Stormwater Management Report

Proposed Development
255-257 Newtonville Avenue
Newton, Massachusetts

Prepared For Submission To:
City of Newton Regulatory Agencies

September 25, 2015

BL Project Number: 15D2781

Prepared For:
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Table of Contents

Introduction

The purpose of this report is to present the City of Newton Regulatory Agency staff with sufficient information regarding the technical aspects of the proposed project and to review the associated potential impacts relative to the stormwater management system. All work is intended to be in full compliance with Commonwealth of Massachusetts and the City of Newton stormwater regulations while taking prevailing site conditions and practical needs into account.

The site is located at intersection of Newtonville Avenue and Lewis Terrace. The site is bounded by Newtonville Avenue on the south, Lewis Terrace to the east, Interstate 90 to the north, and Laundry Brook (partially underground) to the west. The site is currently occupied by two buildings which are to be demolished.

A self storage facility is proposed on this site with associated parking, and other site amenities.

Existing Site Conditions

The site consists of approximately 1.7 acres of land. The site has been developed numerous times with railroad spurs previously occupying the site, and redeveloped during Interstate 90 construction and the Lewis Terrace overpass both of which resulted in major grading and fill placement. Currently the site has a mix of impervious surfaces consisting of buildings, parking lots, driveways, and sidewalks. A significant portion of the site is wooded and another portion is maintained lawn areas. The topography of the land generally slopes from Lewis Terrace to Laundry Brook. Runoff generally leaves the site as sheet flow.

The soils in the area of the site are classified by the Soil Conservation Service soil survey in the area of the proposed development (see Appendix C, Soil Map). The site fall within the “A” and “D” hydrologic groups, respectively, with one soil type not listing a HSG. Due to the numerous development over history of the property, and based on the geotechnical report for the project, a HSG of D is used for calculation purposes to generate the maximum amount of runoff in the post development condition to allow for conservatively sized stormwater management infrastructure.

A copy of Existing Drainage Area Map ED-1 can be found in the Appendix A. The overall site has been modeled as three watersheds and each watershed will represent a point of study. Existing Drainage Area A (E-A) is the largest portion of the site and it consists of the area which drains overland to the western property line and ultimately into Laundry Brook. Laundry Brook is contained entirely underground in a culvert and for approximately 120 feet where the culvert ends Laundry Brook daylights into a drainage channel with vertical walls before entering the culvert beneath Interstate 90. There is a small opening in the channel wall which allows overland flow to enter Laundry Brook.

Existing Drainage Area B (E-B) is the area which drains overland to the northern property line into an existing drainage ditch adjacent Interstate 90, and ultimately into Laundry Brook.

Existing Drainage Area C (E-C) is the small area which drains overland into Newtonville Avenue.

Refer to Appendix B for areas, cover types, curve numbers and time of concentrations.

Proposed Stormwater Management

The project includes the construction of one (1) new Self Storage building with associated parking, sidewalks, and other site amenities. The proposed project will significantly increase impervious area at the project site and the stormwater management system is designed to mitigate negative impacts from the increased impervious areas.

Proposed Drainage Patterns

The proposed drainage patterns will mimic the existing conditions and three watersheds are modeled to analyze changes in volume and flow rates for the three existing points of study.

A copy of the Proposed Drainage Area Map PD-1 can be found in Appendix A. Proposed Drainage Area A (P-A) consists of three sub areas. P-A.1 is the pervious landscaped area which will continue to flow overland to Laundry Brook. P-A.2 and P-A.3 are the impervious areas of roof and pavement which are directed to a proposed underground detention system (UG-A). A single catch basin collects the pavement runoff. The catch basin will have a 4 foot deep sump with a trap. The roof drainage and catch basin drainage are routed through a hydrodynamic separator prior to entering the underground detention system. Due to glacial till near UG-A, no significant infiltration is anticipated, however the system will be installed in crushed stone encased with geotextile. Because of the soil conditions not being conducive to infiltration, the system will be designed to fully drain by gravity, however an outlet control structure restricts the outflow to allow for maximum potential for infiltration while at the same time ensuring the storage volume is available to mitigate the next storm.

Proposed Drainage Area B (P-B) consist of 2 sub areas. P-B.1 is the pervious landscaped area that will continue to flow overland to the existing drainage ditch along Interstate 90. P-B.2 is the roof area which is collected via roof drains and conveyed by underground piping to a hydrodynamic separator and an underground detention system (UG-B). The soil conditions at UG-B restrict infiltration due to potentially contaminated coal ash fill overlying topsoil. No infiltration is proposed at this system and the system will be installed with an impermeable liner to prevent infiltration into the coal ash fill. The detention system is designed to fully drain, however an outlet control structure restricts the outflow to maintain flow rates well below pre development conditions. The system's outlet pipe will daylight and then water will flow overland to the existing drainage ditch along Interstate 90.

Proposed Drainage Area C (P-C) is the mostly pervious area which drains overland to Newtonville Avenue. The proposed grading directs water away from the proposed structure which results in a minor increase of area draining overland to Newtonville Avenue. This results in a negligible increase for the 100 year storm event (0.5 cfs increase) in flow rates to Newtonville Avenue (0.9 cfs post development versus 0.4 cfs pre development).

Overall, there is a net reduction in peak discharge from Points of Study A & B, and a negligible increase for POS C. Combining all Points of Study for the project results in a net reduction in peak discharges for the 2-year, 10-year, 25-year, and 100-year storm events.

Proposed Storm Water Quality

Along with the reduction of peak storm water discharge rates, an important element of the proposed drainage system is to improve the quality of stormwater runoff leaving the property. To do this, numerous Best Management Practices (BMP's) have been implemented in this design.

All catch basins in parking and/or paved areas will have a minimum of four-foot deep sumps to collect sediment carried in the runoff. In addition, all catch basin outlets will be fitted with 'hoods' which trap floating debris in the individual catch basin so they can be removed during regular maintenance. The most basic preventive measure of storm water treatment is to implement regular pavement sweeping along the proposed roads. According to the Massachusetts Stormwater Handbook, such treatment can be credited for up to 10% of total solids removal depending on the frequency of sweeping.

A hydrodynamic separator will be installed upstream of each underground detention system to provide for at least 80% total suspended solid removal from impervious areas on the project site.

Pre-development versus Post-development Comparison

The following charts summarize the comparison between Pre-development and Post-development peak flow rates:

2 Year Storm

	Existing Peak Flow (CFS)	Prop. Peak Flow (CFS)	Change in Flow (CFS)
POS-A	2.6	1.0	-1.6
POS-B	0.7	0.6	-0.1
POS-C	0.1	0.3	0.2
Overall	3.4	1.4	-2.0

10 Year Storm

	Existing Peak Flow (CFS)	Prop. Peak Flow (CFS)	Change in Flow (CFS)
POS-A	4.5	4.0	-0.5
POS-B	1.3	1.1	-0.2
POS-C	0.2	0.5	0.3
Overall	6.0	5.6	-0.4

25 Year Storm

	Existing Peak Flow (CFS)	Prop. Peak Flow (CFS)	Change in Flow (CFS)
POS-A	6.0	5.1	-0.9
POS-B	1.8	1.4	-0.4
POS-C	0.3	0.7	0.4
Overall	8.1	7.2	-0.9

100 Year Storm

	Existing Peak Flow (CFS)	Prop. Peak Flow (CFS)	Change in Flow (CFS)
POS-A	6.9	5.3	-1.6
POS-B	2.1	1.7	-0.4
POS-C	0.4	0.9	0.5
Overall	9.4	7.8	-1.6

Analysis Methodology

The hydrologic analysis was performed using the HydroCAD stormwater modeling system v. 10.0 computer program developed by HydroCAD Software Solutions, LLC.

Hydrographs for each watershed were developed using the SCS Synthetic Unit Hydrograph Method with a Type III rainfall, 2-year 10-year, 25-year, and 100-year distribution.

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

Conclusions

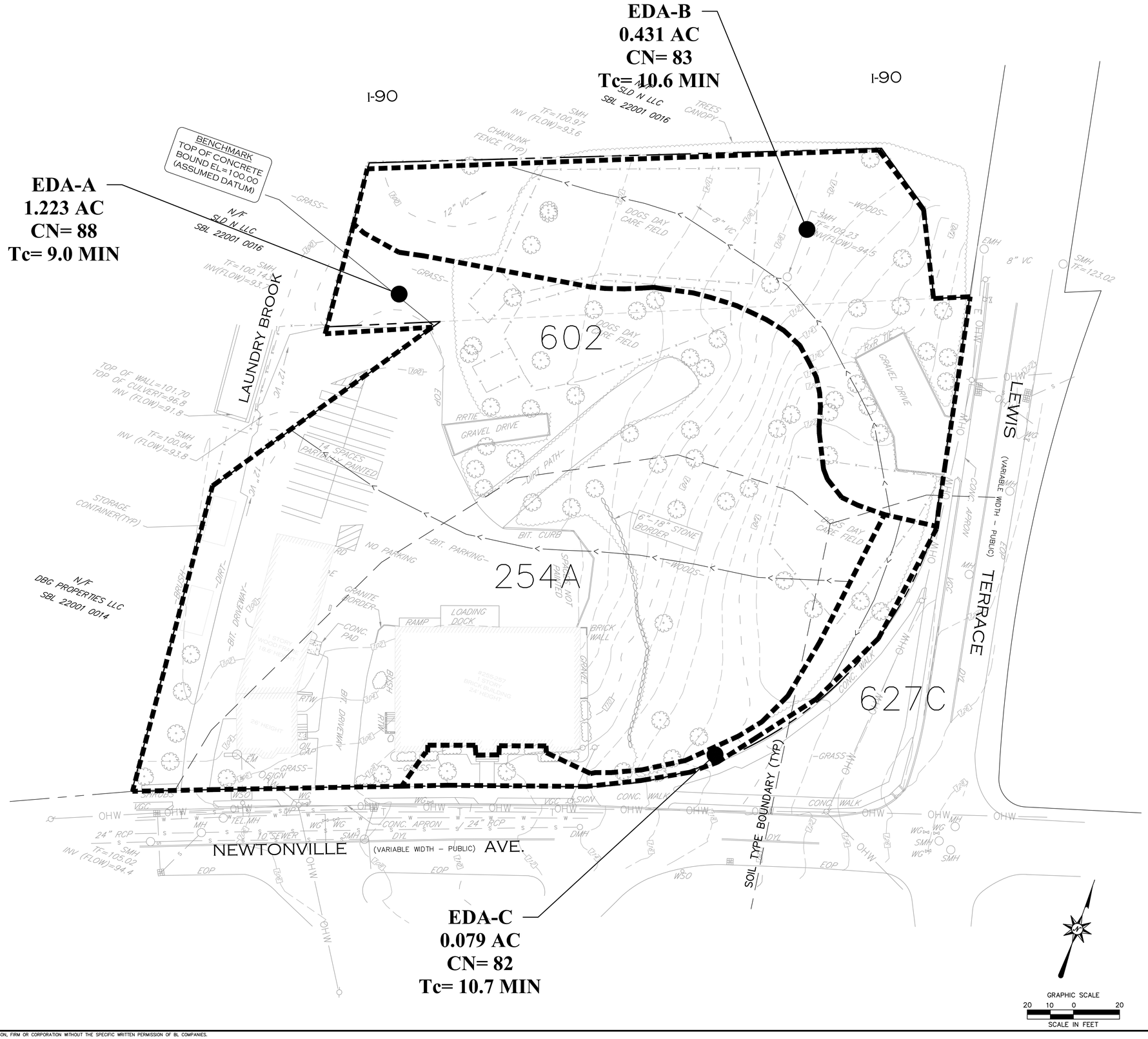
The stormwater management system has been designed to safely collect, treat, convey, and improve the quality of the runoff being discharged from the site. Computer modeling of the proposed systems have demonstrated a reduction in post-development peak rates of runoff to below pre-development levels. With proper annual maintenance the stormwater conveyance system, catch basins, manholes, underground detention systems and water quality structures should operate as anticipated for years to come.

The proposed development will decrease the proposed peak 2-year, 10-year, 25-year, and 100-year storm event peak flows generated by the site and will reduce total runoff volume due to the increase of pervious area. The proposed stormwater conveyance system was designed to safely pass the 100-year storm event and it will continue to safely convey the runoff from the site before being discharged to the existing system during the storm events as required per local and Commonwealth regulations.

This report has been prepared to compliment the submitted project plans as well as to represent the technical basis for the designs presented herein. In consideration of the overall project, we conclude that all technical concerns and design parameters set forth by the City of Newton and Commonwealth of Massachusetts have been met to the maximum extent practical.

Appendix A

Existing Drainage Area Map
Proposed Drainage Area Map
Grading and Drainage Plans (GD-1)



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PROPOSED SELF STORAGE FACILITY

255-257 NEWTONVILLE AVENUE
NEWTON, MASSACHUSETTS

REVISIONS

No.	Date	Desc.

Designed	
Drawn	
Checked	
Approved	
Scale	AS NOTED
Project No.	15D2781
Date	09/25/2015
CAD File:	ED15D278101

Title
EXISTING HYDROLOGY DRAINAGE AREA MAP

Sheet No.
ED-1

Xref (s): , X05BC278710 , xs01 , Border , XC15D278102

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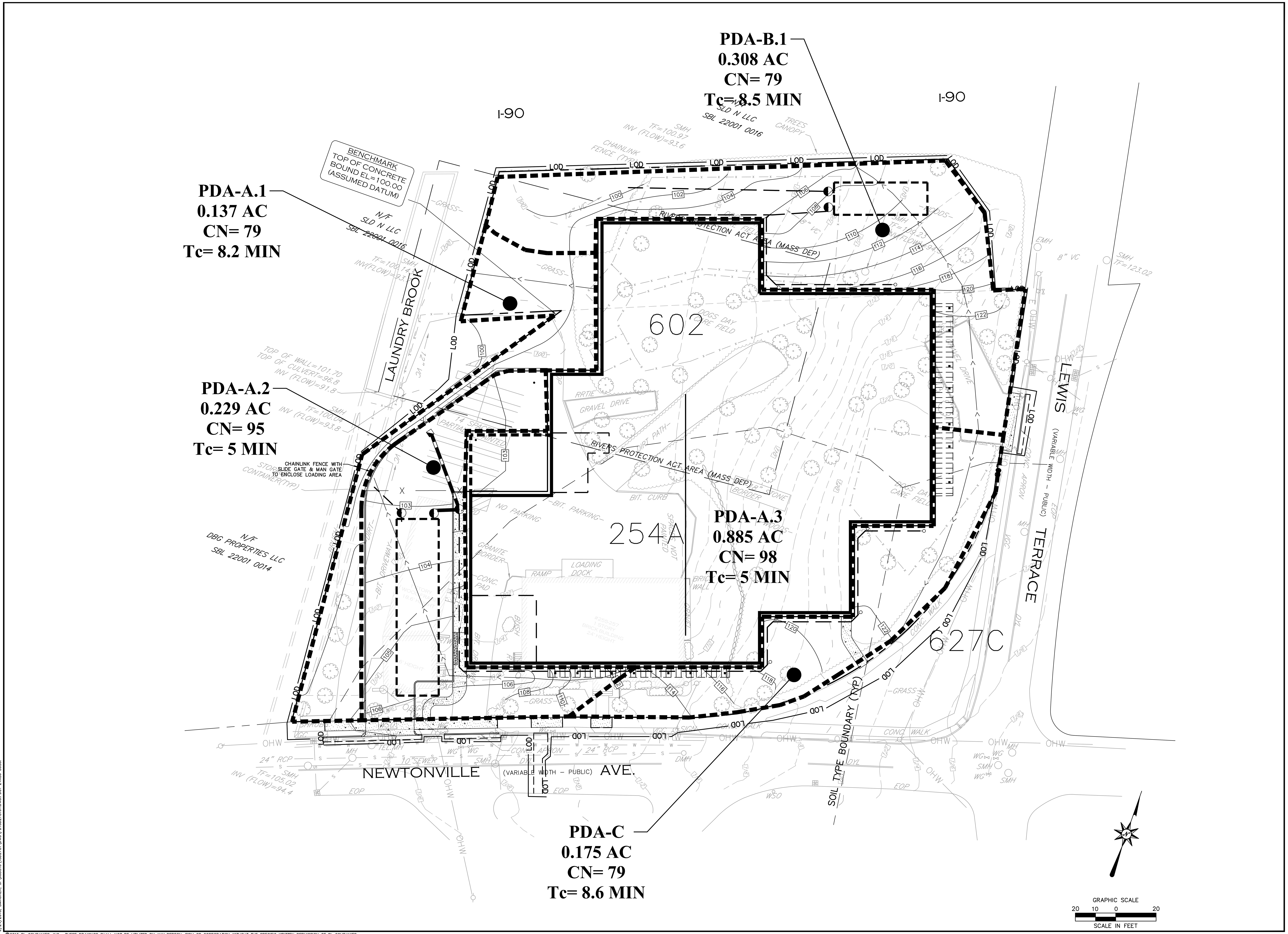

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Designed
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Scale AS NOTED
Project No. 15D2781
Date 09/25/2015
CAD File: PD15D278101

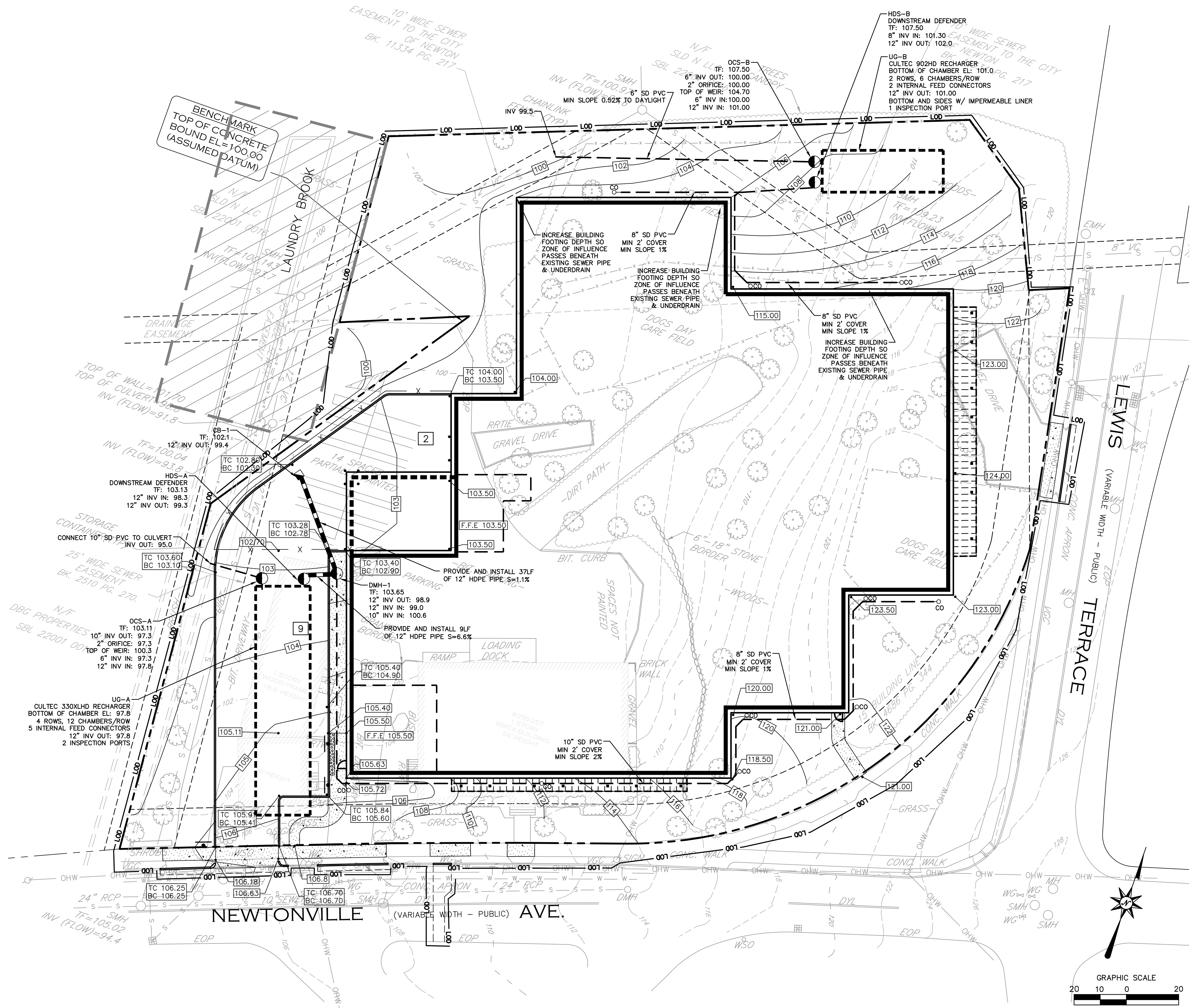
Title
PROPOSED HYDROLOGY DRAINAGE AREA MAP

Sheet No.
PD-1

LEGEND

- PROPOSED STORMWATER PIPE
- PROPOSED CATCH BASIN
- PROPOSED STORMWATER STRUCTURE
- EXISTING CONTOUR
- PROPOSED CONTOUR

NOTE: ON SITE CATCH BASINS SHALL BE INSTALLED WITH HOODED OUTLETS



REFER TO SHEET GN-1 FOR GENERAL NOTES AND GRADING AND DRAINAGE NOTES

**FOR PERMITTING PURPOSES ONLY
NOT RELEASED FOR CONSTRUCTION**

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NEWTON, MASSACHUSETTS

REVISIONS		
No.	Date	Desc.

Designed	A.B.U.
Drawn	A.B.U.
Checked	
Approved	
Scale	1"=20'
Project No.	15D2781
Date	09/25/2015
CAD File:	GD15D278101

Title
GRADING AND DRAINAGE PLAN

Sheet No.
GD-1

Xref (s): BD15D278101 ; XC15D278101 ; XC15D278102 ; XZ15D278101

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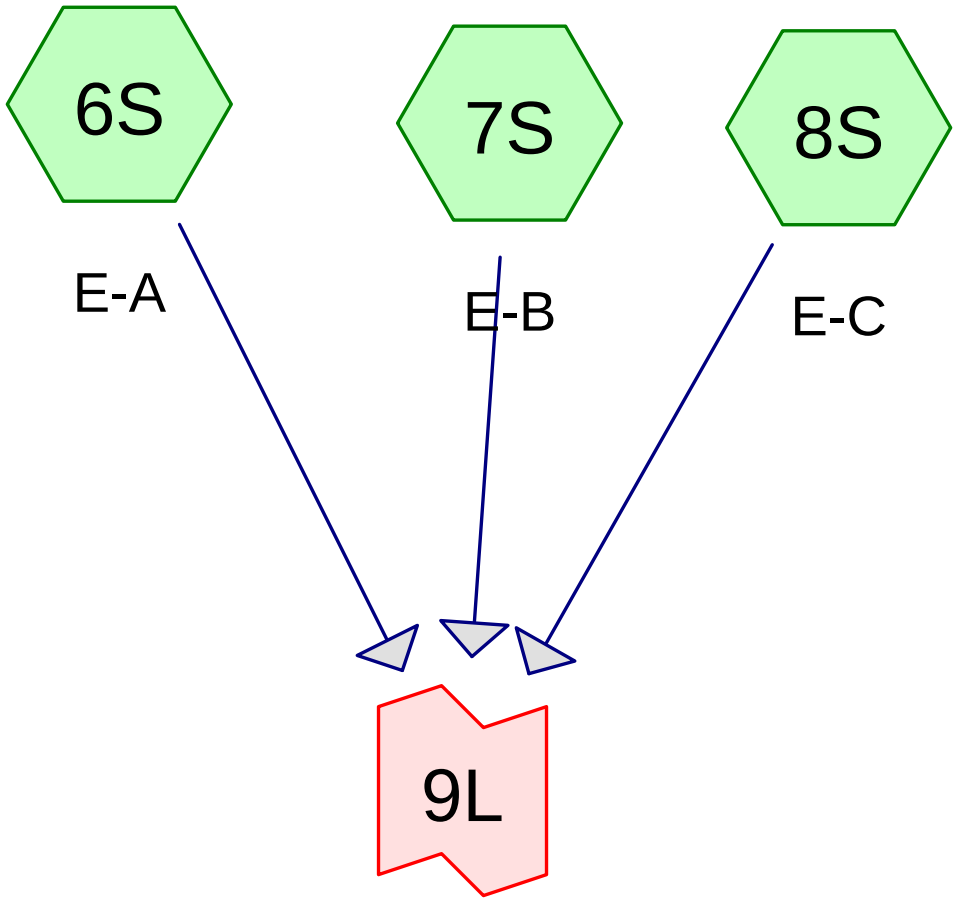
Appendix B

Pre-development Collection System Calculations-HydroCAD
Post-development Collection System Calculations-HydroCAD



Predevelopment
Combined

Subcat Reach Pond Link

Routing Diagram for 15D2781-Hydrology
Prepared by BL Companies, Printed 9/24/2015

Summary for Subcatchment 6S: E-A

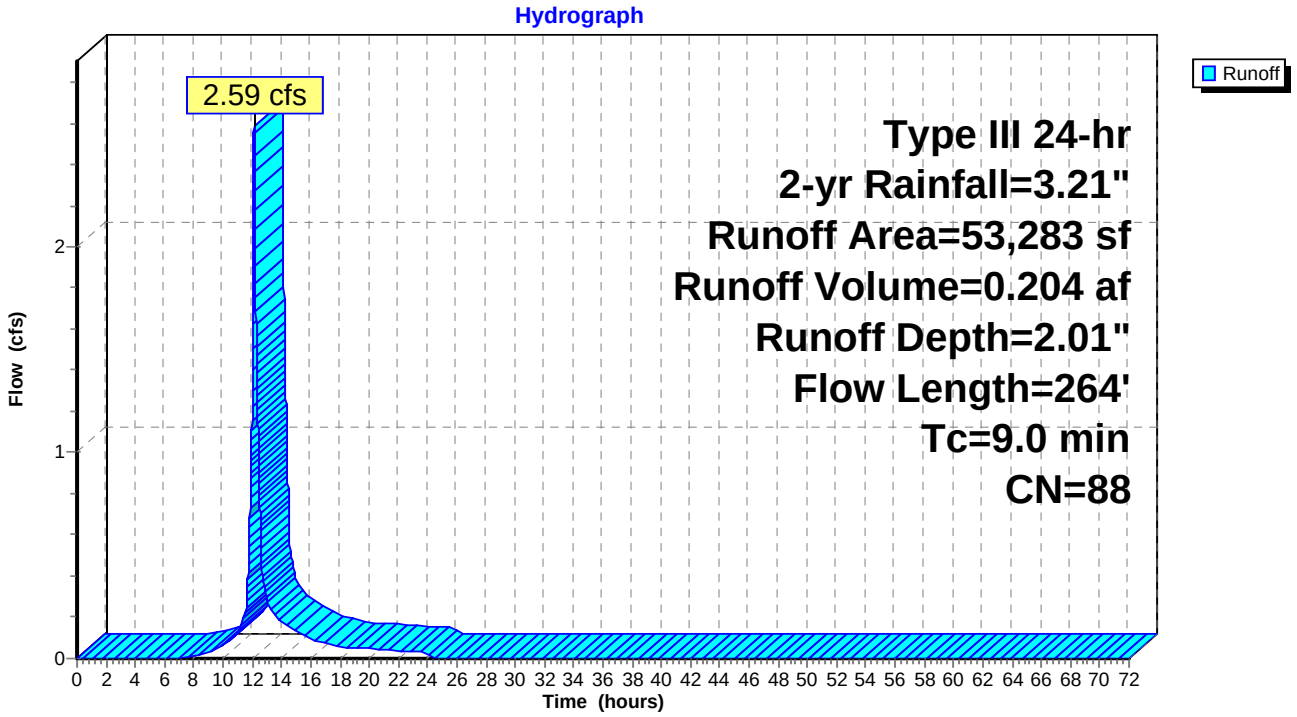
Runoff = 2.59 cfs @ 12.13 hrs, Volume= 0.204 af, Depth= 2.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.21"

Area (sf)	CN	Description
2,435	98	Roofs, HSG D
4,280	98	Roofs, HSG D
13,697	98	Paved parking, HSG D
480	96	Gravel surface, HSG D
1,790	89	Dirt roads, HSG D
30,601	82	Woods/grass comb., Fair, HSG D
53,283	88	Weighted Average
32,871		61.69% Pervious Area
20,412		38.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	40	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.21"
0.1	74	0.2800	8.52		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.1	150	0.0130	2.31		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
9.0	264	Total			

Subcatchment 6S: E-A



Summary for Subcatchment 7S: E-B

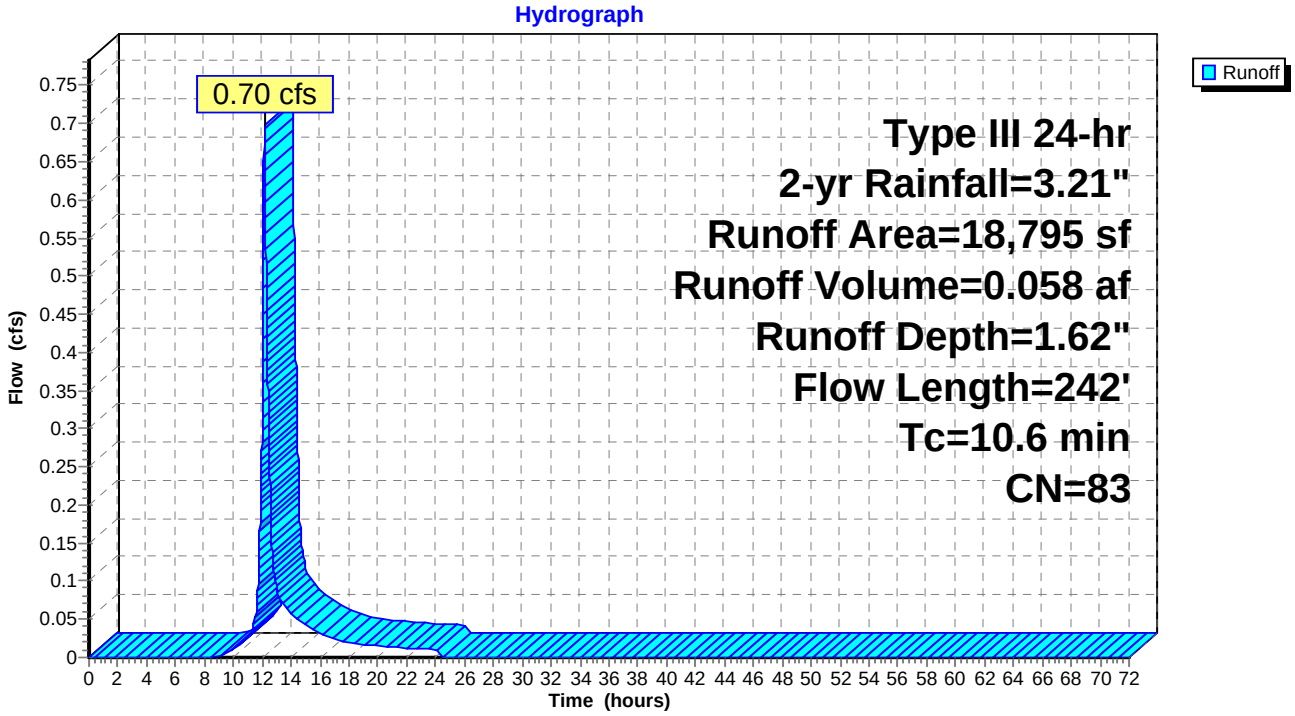
Runoff = 0.70 cfs @ 12.15 hrs, Volume= 0.058 af, Depth= 1.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.21"

Area (sf)	CN	Description
1,380	96	Gravel surface, HSG D
17,415	82	Woods/grass comb., Fair, HSG D
18,795	83	Weighted Average
18,795		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	30	0.0300	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.21"
3.1	20	0.1000	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.21"
0.2	72	0.1800	6.83		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.3	120	0.0800	5.74		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
10.6	242	Total			

Subcatchment 7S: E-B



Summary for Subcatchment 8S: E-C

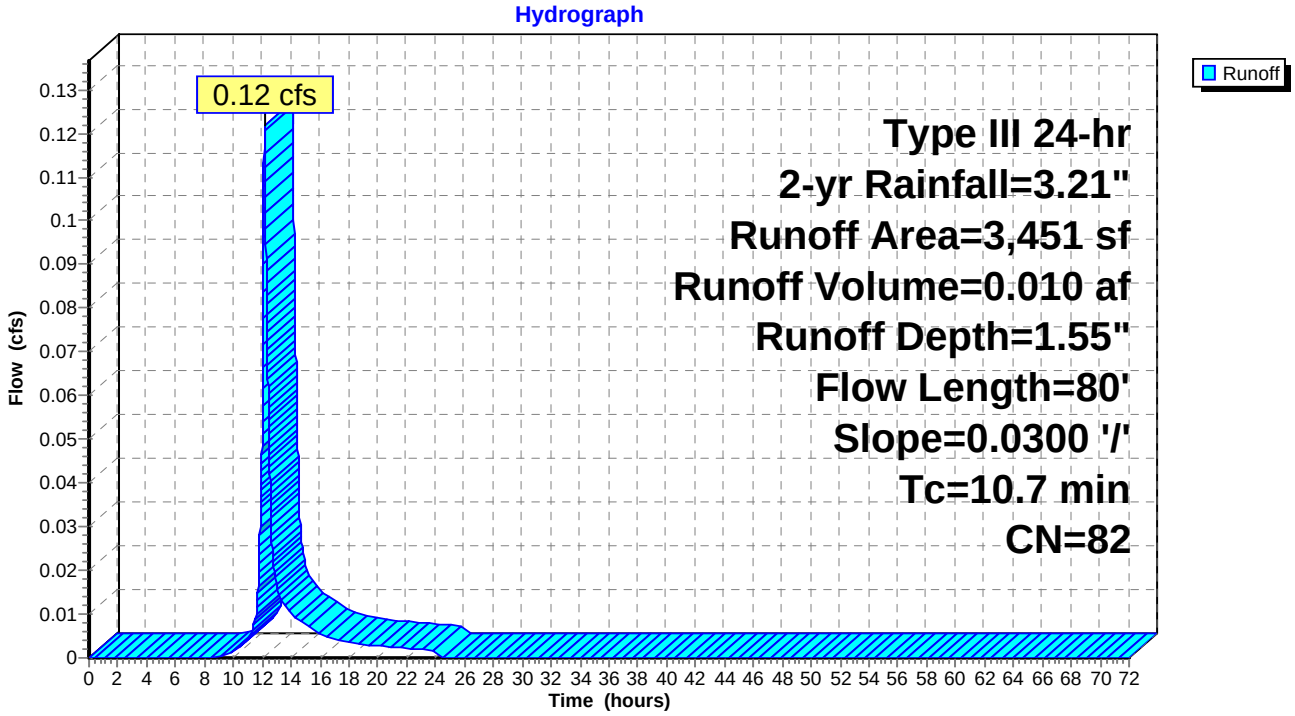
Runoff = 0.12 cfs @ 12.15 hrs, Volume= 0.010 af, Depth= 1.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.21"

Area (sf)	CN	Description
95	98	Paved parking, HSG C
3,356	82	Woods/grass comb., Fair, HSG D
3,451	82	Weighted Average
3,356		97.25% Pervious Area
95		2.75% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	50	0.0300	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.21"
0.2	30	0.0300	2.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
10.7	80	Total			

Subcatchment 8S: E-C

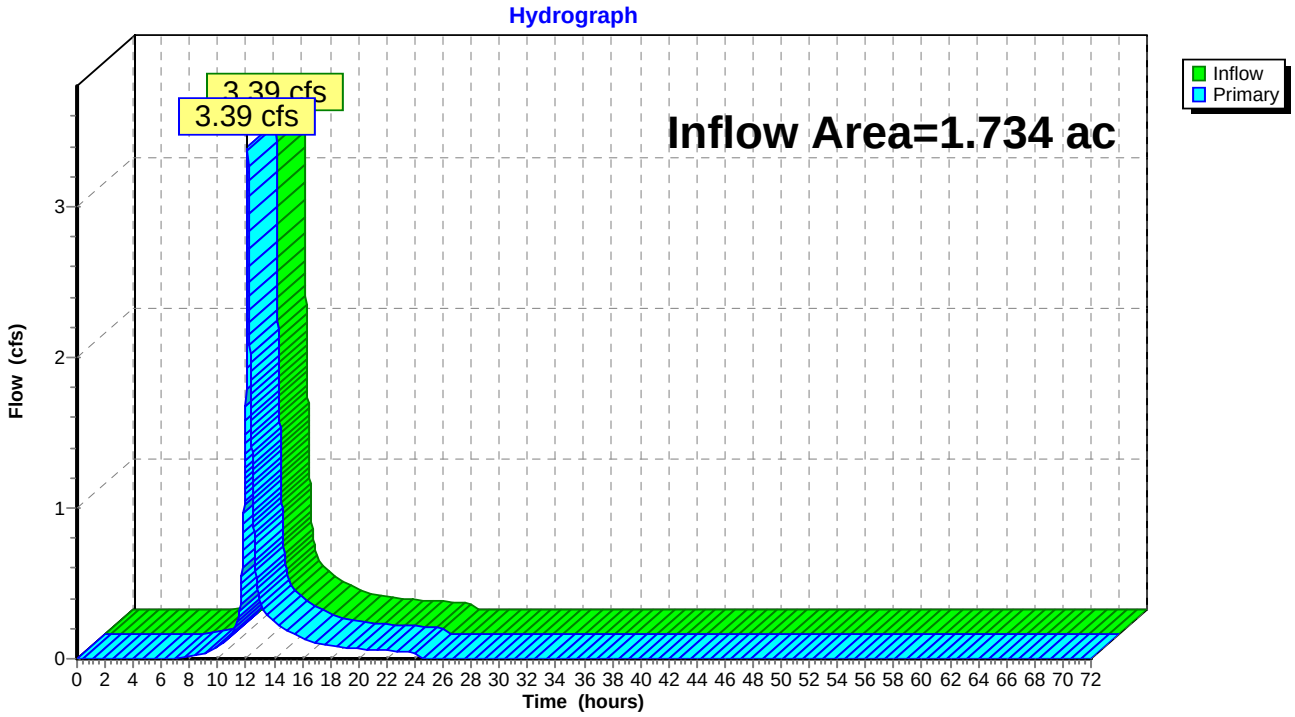


Summary for Link 9L: Predevelopment Combined

Inflow Area = 1.734 ac, 27.15% Impervious, Inflow Depth = 1.89" for 2-yr event
Inflow = 3.39 cfs @ 12.13 hrs, Volume= 0.273 af
Primary = 3.39 cfs @ 12.13 hrs, Volume= 0.273 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 9L: Predevelopment Combined



Summary for Subcatchment 6S: E-A

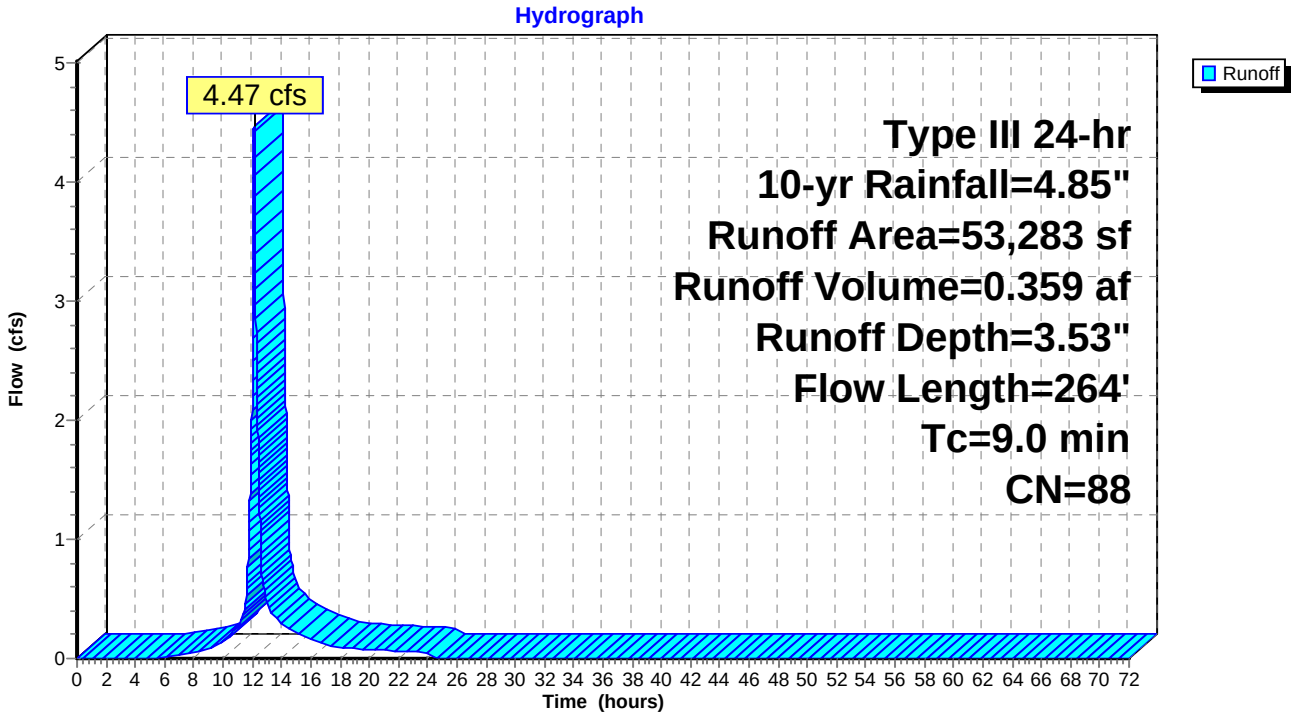
Runoff = 4.47 cfs @ 12.12 hrs, Volume= 0.359 af, Depth= 3.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.85"

Area (sf)	CN	Description
2,435	98	Roofs, HSG D
4,280	98	Roofs, HSG D
13,697	98	Paved parking, HSG D
480	96	Gravel surface, HSG D
1,790	89	Dirt roads, HSG D
30,601	82	Woods/grass comb., Fair, HSG D
53,283	88	Weighted Average
32,871		61.69% Pervious Area
20,412		38.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	40	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.21"
0.1	74	0.2800	8.52		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.1	150	0.0130	2.31		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
9.0	264	Total			

Subcatchment 6S: E-A



Summary for Subcatchment 7S: E-B

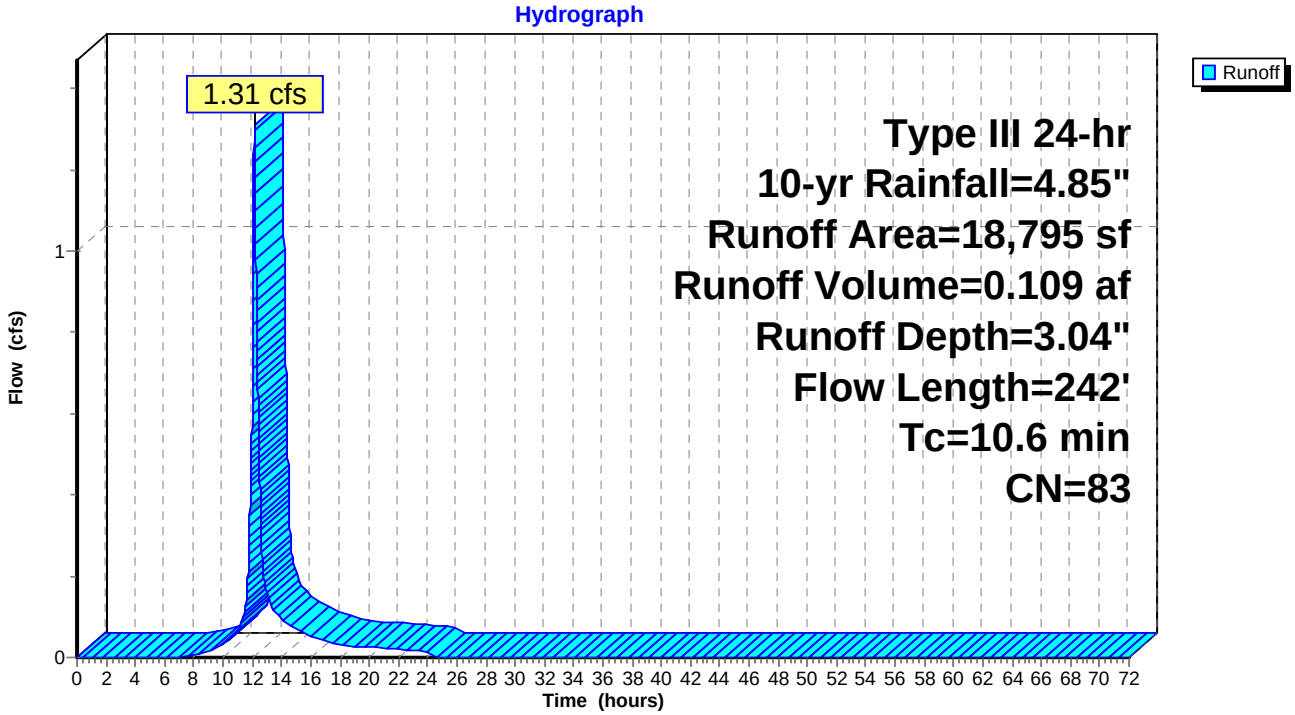
Runoff = 1.31 cfs @ 12.15 hrs, Volume= 0.109 af, Depth= 3.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.85"

Area (sf)	CN	Description
1,380	96	Gravel surface, HSG D
17,415	82	Woods/grass comb., Fair, HSG D
18,795	83	Weighted Average
18,795		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	30	0.0300	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.21"
3.1	20	0.1000	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.21"
0.2	72	0.1800	6.83		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.3	120	0.0800	5.74		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
10.6	242	Total			

Subcatchment 7S: E-B



Summary for Subcatchment 8S: E-C

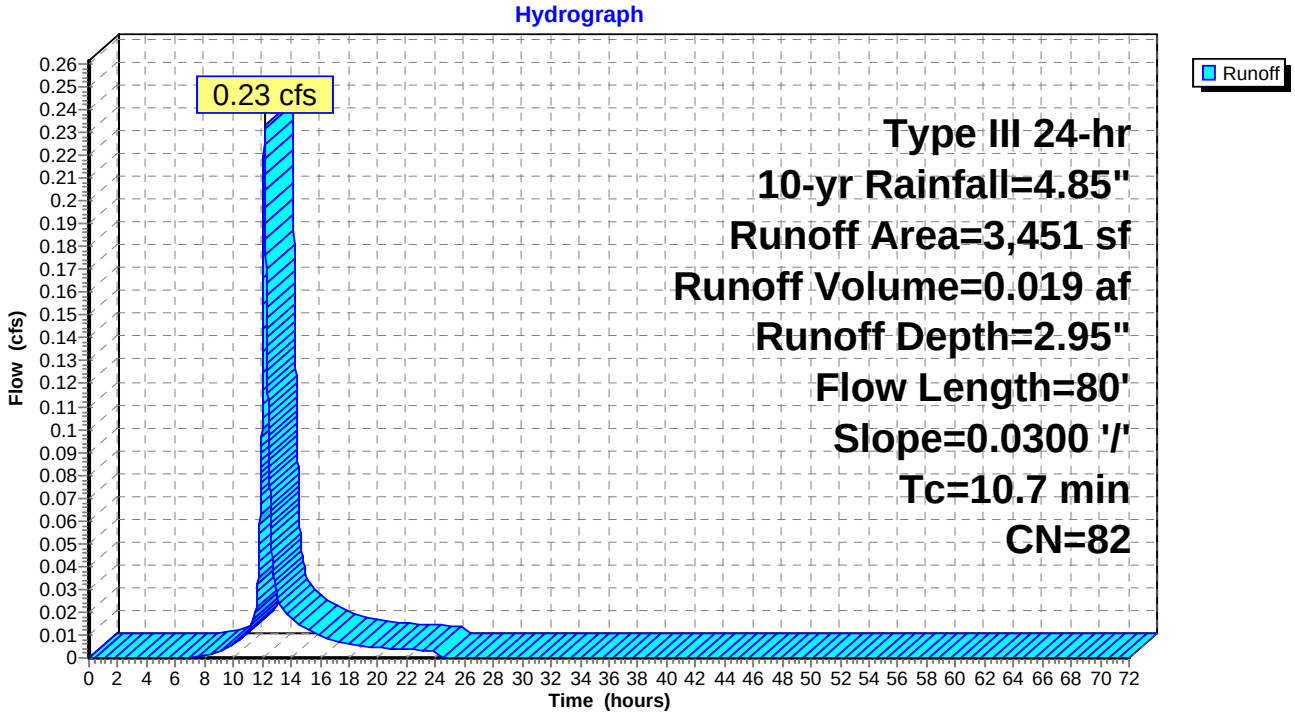
Runoff = 0.23 cfs @ 12.15 hrs, Volume= 0.019 af, Depth= 2.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.85"

Area (sf)	CN	Description
95	98	Paved parking, HSG C
3,356	82	Woods/grass comb., Fair, HSG D
3,451	82	Weighted Average
3,356		97.25% Pervious Area
95		2.75% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	50	0.0300	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.21"
0.2	30	0.0300	2.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
10.7	80	Total			

Subcatchment 8S: E-C

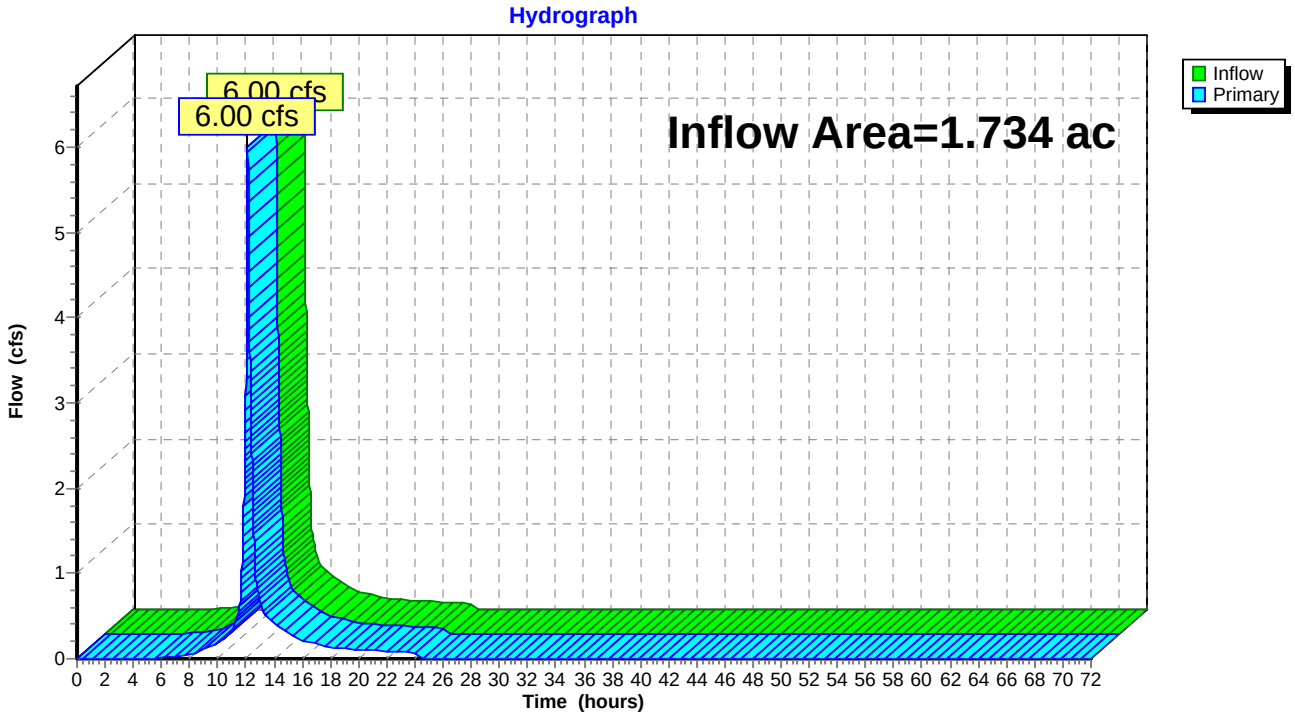


Summary for Link 9L: Predevelopment Combined

Inflow Area = 1.734 ac, 27.15% Impervious, Inflow Depth = 3.38" for 10-yr event
Inflow = 6.00 cfs @ 12.13 hrs, Volume= 0.488 af
Primary = 6.00 cfs @ 12.13 hrs, Volume= 0.488 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 9L: Predevelopment Combined



Summary for Subcatchment 6S: E-A

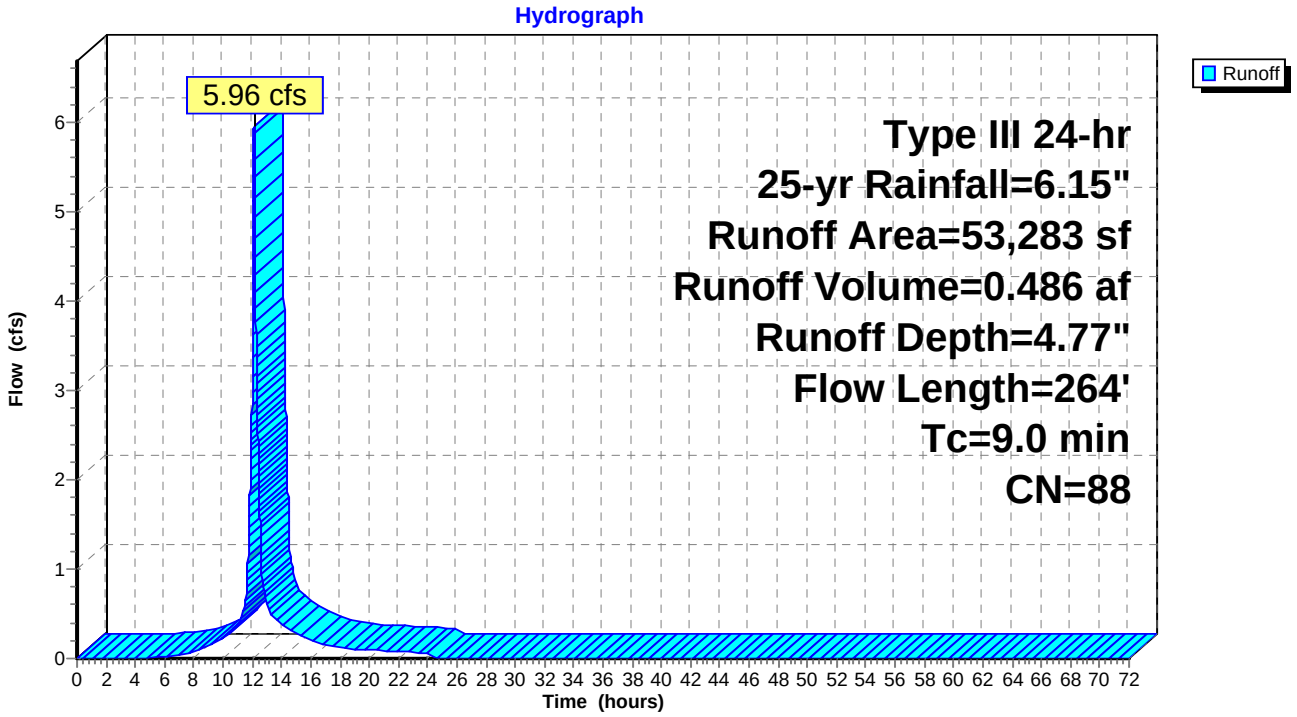
Runoff = 5.96 cfs @ 12.12 hrs, Volume= 0.486 af, Depth= 4.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=6.15"

Area (sf)	CN	Description
2,435	98	Roofs, HSG D
4,280	98	Roofs, HSG D
13,697	98	Paved parking, HSG D
480	96	Gravel surface, HSG D
1,790	89	Dirt roads, HSG D
30,601	82	Woods/grass comb., Fair, HSG D
53,283	88	Weighted Average
32,871		61.69% Pervious Area
20,412		38.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	40	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.21"
0.1	74	0.2800	8.52		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.1	150	0.0130	2.31		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
9.0	264	Total			

Subcatchment 6S: E-A



Summary for Subcatchment 7S: E-B

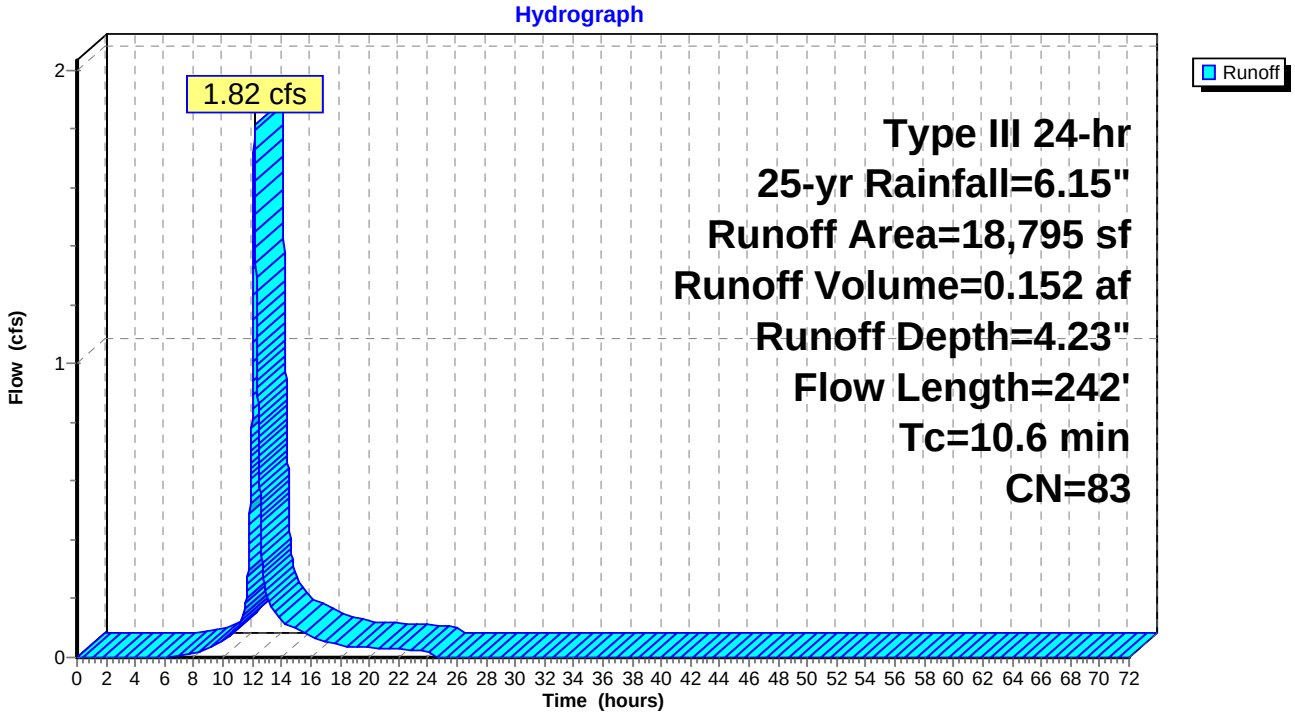
Runoff = 1.82 cfs @ 12.14 hrs, Volume= 0.152 af, Depth= 4.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=6.15"

Area (sf)	CN	Description
1,380	96	Gravel surface, HSG D
17,415	82	Woods/grass comb., Fair, HSG D
18,795	83	Weighted Average
18,795		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	30	0.0300	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.21"
3.1	20	0.1000	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.21"
0.2	72	0.1800	6.83		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.3	120	0.0800	5.74		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
10.6	242	Total			

Subcatchment 7S: E-B



Summary for Subcatchment 8S: E-C

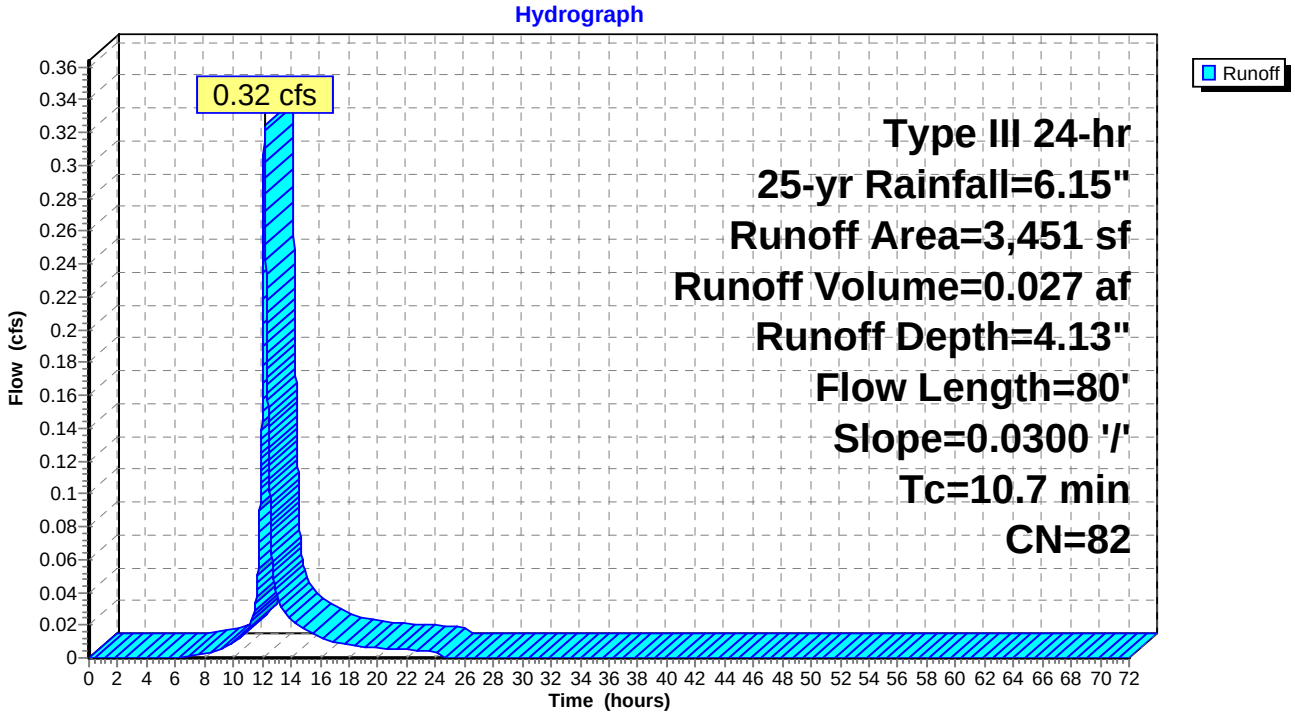
Runoff = 0.32 cfs @ 12.14 hrs, Volume= 0.027 af, Depth= 4.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=6.15"

Area (sf)	CN	Description
95	98	Paved parking, HSG C
3,356	82	Woods/grass comb., Fair, HSG D
3,451	82	Weighted Average
3,356		97.25% Pervious Area
95		2.75% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	50	0.0300	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.21"
0.2	30	0.0300	2.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
10.7	80	Total			

Subcatchment 8S: E-C

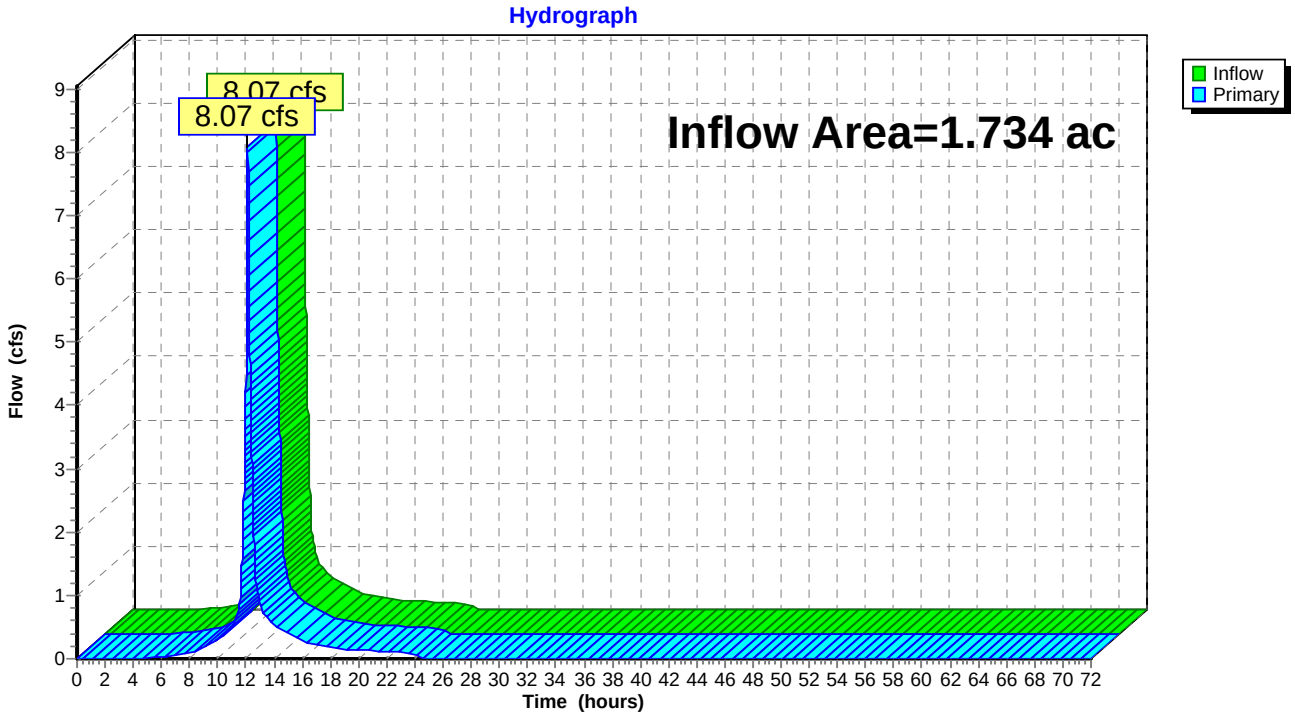


Summary for Link 9L: Predevelopment Combined

Inflow Area = 1.734 ac, 27.15% Impervious, Inflow Depth = 4.61" for 25-yr event
Inflow = 8.07 cfs @ 12.13 hrs, Volume= 0.666 af
Primary = 8.07 cfs @ 12.13 hrs, Volume= 0.666 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 9L: Predevelopment Combined



Summary for Subcatchment 6S: E-A

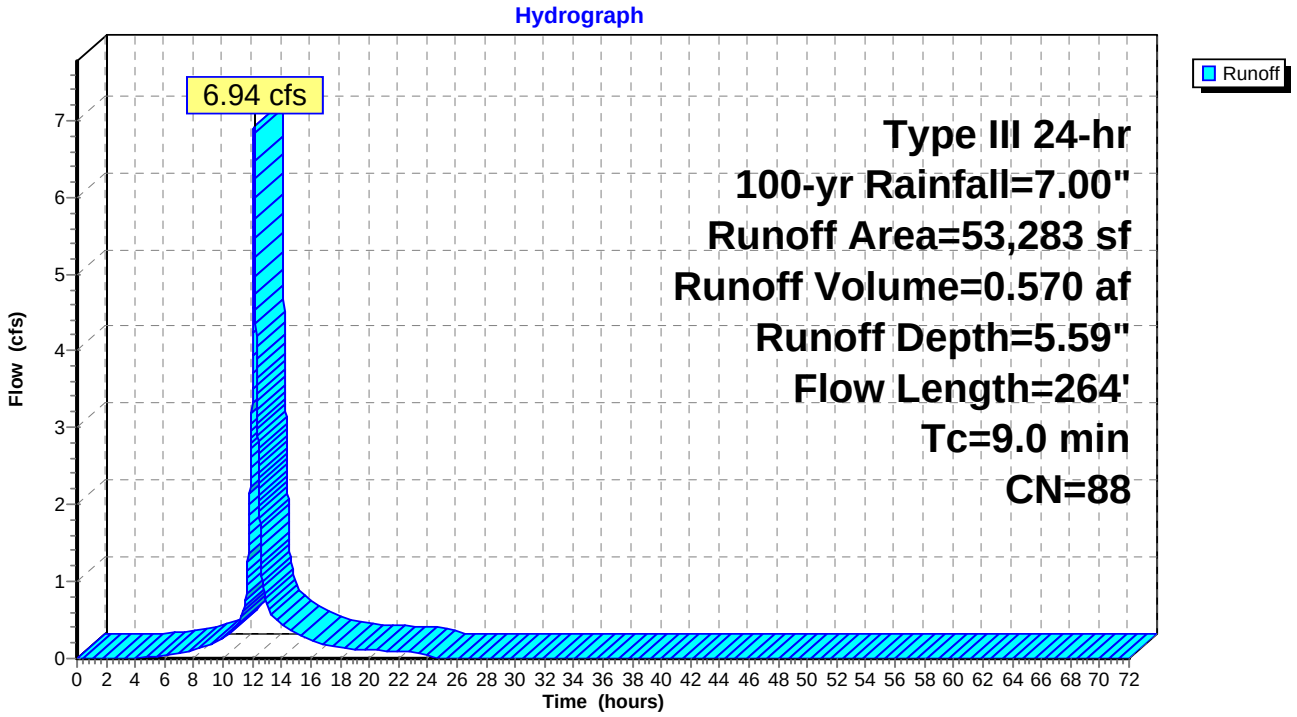
Runoff = 6.94 cfs @ 12.12 hrs, Volume= 0.570 af, Depth= 5.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=7.00"

Area (sf)	CN	Description
2,435	98	Roofs, HSG D
4,280	98	Roofs, HSG D
13,697	98	Paved parking, HSG D
480	96	Gravel surface, HSG D
1,790	89	Dirt roads, HSG D
30,601	82	Woods/grass comb., Fair, HSG D
53,283	88	Weighted Average
32,871		61.69% Pervious Area
20,412		38.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	40	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.21"
0.1	74	0.2800	8.52		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.1	150	0.0130	2.31		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
9.0	264	Total			

Subcatchment 6S: E-A



Summary for Subcatchment 7S: E-B

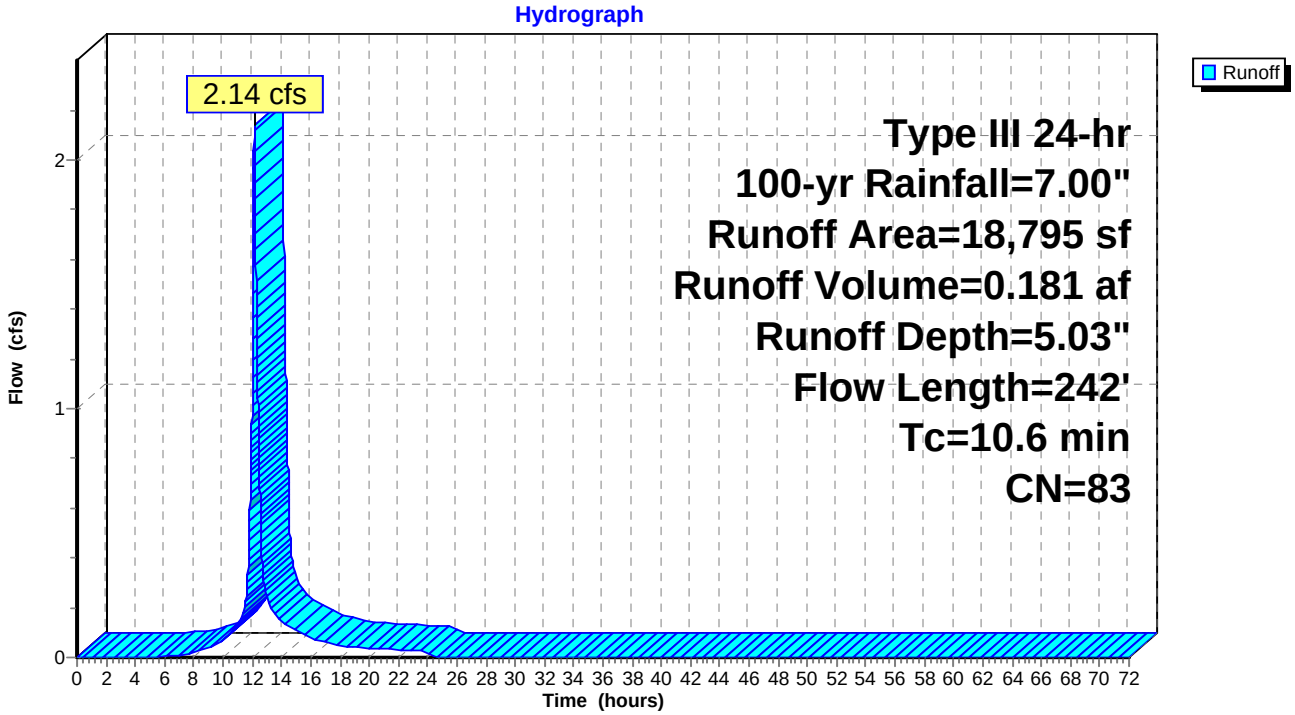
Runoff = 2.14 cfs @ 12.14 hrs, Volume= 0.181 af, Depth= 5.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=7.00"

Area (sf)	CN	Description
1,380	96	Gravel surface, HSG D
17,415	82	Woods/grass comb., Fair, HSG D
18,795	83	Weighted Average
18,795		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	30	0.0300	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.21"
3.1	20	0.1000	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.21"
0.2	72	0.1800	6.83		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.3	120	0.0800	5.74		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
10.6	242	Total			

Subcatchment 7S: E-B



Summary for Subcatchment 8S: E-C

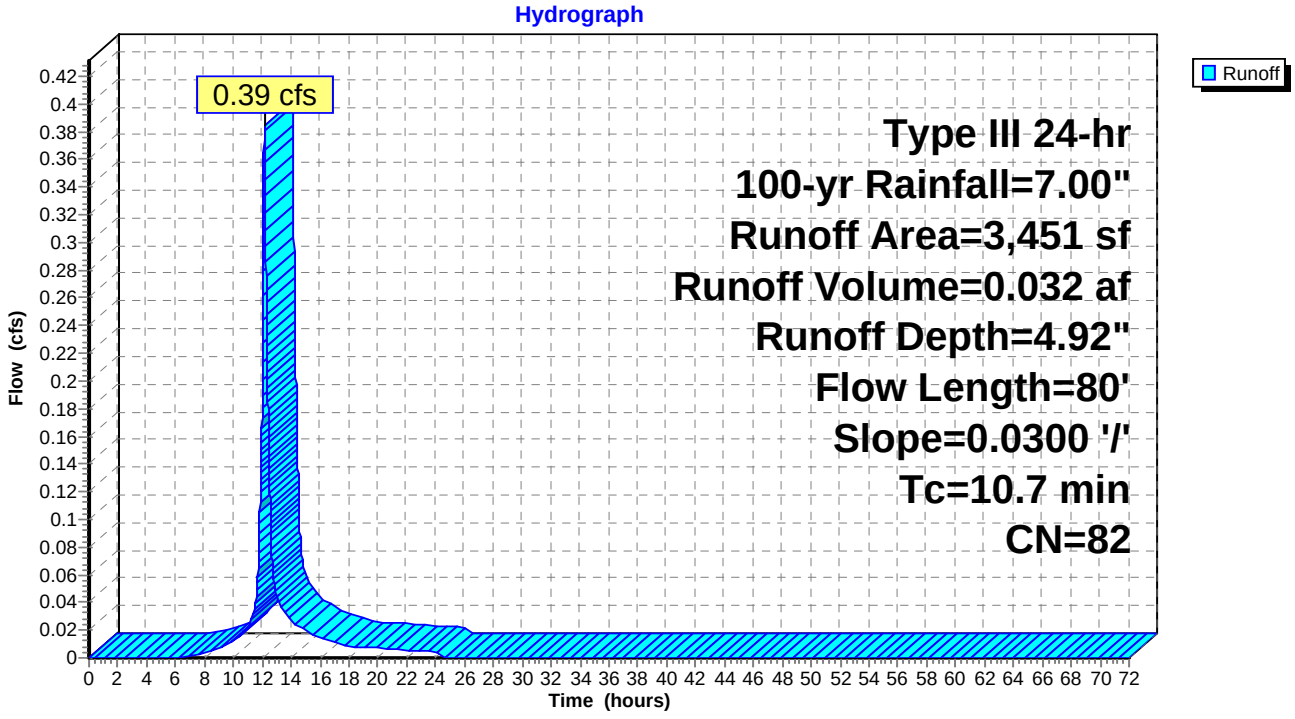
Runoff = 0.39 cfs @ 12.14 hrs, Volume= 0.032 af, Depth= 4.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=7.00"

Area (sf)	CN	Description
95	98	Paved parking, HSG C
3,356	82	Woods/grass comb., Fair, HSG D
3,451	82	Weighted Average
3,356		97.25% Pervious Area
95		2.75% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	50	0.0300	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.21"
0.2	30	0.0300	2.79		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
10.7	80	Total			

Subcatchment 8S: E-C

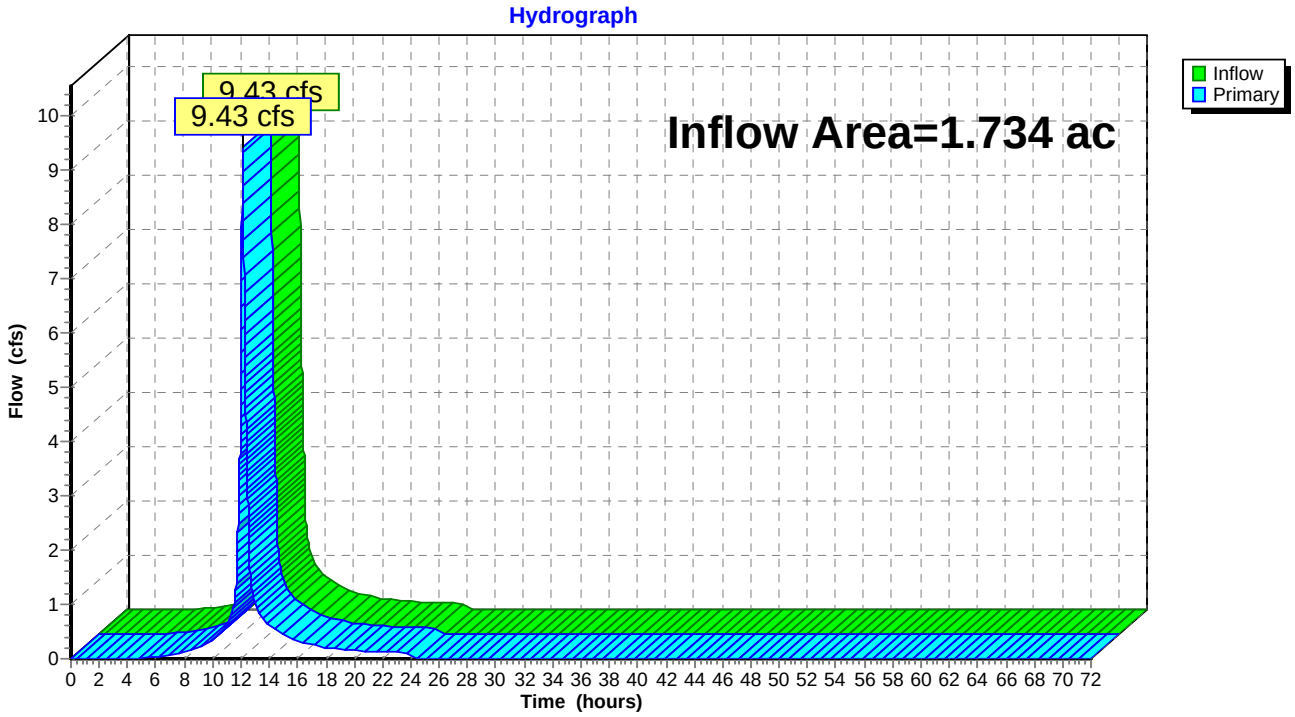


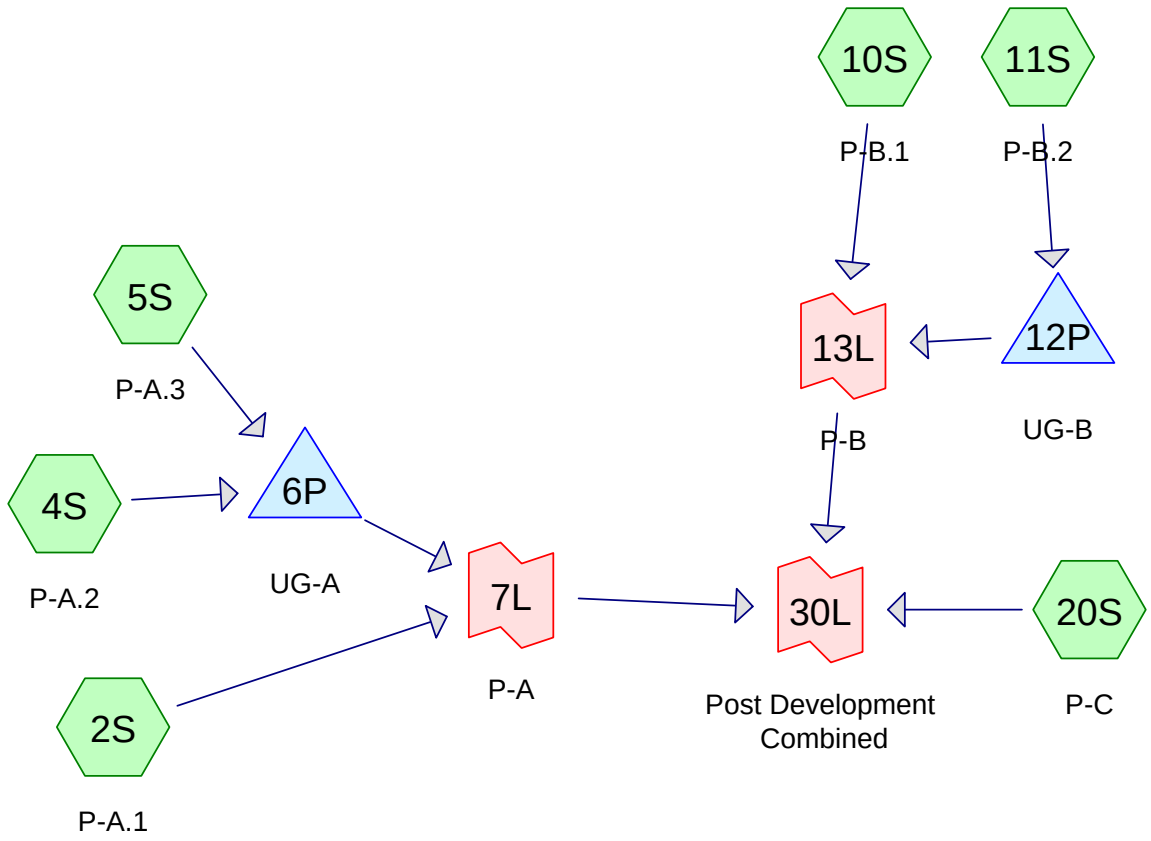
Summary for Link 9L: Predevelopment Combined

Inflow Area = 1.734 ac, 27.15% Impervious, Inflow Depth = 5.42" for 100-yr event
Inflow = 9.43 cfs @ 12.13 hrs, Volume= 0.783 af
Primary = 9.43 cfs @ 12.13 hrs, Volume= 0.783 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 9L: Predevelopment Combined





Subcat Reach Pond Link

Routing Diagram for 15D2781-Hydrology
Prepared by BL Companies, Printed 9/24/2015

Summary for Subcatchment 2S: P-A.1

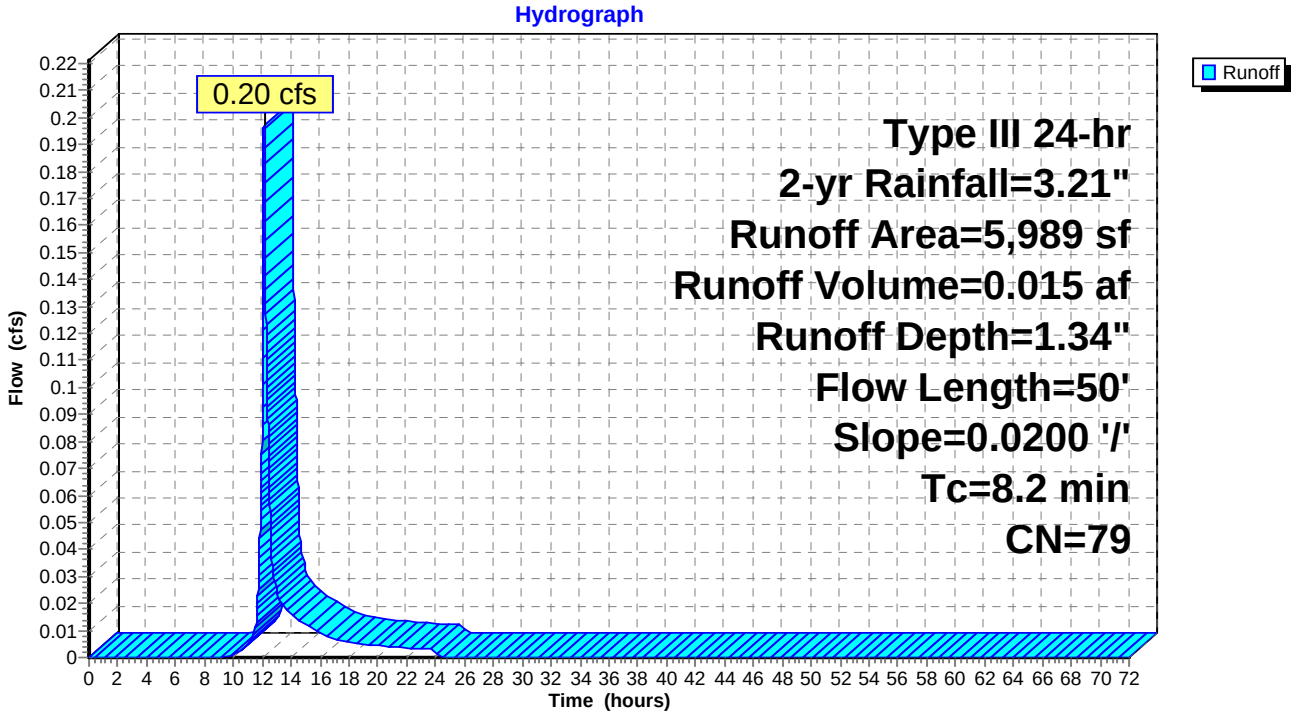
Runoff = 0.20 cfs @ 12.12 hrs, Volume= 0.015 af, Depth= 1.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.21"

Area (sf)	CN	Description
5,989	79	Woods/grass comb., Good, HSG D
5,989		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.21"

Subcatchment 2S: P-A.1



Summary for Subcatchment 4S: P-A.2

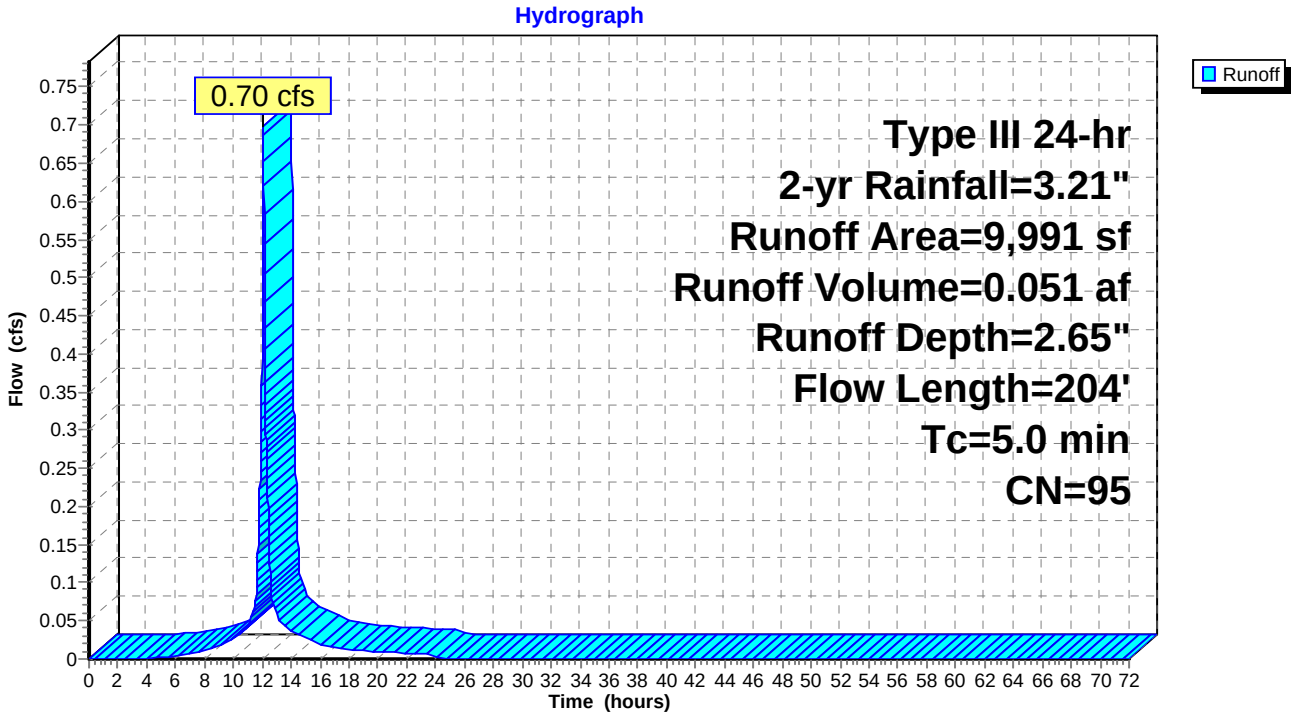
Runoff = 0.70 cfs @ 12.07 hrs, Volume= 0.051 af, Depth= 2.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.21"

Area (sf)	CN	Description
1,830	79	Woods/grass comb., Good, HSG D
8,161	98	Paved parking, HSG D
9,991	95	Weighted Average
1,830		18.32% Pervious Area
8,161		81.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	45	0.1250	0.21		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.21"
0.0	10	0.3300	9.25		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.4	34	0.0100	1.61		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.4	115	0.0500	4.54		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.4	204	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 4S: P-A.2



Summary for Subcatchment 5S: P-A.3

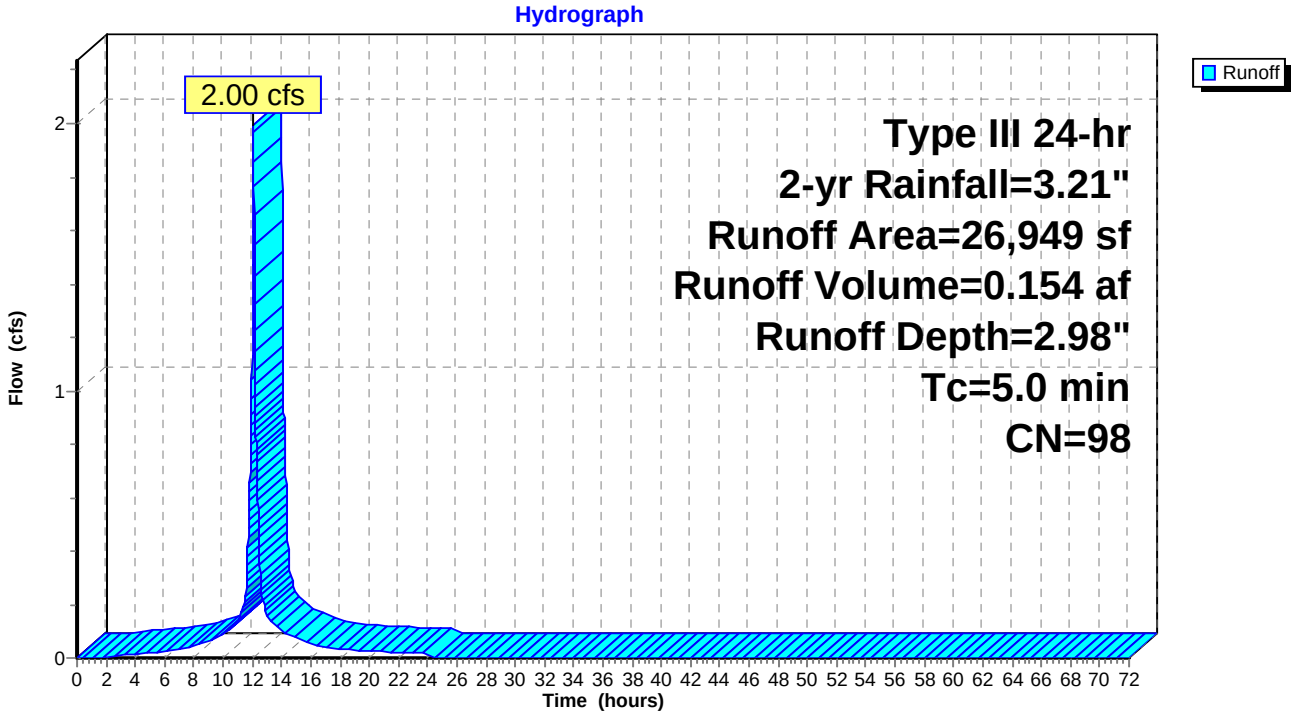
Runoff = 2.00 cfs @ 12.07 hrs, Volume= 0.154 af, Depth= 2.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.21"

Area (sf)	CN	Description
26,949	98	Roofs, HSG D
26,949		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Min. Tc Assumed for Roof**

Subcatchment 5S: P-A.3



Summary for Pond 6P: UG-A

Inflow Area = 0.848 ac, 95.05% Impervious, Inflow Depth = 2.89" for 2-yr event
Inflow = 2.70 cfs @ 12.07 hrs, Volume= 0.204 af
Outflow = 0.85 cfs @ 12.35 hrs, Volume= 0.204 af, Atten= 68%, Lag= 17.1 min
Primary = 0.85 cfs @ 12.35 hrs, Volume= 0.204 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 100.44' @ 12.35 hrs Surf.Area= 1,835 sf Storage= 3,822 cf

Plug-Flow detention time= 223.1 min calculated for 0.204 af (100% of inflow)
Center-of-Mass det. time= 223.2 min (984.7 - 761.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	97.30'	1,563 cf	**20.83'W x 87.50'L x 3.54'H Field A** 6,456 cf Overall - 2,548 cf Embedded = 3,908 cf x 40.0% Voids
#2A	97.80'	2,548 cf	**Cultec R-330XLHD** x 48 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 4 rows
#3	100.00'	31 cf	**4.00'D x 2.50'H Vertical Cone/Cylinder**
#4	102.10'	1,188 cf	**Parking Lot Storage (Prismatic)**Listed below (Recalc)
		5,331 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
102.10	0	0	0
103.00	2,640	1,188	1,188

Device	Routing	Invert	Outlet Devices
#1	Primary	97.30'	**10.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 97.30' / 97.00' S= 0.0150 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.55 sf
#2	Device 1	97.30'	**2.0" Vert. Orifice** C= 0.600
#3	Device 1	100.30'	**Weir, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.70 Width (feet) 4.00 4.00

Primary OutFlow Max=0.85 cfs @ 12.35 hrs HW=100.44' (Free Discharge)
└**1=Culvert** (Passes 0.85 cfs of 3.42 cfs potential flow)
  ├**2=Orifice** (Orifice Controls 0.18 cfs @ 8.41 fps)
  └**3=Weir** (Weir Controls 0.66 cfs @ 1.21 fps)

Pond 6P: UG-A - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 4 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

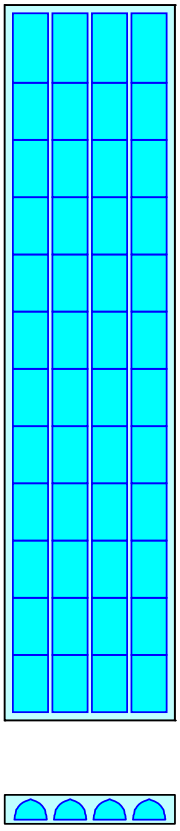
12 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 85.50' Row Length +12.0" End Stone x 2 = 87.50' Base Length
4 Rows x 52.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 20.83' Base Width
6.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.54' Field Height

48 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 4 Rows = 2,548.2 cf Chamber Storage

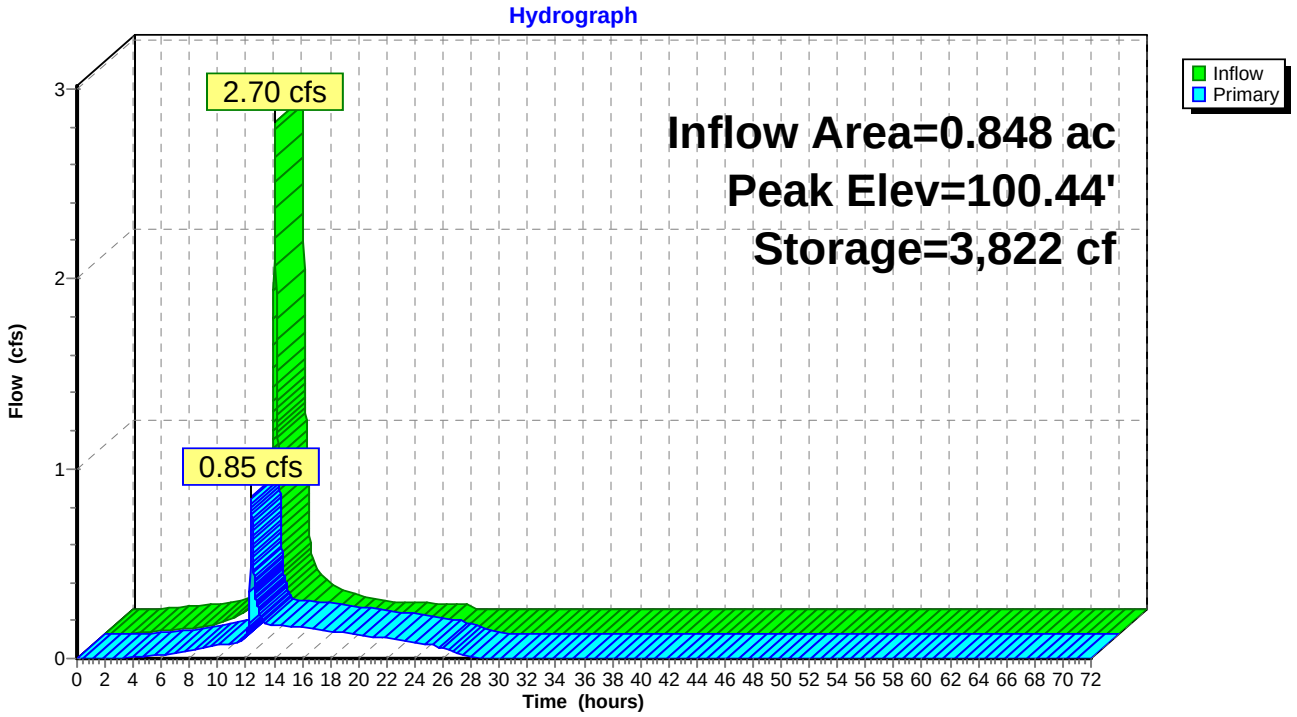
6,456.2 cf Field - 2,548.2 cf Chambers = 3,907.9 cf Stone x 40.0% Voids = 1,563.2 cf Stone Storage

Chamber Storage + Stone Storage = 4,111.4 cf = 0.094 af
Overall Storage Efficiency = 63.7%

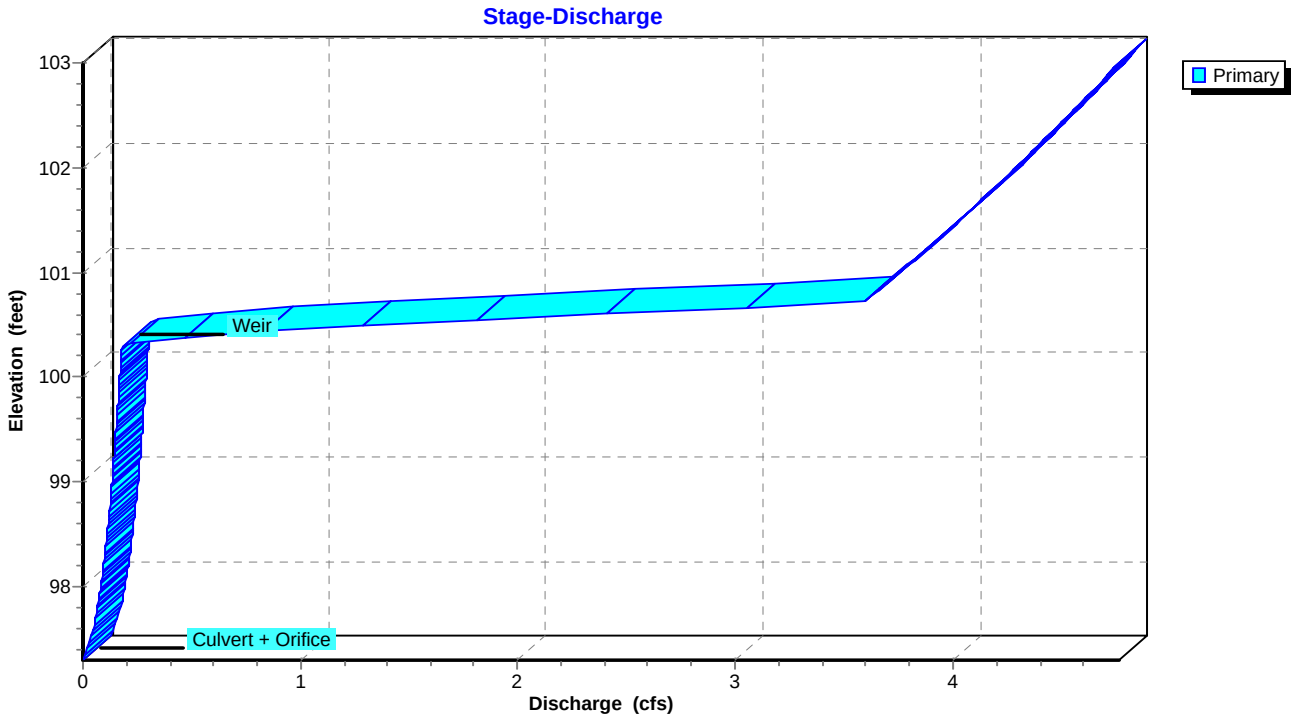
48 Chambers
239.1 cy Field
144.7 cy Stone



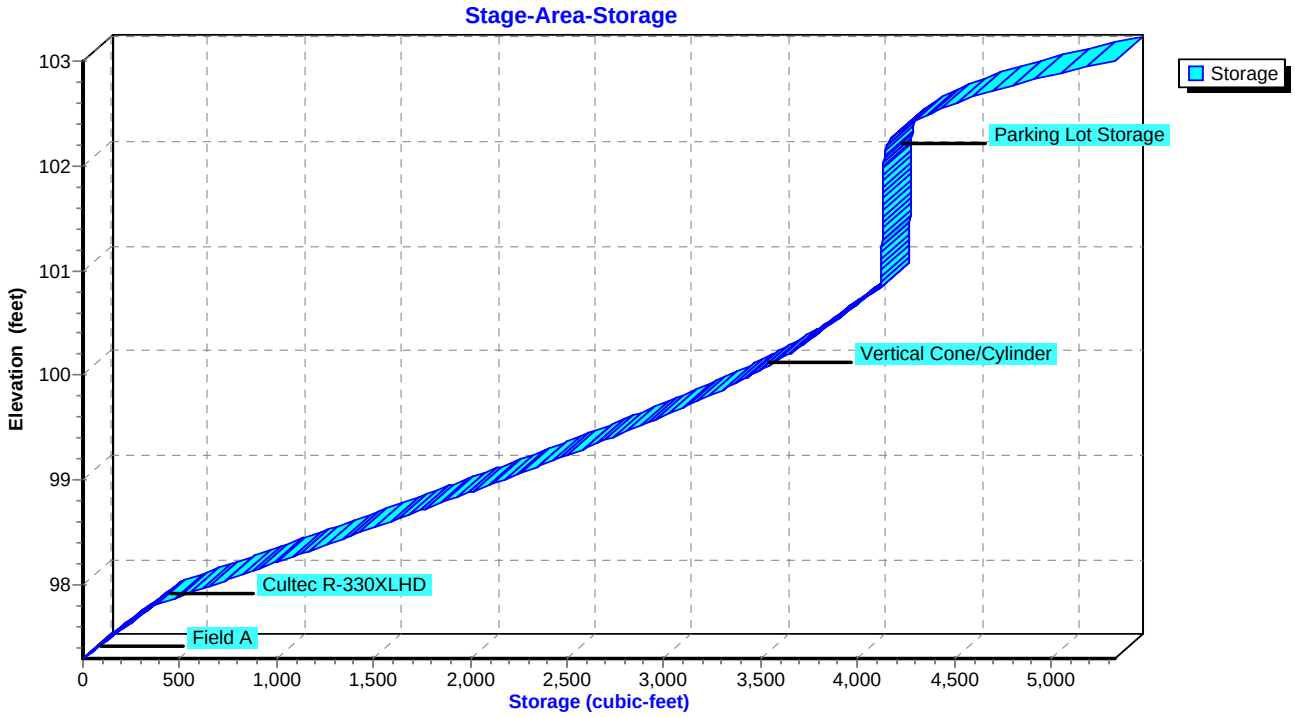
Pond 6P: UG-A



Pond 6P: UG-A



Pond 6P: UG-A

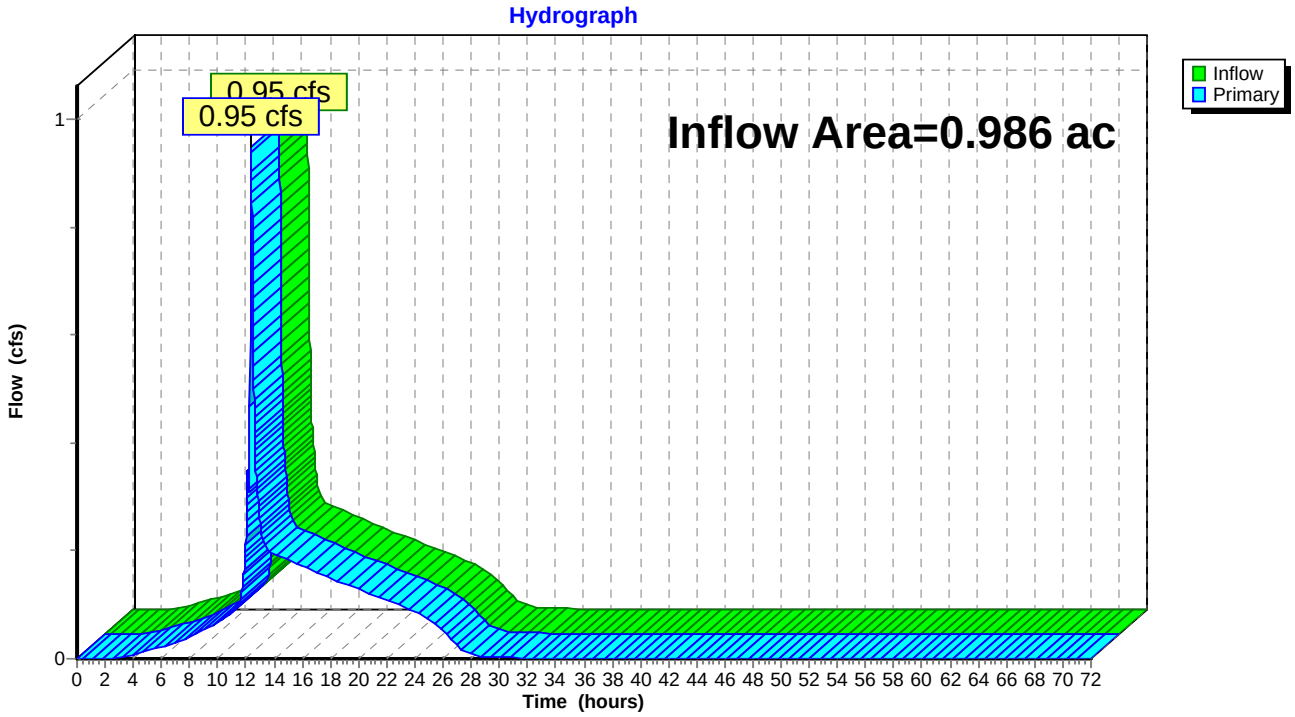

Stage-Area-Storage
Elevation (feet)
103
102
101
100
99
98
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500
5,000
Storage (cubic-feet)
Storage
Parking Lot Storage
Vertical Cone/Cylinder
Cultec R-330XLHD
Field A

Summary for Link 7L: P-A

Inflow Area = 0.986 ac, 81.79% Impervious, Inflow Depth = 2.67" for 2-yr event
Inflow = 0.95 cfs @ 12.35 hrs, Volume= 0.220 af
Primary = 0.95 cfs @ 12.35 hrs, Volume= 0.220 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 7L: P-A



Summary for Subcatchment 10S: P-B.1

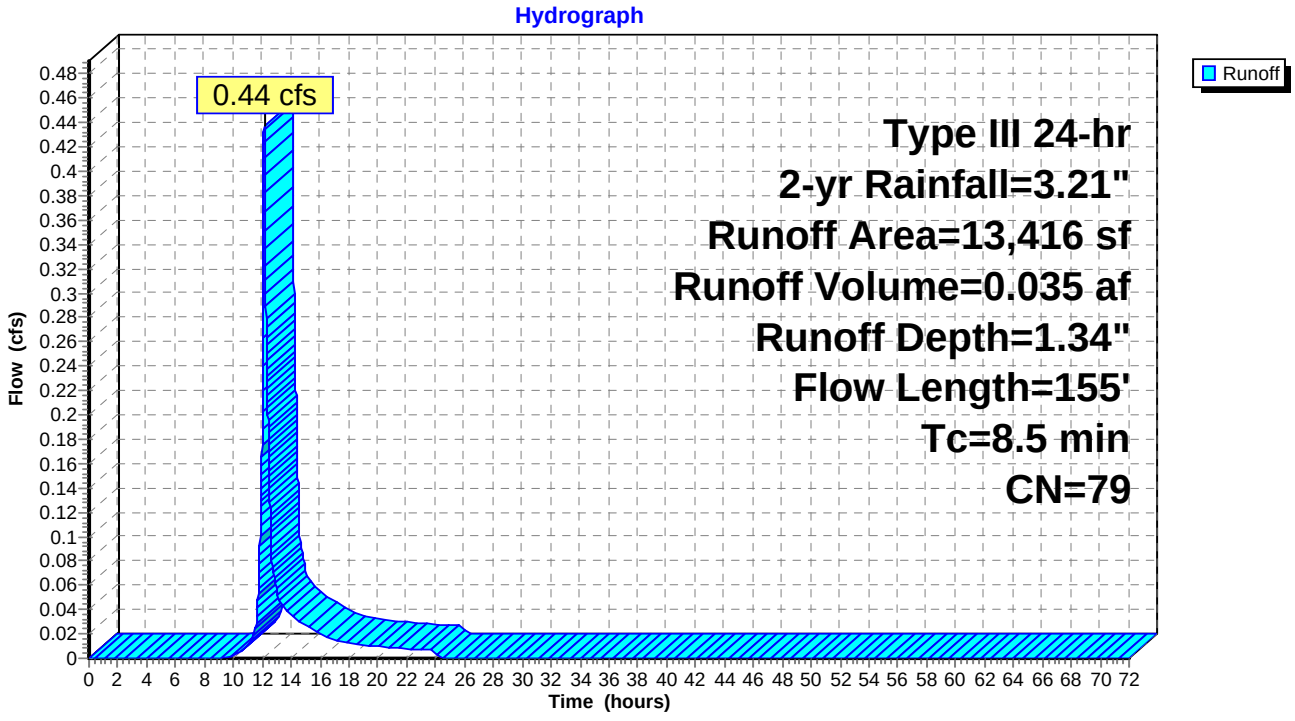
Runoff = 0.44 cfs @ 12.12 hrs, Volume= 0.035 af, Depth= 1.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.21"

Area (sf)	CN	Description
13,416	79	Woods/grass comb., Good, HSG D
13,416		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.21"
0.3	105	0.1500	6.24		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.5	155	Total			

Subcatchment 10S: P-B.1



Summary for Subcatchment 11S: P-B.2

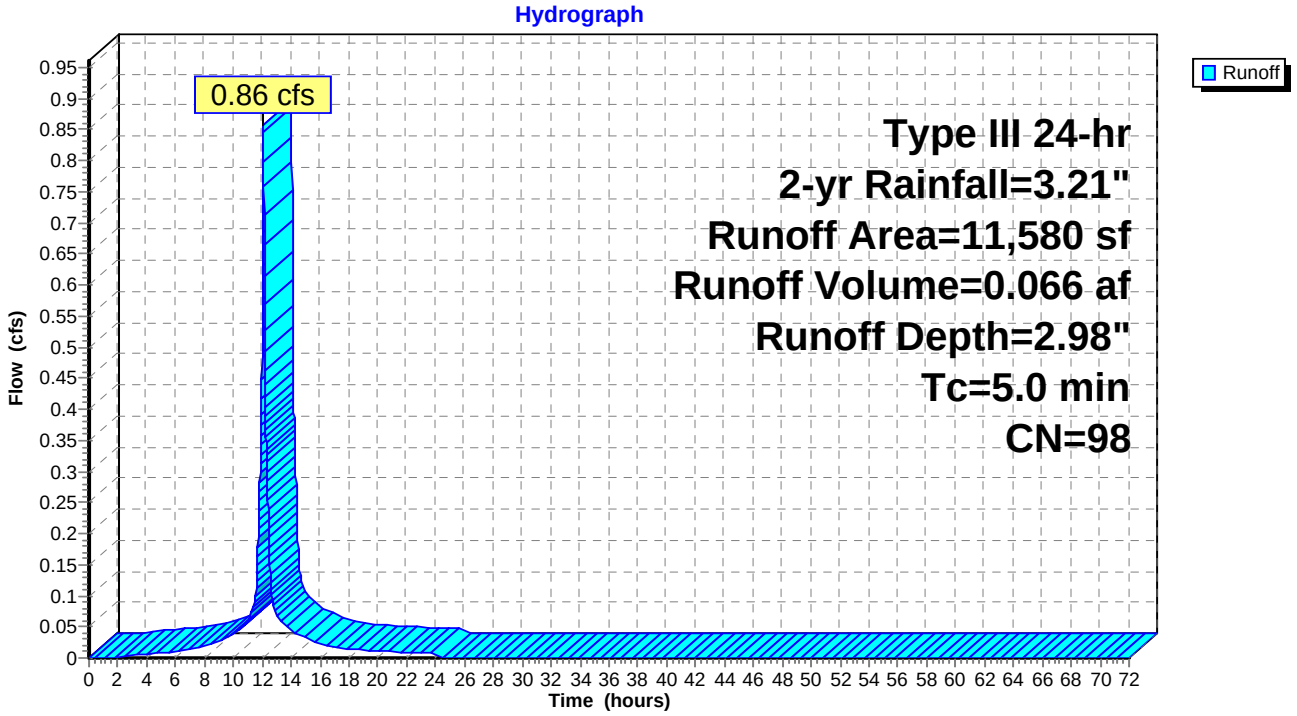
Runoff = 0.86 cfs @ 12.07 hrs, Volume= 0.066 af, Depth= 2.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.21"

Area (sf)	CN	Description
11,580	98	Roofs, HSG D
11,580		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Min. Tc Assumed for Roof**

Subcatchment 11S: P-B.2



Summary for Pond 12P: UG-B

Inflow Area = 0.266 ac,100.00% Impervious, Inflow Depth = 2.98" for 2-yr event
Inflow = 0.86 cfs @ 12.07 hrs, Volume= 0.066 af
Outflow = 0.15 cfs @ 12.51 hrs, Volume= 0.066 af, Atten= 83%, Lag= 26.6 min
Primary = 0.15 cfs @ 12.51 hrs, Volume= 0.066 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 102.10' @ 12.51 hrs Surf.Area= 0.017 ac Storage= 0.022 af

Plug-Flow detention time= 59.5 min calculated for 0.066 af (100% of inflow)
Center-of-Mass det. time= 59.4 min (814.8 - 755.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	100.00'	0.026 af	**15.75'W x 46.25'L x 6.00'H Field A** 0.100 af Overall - 0.036 af Embedded = 0.065 af x 40.0% Voids
#2A	101.00'	0.036 af	**Cultec R-900HD** x 12 Inside #1 Effective Size= 72.7"W x 48.0"H => 17.61 sf x 7.00'L = 123.3 cf Overall Size= 78.0"W x 48.0"H x 9.25'L with 2.25' Overlap Row Length Adjustment= +2.25' x 17.61 sf x 2 rows
		0.062 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	100.00'	**6.0" Round Culvert** L= 96.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 100.00' / 99.50' S= 0.0052 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf
#2	Device 1	100.00'	**2.0" Vert. Orifice** C= 0.600
#3	Device 1	104.70'	**Weir, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.50 Width (feet) 4.00 4.00

Primary OutFlow Max=0.15 cfs @ 12.51 hrs HW=102.10' (Free Discharge)
└**1=Culvert** (Passes 0.15 cfs of 0.90 cfs potential flow)
└**2=Orifice** (Orifice Controls 0.15 cfs @ 6.84 fps)
└**3=Weir** (Controls 0.00 cfs)

Pond 12P: UG-B - Chamber Wizard Field A

Chamber Model = Cultec R-900HD (Cultec Recharger® 900HD)
Effective Size= 72.7"W x 48.0"H => 17.61 sf x 7.00'L = 123.3 cf
Overall Size= 78.0"W x 48.0"H x 9.25'L with 2.25' Overlap
Row Length Adjustment= +2.25' x 17.61 sf x 2 rows

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

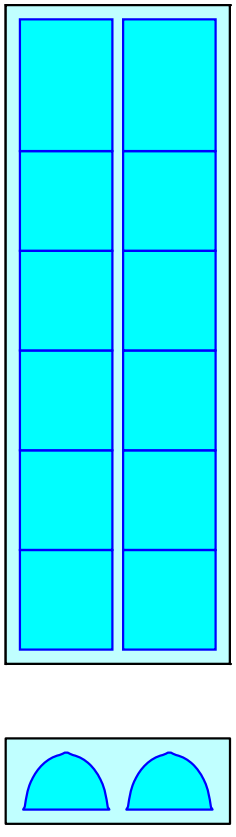
6 Chambers/Row x 7.00' Long +2.25' Row Adjustment = 44.25' Row Length +12.0" End Stone x 2 = 46.25' Base Length
2 Rows x 78.0" Wide + 9.0" Spacing x 1 + 12.0" Side Stone x 2 = 15.75' Base Width
12.0" Base + 48.0" Chamber Height + 12.0" Cover = 6.00' Field Height

12 Chambers x 123.3 cf +2.25' Row Adjustment x 17.61 sf x 2 Rows = 1,558.9 cf Chamber Storage

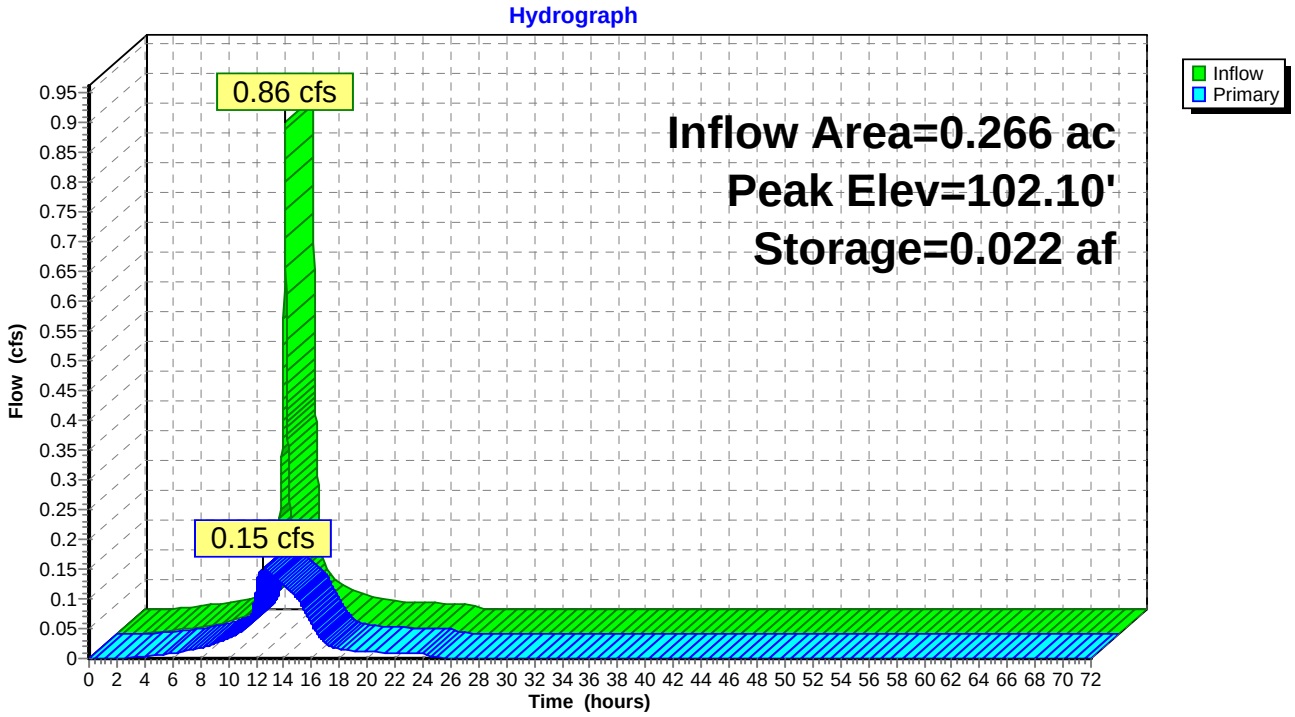
4,370.6 cf Field - 1,558.9 cf Chambers = 2,811.7 cf Stone x 40.0% Voids = 1,124.7 cf Stone Storage

Chamber Storage + Stone Storage = 2,683.6 cf = 0.062 af
Overall Storage Efficiency = 61.4%

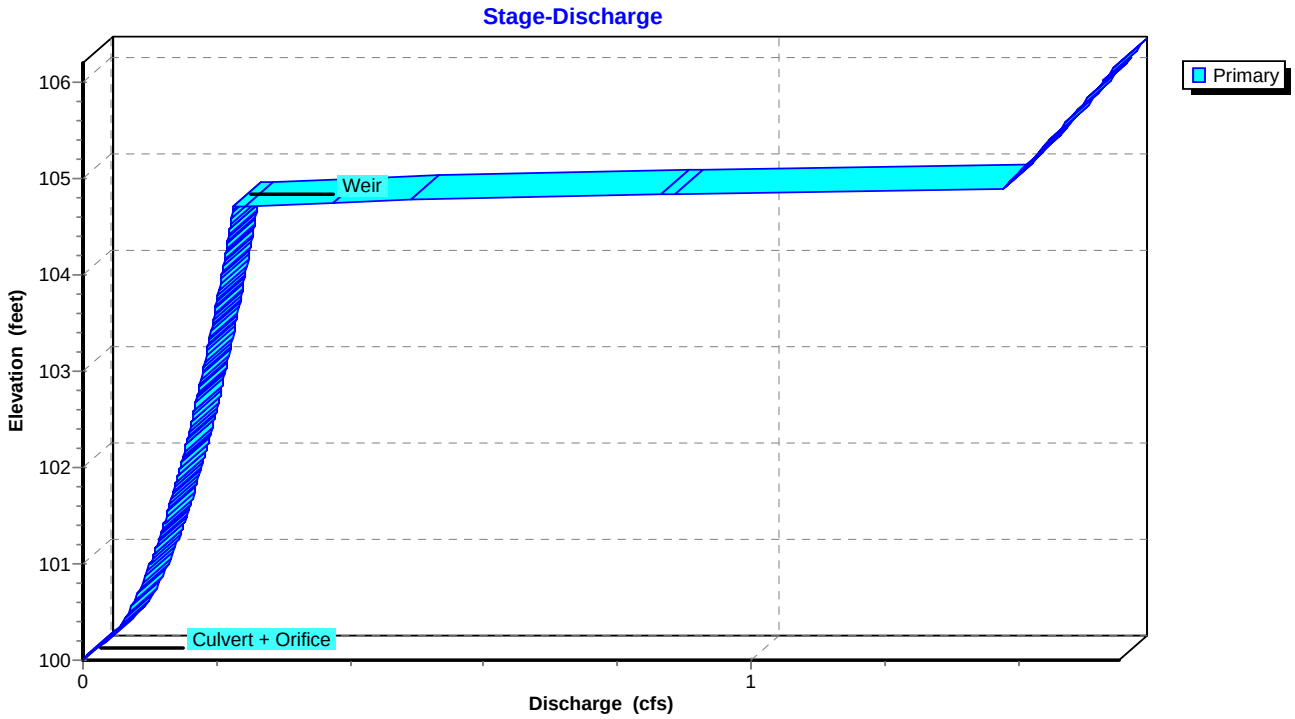
12 Chambers
161.9 cy Field
104.1 cy Stone



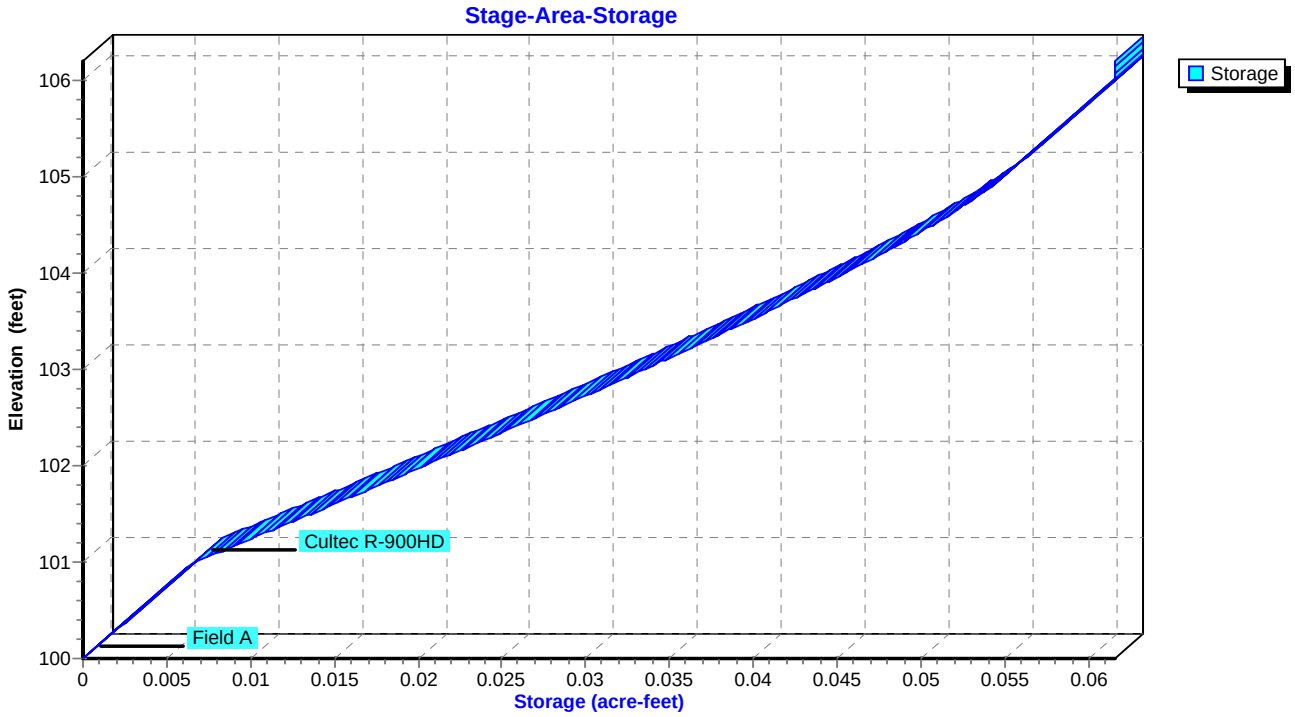
Pond 12P: UG-B



Pond 12P: UG-B



Pond 12P: UG-B

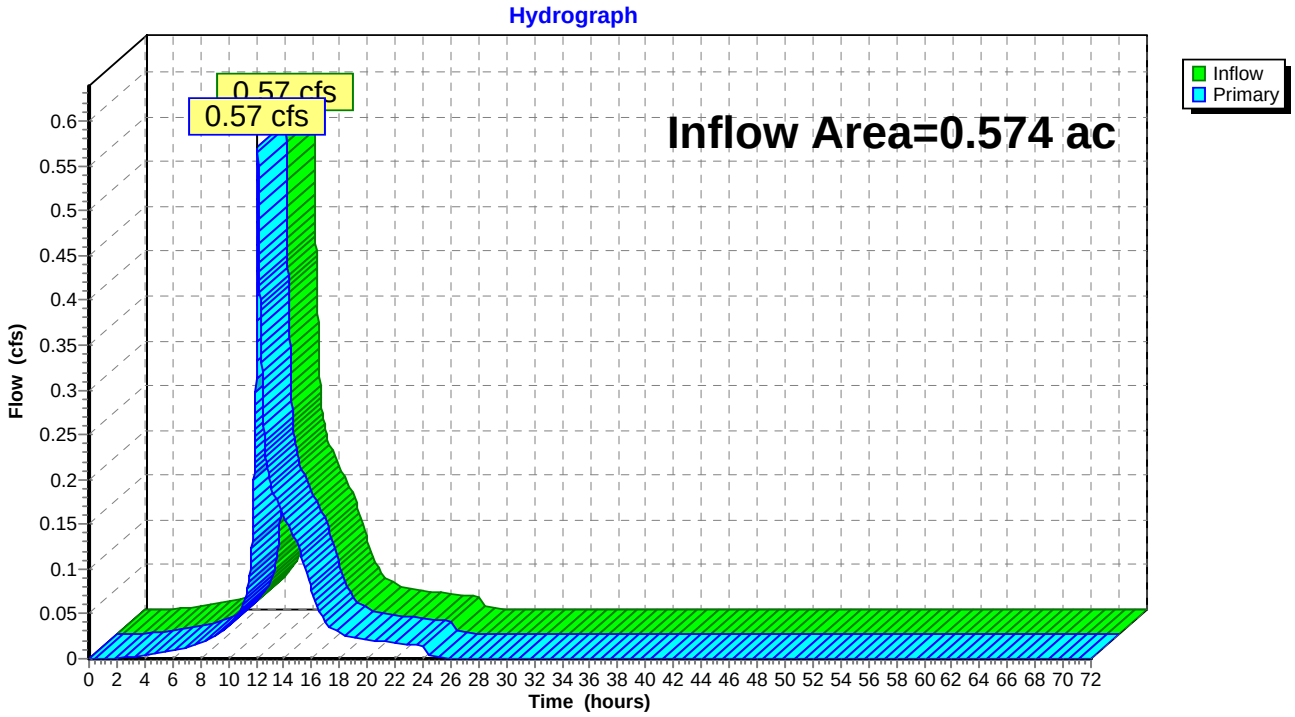

Stage-Area-Storage
Storage
Elevation (feet)
106
105
104
103
102
101
100
Cultec R-900HD
Field A
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
0.04
0.045
0.05
0.055
0.06
Storage (acre-feet)

Summary for Link 13L: P-B

Inflow Area = 0.574 ac, 46.33% Impervious, Inflow Depth = 2.10" for 2-yr event
Inflow = 0.57 cfs @ 12.13 hrs, Volume= 0.100 af
Primary = 0.57 cfs @ 12.13 hrs, Volume= 0.100 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 13L: P-B



Summary for Subcatchment 20S: P-C

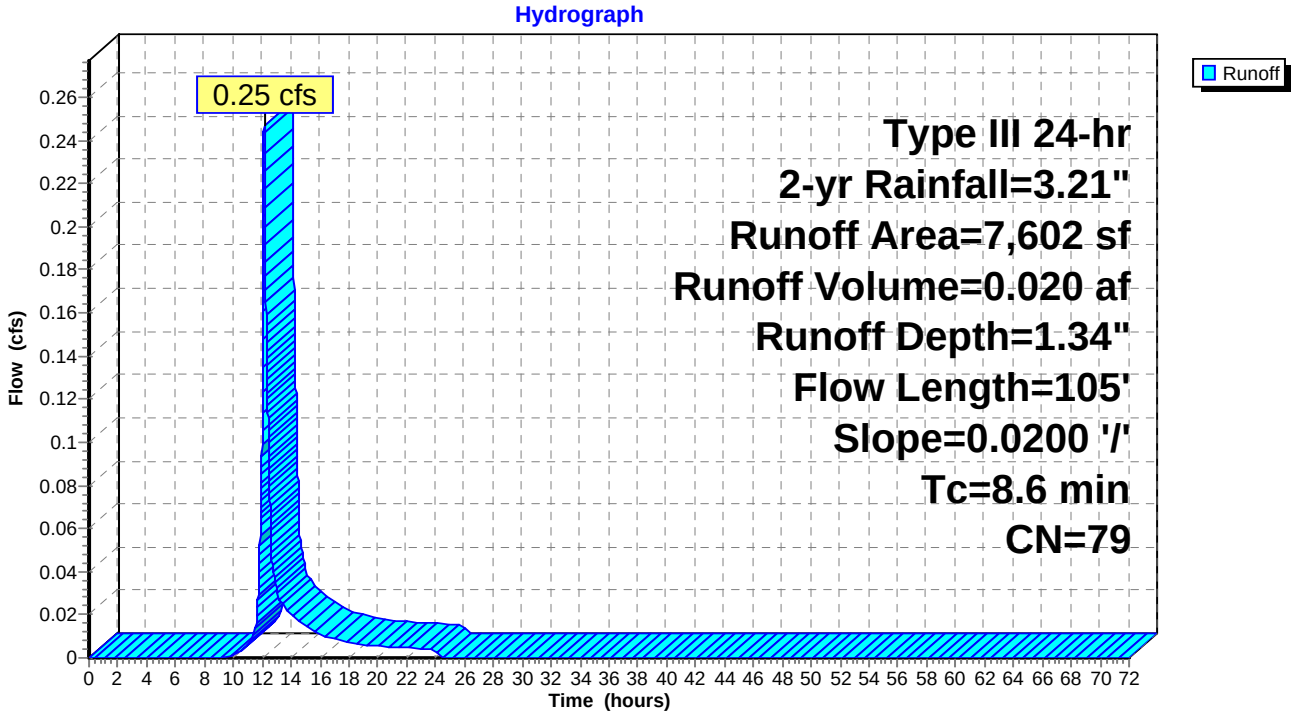
Runoff = 0.25 cfs @ 12.13 hrs, Volume= 0.020 af, Depth= 1.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.21"

	Area (sf)	CN	Description
	7,482	79	Woods/grass comb., Good, HSG D
*	120	98	Pavement
	7,602	79	Weighted Average
	7,482		98.42% Pervious Area
	120		1.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.21"
0.4	55	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.6	105	Total			

Subcatchment 20S: P-C

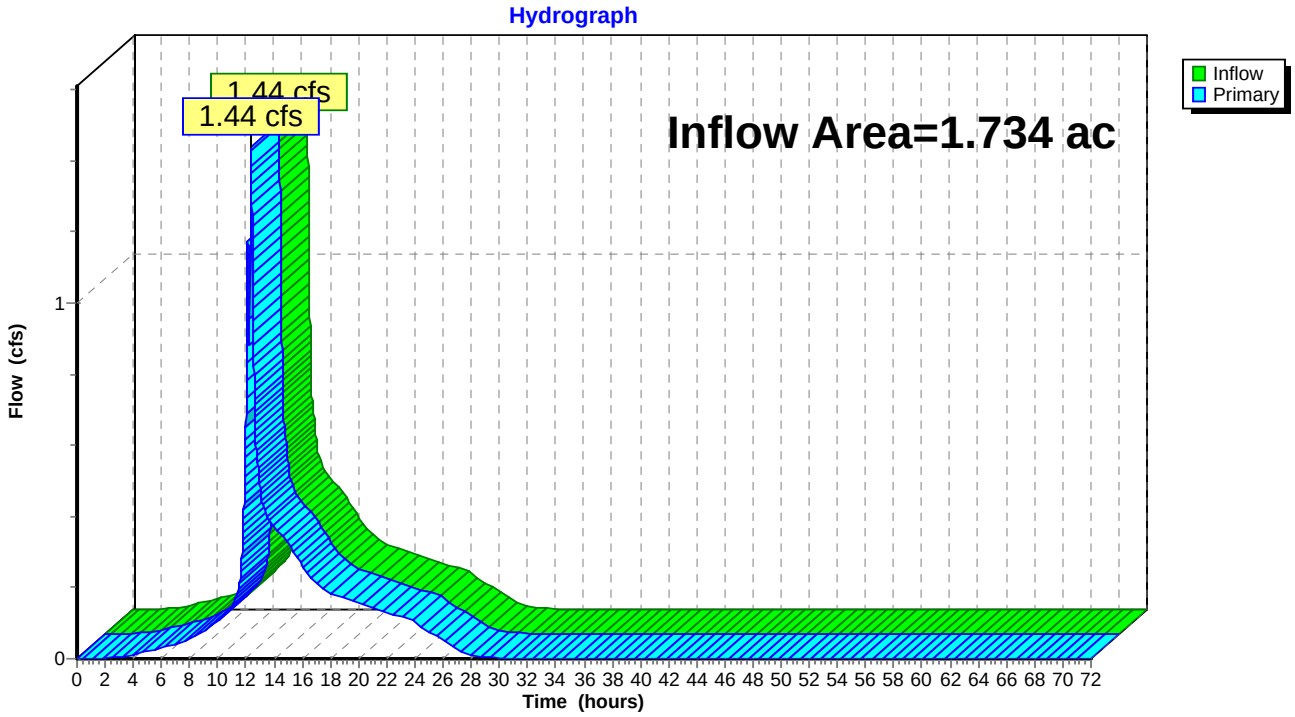


Summary for Link 30L: Post Development Combined

Inflow Area = 1.734 ac, 61.98% Impervious, Inflow Depth = 2.35" for 2-yr event
Inflow = 1.44 cfs @ 12.35 hrs, Volume= 0.340 af
Primary = 1.44 cfs @ 12.35 hrs, Volume= 0.340 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 30L: Post Development Combined



Summary for Subcatchment 2S: P-A.1

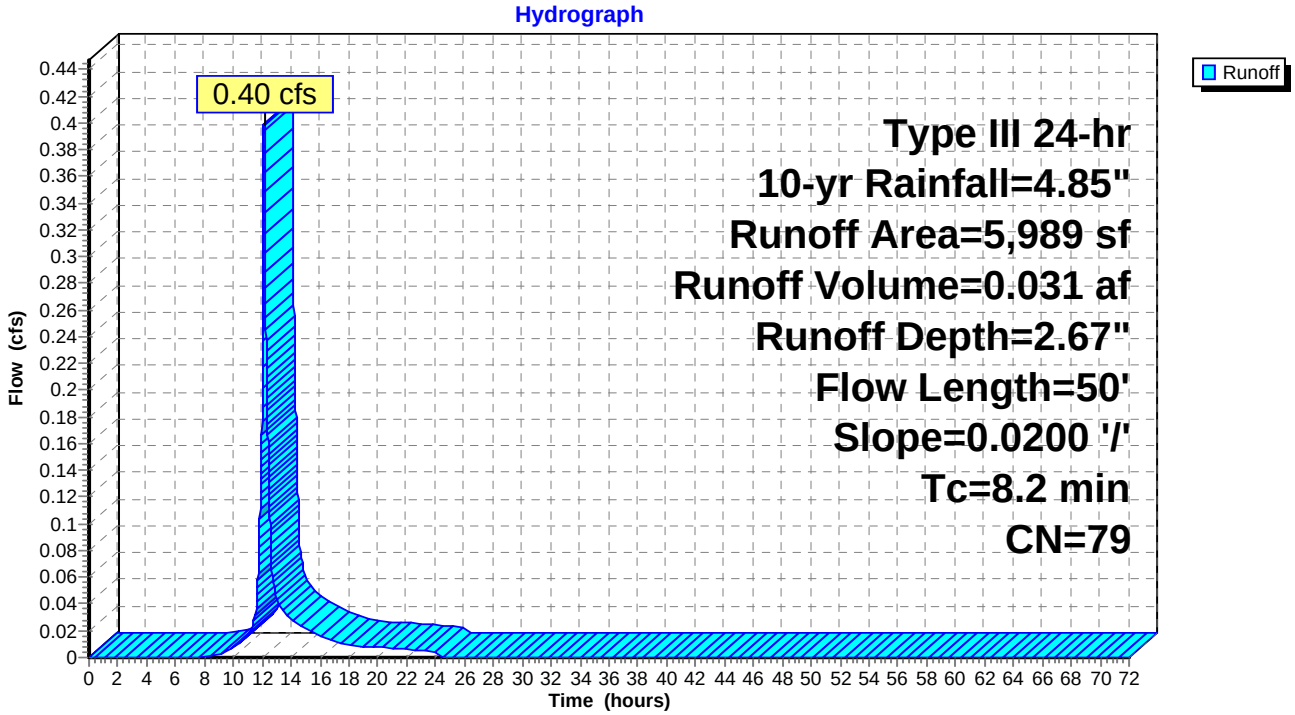
Runoff = 0.40 cfs @ 12.12 hrs, Volume= 0.031 af, Depth= 2.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.85"

Area (sf)	CN	Description
5,989	79	Woods/grass comb., Good, HSG D
5,989		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.21"

Subcatchment 2S: P-A.1



Summary for Subcatchment 4S: P-A.2

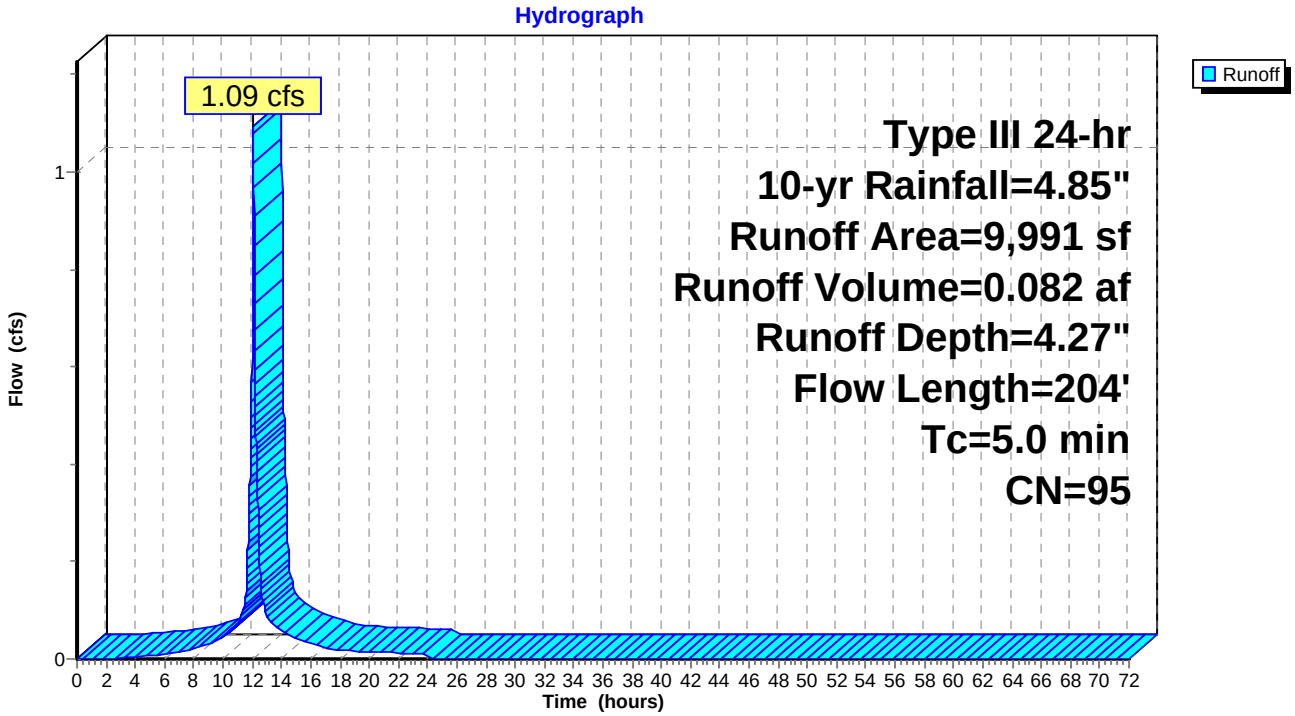
Runoff = 1.09 cfs @ 12.07 hrs, Volume= 0.082 af, Depth= 4.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.85"

Area (sf)	CN	Description
1,830	79	Woods/grass comb., Good, HSG D
8,161	98	Paved parking, HSG D
9,991	95	Weighted Average
1,830		18.32% Pervious Area
8,161		81.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	45	0.1250	0.21		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.21"
0.0	10	0.3300	9.25		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.4	34	0.0100	1.61		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.4	115	0.0500	4.54		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.4	204	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 4S: P-A.2



Summary for Subcatchment 5S: P-A.3

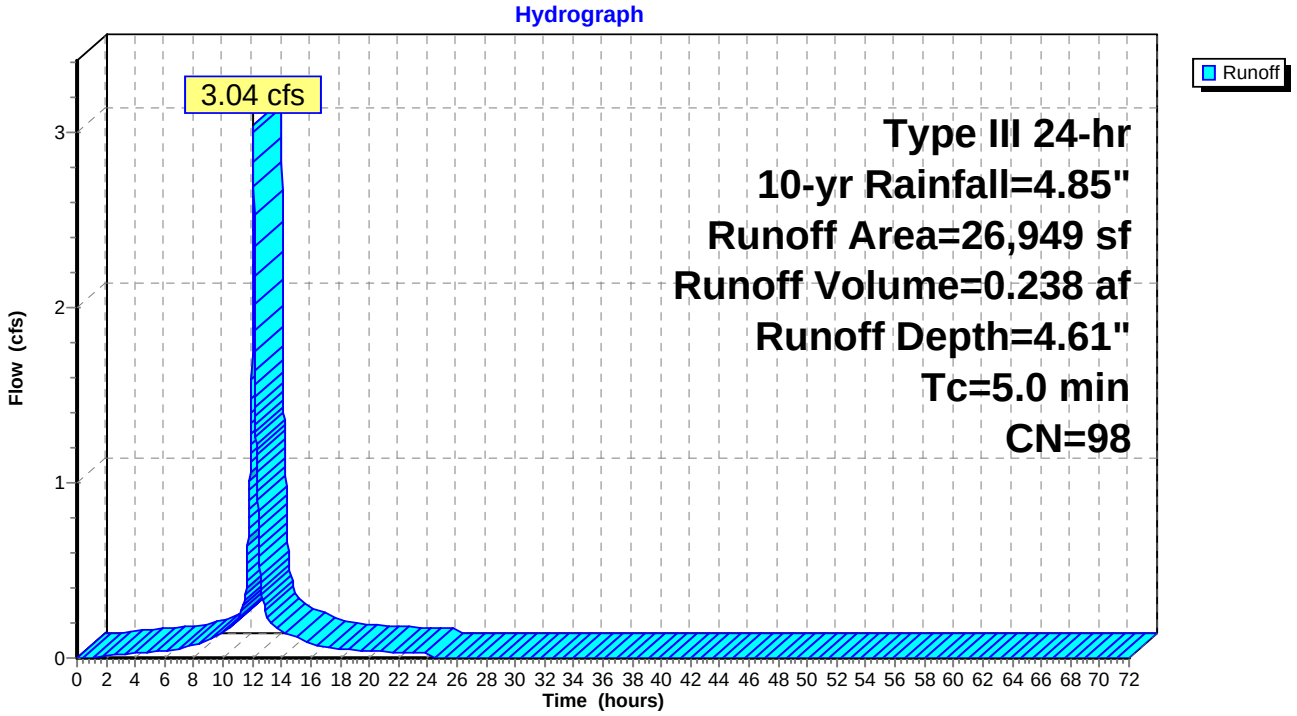
Runoff = 3.04 cfs @ 12.07 hrs, Volume= 0.238 af, Depth= 4.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.85"

Area (sf)	CN	Description
26,949	98	Roofs, HSG D
26,949		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Min. Tc Assumed for Roof**

Subcatchment 5S: P-A.3



Summary for Pond 6P: UG-A

Inflow Area = 0.848 ac, 95.05% Impervious, Inflow Depth = 4.52" for 10-yr event
Inflow = 4.13 cfs @ 12.07 hrs, Volume= 0.319 af
Outflow = 3.63 cfs @ 12.11 hrs, Volume= 0.319 af, Atten= 12%, Lag= 2.4 min
Primary = 3.63 cfs @ 12.11 hrs, Volume= 0.319 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 100.79' @ 12.11 hrs Surf.Area= 1,835 sf Storage= 4,081 cf

Plug-Flow detention time= 179.2 min calculated for 0.319 af (100% of inflow)
Center-of-Mass det. time= 179.1 min (931.9 - 752.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	97.30'	1,563 cf	**20.83'W x 87.50'L x 3.54'H Field A** 6,456 cf Overall - 2,548 cf Embedded = 3,908 cf x 40.0% Voids
#2A	97.80'	2,548 cf	**Cultec R-330XLHD** x 48 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 4 rows
#3	100.00'	31 cf	**4.00'D x 2.50'H Vertical Cone/Cylinder**
#4	102.10'	1,188 cf	**Parking Lot Storage (Prismatic)**Listed below (Recalc)
		5,331 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
102.10	0	0	0
103.00	2,640	1,188	1,188

Device	Routing	Invert	Outlet Devices
#1	Primary	97.30'	**10.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 97.30' / 97.00' S= 0.0150 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.55 sf
#2	Device 1	97.30'	**2.0" Vert. Orifice** C= 0.600
#3	Device 1	100.30'	**Weir, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.70 Width (feet) 4.00 4.00

Primary OutFlow Max=3.63 cfs @ 12.11 hrs HW=100.79' (Free Discharge)
└**1=Culvert** (Inlet Controls 3.63 cfs @ 6.66 fps)
└**2=Orifice** (Passes < 0.19 cfs potential flow)
└**3=Weir** (Passes < 4.43 cfs potential flow)

Pond 6P: UG-A - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 4 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

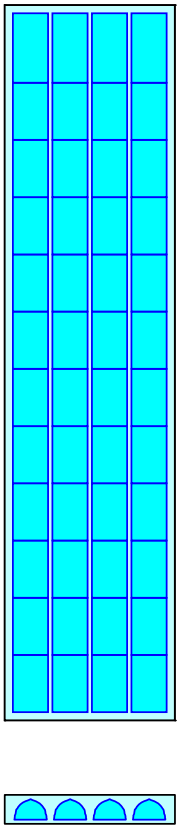
12 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 85.50' Row Length +12.0" End Stone x 2 = 87.50' Base Length
4 Rows x 52.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 20.83' Base Width
6.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.54' Field Height

48 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 4 Rows = 2,548.2 cf Chamber Storage

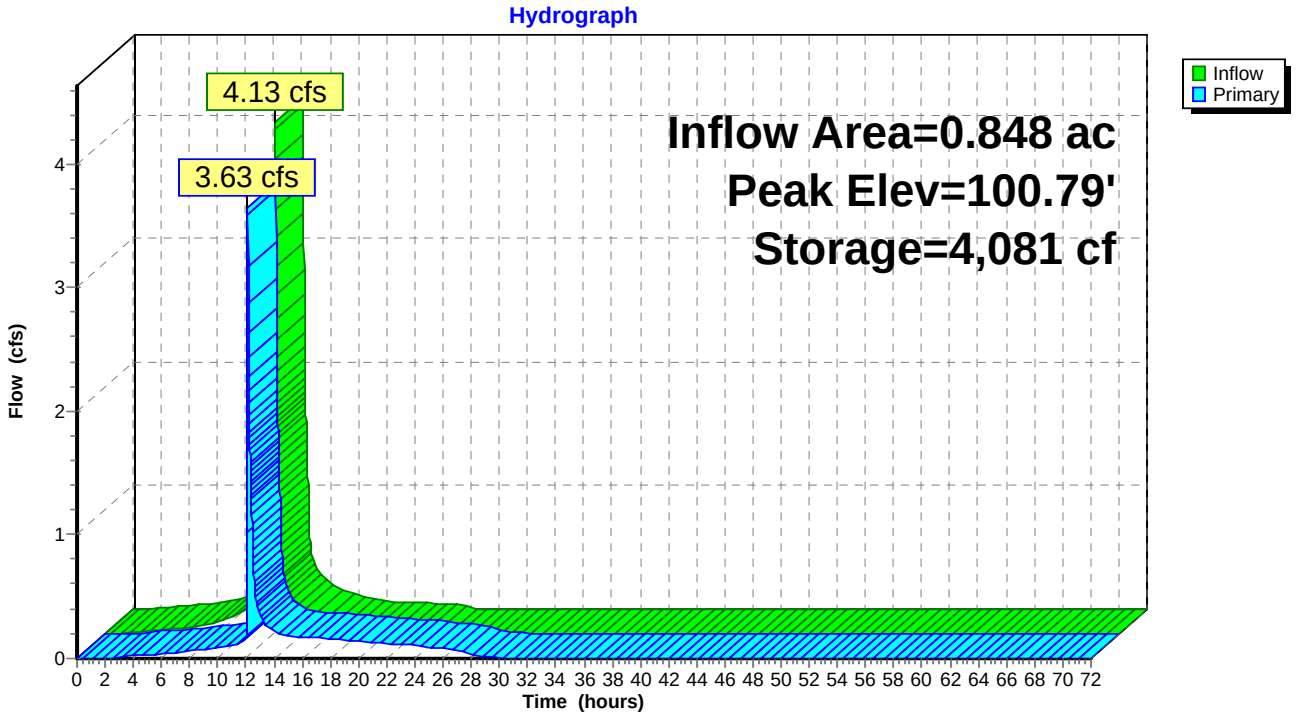
6,456.2 cf Field - 2,548.2 cf Chambers = 3,907.9 cf Stone x 40.0% Voids = 1,563.2 cf Stone Storage

Chamber Storage + Stone Storage = 4,111.4 cf = 0.094 af
Overall Storage Efficiency = 63.7%

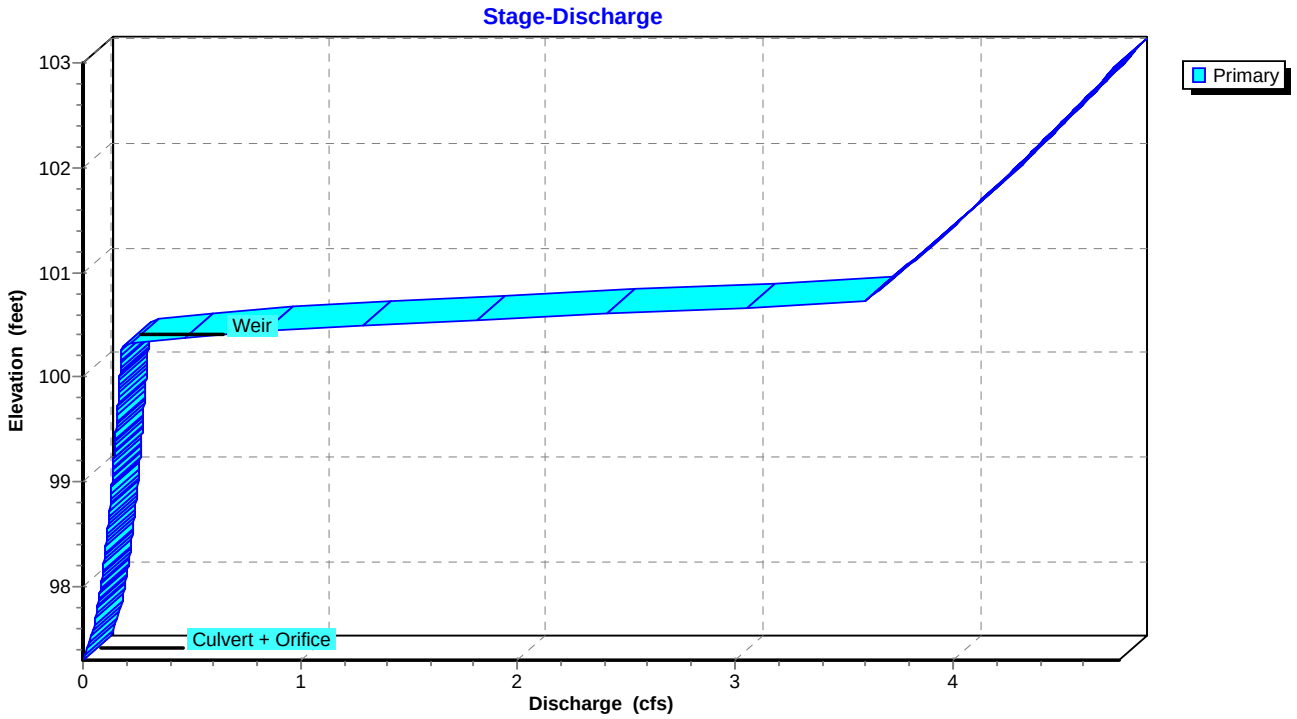
48 Chambers
239.1 cy Field
144.7 cy Stone



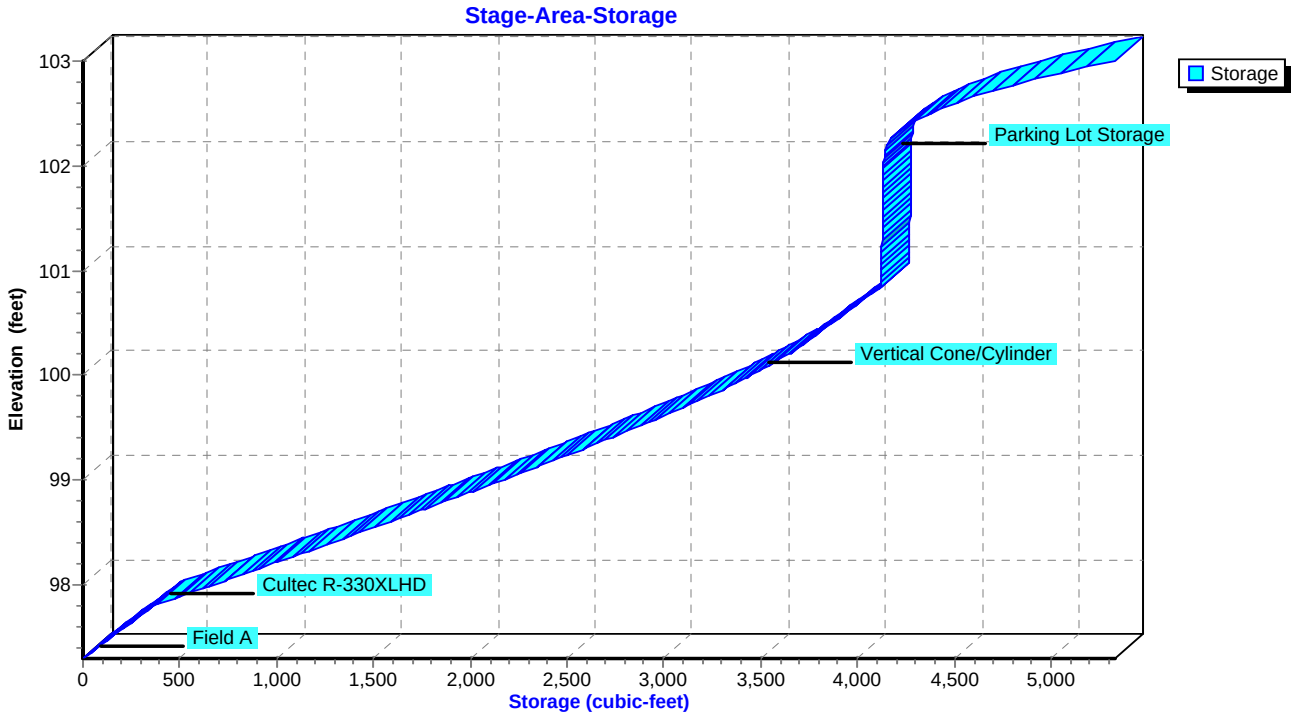
Pond 6P: UG-A



Pond 6P: UG-A



Pond 6P: UG-A

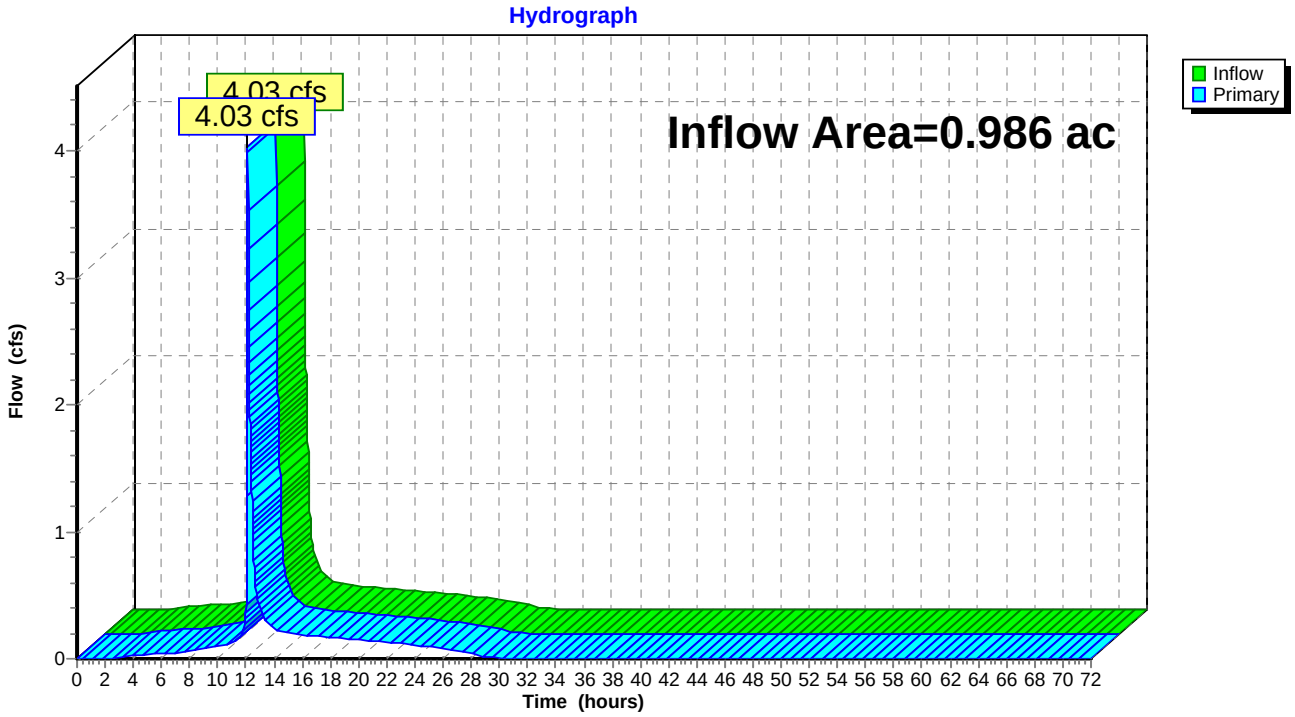

Stage-Area-Storage
Elevation (feet)
103
102
101
100
99
98
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500
5,000
Storage (cubic-feet)
Storage
Parking Lot Storage
Vertical Cone/Cylinder
Cultec R-330XLHD
Field A

Summary for Link 7L: P-A

Inflow Area = 0.986 ac, 81.79% Impervious, Inflow Depth = 4.26" for 10-yr event
Inflow = 4.03 cfs @ 12.11 hrs, Volume= 0.350 af
Primary = 4.03 cfs @ 12.11 hrs, Volume= 0.350 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 7L: P-A



Summary for Subcatchment 10S: P-B.1

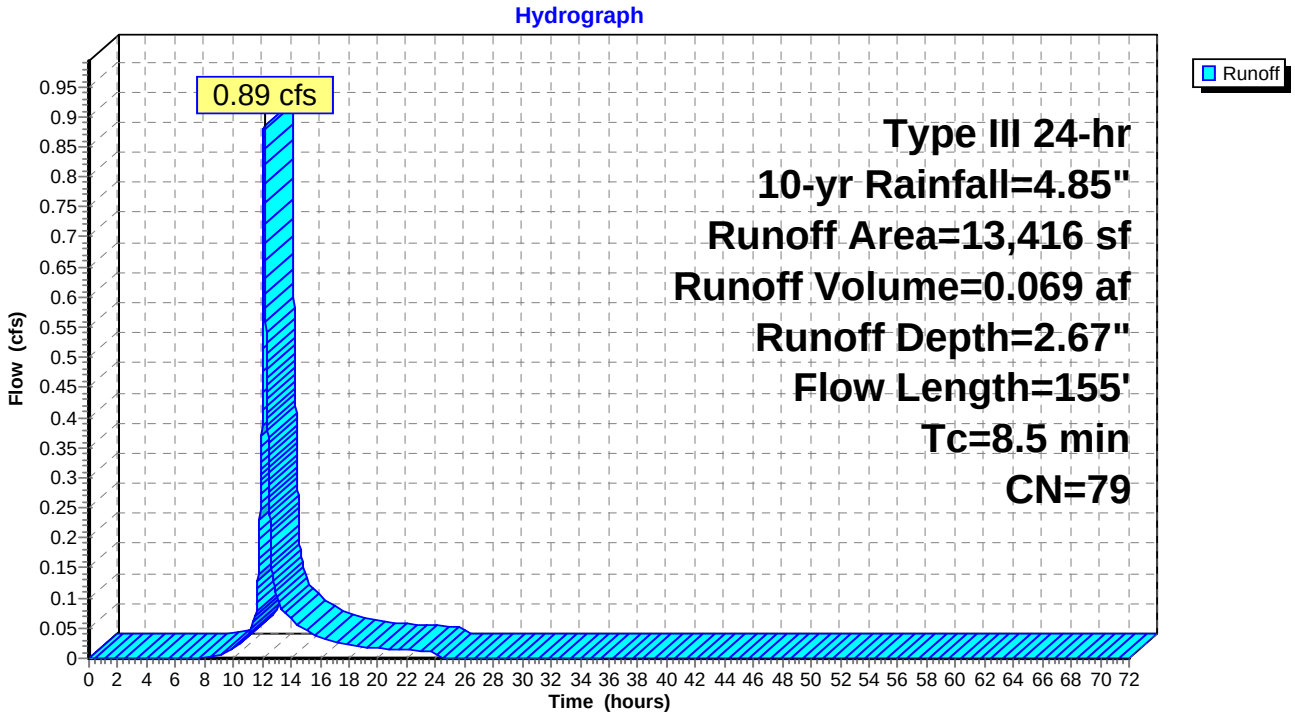
Runoff = 0.89 cfs @ 12.12 hrs, Volume= 0.069 af, Depth= 2.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.85"

Area (sf)	CN	Description
13,416	79	Woods/grass comb., Good, HSG D
13,416		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.21"
0.3	105	0.1500	6.24		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.5	155	Total			

Subcatchment 10S: P-B.1



Summary for Subcatchment 11S: P-B.2

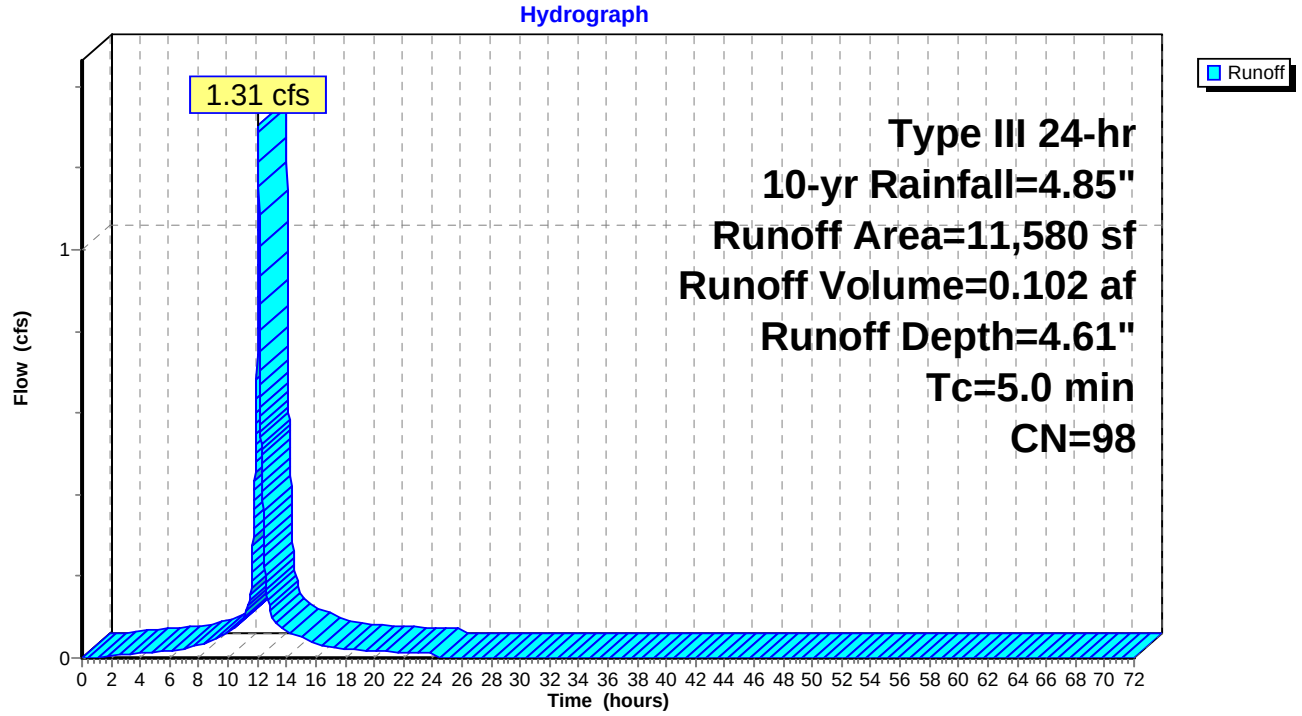
Runoff = 1.31 cfs @ 12.07 hrs, Volume= 0.102 af, Depth= 4.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.85"

Area (sf)	CN	Description
11,580	98	Roofs, HSG D
11,580		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Min. Tc Assumed for Roof**

Subcatchment 11S: P-B.2



Summary for Pond 12P: UG-B

Inflow Area = 0.266 ac,100.00% Impervious, Inflow Depth = 4.61" for 10-yr event
Inflow = 1.31 cfs @ 12.07 hrs, Volume= 0.102 af
Outflow = 0.19 cfs @ 12.55 hrs, Volume= 0.102 af, Atten= 86%, Lag= 28.9 min
Primary = 0.19 cfs @ 12.55 hrs, Volume= 0.102 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 103.23' @ 12.55 hrs Surf.Area= 0.017 ac Storage= 0.036 af

Plug-Flow detention time= 79.2 min calculated for 0.102 af (100% of inflow)
Center-of-Mass det. time= 79.2 min (826.8 - 747.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	100.00'	0.026 af	**15.75'W x 46.25'L x 6.00'H Field A** 0.100 af Overall - 0.036 af Embedded = 0.065 af x 40.0% Voids
#2A	101.00'	0.036 af	**Cultec R-900HD** x 12 Inside #1 Effective Size= 72.7"W x 48.0"H => 17.61 sf x 7.00'L = 123.3 cf Overall Size= 78.0"W x 48.0"H x 9.25'L with 2.25' Overlap Row Length Adjustment= +2.25' x 17.61 sf x 2 rows
		0.062 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	100.00'	**6.0" Round Culvert** L= 96.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 100.00' / 99.50' S= 0.0052 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf
#2	Device 1	100.00'	**2.0" Vert. Orifice** C= 0.600
#3	Device 1	104.70'	**Weir, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.50 Width (feet) 4.00 4.00

Primary OutFlow Max=0.19 cfs @ 12.55 hrs HW=103.23' (Free Discharge)
└**1=Culvert** (Passes 0.19 cfs of 1.12 cfs potential flow)
└**2=Orifice** (Orifice Controls 0.19 cfs @ 8.54 fps)
└**3=Weir** (Controls 0.00 cfs)

Pond 12P: UG-B - Chamber Wizard Field A

Chamber Model = Cultec R-900HD (Cultec Recharger® 900HD)
Effective Size= 72.7"W x 48.0"H => 17.61 sf x 7.00'L = 123.3 cf
Overall Size= 78.0"W x 48.0"H x 9.25'L with 2.25' Overlap
Row Length Adjustment= +2.25' x 17.61 sf x 2 rows

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

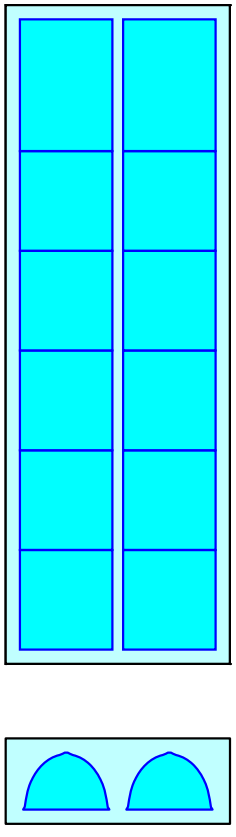
6 Chambers/Row x 7.00' Long +2.25' Row Adjustment = 44.25' Row Length +12.0" End Stone x 2 = 46.25' Base Length
2 Rows x 78.0" Wide + 9.0" Spacing x 1 + 12.0" Side Stone x 2 = 15.75' Base Width
12.0" Base + 48.0" Chamber Height + 12.0" Cover = 6.00' Field Height

12 Chambers x 123.3 cf +2.25' Row Adjustment x 17.61 sf x 2 Rows = 1,558.9 cf Chamber Storage

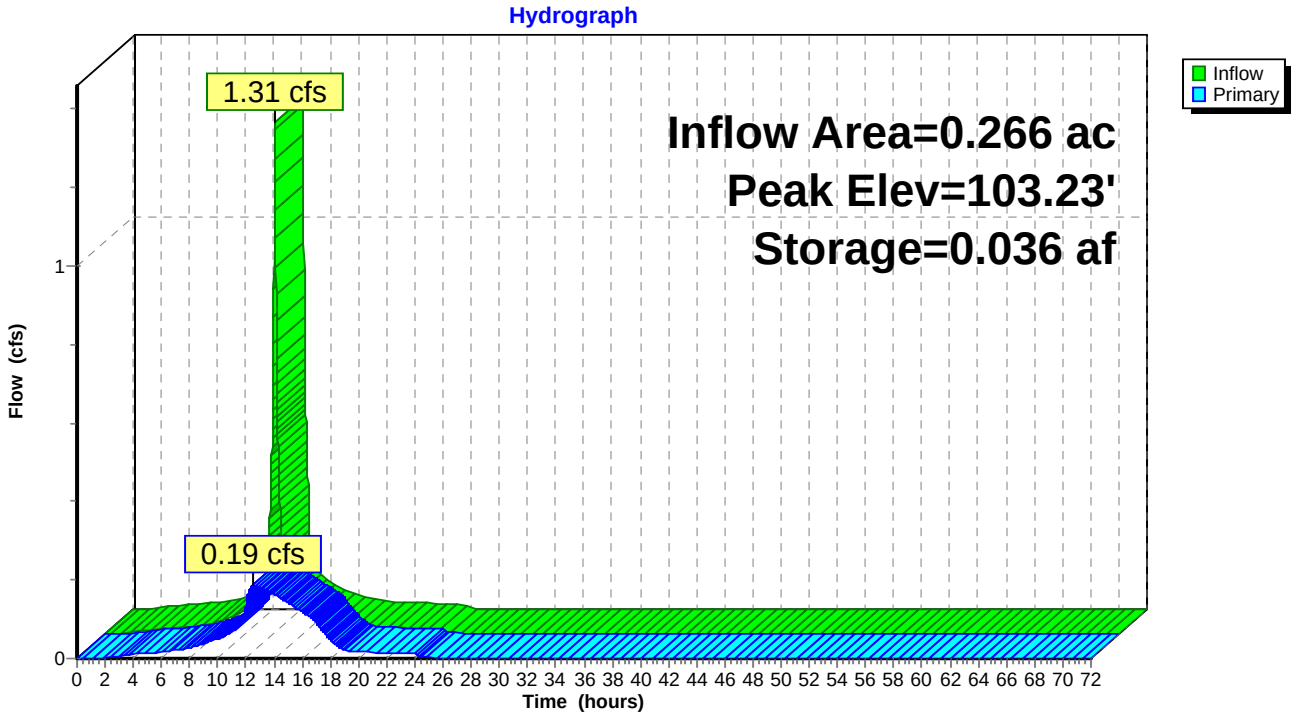
4,370.6 cf Field - 1,558.9 cf Chambers = 2,811.7 cf Stone x 40.0% Voids = 1,124.7 cf Stone Storage

Chamber Storage + Stone Storage = 2,683.6 cf = 0.062 af
Overall Storage Efficiency = 61.4%

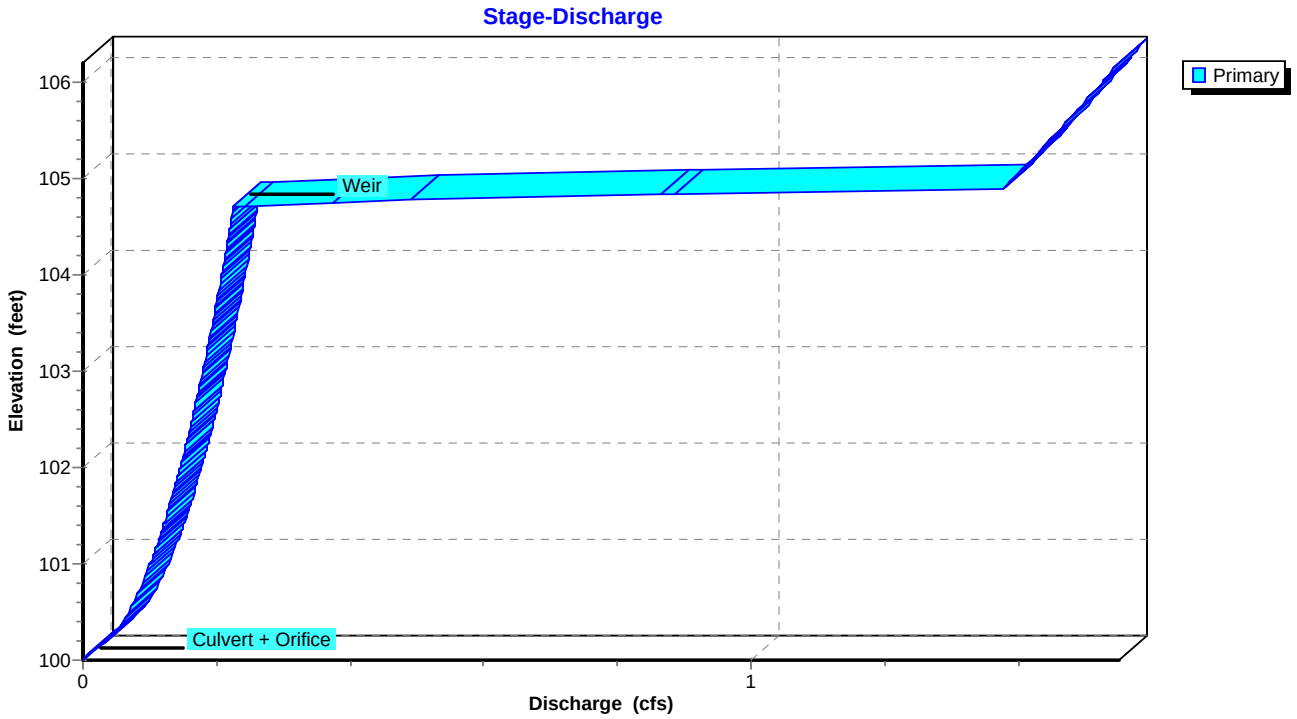
12 Chambers
161.9 cy Field
104.1 cy Stone



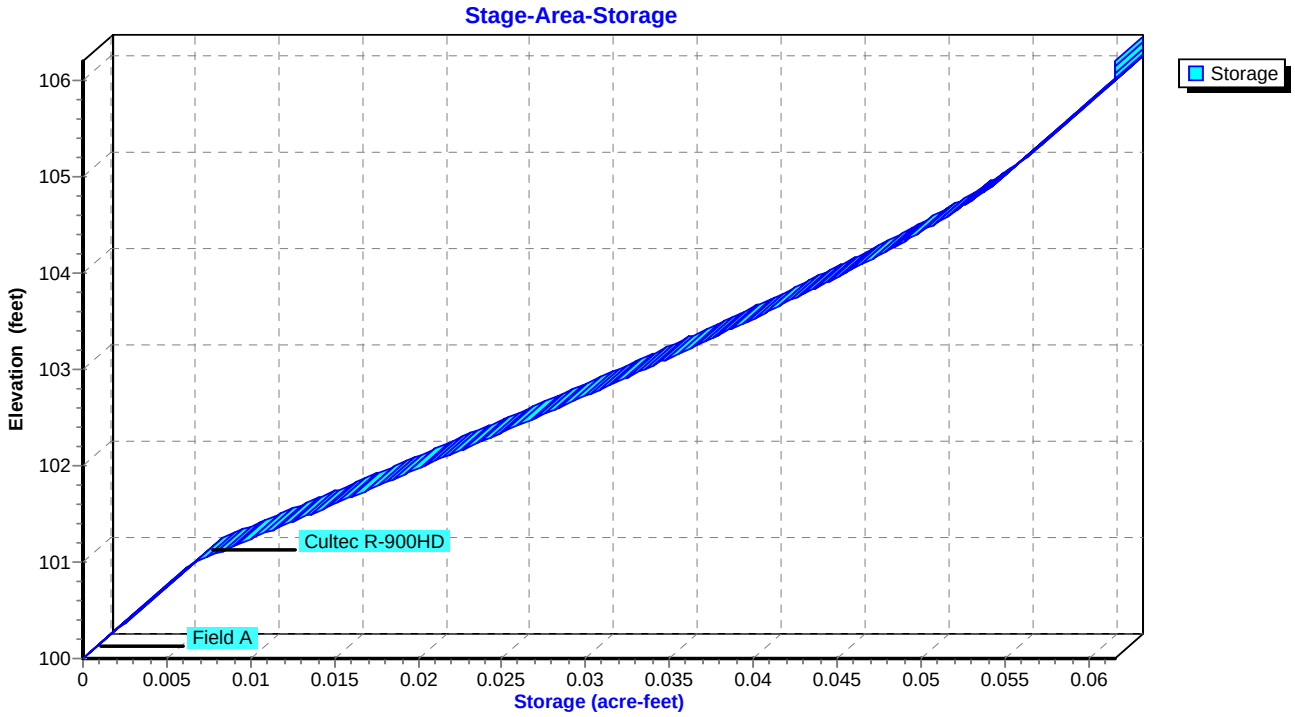
Pond 12P: UG-B



Pond 12P: UG-B



Pond 12P: UG-B

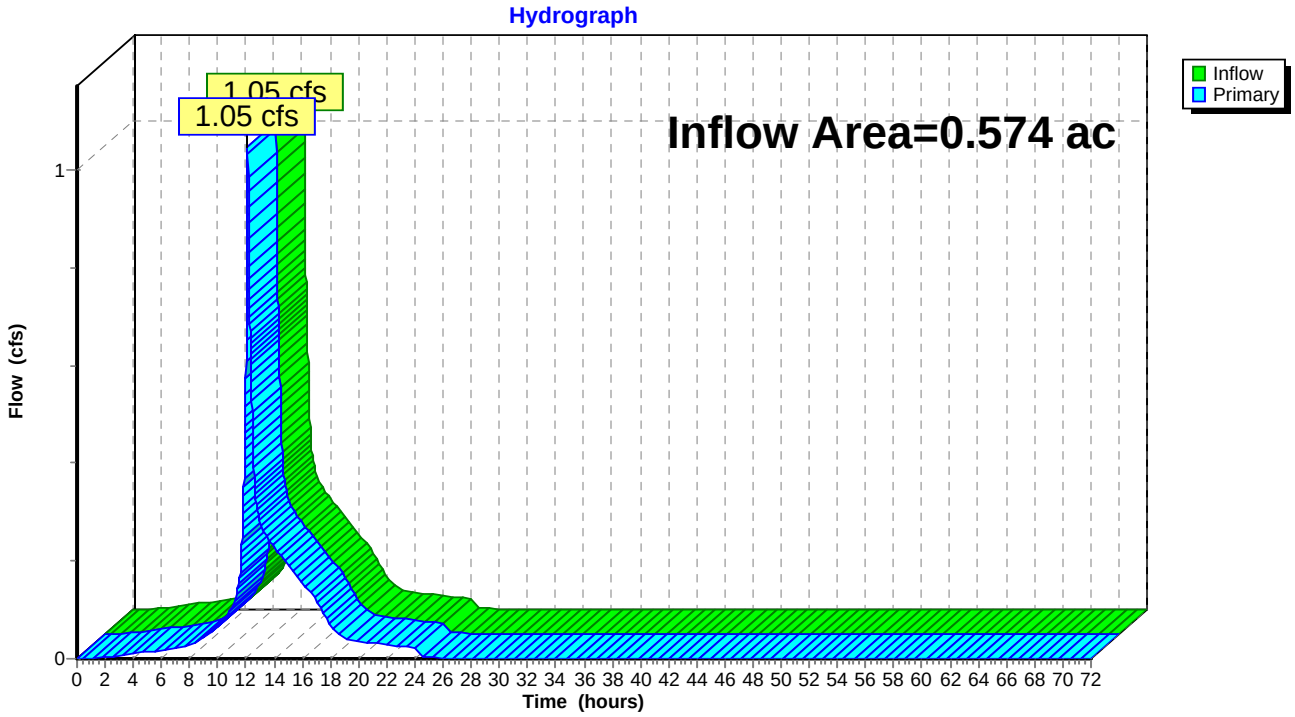

Stage-Area-Storage
Storage
Elevation (feet)
106
105
104
103
102
101
100
Cultec R-900HD
Field A
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
0.04
0.045
0.05
0.055
0.06
Storage (acre-feet)

Summary for Link 13L: P-B

Inflow Area = 0.574 ac, 46.33% Impervious, Inflow Depth = 3.57" for 10-yr event
Inflow = 1.05 cfs @ 12.12 hrs, Volume= 0.171 af
Primary = 1.05 cfs @ 12.12 hrs, Volume= 0.171 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 13L: P-B



Summary for Subcatchment 20S: P-C

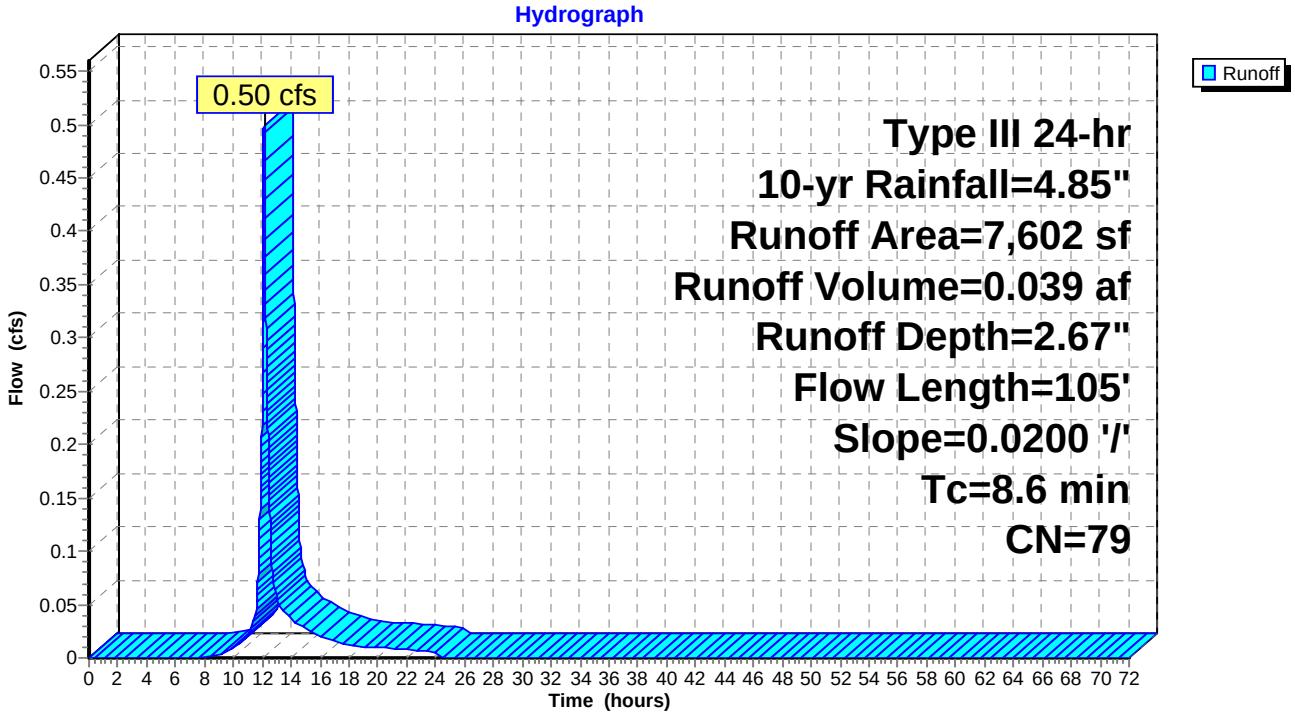
Runoff = 0.50 cfs @ 12.12 hrs, Volume= 0.039 af, Depth= 2.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.85"

	Area (sf)	CN	Description
	7,482	79	Woods/grass comb., Good, HSG D
*	120	98	Pavement
	7,602	79	Weighted Average
	7,482		98.42% Pervious Area
	120		1.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.21"
0.4	55	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.6	105	Total			

Subcatchment 20S: P-C

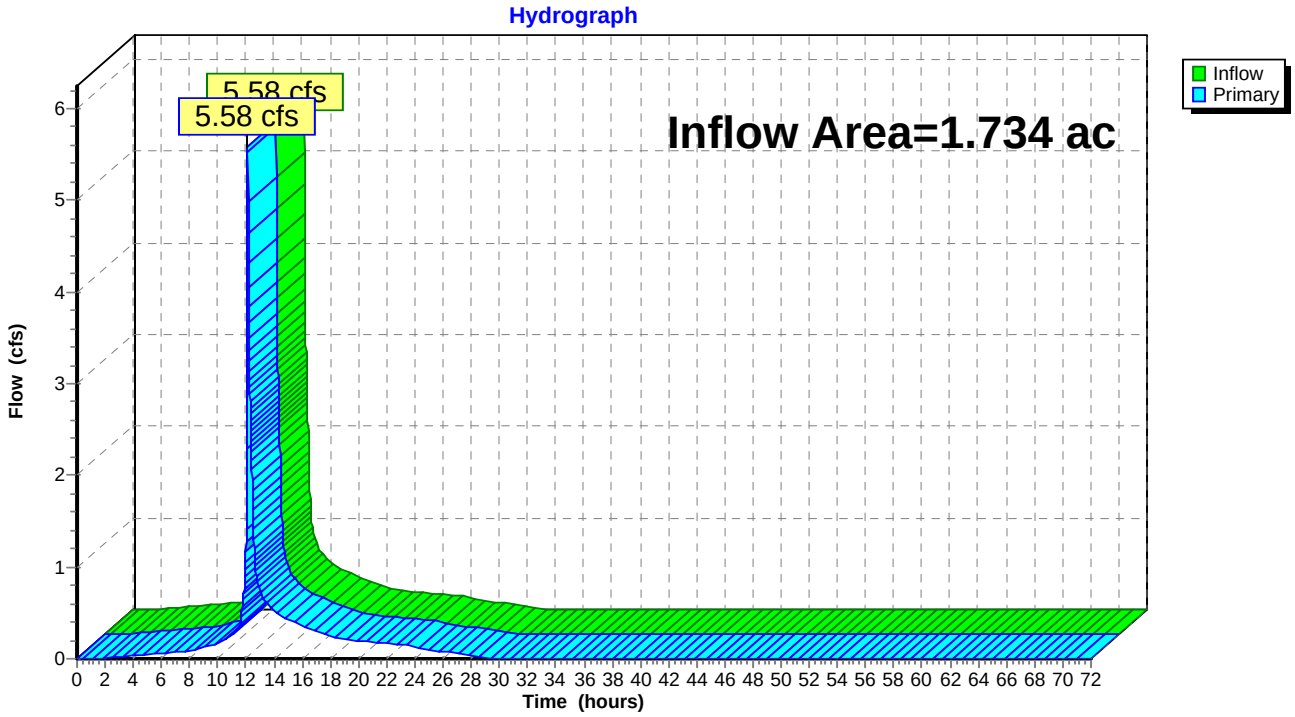


Summary for Link 30L: Post Development Combined

Inflow Area = 1.734 ac, 61.98% Impervious, Inflow Depth = 3.87" for 10-yr event
Inflow = 5.58 cfs @ 12.12 hrs, Volume= 0.560 af
Primary = 5.58 cfs @ 12.12 hrs, Volume= 0.560 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 30L: Post Development Combined



Summary for Subcatchment 2S: P-A.1

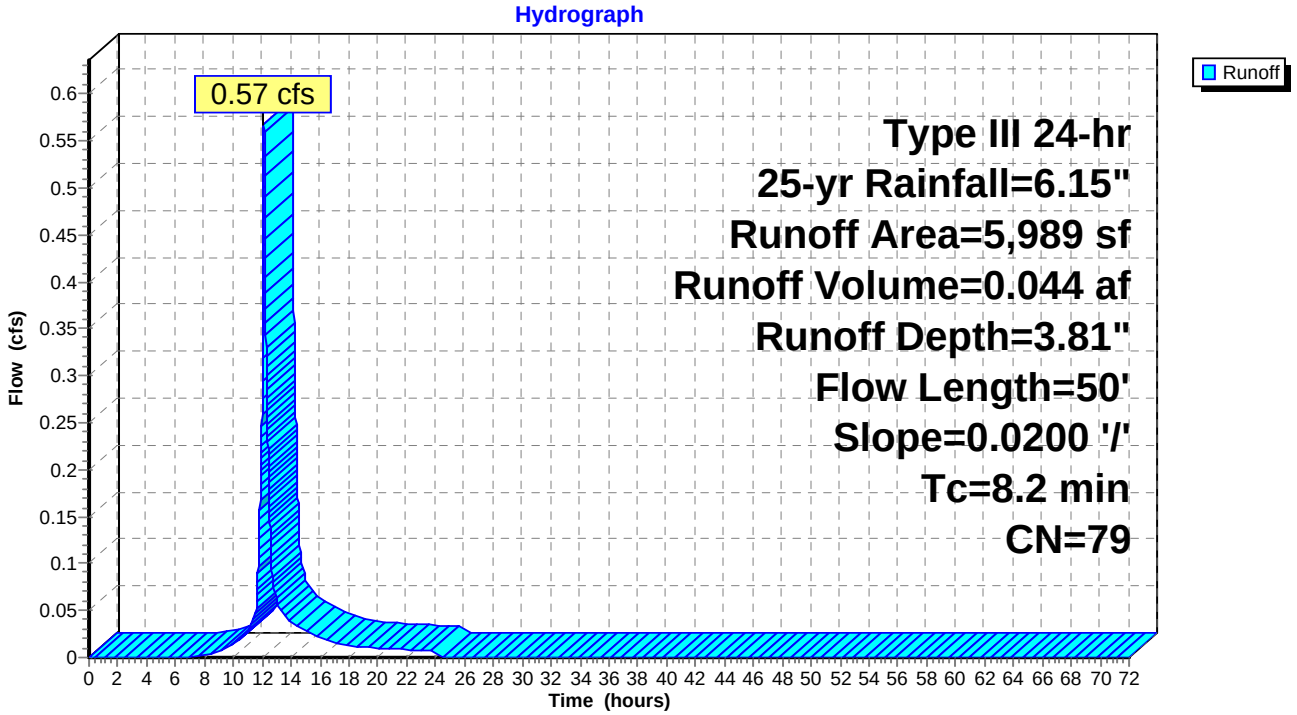
Runoff = 0.57 cfs @ 12.12 hrs, Volume= 0.044 af, Depth= 3.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=6.15"

Area (sf)	CN	Description
5,989	79	Woods/grass comb., Good, HSG D
5,989		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.21"

Subcatchment 2S: P-A.1



Summary for Subcatchment 4S: P-A.2

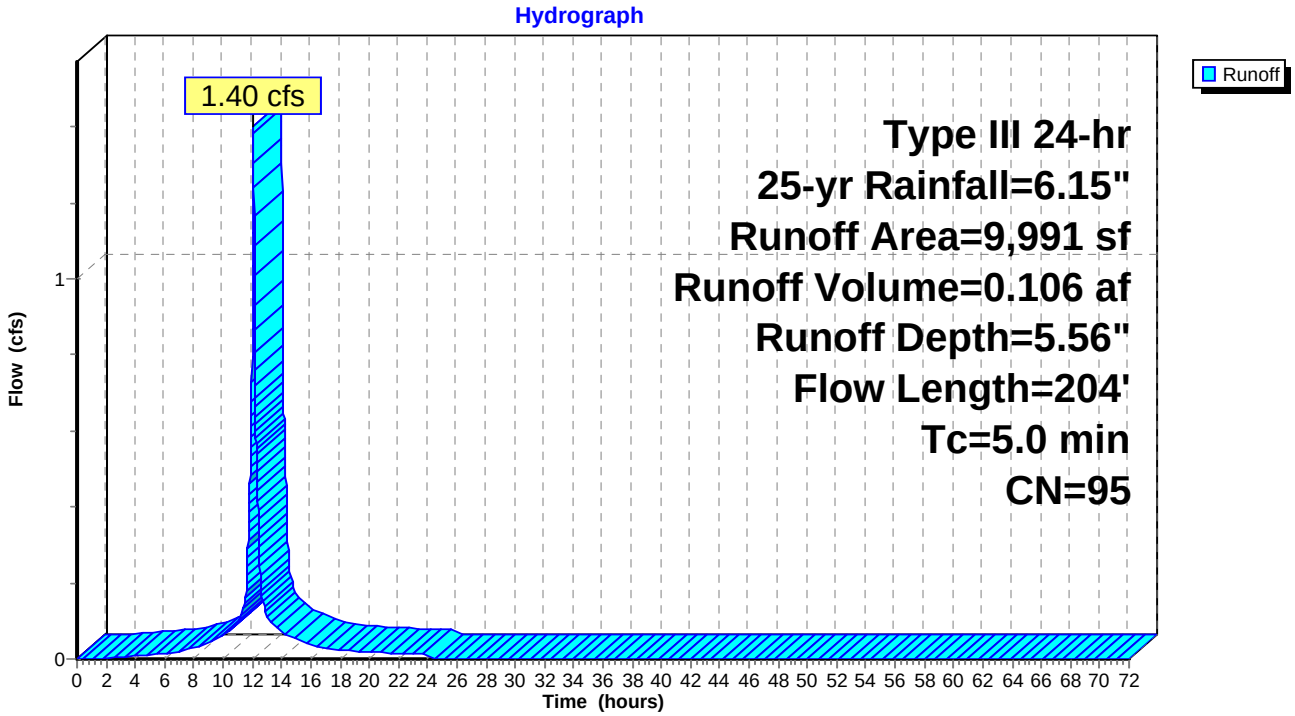
Runoff = 1.40 cfs @ 12.07 hrs, Volume= 0.106 af, Depth= 5.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=6.15"

Area (sf)	CN	Description
1,830	79	Woods/grass comb., Good, HSG D
8,161	98	Paved parking, HSG D
9,991	95	Weighted Average
1,830		18.32% Pervious Area
8,161		81.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	45	0.1250	0.21		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.21"
0.0	10	0.3300	9.25		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.4	34	0.0100	1.61		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.4	115	0.0500	4.54		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.4	204	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 4S: P-A.2



Summary for Subcatchment 5S: P-A.3

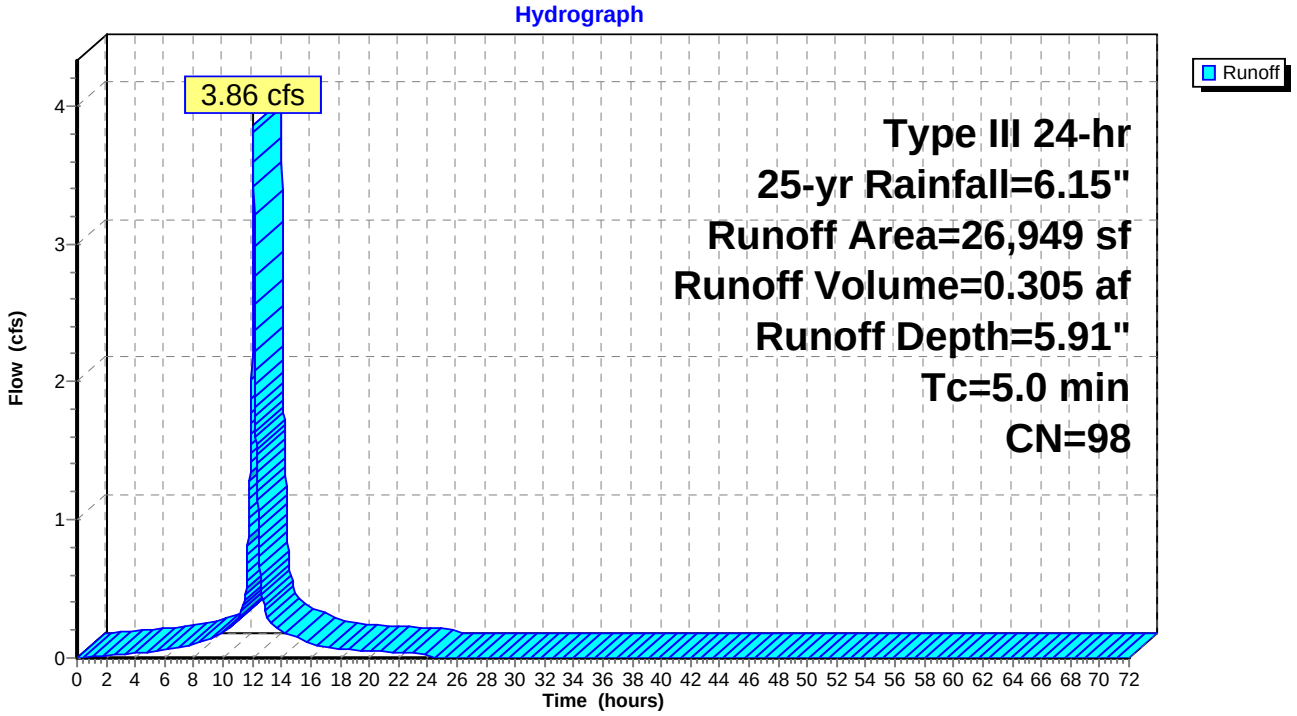
Runoff = 3.86 cfs @ 12.07 hrs, Volume= 0.305 af, Depth= 5.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=6.15"

Area (sf)	CN	Description
26,949	98	Roofs, HSG D
26,949		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Min. Tc Assumed for Roof**

Subcatchment 5S: P-A.3



Summary for Pond 6P: UG-A

Inflow Area = 0.848 ac, 95.05% Impervious, Inflow Depth = 5.82" for 25-yr event
Inflow = 5.27 cfs @ 12.07 hrs, Volume= 0.411 af
Outflow = 4.49 cfs @ 12.12 hrs, Volume= 0.411 af, Atten= 15%, Lag= 2.7 min
Primary = 4.49 cfs @ 12.12 hrs, Volume= 0.411 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 102.40' @ 12.12 hrs Surf.Area= 2,729 sf Storage= 4,278 cf

Plug-Flow detention time= 158.6 min calculated for 0.411 af (100% of inflow)
Center-of-Mass det. time= 158.5 min (907.1 - 748.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	97.30'	1,563 cf	**20.83'W x 87.50'L x 3.54'H Field A** 6,456 cf Overall - 2,548 cf Embedded = 3,908 cf x 40.0% Voids
#2A	97.80'	2,548 cf	**Cultec R-330XLHD** x 48 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 4 rows
#3	100.00'	31 cf	**4.00'D x 2.50'H Vertical Cone/Cylinder**
#4	102.10'	1,188 cf	**Parking Lot Storage (Prismatic)**Listed below (Recalc)
		5,331 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
102.10	0	0	0
103.00	2,640	1,188	1,188

Device	Routing	Invert	Outlet Devices
#1	Primary	97.30'	**10.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 97.30' / 97.00' S= 0.0150 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.55 sf
#2	Device 1	97.30'	**2.0" Vert. Orifice** C= 0.600
#3	Device 1	100.30'	**Weir, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.70 Width (feet) 4.00 4.00

Primary OutFlow Max=4.49 cfs @ 12.12 hrs HW=102.40' (Free Discharge)
└**1=Culvert** (Inlet Controls 4.49 cfs @ 8.23 fps)
└**2=Orifice** (Passes < 0.24 cfs potential flow)
└**3=Weir** (Passes < 36.60 cfs potential flow)

Pond 6P: UG-A - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 4 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

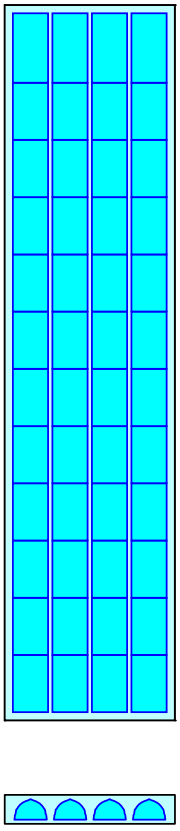
12 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 85.50' Row Length +12.0" End Stone x 2 = 87.50' Base Length
4 Rows x 52.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 20.83' Base Width
6.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.54' Field Height

48 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 4 Rows = 2,548.2 cf Chamber Storage

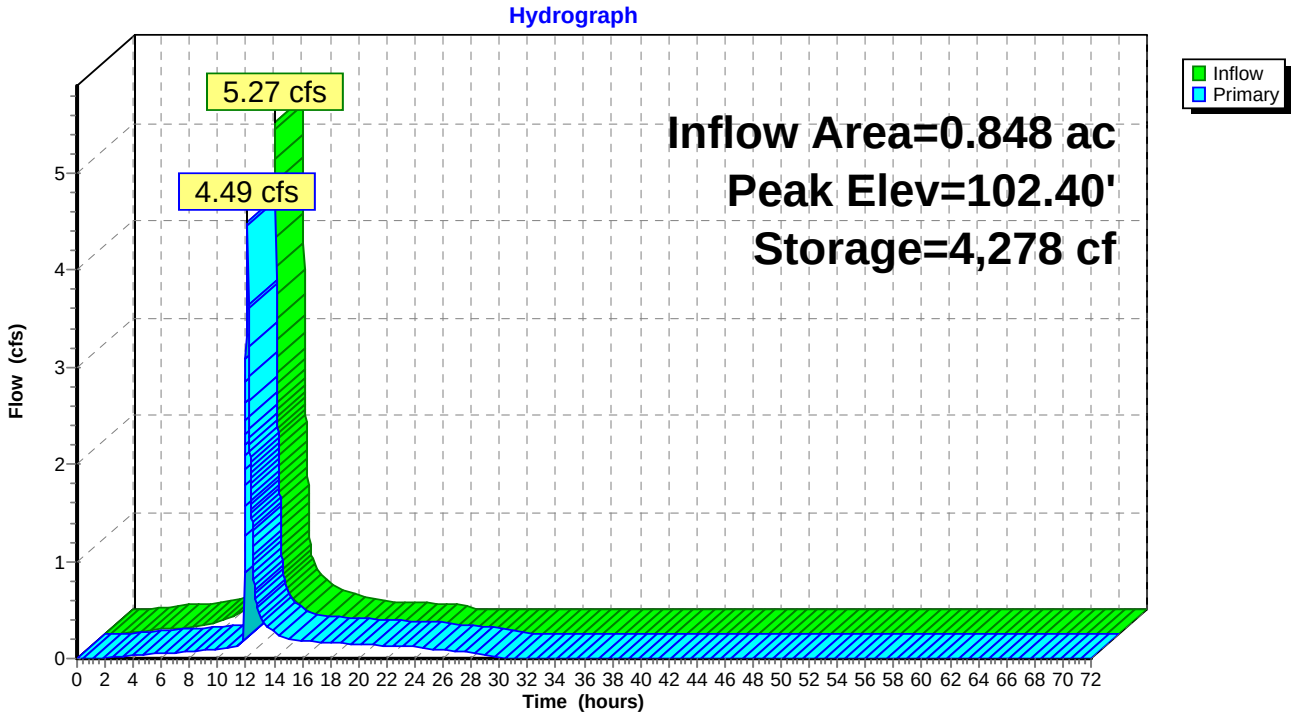
6,456.2 cf Field - 2,548.2 cf Chambers = 3,907.9 cf Stone x 40.0% Voids = 1,563.2 cf Stone Storage

Chamber Storage + Stone Storage = 4,111.4 cf = 0.094 af
Overall Storage Efficiency = 63.7%

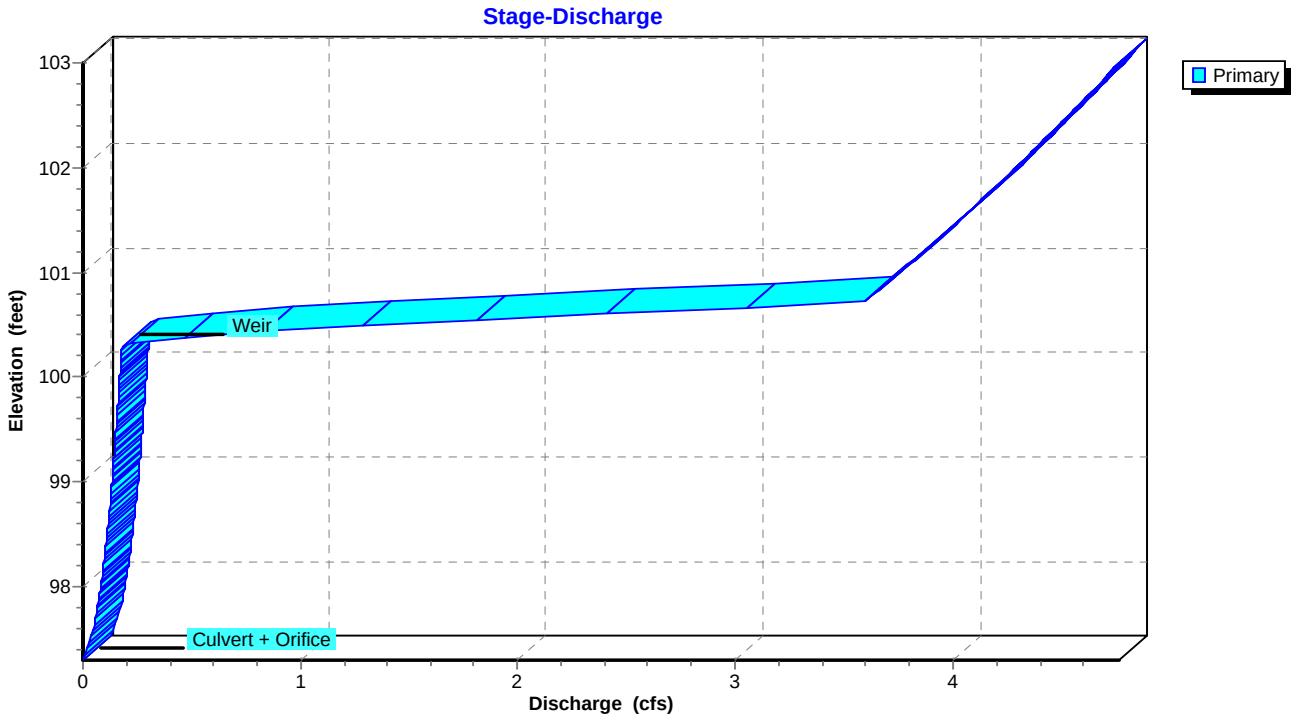
48 Chambers
239.1 cy Field
144.7 cy Stone



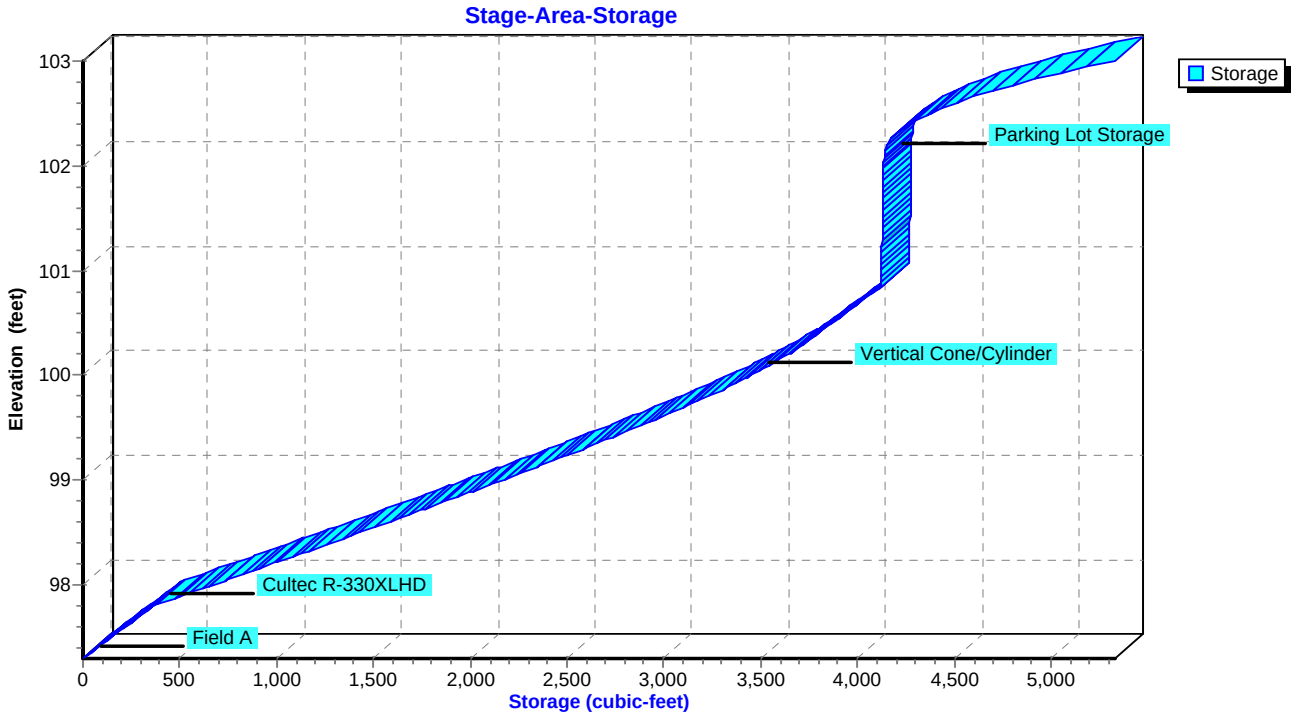
Pond 6P: UG-A



Pond 6P: UG-A



Pond 6P: UG-A

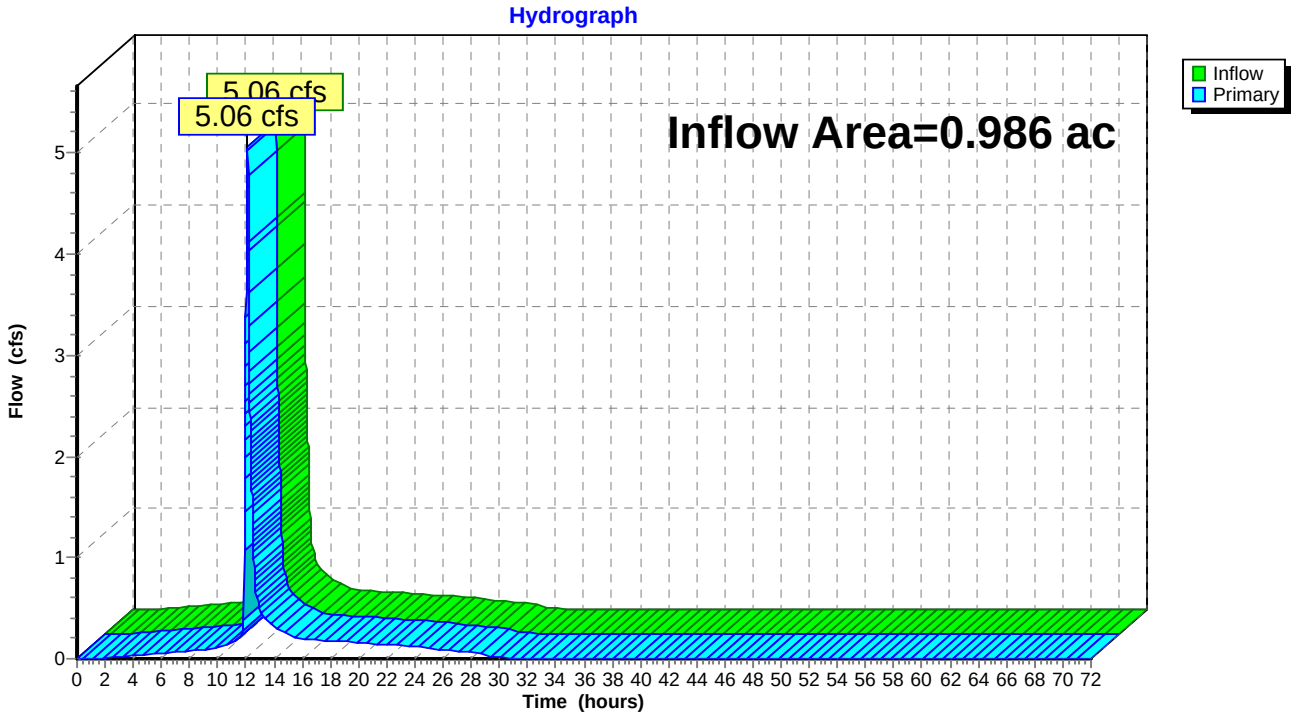

Stage-Area-Storage
Storage
Parking Lot Storage
Vertical Cone/Cylinder
Cultec R-330XLHD
Field A
Elevation (feet)
103
102
101
100
99
98
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500
5,000
Storage (cubic-feet)

Summary for Link 7L: P-A

Inflow Area = 0.986 ac, 81.79% Impervious, Inflow Depth = 5.54" for 25-yr event
Inflow = 5.06 cfs @ 12.12 hrs, Volume= 0.455 af
Primary = 5.06 cfs @ 12.12 hrs, Volume= 0.455 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 7L: P-A



Summary for Subcatchment 10S: P-B.1

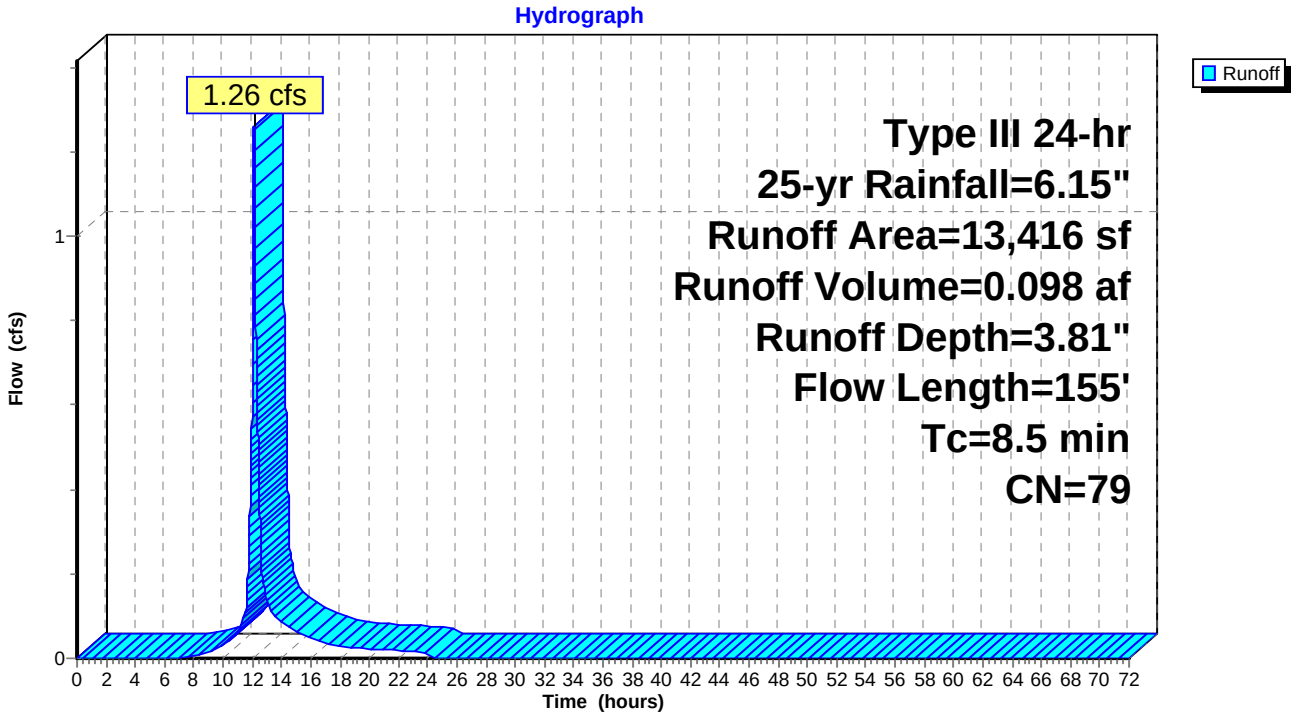
Runoff = 1.26 cfs @ 12.12 hrs, Volume= 0.098 af, Depth= 3.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=6.15"

Area (sf)	CN	Description
13,416	79	Woods/grass comb., Good, HSG D
13,416		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.21"
0.3	105	0.1500	6.24		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.5	155	Total			

Subcatchment 10S: P-B.1



Summary for Subcatchment 11S: P-B.2

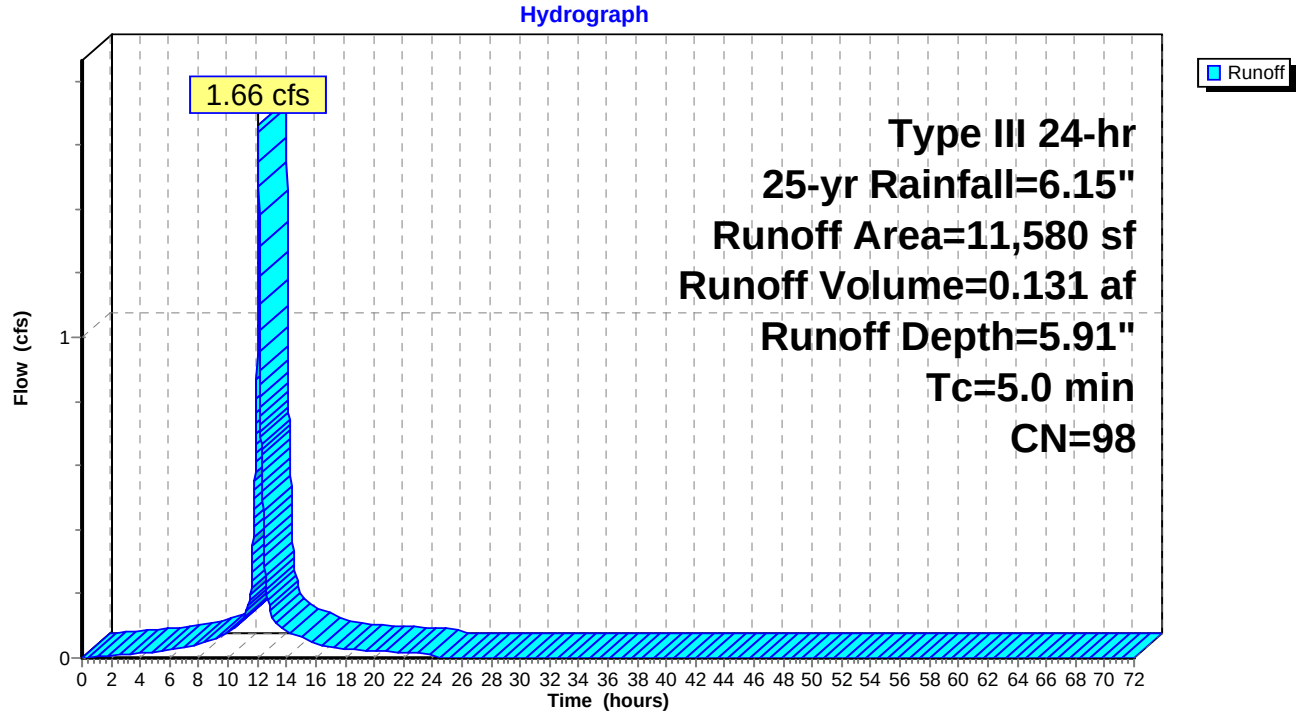
Runoff = 1.66 cfs @ 12.07 hrs, Volume= 0.131 af, Depth= 5.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=6.15"

Area (sf)	CN	Description
11,580	98	Roofs, HSG D
11,580		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Min. Tc Assumed for Roof**

Subcatchment 11S: P-B.2



Summary for Pond 12P: UG-B

Inflow Area = 0.266 ac,100.00% Impervious, Inflow Depth = 5.91" for 25-yr event
Inflow = 1.66 cfs @ 12.07 hrs, Volume= 0.131 af
Outflow = 0.22 cfs @ 12.58 hrs, Volume= 0.131 af, Atten= 87%, Lag= 30.3 min
Primary = 0.22 cfs @ 12.58 hrs, Volume= 0.131 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 104.29' @ 12.58 hrs Surf.Area= 0.017 ac Storage= 0.049 af

Plug-Flow detention time= 93.7 min calculated for 0.131 af (100% of inflow)
Center-of-Mass det. time= 93.7 min (837.5 - 743.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	100.00'	0.026 af	**15.75'W x 46.25'L x 6.00'H Field A** 0.100 af Overall - 0.036 af Embedded = 0.065 af x 40.0% Voids
#2A	101.00'	0.036 af	**Cultec R-900HD** x 12 Inside #1 Effective Size= 72.7"W x 48.0"H => 17.61 sf x 7.00'L = 123.3 cf Overall Size= 78.0"W x 48.0"H x 9.25'L with 2.25' Overlap Row Length Adjustment= +2.25' x 17.61 sf x 2 rows
		0.062 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	100.00'	**6.0" Round Culvert** L= 96.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 100.00' / 99.50' S= 0.0052 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf
#2	Device 1	100.00'	**2.0" Vert. Orifice** C= 0.600
#3	Device 1	104.70'	**Weir, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.50 Width (feet) 4.00 4.00

Primary OutFlow Max=0.22 cfs @ 12.58 hrs HW=104.29' (Free Discharge)
└**1=Culvert** (Passes 0.22 cfs of 1.29 cfs potential flow)
└**2=Orifice** (Orifice Controls 0.22 cfs @ 9.88 fps)
└**3=Weir** (Controls 0.00 cfs)

Pond 12P: UG-B - Chamber Wizard Field A

Chamber Model = Cultec R-900HD (Cultec Recharger® 900HD)
Effective Size= 72.7"W x 48.0"H => 17.61 sf x 7.00'L = 123.3 cf
Overall Size= 78.0"W x 48.0"H x 9.25'L with 2.25' Overlap
Row Length Adjustment= +2.25' x 17.61 sf x 2 rows

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

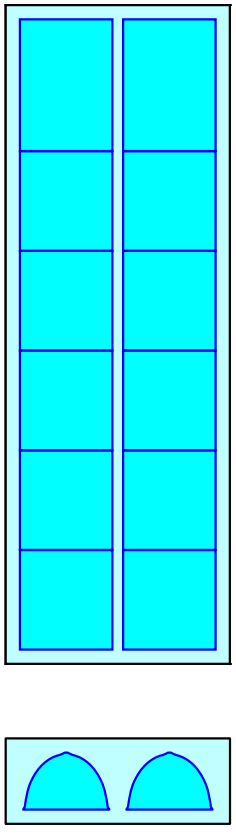
6 Chambers/Row x 7.00' Long +2.25' Row Adjustment = 44.25' Row Length +12.0" End Stone x 2 = 46.25' Base Length
2 Rows x 78.0" Wide + 9.0" Spacing x 1 + 12.0" Side Stone x 2 = 15.75' Base Width
12.0" Base + 48.0" Chamber Height + 12.0" Cover = 6.00' Field Height

12 Chambers x 123.3 cf +2.25' Row Adjustment x 17.61 sf x 2 Rows = 1,558.9 cf Chamber Storage

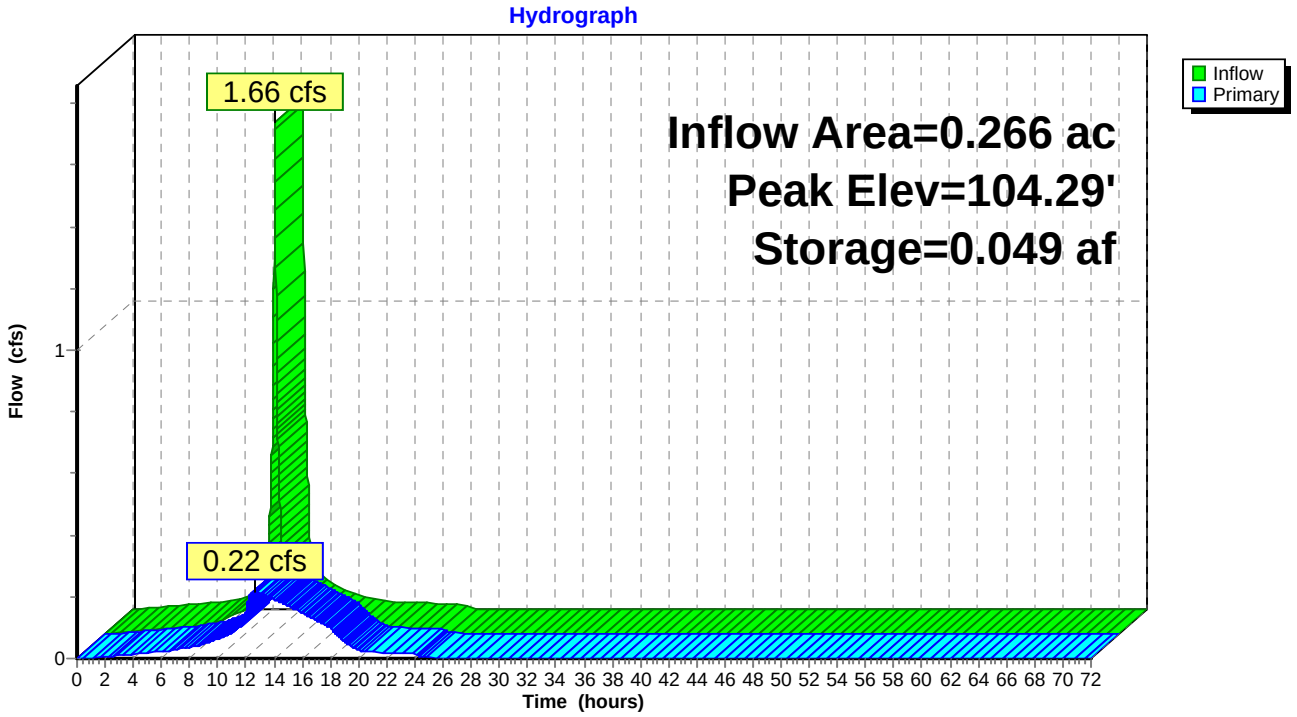
4,370.6 cf Field - 1,558.9 cf Chambers = 2,811.7 cf Stone x 40.0% Voids = 1,124.7 cf Stone Storage

Chamber Storage + Stone Storage = 2,683.6 cf = 0.062 af
Overall Storage Efficiency = 61.4%

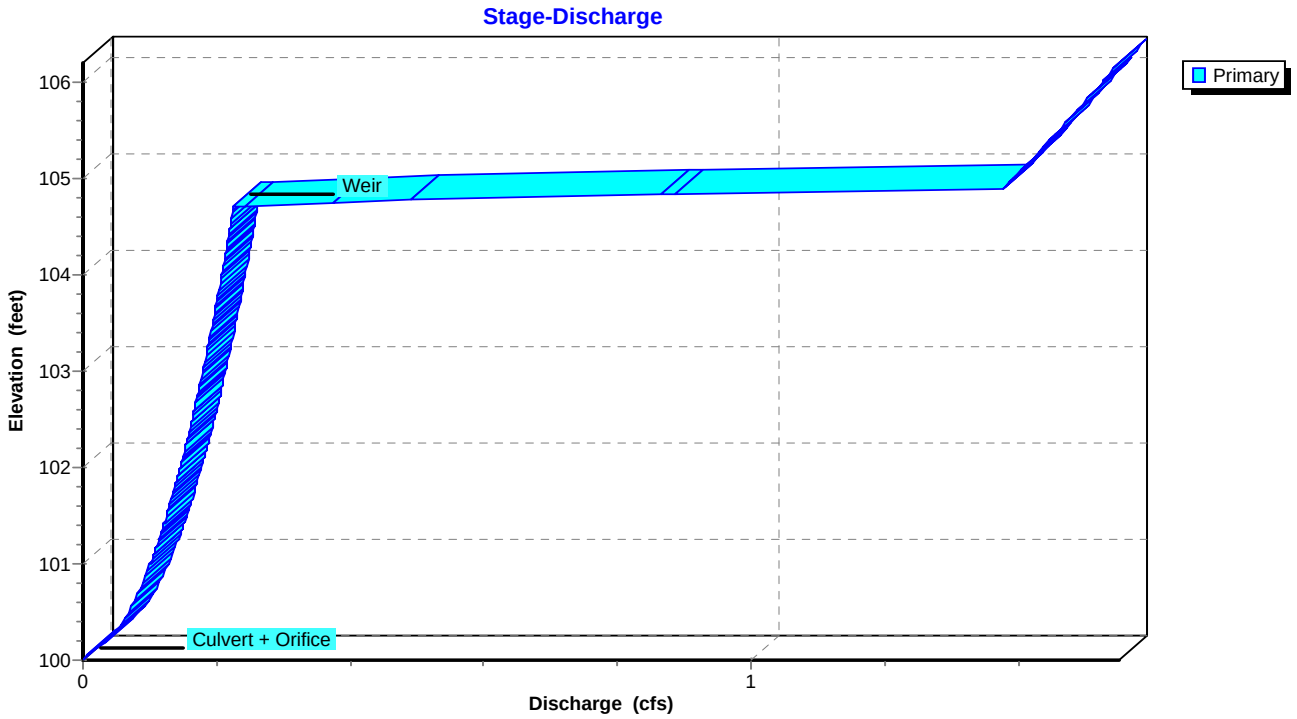
12 Chambers
161.9 cy Field
104.1 cy Stone



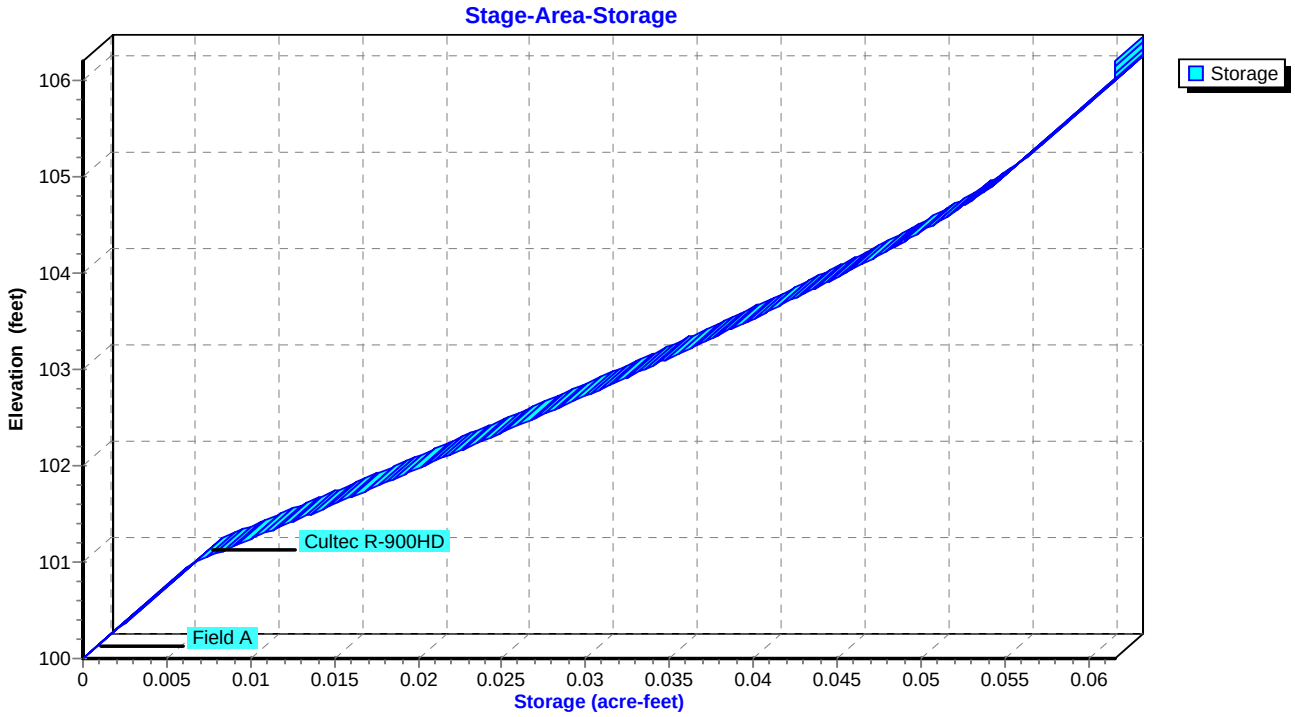
Pond 12P: UG-B



Pond 12P: UG-B



Pond 12P: UG-B

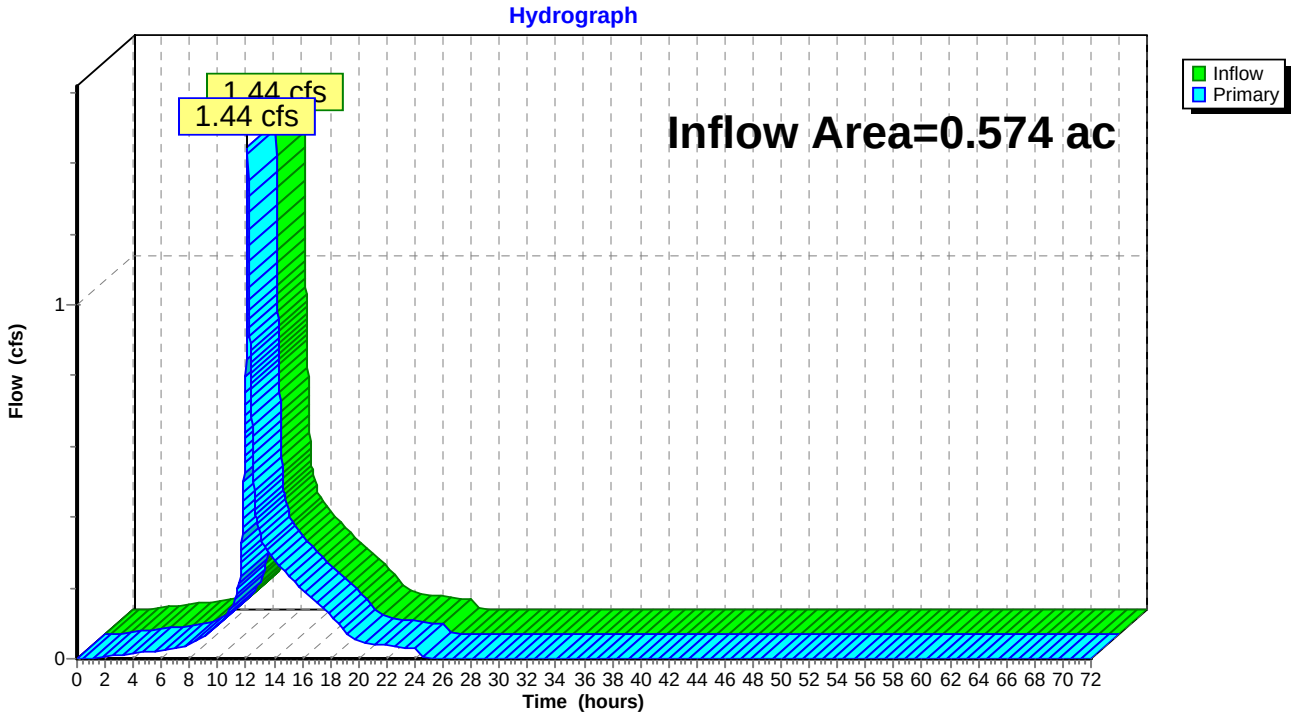

Stage-Area-Storage
Storage
Elevation (feet)
106
105
104
103
102
101
100
Cultec R-900HD
Field A
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
0.04
0.045
0.05
0.055
0.06
Storage (acre-feet)

Summary for Link 13L: P-B

Inflow Area = 0.574 ac, 46.33% Impervious, Inflow Depth = 4.79" for 25-yr event
Inflow = 1.44 cfs @ 12.12 hrs, Volume= 0.229 af
Primary = 1.44 cfs @ 12.12 hrs, Volume= 0.229 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 13L: P-B



Summary for Subcatchment 20S: P-C

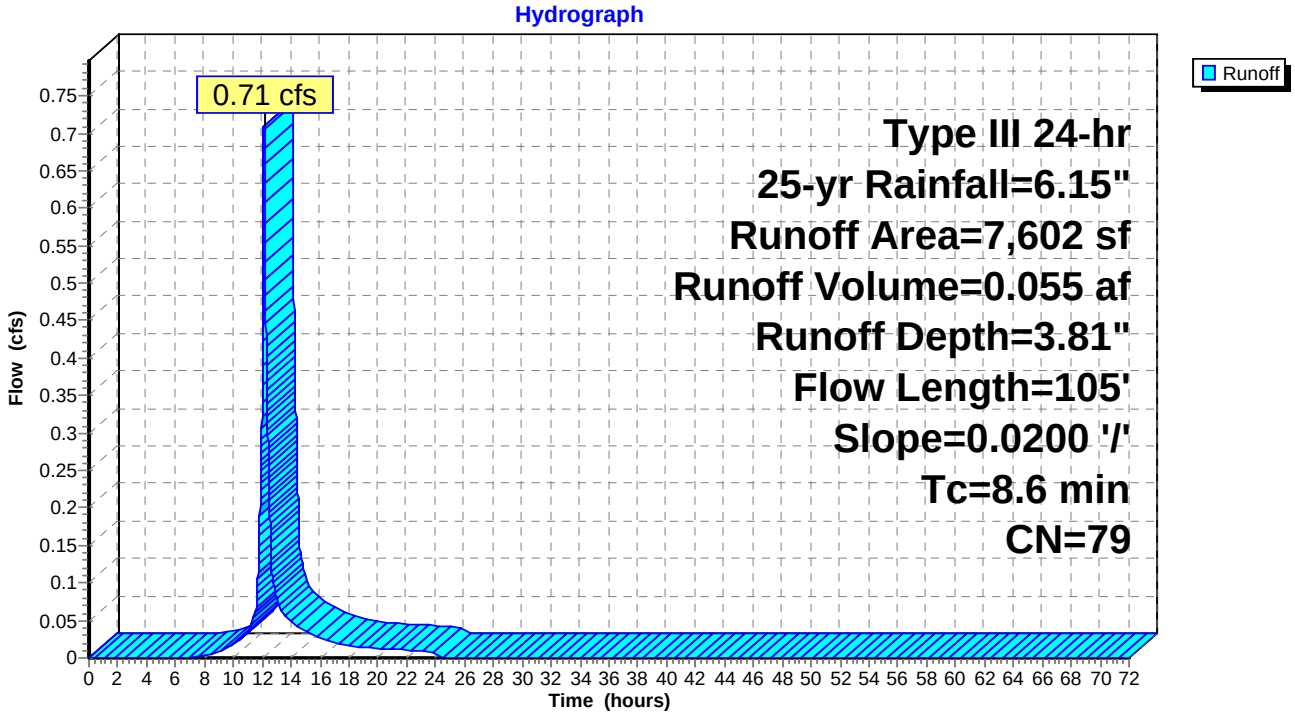
Runoff = 0.71 cfs @ 12.12 hrs, Volume= 0.055 af, Depth= 3.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=6.15"

	Area (sf)	CN	Description
	7,482	79	Woods/grass comb., Good, HSG D
*	120	98	Pavement
	7,602	79	Weighted Average
	7,482		98.42% Pervious Area
	120		1.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.21"
0.4	55	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.6	105	Total			

Subcatchment 20S: P-C

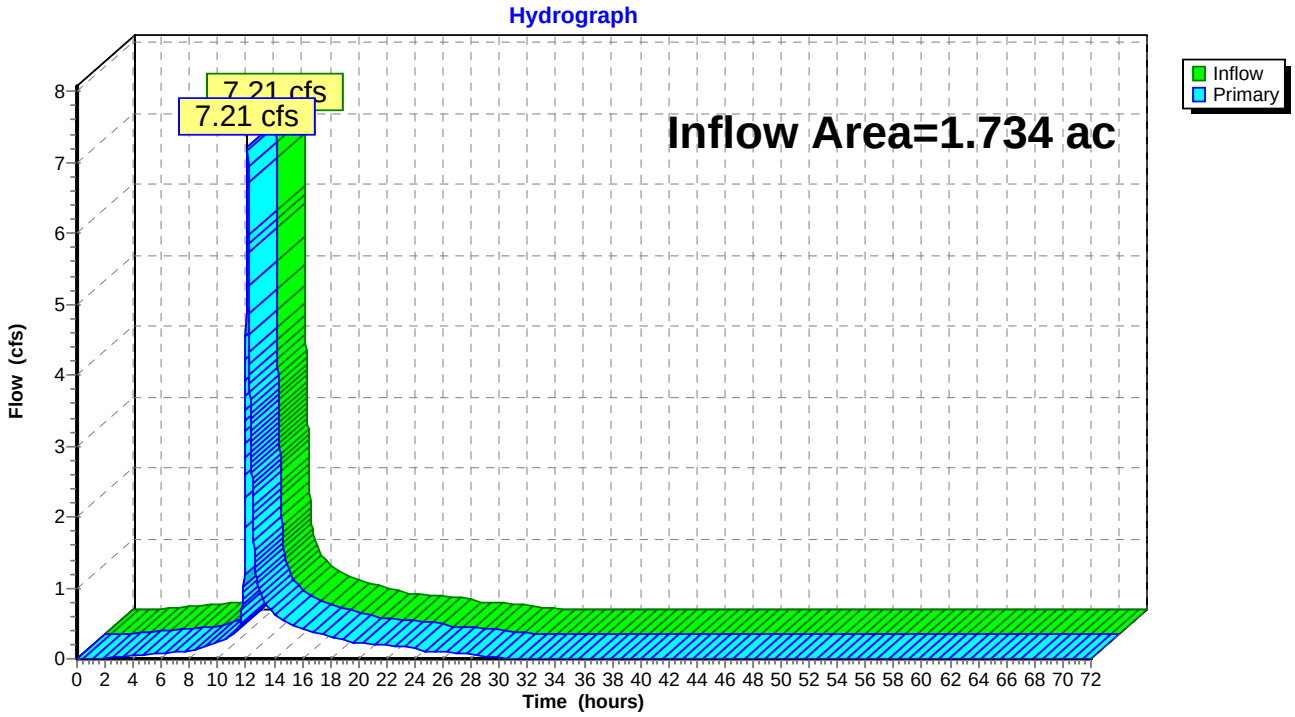


Summary for Link 30L: Post Development Combined

Inflow Area = 1.734 ac, 61.98% Impervious, Inflow Depth = 5.12" for 25-yr event
Inflow = 7.21 cfs @ 12.12 hrs, Volume= 0.739 af
Primary = 7.21 cfs @ 12.12 hrs, Volume= 0.739 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 30L: Post Development Combined



Summary for Subcatchment 2S: P-A.1

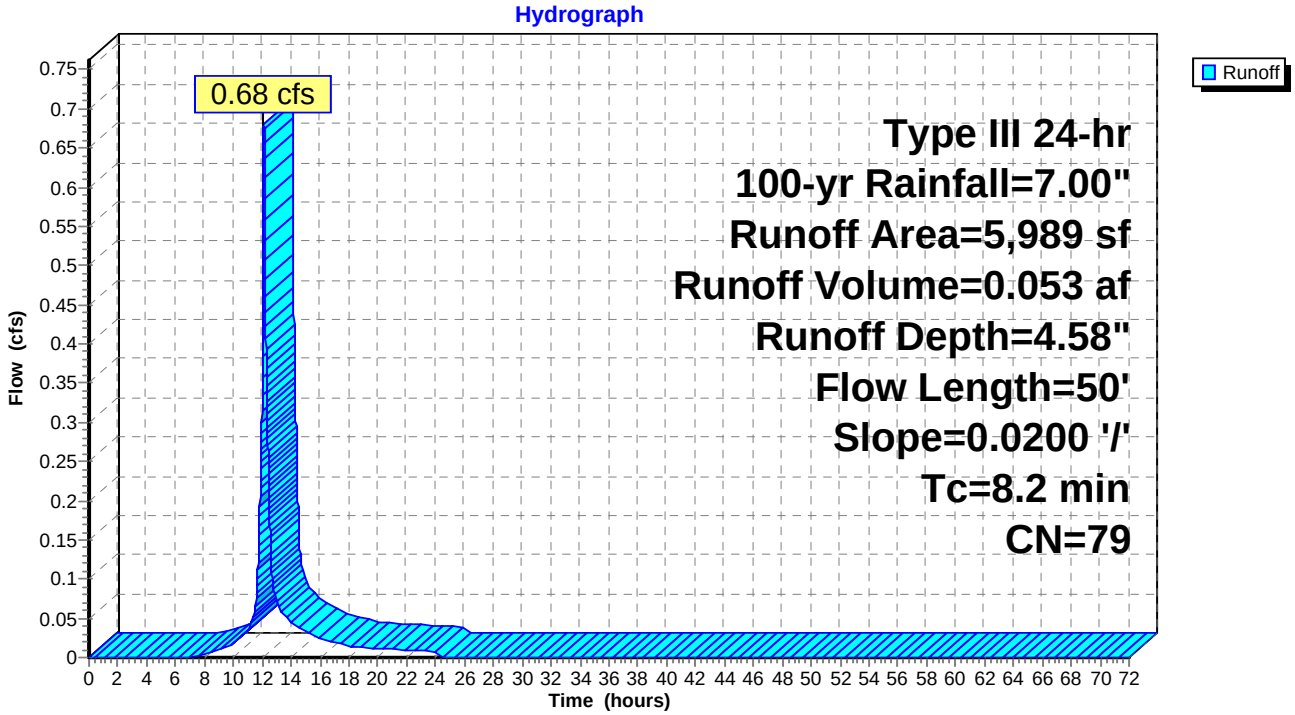
Runoff = 0.68 cfs @ 12.11 hrs, Volume= 0.053 af, Depth= 4.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=7.00"

Area (sf)	CN	Description
5,989	79	Woods/grass comb., Good, HSG D
5,989		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.21"

Subcatchment 2S: P-A.1



Summary for Subcatchment 4S: P-A.2

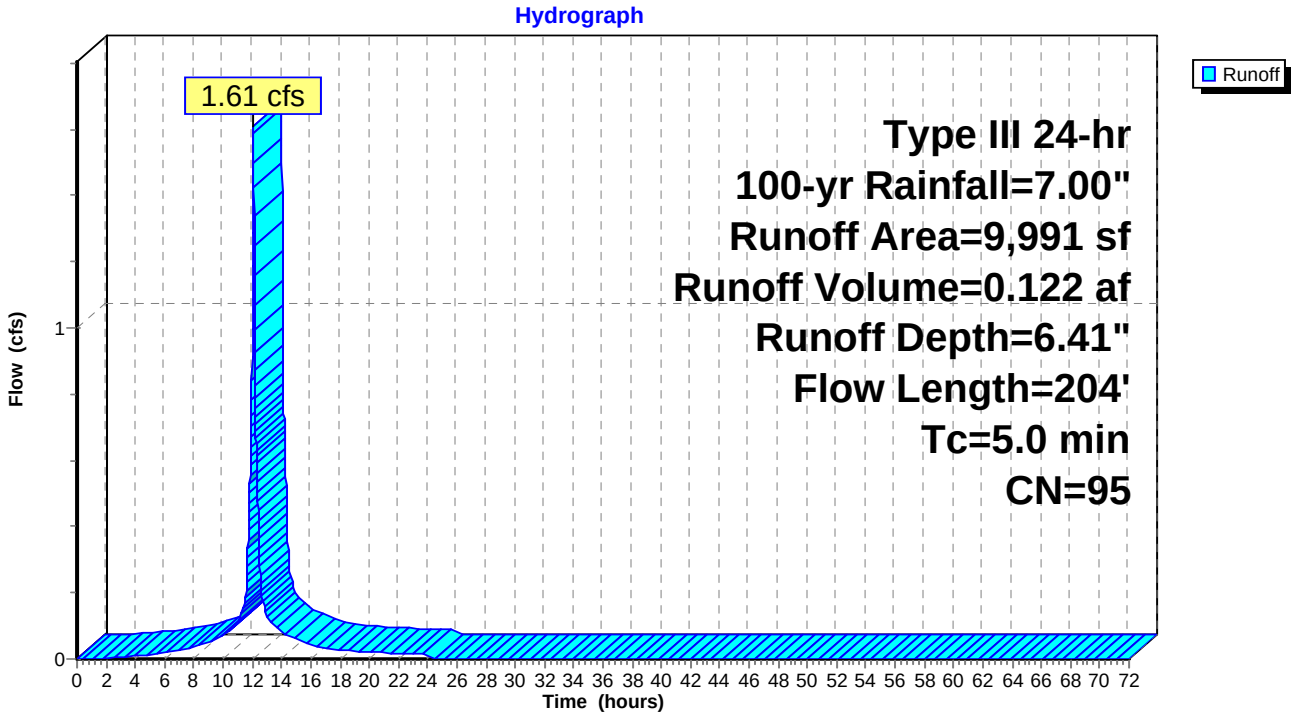
Runoff = 1.61 cfs @ 12.07 hrs, Volume= 0.122 af, Depth= 6.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=7.00"

Area (sf)	CN	Description
1,830	79	Woods/grass comb., Good, HSG D
8,161	98	Paved parking, HSG D
9,991	95	Weighted Average
1,830		18.32% Pervious Area
8,161		81.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	45	0.1250	0.21		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.21"
0.0	10	0.3300	9.25		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.4	34	0.0100	1.61		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.4	115	0.0500	4.54		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.4	204	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 4S: P-A.2



Summary for Subcatchment 5S: P-A.3

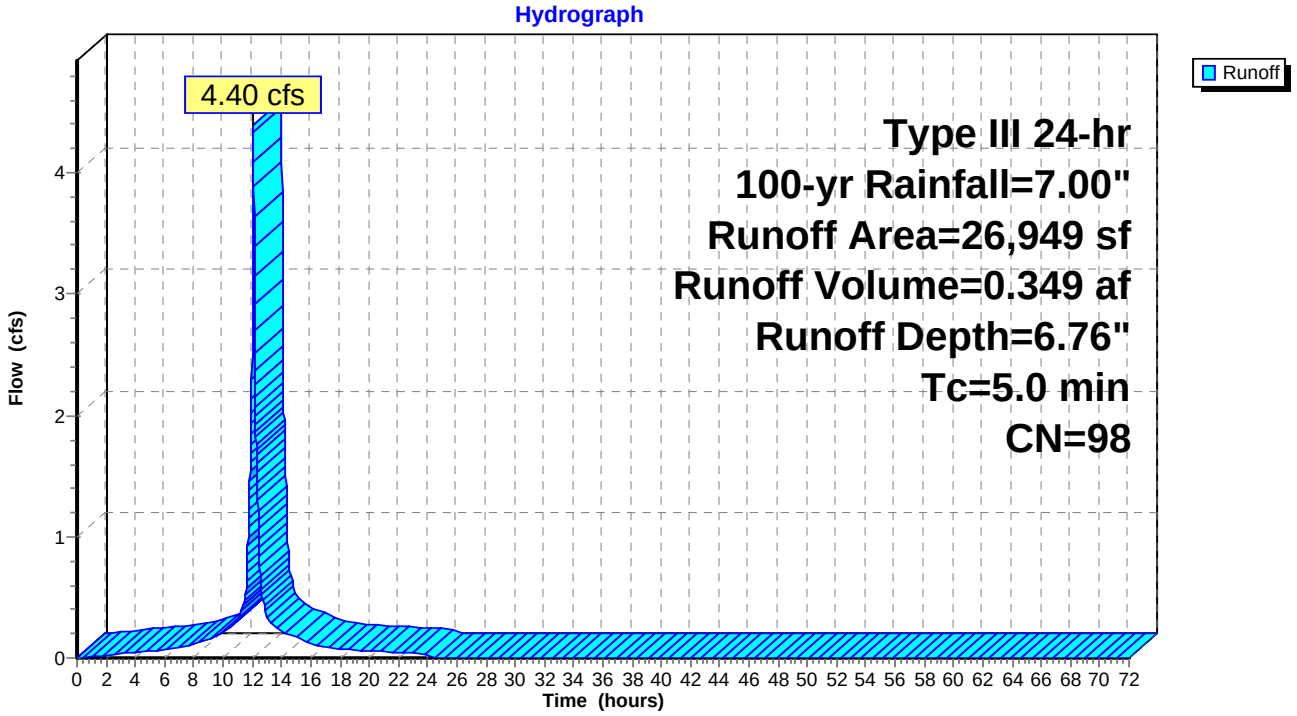
Runoff = 4.40 cfs @ 12.07 hrs, Volume= 0.349 af, Depth= 6.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=7.00"

Area (sf)	CN	Description
26,949	98	Roofs, HSG D
26,949		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Min. Tc Assumed for Roof**

Subcatchment 5S: P-A.3



Summary for Pond 6P: UG-A

Inflow Area = 0.848 ac, 95.05% Impervious, Inflow Depth = 6.66" for 100-yr event
Inflow = 6.01 cfs @ 12.07 hrs, Volume= 0.471 af
Outflow = 4.58 cfs @ 12.13 hrs, Volume= 0.471 af, Atten= 24%, Lag= 3.7 min
Primary = 4.58 cfs @ 12.13 hrs, Volume= 0.471 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 102.61' @ 12.13 hrs Surf.Area= 3,323 sf Storage= 4,520 cf

Plug-Flow detention time= 148.8 min calculated for 0.471 af (100% of inflow)
Center-of-Mass det. time= 148.7 min (895.2 - 746.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	97.30'	1,563 cf	**20.83'W x 87.50'L x 3.54'H Field A** 6,456 cf Overall - 2,548 cf Embedded = 3,908 cf x 40.0% Voids
#2A	97.80'	2,548 cf	**Cultec R-330XLHD** x 48 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 4 rows
#3	100.00'	31 cf	**4.00'D x 2.50'H Vertical Cone/Cylinder**
#4	102.10'	1,188 cf	**Parking Lot Storage (Prismatic)**Listed below (Recalc)
		5,331 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
102.10	0	0	0
103.00	2,640	1,188	1,188

Device	Routing	Invert	Outlet Devices
#1	Primary	97.30'	**10.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 97.30' / 97.00' S= 0.0150 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.55 sf
#2	Device 1	97.30'	**2.0" Vert. Orifice** C= 0.600
#3	Device 1	100.30'	**Weir, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.70 Width (feet) 4.00 4.00

Primary OutFlow Max=4.58 cfs @ 12.13 hrs HW=102.61' (Free Discharge)
└**1=Culvert** (Inlet Controls 4.58 cfs @ 8.41 fps)
  ├**2=Orifice** (Passes < 0.24 cfs potential flow)
  └**3=Weir** (Passes < 39.70 cfs potential flow)

Pond 6P: UG-A - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 4 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

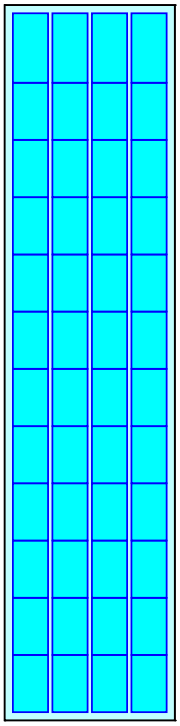
12 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 85.50' Row Length +12.0" End Stone x 2 = 87.50' Base Length
4 Rows x 52.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 20.83' Base Width
6.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.54' Field Height

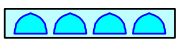
48 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 4 Rows = 2,548.2 cf Chamber Storage

6,456.2 cf Field - 2,548.2 cf Chambers = 3,907.9 cf Stone x 40.0% Voids = 1,563.2 cf Stone Storage

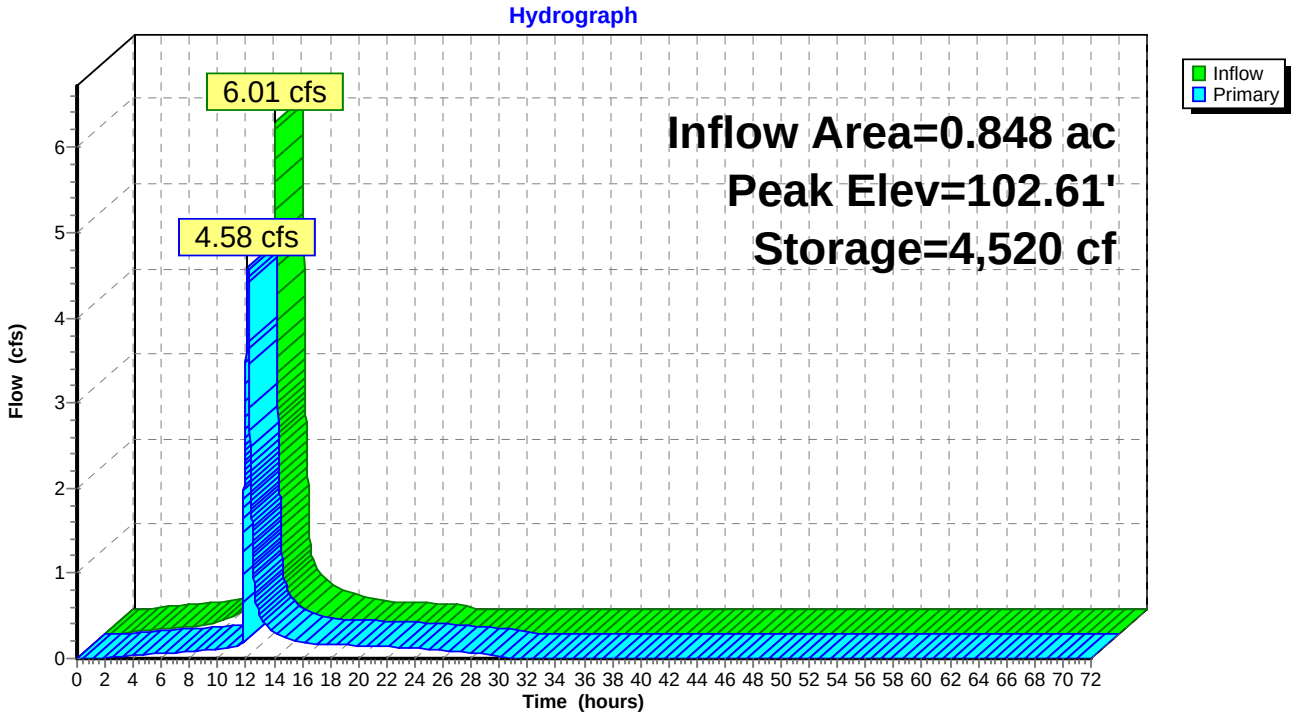
Chamber Storage + Stone Storage = 4,111.4 cf = 0.094 af
Overall Storage Efficiency = 63.7%

48 Chambers
239.1 cy Field
144.7 cy Stone

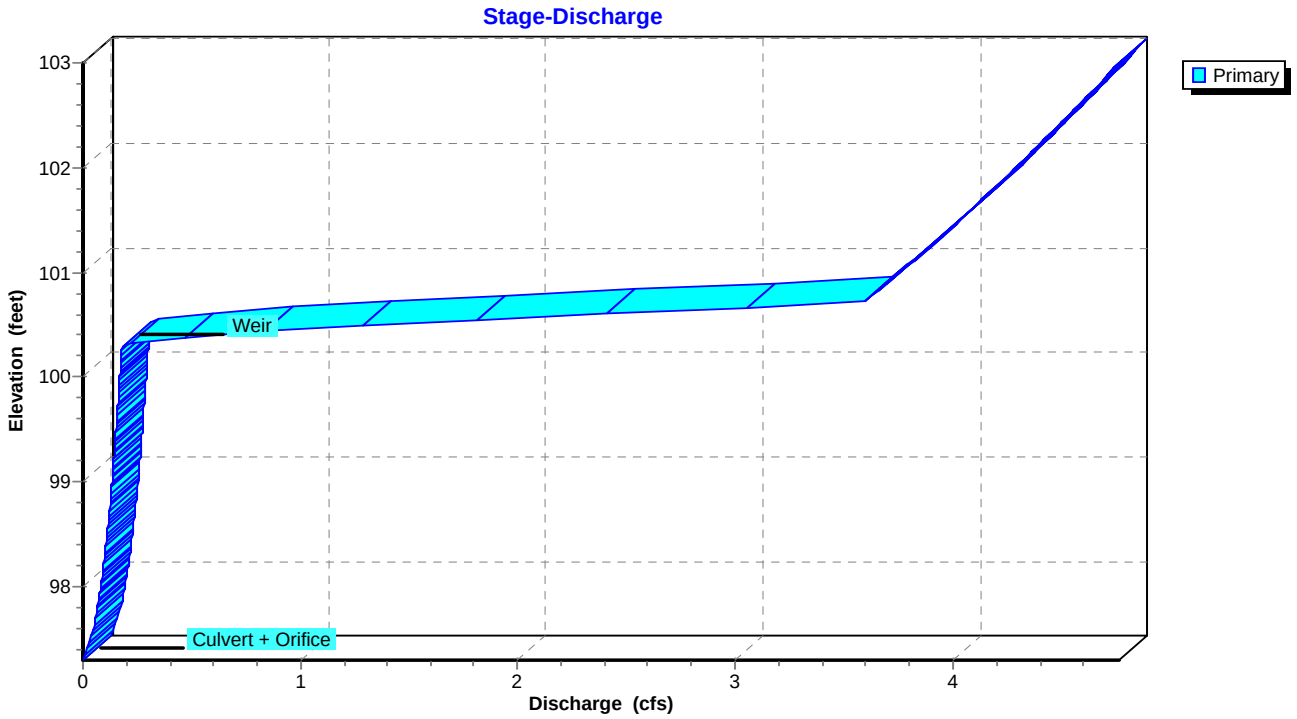




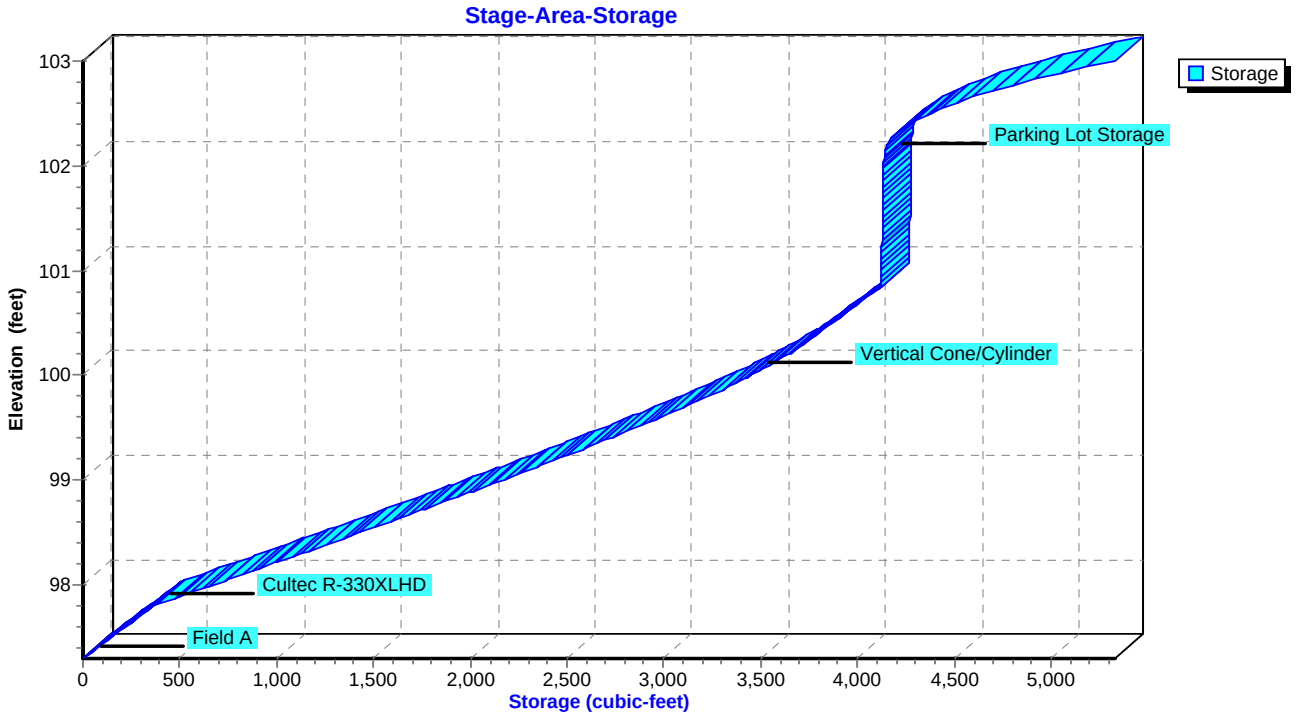
Pond 6P: UG-A



Pond 6P: UG-A



Pond 6P: UG-A

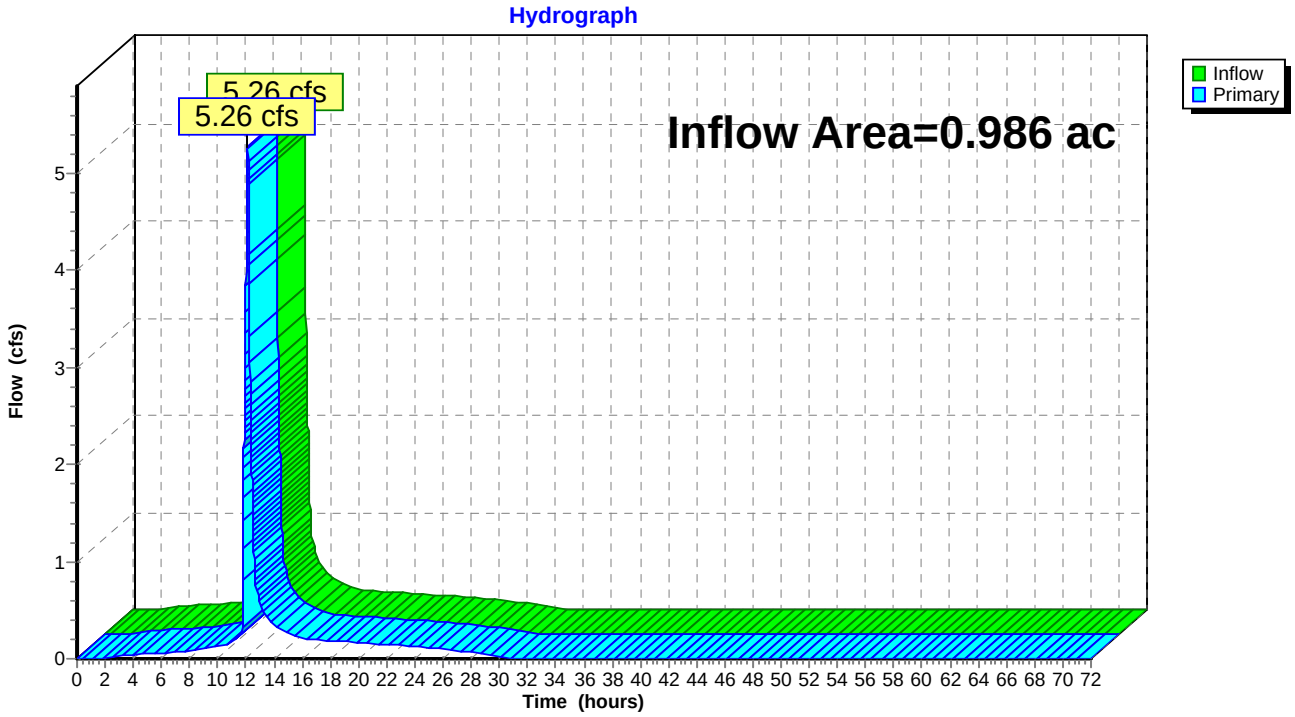

Stage-Area-Storage
Elevation (feet)
103
102
101
100
99
98
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500
5,000
Storage (cubic-feet)
Storage
Parking Lot Storage
Vertical Cone/Cylinder
Cultec R-330XLHD
Field A

Summary for Link 7L: P-A

Inflow Area = 0.986 ac, 81.79% Impervious, Inflow Depth = 6.37" for 100-yr event
Inflow = 5.26 cfs @ 12.12 hrs, Volume= 0.524 af
Primary = 5.26 cfs @ 12.12 hrs, Volume= 0.524 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 7L: P-A



Summary for Subcatchment 10S: P-B.1

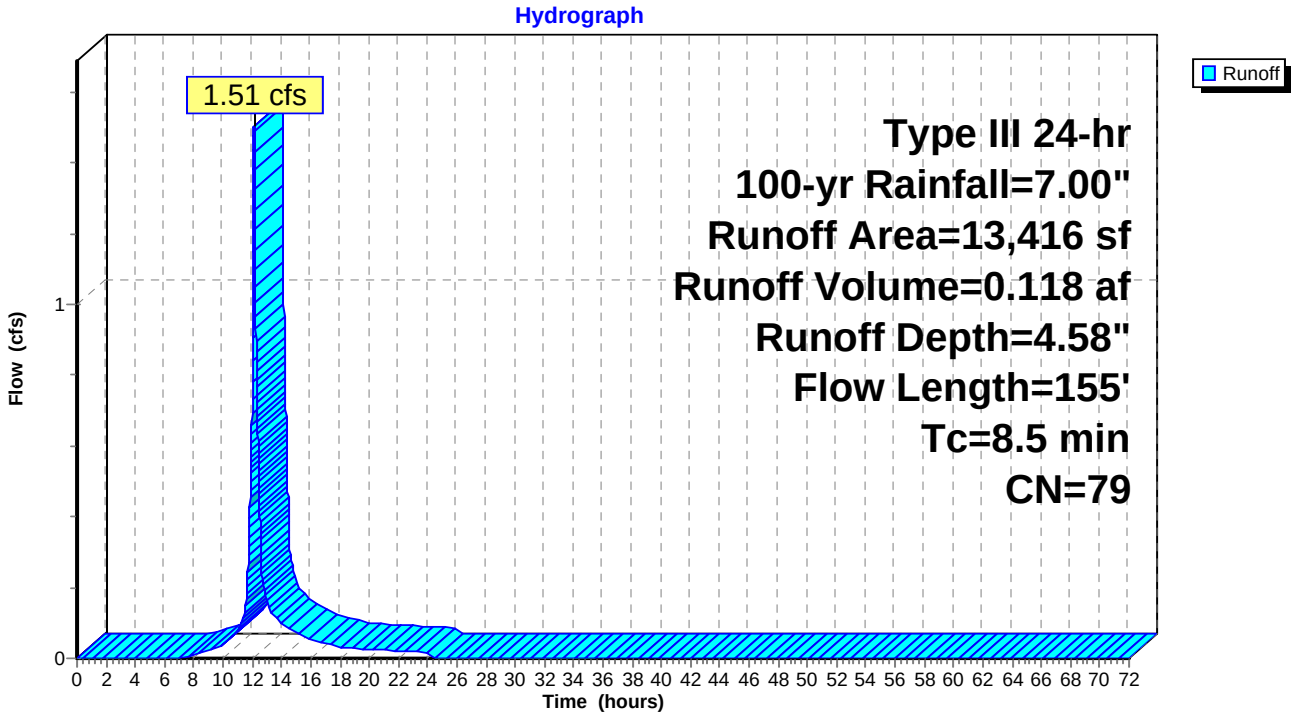
Runoff = 1.51 cfs @ 12.12 hrs, Volume= 0.118 af, Depth= 4.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=7.00"

Area (sf)	CN	Description
13,416	79	Woods/grass comb., Good, HSG D
13,416		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.21"
0.3	105	0.1500	6.24		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.5	155	Total			

Subcatchment 10S: P-B.1



Summary for Subcatchment 11S: P-B.2

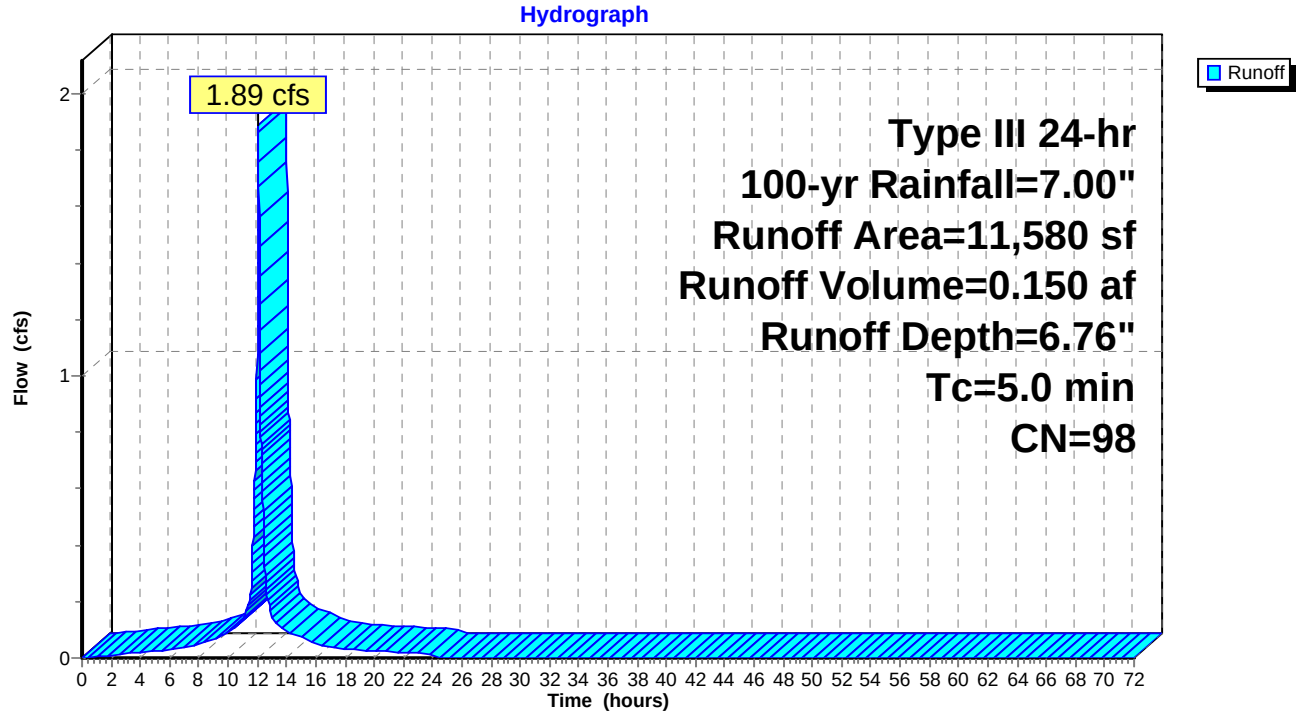
Runoff = 1.89 cfs @ 12.07 hrs, Volume= 0.150 af, Depth= 6.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=7.00"

Area (sf)	CN	Description
11,580	98	Roofs, HSG D
11,580		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, Min. Tc Assumed for Roof**

Subcatchment 11S: P-B.2



Summary for Pond 12P: UG-B

Inflow Area = 0.266 ac,100.00% Impervious, Inflow Depth = 6.76" for 100-yr event
Inflow = 1.89 cfs @ 12.07 hrs, Volume= 0.150 af
Outflow = 0.55 cfs @ 12.38 hrs, Volume= 0.150 af, Atten= 71%, Lag= 18.4 min
Primary = 0.55 cfs @ 12.38 hrs, Volume= 0.150 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 104.78' @ 12.38 hrs Surf.Area= 0.017 ac Storage= 0.053 af

Plug-Flow detention time= 95.8 min calculated for 0.150 af (100% of inflow)
Center-of-Mass det. time= 95.7 min (837.8 - 742.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	100.00'	0.026 af	**15.75'W x 46.25'L x 6.00'H Field A** 0.100 af Overall - 0.036 af Embedded = 0.065 af x 40.0% Voids
#2A	101.00'	0.036 af	**Cultec R-900HD** x 12 Inside #1 Effective Size= 72.7"W x 48.0"H => 17.61 sf x 7.00'L = 123.3 cf Overall Size= 78.0"W x 48.0"H x 9.25'L with 2.25' Overlap Row Length Adjustment= +2.25' x 17.61 sf x 2 rows
		0.062 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	100.00'	**6.0" Round Culvert** L= 96.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 100.00' / 99.50' S= 0.0052 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf
#2	Device 1	100.00'	**2.0" Vert. Orifice** C= 0.600
#3	Device 1	104.70'	**Weir, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.50 Width (feet) 4.00 4.00

Primary OutFlow Max=0.55 cfs @ 12.38 hrs HW=104.78' (Free Discharge)
└**1=Culvert** (Passes 0.55 cfs of 1.36 cfs potential flow)
  └**2=Orifice** (Orifice Controls 0.23 cfs @ 10.44 fps)
  └**3=Weir** (Weir Controls 0.32 cfs @ 0.95 fps)

Pond 12P: UG-B - Chamber Wizard Field A

Chamber Model = Cultec R-900HD (Cultec Recharger® 900HD)
Effective Size= 72.7"W x 48.0"H => 17.61 sf x 7.00'L = 123.3 cf
Overall Size= 78.0"W x 48.0"H x 9.25'L with 2.25' Overlap
Row Length Adjustment= +2.25' x 17.61 sf x 2 rows

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

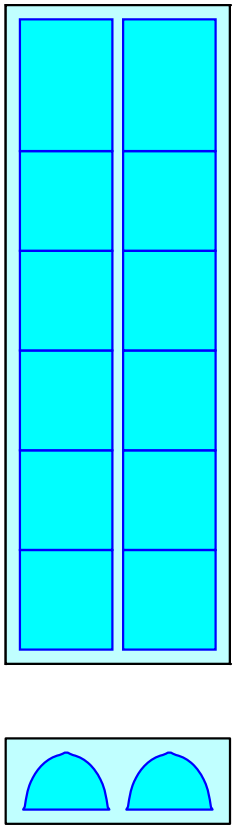
6 Chambers/Row x 7.00' Long +2.25' Row Adjustment = 44.25' Row Length +12.0" End Stone x 2 = 46.25' Base Length
2 Rows x 78.0" Wide + 9.0" Spacing x 1 + 12.0" Side Stone x 2 = 15.75' Base Width
12.0" Base + 48.0" Chamber Height + 12.0" Cover = 6.00' Field Height

12 Chambers x 123.3 cf +2.25' Row Adjustment x 17.61 sf x 2 Rows = 1,558.9 cf Chamber Storage

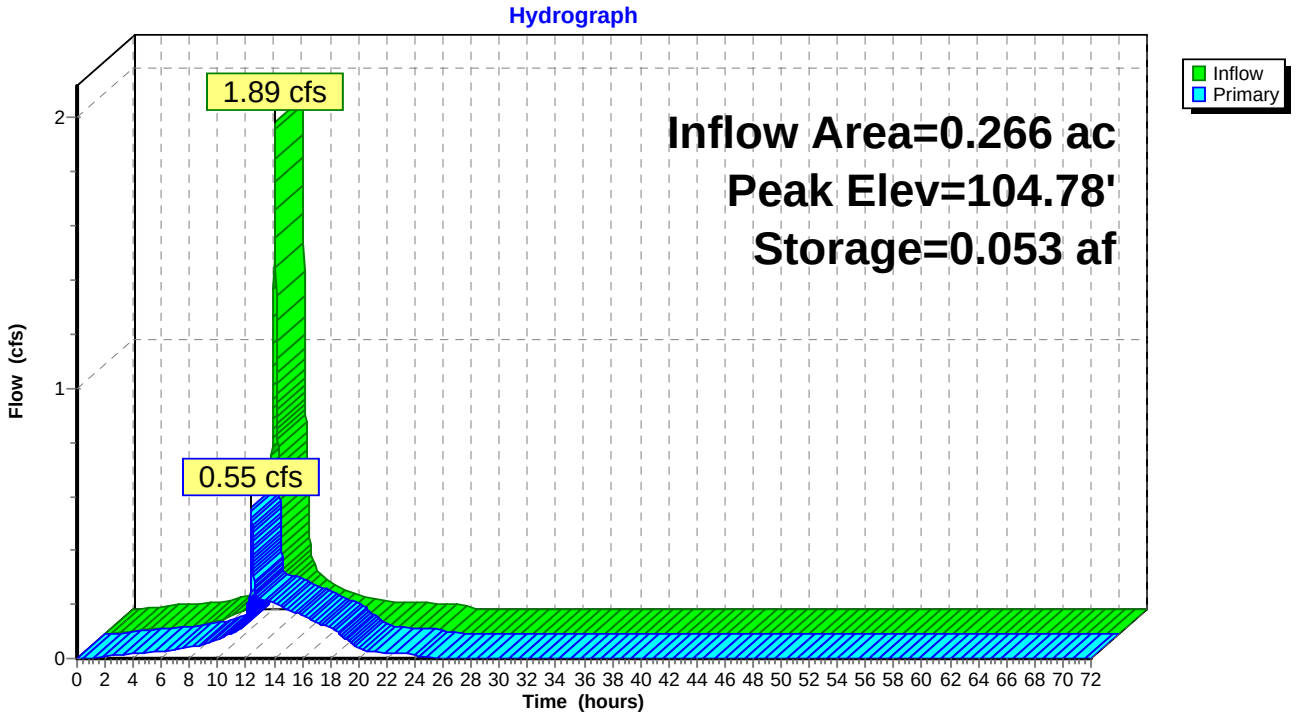
4,370.6 cf Field - 1,558.9 cf Chambers = 2,811.7 cf Stone x 40.0% Voids = 1,124.7 cf Stone Storage

Chamber Storage + Stone Storage = 2,683.6 cf = 0.062 af
Overall Storage Efficiency = 61.4%

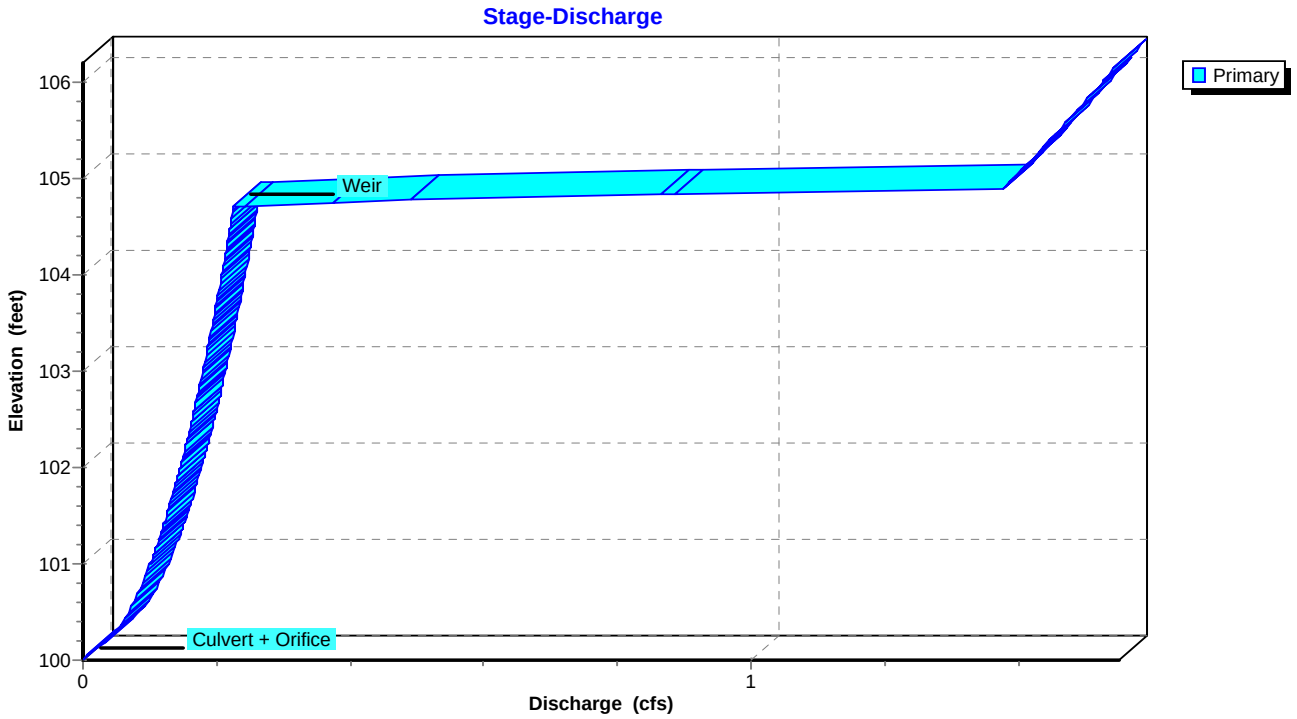
12 Chambers
161.9 cy Field
104.1 cy Stone



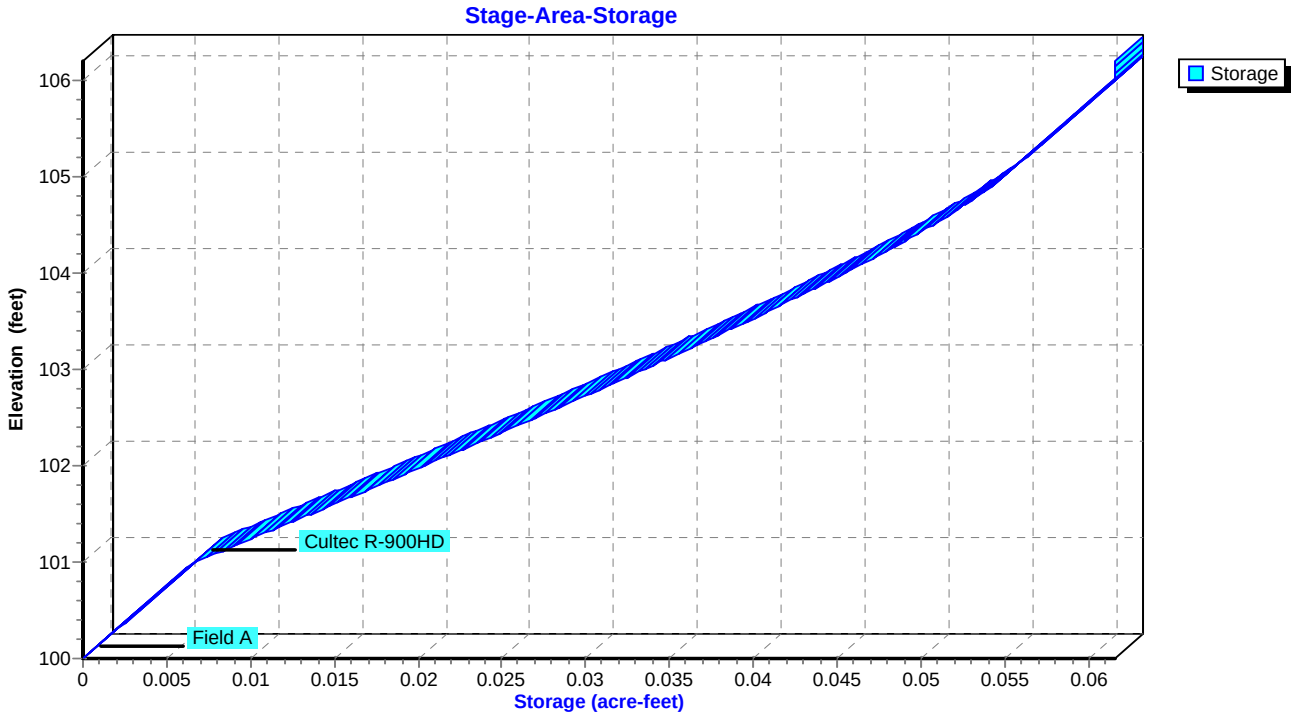
Pond 12P: UG-B



Pond 12P: UG-B



Pond 12P: UG-B

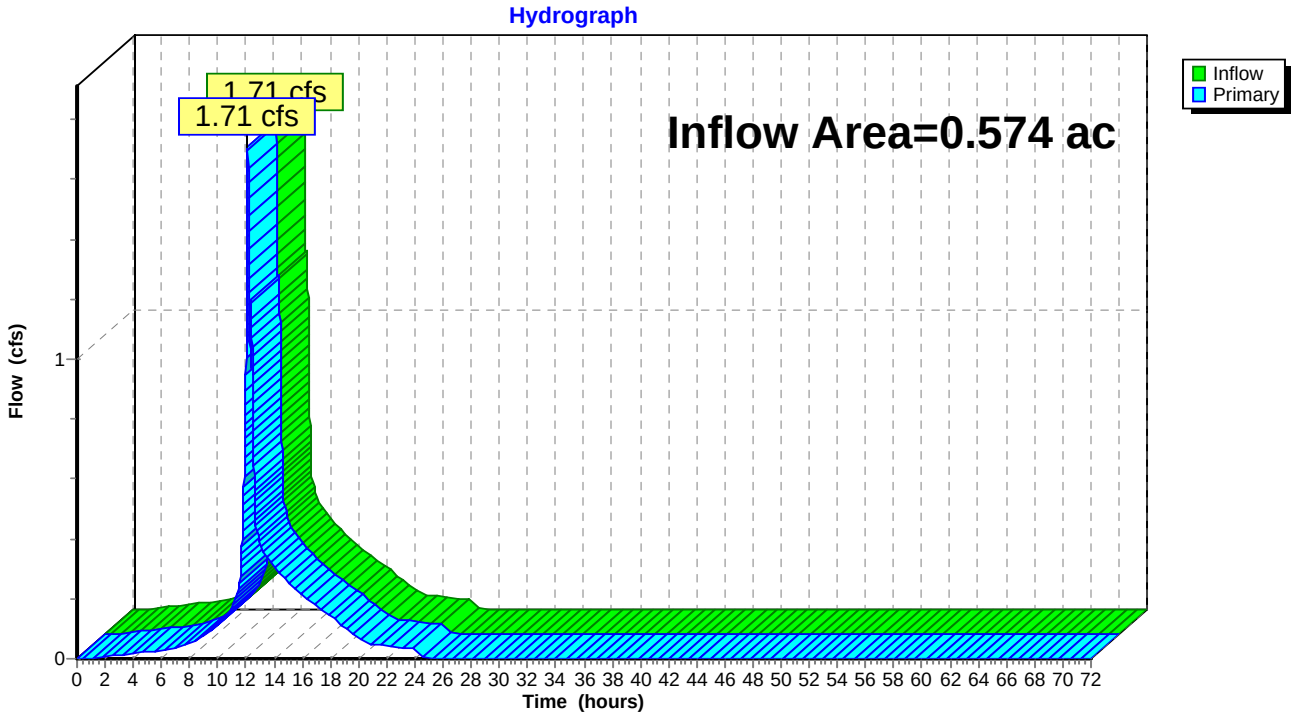

Stage-Area-Storage
Storage
Elevation (feet)
106
105
104
103
102
101
100
Cultec R-900HD
Field A
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
0.04
0.045
0.05
0.055
0.06
Storage (acre-feet)

Summary for Link 13L: P-B

Inflow Area = 0.574 ac, 46.33% Impervious, Inflow Depth = 5.59" for 100-yr event
Inflow = 1.71 cfs @ 12.12 hrs, Volume= 0.267 af
Primary = 1.71 cfs @ 12.12 hrs, Volume= 0.267 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 13L: P-B



Summary for Subcatchment 20S: P-C

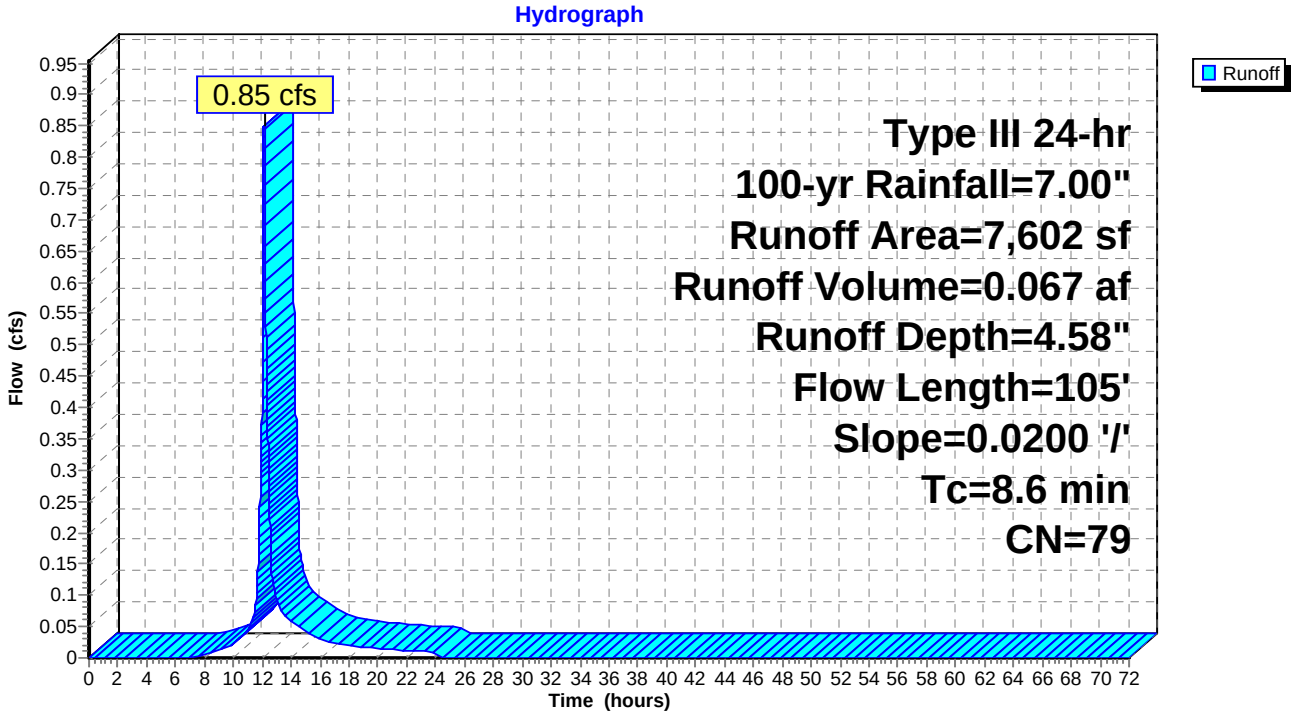
Runoff = 0.85 cfs @ 12.12 hrs, Volume= 0.067 af, Depth= 4.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=7.00"

	Area (sf)	CN	Description
	7,482	79	Woods/grass comb., Good, HSG D
*	120	98	Pavement
	7,602	79	Weighted Average
	7,482		98.42% Pervious Area
	120		1.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.21"
0.4	55	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.6	105	Total			

Subcatchment 20S: P-C

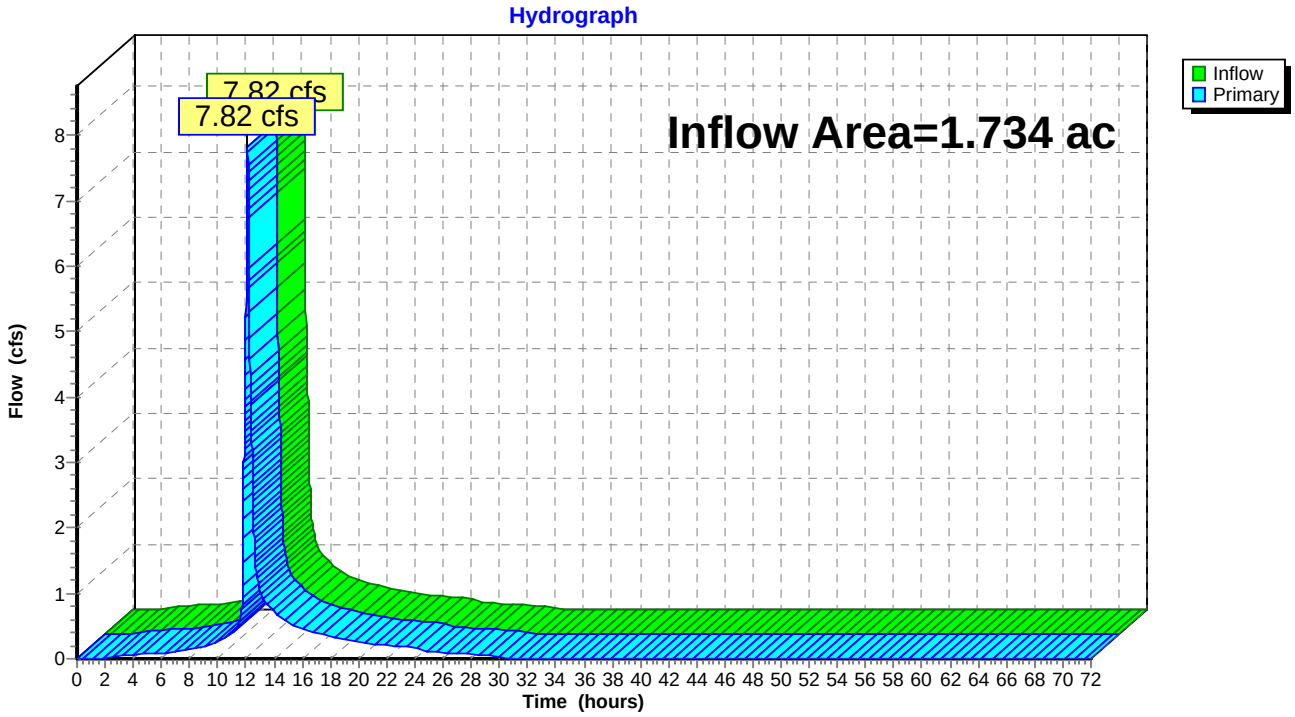


Summary for Link 30L: Post Development Combined

Inflow Area = 1.734 ac, 61.98% Impervious, Inflow Depth = 5.94" for 100-yr event
Inflow = 7.82 cfs @ 12.12 hrs, Volume= 0.858 af
Primary = 7.82 cfs @ 12.12 hrs, Volume= 0.858 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 30L: Post Development Combined



Appendix C

NRCS Soil Map and Classifications
FEMA FIRM Map

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Middlesex County, Massachusetts

255-257 Newtonville Ave

August 26, 2015

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

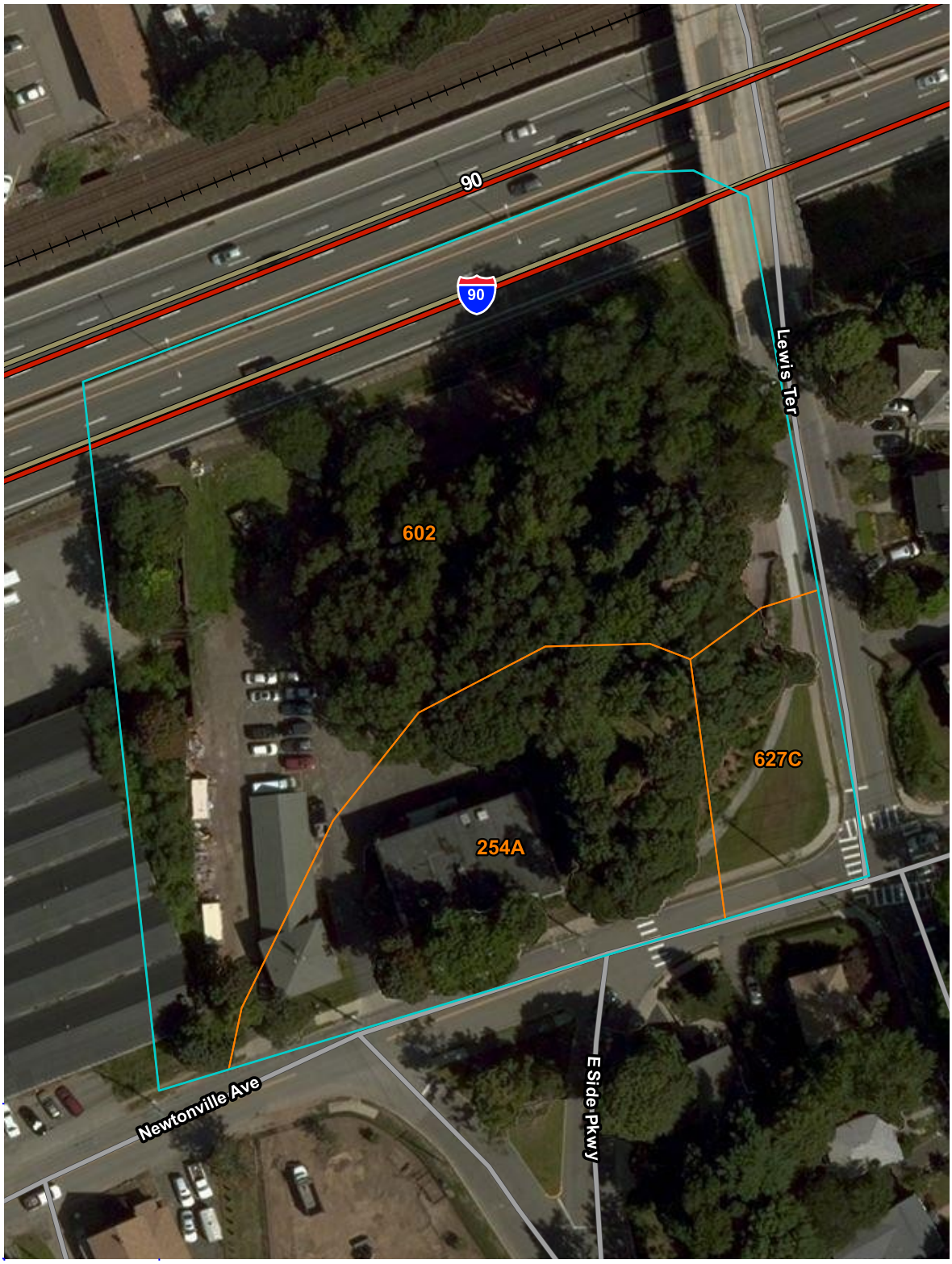
Custom Soil Resource Report
Soil Map

71° 11' 53" W

71° 11' 47" W

42° 21' 14" N

42° 21' 14" N



42° 21' 8" N

42° 21' 8" N

71° 11' 53" W

71° 11' 47" W

Map Scale: 1:923 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 10 20 40 60

Feet
0 40 80 160 240

Map projection: Web Mercator Corner coordinates: WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 14, Sep 19, 2014

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

Date(s) aerial images were photographed: Aug 10, 2014—Aug 25, 2014

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

Map Unit Legend

Middlesex County, Massachusetts (MA017)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
254A	Merrimac fine sandy loam, 0 to 3 percent slopes	0.7	23.9%
602	Urban land	2.0	68.3%
627C	Newport-Urban land complex, 3 to 15 percent slopes	0.2	7.8%
Totals for Area of Interest		**2.9**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If

intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Middlesex County, Massachusetts

254A—Merrimac fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2tyqr
Elevation: 0 to 1,100 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Merrimac and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Merrimac

Setting

Landform: Outwash terraces, eskers, moraines, outwash plains, kames
Landform position (two-dimensional): Backslope, footslope, summit, shoulder
Landform position (three-dimensional): Side slope, crest, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy glaciofluvial deposits derived from granite, schist, and gneiss over sandy and gravelly glaciofluvial deposits derived from granite, schist, and gneiss

Typical profile

Ap - 0 to 10 inches: fine sandy loam
Bw1 - 10 to 22 inches: fine sandy loam
Bw2 - 22 to 26 inches: stratified gravel to gravelly loamy sand
2C - 26 to 65 inches: stratified gravel to very gravelly sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline (0.0 to 1.4 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 1.0
Available water storage in profile: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A

Minor Components

Hinckley

Percent of map unit: 5 percent
Landform: Eskers, deltas, outwash plains, kames
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear

Sudbury

Percent of map unit: 5 percent
Landform: Deltas, terraces, outwash plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Linear

Agawam

Percent of map unit: 3 percent
Landform: Outwash terraces, eskers, moraines, outwash plains, stream terraces, kames
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Convex

Windsor

Percent of map unit: 2 percent
Landform: Outwash terraces, deltas, outwash plains, dunes
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread, riser
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex

602—Urban land

Map Unit Setting

National map unit symbol: 9950
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 110 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Excavated and filled land

Minor Components

Udorthents, wet substratum

Percent of map unit: 5 percent

Udorthents, loamy

Percent of map unit: 5 percent

Rock outcrop

Percent of map unit: 5 percent
Landform: Ledges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Head slope
Down-slope shape: Concave
Across-slope shape: Concave

627C—Newport-Urban land complex, 3 to 15 percent slopes

Map Unit Setting

National map unit symbol: 9958
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Newport and similar soils: 45 percent
Urban land: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Newport

Setting

Landform: Ridges, drumlins, moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Friable loamy basal till over dense loamy lodgment till derived from phyllite

Typical profile

H1 - 0 to 8 inches: channery fine sandy loam
H2 - 8 to 18 inches: channery silt loam
H3 - 18 to 24 inches: channery sandy loam
H4 - 24 to 65 inches: channery fine sandy loam

Properties and qualities

Slope: 8 to 20 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately high (0.01 to 0.20 in/hr)
Depth to water table: About 18 to 21 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D

Description of Urban Land

Setting

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Excavated and filled land

Minor Components

Udorthents, loamy

Percent of map unit: 10 percent

Pittstown

Percent of map unit: 3 percent
Landform: Depressions, drumlins
Landform position (two-dimensional): Toeslope, backslope, shoulder
Landform position (three-dimensional): Base slope, nose slope, side slope
Down-slope shape: Linear
Across-slope shape: Concave

Paxton

Percent of map unit: 2 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Convex
Across-slope shape: Convex

Soil Information for All Uses

Soil Reports

The Soil Reports section includes various formatted tabular and narrative reports (tables) containing data for each selected soil map unit and each component of each unit. No aggregation of data has occurred as is done in reports in the Soil Properties and Qualities and Suitabilities and Limitations sections.

The reports contain soil interpretive information as well as basic soil properties and qualities. A description of each report (table) is included.

Soil Physical Properties

This folder contains a collection of tabular reports that present soil physical properties. The reports (tables) include all selected map units and components for each map unit. Soil physical properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

Engineering Properties

This table gives the engineering classifications and the range of engineering properties for the layers of each soil in the survey area.

Hydrologic soil group is a group of soils having similar runoff potential under similar storm and cover conditions. The criteria for determining Hydrologic soil group is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Listing HSGs by soil map unit component and not by soil series is a new concept for the engineers. Past engineering references contained lists of HSGs by soil series. Soil series are continually being defined and redefined, and the list of soil series names changes so frequently as to make the task of maintaining a single national list virtually impossible. Therefore, the criteria is now used to calculate the HSG using the component soil properties and no such national series lists will be maintained. All such references are obsolete and their use should be discontinued. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonal high water table, saturated hydraulic conductivity after prolonged wetting, and depth to a layer with a very slow water transmission rate. Changes in soil properties caused by land management or climate changes also cause the hydrologic

soil group to change. The influence of ground cover is treated independently. There are four hydrologic soil groups, A, B, C, and D, and three dual groups, A/D, B/D, and C/D. In the dual groups, the first letter is for drained areas and the second letter is for undrained areas.

The four hydrologic soil groups are described in the following paragraphs:

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

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

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

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

Depth to the upper and lower boundaries of each layer is indicated.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

Classification of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number.

Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

References:

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Absence of an entry indicates that the data were not estimated. The asterisk '*' denotes the representative texture; other possible textures follow the dash. The criteria for determining the hydrologic soil group for individual soil components is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba).

Engineering Properties–Middlesex County, Massachusetts														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*Pct*	*Pct*					*Pct*	
254A—Merrimac fine sandy loam, 0 to 3 percent slopes														
Merrimac	85	A	0-10	Fine sandy loam, sandy loam, very fine sandy loam, gravelly sandy loam, gravelly very fine sandy loam, gravelly fine sandy loam	SM, ML	A-4, A-2-4	0- 0- 0	0- 0- 0	69-84-100	68-83-100	53-72-97	29-44-62	0-26 -34	NP-2 -4
			10-22	Fine sandy loam, sandy loam, very fine sandy loam, coarse sandy loam, gravelly sandy loam, gravelly very fine sandy loam, gravelly coarse sandy loam, gravelly fine sandy loam	SM	A-1-b, A-2-4, A-4	0- 0- 0	0- 0- 0	70-78-100	68-77-100	50-62-93	24-31-54	0-16 -24	NP-1 -4

Engineering Properties–Middlesex County, Massachusetts														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*Pct*	*Pct*					*Pct*	
			22-26	Stratified gravel to loamy sand, stratified gravel to sandy loam, stratified gravel to gravelly loamy coarse sand, stratified gravel to gravelly loamy fine sand, stratified gravel to gravelly loamy sand, stratified gravel to gravelly sandy loam, stratified gravel to loamy coarse sand, stratified gravel to loamy fine sand, stratified gravel to coarse sandy loam, stratified gravel to gravelly coarse sandy loam	SM, SC-SM	A-1-b, A-2-4, A-4	0- 0- 0	0- 0- 0	58-76-100	56-75-100	38-56-88	14-24-45	0-17 -24	NP-1 -4

Engineering Properties–Middlesex County, Massachusetts														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*Pct*	*Pct*					*Pct*	
			26-65	Gravel, stratified gravel to cobbles, stratified gravel to coarse sand, stratified gravel to gravelly coarse sand, stratified gravel to gravelly sand, stratified gravel to very gravelly coarse sand, stratified gravel to very gravelly sand, stratified gravel to extremely gravelly coarse sand, stratified gravel to extremely gravelly sand, stratified gravel to sand	SP, GP, SM, GP-GM, SP-SM	A-1-a, A-2-4	0- 0- 0	0-12- 31	13-44-78	9-41- 77	5-25- 58	1- 5- 15	0-0 -14	NP

Engineering Properties–Middlesex County, Massachusetts														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*Pct*	*Pct*					*Pct*	
627C—Newport-Urban land complex, 3 to 15 percent slopes														
Newport	45	D	0-8	Channery fine sandy loam	GM, ML, SM, SC-SM	A-2, A-4	0- 0- 0	0- 0- 0	65-75-85	60-60-75	45-58-70	30-45-60	15-25-35	NP-5-10
			8-18	Channery silt loam, channery loam, very fine sandy loam	GM, ML, SM	A-2, A-4	0- 5- 10	0- 5- 10	65-85-95	60-75-90	45-65-85	30-53-75	15-23-30	NP-4 -7
			18-24	Channery sandy loam, channery loam, fine sandy loam	GM, ML, SM	A-2, A-4	0- 5- 10	0- 5- 10	60-76-90	55-65-85	45-63-80	25-48-70	15-20-25	NP-2 -4
			24-65	Channery silt loam, channery loam, channery fine sandy loam	GM, ML, SM	A-2, A-4	0- 5- 10	0- 5- 10	60-82-90	55-70-85	45-63-80	25-48-70	15-20-25	NP-2 -4

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

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MAP SCALE 1" = 500'

250 0 500 1000

FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0552E

FIRM

FLOOD INSURANCE RATE MAP

MIDDLESEX COUNTY, MASSACHUSETTS

(ALL JURISDICTIONS)

PANEL 552 OF 656

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
NEWTON, CITY OF	250208	0552	E
WALTHAM, CITY OF	250222	0552	E
WATERTOWN, TOWN OF	250223	0552	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
25017C0552E

EFFECTIVE DATE
JUNE 4, 2010

Federal Emergency Management Agency

Appendix D

Operation and Maintenance Manual

Operation and Maintenance Manual

Proposed Development
255-257 Newtonville Avenue
Newton, Massachusetts

Prepared For Submission To:
City of Newton Regulatory Agencies

September 25, 2015

BL Project Number: 15D2781

Prepared For:
Storage Development Partners, LLC
30665 Northwestern Highway, Suite 100
Farmington Hills, Michigan 48334

Prepared By:
BL Companies

355 Research Parkway
Meriden, Connecticut
(203) 630-1406 Fax (203) 630-2615

Table of Contents

General Overview

The site is located at intersection of Newtonville Avenue and Lewis Terrace. The site is bounded by Newtonville Avenue on the south, Lewis Terrace to the east, Interstate 90 to the north, and Laundry Brook (partially underground) to the west. The site is currently occupied by two buildings which are to be demolished.

A self storage facility is proposed on this site with associated parking, and other site amenities.

The following Operations and Maintenance Plan was prepared specifically for the Self-Storage facility building in Newtonv, Massachusetts. The Plan was developed to satisfy the Massachusetts DEP and City of Newton requirements.

Purpose & Goals

The purpose of this Operations and Maintenance Plan is to ensure that the Self-Storage facility is operated in accordance with all approvals and permits. The primary goal is to inform the property managers about how the system operates and what maintenance items are necessary to protect downstream watercourses. The secondary goal is to provide a practical, efficient means of maintenance planning and record keeping to verify permit compliance.

Responsible Parties

The property owner/facility manager will be responsible for implementing the Plan on the subject property. The party will retain a management company to oversee the maintenance of the entire property.

List of Permits & Special Conditions

The site will receive the following permits, which may contain special conditions that require compliance by the owners, tenants, and maintenance contractors. These permits may include the following:

- City of Newton Special Permit Application
- City of Newton Conservation Commission Order of Conditions

Maintenance Logs and Checklists

The property owner/facility manager will keep a record of all maintenance procedures performed, date of inspection/ cleanings, etc. Copies of inspection reports and maintenance records shall be kept on site in the manager's office once they are established.

Forms

The following forms will be developed for annual maintenance. Copies of the forms will be kept on-site as part of the Storm Water Management Plan.

- Annual Checklist

- Quarterly Checklist
- Monthly Checklist

Employee Training

The property owner/facility manager will have an employee-training program, with annual updates, to ensure that the employees charged with maintaining the site do so in accordance with the approved permit conditions. Personnel that have maintenance duties will be adequately informed of their responsibilities. All sub-contractors (Vactor, landscaping, snowplowing, etc.) will be informed of special requirements and responsibilities.

Spill Control

The facility will have a spill control program. That program will be updated annually and incorporated into the employee-training program.

Storm Water Management

System Components

The storm water management system has several components that are shown on the Grading and Drainage Plan (GD-1), and they perform various functions in treating storm water runoff:

Catch Basins are inlets, which trap road sand and floatable debris prior to draining through the storm sewer system. The catch basins (CBs) are equipped with 4 foot deep sumps and hooded outlets.

Water Quality Structure

The property owner/facility manager is responsible for cleaning the water quality structures on the property. The water quality structures shall be inspected every four months for the first year of operation. The inspection schedule for subsequent years can be revised to reflect the site-specific conditions observed during the first year of inspection, requiring a minimum of two inspections per year. The structure shall be cleaned out as necessary by a Massachusetts licensed hauler with the sediment and debris disposed of legally. It is recommended that the property owner/facility manager retain a contract with a company in order to maintain the structure.

A detailed maintenance logbook shall be kept for each structure. Information is to include, but not be limited to, the date of inspection, record of grit depth, condition of baffles, observation of any floatables, a date of cleaning performed, and date of any replacements of components.

Catch Basins, Manholes and Outlet Protection

The property owner/facility manager is responsible for cleaning the catch basins on the property. A Massachusetts licensed hauler shall clean the sumps, and dispose of removed sand legally. The road sand may be reused for winter sanding, but may not be stored on-site.

As part of the hauling contract, the hauler shall notify the property owner/facility manager in writing where the material is being disposed.

Each catch basin shall be inspected every four months, with one inspection occurring during the month of April. Any debris occurring within one foot from the bottom of each sump shall be removed by Vacuum "Vactor" type of maintenance equipment.

During the inspection of each of the catch basin sumps, the hoods on each of the outlet pipes shall also be observed. In the event that a hood is damaged or off the hanger, it shall be reset or repaired.

Underground Detention System

Each underground detention system is outfitted with inspection ports. Each time catch basin cleaning occurs, the inspection ports should be opened and observations made regarding water level if present, date of last storm, and any visible debris or sediment.

There are numerous pre treatment devices employed to prevent the accumulation of sediment in the underground detention system and it is imperative that these pretreatment devices (catch basin sumps and hydrodynamic separators) are routinely maintained to protect the underground detention systems.

Site Maintenance

Parking Lots

Parking lots and sidewalks shall be swept monthly by the management company retained by The property owner/facility manager to clean trash and other debris. The management company retained by the property owner/facility manager will sweep parking lots on its property in the spring and fall using a mechanical sweeper (rotary broom). Special attention shall be given to sweeping paves surfaces in March/April before spring rains was residual sand from winter applications to surface waters.

Landscaping

The management company retained by the property owner/facility manager will maintain landscaped areas. Normally the landscaping maintenance will consist of pruning, mulching, planting, mowing lawns, raking leaves, etc. Use of fertilizers and pesticides will be controlled and limited to minimal amounts necessary for healthy landscape maintenance.

Soil tests will be performed prior to fertilization. Trees will be fertilized no more than once in the fall season with an organic fertilizer. Shrubs will be fertilized with an organic slow-release fertilizer each spring. Lawns shall receive a minimum of one application of fertilizer in the fall. Liming of lawn areas to control pH will be done in the spring if testing indicates that it is necessary. The low-maintenance slopes will not be fertilized following initial planting and stabilization.

The lawn areas, once established, will be maintained at a typical height of 3 ½". This will allow the grass to be maintained with minimal impact from weeds and/or pests. The low-maintenance areas will be maintained as a meadow or allowed to revert back to natural conditions.

Pesticides will only be used as a control method when a problem has been clearly identified and other natural control methods are not successful. All pesticide applications shall be by licensed applicators, where necessary.

Topsoil, brush, leaves, clippings, woodchips, mulch, equipment, and other material shall be stored off site.

Trash Collection

All trash will be contained in litter/recyclable receptacles or dumpster enclosures. All dumpsters will be equipped with covers. All trash will be collected on a regular basis and disposed of legally off-site.

Maintaining Native Vegetation

Existing vegetation around the perimeter of the development will be maintained in its native condition. No clearing, grading, stockpiling, storage, or development will occur in these areas.

Outdoor Storage

There will be no outdoor storage of hazardous chemicals, fertilizer, pesticides, or herbicides anywhere on the site.

Clean wooden pallets and baled cardboard may be stored outside. These items will be removed from the site on a regular schedule.

Snow Removal & Storage

Snow shall be shoveled and plowed from sidewalk and parking areas as soon as practical during and after winter storms.

Utilities

Water System

The on-site services will be maintained by the property owner/facility manager.

Electric\Telephone System

The electric system will be owned and maintained up to the transformers by Eversource. The property owner/facility manager will maintain the secondary lines from the transformers to the buildings. The telephone system will be owned and maintained by the local telecommunications provider up to the building.

Site Lighting

The property owner/facility manager is responsible for maintaining the parking lot building-mounted lights on the property.

Operations and Maintenance Budget

Component	Scheduled Maintenance	Estimated Costs
Catch Basins	Every 4 months, including once in April	$5,000.00/yr
Water Quality Structure	Every 3 months during the 1st year; adjust maintenance plan afterwards to be site-specific	$5,000.00/yr
Landscaping	Mow lawn / rake leaves as necessary to maintain grass height of 3 ½"	$10,000.00/yr

Operations and Maintenance Log Form

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Inspection Type	Inspection Date	Inspector Initials	Tenant Initials
Catch Basins			
Water Quality Structures			
Underground Detention			
Landscaping			