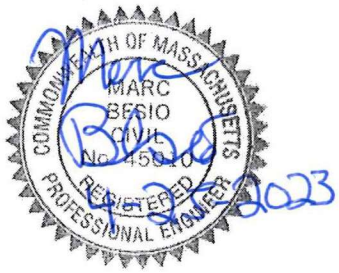
DRAINAGE REPORT
280 Nevada Street
Newton, Massachusetts



Date: April 25, 2023

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Table of Contents

Report

NRCS Soil Map and Soil Description

Pre-Development Drainage Plan

Post-Development Drainage Plan

Hydrocad Report

Other Calculations:
Area
Storage Volumes
TSS Removal
Phosphorus Removal

INTRODUCTION

VTP Associates has performed a stormwater management analysis to evaluate the post-development impacts created by the proposed residential development at #280 Nevada Street, Newton, Massachusetts. The project will include the demolition of the existing and rebuilding a new house. The new residence building will include a total of two units, a new surface driveway with parking, landscaped areas, and an associated stormwater management system.

VTP Associates analyzed the hydrology for the drainage areas impacted by the proposed work utilizing the Soil Conservation Service's (SCS) Runoff Curve Number (CN) methodology. VTP Associates used the HydroCAD computer modeling system in conjunction with the SCS's methods to determine the peak rate of runoff for the 2, 10, 25 and 100-year storm events.

VTP Associates proposes the use of best management practices (BMPs) as defined by the Massachusetts Department of Environmental Protection (MA DEP) for stormwater management onsite to protect downstream receiving waters from adverse water quality impacts due to stormwater runoff. Mitigating the rate and quality of stormwater runoff from the project site will also help to lessen the environmental impact of the proposed development.

METHODOLOGY

Hydrology and Hydraulics

VTP Associates analyzed the survey base plan and conducted a site visit to determine the existing drainage flow patterns onsite. The existing conditions survey, in conjunction with aerial photography, and site visits were used to determine existing surface coverage areas for the site. VTP Associates determined that a majority of the pre-developed surface cover for the study area is impervious cover. Initial soil research was determined using the Natural Resources Conservation Service (NRCS) soil survey maps for Middlesex County, Massachusetts via Web Soil Survey 1.1. According to the soil survey, the soil on the site consists of the following:

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

Test pit were conducted and determined that the site consists of a moderately high draining loamy sand. Based upon these findings, VTP Associates used a Hydrologic soil group 'A' for its drainage calculations. The test pits information has been included within this report. As per the Mass DEP Stormwater Hydrology Handbook for Conservation Commissions, VTP used a design infiltration rate of 8.27in/hr for 'A' soils.

For each subcatchment area, VTP Associates determined drainage flow path lengths, surface cover type and slopes for sheet and shallow concentrated flow. The information was used to calculate the time of concentration (Tc) for each subcatchment areas. Where applicable, a minimum Tc of 5 minutes was used; the minimum value for highly developed, small catchment areas. SCS Runoff Curve Numbers were selected by using the cover type and hydrologic soil group of each area. The peak runoff rates for the 2, 25,10 and 100-year storm events were then determined by inputting the weighted CN, Tc, drainage areas, and drainage system information into the HydroCAD storm water modeling system computer program. The storm events were based on the 24-hour duration storm with a SCS Type III storm distribution curve.

Storm Event

VTP Associates used Massachusetts rainfall data maps from Technical Paper 40, Rainfall Frequency Atlas of the United States and the City of Newton's Requirements for On-Site Drainage to estimate the rainfall depth for the 2, 10 and 100-year storms. The rainfall depths for the 24-hour storm events used are as follows:

Storm Event	24-Hour Rainfall Depth (inches)
2-year	3.10
10-year	4.50
25-year	5.30
100-year	8.78

HYDROLOGICAL ANALYSIS

PRE-DEVELOPMENT	Design point A1
	POD1
Building	3,289.2 s.f.
Driveway	6,646.0 s.f.
Other	5,736.0 s.f.
Grass	13,878.8 s.f.
Wooded	
Total impervious areas	15,671.2 s.f.
Total pervious areas	13,878.8 s.f.
Total areas	29,550.0 s.f.

POST-DEVELOPMENT	Design point A1			
	POD1	IS #1	IS #2	IS #3
Building		2,259.8 s.f.	3,360.0 s.f.	1,120.0 s.f.
Driveway		2,237.9 s.f.		4,038.4 s.f.
Other	452.0 s.f.	38.3 s.f.		
Grass	16,043.7			
Wooded				
Total impervious areas	13,506.3 s.f.	4,536.0 s.f.	3,360.0 s.f.	5,158.4 s.f.
Total pervious areas	16,043.7 s.f.	0.0 s.f.	0.0 s.f.	0.0 s.f.
Total areas	29,550.0 s.f.			

Pre-Development Conditions

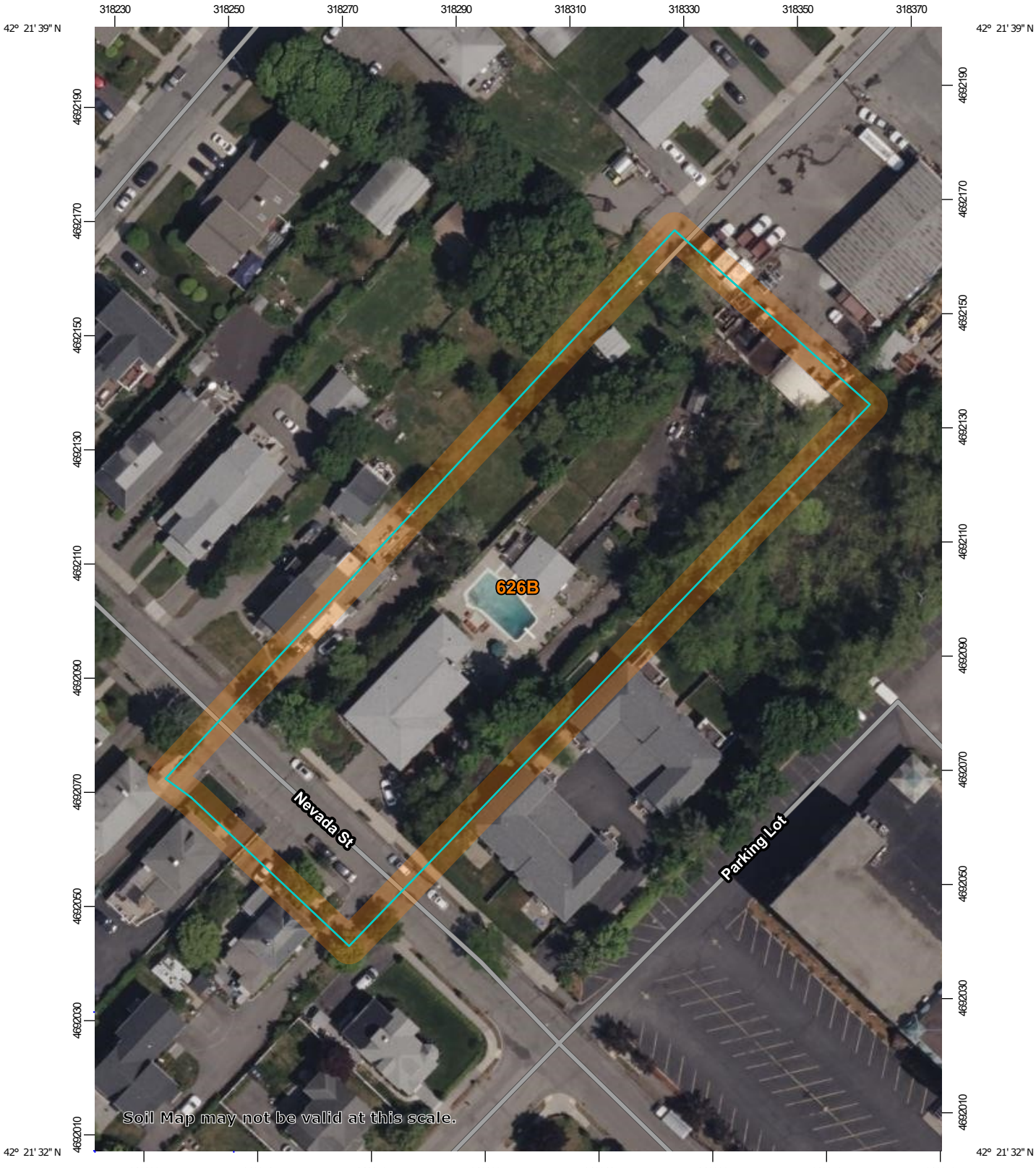
The existing site consists of a three-story wood building, driveway, walkway, patio and landscape areas.

Approximately 15,671.2 s.f.(53.0%) of the site is impervious cover.

The site is bound by residential buildings and by Albemarle Road.

VTP Associates compiled the existing drainage areas from an existing conditions survey prepared by VTP Associates. Additionally, VTP Associates conducted site visits to evaluate the existing onsite drainage patterns and watershed divides from the existing conditions survey. At present, stormwater runoffs from the existing study area drain to the south-west (POD1). These areas are shown on the table above.

Soil Map—Middlesex County, Massachusetts
(VTP Associates, Inc.)



Map Scale: 1:960 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 10 20 40 60

Feet
0 45 90 180 270

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

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

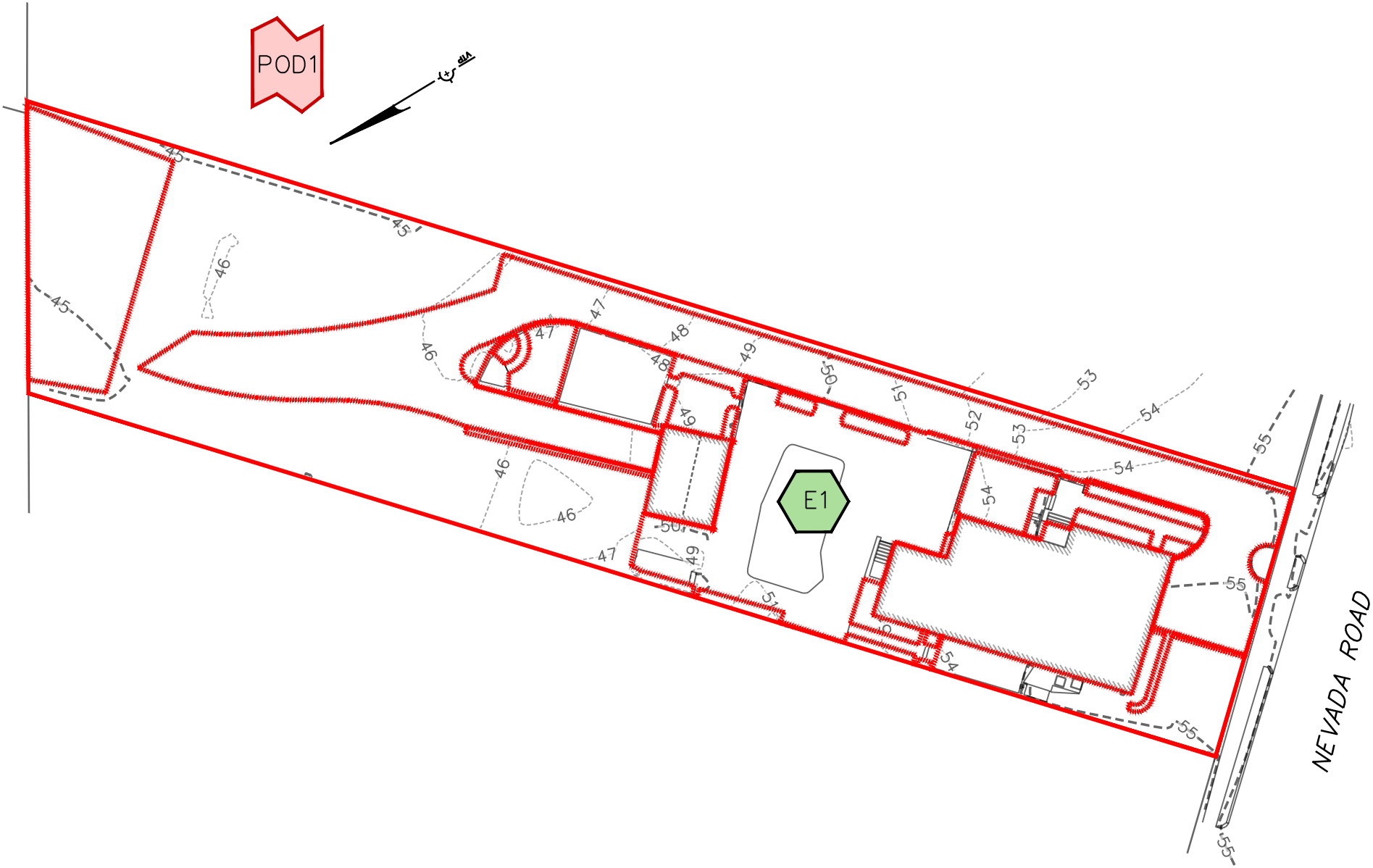
Typical profile

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

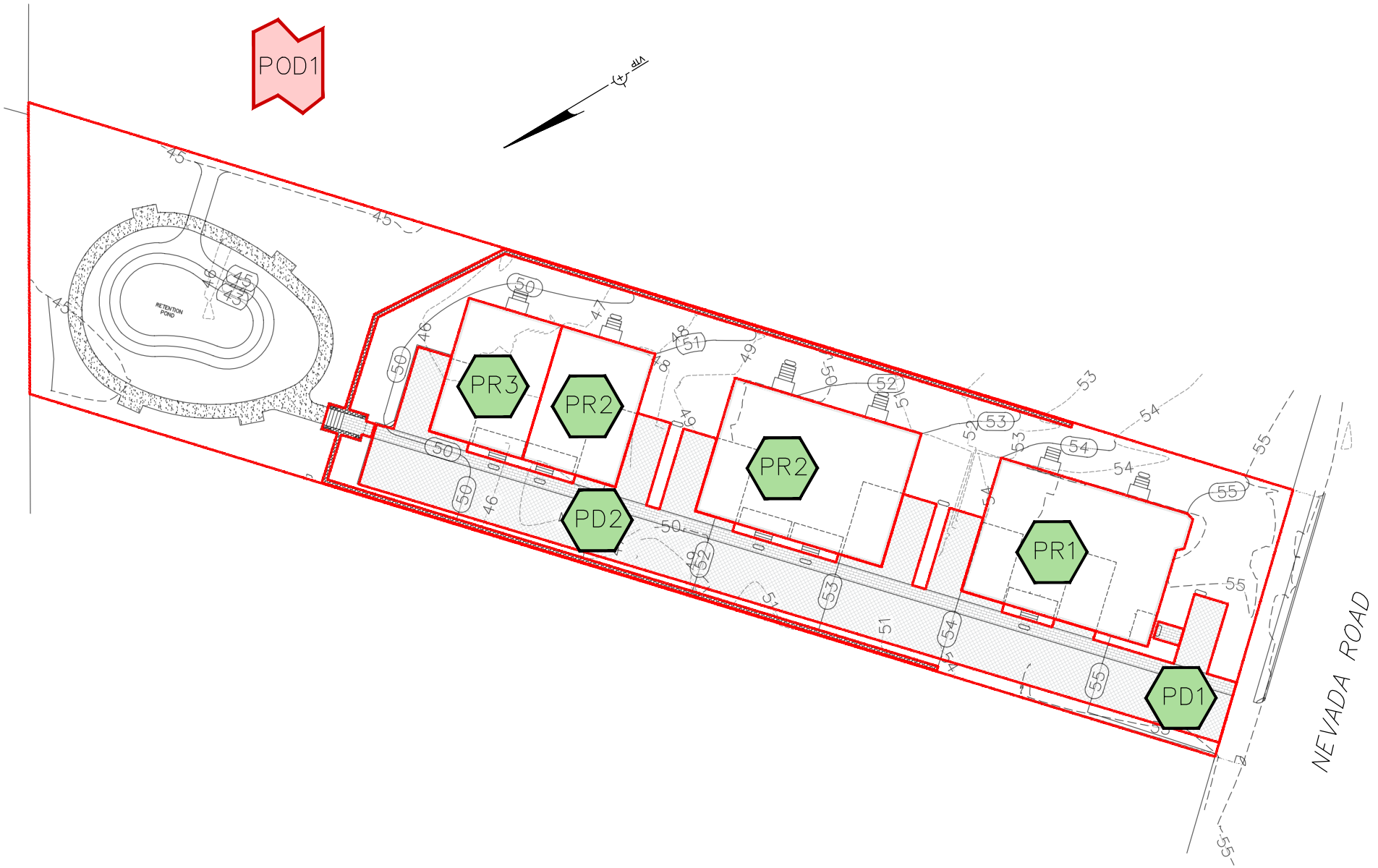
Properties and qualities

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)

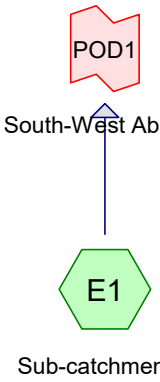
PRE-DEVELOPMENT



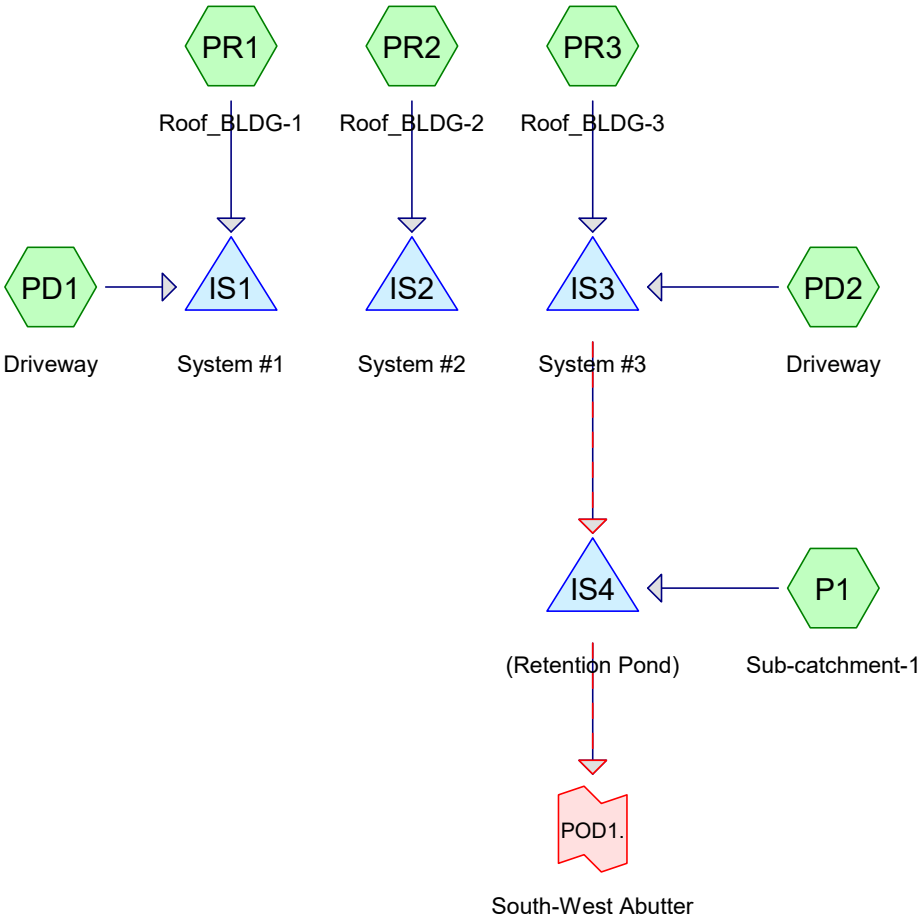
POST-DEVELOPMENT



PRE-DEVELOPMENT CONDITIONS



POST-DEVELOPMENT CONDITIONS



Subcat Reach Pond Link

Routing Diagram for 222183-hydrocad
Prepared by VTP ASSOCIATES, Printed 4/24/2023
HydroCAD® 10.00-25 s/n 08174 © 2019 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.678	68	<50% Grass cover, Poor, HSG A (E1)
0.060	39	>75% Grass cover, Good, HSG A (P1)
0.020	76	Gravel roads, HSG A (P1)
0.144	98	Paved parking, HSG A (PD1, PD2)
0.001	65	Paver walkway (PD1)
0.155	98	Roofs, HSG A (PR1, PR2, PR3)
0.085	36	Woods, Fair, HSG A (P1)
1.143	**72**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
1.142	HSG A	E1, P1, PD1, PD2, PR1, PR2, PR3
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.001	Other	PD1
1.143		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.678	0.000	0.000	0.000	0.000	0.678	<50% Grass cover, Poor	E1
0.060	0.000	0.000	0.000	0.000	0.060	>75% Grass cover, Good	P1
0.020	0.000	0.000	0.000	0.000	0.020	Gravel roads	P1
0.144	0.000	0.000	0.000	0.000	0.144	Paved parking	PD1, PD2
0.000	0.000	0.000	0.000	0.001	0.001	Paver walkway	PD1
0.155	0.000	0.000	0.000	0.000	0.155	Roofs	PR1, PR2, PR3
0.085	0.000	0.000	0.000	0.000	0.085	Woods, Fair	P1
1.142	**0.000**	**0.000**	**0.000**	**0.001**	**1.143**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	IS3	46.80	45.00	72.0	0.0250	0.012	8.0	0.0	0.0

Time span=0.50-30.00 hrs, dt=0.010 hrs, 2951 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E1: Sub-catchment-1 Runoff Area=29,550 sf 0.00% Impervious Runoff Depth=0.68"
Tc=5.0 min CN=68 Runoff=0.47 cfs 0.038 af

Subcatchment P1: Sub-catchment-1 Runoff Area=7,199 sf 0.00% Impervious Runoff Depth=0.01"
Tc=5.0 min CN=42 Runoff=0.00 cfs 0.000 af

Subcatchment PD1: Driveway Runoff Area=2,276 sf 98.33% Impervious Runoff Depth=2.76"
Tc=5.0 min CN=97 Runoff=0.16 cfs 0.012 af

Subcatchment PD2: Driveway Runoff Area=4,038 sf 100.00% Impervious Runoff Depth=2.87"
Tc=5.0 min CN=98 Runoff=0.29 cfs 0.022 af

Subcatchment PR1: Roof_BLDG-1 Runoff Area=2,260 sf 100.00% Impervious Runoff Depth=2.87"
Tc=5.0 min CN=98 Runoff=0.16 cfs 0.012 af

Subcatchment PR2: Roof_BLDG-2 Runoff Area=3,360 sf 100.00% Impervious Runoff Depth=2.87"
Tc=5.0 min CN=98 Runoff=0.24 cfs 0.018 af

Subcatchment PR3: Roof_BLDG-3 Runoff Area=1,120 sf 100.00% Impervious Runoff Depth=2.87"
Tc=5.0 min CN=98 Runoff=0.08 cfs 0.006 af

Pond IS1: System #1 Peak Elev=48.01' Storage=198 cf Inflow=0.32 cfs 0.024 af
Outflow=0.08 cfs 0.024 af

Pond IS2: System #2 Peak Elev=46.46' Storage=147 cf Inflow=0.24 cfs 0.018 af
Outflow=0.06 cfs 0.018 af

Pond IS3: System #3 Peak Elev=44.24' Storage=286 cf Inflow=0.37 cfs 0.028 af
Discarded=0.07 cfs 0.028 af Primary=0.00 cfs 0.000 af Outflow=0.07 cfs 0.028 af

Pond IS4: (Retention Pond) Peak Elev=43.01' Storage=5 cf Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Link POD1: South-West Abutter Inflow=0.47 cfs 0.038 af
Primary=0.47 cfs 0.038 af

Link POD1.: South-West Abutter Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 1.143 ac Runoff Volume = 0.110 af Average Runoff Depth = 1.15"
73.87% Pervious = 0.845 ac 26.13% Impervious = 0.299 ac

Summary for Subcatchment E1: Sub-catchment-1

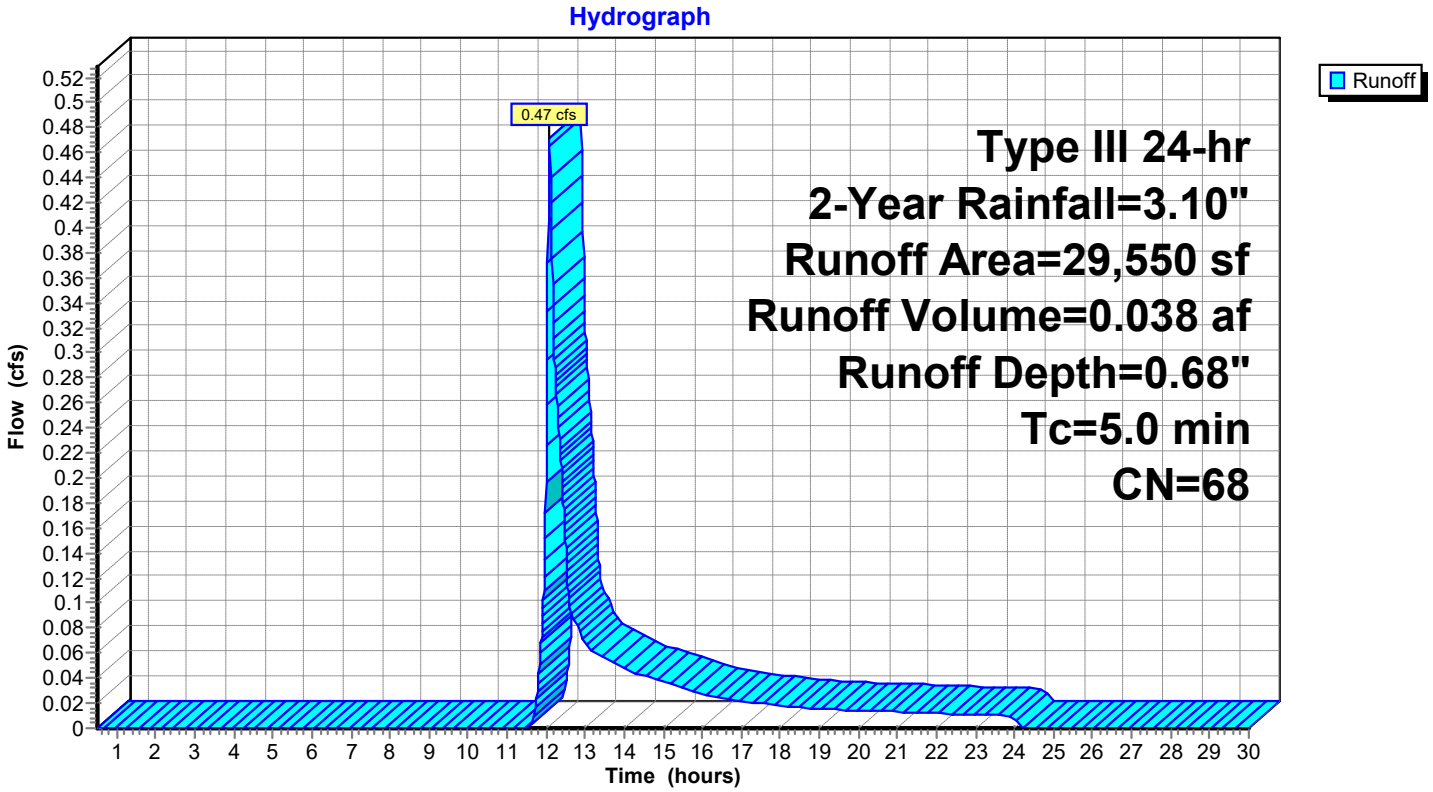
Runoff = 0.47 cfs @ 12.09 hrs, Volume= 0.038 af, Depth= 0.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
29,550	68	<50% Grass cover, Poor, HSG A
29,550		100.00% Pervious Area

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

Subcatchment E1: Sub-catchment-1



Summary for Subcatchment P1: Sub-catchment-1

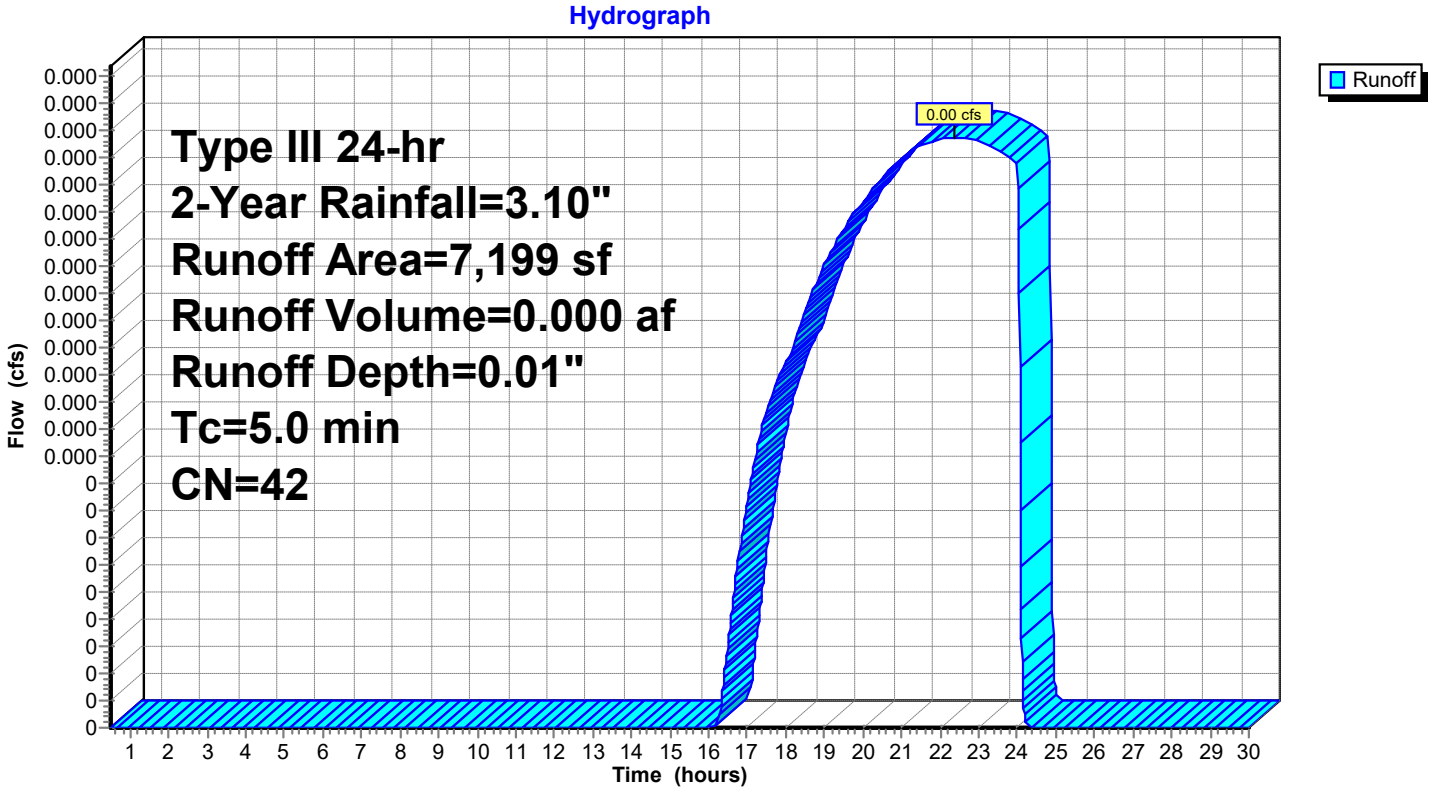
Runoff = 0.00 cfs @ 22.35 hrs, Volume= 0.000 af, Depth= 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
2,623	39	>75% Grass cover, Good, HSG A
3,705	36	Woods, Fair, HSG A
871	76	Gravel roads, HSG A
7,199	42	Weighted Average
7,199		100.00% Pervious Area

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

Subcatchment P1: Sub-catchment-1



Summary for Subcatchment PD1: Driveway

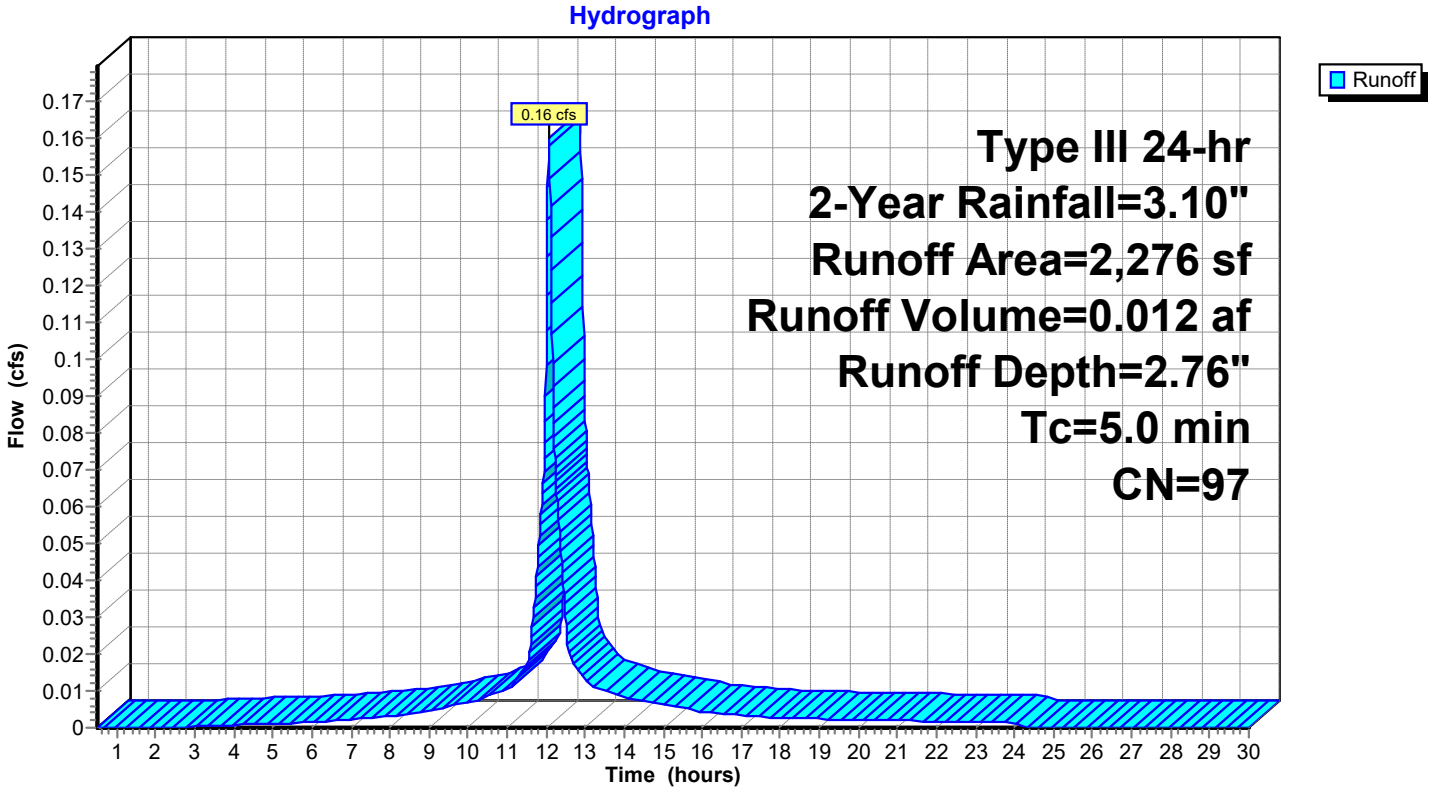
Runoff = 0.16 cfs @ 12.07 hrs, Volume= 0.012 af, Depth= 2.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 2-Year Rainfall=3.10"

	Area (sf)	CN	Description
	2,238	98	Paved parking, HSG A
*	38	65	Paver walkway
	2,276	97	Weighted Average
	38		1.67% Pervious Area
	2,238		98.33% Impervious Area

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

Subcatchment PD1: Driveway



Summary for Subcatchment PD2: Driveway

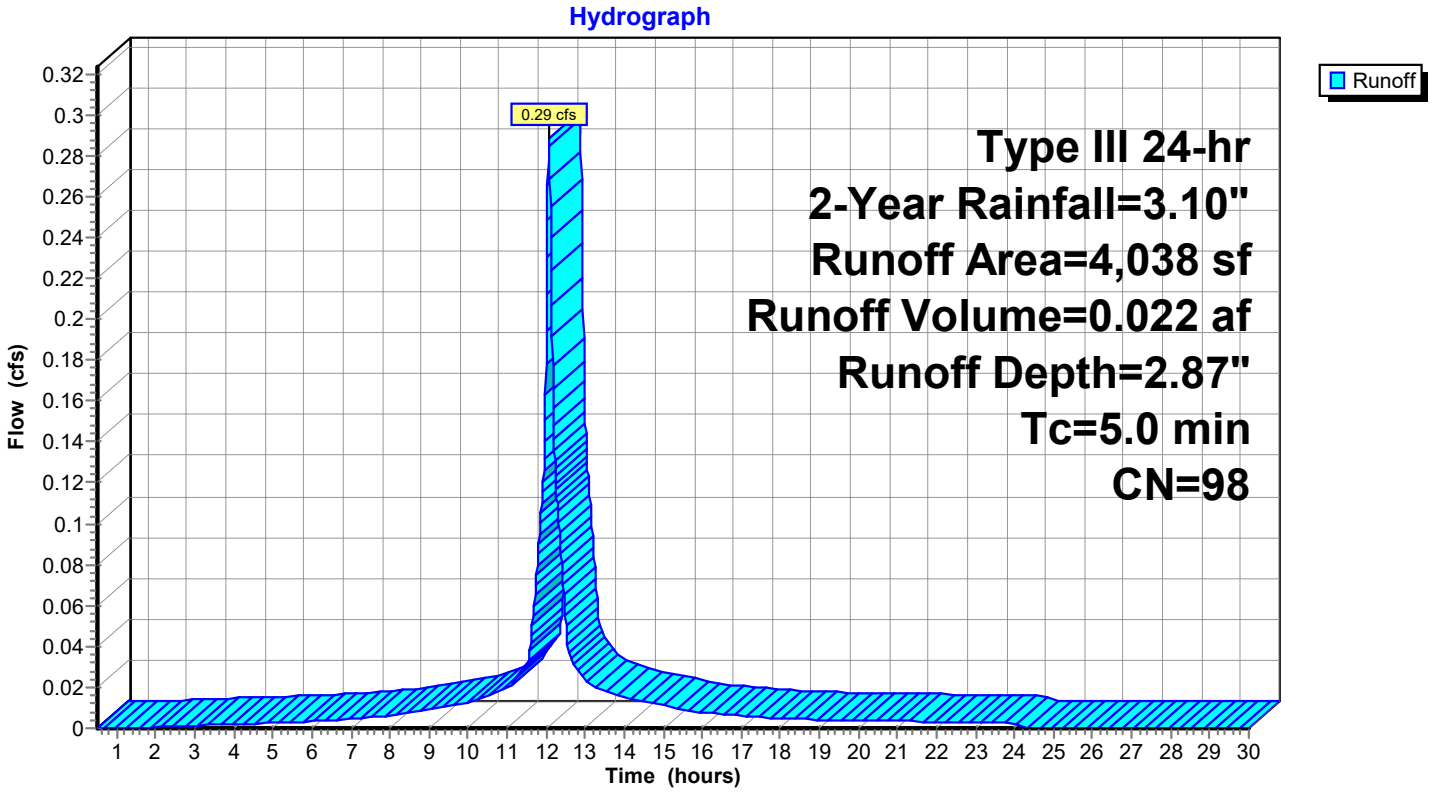
Runoff = 0.29 cfs @ 12.07 hrs, Volume= 0.022 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
4,038	98	Paved parking, HSG A
4,038		100.00% Impervious Area

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

Subcatchment PD2: Driveway



Summary for Subcatchment PR1: Roof_BLDG-1

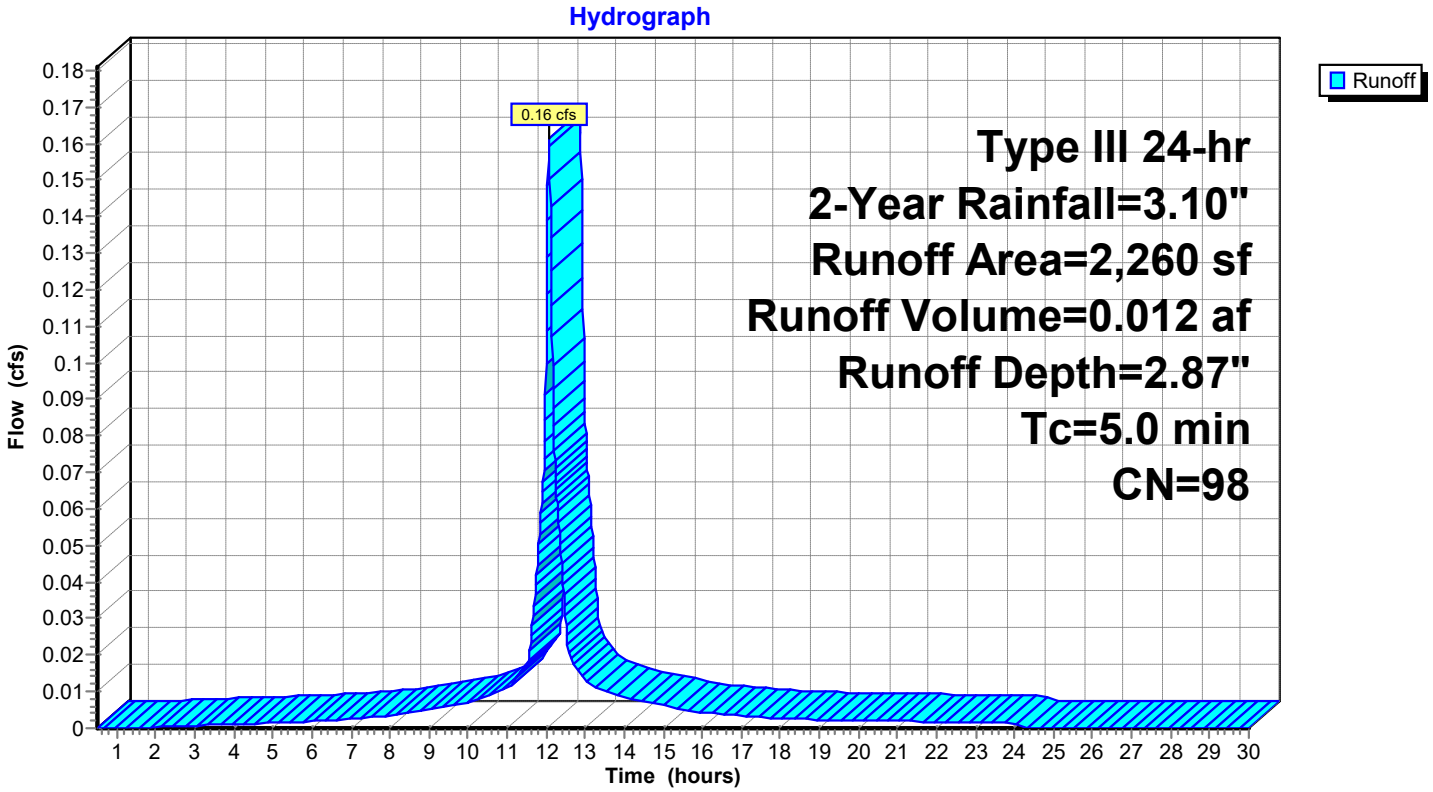
Runoff = 0.16 cfs @ 12.07 hrs, Volume= 0.012 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 2-Year Rainfall=3.10"

	Area (sf)	CN	Description
*	2,260	98	Roofs, HSG A
	2,260		100.00% Impervious Area

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

Subcatchment PR1: Roof_BLDG-1



Summary for Subcatchment PR2: Roof_BLDG-2

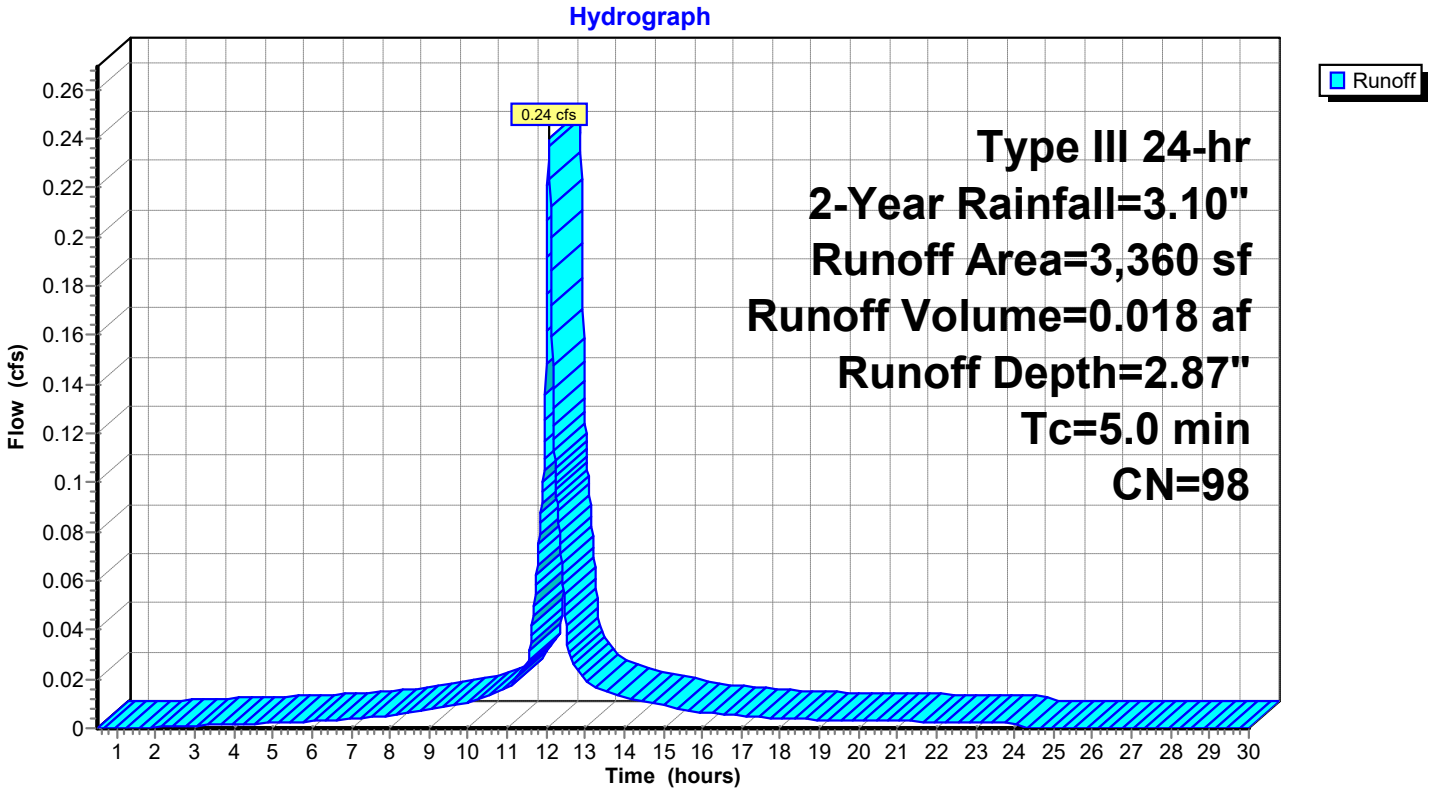
Runoff = 0.24 cfs @ 12.07 hrs, Volume= 0.018 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 2-Year Rainfall=3.10"

	Area (sf)	CN	Description
*	3,360	98	Roofs, HSG A
	3,360		100.00% Impervious Area

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

Subcatchment PR2: Roof_BLDG-2



Summary for Subcatchment PR3: Roof_BLDG-3

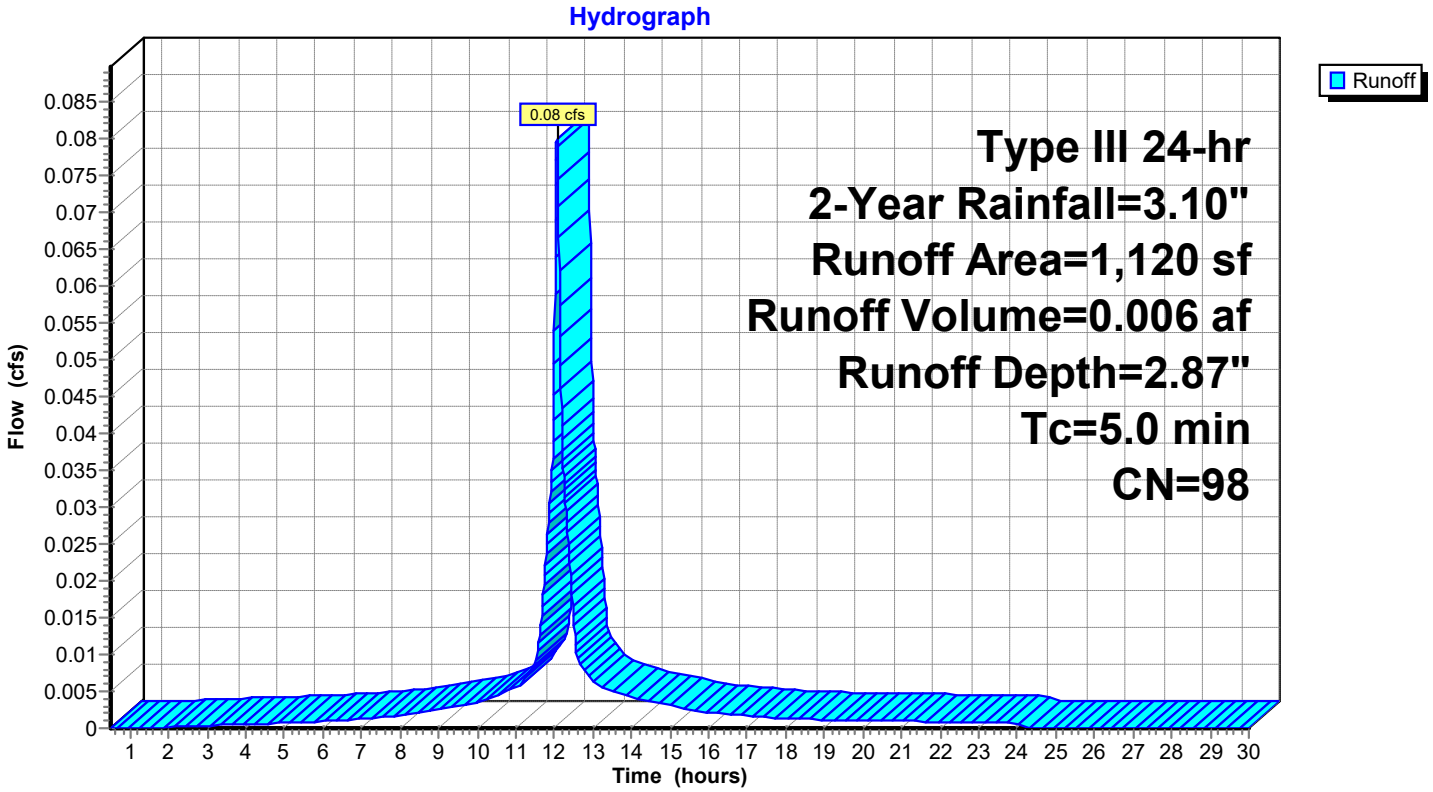
Runoff = 0.08 cfs @ 12.07 hrs, Volume= 0.006 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 2-Year Rainfall=3.10"

	Area (sf)	CN	Description
*	1,120	98	Roofs, HSG A
	1,120		100.00% Impervious Area

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

Subcatchment PR3: Roof_BLDG-3



Summary for Pond IS1: System #1

Inflow Area = 0.104 ac, 99.16% Impervious, Inflow Depth = 2.81" for 2-Year event
Inflow = 0.32 cfs @ 12.07 hrs, Volume= 0.024 af
Outflow = 0.08 cfs @ 11.85 hrs, Volume= 0.024 af, Atten= 75%, Lag= 0.0 min
Discarded = 0.08 cfs @ 11.85 hrs, Volume= 0.024 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 48.01' @ 12.43 hrs Surf.Area= 416 sf Storage= 198 cf

Plug-Flow detention time= 11.2 min calculated for 0.024 af (100% of inflow)
Center-of-Mass det. time= 11.2 min (772.1 - 761.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	46.80'	459 cf	**13.00'W x 32.00'L x 5.25'H Field A** 2,184 cf Overall - 873 cf Embedded = 1,311 cf x 35.0% Voids
#2A	47.80'	649 cf	**Concrete Galley 4x4x4.25** x 14 Inside #1 Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf 14 Chambers in 2 Rows
		1,108 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	46.80'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.08 cfs @ 11.85 hrs HW=46.86' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.08 cfs)

Pond IS1: System #1 - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x4x4.25 (Concrete Galley, Shea LE-EGH, LE-CGH or equivalent)
Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf
Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf

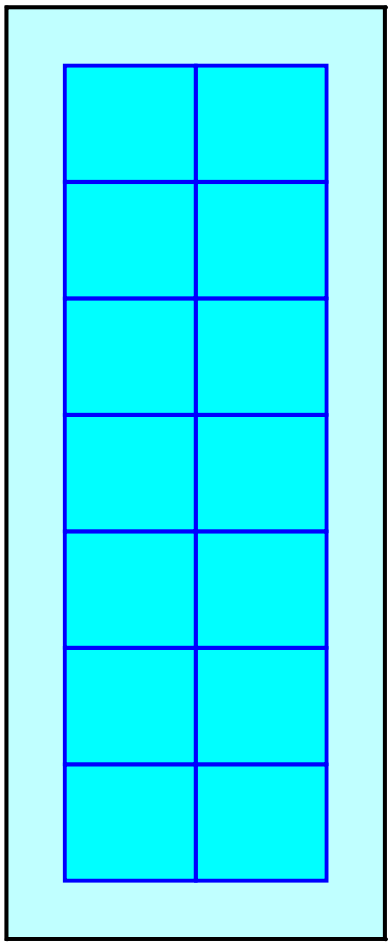
7 Chambers/Row x 4.00' Long = 28.00' Row Length +24.0" End Stone x 2 = 32.00' Base Length
2 Rows x 54.0" Wide + 24.0" Side Stone x 2 = 13.00' Base Width
12.0" Base + 51.0" Chamber Height = 5.25' Field Height

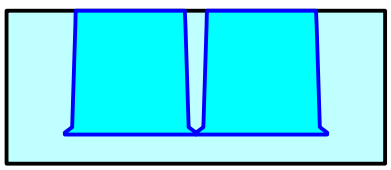
14 Chambers x 46.4 cf = 649.3 cf Chamber Storage
14 Chambers x 62.3 cf = 872.6 cf Displacement

2,184.0 cf Field - 872.6 cf Chambers = 1,311.4 cf Stone x 35.0% Voids = 459.0 cf Stone Storage

Chamber Storage + Stone Storage = 1,108.3 cf = 0.025 af
Overall Storage Efficiency = 50.7%
Overall System Size = 32.00' x 13.00' x 5.25'

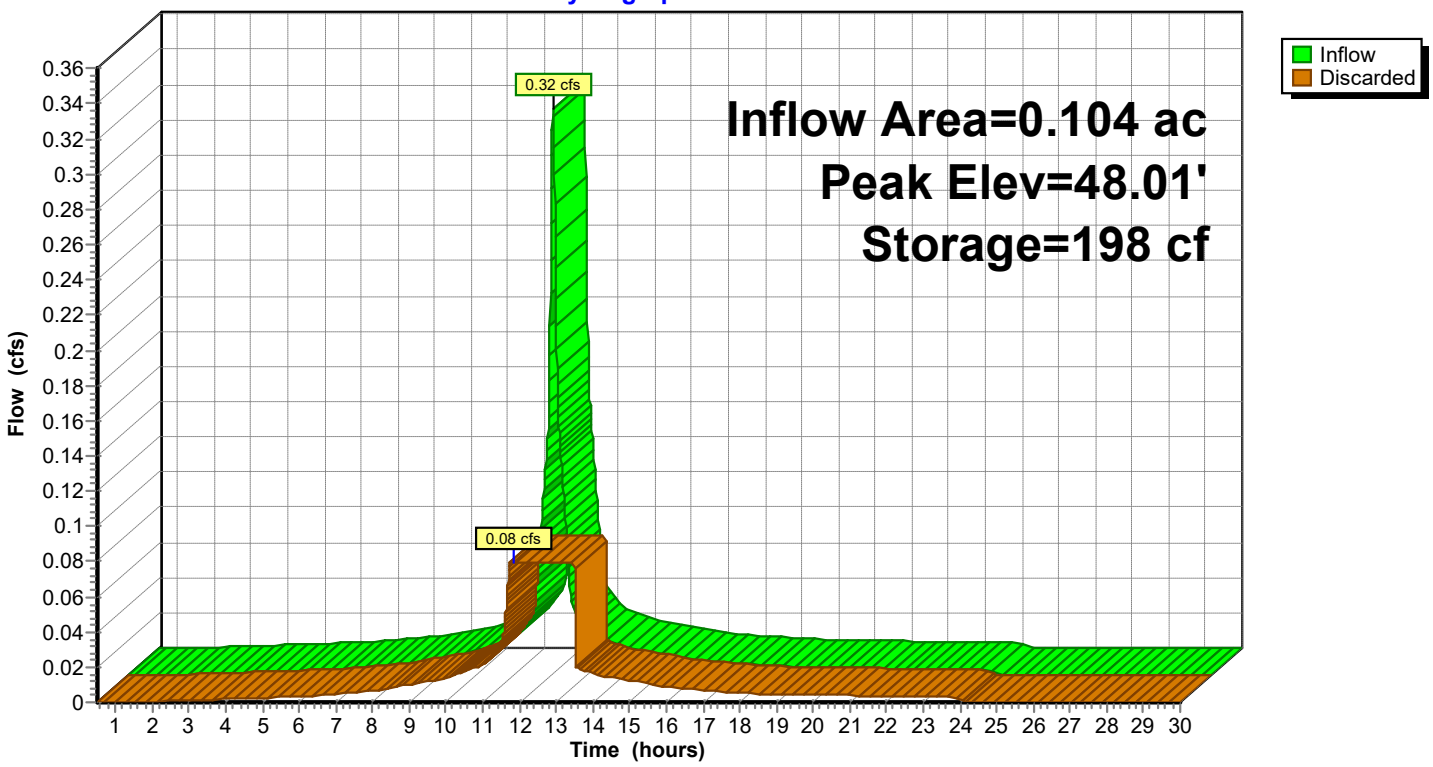
14 Chambers
80.9 cy Field
48.6 cy Stone





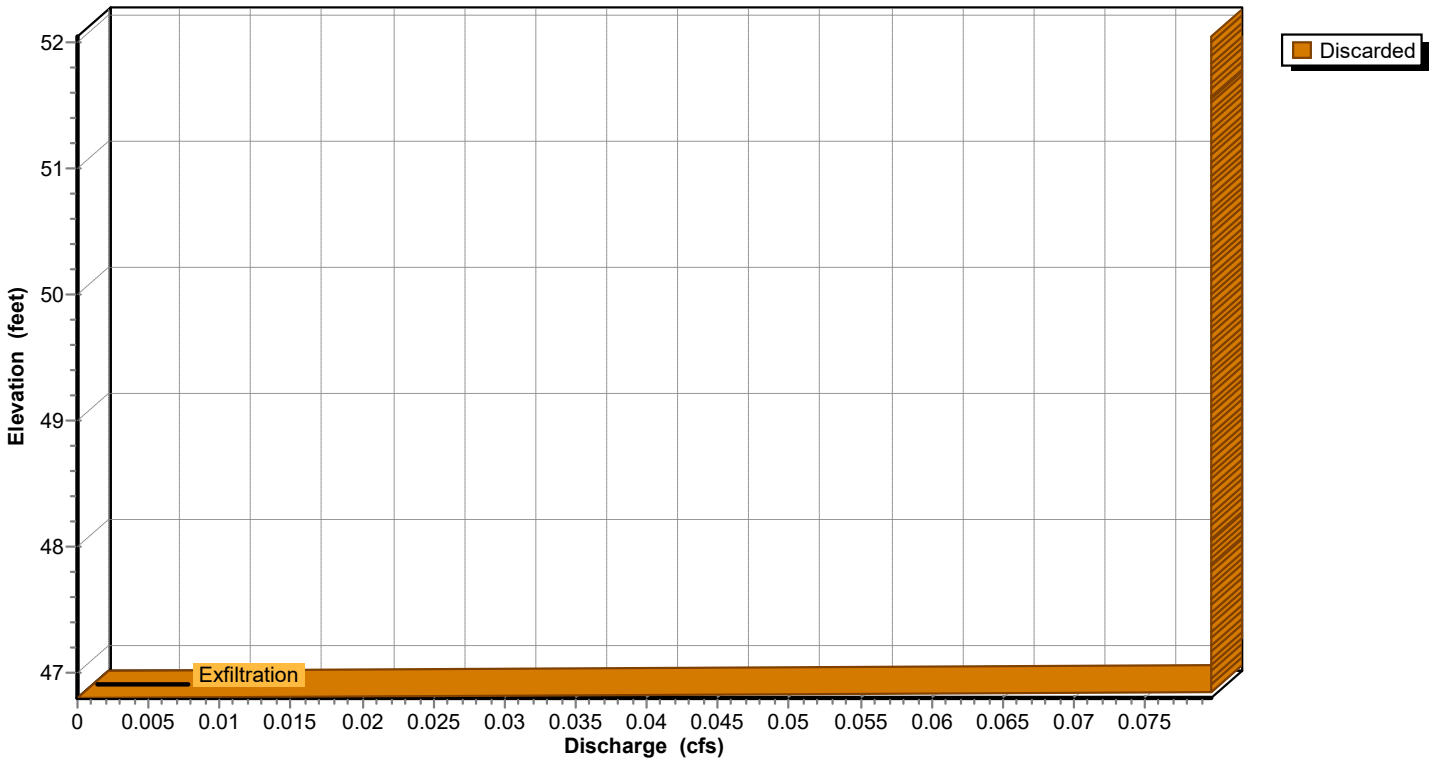
Pond IS1: System #1

Hydrograph

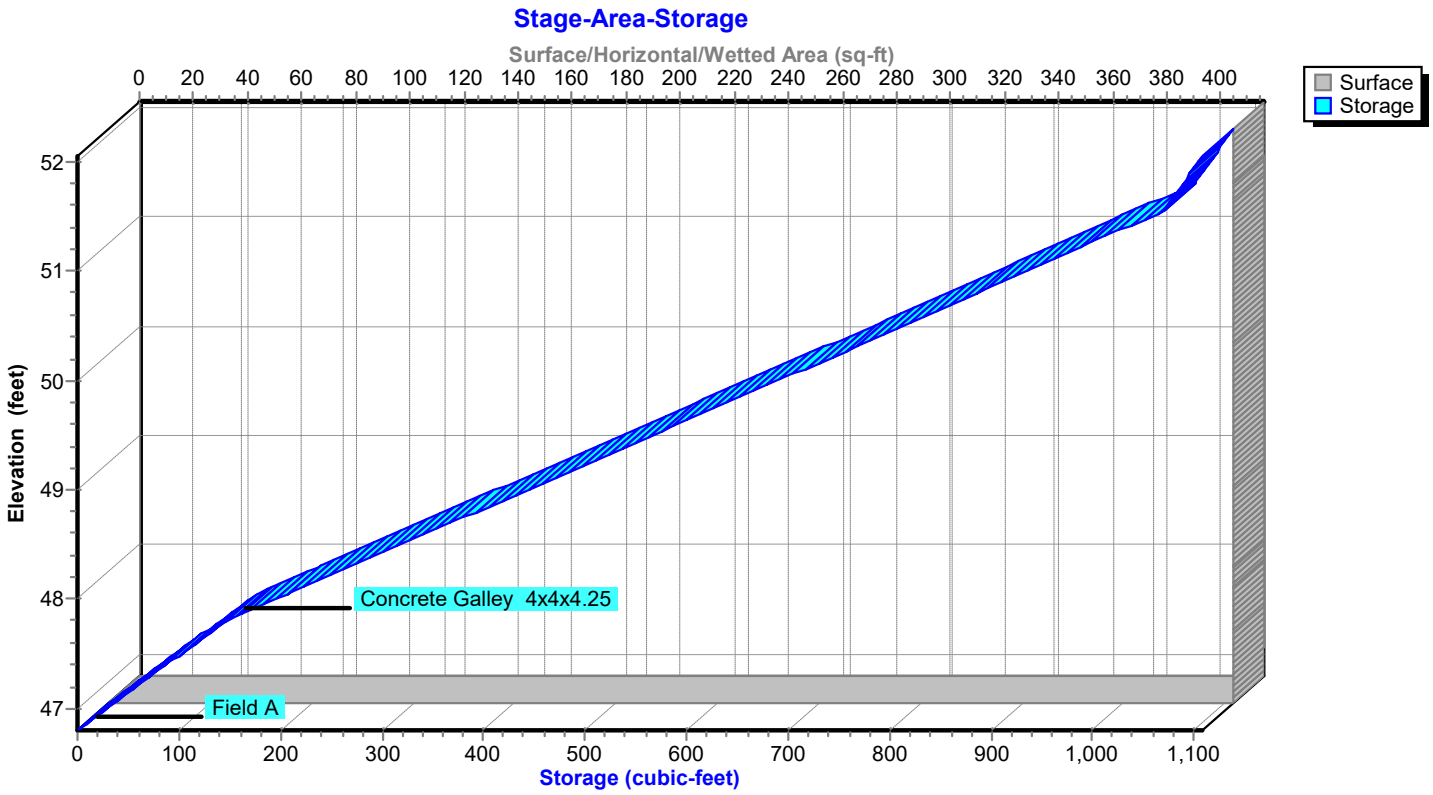


Pond IS1: System #1

Stage-Discharge



Pond IS1: System #1



Summary for Pond IS2: System #2

Inflow Area = 0.077 ac,100.00% Impervious, Inflow Depth = 2.87" for 2-Year event
Inflow = 0.24 cfs @ 12.07 hrs, Volume= 0.018 af
Outflow = 0.06 cfs @ 11.85 hrs, Volume= 0.018 af, Atten= 75%, Lag= 0.0 min
Discarded = 0.06 cfs @ 11.85 hrs, Volume= 0.018 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 46.46' @ 12.43 hrs Surf.Area= 312 sf Storage= 147 cf

Plug-Flow detention time= 11.0 min calculated for 0.018 af (100% of inflow)
Center-of-Mass det. time= 11.0 min (767.1 - 756.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	45.25'	355 cf	**13.00'W x 24.00'L x 5.25'H Field A** 1,638 cf Overall - 623 cf Embedded = 1,015 cf x 35.0% Voids
#2A	46.25'	464 cf	**Concrete Galley 4x4x4.25** x 10 Inside #1 Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf 10 Chambers in 2 Rows
		819 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	45.25'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.06 cfs @ 11.85 hrs HW=45.31' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.06 cfs)

Pond IS2: System #2 - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x4x4.25 (Concrete Galley, Shea LE-EGH, LE-CGH or equivalent)
Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf
Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf

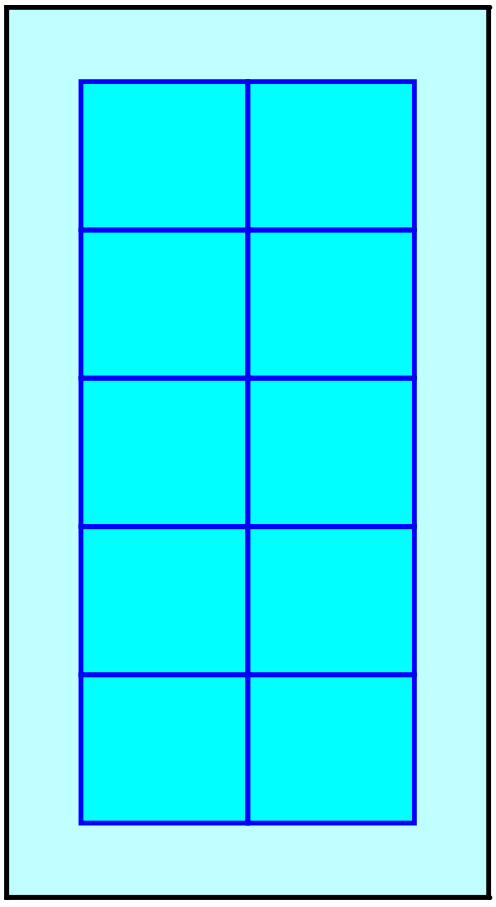
5 Chambers/Row x 4.00' Long = 20.00' Row Length +24.0" End Stone x 2 = 24.00' Base Length
2 Rows x 54.0" Wide + 24.0" Side Stone x 2 = 13.00' Base Width
12.0" Base + 51.0" Chamber Height = 5.25' Field Height

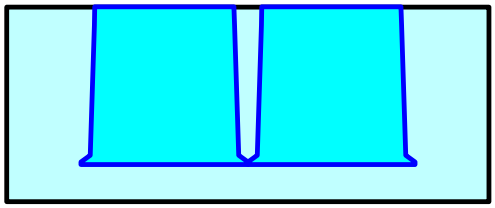
10 Chambers x 46.4 cf = 463.8 cf Chamber Storage
10 Chambers x 62.3 cf = 623.3 cf Displacement

1,638.0 cf Field - 623.3 cf Chambers = 1,014.7 cf Stone x 35.0% Voids = 355.1 cf Stone Storage

Chamber Storage + Stone Storage = 818.9 cf = 0.019 af
Overall Storage Efficiency = 50.0%
Overall System Size = 24.00' x 13.00' x 5.25'

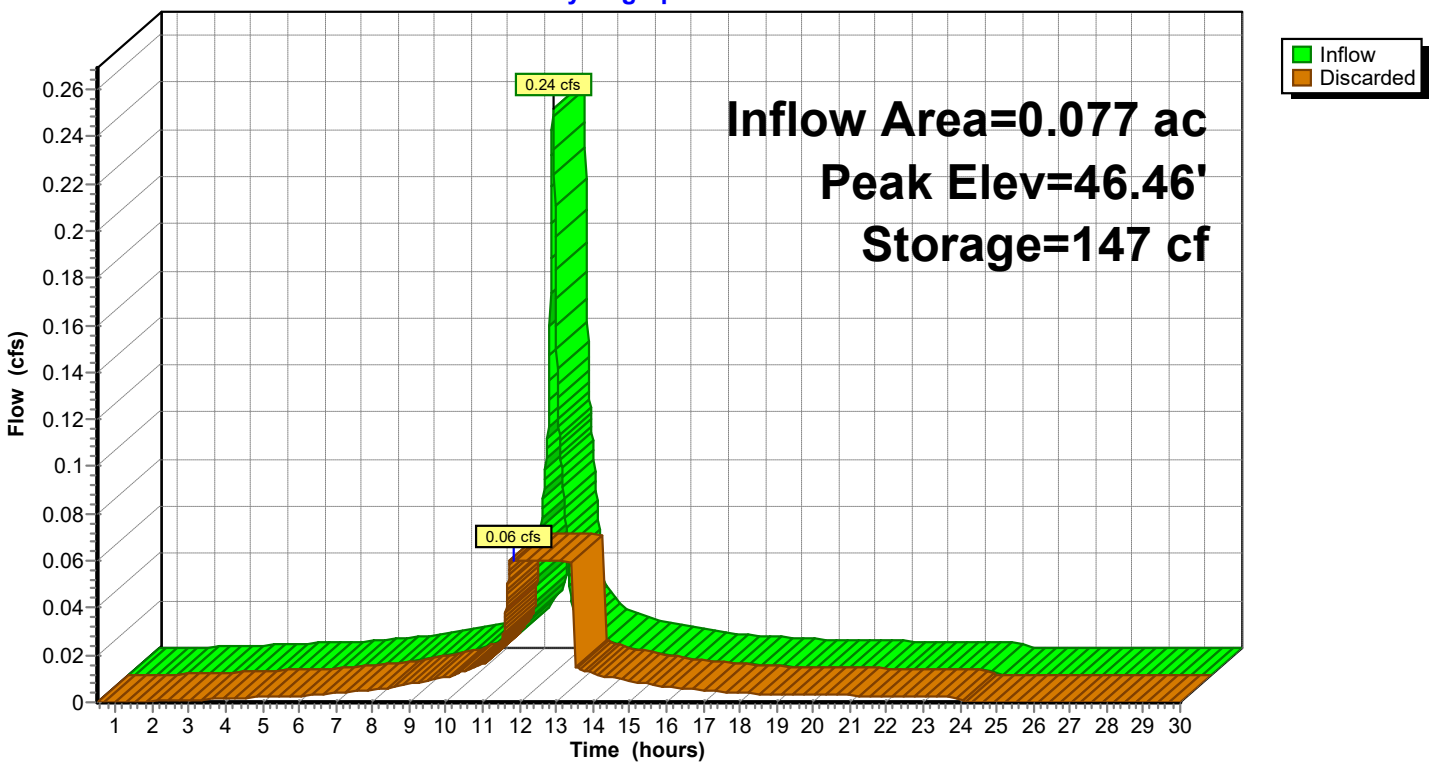
10 Chambers
60.7 cy Field
37.6 cy Stone





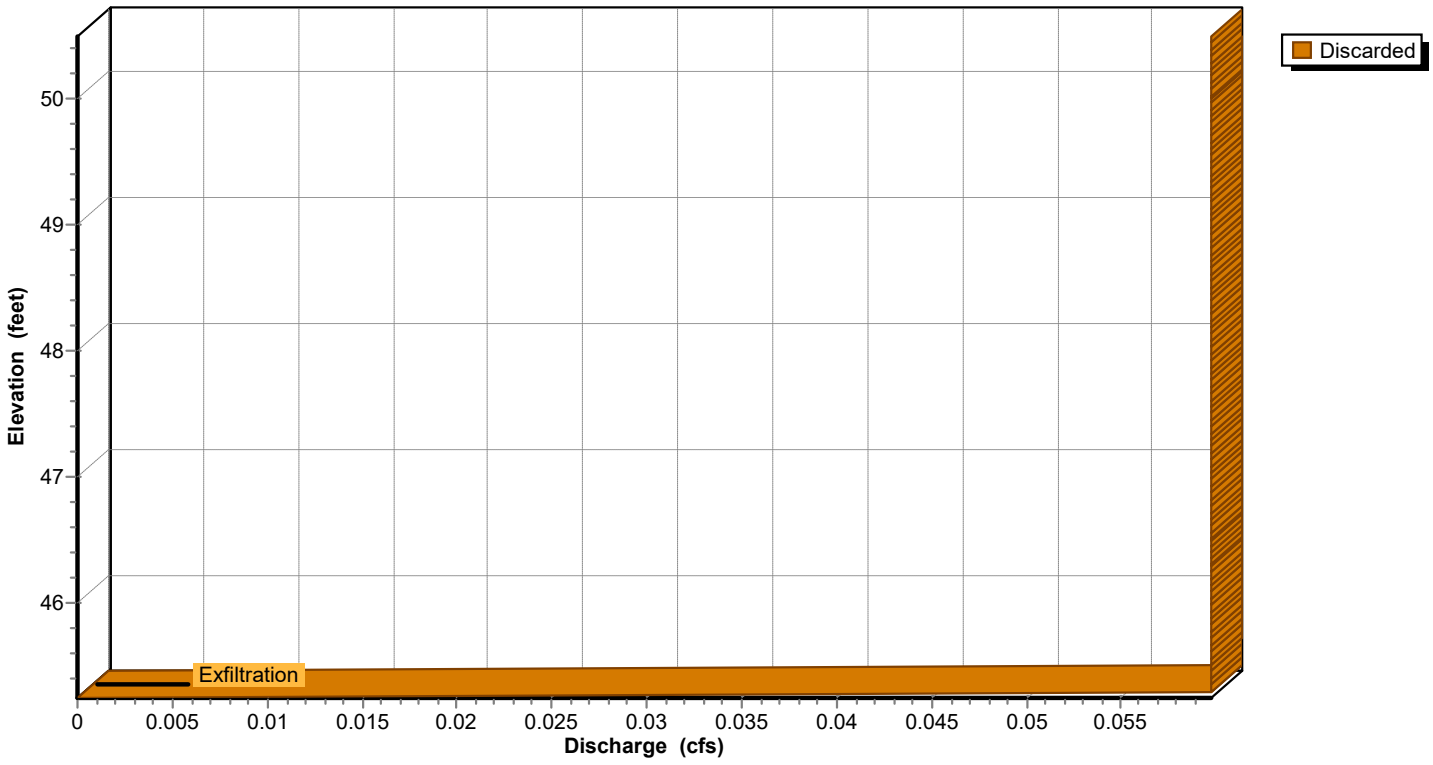
Pond IS2: System #2

Hydrograph

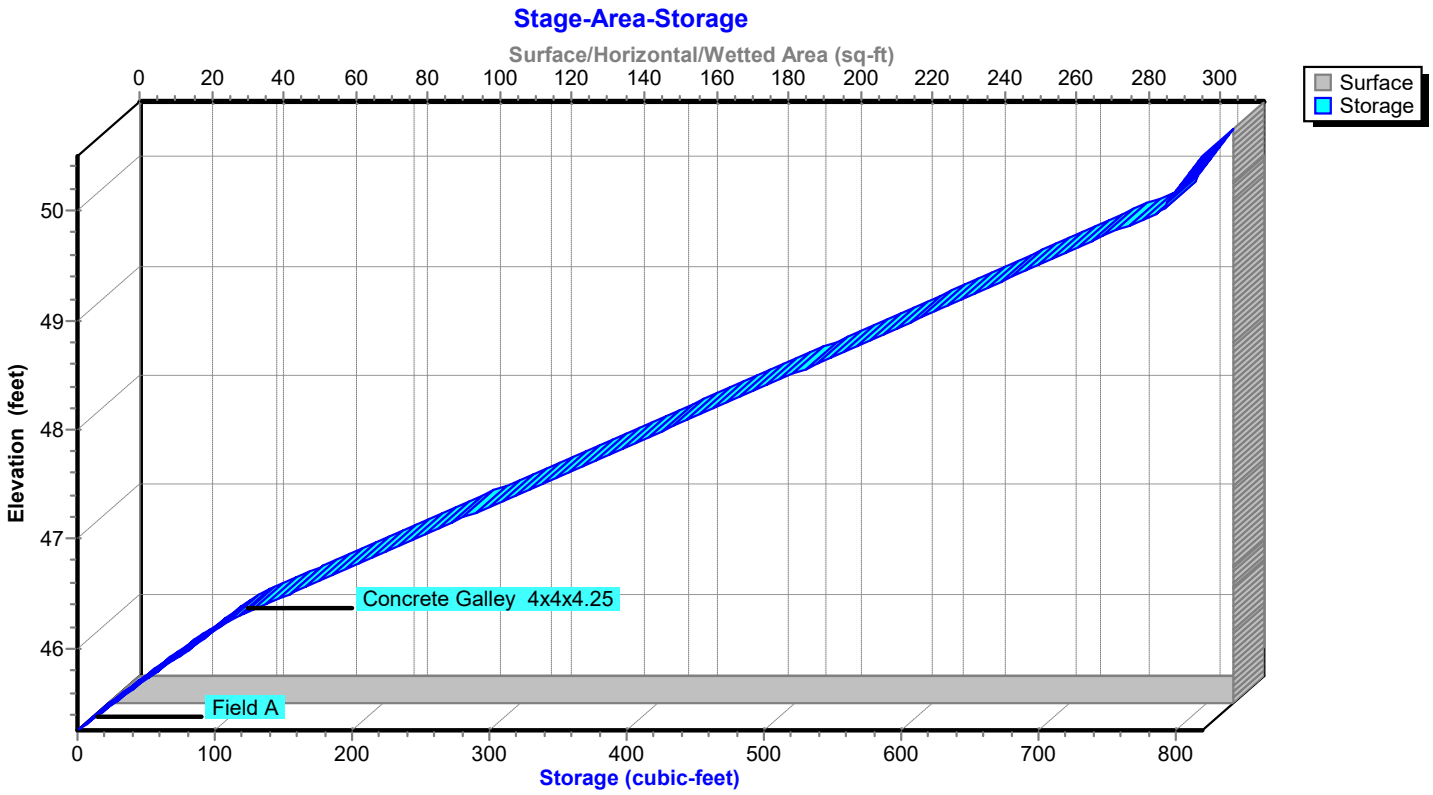


Pond IS2: System #2

Stage-Discharge



Pond IS2: System #2



Summary for Pond IS3: System #3

Inflow Area = 0.118 ac,100.00% Impervious, Inflow Depth = 2.87" for 2-Year event
Inflow = 0.37 cfs @ 12.07 hrs, Volume= 0.028 af
Outflow = 0.07 cfs @ 11.77 hrs, Volume= 0.028 af, Atten= 81%, Lag= 0.0 min
Discarded = 0.07 cfs @ 11.77 hrs, Volume= 0.028 af
Primary = 0.00 cfs @ 0.50 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 44.24' @ 12.50 hrs Surf.Area= 364 sf Storage= 286 cf

Plug-Flow detention time= 20.4 min calculated for 0.028 af (100% of inflow)
Center-of-Mass det. time= 20.4 min (776.6 - 756.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	42.50'	407 cf	**13.00'W x 28.00'L x 5.25'H Field A** 1,911 cf Overall - 748 cf Embedded = 1,163 cf x 35.0% Voids
#2A	43.50'	557 cf	**Concrete Galley 4x4x4.25** x 12 Inside #1 Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf 12 Chambers in 2 Rows
		964 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	42.50'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	46.80'	**8.0" Round Culvert** L= 72.0' Ke= 0.090 Inlet / Outlet Invert= 46.80' / 45.00' S= 0.0250 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.07 cfs @ 11.77 hrs HW=42.56' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=0.00 cfs @ 0.50 hrs HW=42.50' TW=43.00' (Dynamic Tailwater)
↑—**2=Culvert** (Controls 0.00 cfs)

Pond IS3: System #3 - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x4x4.25 (Concrete Galley, Shea LE-EGH, LE-CGH or equivalent)
Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf
Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf

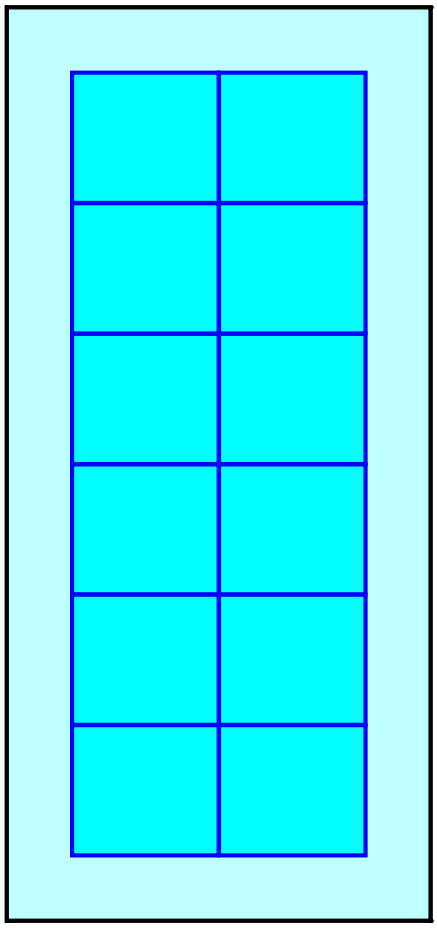
6 Chambers/Row x 4.00' Long = 24.00' Row Length +24.0" End Stone x 2 = 28.00' Base Length
2 Rows x 54.0" Wide + 24.0" Side Stone x 2 = 13.00' Base Width
12.0" Base + 51.0" Chamber Height = 5.25' Field Height

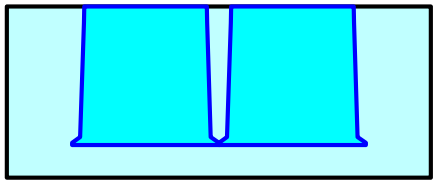
12 Chambers x 46.4 cf = 556.6 cf Chamber Storage
12 Chambers x 62.3 cf = 748.0 cf Displacement

1,911.0 cf Field - 748.0 cf Chambers = 1,163.0 cf Stone x 35.0% Voids = 407.1 cf Stone Storage

Chamber Storage + Stone Storage = 963.6 cf = 0.022 af
Overall Storage Efficiency = 50.4%
Overall System Size = 28.00' x 13.00' x 5.25'

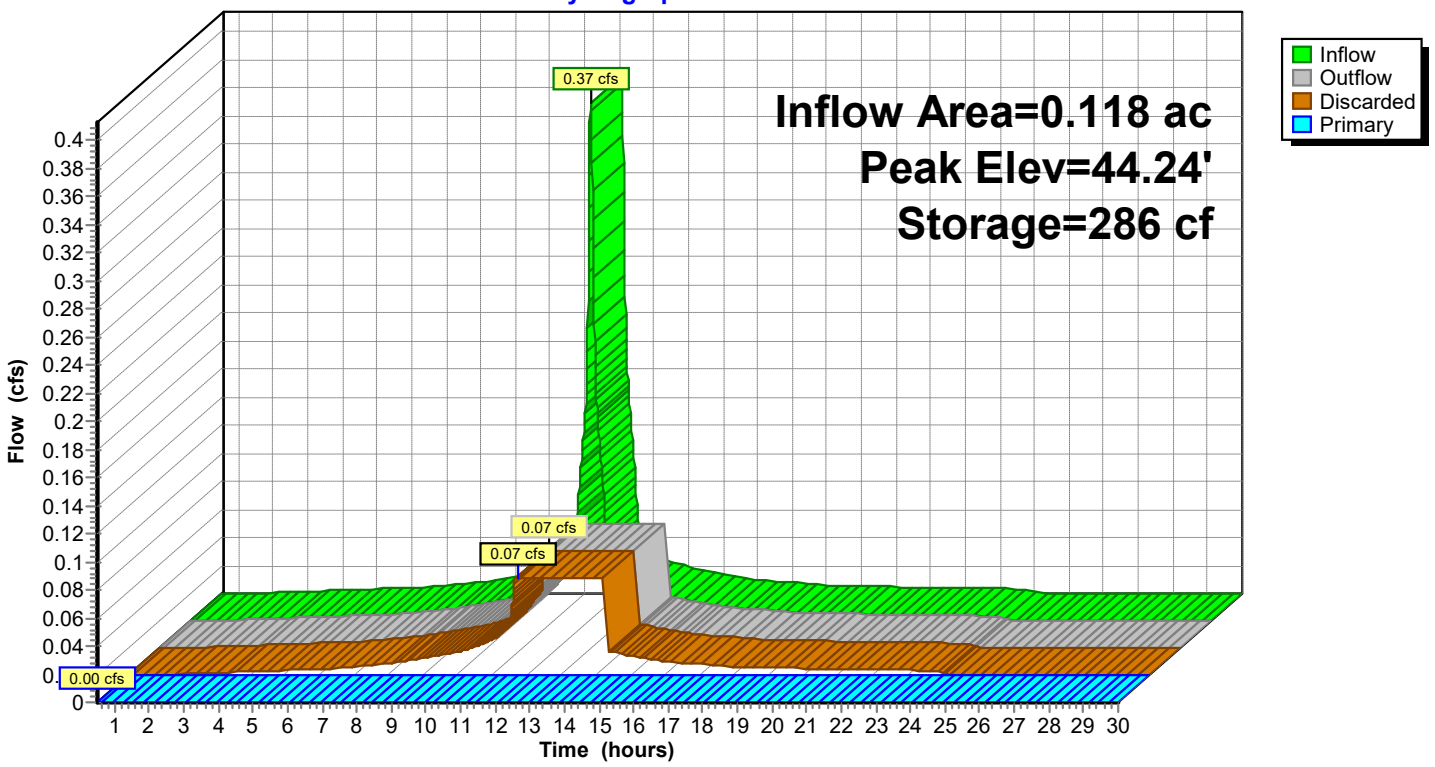
12 Chambers
70.8 cy Field
43.1 cy Stone





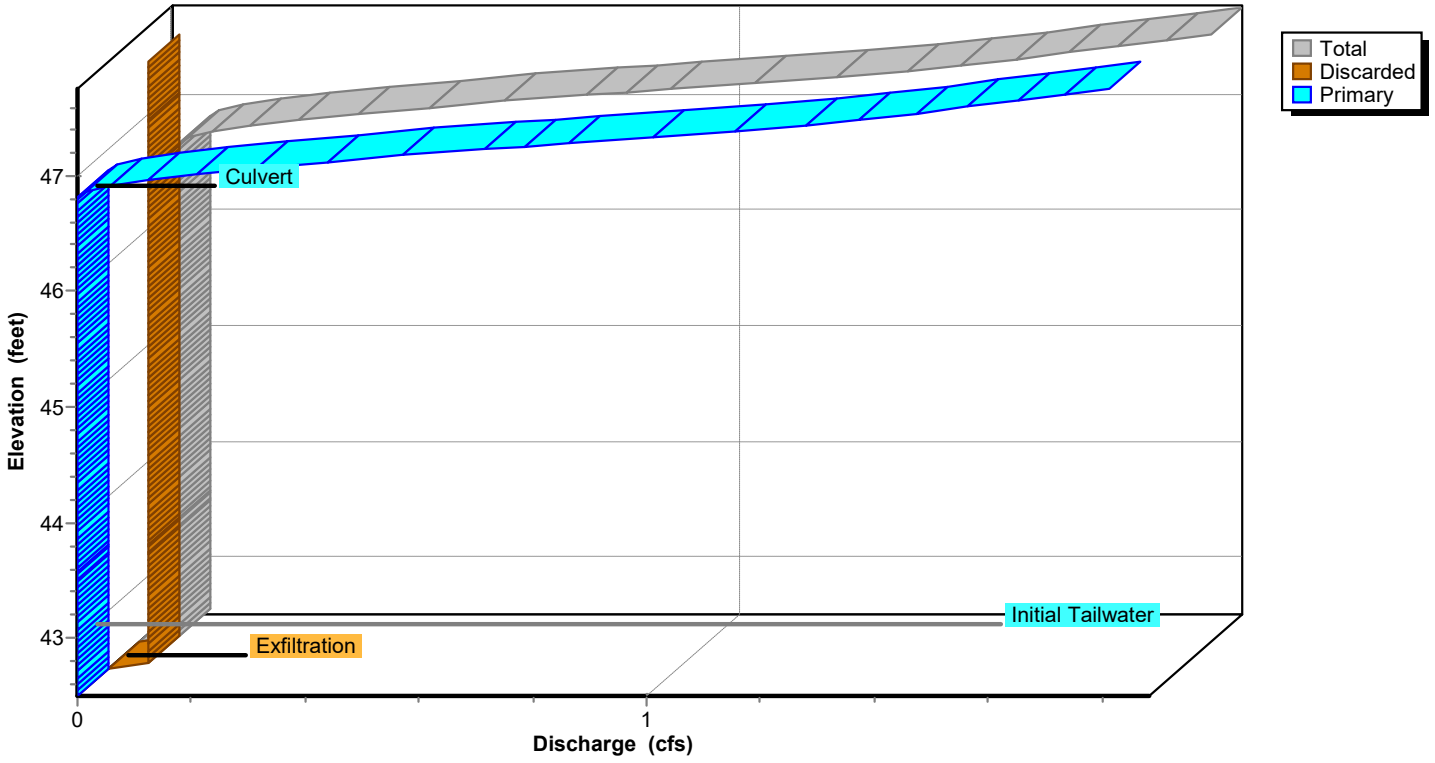
Pond IS3: System #3

Hydrograph

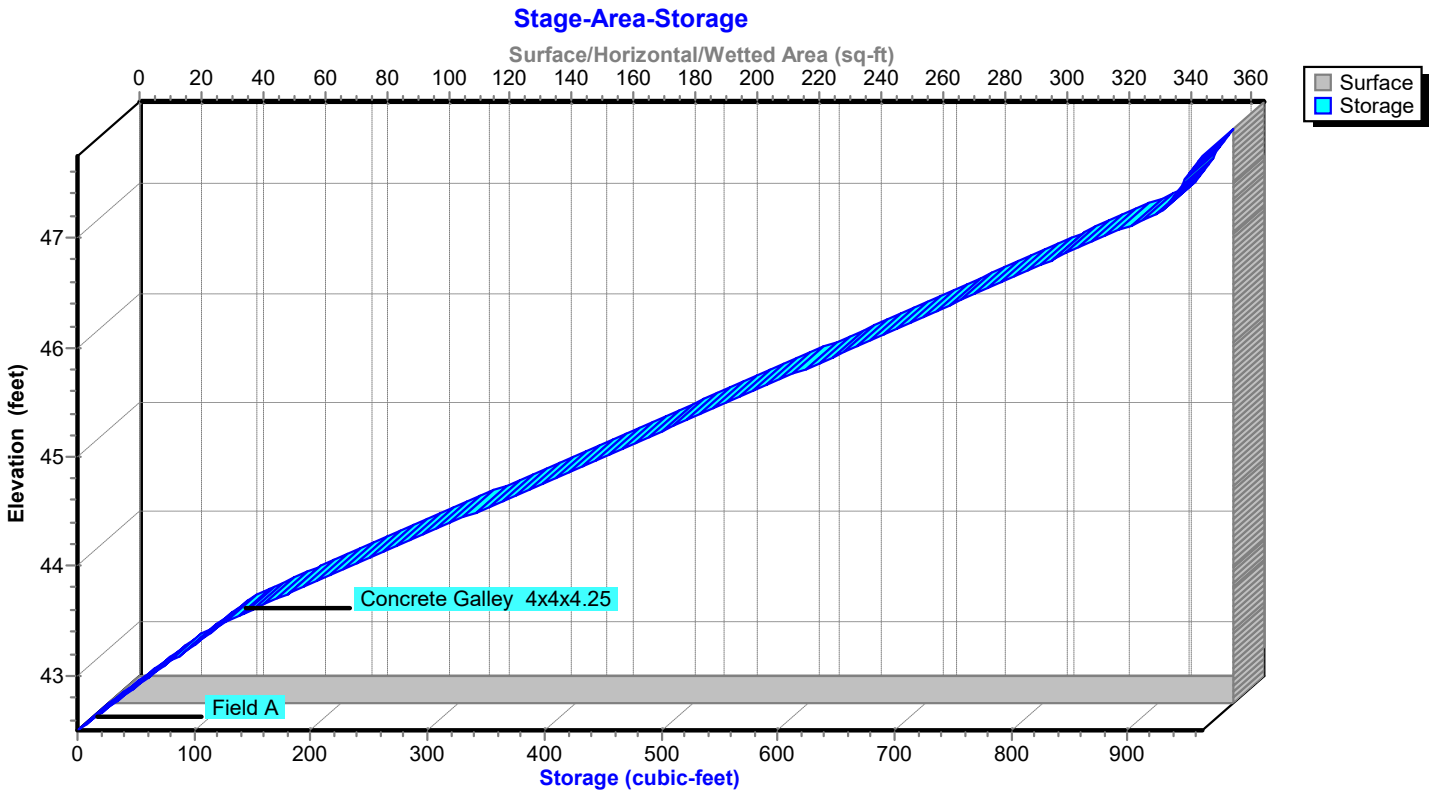


Pond IS3: System #3

Stage-Discharge



Pond IS3: System #3



Summary for Pond IS4: (Retention Pond)

Inflow Area = 0.284 ac, 41.74% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.00 cfs @ 22.35 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.50 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Secondary = 0.00 cfs @ 0.50 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 43.01' @ 24.29 hrs Surf.Area= 639 sf Storage= 5 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	43.00'	1,949 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

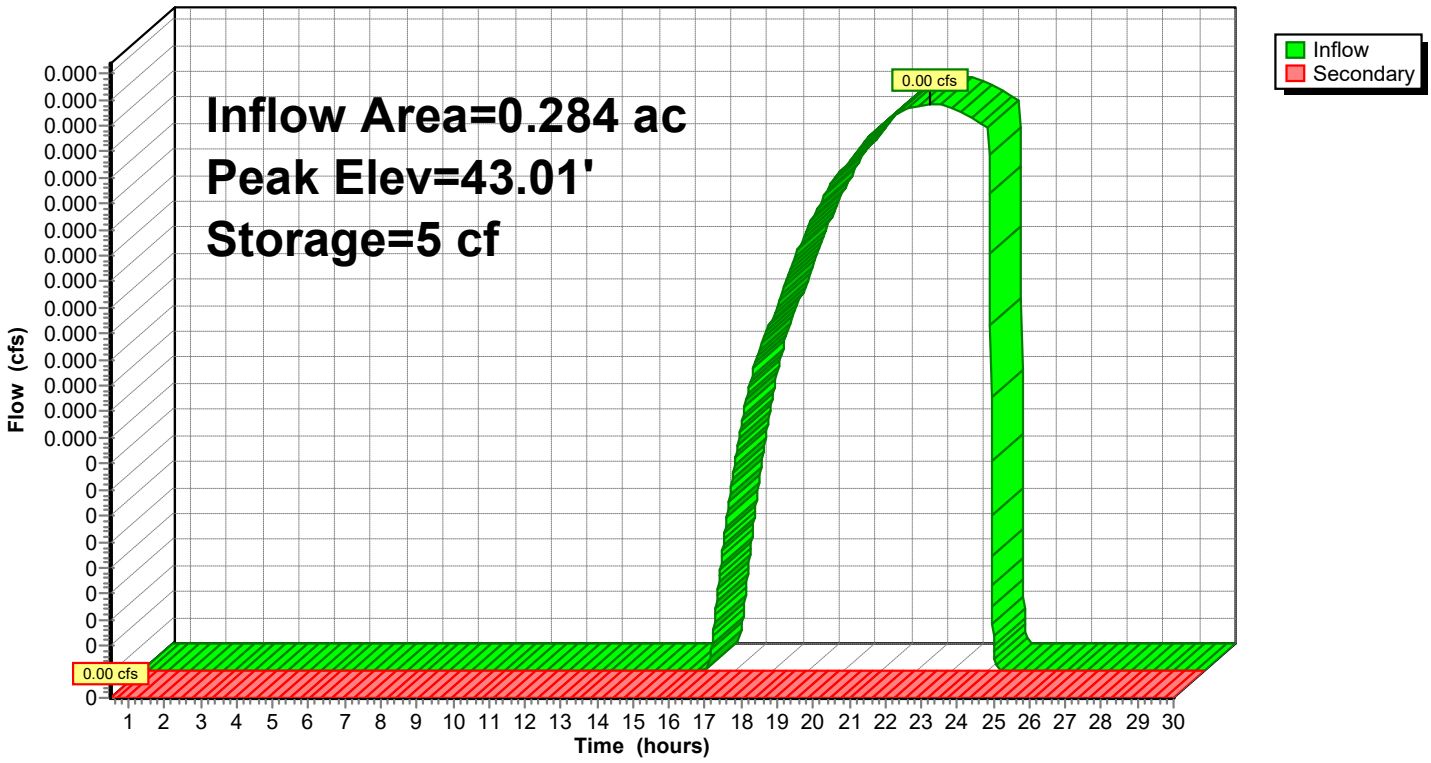
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
43.00	637	100.0	0	0	637
44.00	966	119.0	796	796	986
45.00	1,351	137.0	1,153	1,949	1,374

Device	Routing	Invert	Outlet Devices
#1	Secondary	44.50'	**45.0 deg x 3.0' wide x 0.50' high Dam Breach** C= 2.56 Top of breach = 45.00' Bottom of breach = 44.50' Breach starts at 44.50' WSE and develops over 1.000 hrs

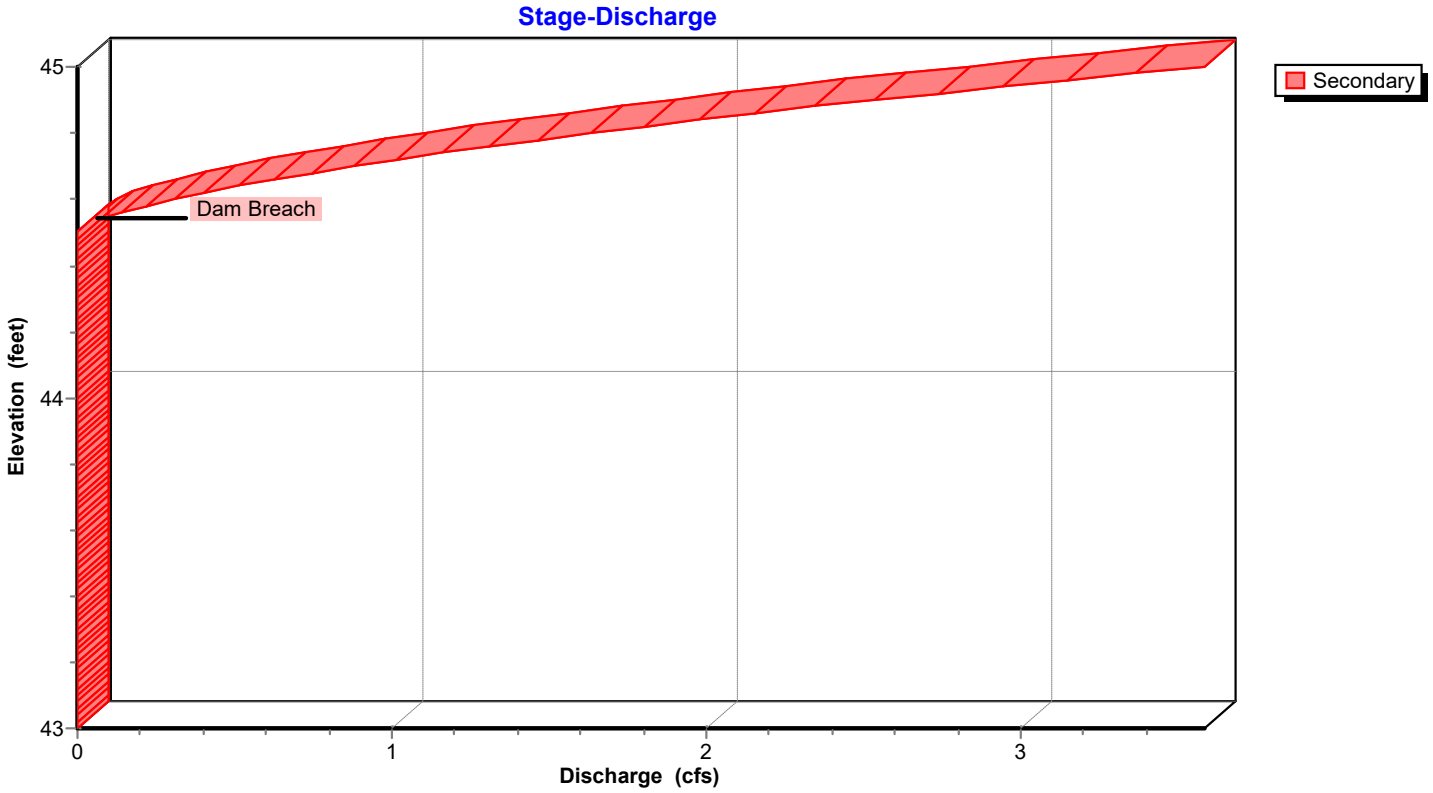
Secondary OutFlow Max=0.00 cfs @ 0.50 hrs HW=43.00' TW=0.00' (Dynamic Tailwater)
└**1=Dam Breach** (Controls 0.00 cfs)

Pond IS4: (Retention Pond)

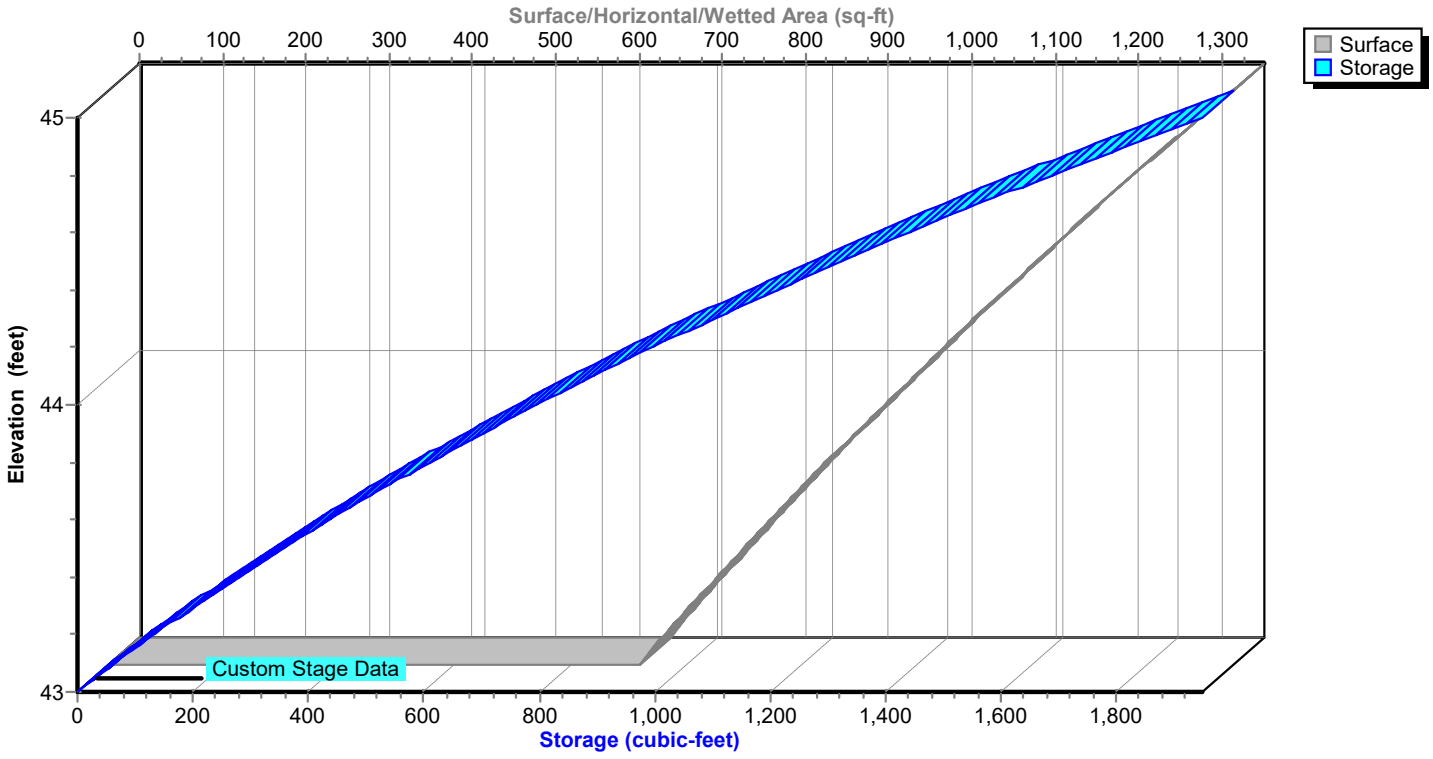
Hydrograph



Pond IS4: (Retention Pond)



Pond IS4: (Retention Pond)

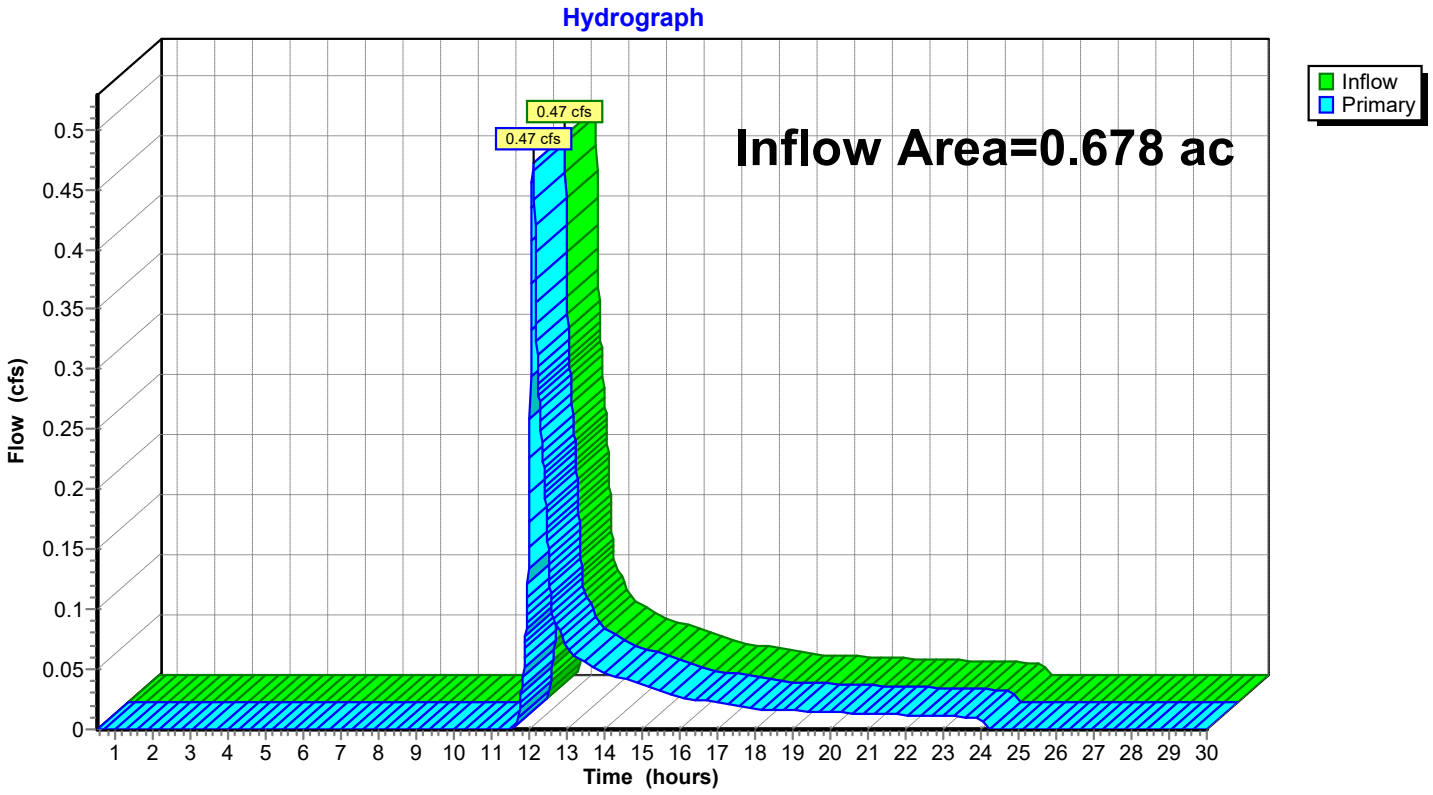


Summary for Link POD1: South-West Abutter

Inflow Area = 0.678 ac, 0.00% Impervious, Inflow Depth = 0.68" for 2-Year event
Inflow = 0.47 cfs @ 12.09 hrs, Volume= 0.038 af
Primary = 0.47 cfs @ 12.09 hrs, Volume= 0.038 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs

Link POD1: South-West Abutter

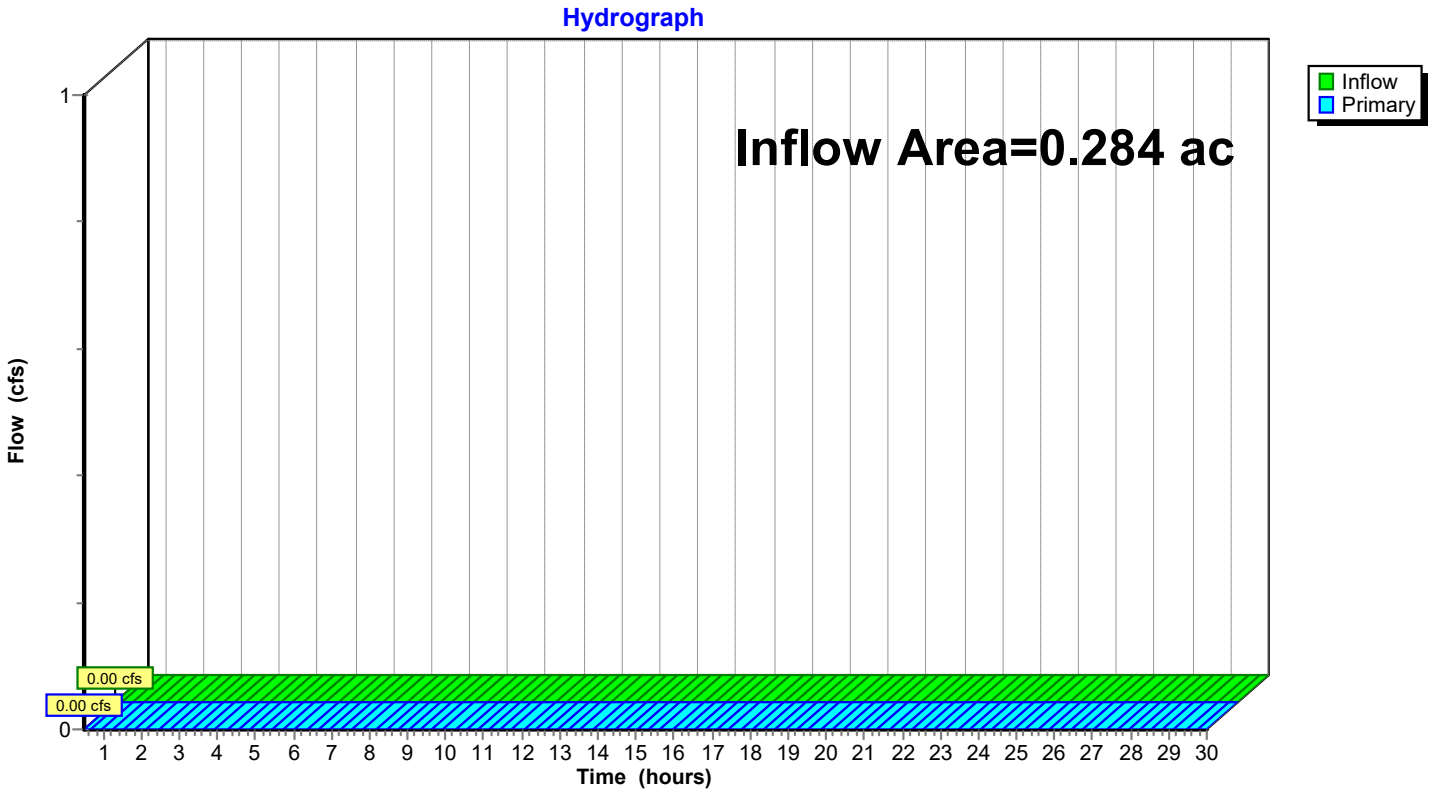


Summary for Link POD1.: South-West Abutter

Inflow Area = 0.284 ac, 41.74% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.00 cfs @ 0.50 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.50 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs

Link POD1.: South-West Abutter



Time span=0.50-30.00 hrs, dt=0.010 hrs, 2951 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E1: Sub-catchment-1 Runoff Area=29,550 sf 0.00% Impervious Runoff Depth=1.53"
Tc=5.0 min CN=68 Runoff=1.21 cfs 0.087 af

Subcatchment P1: Sub-catchment-1 Runoff Area=7,199 sf 0.00% Impervious Runoff Depth=0.19"
Tc=5.0 min CN=42 Runoff=0.01 cfs 0.003 af

Subcatchment PD1: Driveway Runoff Area=2,276 sf 98.33% Impervious Runoff Depth=4.15"
Tc=5.0 min CN=97 Runoff=0.24 cfs 0.018 af

Subcatchment PD2: Driveway Runoff Area=4,038 sf 100.00% Impervious Runoff Depth=4.26"
Tc=5.0 min CN=98 Runoff=0.42 cfs 0.033 af

Subcatchment PR1: Roof_BLDG-1 Runoff Area=2,260 sf 100.00% Impervious Runoff Depth=4.26"
Tc=5.0 min CN=98 Runoff=0.24 cfs 0.018 af

Subcatchment PR2: Roof_BLDG-2 Runoff Area=3,360 sf 100.00% Impervious Runoff Depth=4.26"
Tc=5.0 min CN=98 Runoff=0.35 cfs 0.027 af

Subcatchment PR3: Roof_BLDG-3 Runoff Area=1,120 sf 100.00% Impervious Runoff Depth=4.26"
Tc=5.0 min CN=98 Runoff=0.12 cfs 0.009 af

Pond IS1: System #1 Peak Elev=48.81' Storage=396 cf Inflow=0.47 cfs 0.037 af
Outflow=0.08 cfs 0.037 af

Pond IS2: System #2 Peak Elev=47.26' Storage=293 cf Inflow=0.35 cfs 0.027 af
Outflow=0.06 cfs 0.027 af

Pond IS3: System #3 Peak Elev=45.34' Storage=524 cf Inflow=0.54 cfs 0.042 af
Discarded=0.07 cfs 0.042 af Primary=0.00 cfs 0.000 af Outflow=0.07 cfs 0.042 af

Pond IS4: (Retention Pond) Peak Elev=43.18' Storage=117 cf Inflow=0.01 cfs 0.003 af
Outflow=0.00 cfs 0.000 af

Link POD1: South-West Abutter Inflow=1.21 cfs 0.087 af
Primary=1.21 cfs 0.087 af

Link POD1.: South-West Abutter Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 1.143 ac Runoff Volume = 0.195 af Average Runoff Depth = 2.05"
73.87% Pervious = 0.845 ac 26.13% Impervious = 0.299 ac

Summary for Subcatchment E1: Sub-catchment-1

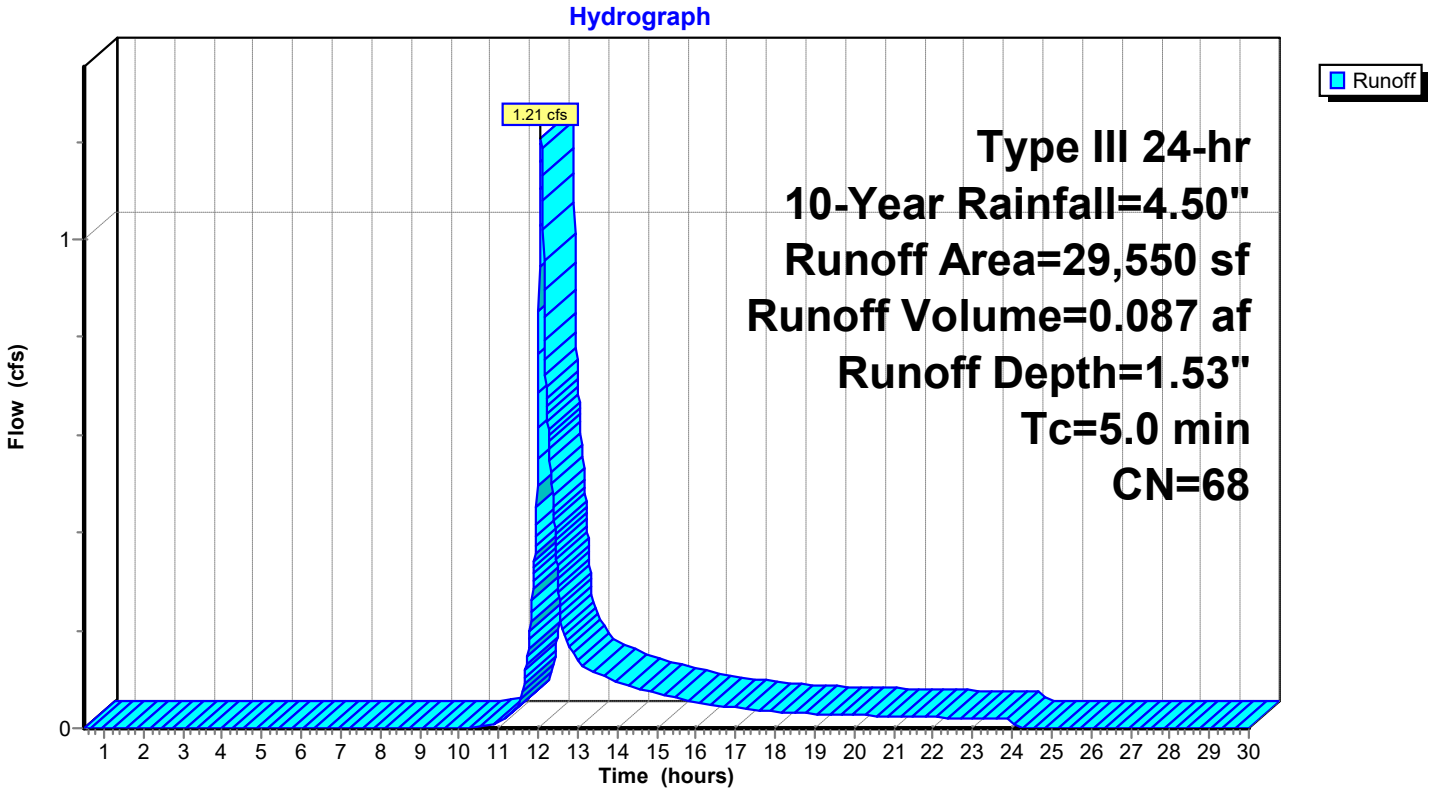
Runoff = 1.21 cfs @ 12.08 hrs, Volume= 0.087 af, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
29,550	68	<50% Grass cover, Poor, HSG A
29,550		100.00% Pervious Area

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

Subcatchment E1: Sub-catchment-1



Summary for Subcatchment P1: Sub-catchment-1

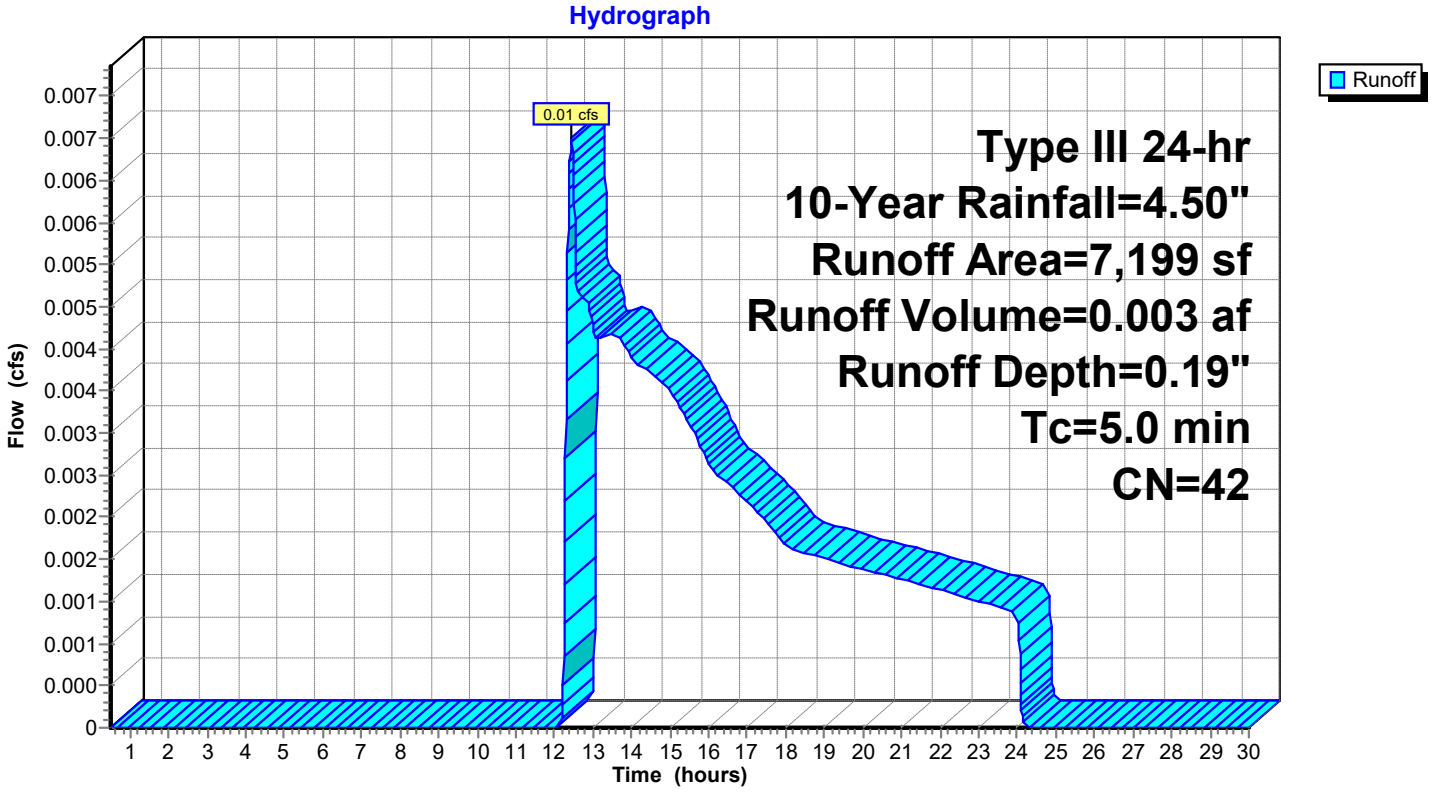
Runoff = 0.01 cfs @ 12.44 hrs, Volume= 0.003 af, Depth= 0.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
2,623	39	>75% Grass cover, Good, HSG A
3,705	36	Woods, Fair, HSG A
871	76	Gravel roads, HSG A
7,199	42	Weighted Average
7,199		100.00% Pervious Area

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

Subcatchment P1: Sub-catchment-1



Summary for Subcatchment PD1: Driveway

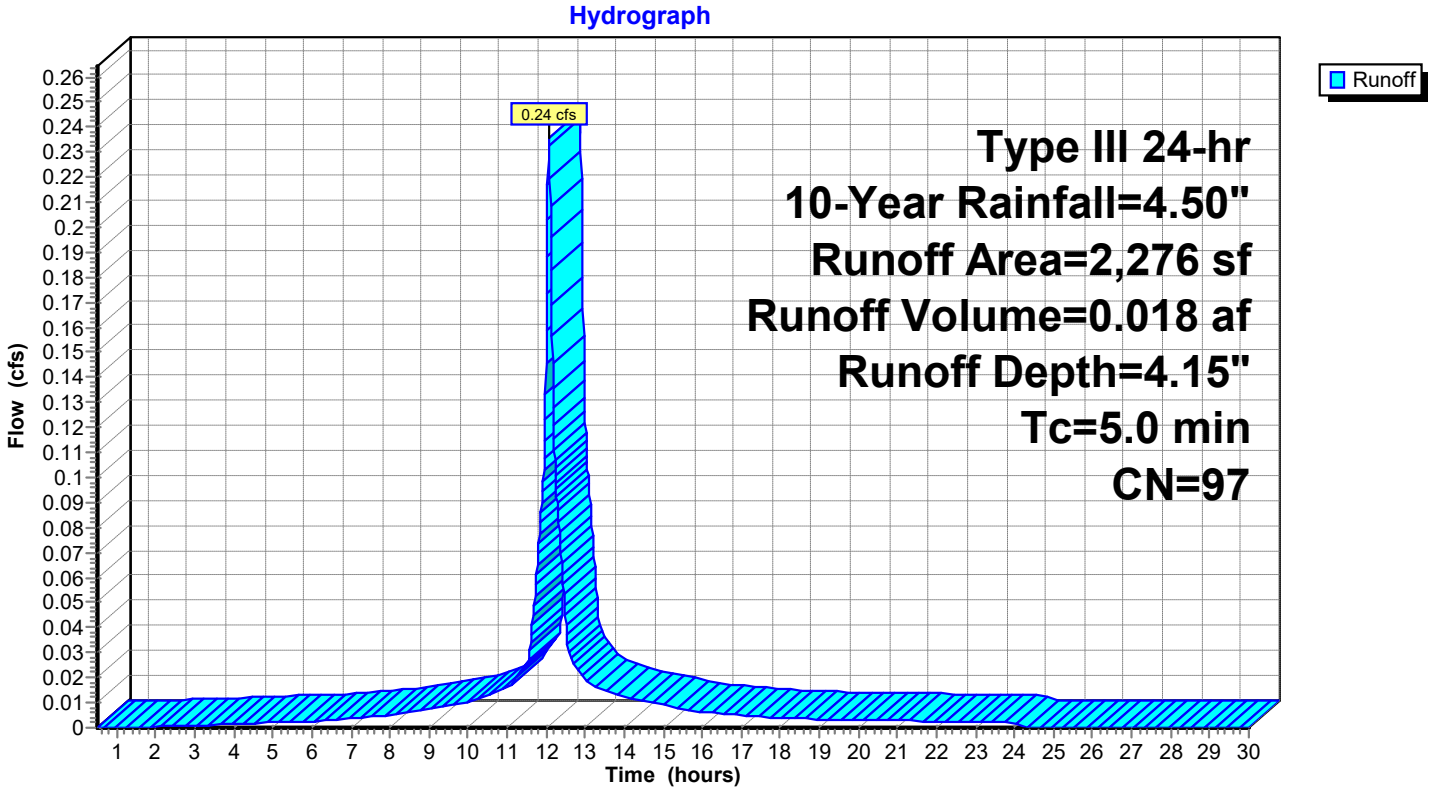
Runoff = 0.24 cfs @ 12.07 hrs, Volume= 0.018 af, Depth= 4.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
	2,238	98	Paved parking, HSG A
*	38	65	Paver walkway
	2,276	97	Weighted Average
	38		1.67% Pervious Area
	2,238		98.33% Impervious Area

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

Subcatchment PD1: Driveway



Summary for Subcatchment PD2: Driveway

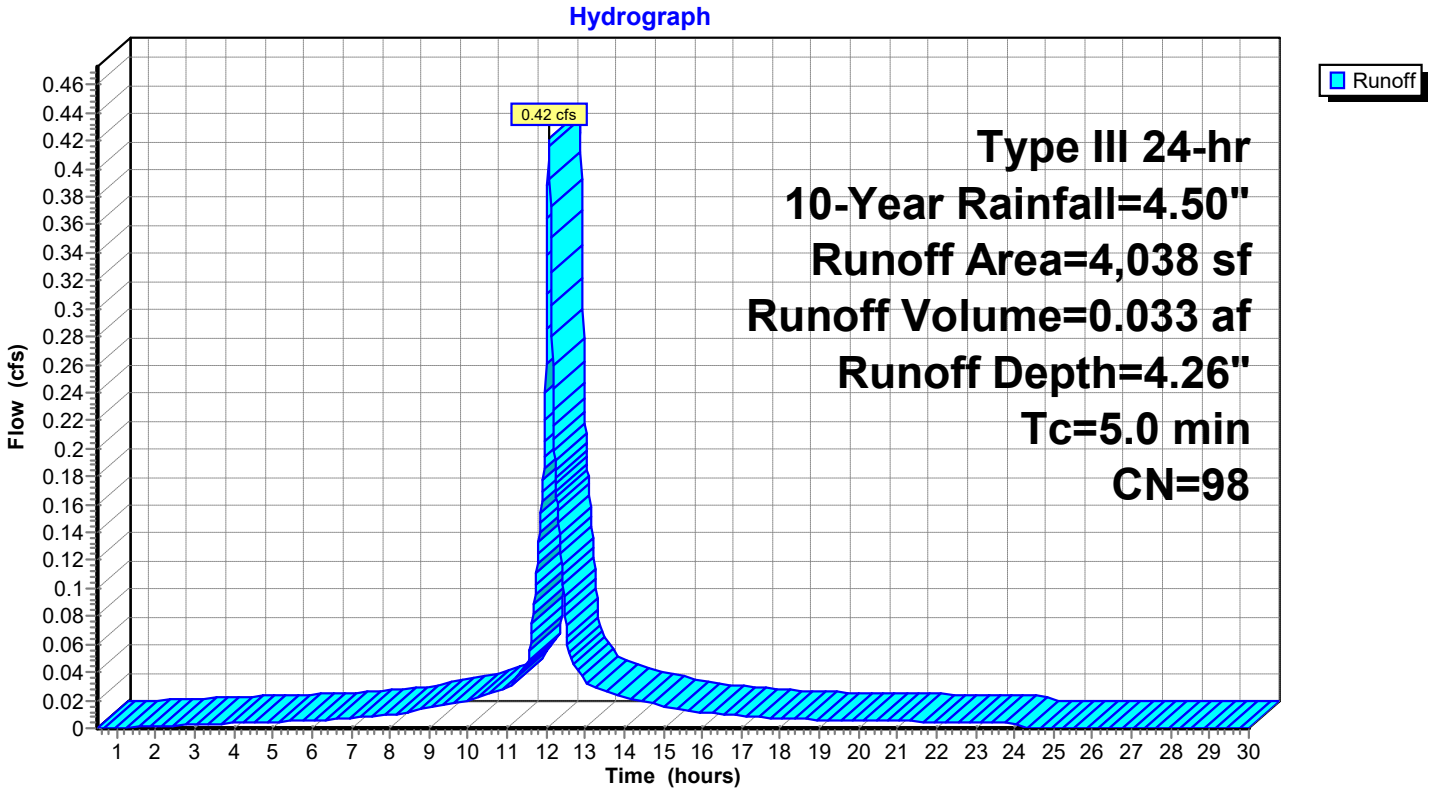
Runoff = 0.42 cfs @ 12.07 hrs, Volume= 0.033 af, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
4,038	98	Paved parking, HSG A
4,038		100.00% Impervious Area

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

Subcatchment PD2: Driveway



Summary for Subcatchment PR1: Roof_BLDG-1

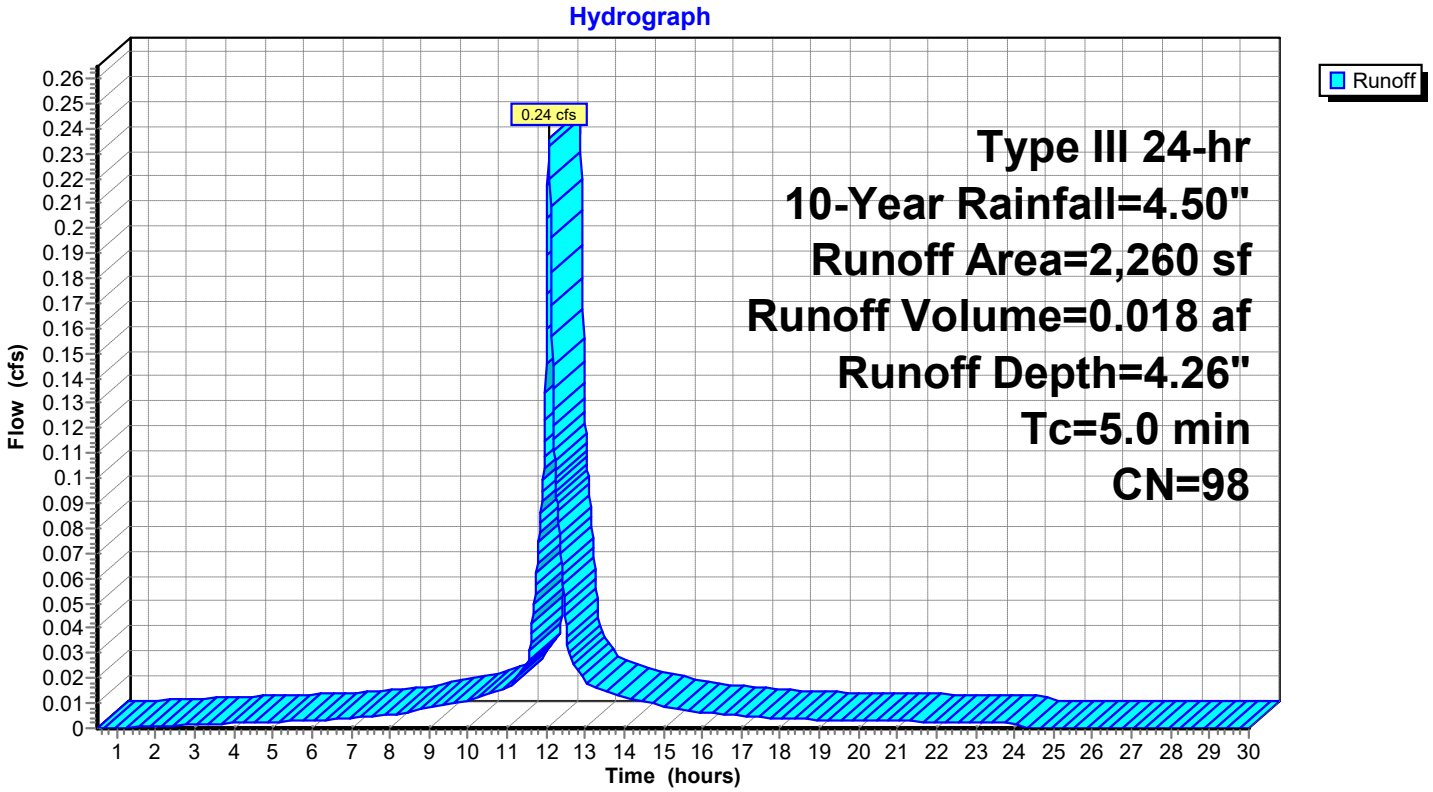
Runoff = 0.24 cfs @ 12.07 hrs, Volume= 0.018 af, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	2,260	98	Roofs, HSG A
	2,260		100.00% Impervious Area

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

Subcatchment PR1: Roof_BLDG-1



Summary for Subcatchment PR2: Roof_BLDG-2

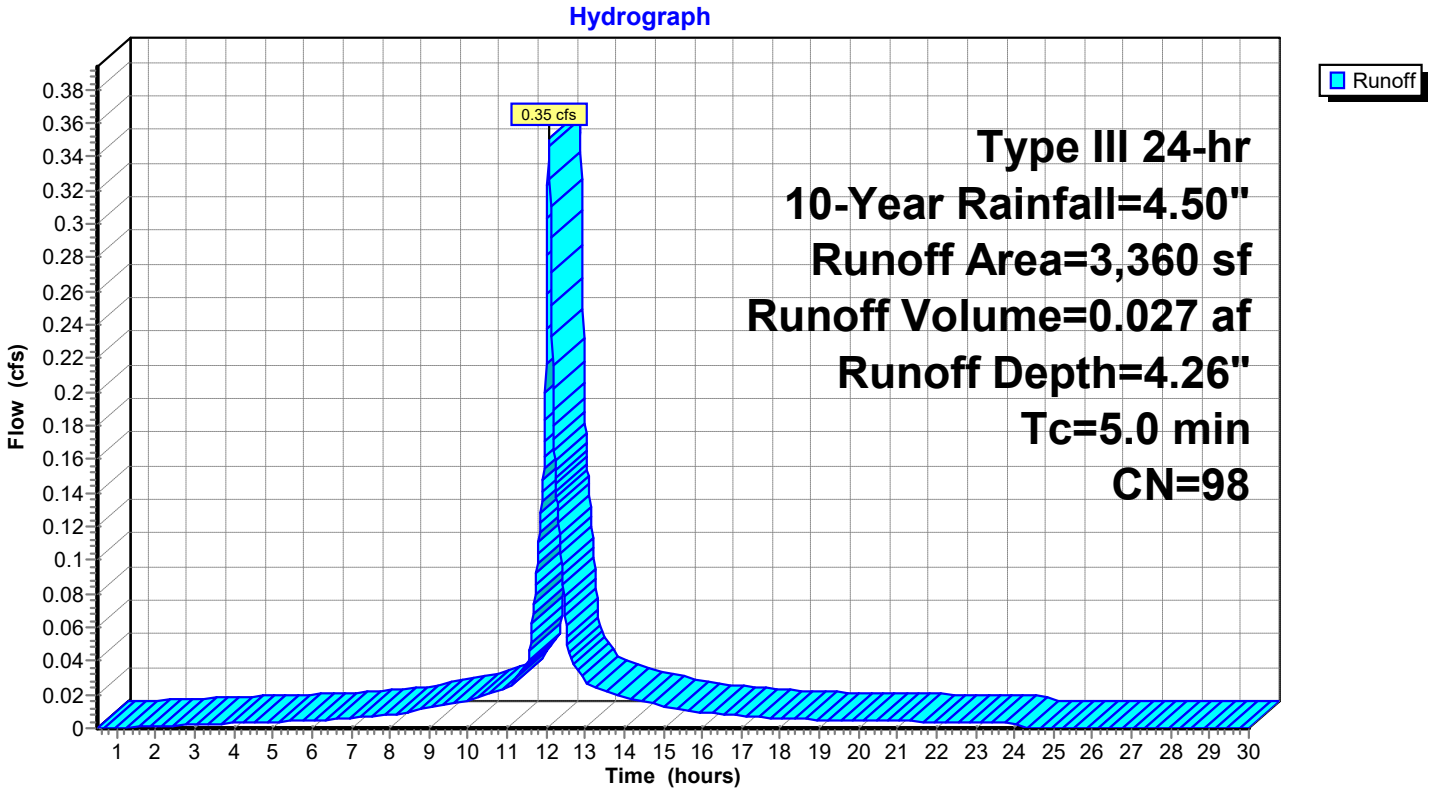
Runoff = 0.35 cfs @ 12.07 hrs, Volume= 0.027 af, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	3,360	98	Roofs, HSG A
	3,360		100.00% Impervious Area

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

Subcatchment PR2: Roof_BLDG-2



Summary for Subcatchment PR3: Roof_BLDG-3

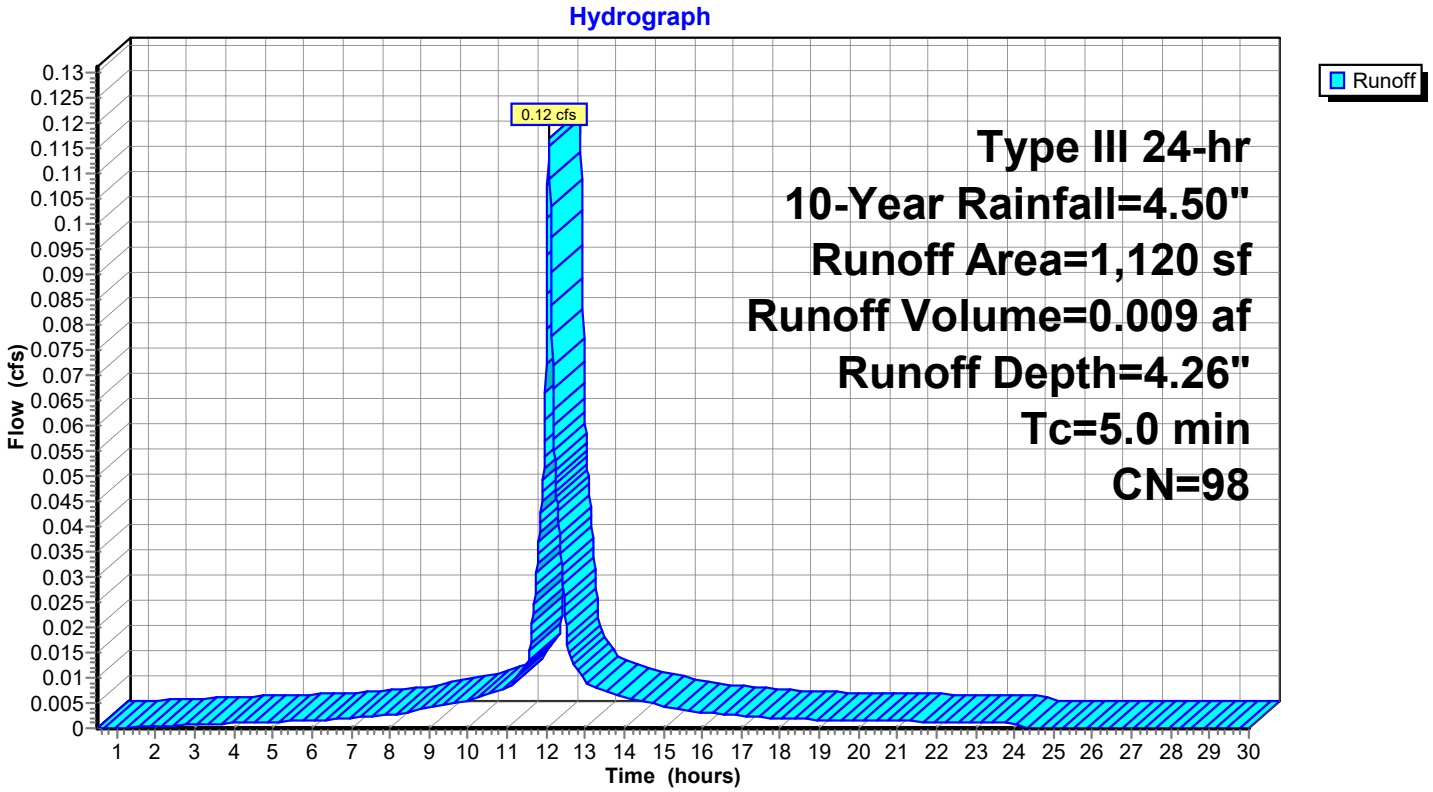
Runoff = 0.12 cfs @ 12.07 hrs, Volume= 0.009 af, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	1,120	98	Roofs, HSG A
	1,120		100.00% Impervious Area

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

Subcatchment PR3: Roof_BLDG-3



Summary for Pond IS1: System #1

Inflow Area = 0.104 ac, 99.16% Impervious, Inflow Depth = 4.21" for 10-Year event
Inflow = 0.47 cfs @ 12.07 hrs, Volume= 0.037 af
Outflow = 0.08 cfs @ 11.74 hrs, Volume= 0.037 af, Atten= 83%, Lag= 0.0 min
Discarded = 0.08 cfs @ 11.74 hrs, Volume= 0.037 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 48.81' @ 12.52 hrs Surf.Area= 416 sf Storage= 396 cf

Plug-Flow detention time= 25.8 min calculated for 0.037 af (100% of inflow)
Center-of-Mass det. time= 25.8 min (778.7 - 752.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	46.80'	459 cf	**13.00'W x 32.00'L x 5.25'H Field A** 2,184 cf Overall - 873 cf Embedded = 1,311 cf x 35.0% Voids
#2A	47.80'	649 cf	**Concrete Galley 4x4x4.25** x 14 Inside #1 Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf 14 Chambers in 2 Rows
		1,108 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	46.80'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.08 cfs @ 11.74 hrs HW=46.86' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Pond IS1: System #1 - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x4x4.25 (Concrete Galley, Shea LE-EGH, LE-CGH or equivalent)
Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf
Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf

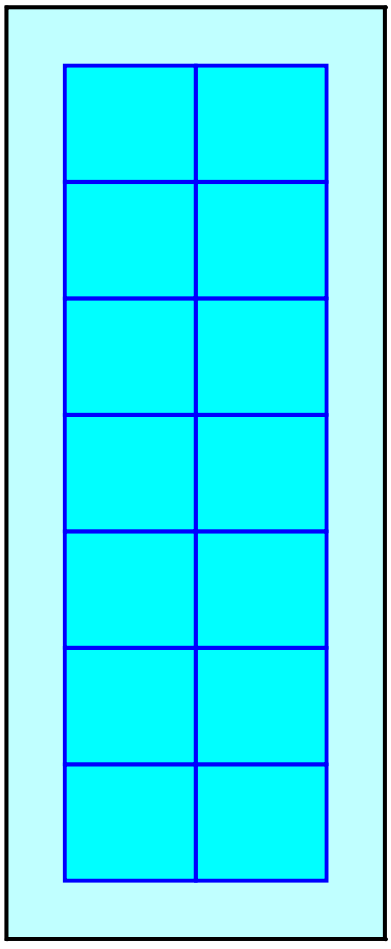
7 Chambers/Row x 4.00' Long = 28.00' Row Length +24.0" End Stone x 2 = 32.00' Base Length
2 Rows x 54.0" Wide + 24.0" Side Stone x 2 = 13.00' Base Width
12.0" Base + 51.0" Chamber Height = 5.25' Field Height

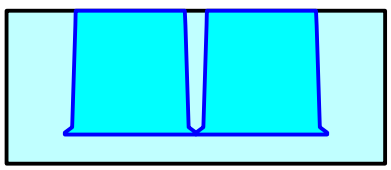
14 Chambers x 46.4 cf = 649.3 cf Chamber Storage
14 Chambers x 62.3 cf = 872.6 cf Displacement

2,184.0 cf Field - 872.6 cf Chambers = 1,311.4 cf Stone x 35.0% Voids = 459.0 cf Stone Storage

Chamber Storage + Stone Storage = 1,108.3 cf = 0.025 af
Overall Storage Efficiency = 50.7%
Overall System Size = 32.00' x 13.00' x 5.25'

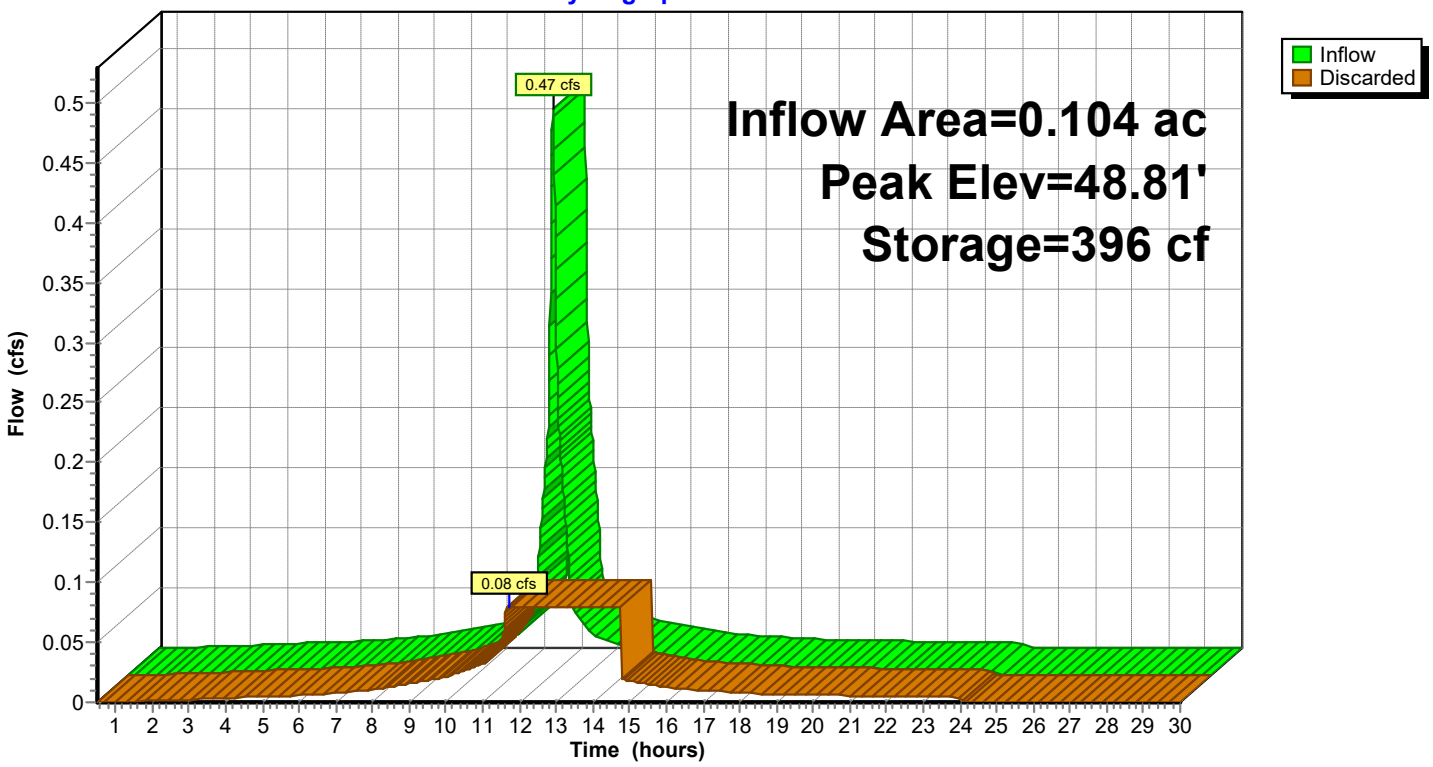
14 Chambers
80.9 cy Field
48.6 cy Stone





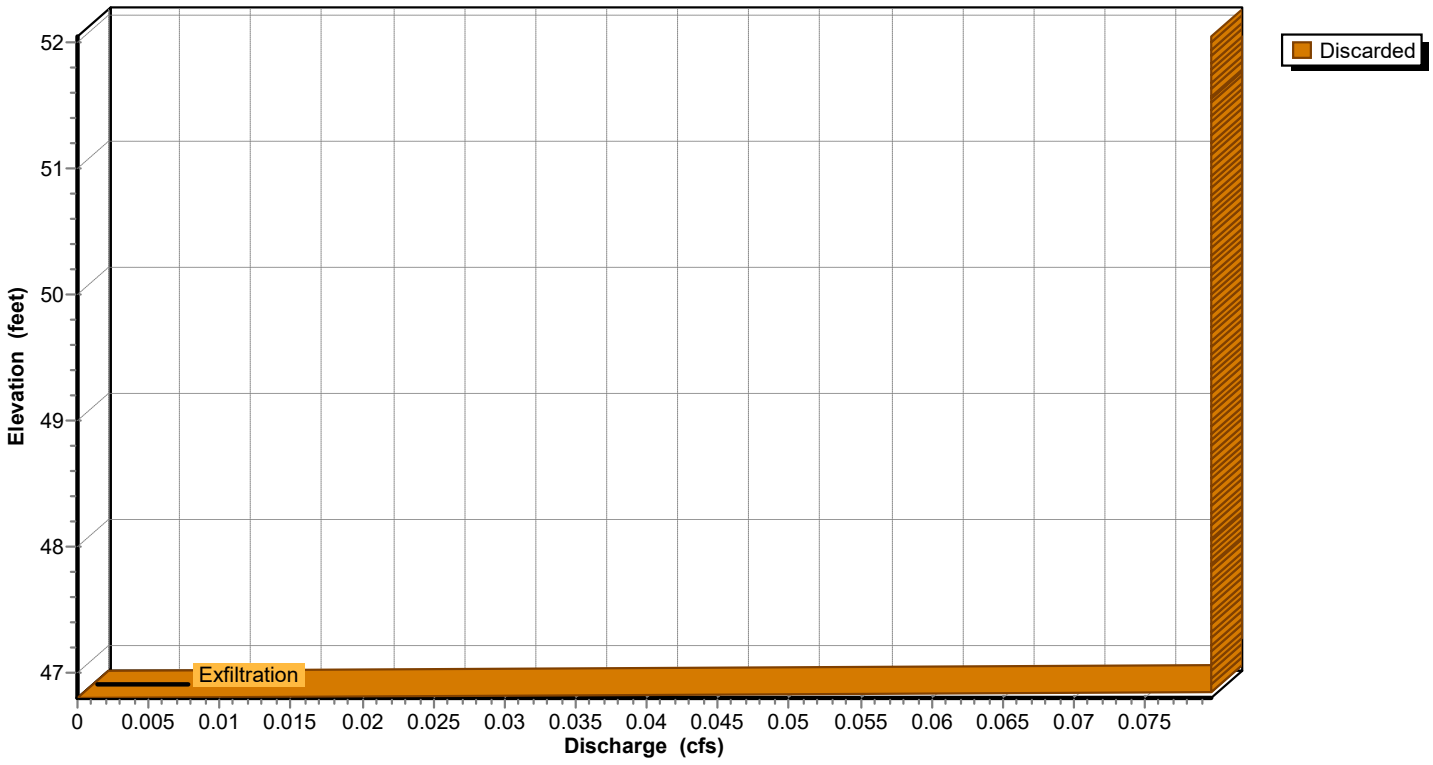
Pond IS1: System #1

Hydrograph

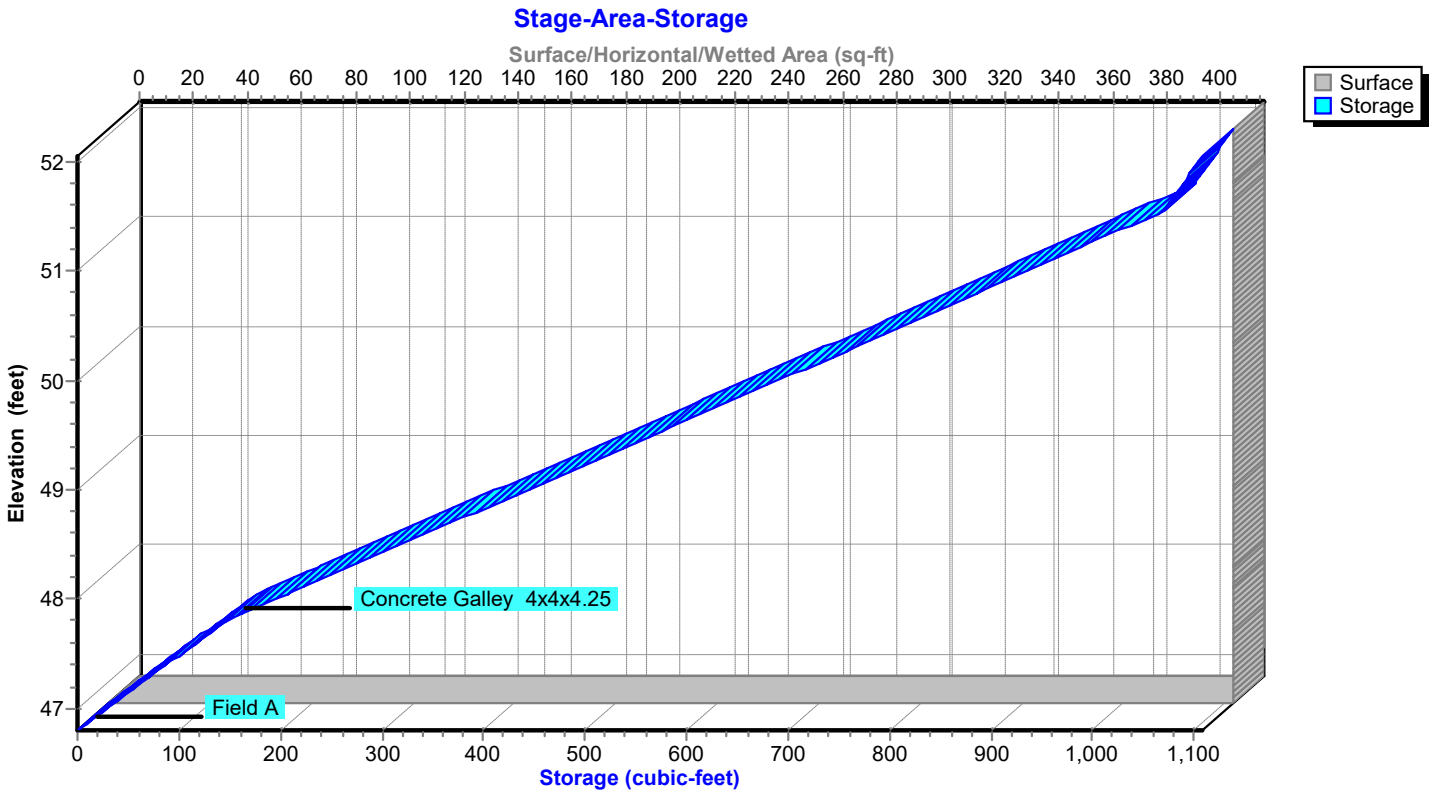


Pond IS1: System #1

Stage-Discharge



Pond IS1: System #1



Summary for Pond IS2: System #2

Inflow Area = 0.077 ac,100.00% Impervious, Inflow Depth = 4.26" for 10-Year event
Inflow = 0.35 cfs @ 12.07 hrs, Volume= 0.027 af
Outflow = 0.06 cfs @ 11.74 hrs, Volume= 0.027 af, Atten= 83%, Lag= 0.0 min
Discarded = 0.06 cfs @ 11.74 hrs, Volume= 0.027 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 47.26' @ 12.52 hrs Surf.Area= 312 sf Storage= 293 cf

Plug-Flow detention time= 25.1 min calculated for 0.027 af (100% of inflow)
Center-of-Mass det. time= 25.1 min (774.0 - 748.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	45.25'	355 cf	**13.00'W x 24.00'L x 5.25'H Field A** 1,638 cf Overall - 623 cf Embedded = 1,015 cf x 35.0% Voids
#2A	46.25'	464 cf	**Concrete Galley 4x4x4.25** x 10 Inside #1 Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf 10 Chambers in 2 Rows
		819 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	45.25'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.06 cfs @ 11.74 hrs HW=45.31' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.06 cfs)

Pond IS2: System #2 - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x4x4.25 (Concrete Galley, Shea LE-EGH, LE-CGH or equivalent)
Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf
Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf

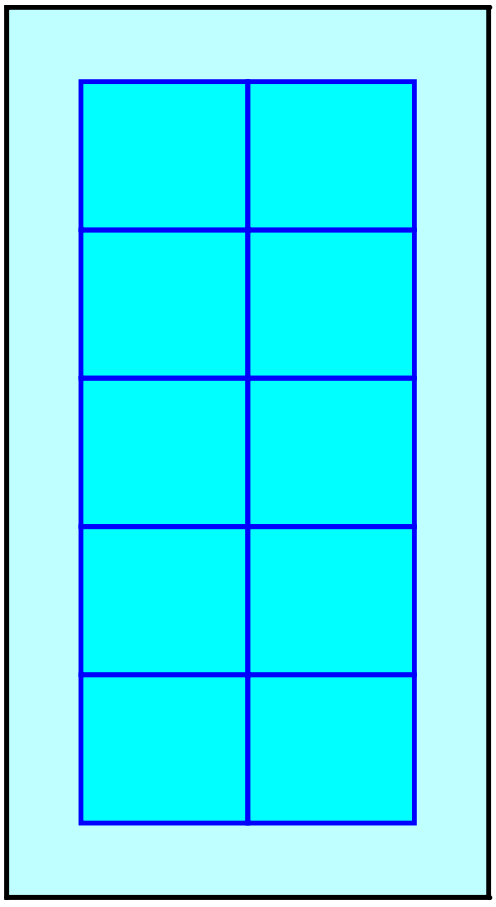
5 Chambers/Row x 4.00' Long = 20.00' Row Length +24.0" End Stone x 2 = 24.00' Base Length
2 Rows x 54.0" Wide + 24.0" Side Stone x 2 = 13.00' Base Width
12.0" Base + 51.0" Chamber Height = 5.25' Field Height

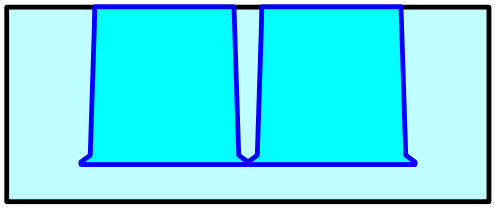
10 Chambers x 46.4 cf = 463.8 cf Chamber Storage
10 Chambers x 62.3 cf = 623.3 cf Displacement

1,638.0 cf Field - 623.3 cf Chambers = 1,014.7 cf Stone x 35.0% Voids = 355.1 cf Stone Storage

Chamber Storage + Stone Storage = 818.9 cf = 0.019 af
Overall Storage Efficiency = 50.0%
Overall System Size = 24.00' x 13.00' x 5.25'

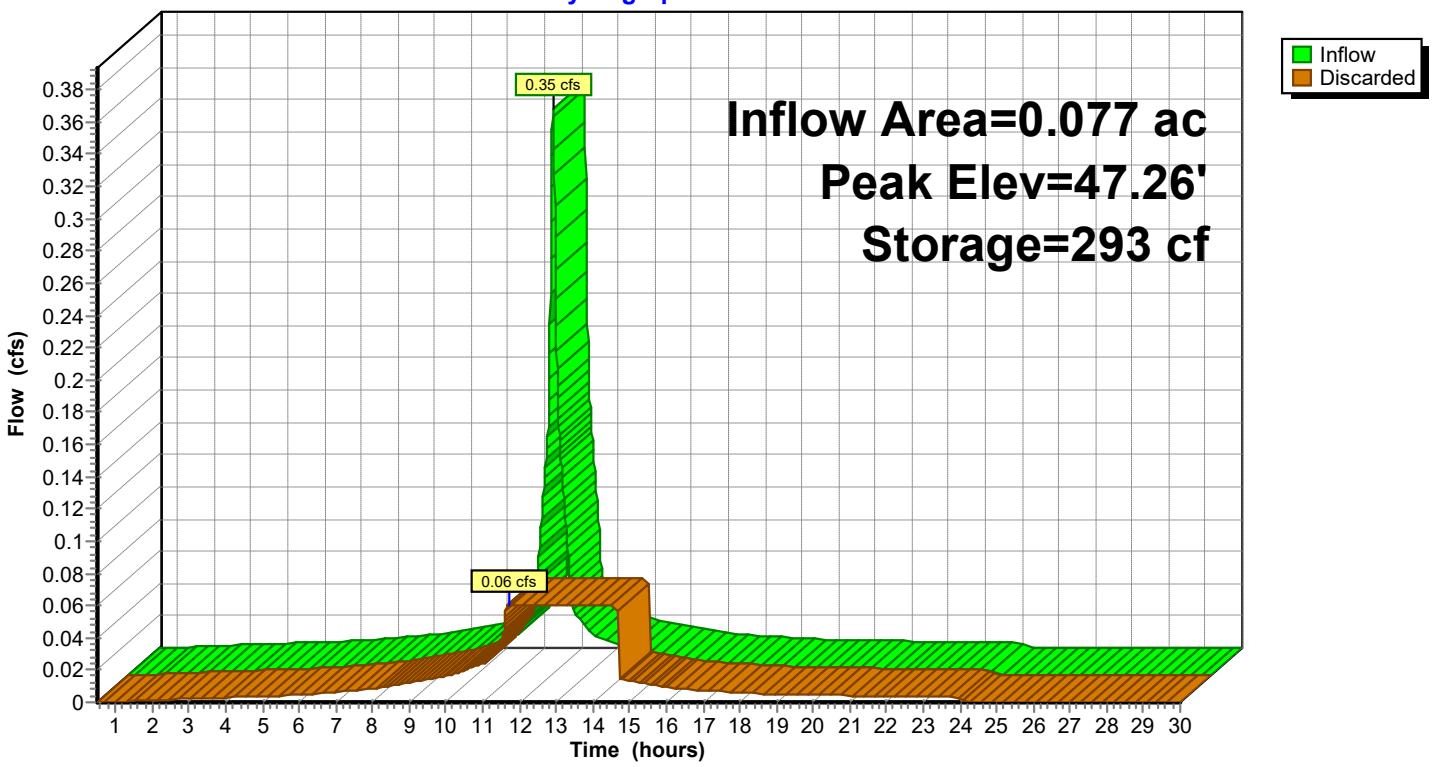
10 Chambers
60.7 cy Field
37.6 cy Stone





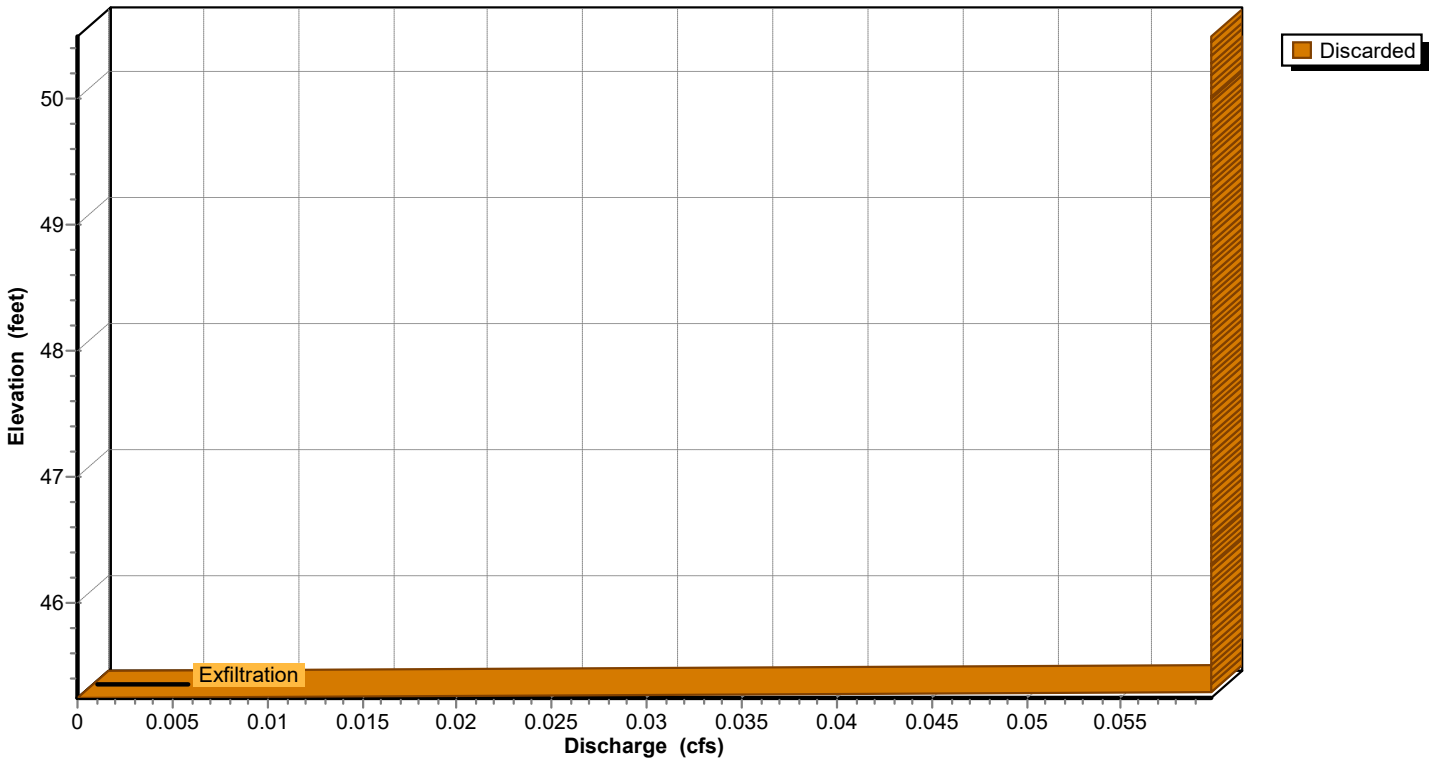
Pond IS2: System #2

Hydrograph

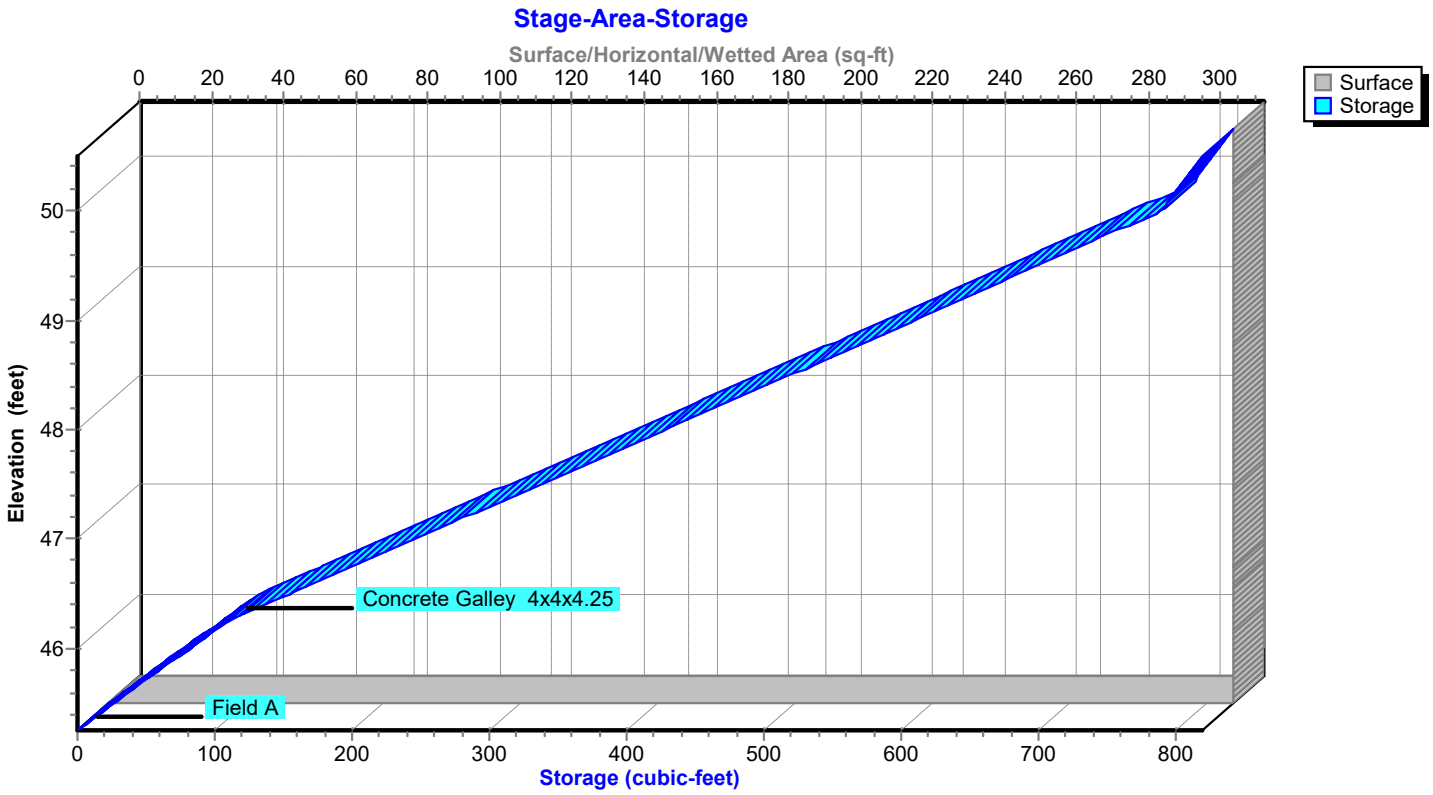


Pond IS2: System #2

Stage-Discharge



Pond IS2: System #2



Summary for Pond IS3: System #3

Inflow Area = 0.118 ac,100.00% Impervious, Inflow Depth = 4.26" for 10-Year event
Inflow = 0.54 cfs @ 12.07 hrs, Volume= 0.042 af
Outflow = 0.07 cfs @ 11.67 hrs, Volume= 0.042 af, Atten= 87%, Lag= 0.0 min
Discarded = 0.07 cfs @ 11.67 hrs, Volume= 0.042 af
Primary = 0.00 cfs @ 0.50 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 45.34' @ 12.58 hrs Surf.Area= 364 sf Storage= 524 cf

Plug-Flow detention time= 43.4 min calculated for 0.042 af (100% of inflow)
Center-of-Mass det. time= 43.4 min (792.3 - 748.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	42.50'	407 cf	**13.00'W x 28.00'L x 5.25'H Field A** 1,911 cf Overall - 748 cf Embedded = 1,163 cf x 35.0% Voids
#2A	43.50'	557 cf	**Concrete Galley 4x4x4.25** x 12 Inside #1 Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf 12 Chambers in 2 Rows
		964 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	42.50'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	46.80'	**8.0" Round Culvert** L= 72.0' Ke= 0.090 Inlet / Outlet Invert= 46.80' / 45.00' S= 0.0250 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.07 cfs @ 11.67 hrs HW=42.55' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=0.00 cfs @ 0.50 hrs HW=42.50' TW=43.00' (Dynamic Tailwater)
↑—**2=Culvert** (Controls 0.00 cfs)

Pond IS3: System #3 - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x4x4.25 (Concrete Galley, Shea LE-EGH, LE-CGH or equivalent)
Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf
Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf

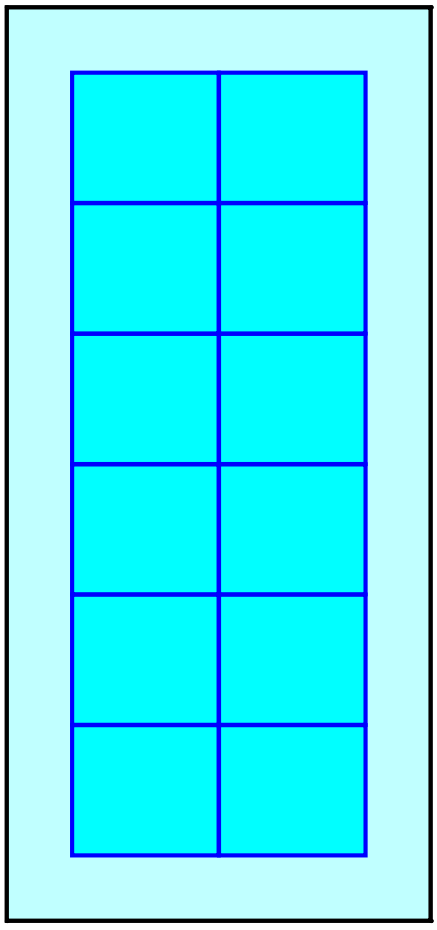
6 Chambers/Row x 4.00' Long = 24.00' Row Length +24.0" End Stone x 2 = 28.00' Base Length
2 Rows x 54.0" Wide + 24.0" Side Stone x 2 = 13.00' Base Width
12.0" Base + 51.0" Chamber Height = 5.25' Field Height

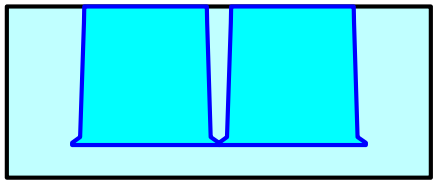
12 Chambers x 46.4 cf = 556.6 cf Chamber Storage
12 Chambers x 62.3 cf = 748.0 cf Displacement

1,911.0 cf Field - 748.0 cf Chambers = 1,163.0 cf Stone x 35.0% Voids = 407.1 cf Stone Storage

Chamber Storage + Stone Storage = 963.6 cf = 0.022 af
Overall Storage Efficiency = 50.4%
Overall System Size = 28.00' x 13.00' x 5.25'

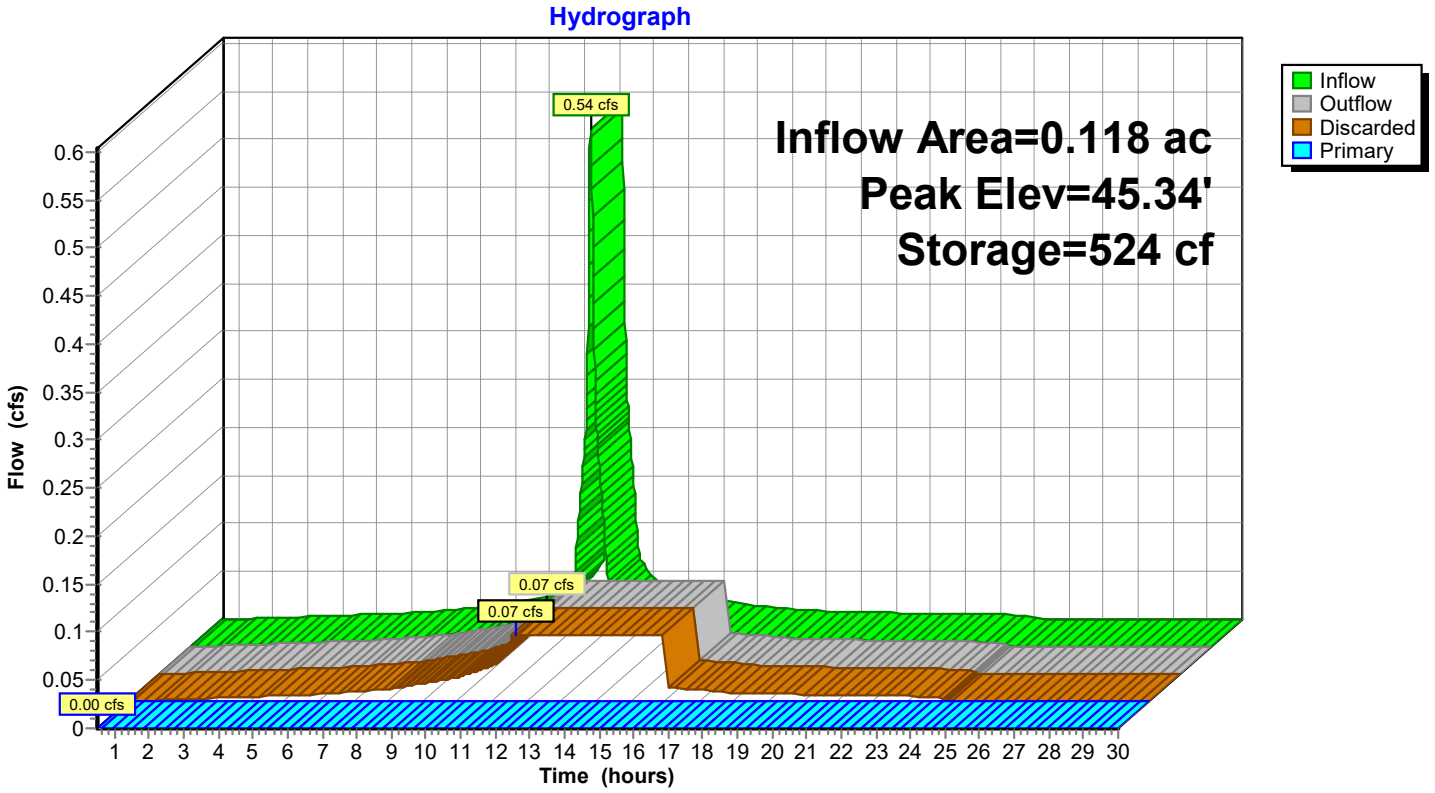
12 Chambers
70.8 cy Field
43.1 cy Stone





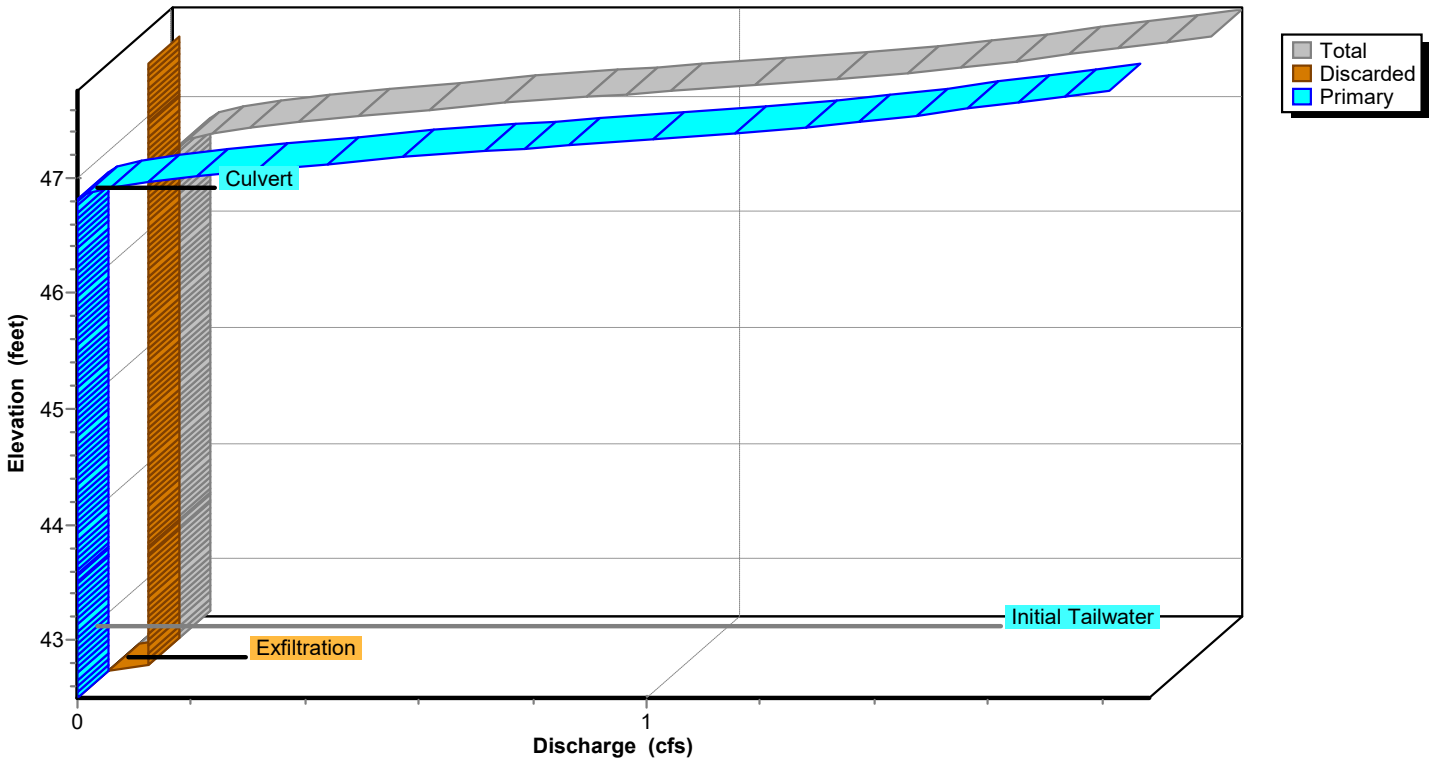
Pond IS3: System #3

Hydrograph

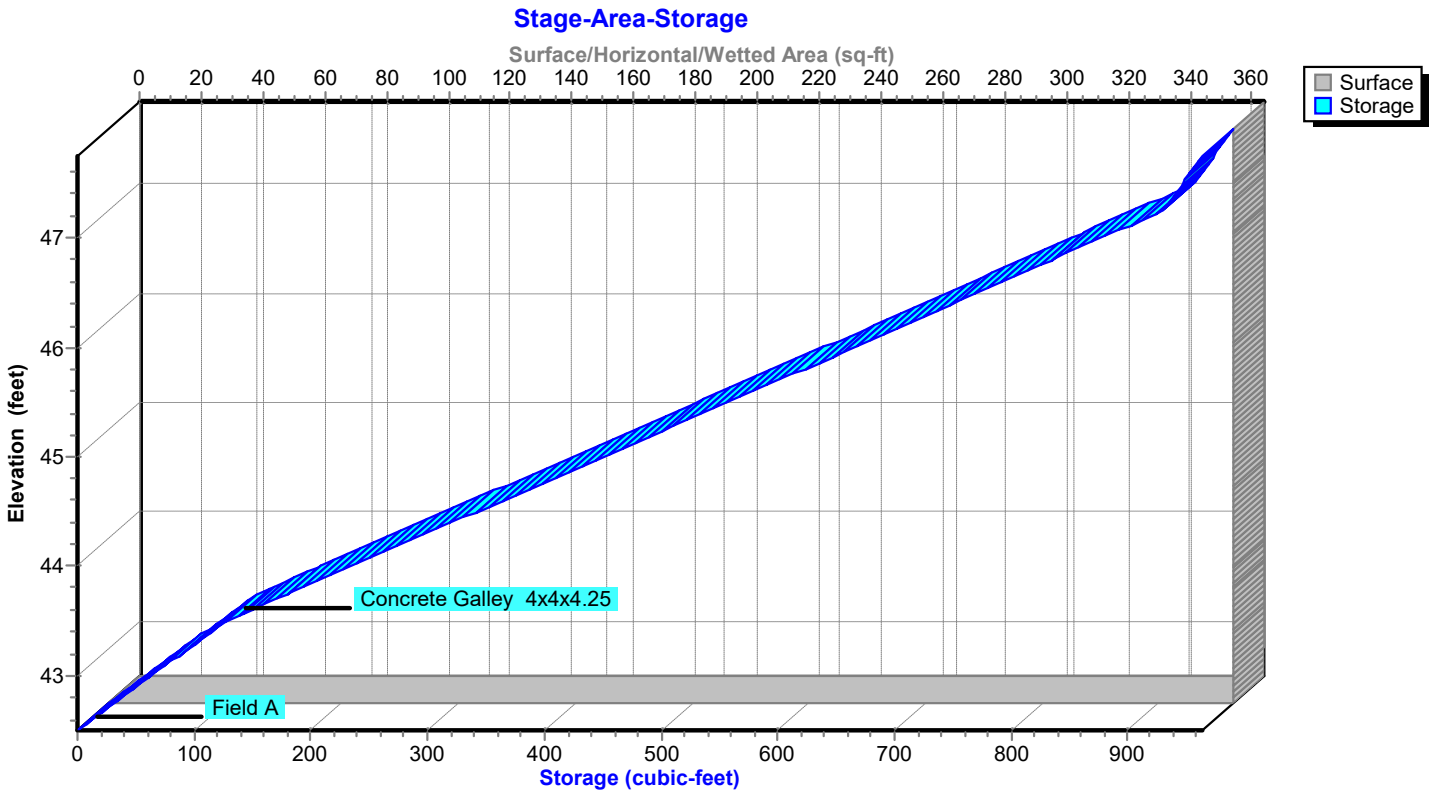


Pond IS3: System #3

Stage-Discharge



Pond IS3: System #3



Summary for Pond IS4: (Retention Pond)

Inflow Area = 0.284 ac, 41.74% Impervious, Inflow Depth = 0.11" for 10-Year event
Inflow = 0.01 cfs @ 12.44 hrs, Volume= 0.003 af
Outflow = 0.00 cfs @ 0.50 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Secondary = 0.00 cfs @ 0.50 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 43.18' @ 24.29 hrs Surf.Area= 690 sf Storage= 117 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	43.00'	1,949 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

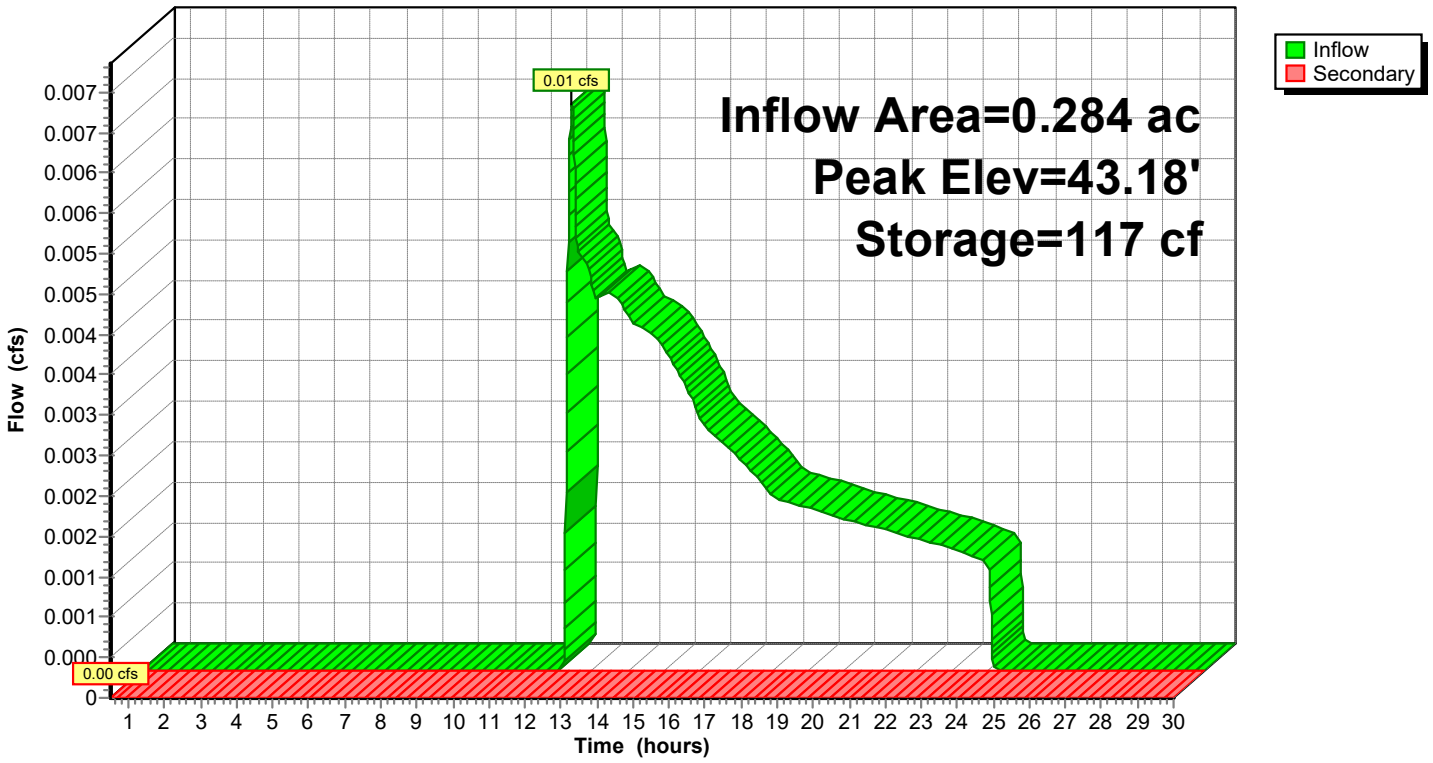
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
43.00	637	100.0	0	0	637
44.00	966	119.0	796	796	986
45.00	1,351	137.0	1,153	1,949	1,374

Device	Routing	Invert	Outlet Devices
#1	Secondary	44.50'	**45.0 deg x 3.0' wide x 0.50' high Dam Breach** C= 2.56 Top of breach = 45.00' Bottom of breach = 44.50' Breach starts at 44.50' WSE and develops over 1.000 hrs

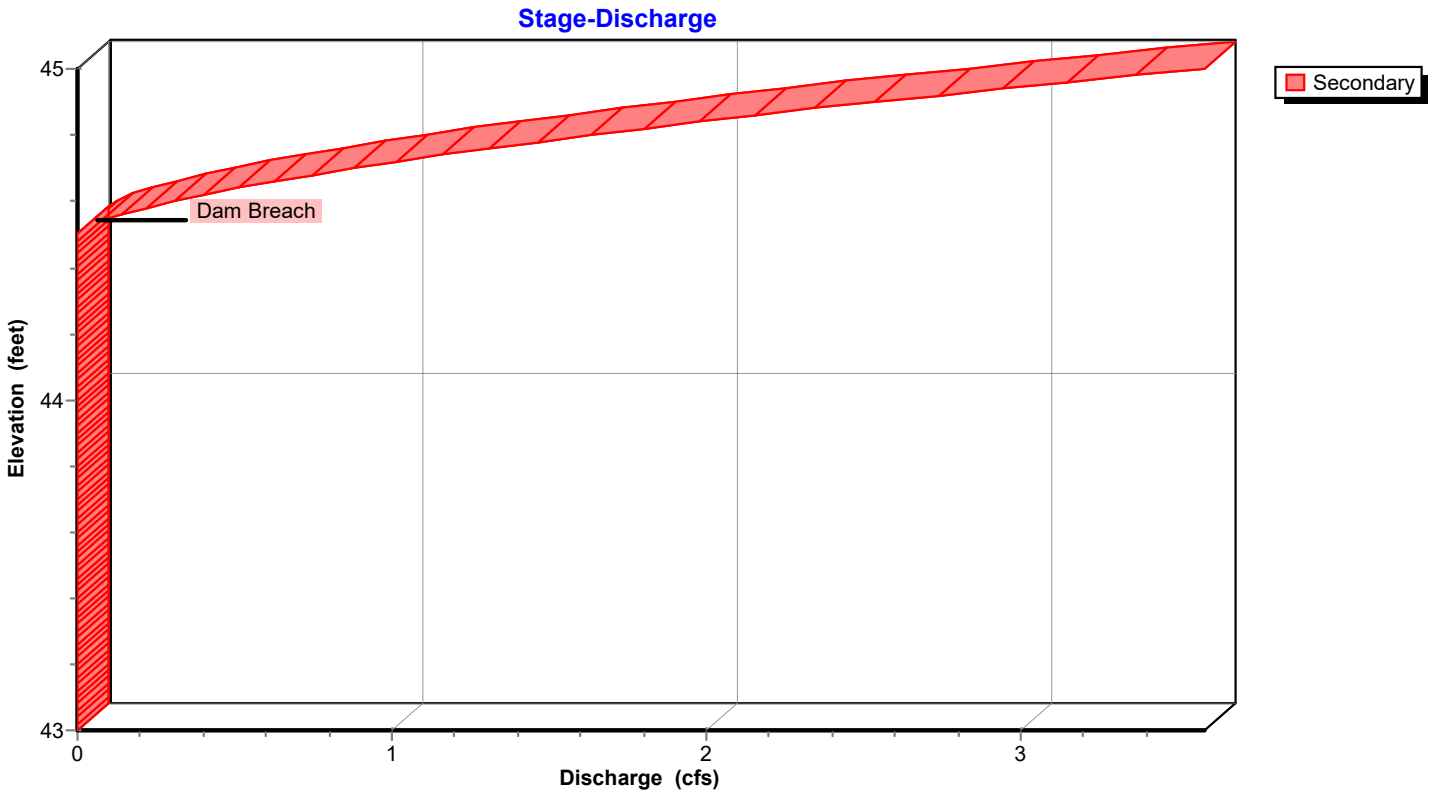
Secondary OutFlow Max=0.00 cfs @ 0.50 hrs HW=43.00' TW=0.00' (Dynamic Tailwater)
1=Dam Breach (Controls 0.00 cfs)

Pond IS4: (Retention Pond)

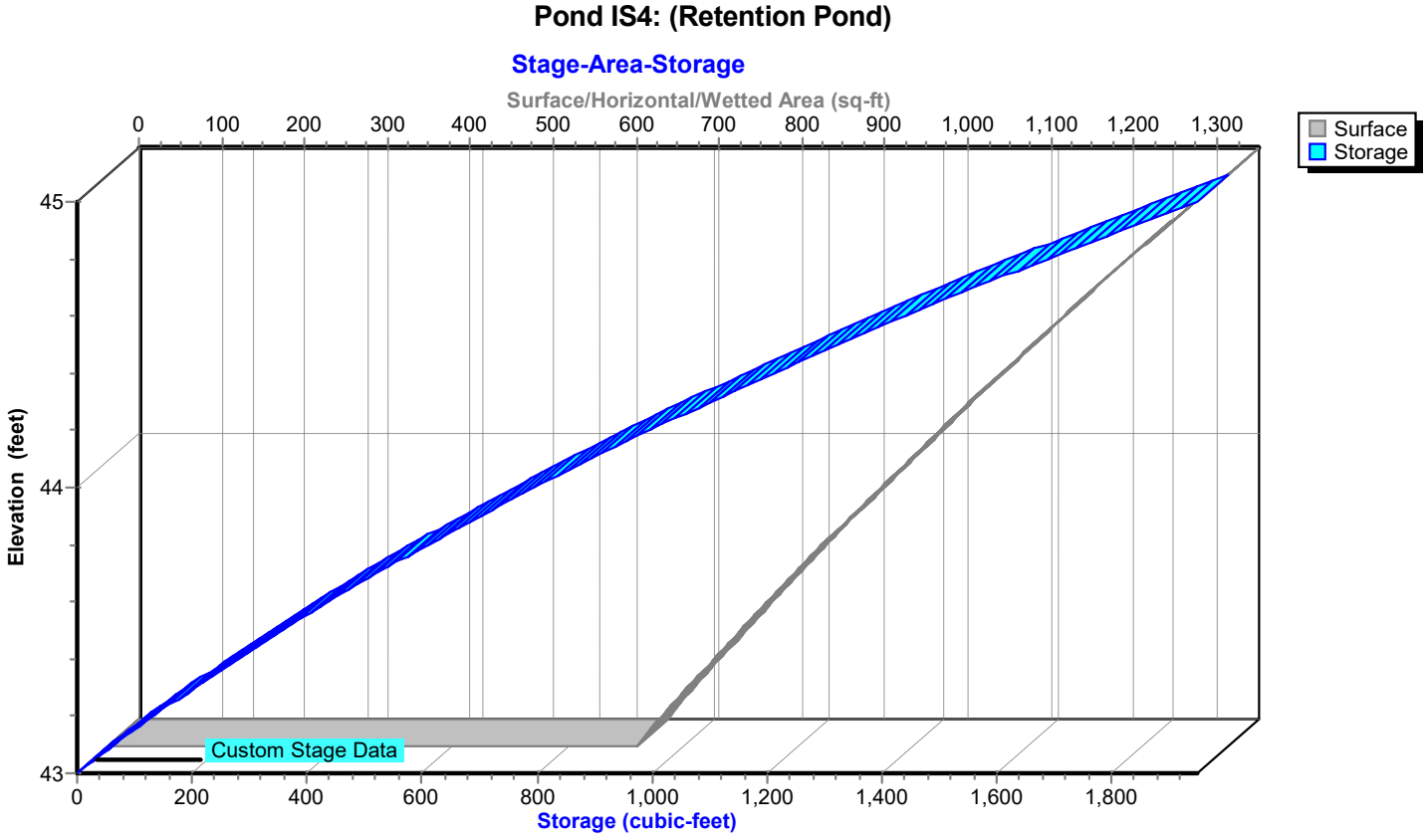
Hydrograph



Pond IS4: (Retention Pond)



Pond IS4: (Retention Pond)

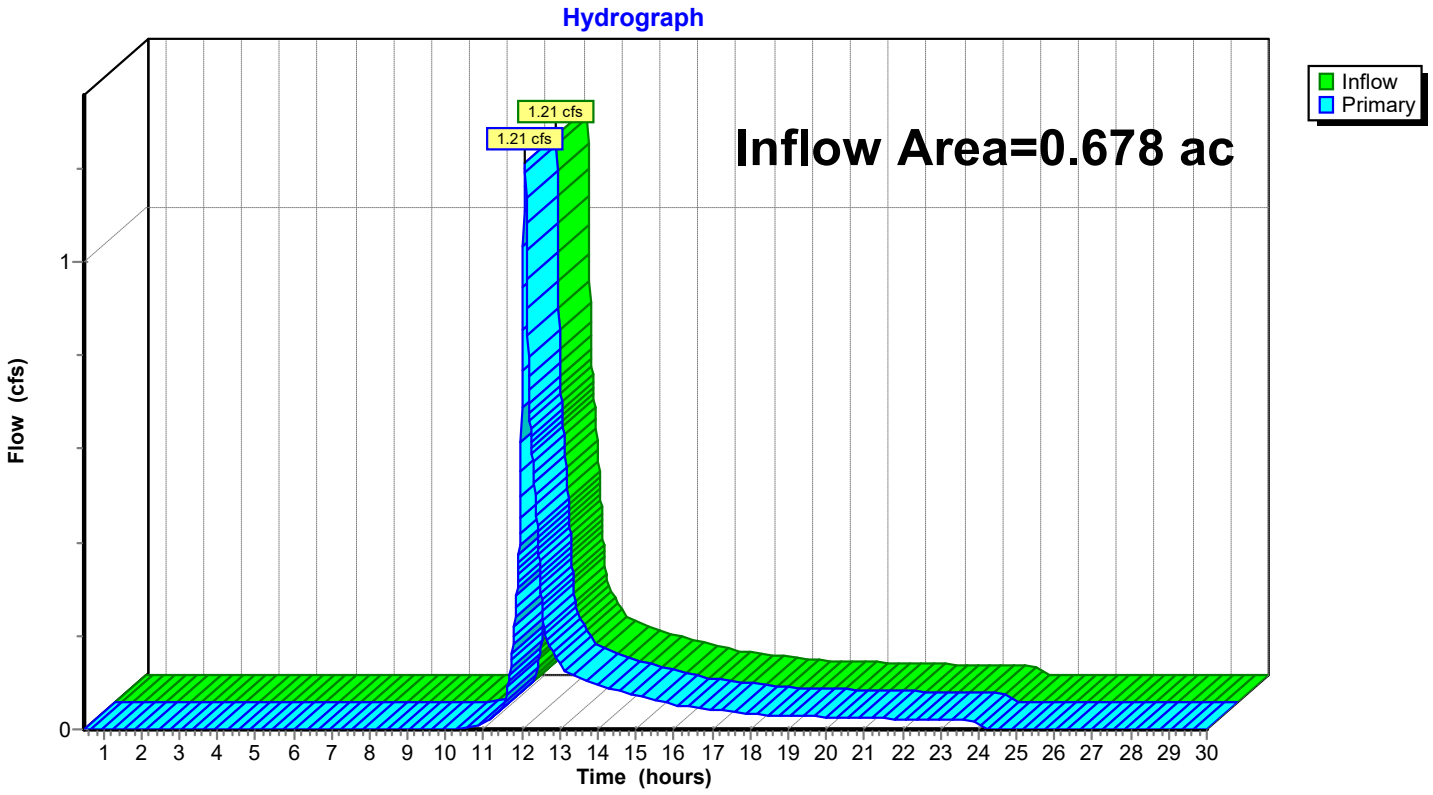


Summary for Link POD1: South-West Abutter

Inflow Area = 0.678 ac, 0.00% Impervious, Inflow Depth = 1.53" for 10-Year event
Inflow = 1.21 cfs @ 12.08 hrs, Volume= 0.087 af
Primary = 1.21 cfs @ 12.08 hrs, Volume= 0.087 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs

Link POD1: South-West Abutter

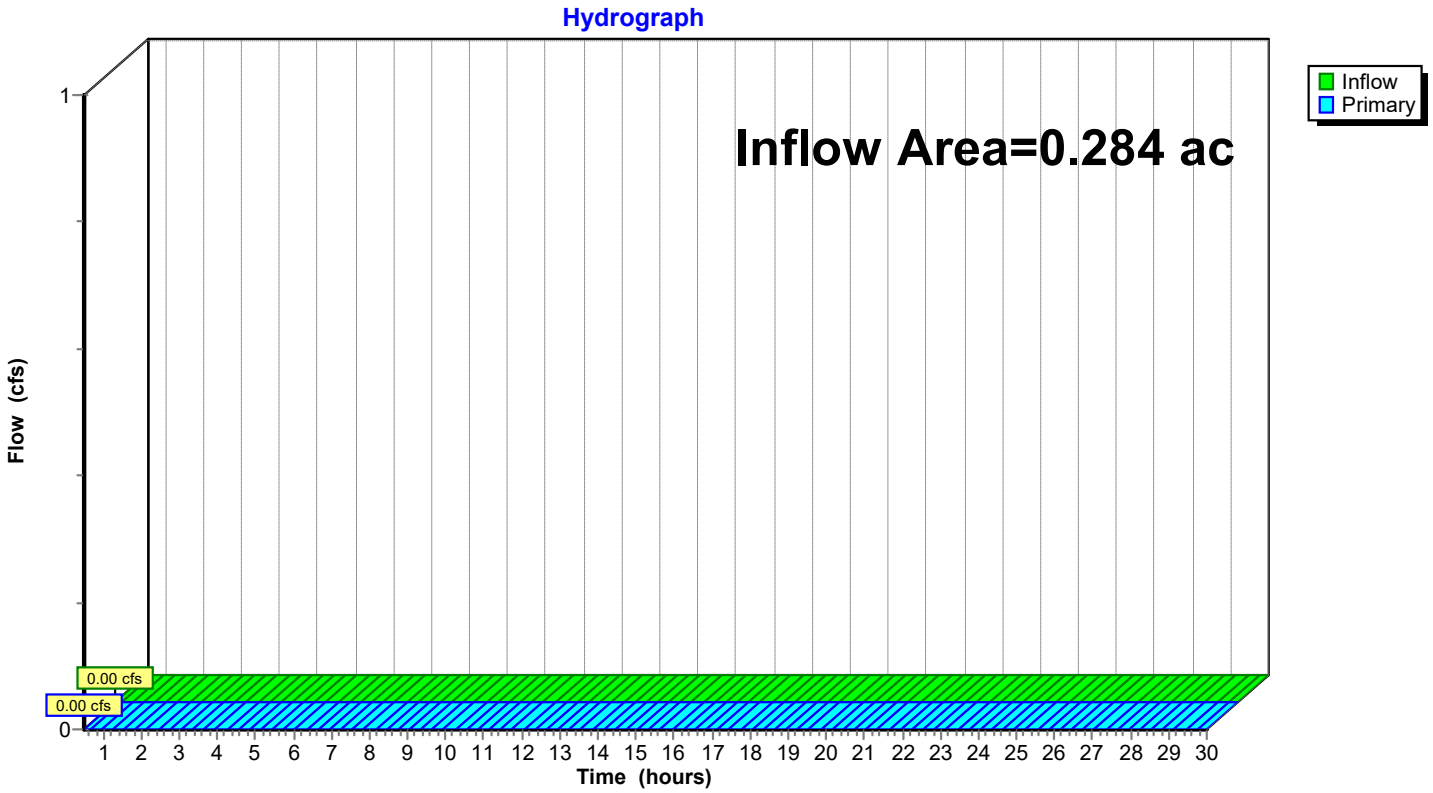


Summary for Link POD1.: South-West Abutter

Inflow Area = 0.284 ac, 41.74% Impervious, Inflow Depth = 0.00" for 10-Year event
Inflow = 0.00 cfs @ 0.50 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.50 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs

Link POD1.: South-West Abutter



Time span=0.50-30.00 hrs, dt=0.010 hrs, 2951 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E1: Sub-catchment-1 Runoff Area=29,550 sf 0.00% Impervious Runoff Depth=2.10"
Tc=5.0 min CN=68 Runoff=1.69 cfs 0.118 af

Subcatchment P1: Sub-catchment-1 Runoff Area=7,199 sf 0.00% Impervious Runoff Depth=0.39"
Tc=5.0 min CN=42 Runoff=0.03 cfs 0.005 af

Subcatchment PD1: Driveway Runoff Area=2,276 sf 98.33% Impervious Runoff Depth=4.95"
Tc=5.0 min CN=97 Runoff=0.28 cfs 0.022 af

Subcatchment PD2: Driveway Runoff Area=4,038 sf 100.00% Impervious Runoff Depth=5.06"
Tc=5.0 min CN=98 Runoff=0.50 cfs 0.039 af

Subcatchment PR1: Roof_BLDG-1 Runoff Area=2,260 sf 100.00% Impervious Runoff Depth=5.06"
Tc=5.0 min CN=98 Runoff=0.28 cfs 0.022 af

Subcatchment PR2: Roof_BLDG-2 Runoff Area=3,360 sf 100.00% Impervious Runoff Depth=5.06"
Tc=5.0 min CN=98 Runoff=0.41 cfs 0.033 af

Subcatchment PR3: Roof_BLDG-3 Runoff Area=1,120 sf 100.00% Impervious Runoff Depth=5.06"
Tc=5.0 min CN=98 Runoff=0.14 cfs 0.011 af

Pond IS1: System #1 Peak Elev=49.29' Storage=516 cf Inflow=0.56 cfs 0.043 af
Outflow=0.08 cfs 0.043 af

Pond IS2: System #2 Peak Elev=47.74' Storage=382 cf Inflow=0.41 cfs 0.033 af
Outflow=0.06 cfs 0.033 af

Pond IS3: System #3 Peak Elev=46.01' Storage=666 cf Inflow=0.64 cfs 0.050 af
Discarded=0.07 cfs 0.050 af Primary=0.00 cfs 0.000 af Outflow=0.07 cfs 0.050 af

Pond IS4: (Retention Pond) Peak Elev=43.34' Storage=236 cf Inflow=0.03 cfs 0.005 af
Outflow=0.00 cfs 0.000 af

Link POD1: South-West Abutter Inflow=1.69 cfs 0.118 af
Primary=1.69 cfs 0.118 af

Link POD1.: South-West Abutter Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 1.143 ac Runoff Volume = 0.250 af Average Runoff Depth = 2.62"
73.87% Pervious = 0.845 ac 26.13% Impervious = 0.299 ac

Summary for Subcatchment E1: Sub-catchment-1

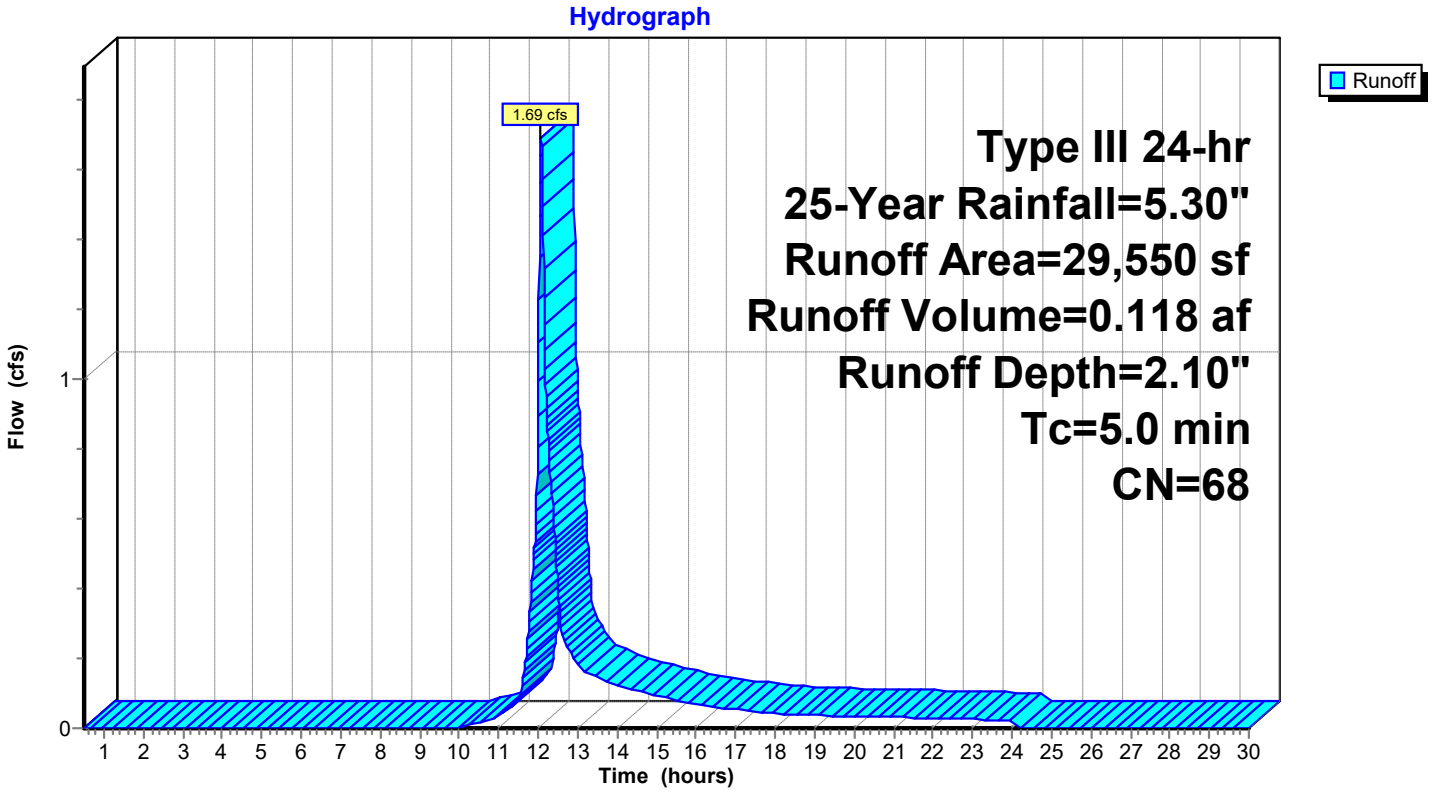
Runoff = 1.69 cfs @ 12.08 hrs, Volume= 0.118 af, Depth= 2.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Description
29,550	68	<50% Grass cover, Poor, HSG A
29,550		100.00% Pervious Area

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

Subcatchment E1: Sub-catchment-1



Summary for Subcatchment P1: Sub-catchment-1

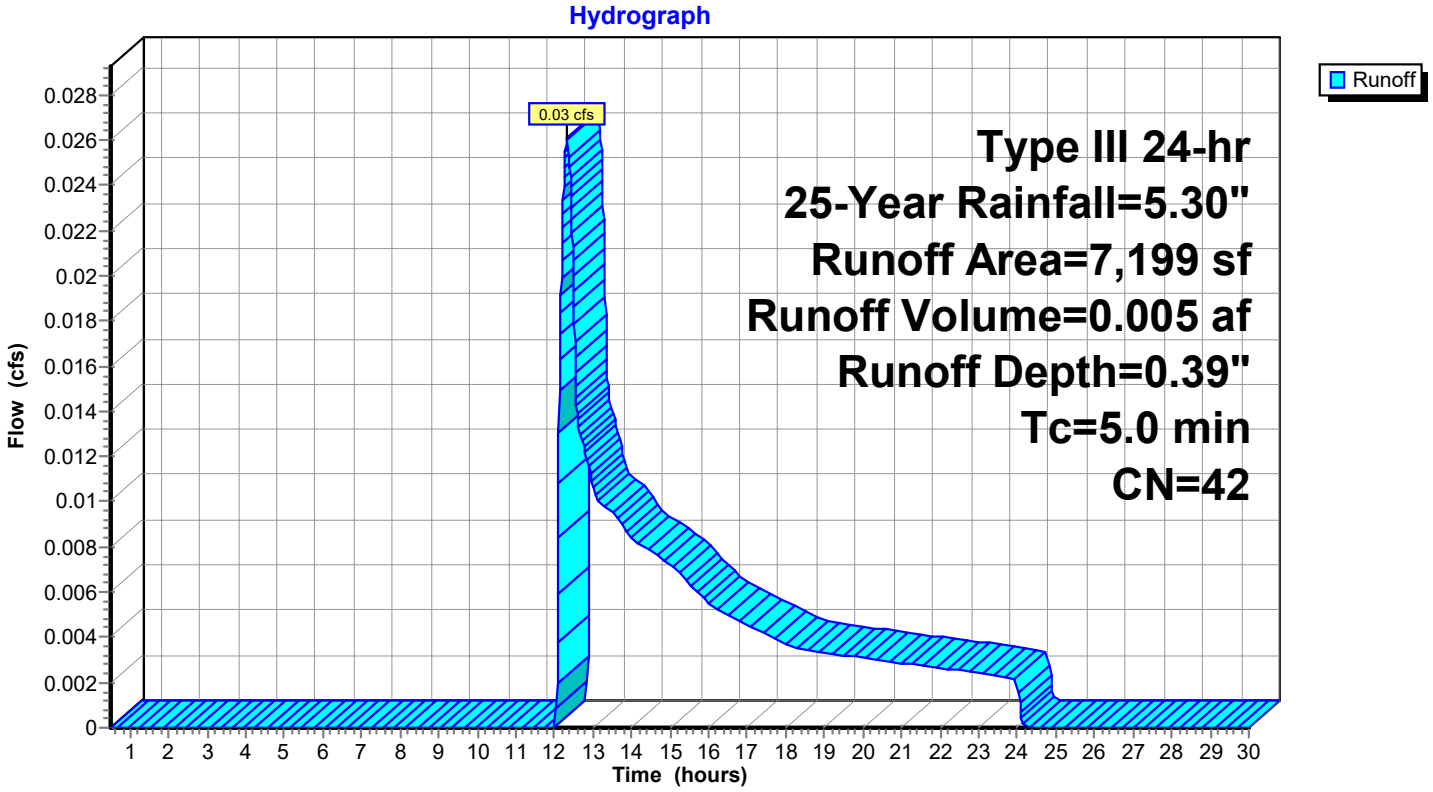
Runoff = 0.03 cfs @ 12.33 hrs, Volume= 0.005 af, Depth= 0.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Description
2,623	39	>75% Grass cover, Good, HSG A
3,705	36	Woods, Fair, HSG A
871	76	Gravel roads, HSG A
7,199	42	Weighted Average
7,199		100.00% Pervious Area

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

Subcatchment P1: Sub-catchment-1



Summary for Subcatchment PD1: Driveway

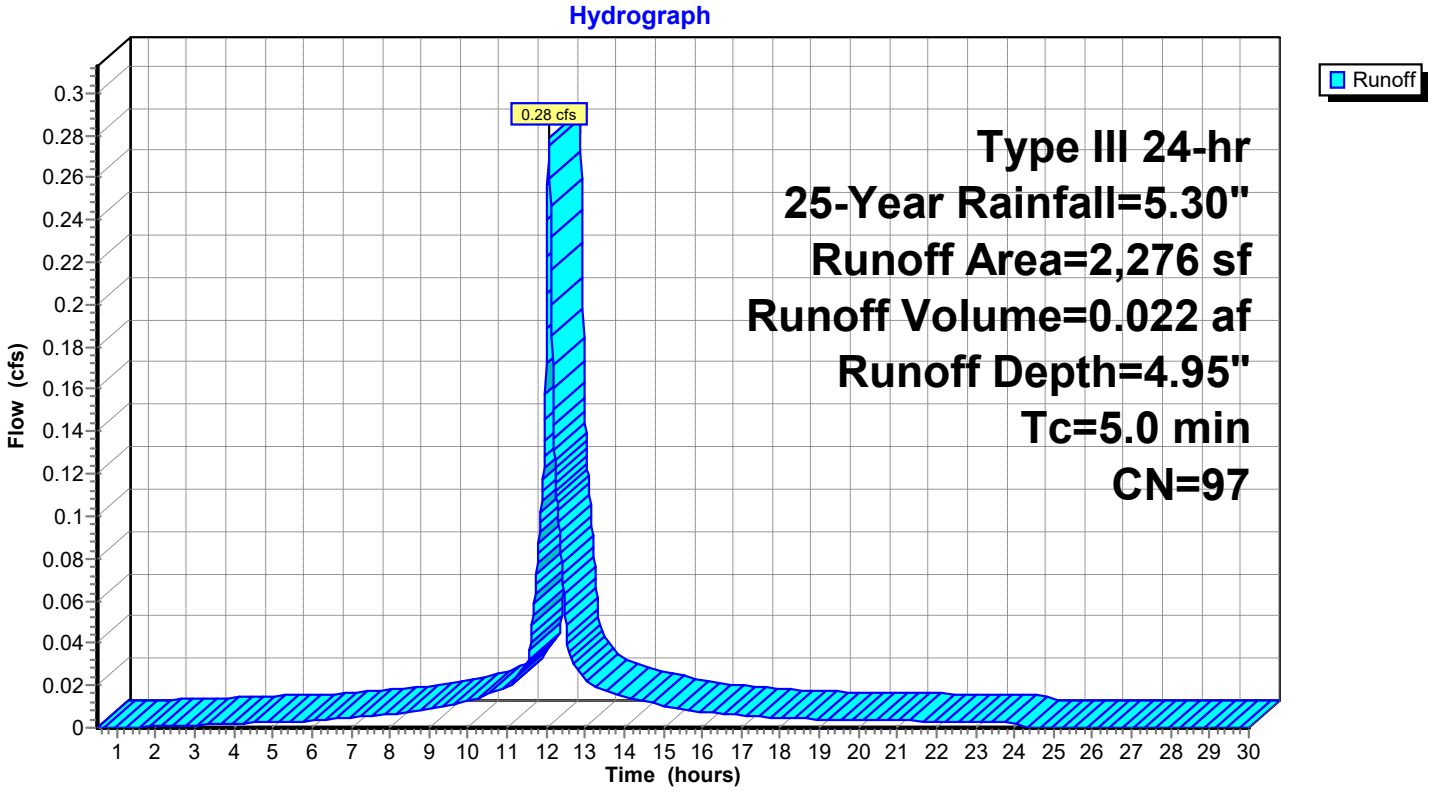
Runoff = 0.28 cfs @ 12.07 hrs, Volume= 0.022 af, Depth= 4.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 25-Year Rainfall=5.30"

	Area (sf)	CN	Description
	2,238	98	Paved parking, HSG A
*	38	65	Paver walkway
	2,276	97	Weighted Average
	38		1.67% Pervious Area
	2,238		98.33% Impervious Area

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

Subcatchment PD1: Driveway



Summary for Subcatchment PD2: Driveway

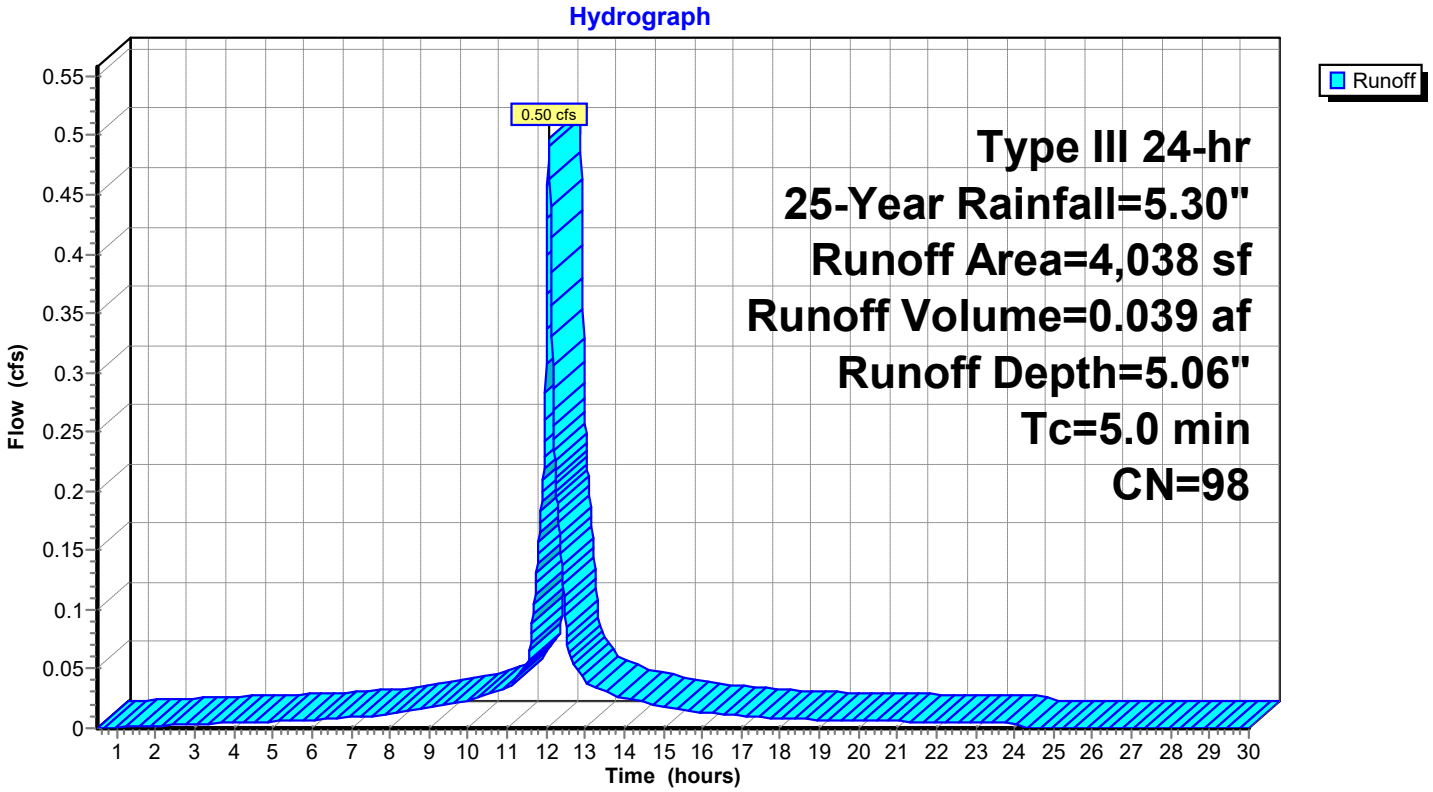
Runoff = 0.50 cfs @ 12.07 hrs, Volume= 0.039 af, Depth= 5.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 25-Year Rainfall=5.30"

Area (sf)	CN	Description
4,038	98	Paved parking, HSG A
4,038		100.00% Impervious Area

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

Subcatchment PD2: Driveway



Summary for Subcatchment PR1: Roof_BLDG-1

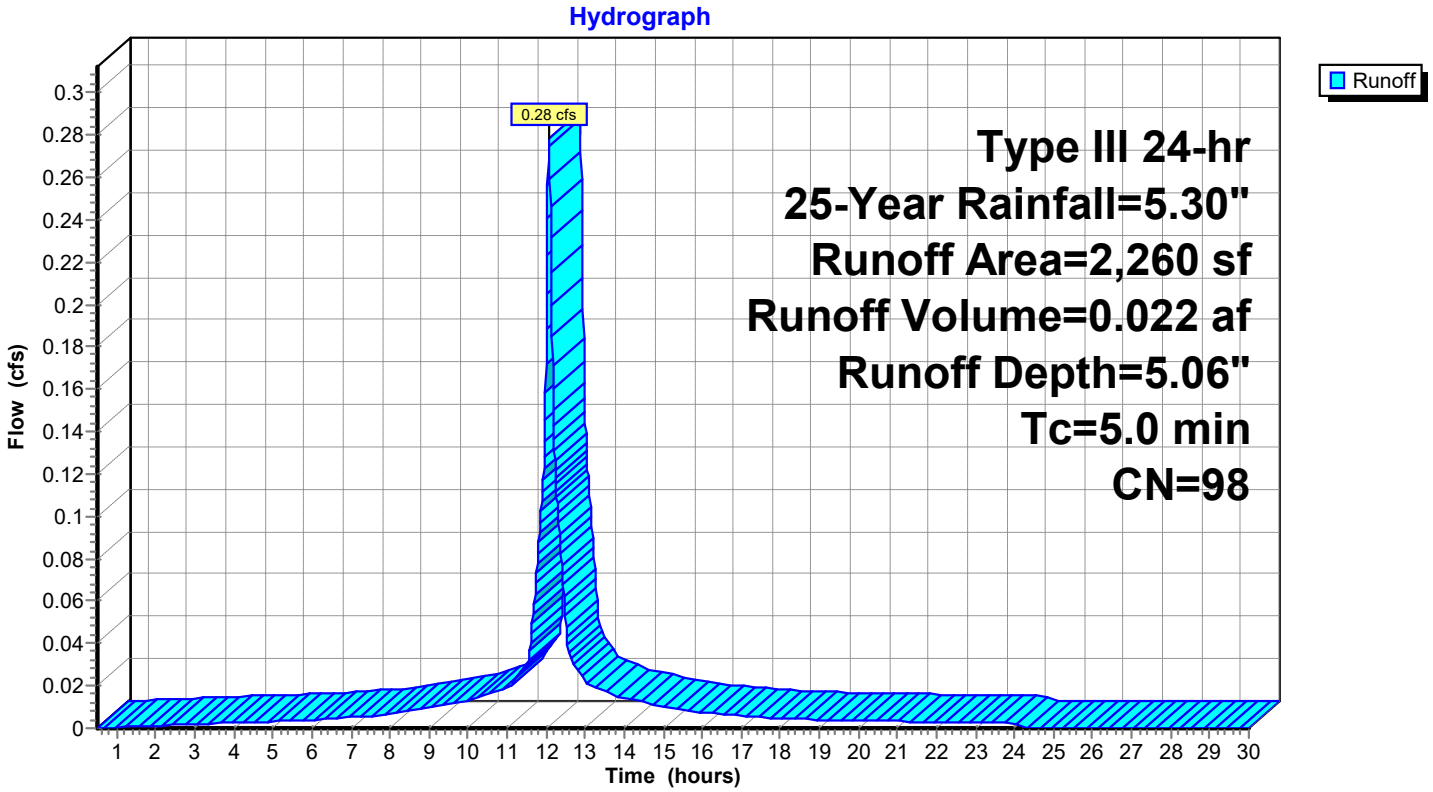
Runoff = 0.28 cfs @ 12.07 hrs, Volume= 0.022 af, Depth= 5.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 25-Year Rainfall=5.30"

	Area (sf)	CN	Description
*	2,260	98	Roofs, HSG A
	2,260		100.00% Impervious Area

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

Subcatchment PR1: Roof_BLDG-1



Summary for Subcatchment PR2: Roof_BLDG-2

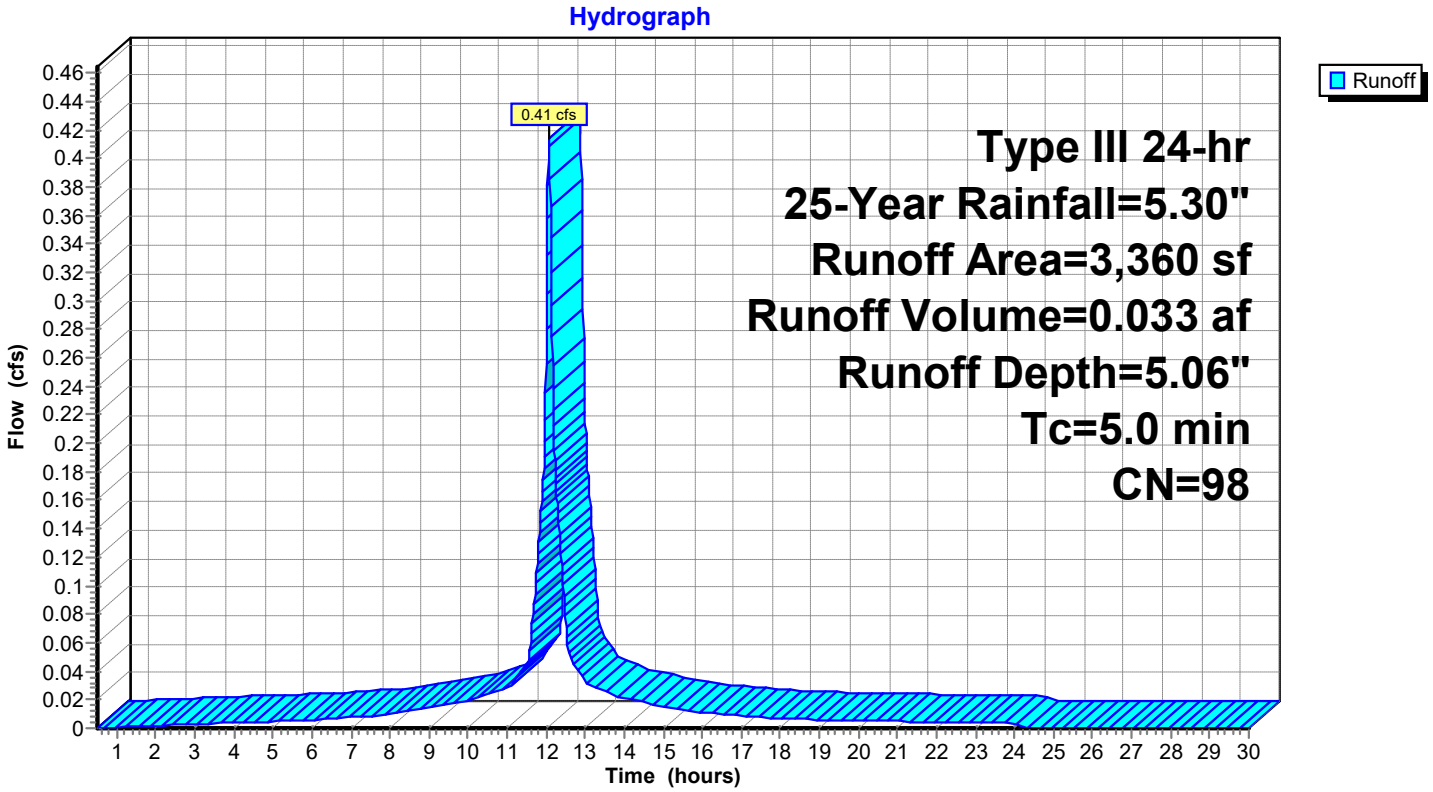
Runoff = 0.41 cfs @ 12.07 hrs, Volume= 0.033 af, Depth= 5.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 25-Year Rainfall=5.30"

	Area (sf)	CN	Description
*	3,360	98	Roofs, HSG A
	3,360		100.00% Impervious Area

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

Subcatchment PR2: Roof_BLDG-2



Summary for Subcatchment PR3: Roof_BLDG-3

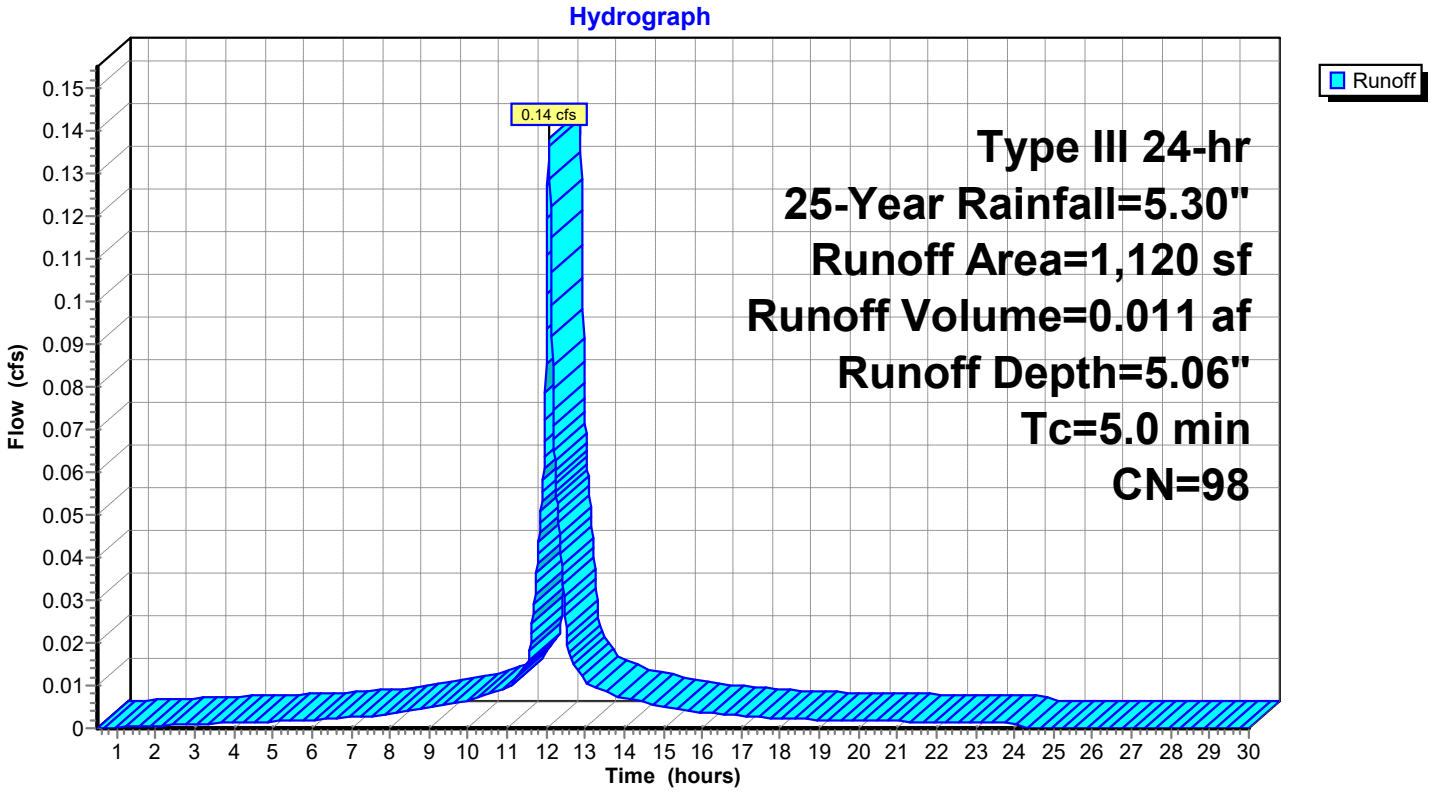
Runoff = 0.14 cfs @ 12.07 hrs, Volume= 0.011 af, Depth= 5.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 25-Year Rainfall=5.30"

	Area (sf)	CN	Description
*	1,120	98	Roofs, HSG A
	1,120		100.00% Impervious Area

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

Subcatchment PR3: Roof_BLDG-3



Summary for Pond IS1: System #1

Inflow Area = 0.104 ac, 99.16% Impervious, Inflow Depth = 5.00" for 25-Year event
Inflow = 0.56 cfs @ 12.07 hrs, Volume= 0.043 af
Outflow = 0.08 cfs @ 11.70 hrs, Volume= 0.043 af, Atten= 86%, Lag= 0.0 min
Discarded = 0.08 cfs @ 11.70 hrs, Volume= 0.043 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 49.29' @ 12.55 hrs Surf.Area= 416 sf Storage= 516 cf

Plug-Flow detention time= 35.9 min calculated for 0.043 af (100% of inflow)
Center-of-Mass det. time= 35.8 min (785.7 - 749.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	46.80'	459 cf	**13.00'W x 32.00'L x 5.25'H Field A** 2,184 cf Overall - 873 cf Embedded = 1,311 cf x 35.0% Voids
#2A	47.80'	649 cf	**Concrete Galley 4x4x4.25** x 14 Inside #1 Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf 14 Chambers in 2 Rows
		1,108 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	46.80'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.08 cfs @ 11.70 hrs HW=46.86' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.08 cfs)

Pond IS1: System #1 - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x4x4.25 (Concrete Galley, Shea LE-EGH, LE-CGH or equivalent)
Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf
Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf

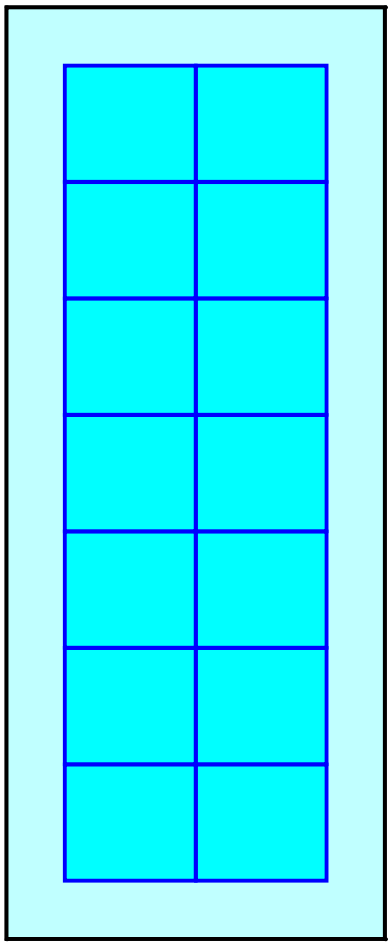
7 Chambers/Row x 4.00' Long = 28.00' Row Length +24.0" End Stone x 2 = 32.00' Base Length
2 Rows x 54.0" Wide + 24.0" Side Stone x 2 = 13.00' Base Width
12.0" Base + 51.0" Chamber Height = 5.25' Field Height

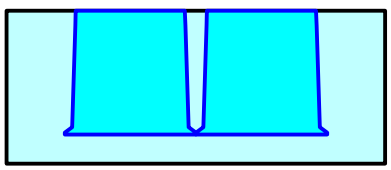
14 Chambers x 46.4 cf = 649.3 cf Chamber Storage
14 Chambers x 62.3 cf = 872.6 cf Displacement

2,184.0 cf Field - 872.6 cf Chambers = 1,311.4 cf Stone x 35.0% Voids = 459.0 cf Stone Storage

Chamber Storage + Stone Storage = 1,108.3 cf = 0.025 af
Overall Storage Efficiency = 50.7%
Overall System Size = 32.00' x 13.00' x 5.25'

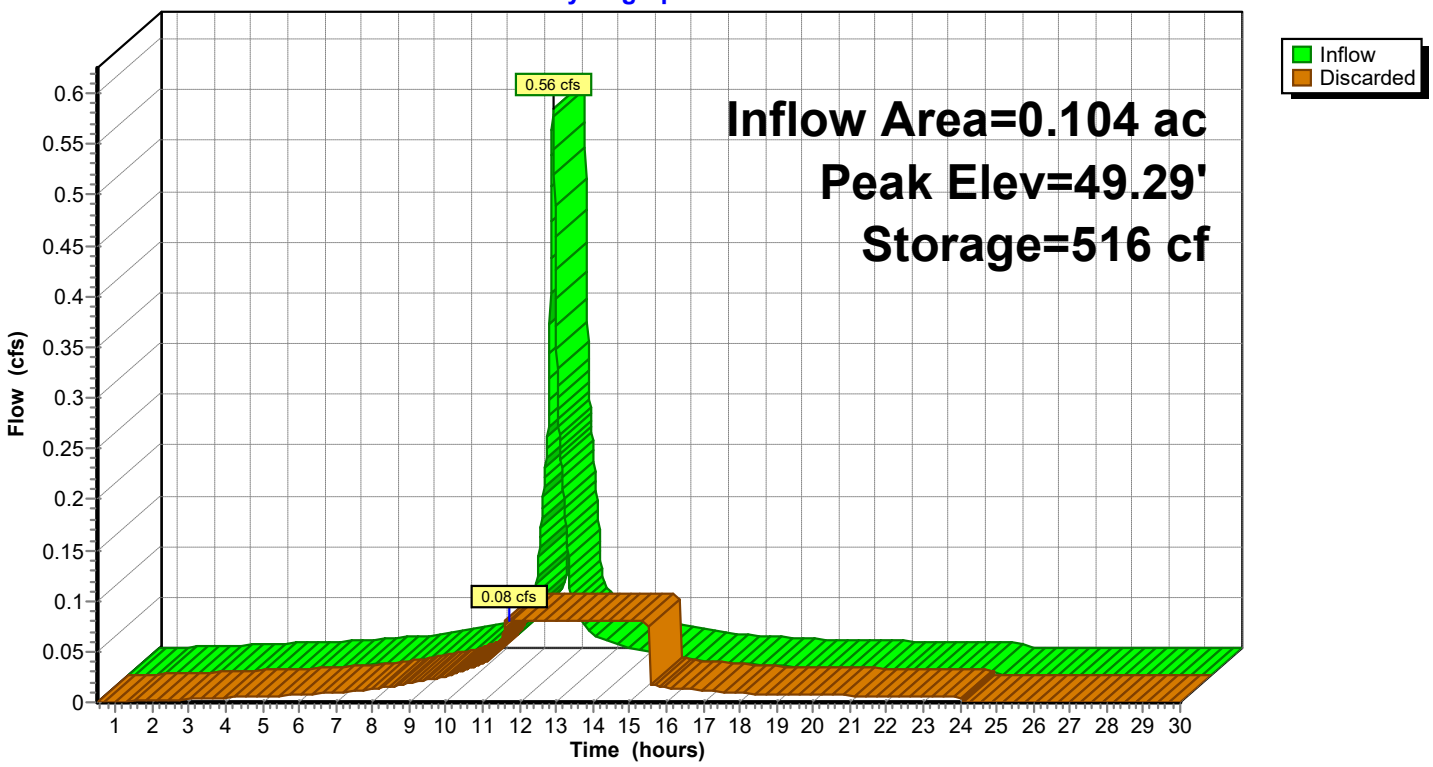
14 Chambers
80.9 cy Field
48.6 cy Stone





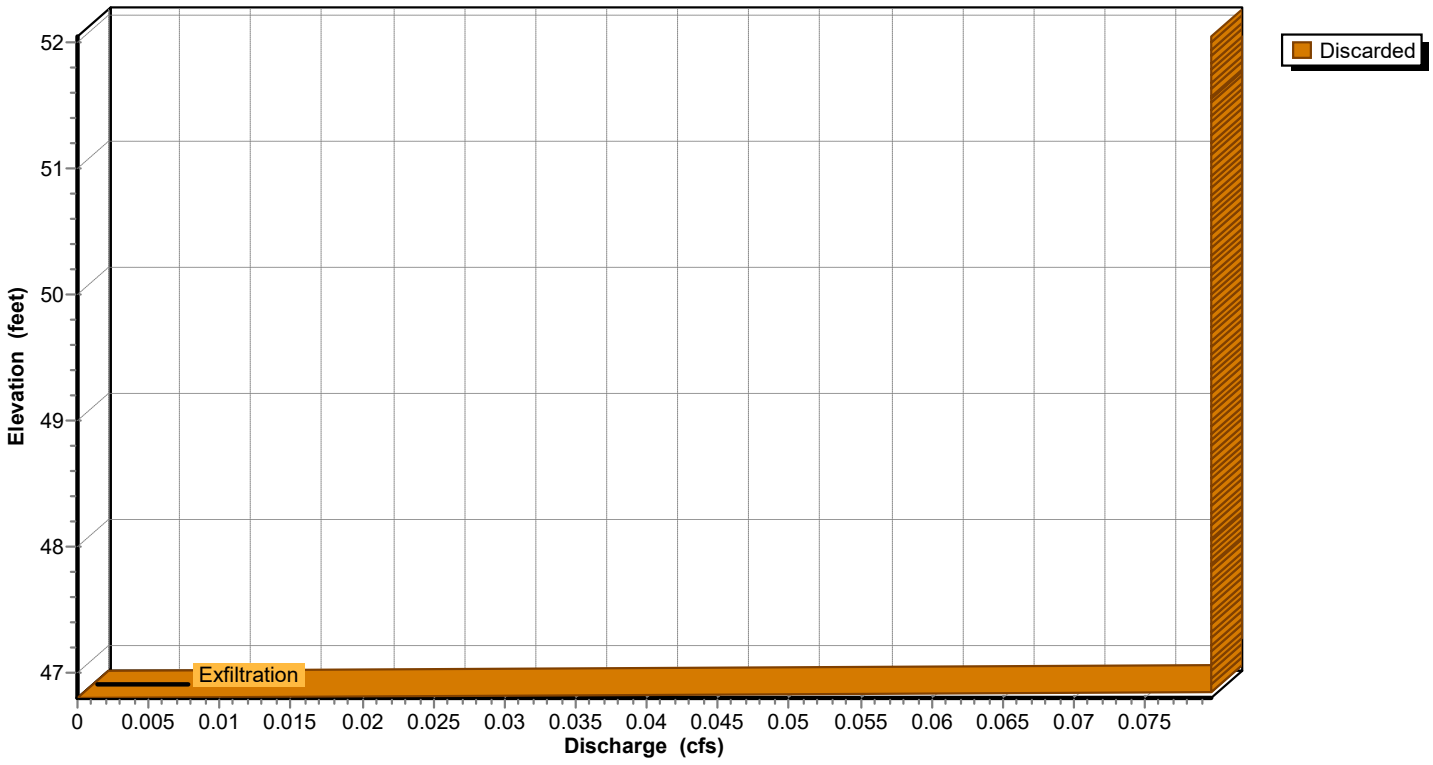
Pond IS1: System #1

Hydrograph

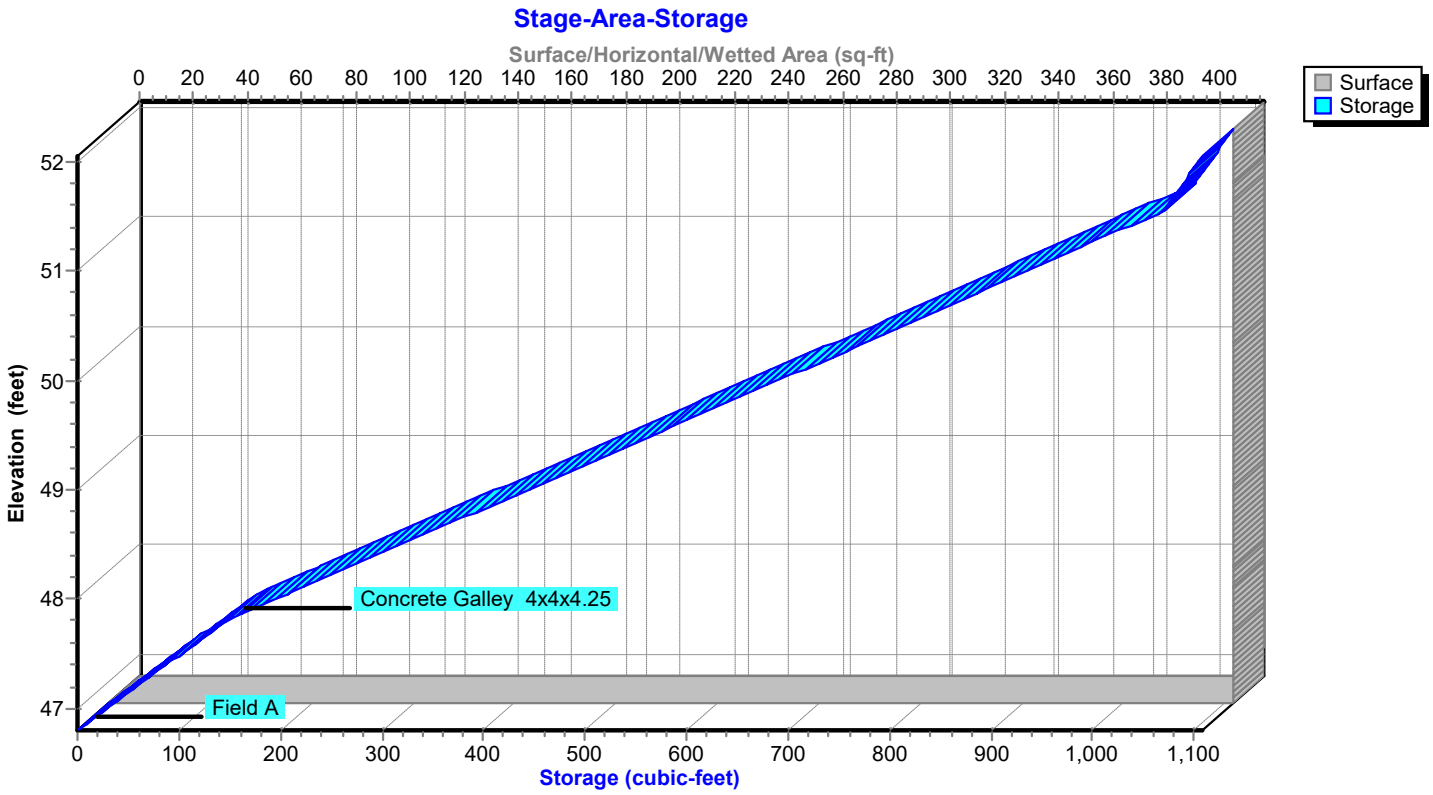


Pond IS1: System #1

Stage-Discharge



Pond IS1: System #1



Summary for Pond IS2: System #2

Inflow Area = 0.077 ac,100.00% Impervious, Inflow Depth = 5.06" for 25-Year event
Inflow = 0.41 cfs @ 12.07 hrs, Volume= 0.033 af
Outflow = 0.06 cfs @ 11.70 hrs, Volume= 0.033 af, Atten= 86%, Lag= 0.0 min
Discarded = 0.06 cfs @ 11.70 hrs, Volume= 0.033 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 47.74' @ 12.55 hrs Surf.Area= 312 sf Storage= 382 cf

Plug-Flow detention time= 34.9 min calculated for 0.033 af (100% of inflow)
Center-of-Mass det. time= 34.9 min (781.1 - 746.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	45.25'	355 cf	**13.00'W x 24.00'L x 5.25'H Field A** 1,638 cf Overall - 623 cf Embedded = 1,015 cf x 35.0% Voids
#2A	46.25'	464 cf	**Concrete Galley 4x4x4.25** x 10 Inside #1 Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf 10 Chambers in 2 Rows
		819 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	45.25'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.06 cfs @ 11.70 hrs HW=45.31' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.06 cfs)

Pond IS2: System #2 - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x4x4.25 (Concrete Galley, Shea LE-EGH, LE-CGH or equivalent)
Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf
Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf

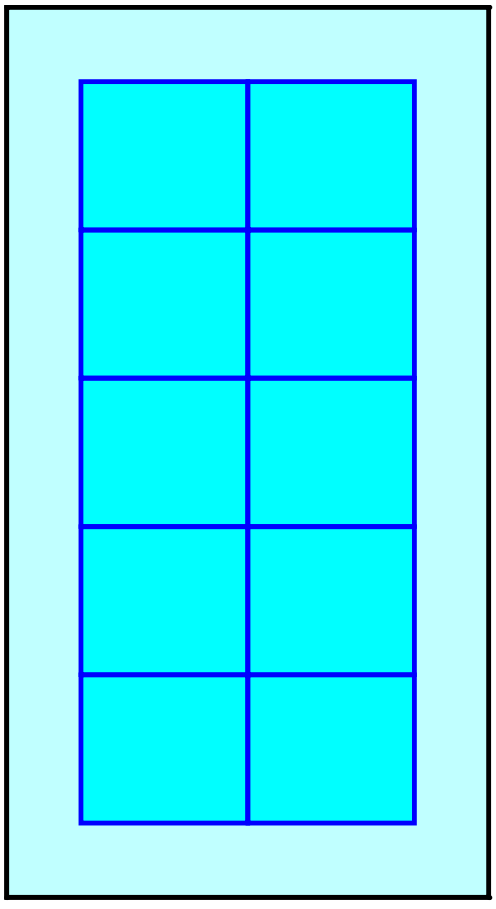
5 Chambers/Row x 4.00' Long = 20.00' Row Length +24.0" End Stone x 2 = 24.00' Base Length
2 Rows x 54.0" Wide + 24.0" Side Stone x 2 = 13.00' Base Width
12.0" Base + 51.0" Chamber Height = 5.25' Field Height

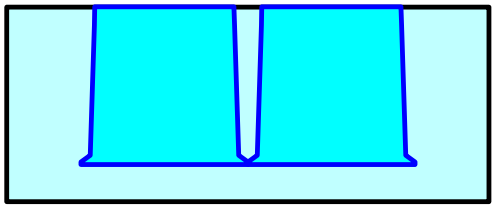
10 Chambers x 46.4 cf = 463.8 cf Chamber Storage
10 Chambers x 62.3 cf = 623.3 cf Displacement

1,638.0 cf Field - 623.3 cf Chambers = 1,014.7 cf Stone x 35.0% Voids = 355.1 cf Stone Storage

Chamber Storage + Stone Storage = 818.9 cf = 0.019 af
Overall Storage Efficiency = 50.0%
Overall System Size = 24.00' x 13.00' x 5.25'

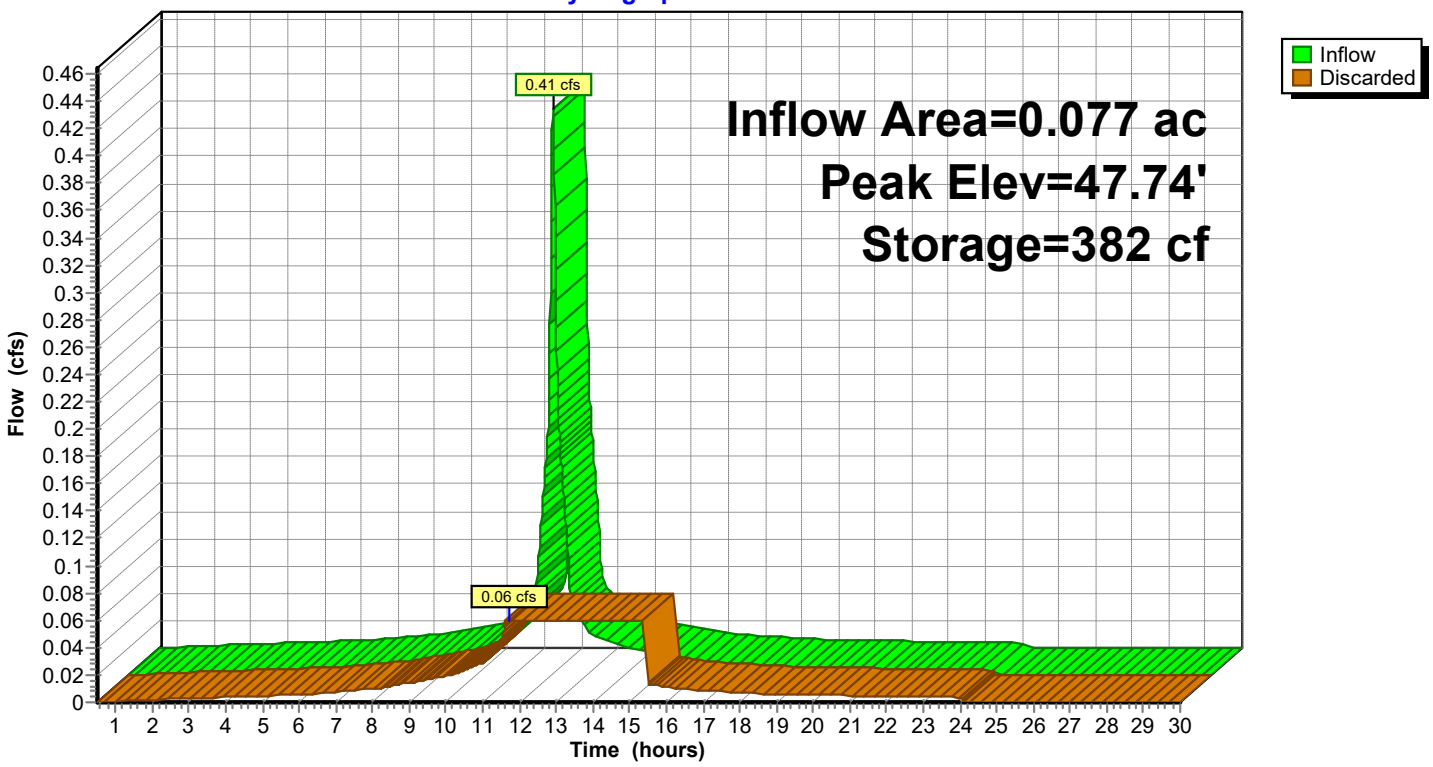
10 Chambers
60.7 cy Field
37.6 cy Stone





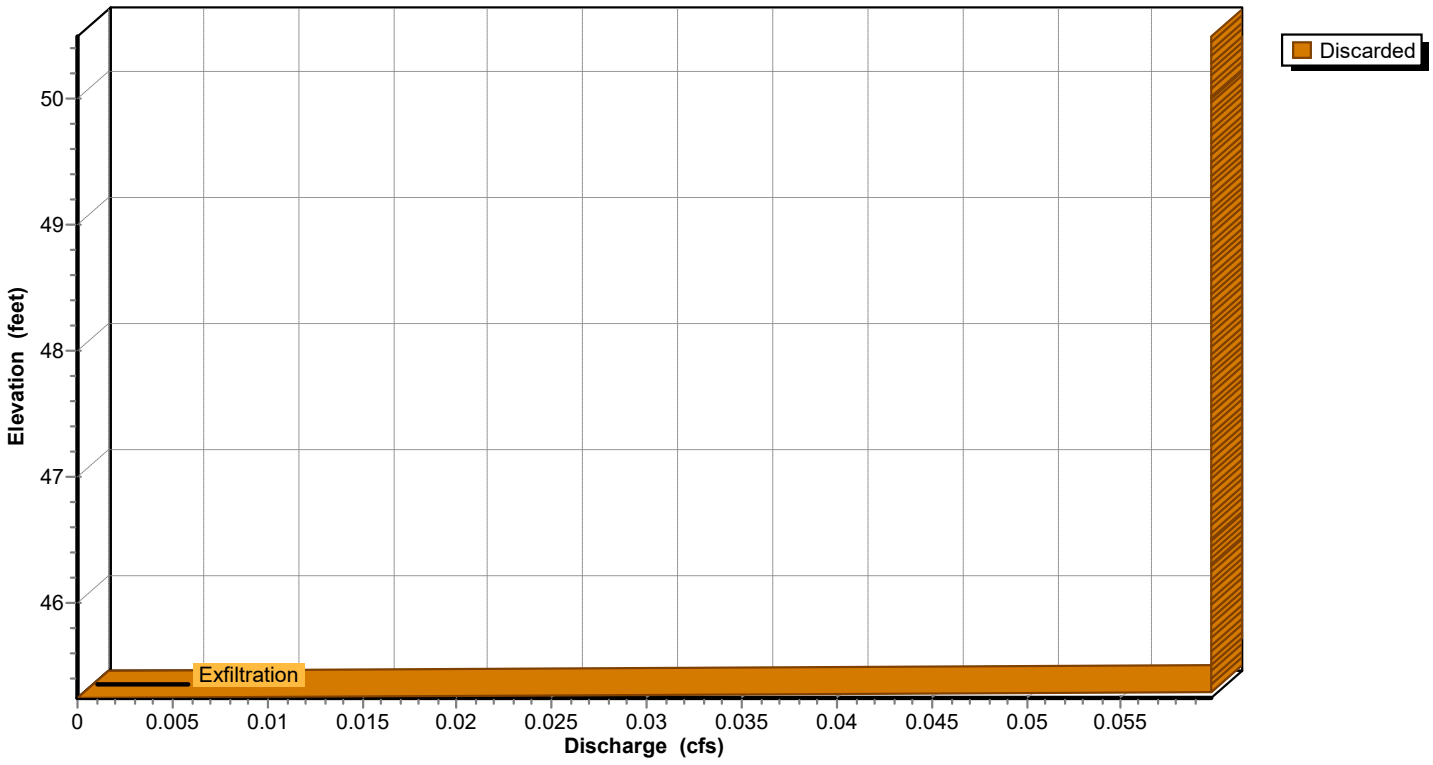
Pond IS2: System #2

Hydrograph

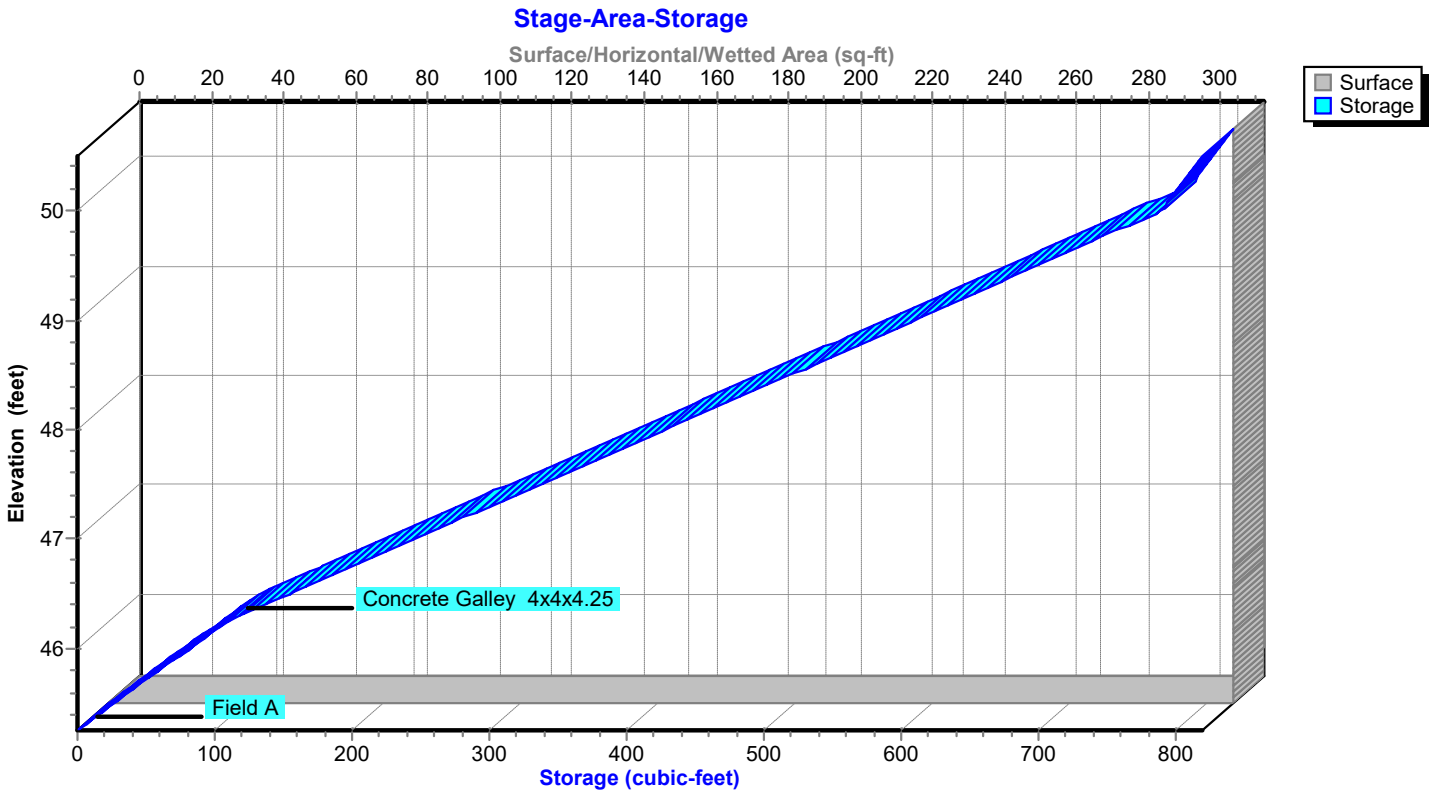


Pond IS2: System #2

Stage-Discharge



Pond IS2: System #2



Summary for Pond IS3: System #3

Inflow Area = 0.118 ac,100.00% Impervious, Inflow Depth = 5.06" for 25-Year event
Inflow = 0.64 cfs @ 12.07 hrs, Volume= 0.050 af
Outflow = 0.07 cfs @ 11.64 hrs, Volume= 0.050 af, Atten= 89%, Lag= 0.0 min
Discarded = 0.07 cfs @ 11.64 hrs, Volume= 0.050 af
Primary = 0.00 cfs @ 0.50 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 46.01' @ 12.68 hrs Surf.Area= 364 sf Storage= 666 cf

Plug-Flow detention time= 58.9 min calculated for 0.050 af (100% of inflow)
Center-of-Mass det. time= 58.8 min (805.0 - 746.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	42.50'	407 cf	**13.00'W x 28.00'L x 5.25'H Field A** 1,911 cf Overall - 748 cf Embedded = 1,163 cf x 35.0% Voids
#2A	43.50'	557 cf	**Concrete Galley 4x4x4.25** x 12 Inside #1 Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf 12 Chambers in 2 Rows
		964 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	42.50'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	46.80'	**8.0" Round Culvert** L= 72.0' Ke= 0.090 Inlet / Outlet Invert= 46.80' / 45.00' S= 0.0250 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.07 cfs @ 11.64 hrs HW=42.56' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=0.00 cfs @ 0.50 hrs HW=42.50' TW=43.00' (Dynamic Tailwater)
↑—**2=Culvert** (Controls 0.00 cfs)

Pond IS3: System #3 - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x4x4.25 (Concrete Galley, Shea LE-EGH, LE-CGH or equivalent)
Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf
Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf

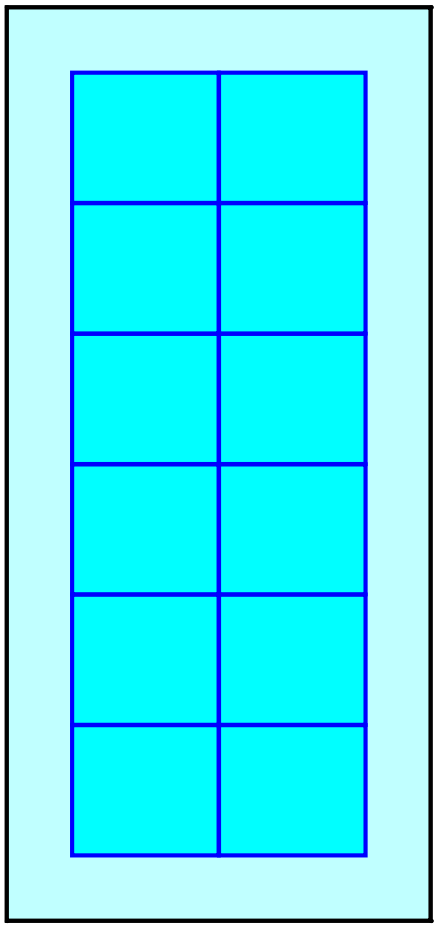
6 Chambers/Row x 4.00' Long = 24.00' Row Length +24.0" End Stone x 2 = 28.00' Base Length
2 Rows x 54.0" Wide + 24.0" Side Stone x 2 = 13.00' Base Width
12.0" Base + 51.0" Chamber Height = 5.25' Field Height

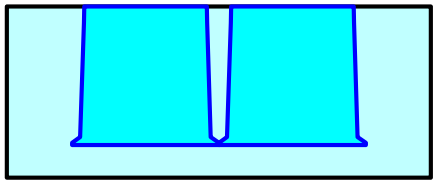
12 Chambers x 46.4 cf = 556.6 cf Chamber Storage
12 Chambers x 62.3 cf = 748.0 cf Displacement

1,911.0 cf Field - 748.0 cf Chambers = 1,163.0 cf Stone x 35.0% Voids = 407.1 cf Stone Storage

Chamber Storage + Stone Storage = 963.6 cf = 0.022 af
Overall Storage Efficiency = 50.4%
Overall System Size = 28.00' x 13.00' x 5.25'

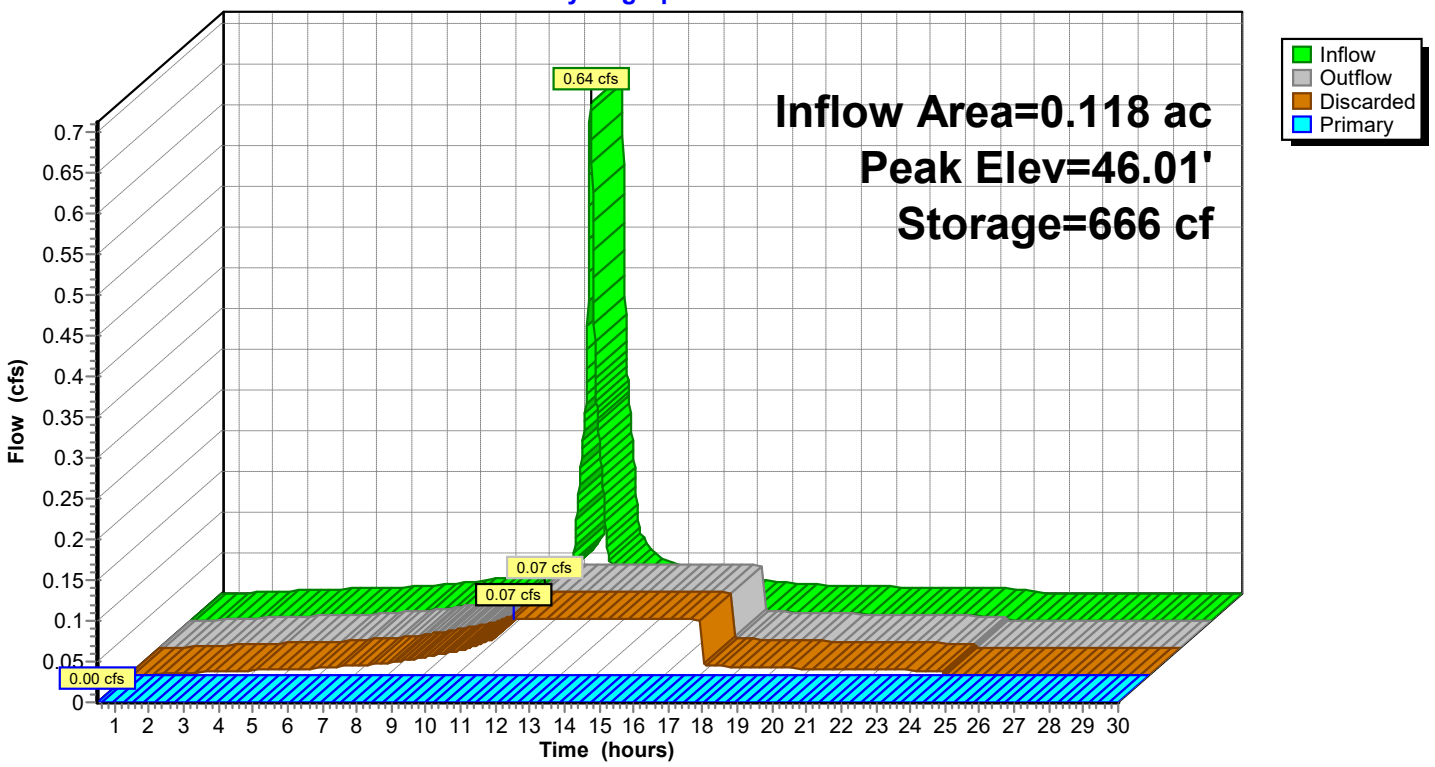
12 Chambers
70.8 cy Field
43.1 cy Stone





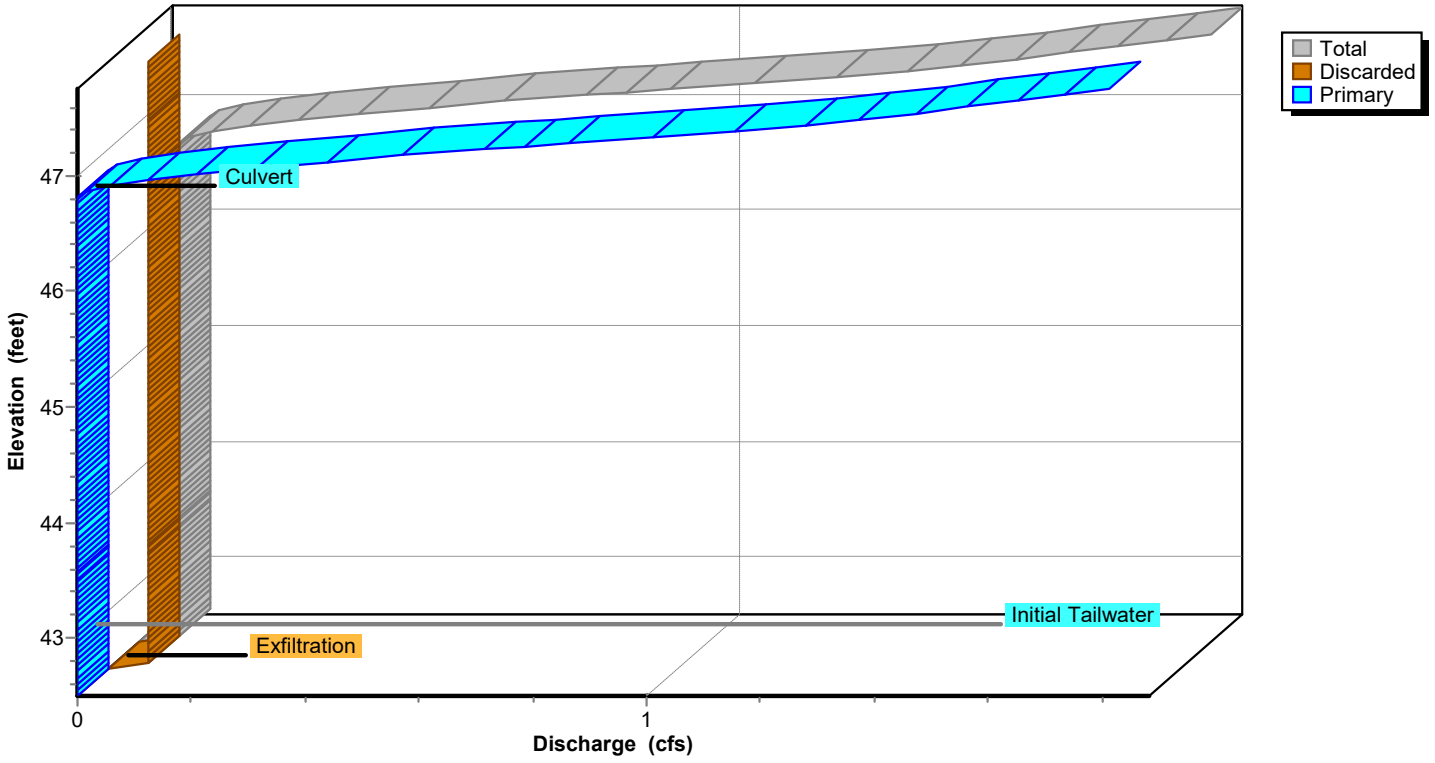
Pond IS3: System #3

Hydrograph

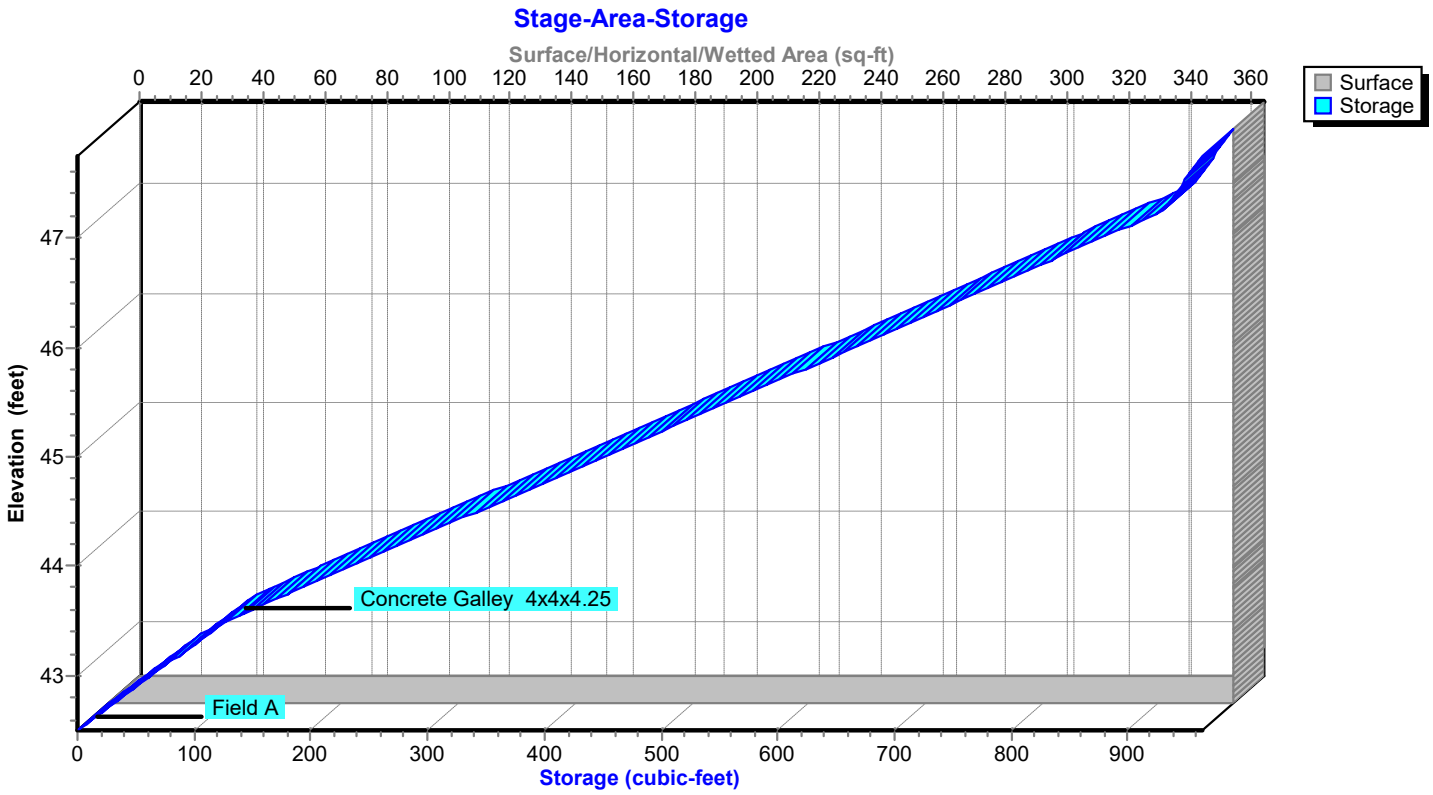


Pond IS3: System #3

Stage-Discharge



Pond IS3: System #3



Summary for Pond IS4: (Retention Pond)

Inflow Area = 0.284 ac, 41.74% Impervious, Inflow Depth = 0.23" for 25-Year event
Inflow = 0.03 cfs @ 12.33 hrs, Volume= 0.005 af
Outflow = 0.00 cfs @ 0.50 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Secondary = 0.00 cfs @ 0.50 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 43.34' @ 24.29 hrs Surf.Area= 742 sf Storage= 236 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	43.00'	1,949 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

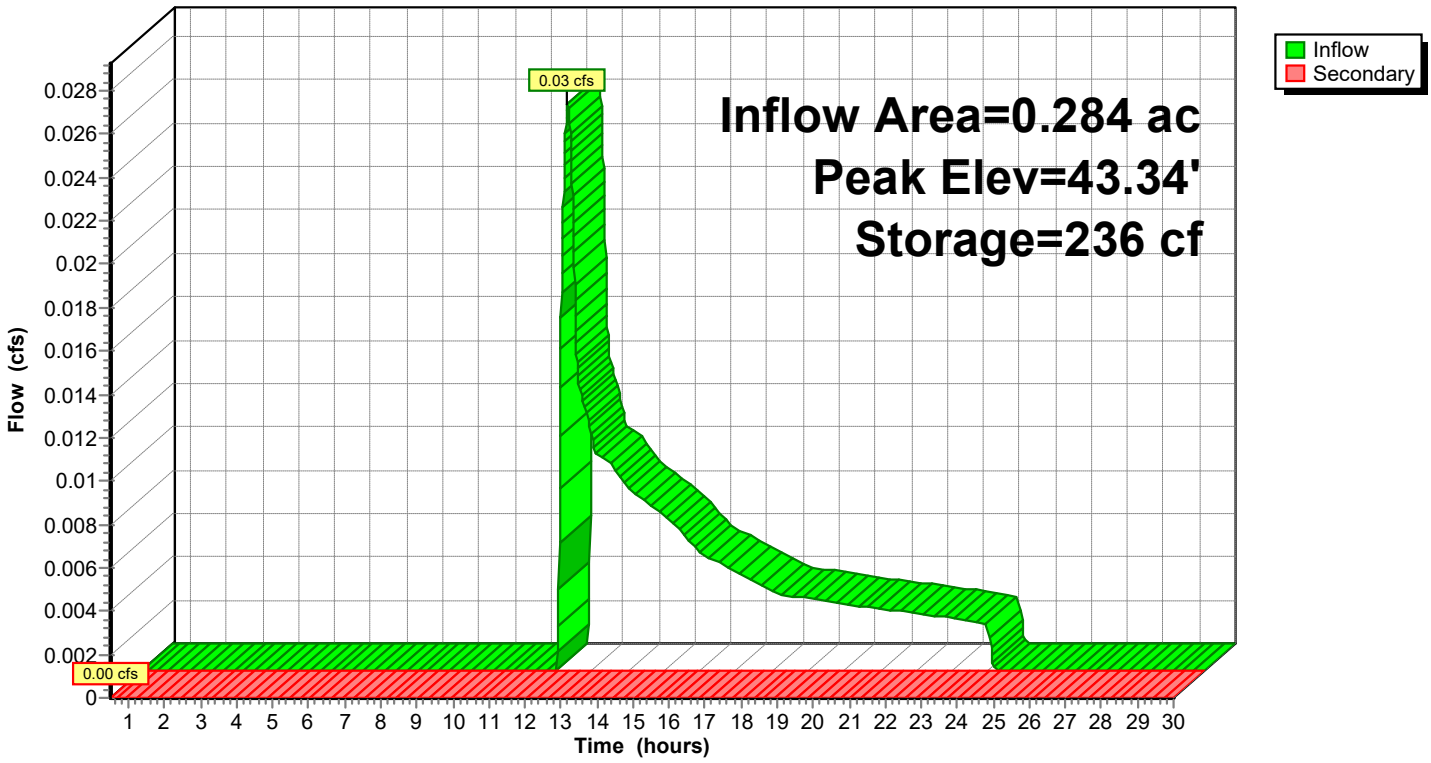
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
43.00	637	100.0	0	0	637
44.00	966	119.0	796	796	986
45.00	1,351	137.0	1,153	1,949	1,374

Device	Routing	Invert	Outlet Devices
#1	Secondary	44.50'	**45.0 deg x 3.0' wide x 0.50' high Dam Breach** C= 2.56 Top of breach = 45.00' Bottom of breach = 44.50' Breach starts at 44.50' WSE and develops over 1.000 hrs

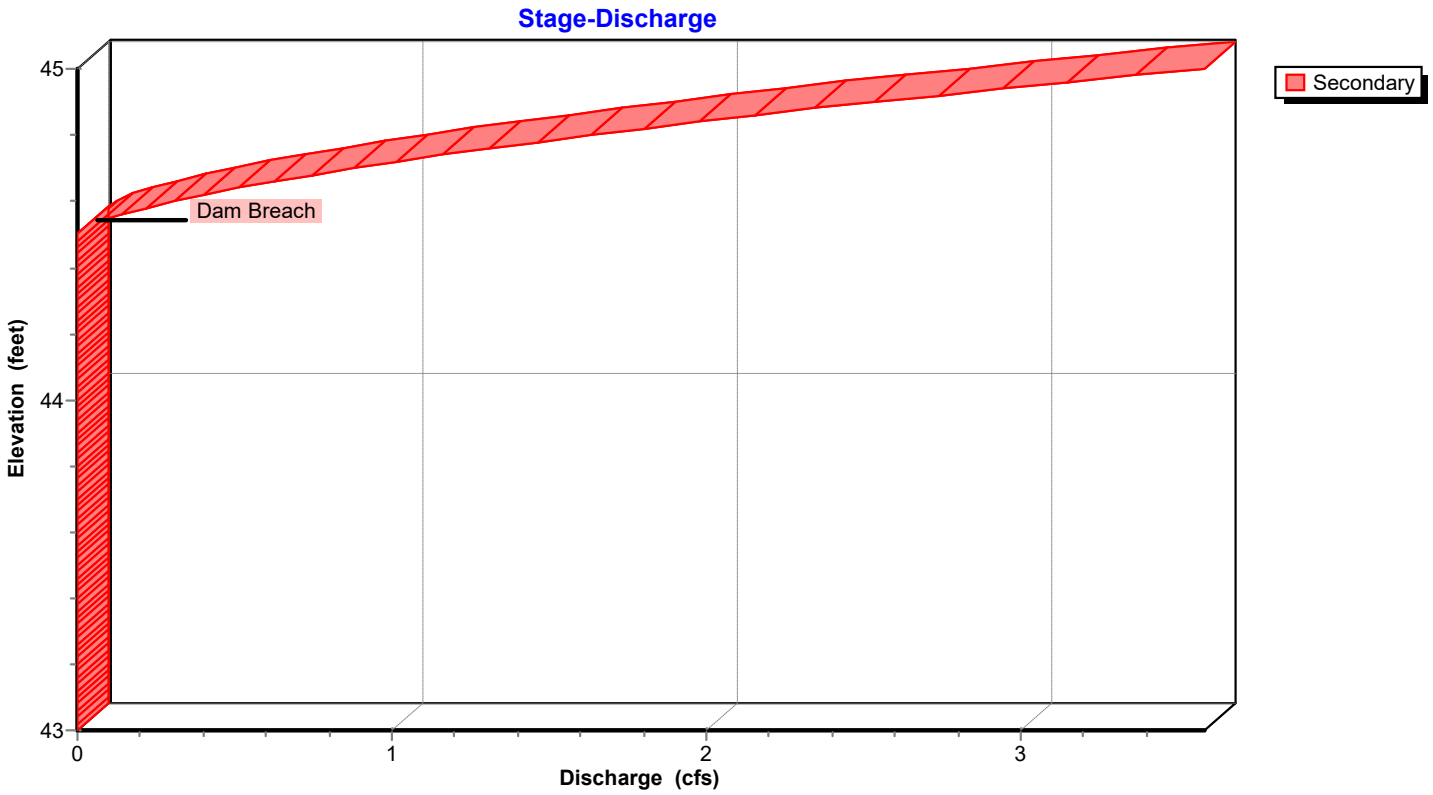
Secondary OutFlow Max=0.00 cfs @ 0.50 hrs HW=43.00' TW=0.00' (Dynamic Tailwater)
1=Dam Breach (Controls 0.00 cfs)

Pond IS4: (Retention Pond)

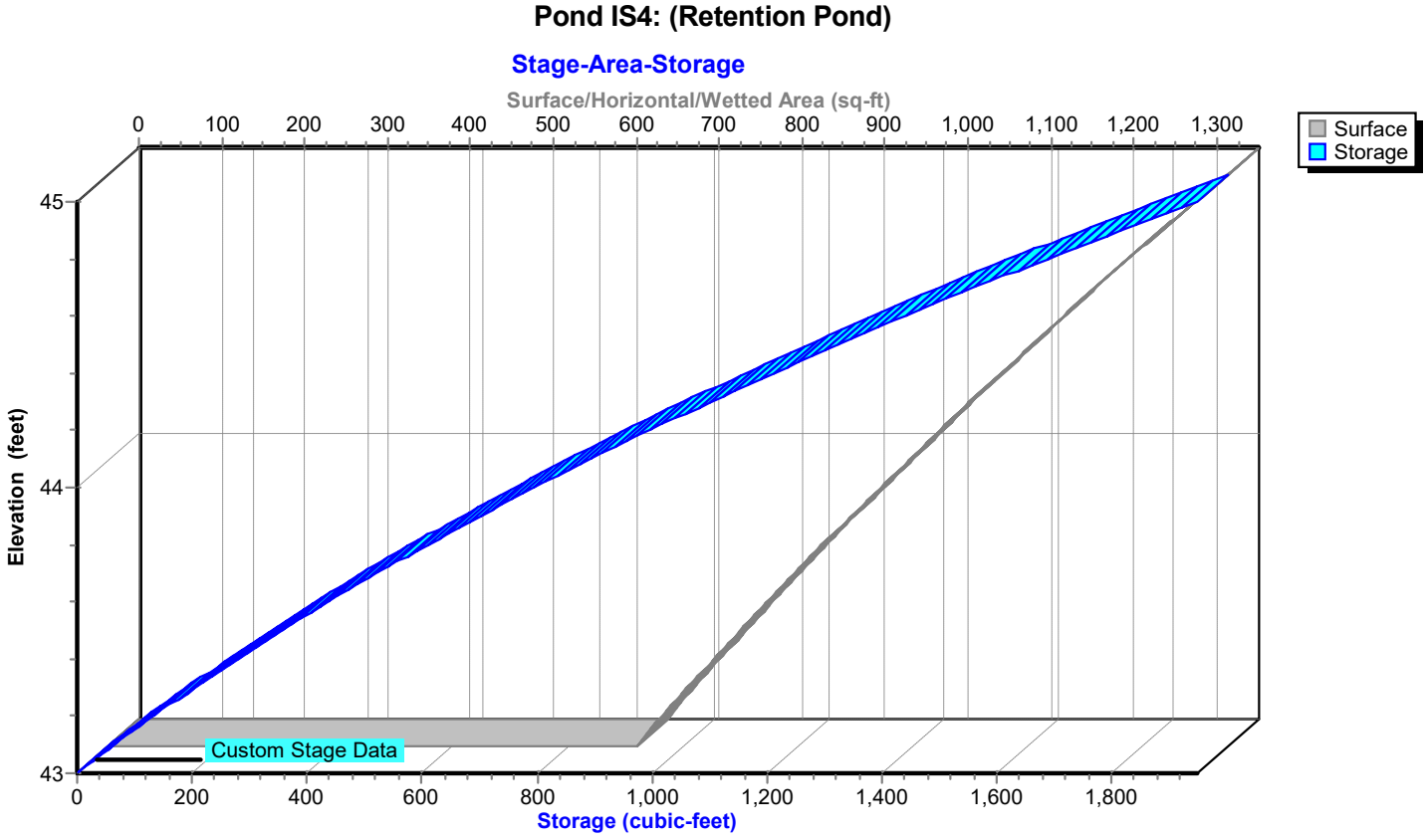
Hydrograph



Pond IS4: (Retention Pond)



Pond IS4: (Retention Pond)

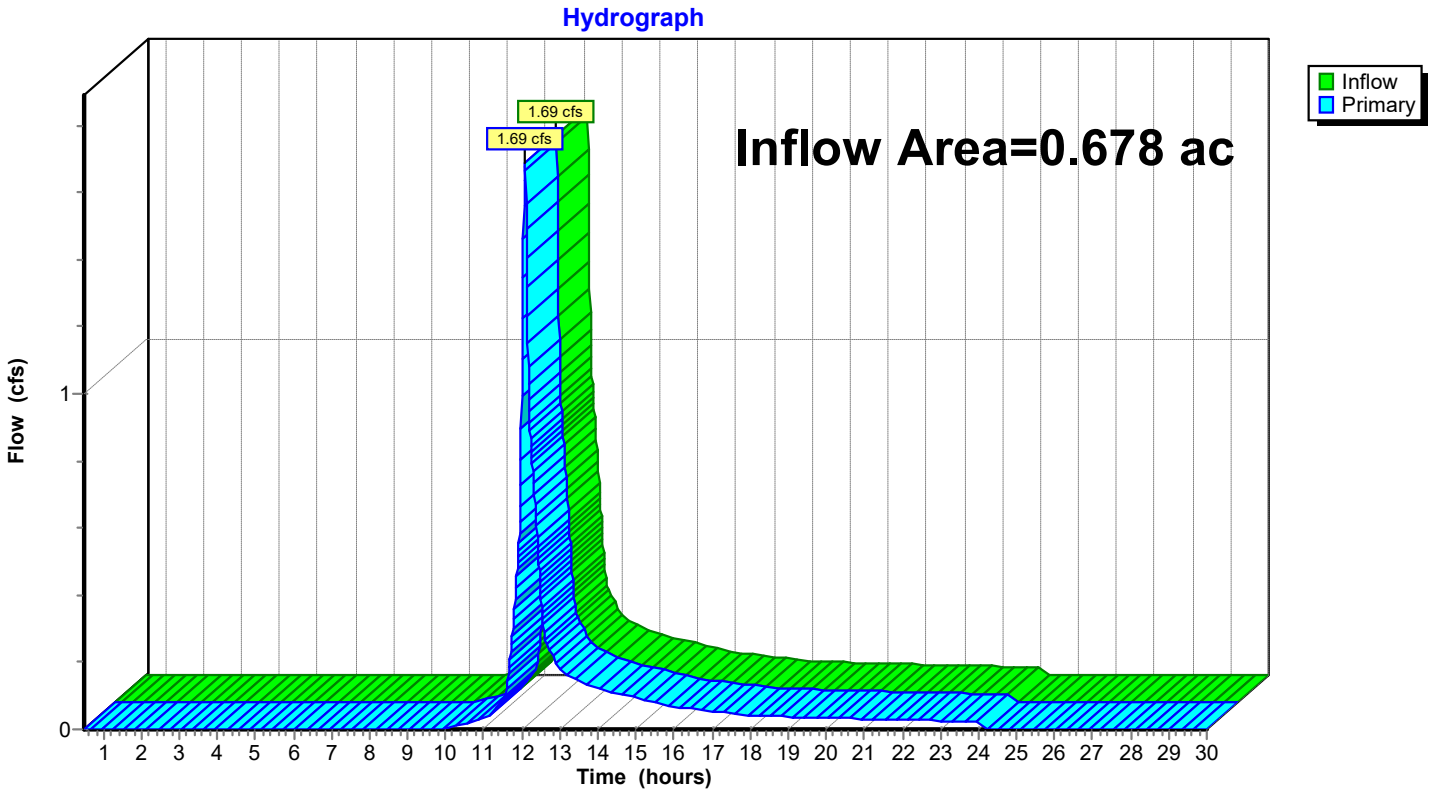


Summary for Link POD1: South-West Abutter

Inflow Area = 0.678 ac, 0.00% Impervious, Inflow Depth = 2.10" for 25-Year event
Inflow = 1.69 cfs @ 12.08 hrs, Volume= 0.118 af
Primary = 1.69 cfs @ 12.08 hrs, Volume= 0.118 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs

Link POD1: South-West Abutter

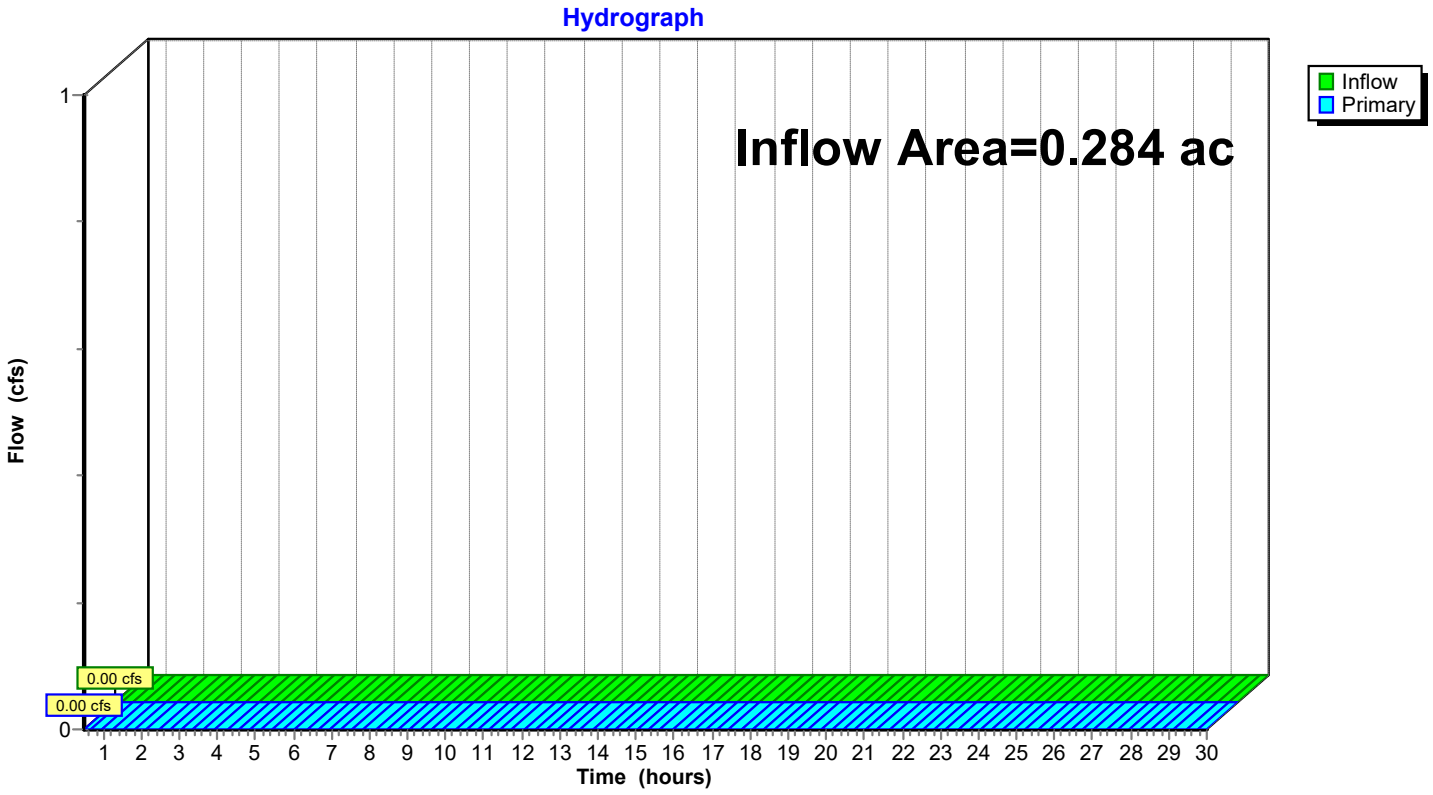


Summary for Link POD1.: South-West Abutter

Inflow Area = 0.284 ac, 41.74% Impervious, Inflow Depth = 0.00" for 25-Year event
Inflow = 0.00 cfs @ 0.50 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.50 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs

Link POD1.: South-West Abutter



Time span=0.50-30.00 hrs, dt=0.010 hrs, 2951 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E1: Sub-catchment-1 Runoff Area=29,550 sf 0.00% Impervious Runoff Depth=4.90"
Tc=5.0 min CN=68 Runoff=4.04 cfs 0.277 af

Subcatchment P1: Sub-catchment-1 Runoff Area=7,199 sf 0.00% Impervious Runoff Depth=1.83"
Tc=5.0 min CN=42 Runoff=0.30 cfs 0.025 af

Subcatchment PD1: Driveway Runoff Area=2,276 sf 98.33% Impervious Runoff Depth=8.42"
Tc=5.0 min CN=97 Runoff=0.47 cfs 0.037 af

Subcatchment PD2: Driveway Runoff Area=4,038 sf 100.00% Impervious Runoff Depth=8.54"
Tc=5.0 min CN=98 Runoff=0.83 cfs 0.066 af

Subcatchment PR1: Roof_BLDG-1 Runoff Area=2,260 sf 100.00% Impervious Runoff Depth=8.54"
Tc=5.0 min CN=98 Runoff=0.46 cfs 0.037 af

Subcatchment PR2: Roof_BLDG-2 Runoff Area=3,360 sf 100.00% Impervious Runoff Depth=8.54"
Tc=5.0 min CN=98 Runoff=0.69 cfs 0.055 af

Subcatchment PR3: Roof_BLDG-3 Runoff Area=1,120 sf 100.00% Impervious Runoff Depth=8.54"
Tc=5.0 min CN=98 Runoff=0.23 cfs 0.018 af

Pond IS1: System #1 Peak Elev=51.77' Storage=1,087 cf Inflow=0.93 cfs 0.074 af
Outflow=0.08 cfs 0.074 af

Pond IS2: System #2 Peak Elev=50.23' Storage=803 cf Inflow=0.69 cfs 0.055 af
Outflow=0.06 cfs 0.055 af

Pond IS3: System #3 Peak Elev=47.14' Storage=907 cf Inflow=1.06 cfs 0.084 af
Discarded=0.07 cfs 0.072 af Primary=0.50 cfs 0.013 af Outflow=0.57 cfs 0.084 af

Pond IS4: (Retention Pond) Peak Elev=44.55' Storage=1,383 cf Inflow=0.71 cfs 0.038 af
Outflow=0.09 cfs 0.007 af

Link POD1: South-West Abutter Inflow=4.04 cfs 0.277 af
Primary=4.04 cfs 0.277 af

Link POD1.: South-West Abutter Inflow=0.09 cfs 0.007 af
Primary=0.09 cfs 0.007 af

Total Runoff Area = 1.143 ac Runoff Volume = 0.515 af Average Runoff Depth = 5.40"
73.87% Pervious = 0.845 ac 26.13% Impervious = 0.299 ac

Summary for Subcatchment E1: Sub-catchment-1

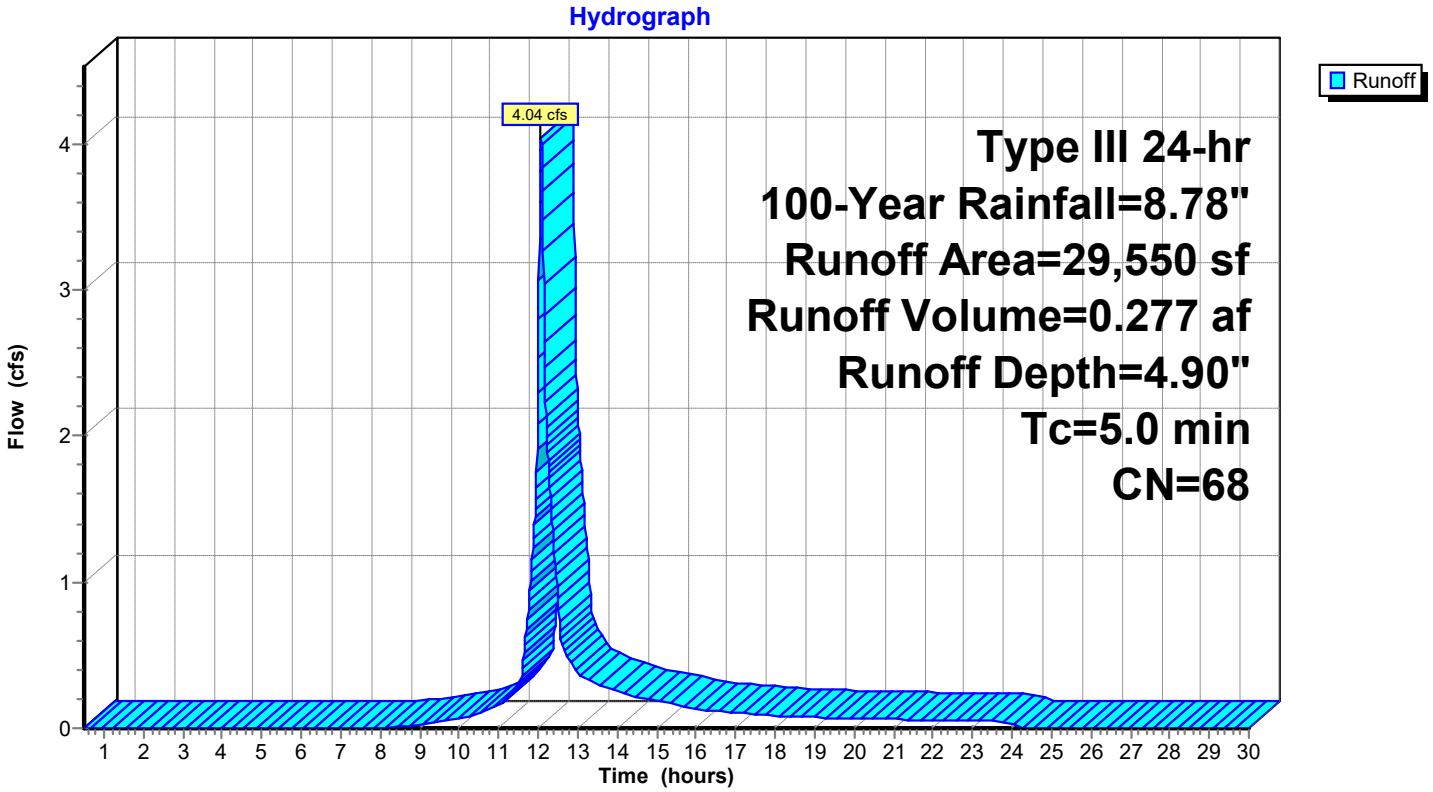
Runoff = 4.04 cfs @ 12.07 hrs, Volume= 0.277 af, Depth= 4.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 100-Year Rainfall=8.78"

Area (sf)	CN	Description
29,550	68	<50% Grass cover, Poor, HSG A
29,550		100.00% Pervious Area

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

Subcatchment E1: Sub-catchment-1



Summary for Subcatchment P1: Sub-catchment-1

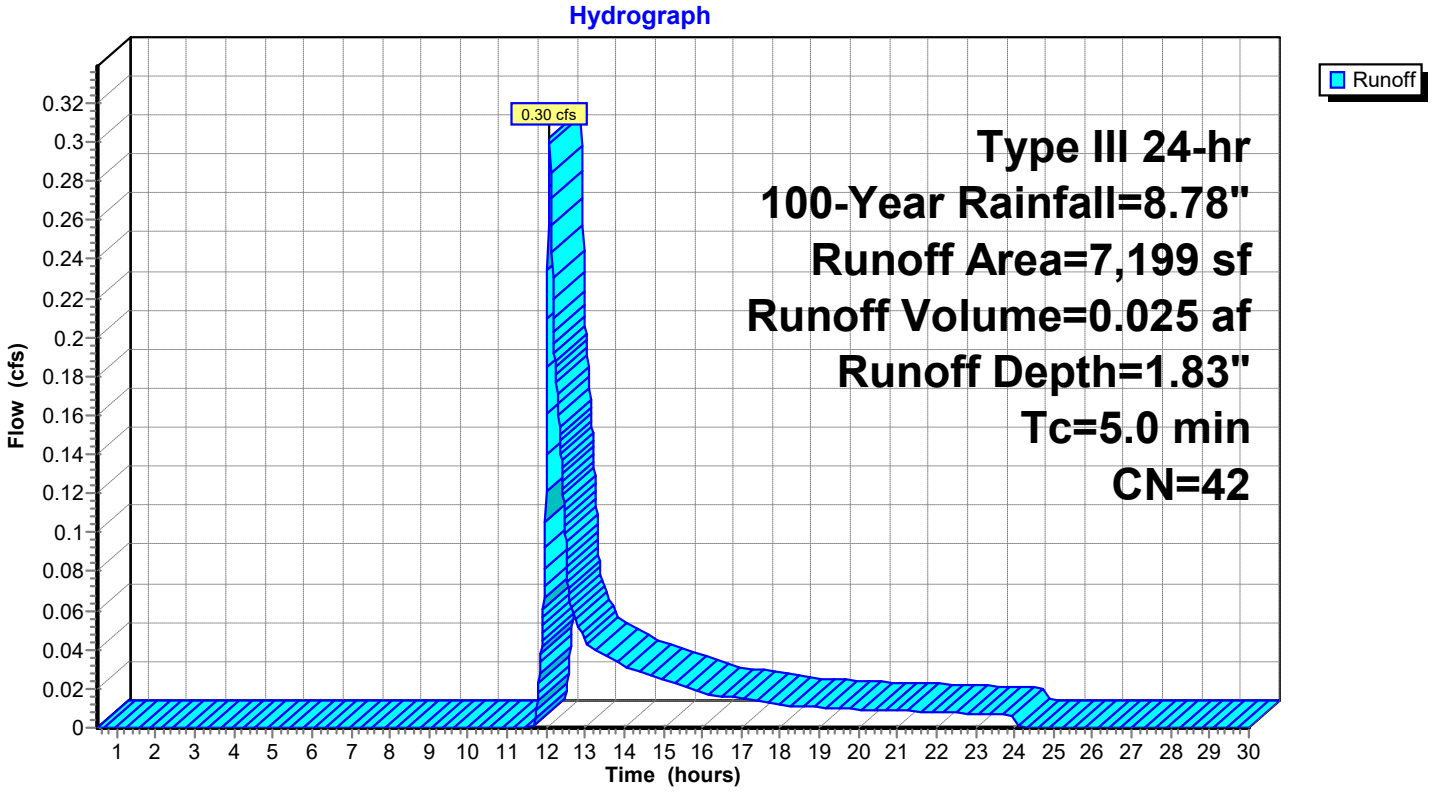
Runoff = 0.30 cfs @ 12.09 hrs, Volume= 0.025 af, Depth= 1.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 100-Year Rainfall=8.78"

Area (sf)	CN	Description
2,623	39	>75% Grass cover, Good, HSG A
3,705	36	Woods, Fair, HSG A
871	76	Gravel roads, HSG A
7,199	42	Weighted Average
7,199		100.00% Pervious Area

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

Subcatchment P1: Sub-catchment-1



Summary for Subcatchment PD1: Driveway

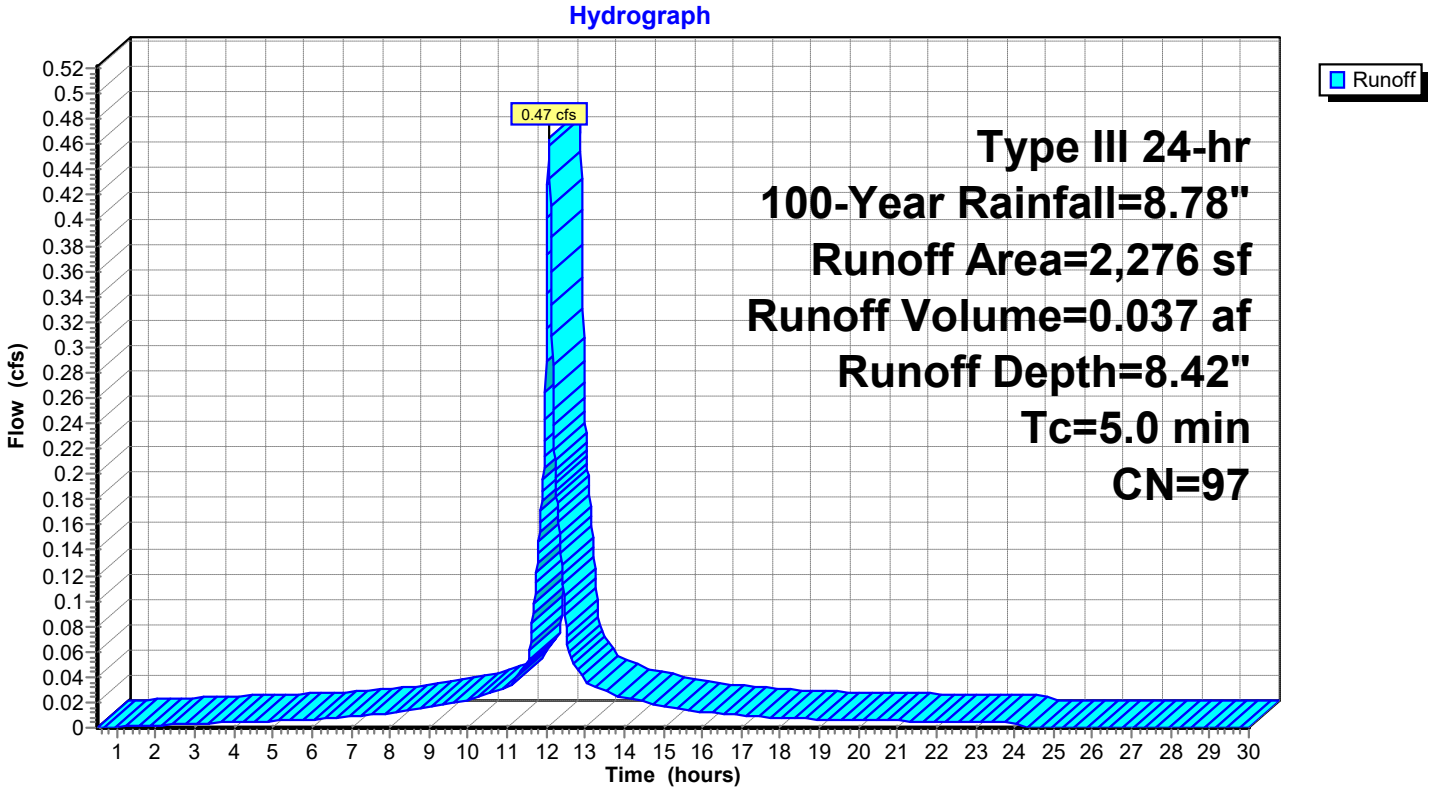
Runoff = 0.47 cfs @ 12.07 hrs, Volume= 0.037 af, Depth= 8.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 100-Year Rainfall=8.78"

	Area (sf)	CN	Description
	2,238	98	Paved parking, HSG A
*	38	65	Paver walkway
	2,276	97	Weighted Average
	38		1.67% Pervious Area
	2,238		98.33% Impervious Area

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

Subcatchment PD1: Driveway



Summary for Subcatchment PD2: Driveway

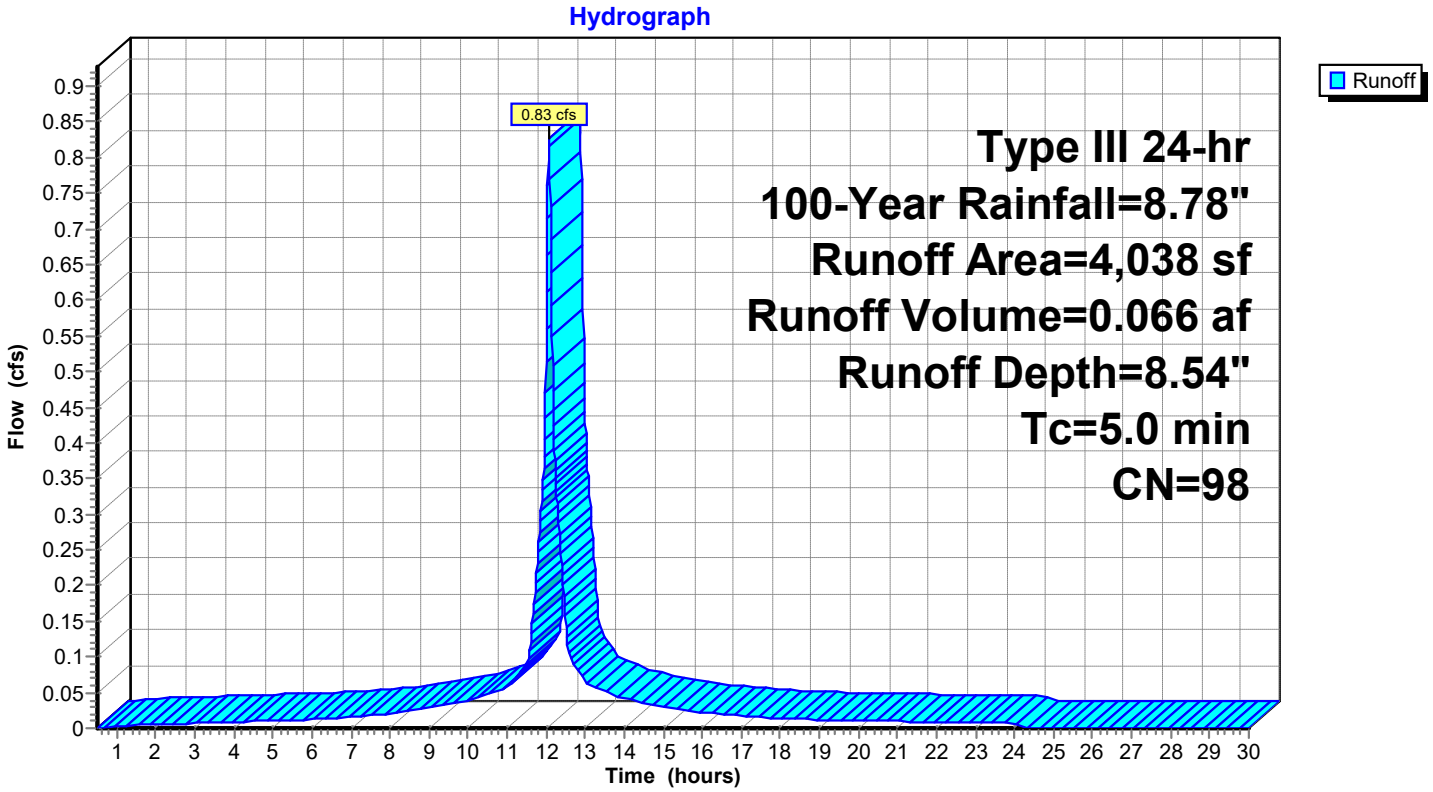
Runoff = 0.83 cfs @ 12.07 hrs, Volume= 0.066 af, Depth= 8.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 100-Year Rainfall=8.78"

Area (sf)	CN	Description
4,038	98	Paved parking, HSG A
4,038		100.00% Impervious Area

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

Subcatchment PD2: Driveway



Summary for Subcatchment PR1: Roof_BLDG-1

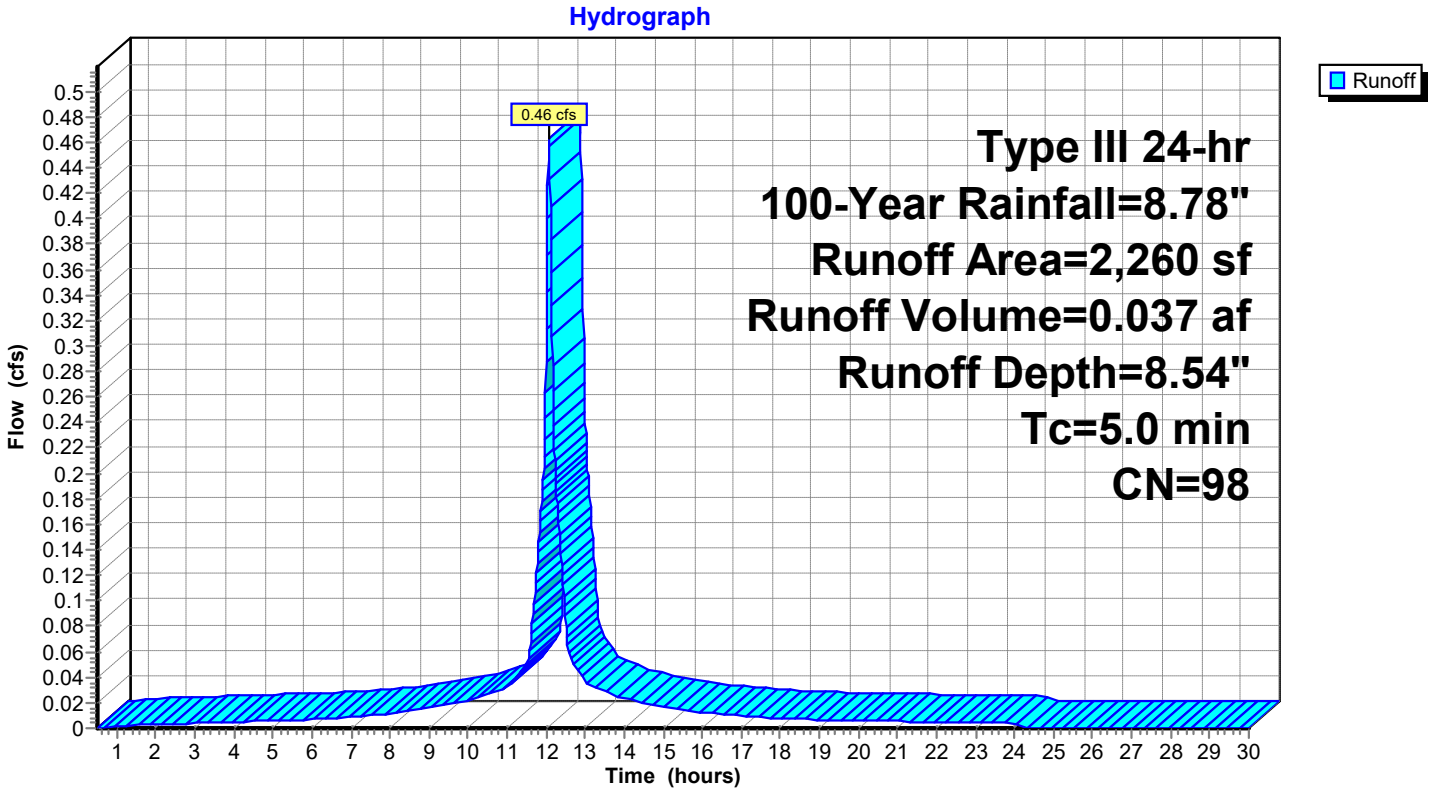
Runoff = 0.46 cfs @ 12.07 hrs, Volume= 0.037 af, Depth= 8.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 100-Year Rainfall=8.78"

	Area (sf)	CN	Description
*	2,260	98	Roofs, HSG A
	2,260		100.00% Impervious Area

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

Subcatchment PR1: Roof_BLDG-1



Summary for Subcatchment PR2: Roof_BLDG-2

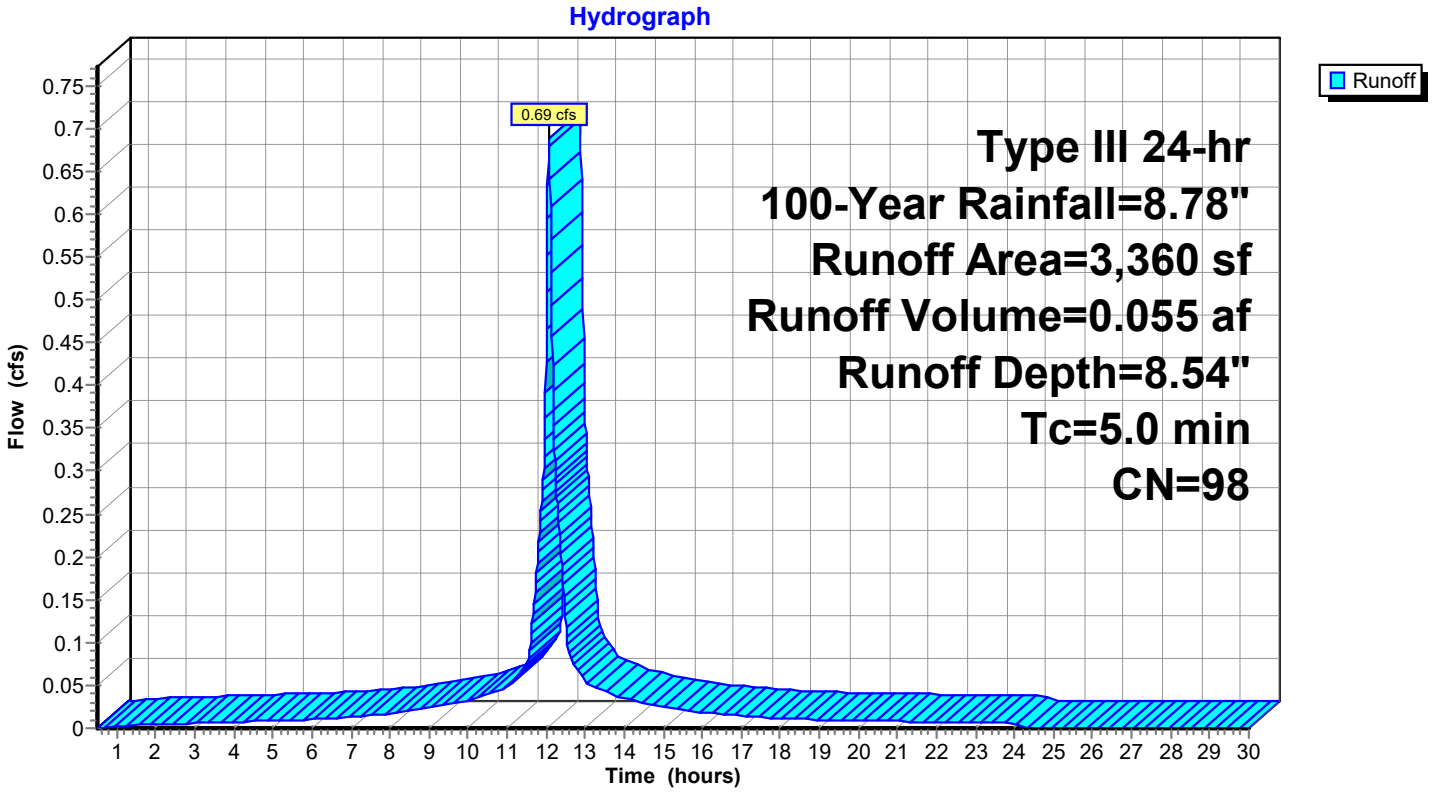
Runoff = 0.69 cfs @ 12.07 hrs, Volume= 0.055 af, Depth= 8.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 100-Year Rainfall=8.78"

	Area (sf)	CN	Description
*	3,360	98	Roofs, HSG A
	3,360		100.00% Impervious Area

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

Subcatchment PR2: Roof_BLDG-2



Summary for Subcatchment PR3: Roof_BLDG-3

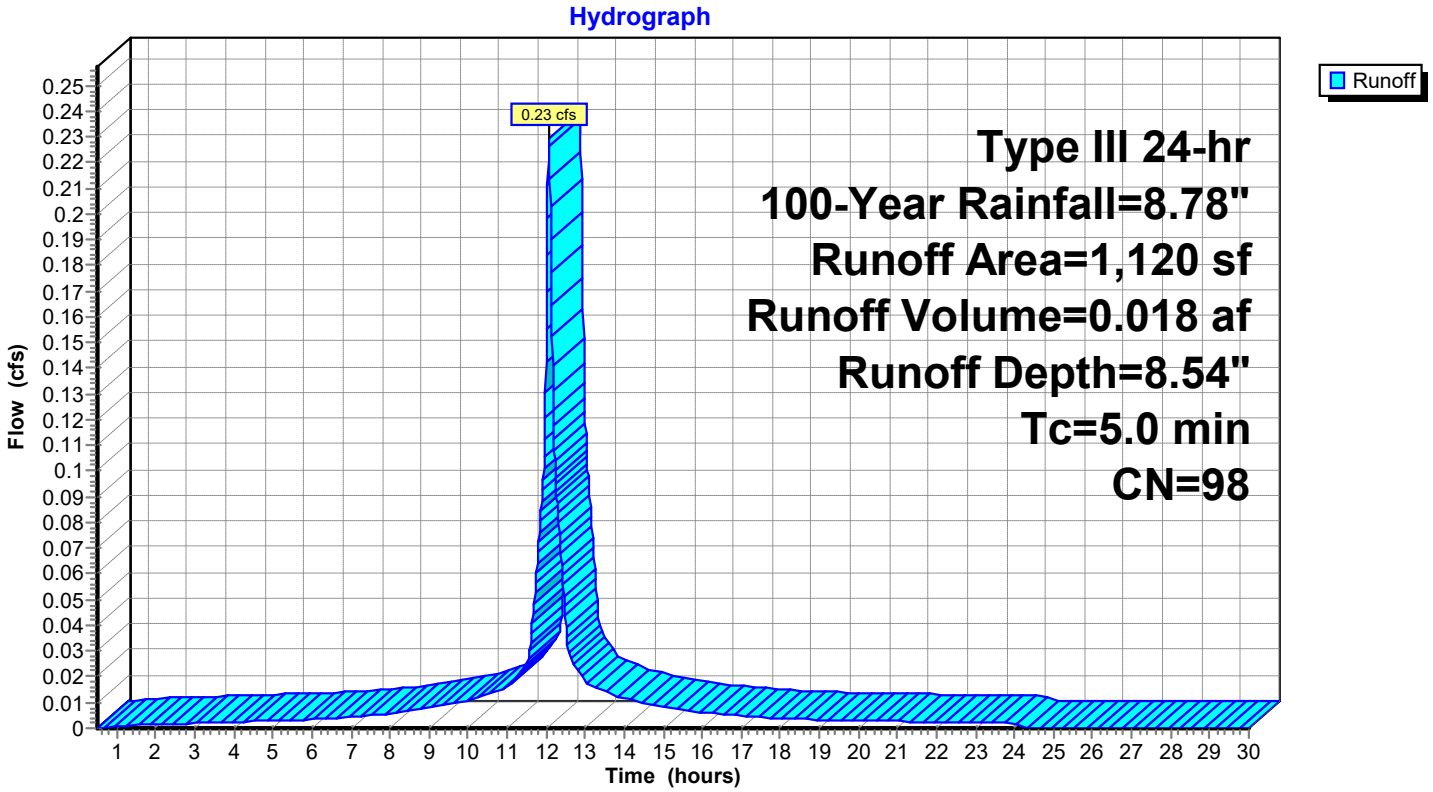
Runoff = 0.23 cfs @ 12.07 hrs, Volume= 0.018 af, Depth= 8.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Type III 24-hr 100-Year Rainfall=8.78"

	Area (sf)	CN	Description
*	1,120	98	Roofs, HSG A
	1,120		100.00% Impervious Area

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

Subcatchment PR3: Roof_BLDG-3



Summary for Pond IS1: System #1

Inflow Area = 0.104 ac, 99.16% Impervious, Inflow Depth = 8.48" for 100-Year event
Inflow = 0.93 cfs @ 12.07 hrs, Volume= 0.074 af
Outflow = 0.08 cfs @ 11.44 hrs, Volume= 0.074 af, Atten= 91%, Lag= 0.0 min
Discarded = 0.08 cfs @ 11.44 hrs, Volume= 0.074 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 51.77' @ 12.93 hrs Surf.Area= 416 sf Storage= 1,087 cf

Plug-Flow detention time= 91.5 min calculated for 0.074 af (100% of inflow)
Center-of-Mass det. time= 91.5 min (833.5 - 741.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	46.80'	459 cf	**13.00'W x 32.00'L x 5.25'H Field A** 2,184 cf Overall - 873 cf Embedded = 1,311 cf x 35.0% Voids
#2A	47.80'	649 cf	**Concrete Galley 4x4x4.25** x 14 Inside #1 Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf 14 Chambers in 2 Rows
		1,108 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	46.80'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.08 cfs @ 11.44 hrs HW=46.85' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.08 cfs)

Pond IS1: System #1 - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x4x4.25 (Concrete Galley, Shea LE-EGH, LE-CGH or equivalent)
Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf
Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf

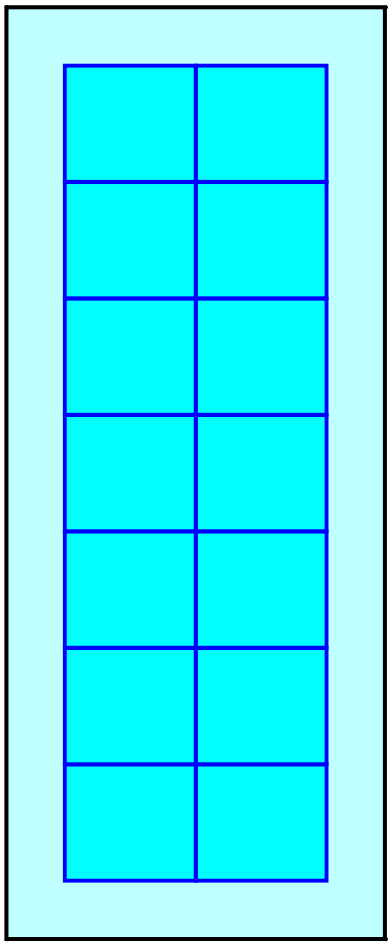
7 Chambers/Row x 4.00' Long = 28.00' Row Length +24.0" End Stone x 2 = 32.00' Base Length
2 Rows x 54.0" Wide + 24.0" Side Stone x 2 = 13.00' Base Width
12.0" Base + 51.0" Chamber Height = 5.25' Field Height

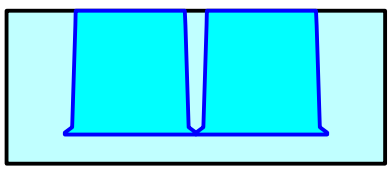
14 Chambers x 46.4 cf = 649.3 cf Chamber Storage
14 Chambers x 62.3 cf = 872.6 cf Displacement

2,184.0 cf Field - 872.6 cf Chambers = 1,311.4 cf Stone x 35.0% Voids = 459.0 cf Stone Storage

Chamber Storage + Stone Storage = 1,108.3 cf = 0.025 af
Overall Storage Efficiency = 50.7%
Overall System Size = 32.00' x 13.00' x 5.25'

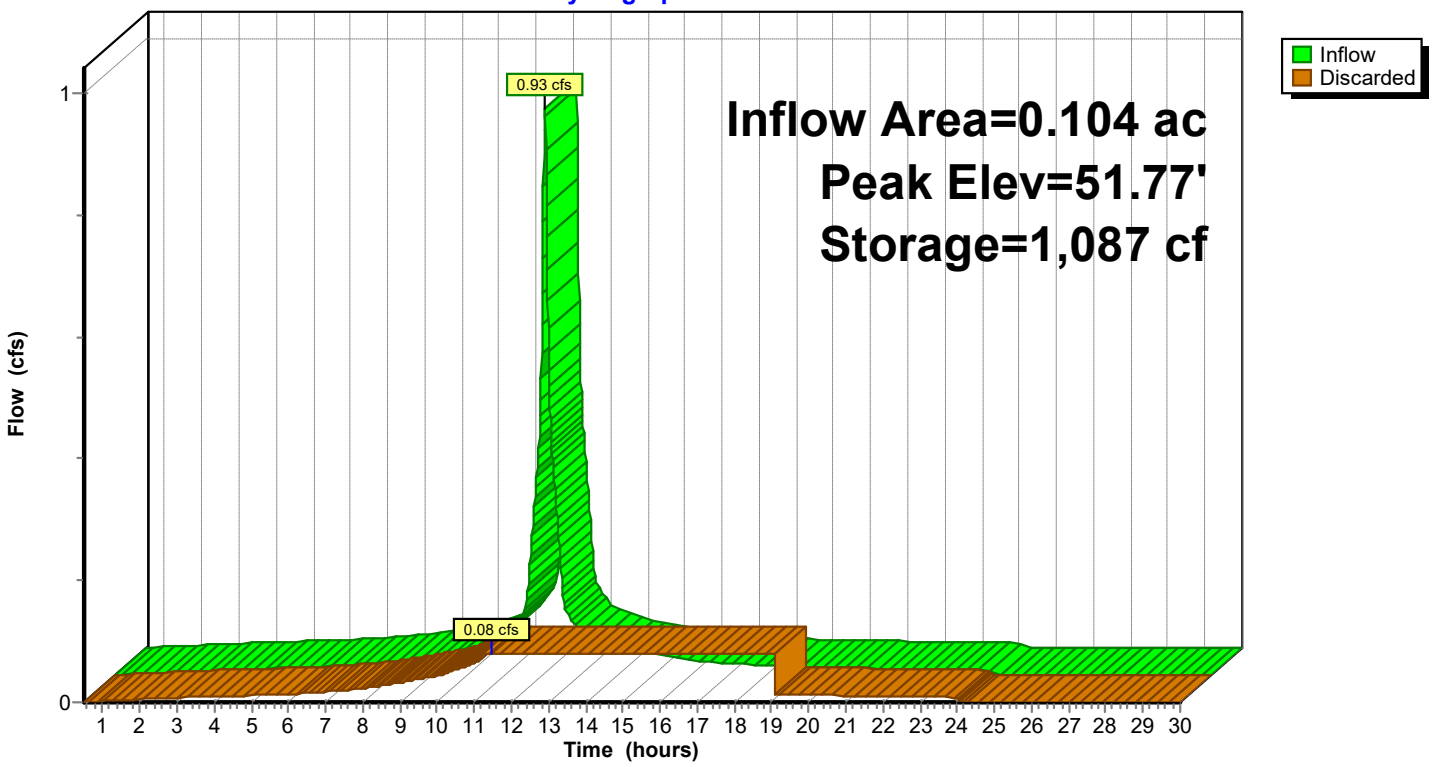
14 Chambers
80.9 cy Field
48.6 cy Stone





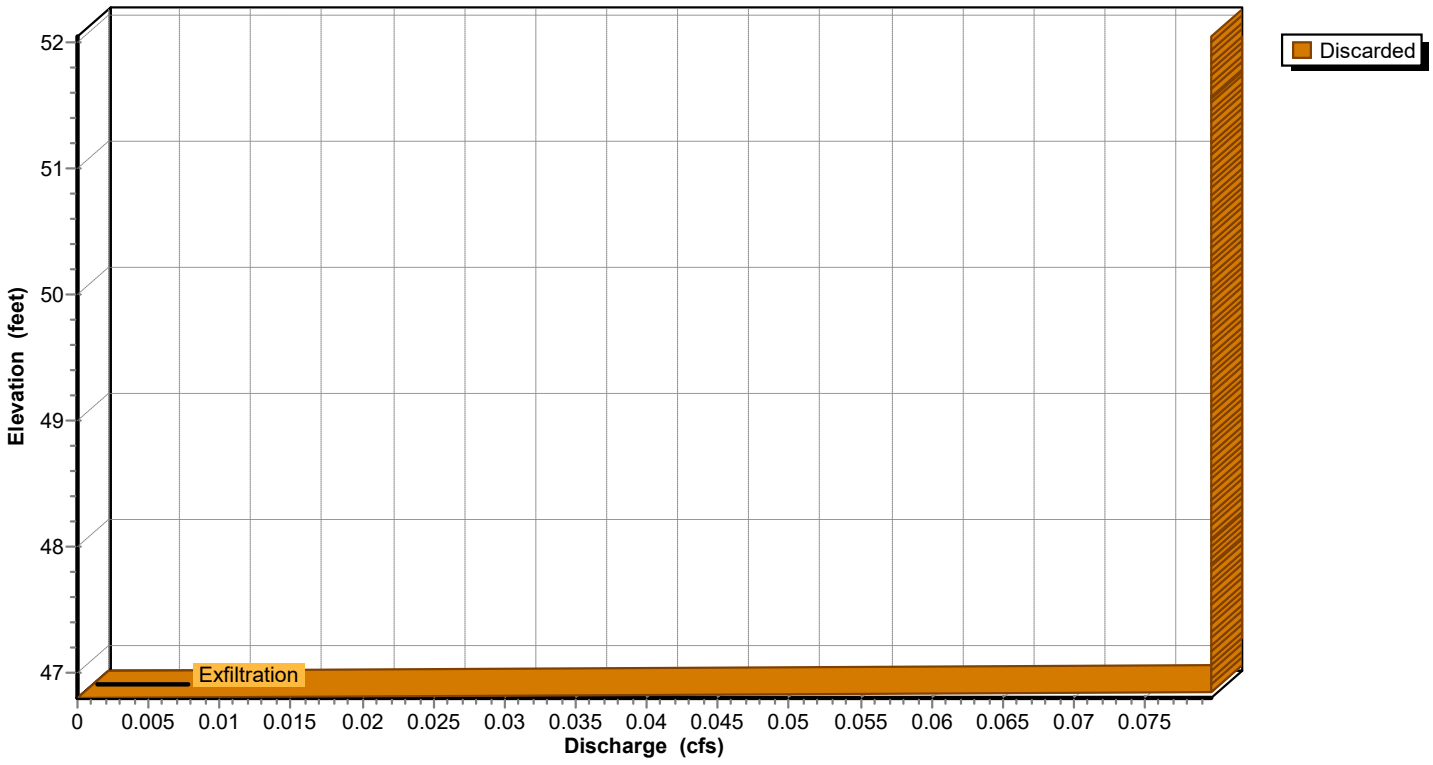
Pond IS1: System #1

Hydrograph

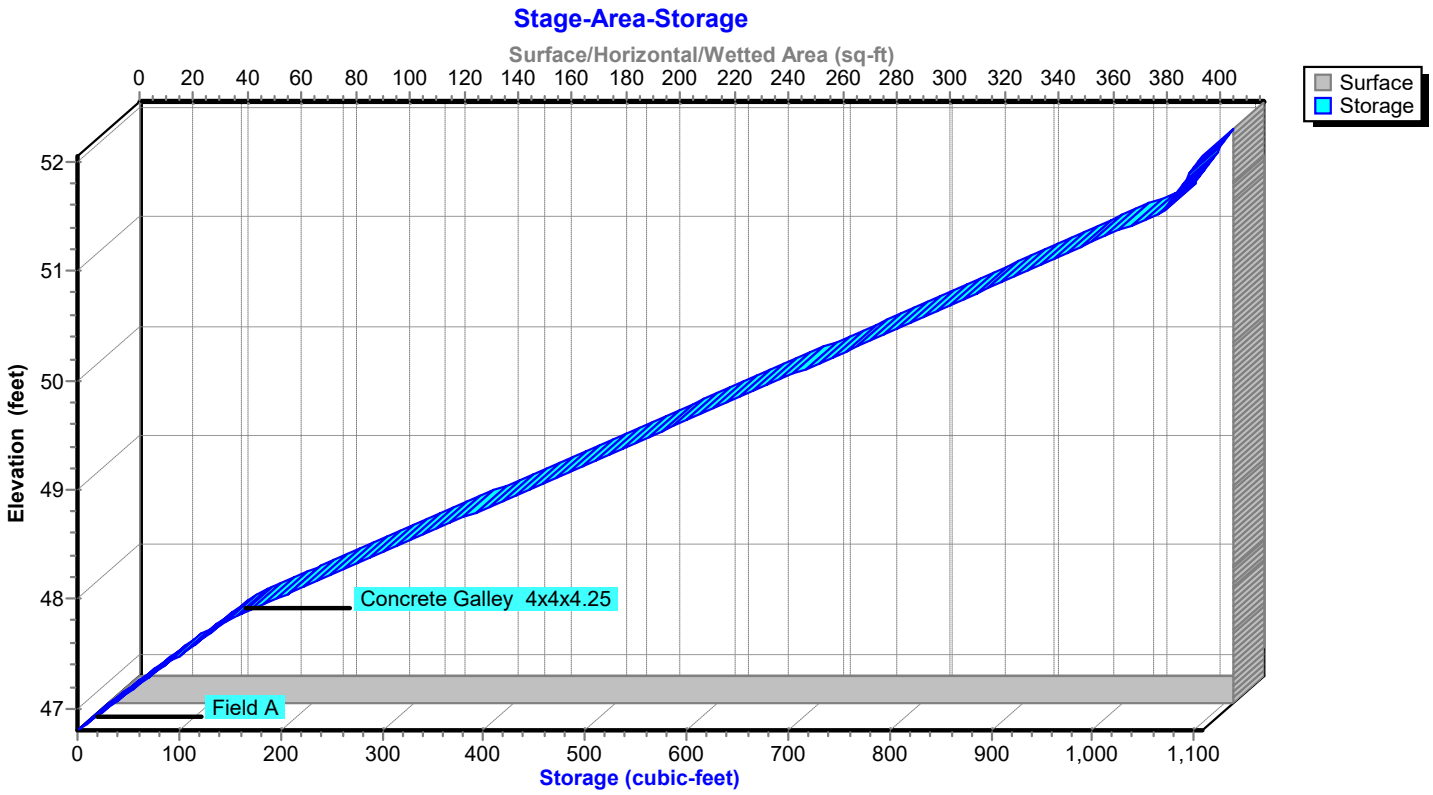


Pond IS1: System #1

Stage-Discharge



Pond IS1: System #1



Summary for Pond IS2: System #2

Inflow Area = 0.077 ac,100.00% Impervious, Inflow Depth = 8.54" for 100-Year event
Inflow = 0.69 cfs @ 12.07 hrs, Volume= 0.055 af
Outflow = 0.06 cfs @ 11.45 hrs, Volume= 0.055 af, Atten= 91%, Lag= 0.0 min
Discarded = 0.06 cfs @ 11.45 hrs, Volume= 0.055 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 50.23' @ 12.92 hrs Surf.Area= 312 sf Storage= 803 cf

Plug-Flow detention time= 89.2 min calculated for 0.055 af (100% of inflow)
Center-of-Mass det. time= 89.2 min (828.4 - 739.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	45.25'	355 cf	**13.00'W x 24.00'L x 5.25'H Field A** 1,638 cf Overall - 623 cf Embedded = 1,015 cf x 35.0% Voids
#2A	46.25'	464 cf	**Concrete Galley 4x4x4.25** x 10 Inside #1 Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf 10 Chambers in 2 Rows
		819 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	45.25'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.06 cfs @ 11.45 hrs HW=45.31' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.06 cfs)

Pond IS2: System #2 - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x4x4.25 (Concrete Galley, Shea LE-EGH, LE-CGH or equivalent)
Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf
Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf

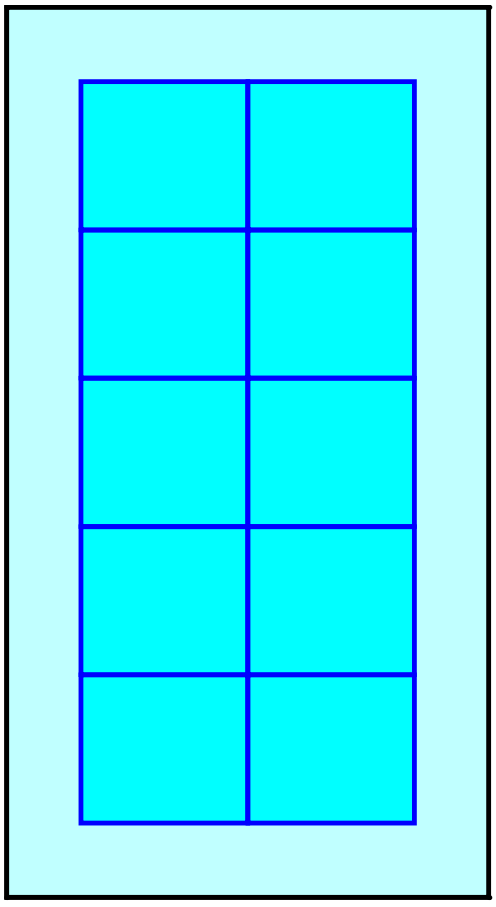
5 Chambers/Row x 4.00' Long = 20.00' Row Length +24.0" End Stone x 2 = 24.00' Base Length
2 Rows x 54.0" Wide + 24.0" Side Stone x 2 = 13.00' Base Width
12.0" Base + 51.0" Chamber Height = 5.25' Field Height

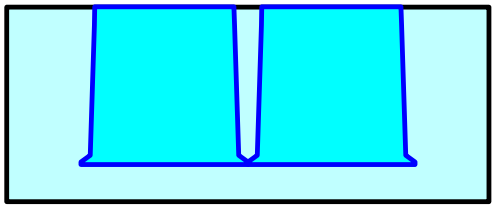
10 Chambers x 46.4 cf = 463.8 cf Chamber Storage
10 Chambers x 62.3 cf = 623.3 cf Displacement

1,638.0 cf Field - 623.3 cf Chambers = 1,014.7 cf Stone x 35.0% Voids = 355.1 cf Stone Storage

Chamber Storage + Stone Storage = 818.9 cf = 0.019 af
Overall Storage Efficiency = 50.0%
Overall System Size = 24.00' x 13.00' x 5.25'

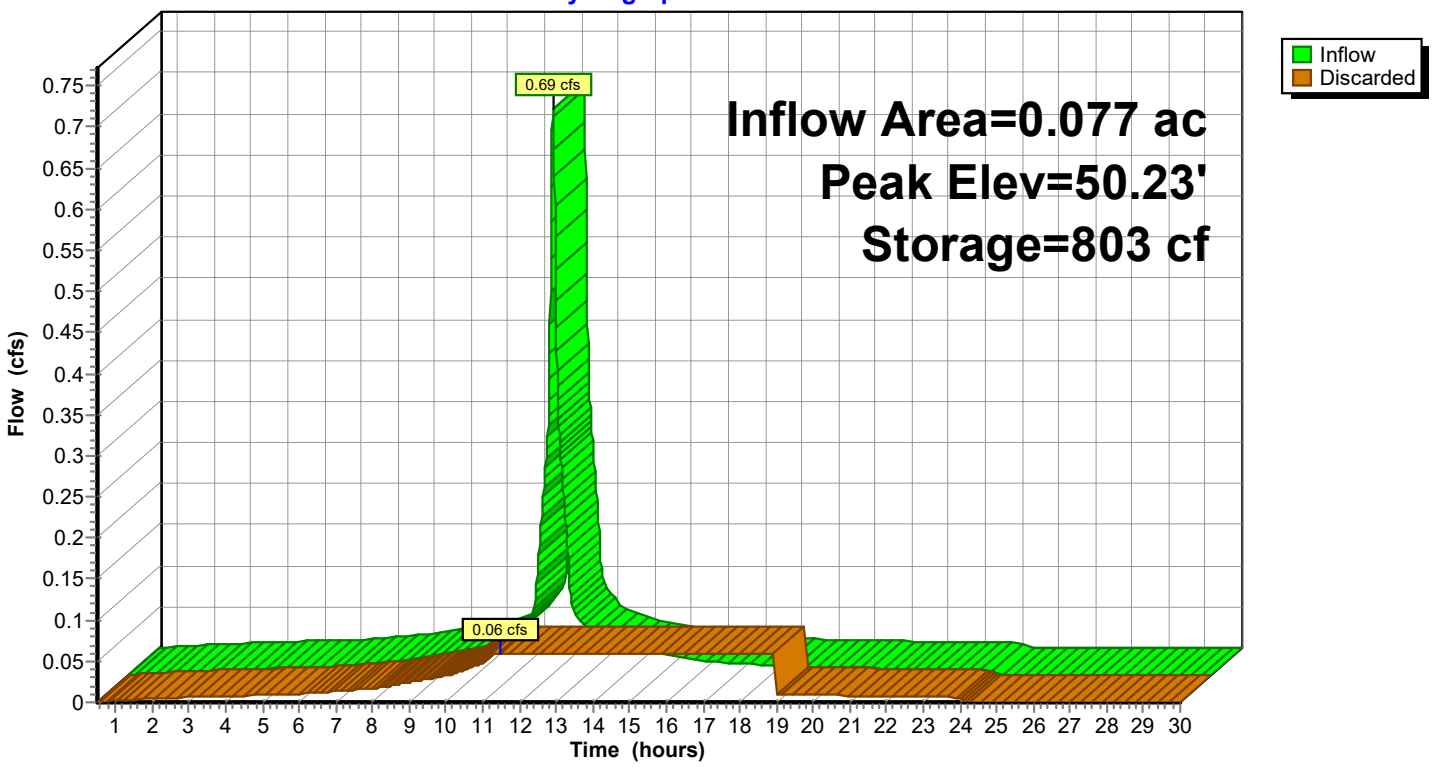
10 Chambers
60.7 cy Field
37.6 cy Stone





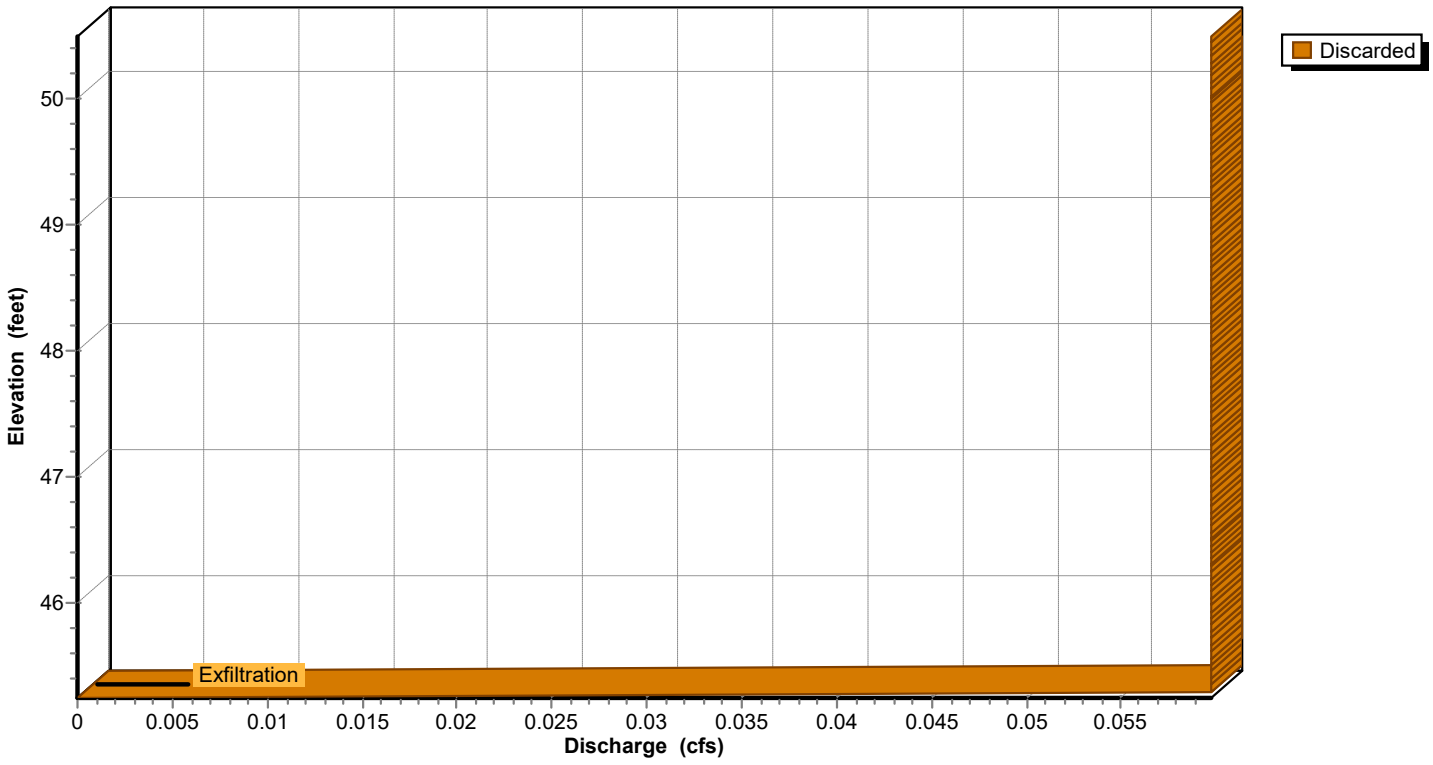
Pond IS2: System #2

Hydrograph

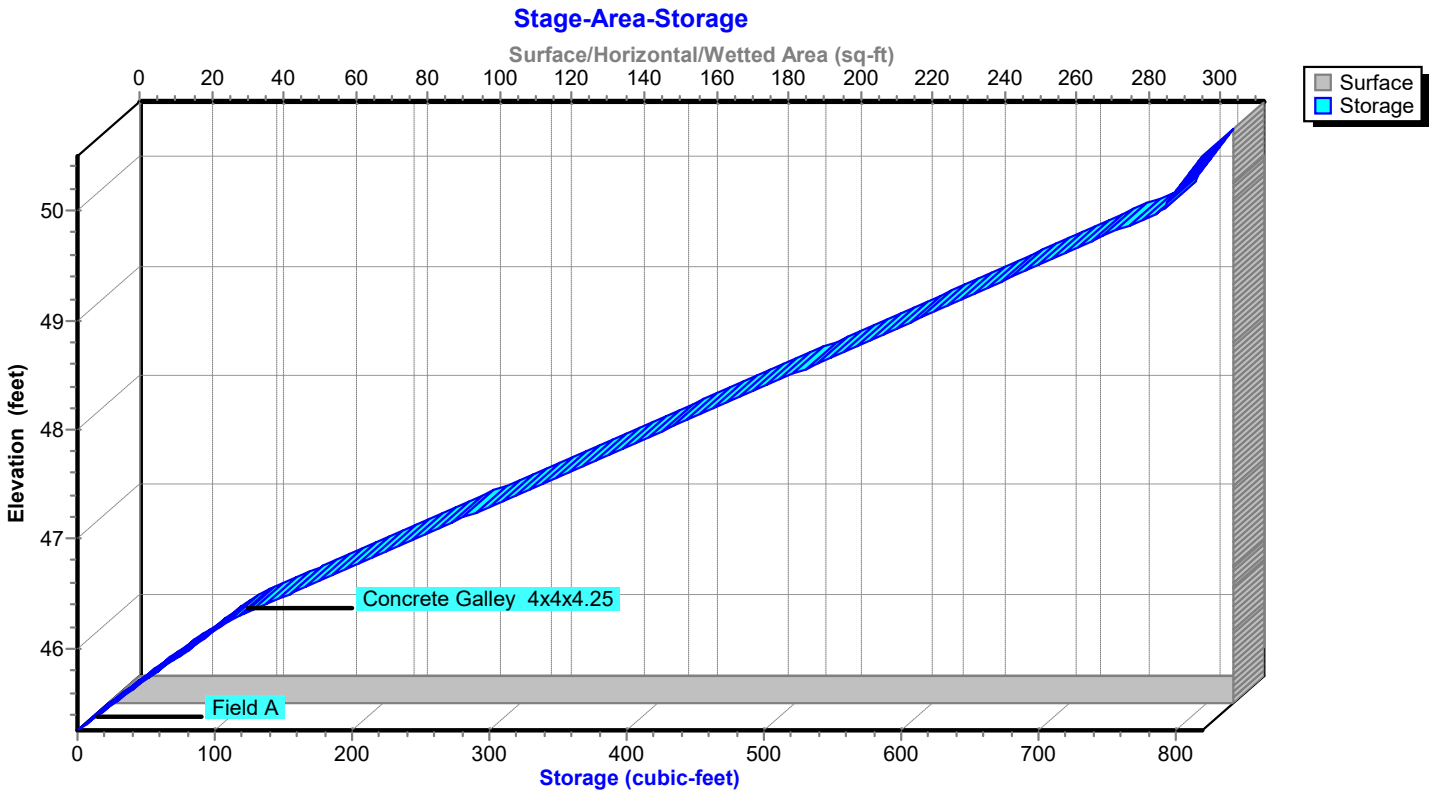


Pond IS2: System #2

Stage-Discharge



Pond IS2: System #2



Summary for Pond IS3: System #3

Inflow Area = 0.118 ac,100.00% Impervious, Inflow Depth = 8.54" for 100-Year event
Inflow = 1.06 cfs @ 12.07 hrs, Volume= 0.084 af
Outflow = 0.57 cfs @ 12.18 hrs, Volume= 0.084 af, Atten= 46%, Lag= 6.7 min
Discarded = 0.07 cfs @ 11.15 hrs, Volume= 0.072 af
Primary = 0.50 cfs @ 12.18 hrs, Volume= 0.013 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 47.14' @ 12.18 hrs Surf.Area= 364 sf Storage= 907 cf

Plug-Flow detention time= 70.5 min calculated for 0.084 af (100% of inflow)
Center-of-Mass det. time= 70.5 min (809.7 - 739.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	42.50'	407 cf	**13.00'W x 28.00'L x 5.25'H Field A** 1,911 cf Overall - 748 cf Embedded = 1,163 cf x 35.0% Voids
#2A	43.50'	557 cf	**Concrete Galley 4x4x4.25** x 12 Inside #1 Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf 12 Chambers in 2 Rows
		964 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	42.50'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	46.80'	**8.0" Round Culvert** L= 72.0' Ke= 0.090 Inlet / Outlet Invert= 46.80' / 45.00' S= 0.0250 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.07 cfs @ 11.15 hrs HW=42.55' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=0.50 cfs @ 12.18 hrs HW=47.14' TW=43.40' (Dynamic Tailwater)
↑—**2=Culvert** (Inlet Controls 0.50 cfs @ 2.75 fps)

Pond IS3: System #3 - Chamber Wizard Field A

Chamber Model = Concrete Galley 4x4x4.25 (Concrete Galley, Shea LE-EGH, LE-CGH or equivalent)
Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf
Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf

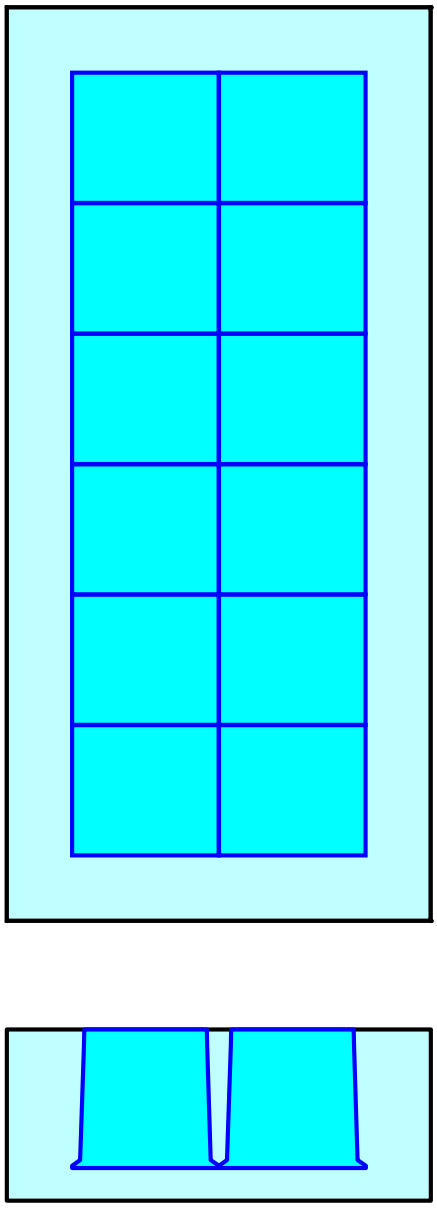
6 Chambers/Row x 4.00' Long = 24.00' Row Length +24.0" End Stone x 2 = 28.00' Base Length
2 Rows x 54.0" Wide + 24.0" Side Stone x 2 = 13.00' Base Width
12.0" Base + 51.0" Chamber Height = 5.25' Field Height

12 Chambers x 46.4 cf = 556.6 cf Chamber Storage
12 Chambers x 62.3 cf = 748.0 cf Displacement

1,911.0 cf Field - 748.0 cf Chambers = 1,163.0 cf Stone x 35.0% Voids = 407.1 cf Stone Storage

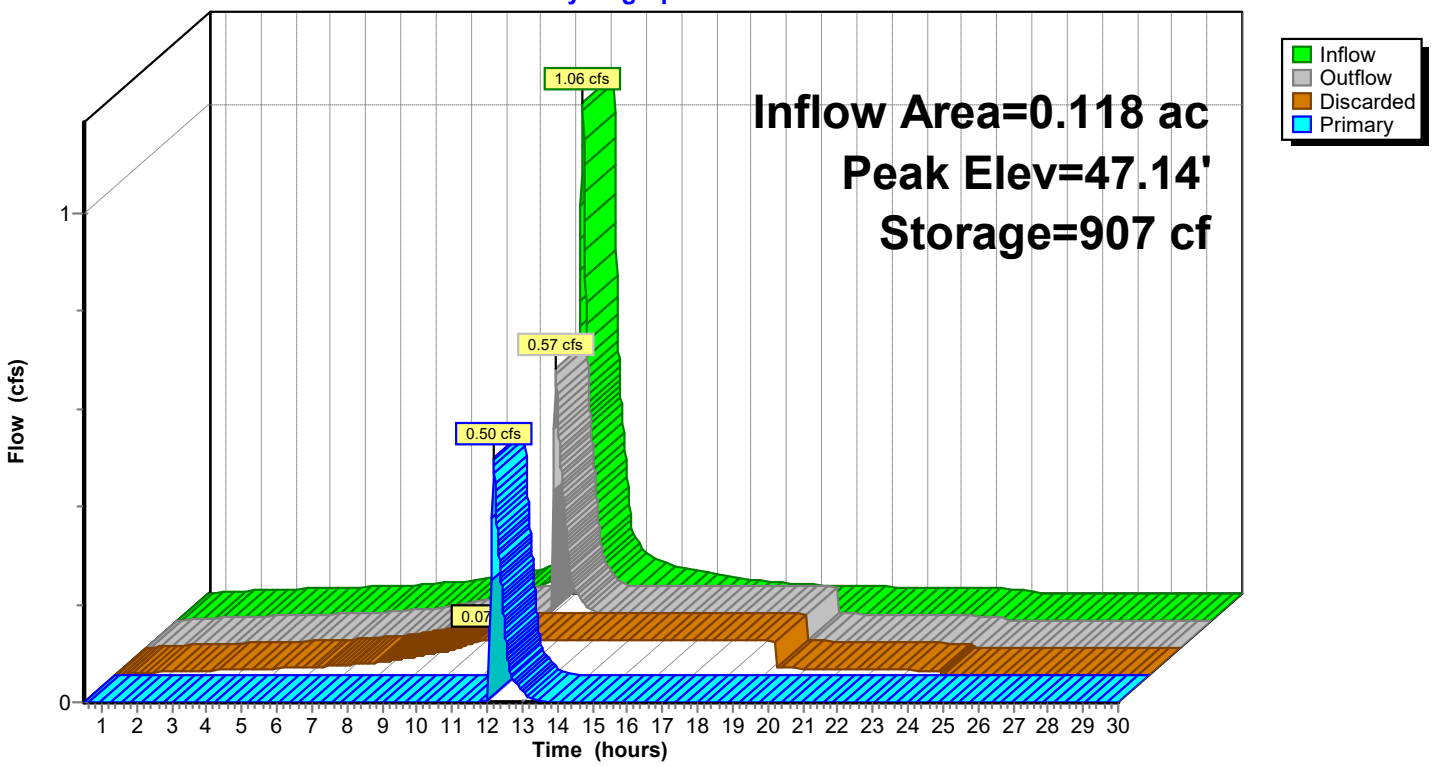
Chamber Storage + Stone Storage = 963.6 cf = 0.022 af
Overall Storage Efficiency = 50.4%
Overall System Size = 28.00' x 13.00' x 5.25'

12 Chambers
70.8 cy Field
43.1 cy Stone



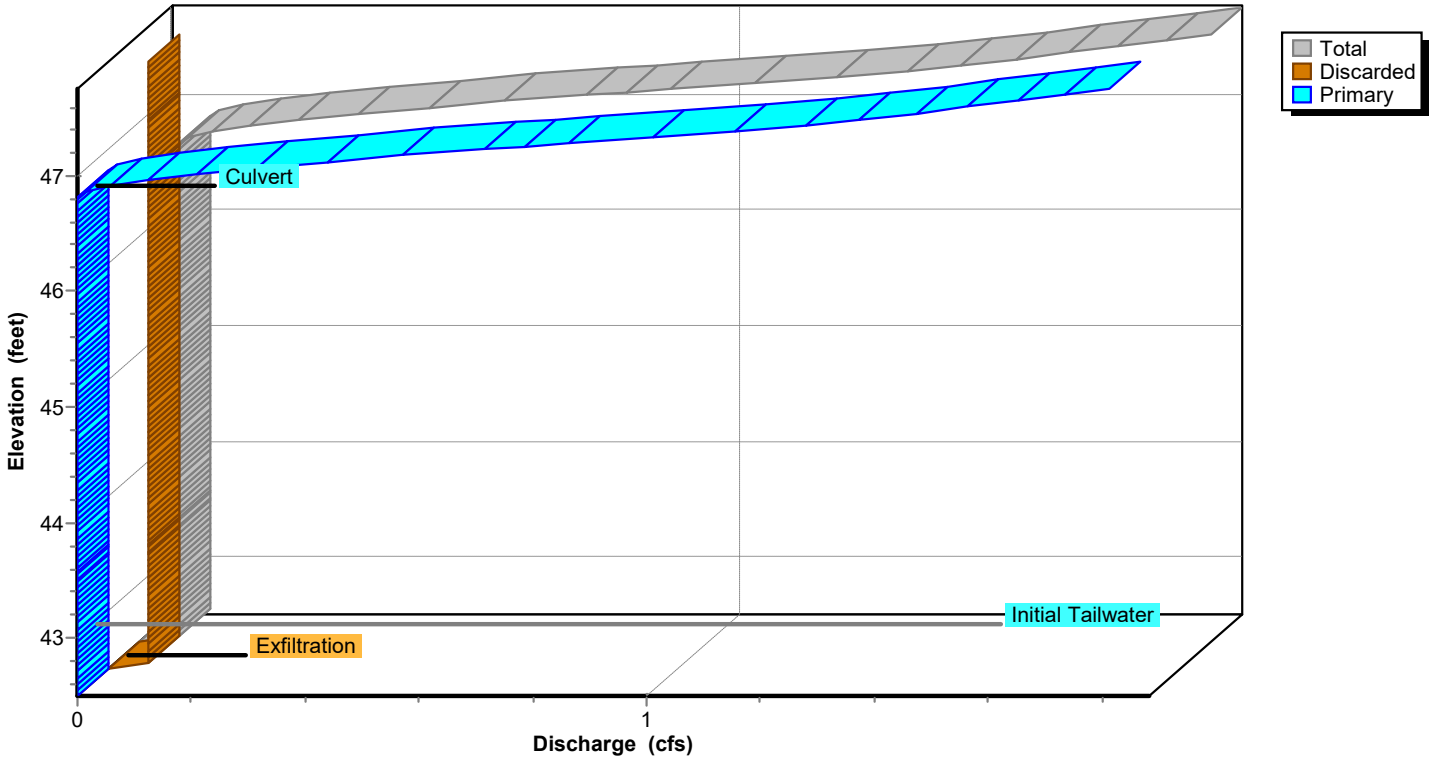
Pond IS3: System #3

Hydrograph

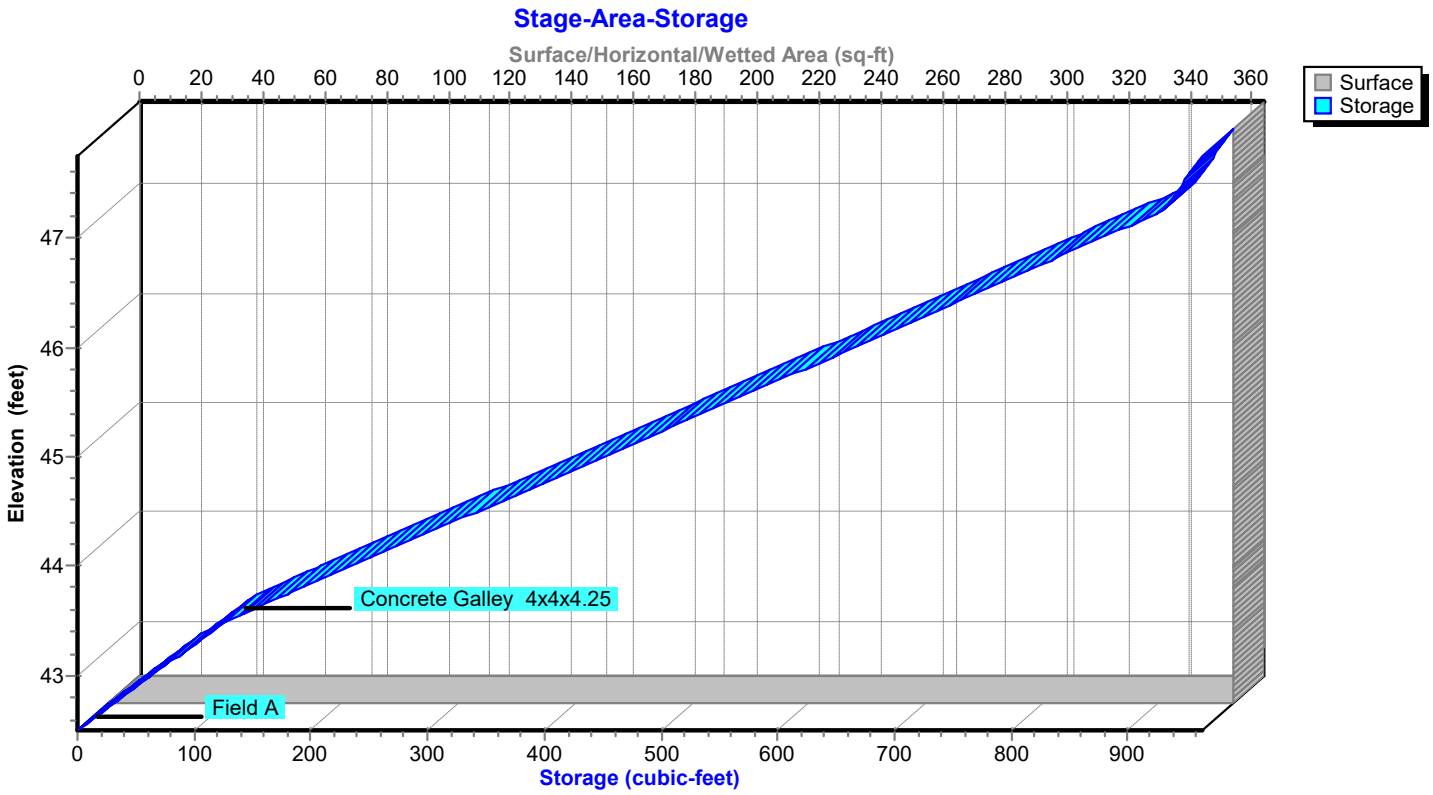


Pond IS3: System #3

Stage-Discharge



Pond IS3: System #3



Summary for Pond IS4: (Retention Pond)

[56] Hint: Dam Breach started at 15.70 hrs WSE=44.50'

Inflow Area = 0.284 ac, 41.74% Impervious, Inflow Depth = 1.60" for 100-Year event
Inflow = 0.71 cfs @ 12.18 hrs, Volume= 0.038 af
Outflow = 0.09 cfs @ 16.70 hrs, Volume= 0.007 af, Atten= 88%, Lag= 271.5 min
Secondary = 0.09 cfs @ 16.70 hrs, Volume= 0.007 af

Routing by Dyn-Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs
Peak Elev= 44.55' @ 16.63 hrs Surf.Area= 1,170 sf Storage= 1,383 cf

Plug-Flow detention time= 448.0 min calculated for 0.007 af (19% of inflow)
Center-of-Mass det. time= 334.1 min (1,173.8 - 839.7)

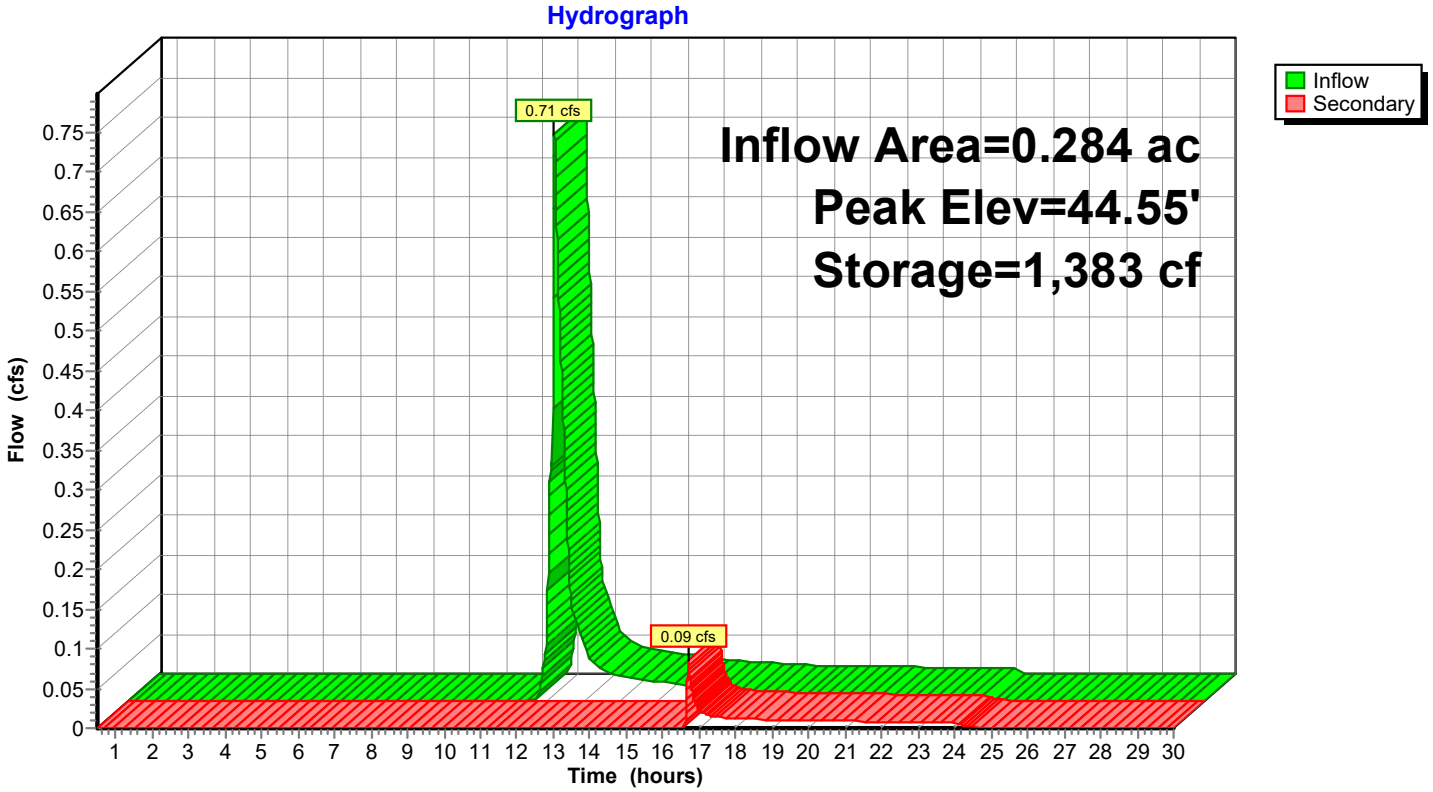
Volume	Invert	Avail.Storage	Storage Description
#1	43.00'	1,949 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
43.00	637	100.0	0	0	637
44.00	966	119.0	796	796	986
45.00	1,351	137.0	1,153	1,949	1,374

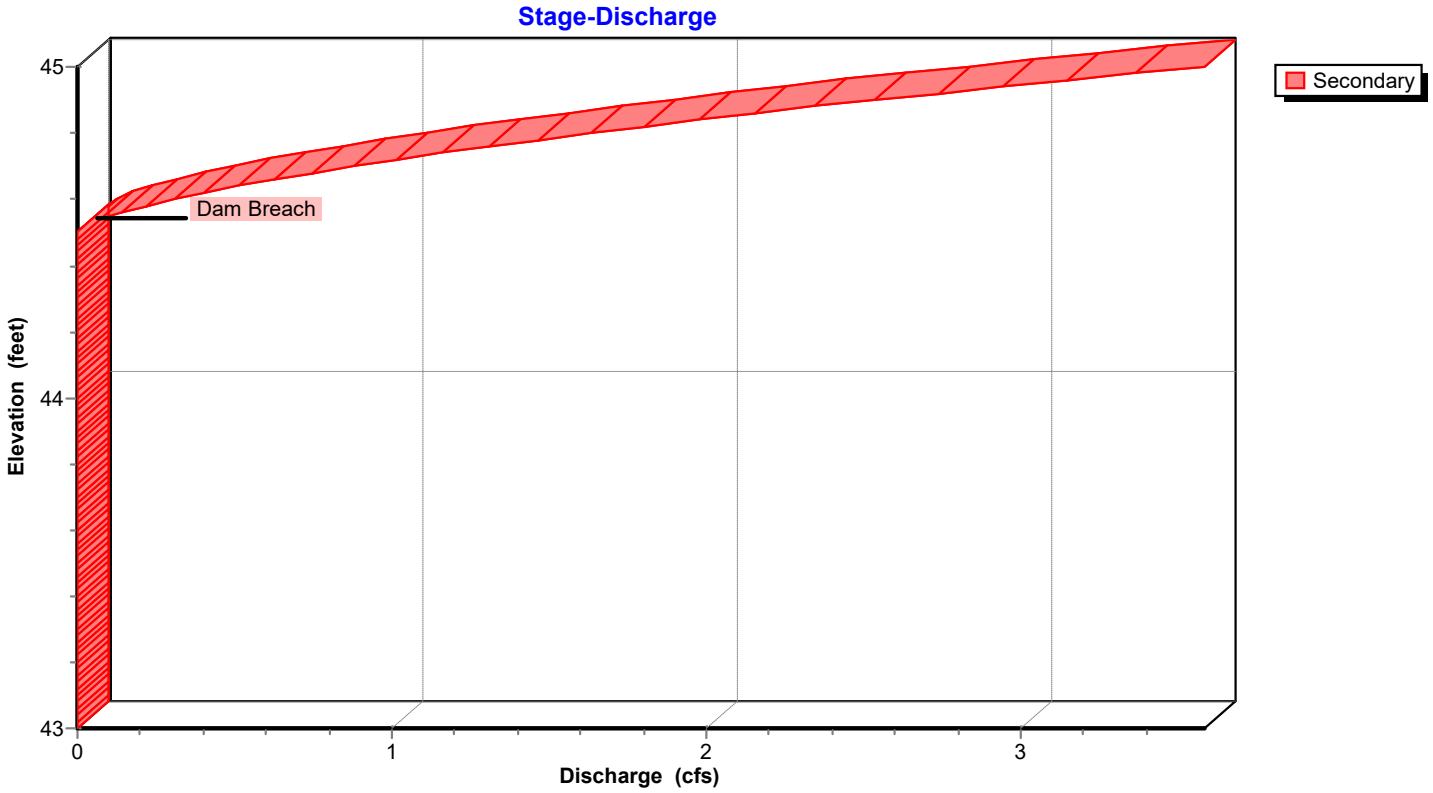
Device	Routing	Invert	Outlet Devices (Turned on 1 times)
#1	Secondary	44.50'	**45.0 deg x 3.0' wide x 0.50' high Dam Breach** C= 2.56 Top of breach = 45.00' Bottom of breach = 44.50' Breach starts at 44.50' WSE and develops over 1.000 hrs

Secondary OutFlow Max=0.08 cfs @ 16.70 hrs HW=44.54' TW=0.00' (Dynamic Tailwater)
1=Dam Breach (Weir Controls 0.08 cfs @ 0.66 fps)

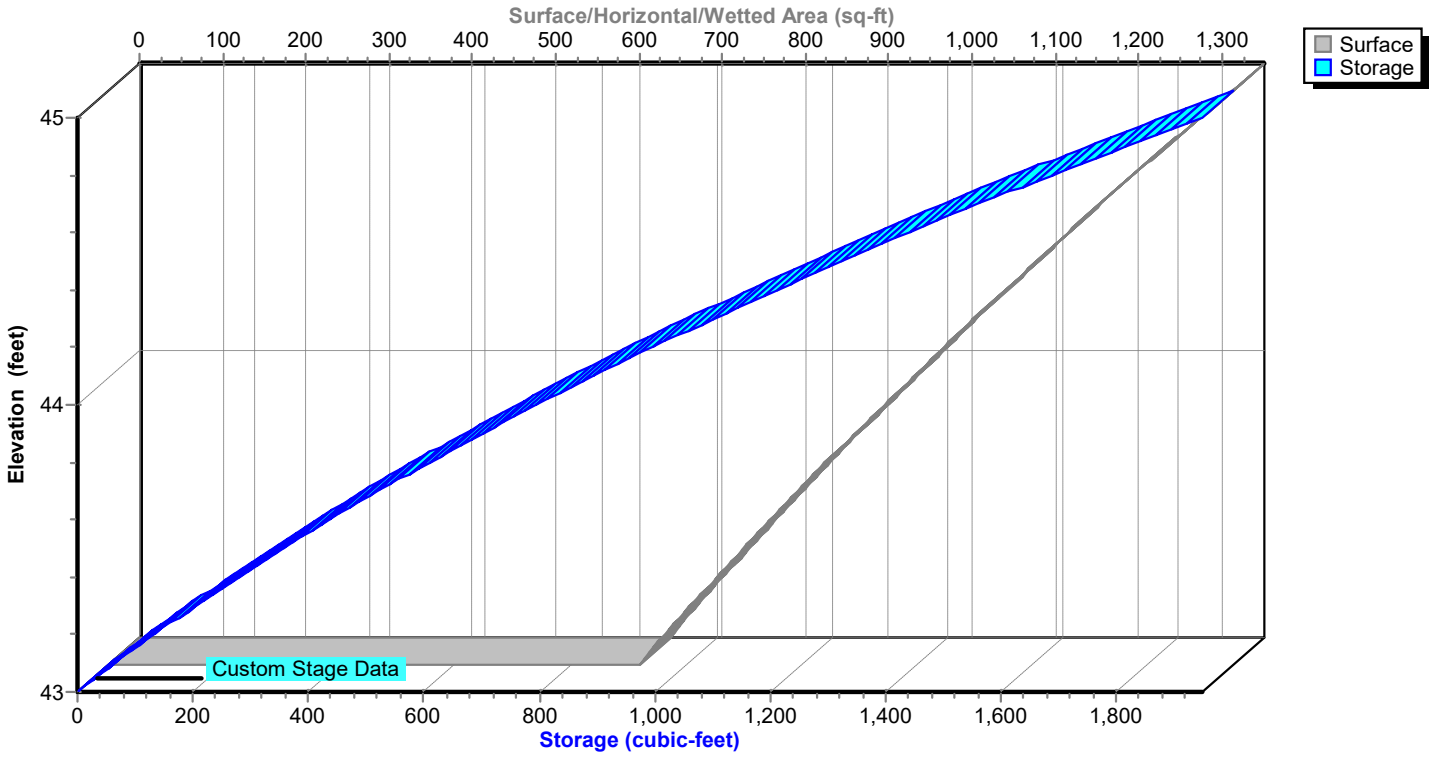
Pond IS4: (Retention Pond)



Pond IS4: (Retention Pond)



Pond IS4: (Retention Pond)

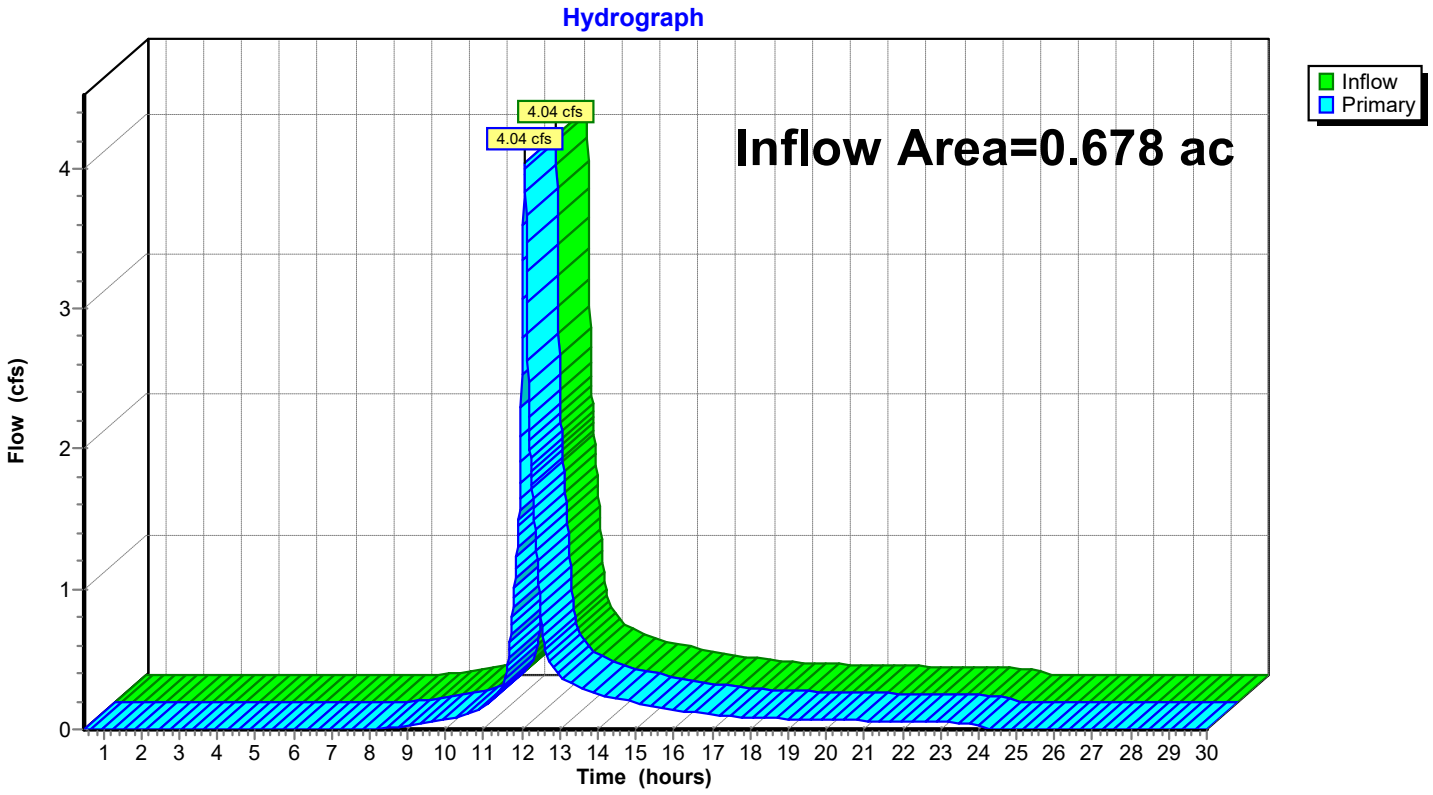


Summary for Link POD1: South-West Abutter

Inflow Area = 0.678 ac, 0.00% Impervious, Inflow Depth = 4.90" for 100-Year event
Inflow = 4.04 cfs @ 12.07 hrs, Volume= 0.277 af
Primary = 4.04 cfs @ 12.07 hrs, Volume= 0.277 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs

Link POD1: South-West Abutter

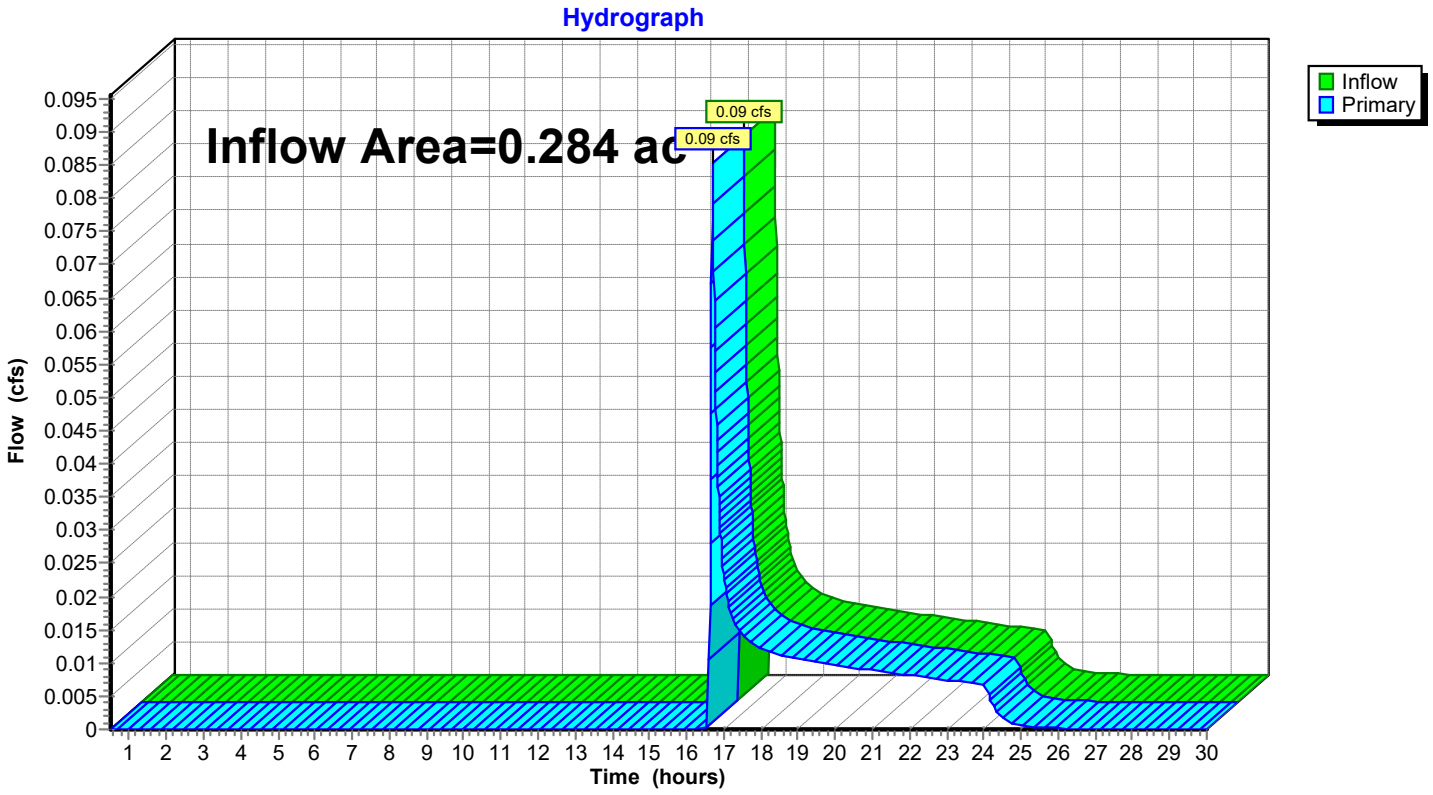


Summary for Link POD1.: South-West Abutter

Inflow Area = 0.284 ac, 41.74% Impervious, Inflow Depth > 0.31" for 100-Year event
Inflow = 0.09 cfs @ 16.70 hrs, Volume= 0.007 af
Primary = 0.09 cfs @ 16.70 hrs, Volume= 0.007 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-30.00 hrs, dt= 0.010 hrs

Link POD1.: South-West Abutter



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

Data Source Information

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 22, Sep 9, 2022

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	1.5	100.0%
Totals for Area of Interest		**1.5**	**100.0%**

Post Development Conditions

The proposed project consists of the demolition of the existing building, three new 2-1/2 story buildings, driveway, walkways and a retention pond.

Approximately 26,560.7 s.f. (89.9%) of the site will be impervious areas.

The same overall area was analyzed for the proposed conditions as in the pre-development conditions and is shown on the previous table. Similar to pre-development conditions, the stormwater runoff flows in the same direction. The same design points were used as in the pre-development conditions.

The roofs and driveway runoff areas will be collected by roof leaders and catch basing and connected to three infiltration systems.

The intent of the proposed stormwater management systems is to infiltrate stormwater runoff of the new building roof and driveway. The infiltration system was designed to control the 100-year storm event and help mitigate the proposed peak rates of runoff to less than existing conditions.

VTP Associates analyzed the pre- and post-development site conditions to determine the peak rates of runoff at the design points. By incorporating the stormwater management features discussed above, the peak rates of runoff in the post-development condition is to be equal or better than pre-development levels. Pre-development peak runoff rates vs. post-development peak runoff rates for the 2, 10, 25 and 100-year storm events are presented in the table below.

	Design Point #1			
	Peak Rate of Runoff (CFS)		Volume of Runoff (AF)	
	PRE	POST	PRE	POST
2-year	0.47	0.00	0.038	0.000
10-year	1.21	0.00	0.087	0.000
25-year	1.69	0.00	0.118	0.000
100-year	4.04	0.09	0.277	0.007

CONCLUSION

The post-development peak rate of runoff contributing to James Street is expected to be less than or equal to pre-development levels for the 2, 10, 25 and 100-year storm events. Although there is increased impervious coverage on the site as a result of the proposed redevelopment, the addition of the underground infiltration systems controls the post-development runoff to pre-development levels or better.

HYDROCAD AREAS

Design Point POD1	29,550.0 s.f.
Total Lot Area	29,550.0 s.f.

PRE-DEVELOPMENT	Design point A1
	POD1
Building	3,289.2 s.f.
Driveway	6,646.0 s.f.
Other	0.0 s.f.
Grass	19,614.8 s.f.
Wooded	
Total impervious areas	9,935.2 s.f.
Total pervious areas	19,614.8 s.f.
Total areas	29,550.0 s.f.

POST-DEVELOPMENT	Design point A1				
	POD1	IS #1	IS #2	IS #3	
Building		2,260.0 s.f.	3,360.0 s.f.	1,120.0 s.f.	
Driveway		2,096.0 s.f.			
Other	452.0 s.f.	193.0 s.f.			
Grass	20,069.0				
Wooded					
Total impervious areas	9,481.0 s.f.	4,549.0 s.f.	3,360.0 s.f.	1,120.0 s.f.	
Total pervious areas	20,069.0 s.f.	0.0 s.f.	0.0 s.f.	0.0 s.f.	
Total areas		29,550.0 s.f.			

DRAWDOWN TIME CALCULATIONS

Time=Rv/(k*Ab) *Rv=recharge voluyme of the system. See HydroCad report*
Ab=bottom area of the infiltration system. See HydroCad report
k=infiltration rate

Infiltration System #1	Rv =	**1,108.30 cu-ft**		
	K =	8.27 in/hr		
	=	**0.69 ft/hr**		
	Ab =	**416.0 sq. ft.**		
	Time =	3.86 Hr	< 72 Hr	✓
Infiltration System #1	Rv =	**818.90 cu-ft**		
	K =	8.27 in/hr		
	=	**0.69 ft/hr**		
	Ab =	**0.0 sq. ft.**		
	Time =	312.00 Hr	< 72 Hr	✓
Infiltration System #1	Rv =	**936.60 cu-ft**		
	K =	8.27 in/hr		
	=	**0.69 ft/hr**		
	Ab =	**364.0 sq. ft.**		
	Time =	3.73 Hr	< 72 Hr	✓

BMP PERFORMANCE

Location: Infiltration system #1

B	*C*	*D*	*E*	*F*
BMP[1]	**TSS Removal Rate[1]**	**Starting TSS Load***	**Amount Removed (C*D)**	**Remaining Load (D-E)**
Infiltration Basin	0.80	1.00	0.80	0.20
Infiltration Basin	0.80	0.20	0.16	0.04
	0.00	0.04	0.00	0.04
	0.00	0.04	0.00	0.04
	0.00	0.04	0.00	0.04

Total TSS Removal =

96%

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

Location: Infiltration system #2

B	*C*	*D*	*E*	*F*
BMP[1]	**TSS Removal Rate[1]**	**Starting TSS Load***	**Amount Removed (C*D)**	**Remaining Load (D-E)**
Infiltration Basin	0.80	1.00	0.80	0.20
Infiltration Basin	0.80	0.20	0.16	0.04
	0.00	0.04	0.00	0.04
	0.00	0.04	0.00	0.04
	0.00	0.04	0.00	0.04

Total TSS Removal =

96%

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

PHOSPHORUS REMOVAL CALCULATION

For 2" (0.1667 ft.) of rain multiplied by the impervious surfaces

Infiltration System #1
2,259.0 s.f. x 2/12 ft./in. = 376.50 cu-ft

Infiltration System #2
2,240.0 s.f. x 2/12 ft./in. = 373.33 cu-ft

Infiltration System #2
2,240.0 s.f. x 2/12 ft./in. = 373.33 cu-ft

Volume Provided *		Volume Required
2,863.80 cu-ft	>	1,123.16 cu-ft ✓

** See HydroCad report for provided volume calculations*

Load Factor	1.96 lb-year	
Existing Impervious Area	9,935.2 sq.ft	0.2281 ac
Proposed Impervious Area	9,481.0 sq.ft	0.2177 ac
Infiltrated Area	9,029.0 sq.ft	0.2073 ac
Existing Phophorus Load	0.4471 lb-year	✓
Proposed Phosporus Load	0.4267 lb-year	
Phosphorus Load Reduction	0.4063 lb-year	----------> **95.2%**

Existing Cumulative Load Reduction Infiltration Trench

Infiltration rate (in/hr.)	Imp. areas Runoff Depth (in.)	Phosphurus	Runoff Volume
2.41	0.10	33%	34.00%
	0.20	55%	55.00%
	0.40	81%	78.00%
	0.60	91%	88.00%
	0.80	96%	93.00%
	1.00	98%	96.00%
	1.50	100%	99.00%
	2.00	100%	100.00%

Proposed Cumulative Load Reduction Infiltration Trench

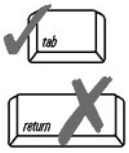
Infiltration rate (in/hr.)	Imp. areas Runoff Depth	Phosphurus	Runoff Volume
2.41	0.10	33%	34.00%
	0.20	55%	55.00%
	0.40	81%	78.00%
	0.60	91%	88.00%
	0.80	96%	93.00%
	1.00	98%	96.00%
	1.50	100%	99.00%
	2.00	100%	100.00%

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature

Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☐ New development

☒ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☐ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☐ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☐ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☐ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☒ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☐ Other (describe): _____

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☒ Required Recharge volume reduced through use of the LID site Design Credits.

☐ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☐ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☒ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☒ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

☐ Site is comprised solely of C and D soils and/or bedrock at the land surface

☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000

☐ Solid Waste Landfill pursuant to 310 CMR 19.000

☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☒ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☒ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☐ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☐ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☐ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

☐ The BMP is sized (and calculations provided) based on:

- ☐ The ½" or 1" Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☐ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☒ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☒ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☐ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☐ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☐ Description and delineation of public safety features;
- ☐ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☐ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☐ An Illicit Discharge Compliance Statement is attached;

☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.