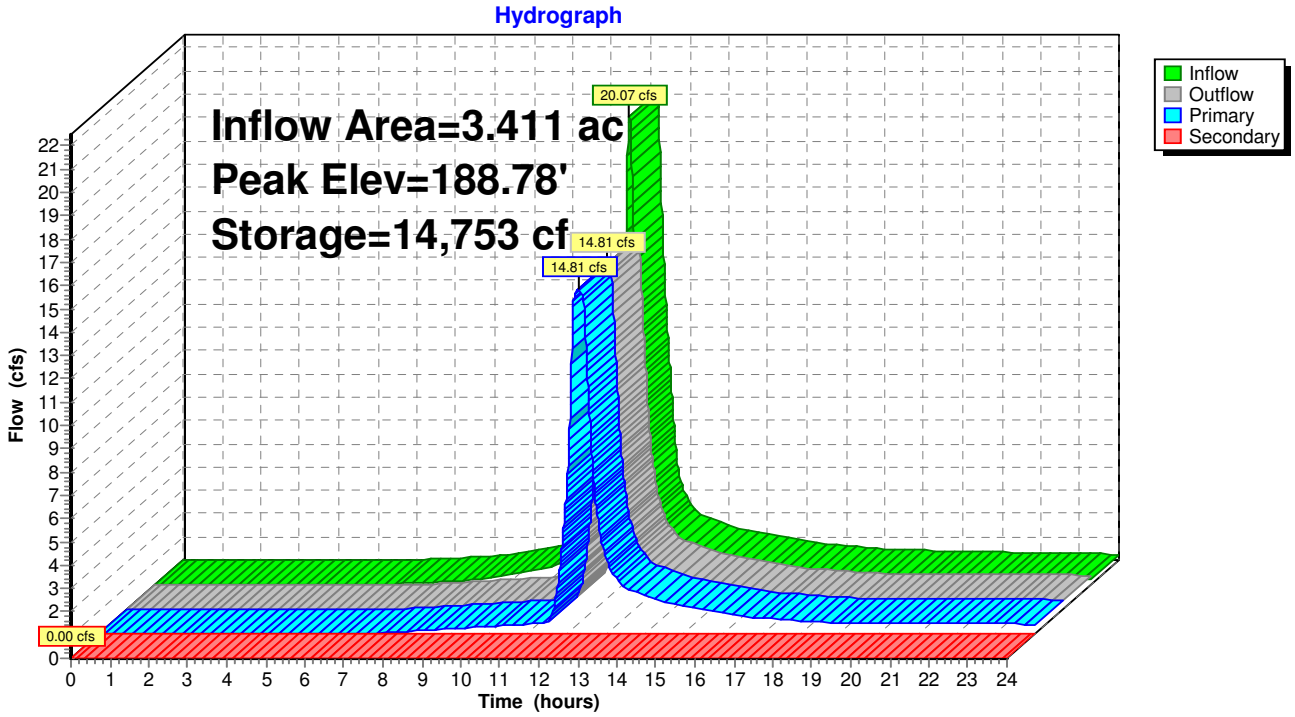
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
186.00	1,685	0	0
187.00	5,388	3,537	3,537
188.00	6,408	5,898	9,435
189.00	7,485	6,947	16,381
190.00	8,618	8,052	24,433

Device	Routing	Invert	Outlet Devices
#1	Primary	185.00'	**18.0" Round Culvert** L= 26.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 185.00' / 184.75' S= 0.0096 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	186.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	187.50'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Secondary	189.00'	**15.0' long x 5.0' 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) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=14.81 cfs @ 12.29 hrs HW=188.78' (Free Discharge)
└─**1=Culvert** (Inlet Controls 14.81 cfs @ 8.38 fps)
  ├─**2=Orifice/Grate** (Passes < 0.68 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Passes < 17.71 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=186.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond East: Proposed Easterly Basin



Summary for Pond OFF-SITE: Existing Off-Site Pond

Inflow Area =	9.880 ac,	0.00% Impervious,	Inflow Depth >	5.66"	for 100 YR-Cornell event
Inflow =	46.18 cfs @	12.24 hrs,	Volume=	4.664 af	
Outflow =	45.86 cfs @	12.27 hrs,	Volume=	3.494 af,	Atten= 1%, Lag= 1.3 min
Discarded =	0.38 cfs @	12.17 hrs,	Volume=	0.421 af	
Primary =	45.48 cfs @	12.27 hrs,	Volume=	3.073 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 438.23' @ 12.27 hrs Surf.Area= 16,000 sf Storage= 54,588 cf

Plug-Flow detention time= 132.3 min calculated for 3.494 af (75% of inflow)
Center-of-Mass det. time= 47.5 min (868.7 - 821.2)

Volume	Invert	Avail.Storage	Storage Description
#1	432.00'	66,840 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

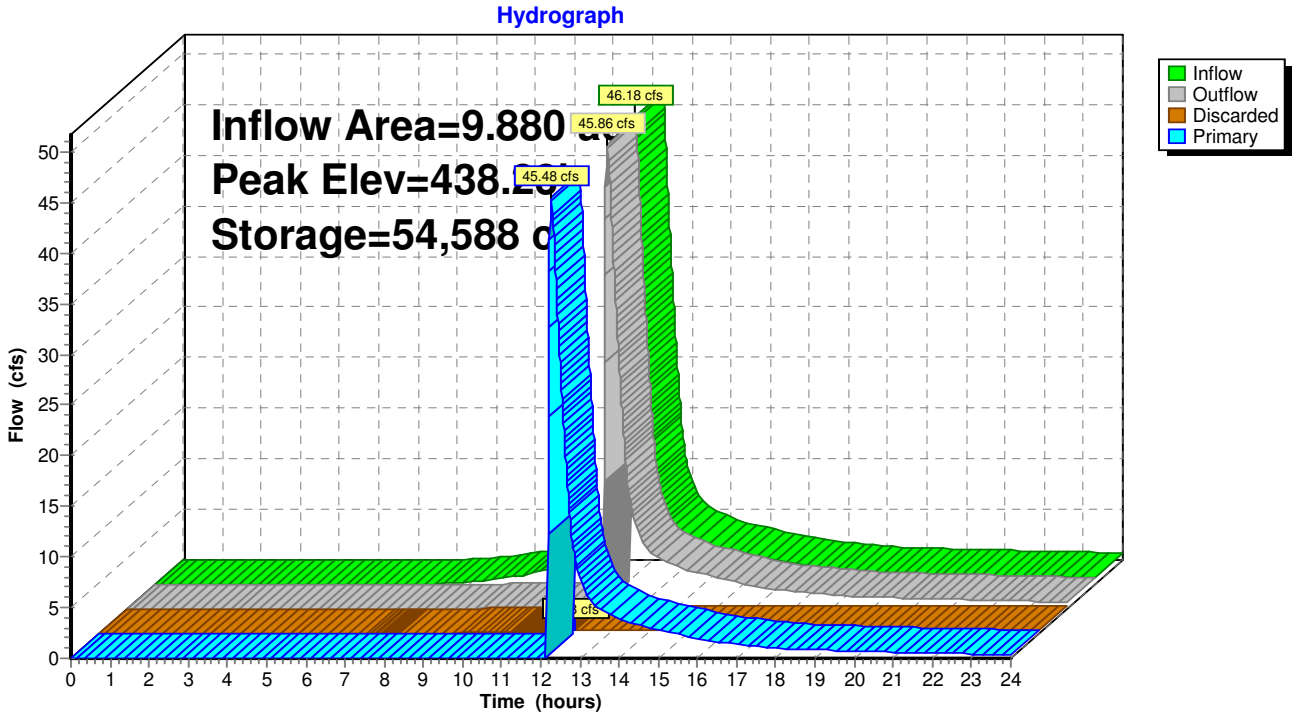
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
432.00	3,000	0	0
434.00	5,120	8,120	8,120
436.00	10,800	15,920	24,040
438.00	16,000	26,800	50,840
439.00	16,000	16,000	66,840

Device	Routing	Invert	Outlet Devices
#1	Primary	438.00'	**160.0' long x 10.0' 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) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Discarded	432.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.38 cfs @ 12.17 hrs HW=438.02' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.38 cfs)

Primary OutFlow Max=45.36 cfs @ 12.27 hrs HW=438.23' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 45.36 cfs @ 1.21 fps)

Pond OFF-SITE: Existing Off-Site Pond



Summary for Pond West: Proposed Westerly Basin

Inflow Area =	3.079 ac,	19.66% Impervious,	Inflow Depth >	6.16"	for 100 YR-Cornell event
Inflow =	17.79 cfs @	12.17 hrs,	Volume=	1.580 af	
Outflow =	8.50 cfs @	12.44 hrs,	Volume=	1.516 af,	Atten= 52%, Lag= 16.4 min
Primary =	8.50 cfs @	12.44 hrs,	Volume=	1.516 af	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 163.94' @ 12.44 hrs Surf.Area= 10,372 sf Storage= 24,803 cf

Plug-Flow detention time= 135.0 min calculated for 1.515 af (96% of inflow)
Center-of-Mass det. time= 112.0 min (920.4 - 808.4)

Volume	Invert	Avail.Storage	Storage Description
#1	161.00'	36,536 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

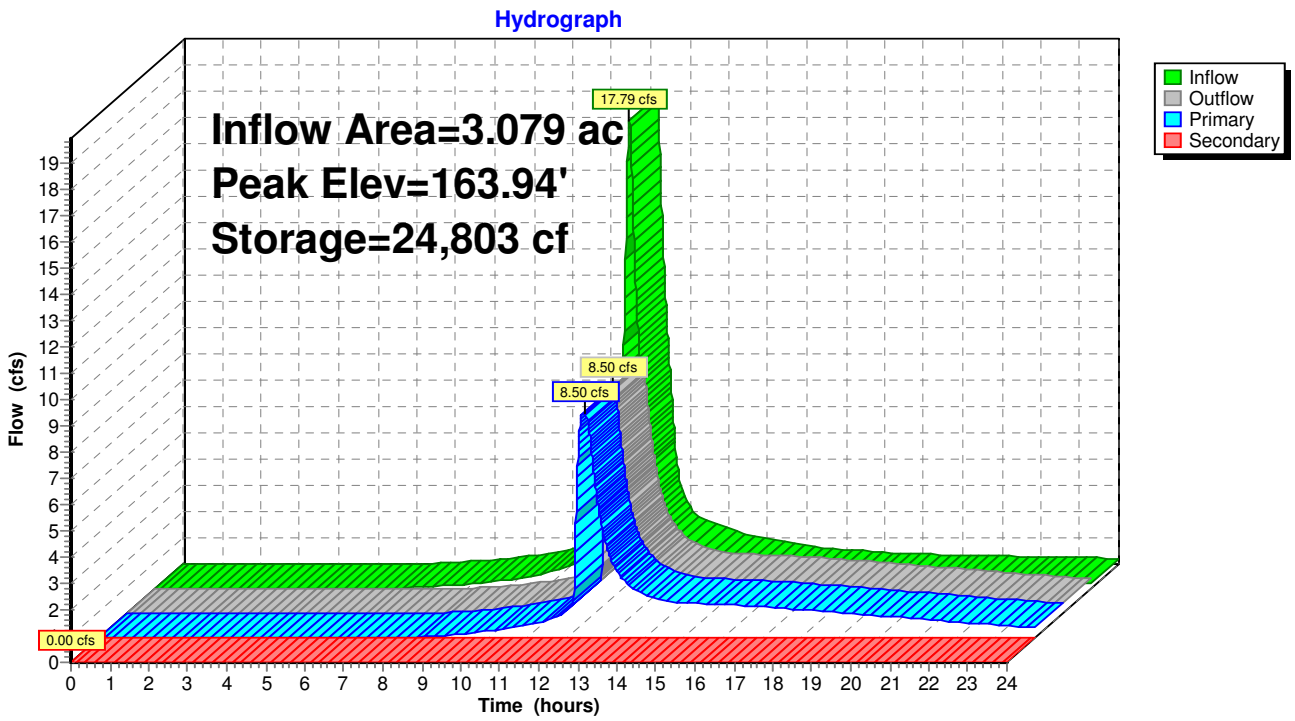
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
161.00	6,535	0	0
162.00	7,796	7,166	7,166
163.00	9,096	8,446	15,612
164.00	10,447	9,772	25,383
165.00	11,858	11,153	36,536

Device	Routing	Invert	Outlet Devices
#1	Primary	160.00'	**15.0" Round Culvert** L= 37.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 160.00' / 159.50' S= 0.0135 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.23 sf
#2	Device 1	161.00'	**6.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	163.25'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Secondary	164.00'	**15.0' long x 5.0' 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) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=8.50 cfs @ 12.44 hrs HW=163.94' (Free Discharge)
└─**1=Culvert** (Inlet Controls 8.50 cfs @ 6.93 fps)
  ├─**2=Orifice/Grate** (Passes < 1.55 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Passes < 7.30 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=161.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond West: Proposed Westerly Basin



Section 4

Supplemental Data

FIELD ENGINEERING, INC. MATTAPOISETT, MA

WATER QUALITY VOLUME CALCULATIONS

Client:	CEC	Job No.	2035
Project:	GRAFTON SOLAR FARM	Date:	7/22/2016
Location:	207 PROVIDENCE ROAD	Design by:	R. RICCIO

REQUIRED WATER QUALITY VOLUME

UNIT VOLUME (in.) =	0.50
IMPERVIOUS AREA (s.f.) =	9,700
WATER QUALITY VOLUME (cu.ft.) =	404

AVAILABLE VOLUME CALCULATION

ELEV (ft.)	AREA (s.f.)	VOL (cu.ft.)	CUM. VOL (cu.ft.)	CUM. VOL (ac.ft.)
**	**			
0.0	120.0	0.0	0.0	0.000
1.0	720.0	420.0	420.0	0.010

WATER QUALITY VOLUME PROVIDED =	420.0	0.010	OK
WATER QUALITY VOLUME REQUIRED =	404.2	0.009	

AVAILABLE WQV BASED ON 1 FOOT STORAGE
BEHIND EACH CHECK DAM ALONG PAVED PORTION
OF ACCESS DRIVE TO ARRAY SITE

FIELD ENGINEERING, INC. MATTAPOISETT, MA

RECHARGE VOLUME CALCULATIONS

Client:	CEC	Job No.	2035
Project:	GRAFTON SOLAR FARM	Date:	7/22/2016
Location:	207 PROVIDENCE ROAD	Design by:	R. RICCIO

RECHARGE VOLUME CALCULATIONS

HYDROLOGIC SOIL GROUP	C
UNIT VOLUME (in.) =	0.25
IMPERVIOUS AREA (s.f.) =	9,700
RECHARGE VOLUME (cu.ft.) =	202

AVAILABLE VOLUME CALCULATION

ELEV (ft.)	AREA (s.f.)	VOL (cu.ft.)	CUM. VOL (cu.ft.)	CUM. VOL (ac.ft.)
**	**			
0.0	120.0	0.0	0.0	0.000
1.0	720.0	420.0	420.0	0.010

RECHARGE VOLUME PROVIDED	420.0	0.010
RECHARGE VOLUME REQUIRED	202.1	0.005

AVAILABLE RECHARGE VOLUME BASED ON 1 FOOT STORAGE
BEHIND EACH CHECK DAM ALONG PAVED PORTION
OF ACCESS DRIVE TO ARRAY SITE

DRAWDOWN TIME CALCULATION

DRAWDOWN TIME=(REQ.RECH. VOL.)/(DES. INFILTRATION RATE "K"*BOTTOM AREA)

RECHARGE VOLUME PROVIDED (CF)=	420.0	
DESIGN INFILTRATION RATE (IN/HR)=	1.0	
BOTTOM AREA(SF)=	720.0	
DRAWDOWN TIME (HRS)=	7.0	OK

Appendix A

Revised Pre Development Watershed Plan

SOIL OBSERVATION LOG

DATE: 10/15/15
SOIL EVALUATOR: RICHARD R. RICCIO III, P.E.

TEST PIT #1

TOP ELEVATION: 188.0±

0"–9"	O/A	SANDY LOAM 10 YR 3/2	ELEV. 187.3±
9"–24"	B	SANDY LOAM 10 YR 4/6	ELEV. 186.0±
24"–84"	C	COARSE SANDY LOAM 2.5 Y 5/4	ELEV. 181.0±

OBSERVED DEPTH TO WEEPING – N/E
ESTIMATED DEPTH TO SEASONAL HIGH GROUNDWATER – 36" (MOTTLE DEPTH @ ELEV. 185.0±)

SOIL OBSERVATION LOG

DATE: 10/15/15
SOIL EVALUATOR: RICHARD R. RICCIO III, P.E.

TEST PIT #2

TOP ELEVATION: 189.0±

0"–8"	O/A	SANDY LOAM 10 YR 3/2	ELEV. 188.3±
8"–22"	B	SANDY LOAM 10 YR 4/6	ELEV. 187.2±
22"–80"	C	SANDY LOAM 2.5 Y 6/4	ELEV. 182.3±

OBSERVED DEPTH TO WEEPING – N/E
ESTIMATED DEPTH TO SEASONAL HIGH GROUNDWATER – 40" (MOTTLE DEPTH @ ELEV. 185.7±)

SOIL OBSERVATION LOG

DATE: 10/15/15
SOIL EVALUATOR: RICHARD R. RICCIO III, P.E.

TEST PIT #3

TOP ELEVATION: 164.5±

0"–8"	O/A	SANDY LOAM 10 YR 3/2	ELEV. 163.8±
8"–30"	B_w	SANDY LOAM 10 YR 4/6	ELEV. 162.0±
30"–56"	C	SANDY LOAM 2.5 Y 6/4	ELEV. 159.8±

OBSERVED DEPTH TO WEEPING – N/E
ESTIMATED DEPTH TO SEASONAL HIGH GROUNDWATER – 36" (MOTTLE DEPTH @ ELEV. 161.5±)

SOIL OBSERVATION LOG

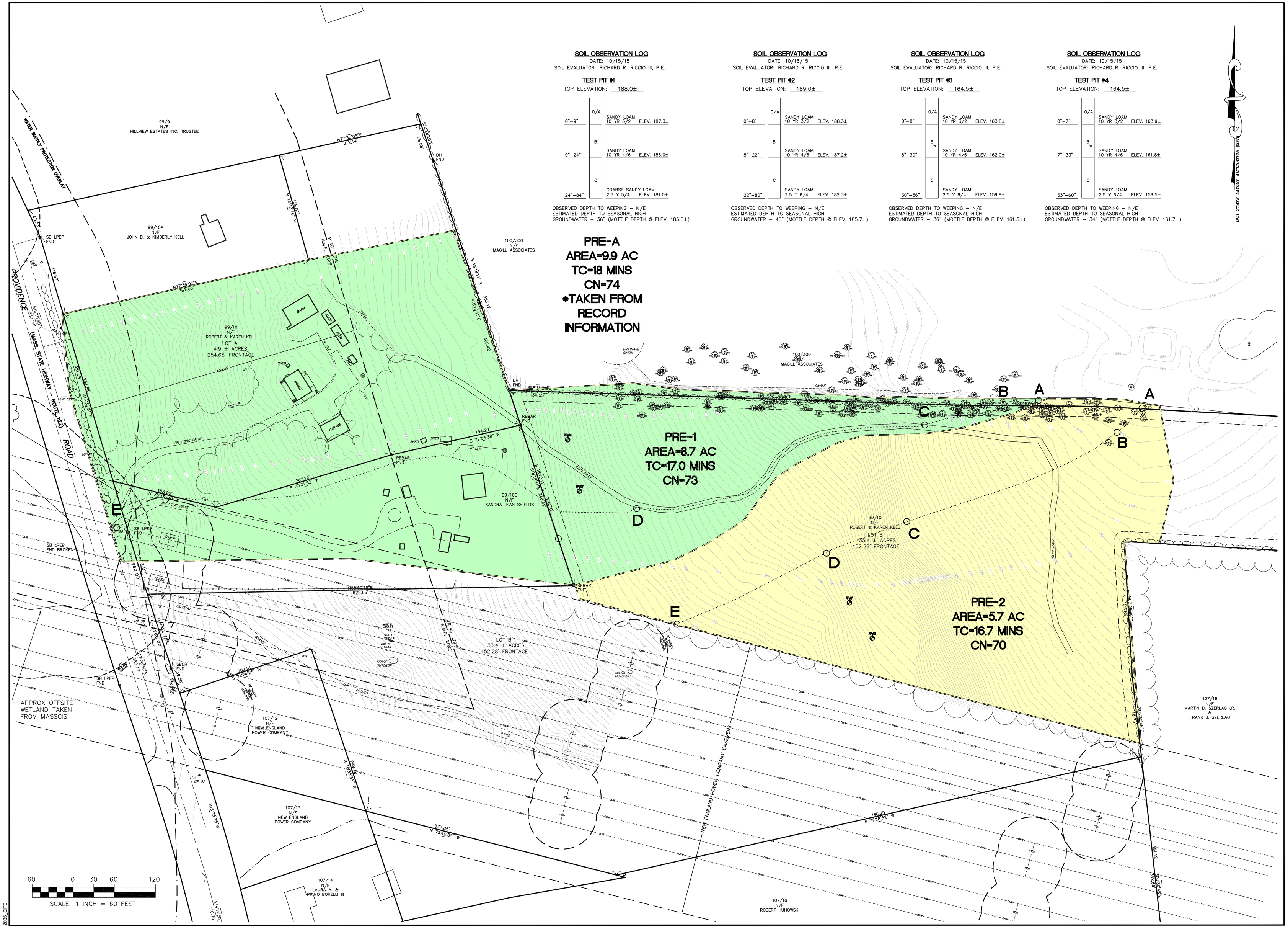
DATE: 10/15/15
SOIL EVALUATOR: RICHARD R. RICCIO III, P.E.

TEST PIT #4

TOP ELEVATION: 164.5±

0"–7"	O/A	SANDY LOAM 10 YR 3/2	ELEV. 163.9±
7"–33"	B_w	SANDY LOAM 10 YR 4/6	ELEV. 161.8±
33"–60"	C	SANDY LOAM 2.5 Y 6/4	ELEV. 159.5±

OBSERVED DEPTH TO WEEPING – N/E
ESTIMATED DEPTH TO SEASONAL HIGH GROUNDWATER – 34" (MOTTLE DEPTH @ ELEV. 161.7±)



FIELD ENGINEERING CO., INC.
CONSULTING ENGINEERS

11D INDUSTRIAL DRIVE
P.O. BOX 1178
MATTAPOISETT, MA 02739
TEL: (508) 758-2749
FAX: (508) 758-2849

THE CROCKER BUILDING
4 COURT STREET SUITE 104
TAUNTON, MA 02780
TEL: (508) 824-9279
FAX: (508) 824-9276

Revisions

No.	Description	Date	Apprvd.
3	REVISED FOR NEW ACCESS ROAD	7/22/16	RRR
2	MINOR REVISIONS PER CONSULTANT REVIEW	10/22/15	RRR
1	REV PER PB COMMENT LETTERS	10/5/15	RRR

Date: 8/12/15

Scale: 1"=60'

Drawn By	Designed By	Checked By
RMS	RRR	RRR

Issued For: PERMITTING

PROPOSED SITE DEVELOPMENT
CEC SOLAR #1056 LLC

207 PROVIDENCE ROAD
GRAFTON, MASSACHUSETTS

Drawing Title: PRE DEVELOPMENT WATERSHED PLAN

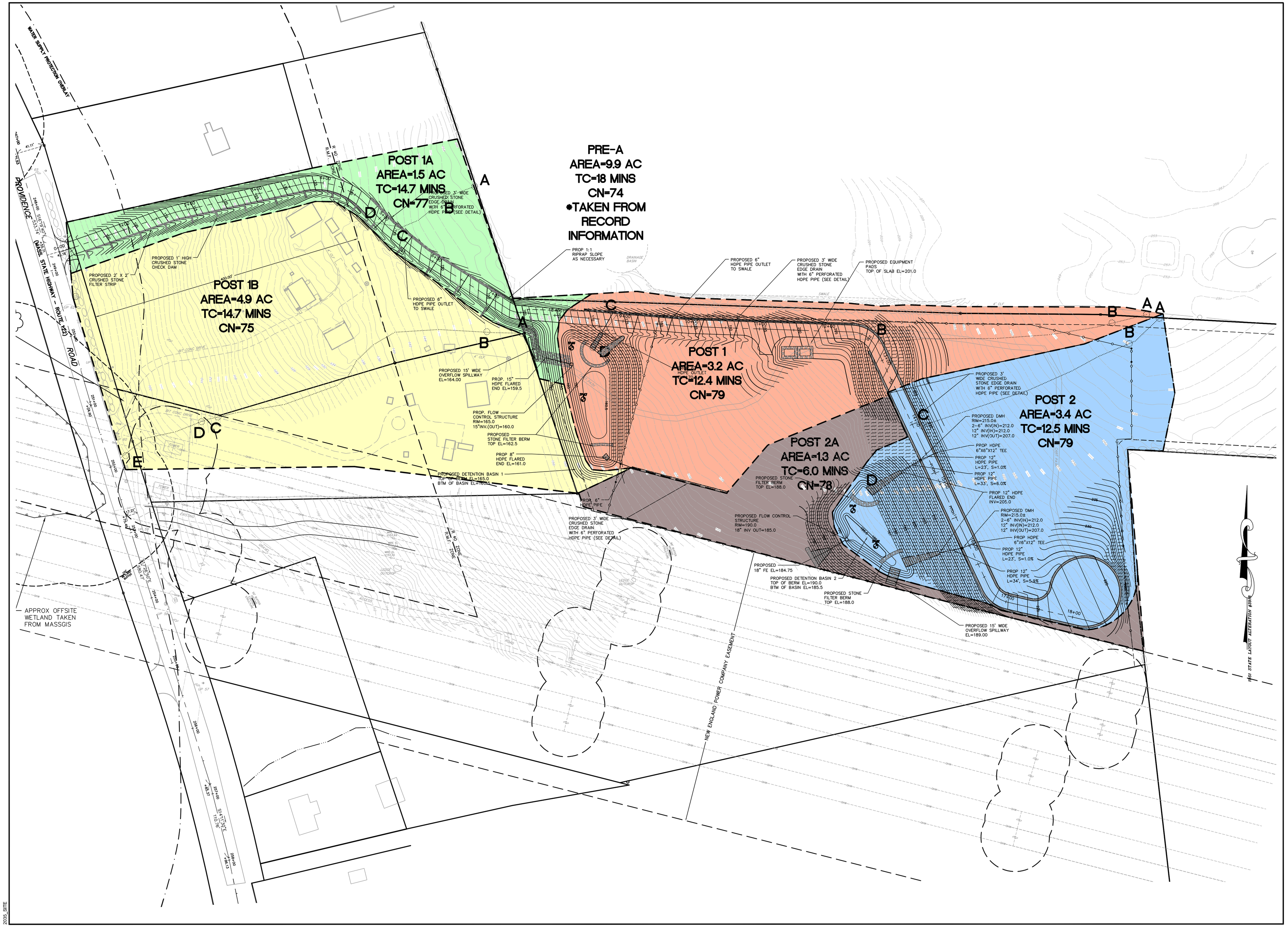
Project No.	Sheet
2035	1 OF 1

PRE-1

2035_SITE

Appendix B

Revised Post Development Watershed Plan



2035_SITE

FIELD ENGINEERING CO., INC.
CONSULTING ENGINEERS

11D INDUSTRIAL DRIVE
P.O. BOX 1178
MATTAPOISETT, MA 02739
TEL: (508) 758-2749
FAX: (508) 758-2849

THE CROCKER BUILDING
4 COURT STREET SUITE 104
TAUNTON, MA 02780
TEL: (508) 824-9279
FAX: (508) 824-9276

Revisions

No.	Description	Date	Apprvd.
3	REVISED FOR NEW ACCESS ROAD	7/22/16	RRR
2	MINOR REVISIONS PER CONSULTANT REVIEW	10/22/15	RRR
1	REV PER PB COMMENT LETTERS	10/5/15	RRR

Date: 7/22/16

Scale: 1"=60'

Drawn By	Designed By	Checked By
RMS	RRR	RRR

Issued For: PERMITTING

PROPOSED SITE DEVELOPMENT
CEC SOLAR #1056 LLC

207 PROVIDENCE ROAD
GRAFTON, MASSACHUSETTS

Drawing Title: POST DEVELOPMENT WATERSHED PLAN

Project No.	Sheet
2035	1 OF 1

POST-1