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STORMWATER REPORT (MAJOR PERMIT)

130 NONANTUM ROAD, NEWTON, MA

Prepared By: Spruhan Engineering, P.C.
Date: April 20th, 2023

Spruhan Engineering, P.C. has prepared this Storm water Report for the proposed development located at 130 Nonantum road , Newton, Massachusetts.

The proposed development consists of a two-family residential building, one & two car garages located in the basements, shared paved driveway, walkways, steps, retaining walls & landscaped areas.

Since the project will disturb land that is currently in a natural vegetated state this project meets the “New development” definition. Also, since the increase of impervious areas is more than 1,000 S.F. the project was designed to comply with the “Major Permit” design standards.

The purpose of this report is to demonstrate that the proposed conditions do not create any increased flowrate or runoff from the site & also to demonstrate that the project complies with the City of Newton Stormwater Management and Erosion Control Rules and Regulations published on April 15th of 2022. This is achieved by installing an infiltration system to capture all the impervious areas of the lot.

2.0 Existing Conditions

The existing property is located at 130 Nonantum Road, Newton, Massachusetts. The site is located on Maple Street off Nonantum Road & is bound by residential dwellings at the rear & on the sides. The existing roof area on the lot is 1,425 S.F., garage 398 S.F., existing walkways, steps, deck, bulkhead 324 S.F., & the remaining existing landscaped area on the lot is 8,698 S.F.

2.1 Existing Topography and Drainage Infrastructure.

In general, the property slopes from south west to the north east of the lot ranging between approximately 11%. As there is no drainage system currently installed, all storm water scours across the surface at grade.

3.1 Project Description

The proposed development consists of a two-family residential building, one & two car garages located in the basements, shared paved driveway, walkways, steps, retaining walls & landscaped areas. The total proposed roof will have an area of 2,410 S.F, the paved driveway 1,183 S.F., the proposed walkways, steps, landings, retaining walls 471 S.F., & the remaining landscaped portion will have an area of 6,781 S.F.

3.2 Proposed site improvements

Proposed site improvements include a storm water recharge systems designed to reduce the run-off from the lot and improve groundwater recharge. All impervious areas are being captured by the infiltration trenches. The infiltration system is sized to reduce the flowrate and total runoff volume generated from the site post construction.

3.3 Storm Water Management System (Infiltration trenches – Storm Tech chamber & Crushed stone system)

The proposed infiltration systems consist of 4 “Storm-Tech” plastic chambers with a 2ft crushed stone bed below for capturing the roof & driveway.

The infiltration system has been sized to fully store the runoff from a 2” storm event across all impervious areas these calculations can be seen on the next page.

The systems are also designed to reduce the flow rate and volume for the 2, 10, 25, and 100-year frequency storm events post-development.
The HydroCAD calculations demonstrate that the post-development runoff flowrate and volume for all storm events have been reduced compared to the pre-development conditions. These calculations can be seen in Appendix A. The summary of these calculations can be seen in the table below.

Summary of Calculations:

STORMTECH SYSTEM

Design Criteria:
Impervious Roof = 2,410 SF
Impervious Pavement = 1,183 SF
Various Impervious = 471 SF
Total = 4,064 SF

Design For **2"** Rainstorm

Storage Volume Required:

V_R = (2"/12) (4,064 SF) = 677.3 CF

CAPACITY OF PROPOSED STORM TECH SYSTEM

Storage Capacity of single Storm Tech UNIT = 49 CF

Void Ratio =0.4

Total Volume= (7'x 11' x 5'$_{\text{depth (2.5ft for Storm Tech unit)}}$ x 4 UNITS) = 1,540 CF

Capacity for 4 UNITS = 196 CF

Storage Capacity in Crushed Stone = (Total Volume – Capacity of Units) x Void Ratio = (1,540 – 196) x 0.4 = 537.6 CF

Total Storage Provided = Capacity in Crushed Stone + Total Capacity in Units = 537.6 CF + 196 CF = 733.6 CF

Therefore, utilize 4-Storm-Tech chambers with 2 ft. of crushed stone beneath to contain a 2" Storm event.

	Summary Table (HydroCAD Results)			
	Runoff Flow Rate		**Volume of Runoff**	
	EXISTING	**PROPOSED**	**EXISTING**	**PROPOSED**
2 Year Storm	0.16 cfs	0.03 cfs	625 cf	185 cf
10 Year Storm	0.28 cfs	0.08 cfs	1,180 cf	473 cf
25 Year Storm	0.40 cfs	0.14 cfs	1,554 cf	684 cf
100 Year Storm	1.02 cfs	0.51 cfs	3,429 cf	1,991cf

3.4 Low Impact Development (LID)

Low Impact Development (LID) strategies use careful site design and decentralized stormwater management to reduce the environmental footprint of new growth and redevelopment. This approach improves water quality, minimizes the need for expensive pipe and pond stormwater systems, and creates more attractive developments.

The following strategies outline the LID methods that were implemented in this project.

1. Infiltration Trench: These are standard stormwater management structures that store water in the void space between crushed stone or gravel; the water slowly percolates downward into the subsoil.
Management Objectives:
Remove suspended solids, heavy metals trash, oil, and grease.
Reduce peak discharge rate and total runoff volume.
Provide modest infiltration and recharge.
Provide snow storage areas.

2. Use of Filter Mitts:
Erosion control
Detains sediment, absorbs orders and degrades volatile organic compounds allows water by-pass, and is a food resource for beneficial microorganisms, which remediate by metabolizing wood preservatives, petroleum products, pesticides and both chlorinated and non-chlorinated hydrocarbons in stormwater runoff from reaching water resources, prevents erosion and silting on embankments parallel to creeks, lakes, and rivers, prevents erosion and turf loss on roadsides, hillsides, playing fields, and golf courses.

3. Maintenance of Paved Surfaces:
No coal-tar pavement sealants.
No sodium de-icers.
Street sweeping

3.5 MassDEP Stormwater management Summary

Standard 1: No New Untreated Discharges

"No new untreated stormwater conveyances (e.g., outfalls) will discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth."

- The project does not propose a connection to the city drain main.
- The entire roof, driveway, patio, steps & walkways will be captured by 2no sub-surface infiltration systems.

Standard 2: Peak Attenuation

"Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates."

- Most of the proposed impervious areas will be captured by the infiltration trenches. The infiltration systems are designed to reduce the flowrate and total runoff volume generated from the site post construction and to retain at least 2" of rain on the total proposed impervious areas.
  Further information can be found on the Appendix A "HydroCAD calculations" and a summary of these calculations can be found in page 3 of this report.

Standard 3: Recharge

"Loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre- development conditions based on soil type. This condition is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook."

- Proposed site improvements include storm water a recharge system designed to reduce the runoff from the lot and improve groundwater recharge.

An infiltration system is being proposed, consisting of four "Storm-Tech" plastic chambers with a 2ft crushed stone bed below, its dimension is 14'x22'x5'.

Standard 4: Water Quality

According to the City of Newton Stormwater Management and Erosion Control Rules and Regulations for "new development" site shall be designed to:

a) Retain the volume of runoff equivalent to, or greater than, two (2) inches multiplied by the total post-construction impervious surface area on the site; and
b) Remove 90% of the average annual load of Total Suspended Solids generated from the total post-construction impervious area on the site; and
c) Calculate the existing and proposed average annual Total Phosphorus (TP) load based on the land use(s) and demonstrate 60% reduction of the TP load generated from the total postconstruction impervious surface area on the site: and
d) Whenever feasible exceed the above minimum phosphorus removal requirement. Infiltration BMPs, bioretention areas, constructed stormwater wetlands, and filter systems are recommended ways to reduce phosphorus in stormwater discharges.

The 85% for TSS credit was achieved in this project using the following strategies:
- Deep Hooded Sump Manhole.
- "1 no Storm-Tech unit" infiltration system (for driveway)
- "1 no crushed stone infiltration system.

Since an infiltration system with a capacity to store 2" of runoff depth is being proposed & the infiltration rate for sand is 8.27 in/hr (Rawls rate) the total phosphorus reduction achieved is 86.9%.

The following tables were used to get the load reduction.

PHOSPHORUS				
TP=A*L				
Where:				
A	=	Total impervious area of post-development (acres)		
L	=	Load of a pollutant in pounds per acre per year.		
A_1	=	Captured impervious area of post-development (acres)		
POST-DEVELOPMENT PHOSPHORUS LOADING (L_{post})				
TP_{post}	=	A*L		
TP_{post}	=	0.0949 ACRES	X	2.32 lbs/acre/year
TP_{post}	=	0.220 lbs/year		
REDUCED TP LOAD				
REDUCED TP	=	A_1*L		
REDUCED TP	=	0.0825 ACRES	X	2.32 lbs/acre/year
REDUCED TP	=	0.191 lbs/year		
TOTAL PHOSPHORUS REDUCTION % (TP)				
TP RED. (%)	=	**86.93 %**		

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: 130 Nonantum Road, Newton, MA

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Infiltration Trench	0.80	1.00	0.80	0.20
Deep Sump and Hooded Catch Basin	0.25	0.20	0.05	0.15
	0.00	0.15	0.00	0.15
	0.00	0.15	0.00	0.15
	0.00	0.15	0.00	0.15

Total TSS Removal = 85%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: 130 NONANTUM RD, NEWTON
Prepared By: SEAN SPRUHAN
Date: 03/31/23

*Equals remaining load from previous BMP (E) which enters the BMP

Standard 5: Land Uses with Higher Potential Pollutant Loads

"For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook."

- The project does not propose Land Uses with Higher potential Pollutant Loads – N/A.

Standard 6: Critical Areas

"Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply and stormwater discharges near or to any other critical area require the use of specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas as provided in the Massachusetts Stormwater Handbook."

- The project is not located in a critical area – N/A

Standard 7: Redevelopment

The City of Newton Stormwater Management and Erosion Control Rules and Regulations define new development and redevelopment as if follows:

New development: Any construction or disturbance of land that is currently in a natural vegetated state. New development also includes any disturbance beyond existing impervious and disturbed areas that is contiguous to redevelopment projects.

Redevelopment: Any construction, land alteration, demolition or improvement of impervious surfaces that does not meet the definition of new development. The following activities are excluded from this definition: Maintenance and improvement of existing roadways, including widening less than a single lane, adding shoulders, and correcting substandard intersections and drainage, repaving, and adding sidewalks and curbing.

Therefore, this project is considered a new development and both the site plan and stormwater report have been prepared to meet those standards.

Standard 8: Construction Period Pollution Prevention, Erosion & Sediment Control
"A plan to control construction related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented."

- Erosion and sedimentation controls will be installed before construction and maintained during the project.
  Further information can be found in the erosion control site plan and in the appendix C of this report.

Standard 9: Long Term Operation and Maintenance Plan

"A long-term operation and maintenance plan shall be delivered and implemented to ensure that stormwater management systems function as designed."

- Operations and Maintenance Plan will be the responsibility of the owner. The details of this plan can be found in the attached appendix C.

Standard 10: Prohibition of Illicit Discharges
"All illicit discharges to the stormwater management system are prohibited."

- There are currently no known illicit discharges within the project limits.
- The project does not propose any illicit discharges.

4.0 Soil Information

The NRCS Web Soil Survey shows one Map Unit inside our area of interest. This is listed next and the percentages of Area of Interest in the Map unit Legend Table:

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	0.2	100.0%
Totals for Area of Interest		**0.2**	**100.0%**

- Map unit 626 B refers to fine sandy loam to very gravelly sand, these soils have a Hydrological soil group "A".

  Also, a test pit was performed on the site and the hole log shows sand was found at the same elevation & below the proposed infiltration system. These properties were applied to the Hydro-CAD software calculations.

  Further detailed information is described in Appendix B.

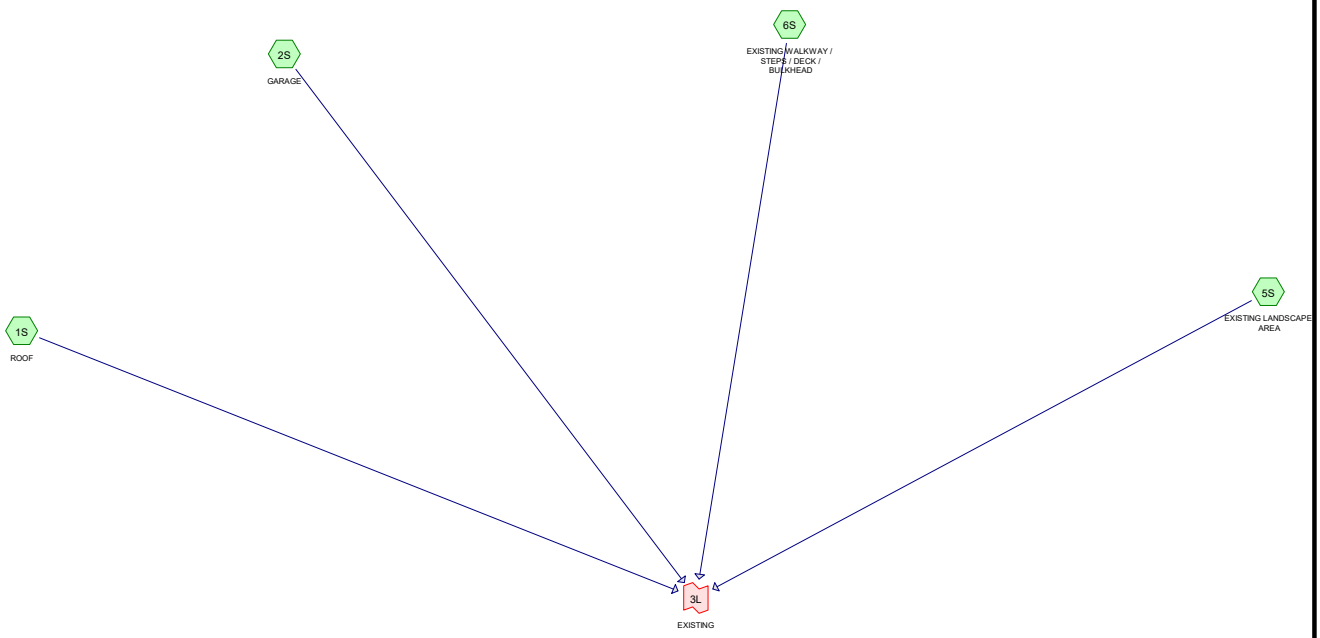
5.0 Draw down time (Time to empty) Calculations.

$$Time = \frac{rv}{(k)(Bottom\ Area)}$$

Storm Tech system

$$Time = \frac{733.6\ cf}{(8.27\ \ in/hr)(\frac{1ft}{12in})(308sf)} = \textbf{3.5 hrs. < 72.00 hrs.}$$

Appendix A
HydroCAD Calculations



Subcat Reach Pond Link

Routing Diagram for EXISTING (130 NONANTUM ROAD)
Prepared by SPRUHAN ENGINEERING, Printed 28/03/2023

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
8,698	49	50-75% Grass cover, Fair, HSG A (5S)
398	98	Paved parking, HSG A (2S)
1,425	98	Roofs, HSG A (1S)
324	98	Unconnected pavement, HSG A (6S)
10,845	**59**	**TOTAL AREA**

Summary for Subcatchment 1S: ROOF

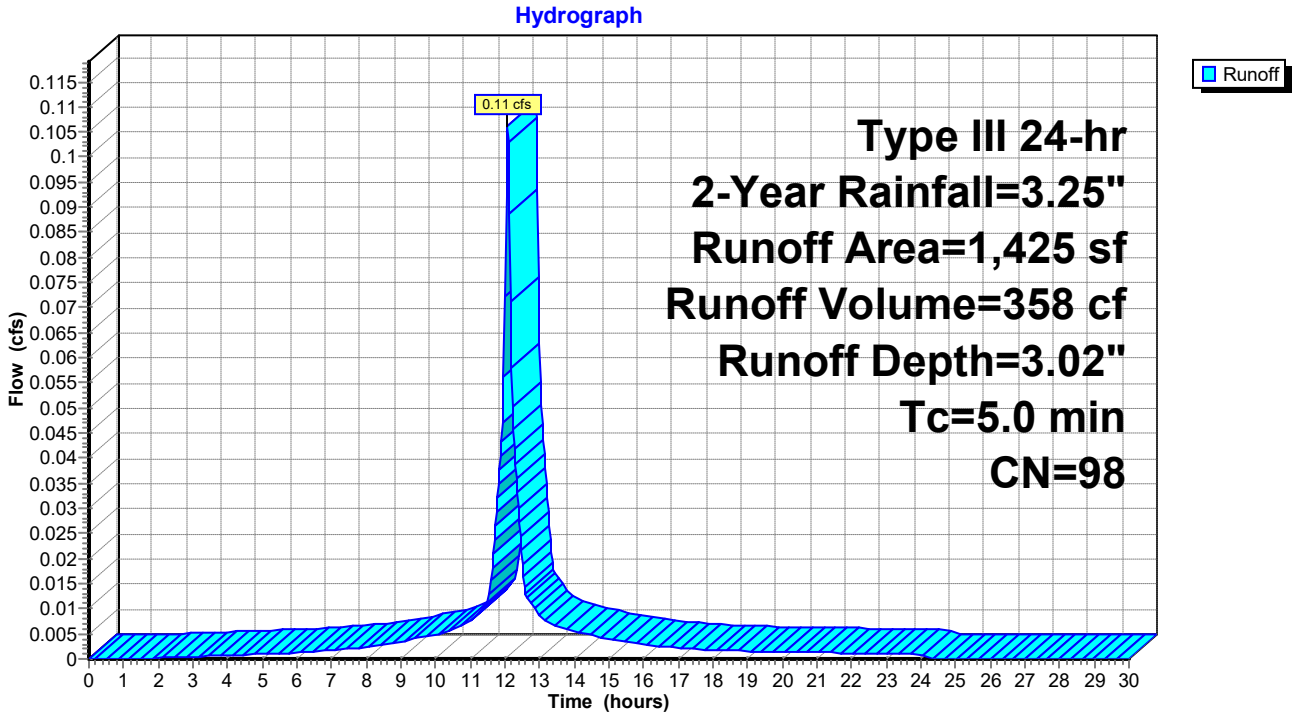
Runoff = 0.11 cfs @ 12.07 hrs, Volume= 358 cf, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-Year Rainfall=3.25"

Area (sf)	CN	Description
1,425	98	Roofs, HSG A
1,425		100.00% Impervious Area

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

Subcatchment 1S: ROOF



Summary for Subcatchment 2S: GARAGE

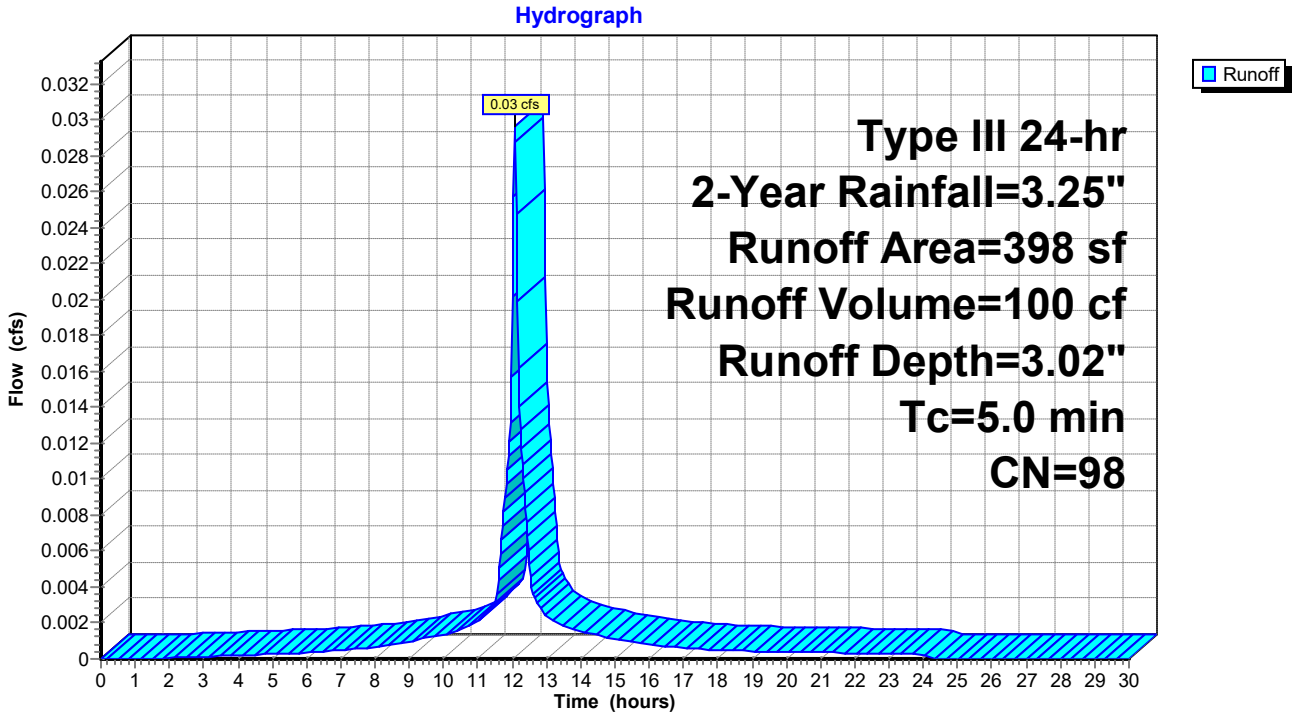
Runoff = 0.03 cfs @ 12.07 hrs, Volume= 100 cf, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-Year Rainfall=3.25"

Area (sf)	CN	Description
398	98	Paved parking, HSG A
398		100.00% Impervious Area

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

Subcatchment 2S: GARAGE



Summary for Subcatchment 5S: EXISTING LANDSCAPE AREA

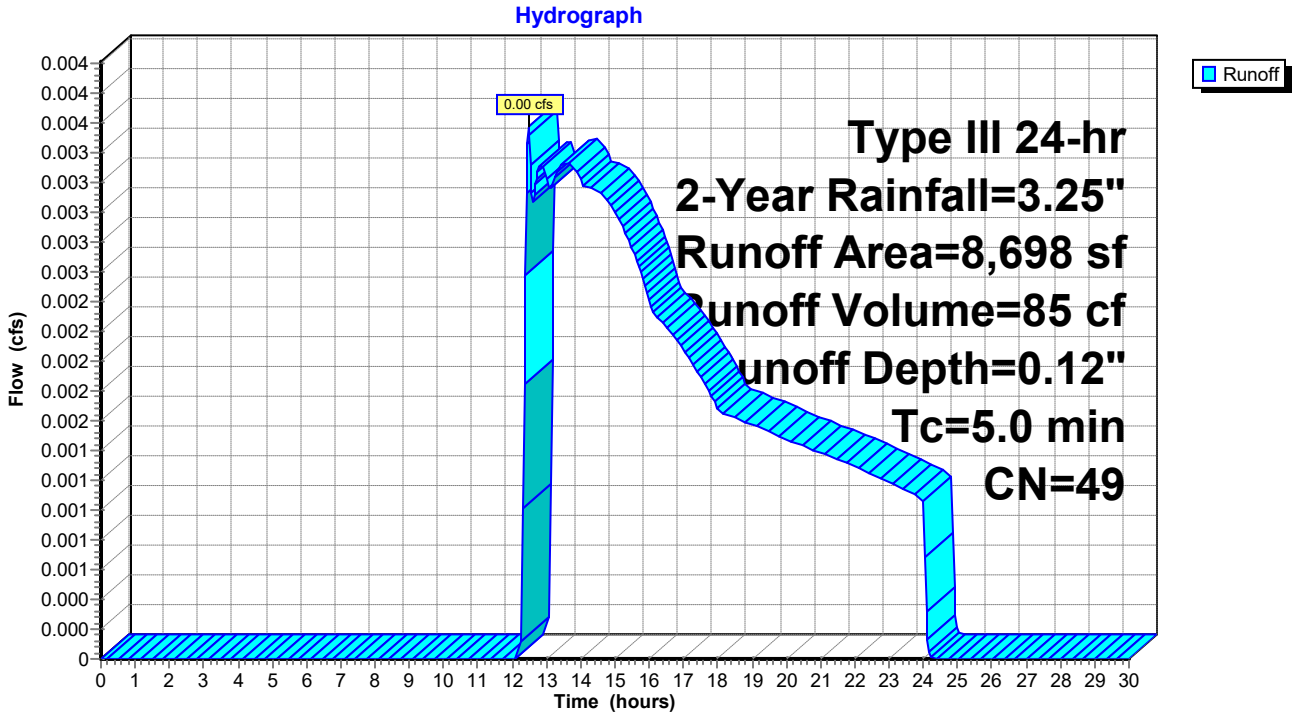
Runoff = 0.00 cfs @ 12.48 hrs, Volume= 85 cf, Depth= 0.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-Year Rainfall=3.25"

Area (sf)	CN	Description
8,698	49	50-75% Grass cover, Fair, HSG A
8,698		100.00% Pervious Area

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

Subcatchment 5S: EXISTING LANDSCAPE AREA



Summary for Subcatchment 6S: EXISTING WALKWAY / STEPS / DECK / BULKHEAD

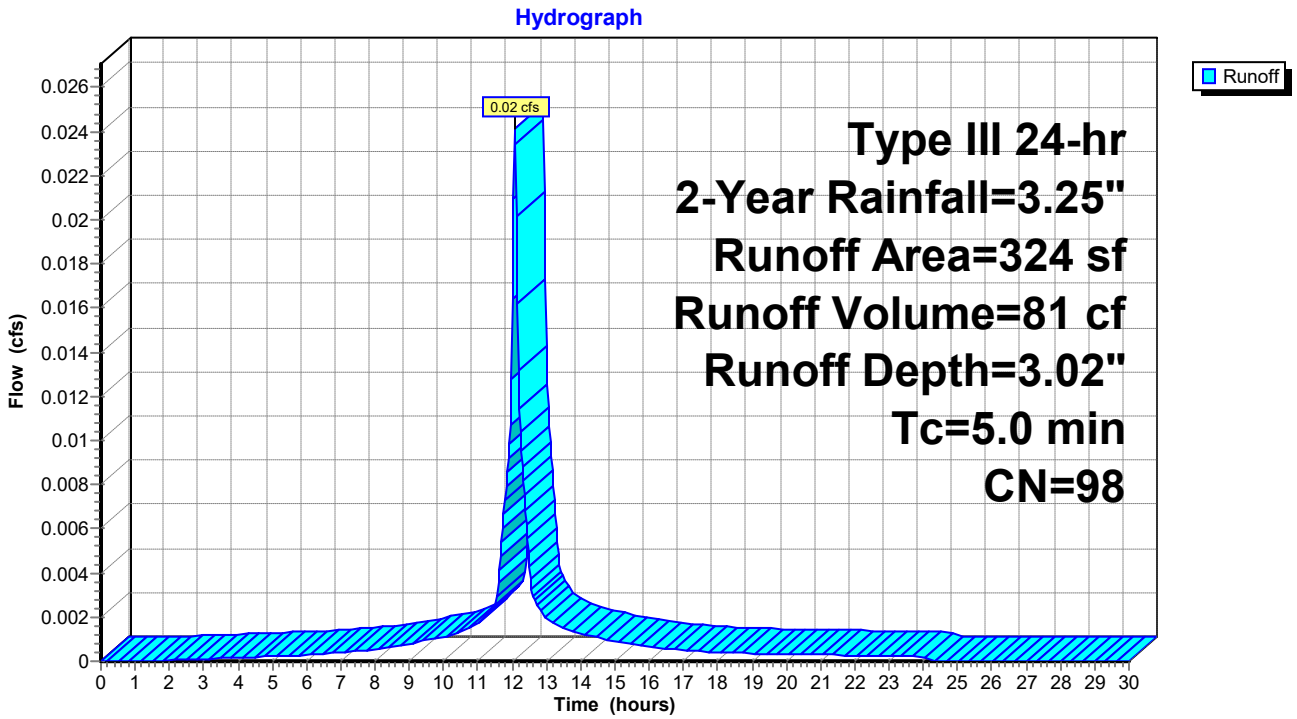
Runoff = 0.02 cfs @ 12.07 hrs, Volume= 81 cf, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-Year Rainfall=3.25"

Area (sf)	CN	Description
324	98	Unconnected pavement, HSG A
324		100.00% Impervious Area
324		100.00% Unconnected

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

Subcatchment 6S: EXISTING WALKWAY / STEPS / DECK / BULKHEAD

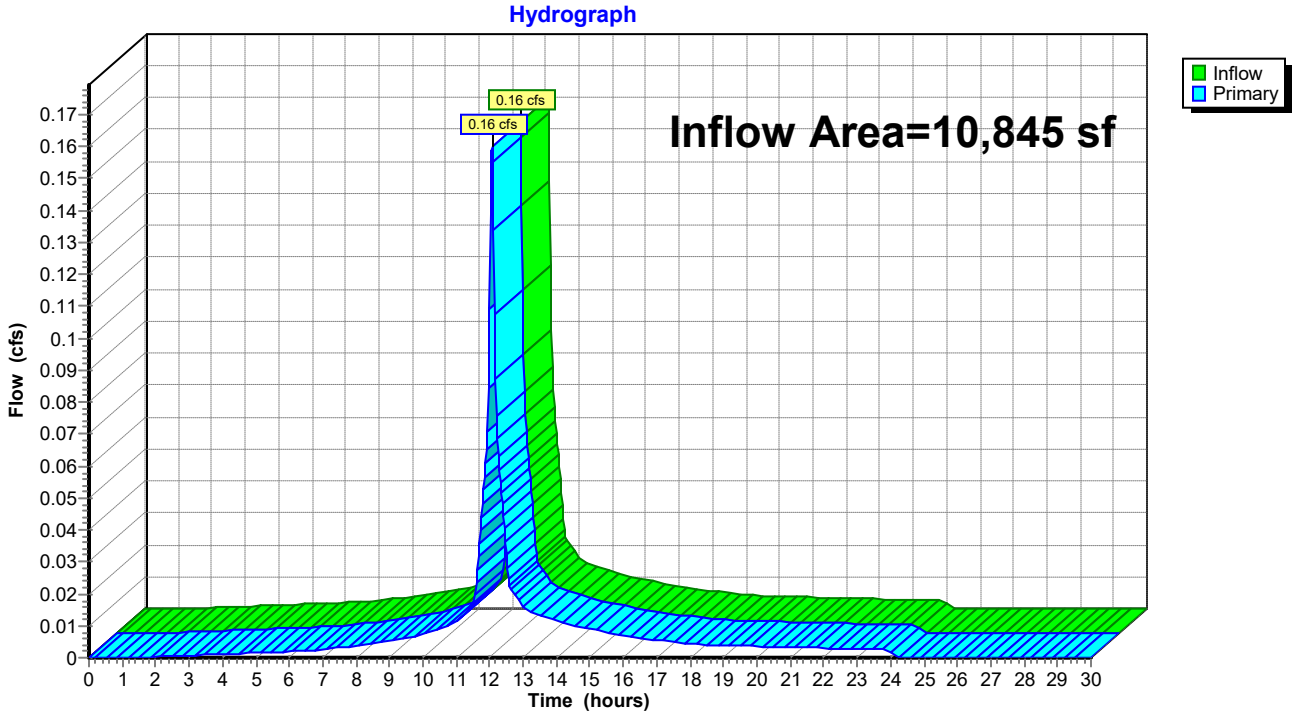


Summary for Link 3L: EXISTING

Inflow Area = 10,845 sf, 19.80% Impervious, Inflow Depth = 0.69" for 2-Year event
Inflow = 0.16 cfs @ 12.07 hrs, Volume= 625 cf
Primary = 0.16 cfs @ 12.07 hrs, Volume= 625 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs

Link 3L: EXISTING



Summary for Subcatchment 1S: ROOF

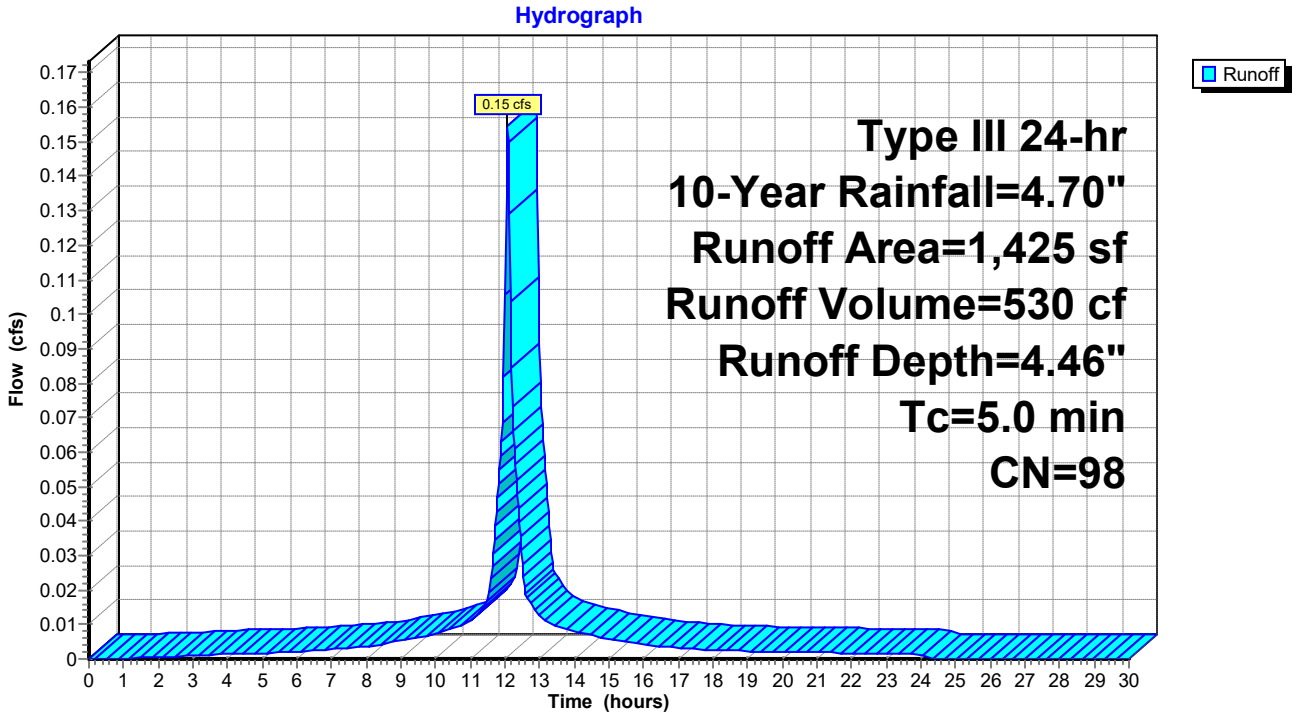
Runoff = 0.15 cfs @ 12.07 hrs, Volume= 530 cf, Depth= 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
1,425	98	Roofs, HSG A
1,425		100.00% Impervious Area

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

Subcatchment 1S: ROOF



Summary for Subcatchment 2S: GARAGE

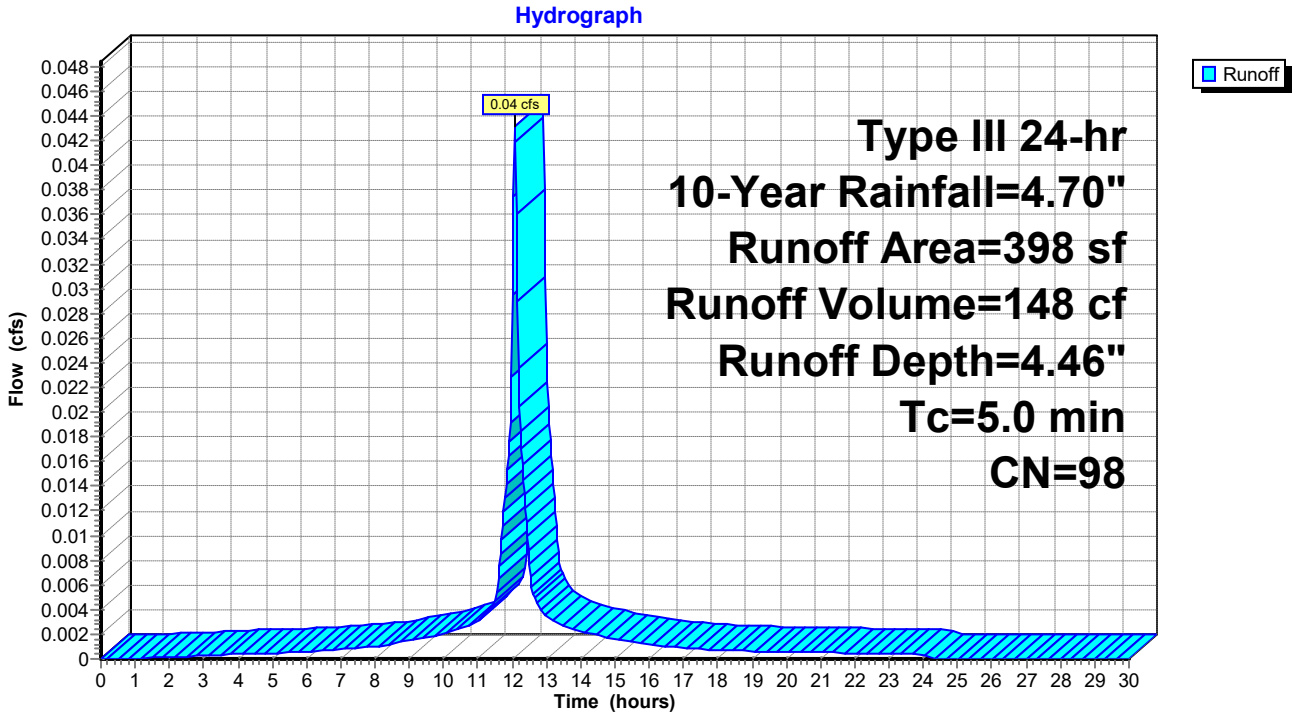
Runoff = 0.04 cfs @ 12.07 hrs, Volume= 148 cf, Depth= 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
398	98	Paved parking, HSG A
398		100.00% Impervious Area

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

Subcatchment 2S: GARAGE



Summary for Subcatchment 5S: EXISTING LANDSCAPE AREA

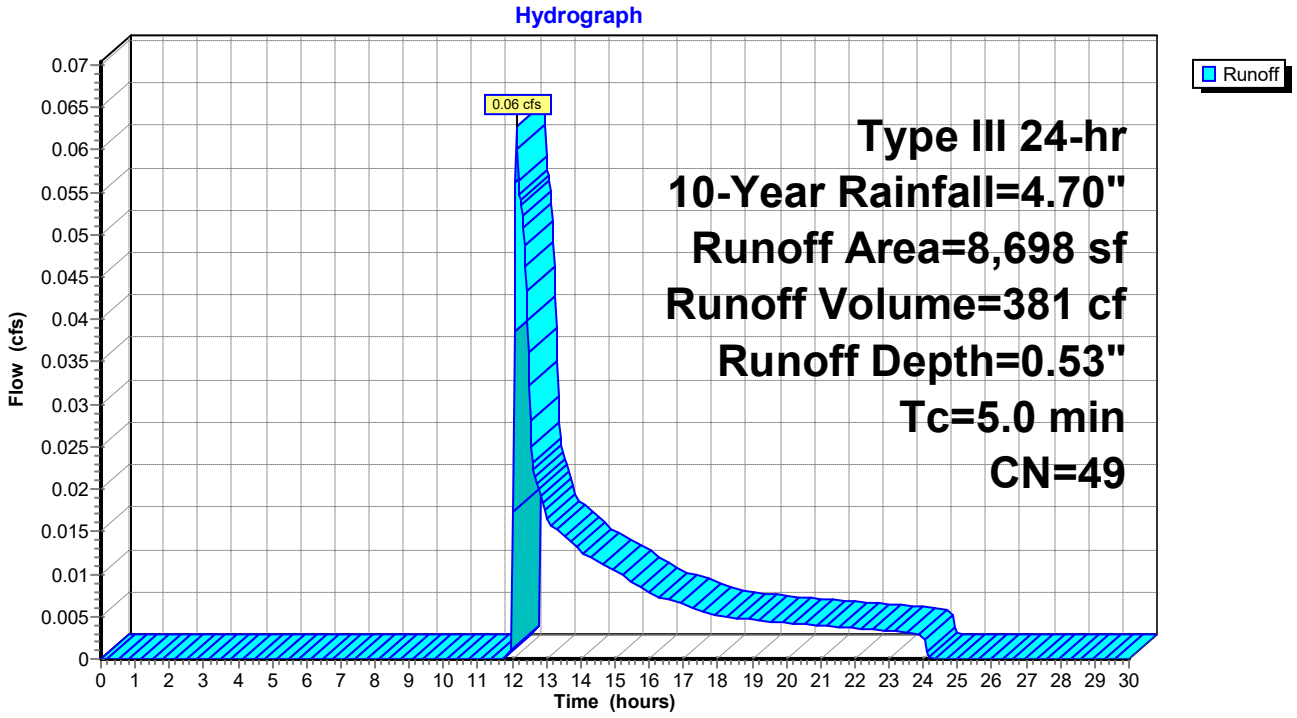
Runoff = 0.06 cfs @ 12.13 hrs, Volume= 381 cf, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
8,698	49	50-75% Grass cover, Fair, HSG A
8,698		100.00% Pervious Area

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

Subcatchment 5S: EXISTING LANDSCAPE AREA



Summary for Subcatchment 6S: EXISTING WALKWAY / STEPS / DECK / BULKHEAD

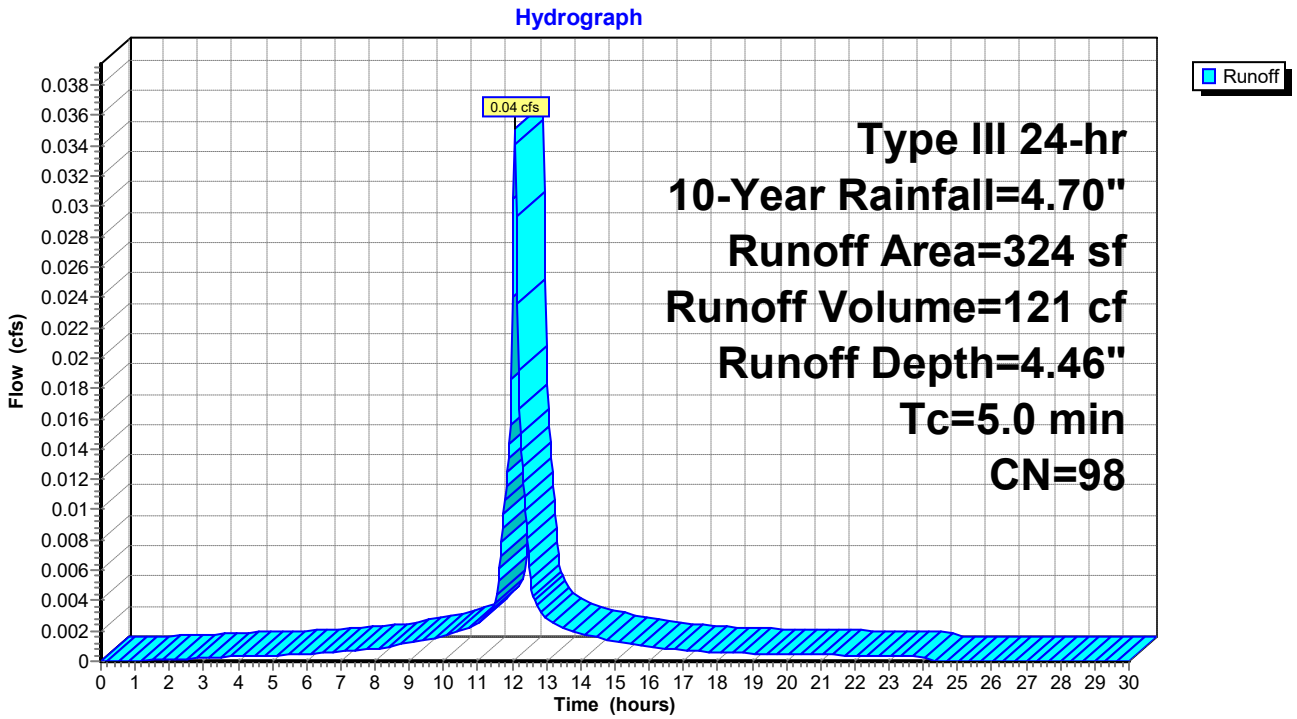
Runoff = 0.04 cfs @ 12.07 hrs, Volume= 121 cf, Depth= 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
324	98	Unconnected pavement, HSG A
324		100.00% Impervious Area
324		100.00% Unconnected

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

Subcatchment 6S: EXISTING WALKWAY / STEPS / DECK / BULKHEAD

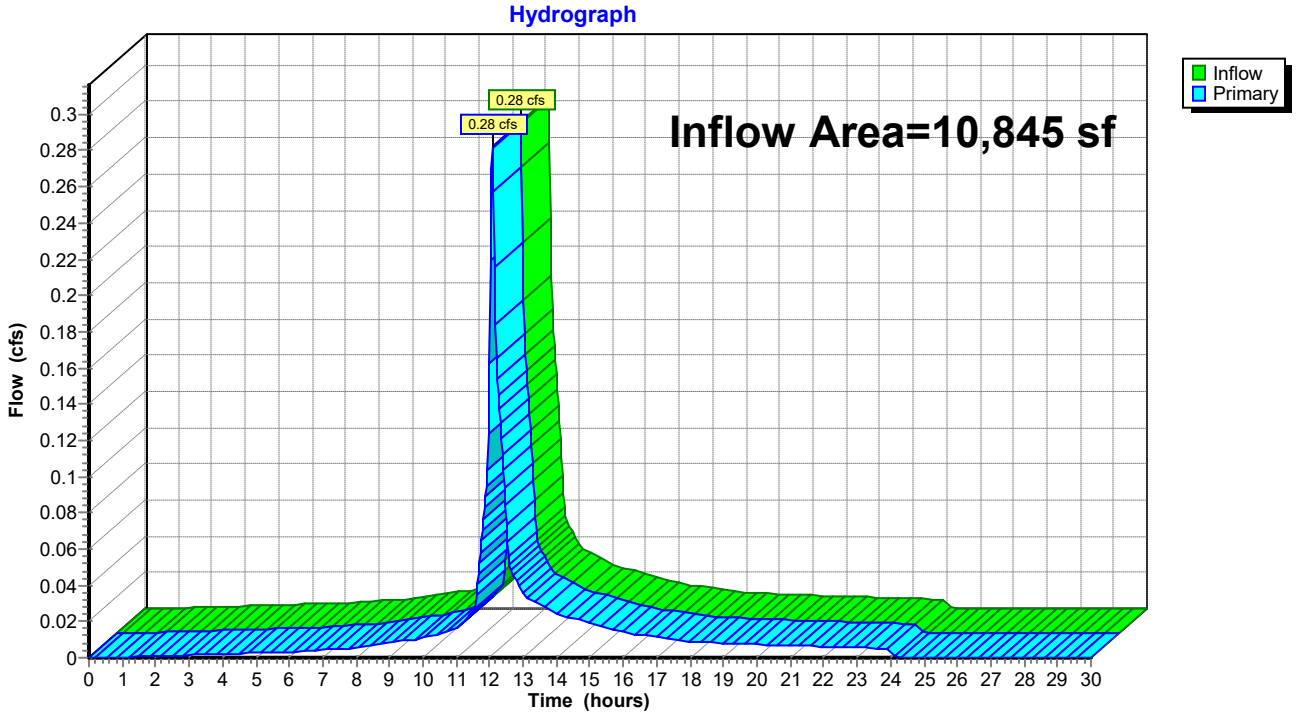


Summary for Link 3L: EXISTING

Inflow Area = 10,845 sf, 19.80% Impervious, Inflow Depth = 1.31" for 10-Year event
Inflow = 0.28 cfs @ 12.08 hrs, Volume= 1,180 cf
Primary = 0.28 cfs @ 12.08 hrs, Volume= 1,180 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs

Link 3L: EXISTING



Summary for Subcatchment 1S: ROOF

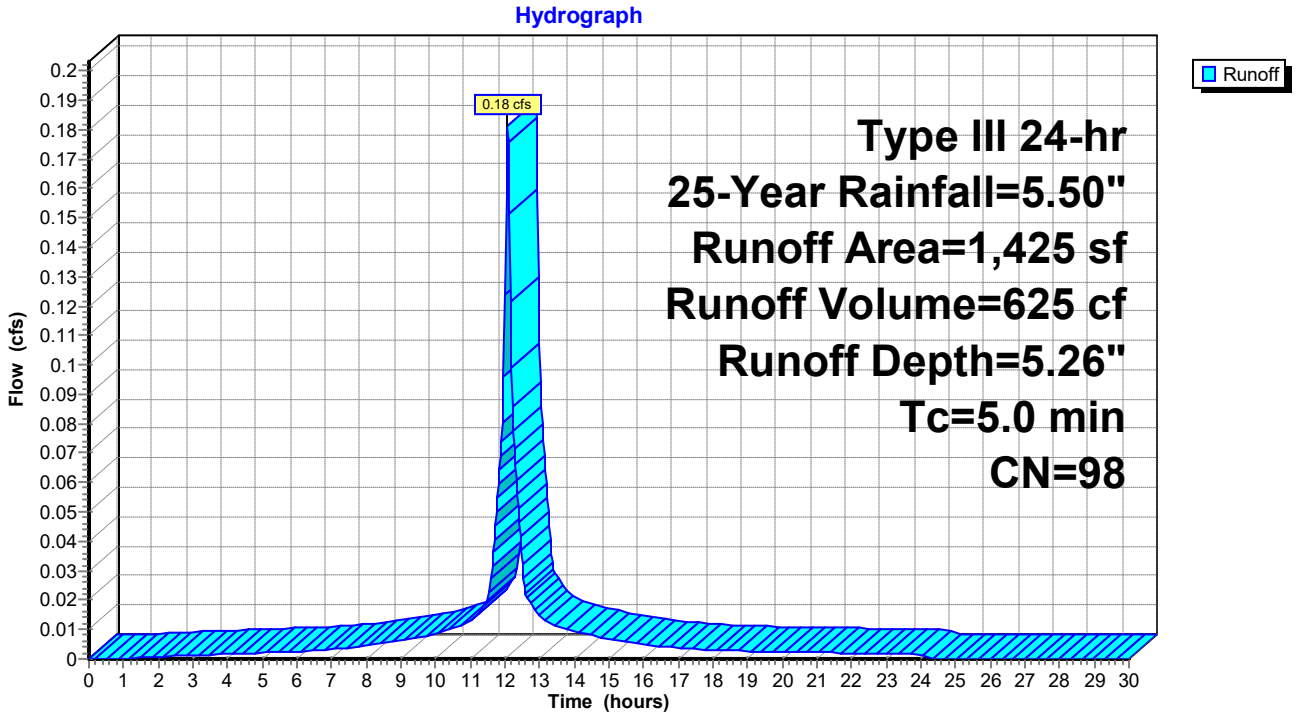
Runoff = 0.18 cfs @ 12.07 hrs, Volume= 625 cf, Depth= 5.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
1,425	98	Roofs, HSG A
1,425		100.00% Impervious Area

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

Subcatchment 1S: ROOF



Summary for Subcatchment 2S: GARAGE

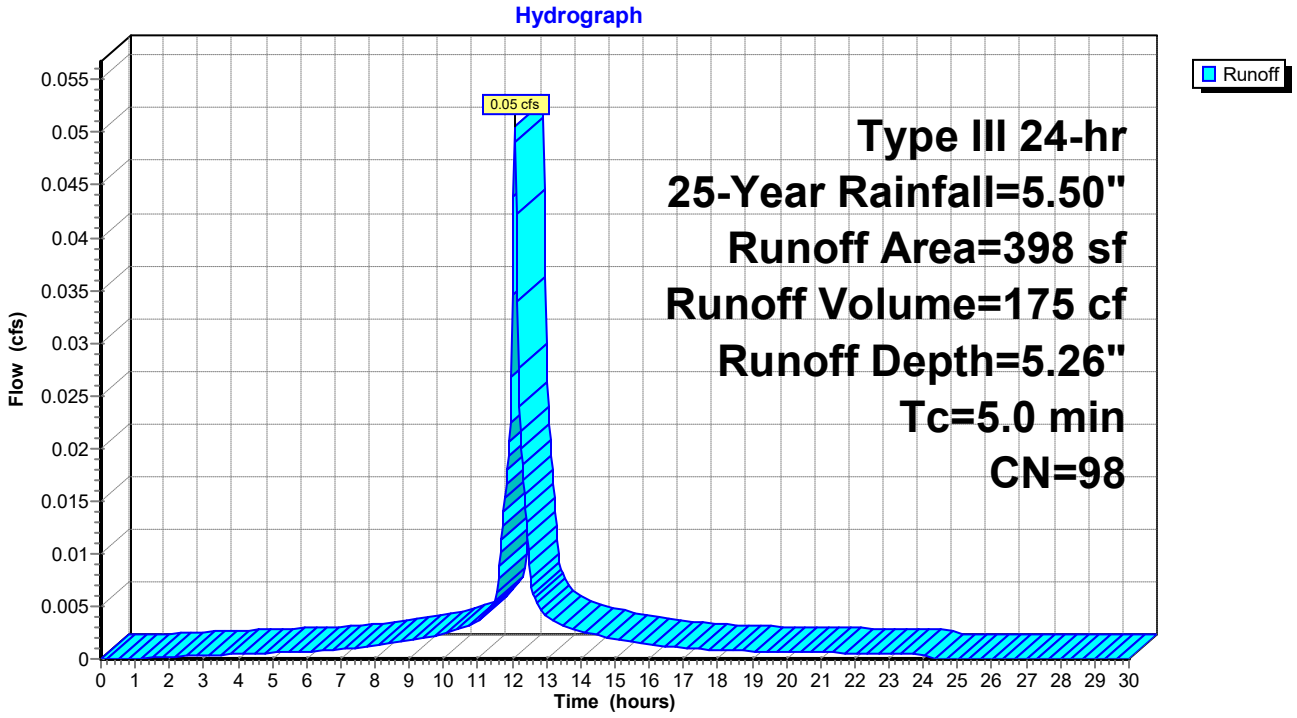
Runoff = 0.05 cfs @ 12.07 hrs, Volume= 175 cf, Depth= 5.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
398	98	Paved parking, HSG A
398		100.00% Impervious Area

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

Subcatchment 2S: GARAGE



Summary for Subcatchment 5S: EXISTING LANDSCAPE AREA

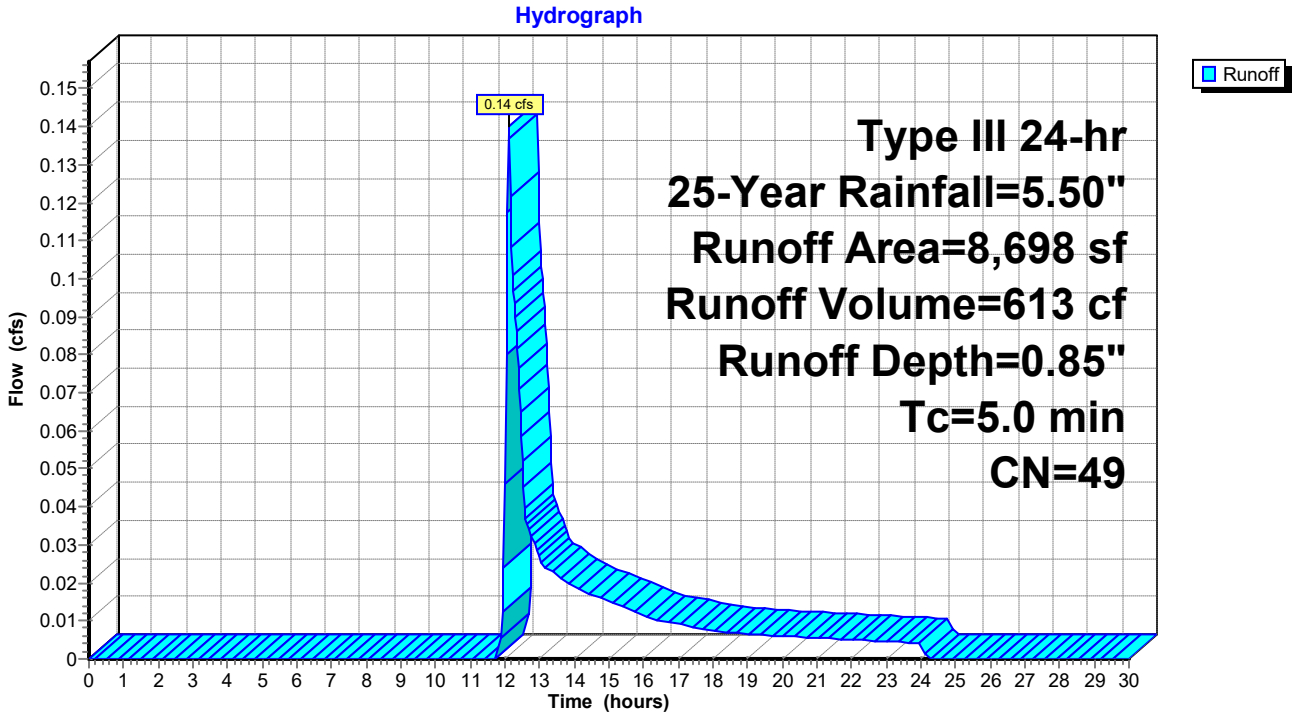
Runoff = 0.14 cfs @ 12.10 hrs, Volume= 613 cf, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
8,698	49	50-75% Grass cover, Fair, HSG A
8,698		100.00% Pervious Area

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

Subcatchment 5S: EXISTING LANDSCAPE AREA



Summary for Subcatchment 6S: EXISTING WALKWAY / STEPS / DECK / BULKHEAD

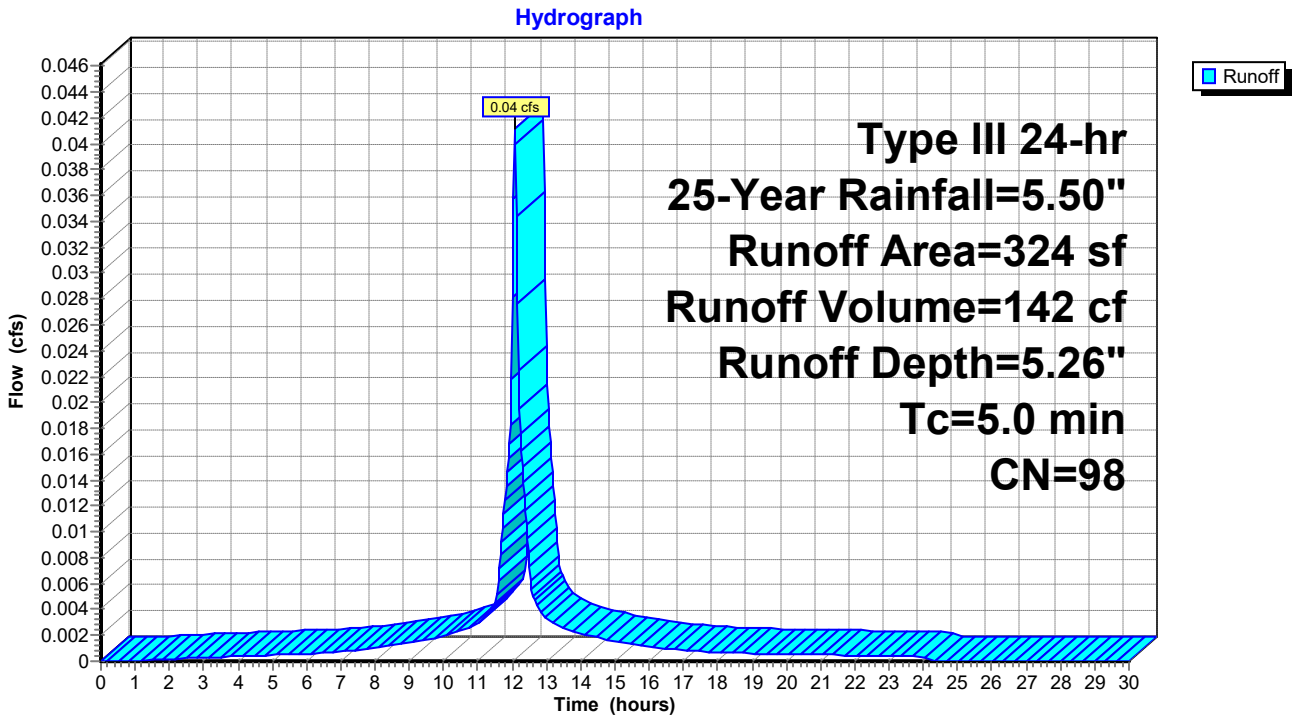
Runoff = 0.04 cfs @ 12.07 hrs, Volume= 142 cf, Depth= 5.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
324	98	Unconnected pavement, HSG A
324		100.00% Impervious Area
324		100.00% Unconnected

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

Subcatchment 6S: EXISTING WALKWAY / STEPS / DECK / BULKHEAD

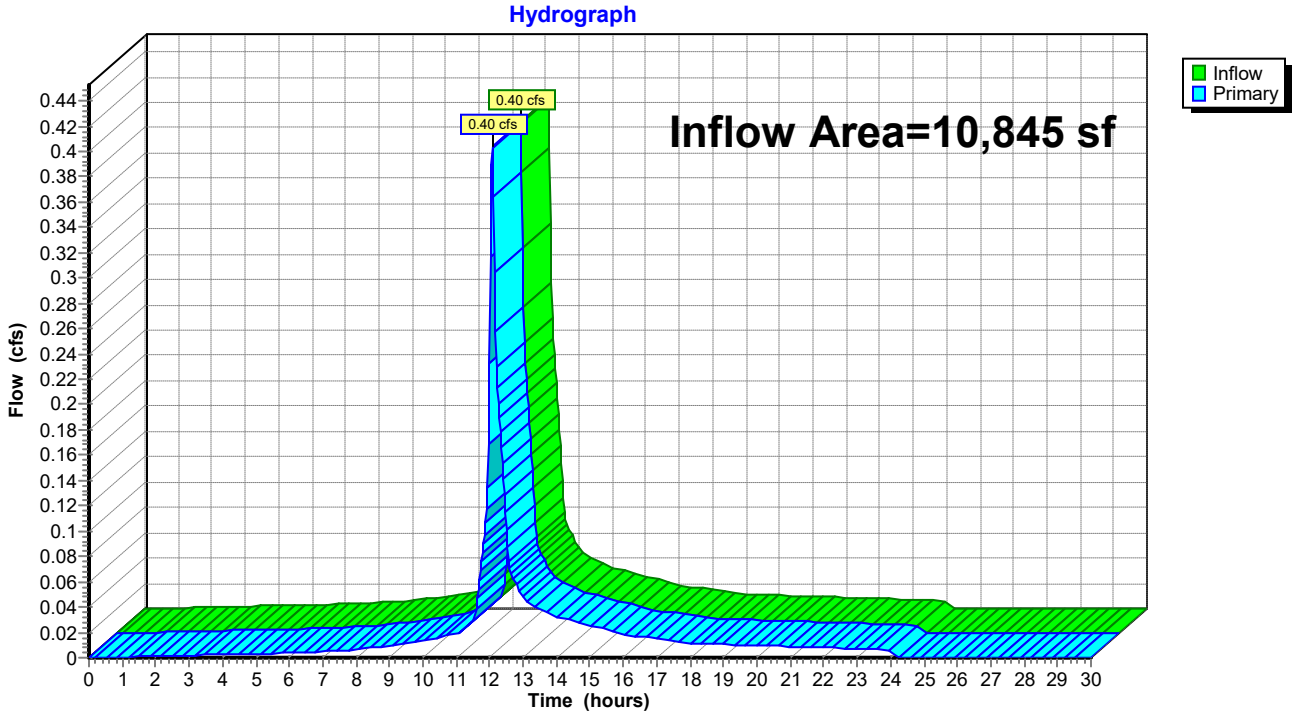


Summary for Link 3L: EXISTING

Inflow Area = 10,845 sf, 19.80% Impervious, Inflow Depth = 1.72" for 25-Year event
Inflow = 0.40 cfs @ 12.08 hrs, Volume= 1,554 cf
Primary = 0.40 cfs @ 12.08 hrs, Volume= 1,554 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs

Link 3L: EXISTING



Summary for Subcatchment 1S: ROOF

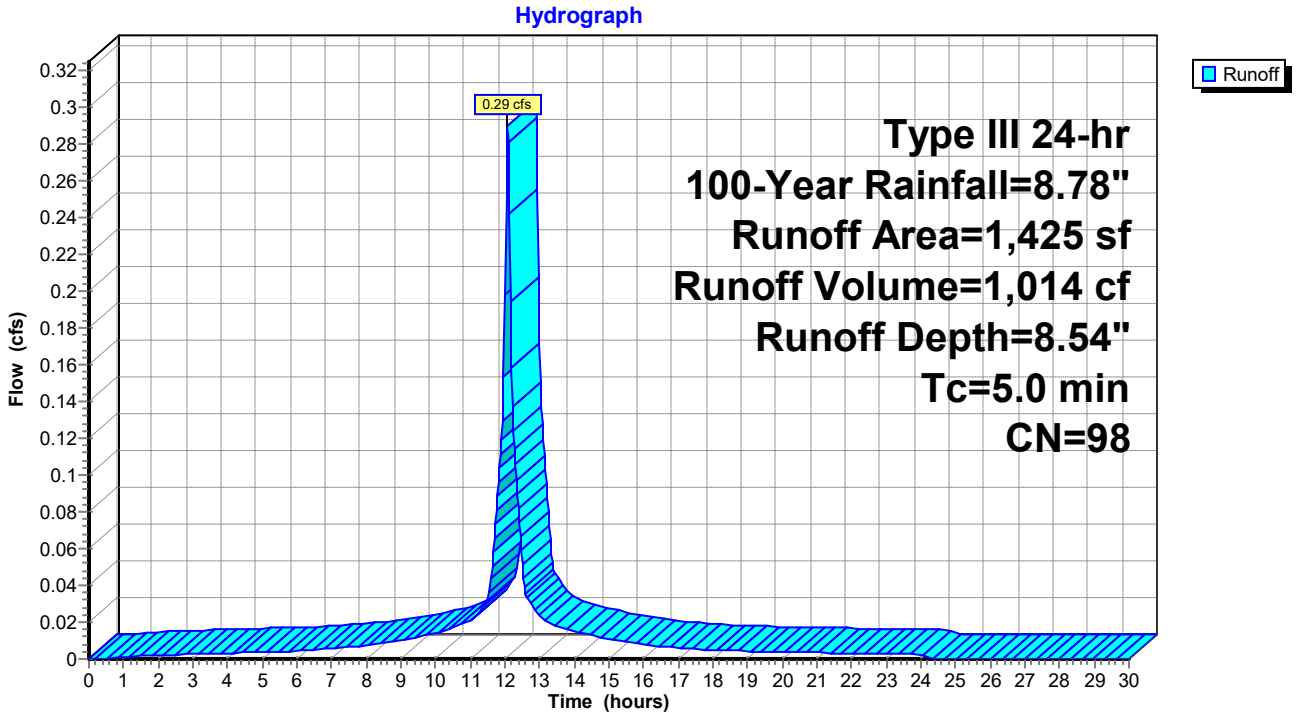
Runoff = 0.29 cfs @ 12.07 hrs, Volume= 1,014 cf, Depth= 8.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 100-Year Rainfall=8.78"

Area (sf)	CN	Description
1,425	98	Roofs, HSG A
1,425		100.00% Impervious Area

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

Subcatchment 1S: ROOF



Summary for Subcatchment 2S: GARAGE

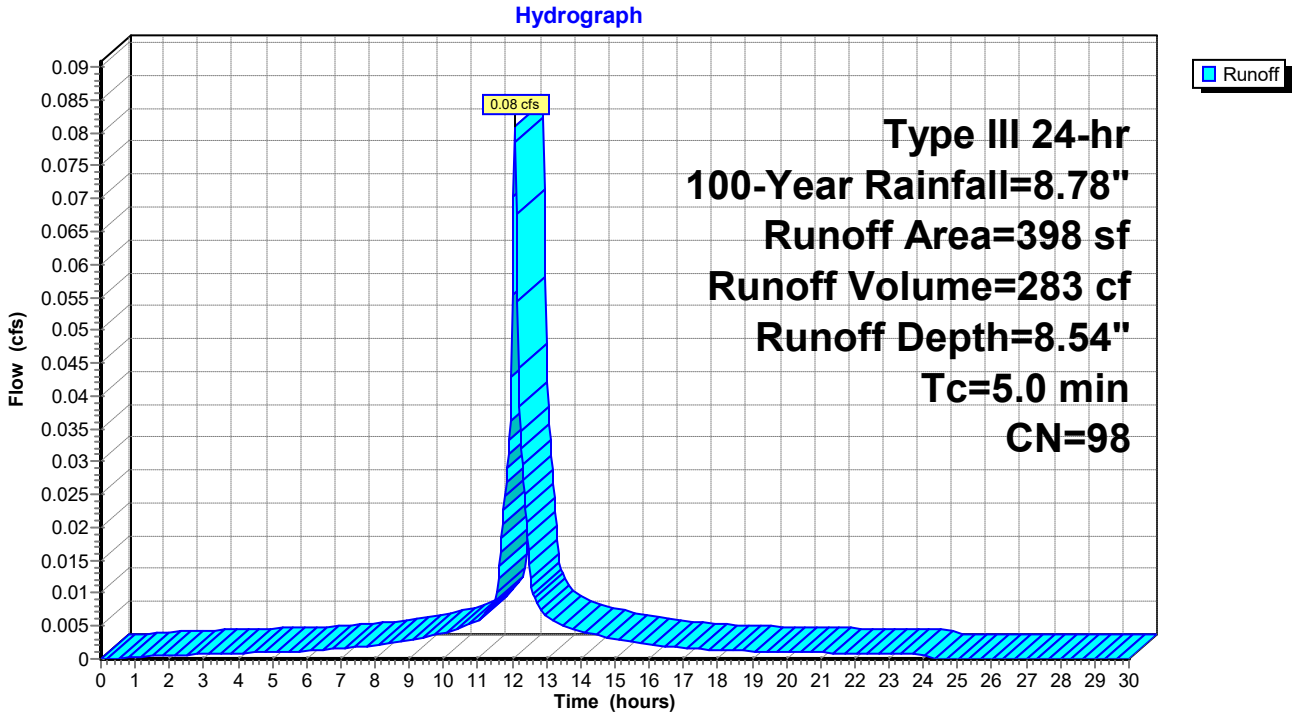
Runoff = 0.08 cfs @ 12.07 hrs, Volume= 283 cf, Depth= 8.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 100-Year Rainfall=8.78"

Area (sf)	CN	Description
398	98	Paved parking, HSG A
398		100.00% Impervious Area

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

Subcatchment 2S: GARAGE



Summary for Subcatchment 5S: EXISTING LANDSCAPE AREA

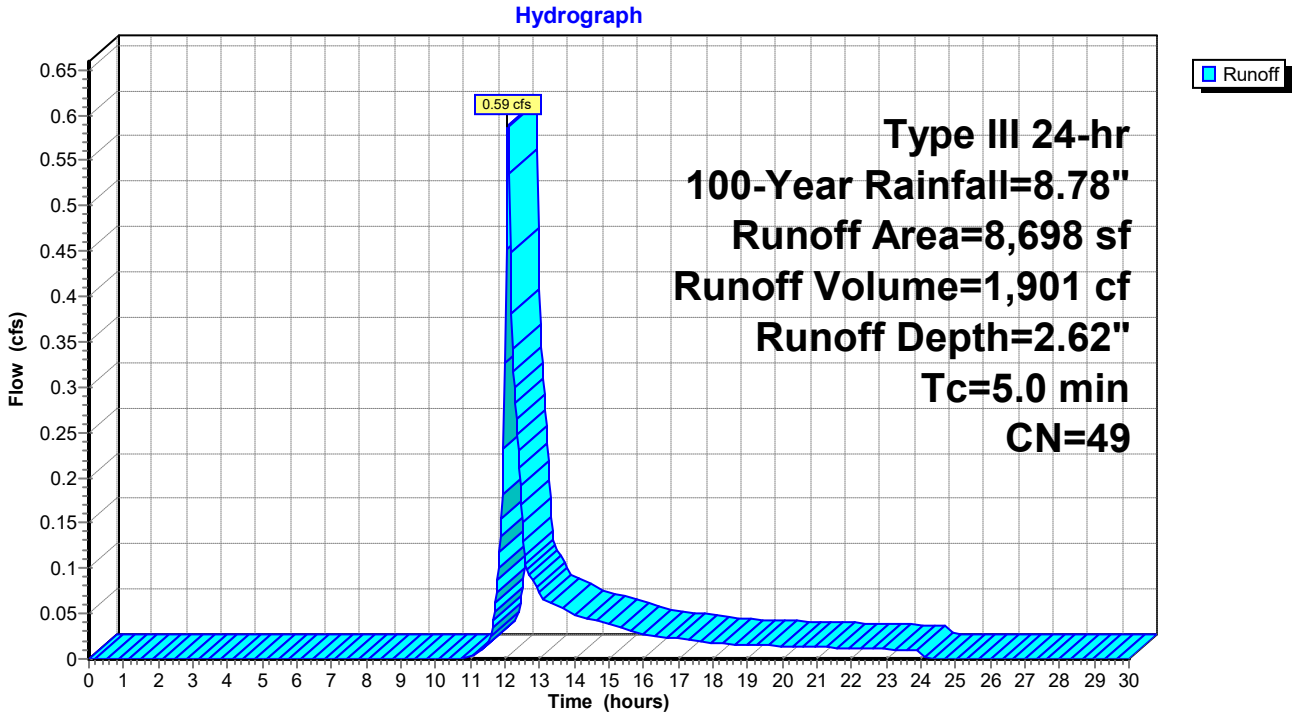
Runoff = 0.59 cfs @ 12.08 hrs, Volume= 1,901 cf, Depth= 2.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 100-Year Rainfall=8.78"

Area (sf)	CN	Description
8,698	49	50-75% Grass cover, Fair, HSG A
8,698		100.00% Pervious Area

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

Subcatchment 5S: EXISTING LANDSCAPE AREA



Summary for Subcatchment 6S: EXISTING WALKWAY / STEPS / DECK / BULKHEAD

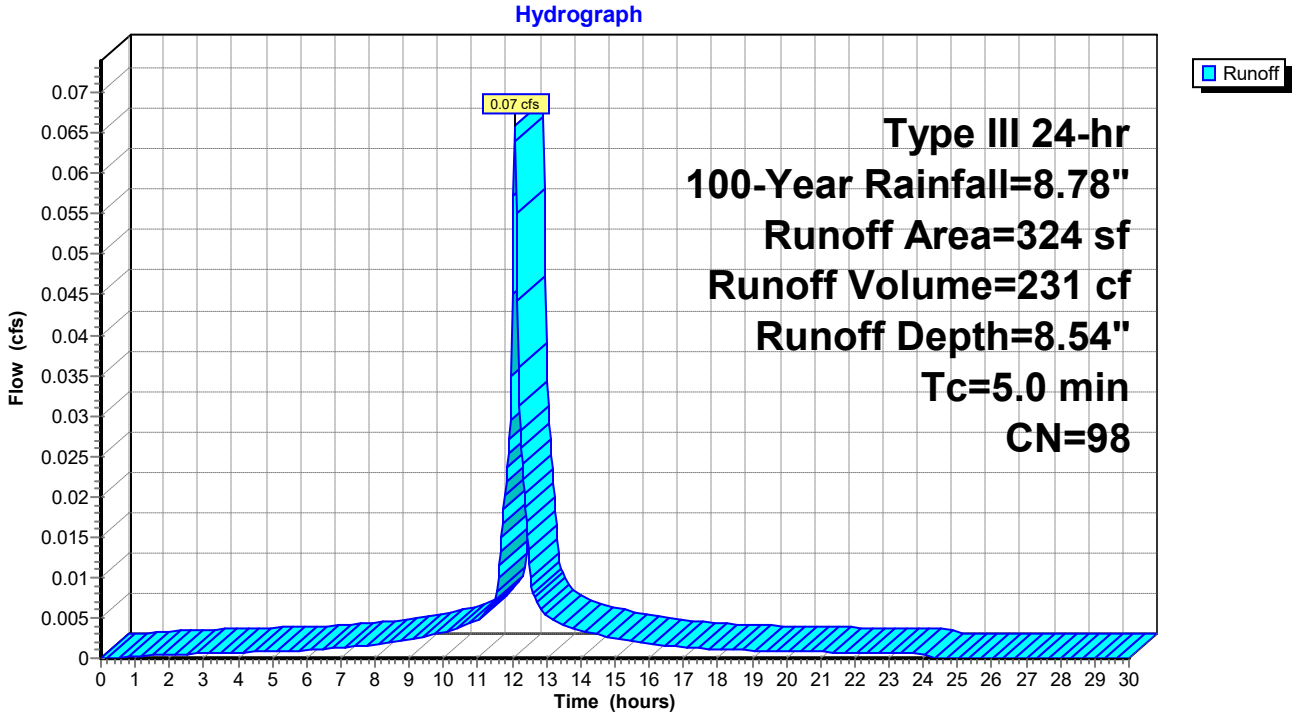
Runoff = 0.07 cfs @ 12.07 hrs, Volume= 231 cf, Depth= 8.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 100-Year Rainfall=8.78"

Area (sf)	CN	Description
324	98	Unconnected pavement, HSG A
324		100.00% Impervious Area
324		100.00% Unconnected

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

Subcatchment 6S: EXISTING WALKWAY / STEPS / DECK / BULKHEAD

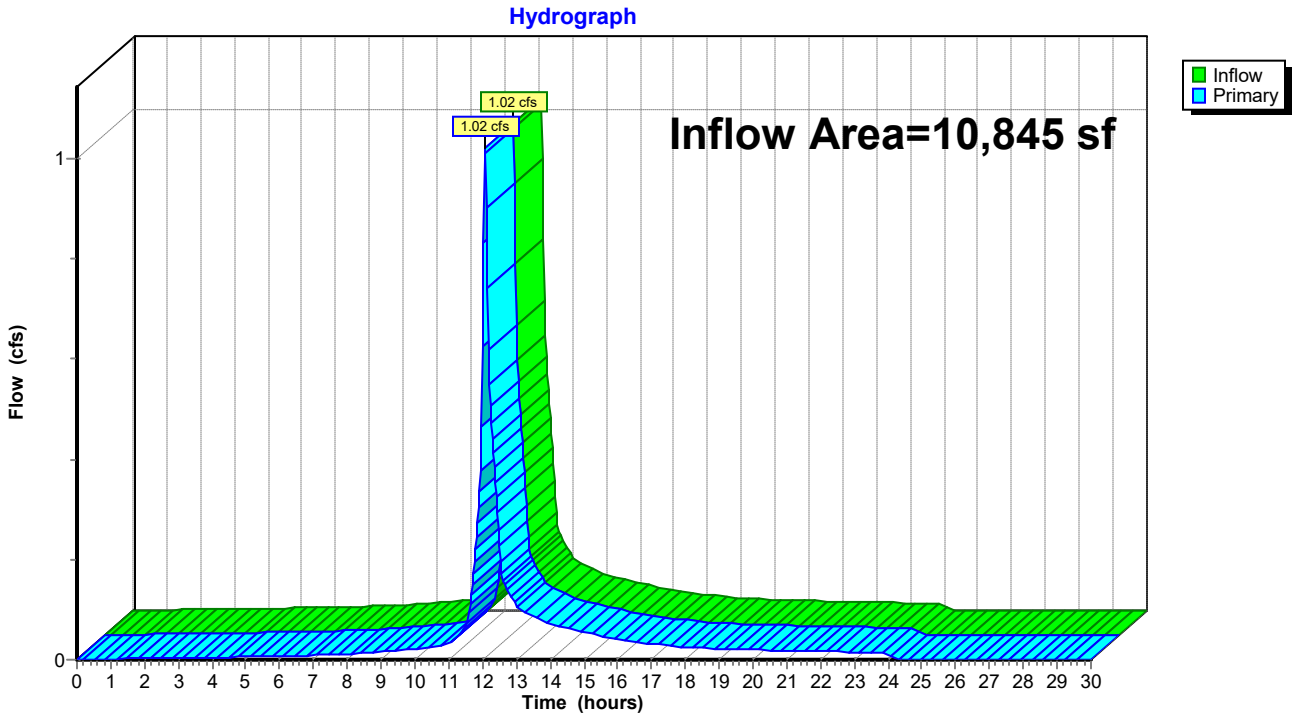


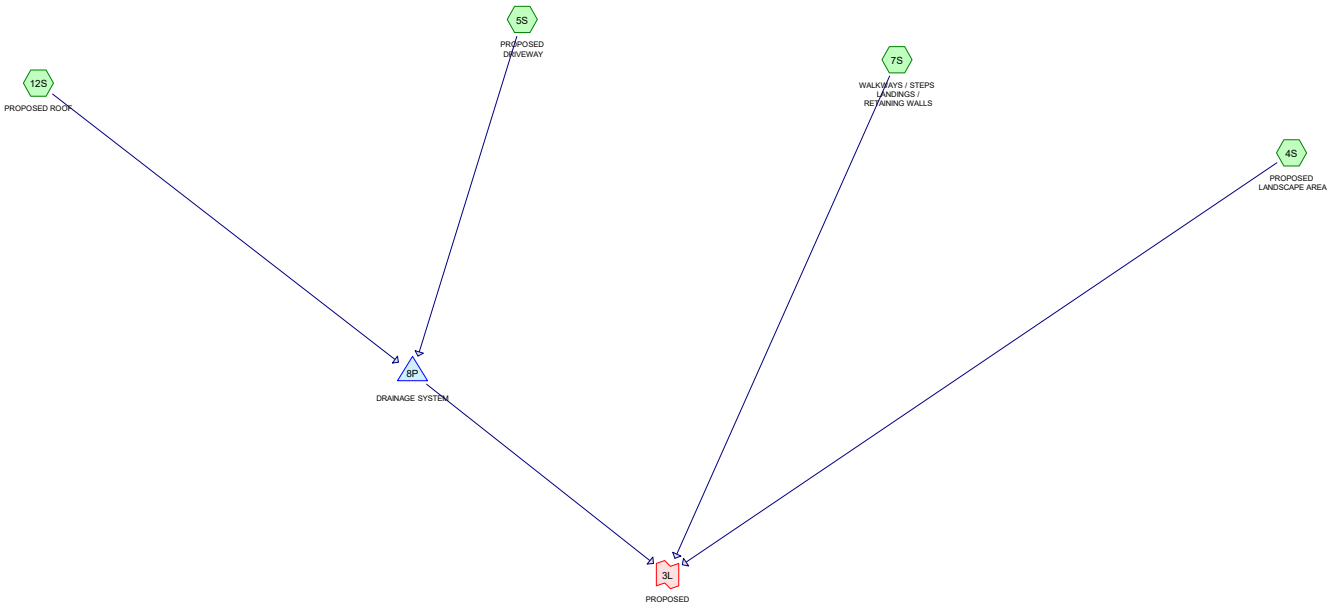
Summary for Link 3L: EXISTING

Inflow Area = 10,845 sf, 19.80% Impervious, Inflow Depth = 3.79" for 100-Year event
Inflow = 1.02 cfs @ 12.08 hrs, Volume= 3,429 cf
Primary = 1.02 cfs @ 12.08 hrs, Volume= 3,429 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs

Link 3L: EXISTING





Subcat Reach Pond Link

Routing Diagram for PROPOSED (130 NONANTUM ROAD)
Prepared by SPRUHAN ENGINEERING, Printed 25/04/2023

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
6,781	49	50-75% Grass cover, Fair, HSG A (4S)
1,183	98	Paved parking, HSG A (5S)
2,410	98	Roofs, HSG A (12S)
471	98	Unconnected pavement, HSG A (7S)
10,845	**67**	**TOTAL AREA**

Summary for Subcatchment 4S: PROPOSED LANDSCAPE AREA

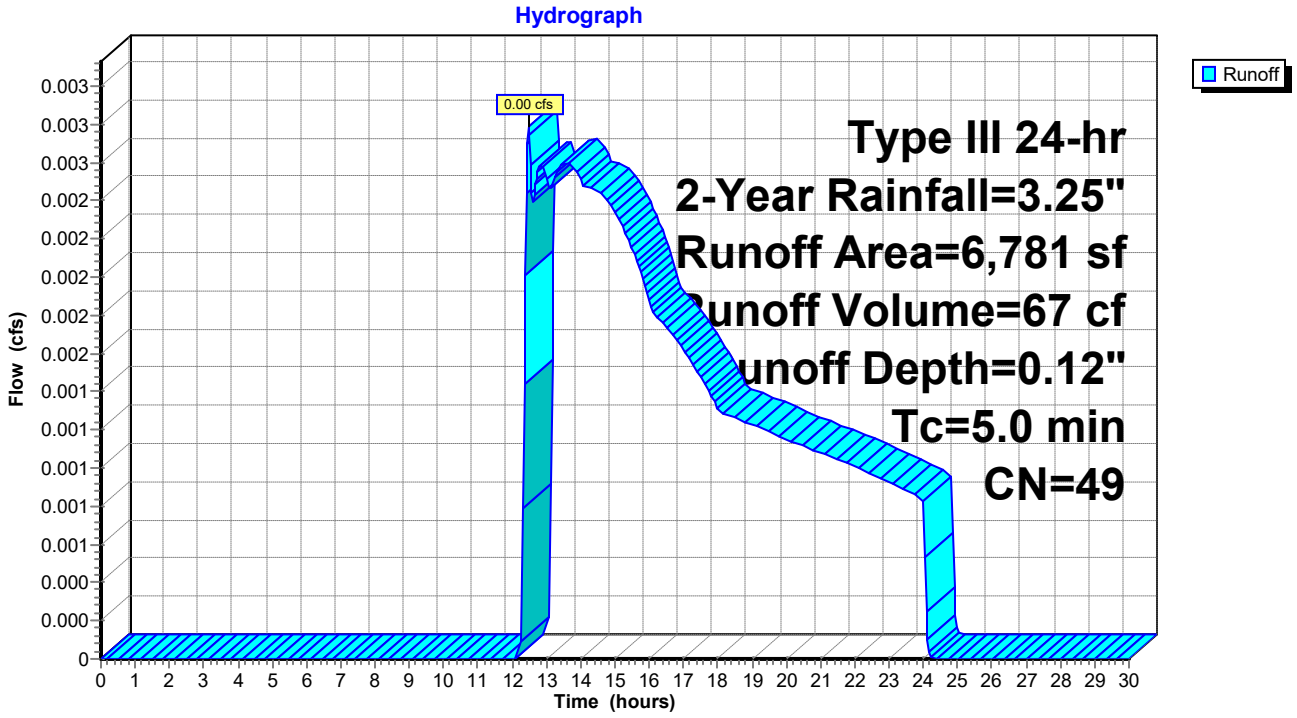
Runoff = 0.00 cfs @ 12.48 hrs, Volume= 67 cf, Depth= 0.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-Year Rainfall=3.25"

Area (sf)	CN	Description
6,781	49	50-75% Grass cover, Fair, HSG A
6,781		100.00% Pervious Area

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

Subcatchment 4S: PROPOSED LANDSCAPE AREA



Summary for Subcatchment 5S: PROPOSED DRIVEWAY

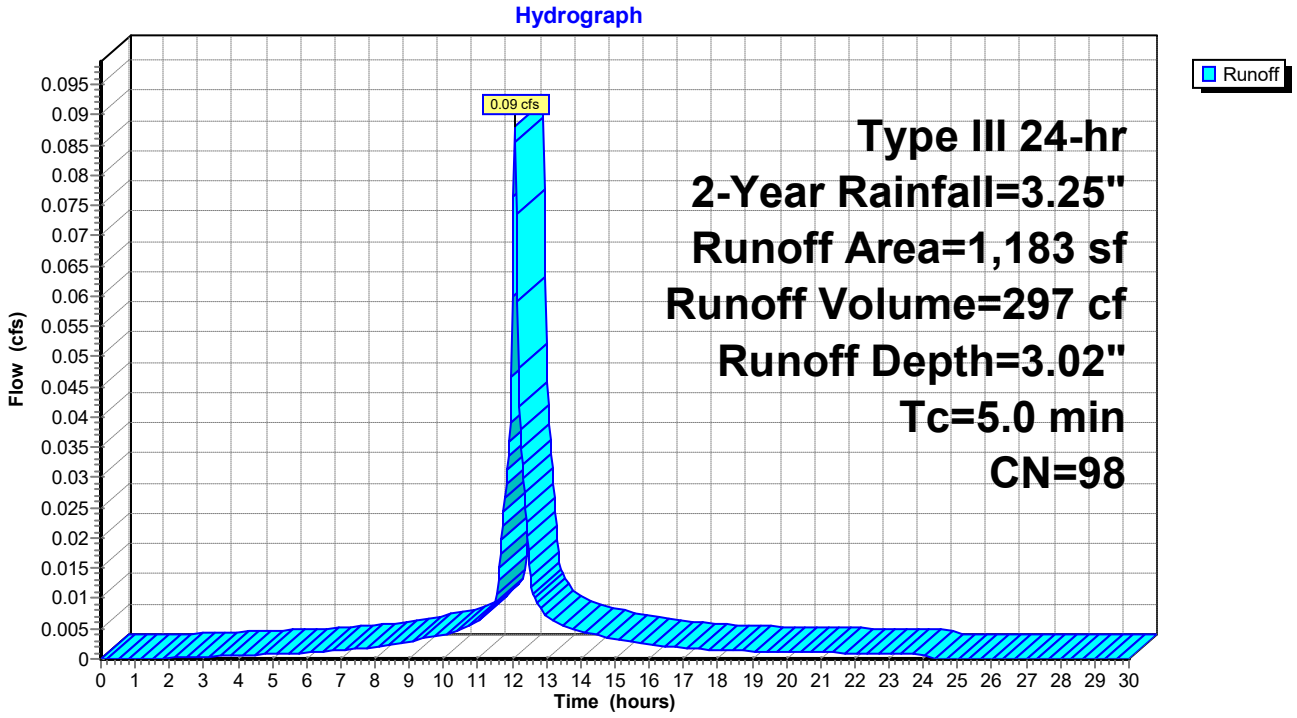
Runoff = 0.09 cfs @ 12.07 hrs, Volume= 297 cf, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-Year Rainfall=3.25"

Area (sf)	CN	Description
1,183	98	Paved parking, HSG A
1,183		100.00% Impervious Area

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

Subcatchment 5S: PROPOSED DRIVEWAY



Summary for Subcatchment 7S: WALKWAYS / STEPS LANDINGS / RETAINING WALLS

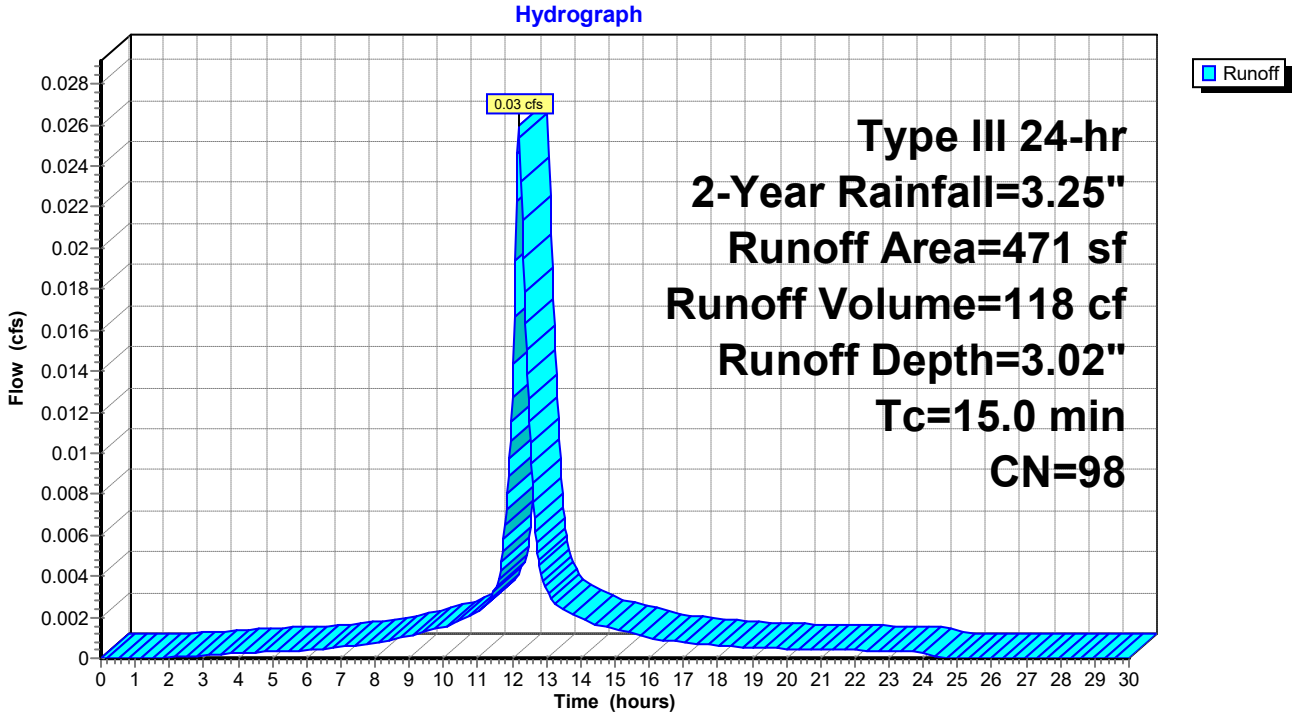
Runoff = 0.03 cfs @ 12.20 hrs, Volume= 118 cf, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-Year Rainfall=3.25"

Area (sf)	CN	Description
471	98	Unconnected pavement, HSG A
471		100.00% Impervious Area
471		100.00% Unconnected

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

Subcatchment 7S: WALKWAYS / STEPS LANDINGS / RETAINING WALLS



Summary for Subcatchment 12S: PROPOSED ROOF

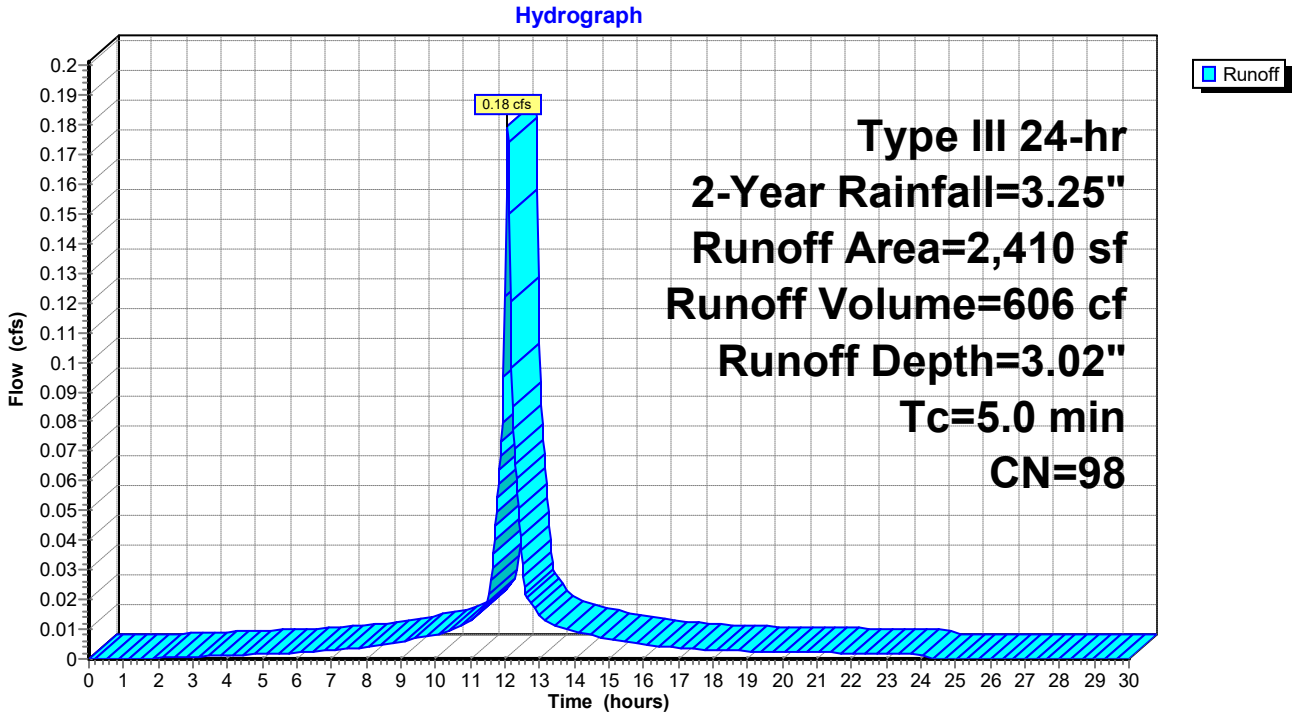
Runoff = 0.18 cfs @ 12.07 hrs, Volume= 606 cf, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-Year Rainfall=3.25"

Area (sf)	CN	Description
2,410	98	Roofs, HSG A
2,410		100.00% Impervious Area

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

Subcatchment 12S: PROPOSED ROOF



Summary for Pond 8P: DRAINAGE SYSTEM

Inflow Area = 3,593 sf,100.00% Impervious, Inflow Depth = 3.02" for 2-Year event
Inflow = 0.27 cfs @ 12.07 hrs, Volume= 903 cf
Outflow = 0.06 cfs @ 11.76 hrs, Volume= 903 cf, Atten= 78%, Lag= 0.0 min
Discarded = 0.06 cfs @ 11.76 hrs, Volume= 903 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs / 4
Peak Elev= 19.07' @ 12.46 hrs Surf.Area= 308 sf Storage= 193 cf

Plug-Flow detention time= 16.9 min calculated for 902 cf (100% of inflow)
Center-of-Mass det. time= 16.8 min (772.0 - 755.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	17.50'	543 cf	**14.00'W x 22.02'L x 5.00'H Field A** 1,542 cf Overall - 184 cf Embedded = 1,358 cf x 40.0% Voids
#2A	19.50'	184 cf	**ADS_StormTech SC-740 +Cap** x 4 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 4 Chambers in 2 Rows
#3	22.50'	10 cf	**Ponding** Listed below -Impervious
		737 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Cum.Store (cubic-feet)
22.50	0
24.50	5
24.70	10

Device	Routing	Invert	Outlet Devices
#1	Discarded	17.50'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	22.40'	**6.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.06 cfs @ 11.76 hrs HW=17.58' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=17.50' (Free Discharge)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 8P: DRAINAGE SYSTEM - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

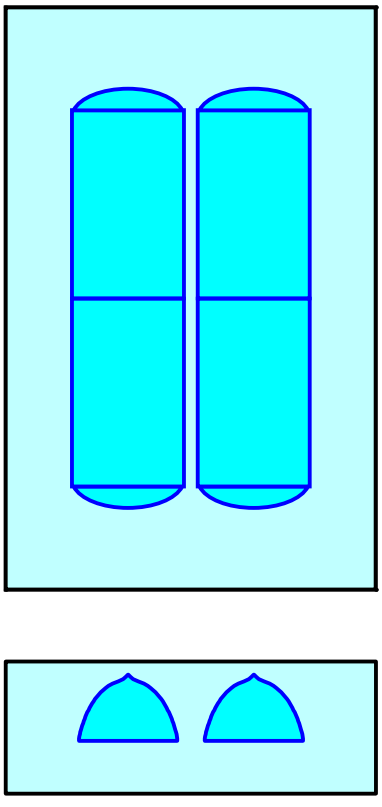
2 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 15.86' Row Length +37.0" End Stone x 2 = 22.02' Base Length
2 Rows x 51.0" Wide + 6.0" Spacing x 1 + 30.0" Side Stone x 2 = 14.00' Base Width
24.0" Base + 30.0" Chamber Height + 6.0" Cover = 5.00' Field Height

4 Chambers x 45.9 cf = 183.8 cf Chamber Storage

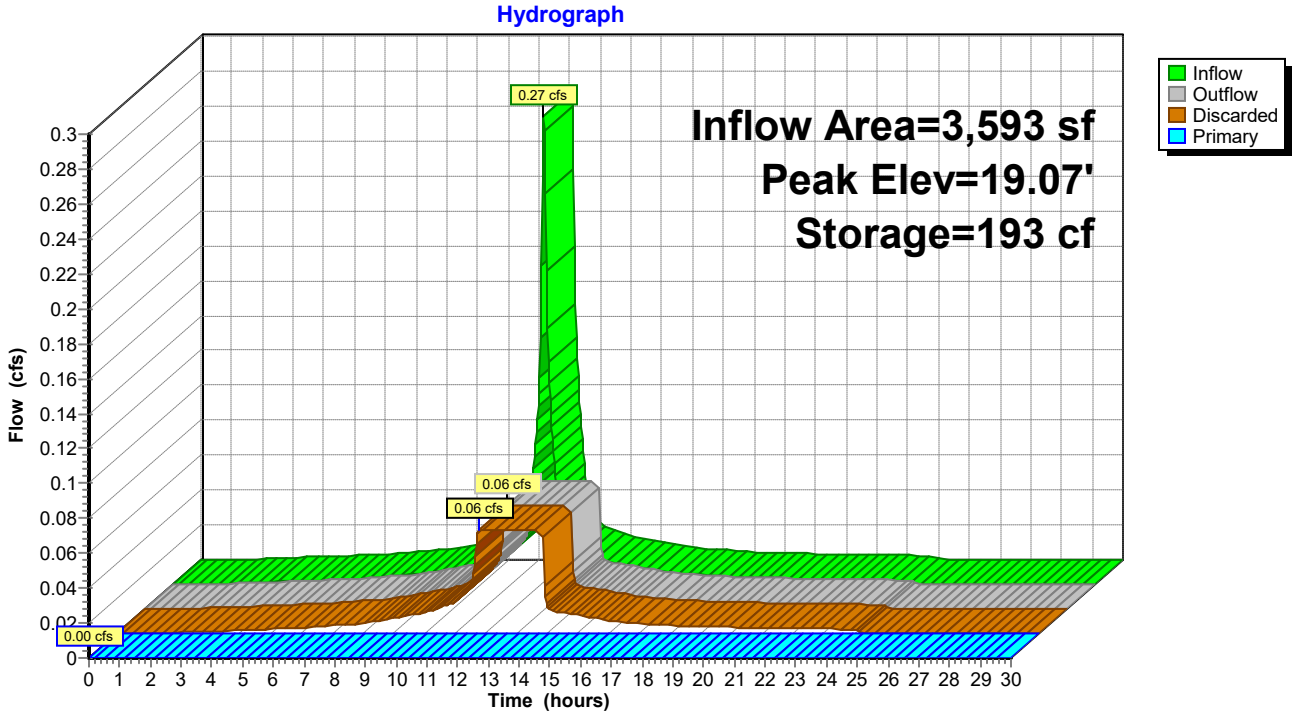
1,541.6 cf Field - 183.8 cf Chambers = 1,357.9 cf Stone x 40.0% Voids = 543.1 cf Stone Storage

Chamber Storage + Stone Storage = 726.9 cf = 0.017 af
Overall Storage Efficiency = 47.2%
Overall System Size = 22.02' x 14.00' x 5.00'

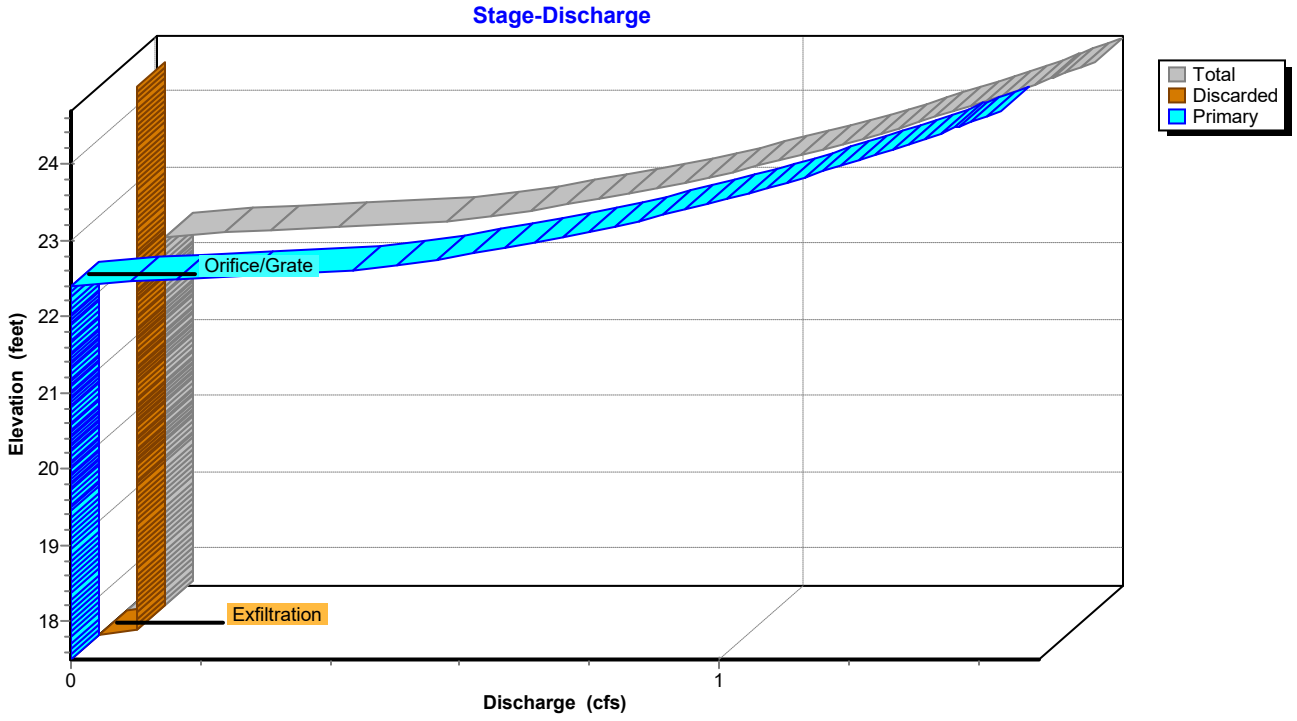
4 Chambers
57.1 cy Field
50.3 cy Stone



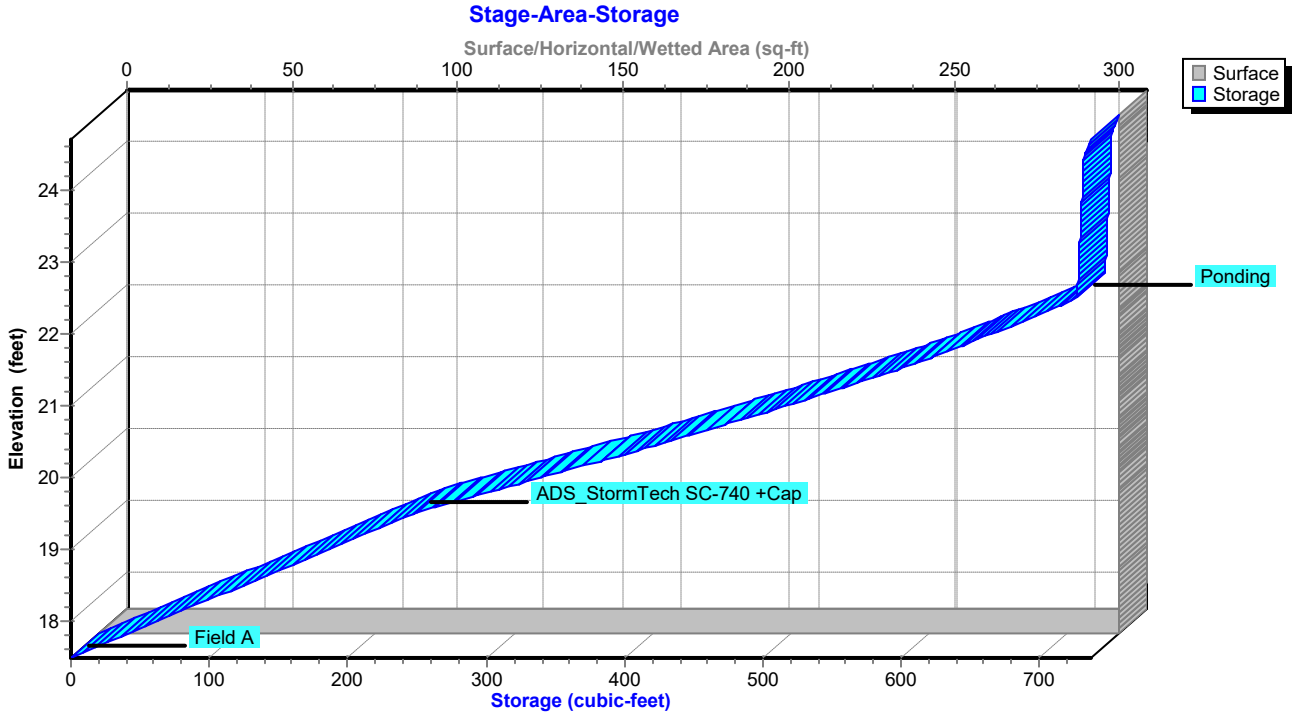
Pond 8P: DRAINAGE SYSTEM



Pond 8P: DRAINAGE SYSTEM



Pond 8P: DRAINAGE SYSTEM

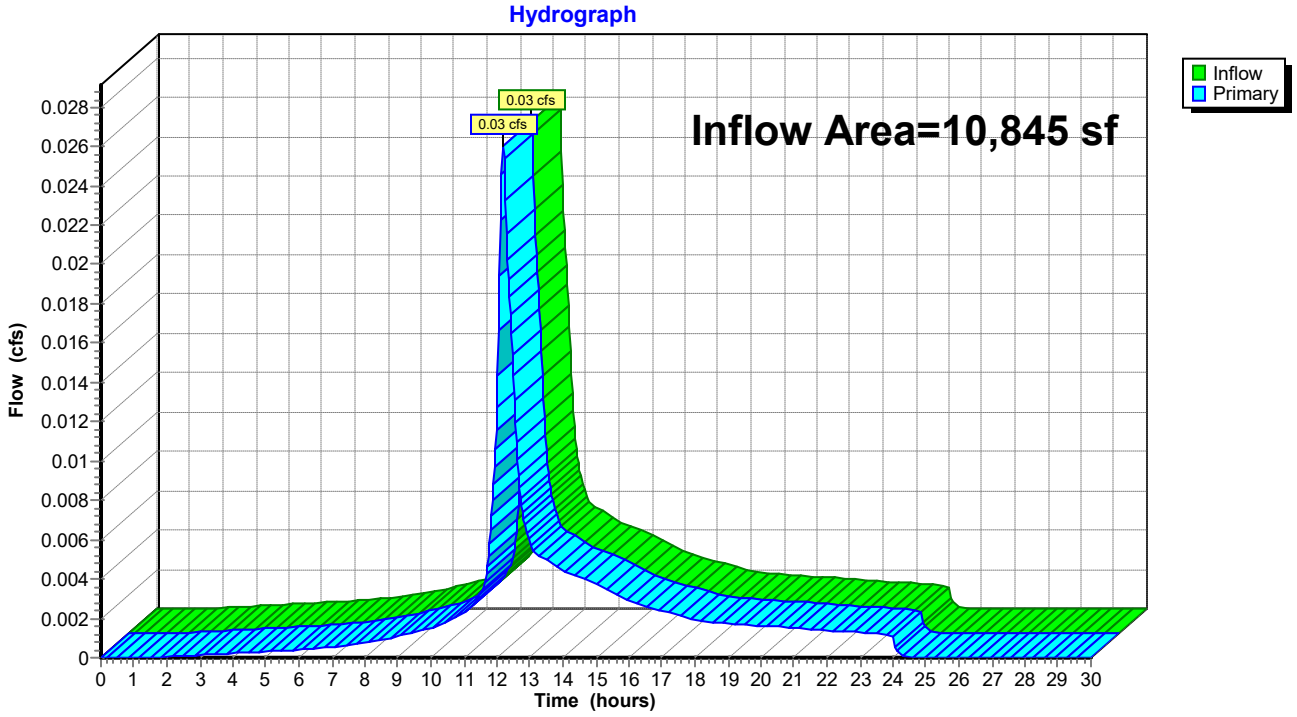


Summary for Link 3L: PROPOSED

Inflow Area = 10,845 sf, 37.47% Impervious, Inflow Depth = 0.20" for 2-Year event
Inflow = 0.03 cfs @ 12.20 hrs, Volume= 185 cf
Primary = 0.03 cfs @ 12.20 hrs, Volume= 185 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs

Link 3L: PROPOSED



Summary for Subcatchment 4S: PROPOSED LANDSCAPE AREA

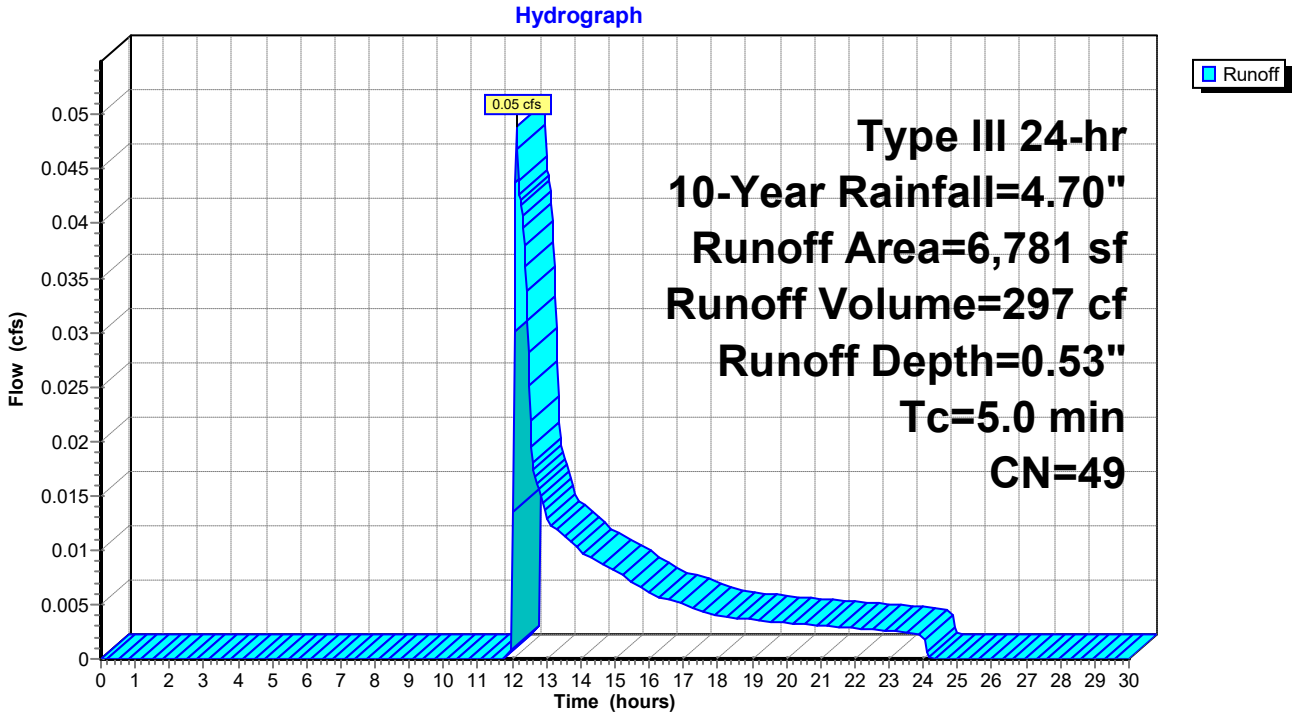
Runoff = 0.05 cfs @ 12.13 hrs, Volume= 297 cf, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
6,781	49	50-75% Grass cover, Fair, HSG A
6,781		100.00% Pervious Area

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

Subcatchment 4S: PROPOSED LANDSCAPE AREA



Summary for Subcatchment 5S: PROPOSED DRIVEWAY

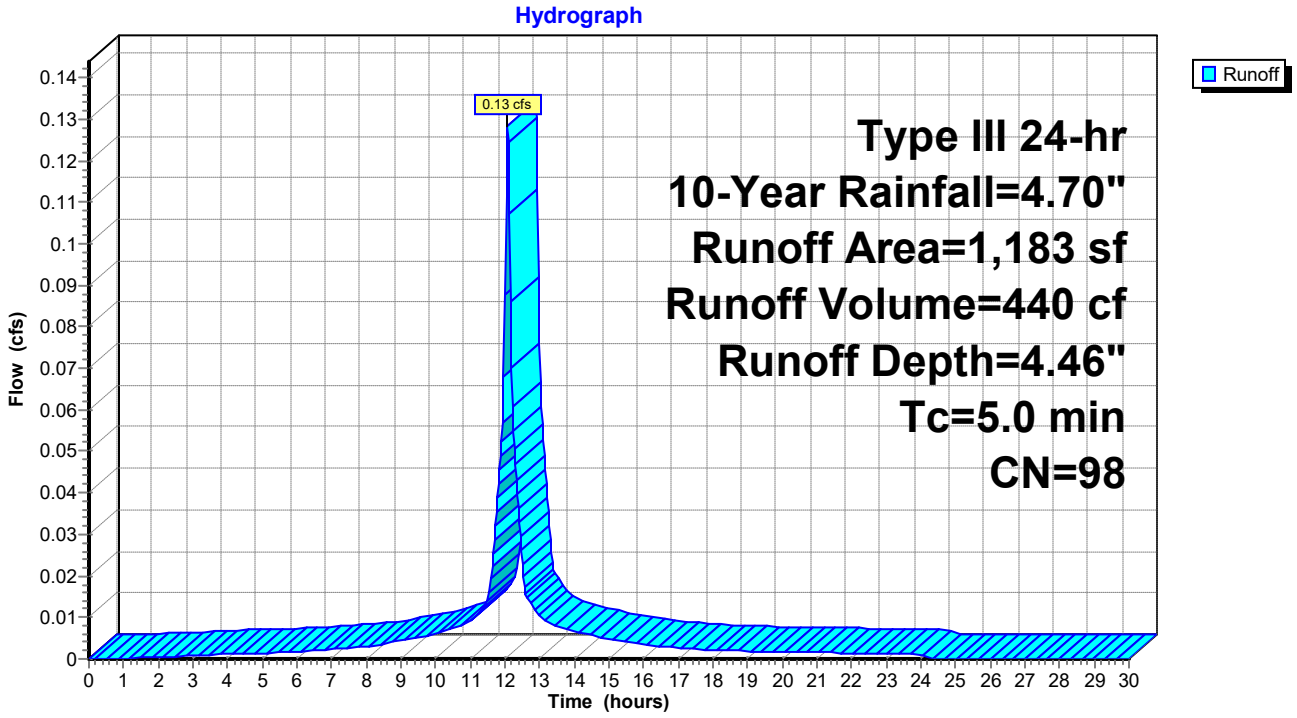
Runoff = 0.13 cfs @ 12.07 hrs, Volume= 440 cf, Depth= 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
1,183	98	Paved parking, HSG A
1,183		100.00% Impervious Area

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

Subcatchment 5S: PROPOSED DRIVEWAY



Summary for Subcatchment 7S: WALKWAYS / STEPS LANDINGS / RETAINING WALLS

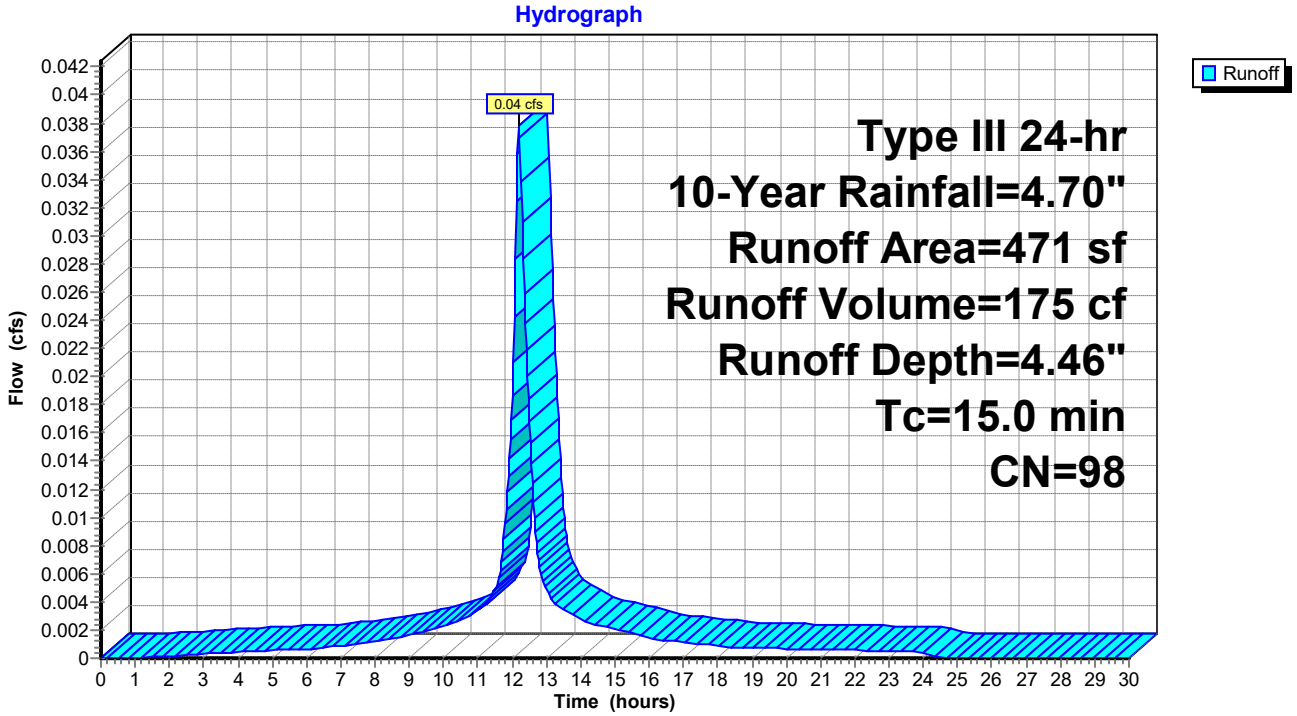
Runoff = 0.04 cfs @ 12.20 hrs, Volume= 175 cf, Depth= 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
471	98	Unconnected pavement, HSG A
471		100.00% Impervious Area
471		100.00% Unconnected

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

Subcatchment 7S: WALKWAYS / STEPS LANDINGS / RETAINING WALLS



Summary for Subcatchment 12S: PROPOSED ROOF

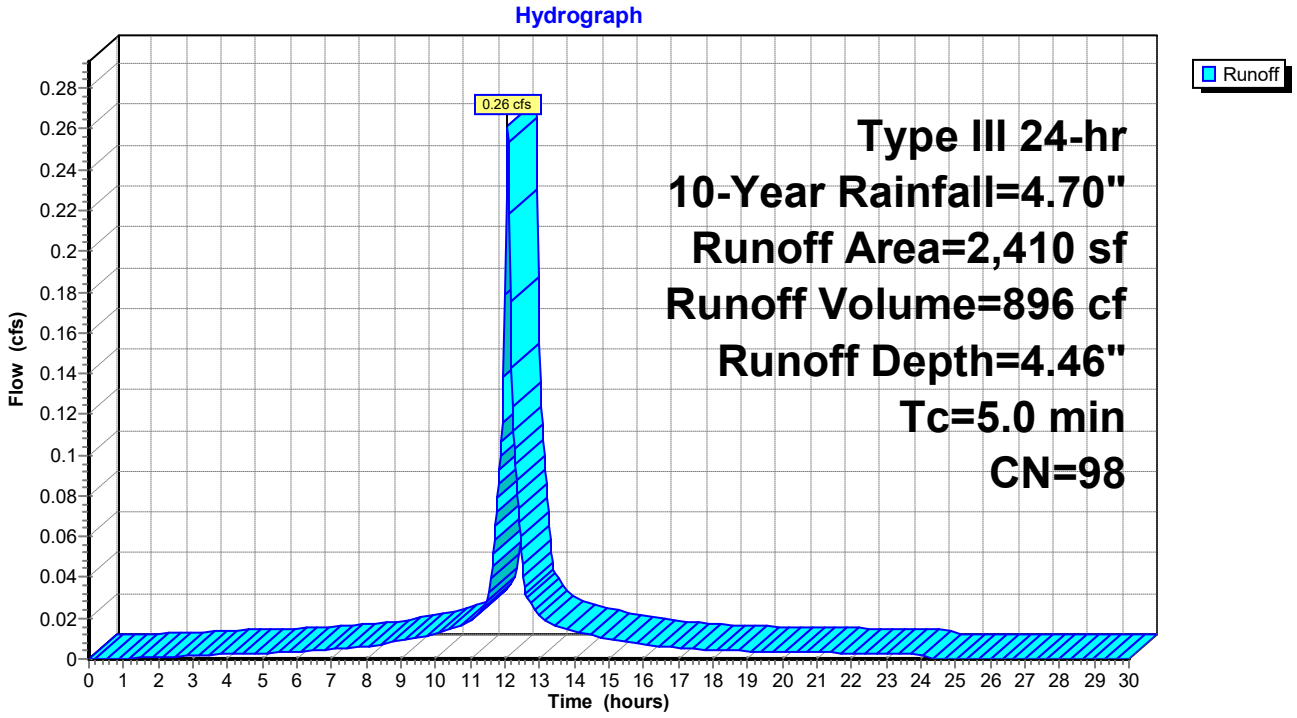
Runoff = 0.26 cfs @ 12.07 hrs, Volume= 896 cf, Depth= 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
2,410	98	Roofs, HSG A
2,410		100.00% Impervious Area

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

Subcatchment 12S: PROPOSED ROOF



Summary for Pond 8P: DRAINAGE SYSTEM

Inflow Area = 3,593 sf,100.00% Impervious, Inflow Depth = 4.46" for 10-Year event
Inflow = 0.39 cfs @ 12.07 hrs, Volume= 1,336 cf
Outflow = 0.06 cfs @ 11.67 hrs, Volume= 1,336 cf, Atten= 85%, Lag= 0.0 min
Discarded = 0.06 cfs @ 11.67 hrs, Volume= 1,336 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs / 4
Peak Elev= 20.11' @ 12.54 hrs Surf.Area= 308 sf Storage= 360 cf

Plug-Flow detention time= 34.4 min calculated for 1,336 cf (100% of inflow)
Center-of-Mass det. time= 34.3 min (782.4 - 748.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	17.50'	543 cf	**14.00'W x 22.02'L x 5.00'H Field A** 1,542 cf Overall - 184 cf Embedded = 1,358 cf x 40.0% Voids
#2A	19.50'	184 cf	**ADS_StormTech SC-740 +Cap** x 4 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 4 Chambers in 2 Rows
#3	22.50'	10 cf	**Ponding** Listed below -Impervious
		737 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Cum.Store (cubic-feet)
22.50	0
24.50	5
24.70	10

Device	Routing	Invert	Outlet Devices
#1	Discarded	17.50'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	22.40'	**6.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.06 cfs @ 11.67 hrs HW=17.58' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=17.50' (Free Discharge)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 8P: DRAINAGE SYSTEM - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

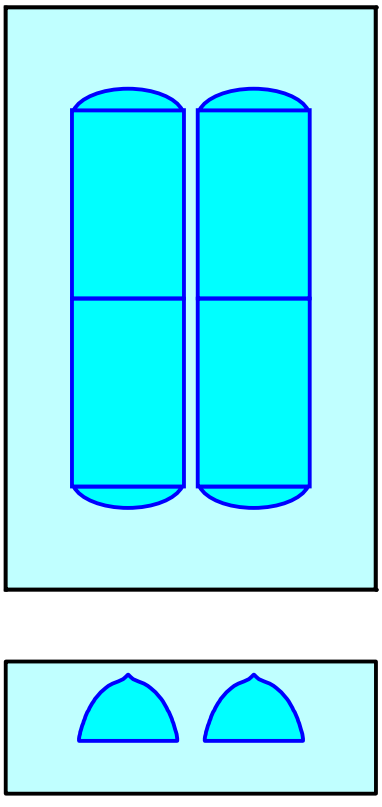
2 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 15.86' Row Length +37.0" End Stone x 2 = 22.02' Base Length
2 Rows x 51.0" Wide + 6.0" Spacing x 1 + 30.0" Side Stone x 2 = 14.00' Base Width
24.0" Base + 30.0" Chamber Height + 6.0" Cover = 5.00' Field Height

4 Chambers x 45.9 cf = 183.8 cf Chamber Storage

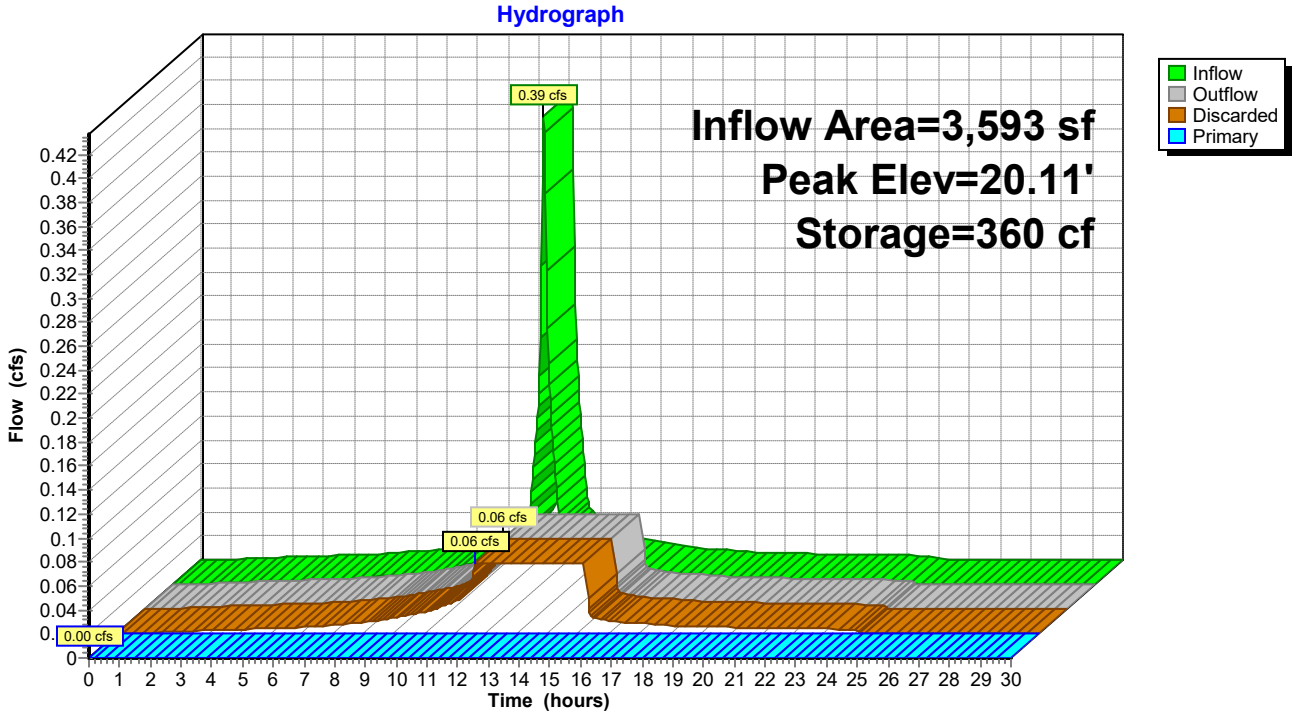
1,541.6 cf Field - 183.8 cf Chambers = 1,357.9 cf Stone x 40.0% Voids = 543.1 cf Stone Storage

Chamber Storage + Stone Storage = 726.9 cf = 0.017 af
Overall Storage Efficiency = 47.2%
Overall System Size = 22.02' x 14.00' x 5.00'

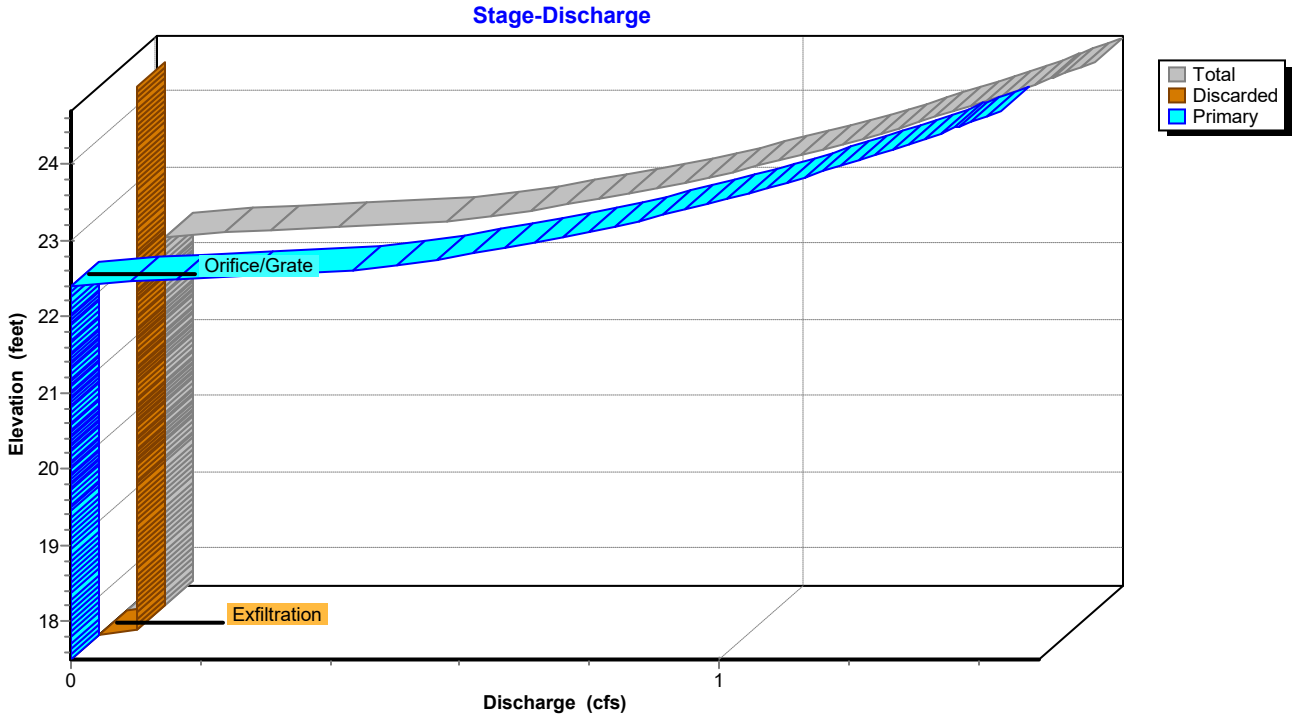
4 Chambers
57.1 cy Field
50.3 cy Stone



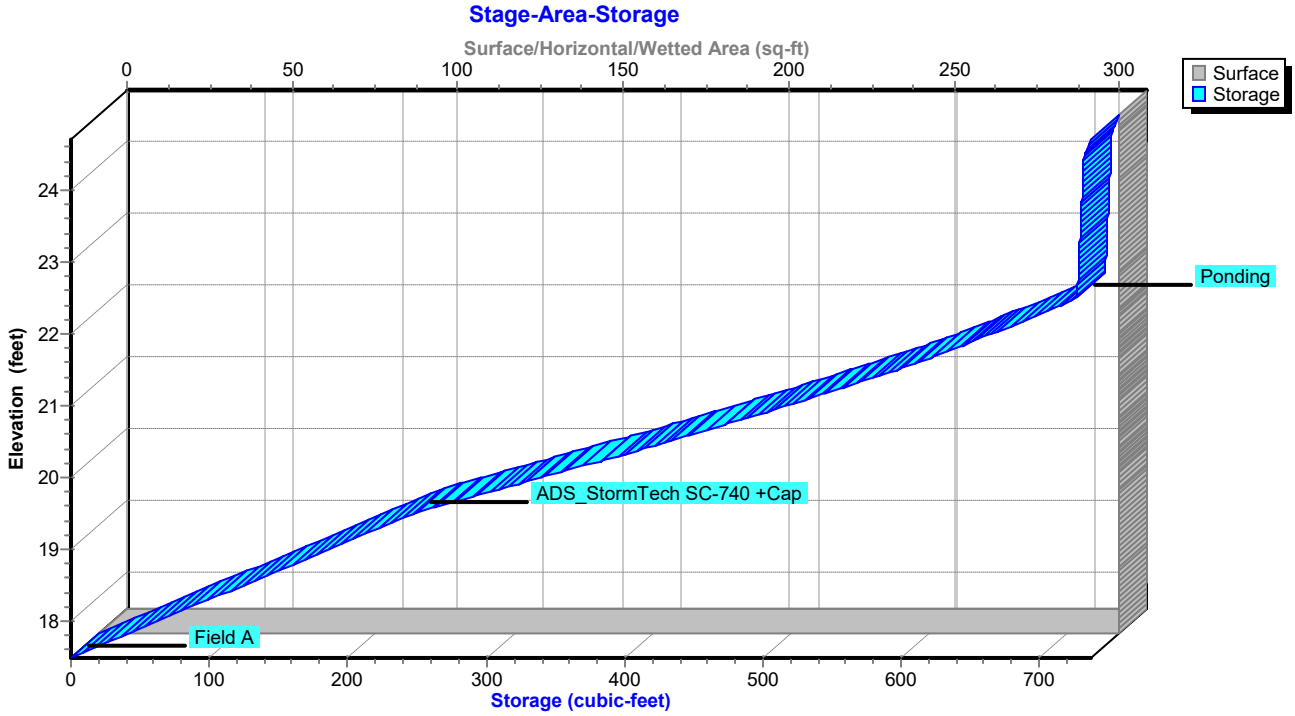
Pond 8P: DRAINAGE SYSTEM



Pond 8P: DRAINAGE SYSTEM



Pond 8P: DRAINAGE SYSTEM

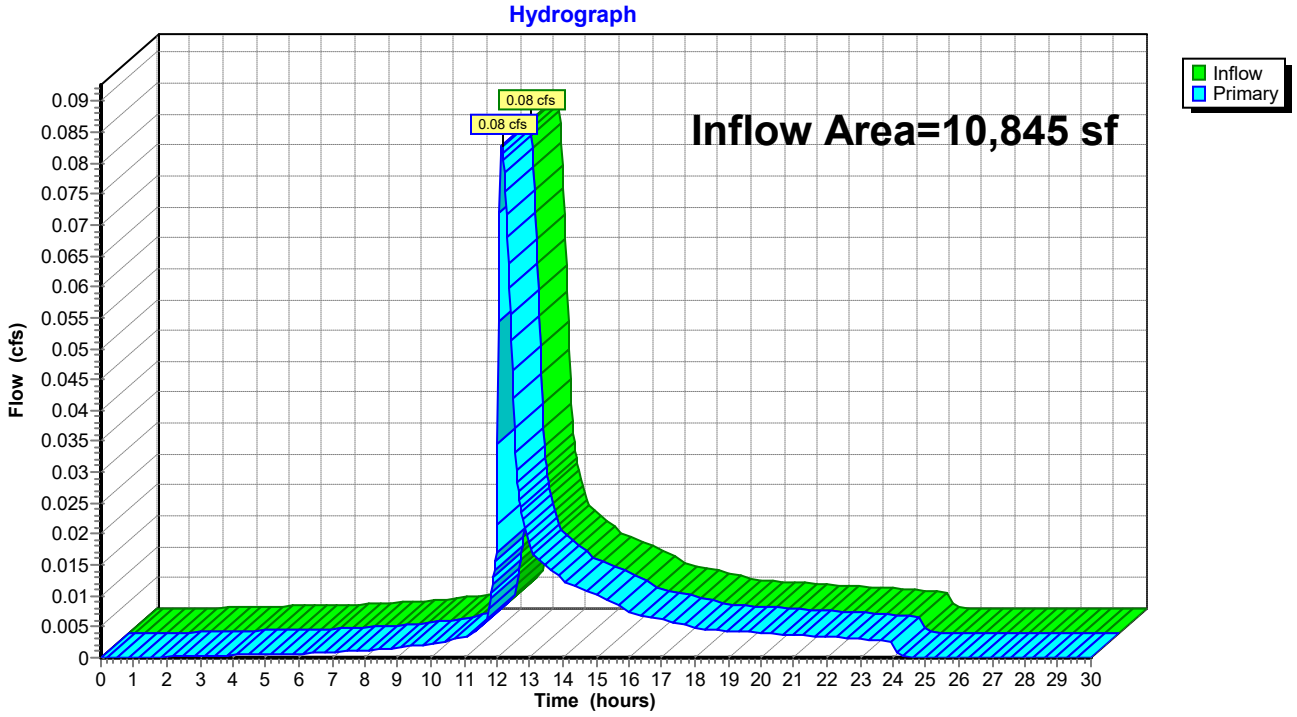


Summary for Link 3L: PROPOSED

Inflow Area = 10,845 sf, 37.47% Impervious, Inflow Depth = 0.52" for 10-Year event
Inflow = 0.08 cfs @ 12.15 hrs, Volume= 473 cf
Primary = 0.08 cfs @ 12.15 hrs, Volume= 473 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs

Link 3L: PROPOSED



Summary for Subcatchment 4S: PROPOSED LANDSCAPE AREA

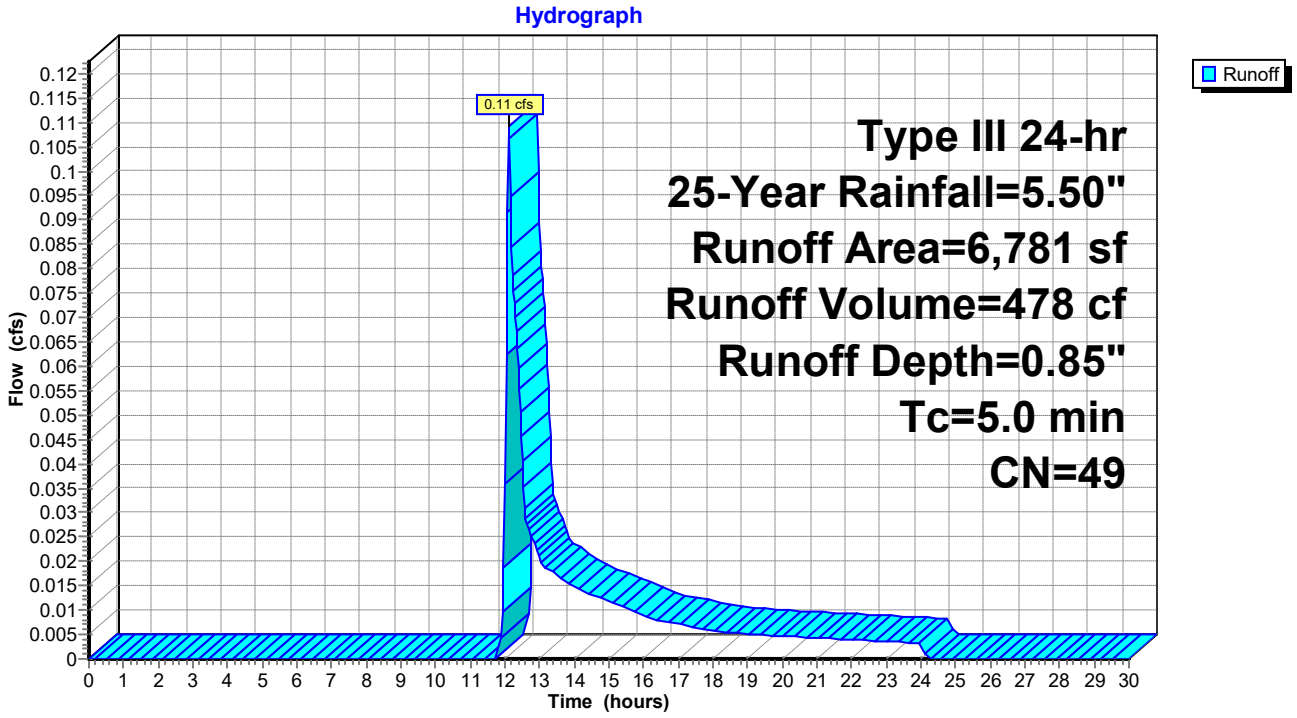
Runoff = 0.11 cfs @ 12.10 hrs, Volume= 478 cf, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
6,781	49	50-75% Grass cover, Fair, HSG A
6,781		100.00% Pervious Area

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

Subcatchment 4S: PROPOSED LANDSCAPE AREA



Summary for Subcatchment 5S: PROPOSED DRIVEWAY

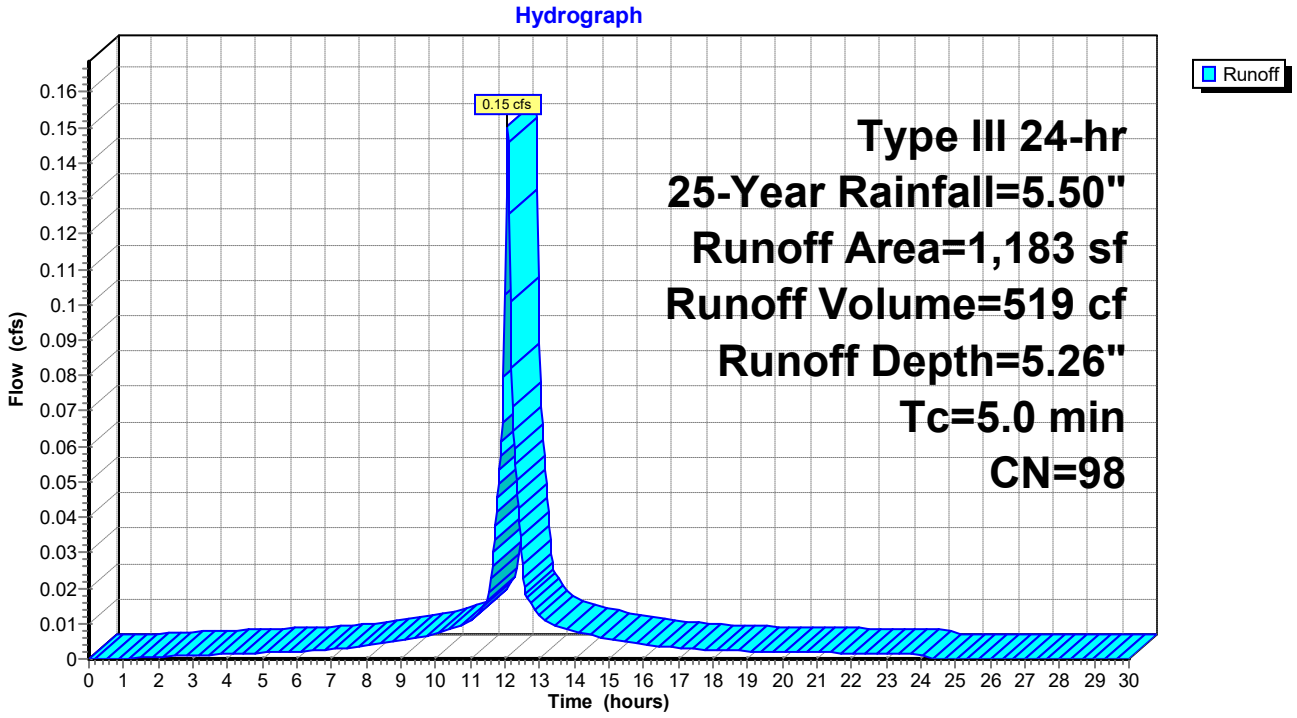
Runoff = 0.15 cfs @ 12.07 hrs, Volume= 519 cf, Depth= 5.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
1,183	98	Paved parking, HSG A
1,183		100.00% Impervious Area

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

Subcatchment 5S: PROPOSED DRIVEWAY



Summary for Subcatchment 7S: WALKWAYS / STEPS LANDINGS / RETAINING WALLS

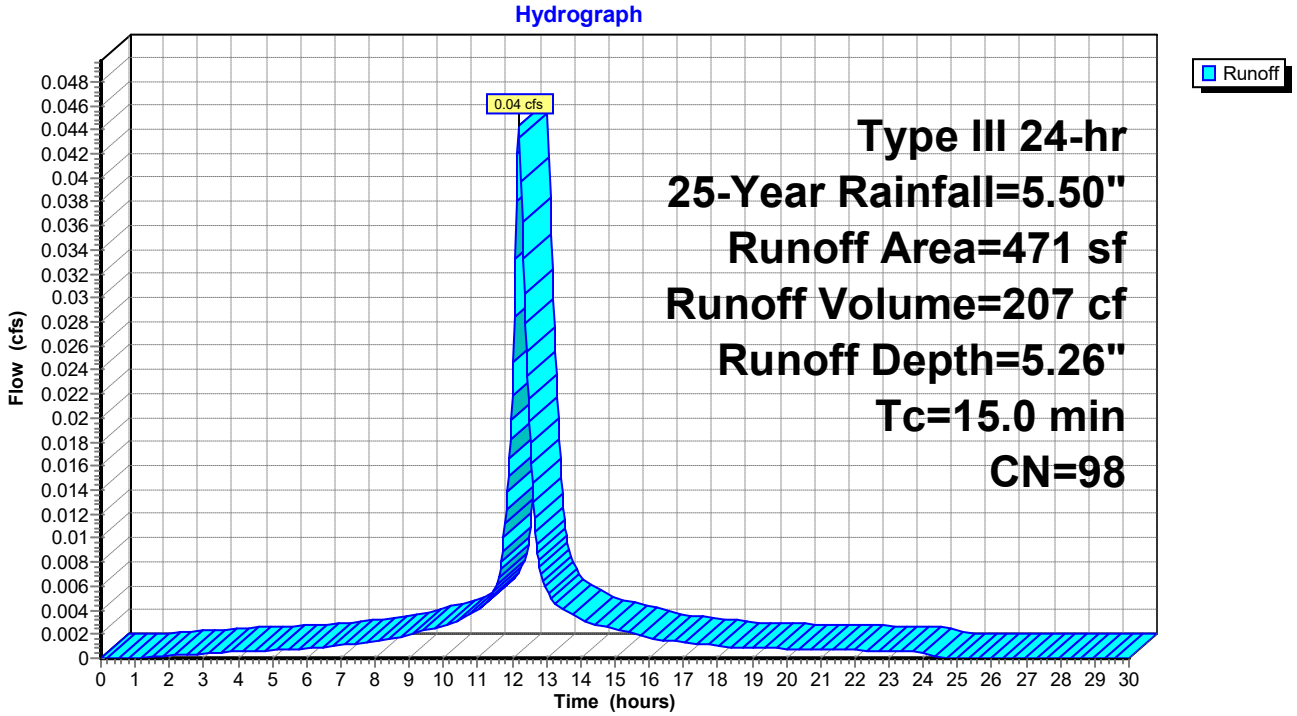
Runoff = 0.04 cfs @ 12.20 hrs, Volume= 207 cf, Depth= 5.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
471	98	Unconnected pavement, HSG A
471		100.00% Impervious Area
471		100.00% Unconnected

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

Subcatchment 7S: WALKWAYS / STEPS LANDINGS / RETAINING WALLS



Summary for Subcatchment 12S: PROPOSED ROOF

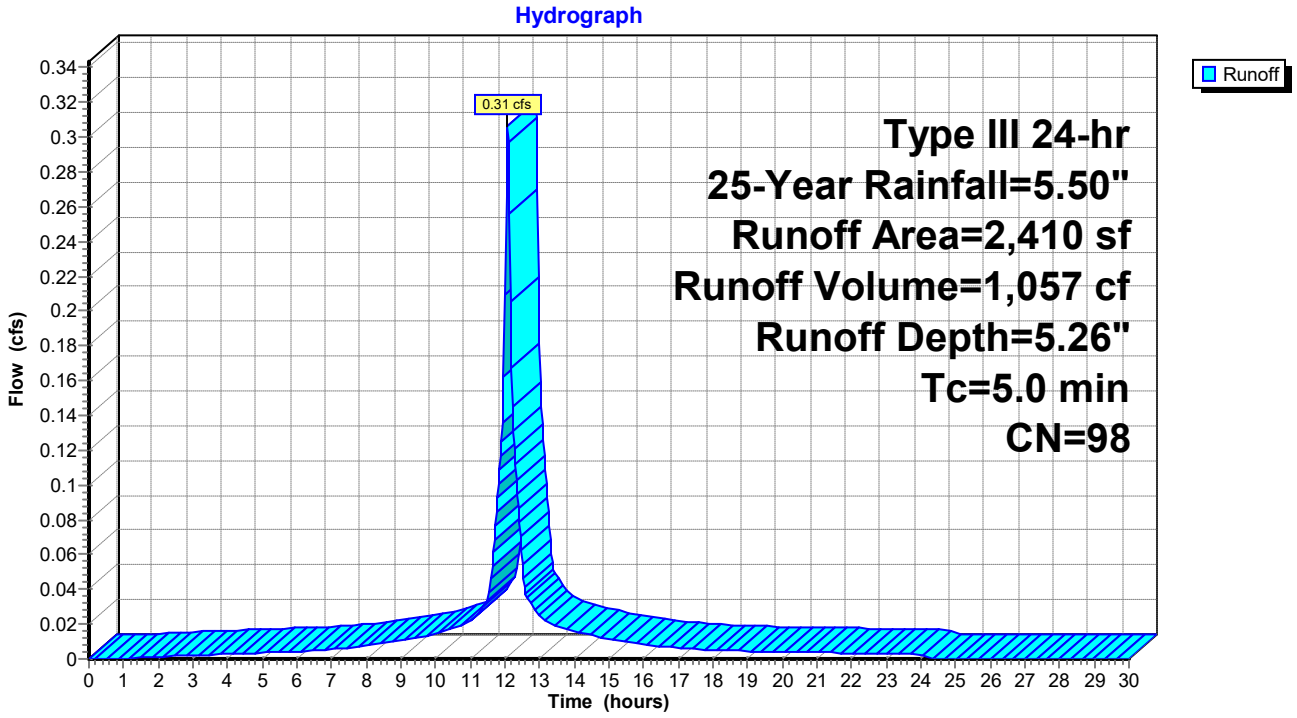
Runoff = 0.31 cfs @ 12.07 hrs, Volume= 1,057 cf, Depth= 5.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
2,410	98	Roofs, HSG A
2,410		100.00% Impervious Area

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

Subcatchment 12S: PROPOSED ROOF



Summary for Pond 8P: DRAINAGE SYSTEM

Inflow Area = 3,593 sf,100.00% Impervious, Inflow Depth = 5.26" for 25-Year event
Inflow = 0.46 cfs @ 12.07 hrs, Volume= 1,576 cf
Outflow = 0.06 cfs @ 11.61 hrs, Volume= 1,576 cf, Atten= 87%, Lag= 0.0 min
Discarded = 0.06 cfs @ 11.61 hrs, Volume= 1,576 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs / 4
Peak Elev= 20.65' @ 12.58 hrs Surf.Area= 308 sf Storage= 456 cf

Plug-Flow detention time= 45.8 min calculated for 1,574 cf (100% of inflow)
Center-of-Mass det. time= 45.8 min (791.4 - 745.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	17.50'	543 cf	**14.00'W x 22.02'L x 5.00'H Field A** 1,542 cf Overall - 184 cf Embedded = 1,358 cf x 40.0% Voids
#2A	19.50'	184 cf	**ADS_StormTech SC-740 +Cap** x 4 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 4 Chambers in 2 Rows
#3	22.50'	10 cf	**Ponding** Listed below -Impervious
		737 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Cum.Store (cubic-feet)
22.50	0
24.50	5
24.70	10

Device	Routing	Invert	Outlet Devices
#1	Discarded	17.50'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	22.40'	**6.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.06 cfs @ 11.61 hrs HW=17.57' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=17.50' (Free Discharge)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 8P: DRAINAGE SYSTEM - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

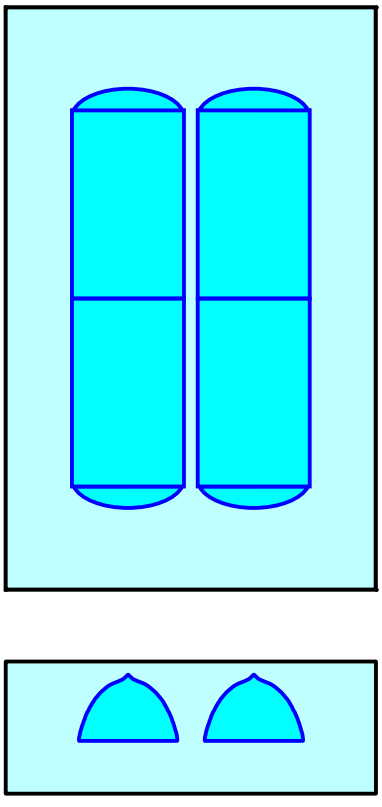
2 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 15.86' Row Length +37.0" End Stone x 2 = 22.02' Base Length
2 Rows x 51.0" Wide + 6.0" Spacing x 1 + 30.0" Side Stone x 2 = 14.00' Base Width
24.0" Base + 30.0" Chamber Height + 6.0" Cover = 5.00' Field Height

4 Chambers x 45.9 cf = 183.8 cf Chamber Storage

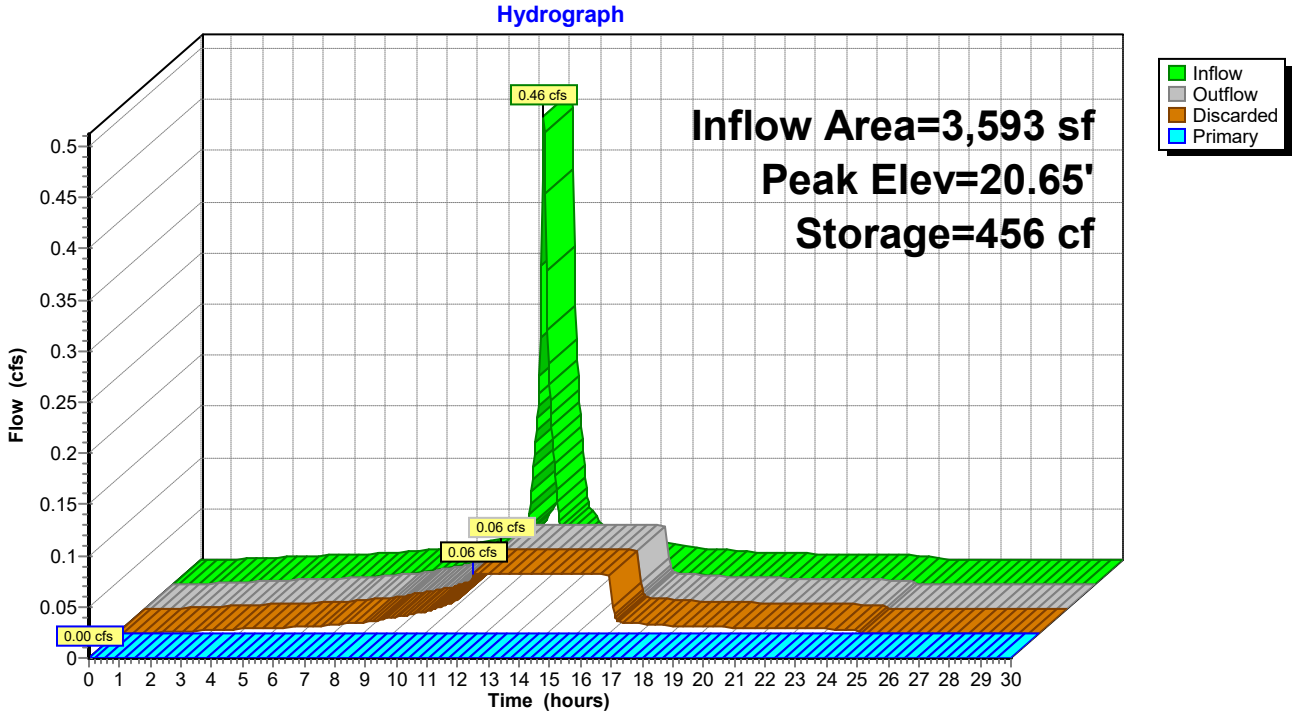
1,541.6 cf Field - 183.8 cf Chambers = 1,357.9 cf Stone x 40.0% Voids = 543.1 cf Stone Storage

Chamber Storage + Stone Storage = 726.9 cf = 0.017 af
Overall Storage Efficiency = 47.2%
Overall System Size = 22.02' x 14.00' x 5.00'

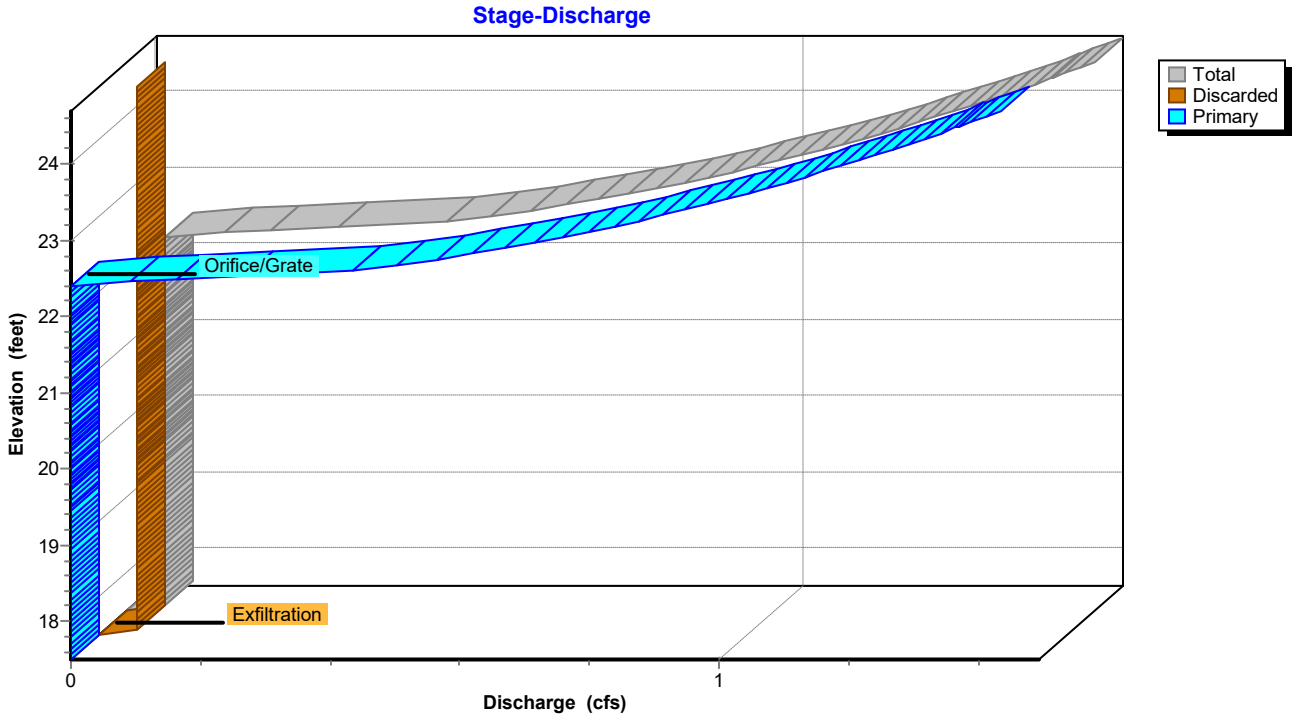
4 Chambers
57.1 cy Field
50.3 cy Stone



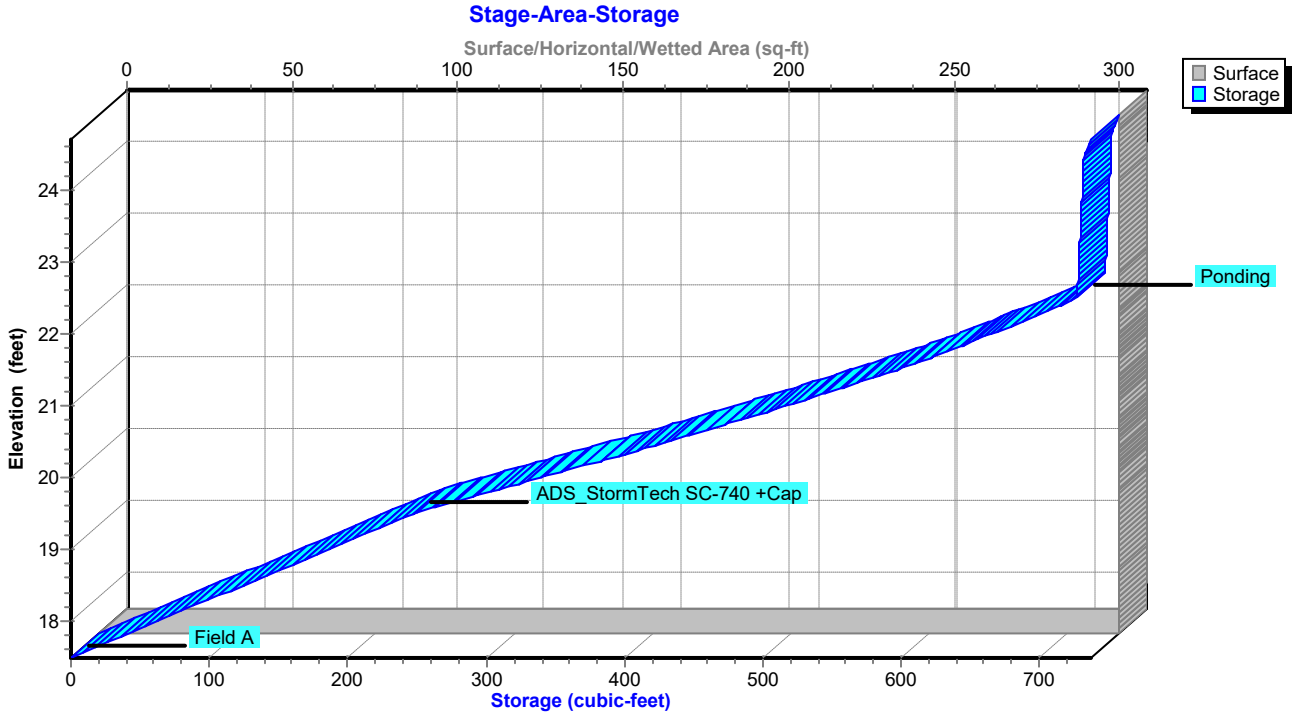
Pond 8P: DRAINAGE SYSTEM



Pond 8P: DRAINAGE SYSTEM



Pond 8P: DRAINAGE SYSTEM

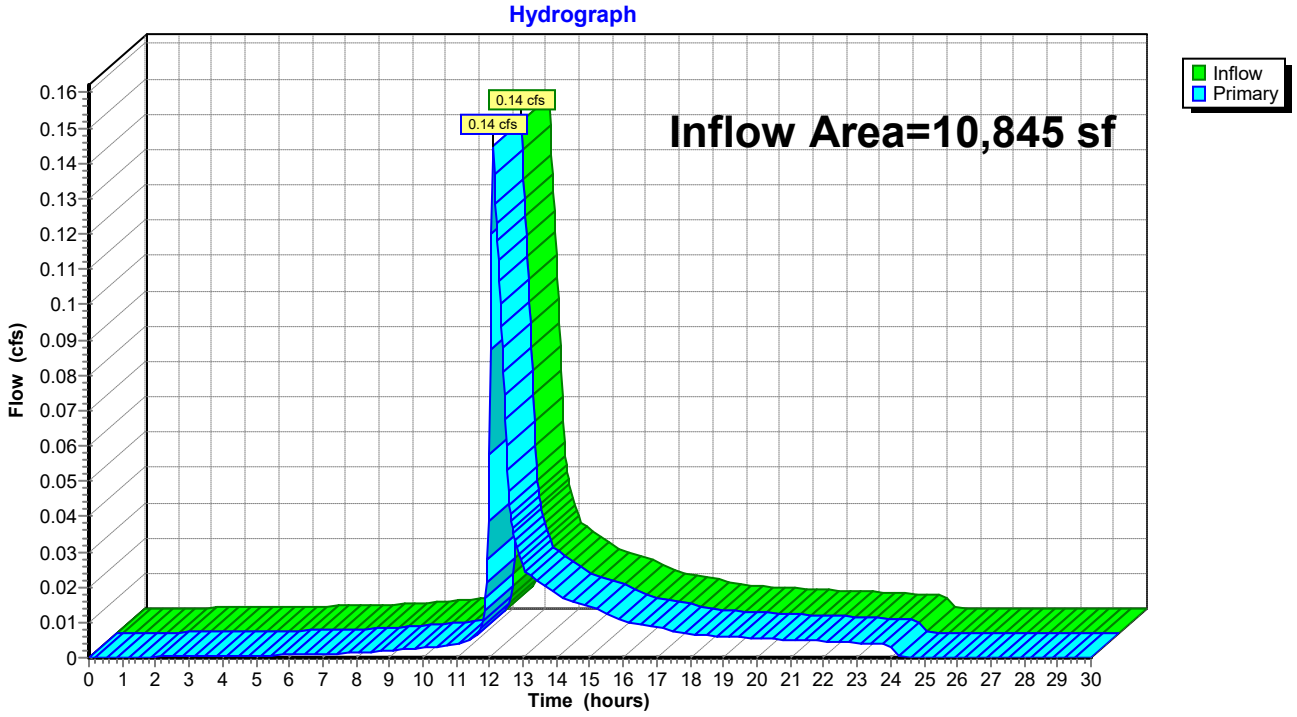


Summary for Link 3L: PROPOSED

Inflow Area = 10,845 sf, 37.47% Impervious, Inflow Depth = 0.76" for 25-Year event
Inflow = 0.14 cfs @ 12.11 hrs, Volume= 684 cf
Primary = 0.14 cfs @ 12.11 hrs, Volume= 684 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs

Link 3L: PROPOSED



Summary for Subcatchment 4S: PROPOSED LANDSCAPE AREA

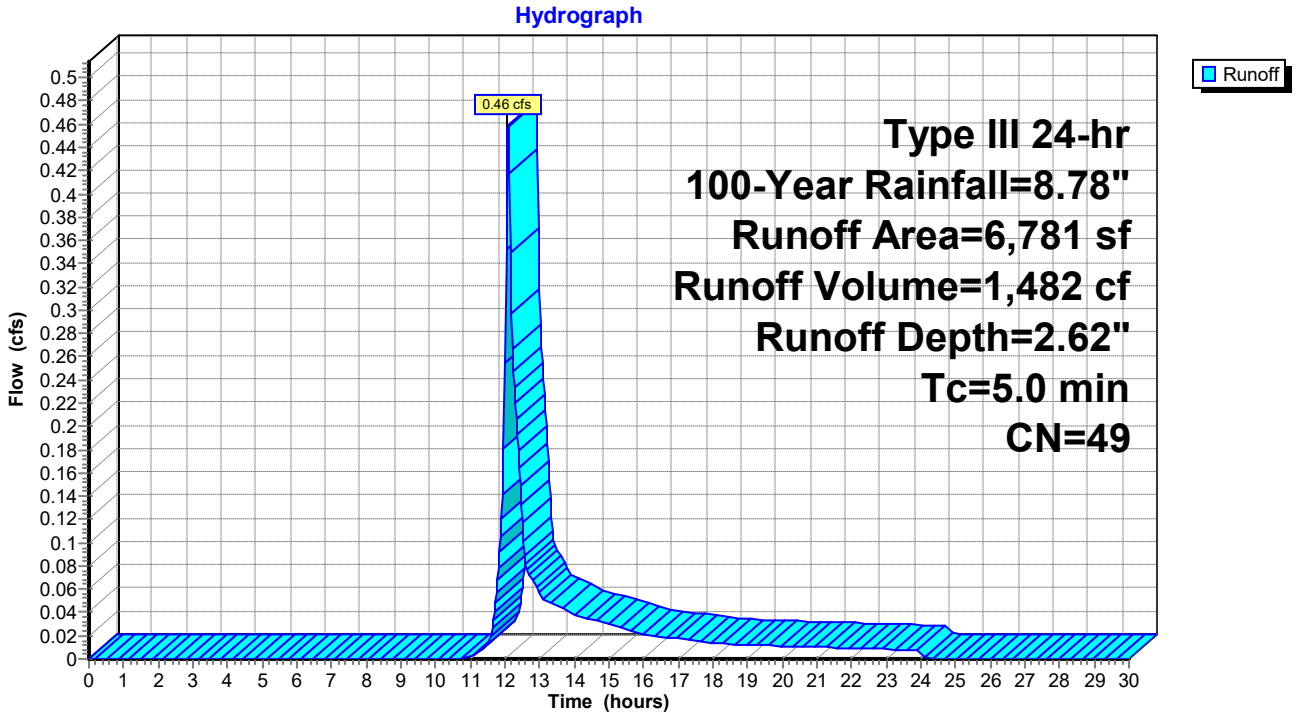
Runoff = 0.46 cfs @ 12.08 hrs, Volume= 1,482 cf, Depth= 2.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 100-Year Rainfall=8.78"

Area (sf)	CN	Description
6,781	49	50-75% Grass cover, Fair, HSG A
6,781		100.00% Pervious Area

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

Subcatchment 4S: PROPOSED LANDSCAPE AREA



Summary for Subcatchment 5S: PROPOSED DRIVEWAY

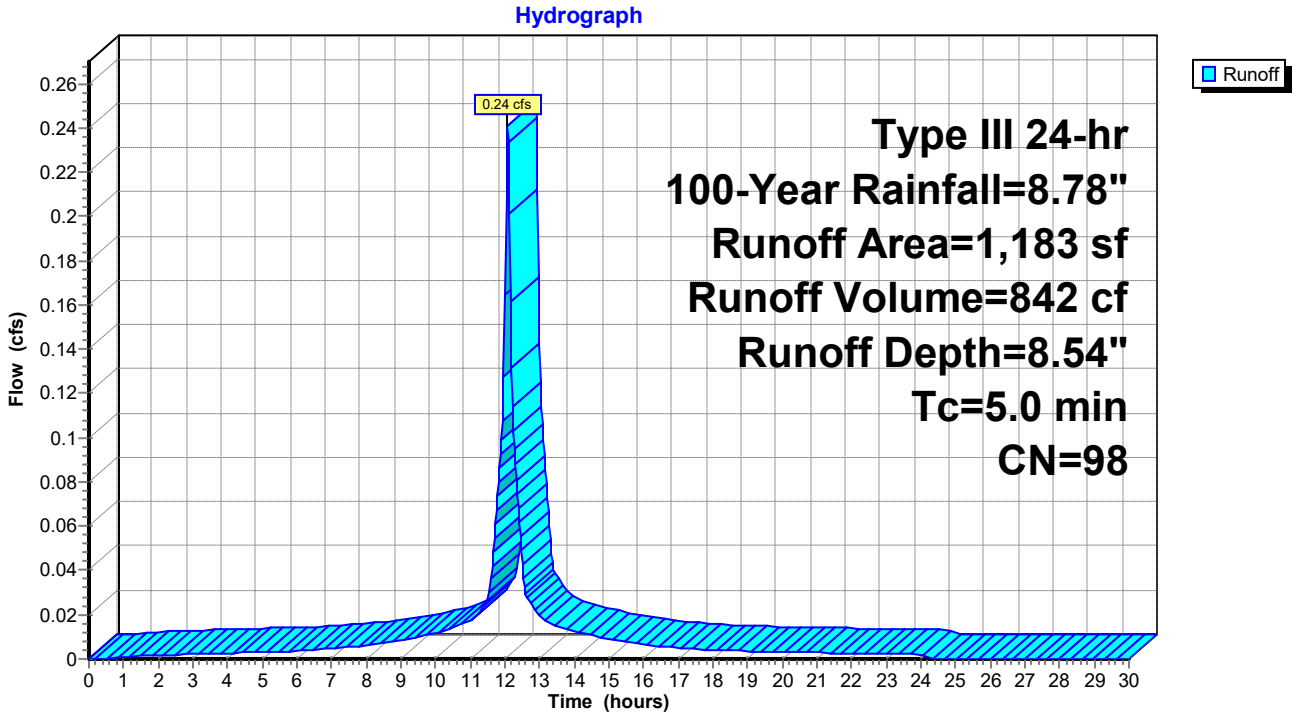
Runoff = 0.24 cfs @ 12.07 hrs, Volume= 842 cf, Depth= 8.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 100-Year Rainfall=8.78"

Area (sf)	CN	Description
1,183	98	Paved parking, HSG A
1,183		100.00% Impervious Area

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

Subcatchment 5S: PROPOSED DRIVEWAY



Summary for Subcatchment 7S: WALKWAYS / STEPS LANDINGS / RETAINING WALLS

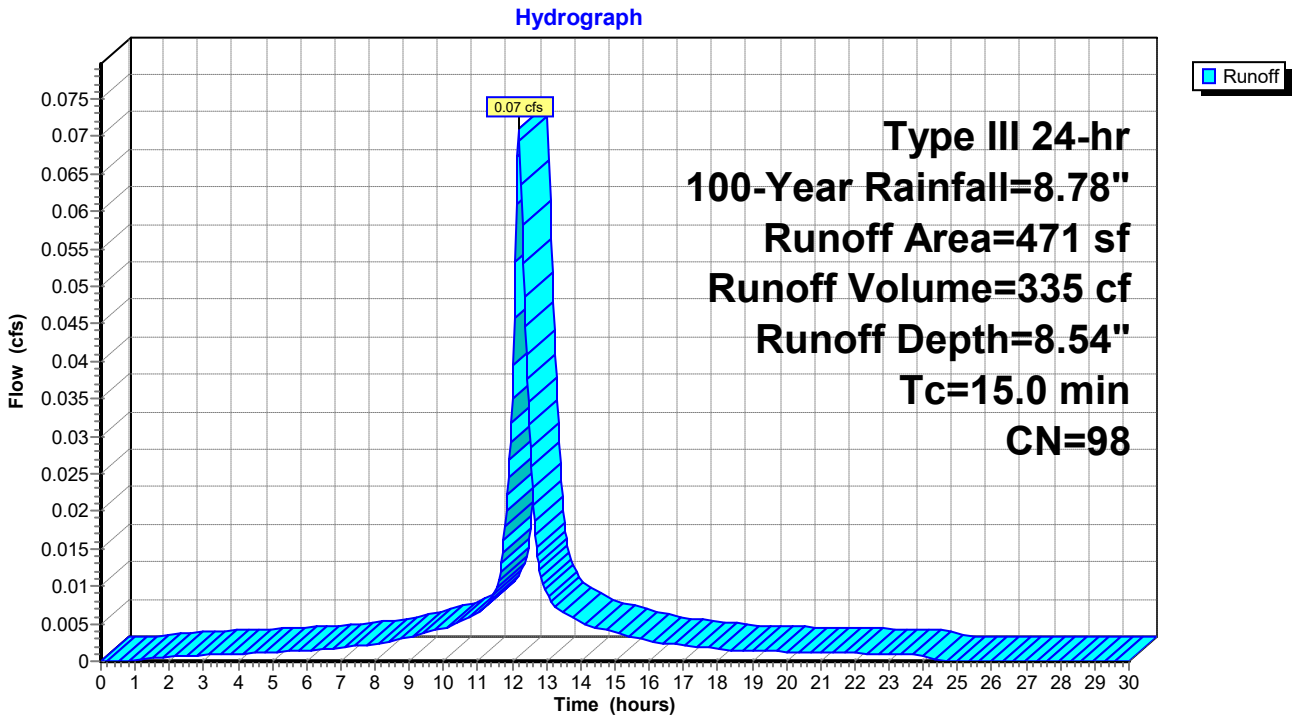
Runoff = 0.07 cfs @ 12.20 hrs, Volume= 335 cf, Depth= 8.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 100-Year Rainfall=8.78"

Area (sf)	CN	Description
471	98	Unconnected pavement, HSG A
471		100.00% Impervious Area
471		100.00% Unconnected

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

Subcatchment 7S: WALKWAYS / STEPS LANDINGS / RETAINING WALLS



Summary for Subcatchment 12S: PROPOSED ROOF

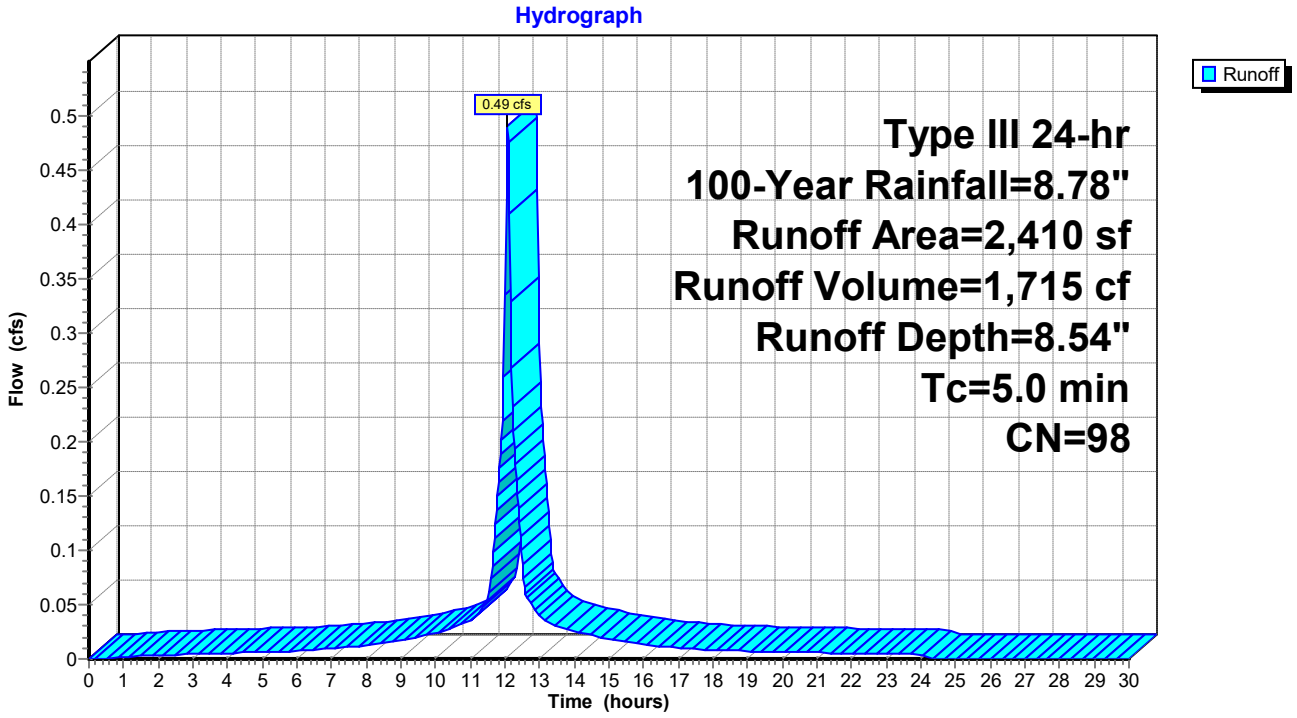
Runoff = 0.49 cfs @ 12.07 hrs, Volume= 1,715 cf, Depth= 8.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type III 24-hr 100-Year Rainfall=8.78"

Area (sf)	CN	Description
2,410	98	Roofs, HSG A
2,410		100.00% Impervious Area

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

Subcatchment 12S: PROPOSED ROOF



Summary for Pond 8P: DRAINAGE SYSTEM

Inflow Area = 3,593 sf,100.00% Impervious, Inflow Depth = 8.54" for 100-Year event
Inflow = 0.73 cfs @ 12.07 hrs, Volume= 2,557 cf
Outflow = 0.23 cfs @ 12.31 hrs, Volume= 2,549 cf, Atten= 68%, Lag= 14.1 min
Discarded = 0.06 cfs @ 11.22 hrs, Volume= 2,376 cf
Primary = 0.17 cfs @ 12.31 hrs, Volume= 174 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs / 4
Peak Elev= 22.50' @ 12.30 hrs Surf.Area= 308 sf Storage= 727 cf

Plug-Flow detention time= 78.2 min calculated for 2,547 cf (100% of inflow)
Center-of-Mass det. time= 76.1 min (815.2 - 739.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	17.50'	543 cf	**14.00'W x 22.02'L x 5.00'H Field A** 1,542 cf Overall - 184 cf Embedded = 1,358 cf x 40.0% Voids
#2A	19.50'	184 cf	**ADS_StormTech SC-740 +Cap** x 4 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 4 Chambers in 2 Rows
#3	22.50'	10 cf	**Ponding** Listed below -Impervious
		737 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Cum.Store (cubic-feet)
22.50	0
24.50	5
24.70	10

Device	Routing	Invert	Outlet Devices
#1	Discarded	17.50'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	22.40'	**6.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.06 cfs @ 11.22 hrs HW=17.57' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=0.17 cfs @ 12.31 hrs HW=22.50' (Free Discharge)
↑—**2=Orifice/Grate** (Weir Controls 0.17 cfs @ 1.05 fps)

Pond 8P: DRAINAGE SYSTEM - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

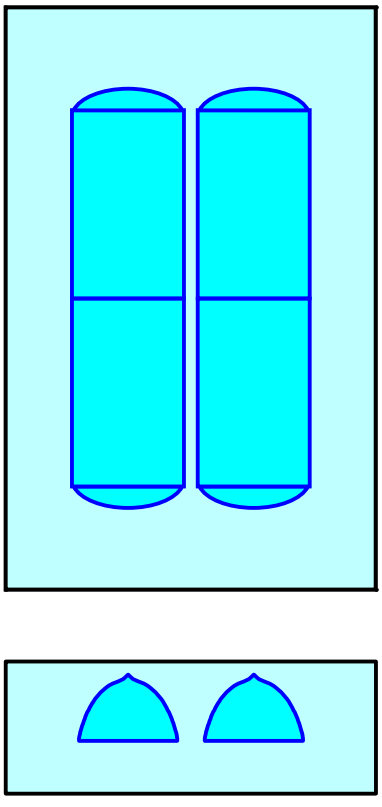
2 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 15.86' Row Length +37.0" End Stone x 2 = 22.02' Base Length
2 Rows x 51.0" Wide + 6.0" Spacing x 1 + 30.0" Side Stone x 2 = 14.00' Base Width
24.0" Base + 30.0" Chamber Height + 6.0" Cover = 5.00' Field Height

4 Chambers x 45.9 cf = 183.8 cf Chamber Storage

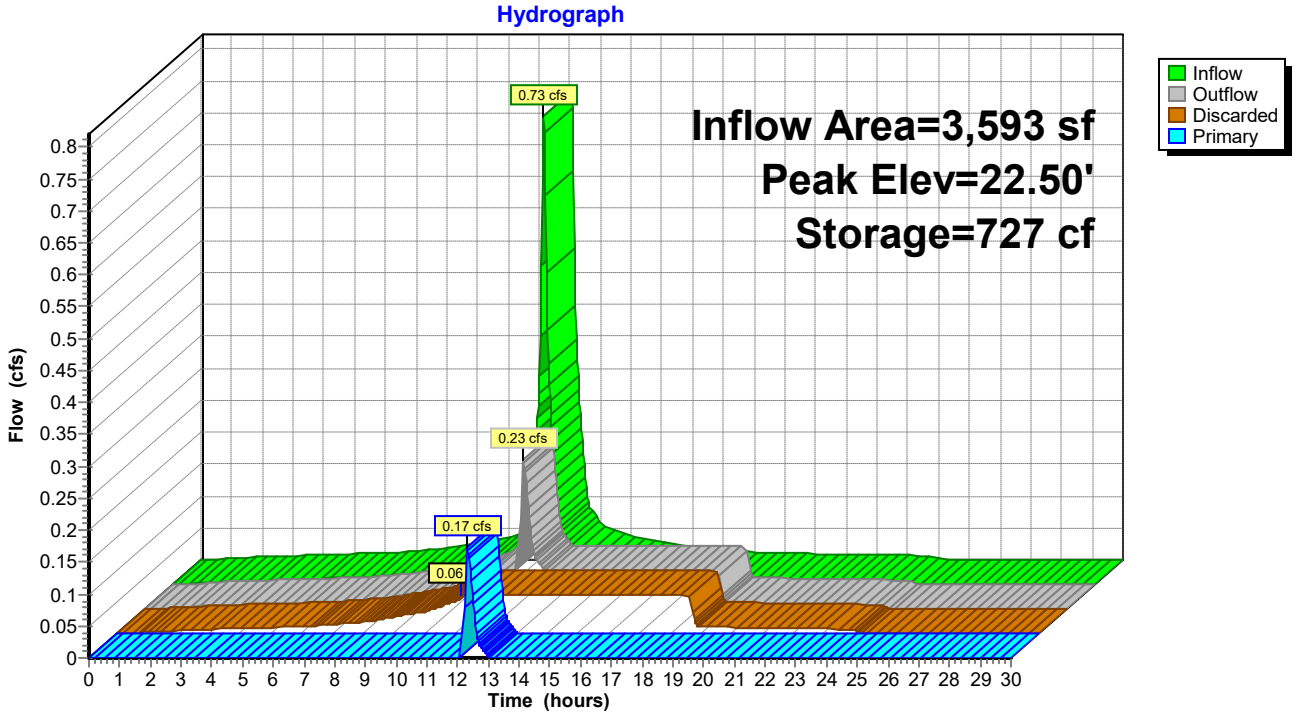
1,541.6 cf Field - 183.8 cf Chambers = 1,357.9 cf Stone x 40.0% Voids = 543.1 cf Stone Storage

Chamber Storage + Stone Storage = 726.9 cf = 0.017 af
Overall Storage Efficiency = 47.2%
Overall System Size = 22.02' x 14.00' x 5.00'

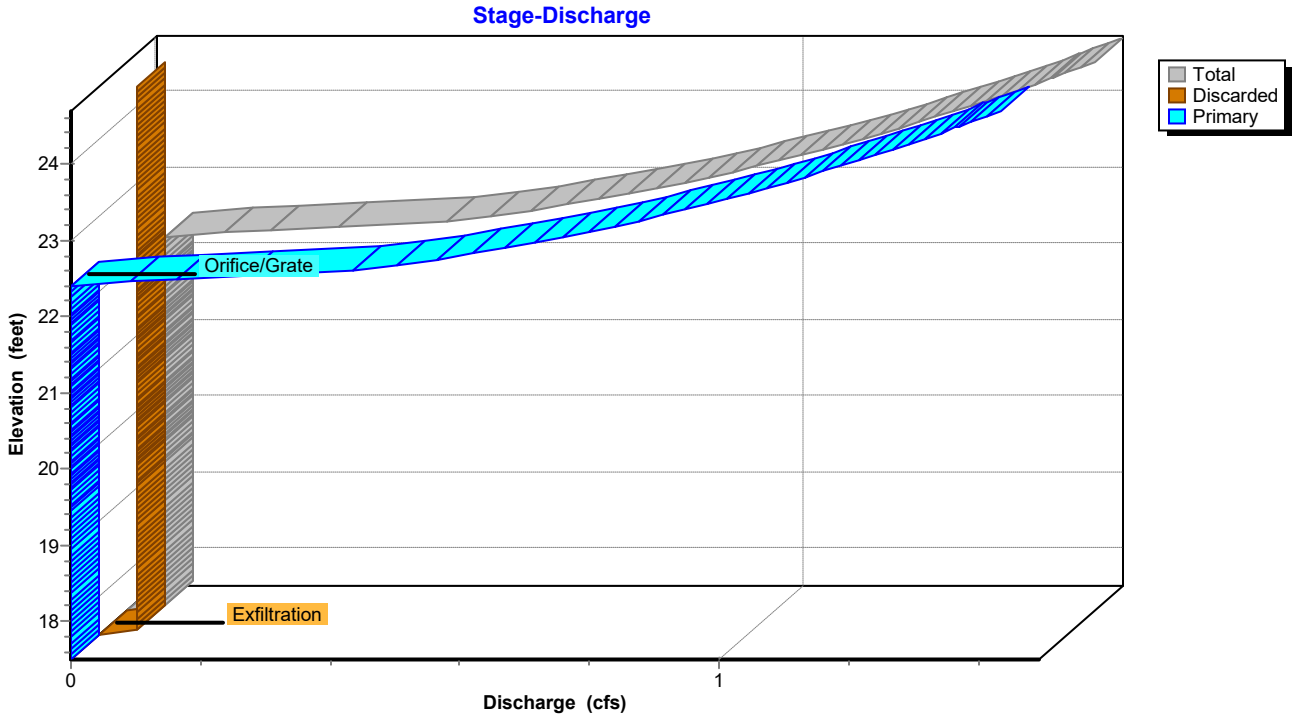
4 Chambers
57.1 cy Field
50.3 cy Stone



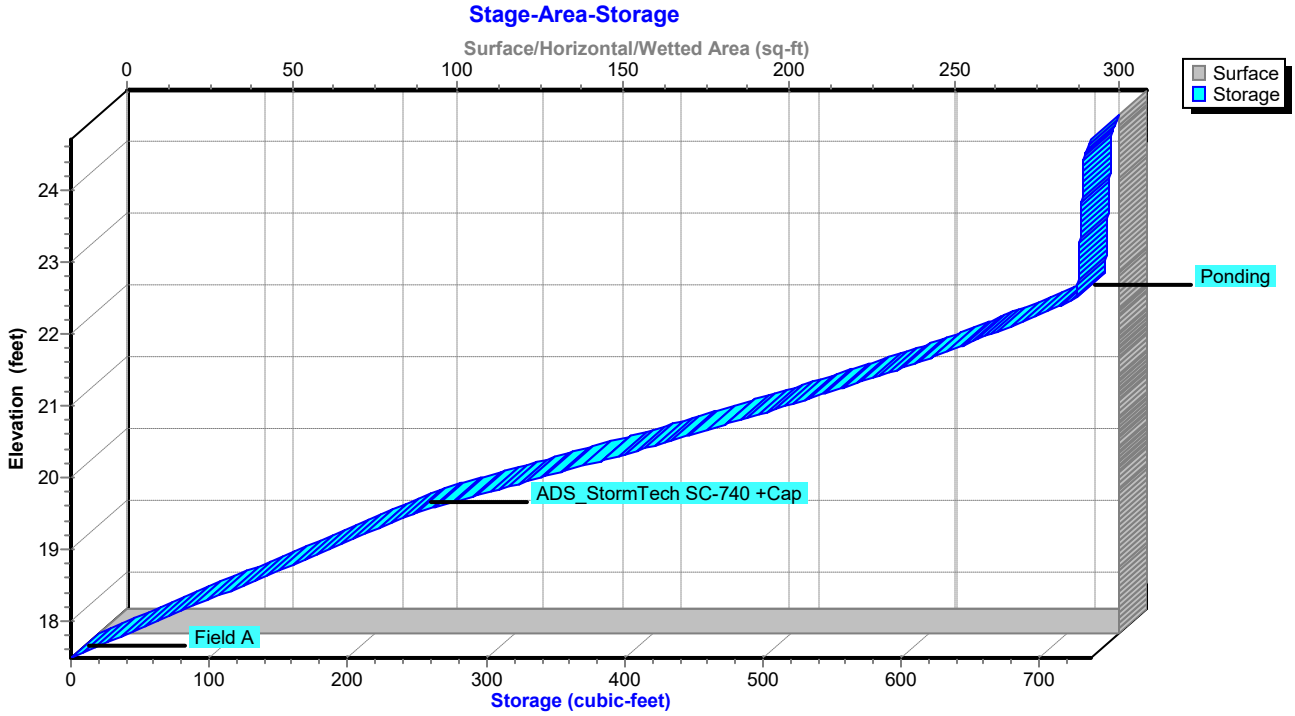
Pond 8P: DRAINAGE SYSTEM



Pond 8P: DRAINAGE SYSTEM



Pond 8P: DRAINAGE SYSTEM

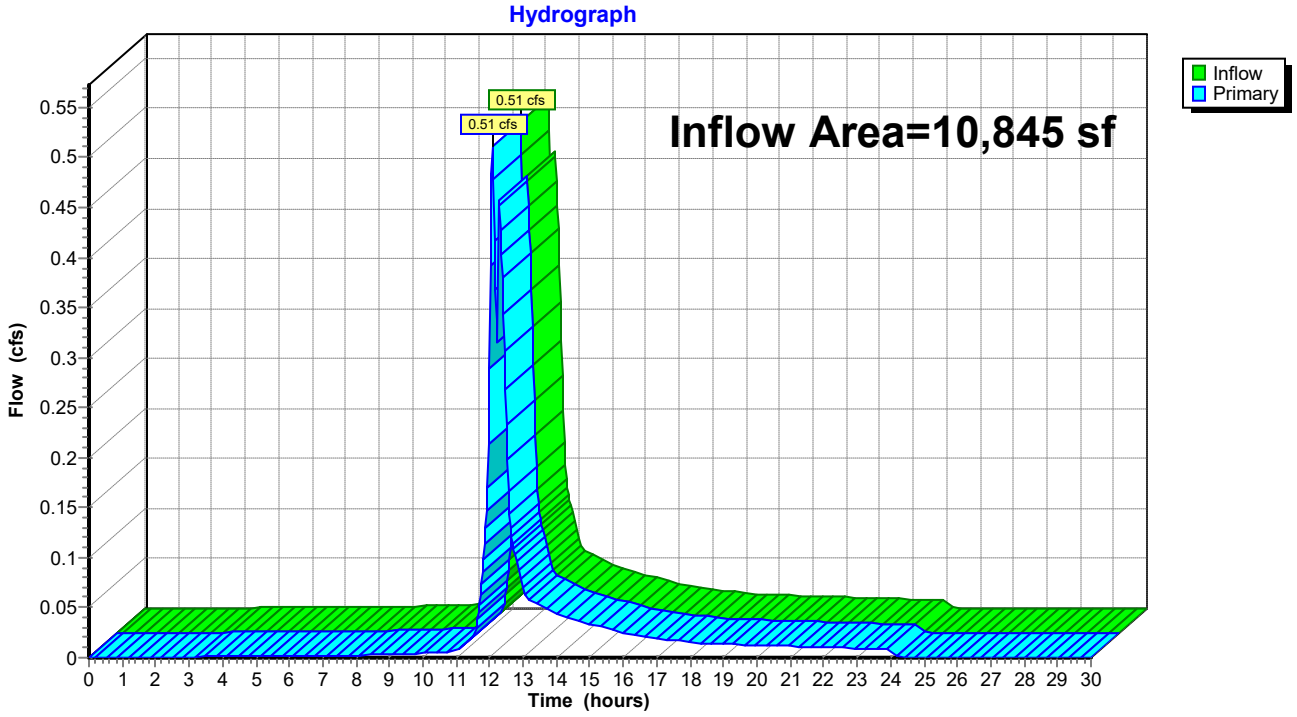


Summary for Link 3L: PROPOSED

Inflow Area = 10,845 sf, 37.47% Impervious, Inflow Depth = 2.20" for 100-Year event
Inflow = 0.51 cfs @ 12.09 hrs, Volume= 1,991 cf
Primary = 0.51 cfs @ 12.09 hrs, Volume= 1,991 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs

Link 3L: PROPOSED



Appendix B
Soils information

Custom Soil Resource Report
Soil Map

Map Scale: 1:263 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 3 7 14 21

Feet: 0 10 20 40 60

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N 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:
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 22, Sep 9, 2022

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

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

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	0.2	100.0%
Totals for Area of Interest		**0.2**	**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

626B—Merrimac-Urban land complex, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2tyr9
Elevation: 0 to 820 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Merrimac 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 Merrimac

Setting

Landform: Outwash plains, outwash terraces, moraines, eskers, kames
Landform position (two-dimensional): Summit, shoulder, backslope, footslope
Landform position (three-dimensional): Crest, side slope, 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 8 percent
Depth to restrictive feature: More than 80 inches
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 content: 2 percent
Maximum salinity: Nonsaline (0.0 to 1.4 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water supply, 0 to 60 inches: Low (about 4.6 inches)

Interpretive groups

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

Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Description of Urban Land

Typical profile

M - 0 to 10 inches: cemented material

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 0 inches to manufactured layer
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Available water supply, 0 to 60 inches: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: Unranked

Minor Components

Windsor

Percent of map unit: 5 percent
Landform: Outwash terraces, dunes, outwash plains, deltas
Landform position (three-dimensional): Tread, riser
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Hydric soil rating: No

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
Hydric soil rating: No

Hinckley

Percent of map unit: 5 percent
Landform: Deltas, kames, eskers, outwash plains
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Head slope, nose slope, crest, side slope, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No