

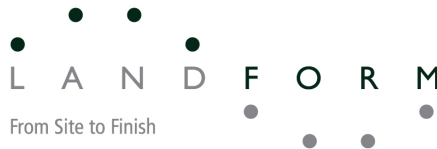
*SuiteLiving*

SPECIALTY SENIOR SERVICES

**RAMSEY, MN**

**STORMWATER NARRATIVE**

**December 3, 2010**





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**APPENDICES**

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- B. Existing HydroCad Model
- C. Proposed Drainage Map
- D. Proposed HydroCad Model
- E. Proposed Storm Sewer Drainage Map
- F. Storm Sewer Design Calculations
- G. Proprietary Treatment Devices



## **PROPOSED DEVELOPMENT**

The proposed development consists of a new multistory assisted living building and associated parking, landscaping, plaza areas and site utilities. The site lies between Sunwood Drive and Civic Center Drive and is adjacent to the existing Ramsey Municipal Parking Ramp located in the “COR” development (F.K.A. Ramsey Town Center) in Ramsey Minnesota.

## **EXISTING SITE CONDITONS**

The project consists of vacant land and is comprised of approximately 1.85 acres. The site has been mass graded and prepped for development as part of the Ramsey Town Center development. Site drainage eventually is routed through the City’s storm water system to a series of regional ponds.

## **JURISDICTIONAL BODIES AND REQUIREMENTS**

The City of Ramsey and Lower Rum River Watershed Management Organization (LRRWMO) have jurisdiction over stormwater runoff from proposed development at this site. The LRRWMO is the review agency for both the City and the Watershed Management Organization. The City requires the removal of at least 80% of total suspended solids. To meet this requirement, BMP’s must be designed to treat the 1” rain event per the City of Ramsey as a method of pretreatment prior to entering the City’s stormwater conveyance system. Onsite stormwater conveyance is to be deigned to handle the 10-year rainfall event by utilizing the rational method.

## **EXISTING SITE DRAINAGE PATTERNS**

The site is currently undeveloped and the site is generally flat with minimal elevation differential. The site is gently sloping from west to east. Storm sewer catch basins in the surrounding roadways serve as potential connections for stormwater conveyance.

## **PROPOSED ON-SITE STORMWATER MANAGEMENT**

The design goal of the proposed drainage plan is to follow existing drainage patterns, provide water quality treatment to at least mandated levels. Since rate control is currently handled by regional ponding provided by the City, no onsite rate control is necessary.

The proposed stormwater management plan will provide the required water quality pretreatment through the utilization of hydrodynamic separators designed to handle the peak runoff rates from the 1” event. Onsite storm sewer has been designed to convey the 10-year rainfall event. Details pertaining to these systems have been included both with this report and as shown on the submitted drawings. This project will share the treatment facilities with the easterly adjacent site due to the shared access location and points of connection for storm water. Since the storm drainage systems are utilizing a shared system for the majority of each project, the rates summary and pretreatment summary are inclusive of both projects. A separate narrative and plans for the Senior Living project adjacent to this site can be referred to for additional information.



Table 1: Runoff Rates Summary

Event	Existing Runoff Rate (cfs)	Proposed Runoff Rate (cfs) to Regional Ponds
2-yr (2.75") event	1.56	16.27
10-yr (4.1") event	6.98	26.16
100-yr (5.9") event	16.85	39.27

Table 2: Pretreatment Summary

Drainage Area	Pretreatment Device	1" Event Peak Runoff Rate (cfs)	Design Treatment Capacity (cfs)
Drainage Area 1	ecoStorm Model #1	0.42	1.9
Drainage Area 2	Aqua-Swirl #1 AS-3 Model	0.88	1.8
Drainage Area 3	Aqua Swirl #2 AS-3 Model	1.39	1.8
Drainage Area 4	ecoStorm Model #1.5	1.07	2.6

The ecoStorm and Aqua-Swirl structures have been sized adequately enough to treat the 1" event and convey the 10-year rainfall events. A diversion weir was used for each system to contain and treat the 1" event, but also to allow stormwater to by-pass during larger events.

**CONCLUSION**

The proposed design will provide pretreatment of storm water runoff prior to entering the City's stormwater system. The proposed design meets the intent of the LRRWMO and City of Ramsey regulations which dictate at least 80% of total suspended solids based on a 1" rain event.

**CONTACT INFORMATION**

This document was prepared by:

Landform

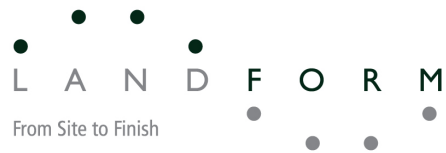
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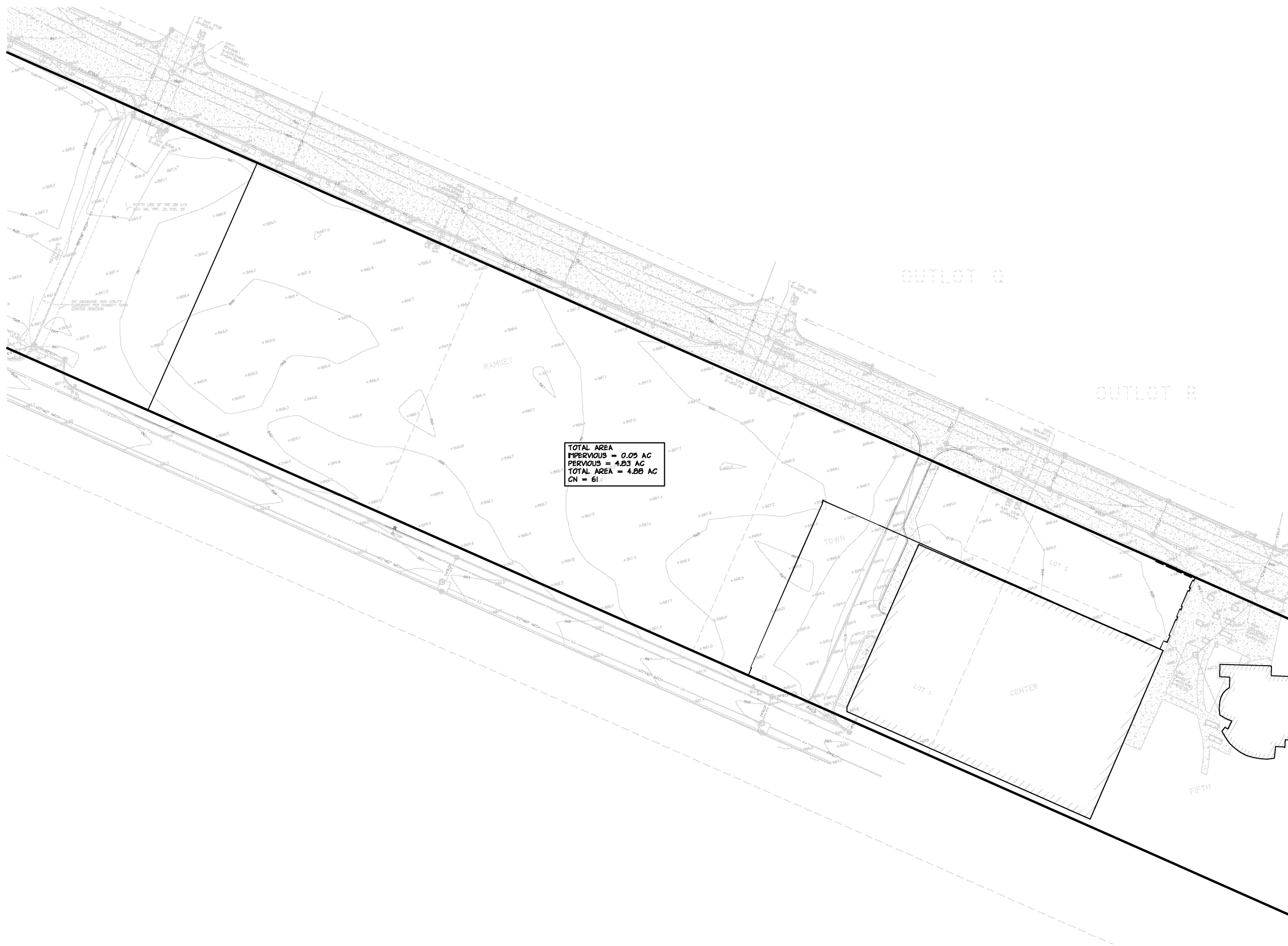
Minneapolis, MN 55401

Please direct any questions regarding this narrative to Steve Sabraski, PE at [ssabraski@landform.net](mailto:ssabraski@landform.net) or 612.638.0243.

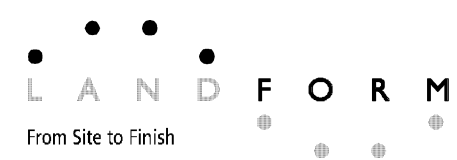
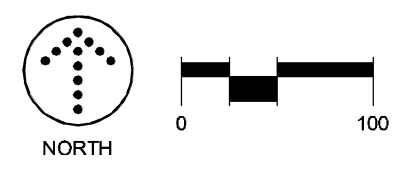
# APPENDIX A

## EXISTING DRAINAGE MAP





TOTAL AREA  
IMPERVIOUS = 0.05 AC  
PERVIOUS = 4.83 AC  
TOTAL AREA = 4.88 AC  
CN = 61

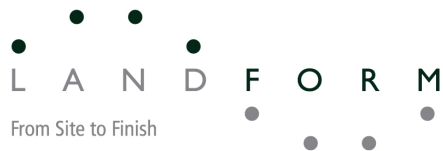


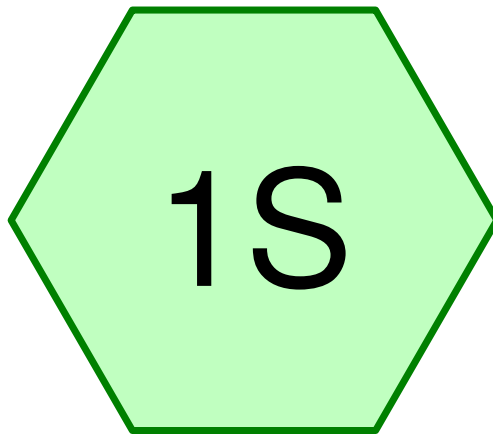
**EXISTING  
DRAINAGE MAP**

12.03.2010

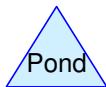
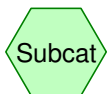
# APPENDIX B

## EXISTING HYDROCAD MODEL





Existing



## UWA10002 - Existing

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Page 2

### Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
4.830	61	>75% Grass cover, Good, HSG B (1S)
0.050	98	Paved parking, HSG B (1S)
<b>4.880</b>		<b>TOTAL AREA</b>

## UWA10002 - Existing

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Page 3

### Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
<b>4.880</b>	HSG B	1S
0.000	HSG C	
0.000	HSG D	
0.000	Other	
4.880		<b>TOTAL AREA</b>

**UWA10002 - Existing**

Type II 24-hr 2-yr Rainfall=2.75"

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Page 4

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1S: Existing**

Runoff Area=4.880 ac 1.02% Impervious Runoff Depth>0.23"

Tc=5.0 min CN=61 Runoff=1.56 cfs 0.094 af

**Total Runoff Area = 4.880 ac Runoff Volume = 0.094 af Average Runoff Depth = 0.23"**

**98.98% Pervious = 4.830 ac 1.02% Impervious = 0.050 ac**

**UWA10002 - Existing**

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Type II 24-hr 2-yr Rainfall=2.75"

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Page 5

**Summary for Subcatchment 1S: Existing**

[49] Hint:  $T_c < 2dt$  may require smaller dt

Runoff = 1.56 cfs @ 12.00 hrs, Volume= 0.094 af, Depth> 0.23"

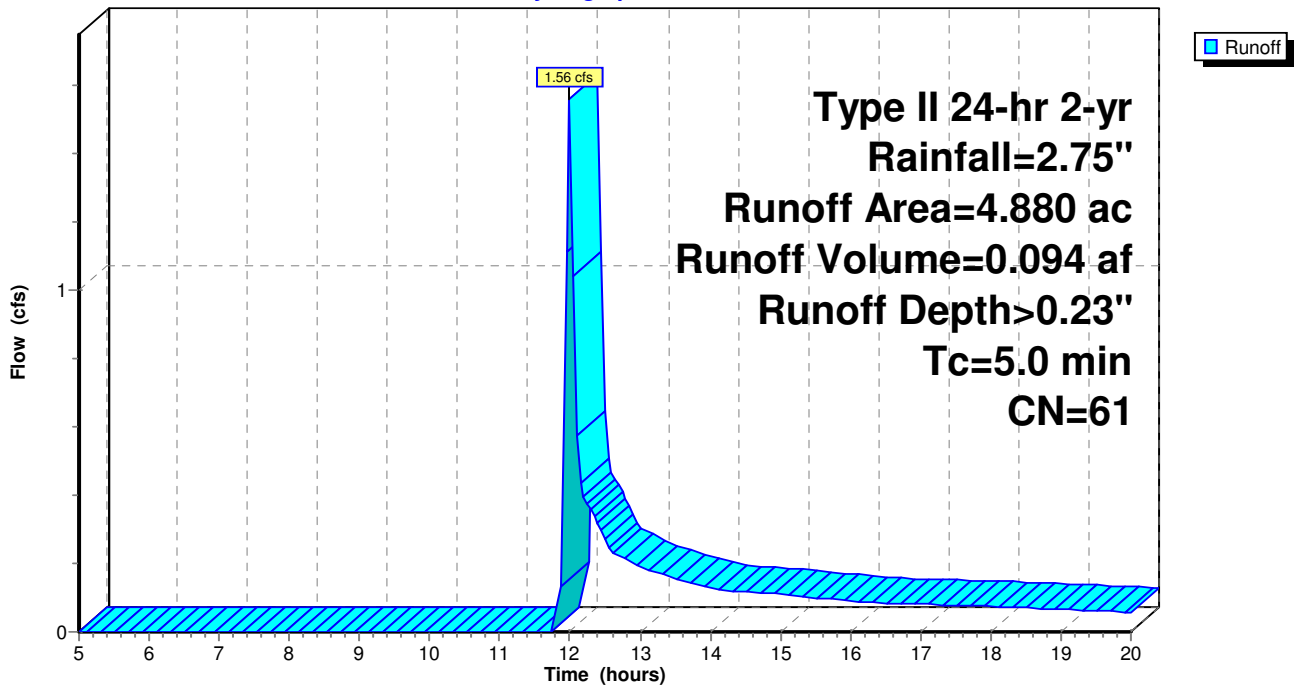
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 2-yr Rainfall=2.75"

Area (ac)	CN	Description
0.050	98	Paved parking, HSG B
4.830	61	>75% Grass cover, Good, HSG B
4.880	61	Weighted Average
4.830		98.98% Pervious Area
0.050		1.02% Impervious Area

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

**Subcatchment 1S: Existing**

Hydrograph



**UWA10002 - Existing**

*Type II 24-hr 10-yr Rainfall=4.10"*

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1S: Existing**

Runoff Area=4.880 ac 1.02% Impervious Runoff Depth>0.76"

Tc=5.0 min CN=61 Runoff=6.98 cfs 0.310 af

**Total Runoff Area = 4.880 ac Runoff Volume = 0.310 af Average Runoff Depth = 0.76"**

**98.98% Pervious = 4.830 ac 1.02% Impervious = 0.050 ac**

**UWA10002 - Existing**

Type II 24-hr 10-yr Rainfall=4.10"

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**Summary for Subcatchment 1S: Existing**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 6.98 cfs @ 11.97 hrs, Volume= 0.310 af, Depth> 0.76"

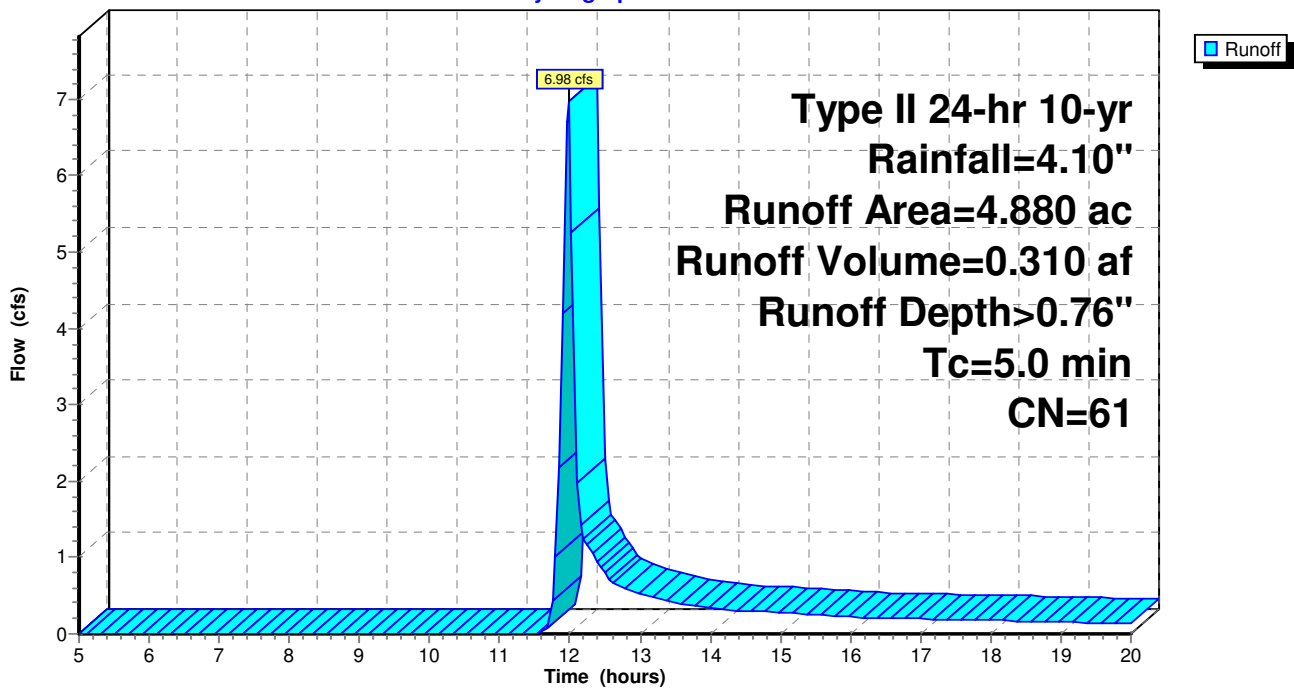
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 10-yr Rainfall=4.10"

Area (ac)	CN	Description
0.050	98	Paved parking, HSG B
4.830	61	>75% Grass cover, Good, HSG B
4.880	61	Weighted Average
4.830		98.98% Pervious Area
0.050		1.02% Impervious Area

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

**Subcatchment 1S: Existing**

Hydrograph



**UWA10002 - Existing**

*Type II 24-hr 100-yr Rainfall=5.90"*

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1S: Existing**

Runoff Area=4.880 ac 1.02% Impervious Runoff Depth>1.75"

Tc=5.0 min CN=61 Runoff=16.85 cfs 0.712 af

**Total Runoff Area = 4.880 ac Runoff Volume = 0.712 af Average Runoff Depth = 1.75"**

**98.98% Pervious = 4.830 ac 1.02% Impervious = 0.050 ac**

**UWA10002 - Existing**

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Type II 24-hr 100-yr Rainfall=5.90"

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Page 9

**Summary for Subcatchment 1S: Existing**

[49] Hint:  $T_c < 2dt$  may require smaller dt

Runoff = 16.85 cfs @ 11.96 hrs, Volume= 0.712 af, Depth > 1.75"

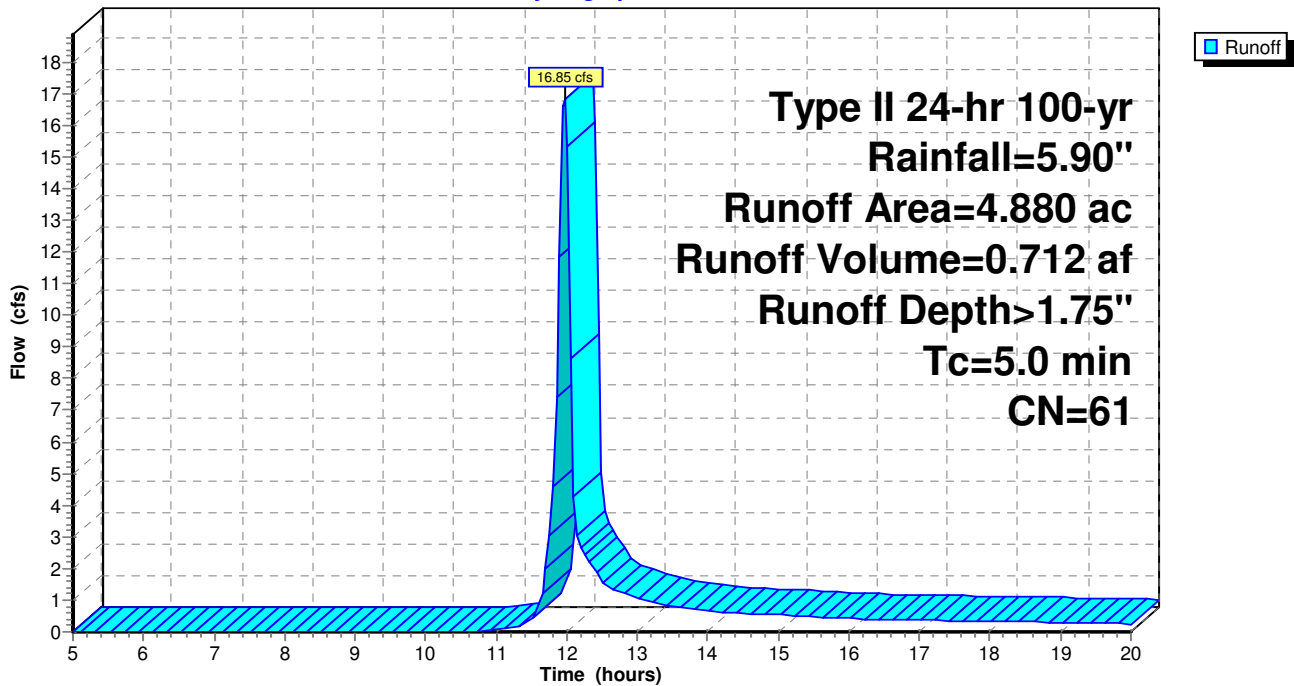
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 Type II 24-hr 100-yr Rainfall=5.90"

Area (ac)	CN	Description
0.050	98	Paved parking, HSG B
4.830	61	>75% Grass cover, Good, HSG B
4.880	61	Weighted Average
4.830		98.98% Pervious Area
0.050		1.02% Impervious Area

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

**Subcatchment 1S: Existing**

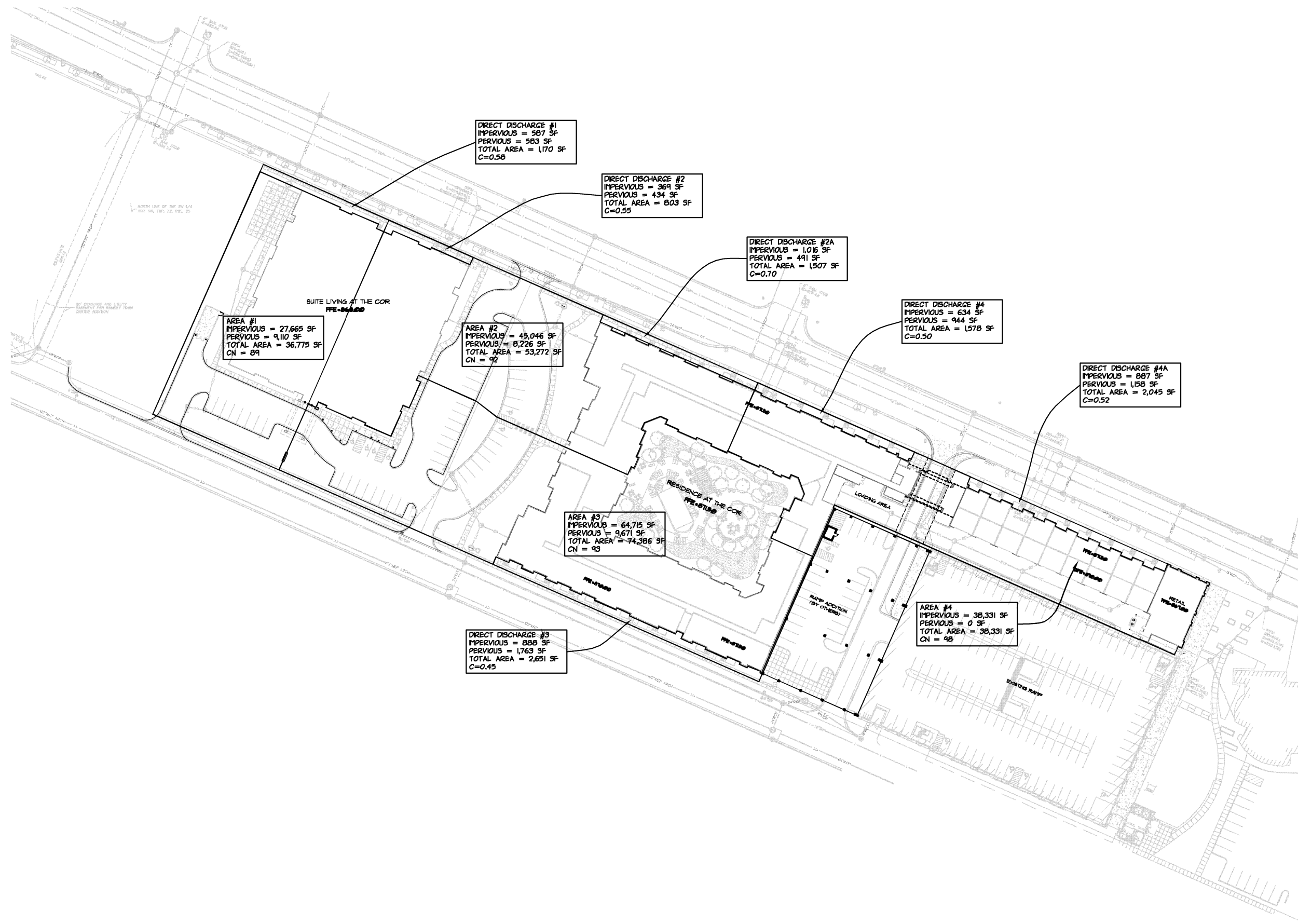
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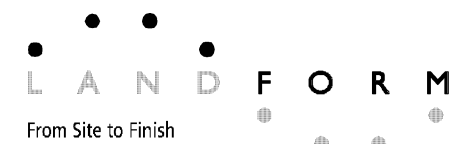
# APPENDIX C

## PROPOSED DRAINAGE MAP





NORTH



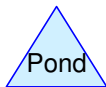
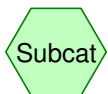
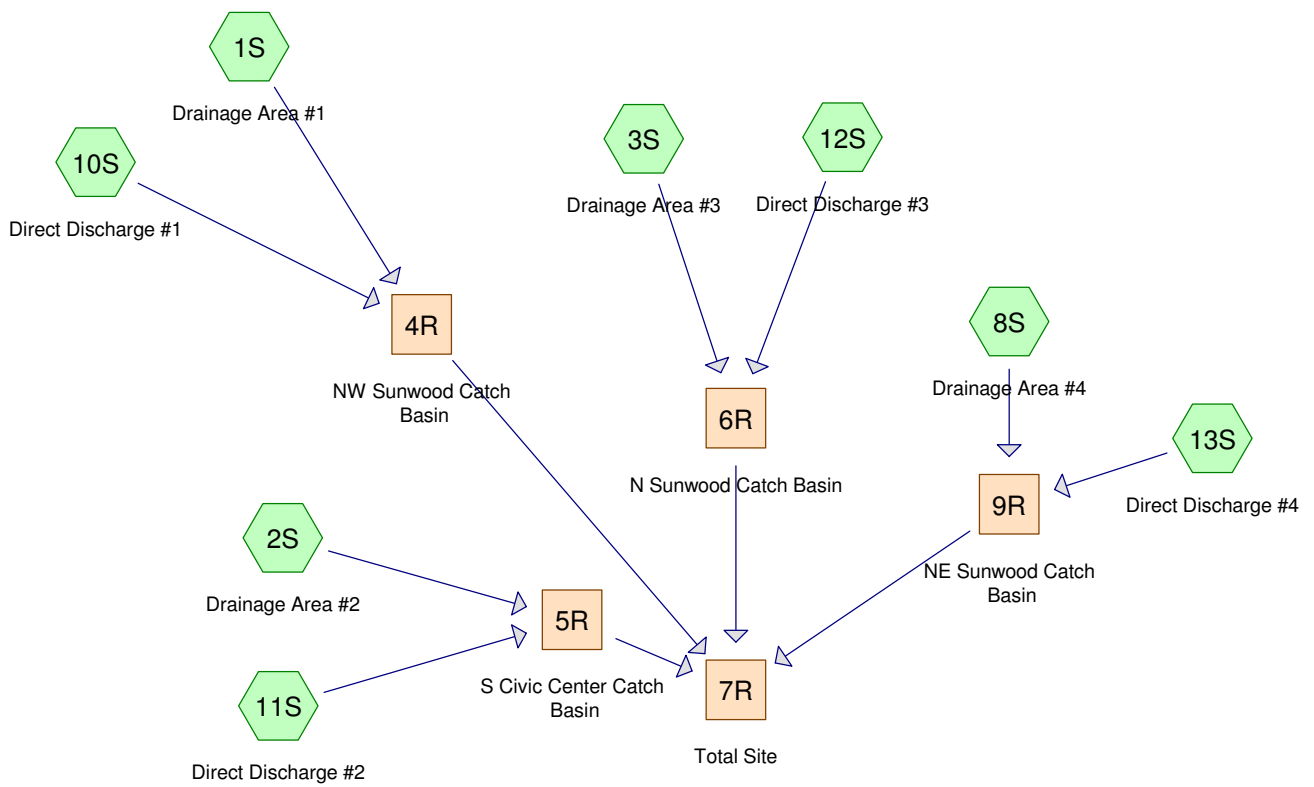
**PROPOSED DRAINAGE MAP**

12.03.2010

# APPENDIX D

## PROPOSED HYDROCAD MODEL





**Drainage Diagram for UWA10002 - Proposed**  
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## UWA10002 - Proposed

Prepared by {enter your company name here}

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Page 2

### Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.743	61	>75% Grass cover, Good, HSG B (1S, 2S, 3S, 10S, 11S, 12S, 13S)
4.135	98	Paved parking, HSG B (1S, 2S, 3S, 8S, 10S, 11S, 12S, 13S)
<b>4.879</b>		<b>TOTAL AREA</b>

**UWA10002 - Proposed**

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Page 3

**Soil Listing (all nodes)**

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
<b>4.879</b>	HSG B	1S, 2S, 3S, 8S, 10S, 11S, 12S, 13S
0.000	HSG C	
0.000	HSG D	
0.000	Other	
4.879		<b>TOTAL AREA</b>

**UWA10002 - Proposed**

Type II 24-hr 1" Event Rainfall=1.00"

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Page 4

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
 Runoff by SCS TR-20 method, UH=SCS  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

<b>Subcatchment 1S: Drainage Area #1</b>	Runoff Area=36,775 sf 75.23% Impervious Runoff Depth>0.26" Tc=5.0 min CN=89 Runoff=0.42 cfs 0.018 af
<b>Subcatchment 2S: Drainage Area #2</b>	Runoff Area=53,272 sf 84.56% Impervious Runoff Depth>0.37" Tc=5.0 min CN=92 Runoff=0.89 cfs 0.037 af
<b>Subcatchment 3S: Drainage Area #3</b>	Runoff Area=74,386 sf 87.00% Impervious Runoff Depth>0.41" Tc=5.0 min CN=93 Runoff=1.39 cfs 0.059 af
<b>Subcatchment 8S: Drainage Area #4</b>	Runoff Area=38,331 sf 100.00% Impervious Runoff Depth>0.74" Tc=5.0 min CN=98 Runoff=1.16 cfs 0.054 af
<b>Subcatchment 10S: Direct Discharge #1</b>	Runoff Area=1,170 sf 50.17% Impervious Runoff Depth>0.07" Tc=5.0 min CN=80 Runoff=0.00 cfs 0.000 af
<b>Subcatchment 11S: Direct Discharge #2</b>	Runoff Area=2,310 sf 59.96% Impervious Runoff Depth>0.11" Tc=5.0 min CN=83 Runoff=0.01 cfs 0.001 af
<b>Subcatchment 12S: Direct Discharge #3</b>	Runoff Area=2,651 sf 33.50% Impervious Runoff Depth>0.01" Tc=5.0 min CN=73 Runoff=0.00 cfs 0.000 af
<b>Subcatchment 13S: Direct Discharge #4</b>	Runoff Area=3,623 sf 41.98% Impervious Runoff Depth>0.04" Tc=5.0 min CN=77 Runoff=0.00 cfs 0.000 af
<b>Reach 4R: NW Sunwood Catch Basin</b>	Inflow=0.42 cfs 0.018 af Outflow=0.42 cfs 0.018 af
<b>Reach 5R: S Civic Center Catch Basin</b>	Inflow=0.90 cfs 0.038 af Outflow=0.90 cfs 0.038 af
<b>Reach 6R: N Sunwood Catch Basin</b>	Inflow=1.39 cfs 0.059 af Outflow=1.39 cfs 0.059 af
<b>Reach 7R: Total Site</b>	Inflow=3.86 cfs 0.169 af Outflow=3.86 cfs 0.169 af
<b>Reach 9R: NE Sunwood Catch Basin</b>	Inflow=1.16 cfs 0.055 af Outflow=1.16 cfs 0.055 af

**Total Runoff Area = 4.879 ac Runoff Volume = 0.169 af Average Runoff Depth = 0.42"**  
**15.24% Pervious = 0.743 ac 84.76% Impervious = 4.135 ac**

**UWA10002 - Proposed**

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Type II 24-hr 1" Event Rainfall=1.00"

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Page 5

**Summary for Subcatchment 1S: Drainage Area #1**

[49] Hint:  $T_c < 2dt$  may require smaller dt

Runoff = 0.42 cfs @ 11.97 hrs, Volume= 0.018 af, Depth> 0.26"

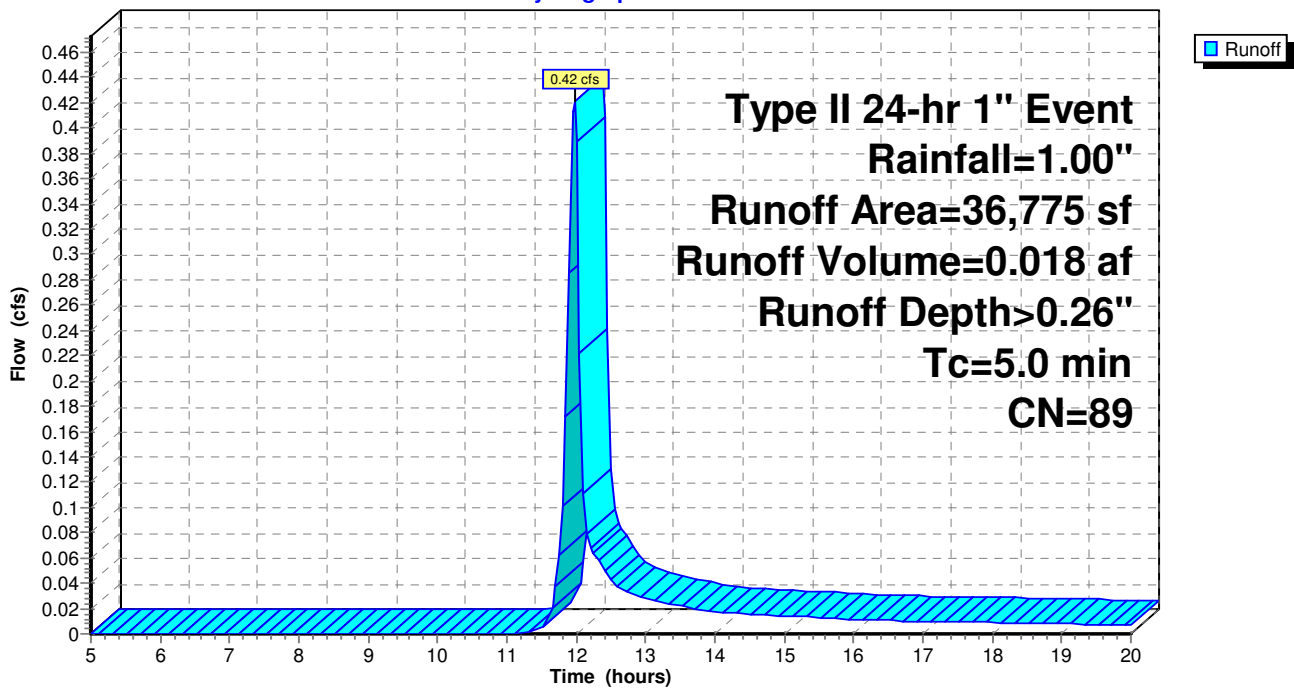
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 1" Event Rainfall=1.00"

Area (sf)	CN	Description
27,665	98	Paved parking, HSG B
9,110	61	>75% Grass cover, Good, HSG B
36,775	89	Weighted Average
9,110		24.77% Pervious Area
27,665		75.23% Impervious Area

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

**Subcatchment 1S: Drainage Area #1**

Hydrograph



**UWA10002 - Proposed**

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Type II 24-hr 1" Event Rainfall=1.00"

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Page 6

**Summary for Subcatchment 2S: Drainage Area #2**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.89 cfs @ 11.96 hrs, Volume= 0.037 af, Depth> 0.37"

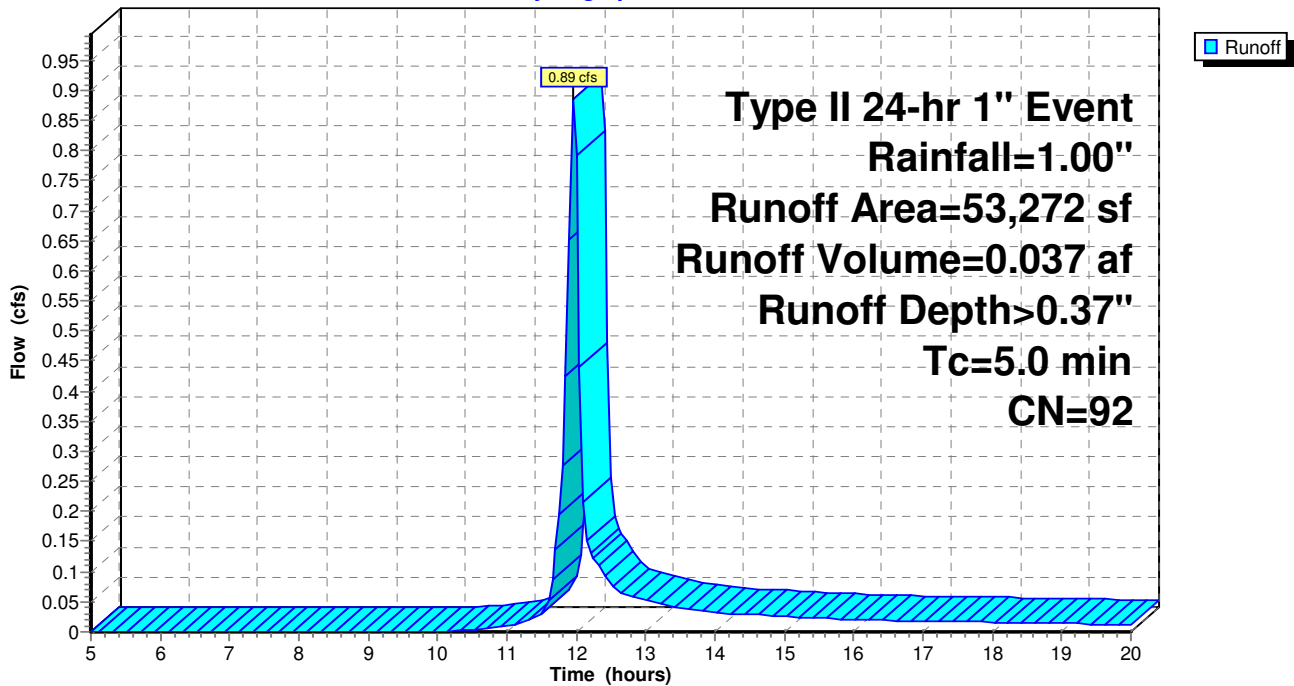
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 1" Event Rainfall=1.00"

Area (sf)	CN	Description
45,046	98	Paved parking, HSG B
8,226	61	>75% Grass cover, Good, HSG B
53,272	92	Weighted Average
8,226		15.44% Pervious Area
45,046		84.56% Impervious Area

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

**Subcatchment 2S: Drainage Area #2**

Hydrograph



**UWA10002 - Proposed**

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Type II 24-hr 1" Event Rainfall=1.00"

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Page 7

**Summary for Subcatchment 3S: Drainage Area #3**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.39 cfs @ 11.96 hrs, Volume= 0.059 af, Depth> 0.41"

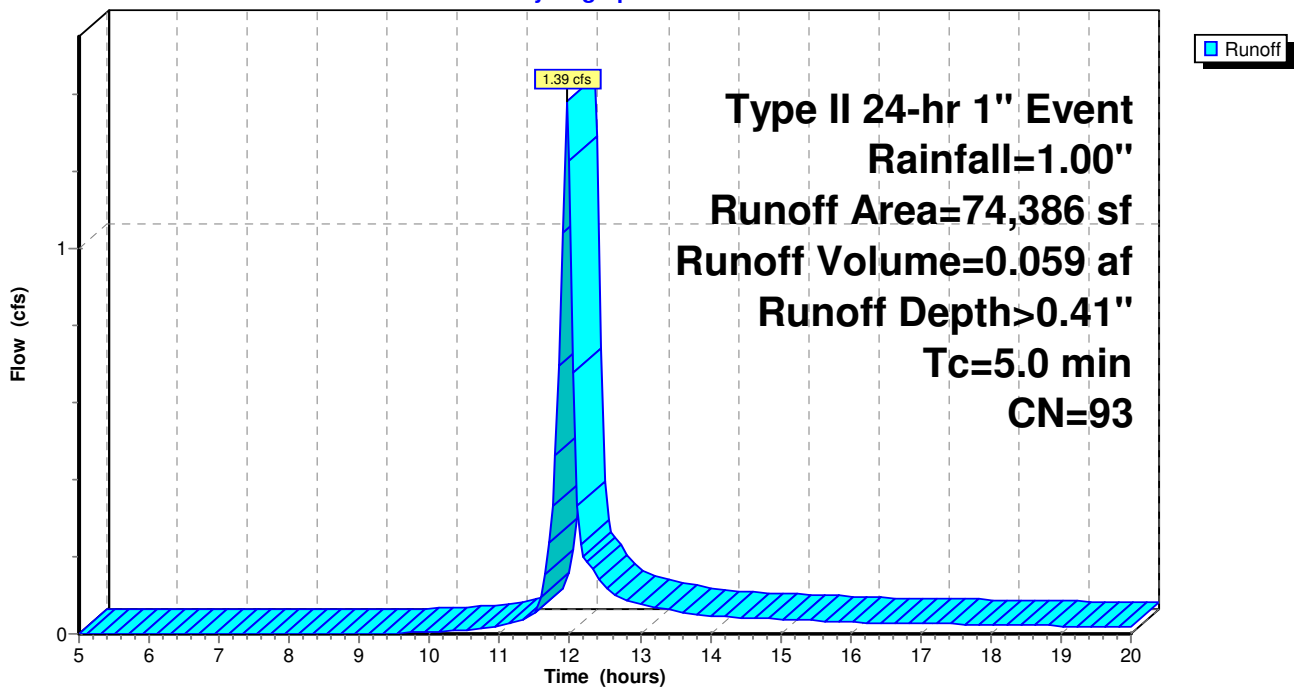
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 1" Event Rainfall=1.00"

Area (sf)	CN	Description
64,715	98	Paved parking, HSG B
9,671	61	>75% Grass cover, Good, HSG B
74,386	93	Weighted Average
9,671		13.00% Pervious Area
64,715		87.00% Impervious Area

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

**Subcatchment 3S: Drainage Area #3**

Hydrograph



# UWA10002 - Proposed

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Type II 24-hr 1" Event Rainfall=1.00"

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Page 8

## Summary for Subcatchment 8S: Drainage Area #4

[49] Hint:  $T_c < 2dt$  may require smaller dt

Runoff = 1.16 cfs @ 11.95 hrs, Volume= 0.054 af, Depth> 0.74"

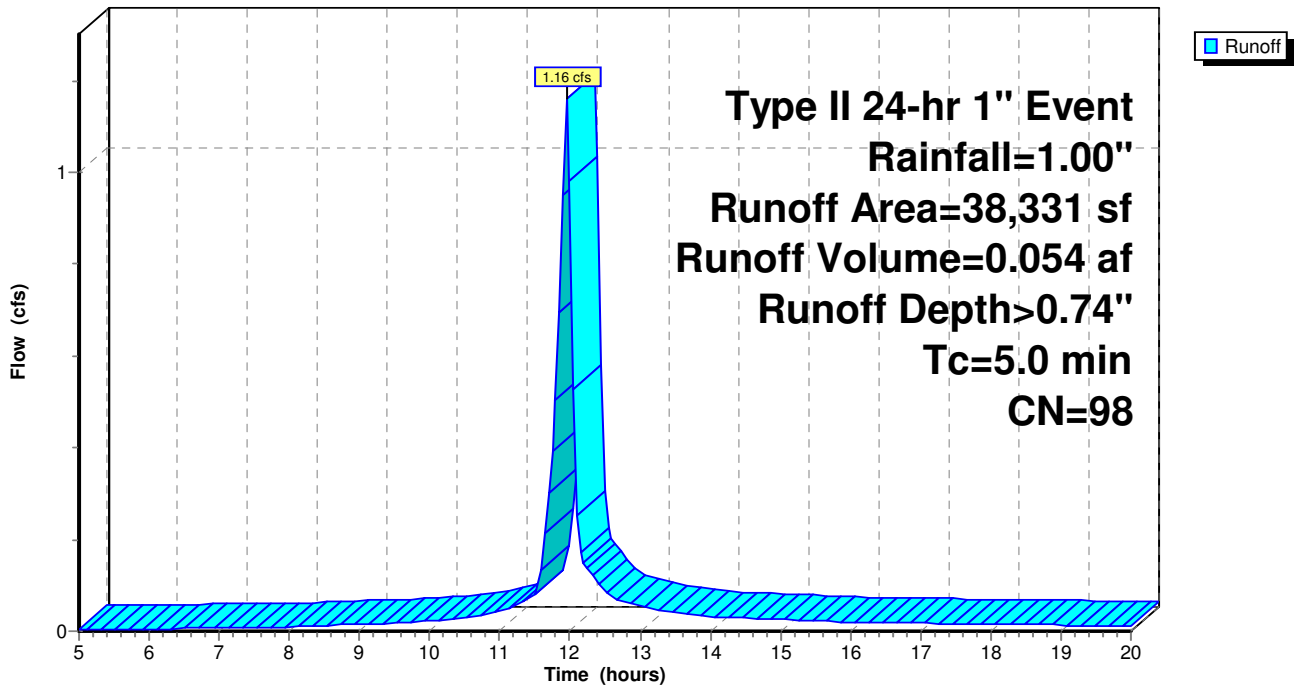
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 1" Event Rainfall=1.00"

Area (sf)	CN	Description
38,331	98	Paved parking, HSG B
0	61	>75% Grass cover, Good, HSG B
38,331	98	Weighted Average
38,331		100.00% Impervious Area

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

## Subcatchment 8S: Drainage Area #4

Hydrograph



**UWA10002 - Proposed**

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Type II 24-hr 1" Event Rainfall=1.00"

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Page 9

**Summary for Subcatchment 10S: Direct Discharge #1**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.00 cfs @ 12.01 hrs, Volume= 0.000 af, Depth> 0.07"

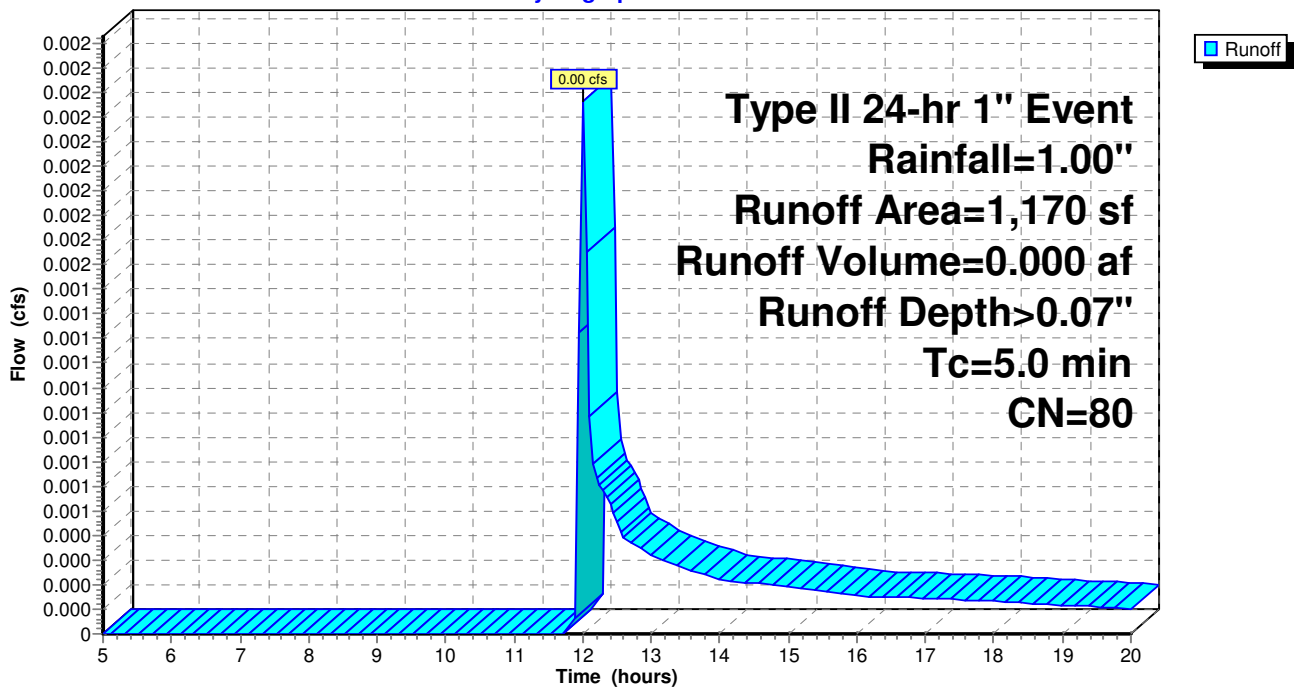
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 1" Event Rainfall=1.00"

Area (sf)	CN	Description
587	98	Paved parking, HSG B
583	61	>75% Grass cover, Good, HSG B
1,170	80	Weighted Average
583		49.83% Pervious Area
587		50.17% Impervious Area

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

**Subcatchment 10S: Direct Discharge #1**

Hydrograph



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Type II 24-hr 1" Event Rainfall=1.00"

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**Summary for Subcatchment 11S: Direct Discharge #2**

[49] Hint:  $T_c < 2dt$  may require smaller dt

Runoff = 0.01 cfs @ 11.99 hrs, Volume= 0.001 af, Depth> 0.11"

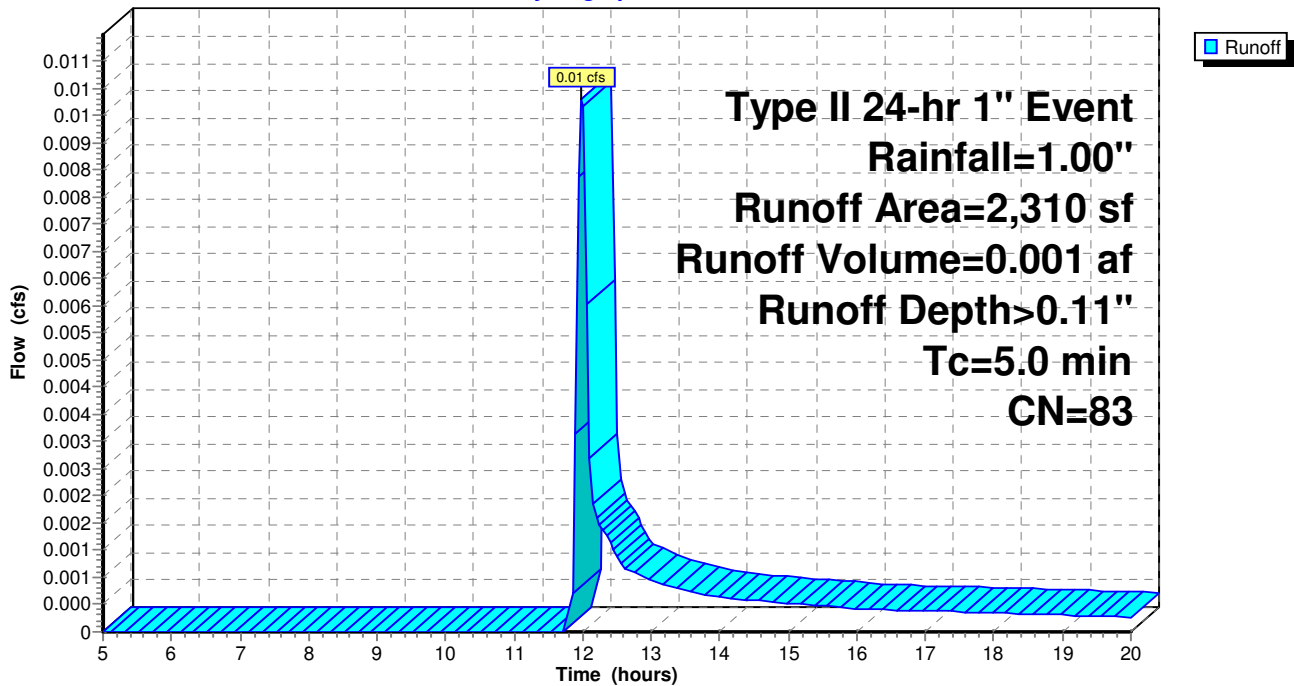
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 1" Event Rainfall=1.00"

Area (sf)	CN	Description
1,385	98	Paved parking, HSG B
925	61	>75% Grass cover, Good, HSG B
2,310	83	Weighted Average
925		40.04% Pervious Area
1,385		59.96% Impervious Area

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

**Subcatchment 11S: Direct Discharge #2**

Hydrograph



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Type II 24-hr 1" Event Rainfall=1.00"

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**Summary for Subcatchment 12S: Direct Discharge #3**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.00 cfs @ 15.17 hrs, Volume= 0.000 af, Depth> 0.01"

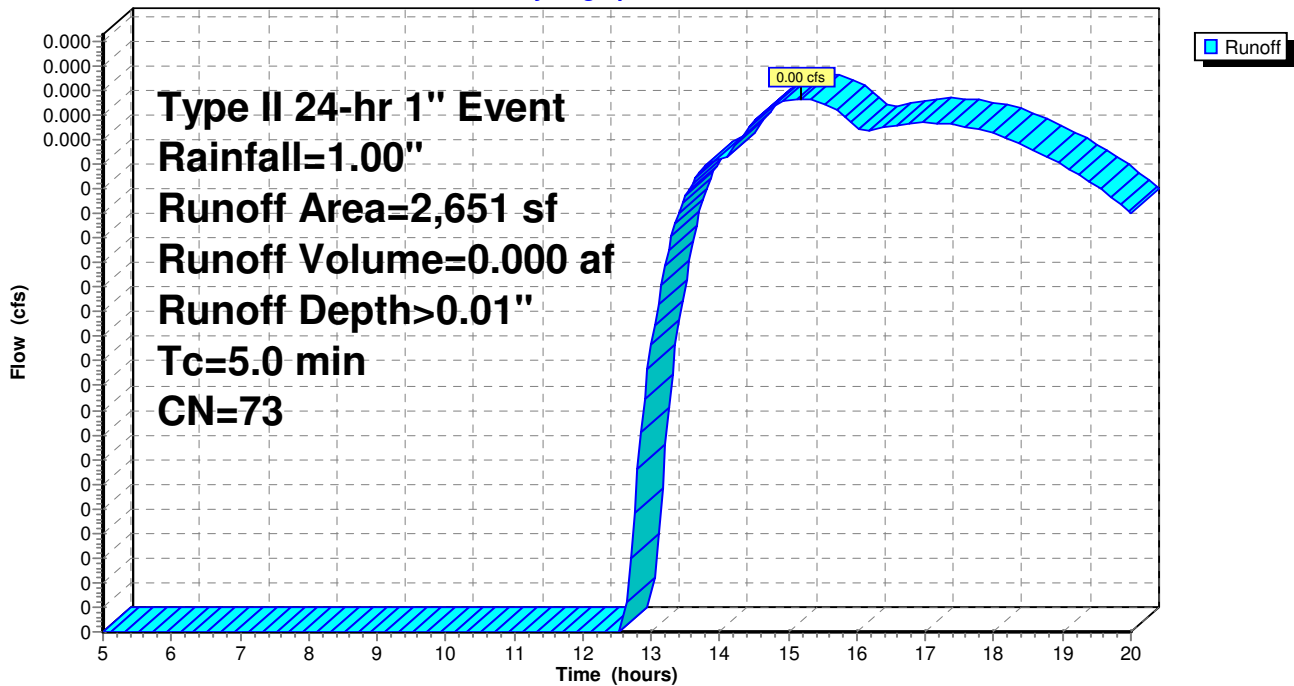
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 1" Event Rainfall=1.00"

Area (sf)	CN	Description
888	98	Paved parking, HSG B
1,763	61	>75% Grass cover, Good, HSG B
2,651	73	Weighted Average
1,763		66.50% Pervious Area
888		33.50% Impervious Area

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

**Subcatchment 12S: Direct Discharge #3**

Hydrograph



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Type II 24-hr 1" Event Rainfall=1.00"

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**Summary for Subcatchment 13S: Direct Discharge #4**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.00 cfs @ 12.05 hrs, Volume= 0.000 af, Depth> 0.04"

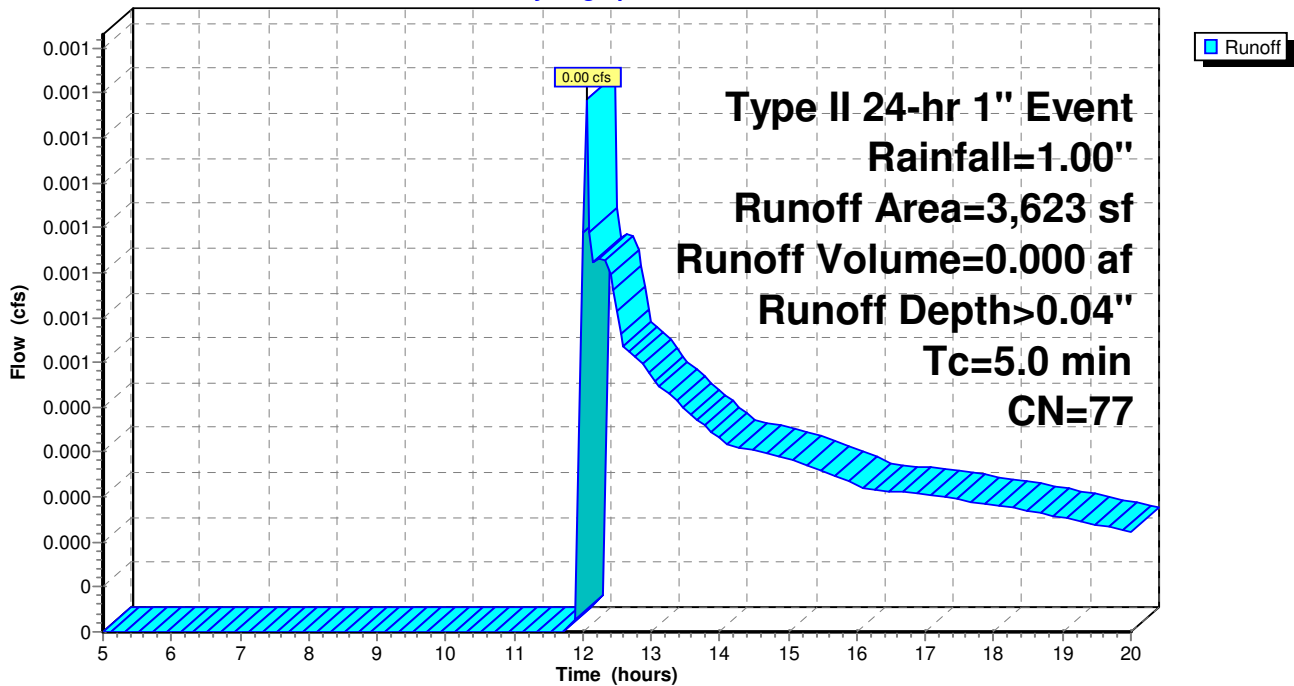
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 1" Event Rainfall=1.00"

Area (sf)	CN	Description
1,521	98	Paved parking, HSG B
2,102	61	>75% Grass cover, Good, HSG B
3,623	77	Weighted Average
2,102		58.02% Pervious Area
1,521		41.98% Impervious Area

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

**Subcatchment 13S: Direct Discharge #4**

Hydrograph



### Summary for Reach 4R: NW Sunwood Catch Basin

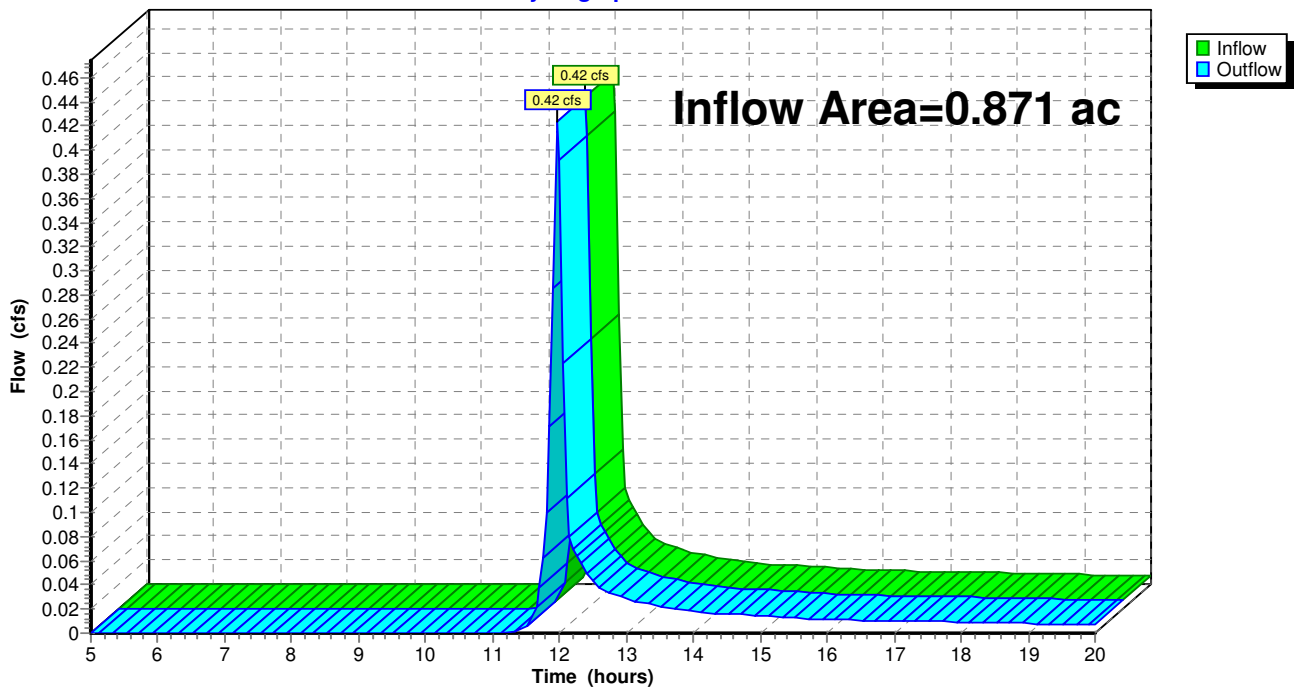
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.871 ac, 74.46% Impervious, Inflow Depth > 0.25" for 1" Event event  
Inflow = 0.42 cfs @ 11.97 hrs, Volume= 0.018 af  
Outflow = 0.42 cfs @ 11.97 hrs, Volume= 0.018 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 4R: NW Sunwood Catch Basin

Hydrograph



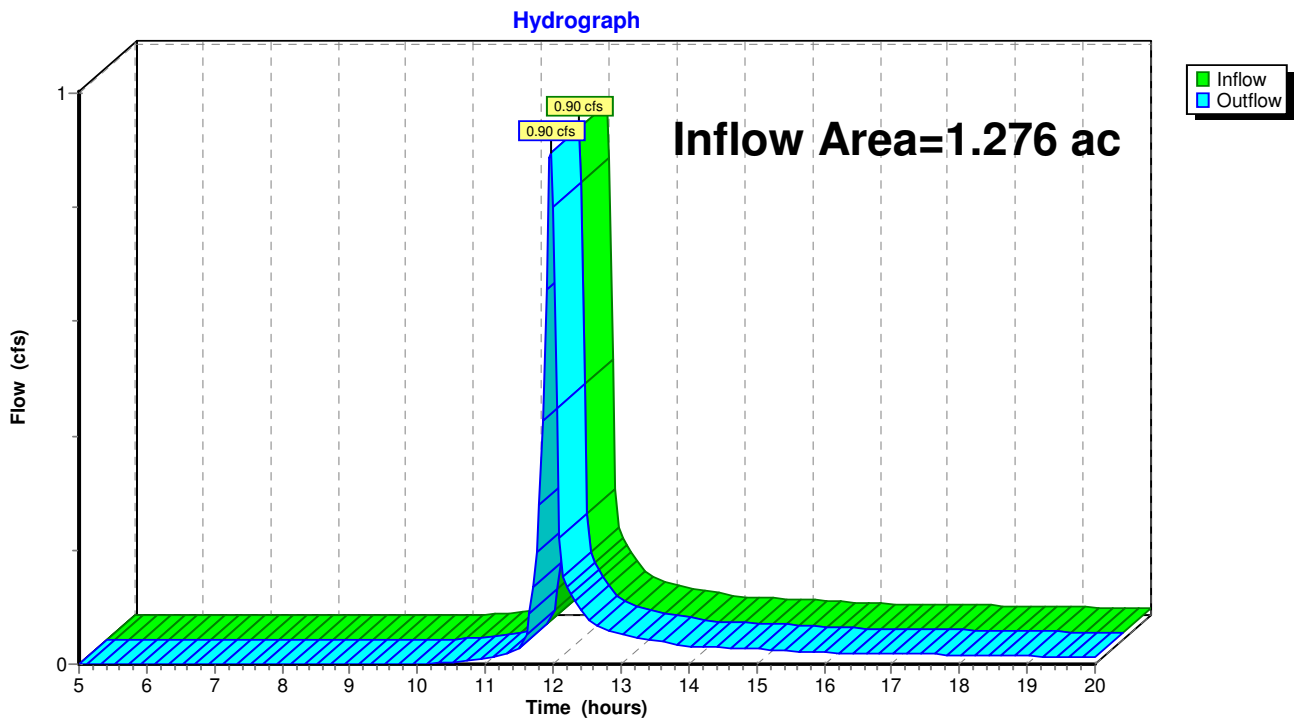
### Summary for Reach 5R: S Civic Center Catch Basin

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

Inflow Area = 1.276 ac, 83.54% Impervious, Inflow Depth > 0.36" for 1" Event event  
Inflow = 0.90 cfs @ 11.96 hrs, Volume= 0.038 af  
Outflow = 0.90 cfs @ 11.96 hrs, Volume= 0.038 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 5R: S Civic Center Catch Basin



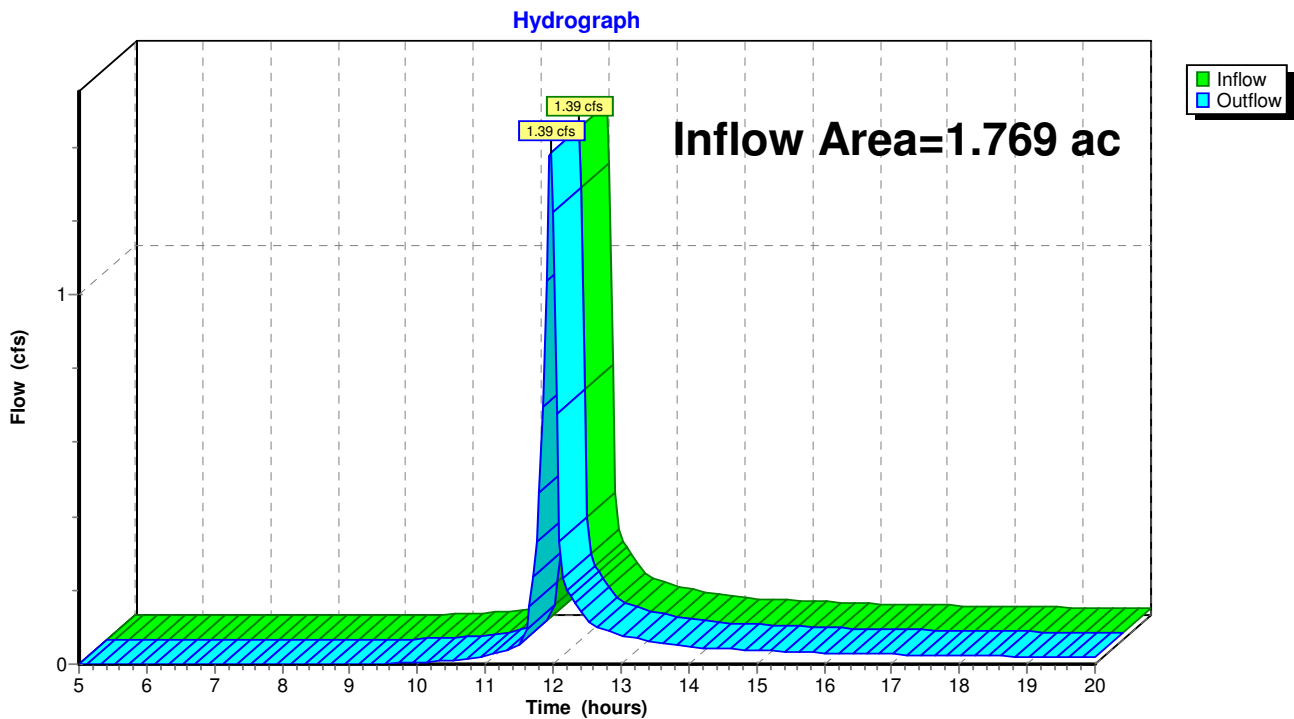
### Summary for Reach 6R: N Sunwood Catch Basin

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

Inflow Area = 1.769 ac, 85.16% Impervious, Inflow Depth > 0.40" for 1" Event event  
Inflow = 1.39 cfs @ 11.96 hrs, Volume= 0.059 af  
Outflow = 1.39 cfs @ 11.96 hrs, Volume= 0.059 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 6R: N Sunwood Catch Basin



### Summary for Reach 7R: Total Site

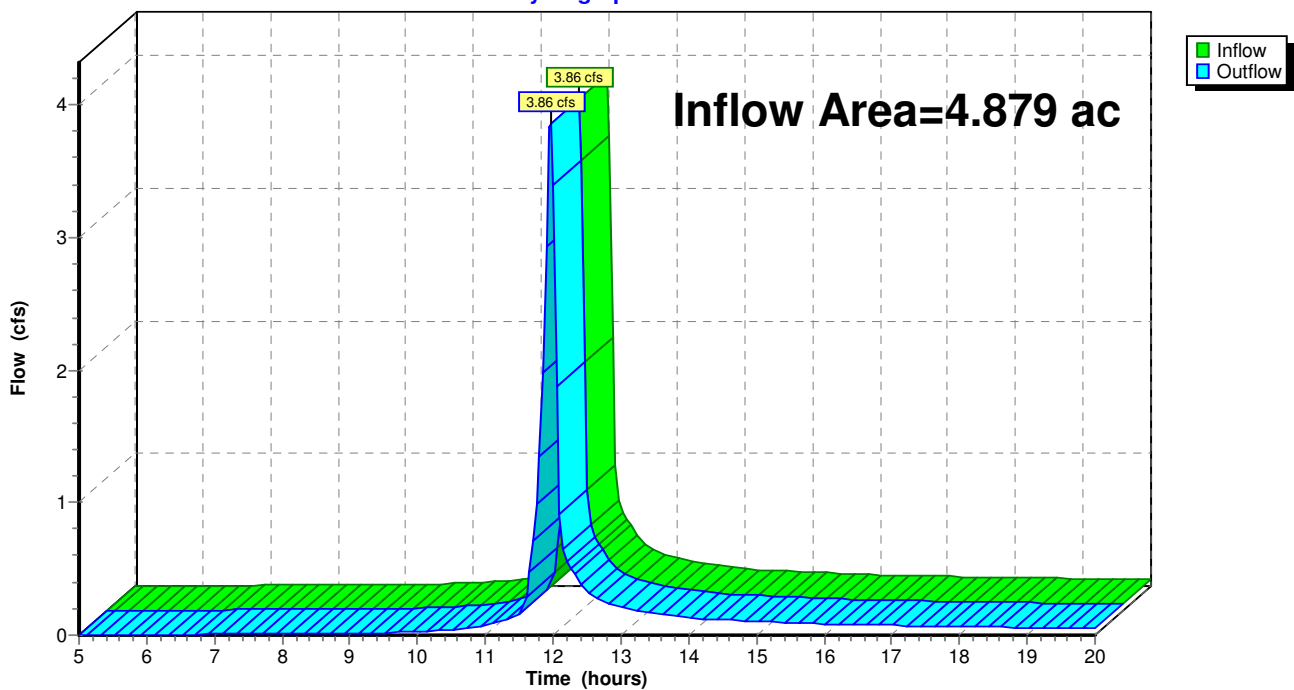
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.879 ac, 84.76% Impervious, Inflow Depth > 0.42" for 1" Event event  
Inflow = 3.86 cfs @ 11.96 hrs, Volume= 0.169 af  
Outflow = 3.86 cfs @ 11.96 hrs, Volume= 0.169 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 7R: Total Site

Hydrograph



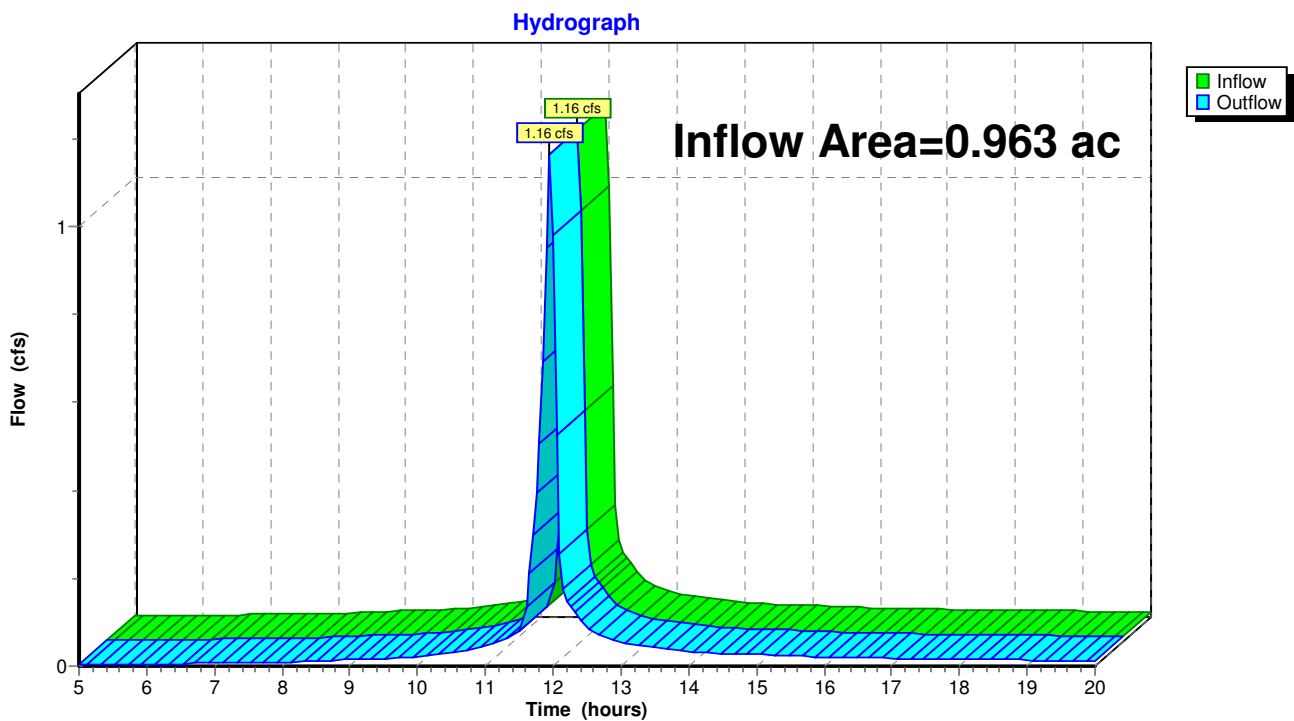
### Summary for Reach 9R: NE Sunwood Catch Basin

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

Inflow Area = 0.963 ac, 94.99% Impervious, Inflow Depth > 0.68" for 1" Event event  
Inflow = 1.16 cfs @ 11.95 hrs, Volume= 0.055 af  
Outflow = 1.16 cfs @ 11.95 hrs, Volume= 0.055 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 9R: NE Sunwood Catch Basin



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Type II 24-hr 2-yr Rainfall=2.75"

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
 Runoff by SCS TR-20 method, UH=SCS  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

<b>Subcatchment 1S: Drainage Area #1</b>	Runoff Area=36,775 sf 75.23% Impervious Runoff Depth>1.56" Tc=5.0 min CN=89 Runoff=2.50 cfs 0.110 af
<b>Subcatchment 2S: Drainage Area #2</b>	Runoff Area=53,272 sf 84.56% Impervious Runoff Depth>1.80" Tc=5.0 min CN=92 Runoff=4.07 cfs 0.184 af
<b>Subcatchment 3S: Drainage Area #3</b>	Runoff Area=74,386 sf 87.00% Impervious Runoff Depth>1.89" Tc=5.0 min CN=93 Runoff=5.88 cfs 0.269 af
<b>Subcatchment 8S: Drainage Area #4</b>	Runoff Area=38,331 sf 100.00% Impervious Runoff Depth>2.34" Tc=5.0 min CN=98 Runoff=3.44 cfs 0.171 af
<b>Subcatchment 10S: Direct Discharge #1</b>	Runoff Area=1,170 sf 50.17% Impervious Runoff Depth>0.97" Tc=5.0 min CN=80 Runoff=0.05 cfs 0.002 af
<b>Subcatchment 11S: Direct Discharge #2</b>	Runoff Area=2,310 sf 59.96% Impervious Runoff Depth>1.14" Tc=5.0 min CN=83 Runoff=0.12 cfs 0.005 af
<b>Subcatchment 12S: Direct Discharge #3</b>	Runoff Area=2,651 sf 33.50% Impervious Runoff Depth>0.63" Tc=5.0 min CN=73 Runoff=0.07 cfs 0.003 af
<b>Subcatchment 13S: Direct Discharge #4</b>	Runoff Area=3,623 sf 41.98% Impervious Runoff Depth>0.81" Tc=5.0 min CN=77 Runoff=0.13 cfs 0.006 af
<b>Reach 4R: NW Sunwood Catch Basin</b>	Inflow=2.55 cfs 0.112 af Outflow=2.55 cfs 0.112 af
<b>Reach 5R: S Civic Center Catch Basin</b>	Inflow=4.19 cfs 0.189 af Outflow=4.19 cfs 0.189 af
<b>Reach 6R: N Sunwood Catch Basin</b>	Inflow=5.96 cfs 0.272 af Outflow=5.96 cfs 0.272 af
<b>Reach 7R: Total Site</b>	Inflow=16.27 cfs 0.749 af Outflow=16.27 cfs 0.749 af
<b>Reach 9R: NE Sunwood Catch Basin</b>	Inflow=3.58 cfs 0.177 af Outflow=3.58 cfs 0.177 af

**Total Runoff Area = 4.879 ac Runoff Volume = 0.749 af Average Runoff Depth = 1.84"**  
**15.24% Pervious = 0.743 ac 84.76% Impervious = 4.135 ac**

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Type II 24-hr 2-yr Rainfall=2.75"

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**Summary for Subcatchment 1S: Drainage Area #1**

[49] Hint:  $T_c < 2dt$  may require smaller dt

Runoff = 2.50 cfs @ 11.96 hrs, Volume= 0.110 af, Depth> 1.56"

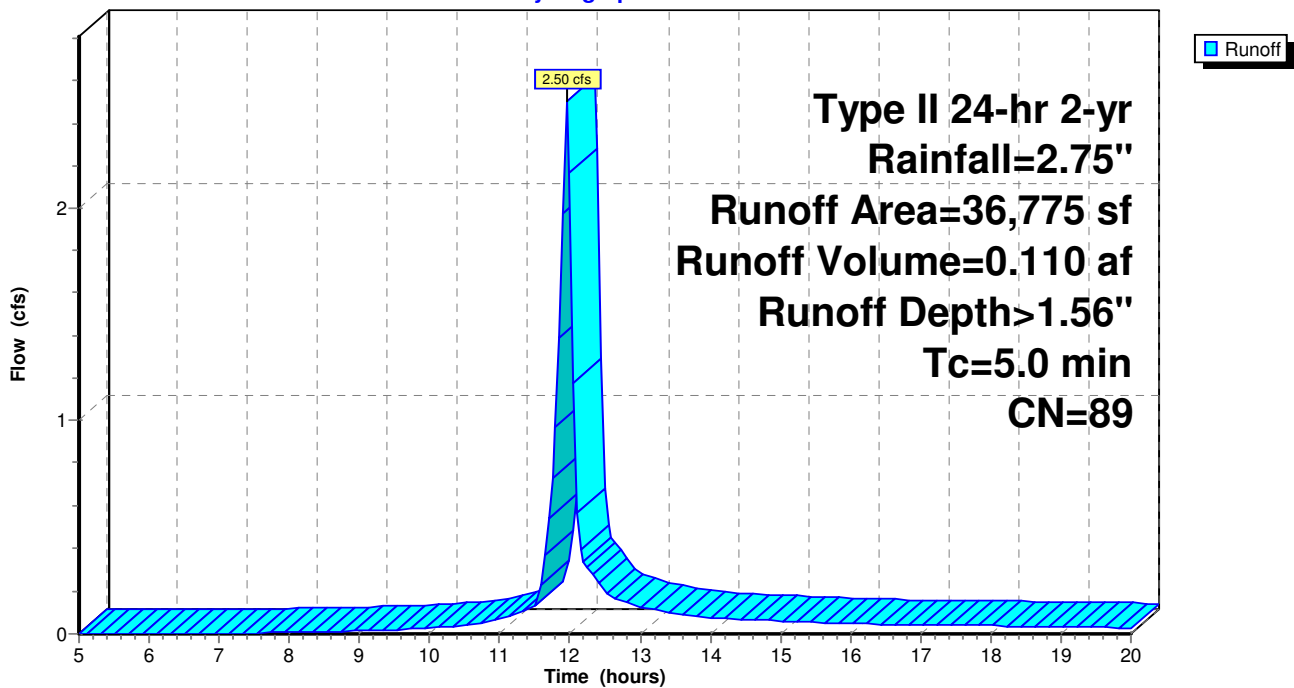
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 2-yr Rainfall=2.75"

Area (sf)	CN	Description
27,665	98	Paved parking, HSG B
9,110	61	>75% Grass cover, Good, HSG B
36,775	89	Weighted Average
9,110		24.77% Pervious Area
27,665		75.23% Impervious Area

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

**Subcatchment 1S: Drainage Area #1**

Hydrograph



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**Summary for Subcatchment 2S: Drainage Area #2**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 4.07 cfs @ 11.95 hrs, Volume= 0.184 af, Depth> 1.80"

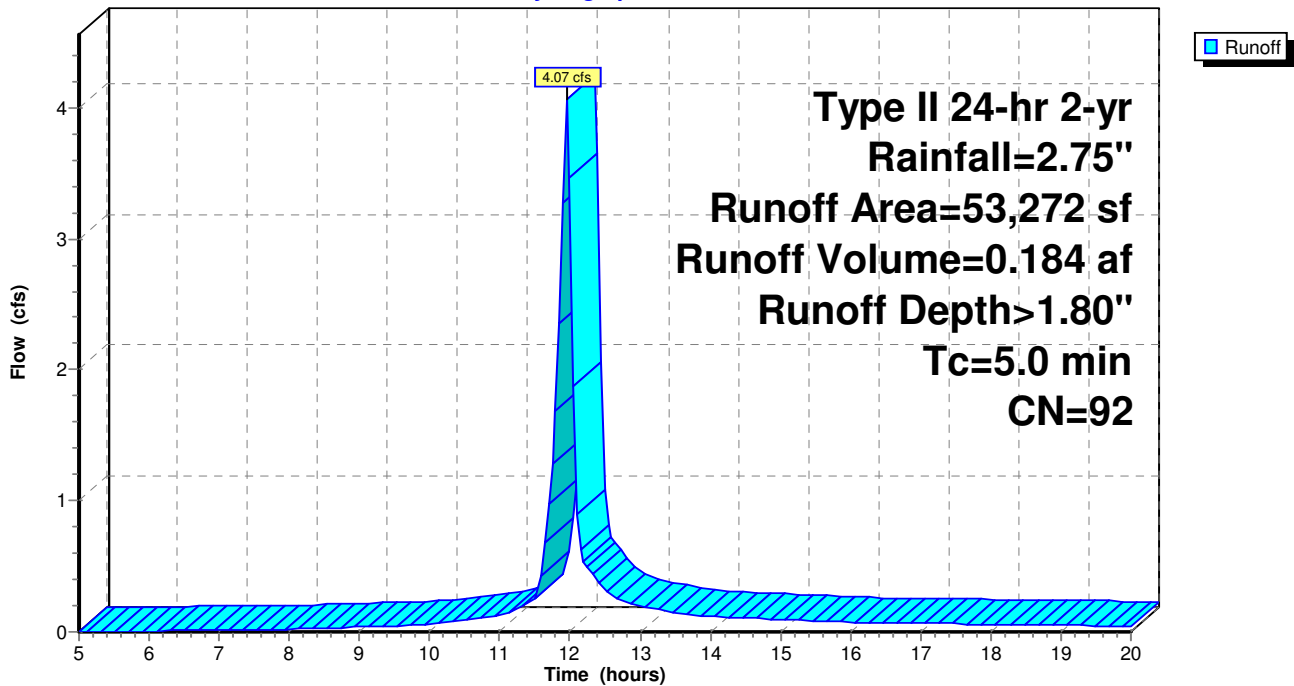
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 2-yr Rainfall=2.75"

Area (sf)	CN	Description
45,046	98	Paved parking, HSG B
8,226	61	>75% Grass cover, Good, HSG B
53,272	92	Weighted Average
8,226		15.44% Pervious Area
45,046		84.56% Impervious Area

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

**Subcatchment 2S: Drainage Area #2**

Hydrograph



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Type II 24-hr 2-yr Rainfall=2.75"

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**Summary for Subcatchment 3S: Drainage Area #3**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 5.88 cfs @ 11.95 hrs, Volume= 0.269 af, Depth> 1.89"

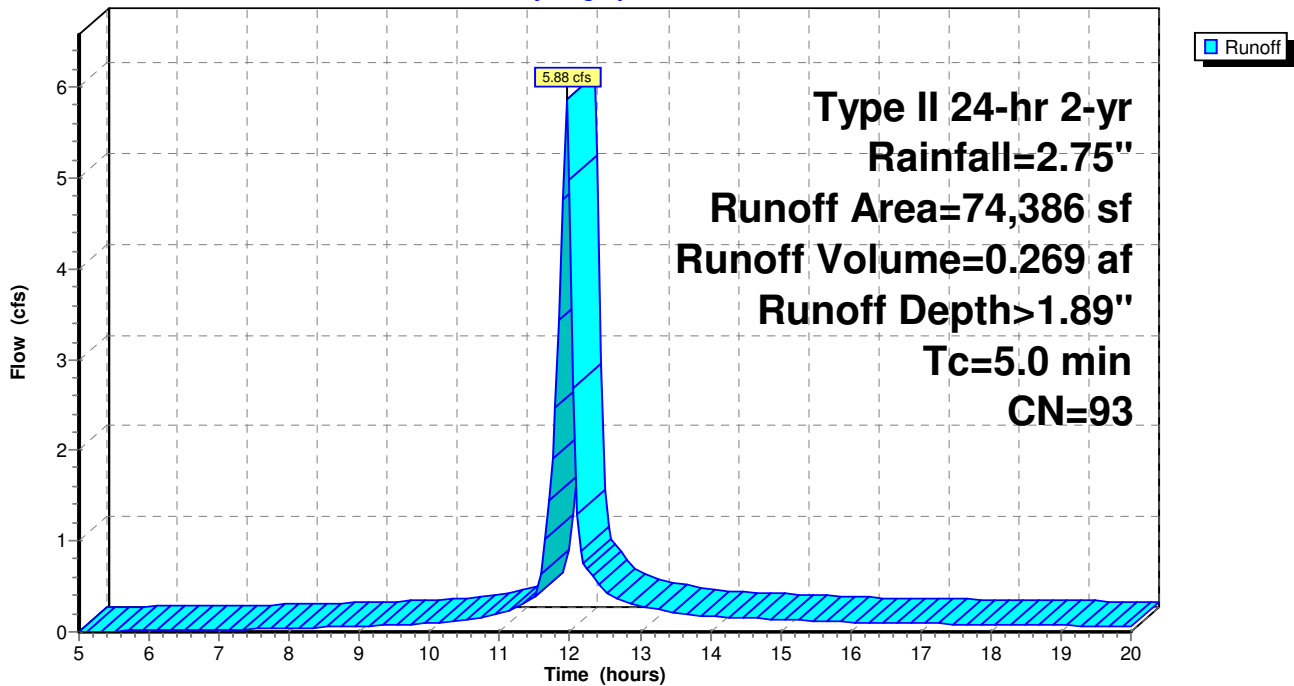
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 2-yr Rainfall=2.75"

Area (sf)	CN	Description
64,715	98	Paved parking, HSG B
9,671	61	>75% Grass cover, Good, HSG B
74,386	93	Weighted Average
9,671		13.00% Pervious Area
64,715		87.00% Impervious Area

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

**Subcatchment 3S: Drainage Area #3**

Hydrograph



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Type II 24-hr 2-yr Rainfall=2.75"

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## Summary for Subcatchment 8S: Drainage Area #4

[49] Hint:  $T_c < 2dt$  may require smaller dt

Runoff = 3.44 cfs @ 11.95 hrs, Volume= 0.171 af, Depth> 2.34"

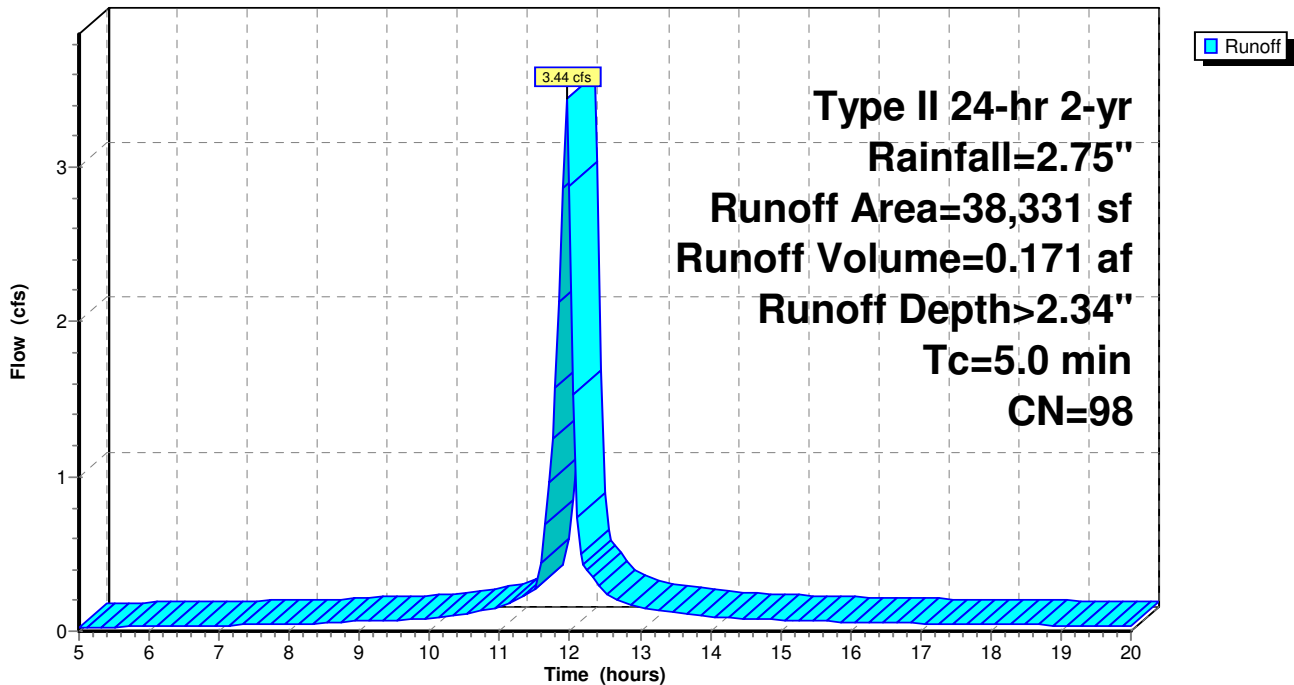
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 2-yr Rainfall=2.75"

Area (sf)	CN	Description
38,331	98	Paved parking, HSG B
0	61	>75% Grass cover, Good, HSG B
38,331	98	Weighted Average
38,331		100.00% Impervious Area

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

## Subcatchment 8S: Drainage Area #4

Hydrograph



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Type II 24-hr 2-yr Rainfall=2.75"

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**Summary for Subcatchment 10S: Direct Discharge #1**

[49] Hint:  $T_c < 2dt$  may require smaller dt

Runoff = 0.05 cfs @ 11.96 hrs, Volume= 0.002 af, Depth> 0.97"

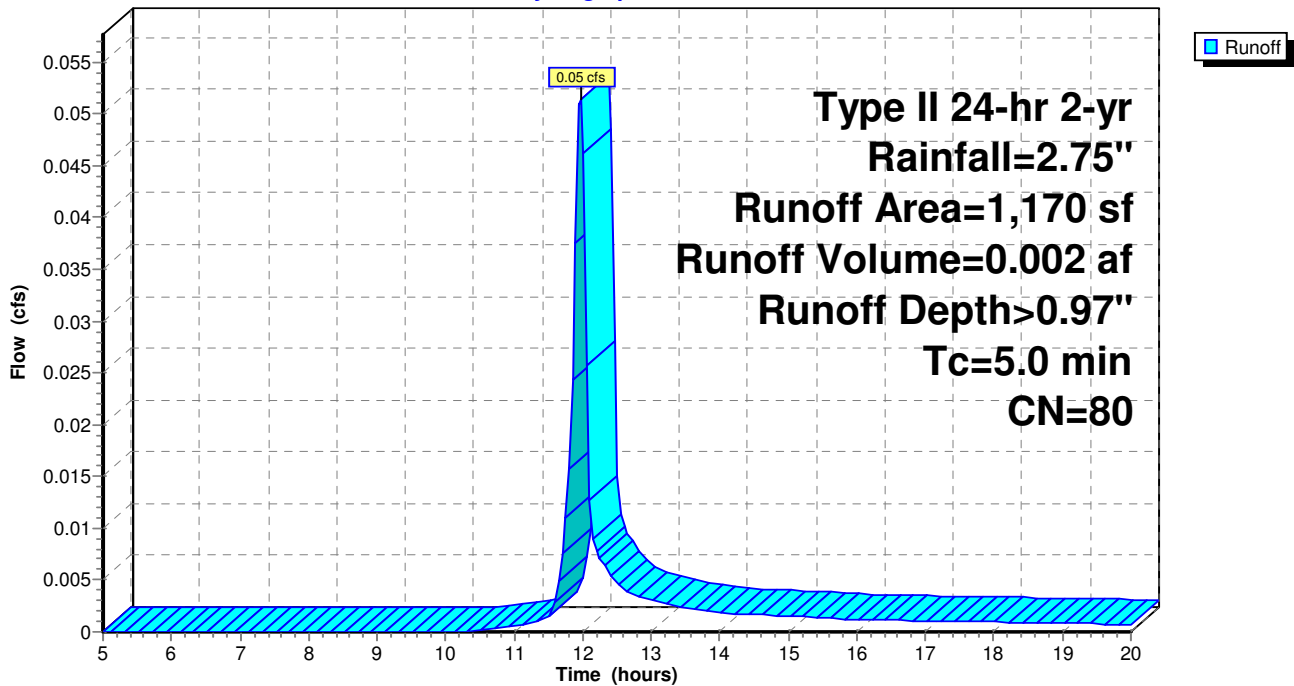
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 2-yr Rainfall=2.75"

Area (sf)	CN	Description
587	98	Paved parking, HSG B
583	61	>75% Grass cover, Good, HSG B
1,170	80	Weighted Average
583		49.83% Pervious Area
587		50.17% Impervious Area

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

**Subcatchment 10S: Direct Discharge #1**

Hydrograph



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Type II 24-hr 2-yr Rainfall=2.75"

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## Summary for Subcatchment 11S: Direct Discharge #2

[49] Hint:  $T_c < 2dt$  may require smaller dt

Runoff = 0.12 cfs @ 11.96 hrs, Volume= 0.005 af, Depth> 1.14"

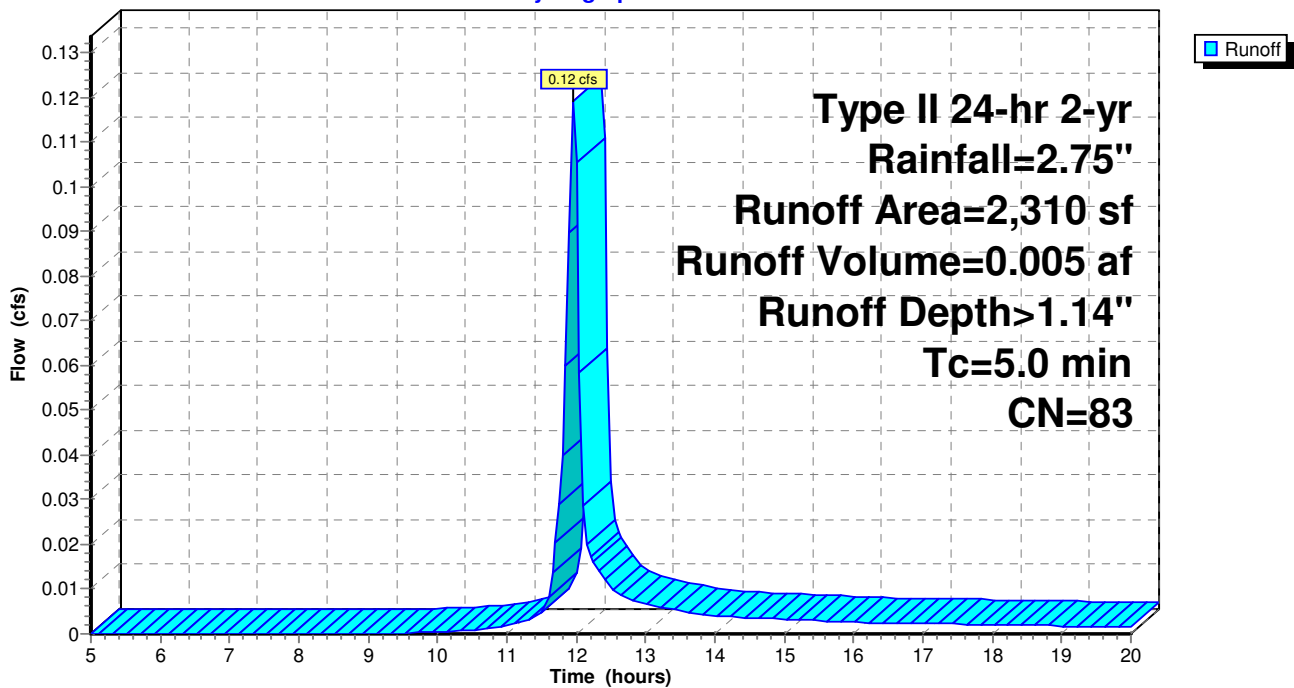
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 2-yr Rainfall=2.75"

Area (sf)	CN	Description
1,385	98	Paved parking, HSG B
925	61	>75% Grass cover, Good, HSG B
2,310	83	Weighted Average
925		40.04% Pervious Area
1,385		59.96% Impervious Area

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

## Subcatchment 11S: Direct Discharge #2

Hydrograph



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Type II 24-hr 2-yr Rainfall=2.75"

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## Summary for Subcatchment 12S: Direct Discharge #3

[49] Hint:  $T_c < 2dt$  may require smaller dt

Runoff = 0.07 cfs @ 11.97 hrs, Volume= 0.003 af, Depth> 0.63"

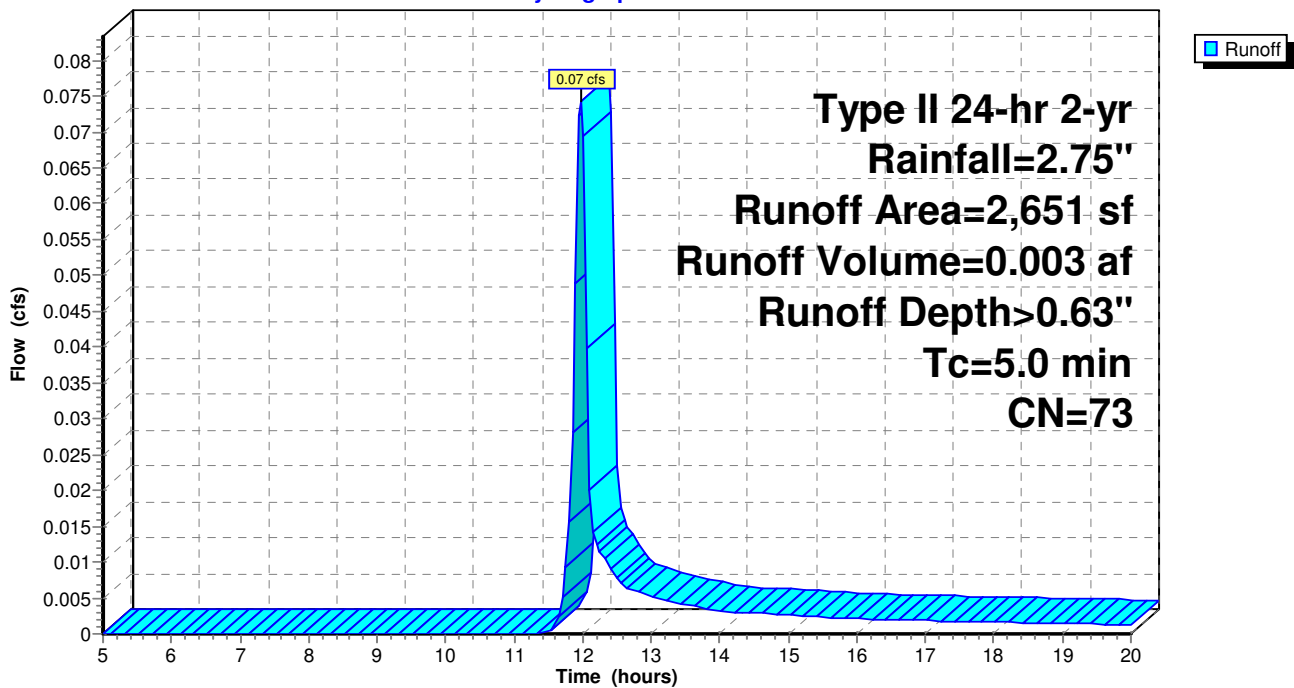
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 2-yr Rainfall=2.75"

Area (sf)	CN	Description
888	98	Paved parking, HSG B
1,763	61	>75% Grass cover, Good, HSG B
2,651	73	Weighted Average
1,763		66.50% Pervious Area
888		33.50% Impervious Area

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

## Subcatchment 12S: Direct Discharge #3

Hydrograph



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Type II 24-hr 2-yr Rainfall=2.75"

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**Summary for Subcatchment 13S: Direct Discharge #4**

[49] Hint:  $T_c < 2dt$  may require smaller dt

Runoff = 0.13 cfs @ 11.96 hrs, Volume= 0.006 af, Depth> 0.81"

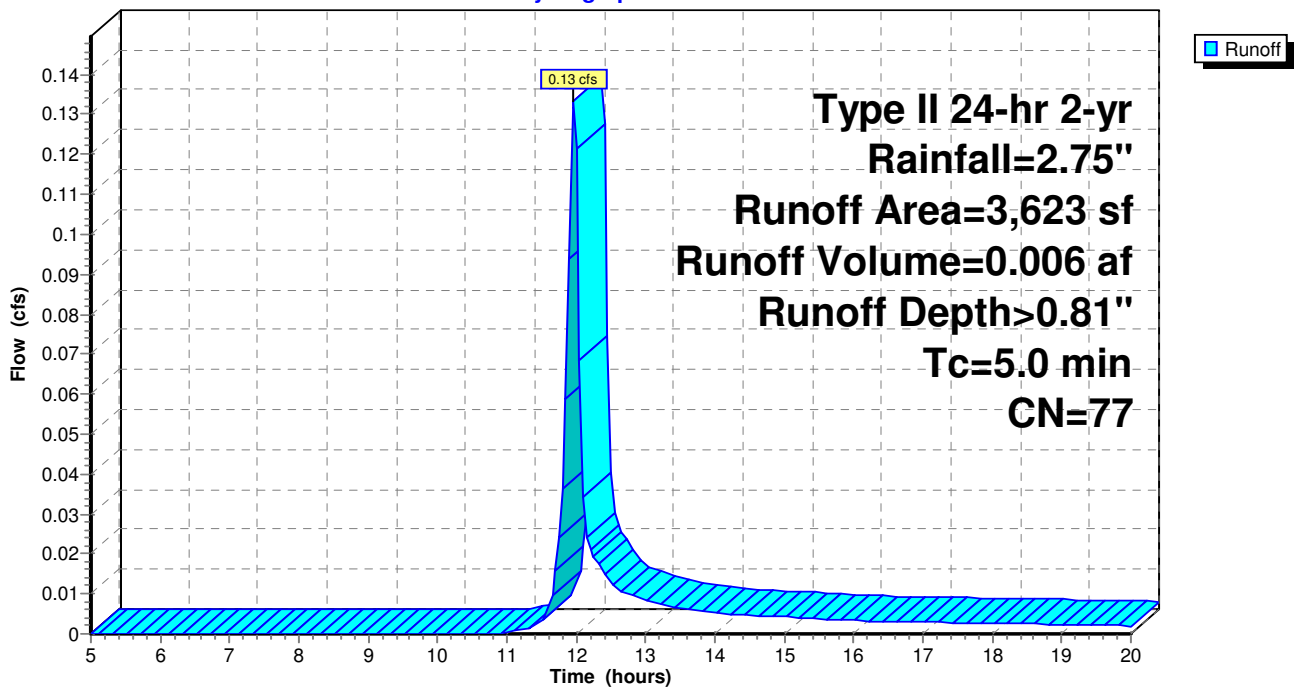
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 2-yr Rainfall=2.75"

Area (sf)	CN	Description
1,521	98	Paved parking, HSG B
2,102	61	>75% Grass cover, Good, HSG B
3,623	77	Weighted Average
2,102		58.02% Pervious Area
1,521		41.98% Impervious Area

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

**Subcatchment 13S: Direct Discharge #4**

Hydrograph



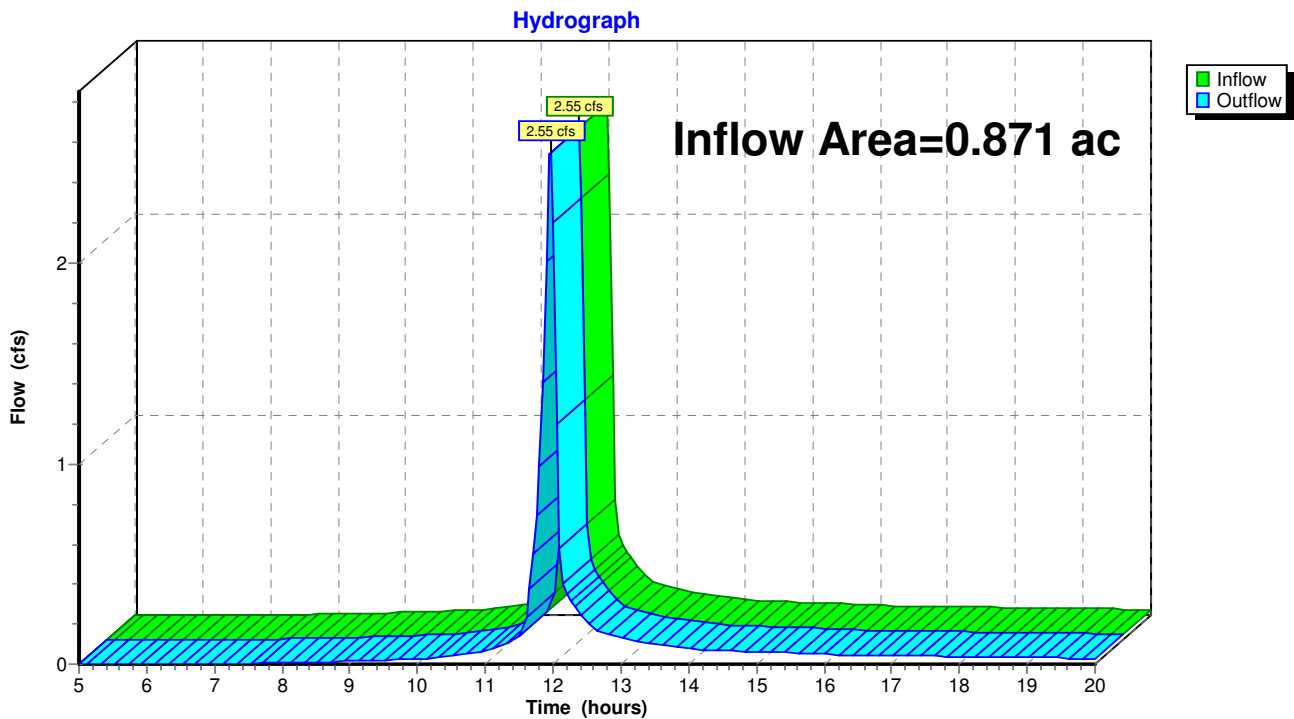
### Summary for Reach 4R: NW Sunwood Catch Basin

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

Inflow Area = 0.871 ac, 74.46% Impervious, Inflow Depth > 1.54" for 2-yr event  
Inflow = 2.55 cfs @ 11.96 hrs, Volume= 0.112 af  
Outflow = 2.55 cfs @ 11.96 hrs, Volume= 0.112 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 4R: NW Sunwood Catch Basin



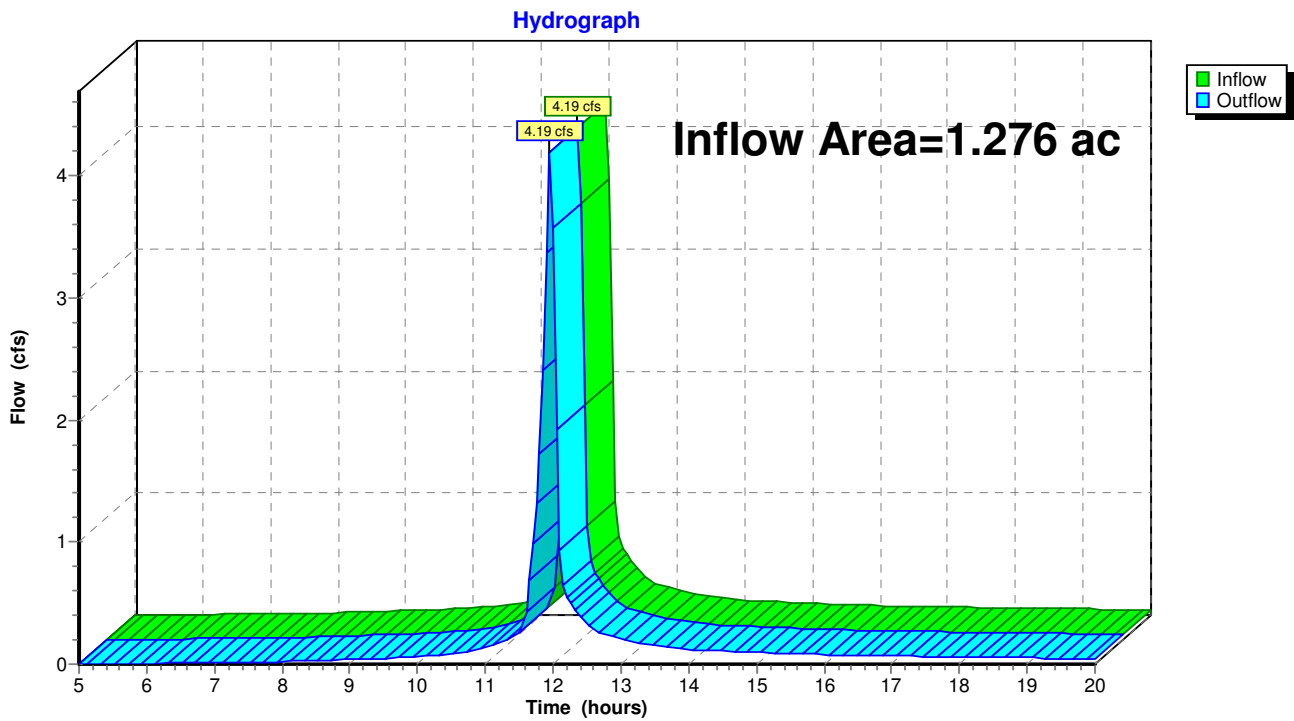
### Summary for Reach 5R: S Civic Center Catch Basin

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

Inflow Area = 1.276 ac, 83.54% Impervious, Inflow Depth > 1.77" for 2-yr event  
Inflow = 4.19 cfs @ 11.95 hrs, Volume= 0.189 af  
Outflow = 4.19 cfs @ 11.95 hrs, Volume= 0.189 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 5R: S Civic Center Catch Basin



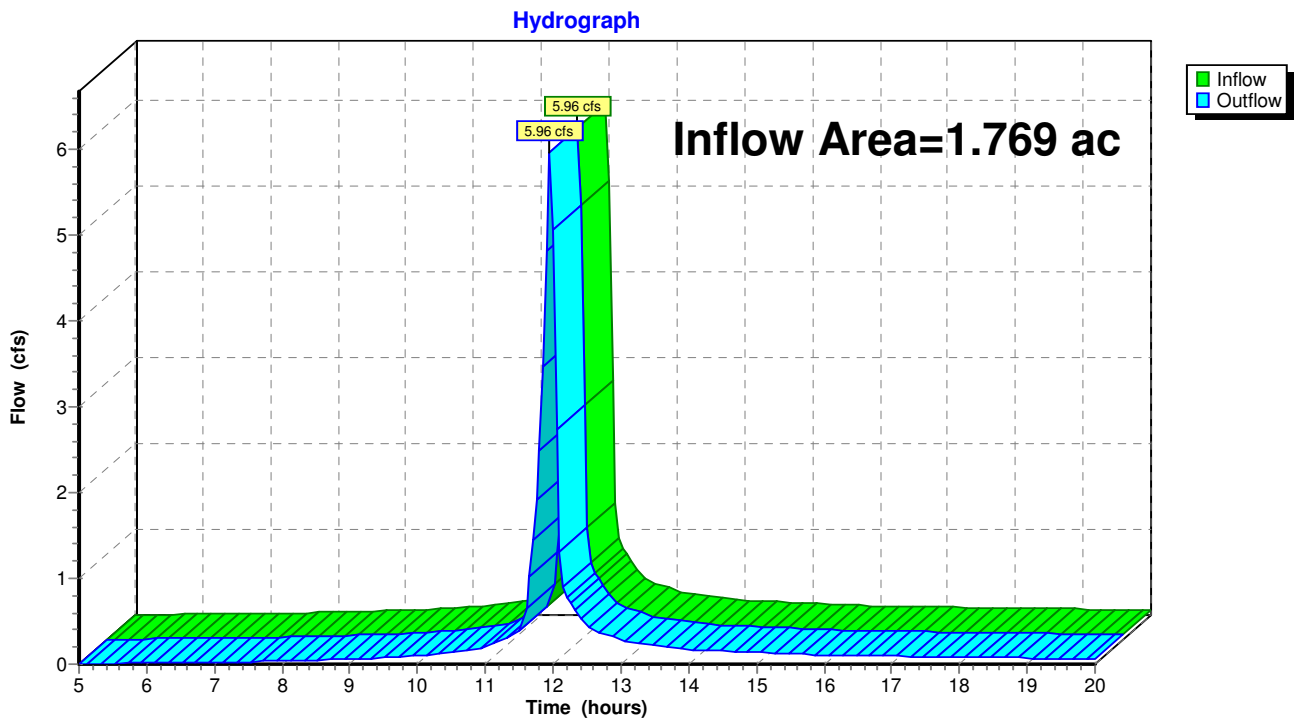
### Summary for Reach 6R: N Sunwood Catch Basin

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

Inflow Area = 1.769 ac, 85.16% Impervious, Inflow Depth > 1.85" for 2-yr event  
Inflow = 5.96 cfs @ 11.95 hrs, Volume= 0.272 af  
Outflow = 5.96 cfs @ 11.95 hrs, Volume= 0.272 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 6R: N Sunwood Catch Basin



### Summary for Reach 7R: Total Site

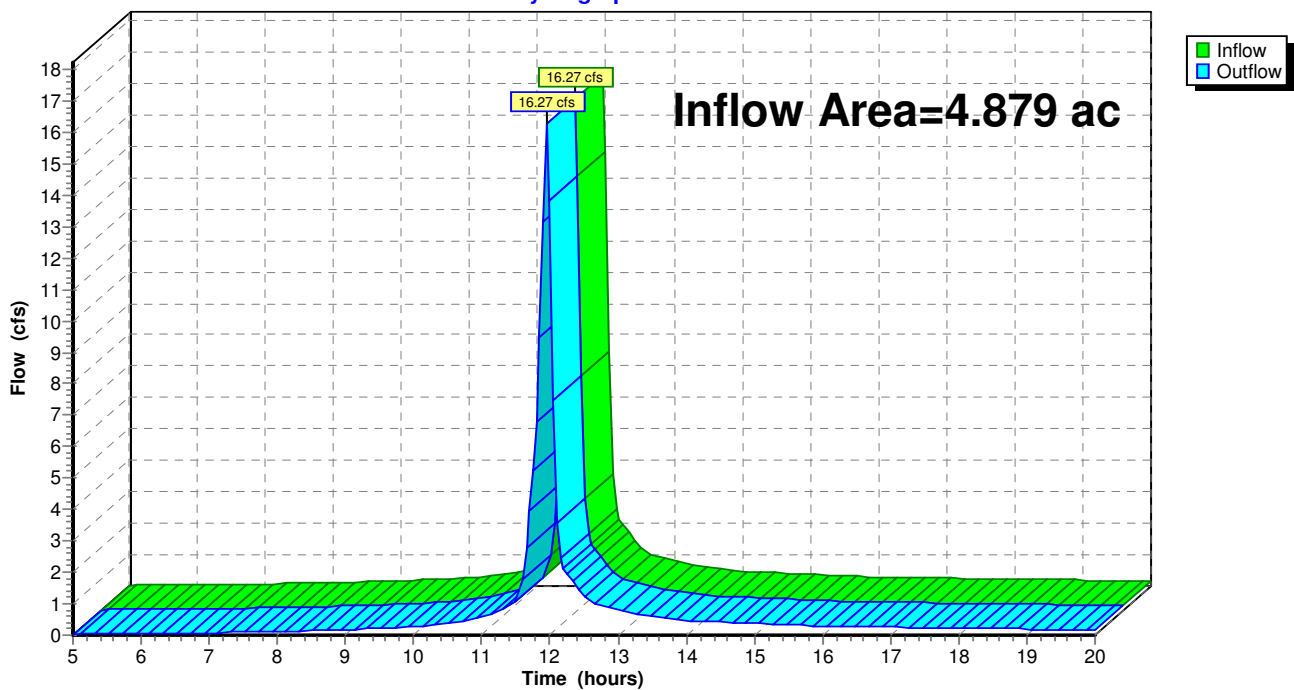
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.879 ac, 84.76% Impervious, Inflow Depth > 1.84" for 2-yr event  
Inflow = 16.27 cfs @ 11.95 hrs, Volume= 0.749 af  
Outflow = 16.27 cfs @ 11.95 hrs, Volume= 0.749 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 7R: Total Site

Hydrograph



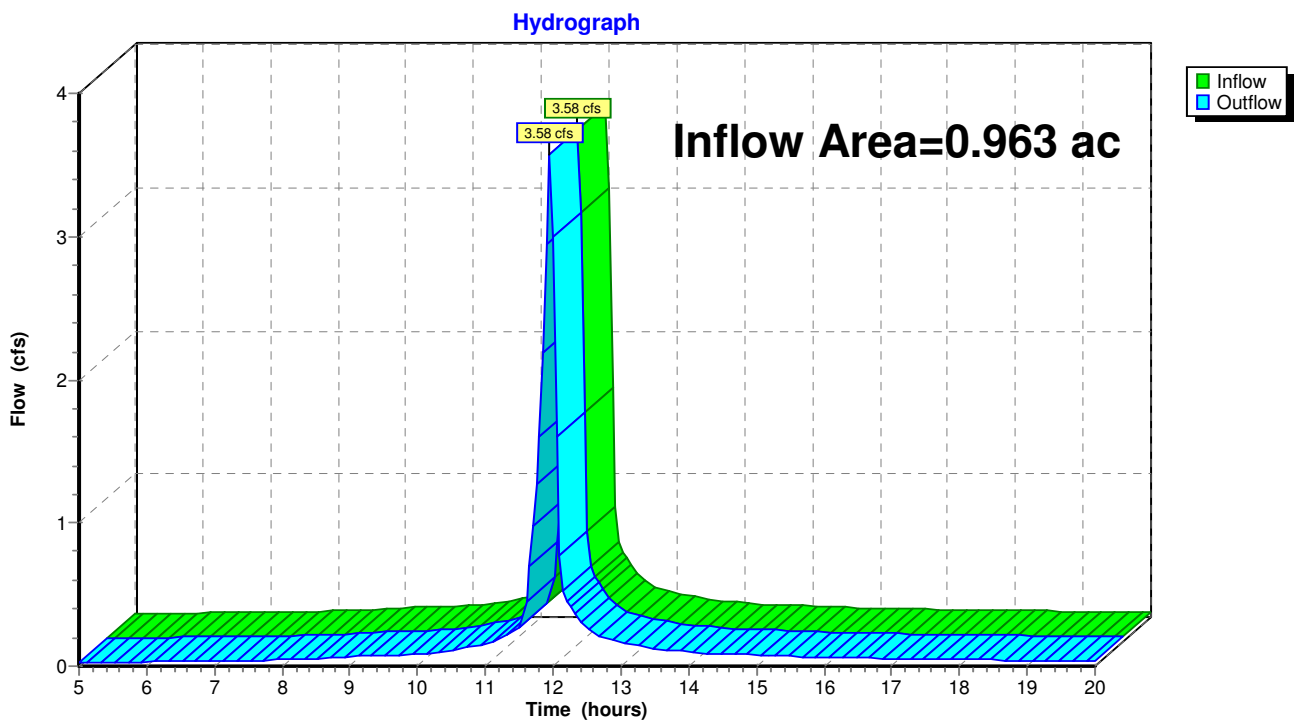
### Summary for Reach 9R: NE Sunwood Catch Basin

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

Inflow Area = 0.963 ac, 94.99% Impervious, Inflow Depth > 2.21" for 2-yr event  
Inflow = 3.58 cfs @ 11.95 hrs, Volume= 0.177 af  
Outflow = 3.58 cfs @ 11.95 hrs, Volume= 0.177 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 9R: NE Sunwood Catch Basin



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Type II 24-hr 10-yr Rainfall=4.10"

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
 Runoff by SCS TR-20 method, UH=SCS  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

<b>Subcatchment 1S: Drainage Area #1</b>	Runoff Area=36,775 sf 75.23% Impervious Runoff Depth>2.73" Tc=5.0 min CN=89 Runoff=4.24 cfs 0.192 af
<b>Subcatchment 2S: Drainage Area #2</b>	Runoff Area=53,272 sf 84.56% Impervious Runoff Depth>3.02" Tc=5.0 min CN=92 Runoff=6.58 cfs 0.307 af
<b>Subcatchment 3S: Drainage Area #3</b>	Runoff Area=74,386 sf 87.00% Impervious Runoff Depth>3.11" Tc=5.0 min CN=93 Runoff=9.38 cfs 0.443 af
<b>Subcatchment 8S: Drainage Area #4</b>	Runoff Area=38,331 sf 100.00% Impervious Runoff Depth>3.56" Tc=5.0 min CN=98 Runoff=5.18 cfs 0.261 af
<b>Subcatchment 10S: Direct Discharge #1</b>	Runoff Area=1,170 sf 50.17% Impervious Runoff Depth>1.96" Tc=5.0 min CN=80 Runoff=0.10 cfs 0.004 af
<b>Subcatchment 11S: Direct Discharge #2</b>	Runoff Area=2,310 sf 59.96% Impervious Runoff Depth>2.20" Tc=5.0 min CN=83 Runoff=0.22 cfs 0.010 af
<b>Subcatchment 12S: Direct Discharge #3</b>	Runoff Area=2,651 sf 33.50% Impervious Runoff Depth>1.46" Tc=5.0 min CN=73 Runoff=0.18 cfs 0.007 af
<b>Subcatchment 13S: Direct Discharge #4</b>	Runoff Area=3,623 sf 41.98% Impervious Runoff Depth>1.73" Tc=5.0 min CN=77 Runoff=0.28 cfs 0.012 af
<b>Reach 4R: NW Sunwood Catch Basin</b>	Inflow=4.34 cfs 0.196 af Outflow=4.34 cfs 0.196 af
<b>Reach 5R: S Civic Center Catch Basin</b>	Inflow=6.81 cfs 0.317 af Outflow=6.81 cfs 0.317 af
<b>Reach 6R: N Sunwood Catch Basin</b>	Inflow=9.55 cfs 0.450 af Outflow=9.55 cfs 0.450 af
<b>Reach 7R: Total Site</b>	Inflow=26.16 cfs 1.236 af Outflow=26.16 cfs 1.236 af
<b>Reach 9R: NE Sunwood Catch Basin</b>	Inflow=5.46 cfs 0.273 af Outflow=5.46 cfs 0.273 af

**Total Runoff Area = 4.879 ac Runoff Volume = 1.236 af Average Runoff Depth = 3.04"**  
**15.24% Pervious = 0.743 ac 84.76% Impervious = 4.135 ac**

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Type II 24-hr 10-yr Rainfall=4.10"

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## Summary for Subcatchment 1S: Drainage Area #1

[49] Hint:  $T_c < 2dt$  may require smaller  $dt$

Runoff = 4.24 cfs @ 11.95 hrs, Volume= 0.192 af, Depth> 2.73"

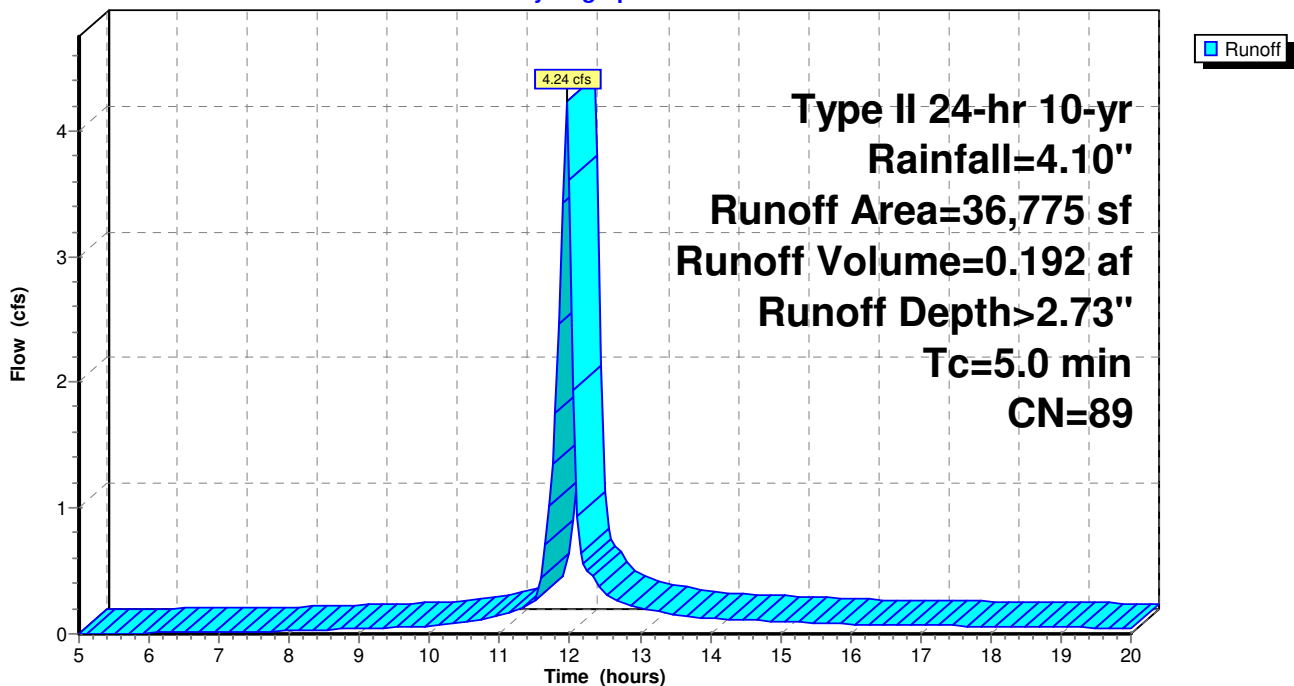
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs,  $dt=0.05$  hrs  
Type II 24-hr 10-yr Rainfall=4.10"

Area (sf)	CN	Description
27,665	98	Paved parking, HSG B
9,110	61	>75% Grass cover, Good, HSG B
36,775	89	Weighted Average
9,110		24.77% Pervious Area
27,665		75.23% Impervious Area

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

## Subcatchment 1S: Drainage Area #1

Hydrograph



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Type II 24-hr 10-yr Rainfall=4.10"

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## Summary for Subcatchment 2S: Drainage Area #2

[49] Hint:  $T_c < 2dt$  may require smaller  $dt$

Runoff = 6.58 cfs @ 11.95 hrs, Volume= 0.307 af, Depth> 3.02"

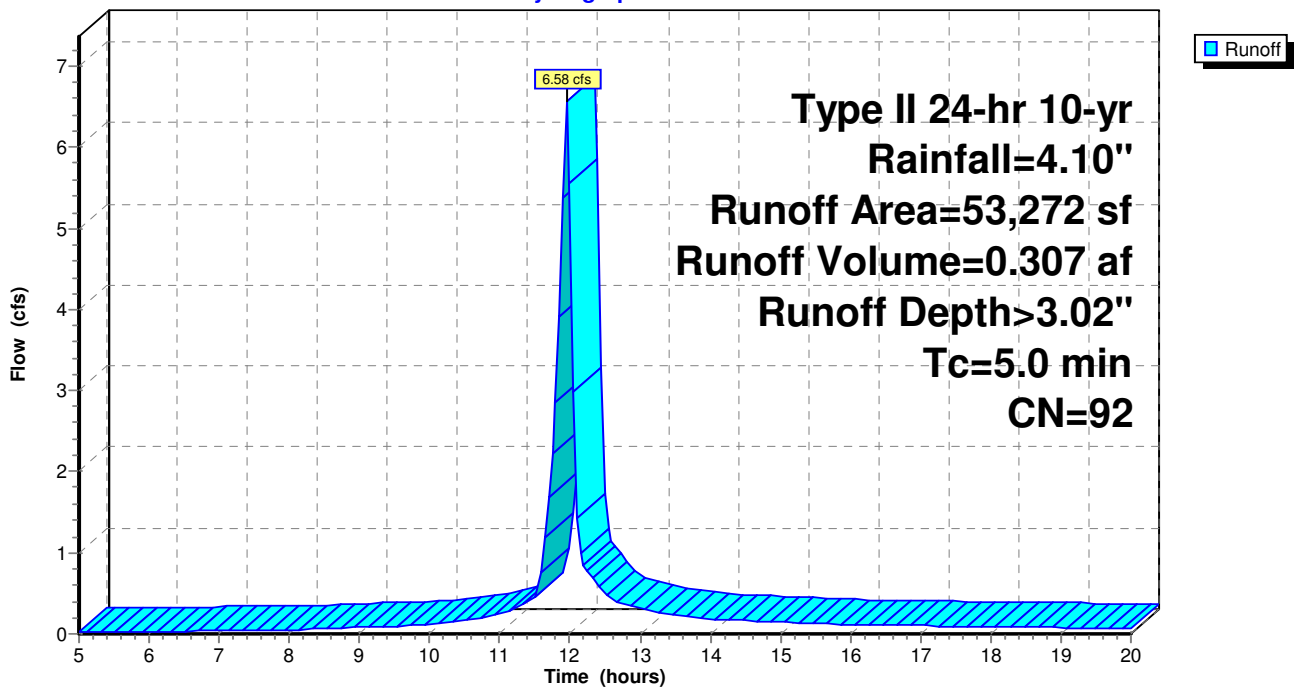
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs,  $dt=0.05$  hrs  
Type II 24-hr 10-yr Rainfall=4.10"

Area (sf)	CN	Description
45,046	98	Paved parking, HSG B
8,226	61	>75% Grass cover, Good, HSG B
53,272	92	Weighted Average
8,226		15.44% Pervious Area
45,046		84.56% Impervious Area

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

## Subcatchment 2S: Drainage Area #2

Hydrograph



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Type II 24-hr 10-yr Rainfall=4.10"

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**Summary for Subcatchment 3S: Drainage Area #3**

[49] Hint:  $T_c < 2dt$  may require smaller dt

Runoff = 9.38 cfs @ 11.95 hrs, Volume= 0.443 af, Depth> 3.11"

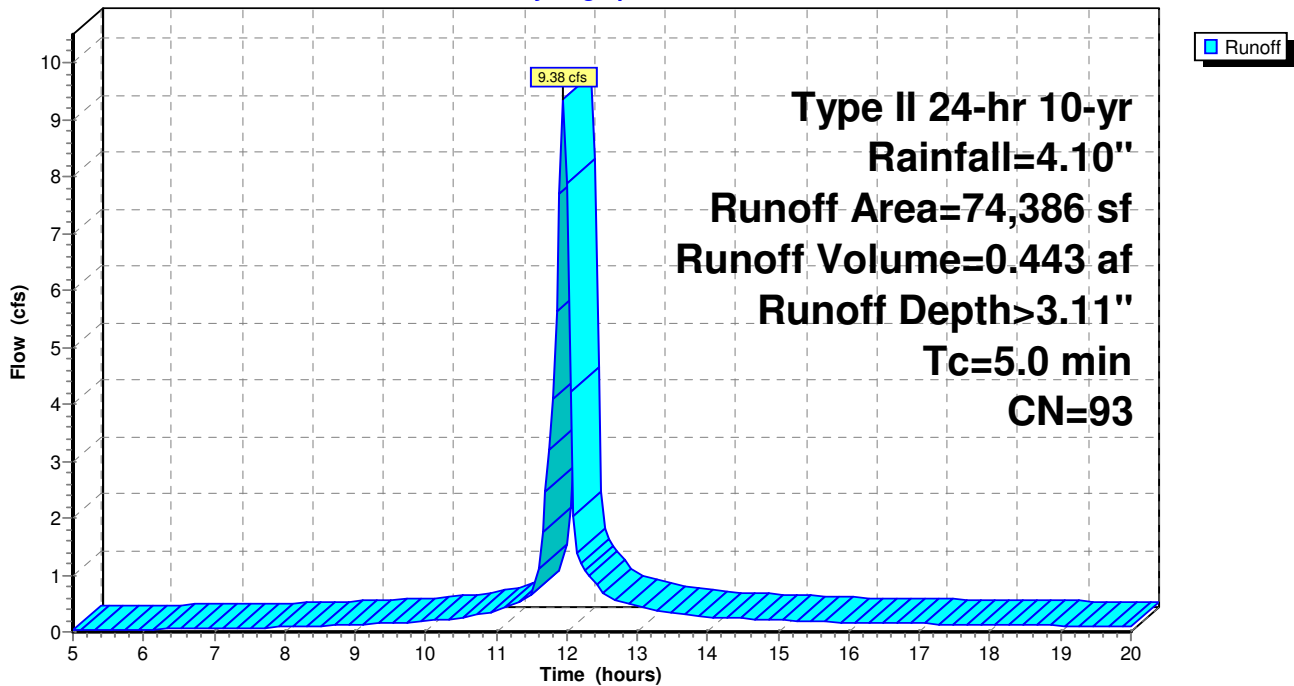
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=4.10"

Area (sf)	CN	Description
64,715	98	Paved parking, HSG B
9,671	61	>75% Grass cover, Good, HSG B
74,386	93	Weighted Average
9,671		13.00% Pervious Area
64,715		87.00% Impervious Area

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

**Subcatchment 3S: Drainage Area #3**

Hydrograph



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Type II 24-hr 10-yr Rainfall=4.10"

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**Summary for Subcatchment 8S: Drainage Area #4**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 5.18 cfs @ 11.95 hrs, Volume= 0.261 af, Depth> 3.56"

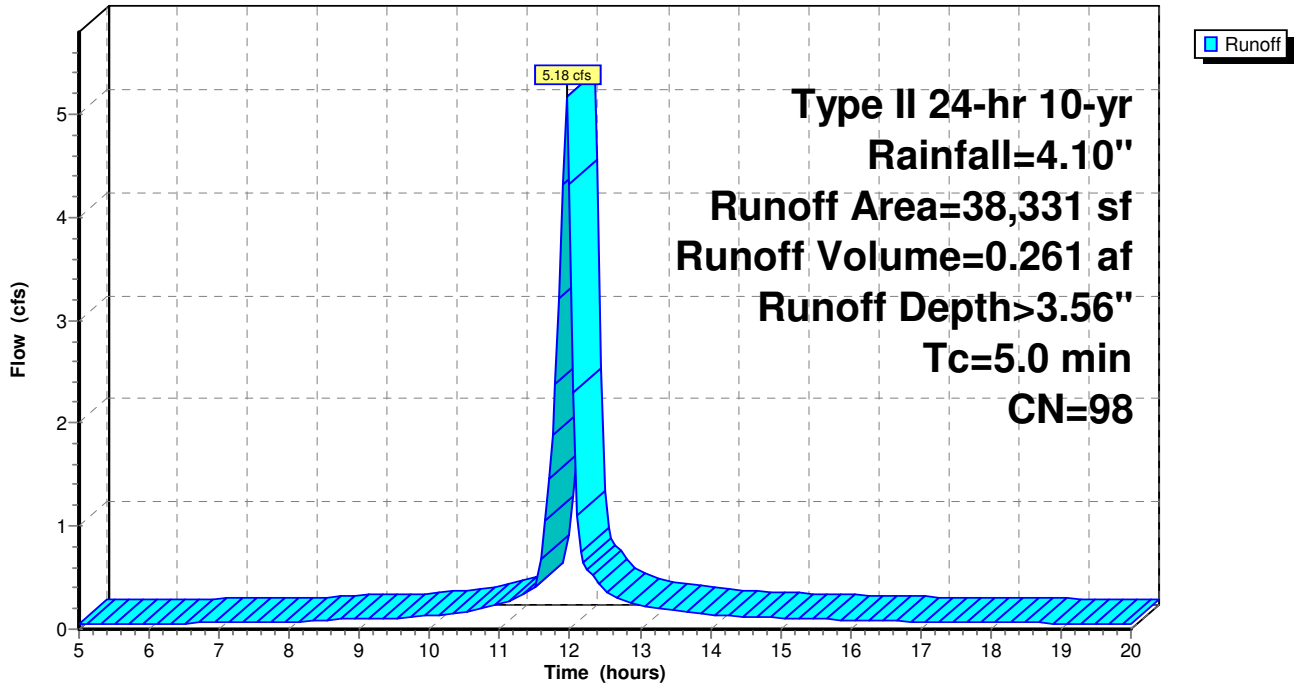
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 10-yr Rainfall=4.10"

Area (sf)	CN	Description
38,331	98	Paved parking, HSG B
0	61	>75% Grass cover, Good, HSG B
38,331	98	Weighted Average
38,331		100.00% Impervious Area

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

**Subcatchment 8S: Drainage Area #4**

Hydrograph



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Type II 24-hr 10-yr Rainfall=4.10"

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**Summary for Subcatchment 10S: Direct Discharge #1**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.10 cfs @ 11.96 hrs, Volume= 0.004 af, Depth> 1.96"

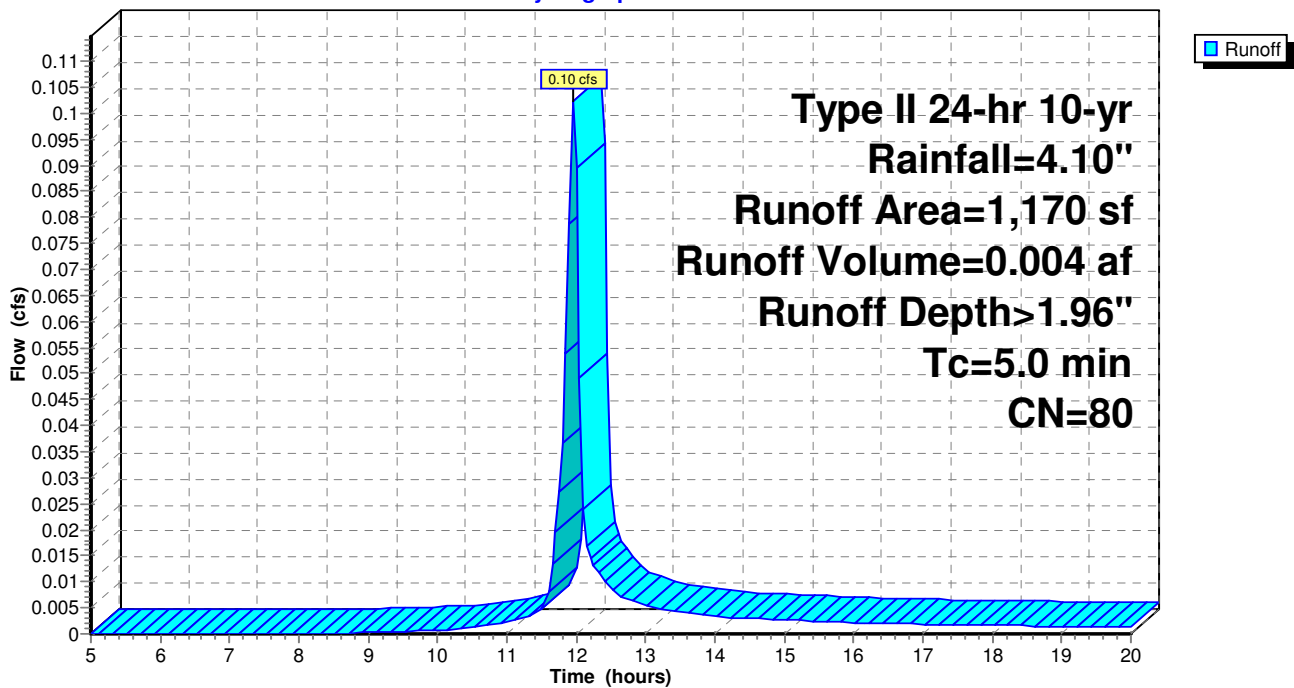
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=4.10"

Area (sf)	CN	Description
587	98	Paved parking, HSG B
583	61	>75% Grass cover, Good, HSG B
1,170	80	Weighted Average
583		49.83% Pervious Area
587		50.17% Impervious Area

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

**Subcatchment 10S: Direct Discharge #1**

Hydrograph



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Type II 24-hr 10-yr Rainfall=4.10"

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**Summary for Subcatchment 11S: Direct Discharge #2**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.22 cfs @ 11.96 hrs, Volume= 0.010 af, Depth> 2.20"

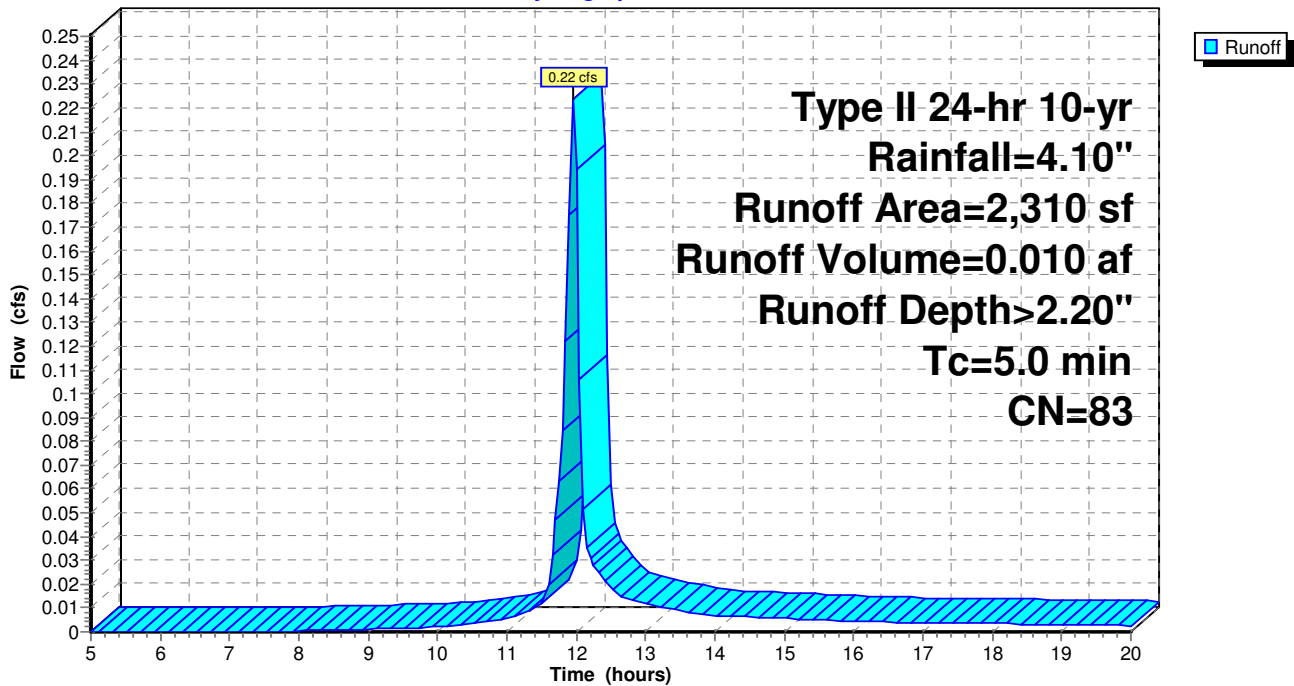
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 10-yr Rainfall=4.10"

Area (sf)	CN	Description
1,385	98	Paved parking, HSG B
925	61	>75% Grass cover, Good, HSG B
2,310	83	Weighted Average
925		40.04% Pervious Area
1,385		59.96% Impervious Area

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

**Subcatchment 11S: Direct Discharge #2**

Hydrograph



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Type II 24-hr 10-yr Rainfall=4.10"

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**Summary for Subcatchment 12S: Direct Discharge #3**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.18 cfs @ 11.96 hrs, Volume= 0.007 af, Depth> 1.46"

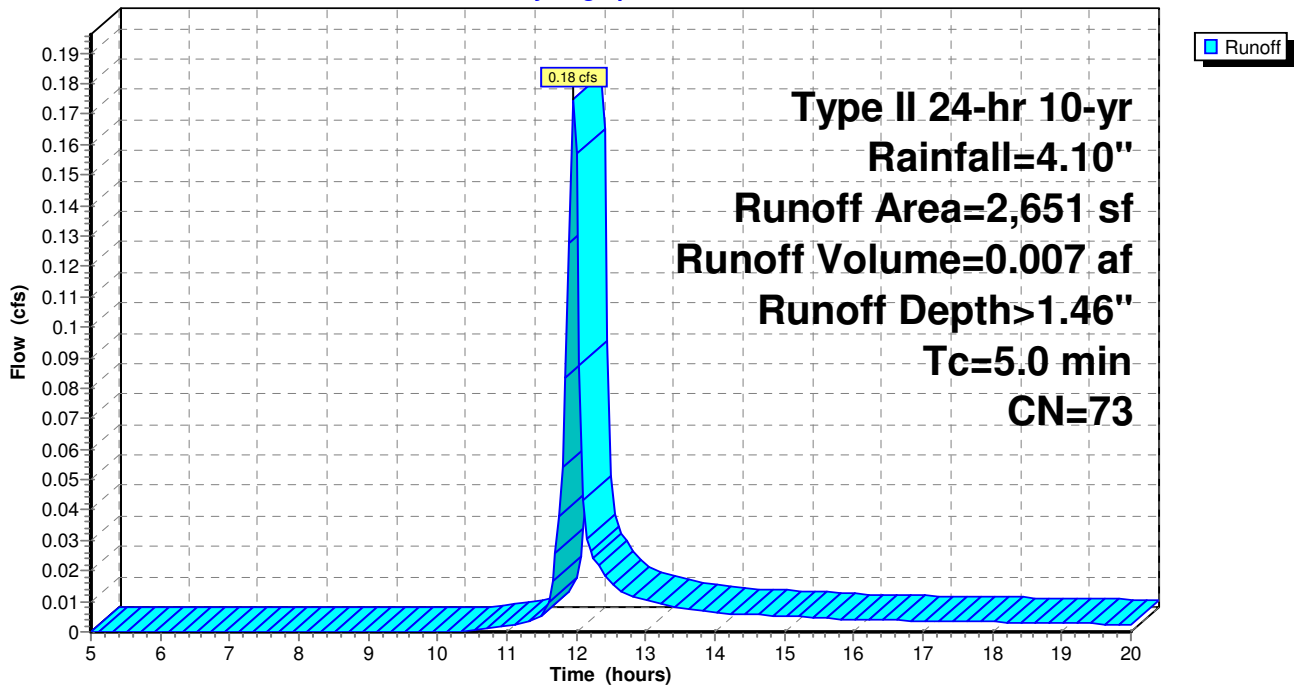
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 10-yr Rainfall=4.10"

Area (sf)	CN	Description
888	98	Paved parking, HSG B
1,763	61	>75% Grass cover, Good, HSG B
2,651	73	Weighted Average
1,763		66.50% Pervious Area
888		33.50% Impervious Area

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

**Subcatchment 12S: Direct Discharge #3**

Hydrograph



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Type II 24-hr 10-yr Rainfall=4.10"

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**Summary for Subcatchment 13S: Direct Discharge #4**

[49] Hint:  $T_c < 2dt$  may require smaller dt

Runoff = 0.28 cfs @ 11.96 hrs, Volume= 0.012 af, Depth> 1.73"

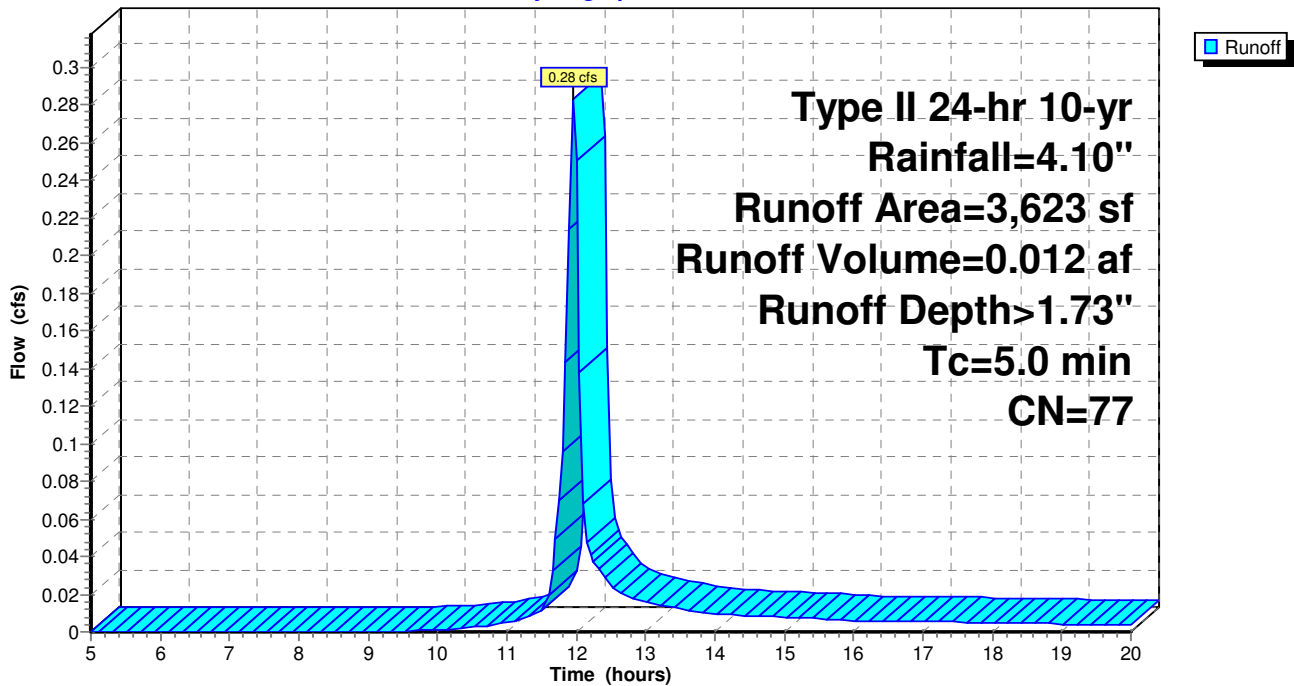
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 10-yr Rainfall=4.10"

Area (sf)	CN	Description
1,521	98	Paved parking, HSG B
2,102	61	>75% Grass cover, Good, HSG B
3,623	77	Weighted Average
2,102		58.02% Pervious Area
1,521		41.98% Impervious Area

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

**Subcatchment 13S: Direct Discharge #4**

Hydrograph



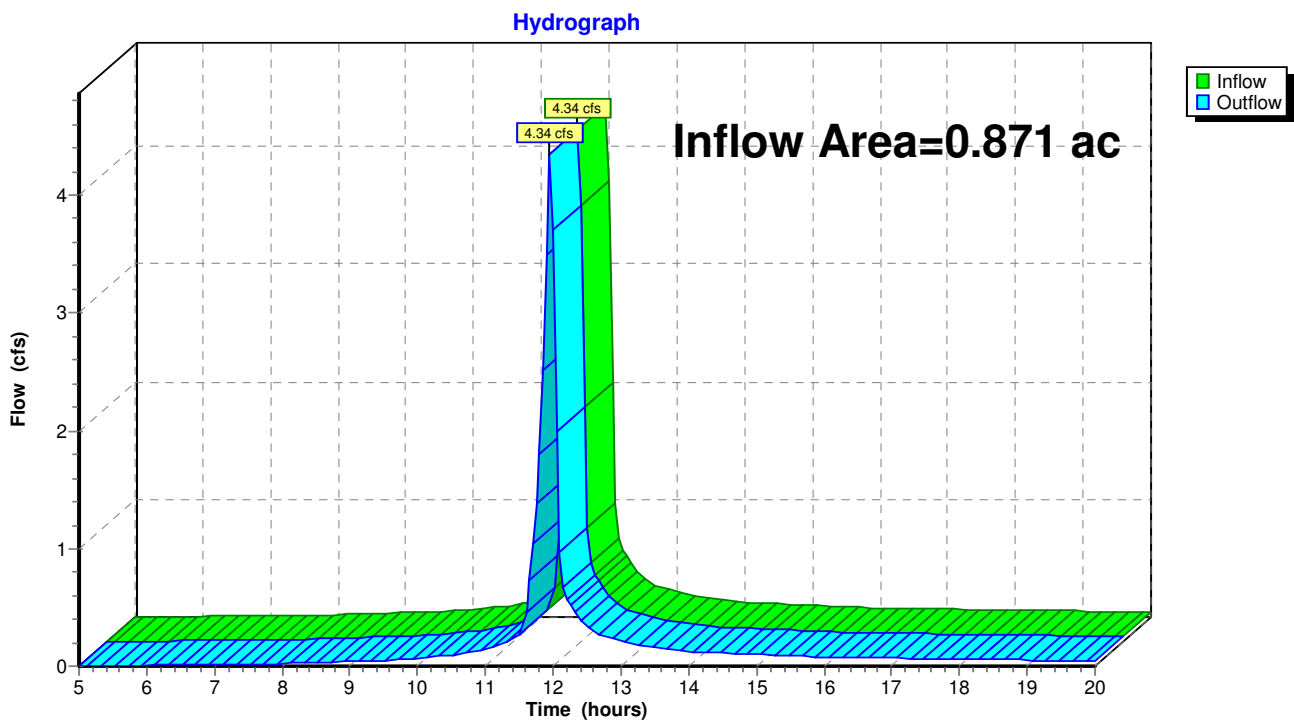
### Summary for Reach 4R: NW Sunwood Catch Basin

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

Inflow Area = 0.871 ac, 74.46% Impervious, Inflow Depth > 2.71" for 10-yr event  
Inflow = 4.34 cfs @ 11.95 hrs, Volume= 0.196 af  
Outflow = 4.34 cfs @ 11.95 hrs, Volume= 0.196 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 4R: NW Sunwood Catch Basin



### Summary for Reach 5R: S Civic Center Catch Basin

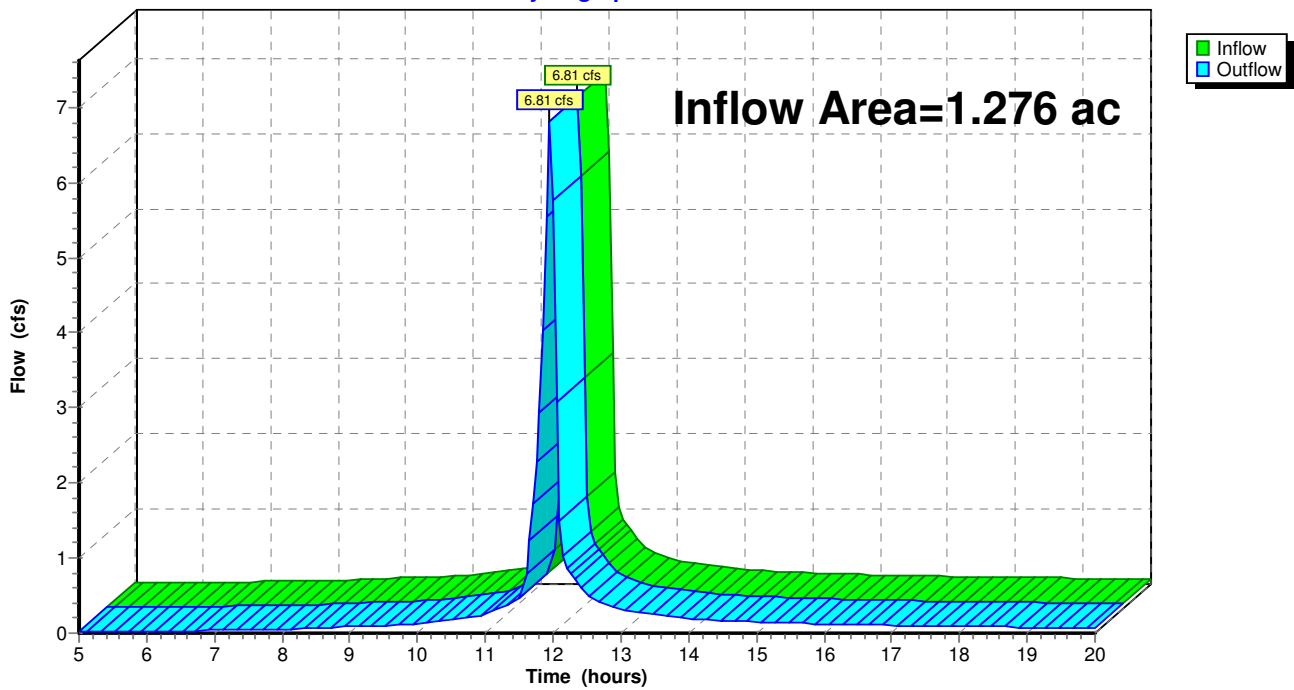
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.276 ac, 83.54% Impervious, Inflow Depth > 2.98" for 10-yr event  
Inflow = 6.81 cfs @ 11.95 hrs, Volume= 0.317 af  
Outflow = 6.81 cfs @ 11.95 hrs, Volume= 0.317 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 5R: S Civic Center Catch Basin

Hydrograph



### Summary for Reach 6R: N Sunwood Catch Basin

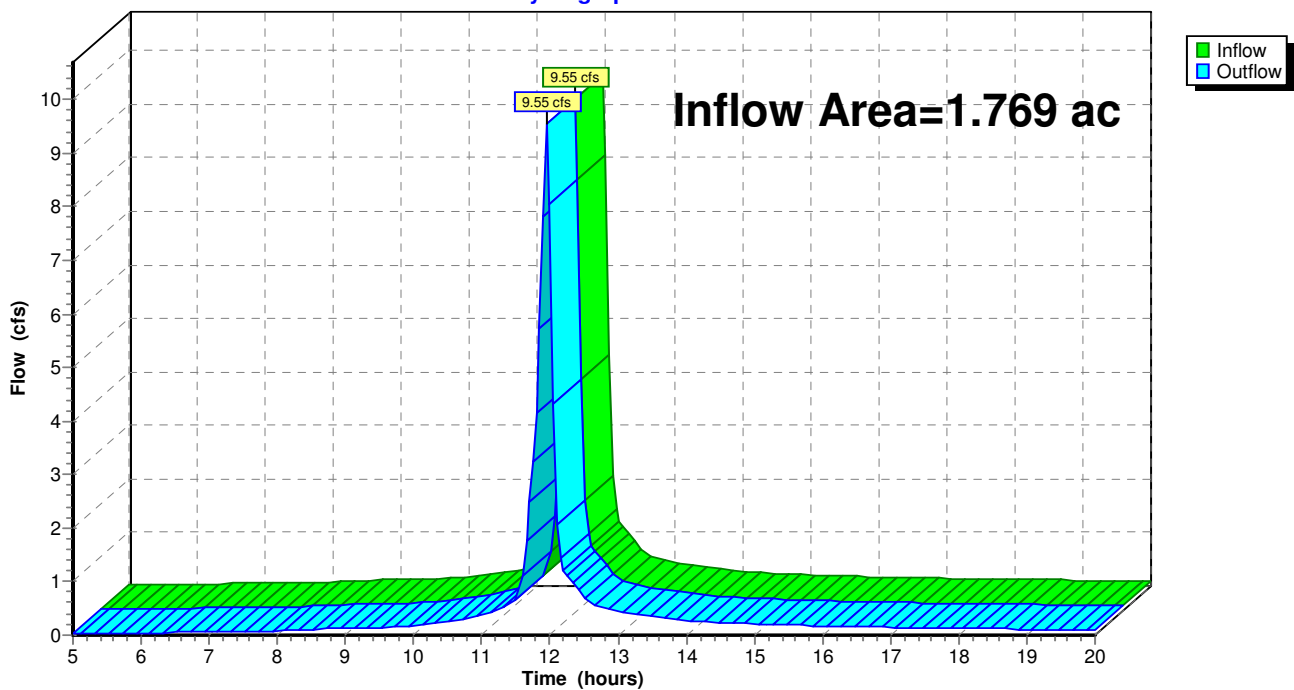
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.769 ac, 85.16% Impervious, Inflow Depth > 3.05" for 10-yr event  
Inflow = 9.55 cfs @ 11.95 hrs, Volume= 0.450 af  
Outflow = 9.55 cfs @ 11.95 hrs, Volume= 0.450 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 6R: N Sunwood Catch Basin

Hydrograph



### Summary for Reach 7R: Total Site

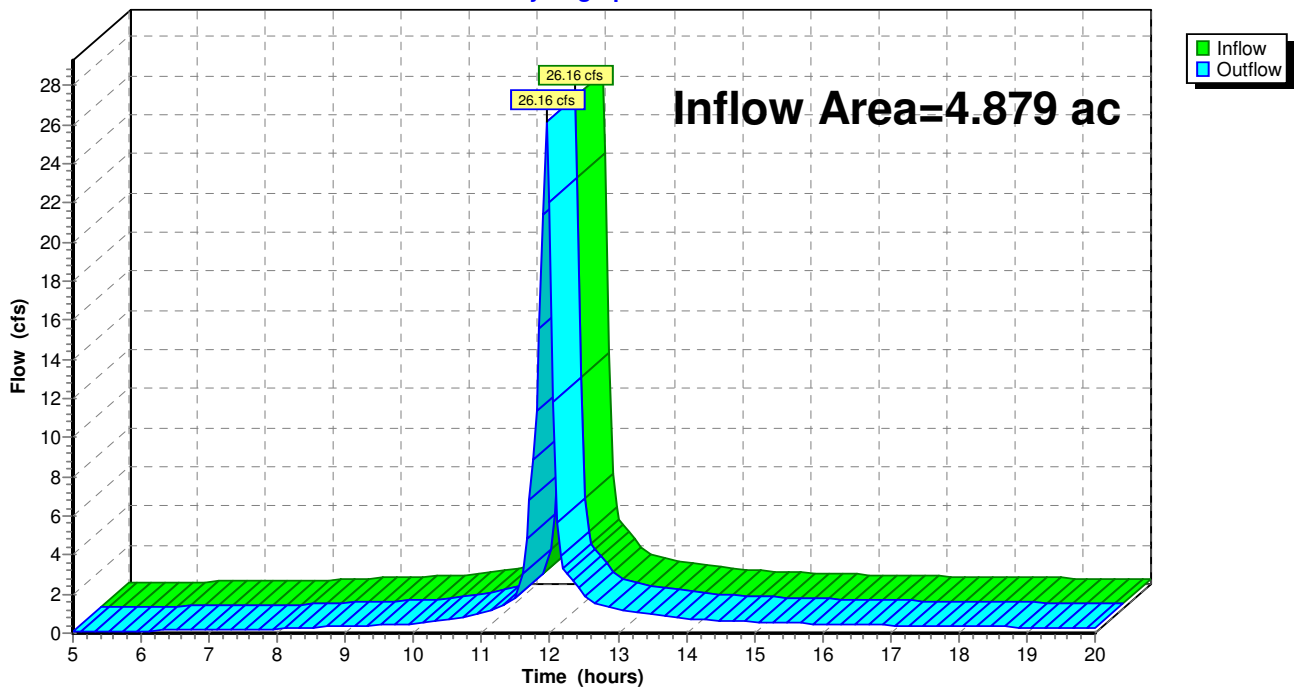
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.879 ac, 84.76% Impervious, Inflow Depth > 3.04" for 10-yr event  
Inflow = 26.16 cfs @ 11.95 hrs, Volume= 1.236 af  
Outflow = 26.16 cfs @ 11.95 hrs, Volume= 1.236 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 7R: Total Site

Hydrograph



### Summary for Reach 9R: NE Sunwood Catch Basin

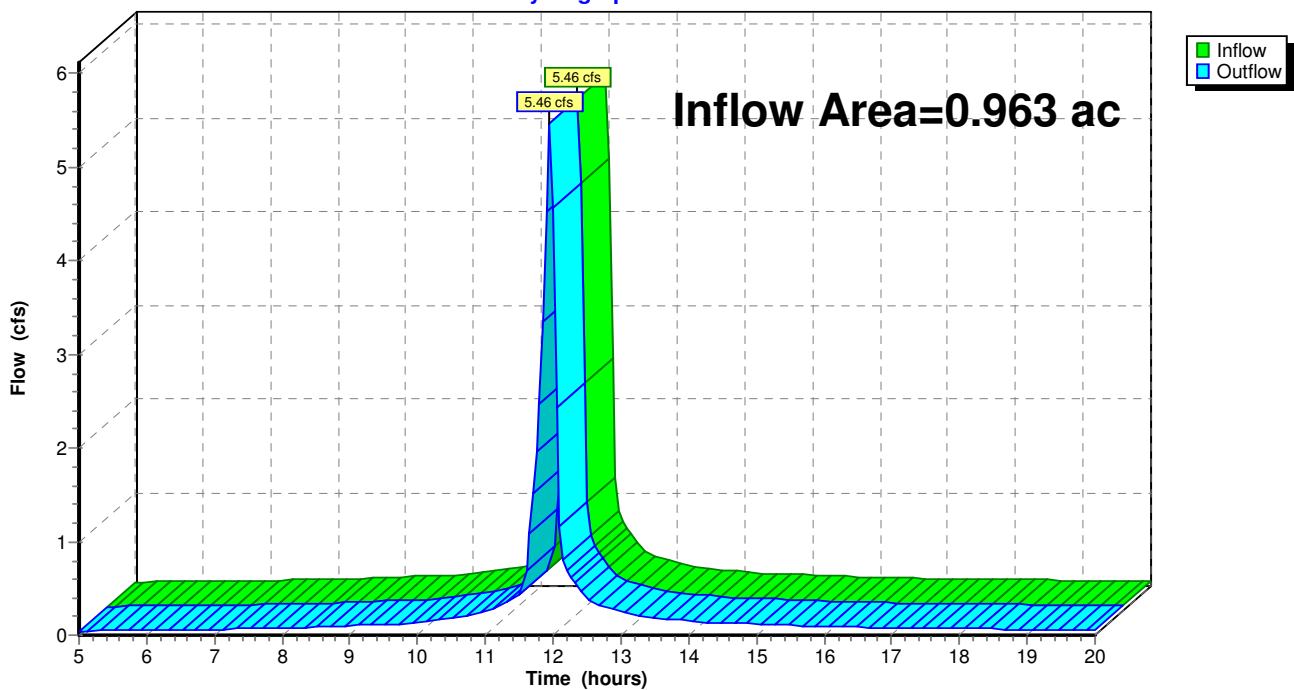
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.963 ac, 94.99% Impervious, Inflow Depth > 3.40" for 10-yr event  
Inflow = 5.46 cfs @ 11.95 hrs, Volume= 0.273 af  
Outflow = 5.46 cfs @ 11.95 hrs, Volume= 0.273 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 9R: NE Sunwood Catch Basin

Hydrograph



**UWA10002 - Proposed***Type II 24-hr 100-yr Rainfall=5.90"*

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
 Runoff by SCS TR-20 method, UH=SCS  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

<b>Subcatchment 1S: Drainage Area #1</b>	Runoff Area=36,775 sf 75.23% Impervious Runoff Depth>4.35" Tc=5.0 min CN=89 Runoff=6.55 cfs 0.306 af
<b>Subcatchment 2S: Drainage Area #2</b>	Runoff Area=53,272 sf 84.56% Impervious Runoff Depth>4.66" Tc=5.0 min CN=92 Runoff=9.89 cfs 0.474 af
<b>Subcatchment 3S: Drainage Area #3</b>	Runoff Area=74,386 sf 87.00% Impervious Runoff Depth>4.75" Tc=5.0 min CN=93 Runoff=13.97 cfs 0.677 af
<b>Subcatchment 8S: Drainage Area #4</b>	Runoff Area=38,331 sf 100.00% Impervious Runoff Depth>5.18" Tc=5.0 min CN=98 Runoff=7.48 cfs 0.380 af
<b>Subcatchment 10S: Direct Discharge #1</b>	Runoff Area=1,170 sf 50.17% Impervious Runoff Depth>3.43" Tc=5.0 min CN=80 Runoff=0.17 cfs 0.008 af
<b>Subcatchment 11S: Direct Discharge #2</b>	Runoff Area=2,310 sf 59.96% Impervious Runoff Depth>3.73" Tc=5.0 min CN=83 Runoff=0.37 cfs 0.016 af
<b>Subcatchment 12S: Direct Discharge #3</b>	Runoff Area=2,651 sf 33.50% Impervious Runoff Depth>2.77" Tc=5.0 min CN=73 Runoff=0.33 cfs 0.014 af
<b>Subcatchment 13S: Direct Discharge #4</b>	Runoff Area=3,623 sf 41.98% Impervious Runoff Depth>3.14" Tc=5.0 min CN=77 Runoff=0.50 cfs 0.022 af
<b>Reach 4R: NW Sunwood Catch Basin</b>	Inflow=6.73 cfs 0.314 af Outflow=6.73 cfs 0.314 af
<b>Reach 5R: S Civic Center Catch Basin</b>	Inflow=10.26 cfs 0.491 af Outflow=10.26 cfs 0.491 af
<b>Reach 6R: N Sunwood Catch Basin</b>	Inflow=14.30 cfs 0.691 af Outflow=14.30 cfs 0.691 af
<b>Reach 7R: Total Site</b>	Inflow=39.27 cfs 1.897 af Outflow=39.27 cfs 1.897 af
<b>Reach 9R: NE Sunwood Catch Basin</b>	Inflow=7.98 cfs 0.402 af Outflow=7.98 cfs 0.402 af

**Total Runoff Area = 4.879 ac Runoff Volume = 1.897 af Average Runoff Depth = 4.67"**  
**15.24% Pervious = 0.743 ac 84.76% Impervious = 4.135 ac**

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Type II 24-hr 100-yr Rainfall=5.90"

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## Summary for Subcatchment 1S: Drainage Area #1

[49] Hint:  $T_c < 2dt$  may require smaller dt

Runoff = 6.55 cfs @ 11.95 hrs, Volume= 0.306 af, Depth> 4.35"

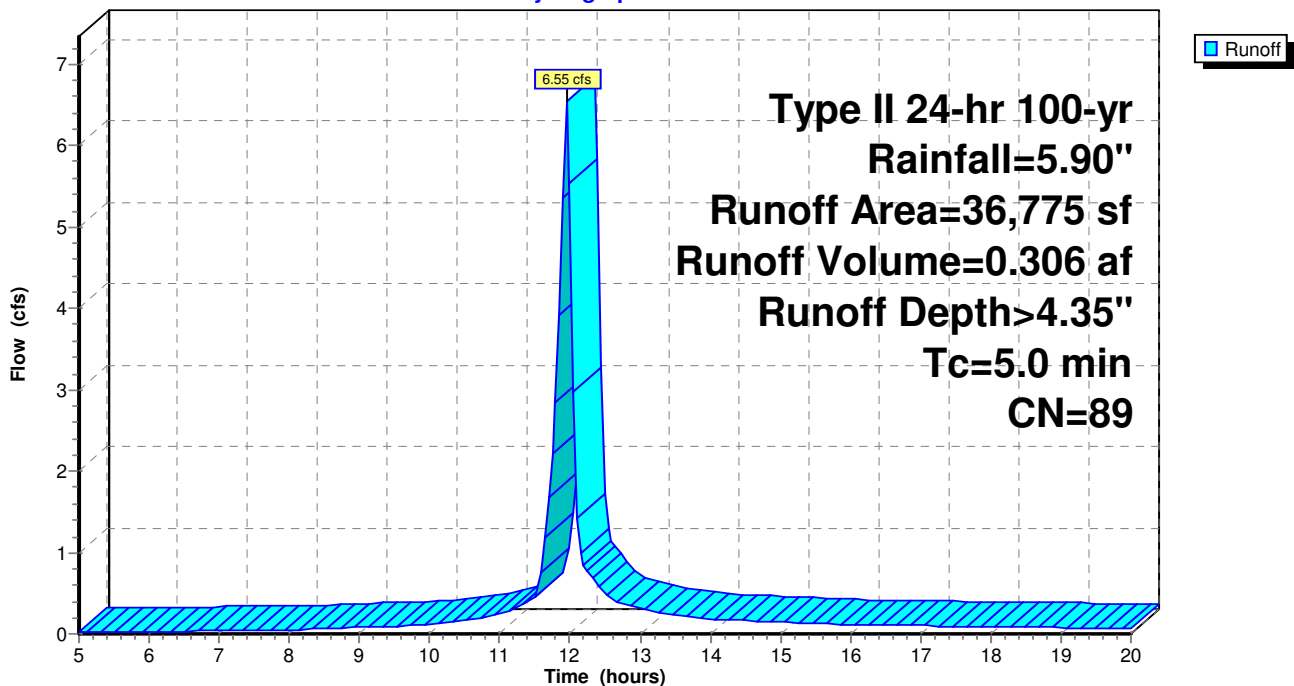
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 100-yr Rainfall=5.90"

Area (sf)	CN	Description
27,665	98	Paved parking, HSG B
9,110	61	>75% Grass cover, Good, HSG B
36,775	89	Weighted Average
9,110		24.77% Pervious Area
27,665		75.23% Impervious Area

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

## Subcatchment 1S: Drainage Area #1

Hydrograph



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Type II 24-hr 100-yr Rainfall=5.90"

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**Summary for Subcatchment 2S: Drainage Area #2**

[49] Hint:  $T_c < 2dt$  may require smaller dt

Runoff = 9.89 cfs @ 11.95 hrs, Volume= 0.474 af, Depth> 4.66"

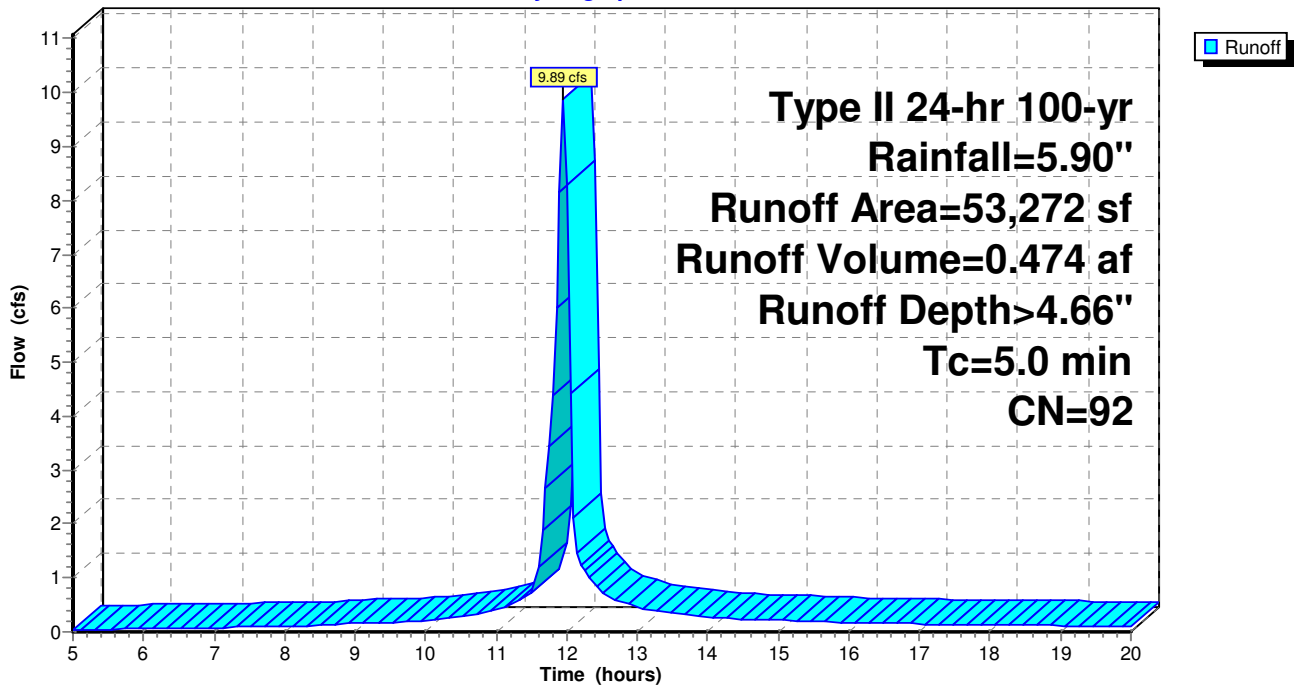
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 100-yr Rainfall=5.90"

Area (sf)	CN	Description
45,046	98	Paved parking, HSG B
8,226	61	>75% Grass cover, Good, HSG B
53,272	92	Weighted Average
8,226		15.44% Pervious Area
45,046		84.56% Impervious Area

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

**Subcatchment 2S: Drainage Area #2**

Hydrograph



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Type II 24-hr 100-yr Rainfall=5.90"

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## Summary for Subcatchment 3S: Drainage Area #3

[49] Hint:  $T_c < 2dt$  may require smaller dt

Runoff = 13.97 cfs @ 11.95 hrs, Volume= 0.677 af, Depth> 4.75"

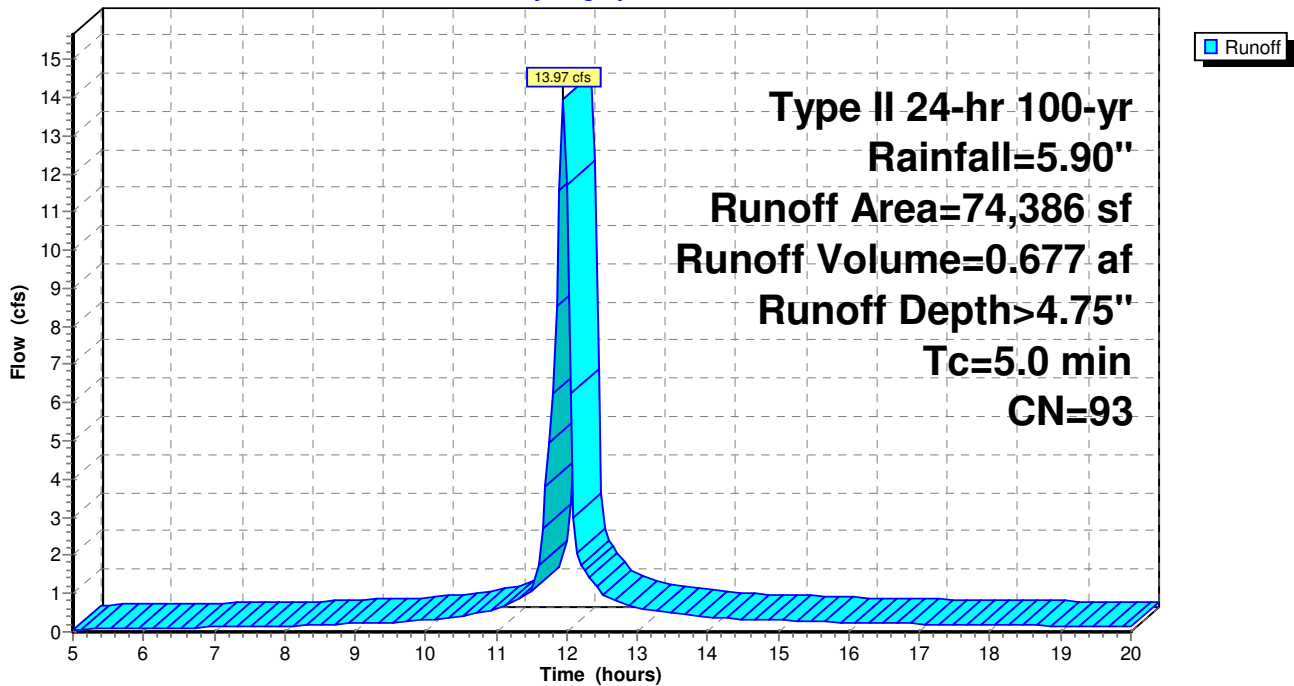
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 100-yr Rainfall=5.90"

Area (sf)	CN	Description
64,715	98	Paved parking, HSG B
9,671	61	>75% Grass cover, Good, HSG B
74,386	93	Weighted Average
9,671		13.00% Pervious Area
64,715		87.00% Impervious Area

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

### Subcatchment 3S: Drainage Area #3

Hydrograph



**UWA10002 - Proposed**

Prepared by {enter your company name here}

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Type II 24-hr 100-yr Rainfall=5.90"

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**Summary for Subcatchment 8S: Drainage Area #4**

[49] Hint:  $T_c < 2dt$  may require smaller dt

Runoff = 7.48 cfs @ 11.95 hrs, Volume= 0.380 af, Depth> 5.18"

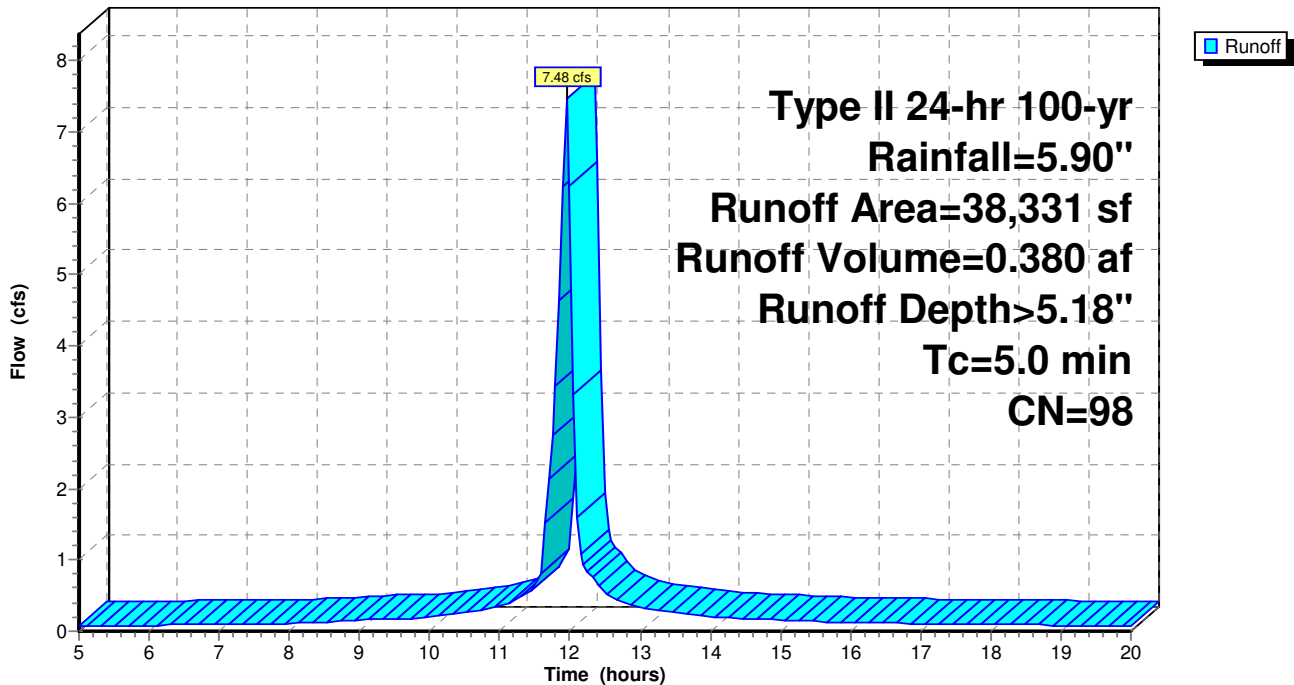
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 100-yr Rainfall=5.90"

Area (sf)	CN	Description
38,331	98	Paved parking, HSG B
0	61	>75% Grass cover, Good, HSG B
38,331	98	Weighted Average
38,331		100.00% Impervious Area

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

**Subcatchment 8S: Drainage Area #4**

Hydrograph



**UWA10002 - Proposed**

Prepared by {enter your company name here}

HydroCAD® 9.10 s/n 01542 © 2009 HydroCAD Software Solutions LLC

Type II 24-hr 100-yr Rainfall=5.90"

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**Summary for Subcatchment 10S: Direct Discharge #1**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.17 cfs @ 11.95 hrs, Volume= 0.008 af, Depth> 3.43"

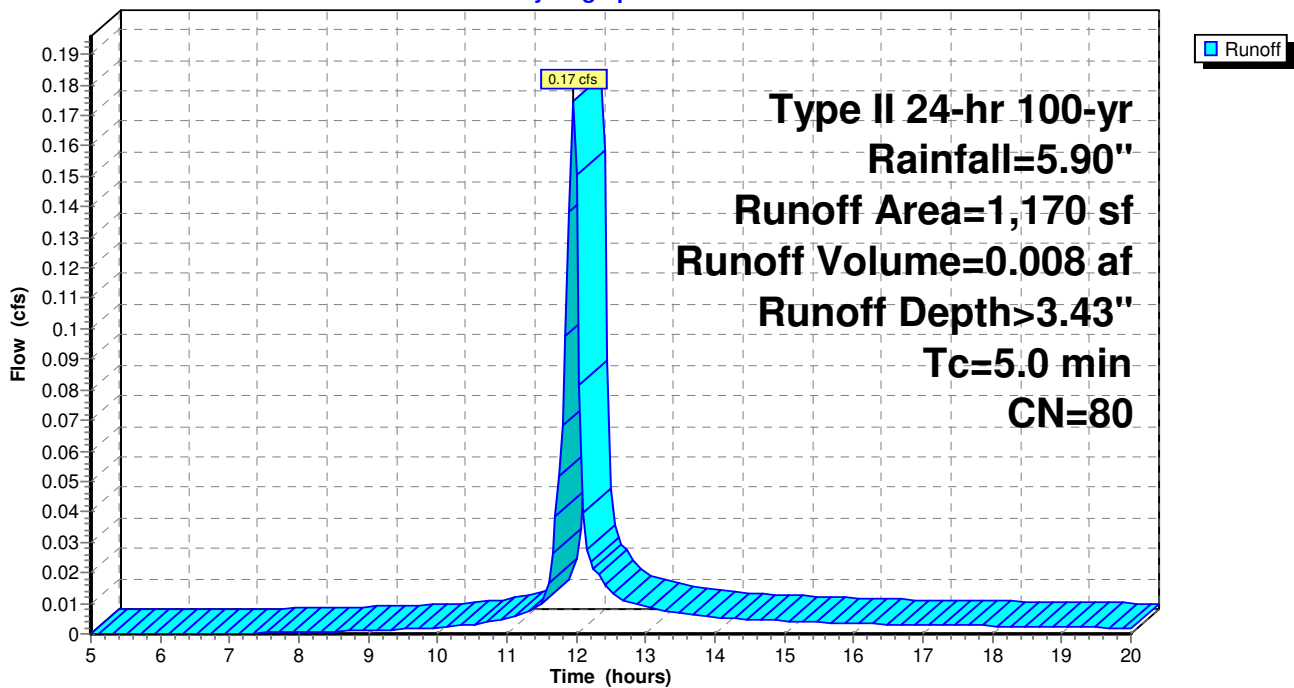
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 100-yr Rainfall=5.90"

Area (sf)	CN	Description
587	98	Paved parking, HSG B
583	61	>75% Grass cover, Good, HSG B
1,170	80	Weighted Average
583		49.83% Pervious Area
587		50.17% Impervious Area

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

**Subcatchment 10S: Direct Discharge #1**

Hydrograph



# UWA10002 - Proposed

Prepared by {enter your company name here}

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Type II 24-hr 100-yr Rainfall=5.90"

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## Summary for Subcatchment 11S: Direct Discharge #2

[49] Hint:  $T_c < 2dt$  may require smaller dt

Runoff = 0.37 cfs @ 11.95 hrs, Volume= 0.016 af, Depth> 3.73"

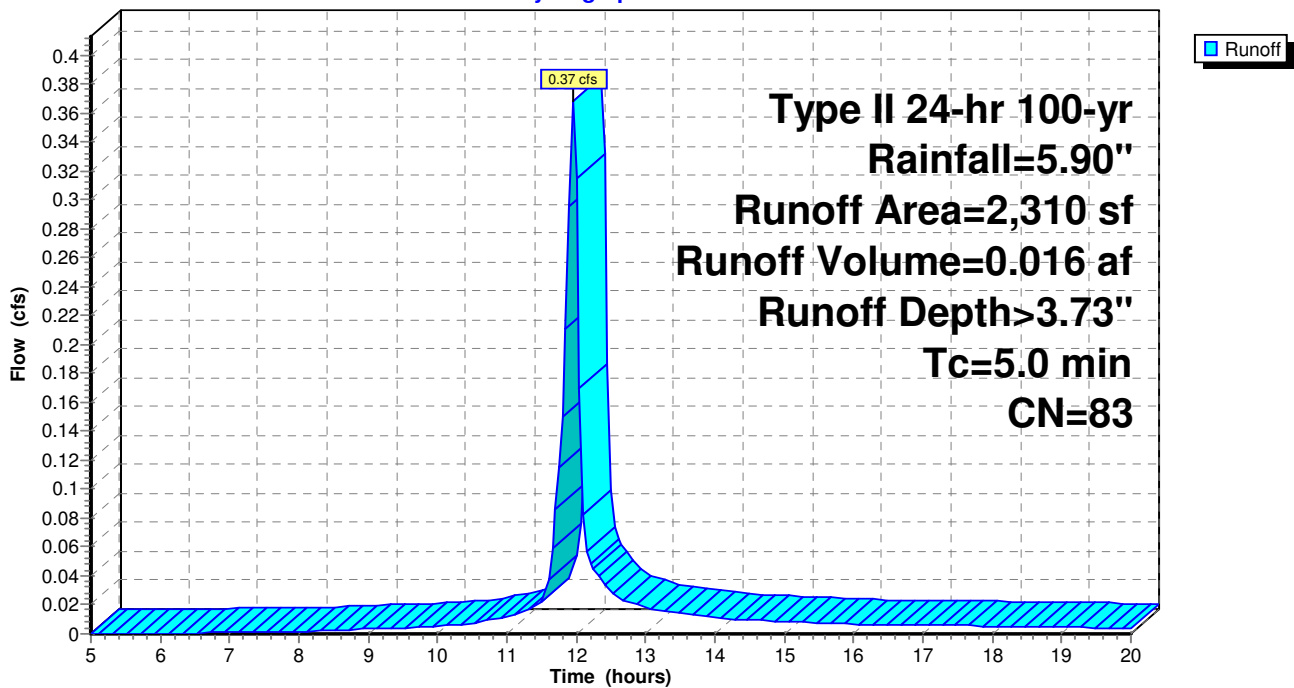
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 100-yr Rainfall=5.90"

Area (sf)	CN	Description
1,385	98	Paved parking, HSG B
925	61	>75% Grass cover, Good, HSG B
2,310	83	Weighted Average
925		40.04% Pervious Area
1,385		59.96% Impervious Area

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

## Subcatchment 11S: Direct Discharge #2

Hydrograph



# UWA10002 - Proposed

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Type II 24-hr 100-yr Rainfall=5.90"

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## Summary for Subcatchment 12S: Direct Discharge #3

[49] Hint:  $T_c < 2dt$  may require smaller dt

Runoff = 0.33 cfs @ 11.96 hrs, Volume= 0.014 af, Depth> 2.77"

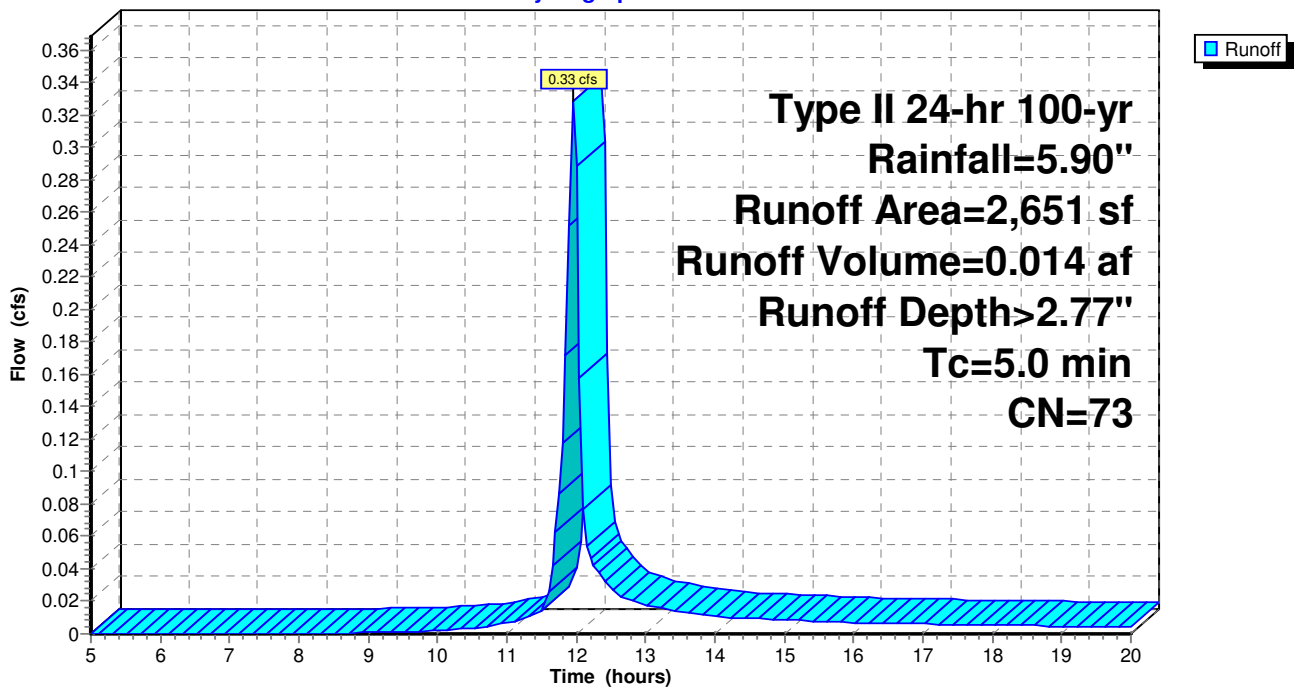
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type II 24-hr 100-yr Rainfall=5.90"

Area (sf)	CN	Description
888	98	Paved parking, HSG B
1,763	61	>75% Grass cover, Good, HSG B
2,651	73	Weighted Average
1,763		66.50% Pervious Area
888		33.50% Impervious Area

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

## Subcatchment 12S: Direct Discharge #3

Hydrograph



**UWA10002 - Proposed**

Prepared by {enter your company name here}

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Type II 24-hr 100-yr Rainfall=5.90"

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**Summary for Subcatchment 13S: Direct Discharge #4**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.50 cfs @ 11.96 hrs, Volume= 0.022 af, Depth> 3.14"

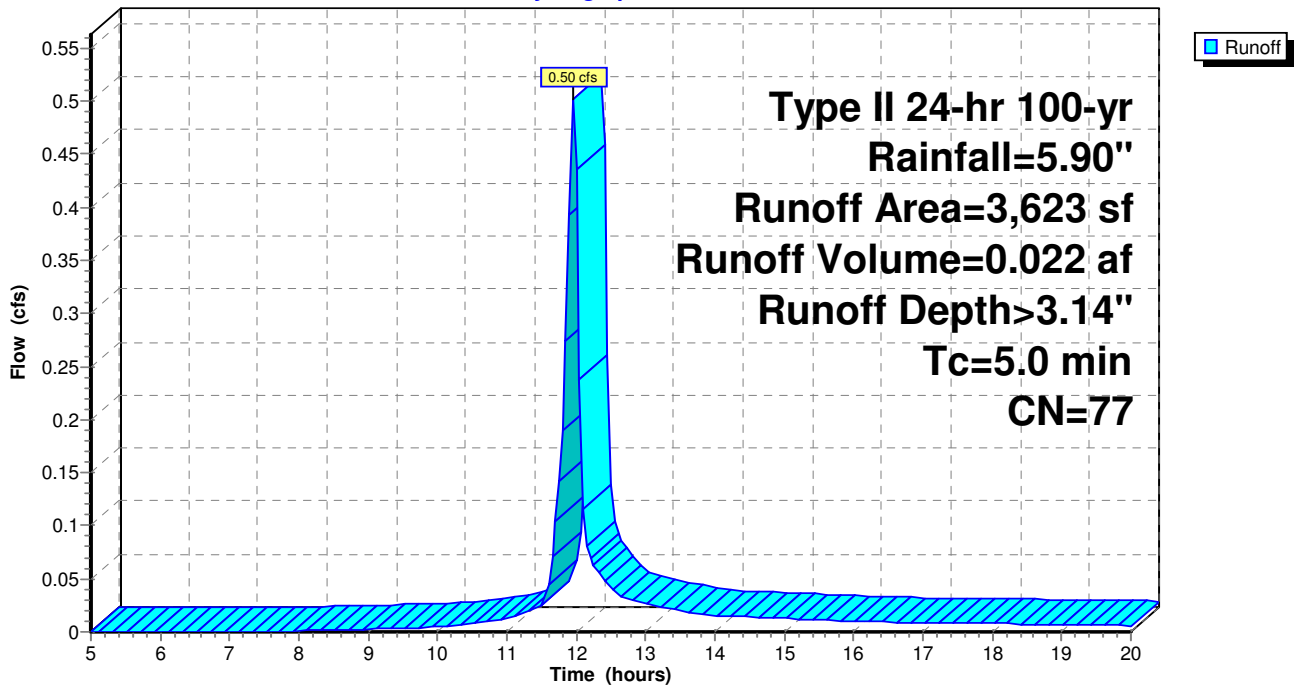
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 100-yr Rainfall=5.90"

Area (sf)	CN	Description
1,521	98	Paved parking, HSG B
2,102	61	>75% Grass cover, Good, HSG B
3,623	77	Weighted Average
2,102		58.02% Pervious Area
1,521		41.98% Impervious Area

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

**Subcatchment 13S: Direct Discharge #4**

Hydrograph



### Summary for Reach 4R: NW Sunwood Catch Basin

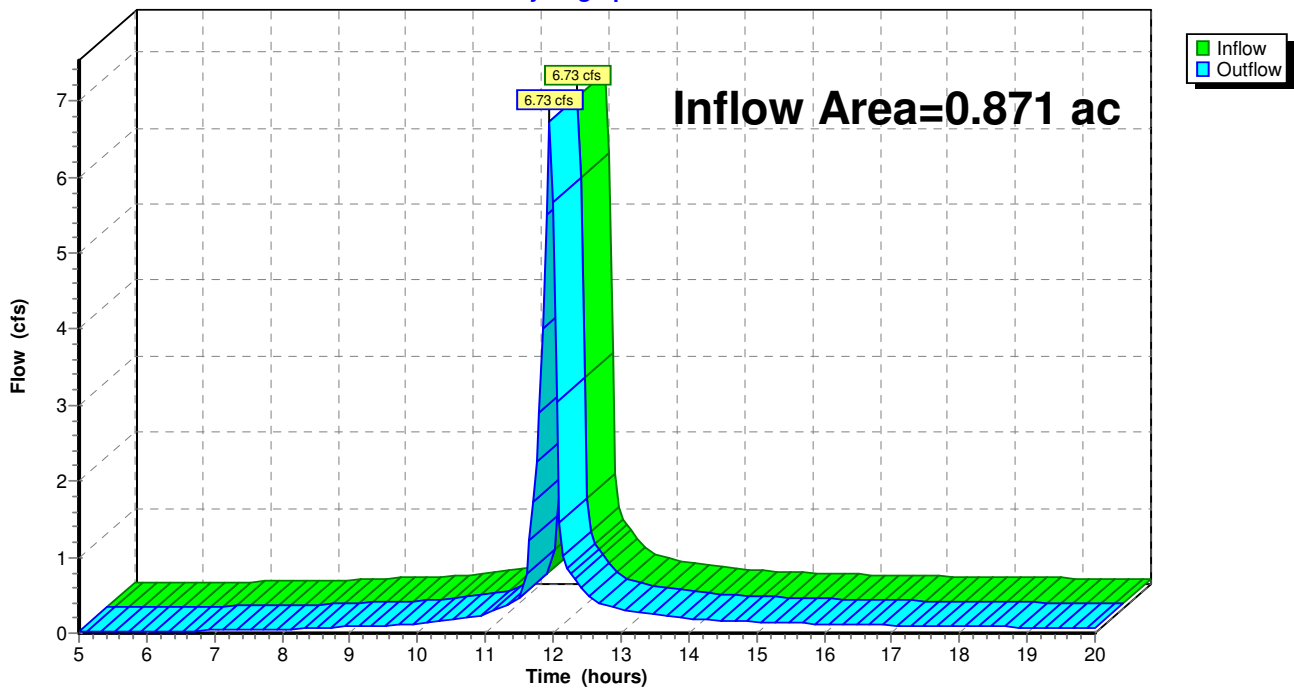
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.871 ac, 74.46% Impervious, Inflow Depth > 4.32" for 100-yr event  
Inflow = 6.73 cfs @ 11.95 hrs, Volume= 0.314 af  
Outflow = 6.73 cfs @ 11.95 hrs, Volume= 0.314 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 4R: NW Sunwood Catch Basin

Hydrograph



### Summary for Reach 5R: S Civic Center Catch Basin

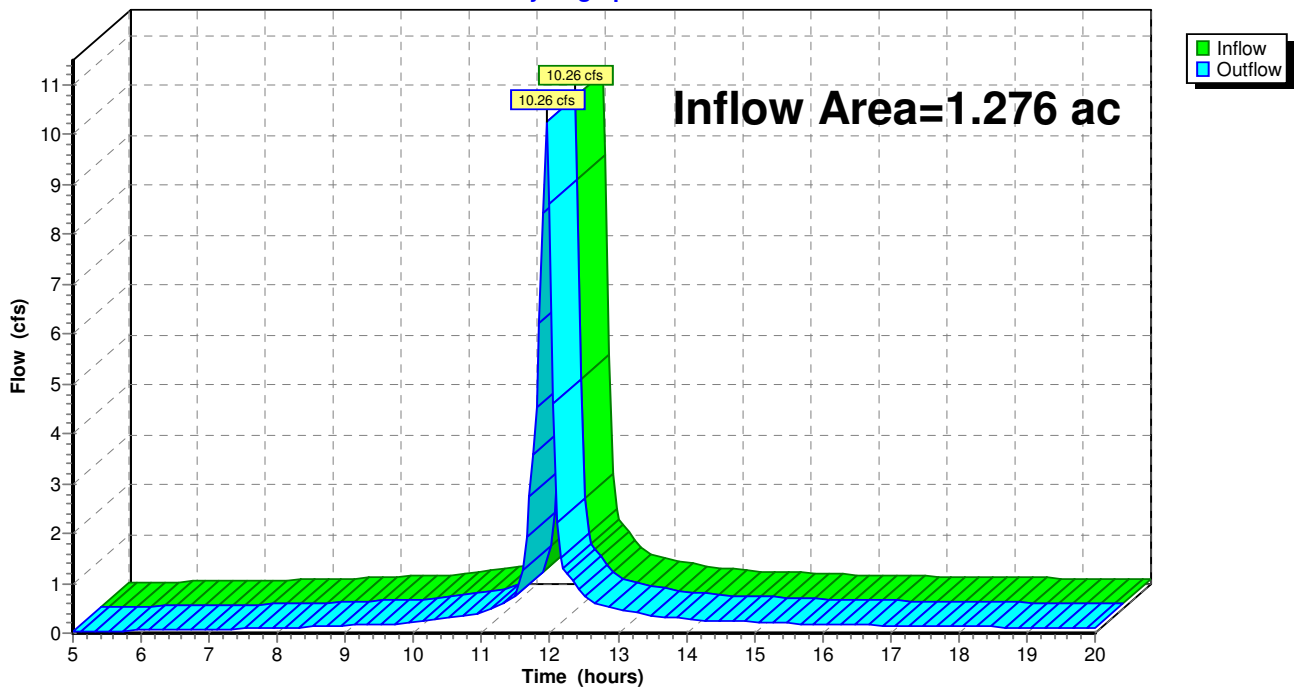
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.276 ac, 83.54% Impervious, Inflow Depth > 4.62" for 100-yr event  
Inflow = 10.26 cfs @ 11.95 hrs, Volume= 0.491 af  
Outflow = 10.26 cfs @ 11.95 hrs, Volume= 0.491 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 5R: S Civic Center Catch Basin

Hydrograph



### Summary for Reach 6R: N Sunwood Catch Basin

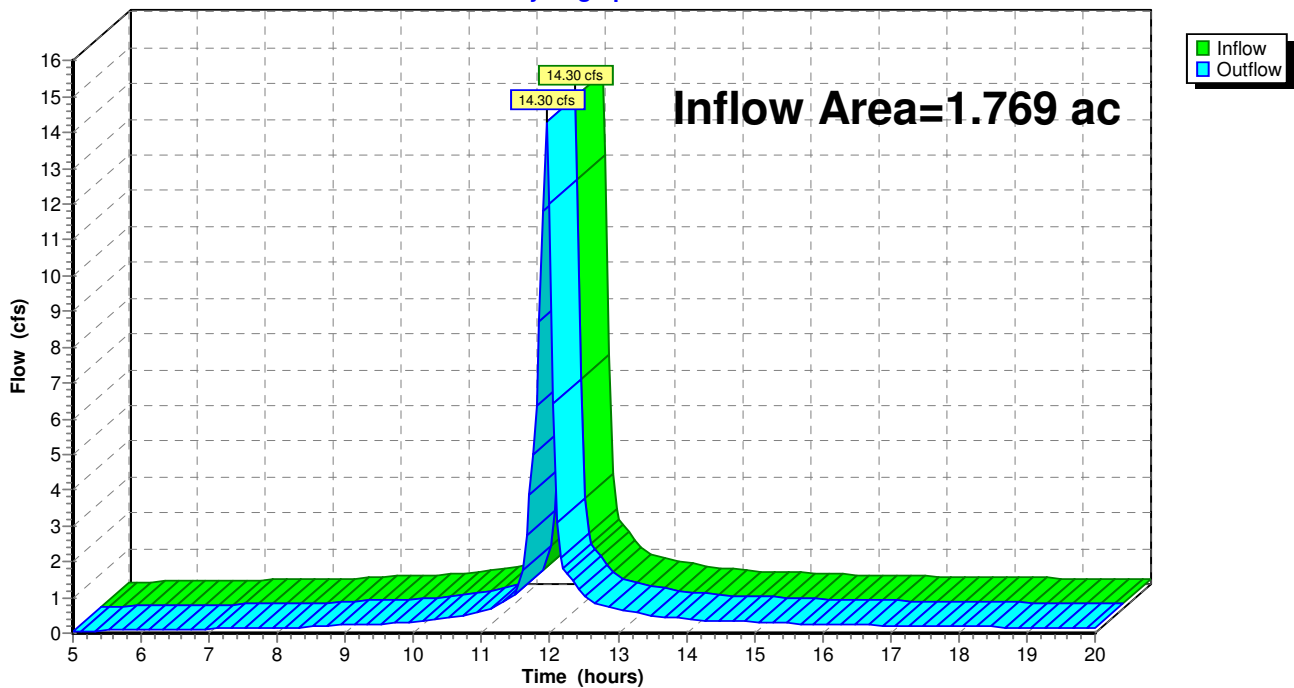
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.769 ac, 85.16% Impervious, Inflow Depth > 4.69" for 100-yr event  
Inflow = 14.30 cfs @ 11.95 hrs, Volume= 0.691 af  
Outflow = 14.30 cfs @ 11.95 hrs, Volume= 0.691 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 6R: N Sunwood Catch Basin

Hydrograph



### Summary for Reach 7R: Total Site

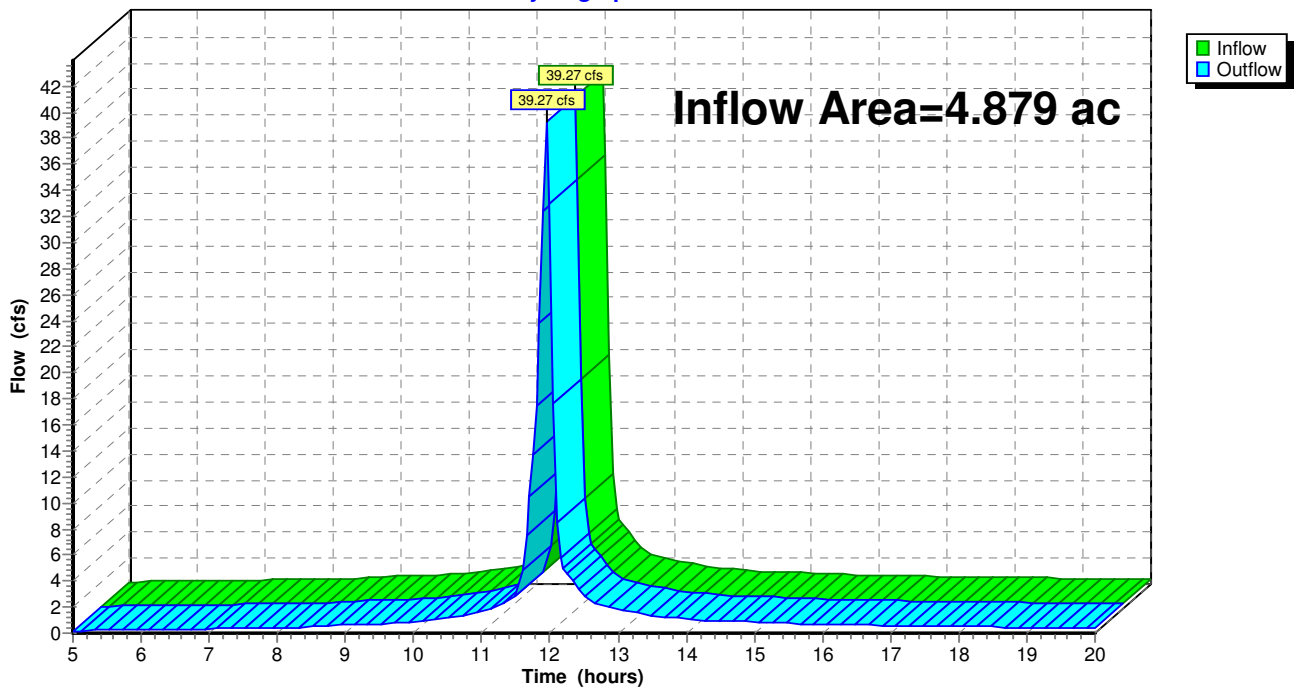
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.879 ac, 84.76% Impervious, Inflow Depth > 4.67" for 100-yr event  
Inflow = 39.27 cfs @ 11.95 hrs, Volume= 1.897 af  
Outflow = 39.27 cfs @ 11.95 hrs, Volume= 1.897 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 7R: Total Site

Hydrograph



### Summary for Reach 9R: NE Sunwood Catch Basin

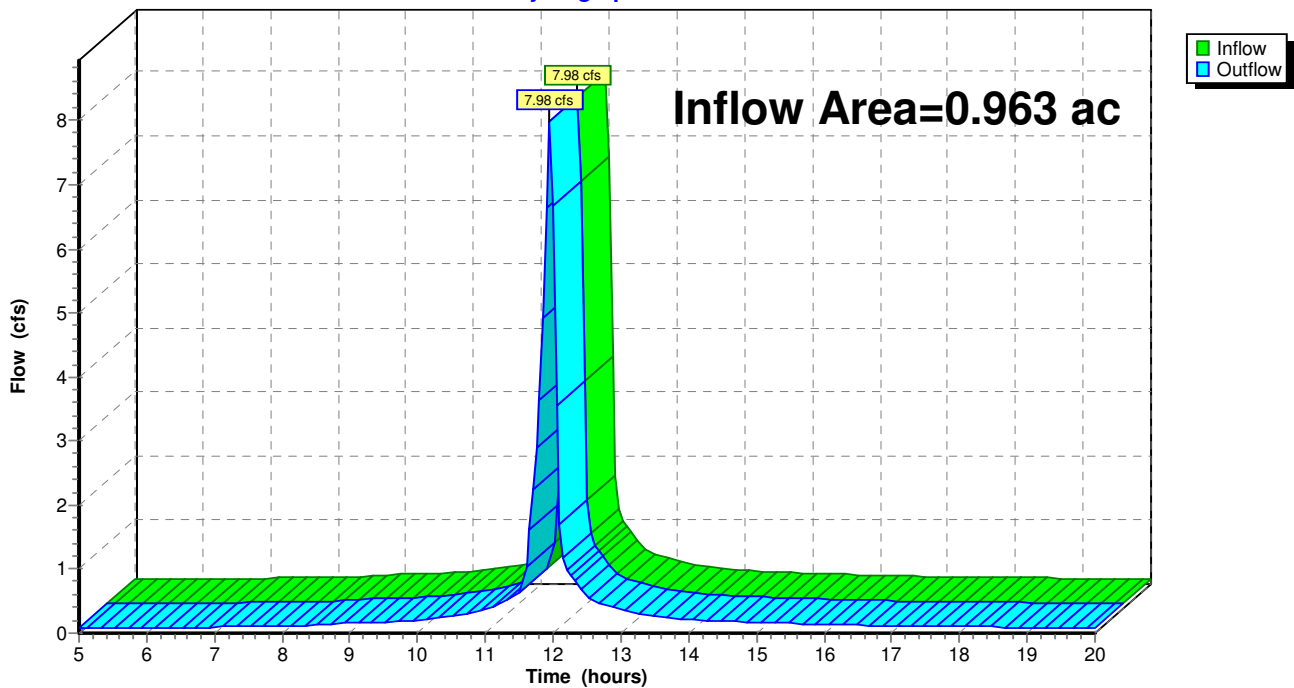
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.963 ac, 94.99% Impervious, Inflow Depth > 5.00" for 100-yr event  
Inflow = 7.98 cfs @ 11.95 hrs, Volume= 0.402 af  
Outflow = 7.98 cfs @ 11.95 hrs, Volume= 0.402 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 9R: NE Sunwood Catch Basin

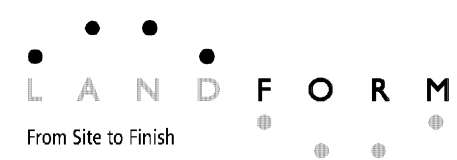
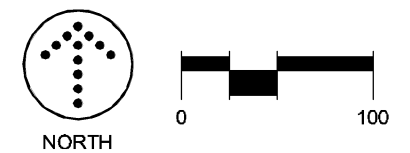
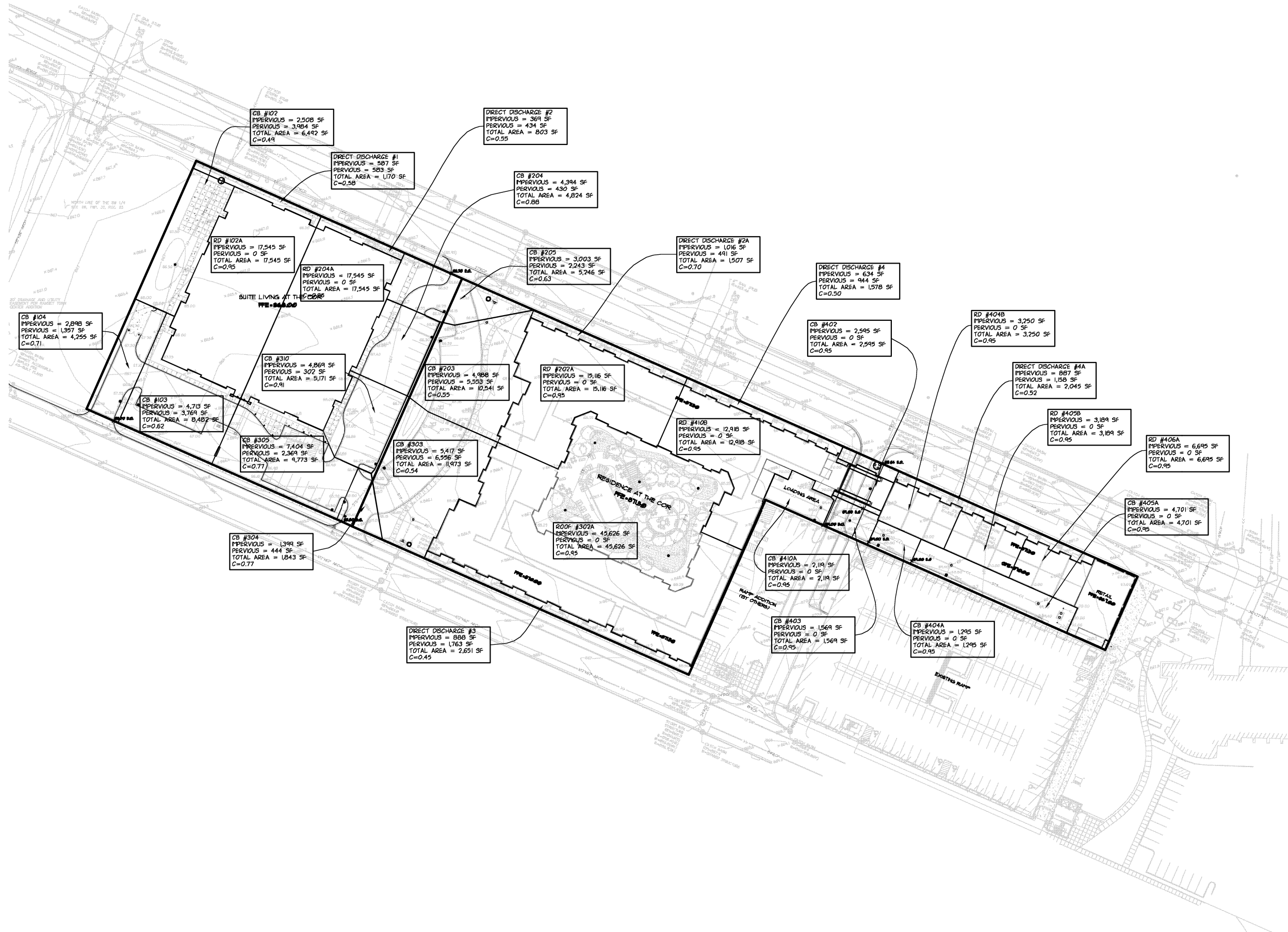
Hydrograph



# APPENDIX E

## PROPOSED STORM SEWER DRAINAGE MAP



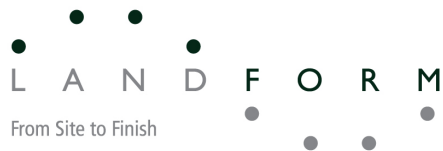


**PROPOSED STORM  
SEWER DRAINAGE MAP**

12.03.2010

# APPENDIX F

## STORM SEWER DESIGN CALCULATIONS



# STORM SEWER DESIGN CALCULATIONS

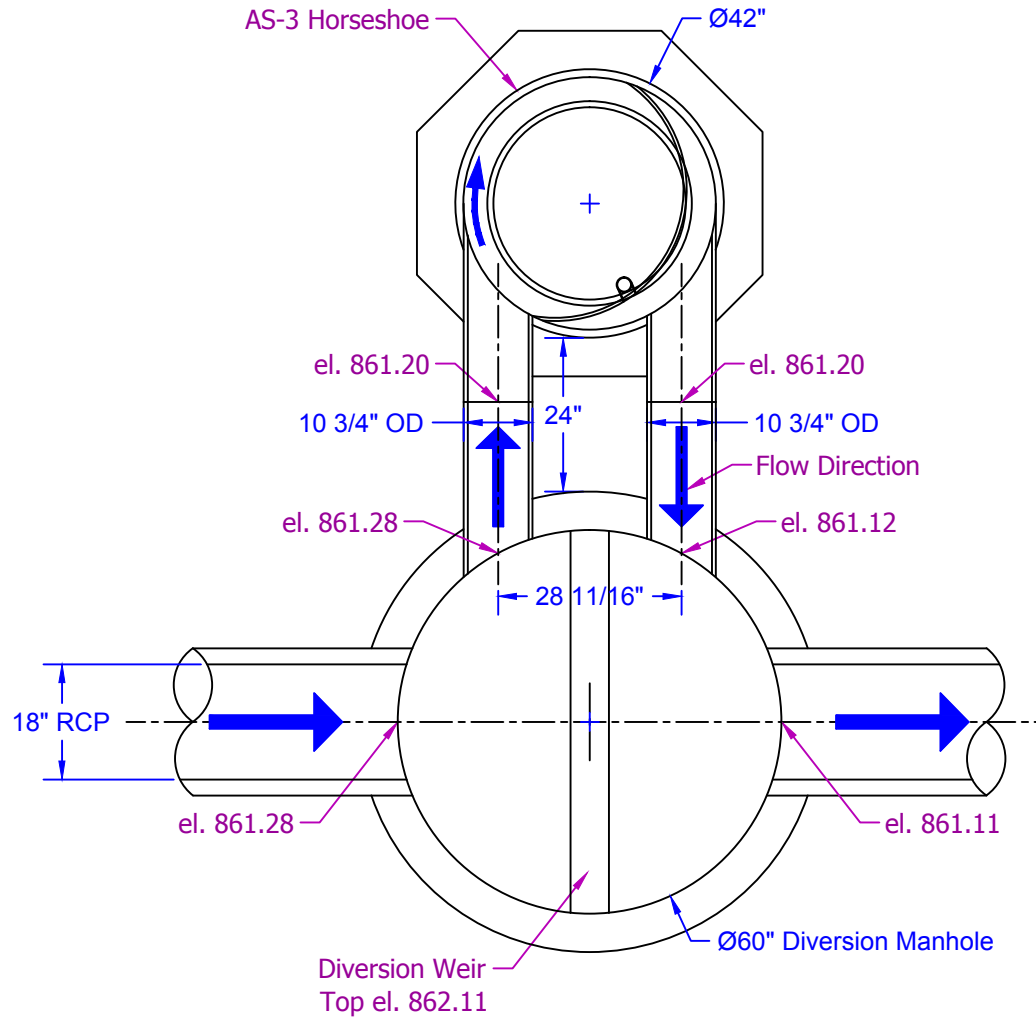
DATE	12/03/10	FILE	UWA10002 Storm Sewer Design Calculations.xls
PROJECT NAME	The Residence at the COR / COR Senior Living	STORM FREQUENCY	10 years
PROJECT NUMBER	UWA10002 / TOT10005	CALCULATIONS BY	SES
PROJECT LOCATION	Ramsey, MN	MN STATE ZONE	1 (Use "1" for areas within Twin Cities and southward)
PROJECT ENGINEER	DWH		

Segment	A - Trib. Areas		C - Coef.		Tc - Time of Conc.			I - Intensity		Q - Rate		Pipe						Upstream Structure					Downstream Structure					Comments				
	From	To	CB Ac.	Pipe Ac.	CB Indiv.	Pipe Avg.	CB Min.	Pipe Min.	Total Min.	CB In/Hr	Total In/Hr	CB CFS	Pipe CFS	Len. Ft.	Dia. In.	Grade %	Mat'l.	Man's n	Vel. Ft/S	Cap. CFS	Excess Cap.	Structure	Top Rim	Invert	Build	Size	Casting		Structure	Top Rim	Inlet	Match
<b>100 SERIES</b>																																
CB 104	CB 103	0.10	0.10	0.71	0.71	5.0	0.1	5.1	7.10	7.10	0.5	0.5	18	12	0.90	RCP	0.013	4.3	3.4	2.9	CB 104	866.23	863.26	2.97	27"	R-3250-A	CB 103	866.23	863.09	8/10ths		3.14
CB 103	CB 102	0.19	0.29	0.62	0.65	5.0	0.6	5.6	7.10	6.95	0.9	1.3	147	12	0.90	RCP	0.013	4.3	3.4	2.1	CB 103	866.23	863.09	3.14	48"	R-3250-A	CB 102	866.50	861.77	8/10ths		4.73
CB 102	Eco St #1	0.15	0.84	0.49	0.76	5.0	0.2	5.9	7.10	6.95	0.5	4.5	97	15	0.90	PVC	0.010	6.5	8.0	3.5	CB 102	866.50	861.57	4.93	48"	R-1792-FG	Eco St #1	866.00	860.70	8/10ths		5.30
Eco St #1	EX 100	0.00	0.84	0.00	0.76	5.0	0.1	6.0	7.10	6.95	0.0	4.5	22	15	0.90	RCP	0.013	5.0	6.1	1.6	Eco St #1	866.00	860.70	5.30	72"	na	EX 100	864.40	860.50	8/10ths		3.90
RD 102A	CB 102	0.40	0.40	0.95	0.95	5.0	0.1	5.1	7.10	7.10	2.7	2.7	22	12	1.00	PVC	0.010	5.9	4.6	1.9	RD 102A	868.00	861.99	6.01	na	na	CB 102	866.50	861.77	8/10ths		4.73
<b>200 SERIES</b>																																
RD 204A	CB 204	0.40	0.40	0.95	0.95	5.0	0.2	5.2	7.10	7.10	2.7	2.7	58	12	0.50	PVC	0.010	4.2	3.3	0.6	RD 204A	868.00	862.38	5.63	na	na	CB 204	866.13	862.09	8/10ths		4.04
CB 204	STUB 203A	0.11	0.63	0.88	0.88	5.0	0.0	5.2	7.10	7.10	0.7	3.9	3	15	0.50	RCP	0.013	3.7	4.6	0.6	CB 204	866.13	861.89	4.25	48"	R-3250-A	STUB 203A	866.25	861.87	8/10ths		4.38
STUB 203A	CB 203	0.00	0.63	0.00	0.88	5.0	0.0	5.3	7.10	7.10	0.0	3.9	5	15	0.50	RCP	0.013	3.7	4.6	0.6	STUB 203A	866.25	861.87	4.38	na	na	CB 203	866.13	861.85	8/10ths		4.28
CB 203	MH 202	0.24	0.88	0.55	0.79	5.0	0.2	5.5	7.10	7.10	1.0	4.9	50	18	0.50	RCP	0.013	4.2	7.4	2.5	CB 203	866.13	861.65	4.49	48"	R-3250-A	MH 202	867.25	861.40	8/10ths		5.86
MH 202	MH 201	0.00	1.22	0.00	0.83	5.0	0.1	5.6	7.10	6.95	0.0	7.1	23	18	0.50	RCP	0.013	4.2	7.4	0.3	MH 202	867.25	861.40	5.86	48"	R-1642	MH 201	867.00	861.28	Drop	0.17	5.72
MH 201	EX 200	0.00	1.22	0.00	0.83	5.0	0.1	5.6	7.10	6.95	0.0	7.1	22	18	0.50	RCP	0.013	4.2	7.4	0.3	MH 201	867.00	861.11	5.89	60"	na	EX 200	866.20	861.00	8/10ths		5.20
CB 205	CB 204	0.12	0.12	0.63	0.63	5.0	0.1	5.1	7.10	7.10	0.5	0.5	28	12	1.00	RCP	0.013	4.5	3.6	3.0	CB 205	865.93	862.37	3.56	48"	R-3250-A	CB 204	866.13	862.09	8/10ths		4.04
RD 202A	MH 202	0.35	0.35	0.95	0.95	5.0	0.1	5.1	7.10	7.10	2.3	2.3	20	12	1.00	PVC	0.010	5.9	4.6	2.3	RD 202A	871.50	862.00	9.51	na	na	MH 202	867.25	861.80	8/10ths		5.46
<b>300 SERIES</b>																																
CB 305	CB 304	0.22	0.22	0.77	0.77	5.0	0.1	5.1	7.10	7.10	1.2	1.2	14	12	1.00	RCP	0.013	4.5	3.6	2.3	CB 305	865.33	861.85	3.48	27"	R-3250-A	CB 304	865.23	861.71	8/10ths		3.52
CB 304	STUB 303A	0.04	0.27	0.77	0.77	5.0	0.2	5.2	7.10	7.10	0.2	1.5	44	12	1.00	RCP	0.013	4.5	3.6	2.1	CB 304	865.23	861.71	3.52	48"	R-3250-A	STUB 303A	866.30	861.27	8/10ths		5.03
STUB 303A	CB 303	0.00	0.27	0.00	0.77	5.0	0.1	5.3	7.10	7.10	0.0	1.5	19	12	1.00	RCP	0.013	4.5	3.6	2.1	STUB 303A	866.30	861.27	5.03	na	na	CB 303	865.83	861.08	8/10ths		4.75
CB 303	MH 302	0.27	0.66	0.54	0.70	5.0	0.2	5.5	7.10	6.95	1.1	3.2	60	12	1.00	RCP	0.013	4.5	3.6	0.4	CB 303	865.83	861.08	4.75	48"	R-3250-A	MH 302	866.50	860.48	8/10ths		6.02
MH 302	MH 301	0.00	1.71	0.00	0.85	5.0	0.1	5.6	7.10	6.95	0.0	10.1	25	18	1.00	RCP	0.013	5.9	10.5	0.4	MH 302	866.50	860.08	6.42	48"	R-1642	MH 301	865.25	859.83	Drop	0.17	5.42
MH 301	EX 300	0.00	1.71	0.00	0.85	5.0	0.0	5.6	7.10	6.95	0.0	10.1	16	18	1.00	RCP	0.013	5.9	10.5	0.4	MH 301	865.25	859.66	5.59	60"	na	EX 300	864.50	859.50	8/10ths		5.00
RD 302A	MH 302	1.05	1.05	0.95	0.95	5.0	0.1	5.1	7.10	7.10	7.1	7.1	30	15	1.00	PVC	0.010	6.8	8.4	1.3	RD 302A	870.00	860.58	9.42	na	na	MH 302	866.50	860.28	8/10ths		6.22
CB 310	STUB 303B	0.12	0.12	0.91	0.91	5.0	0.0	5.0	7.10	7.10	0.8	0.8	4	12	1.00	RCP	0.013	4.5	3.6	2.8	CB 310	865.83	861.17	4.66	na	na	STUB 303B	866.25	861.13	8/10ths		5.12
STUB 303B	CB 303	0.00	0.12	0.00	0.91	5.0	0.0	5.0	7.10	7.10	0.0	0.8	5	12	1.00	RCP	0.013	4.5	3.6	2.8	STUB 303B	866.25	861.13	5.12	na	na	CB 303	865.83	861.08	8/10ths		4.75
<b>400 SERIES</b>																																
RD 406A	MH 406	0.15	0.15	0.95	0.95	5.0	0.1	5.1	7.10	7.10	1.0	1.0	16	12	0.50	PVC	0.010	4.2	3.3	2.2	RD 406A	870.00	866.24	3.76	na	na	MH 406	869.70	866.16	8/10ths		3.54
MH 406	MH 405	0.00	0.15	0.00	0.95	5.0	0.5	5.6	7.10	6.95	0.0	1.0	96	12	0.50	RCP	0.013	3.2	2.5	1.5	MH 406	869.70	866.16	3.54	48"	R-1642	MH 405	869.40	865.68	8/10ths		3.72
MH 405	MH 404	0.00	0.33	0.00	0.95	5.0	0.4	6.0	7.10	6.95	0.0	2.2	75	12	0.50	RCP	0.013	3.2	2.5	0.3	MH 405	869.40	865.68	3.72	48"	R-1642	MH 404	869.40	865.31	8/10ths		4.09
MH 404	CB 403	0.00	0.44	0.00	0.95	5.0	0.2	6.1	7.10	6.80	0.0	2.8	37	12	0.80	RCP	0.013	4.1	3.2	0.3	MH 404	869.40	865.31	4.09	48"	R-1642	CB 403	868.55	865.01	8/10ths		3.54
CB 403	CB 402	0.04	0.82	0.95	0.95	5.0	0.1	6.2	7.10	6.80	0.2	5.3	39	15	0.80	RCP	0.013	4.7	5.8	0.5	CB 403	868.55	864.81	3.74	48"	R-1792-FG	CB 402	868.33	864.50	8/10ths		3.83
CB 402	Eco St #2	0.06	0.88	0.95	0.95	5.0	0.1	6.3	7.10	6.80	0.4	5.7	24	15	0.80	RCP	0.013	4.7	5.8	0.1	CB 402	868.33	864.50	3.83	48"	R-3250-A	Eco St #2	868.61	864.31	8/10ths		4.30
Eco St #2	EX 400	0.00	0.88	0.00	0.95	5.0	0.1	6.4	7.10	6.80	0.0	5.7	26	15	0.80	RCP	0.013	4.7	5.8	0.1	Eco St #2	868.61	864.31	4.30	84"	na	EX 400	867.90	864.10	8/10ths		3.80
CB 405A	MH 405	0.11	0.11	0.95	0.95	5.0	0.0	5.0	7.10	7.10	0.7	0.7	11	12	1.00	RCP	0.013	4.5	3.6	2.8	CB 405A	868.63	865.79	2.84	27"	R-3250-A	MH 405	869.40	865.68	8/10ths		3.72
RD 405B	MH 405	0.07	0.07	0.95	0.95	5.0	0.1	5.1	7.10	7.10	0.5	0.5	16	8	1.00	PVC	0.010	4.5	1.6	1.1	RD 405B	870.00	866.84	3.16	na	na	MH 405	869.40	866.68	Drop	1.00	2.72
CB 404A	MH 404	0.03	0.03	0.95	0.95	5.0	0.0	5.0	7.10	7.10	0.2	0.2	11	12	1.00	RCP	0.013	4.5	3.6	3.4	CB 404A	868.63	865.42	3.21	27"	R-3250-A	MH 404	869.40	865.31	8/10ths		4.09
RD 404B	MH 404	0.07	0.07	0.95	0.95	5.0	0.1	5.1	7.10	7.10	0.5	0.5	19	8	1.00	PVC	0.010	4.5	1.6	1.1	RD 404B	870.00	866.50	3.50	na	na	MH 404	869.40	866.31	Drop	1.00	3.09
CB 410A	MH 410	0.05	0.05	0.95	0.95	5.0	0.1	5.1	7.10	7.10	0.3	0.3	15	12	1.00	RCP	0.013	4.5	3.6	3.2	CB 410A	868.63	865.48	3.15	27"	R-3250-A	MH 410	869.10	865.33	8/10ths		3.77
MH 410	CB 403	0.00	0.35	0.00	0.95	5.0	0.1	5.3	7.10	7.10	0.0	2.3	32	12	1.00	RCP	0.013	4.5	3.6	1.2	MH 410</											

# APPENDIX G

## PROPRIETARY TREATMENT DEVICES



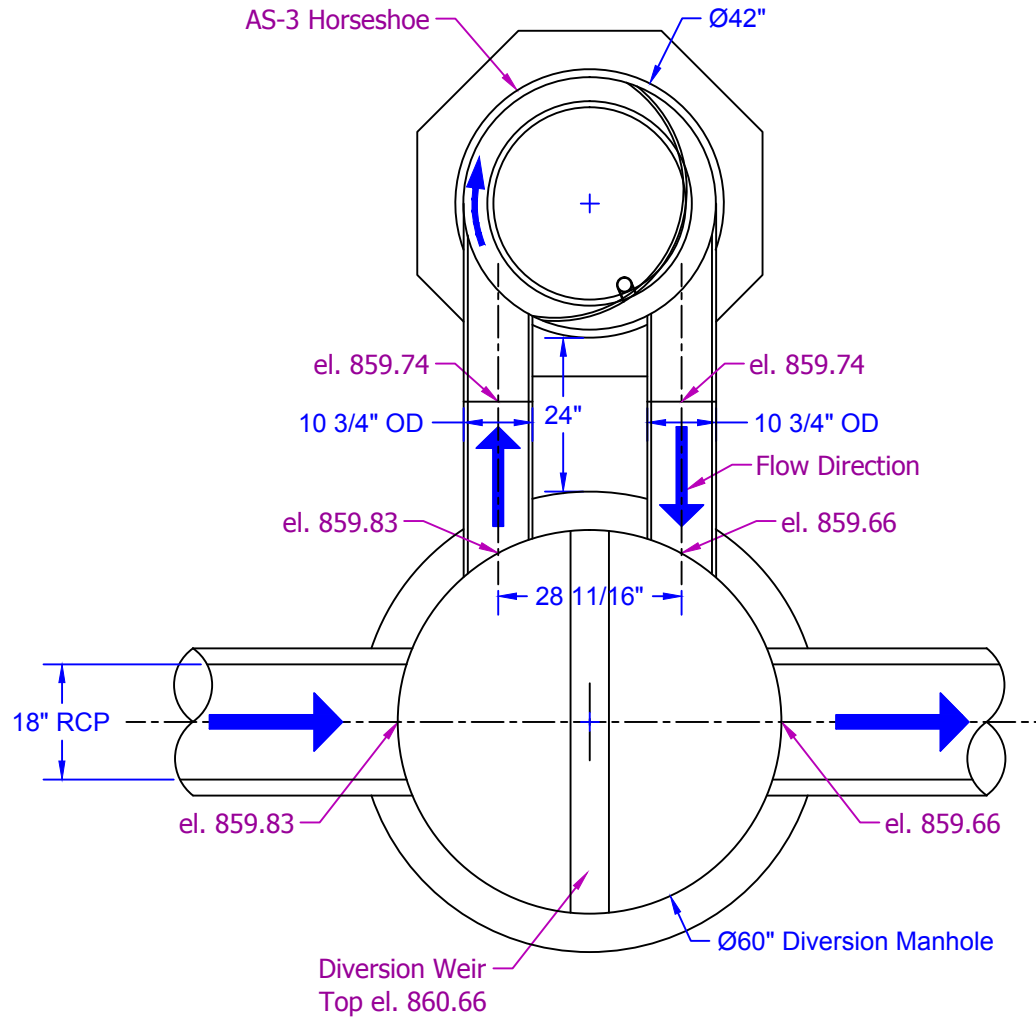


2705 Kanasita Drive, Chattanooga, TN 37343  
 Phone (888) 344-9044 Fax (423) 826-2112  
 www.aquashieldinc.com

Aqua-Swirl Concentrator  
 Model AS-3 Horseshoe Layout STR #1 (North)  
 The Residence at the COR  
 Ramsey, MN - Project: #UWA10002

Document:	AS-3 Off-Line Layout
Drawn By:	JCW
Scale:	1:30
Date:	12/01/10

U.S. Patent No. 6524473 and other Patent Pending



2705 Kanasita Drive, Chattanooga, TN 37343  
 Phone (888) 344-9044 Fax (423) 826-2112  
 www.aquashieldinc.com

Aqua-Swirl Concentrator  
 Model AS-3 Horseshoe Layout STR #2 (South)

The Residence at the COR  
 Ramsey, MN - Project: #UWA10002

Document:	AS-3 Off-Line Layout
Drawn By:	JCW
Scale:	1:30
Date:	12/01/10

U.S. Patent No. 6524473 and other Patent Pending



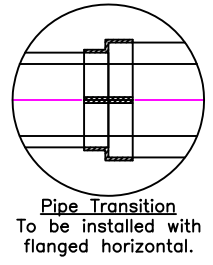
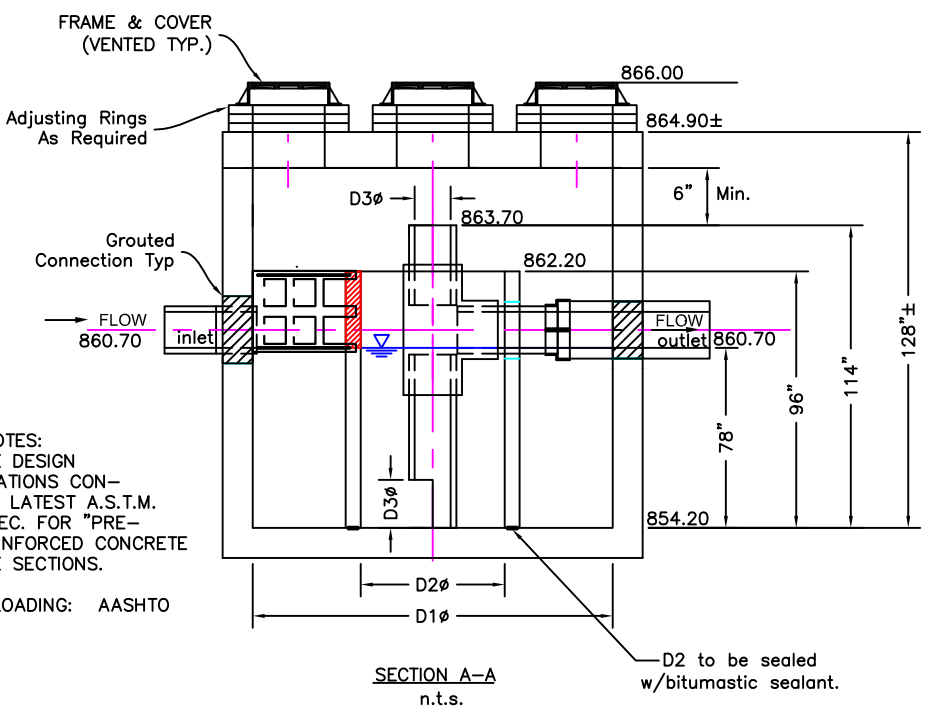
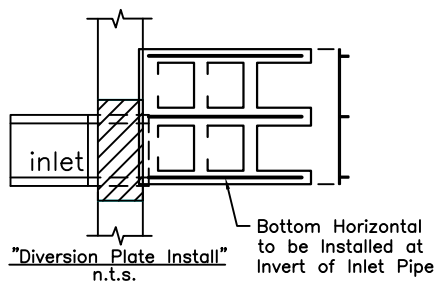
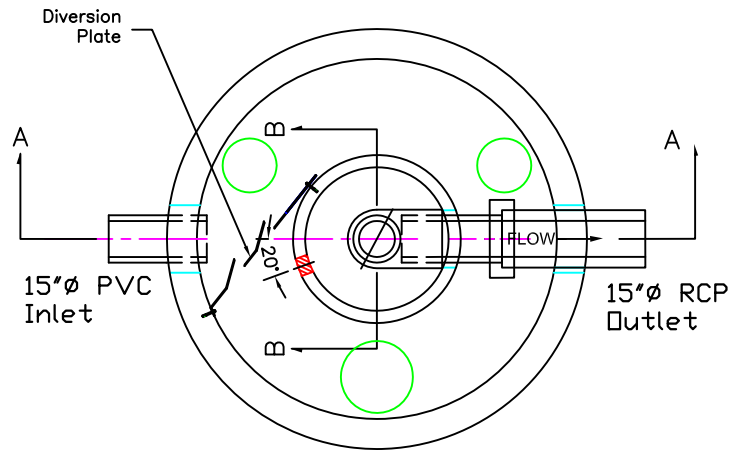
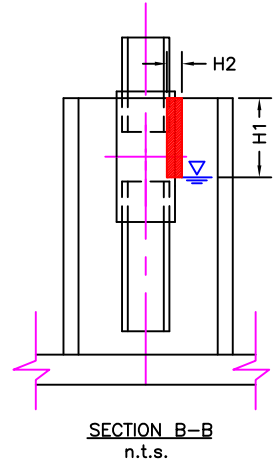
PROJECT:	SUITE LIVING AT THE COR	LOCATION:	RAMSEY, MN
OWNER:	<ENTER OWNER>	SCALE:	NONE
ENGINEER:	LANDFORM	DRAWN BY:	LRH
CONTRACTOR:	TBD	DATE:	11-30-10
MANUFACTURER:	Royal Concrete Pipe	DWG. NO.:	RCP_SuiteCOR-Ramsey_STS1.dwg
PRODUCT DESIGNATION:	ecoStorm - gross particulate separation technology		
DESIGNED BY:	LRH	CHECK 1:	RO
		CHECK 2:	SEG

REVISIONS

<b>ecoStorm</b>				vertical weir		"tee" Fibergl.	Flow Diffuser	
ecoStorm model no.	D1 dia. (ft.)	D2 dia. (ft.)	D3 dia. (in.)	H1 (in.)	H2 (in.)	(in.)	Stainless Steel Diversion Plate	45° pvc (in.)
1	6.00	2.50	15.00	18.00	6.00	15.00		

## ecoStorm #1


### Online



GENERAL NOTES:  
 MANHOLE DESIGN SPECIFICATIONS CONFORM TO LATEST A.S.T.M. C478 SPEC. FOR "PRE-CAST REINFORCED CONCRETE MANHOLE SECTIONS."  
 DESIGN LOADING: AASHTO HS25

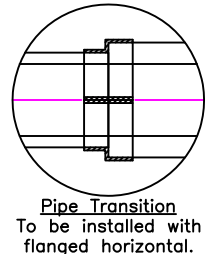
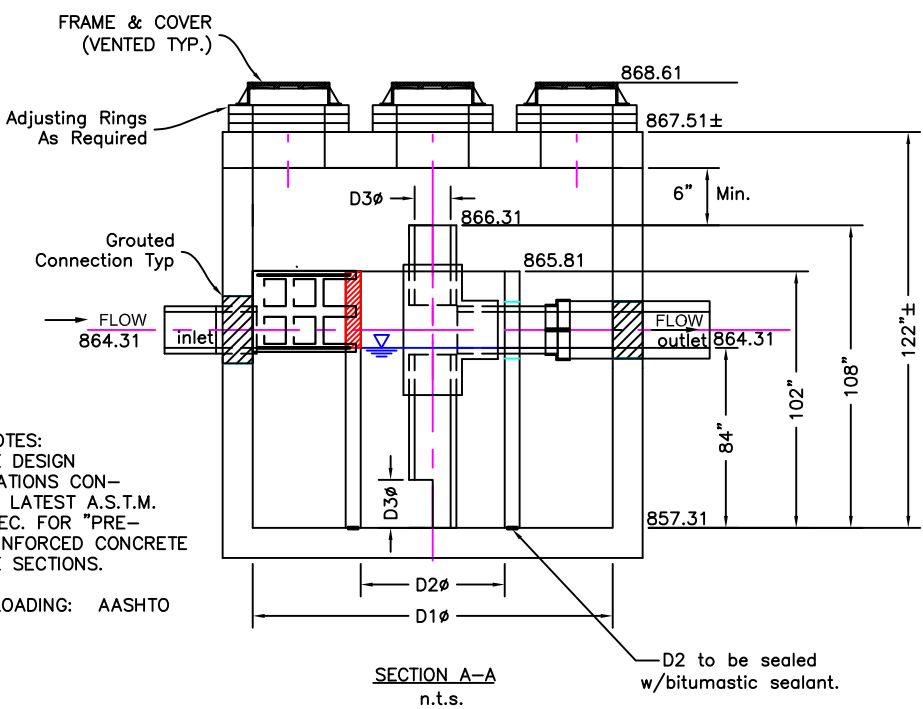
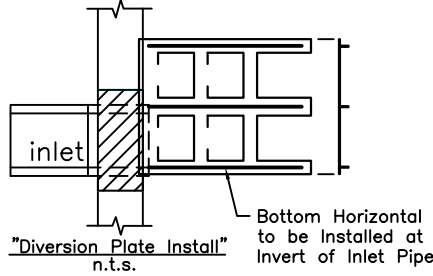
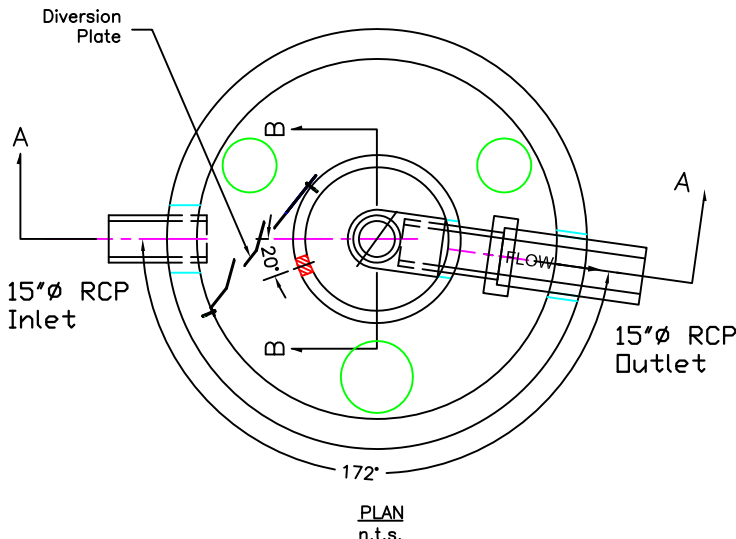
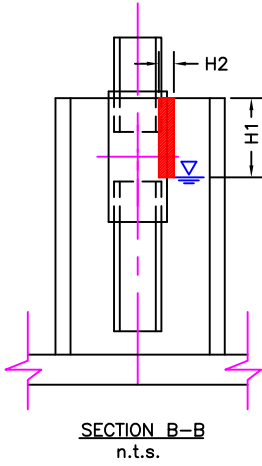
PROJECT:	RESIDENCE AT THE COR	LOCATION:	RAMSEY, MN
OWNER:	<ENTER OWNER>	SCALE:	NONE
ENGINEER:	LANDFORM	DRAWN BY:	LRH
CONTRACTOR:	TBD	DATE:	11-30-10
MANUFACTURER:	Royal Concrete Pipe	DWG. NO.:	RCP_ResidenceCOR-Ramsey_STS2.dwg
PRODUCT DESIGNATION:	ecoStorm - gross particulate separation technology		
DESIGNED BY:	LRH	CHECK 1:	RO
		CHECK 2:	SEG

REVISIONS

				vertical weir		"tee" Fibergl.	Flow Diffuser	
ecoStorm model no.	D1 dia. (ft.)	D2 dia. (ft.)	D3 dia. (in.)	H1 (in.)	H2 (in.)	(in.)	Stainless Steel Diversion Plate	45° pvc (in.)
1.5	7.00	2.50	15.00	18.00	6.00	15.00		

## ecoStorm #2

Online



GENERAL NOTES:  
 MANHOLE DESIGN SPECIFICATIONS CONFORM TO LATEST A.S.T.M. C478 SPEC. FOR "PRE-CAST REINFORCED CONCRETE MANHOLE SECTIONS."  
 DESIGN LOADING: AASHTO HS25



## ecoStorm® Stormwater Treatment Specifications

Structural, hydrodynamic, gross particulate separation technology

### Part 1.00 – General

#### 1.01 Description

A. Work included:

The contractor, and/or manufacturer selected by the contractor and approved by the engineer, shall furnish all labor, commodity materials, equipment, and incidentals required and shall install the structural stormwater treatment system and appurtenances in accordance with the drawings and these specifications.

#### 1.02 Quality Control Inspection

- A. The structural stormwater treatment system shall be dry-fitted in the manufacturer's yard prior to shipment to the project site. The unit, when dry-fitted, shall have all component connections pre-drilled and anchored. Section joints shall be clearly marked for the contractor to properly install and align the unit in the field.
- B. The quality of materials, the process of manufacture, and the finished sections shall be subject to inspection by the engineer. Such inspection may be made at the place of manufacture, on the work site after delivery, or at both locations. Sections rejected after delivery to the site shall be marked for identification and shall be removed from the site at once. Any section that has been damaged after delivery may be rejected and, if already installed, shall be acceptably repaired (if permitted) or removed and replaced, entirely at the contractor's expense.
- C. All sections shall be inspected for general appearance, dimensions, soundness, etc. The surface shall be dense, close-textured, and free of excess bug holes, cracks, roughness, and exposure of reinforcement.
- D. Imperfections may be repaired, subject to the acceptance of the engineer. Repairs shall be carefully inspected before final acceptance.

#### 1.03 Submittals

A. Shop drawings:

The contractor shall submit to the engineer six sets of shop drawings and the corresponding hydraulic sizing and calibration for the specific site for which the stormwater treatment system has been designed prior to release of bid documents.

## Part 2.00 – Products

### 2.01 Materials and Design

The structural stormwater treatment system shall be made of pre-cast concrete. The manufacturer shall be a member of the American Concrete Pipe Association or the National Pre-cast Concrete Association and meet the following manufacturing requirements:

- A. Structures shall be designed to comply with ASTM Designation C-478.
- B. Sections shall have watertight joints consisting of either gasketed joints per ASTM C-443, or a butyl mastic sealant conforming to ASTM C-990.
- C. Pipe openings shall be provided with a flexible rubber sleeve per ASTM C-923, or shall be made watertight by the contractor with cement mortar, and shall be sized to accept pipes of the specified size(s) and material(s).
- D. Internal components shall be made of stainless steel, fiberglass, and/or high density polyethylene (HDPE).
- E. Casting for manhole frames and covers shall be vented and per the governing city's requirements.
- F. All sections shall be cured by an approved method. Sections shall not be shipped until the concrete has attained a compressive strength of 4,000 psi.

### 2.02 Hydraulic Design

The specified stormwater treatment system shall be hydraulically designed for the specific site in which it will be installed. The calibration of the specified system shall account for peak flow rates (supplied to specified stormwater treatment system company by owner/engineer) that correspond with predetermined regional rainfall data to maintain peak removal efficiencies and to not cause upstream flooding or pooling of stormwater.

The structural stormwater treatment system shall consist of one round pre-cast concrete structure (D1) with another smaller diameter structure (D2) housed within the main structure D1. The D2 structure should be integrally cast or sealed with a bitumastic sealant to the base of the D1 structure.

The D1 structure shall have an on-center, mechanically fastened inlet deflector plate that induces a swirling flow pattern between the D1 and the D2 walls. This area will accumulate, store and retain captured/settled solids deposited by numerous storm events and prevent washout of separated solid pollutants under peak design flow until which time the maximum storage volume of solid contaminants is reached.

The D3 internal piping shall be fiberglass or PVC and designed to discharge clean water downstream, while retaining floatable debris within the structure to a defined peak flow rate.

### 2.03 Device Testing and Analysis

The following minimum testing standards are critical to ensure proper design and function of the stormwater treatment system:

- Testing was performed using a full scale unit to minimize scaling error.
- Testing, data analysis, and development of the performance function was performed by an independent 3<sup>rd</sup> party.
- Removal efficiencies were determined by using a sediment mass balance approach to ensure accurate measurement. No automated samplers or grab samples were utilized to determine device removal efficiency.
- Water temperature was recorded during testing and water viscosity is accounted for in the device performance function.
- Testing was performed with several wholly independent particle sizes or particle size distributions (able to be separated by sieving) to promote repeatability of tests and development of an accurate performance function applicable to a wide range of particle sizes.
- Each test must be repeated a minimum of three times with all input values ~constant (e.g. flow rate, temp., influent sediment concentration, etc.). Test repeatability must be sufficiently accurate as to result in a greater than 95% confidence of the final performance function when including all testing data points.
- A performance function must be created using the testing data and provide for scaling of the treatment unit; allowing for design variability of the unit dimensions, flow rate, and sediment gradation at a minimum.
- Testing must be performed to determine not only the device removal efficiency, but also the devices ability to retain previously captured material.

### 2.04 Performance

The device(s) shall meet and utilize the testing and analysis requirements listed in Section 2.03 above to meet the following treatment targets (default treatment targets are based on the ecoStorm design guidelines):

- 80% TSS removal
- Particle size of 110 microns
- Flow rate generated during a 1" storm event

The device must also be capable of conveying the peak flow, as defined by the engineer, with negligible hydraulic impacts to the upstream storm sewer system and minimal washout of previously captured material.

### 2.05 Manufacturer

The structural stormwater treatment system shall be the ecoStorm® Stormwater Treatment System as manufactured by Royal Environmental Systems of Stacy, Minnesota, or an authorized manufacturer approved by Royal Environmental Systems to produce the ecoStorm Stormwater Treatment System.

## Part 3.00 – Execution

### 3.01 Installation

- A. The structural stormwater treatment system shall be constructed according to the sizes shown on the drawings and as specified herein. Install at elevations and locations shown on the drawings or as otherwise directed by the engineer.
- B. Place the pre-cast base units on a granular sub-base in accordance with the governing city's requirements. The granular sub-base shall be checked for level prior to setting and the pre-cast base sections of the stormwater treatment system shall be checked with a horizontal level at four quadrants after setting. If the slope exceeds 0.25%, the base section shall be removed and the granular excavation floor material re-leveled.
- C. The ecoStorm Stormwater Treatment System is designed to be watertight. The final installation must guarantee a watertight structure either through infiltration or exfiltration testing. Failure to achieve a watertight structure is grounds for rejection.

**END OF SECTION**