CIVIL SITE ENGINEERING LLC

SITE PLANNING SEPTIC DESIGN WETLANDS

Stormwater Analysis

90 Armsby Rd

Prepared for:

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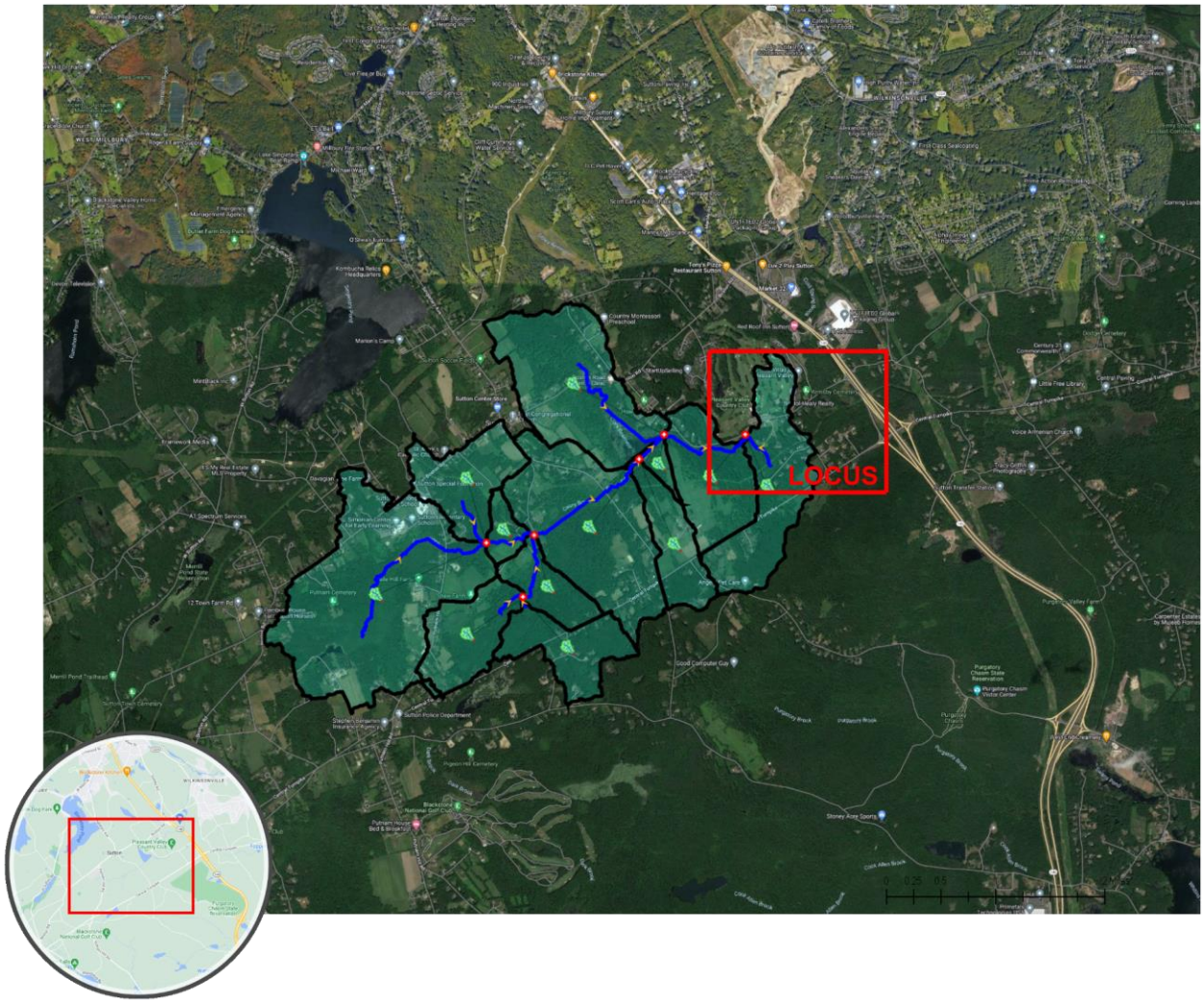
Contents

Project Description 1
Purpose 1
Methodology Used 1
  Default Scenario 2
Default Scenario 3
  Watershed Routing Diagram 3
  Design Storm 4
  Watershed Summary 5
  Subbasins 6
  Nodes 39
  Routing Reaches 40
Pre vs Post Development 41

Project Description

The project is located at **36 Bond Hollow Rd, Sutton, MA 01590.** The site is 2,135.187 acres in size.



Purpose

The purpose of this hydrology study is to determine the peak runoff rates for pre-development and post-development conditions.

Methodology Used

The HEC-HMS version 4.5 computer software was used in this hydrology study. The **SCS Curve Number** infiltration (loss) method and **SCS Unit Hydrograph** runoff (transform) method was used for determining the stormwater runoff**.** The **Kinematic Wave** routing method was used for routing the stormwater**.**

The following scenarios were analyzed in this hydrology study:

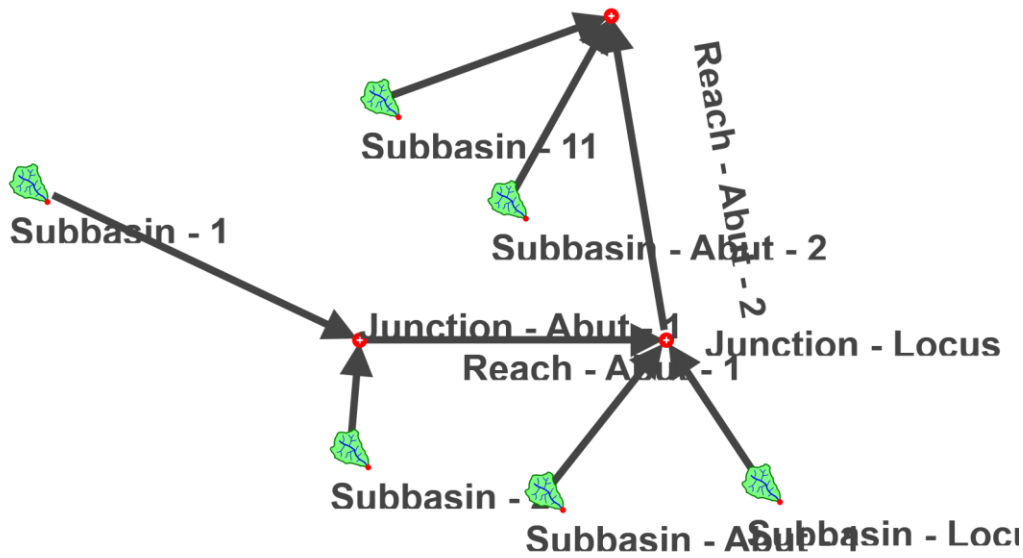
Default Scenario

This scenario contains:

- 12 delineated subbasin areas and corresponding lag time flow paths.
- 12 routing reaches.
- 6 connecting junctions.

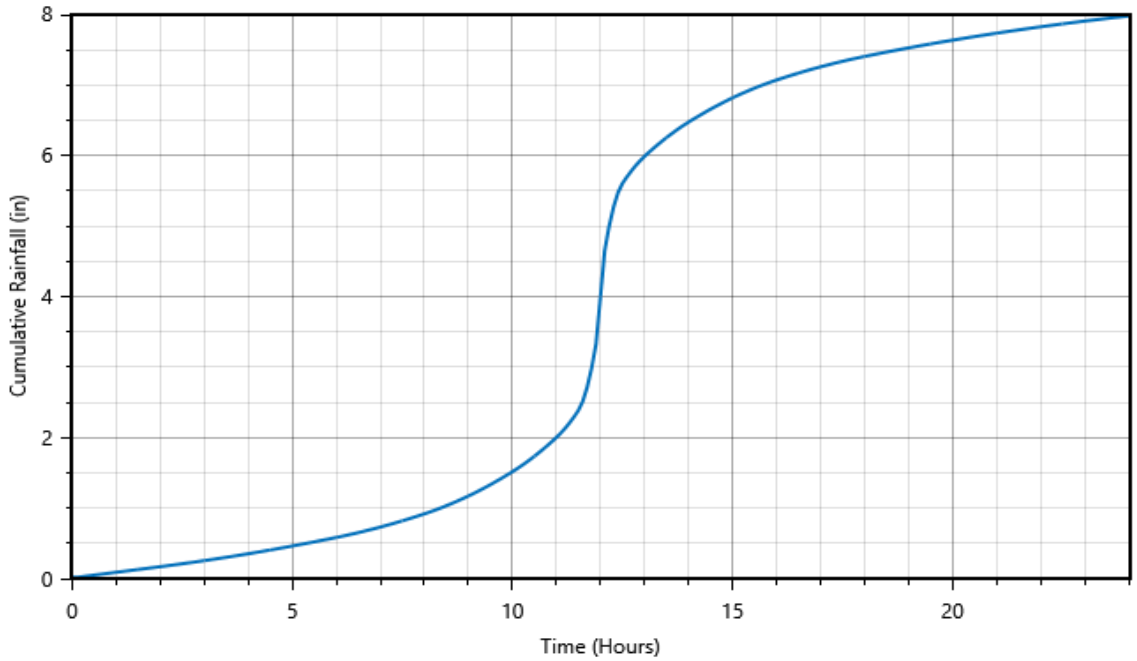
Default Scenario

Watershed Routing Diagram



Design Storm

Precipitation type: SCS Storm
SCS storm distribution: Type III
Rainfall depth: 7.97 in



Watershed Summary

Subbasin ID	Drainage Area (acres)	Initial Abstraction (in)	Curve Number	Impervious Surface (%)	Lag Time (minutes)	Peak Discharge (cfs)
Subbasin - 1	290.449	0.70	74.00	0.00	41.52	621.92
Subbasin - 2	19.747	0.57	77.90	0.00	8.89	87.59
Subbasin - 3	101.122	0.73	73.32	3.20	18.72	317.00
Subbasin - 4	332.545	0.63	75.97	2.85	23.93	991.21
Subbasin - 5	33.718	0.72	73.48	0.22	8.85	136.19
Subbasin - 6	77.408	0.63	75.99	0.57	16.15	270.19
Subbasin - 7	136.668	0.58	77.55	7.33	22.45	439.97
Subbasin - 8	525.519	N/A	76.94	3.61	49.92	1,089.20
Subbasin - 9	124.687	0.62	76.22	2.19	19.04	411.56
Subbasin - 10	120.193	0.79	71.76	1.81	15.02	390.35
Subbasin - Abut - 1	157.467	0.78	71.99	1.43	14.55	520.02
Subbasin - Locus	215.666	1.03	66.05	7.48	18.43	582.32

Subbasins

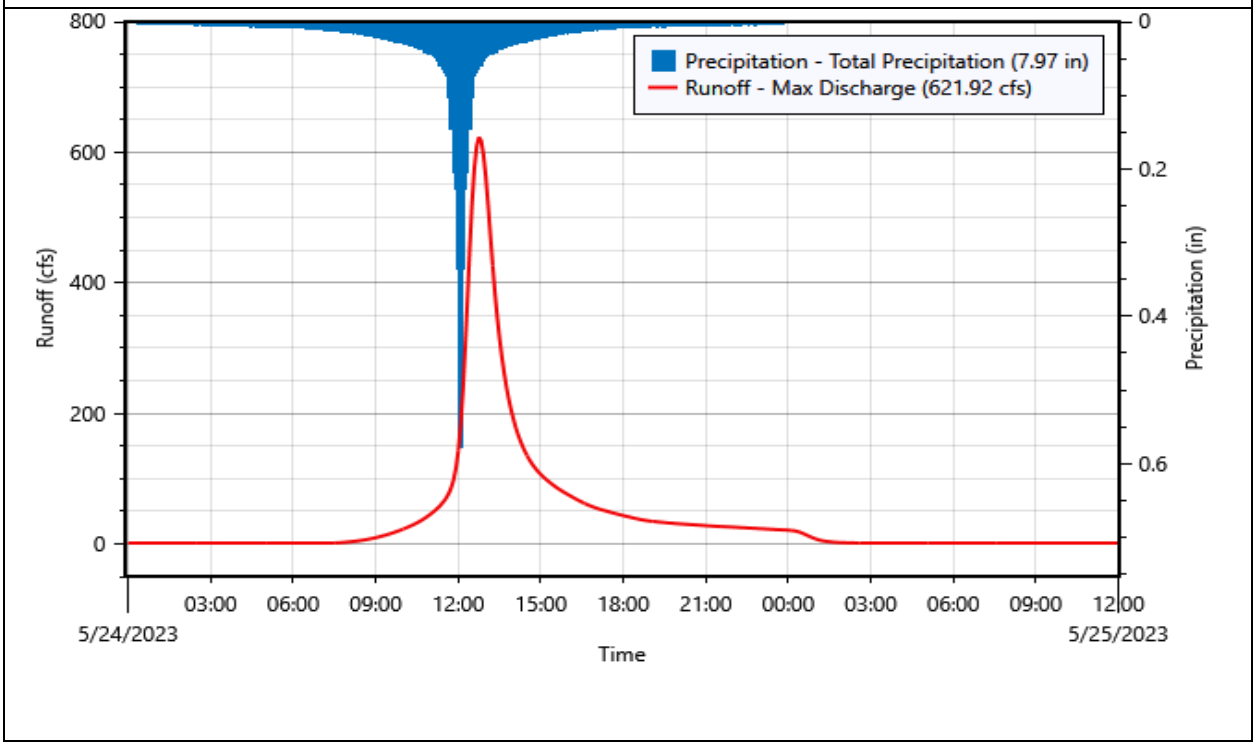
Subbasin ID:	**Subbasin - 1**			
Scenario:	**100 Yr 24 Hr Storm Event**		**Depth**	**Volume**
Peak discharge:	621.92 cfs	**Time of peak:**	24 May 2023, 12:45	
Drainage area:	290.449 acres	**Total rainfall:**	7.97 in	192.895 ac-ft
Initial abstraction:	0.70 in	**Losses:**	3.07 in	74.271 ac-ft
Curve Number:	74.00	**Precip excess:**	4.90 in	118.624 ac-ft
Impervious surface:	0.00%	**Direct runoff:**	4.90 in	118.624 ac-ft
Peaking factor:	484	**Baseflow:**	0.00 in	0.000 ac-ft
Lag time:	41.52 minutes	**Total runoff:**	4.90 in	118.624 ac-ft

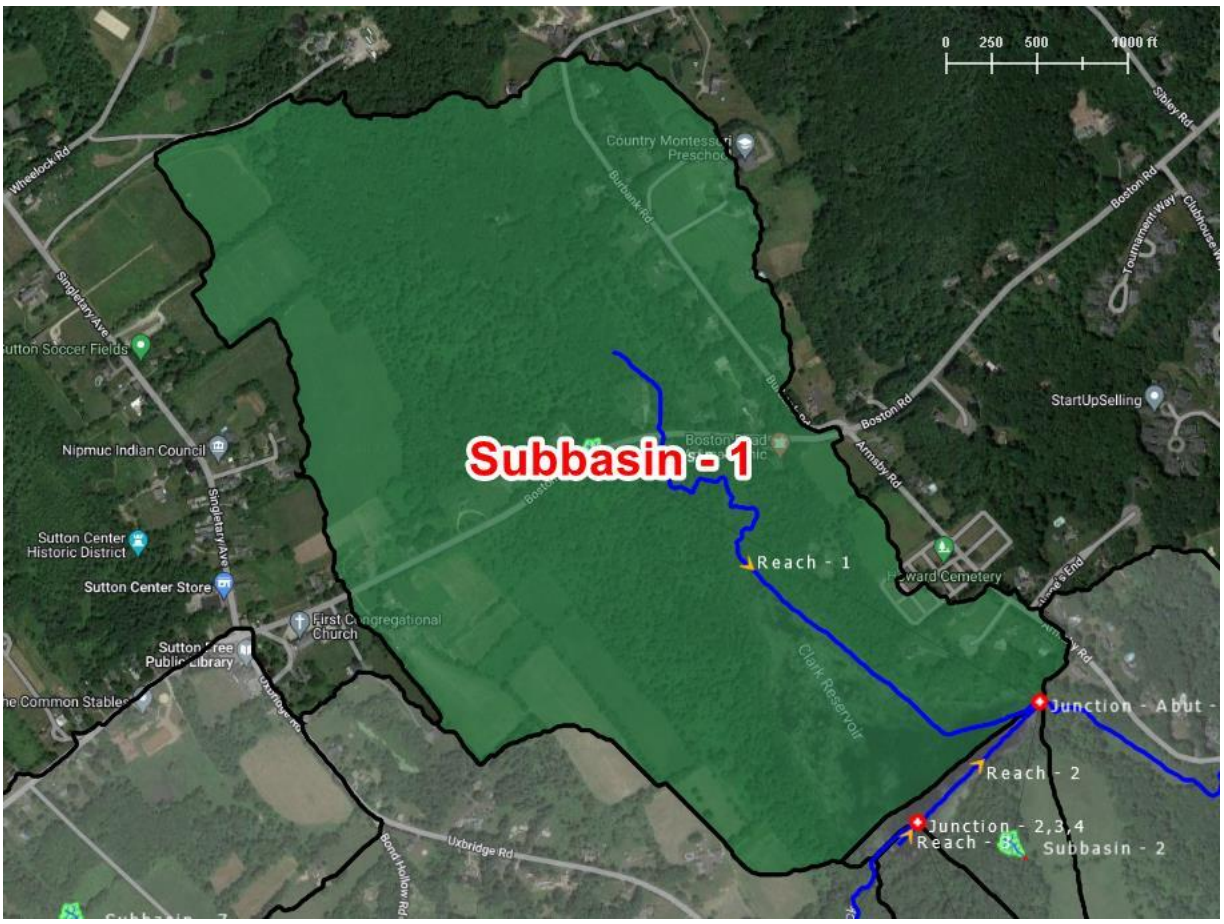
Weighted Curve Number Calculations

Soil Group	**Land Use Description**	**Area (acres)**	**Area (%)**	**Composite CN**
C	Agricultural, Pasture/Hay	0.015	100.00	74.00
Weighted Average		**0.015**	**100.00**	**74.00**

Time of Concentration (TOC) / Lag time Calculations

TOC (min)	**Length (ft)**	**Slope (ft/ft)**	**Velocity (ft/s)**	**Description**
5.45	20.00	0.02391	0.5744	Sheet Flow
20.90	3,849.57	0.03621	6.2840	Shallow Concentrated Flow
42.85	4,076.88	0.00665	2.6923	Channel Flow
69.20	**7,946.45**	**Total**	**Lag Time = 41.52 minutes**	




0 250 500 1000 ft
Subbasin - 1
Reach - 1
Reach - 2
Junction - 2,3,4
Subbasin - 2
Junction - Abut
Clark Reservoir
Country Montessori Preschool
Nipmuc Indian Council
Sutton Center Historic District
Sutton Center Store
First Congregational Church
Sutton Soccer Fields
StartUpSelling
Boston Rd
Armsby Rd
Uxbridge Rd
Bond Hollow Rd
Singletary Ave
Wheelock Rd
Sibley Rd
Tournament Way
Clubhouse Way
Burbank Rd
Dana's End

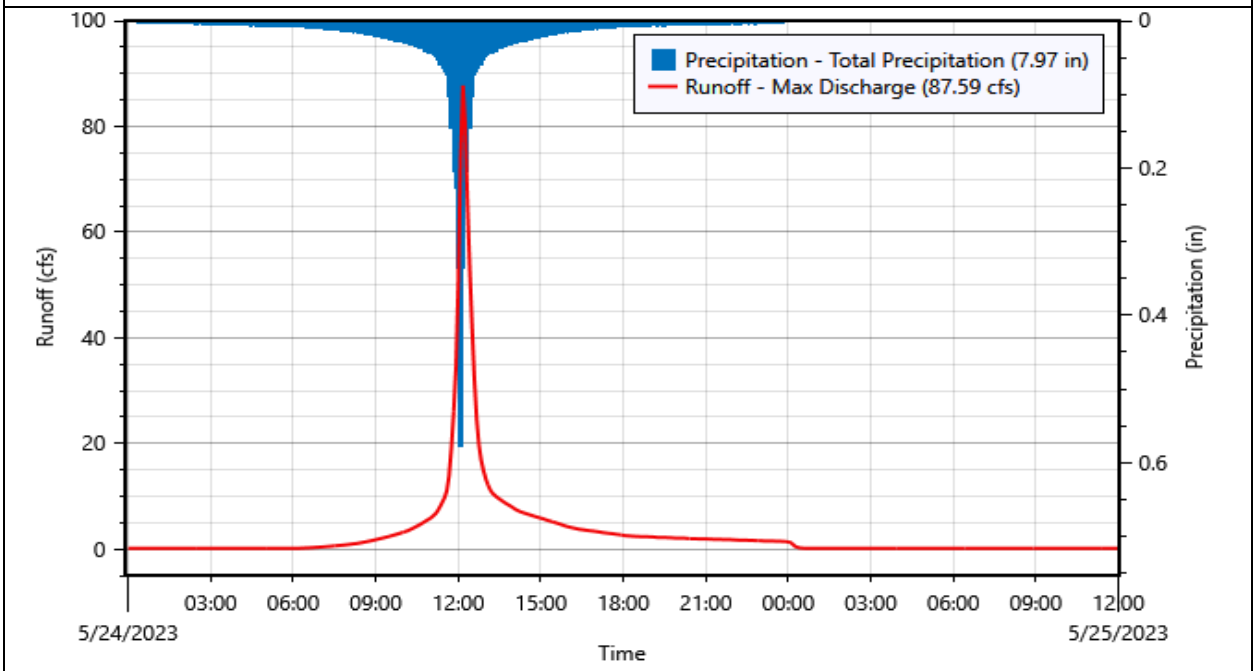
Subbasin ID:	**Subbasin - 2**			
Scenario:	**100 Yr 24 Hr Storm Event**		**Depth**	**Volume**
Peak discharge:	87.59 cfs	**Time of peak:**	24 May 2023, 12:10	
Drainage area:	19.747 acres	**Total rainfall:**	7.97 in	13.135 ac-ft
Initial abstraction:	0.57 in	**Losses:**	2.62 in	4.319 ac-ft
Curve Number:	77.90	**Precip excess:**	5.35 in	8.816 ac-ft
Impervious surface:	0.00%	**Direct runoff:**	5.35 in	8.816 ac-ft
Peaking factor:	484	**Baseflow:**	0.00 in	0.000 ac-ft
Lag time:	8.89 minutes	**Total runoff:**	5.35 in	8.816 ac-ft

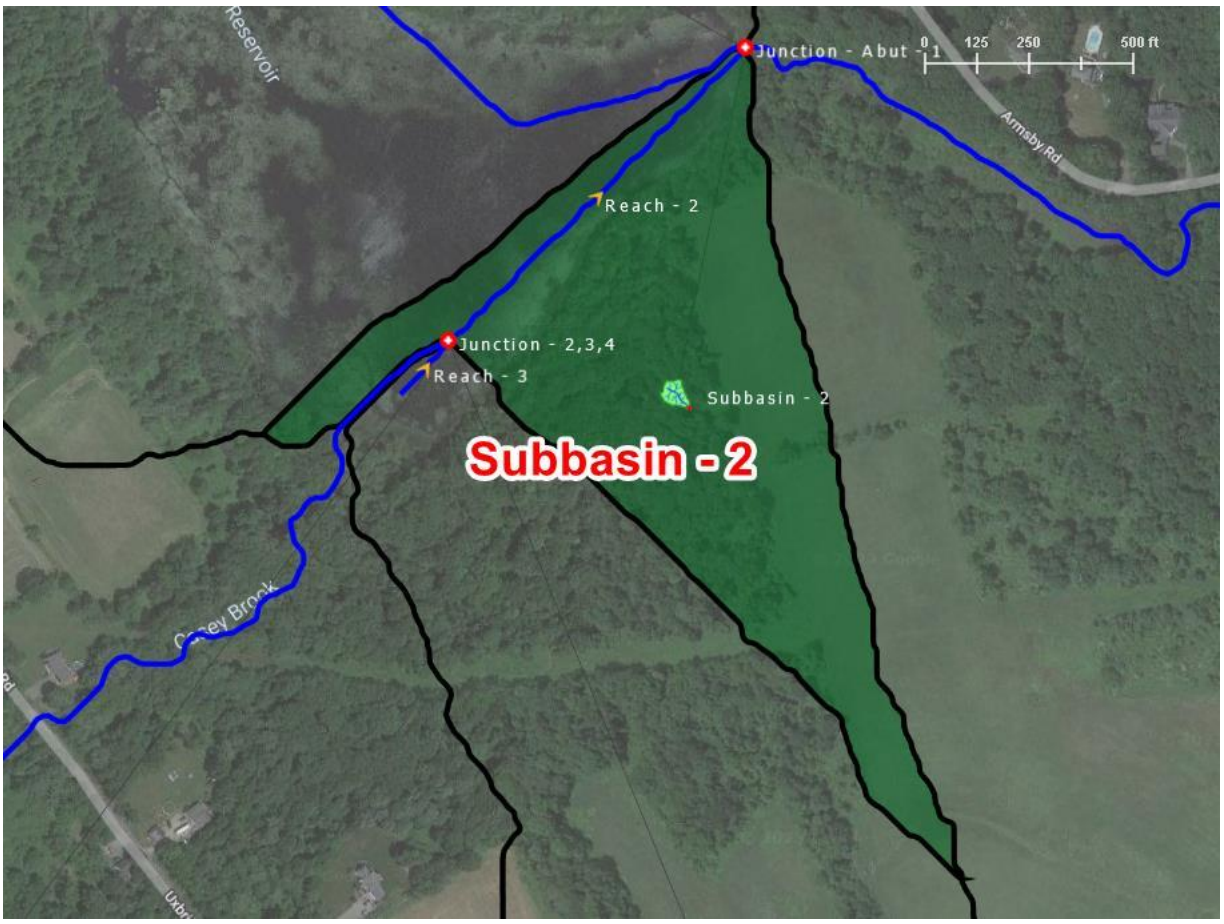
Weighted Curve Number Calculations

Soil Group	Land Use Description	Area (acres)	Area (%)	Composite CN
C	Agricultural, Pasture/Hay	3.083	15.61	74.00
D	Wetlands, Forested	0.322	1.63	100.00
C	Wetlands, Forested	0.304	1.54	100.00
D	Undeveloped, Deciduous Forest	0.188	0.95	77.00
C	Undeveloped, Mixed Forest	3.500	17.72	70.00
C	Open Water	1.811	9.17	100.00
C	Wetlands, Non-Forested	2.305	11.67	100.00
C	Undeveloped, Deciduous Forest	8.233	41.70	70.00
Weighted Average		**19.747**	**100.00**	**77.90**

Time of Concentration (TOC) / Lag time Calculations

TOC (min)	Length (ft)	Slope (ft/ft)	Velocity (ft/s)	Description
3.89	20.00	0.05571	0.8769	Sheet Flow
10.92	2,637.29	0.06226	8.2395	Shallow Concentrated Flow
14.81	**2,657.29**	**Total**	**Lag Time = 8.89 minutes**	




Reservoir
Junction - Abut
0 125 250 500 ft
Armsby Rd
Reach - 2
Junction - 2,3,4
Reach - 3
Subbasin - 2
Subbasin - 2

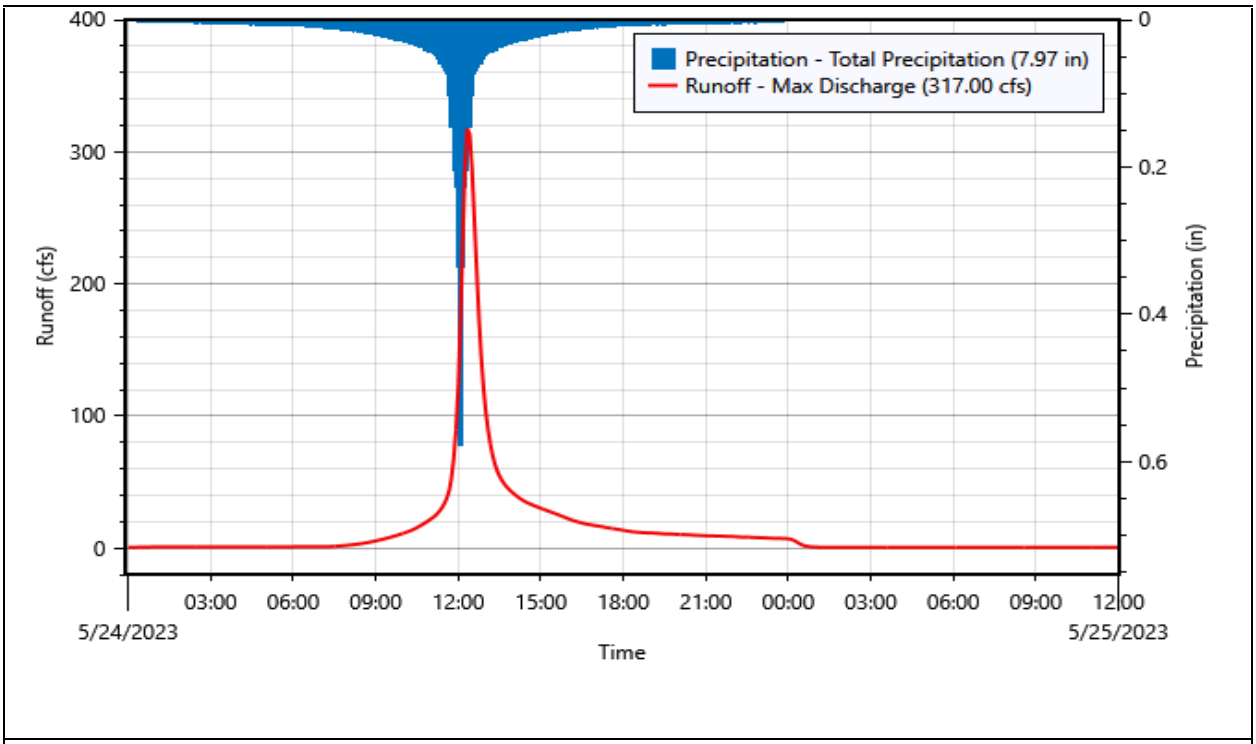
Subbasin ID:	**Subbasin - 3**			
Scenario:	**100 Yr 24 Hr Storm Event**		**Depth**	**Volume**
Peak discharge:	317.00 cfs	**Time of peak:**	24 May 2023, 12:20	
Drainage area:	101.122 acres	**Total rainfall:**	7.97 in	67.161 ac-ft
Initial abstraction:	0.73 in	**Losses:**	3.05 in	25.708 ac-ft
Curve Number:	73.32	**Precip excess:**	4.92 in	41.452 ac-ft
Impervious surface:	3.20%	**Direct runoff:**	4.92 in	41.452 ac-ft
Peaking factor:	484	**Baseflow:**	0.00 in	0.000 ac-ft
Lag time:	18.72 minutes	**Total runoff:**	4.92 in	41.452 ac-ft

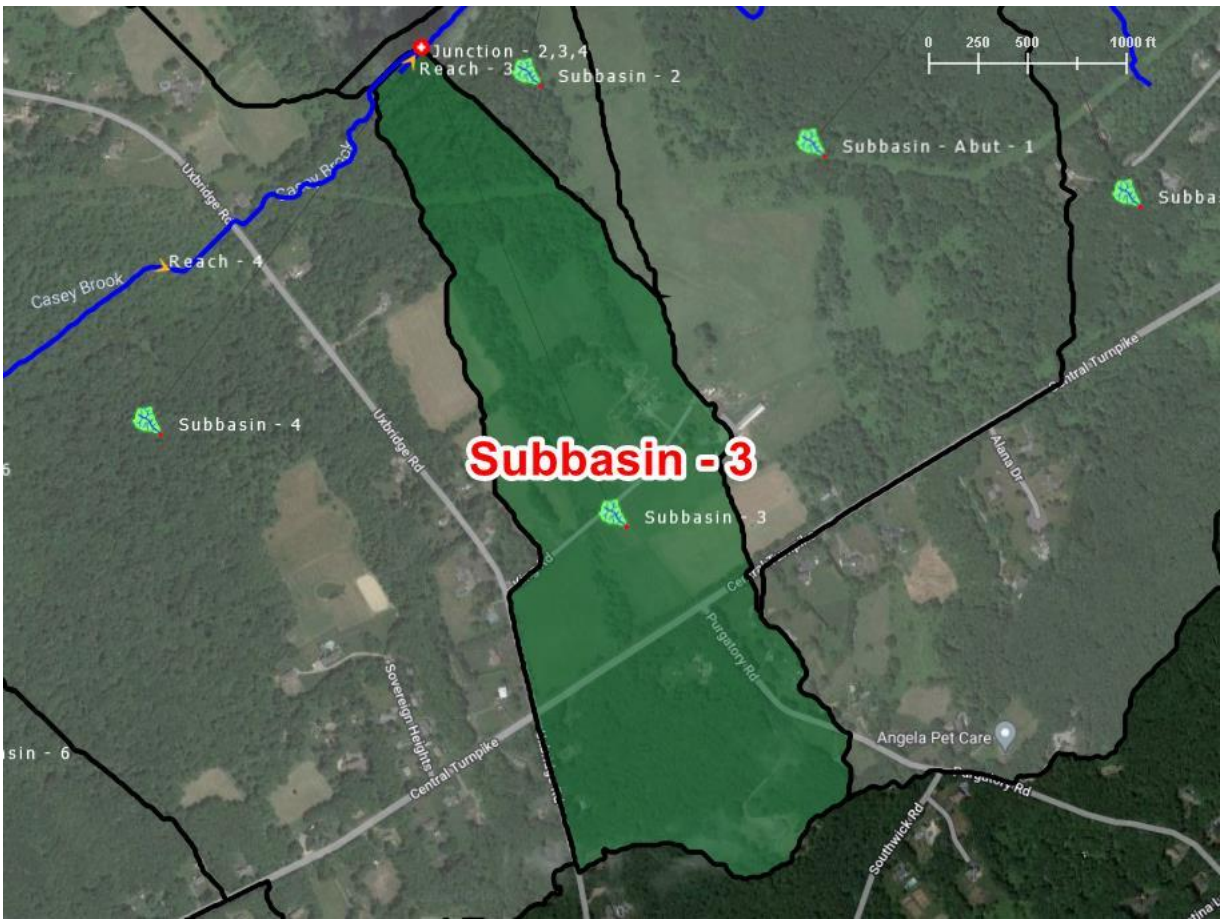
Weighted Curve Number Calculations

Soil Group	**Land Use Description**	**Area (acres)**	**Area (%)**	**Composite CN**
D	Developed, Open Space	0.015	0.01	84.00
C	Agricultural, Pasture/Hay	25.234	24.95	74.00
C	Undeveloped, Grassland	1.897	1.88	71.00
D	Wetlands, Forested	0.159	0.16	100.00
C	Wetlands, Forested	2.040	2.02	100.00
C	Undeveloped, Shrub/Scrub	4.276	4.23	65.00
C	Developed, Medium Density	1.197	1.18	90.00
C	Undeveloped, Mixed Forest	9.386	9.28	70.00
C	Developed, Low Density	5.724	5.66	83.00
C	Open Water	0.168	0.17	100.00
C	Wetlands, Non-Forested	0.314	0.31	100.00
C	Developed, Open Space	8.407	8.31	79.00
C	Undeveloped, Deciduous Forest	42.306	41.84	70.00
Weighted Average		**101.122**	**100.00**	**73.32**

Time of Concentration (TOC) / Lag time Calculations

TOC (min)	**Length (ft)**	**Slope (ft/ft)**	**Velocity (ft/s)**	**Description**
6.03	20.00	0.01854	0.5059	Sheet Flow
25.17	5,699.65	0.05476	7.7278	Shallow Concentrated Flow
31.20	**5,719.65**	**Total**	**Lag Time = 18.72 minutes**	


Precipitation - Total Precipitation (7.97 in)
Runoff - Max Discharge (317.00 cfs)
Runoff (cfs)
Precipitation (in)
400
300
200
100
0
0
0.2
0.4
0.6
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
5/24/2023
5/25/2023
Time


Junction - 2,3,4
Reach - 3
Subbasin - 2
0
250
500
1000 ft
Subbasin - Abut - 1
Subba
Uxbridge Rd
Reach - 4
Casey Brook
Subbasin - 4
Subbasin - 3
Subbasin - 3
Central Turnpike
Alana Dr
Purgatory Rd
Sovereign Heights
Angela Pet Care
Southwick Rd
sin - 6

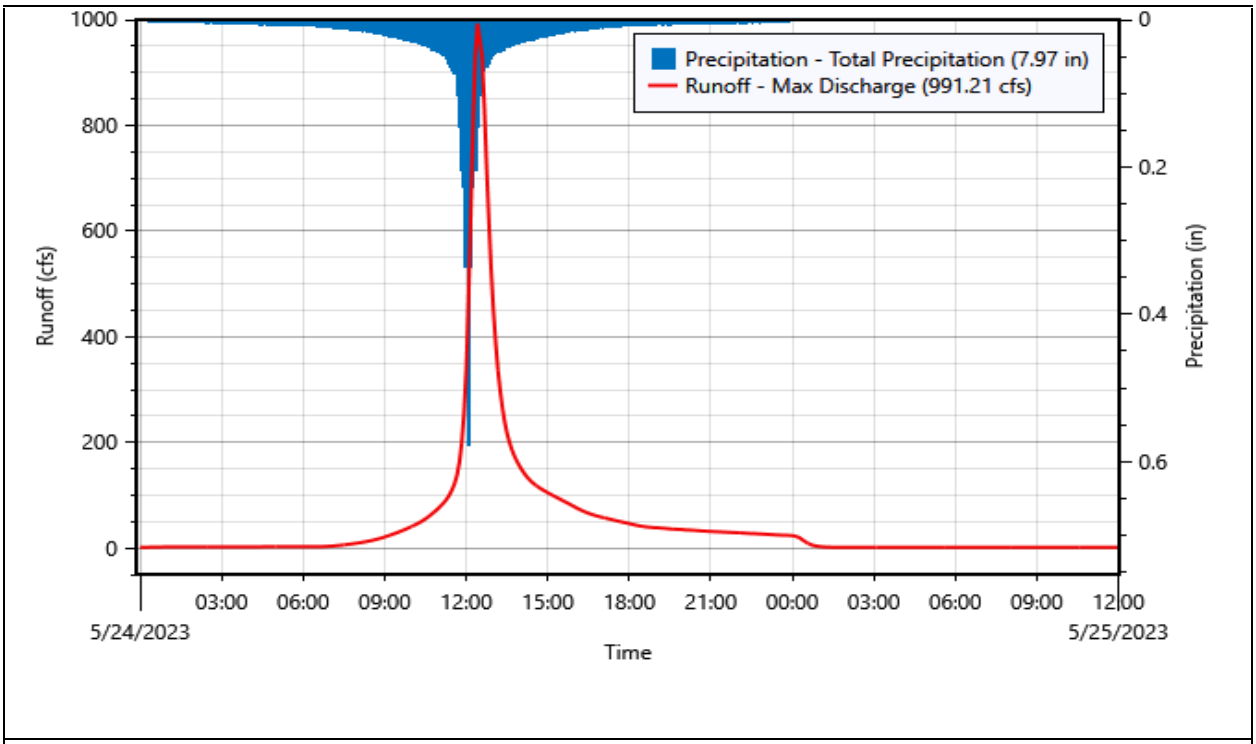
Subbasin ID:	**Subbasin - 4**			
Scenario:	**100 Yr 24 Hr Storm Event**		**Depth**	**Volume**
Peak discharge:	991.21 cfs	**Time of peak:**	24 May 2023, 12:25	
Drainage area:	332.545 acres	**Total rainfall:**	7.97 in	220.865 ac-ft
Initial abstraction:	0.63 in	**Losses:**	2.76 in	76.473 ac-ft
Curve Number:	75.97	**Precip excess:**	5.21 in	144.392 ac-ft
Impervious surface:	2.85%	**Direct runoff:**	5.21 in	144.392 ac-ft
Peaking factor:	484	**Baseflow:**	0.00 in	0.000 ac-ft
Lag time:	23.93 minutes	**Total runoff:**	5.21 in	144.392 ac-ft

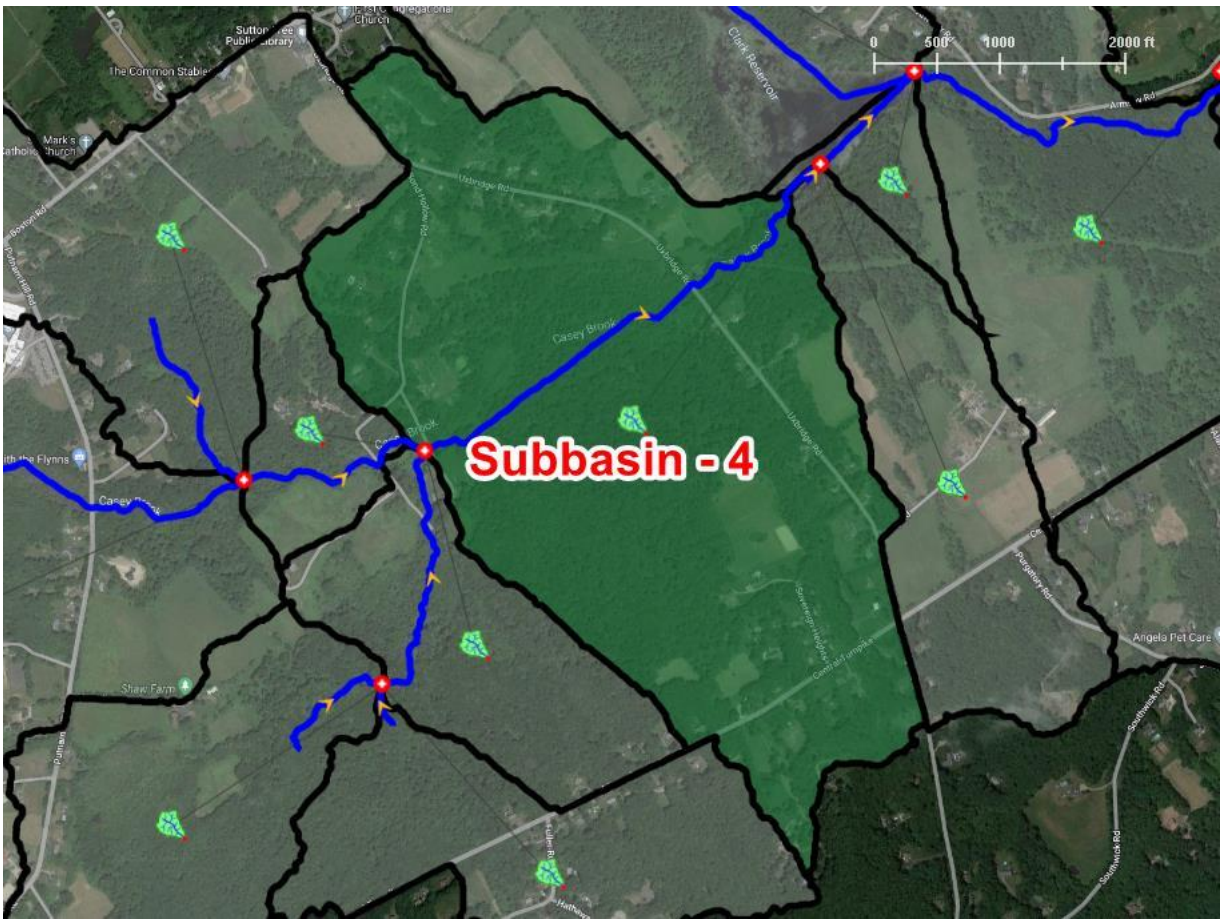
Weighted Curve Number Calculations

Soil Group	**Land Use Description**	**Area (acres)**	**Area (%)**	**Composite CN**
C	Agricultural, Pasture/Hay	32.304	9.71	74.00
D	Undeveloped, Grassland	0.270	0.08	78.00
C	Undeveloped, Grassland	5.776	1.74	71.00
C	Wetlands, Non-Forested	0.039	0.01	100.00
C	Developed, Open Space	23.499	7.07	79.00
C	Developed, High Density	0.233	0.07	94.00
D	Developed, Open Space	1.385	0.42	84.00
B	Developed, Open Space	0.502	0.15	69.00
D	Undeveloped, Mixed Forest	2.178	0.66	77.00
C	Undeveloped, Mixed Forest	30.045	9.03	70.00
B	Undeveloped, Mixed Forest	1.554	0.47	55.00
D	Developed, Low Density	1.672	0.50	87.00
D	Undeveloped, Deciduous Forest	9.582	2.88	77.00
C	Developed, Low Density	13.263	3.99	83.00
B	Undeveloped, Deciduous Forest	1.606	0.48	55.00
C	Developed, Medium Density	4.014	1.21	90.00
B	Wetlands, Forested	25.800	7.76	100.00
D	Wetlands, Forested	11.062	3.33	100.00
C	Wetlands, Forested	6.906	2.08	100.00
C	Open Water	0.029	0.01	100.00
C	Undeveloped, Shrub/Scrub	1.369	0.41	65.00
B	Agricultural, Pasture/Hay	2.203	0.66	61.00
D	Agricultural, Pasture/Hay	0.626	0.19	80.00
C	Undeveloped, Deciduous Forest	156.626	47.10	70.00
Weighted Average		**332.545**	**100.00**	**75.97**

Time of Concentration (TOC) / Lag time Calculations

TOC (min)	**Length (ft)**	**Slope (ft/ft)**	**Velocity (ft/s)**	**Description**
5.53	20.00	0.02302	0.5637	Sheet Flow
22.54	5,189.19	0.05661	7.8567	Shallow Concentrated Flow
11.82	1,542.25	0.01251	3.6938	Channel Flow
39.89	**6,751.44**	**Total**	**Lag Time = 23.94 minutes**	


Precipitation - Total Precipitation (7.97 in)
Runoff - Max Discharge (991.21 cfs)
Runoff (cfs)
Precipitation (in)
Time
5/24/2023
5/25/2023
1000
800
600
400
200
0
0.2
0.4
0.6
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00


Subbasin - 4
0
500
1000
2000 ft

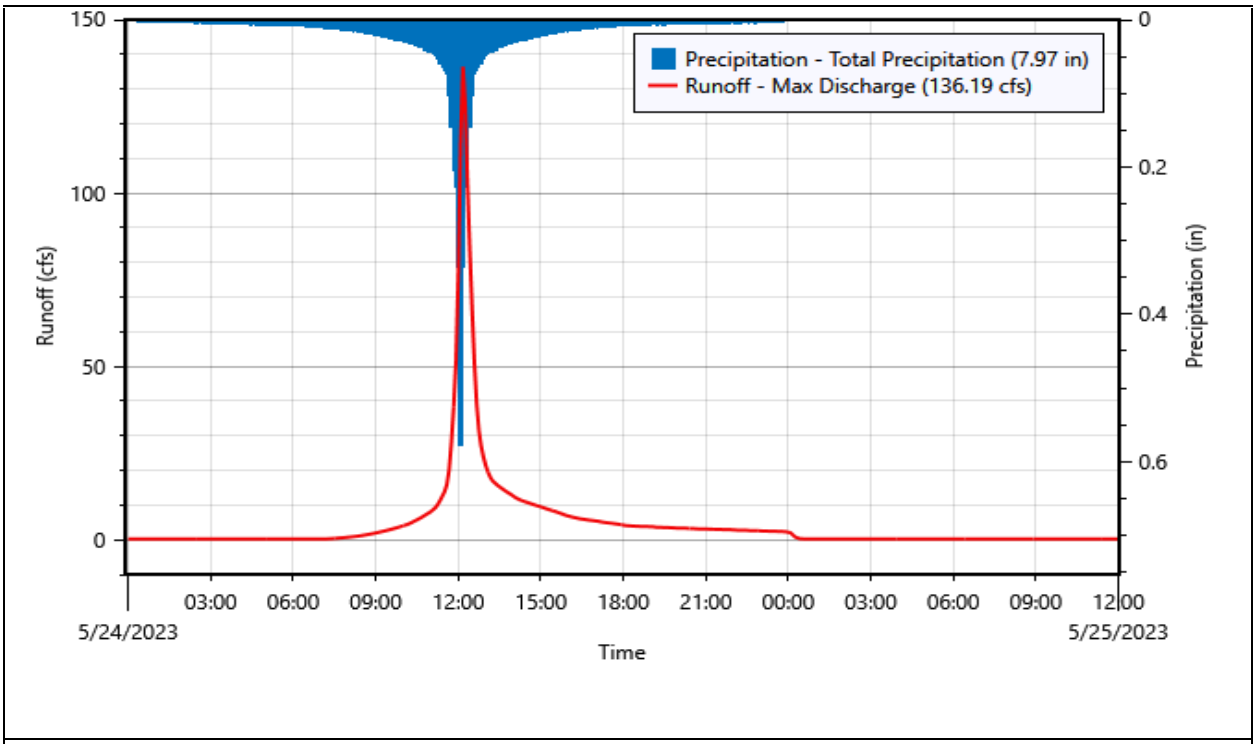
Subbasin ID:	**Subbasin - 5**			
Scenario:	**100 Yr 24 Hr Storm Event**		**Depth**	**Volume**
Peak discharge:	136.19 cfs	**Time of peak:**	24 May 2023, 12:10	
Drainage area:	33.718 acres	**Total rainfall:**	7.97 in	22.401 ac-ft
Initial abstraction:	0.72 in	**Losses:**	3.12 in	8.777 ac-ft
Curve Number:	73.48	**Precip excess:**	4.85 in	13.624 ac-ft
Impervious surface:	0.22%	**Direct runoff:**	4.85 in	13.624 ac-ft
Peaking factor:	484	**Baseflow:**	0.00 in	0.000 ac-ft
Lag time:	8.85 minutes	**Total runoff:**	4.85 in	13.624 ac-ft

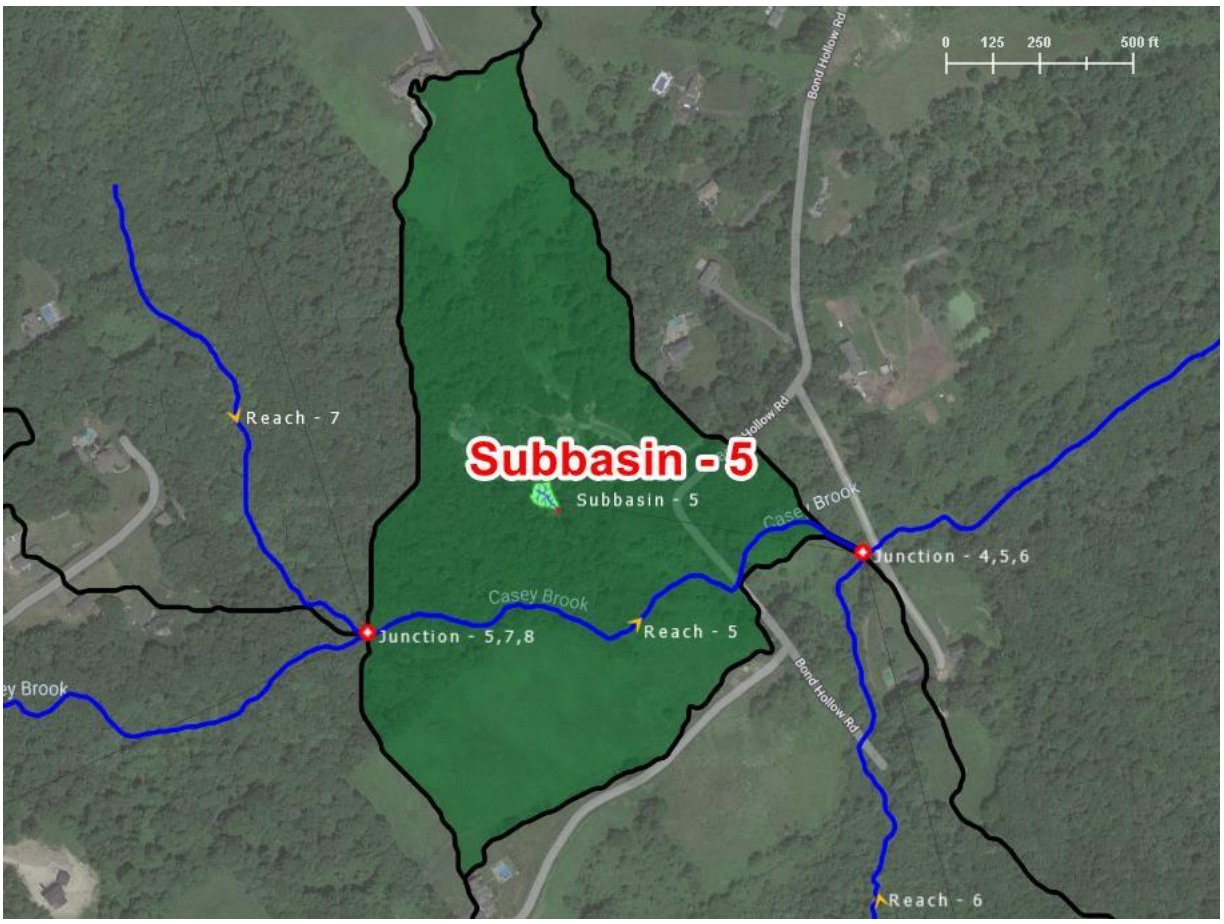
Weighted Curve Number Calculations

Soil Group	**Land Use Description**	**Area (acres)**	**Area (%)**	**Composite CN**
B	Agricultural, Pasture/Hay	0.012	0.04	61.00
D	Developed, Open Space	1.342	3.98	84.00
D	Agricultural, Pasture/Hay	0.739	2.19	80.00
C	Agricultural, Pasture/Hay	8.509	25.23	74.00
B	Wetlands, Forested	0.099	0.29	100.00
C	Undeveloped, Grassland	1.328	3.94	71.00
D	Wetlands, Forested	0.612	1.81	100.00
C	Wetlands, Forested	0.001	0.00	100.00
D	Undeveloped, Deciduous Forest	4.574	13.57	77.00
B	Undeveloped, Deciduous Forest	0.294	0.87	55.00
D	Developed, Medium Density	0.050	0.15	92.00
C	Undeveloped, Mixed Forest	0.005	0.02	70.00
C	Developed, Open Space	0.637	1.89	79.00
C	Undeveloped, Deciduous Forest	15.516	46.02	70.00
Weighted Average		**33.718**	**100.00**	**73.48**

Time of Concentration (TOC) / Lag time Calculations

TOC (min)	**Length (ft)**	**Slope (ft/ft)**	**Velocity (ft/s)**	**Description**
3.91	20.00	0.05492	0.8706	Sheet Flow
6.06	1,764.10	0.09033	9.9247	Shallow Concentrated Flow
4.78	578.31	0.01075	3.4233	Channel Flow
14.75	**2,362.41**	**Total**	**Lag Time = 8.85 minutes**	


Precipitation - Total Precipitation (7.97 in)
Runoff - Max Discharge (136.19 cfs)
Runoff (cfs)
Precipitation (in)
150
100
50
0
0
0.2
0.4
0.6
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
5/24/2023
5/25/2023
Time


0 125 250 500 ft
Bond Hollow Rd
Reach - 7
Subbasin - 5
Subbasin - 5
Casey Brook
Junction - 4,5,6
Casey Brook
Junction - 5,7,8
Reach - 5
Bond Hollow Rd
Reach - 6

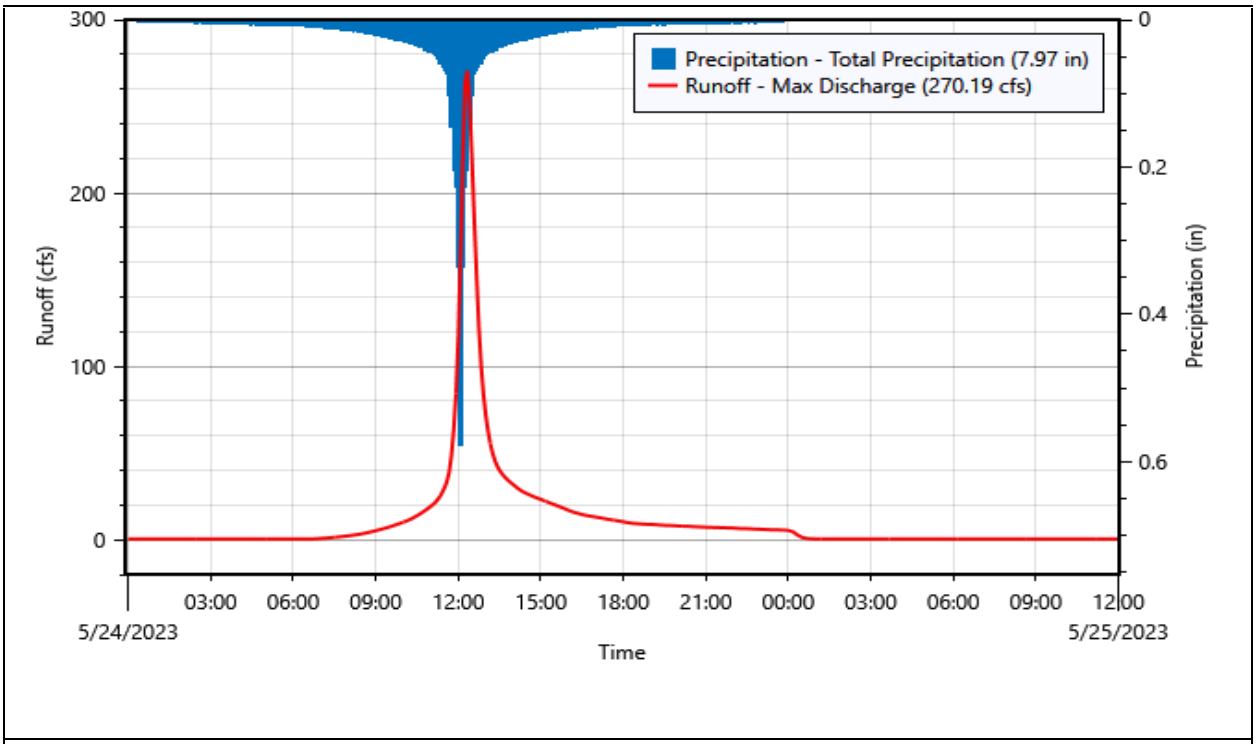
Subbasin ID:	**Subbasin - 6**			
Scenario:	**100 Yr 24 Hr Storm Event**		**Depth**	**Volume**
Peak discharge:	270.19 cfs	**Time of peak:**	24 May 2023, 12:20	
Drainage area:	77.408 acres	**Total rainfall:**	7.97 in	51.391 ac-ft
Initial abstraction:	0.63 in	**Losses:**	2.82 in	18.200 ac-ft
Curve Number:	75.99	**Precip excess:**	5.15 in	33.190 ac-ft
Impervious surface:	0.57%	**Direct runoff:**	5.15 in	33.190 ac-ft
Peaking factor:	484	**Baseflow:**	0.00 in	0.000 ac-ft
Lag time:	16.15 minutes	**Total runoff:**	5.15 in	33.190 ac-ft

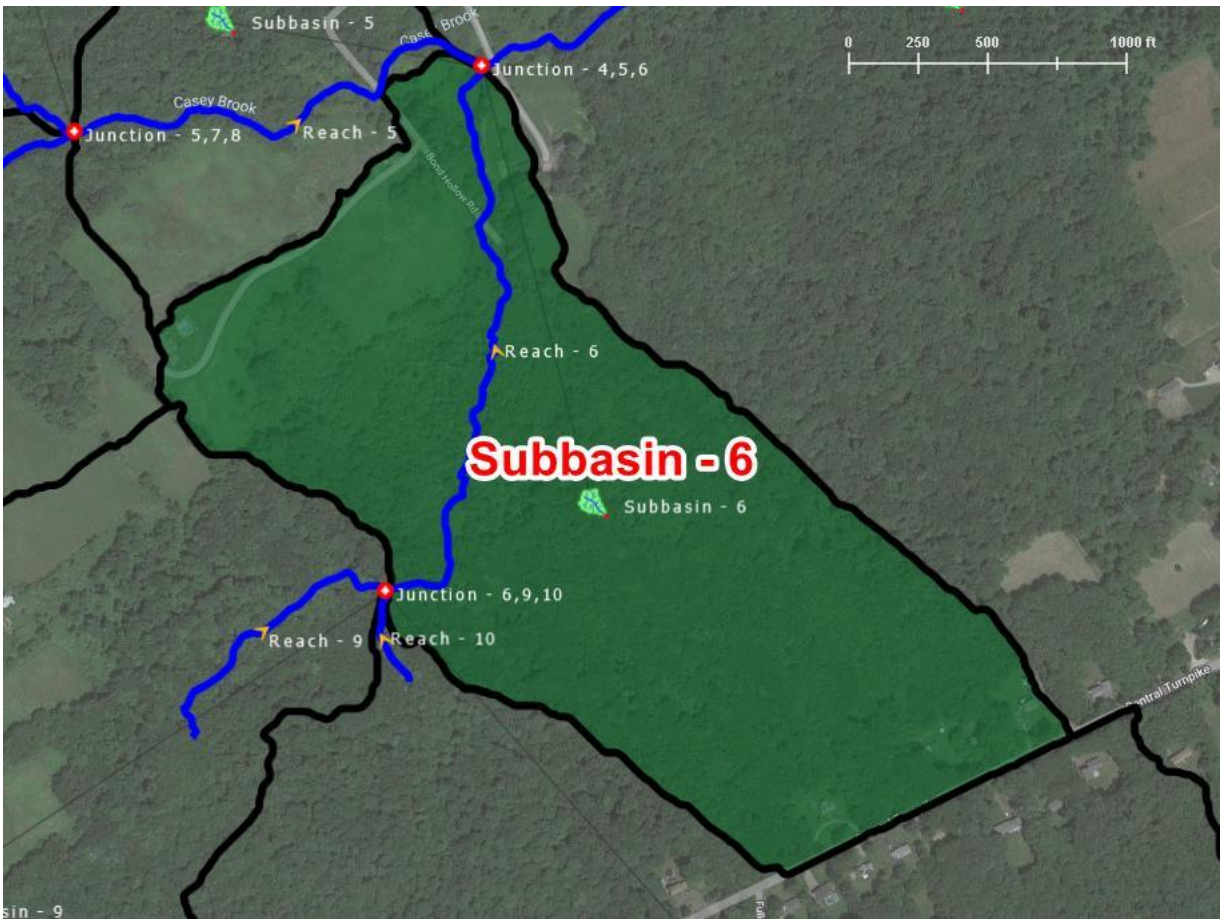
Weighted Curve Number Calculations

Soil Group	**Land Use Description**	**Area (acres)**	**Area (%)**	**Composite CN**
B	Agricultural, Pasture/Hay	1.178	1.52	61.00
D	Developed, Open Space	0.408	0.53	84.00
D	Agricultural, Pasture/Hay	2.580	3.33	80.00
C	Agricultural, Pasture/Hay	5.108	6.60	74.00
C	Undeveloped, Grassland	0.002	0.00	71.00
B	Wetlands, Forested	7.773	10.04	100.00
D	Wetlands, Forested	1.438	1.86	100.00
C	Wetlands, Forested	3.450	4.46	100.00
D	Undeveloped, Deciduous Forest	2.338	3.02	77.00
B	Undeveloped, Deciduous Forest	1.042	1.35	55.00
D	Developed, Medium Density	0.185	0.24	92.00
D	Undeveloped, Mixed Forest	0.946	1.22	77.00
B	Developed, Low Density	0.001	0.00	75.00
C	Undeveloped, Mixed Forest	3.164	4.09	70.00
B	Undeveloped, Mixed Forest	0.235	0.30	55.00
D	Developed, Low Density	0.249	0.32	87.00
C	Developed, Low Density	0.361	0.47	83.00
C	Developed, Open Space	2.819	3.64	79.00
C	Undeveloped, Deciduous Forest	44.131	57.01	70.00
Weighted Average		**77.408**	**100.00**	**75.99**

Time of Concentration (TOC) / Lag time Calculations

TOC (min)	**Length (ft)**	**Slope (ft/ft)**	**Velocity (ft/s)**	**Description**
4.69	20.00	0.03486	0.6936	Sheet Flow
7.37	2,236.08	0.09824	10.3504	Shallow Concentrated Flow
14.86	1,370.17	0.00625	2.6109	Channel Flow
26.92	**3,626.25**	**Total**	**Lag Time = 16.16 minutes**	


Precipitation - Total Precipitation (7.97 in)
Runoff - Max Discharge (270.19 cfs)
Runoff (cfs)
Precipitation (in)
300
200
100
0
0
0.2
0.4
0.6
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
5/24/2023
5/25/2023
Time


Subbasin - 5
Casey Brook
Junction - 4,5,6
Casey Brook
Junction - 5,7,8
Reach - 5
Reach - 6
Subbasin - 6
Subbasin - 6
Junction - 6,9,10
Reach - 9
Reach - 10
0
250
500
1000 ft

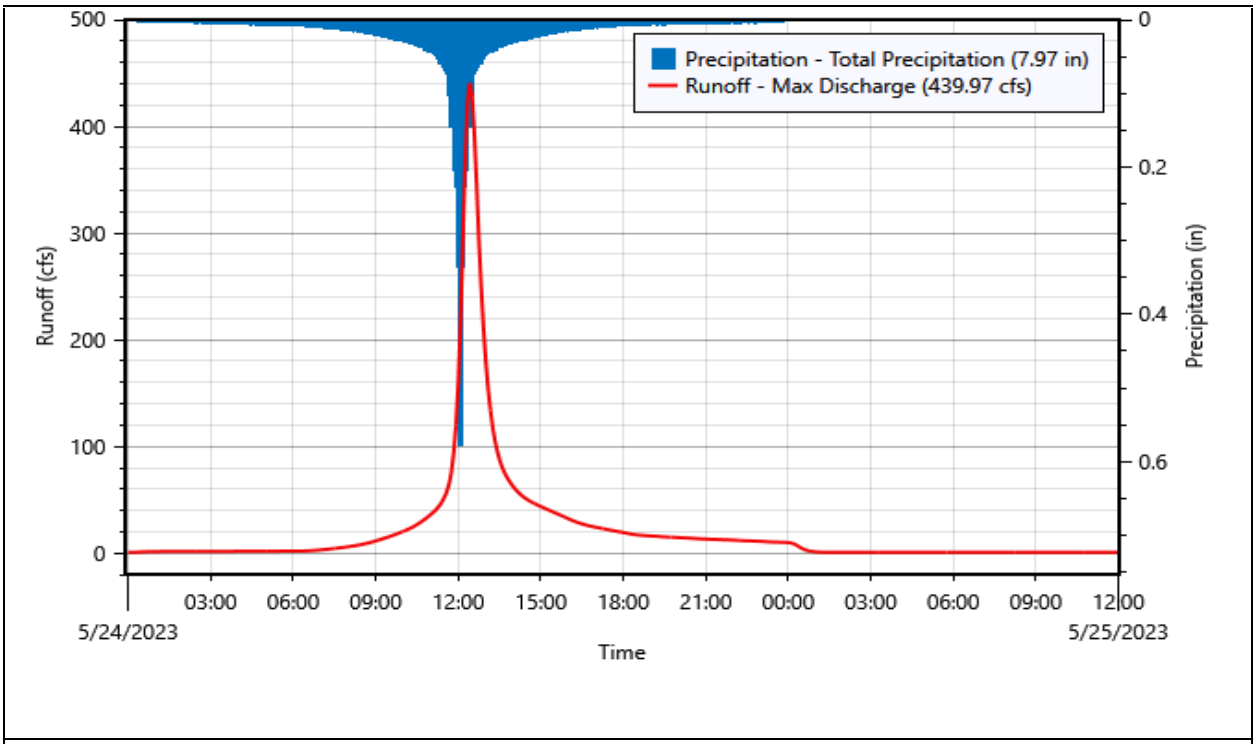
Subbasin ID:	**Subbasin - 7**			
Scenario:	**100 Yr 24 Hr Storm Event**		**Depth**	**Volume**
Peak discharge:	439.97 cfs	**Time of peak:**	24 May 2023, 12:25	
Drainage area:	136.668 acres	**Total rainfall:**	7.97 in	90.752 ac-ft
Initial abstraction:	0.58 in	**Losses:**	2.47 in	28.069 ac-ft
Curve Number:	77.55	**Precip excess:**	5.50 in	62.683 ac-ft
Impervious surface:	7.33%	**Direct runoff:**	5.50 in	62.683 ac-ft
Peaking factor:	484	**Baseflow:**	0.00 in	0.000 ac-ft
Lag time:	22.45 minutes	**Total runoff:**	5.50 in	62.683 ac-ft

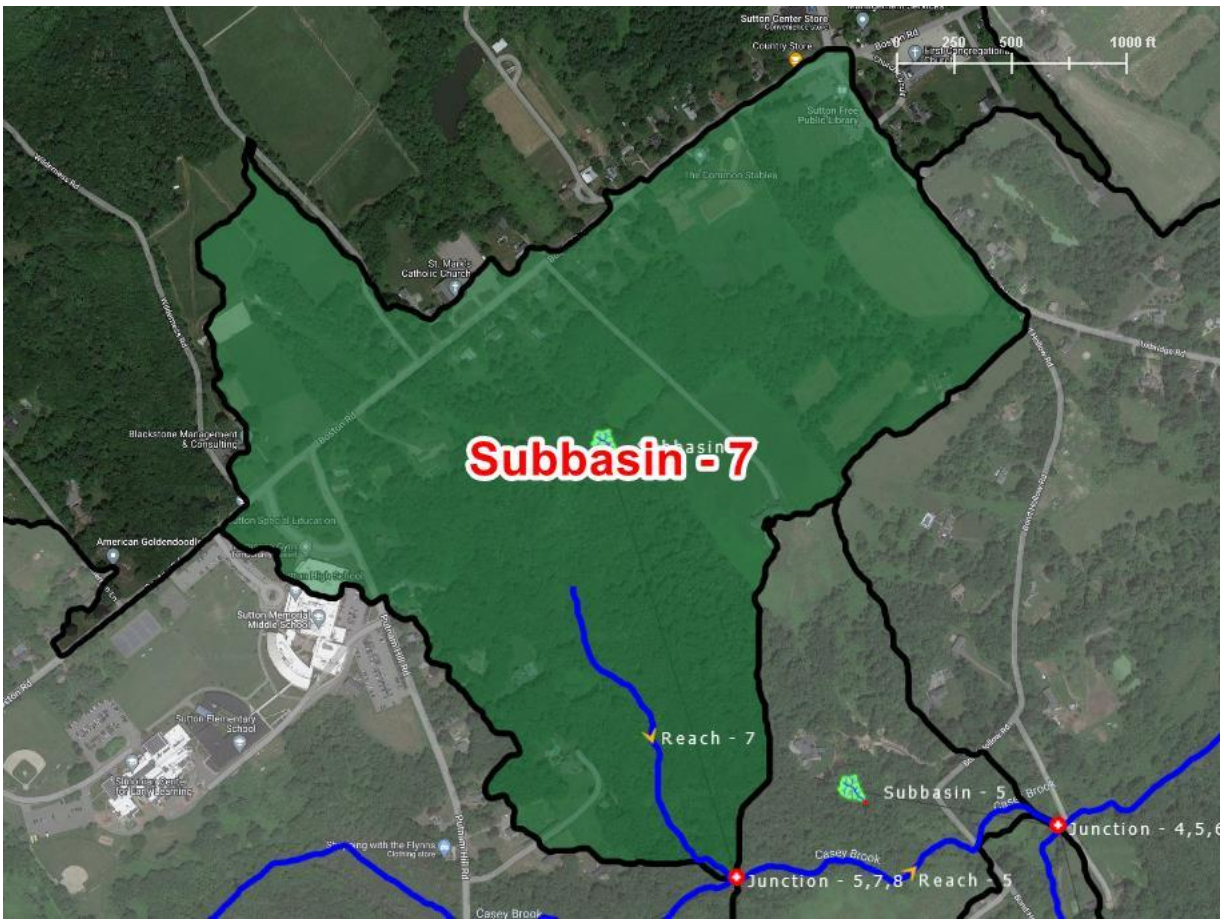
Weighted Curve Number Calculations

Soil Group	**Land Use Description**	**Area (acres)**	**Area (%)**	**Composite CN**
C	Agricultural, Pasture/Hay	21.224	15.53	74.00
C	Undeveloped, Grassland	0.118	0.09	71.00
D	Wetlands, Non-Forested	0.090	0.07	100.00
C	Wetlands, Non-Forested	0.273	0.20	100.00
A	Undeveloped, Grassland	0.098	0.07	30.00
C	Developed, Open Space	3.273	2.39	79.00
C	Developed, High Density	2.416	1.77	94.00
D	Developed, Open Space	1.560	1.14	84.00
B	Developed, High Density	0.058	0.04	92.00
A	Developed, High Density	0.279	0.20	89.00
B	Developed, Open Space	0.000	0.00	0.00
D	Undeveloped, Mixed Forest	2.836	2.08	77.00
C	Undeveloped, Mixed Forest	12.640	9.25	70.00
C	Undeveloped, Evergreen Forest	0.089	0.06	70.00
B	Developed, Low Density	0.059	0.04	75.00
A	Developed, Low Density	0.151	0.11	61.00
D	Developed, Low Density	0.969	0.71	87.00
D	Undeveloped, Deciduous Forest	16.025	11.73	77.00
C	Developed, Low Density	7.005	5.13	83.00
B	Undeveloped, Deciduous Forest	0.000	0.00	0.00
D	Developed, Medium Density	0.093	0.07	92.00
C	Developed, Medium Density	6.532	4.78	90.00
B	Wetlands, Forested	0.006	0.00	100.00
A	Developed, Medium Density	0.173	0.13	77.00
D	Wetlands, Forested	10.865	7.95	100.00
C	Wetlands, Forested	4.120	3.01	100.00
C	Undeveloped, Shrub/Scrub	0.111	0.08	65.00
D	Agricultural, Pasture/Hay	0.180	0.13	80.00
C	Undeveloped, Deciduous Forest	45.425	33.24	70.00
Weighted Average		**136.668**	**100.00**	**77.55**

Time of Concentration (TOC) / Lag time Calculations

TOC (min)	**Length (ft)**	**Slope (ft/ft)**	**Velocity (ft/s)**	**Description**
8.23	20.00	0.00853	0.3431	Sheet Flow
22.46	3,600.29	0.02743	5.4692	Shallow Concentrated Flow
6.72	1,507.89	0.03695	6.3481	Channel Flow
37.41	**5,128.18**	**Total**	**Lag Time = 22.45 minutes**	


Precipitation - Total Precipitation (7.97 in)
Runoff - Max Discharge (439.97 cfs)
Runoff (cfs)
Precipitation (in)
500
400
300
200
100
0
0
0.2
0.4
0.6
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
5/24/2023
5/25/2023
Time


Subbasin - 7
Reach - 7
Subbasin - 5
Junction - 5,7,8
Reach - 5
Junction - 4,5,6
Casey Brook
250
500
1000 ft

Subbasin ID:	**Subbasin - 8**			
Scenario:	**100 Yr 24 Hr Storm Event**		**Depth**	**Volume**
Peak discharge:	1,089.20 cfs	**Time of peak:**	24 May 2023, 12:55	
Drainage area:	525.519 acres	**Total rainfall:**	7.97 in	349.022 ac-ft
Initial abstraction:	N/A	**Losses:**	2.63 in	115.242 ac-ft
Curve Number:	76.94	**Precip excess:**	5.34 in	233.780 ac-ft
Impervious surface:	3.61%	**Direct runoff:**	5.34 in	233.780 ac-ft
Peaking factor:	484	**Baseflow:**	0.00 in	0.000 ac-ft
Lag time:	49.92 minutes	**Total runoff:**	5.34 in	233.780 ac-ft

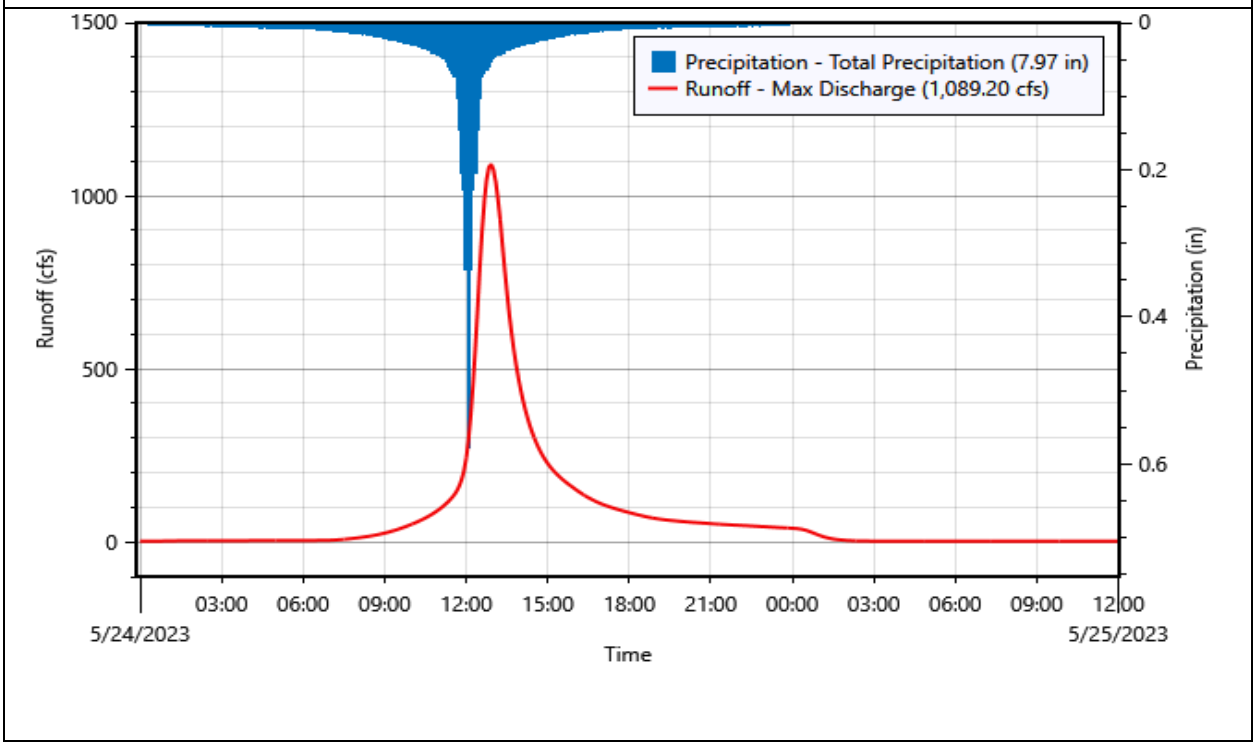
Weighted Curve Number Calculations

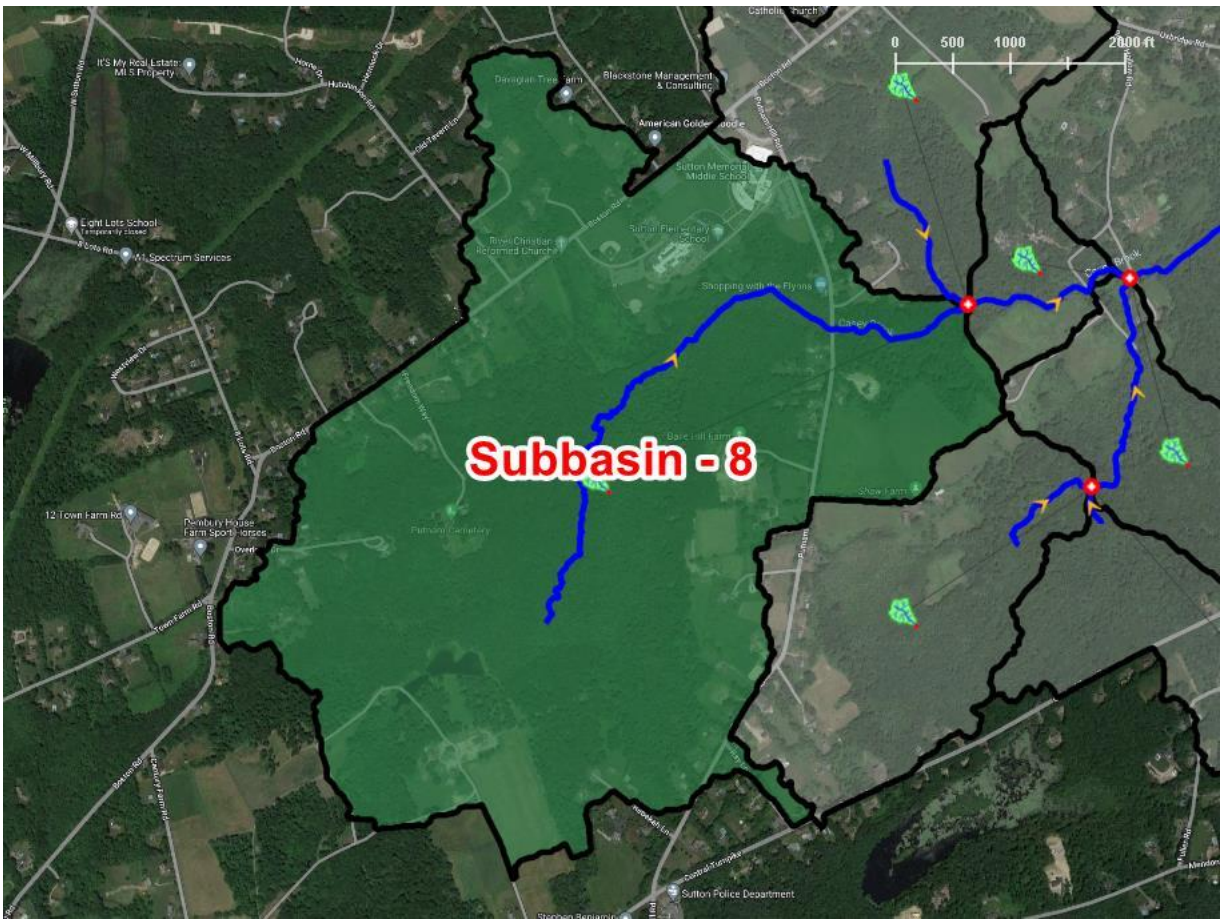
Soil Group	**Land Use Description**	**Area (acres)**	**Area (%)**	**Composite CN**
B	Developed, Low Density	0.068	0.01	75.00
A	Developed, Low Density	0.477	0.09	61.00
D	Developed, Low Density	1.058	0.20	87.00
C	Developed, Low Density	19.619	3.73	83.00
B	Undeveloped, Evergreen Forest	0.472	0.09	55.00
C	Undeveloped, Evergreen Forest	2.200	0.42	70.00
C	Undeveloped, Grassland	13.391	2.55	71.00
A	Undeveloped, Grassland	4.657	0.89	30.00
C	Open Water	0.573	0.11	100.00
B	Open Water	0.173	0.03	100.00
D	Undeveloped, Deciduous Forest	36.876	7.02	77.00
B	Undeveloped, Deciduous Forest	3.521	0.67	55.00
A	Undeveloped, Deciduous Forest	0.748	0.14	30.00
C	Undeveloped, Barren Land	1.069	0.20	91.00
C	Undeveloped, Shrub/Scrub	5.025	0.96	65.00
B	Undeveloped, Shrub/Scrub	0.122	0.02	48.00
A	Undeveloped, Barren Land	0.968	0.18	77.00
B	Agricultural, Pasture/Hay	0.818	0.16	61.00
A	Agricultural, Pasture/Hay	4.958	0.94	39.00
D	Agricultural, Pasture/Hay	4.206	0.80	80.00
C	Agricultural, Pasture/Hay	64.036	12.19	74.00
D	Undeveloped, Mixed Forest	4.219	0.80	77.00
C	Undeveloped, Mixed Forest	28.716	5.46	70.00
B	Undeveloped, Mixed Forest	3.141	0.60	55.00
D	Developed, Medium Density	0.000	0.00	92.00
C	Developed, Medium Density	8.288	1.58	90.00
C	Developed, Open Space	18.921	3.60	79.00
B	Developed, Medium Density	0.085	0.02	85.00
D	Developed, Open Space	2.780	0.53	84.00
A	Developed, Open Space	0.102	0.02	49.00
A	Developed, Medium Density	1.930	0.37	77.00
B	Developed, Open Space	1.427	0.27	69.00
B	Wetlands, Forested	54.578	10.39	100.00
D	Wetlands, Forested	14.569	2.77	100.00
C	Wetlands, Forested	22.669	4.31	100.00
C	Developed, High Density	2.224	0.42	94.00
B	Developed, High Density	0.049	0.01	92.00
A	Developed, High Density	2.384	0.45	89.00
C	Undeveloped, Deciduous Forest	194.399	36.99	70.00
Weighted Average		**525.519**	**100.00**	**76.94**

Time of Concentration (TOC) / Lag time Calculations

TOC (min)	**Length (ft)**	**Slope (ft/ft)**	**Velocity (ft/s)**	**Description**

7.81	20.00	0.00973	0.3664	Sheet Flow
24.68	4,243.83	0.03156	5.8667	Shallow Concentrated Flow
50.71	5,918.93	0.01001	3.3035	Channel Flow
83.20	**10,182.76**	**Total**	**Lag Time = 49.92 minutes**	




Subbasin - 8
0
500
1000
2000 ft
Blackstone Management & Consulting
Sutton Memorial Middle School
Sutton Elementary School
Eight Lots School
Temporarily closed
M1 Spectrum Services
12 Town Farm Rd
Sutton Police Department

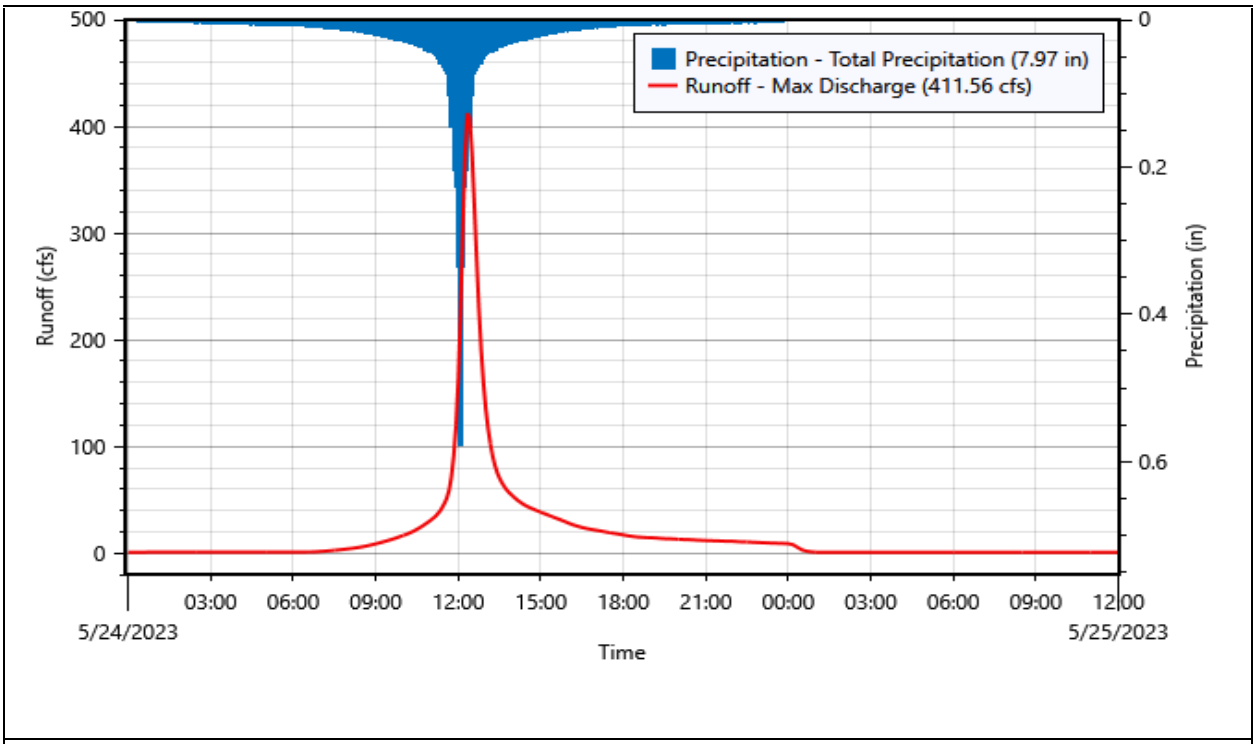
Subbasin ID:	**Subbasin - 9**			
Scenario:	**100 Yr 24 Hr Storm Event**		**Depth**	**Volume**
Peak discharge:	411.56 cfs	**Time of peak:**	24 May 2023, 12:20	
Drainage area:	124.687 acres	**Total rainfall:**	7.97 in	82.803 ac-ft
Initial abstraction:	0.62 in	**Losses:**	2.75 in	28.557 ac-ft
Curve Number:	76.22	**Precip excess:**	5.22 in	54.246 ac-ft
Impervious surface:	2.19%	**Direct runoff:**	5.22 in	54.246 ac-ft
Peaking factor:	484	**Baseflow:**	0.00 in	0.000 ac-ft
Lag time:	19.04 minutes	**Total runoff:**	5.22 in	54.246 ac-ft

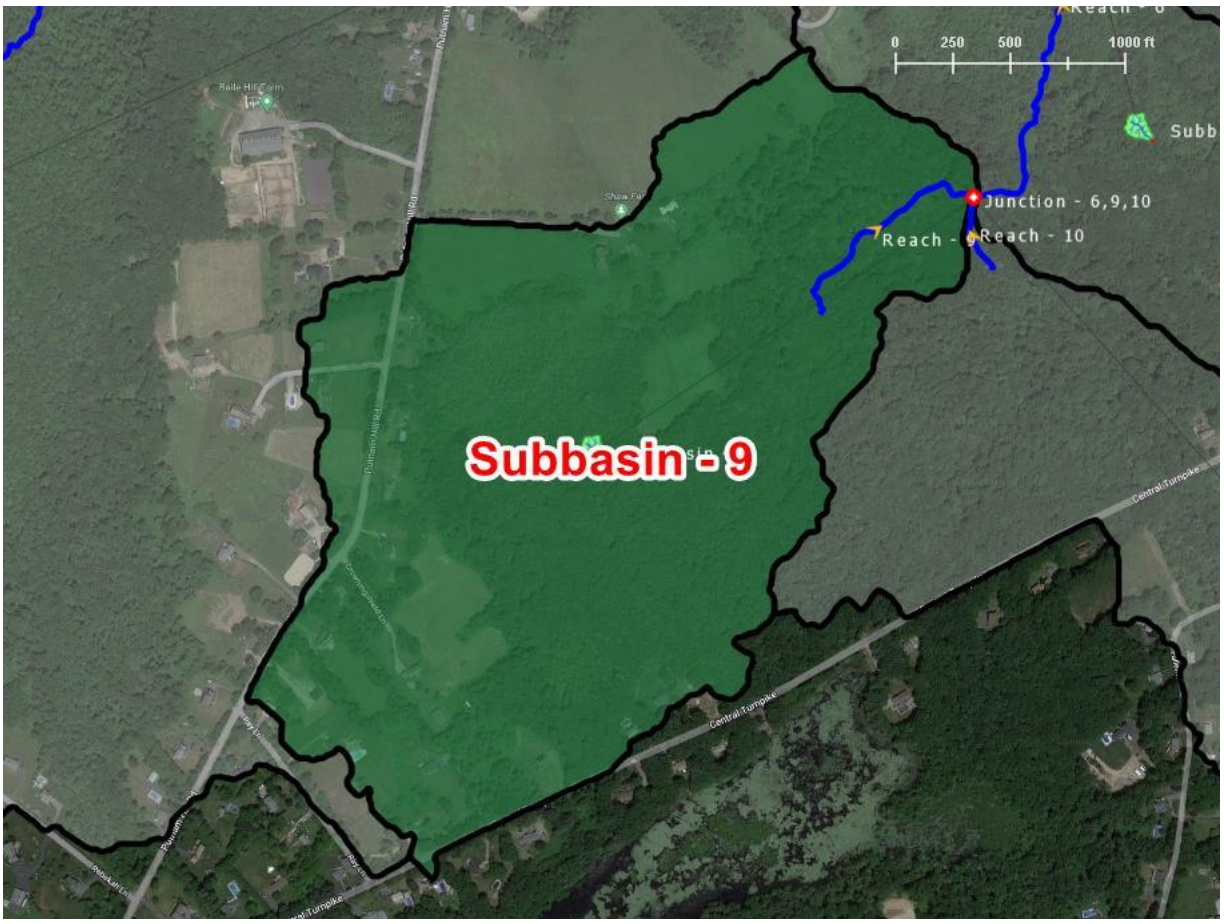
Weighted Curve Number Calculations

Soil Group	**Land Use Description**	**Area (acres)**	**Area (%)**	**Composite CN**
B	Agricultural, Pasture/Hay	1.866	1.50	61.00
B	Developed, Open Space	0.443	0.36	69.00
C	Agricultural, Pasture/Hay	26.566	21.31	74.00
B	Wetlands, Forested	15.876	12.73	100.00
D	Wetlands, Forested	1.415	1.13	100.00
C	Wetlands, Forested	4.374	3.51	100.00
D	Undeveloped, Deciduous Forest	1.572	1.26	77.00
B	Undeveloped, Deciduous Forest	5.008	4.02	55.00
C	Developed, Medium Density	0.336	0.27	90.00
B	Developed, Low Density	0.212	0.17	75.00
C	Undeveloped, Mixed Forest	4.848	3.89	70.00
B	Undeveloped, Mixed Forest	2.748	2.20	55.00
C	Developed, Low Density	6.345	5.09	83.00
C	Developed, Open Space	5.691	4.56	79.00
C	Undeveloped, Deciduous Forest	47.387	38.00	70.00
Weighted Average		**124.687**	**100.00**	**76.22**

Time of Concentration (TOC) / Lag time Calculations

TOC (min)	**Length (ft)**	**Slope (ft/ft)**	**Velocity (ft/s)**	**Description**
3.65	20.00	0.06519	0.9485	Sheet Flow
24.10	4,059.32	0.03030	5.7482	Shallow Concentrated Flow
3.99	1,006.28	0.04679	7.1434	Channel Flow
31.74	**5,085.60**	**Total**	**Lag Time = 19.05 minutes**	


Precipitation - Total Precipitation (7.97 in)
Runoff - Max Discharge (411.56 cfs)
Runoff (cfs)
Precipitation (in)
500
400
300
200
100
0
0
0.2
0.4
0.6
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
5/24/2023
5/25/2023
Time


0
250
500
1000 ft
Junction - 6,9,10
Reach - 10
Subbasin - 9

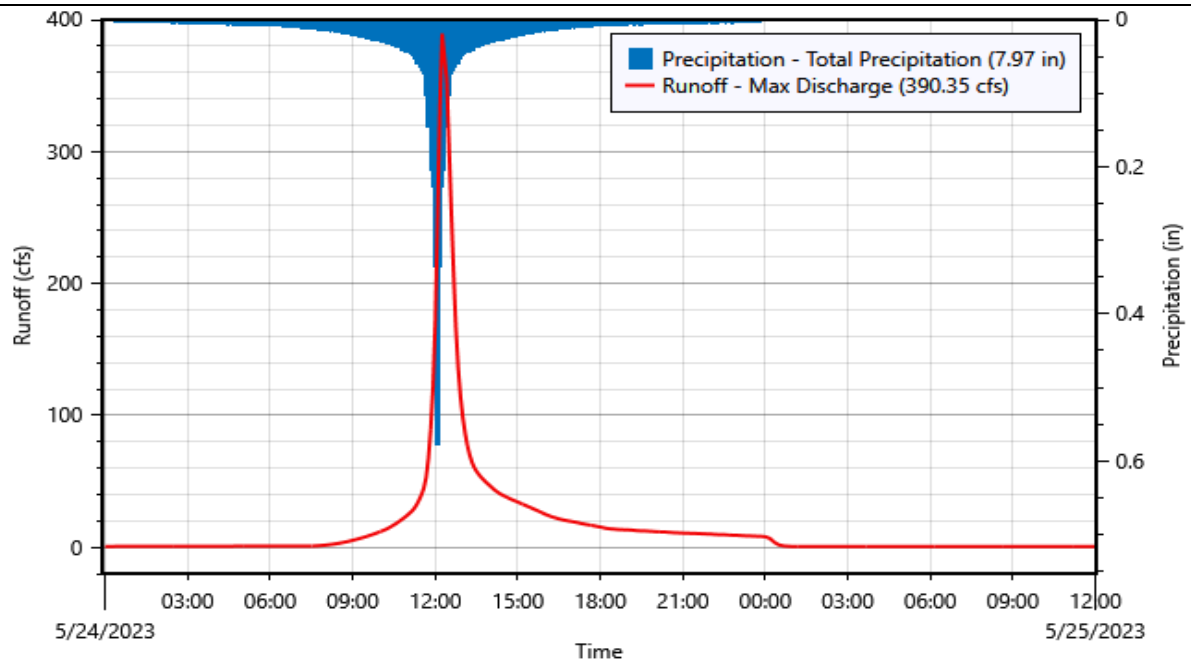
Subbasin ID:	**Subbasin - 10**			
Scenario:	**100 Yr 24 Hr Storm Event**		**Depth**	**Volume**
Peak discharge:	390.35 cfs	**Time of peak:**	24 May 2023, 12:20	
Drainage area:	120.193 acres	**Total rainfall:**	7.97 in	79.828 ac-ft
Initial abstraction:	0.79 in	**Losses:**	3.27 in	32.770 ac-ft
Curve Number:	71.76	**Precip excess:**	4.70 in	47.058 ac-ft
Impervious surface:	1.81%	**Direct runoff:**	4.70 in	47.058 ac-ft
Peaking factor:	484	**Baseflow:**	0.00 in	0.000 ac-ft
Lag time:	15.02 minutes	**Total runoff:**	4.70 in	47.058 ac-ft

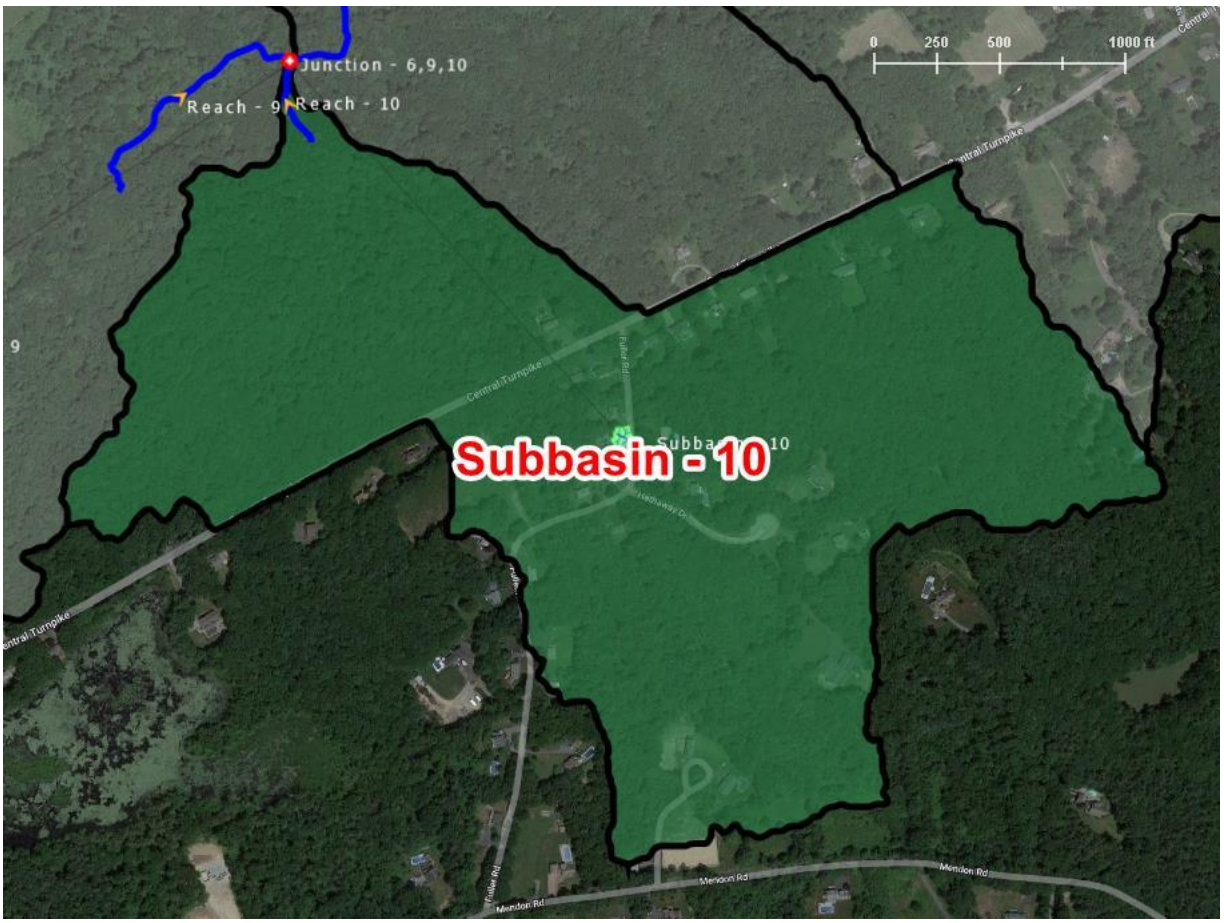
Weighted Curve Number Calculations

Soil Group	Land Use Description	Area (acres)	Area (%)	Composite CN
D	Developed, Open Space	1.300	1.08	84.00
C	Agricultural, Pasture/Hay	0.177	0.15	74.00
D	Undeveloped, Deciduous Forest	4.341	3.61	77.00
D	Undeveloped, Mixed Forest	0.672	0.56	77.00
C	Undeveloped, Mixed Forest	16.917	14.08	70.00
D	Developed, Low Density	0.410	0.34	87.00
C	Developed, Low Density	4.144	3.45	83.00
C	Developed, Open Space	10.775	8.97	79.00
C	Undeveloped, Deciduous Forest	81.456	67.77	70.00
Weighted Average		**120.193**	**100.00**	**71.76**

Time of Concentration (TOC) / Lag time Calculations

TOC (min)	Length (ft)	Slope (ft/ft)	Velocity (ft/s)	Description
5.54	20.00	0.02290	0.5622	Sheet Flow
18.26	4,342.54	0.06035	8.1120	Shallow Concentrated Flow
1.24	323.55	0.05032	7.4076	Channel Flow
25.04	**4,686.09**	**Total**	**Lag Time = 15.03 minutes**	




Junction - 6,9,10
Reach - 9
Reach - 10
0
250
500
1000 ft
Central Turnpike
Fuller Rd
Subbasin - 10
Meridon Rd

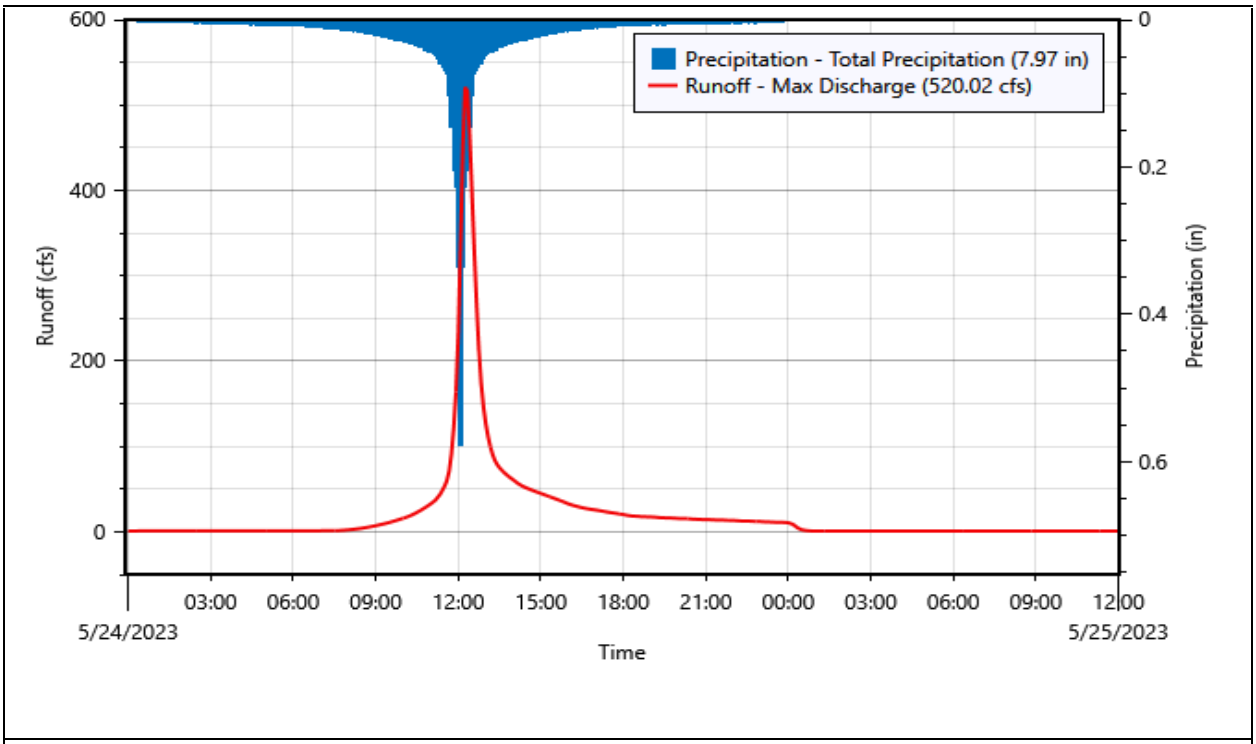
Subbasin ID:	**Subbasin - Abut - 1**			
Scenario:	**100 Yr 24 Hr Storm Event**		**Depth**	**Volume**
Peak discharge:	520.02 cfs	**Time of peak:**	24 May 2023, 12:15	
Drainage area:	157.467 acres	**Total rainfall:**	7.97 in	104.566 ac-ft
Initial abstraction:	0.78 in	**Losses:**	3.26 in	42.737 ac-ft
Curve Number:	71.99	**Precip excess:**	4.71 in	61.830 ac-ft
Impervious surface:	1.43%	**Direct runoff:**	4.71 in	61.830 ac-ft
Peaking factor:	484	**Baseflow:**	0.00 in	0.000 ac-ft
Lag time:	14.55 minutes	**Total runoff:**	4.71 in	61.830 ac-ft

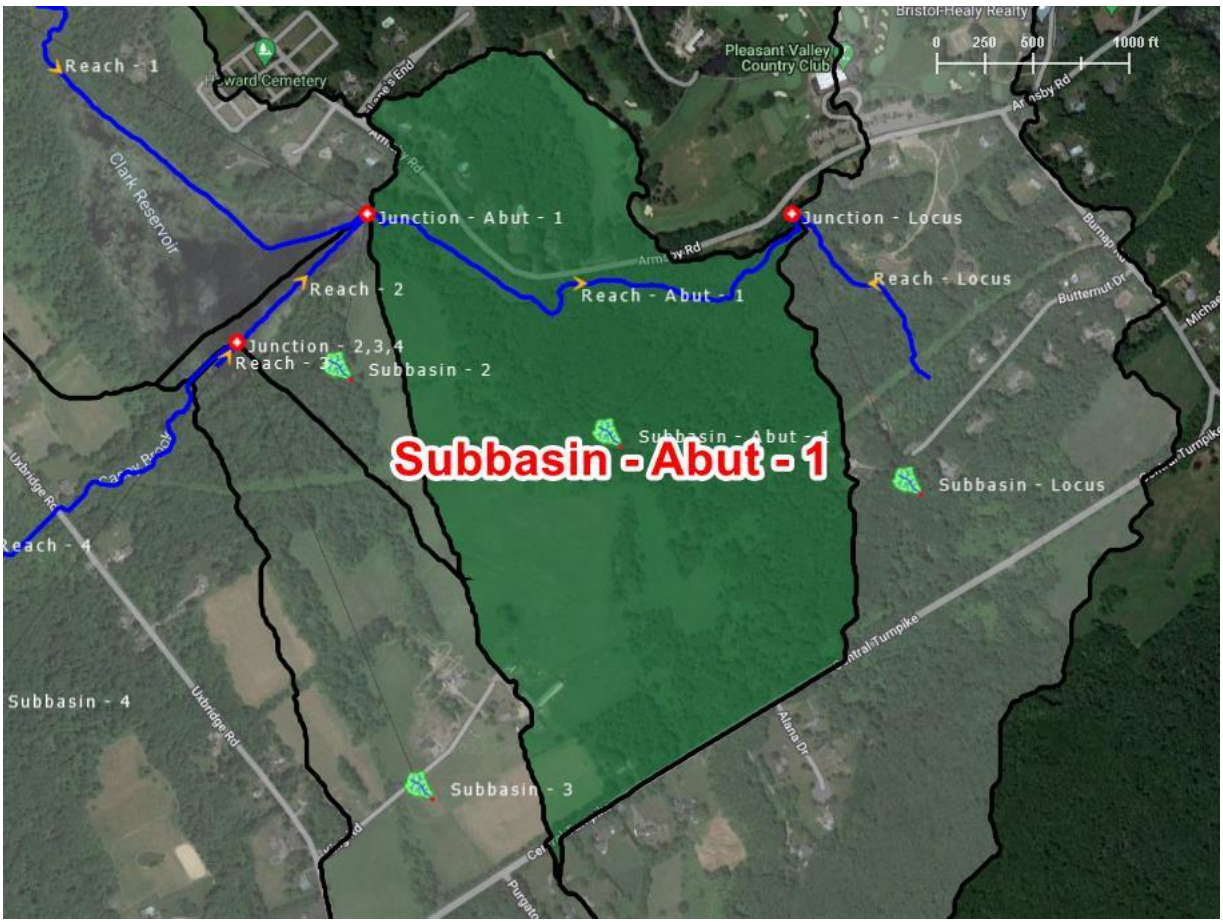
Weighted Curve Number Calculations

Soil Group	**Land Use Description**	**Area (acres)**	**Area (%)**	**Composite CN**
D	Developed, Open Space	2.481	1.58	84.00
D	Agricultural, Pasture/Hay	0.014	0.01	80.00
B	Developed, Open Space	8.826	5.60	69.00
C	Agricultural, Pasture/Hay	32.993	20.95	74.00
B	Wetlands, Forested	1.916	1.22	100.00
D	Wetlands, Forested	4.893	3.11	100.00
C	Wetlands, Forested	4.418	2.81	100.00
D	Undeveloped, Deciduous Forest	15.367	9.76	77.00
B	Undeveloped, Deciduous Forest	19.305	12.26	55.00
C	Undeveloped, Shrub/Scrub	0.040	0.03	65.00
D	Undeveloped, Mixed Forest	1.311	0.83	77.00
C	Developed, Medium Density	0.121	0.08	90.00
B	Developed, Medium Density	0.423	0.27	85.00
B	Developed, Low Density	1.156	0.73	75.00
C	Undeveloped, Mixed Forest	4.840	3.07	70.00
B	Undeveloped, Mixed Forest	4.943	3.14	55.00
D	Developed, Low Density	0.295	0.19	87.00
C	Undeveloped, Barren Land	0.233	0.15	91.00
C	Developed, Low Density	2.227	1.41	83.00
C	Developed, Open Space	1.450	0.92	79.00
C	Undeveloped, Deciduous Forest	50.215	31.89	70.00
Weighted Average		**157.467**	**100.00**	**71.99**

Time of Concentration (TOC) / Lag time Calculations

TOC (min)	**Length (ft)**	**Slope (ft/ft)**	**Velocity (ft/s)**	**Description**
3.98	20.00	0.05254	0.8515	Sheet Flow
15.38	3,991.73	0.07188	8.8534	Shallow Concentrated Flow
4.89	605.60	0.01128	3.5080	Channel Flow
24.25	**4,617.33**	**Total**	**Lag Time = 14.55 minutes**	


Precipitation - Total Precipitation (7.97 in)
Runoff - Max Discharge (520.02 cfs)
Runoff (cfs)
Precipitation (in)
600
400
200
0
0
0.2
0.4
0.6
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
5/24/2023
5/25/2023
Time


Reach - 1
Clark Reservoir
Junction - Abut - 1
Junction - Locus
Reach - 2
Reach - Abut - 1
Reach - Locus
Junction - 2,3,4
Reach - 3
Subbasin - 2
Subbasin - Abut - 1
Subbasin - Locus
Reach - 4
Subbasin - 4
Subbasin - 3
Pleasant Valley Country Club
0 250 500 1000 ft

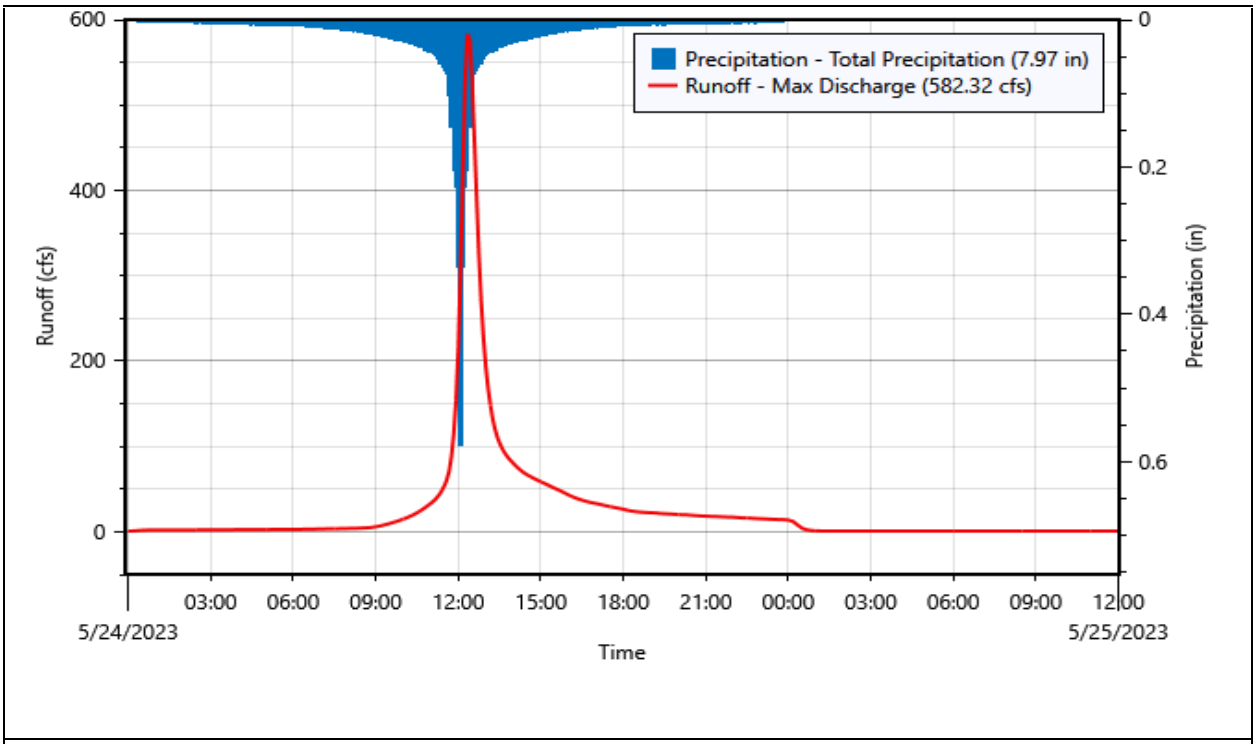
Subbasin ID:	**Subbasin - Locus**			
Scenario:	**100 Yr 24 Hr Storm Event**		**Depth**	**Volume**
Peak discharge:	582.32 cfs	**Time of peak:**	24 May 2023, 12:20	
Drainage area:	215.666 acres	**Total rainfall:**	7.97 in	143.247 ac-ft
Initial abstraction:	1.03 in	**Losses:**	3.69 in	66.232 ac-ft
Curve Number:	66.05	**Precip excess:**	4.28 in	77.015 ac-ft
Impervious surface:	7.48%	**Direct runoff:**	4.28 in	77.015 ac-ft
Peaking factor:	484	**Baseflow:**	0.00 in	0.000 ac-ft
Lag time:	18.43 minutes	**Total runoff:**	4.28 in	77.015 ac-ft

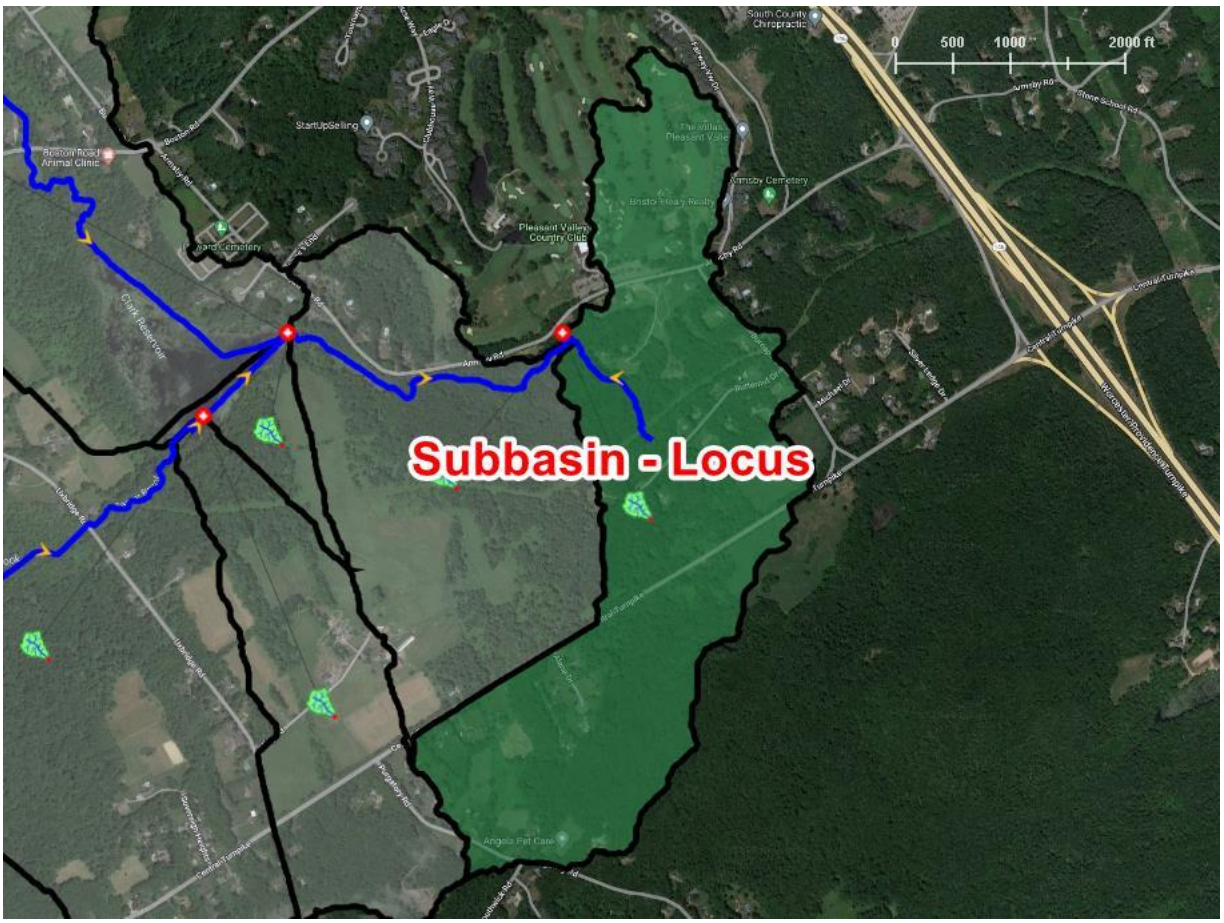
Weighted Curve Number Calculations

Soil Group	**Land Use Description**	**Area (acres)**	**Area (%)**	**Composite CN**
C	Agricultural, Pasture/Hay	11.913	5.52	74.00
D	Developed, High Density	0.018	0.01	95.00
C	Developed, Open Space	4.909	2.28	79.00
D	Developed, Open Space	1.555	0.72	84.00
B	Developed, High Density	1.385	0.64	92.00
A	Developed, Open Space	25.979	12.05	49.00
A	Developed, High Density	1.281	0.59	89.00
B	Developed, Open Space	11.997	5.56	69.00
D	Undeveloped, Mixed Forest	1.419	0.66	77.00
C	Undeveloped, Mixed Forest	4.935	2.29	70.00
B	Undeveloped, Mixed Forest	9.252	4.29	55.00
B	Undeveloped, Evergreen Forest	0.845	0.39	55.00
B	Developed, Low Density	7.356	3.41	75.00
A	Developed, Low Density	7.178	3.33	61.00
D	Developed, Low Density	1.493	0.69	87.00
D	Undeveloped, Deciduous Forest	12.355	5.73	77.00
C	Developed, Low Density	3.932	1.82	83.00
C	Undeveloped, Deciduous Forest	38.683	17.94	70.00
A	Undeveloped, Deciduous Forest	0.079	0.04	30.00
D	Developed, Medium Density	0.679	0.31	92.00
C	Developed, Medium Density	0.819	0.38	90.00
B	Wetlands, Forested	1.283	0.59	100.00
B	Developed, Medium Density	2.170	1.01	85.00
A	Developed, Medium Density	2.546	1.18	77.00
D	Wetlands, Forested	4.117	1.91	100.00
C	Wetlands, Forested	1.775	0.82	100.00
C	Undeveloped, Shrub/Scrub	1.557	0.72	65.00
B	Agricultural, Pasture/Hay	9.065	4.20	61.00
A	Agricultural, Pasture/Hay	0.816	0.38	39.00
D	Agricultural, Pasture/Hay	1.154	0.53	80.00
B	Undeveloped, Deciduous Forest	43.121	19.99	55.00
Weighted Average		**215.666**	**100.00**	**66.05**

Time of Concentration (TOC) / Lag time Calculations

TOC (min)	**Length (ft)**	**Slope (ft/ft)**	**Velocity (ft/s)**	**Description**
3.87	20.00	0.05614	0.8803	Sheet Flow
20.99	4,872.06	0.05752	7.9197	Shallow Concentrated Flow
5.86	1,237.95	0.03277	5.9777	Channel Flow
30.72	**6,130.01**	**Total**	**Lag Time = 18.44 minutes**	

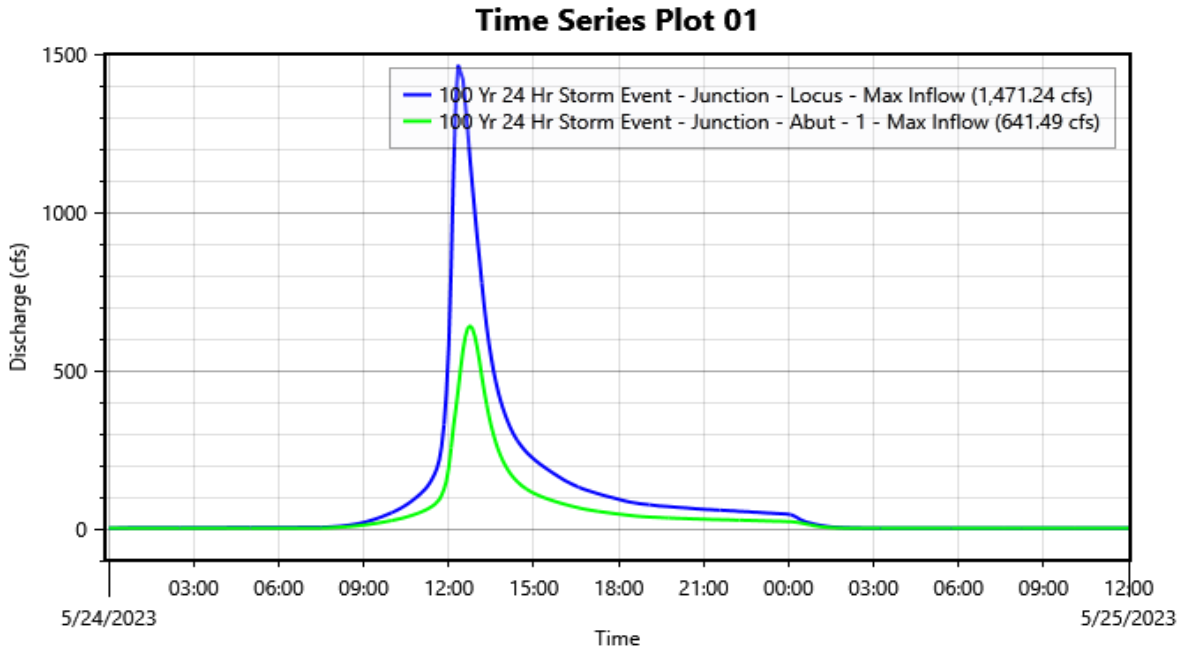

Precipitation - Total Precipitation (7.97 in)
Runoff - Max Discharge (582.32 cfs)
Runoff (cfs)
Precipitation (in)
600
400
200
0
0
0.2
0.4
0.6
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
5/24/2023
5/25/2023
Time


Subbasin - Locus
0
500
1000
2000 ft

Nodes

Element ID	Element Type	Peak Inflow (cfs)	Peak Outflow (cfs)	Peak Diverted Flow (cfs)
Junction - 2,3,4	Junction	3446.44	3446.44	
Junction - 4,5,6	Junction	2187.61	2187.61	
Junction - 5,7,8	Junction	1338.66	1338.66	
Junction - 6,9,10	Junction	801.91	801.91	
Junction - Abut - 1	Junction	641.49	641.49	
Junction - Locus	Junction	1471.24	1471.24	

Routing Reaches

Reach ID	Peak Inflow (cfs)	Peak Outflow (cfs)	Attenuated Flow (cfs)
Reach - 1	0.00	0.00	0.00
Reach - 2	3446.44	3429.53	16.91
Reach - 3	0.00	0.00	0.00
Reach - 4	2187.61	2184.47	3.14
Reach - 5	1338.66	1333.66	5.00
Reach - 6	801.91	787.80	14.11
Reach - 7	0.00	0.00	0.00
Reach - 8	0.00	0.00	0.00
Reach - 9	0.00	0.00	0.00
Reach - 10	0.00	0.00	0.00
Reach - Abut - 1	641.49	641.29	0.20
Reach - Locus	0.00	0.00	0.00

Pre vs Post Development