



# **STORMWATER MANAGEMENT REPORT**

PROPOSED "NORTH CANAAN" SOLAR PROJECT  
100 SAND ROAD  
NORTH CANAAN, CONNECTICUT  
LITCHFIELD COUNTY

**Prepared for:**

**LSE Phoenix LLC**

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**June, 2020**

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## **Introduction**

At the request of LSE Phoenix LLC, All-Points Technology Corporation, P.C. (“APT”) has undertaken analysis of and design to address stormwater impacts resulting from development of a proposed 1.99 MW AC solar electric generating facility in North Canaan, Connecticut (the “Project”). The Project, known as the North Canaan Solar project, involves the installation of solar panels and associated equipment at 100 Sand Road in North Canaan, Connecticut (“Site”).

The purpose of this report is to provide an analysis of the potential stormwater drainage impacts associated with the Project, as well as a description of the design to mitigate such potential stormwater drainage impacts. The design is intended to be in full compliance with the State and Town regulations while taking prevailing site conditions and practical factors into account.

## **Existing Site Conditions**

The Site is a privately-owned irregular shaped parcel located at 100 Sand Road in North Canaan, Connecticut, that consists of approximately 23.93± acres of undeveloped land. The property has an existing gravel drive off of Sand Road and is partially cleared.

The Site’s existing topography generally slopes downward from west to east. Within the project area, the topography includes slopes that range from approximately 0 to 12 percent throughout. Elevations within the Site range from approximately 812 feet AMSL on its western side to approximately 705 feet AMSL on the eastern side and 667 feet AMSL at the existing stone drive at Sand Road.

## **Developed Site Conditions**

The Project will be constructed in the western area of the Site, just north of the existing gravel drive west of the existing wetland area. Access to the site will be provided via a proposed gravel access road connecting to the existing Ryan Avenue to the west of the Site. The Project includes the installation of 7,560 solar panels and associated fencing, access road, utility and stormwater management features, within ±14.00 acres of cleared/wooded area of the site. Of the ±14.00 acres, ±10.79 acres will require clearing and grubbing for the Project. The remaining ±3.21 acres of within the Project limits of disturbance will require tree clearing only with no grubbing.

The proposed solar panels will be installed on a post driven ground mounted racking system, with minimal changes to the existing grades. As a result, the post-development site conditions will mimic the pre-developed site conditions. Areas of clearing and grubbing and any existing ground cover that is disturbed during construction will be reseeded with a low growth seed mix. In order to account for the change in ground cover and time of concentration, a grass-lined stormwater management basin is proposed along the eastern side of the proposed Project area.

## **Stormwater Management**

### *Analysis Methodology*

The hydrologic analysis was performed using the HydroCAD stormwater modeling system computer program developed by HydroCAD Software Solutions, LLC.

Hydrographs for each watershed were developed using the SCS Synthetic Unit Hydrograph Method with a Type III rainfall distribution. Hydrographs were developed for the NOAA Atlas 14, Volume 10, Version 2 Precipitation 2-, 25-, 50-, and 100-year storm event with rainfall depths of 3.09, 6.40, 7.31, and 8.35 inches respectively.

The existing and proposed drainage areas used in the calculations are illustrated on the Existing and Proposed Drainage Area Plans (EDA-1 & PDA-1). These maps and the corresponding HydroCAD output are attached.

Utilizing Appendix I, Stormwater Management at Solar Array Construction Projects, provided by Connecticut Department of Energy & Environmental Protection (“CT DEEP”), this hydrologic analysis will reflect a reduction of the Hydrologic Soil Group (“HSG”) present on-site by one (1) step (e.g. soils of HSG B shall be considered HSG C). This reduction, as indicated by CT DEEP, is intended to account for the compaction of soils that results from extensive machinery traffic during construction of the array. The Water Quality Volume (“WQV”) for the site will be calculated assuming that the solar panels, roadways, gravel surfaces, and transformer pads are effectively impervious cover. See Appendix F.

### *Existing Drainage Patterns*

The proposed Project area drains from the west to the east, ultimately into Sand Road and an existing pond located east of the property.

The Site was modeled at three (3) Analysis Points (“AP-1”, “AP-2”, and “AP-3”). AP-1 is the northeastern property line which eventually drains into the existing pond on the adjacent property. AP-2 drains to Sand Road. AP-3 drains from the high point near the western side of the property towards the west. Peak discharges have been computed at the points of study for the 2-, 25-, 50-, and 100-year storm events.

The project site soils identified by the United States Department of Agriculture (USDA) Natural Resources Conservation Service consist of Map Unit Symbol 92B, named “Nellis fine sandy loam, 3 to 8 percent slopes”, 92C, named “Nellis fine sandy loam, 8 to 15 percent slopes”, and 92E, named “Farmington-Rock outcrop complex, 15 to 45 percent slopes”. Map Unit Symbols 92B and 92C are classified in the HSG rating of “B” while 92E is classified in the HSG rating of “D”.

The pre-developed discharges at the Analysis Point are tabulated in Table 1-1.

**Table 1-1**

<i>Analysis Point</i>	<b>Pre-developed Peak Storm Runoff (Q), cubic feet per second (cfs)</b>			
	<b>2-year</b>	<b>25-year</b>	<b>50-year</b>	<b>100-year</b>
AP-1	1.26	19.03	25.88	34.32
AP-2	2.10	12.88	16.44	20.70
AP-3	0.09	1.63	2.24	2.99

*Proposed Drainage Patterns*

The Project will require clearing and grubbing in the immediate area for the proposed solar installation, including the necessary utilities, access road, and stormwater management features, resulting in approximately ±14.00 acres of disturbance. Overall, hydrologically, through the addition of catchment areas associated with the individual drainage areas of each proposed basin, the post-developed condition is designed to mimic the pre-developed condition.

To manage the increase in post-development runoff due to the change in cover type associated with converting woods to meadow and the reductions in one full HSG within the proposed limit of disturbance, one (1) grass-lined stormwater management basin is proposed along the eastern edge of the project area. Additionally, two (2) swales are proposed to facilitate flow to the proposed basin. Using an outlet control structure with a low flow orifice and grate top, the infiltration basin is designed to provide the necessary water quality treatment volume for the additional impervious area, as recommended by CT DEEP Appendix I. See calculations attached.

Infiltration rates for the grass lined stormwater management basins are modeled with a maximum rate of 0.5 inches/hour, using infiltration rates from United States Department of Agriculture (USDA) Natural Resources Conservation Service website for the associated soils. The basin is designed with an outlet control structure, rip-rap overflow weir, and plunge pool level spreader. Two (2) swales are proposed near the northern and eastern limits of disturbance to facilitate all the flow reaching the basin.

Since the proposed development mimics the existing conditions, the post-development condition was modeled using the same Analysis Point. Peak discharges have been computed at the point of study for the 2-year, 25-year, 50-year, and 100-year storm events. The post-development discharges at each point of study are tabulated in Table 1-2.

**Table 1-2**

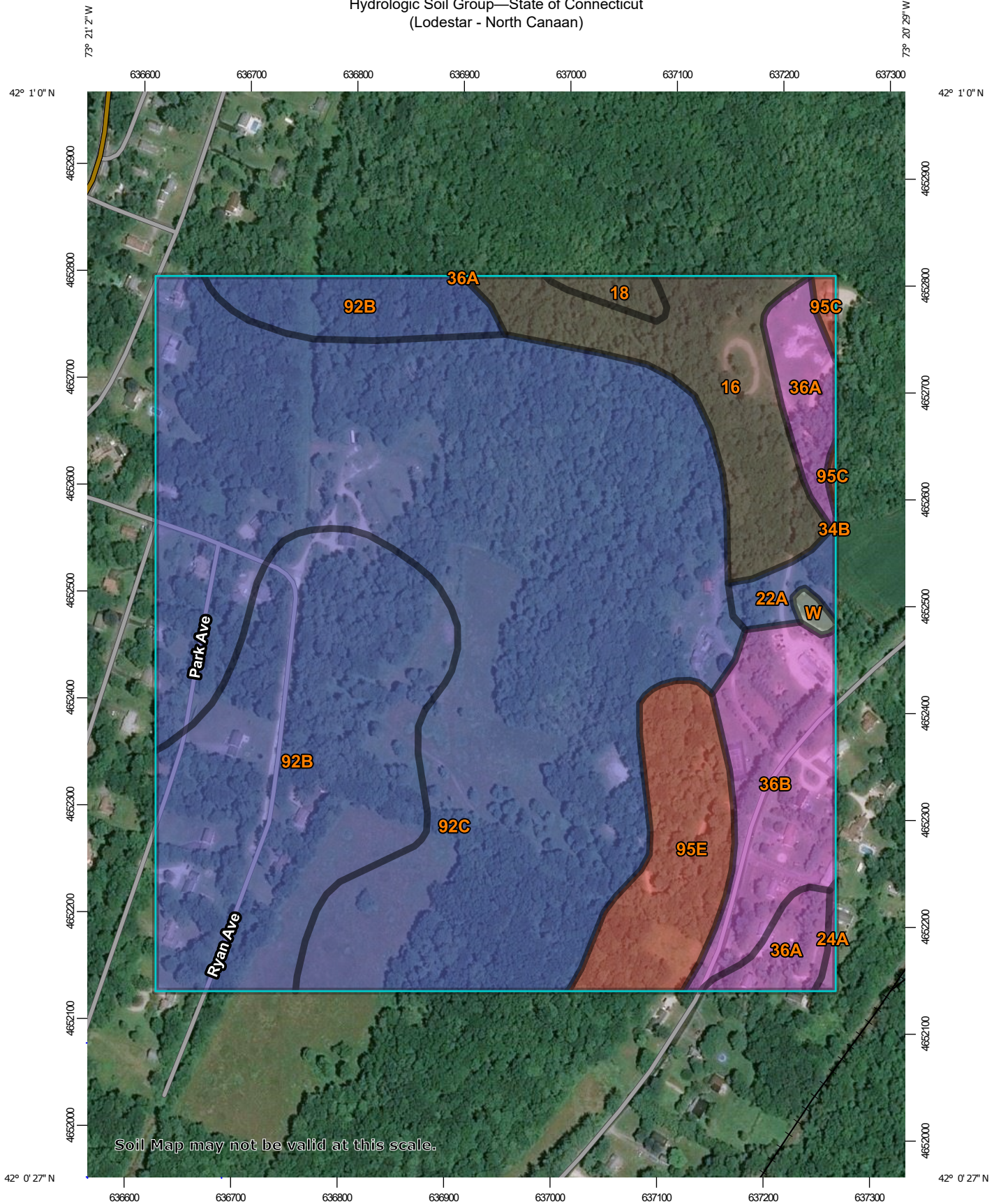
<b><i>Analysis Point</i></b>	<b>Post-developed Peak Storm Runoff (Q), cubic feet per second (cfs)</b>			
	<b>2-year</b>	<b>25-year</b>	<b>50-year</b>	<b>100-year</b>
AP-1	0.51	17.02	21.99	32.56
AP-2	2.10	12.88	16.44	20.69
AP-3	0.09	1.63	2.24	2.99

**Conclusion**

The stormwater management for the proposed site has been designed such that the post-development peak discharges to the waters of the State of Connecticut for the 2-, 25-, 50-, and 100- year storm events are less than the pre-development peak discharges. As a result, the proposed solar array will not result in any adverse conditions to the surrounding areas and properties.

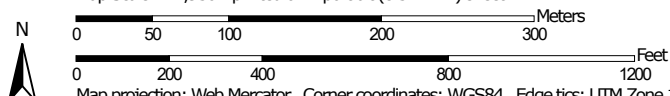
**APPENDIX A: NRCS SOIL SURVEY**

Hydrologic Soil Group—State of Connecticut  
(Lodestar - North Canaan)



Soil Map may not be valid at this scale.

Map Scale: 1:4,950 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84





## MAP LEGEND

### Area of Interest (AOI)









 Area of Interest (AOI)

### Soils

#### Soil Rating Polygons

 A  
 A/D  
 B  
 B/D  
 C  
 C/D  
 D  
 Not rated or not available

#### Soil Rating Lines

 A  
 A/D  
 B  
 B/D  
 C  
 C/D  
 D  
 Not rated or not available

#### Soil Rating Points

 A  
 A/D  
 B  
 B/D

 C  
 C/D  
 D  
 Not rated or not available


### Water Features

 Streams and Canals

### Transportation

 Rails  
 Interstate Highways  
 US Routes  
 Major Roads  
 Local Roads

### Background

 Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service  
 Web Soil Survey URL:  
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: State of Connecticut  
 Survey Area Data: Version 19, Sep 13, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 23, 2018—Sep 17, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

## Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
16	Halsey silt loam	B/D	8.2	7.7%
18	Catden and Freetown soils, 0 to 2 percent slopes	B/D	0.7	0.6%
22A	Hero gravelly loam, 0 to 3 percent slopes	B	1.2	1.2%
24A	Deerfield loamy fine sand, 0 to 3 percent slopes	A	0.2	0.2%
34B	Merrimac fine sandy loam, 3 to 8 percent slopes	A	0.0	0.0%
36A	Windsor loamy sand, 0 to 3 percent slopes	A	3.8	3.6%
36B	Windsor loamy sand, 3 to 8 percent slopes	A	7.2	6.8%
92B	Nellis fine sandy loam, 3 to 8 percent slopes	B	23.8	22.5%
92C	Nellis fine sandy loam, 8 to 15 percent slopes	B	54.0	51.0%
95C	Farmington-Rock outcrop complex, 3 to 15 percent slopes	D	0.4	0.3%
95E	Farmington-Rock outcrop complex, 15 to 45 percent slopes	D	6.3	5.9%
W	Water		0.3	0.2%
<b>Totals for Area of Interest</b>			<b>106.0</b>	<b>100.0%</b>

## Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

## Rating Options

*Aggregation Method:* Dominant Condition

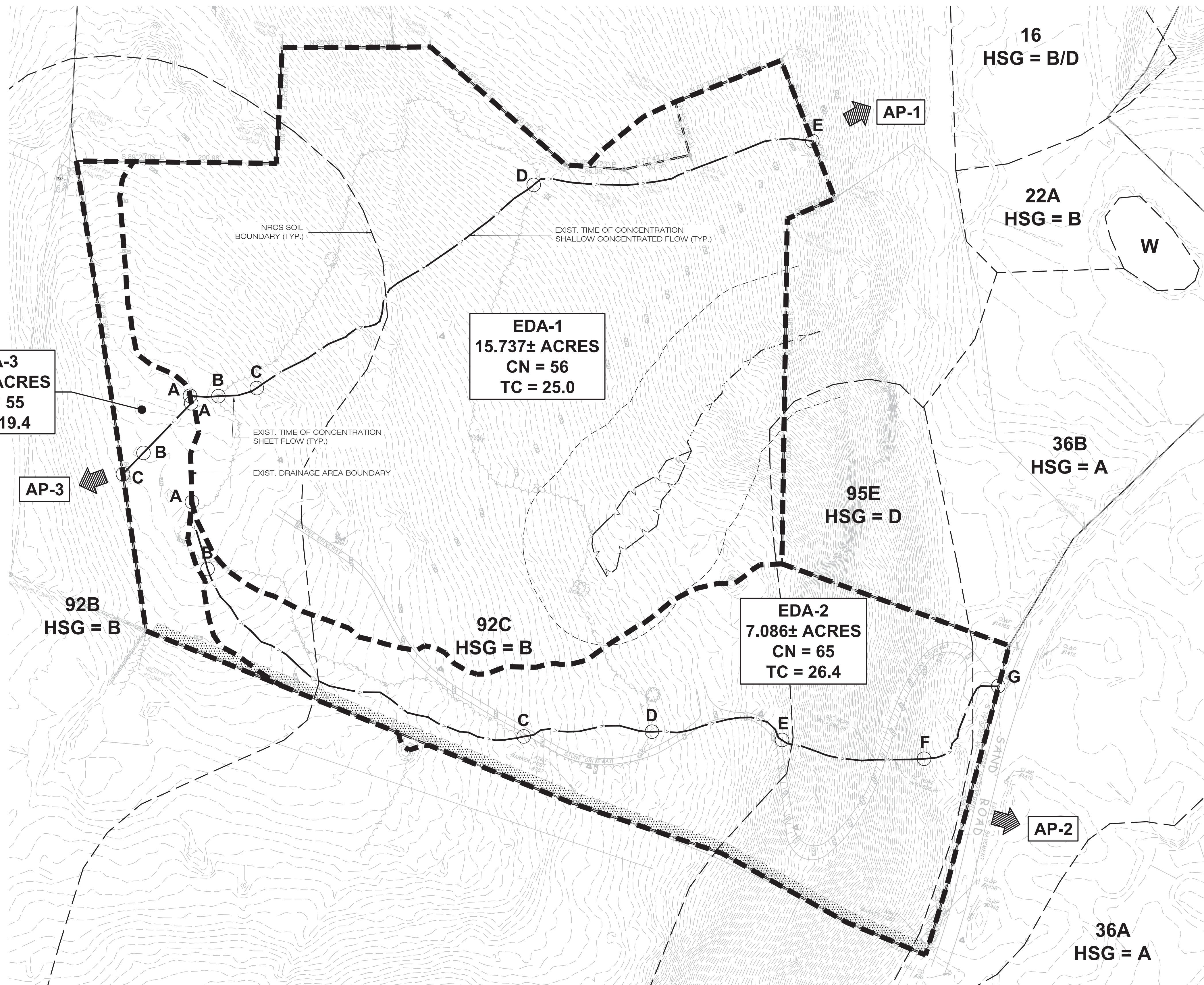
*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher

**APPENDIX B: EXISTING DRAINAGE AREA MAP (EDA-1) &  
HYDROLOGIC COMPUTATION (HYDROCAD)**

**EXISTING DRAINAGE AREAS**

	TOTAL AREA (ACRES)	COMPOSITE CN	TC (MINS.)
EDA-1	15.737±	56	25.0
EDA-2	7.086±	65	26.4
EDA-3	1.290±	55	19.4



**EDA-3**  
1.290± ACRES  
CN = 55  
TC = 19.4

**EDA-1**  
15.737± ACRES  
CN = 56  
TC = 25.0

**EDA-2**  
7.086± ACRES  
CN = 65  
TC = 26.4

**ALL-POINTS**  
TECHNOLOGY CORPORATION  
567 VAUXHALL STREET EXTENSION - SUITE 311  
WATERFORD, CT 06385 PH: (860)-663-1697  
WWW.ALLPOINTS TECH.COM FAX: (860)-663-0935

**PRELIMINARY**

NO	DATE	REVISION
0	02/26/20	FOR REVIEW: BJP
1		
2		
3		
4		
5		
6		

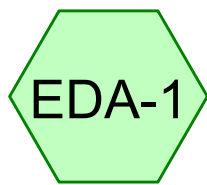
**DESIGN PROFESSIONAL OF RECORD**  
PROF: BRADLEY J. PARSONS P.E.  
COMP: ALL-POINTS TECHNOLOGY CORPORATION  
ADD: 567 VAUXHALL STREET EXTENSION - SUITE 311 WATERFORD, CT 06385  
OWNER: JOHN DOUGLAS & CECELIA S. BATES  
ADDRESS: 276 HOUSATONIC RIVER ROAD FALLS VILLAGE, CT 06031

**NORTH CANAAN SOLAR**  
SITE 100 SAND ROAD  
ADDRESS: NORTH CANAAN, CT 06018  
APT FILING NUMBER: CT606110  
DRAWN BY: JT  
DATE: 02/26/20 CHECKED BY: BJP

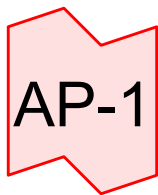
SHEET TITLE:  
**EXISTING DRAINAGE AREA MAP**

SHEET NUMBER:  
**EDA-1**

**1 EXISTING DRAINAGE AREA MAP**  
SCALE: 1" = 80'-0"  
(IN FEET) 1 inch = 80 ft.



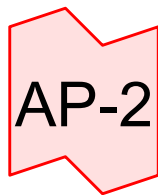
EDA-1



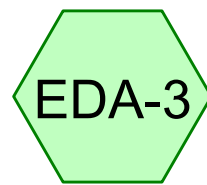
AP-1



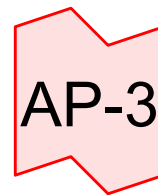
EDA-2



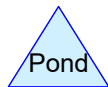
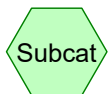
AP-2



EDA-3



AP-3



Routing Diagram for CT606110\_NorthCanaan - EX - Rev0

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**Area Listing (all nodes)**

Area (acres)	CN	Description (subcatchment-numbers)
7.267	58	Meadow, non-grazed, HSG B (EDA-1, EDA-2, EDA-3)
13.627	55	Woods, Good, HSG B (EDA-1, EDA-2, EDA-3)
3.219	77	Woods, Good, HSG D (EDA-1, EDA-2)
<b>24.113</b>	<b>59</b>	<b>TOTAL AREA</b>

**Soil Listing (all nodes)**

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
20.894	HSG B	EDA-1, EDA-2, EDA-3
0.000	HSG C	
3.219	HSG D	EDA-1, EDA-2
0.000	Other	
<b>24.113</b>		<b>TOTAL AREA</b>



**CT606110\_NorthCanaan - EX - Rev0**

Prepared by Microsoft

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Page 4

**Ground Covers (all nodes)**

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	7.267	0.000	0.000	0.000	7.267	Meadow, non-grazed	EDA-1, EDA-2, EDA-3
0.000	13.627	0.000	3.219	0.000	16.846	Woods, Good	EDA-1, EDA-2, EDA-3
<b>0.000</b>	<b>20.894</b>	<b>0.000</b>	<b>3.219</b>	<b>0.000</b>	<b>24.113</b>	<b>TOTAL AREA</b>	

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment EDA-1: EDA-1**

Runoff Area=685,503 sf 0.00% Impervious Runoff Depth=3.14"  
Flow Length=1,032' Tc=25.0 min CN=56 Runoff=34.32 cfs 4.117 af

**Subcatchment EDA-2: EDA-2**

Runoff Area=7.086 ac 0.00% Impervious Runoff Depth=4.18"  
Flow Length=1,432' Tc=26.4 min CN=65 Runoff=20.70 cfs 2.468 af

**Subcatchment EDA-3: EDA-3**

Runoff Area=1.290 ac 0.00% Impervious Runoff Depth=3.03"  
Flow Length=143' Tc=19.4 min CN=55 Runoff=2.99 cfs 0.325 af

**Link AP-1: AP-1**

Inflow=34.32 cfs 4.117 af  
Primary=34.32 cfs 4.117 af

**Link AP-2: AP-2**

Inflow=20.70 cfs 2.468 af  
Primary=20.70 cfs 2.468 af

**Link AP-3: AP-3**

Inflow=2.99 cfs 0.325 af  
Primary=2.99 cfs 0.325 af

**Total Runoff Area = 24.113 ac Runoff Volume = 6.910 af Average Runoff Depth = 3.44"**  
**100.00% Pervious = 24.113 ac 0.00% Impervious = 0.000 ac**

**Summary for Subcatchment EDA-1: EDA-1**

Runoff = 34.32 cfs @ 12.37 hrs, Volume= 4.117 af, Depth= 3.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100 YR Rainfall=8.35"

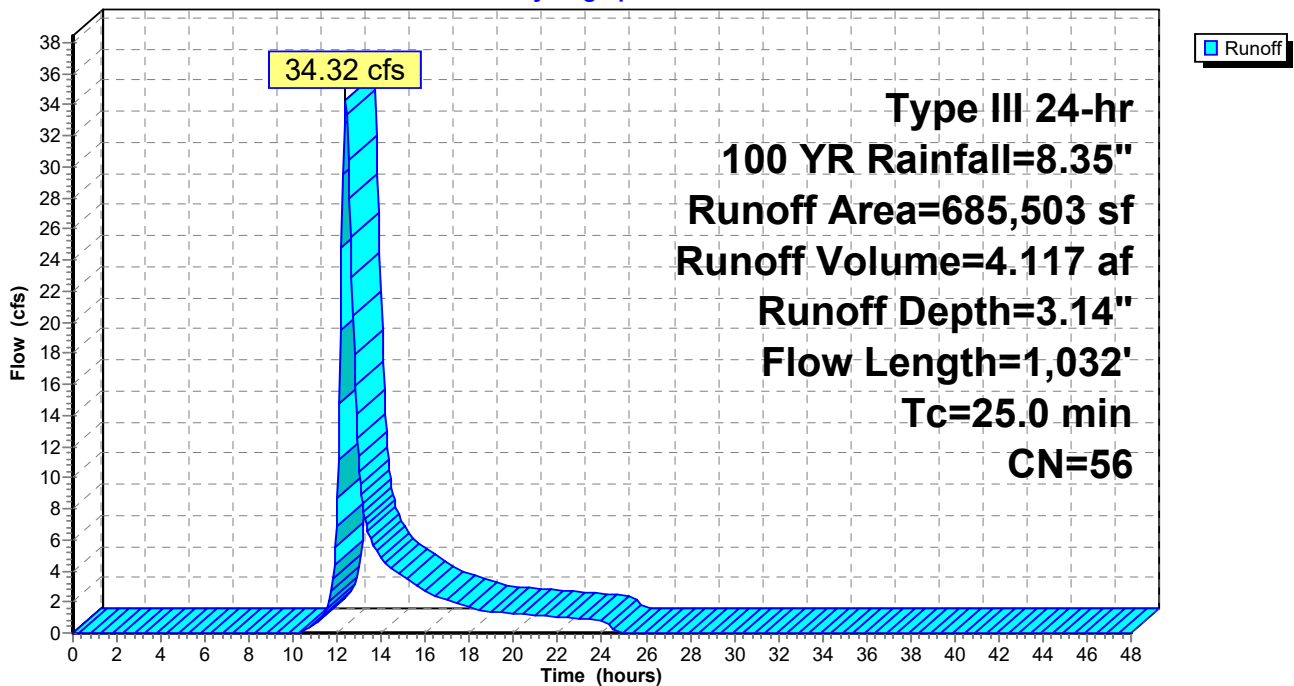
Area (sf)	CN	Description
412,091	55	Woods, Good, HSG B
270,032	58	Meadow, non-grazed, HSG B
3,380	77	Woods, Good, HSG D
685,503	56	Weighted Average
685,503		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	42	0.0425	0.09		<b>Sheet Flow, A-B</b> Woods: Light underbrush n= 0.400 P2= 3.09"
9.3	58	0.0570	0.10		<b>Sheet Flow, B-C</b> Woods: Light underbrush n= 0.400 P2= 3.09"
3.6	513	0.1159	2.38		<b>Shallow Concentrated Flow, C-D</b> Short Grass Pasture Kv= 7.0 fps
4.0	419	0.1247	1.77		<b>Shallow Concentrated Flow, D-E</b> Woodland Kv= 5.0 fps
25.0	1,032	Total			

**Subcatchment EDA-1: EDA-1**

Hydrograph



**Summary for Subcatchment EDA-2: EDA-2**

Runoff = 20.70 cfs @ 12.37 hrs, Volume= 2.468 af, Depth= 4.18"

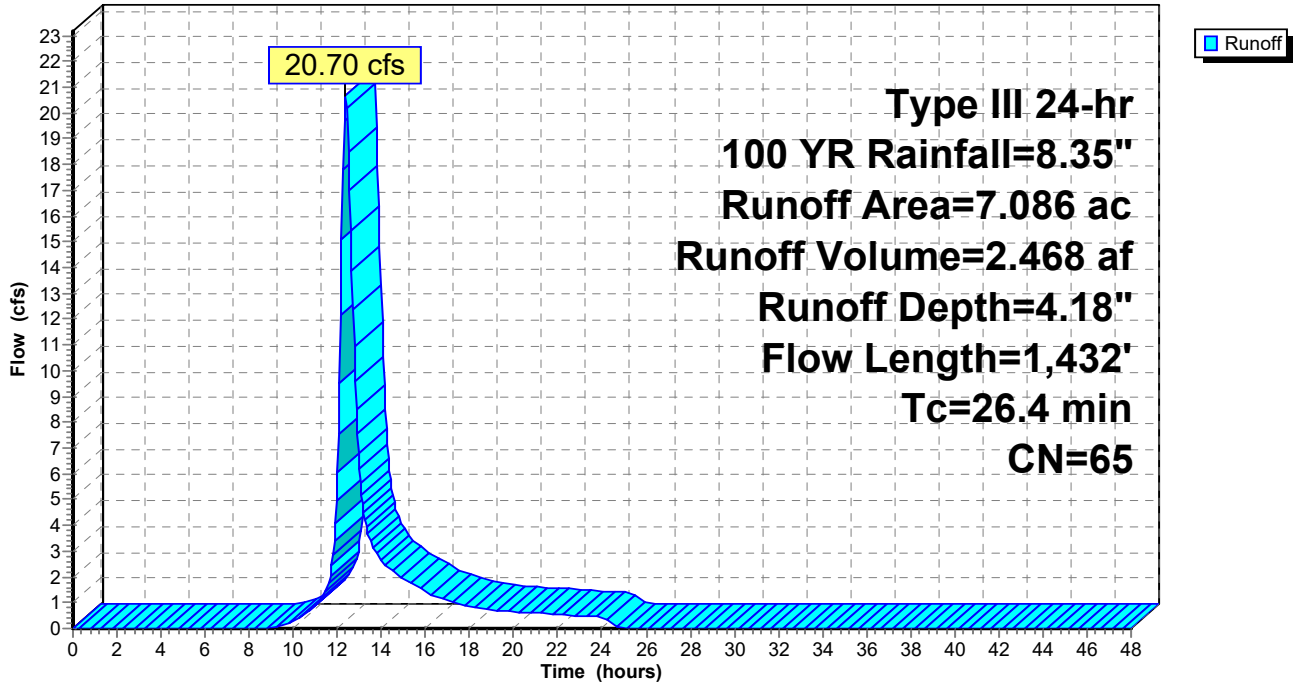
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100 YR Rainfall=8.35"

Area (ac)	CN	Description
1.055	58	Meadow, non-grazed, HSG B
2.890	55	Woods, Good, HSG B
3.141	77	Woods, Good, HSG D
7.086	65	Weighted Average
7.086		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.2	100	0.0149	0.15		<b>Sheet Flow, A-B</b> Grass: Short n= 0.150 P2= 3.09"
8.4	553	0.0482	1.10		<b>Shallow Concentrated Flow, B-C</b> Woodland Kv= 5.0 fps
1.8	190	0.0663	1.80		<b>Shallow Concentrated Flow, C-D</b> Short Grass Pasture Kv= 7.0 fps
2.2	206	0.0989	1.57		<b>Shallow Concentrated Flow, D-E</b> Woodland Kv= 5.0 fps
1.2	211	0.3360	2.90		<b>Shallow Concentrated Flow, E-F</b> Woodland Kv= 5.0 fps
1.6	172	0.0670	1.81		<b>Shallow Concentrated Flow, F-G</b> Short Grass Pasture Kv= 7.0 fps
26.4	1,432	Total			

Subcatchment EDA-2: EDA-2

Hydrograph



**Summary for Subcatchment EDA-3: EDA-3**

Runoff = 2.99 cfs @ 12.29 hrs, Volume= 0.325 af, Depth= 3.03"

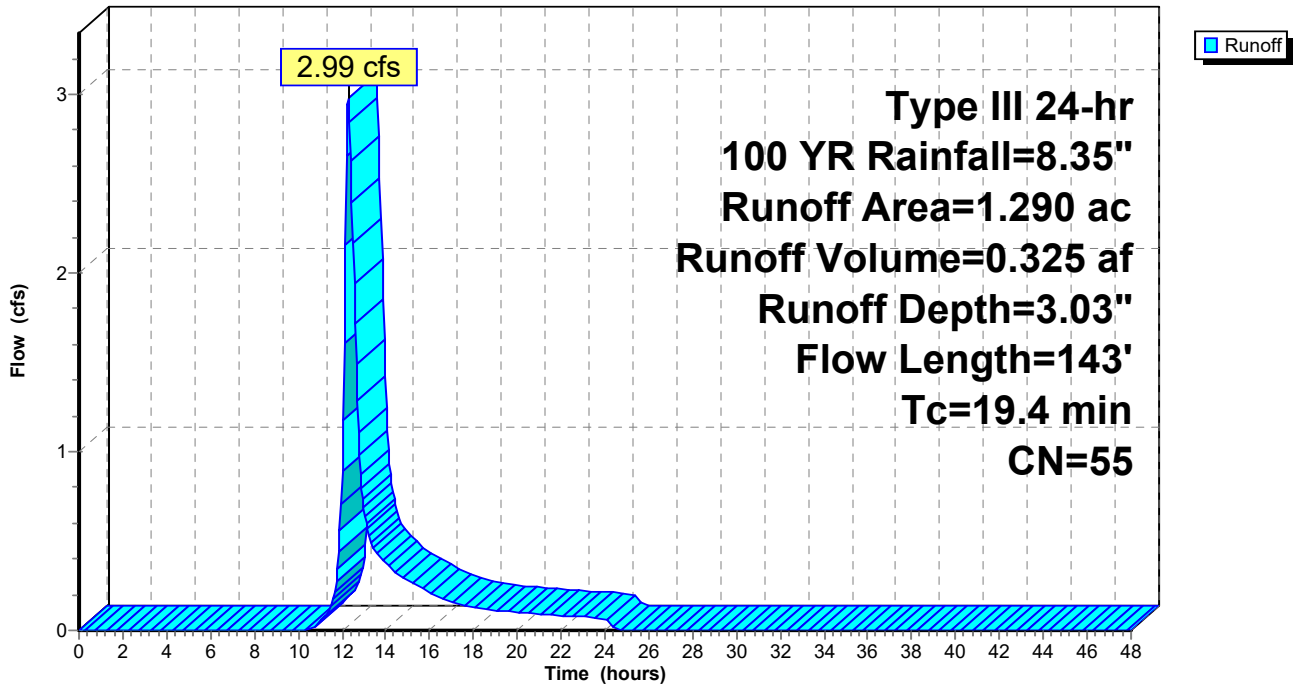
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100 YR Rainfall=8.35"

Area (ac)	CN	Description
0.013	58	Meadow, non-grazed, HSG B
1.277	55	Woods, Good, HSG B
1.290	55	Weighted Average
1.290		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.6	100	0.0300	0.09		<b>Sheet Flow, A-B</b> Woods: Light underbrush n= 0.400 P2= 3.09"
0.8	43	0.0350	0.94		<b>Shallow Concentrated Flow, B-C</b> Woodland Kv= 5.0 fps
19.4	143	Total			

**Subcatchment EDA-3: EDA-3**

Hydrograph



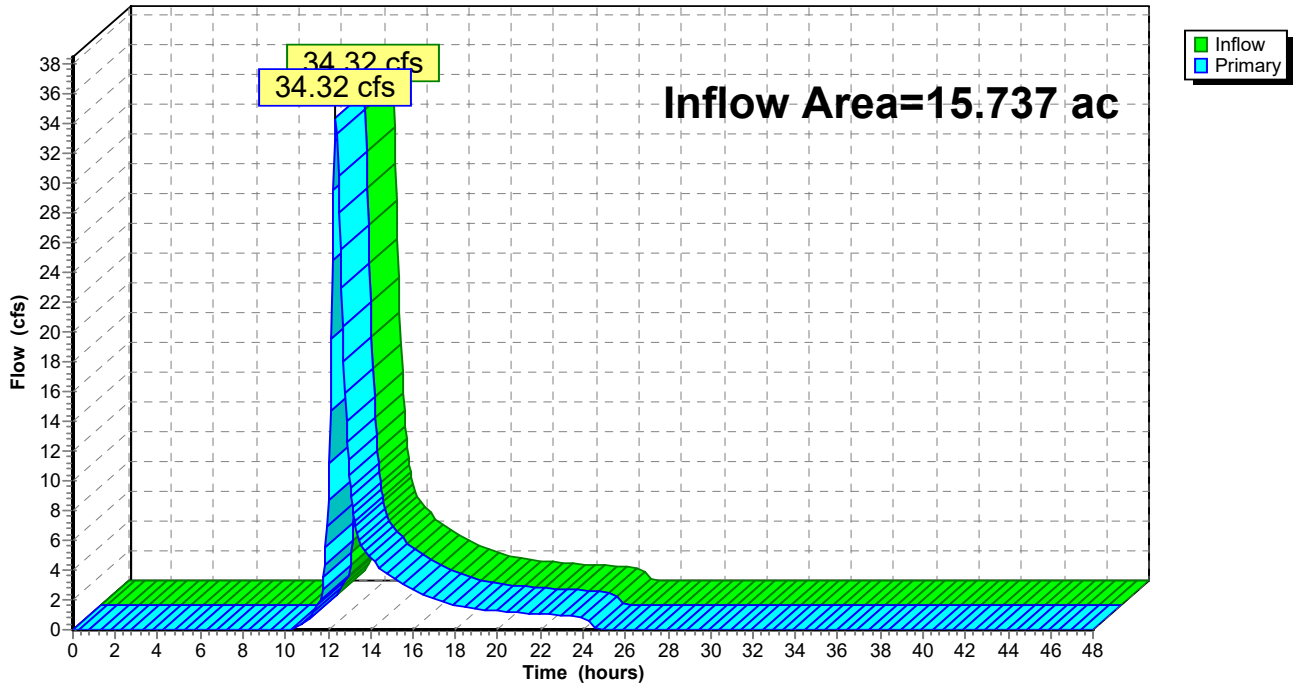
### Summary for Link AP-1: AP-1

Inflow Area = 15.737 ac, 0.00% Impervious, Inflow Depth = 3.14" for 100 YR event  
Inflow = 34.32 cfs @ 12.37 hrs, Volume= 4.117 af  
Primary = 34.32 cfs @ 12.37 hrs, Volume= 4.117 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

### Link AP-1: AP-1

Hydrograph



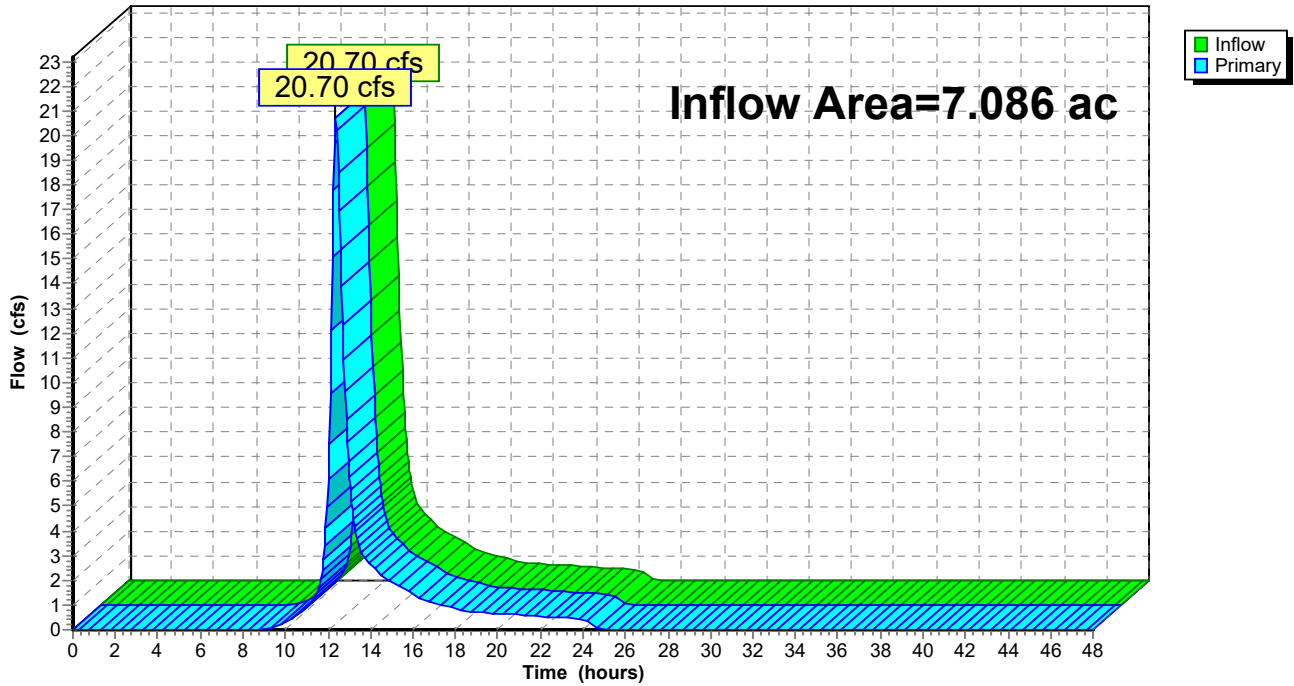
### Summary for Link AP-2: AP-2

Inflow Area = 7.086 ac, 0.00% Impervious, Inflow Depth = 4.18" for 100 YR event  
Inflow = 20.70 cfs @ 12.37 hrs, Volume= 2.468 af  
Primary = 20.70 cfs @ 12.37 hrs, Volume= 2.468 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

### Link AP-2: AP-2

Hydrograph





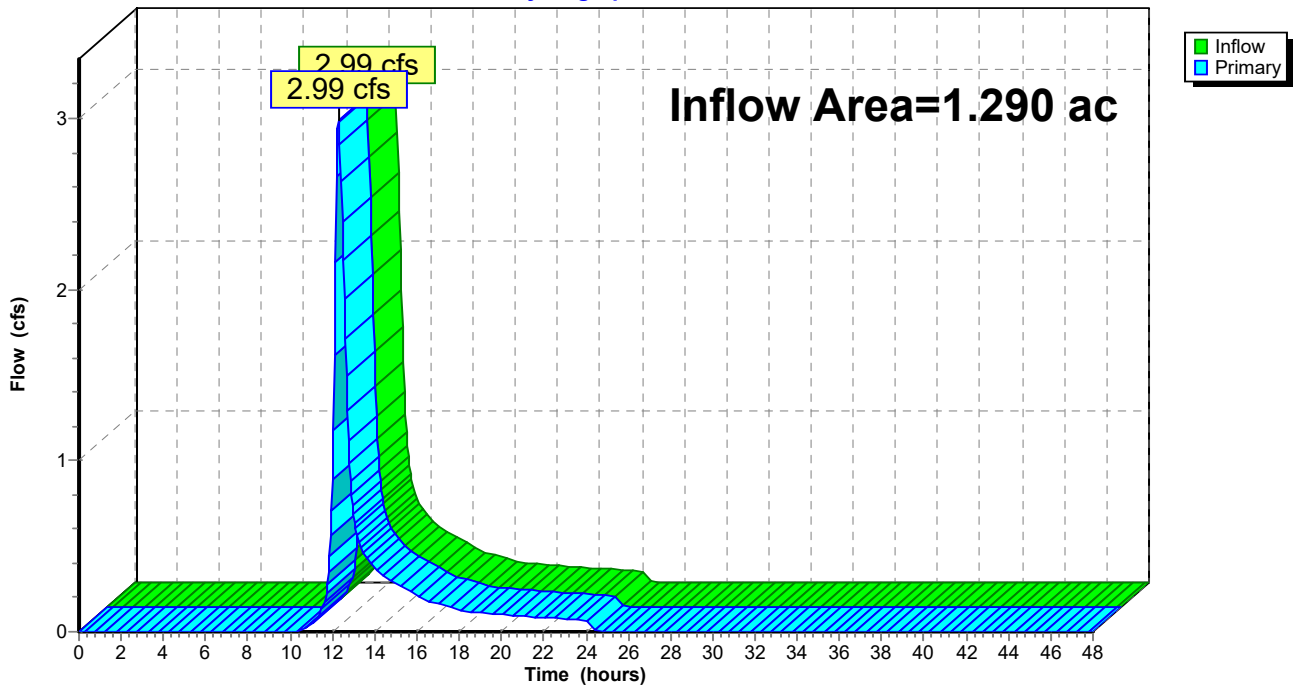
### Summary for Link AP-3: AP-3

Inflow Area = 1.290 ac, 0.00% Impervious, Inflow Depth = 3.03" for 100 YR event  
Inflow = 2.99 cfs @ 12.29 hrs, Volume= 0.325 af  
Primary = 2.99 cfs @ 12.29 hrs, Volume= 0.325 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

### Link AP-3: AP-3

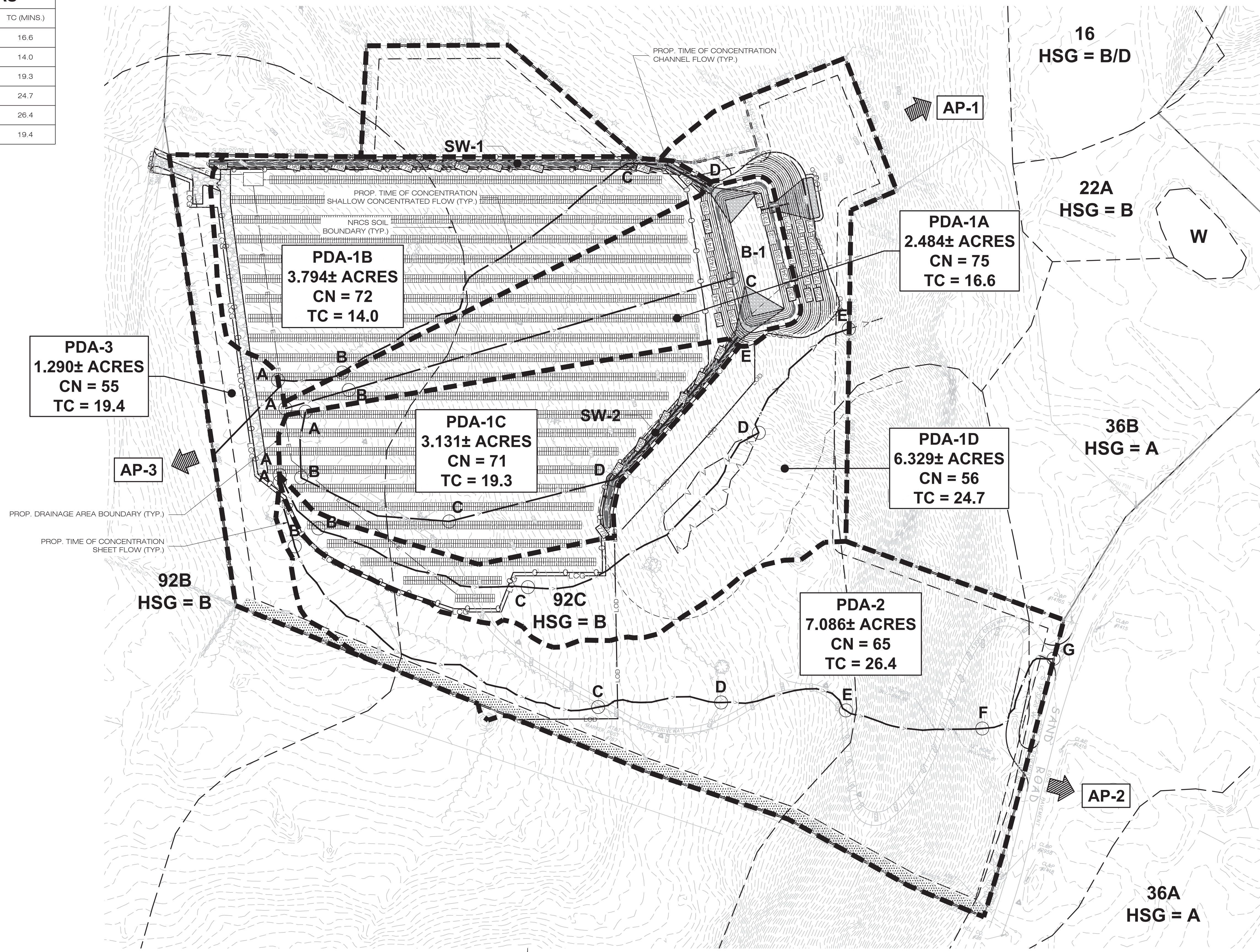
Hydrograph



**APPENDIX C: PROPOSED DRAINAGE AREA MAP (PDA-1) &  
HYDROLOGIC COMPUTATION (HYDROCAD)**

**PROPOSED DRAINAGE AREAS**

	TOTAL AREA (ACRES)	COMPOSITE CN	TC (MINS.)
PDA-1A	2.484±	75	16.6
PDA-1B	3.794±	72	14.0
PDA-1C	3.131±	71	19.3
PDA-1D	6.329±	56	24.7
PDA-2	7.086±	65	26.4
PDA-3	1.290±	55	19.4



**ALL-POINTS TECHNOLOGY CORPORATION**  
 567 VAUXHALL STREET EXTENSION - SUITE 311  
 WATERFORD, CT 06385 PH: (860)-663-1697  
 WWW.ALLPOINTSTECH.COM FAX: (860)-663-0935

PRELIMINARY

NO	DATE	REVISION
0	02/26/20	FOR REVIEW: BJP
1		
2		
3		
4		
5		
6		

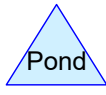
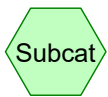
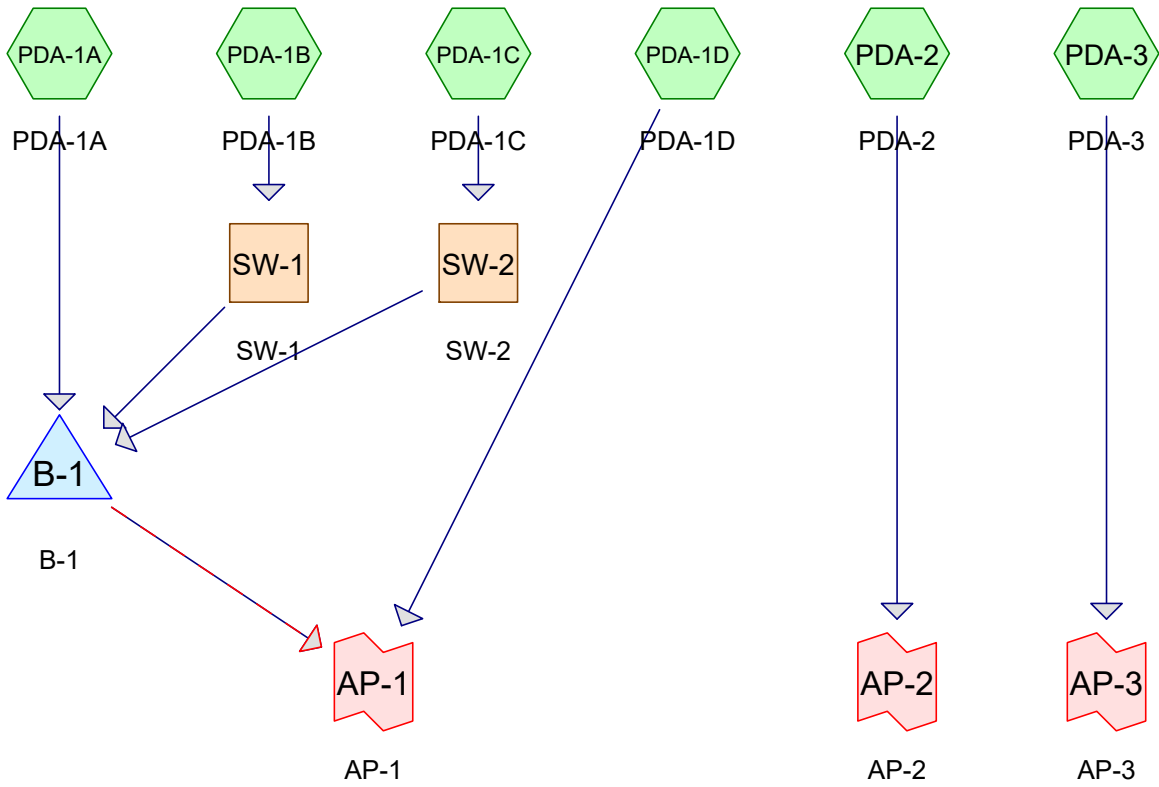
DESIGN PROFESSIONAL OF RECORD  
 PROF: BRADLEY J. PARSONS P.E.  
 COMP: ALL-POINTS TECHNOLOGY CORPORATION  
 ADD: 567 VAUXHALL STREET EXTENSION - SUITE 311 WATERFORD, CT 06385  
 OWNER: JOHN DOUGLAS & CECELIA S. BATES  
 ADDRESS: 276 HOUSATONIC RIVER ROAD FALLS VILLAGE, CT 06031

**NORTH CANAAN SOLAR**  
 SITE 100 SAND ROAD  
 ADDRESS: NORTH CANAAN, CT 06018  
 APT FILING NUMBER: CT606110  
 DATE: 02/26/20  
 DRAWN BY: JT  
 CHECKED BY: BJP

SHEET TITLE:  
**PROPOSED DRAINAGE AREA MAP**

SHEET NUMBER:  
**PDA-1**

**1 PROPOSED DRAINAGE AREA MAP**  
 SCALE: 1" = 80'-0"  
 (IN FEET) 1 inch = 80 ft.



**Area Listing (all nodes)**

Area (acres)	CN	Description (subcatchment-numbers)
0.977	48	Brush, Good, HSG B (PDA-3)
0.201	96	Gravel surface, HSG C (PDA-1B, PDA-3)
2.514	58	Meadow, non-grazed, HSG B (PDA-1D, PDA-2)
9.143	71	Meadow, non-grazed, HSG C (PDA-1A, PDA-1B, PDA-1C, PDA-2, PDA-3)
0.014	98	Unconnected pavement, HSG C (PDA-1B)
0.381	98	Water Surface, HSG C (PDA-1A)
7.665	55	Woods, Good, HSG B (PDA-1D, PDA-2)
3.219	77	Woods, Good, HSG D (PDA-1D, PDA-2)
<b>24.114</b>	<b>65</b>	<b>TOTAL AREA</b>

**Soil Listing (all nodes)**

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
11.156	HSG B	PDA-1D, PDA-2, PDA-3
9.739	HSG C	PDA-1A, PDA-1B, PDA-1C, PDA-2, PDA-3
3.219	HSG D	PDA-1D, PDA-2
0.000	Other	
<b>24.114</b>		<b>TOTAL AREA</b>

**CT606110\_NorthCanaan - PR - Rev0**

Prepared by Microsoft

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Page 4

**Ground Covers (all nodes)**

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.977	0.000	0.000	0.000	0.977	Brush, Good	PDA-3
0.000	0.000	0.201	0.000	0.000	0.201	Gravel surface	PDA-1B, PDA-3
0.000	2.514	9.143	0.000	0.000	11.657	Meadow, non-grazed	PDA-1A, PDA-1B, PDA-1C, PDA-1D, PDA-2, PDA-3
0.000	0.000	0.014	0.000	0.000	0.014	Unconnected pavement	PDA-1B
0.000	0.000	0.381	0.000	0.000	0.381	Water Surface	PDA-1A
0.000	7.665	0.000	3.219	0.000	10.884	Woods, Good	PDA-1D, PDA-2
<b>0.000</b>	<b>11.156</b>	<b>9.739</b>	<b>3.219</b>	<b>0.000</b>	<b>24.114</b>	<b>TOTAL AREA</b>	

**Pipe Listing (all nodes)**

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	B-1	730.00	729.00	40.0	0.0250	0.013	18.0	0.0	0.0



Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment PDA-1A: PDA-1A** Runoff Area=2.484 ac 15.34% Impervious Runoff Depth=5.36"  
Flow Length=705' Tc=16.6 min CN=75 Runoff=11.24 cfs 1.109 af

**Subcatchment PDA-1B: PDA-1B** Runoff Area=3.794 ac 0.37% Impervious Runoff Depth=5.00"  
Flow Length=779' Tc=14.0 min CN=72 Runoff=17.16 cfs 1.582 af

**Subcatchment PDA-1C: PDA-1C** Runoff Area=3.131 ac 0.00% Impervious Runoff Depth=4.88"  
Flow Length=880' Tc=19.3 min CN=71 Runoff=12.24 cfs 1.274 af

**Subcatchment PDA-1D: PDA-1D** Runoff Area=6.329 ac 0.00% Impervious Runoff Depth=3.14"  
Flow Length=1,105' Tc=24.7 min CN=56 Runoff=13.87 cfs 1.656 af

**Subcatchment PDA-2: PDA-2** Runoff Area=7.086 ac 0.00% Impervious Runoff Depth=4.18"  
Flow Length=1,432' Tc=26.4 min CN=65 Runoff=20.70 cfs 2.468 af

**Subcatchment PDA-3: PDA-3** Runoff Area=1.290 ac 0.00% Impervious Runoff Depth=3.03"  
Flow Length=143' Tc=19.4 min CN=55 Runoff=2.99 cfs 0.325 af

**Reach SW-1: SW-1** Avg. Flow Depth=0.60' Max Vel=7.41 fps Inflow=17.16 cfs 1.582 af  
n=0.030 L=771.0' S=0.0778 '/' Capacity=120.78 cfs Outflow=17.00 cfs 1.582 af

**Reach SW-2: SW-2** Avg. Flow Depth=0.49' Max Vel=7.11 fps Inflow=12.24 cfs 1.274 af  
n=0.030 L=360.0' S=0.0889 '/' Capacity=129.08 cfs Outflow=12.20 cfs 1.274 af

**Pond B-1: B-1** Peak Elev=734.90' Storage=61,362 cf Inflow=39.88 cfs 3.965 af  
Discarded=0.19 cfs 0.444 af Primary=14.26 cfs 3.165 af Secondary=6.41 cfs 0.165 af Outflow=20.87 cfs 3.774 af

**Link AP-1: AP-1** Inflow=32.56 cfs 4.985 af  
Primary=32.56 cfs 4.985 af

**Link AP-2: AP-2** Inflow=20.70 cfs 2.468 af  
Primary=20.70 cfs 2.468 af

**Link AP-3: AP-3** Inflow=2.99 cfs 0.325 af  
Primary=2.99 cfs 0.325 af

**Total Runoff Area = 24.114 ac Runoff Volume = 8.414 af Average Runoff Depth = 4.19"**  
**98.36% Pervious = 23.719 ac 1.64% Impervious = 0.395 ac**

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

Runoff = 11.24 cfs @ 12.23 hrs, Volume= 1.109 af, Depth= 5.36"

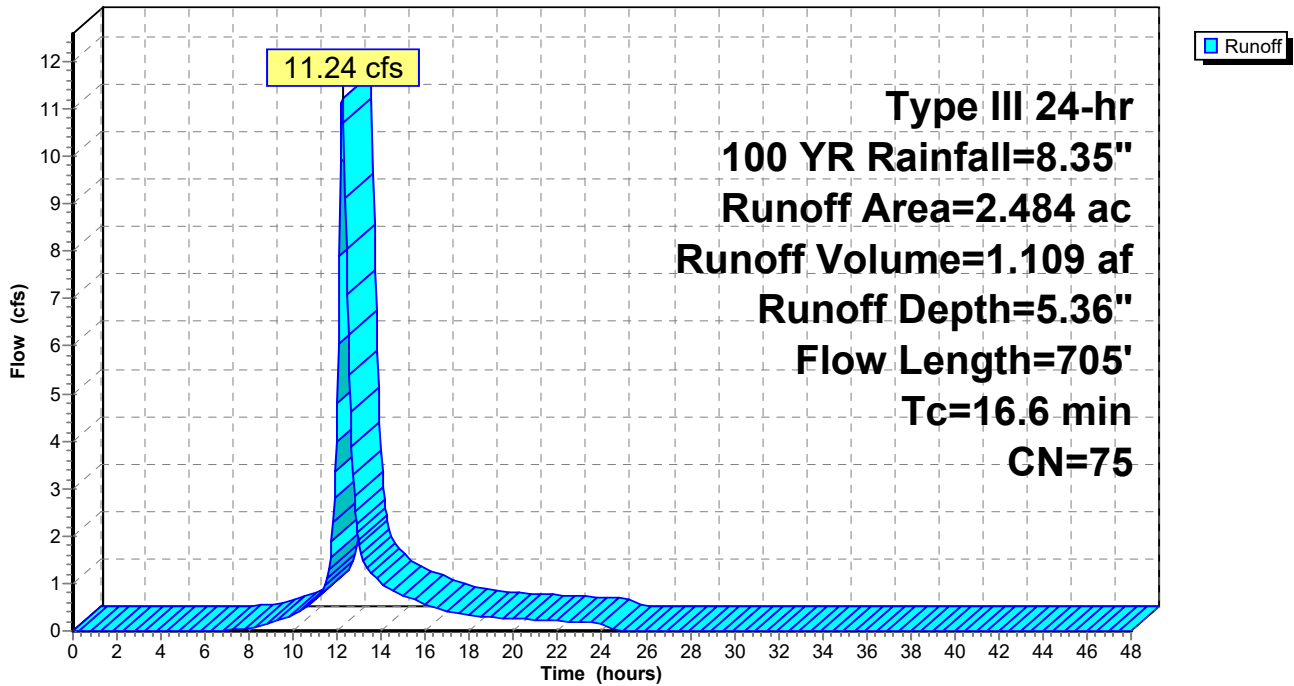
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100 YR Rainfall=8.35"

Area (ac)	CN	Description
2.103	71	Meadow, non-grazed, HSG C
0.381	98	Water Surface, HSG C
2.484	75	Weighted Average
2.103		84.66% Pervious Area
0.381		15.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	100	0.0304	0.14		<b>Sheet Flow, A-B</b> Grass: Dense n= 0.240 P2= 3.09"
4.3	605	0.1132	2.36		<b>Shallow Concentrated Flow, B-C</b> Short Grass Pasture Kv= 7.0 fps
16.6	705	Total			

**Subcatchment PDA-1A: PDA-1A**

Hydrograph



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

Runoff = 17.16 cfs @ 12.20 hrs, Volume= 1.582 af, Depth= 5.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100 YR Rainfall=8.35"

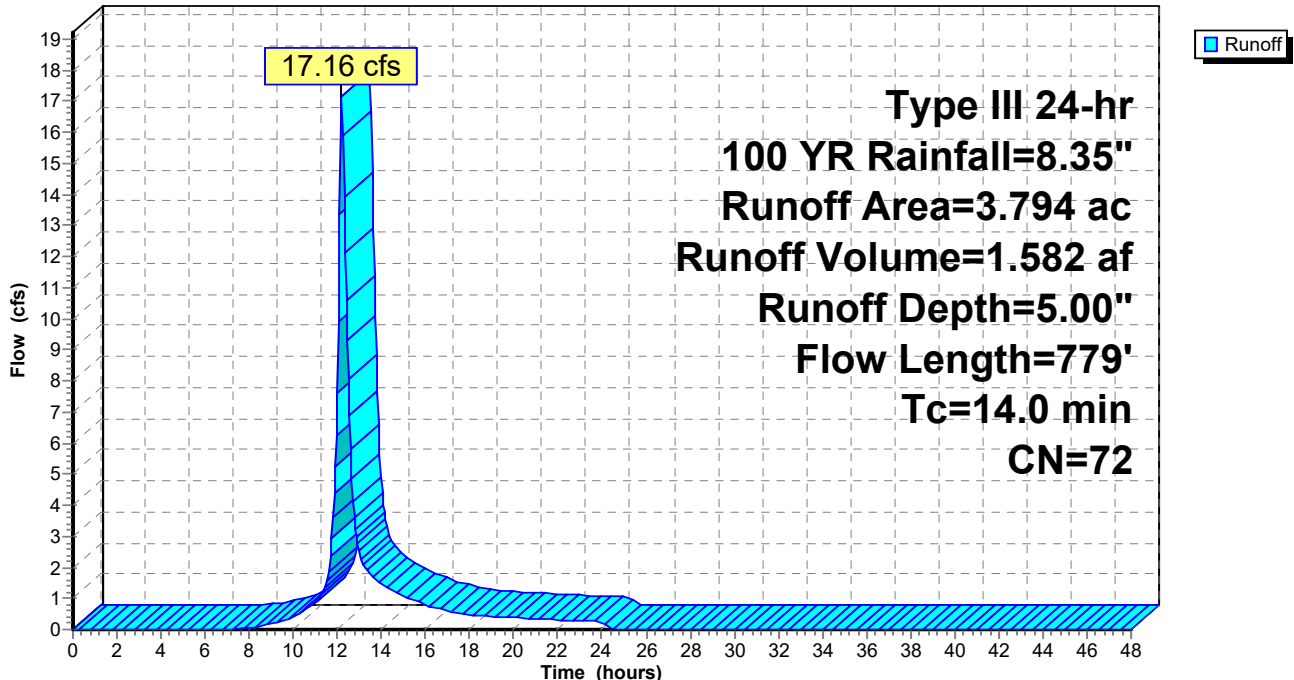
Area (ac)	CN	Description
3.677	71	Meadow, non-grazed, HSG C
0.103	96	Gravel surface, HSG C
0.014	98	Unconnected pavement, HSG C
3.794	72	Weighted Average
3.780		99.63% Pervious Area
0.014		0.37% Impervious Area
0.014		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	100	0.0500	0.17		<b>Sheet Flow, A-B</b> Grass: Dense n= 0.240 P2= 3.09"
3.8	549	0.1159	2.38		<b>Shallow Concentrated Flow, B-C</b> Short Grass Pasture Kv= 7.0 fps
0.1	130	0.8000	40.74	395.18	<b>Channel Flow, C-D</b> Area= 9.7 sf Perim= 11.0' r= 0.88' n= 0.030 Earth, grassed & winding
14.0	779	Total			

**Subcatchment PDA-1B: PDA-1B**

Hydrograph



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

Runoff = 12.24 cfs @ 12.27 hrs, Volume= 1.274 af, Depth= 4.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100 YR Rainfall=8.35"

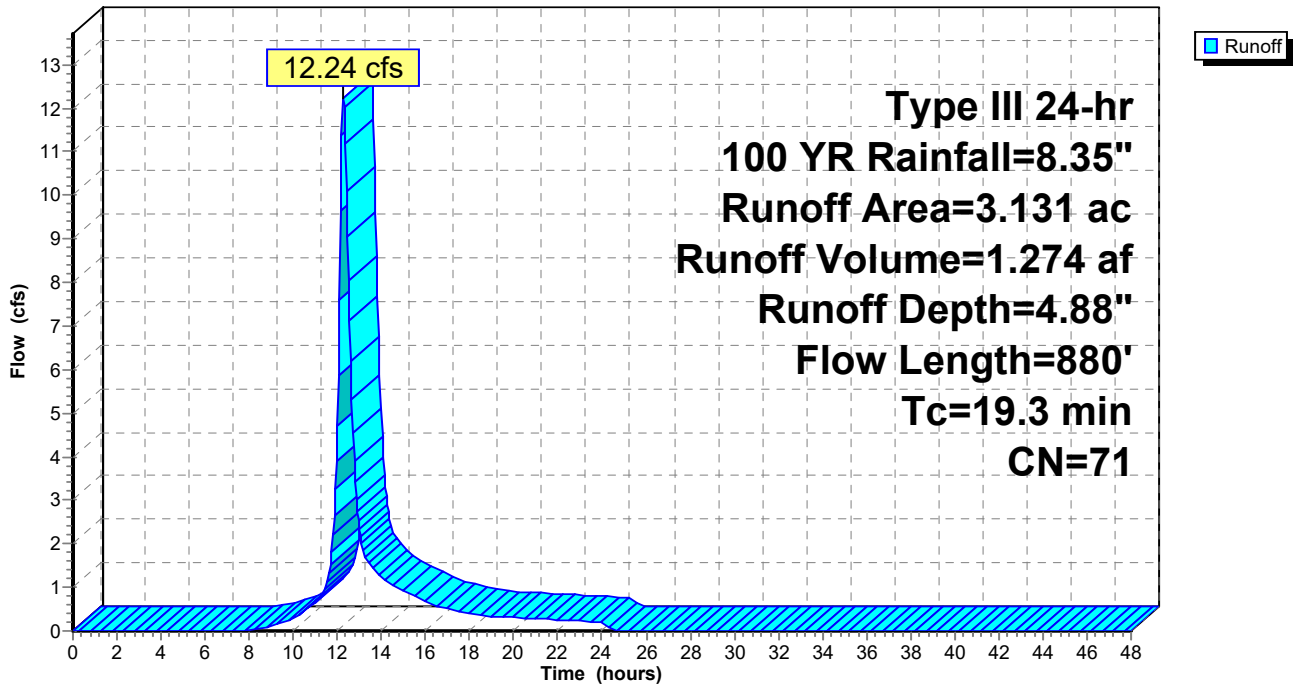
Area (ac)	CN	Description
3.131	71	Meadow, non-grazed, HSG C
3.131		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.8	100	0.0190	0.11		<b>Sheet Flow, A-B</b> Grass: Dense n= 0.240 P2= 3.09"
2.2	238	0.0646	1.78		<b>Shallow Concentrated Flow, B-C</b> Short Grass Pasture Kv= 7.0 fps
1.9	255	0.1029	2.25		<b>Shallow Concentrated Flow, C-D</b> Short Grass Pasture Kv= 7.0 fps
0.4	287	0.0889	13.58	131.74	<b>Channel Flow, D-E</b> Area= 9.7 sf Perim= 11.0' r= 0.88' n= 0.030 Earth, grassed & winding
19.3	880	Total			

**Subcatchment PDA-1C: PDA-1C**

Hydrograph



**Summary for Subcatchment PDA-1D: PDA-1D**

Runoff = 13.87 cfs @ 12.37 hrs, Volume= 1.656 af, Depth= 3.14"

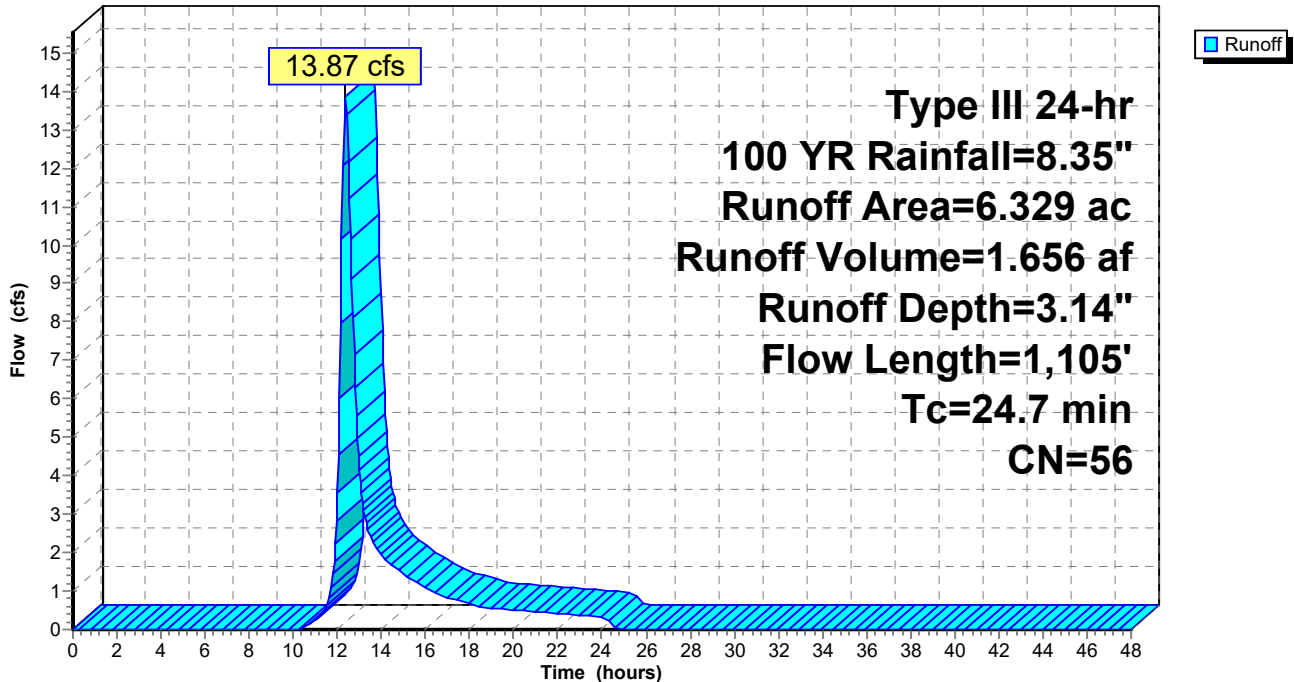
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100 YR Rainfall=8.35"

Area (ac)	CN	Description
4.792	55	Woods, Good, HSG B
1.459	58	Meadow, non-grazed, HSG B
0.078	77	Woods, Good, HSG D
6.329	56	Weighted Average
6.329		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	100	0.0150	0.10		<b>Sheet Flow, A-B</b> Grass: Dense n= 0.240 P2= 3.09"
3.5	336	0.0536	1.62		<b>Shallow Concentrated Flow, B-C</b> Short Grass Pasture Kv= 7.0 fps
4.6	443	0.1016	1.59		<b>Shallow Concentrated Flow, C-D</b> Woodland Kv= 5.0 fps
0.3	226	0.1334	11.40	34.19	<b>Channel Flow, D-E</b> Area= 3.0 sf Perim= 6.0' r= 0.50' n= 0.030 Earth, grassed & winding
24.7	1,105	Total			

**Subcatchment PDA-1D: PDA-1D**

Hydrograph



**Summary for Subcatchment PDA-2: PDA-2**

Runoff = 20.70 cfs @ 12.37 hrs, Volume= 2.468 af, Depth= 4.18"

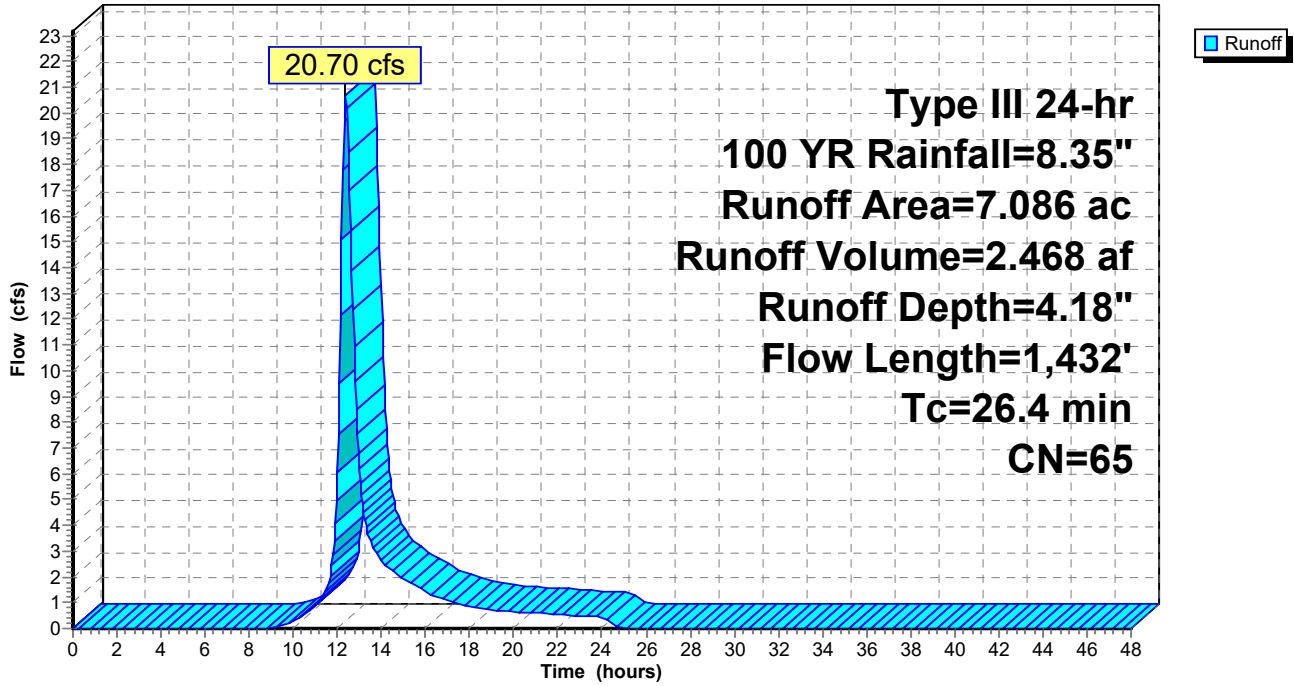
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100 YR Rainfall=8.35"

Area (ac)	CN	Description
2.873	55	Woods, Good, HSG B
1.055	58	Meadow, non-grazed, HSG B
0.017	71	Meadow, non-grazed, HSG C
3.141	77	Woods, Good, HSG D
7.086	65	Weighted Average
7.086		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.2	100	0.0149	0.15		<b>Sheet Flow, A-B</b> Grass: Short n= 0.150 P2= 3.09"
8.4	553	0.0482	1.10		<b>Shallow Concentrated Flow, B-C</b> Woodland Kv= 5.0 fps
1.8	190	0.0663	1.80		<b>Shallow Concentrated Flow, C-D</b> Short Grass Pasture Kv= 7.0 fps
2.2	206	0.0989	1.57		<b>Shallow Concentrated Flow, D-E</b> Woodland Kv= 5.0 fps
1.2	211	0.3360	2.90		<b>Shallow Concentrated Flow, E-F</b> Woodland Kv= 5.0 fps
1.6	172	0.0670	1.81		<b>Shallow Concentrated Flow, F-G</b> Short Grass Pasture Kv= 7.0 fps
26.4	1,432	Total			

Subcatchment PDA-2: PDA-2

Hydrograph



**Summary for Subcatchment PDA-3: PDA-3**

Runoff = 2.99 cfs @ 12.29 hrs, Volume= 0.325 af, Depth= 3.03"

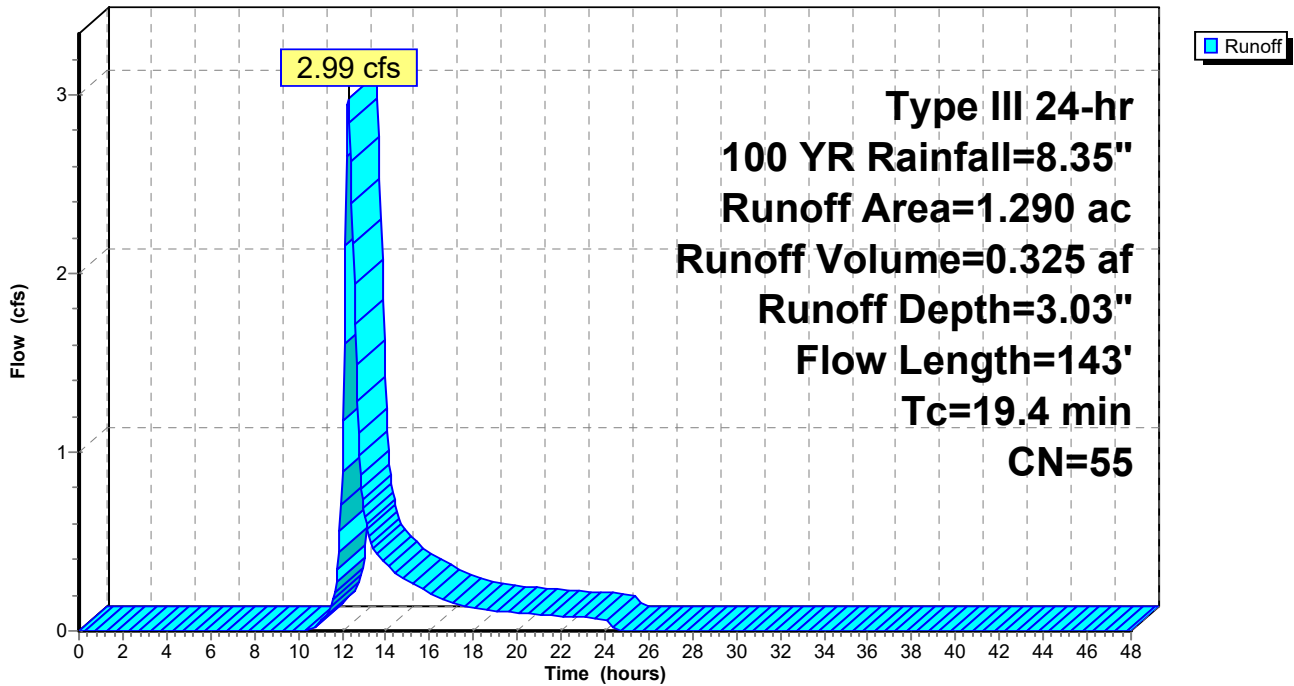
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100 YR Rainfall=8.35"

Area (ac)	CN	Description
0.977	48	Brush, Good, HSG B
0.215	71	Meadow, non-grazed, HSG C
0.098	96	Gravel surface, HSG C
1.290	55	Weighted Average
1.290		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.6	100	0.0300	0.09		<b>Sheet Flow, A-B</b> Woods: Light underbrush n= 0.400 P2= 3.09"
0.8	43	0.0350	0.94		<b>Shallow Concentrated Flow, F-G</b> Woodland Kv= 5.0 fps
19.4	143	Total			

**Subcatchment PDA-3: PDA-3**

Hydrograph





**Summary for Reach SW-1: SW-1**

Inflow Area = 3.794 ac, 0.37% Impervious, Inflow Depth = 5.00" for 100 YR event  
 Inflow = 17.16 cfs @ 12.20 hrs, Volume= 1.582 af  
 Outflow = 17.00 cfs @ 12.22 hrs, Volume= 1.582 af, Atten= 1%, Lag= 1.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Max. Velocity= 7.41 fps, Min. Travel Time= 1.7 min  
 Avg. Velocity = 2.54 fps, Avg. Travel Time= 5.1 min

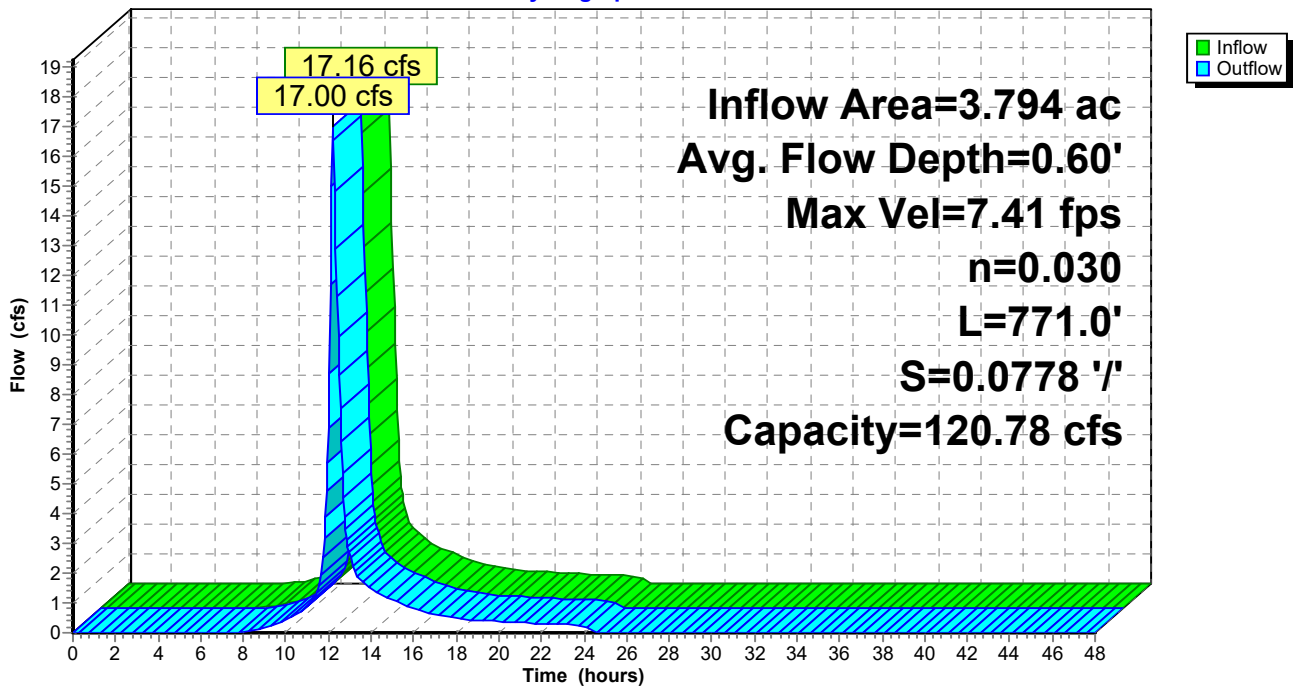
Peak Storage= 1,764 cf @ 12.22 hrs  
 Average Depth at Peak Storage= 0.60'  
 Bank-Full Depth= 1.50' Flow Area= 9.8 sf, Capacity= 120.78 cfs

2.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding  
 Side Slope Z-value= 3.0 '/' Top Width= 11.00'  
 Length= 771.0' Slope= 0.0778 '/'  
 Inlet Invert= 795.00', Outlet Invert= 735.00'



**Reach SW-1: SW-1**

Hydrograph



### Summary for Reach SW-2: SW-2

Inflow Area = 3.131 ac, 0.00% Impervious, Inflow Depth = 4.88" for 100 YR event  
 Inflow = 12.24 cfs @ 12.27 hrs, Volume= 1.274 af  
 Outflow = 12.20 cfs @ 12.28 hrs, Volume= 1.274 af, Atten= 0%, Lag= 0.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Max. Velocity= 7.11 fps, Min. Travel Time= 0.8 min  
 Avg. Velocity = 2.56 fps, Avg. Travel Time= 2.3 min

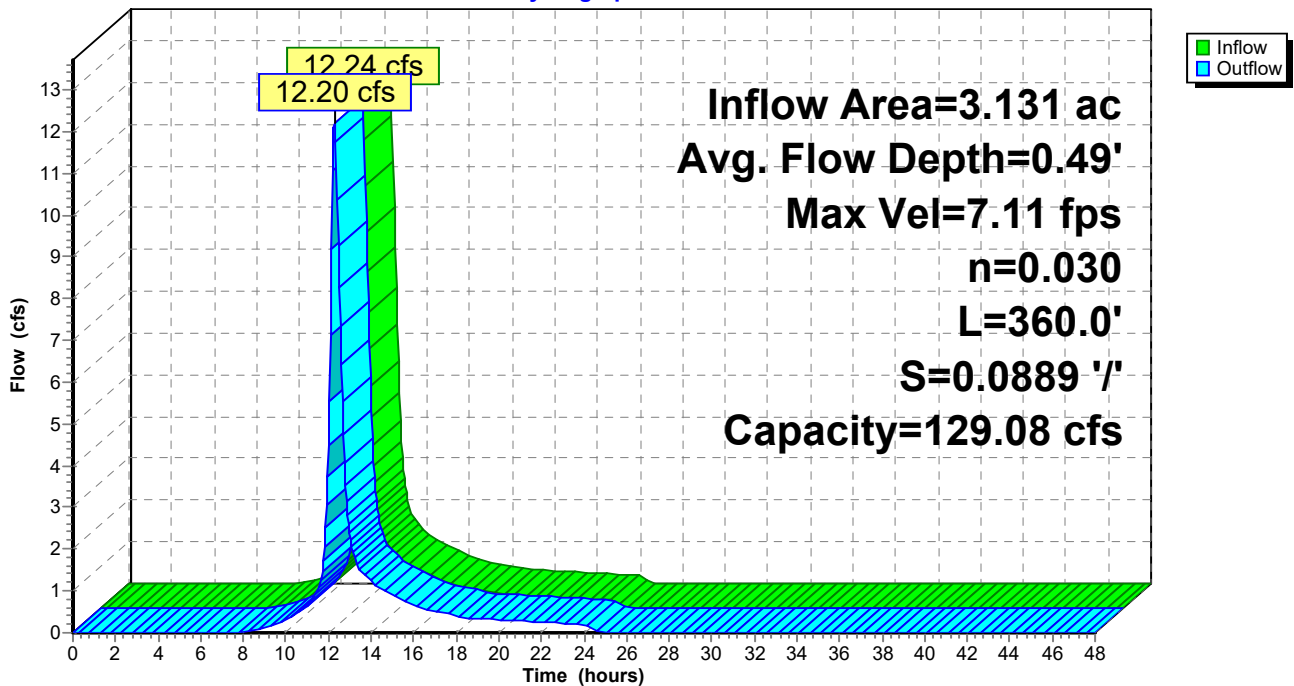
Peak Storage= 617 cf @ 12.28 hrs  
 Average Depth at Peak Storage= 0.49'  
 Bank-Full Depth= 1.50' Flow Area= 9.8 sf, Capacity= 129.08 cfs

2.00' x 1.50' deep channel, n= 0.030 Earth, grassed & winding  
 Side Slope Z-value= 3.0 '/' Top Width= 11.00'  
 Length= 360.0' Slope= 0.0889 '/'  
 Inlet Invert= 772.00', Outlet Invert= 740.00'



### Reach SW-2: SW-2

Hydrograph



**Summary for Pond B-1: B-1**

Inflow Area = 9.409 ac, 4.20% Impervious, Inflow Depth = 5.06" for 100 YR event  
 Inflow = 39.88 cfs @ 12.24 hrs, Volume= 3.965 af  
 Outflow = 20.87 cfs @ 12.54 hrs, Volume= 3.774 af, Atten= 48%, Lag= 18.4 min  
 Discarded = 0.19 cfs @ 12.54 hrs, Volume= 0.444 af  
 Primary = 14.26 cfs @ 12.54 hrs, Volume= 3.165 af  
 Secondary = 6.41 cfs @ 12.54 hrs, Volume= 0.165 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
 Peak Elev= 734.90' @ 12.54 hrs Surf.Area= 16,428 sf Storage= 61,362 cf

Plug-Flow detention time= 195.5 min calculated for 3.774 af (95% of inflow)  
 Center-of-Mass det. time= 168.7 min ( 997.8 - 829.1 )

Volume	Invert	Avail.Storage	Storage Description			
#1	730.00'	63,054 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc)			
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
730.00	9,000	460.0	0	0	9,000	
735.00	16,607	554.2	63,054	63,054	17,014	

Device	Routing	Invert	Outlet Devices
#1	Discarded	730.00'	<b>0.500 in/hr Exfiltration over Surface area</b> Conductivity to Groundwater Elevation = 1.00'
#2	Primary	730.00'	<b>18.0" Round Culvert</b> L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 730.00' / 729.00' S= 0.0250 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#3	Device 2	731.50'	<b>6.0" W x 3.0" H Vert. Orifice/Grate</b> C= 0.600
#4	Device 2	732.50'	<b>18.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#5	Secondary	734.50'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Discarded OutFlow** Max=0.19 cfs @ 12.54 hrs HW=734.90' (Free Discharge)

↑1=Exfiltration ( Controls 0.19 cfs)

**Primary OutFlow** Max=14.26 cfs @ 12.54 hrs HW=734.90' TW=0.00' (Dynamic Tailwater)

↑2=Culvert (Passes 14.26 cfs of 17.32 cfs potential flow)

↑3=Orifice/Grate (Orifice Controls 1.09 cfs @ 8.71 fps)

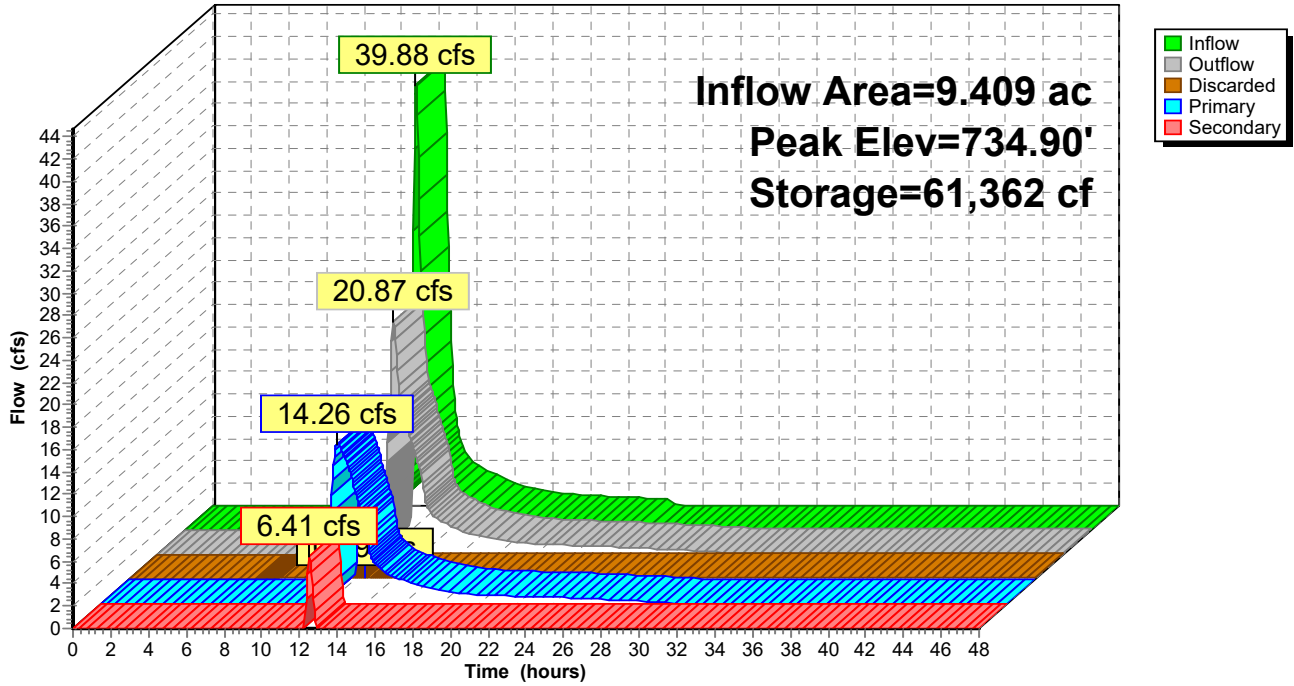
↑4=Orifice/Grate (Orifice Controls 13.17 cfs @ 7.45 fps)

**Secondary OutFlow** Max=6.37 cfs @ 12.54 hrs HW=734.90' TW=0.00' (Dynamic Tailwater)

↑5=Broad-Crested Rectangular Weir (Weir Controls 6.37 cfs @ 1.61 fps)

### Pond B-1: B-1

Hydrograph



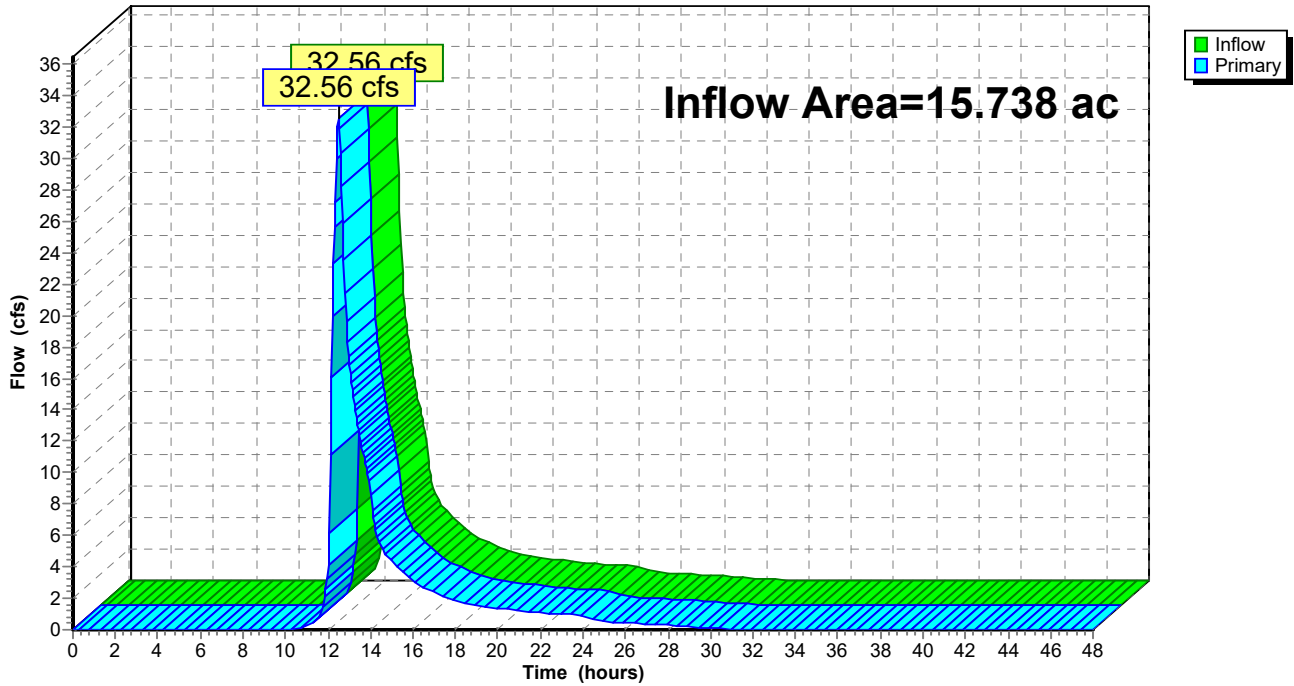
### Summary for Link AP-1: AP-1

Inflow Area = 15.738 ac, 2.51% Impervious, Inflow Depth = 3.80" for 100 YR event  
Inflow = 32.56 cfs @ 12.50 hrs, Volume= 4.985 af  
Primary = 32.56 cfs @ 12.50 hrs, Volume= 4.985 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

### Link AP-1: AP-1

Hydrograph



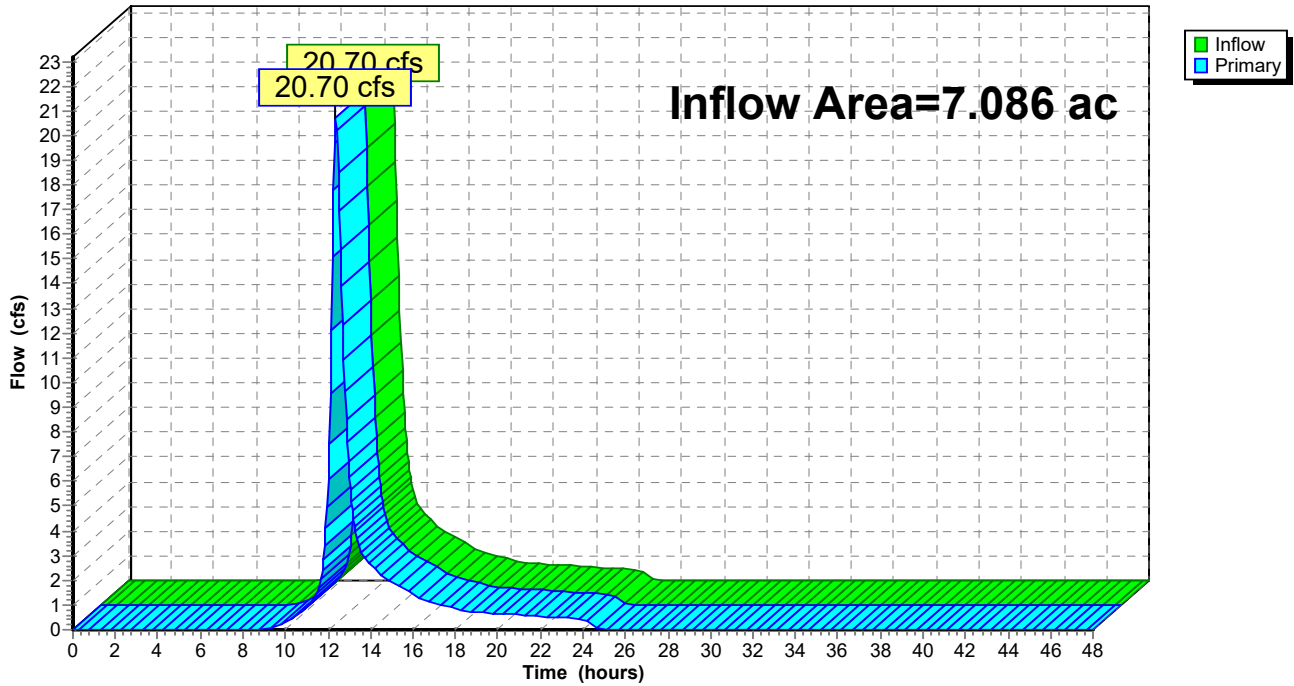
### Summary for Link AP-2: AP-2

Inflow Area = 7.086 ac, 0.00% Impervious, Inflow Depth = 4.18" for 100 YR event  
Inflow = 20.70 cfs @ 12.37 hrs, Volume= 2.468 af  
Primary = 20.70 cfs @ 12.37 hrs, Volume= 2.468 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

### Link AP-2: AP-2

Hydrograph



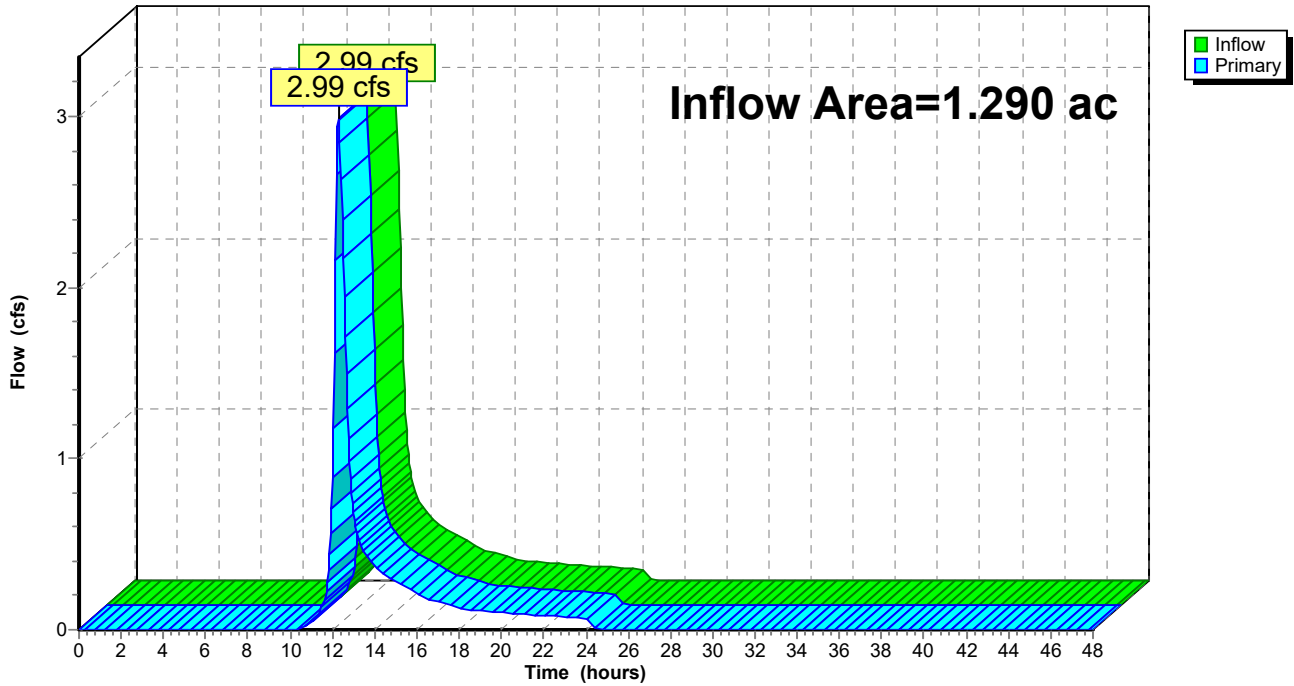
### Summary for Link AP-3: AP-3

Inflow Area = 1.290 ac, 0.00% Impervious, Inflow Depth = 3.03" for 100 YR event  
Inflow = 2.99 cfs @ 12.29 hrs, Volume= 0.325 af  
Primary = 2.99 cfs @ 12.29 hrs, Volume= 0.325 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

### Link AP-3: AP-3

Hydrograph



# **APPENDIX D: NOAA ATLAS 14 PRECIPITATION FREQUENCY TABLE**





**NOAA Atlas 14, Volume 10, Version 3**  
**Location name: Canaan, Connecticut, USA\***  
**Latitude: 42.0118°, Longitude: -73.3466°**  
**Elevation: 792.12 ft\*\***  
\* source: ESRI Maps  
\*\* source: USGS



**POINT PRECIPITATION FREQUENCY ESTIMATES**

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

[PF\\_tabular](#) | [PF\\_graphical](#) | [Maps & aerials](#)

**PF tabular**

<b>PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)<sup>1</sup></b>										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
<b>5-min</b>	<b>0.336</b> (0.260-0.436)	<b>0.398</b> (0.308-0.516)	<b>0.499</b> (0.384-0.649)	<b>0.582</b> (0.446-0.762)	<b>0.696</b> (0.516-0.951)	<b>0.783</b> (0.568-1.09)	<b>0.872</b> (0.614-1.26)	<b>0.968</b> (0.651-1.44)	<b>1.10</b> (0.712-1.70)	<b>1.20</b> (0.762-1.90)
<b>10-min</b>	<b>0.477</b> (0.369-0.617)	<b>0.563</b> (0.436-0.731)	<b>0.705</b> (0.544-0.918)	<b>0.823</b> (0.631-1.08)	<b>0.985</b> (0.731-1.35)	<b>1.11</b> (0.806-1.55)	<b>1.24</b> (0.871-1.79)	<b>1.37</b> (0.922-2.04)	<b>1.56</b> (1.01-2.41)	<b>1.71</b> (1.08-2.69)
<b>15-min</b>	<b>0.561</b> (0.434-0.726)	<b>0.663</b> (0.513-0.860)	<b>0.830</b> (0.640-1.08)	<b>0.968</b> (0.742-1.27)	<b>1.16</b> (0.860-1.58)	<b>1.30</b> (0.948-1.82)	<b>1.45</b> (1.02-2.10)	<b>1.61</b> (1.09-2.40)	<b>1.83</b> (1.19-2.83)	<b>2.01</b> (1.27-3.17)
<b>30-min</b>	<b>0.770</b> (0.596-0.998)	<b>0.911</b> (0.704-1.18)	<b>1.14</b> (0.880-1.49)	<b>1.33</b> (1.02-1.74)	<b>1.59</b> (1.18-2.18)	<b>1.79</b> (1.30-2.50)	<b>2.00</b> (1.41-2.89)	<b>2.22</b> (1.49-3.31)	<b>2.52</b> (1.63-3.90)	<b>2.76</b> (1.75-4.36)
<b>60-min</b>	<b>0.979</b> (0.758-1.27)	<b>1.16</b> (0.896-1.50)	<b>1.45</b> (1.12-1.89)	<b>1.69</b> (1.30-2.22)	<b>2.03</b> (1.50-2.77)	<b>2.28</b> (1.66-3.19)	<b>2.54</b> (1.79-3.68)	<b>2.82</b> (1.90-4.21)	<b>3.21</b> (2.08-4.96)	<b>3.52</b> (2.23-5.56)
<b>2-hr</b>	<b>1.28</b> (0.999-1.65)	<b>1.49</b> (1.16-1.92)	<b>1.82</b> (1.41-2.36)	<b>2.10</b> (1.62-2.73)	<b>2.48</b> (1.85-3.37)	<b>2.77</b> (2.02-3.85)	<b>3.07</b> (2.17-4.42)	<b>3.39</b> (2.29-5.04)	<b>3.85</b> (2.50-5.93)	<b>4.21</b> (2.67-6.64)
<b>3-hr</b>	<b>1.47</b> (1.15-1.89)	<b>1.71</b> (1.33-2.20)	<b>2.09</b> (1.62-2.70)	<b>2.41</b> (1.86-3.13)	<b>2.84</b> (2.13-3.86)	<b>3.17</b> (2.33-4.41)	<b>3.52</b> (2.51-5.08)	<b>3.91</b> (2.64-5.79)	<b>4.47</b> (2.91-6.88)	<b>4.93</b> (3.14-7.75)
<b>6-hr</b>	<b>1.80</b> (1.41-2.30)	<b>2.13</b> (1.67-2.73)	<b>2.68</b> (2.09-3.44)	<b>3.13</b> (2.43-4.04)	<b>3.75</b> (2.83-5.10)	<b>4.21</b> (3.12-5.88)	<b>4.71</b> (3.41-6.88)	<b>5.33</b> (3.61-7.88)	<b>6.27</b> (4.10-9.63)	<b>7.09</b> (4.52-11.1)
<b>12-hr</b>	<b>2.10</b> (1.66-2.67)	<b>2.61</b> (2.06-3.32)	<b>3.43</b> (2.70-4.38)	<b>4.12</b> (3.22-5.29)	<b>5.06</b> (3.85-6.90)	<b>5.75</b> (4.30-8.06)	<b>6.51</b> (4.79-9.61)	<b>7.51</b> (5.10-11.1)	<b>9.13</b> (5.97-14.0)	<b>10.6</b> (6.77-16.5)
<b>24-hr</b>	<b>2.41</b> (1.91-3.04)	<b>3.09</b> (2.45-3.91)	<b>4.20</b> (3.32-5.34)	<b>5.13</b> (4.02-6.55)	<b>6.40</b> (4.90-8.71)	<b>7.31</b> (5.52-10.3)	<b>8.35</b> (6.20-12.4)	<b>9.75</b> (6.64-14.4)	<b>12.1</b> (7.91-18.4)	<b>14.1</b> (9.08-22.0)
<b>2-day</b>	<b>2.75</b> (2.20-3.46)	<b>3.56</b> (2.83-4.47)	<b>4.87</b> (3.87-6.15)	<b>5.95</b> (4.70-7.57)	<b>7.45</b> (5.75-10.1)	<b>8.53</b> (6.48-11.9)	<b>9.76</b> (7.30-14.4)	<b>11.4</b> (7.81-16.8)	<b>14.2</b> (9.36-21.7)	<b>16.8</b> (10.8-26.0)
<b>3-day</b>	<b>3.01</b> (2.41-3.77)	<b>3.88</b> (3.10-4.86)	<b>5.29</b> (4.21-6.66)	<b>6.46</b> (5.12-8.19)	<b>8.08</b> (6.25-10.9)	<b>9.24</b> (7.04-12.9)	<b>10.6</b> (7.93-15.6)	<b>12.4</b> (8.48-18.1)	<b>15.4</b> (10.2-23.4)	<b>18.2</b> (11.7-28.2)
<b>4-day</b>	<b>3.24</b> (2.60-4.04)	<b>4.15</b> (3.32-5.19)	<b>5.64</b> (4.50-7.09)	<b>6.88</b> (5.46-8.70)	<b>8.59</b> (6.65-11.6)	<b>9.82</b> (7.49-13.7)	<b>11.2</b> (8.42-16.5)	<b>13.1</b> (9.00-19.2)	<b>16.3</b> (10.8-24.8)	<b>19.2</b> (12.4-29.8)
<b>7-day</b>	<b>3.85</b> (3.10-4.79)	<b>4.87</b> (3.92-6.06)	<b>6.53</b> (5.23-8.16)	<b>7.91</b> (6.30-9.95)	<b>9.80</b> (7.62-13.2)	<b>11.2</b> (8.54-15.5)	<b>12.7</b> (9.55-18.6)	<b>14.8</b> (10.2-21.6)	<b>18.2</b> (12.1-27.6)	<b>21.3</b> (13.8-32.9)
<b>10-day</b>	<b>4.49</b> (3.63-5.57)	<b>5.56</b> (4.49-6.90)	<b>7.30</b> (5.87-9.10)	<b>8.75</b> (6.99-11.0)	<b>10.7</b> (8.36-14.3)	<b>12.2</b> (9.32-16.8)	<b>13.8</b> (10.4-20.0)	<b>16.0</b> (11.0-23.2)	<b>19.4</b> (12.9-29.4)	<b>22.6</b> (14.6-34.8)
<b>20-day</b>	<b>6.57</b> (5.34-8.10)	<b>7.68</b> (6.23-9.49)	<b>9.50</b> (7.68-11.8)	<b>11.0</b> (8.84-13.7)	<b>13.1</b> (10.2-17.2)	<b>14.6</b> (11.2-19.8)	<b>16.3</b> (12.1-23.2)	<b>18.4</b> (12.7-26.5)	<b>21.6</b> (14.4-32.5)	<b>24.5</b> (15.9-37.6)
<b>30-day</b>	<b>8.33</b> (6.79-10.2)	<b>9.46</b> (7.70-11.6)	<b>11.3</b> (9.18-14.0)	<b>12.9</b> (10.4-16.0)	<b>15.0</b> (11.7-19.6)	<b>16.5</b> (12.6-22.2)	<b>18.2</b> (13.5-25.6)	<b>20.2</b> (14.1-29.1)	<b>23.2</b> (15.5-34.7)	<b>25.6</b> (16.7-39.3)
<b>45-day</b>	<b>10.5</b> (8.57-12.8)	<b>11.7</b> (9.53-14.3)	<b>13.6</b> (11.1-16.8)	<b>15.2</b> (12.3-18.9)	<b>17.4</b> (13.6-22.6)	<b>19.1</b> (14.6-25.4)	<b>20.8</b> (15.3-28.8)	<b>22.7</b> (15.9-32.5)	<b>25.2</b> (16.9-37.6)	<b>27.1</b> (17.7-41.5)
<b>60-day</b>	<b>12.3</b> (10.1-15.0)	<b>13.5</b> (11.1-16.5)	<b>15.6</b> (12.7-19.1)	<b>17.3</b> (14.0-21.3)	<b>19.6</b> (15.3-25.2)	<b>21.4</b> (16.3-28.2)	<b>23.2</b> (17.0-31.6)	<b>24.9</b> (17.5-35.5)	<b>27.0</b> (18.2-40.2)	<b>28.5</b> (18.6-43.6)

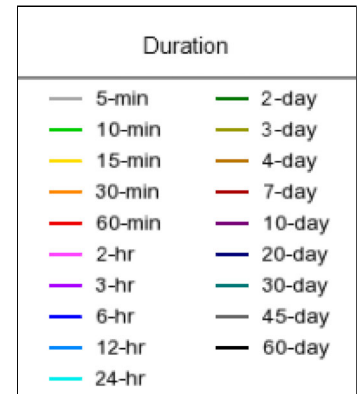
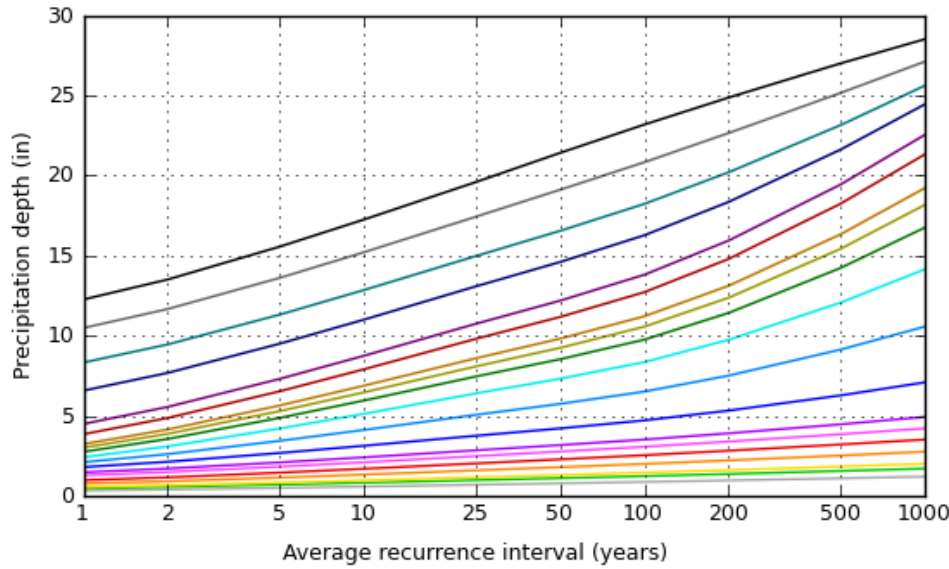
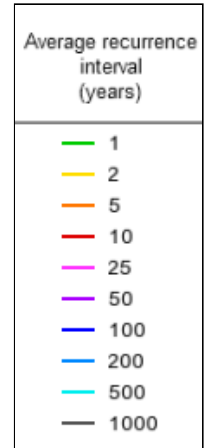
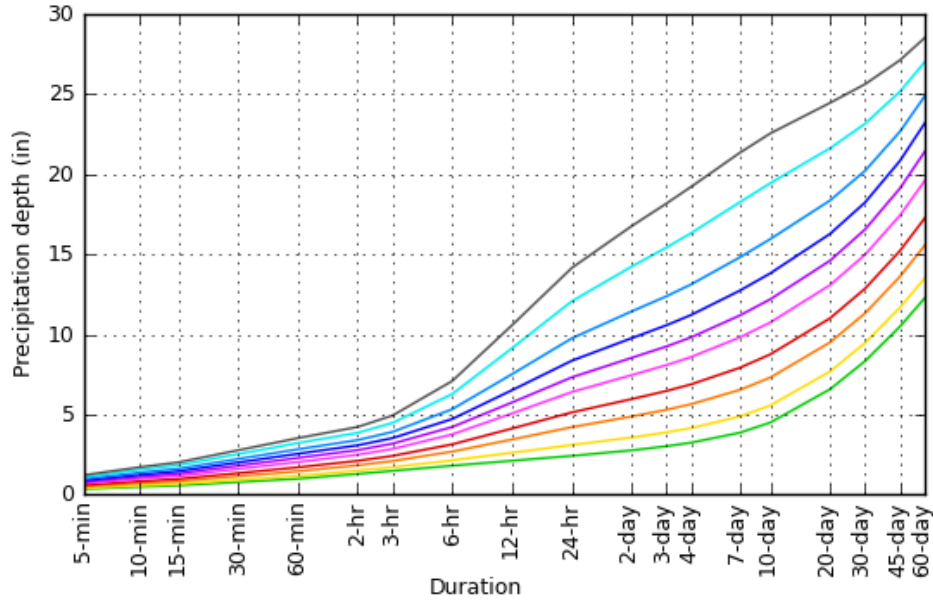
<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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**PF graphical**

PDS-based depth-duration-frequency (DDF) curves

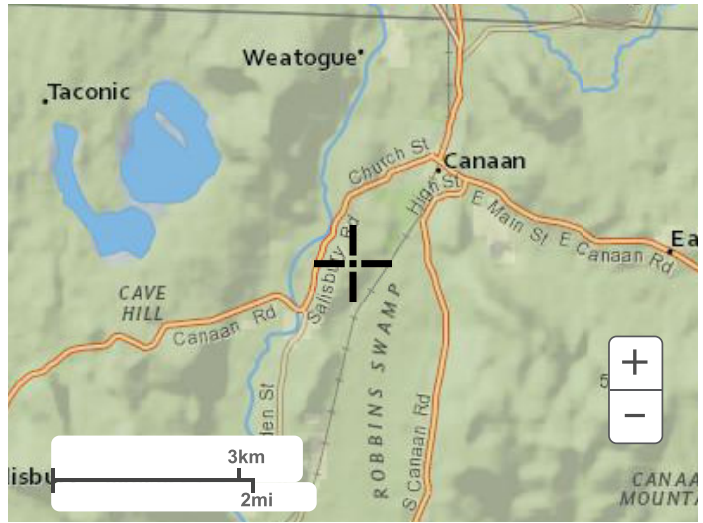
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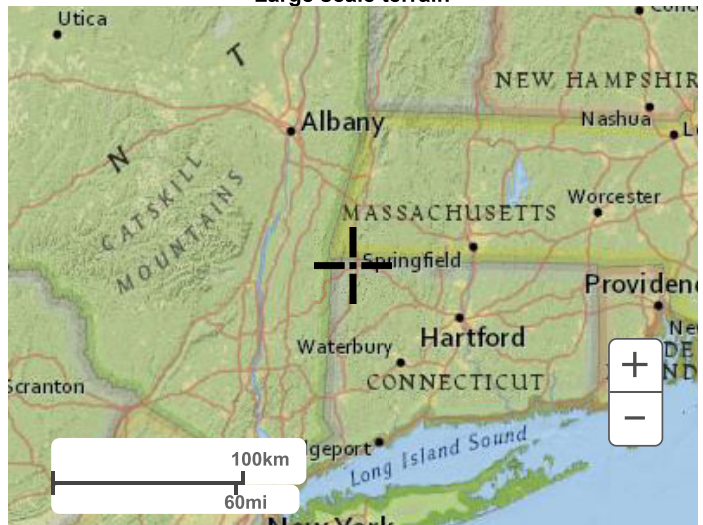
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**Maps & aerials**

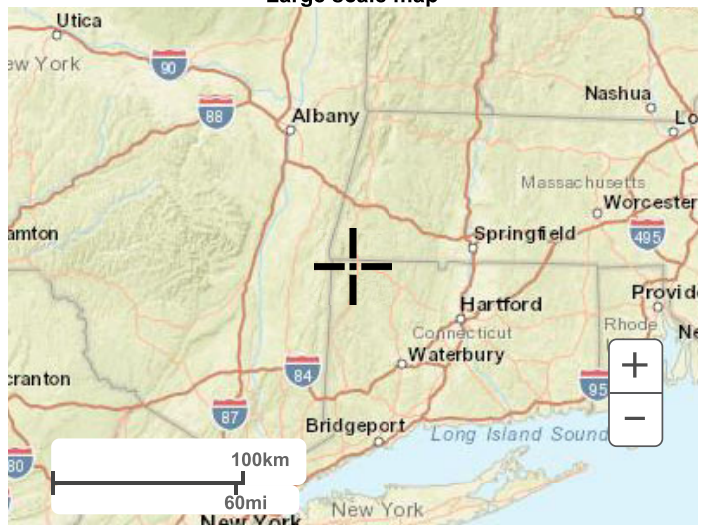
**Small scale terrain**



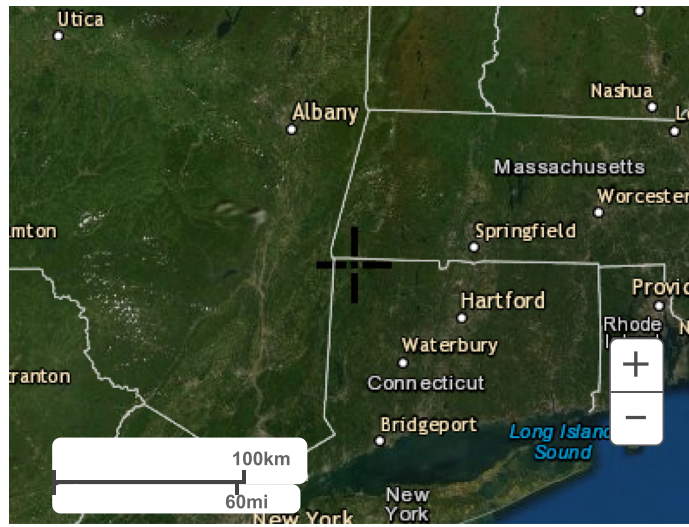
Large scale terrain



Large scale map



Large scale aerial



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[National Weather Service](#)  
[National Water Center](#)  
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Silver Spring, MD 20910  
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## **APPENDIX E: WATER QUALITY VOLUME CALCULATIONS**

WATER QUALITY VOLUME CALCULATIONS  
FOR  
NORTH CANAAN SOLAR  
100 SAND ROAD, NORTH CANAAN, CT 06018

$$WQV = \frac{(1")(R)(A)}{12}$$

$$V = WQV + ((P)(A_b)/12)$$

where:  $WQV$  = water quality volume (ac-ft)  
 $R$  = volumetric runoff coefficient  
           =  $0.05 + 0.009(I)$   
 $I$  = percent impervious cover  
 $A$  = site area in acres

$V$  = required basin storage volume (ac-ft)  
 $WQV$  = Water Quality Volume (ac-ft)  
 $P$  = design water quality precipitation (in)  
 $A_b$  = basin surface area (ac)

	Area (ac)	Pervious (ac)	Imperv. (ac)	I	R	WQV (ac-ft)	P (in)	Ab (ac)	V (ac-ft)	Total V Req. (cyd)	V Provided (cyd)
Overall Site	13.98	10.37	3.61	26%	0.28	0.33	n/a	n/a	n/a	530.96	
Basin 1	9.41	6.16	3.25	35%	0.36	0.28	1	0.266531	0.31	492.70	558.94

Overall Total V Required = 530.96 cyd

Overall Total V Provided = 558.94 cyd