STORMWATER REPORT
57 ADAMS AVENUE
NEWTON, MASSACHUSETTS

June 16, 2016

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INTRODUCTION

VTP Associates has performed a stormwater management analysis to evaluate the post-development impacts created by the proposed residence at #57 Adams Avenue in Newton, Massachusetts. The project will include a new two-story house, a surface driveway, 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, 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 pervious 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:

622C: Paxton - Urban land complex

Test pits were conducted and determined that the site consists of a moderately high to high draining loamy sand. Based upon these findings, VTP Associates used a Hydrologic soil group 'A' for its drainage calculations. The test pit 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 2.41 in/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, 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	3.1
10-year	4.5
100-year	7.0

HYDROLOGICAL ANALYSIS

Pre-Development Conditions

The existing site includes a concrete shed/garage, a patio, walks, and a paved area. As a result, the existing site have approximately 1,304 s.f. of impervious cover (10.7%). The site is bound by residential building to the northwest, southwest and southeast, and Adams Avenue to the northeast.

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 southeast (E1), southwest (E2) and northwest (E3) abutters. The pre-development drainage areas are shown on "Figure 1: Pre-Development Drainage Areas."

Post Development Conditions

The proposed project includes a new two-story house, a surface driveway, walkways, landscaped areas and associated drainage improvements. As a result, the proposed site will have approximately 5,167 s.f. of impervious cover (42.7%). The same overall area was analyzed for the proposed conditions as the pre-development conditions and is shown on "Figure 2: Post-Development Drainage Areas." Similar to pre-development conditions, the stormwater runoff flows in the same direction. The same design point was used as in the pre-development conditions.

The new house will have approximately 1,595 square feet of impervious, or roof, and the driveways will be approximately 812 square feet + 1,201 square feet from the abutter property. The roof runoff area (PR) will be collected by roof leaders and discharge into the onsite infiltration system (INF). The driveway runoff (PD) will be collected by a catch basin and discharge into onsite infiltration system (INF). The intent of the proposed stormwater management systems are to infiltrate stormwater runoff of the proposed house and driveway. The infiltration system was designed to infiltrate the 100-year storm and help mitigate proposed peak rates of runoff to less than existing conditions. The drainage areas can be seen on "Figure 2: Post-Development Drainage Areas."

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 better than pre-development levels. Pre-development peak runoff rates vs. post-development peak runoff rates for the 2, 10, and 100-year storm events are presented in Table 1 below.

Table 1, Pre-development vs. Post-Development Peak Rate of Runoff

Design Point #1 – Southeast Abutter

STORM EVENT (DESIGN POINT)	*PRE-DEVELOPMENT PEAK RATE OF RUNOFF (CFS)*	*POST-DEVELOPMENT PEAK RATE OF RUNOFF (CFS)*	*PRE-DEVELOPMENT VOLUME RATE OF RUNOFF (AF)*	*POST-DEVELOPMENT VOLUME RATE OF RUNOFF (AF)*
2-YEAR	0.00	0.00	0.000	0.000
10-YEAR	0.00	0.00	0.000	0.000
100-YEAR	0.02	0.02	0.003	0.003

Design Point #2 – Southwest Abutter

STORM EVENT (DESIGN POINT)	*PRE-DEVELOPMENT PEAK RATE OF RUNOFF (CFS)*	*POST-DEVELOPMENT PEAK RATE OF RUNOFF (CFS)*	*PRE-DEVELOPMENT VOLUME RATE OF RUNOFF (AF)*	*POST-DEVELOPMENT VOLUME RATE OF RUNOFF (AF)*
2-YEAR	0.00	0.00	0.001	0.000
10-YEAR	0.02	0.00	0.003	0.001
100-YEAR	0.15	0.03	0.013	0.004

Design Point #3 – Northwest Abutter

STORM EVENT (DESIGN POINT)	*PRE-DEVELOPMENT PEAK RATE OF RUNOFF (CFS)*	*POST-DEVELOPMENT PEAK RATE OF RUNOFF (CFS)*	*PRE-DEVELOPMENT VOLUME RATE OF RUNOFF (AF)*	*POST-DEVELOPMENT VOLUME RATE OF RUNOFF (AF)*
2-YEAR	0.00	0.00	0.000	0.000
10-YEAR	0.02	0.00	0.003	0.001
100-YEAR	0.15	0.04	0.014	0.006

CONCLUSION

The post-development peak rate of runoff is expected to be less than or equal to pre-development levels for the 2, 10, 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.

ENCLOSURES

Test Pits
NRCS Soil Map
Pre-Development Drainage Areas (Figure 1)
Post-Development Drainage Areas (Figure 2)
Pre & Post Development HydroCAD Calculations

TESTPIT LOG

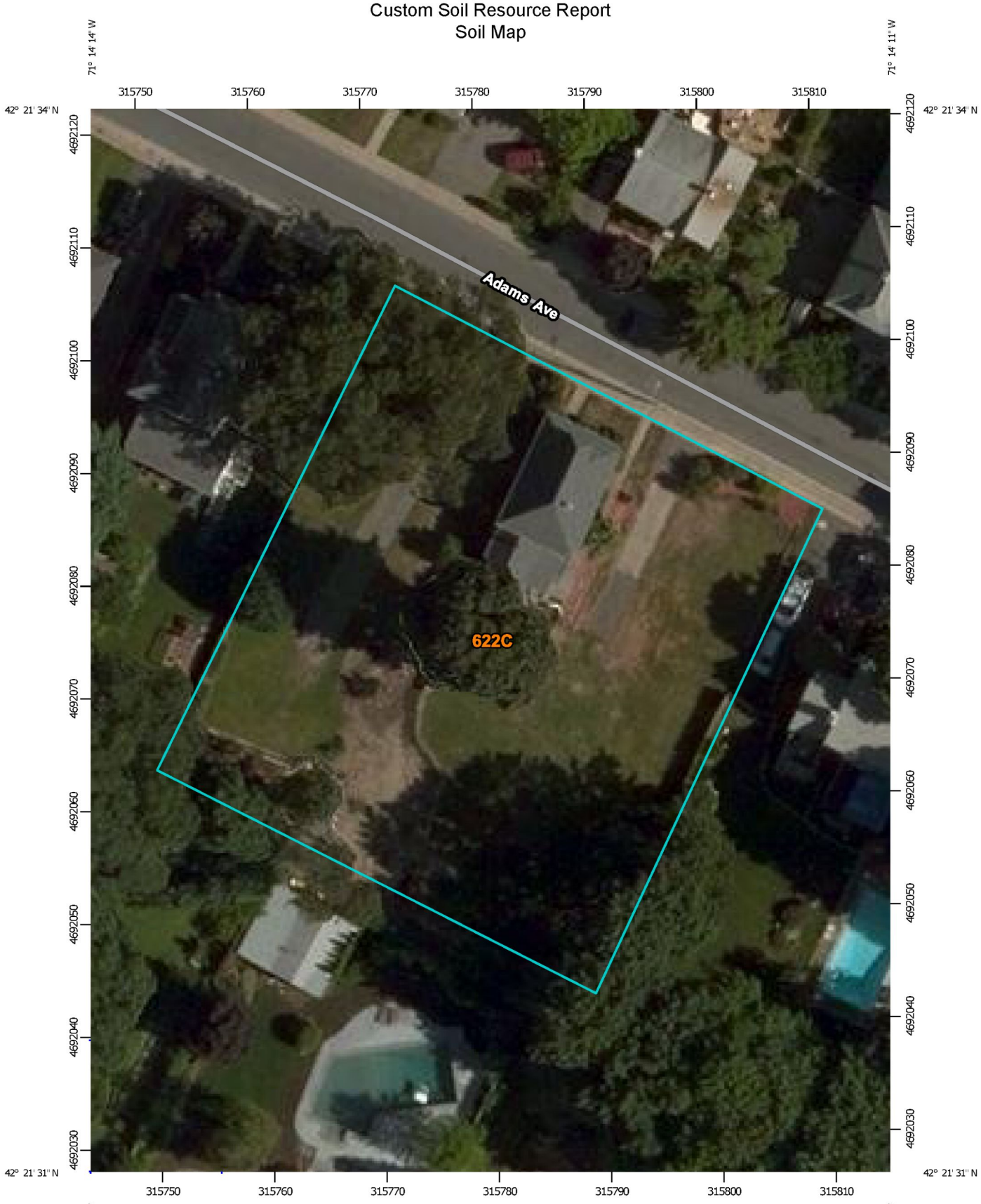
TESTPIT #1
0–16" TOPSOIL
16–40" SUBSOIL
40–107" LOAMY SAND
WITH FEW GRAVEL
& COBBLES

NO WATER
NO REFUSAL
PERC RATE 8MPI

TESTPIT #2
0–18" TOPSOIL FILL
18–38" SUBSOIL
38–127" LOAMY SAND
WITH FEW GRAVEL
& COBBLES

NO WATER
NO REFUSAL
PERC RATE 8MPI

Custom Soil Resource Report
Soil Map



MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 15, Sep 28, 2015

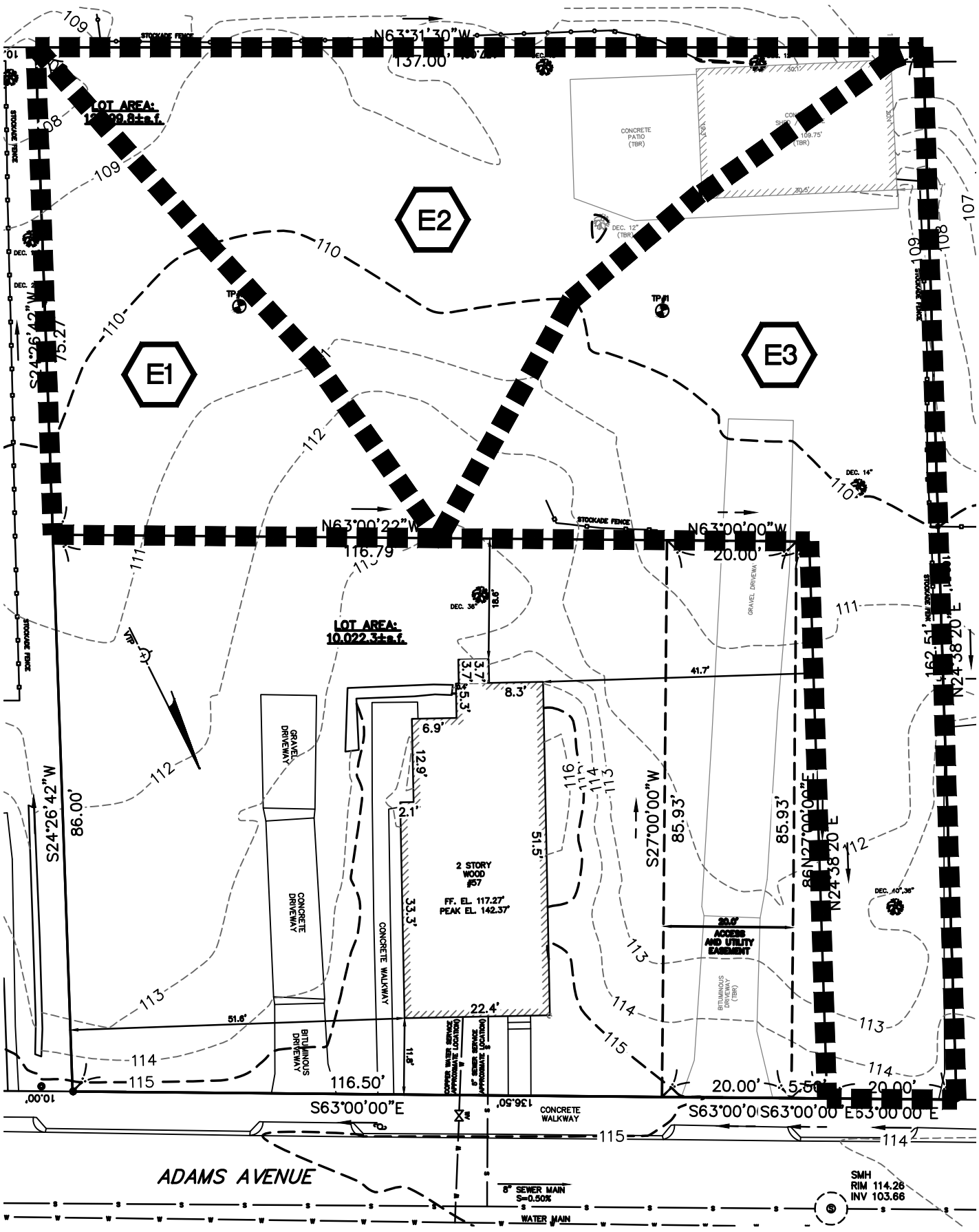
Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

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

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

Map Unit Legend

Middlesex County, Massachusetts (MA017)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
622C	Paxton-Urban land complex, 3 to 15 percent slopes	0.5	100.0%
Totals for Area of Interest		**0.5**	**100.0%**



SCALE: 1in.=20ft.
DATE: JUNE 16, 2016

FIGURE 1:
PRE-DEVELOPMENT DRAINAGE AREAS
#57 ADAMS AVENUE

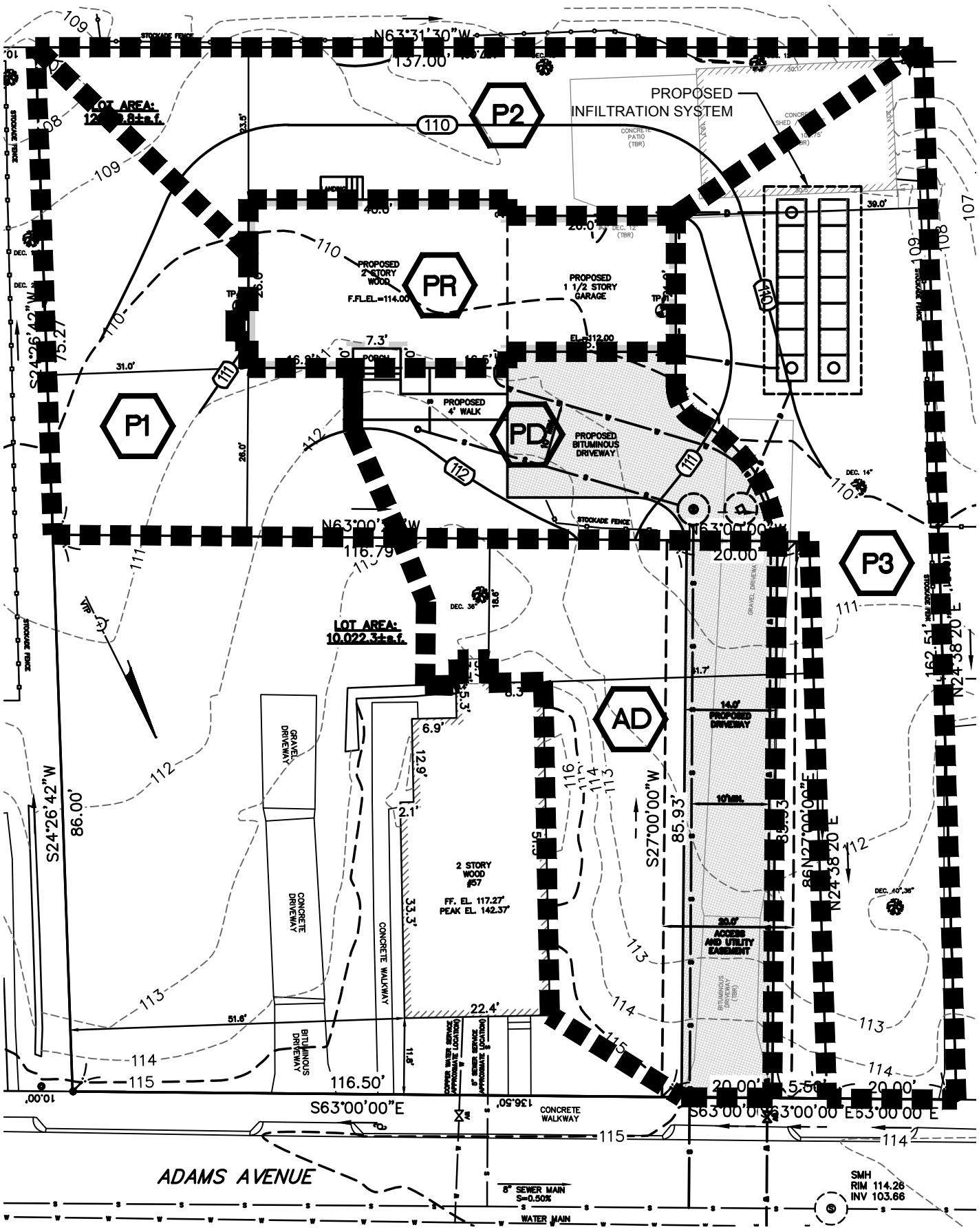
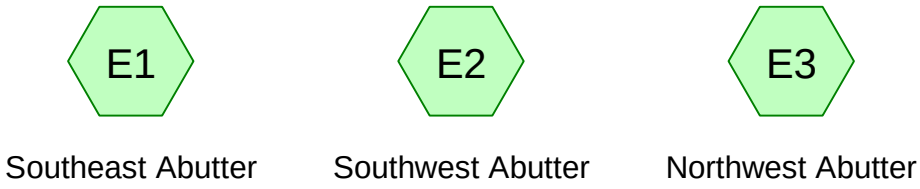


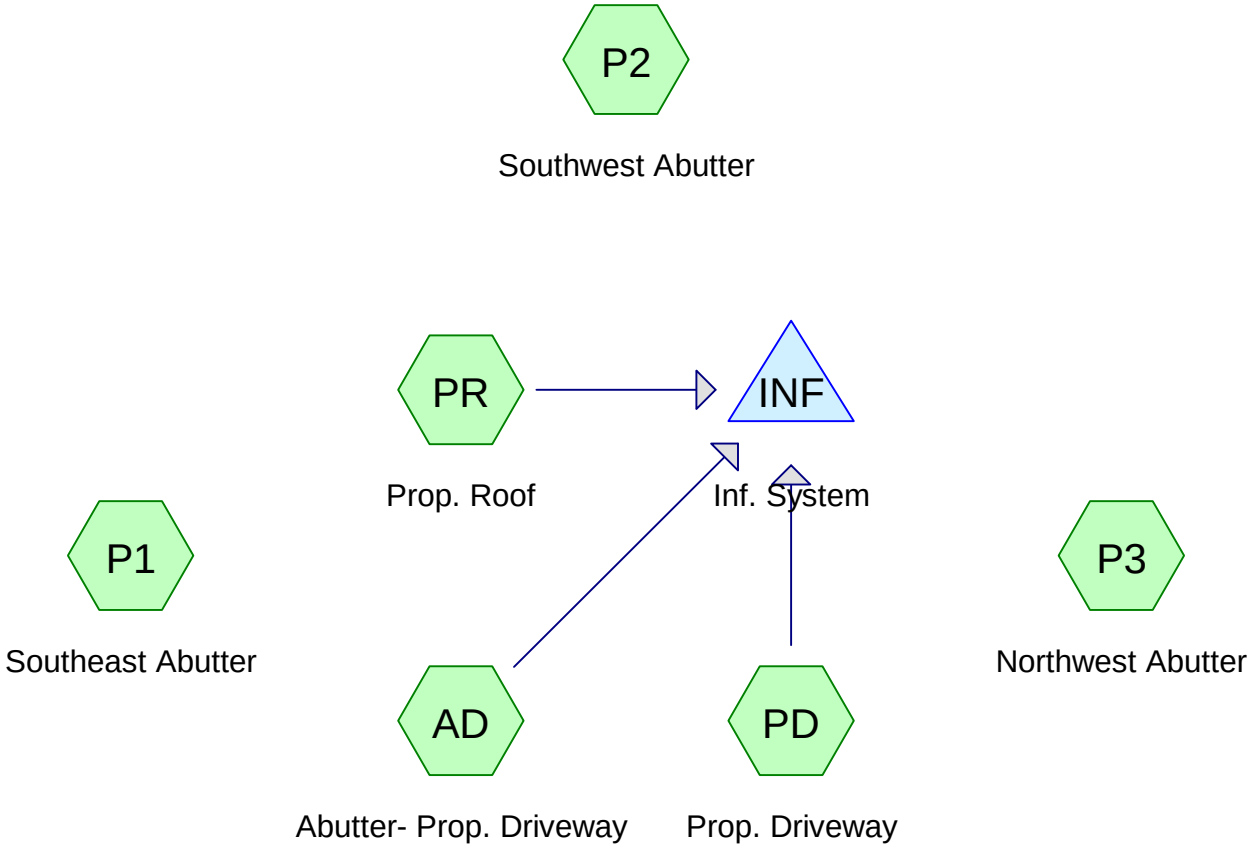
FIGURE 2:
POST-DEVELOPMENT DRAINAGE AREAS
#57 ADAMS AVENUE

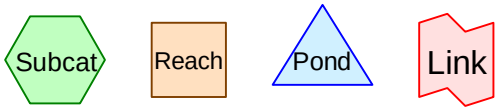
SCALE: 1in.=20ft.
DATE: JUNE 16, 2016

PRE-DEVELOPMENT CONDITIONS



POST-DEVELOPMENT CONDITIONS





Routing Diagram for 214163_ 57 Adams Ave Newton, MA
Prepared by VTP associates, inc., Printed 6/16/2016
HydroCAD® 10.00-17 s/n 08174 © 2016 HydroCAD Software Solutions LLC

Summary for Subcatchment AD: Abutter- Prop. Driveway

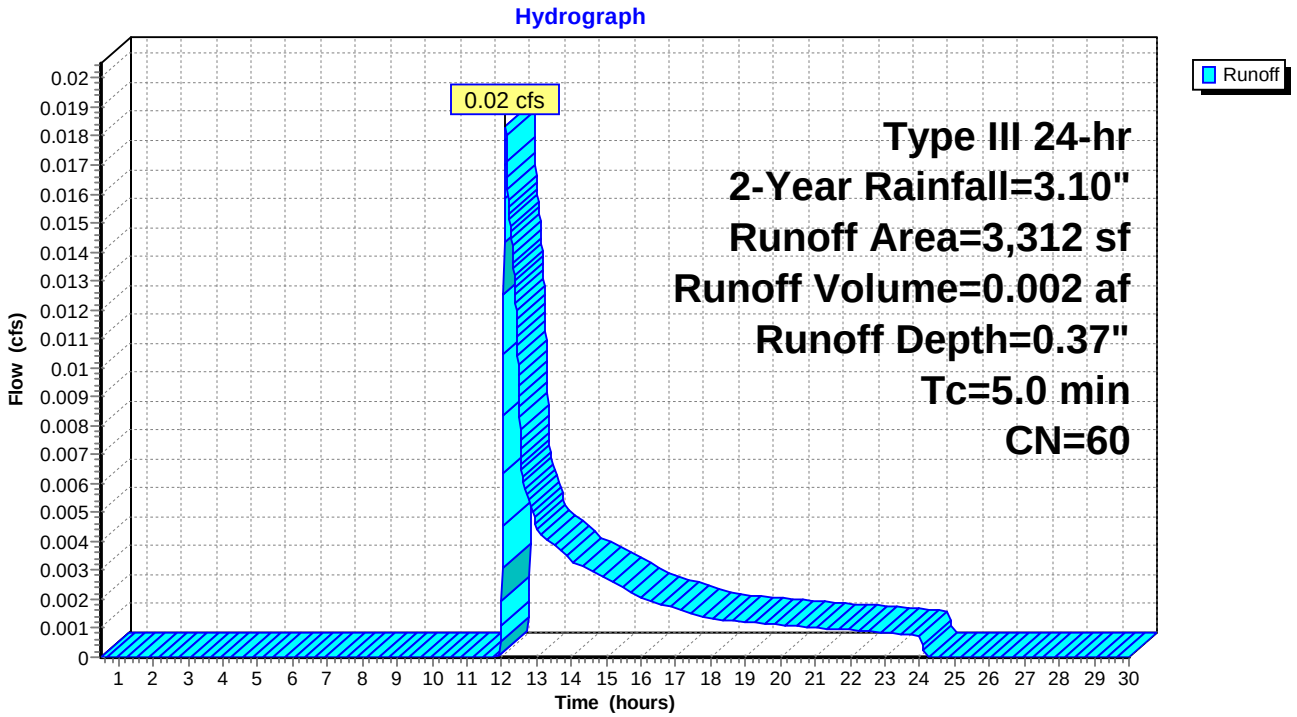
Runoff = 0.02 cfs @ 12.12 hrs, Volume= 0.002 af, Depth= 0.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

	Area (sf)	CN	Description
*	1,201	98	Paved Driveway
	2,111	39	>75% Grass cover, Good, HSG A
	3,312	60	Weighted Average
	2,111		63.74% Pervious Area
	1,201		36.26% Impervious Area

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

Subcatchment AD: Abutter- Prop. Driveway



Summary for Subcatchment E1: Southeast Abutter

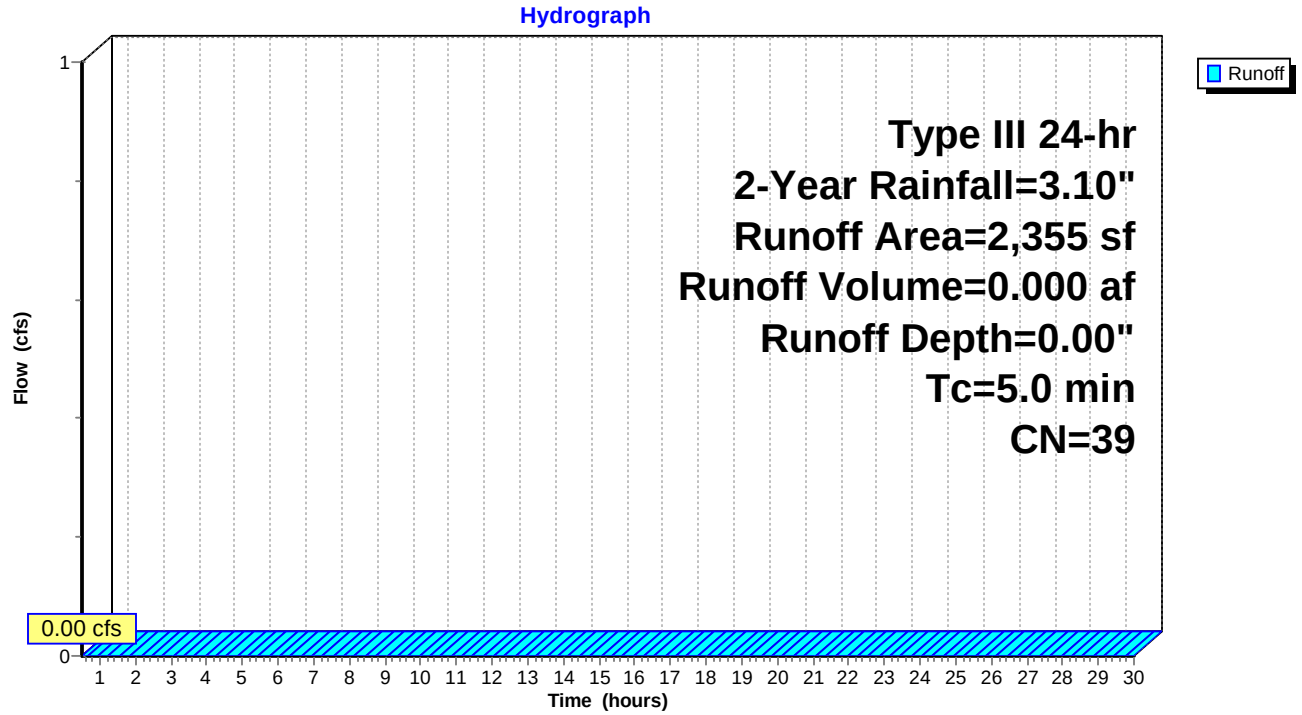
Runoff = 0.00 cfs @ 0.50 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
2,355	39	>75% Grass cover, Good, HSG A
2,355		100.00% Pervious Area

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

Subcatchment E1: Southeast Abutter



Summary for Subcatchment E2: Southwest Abutter

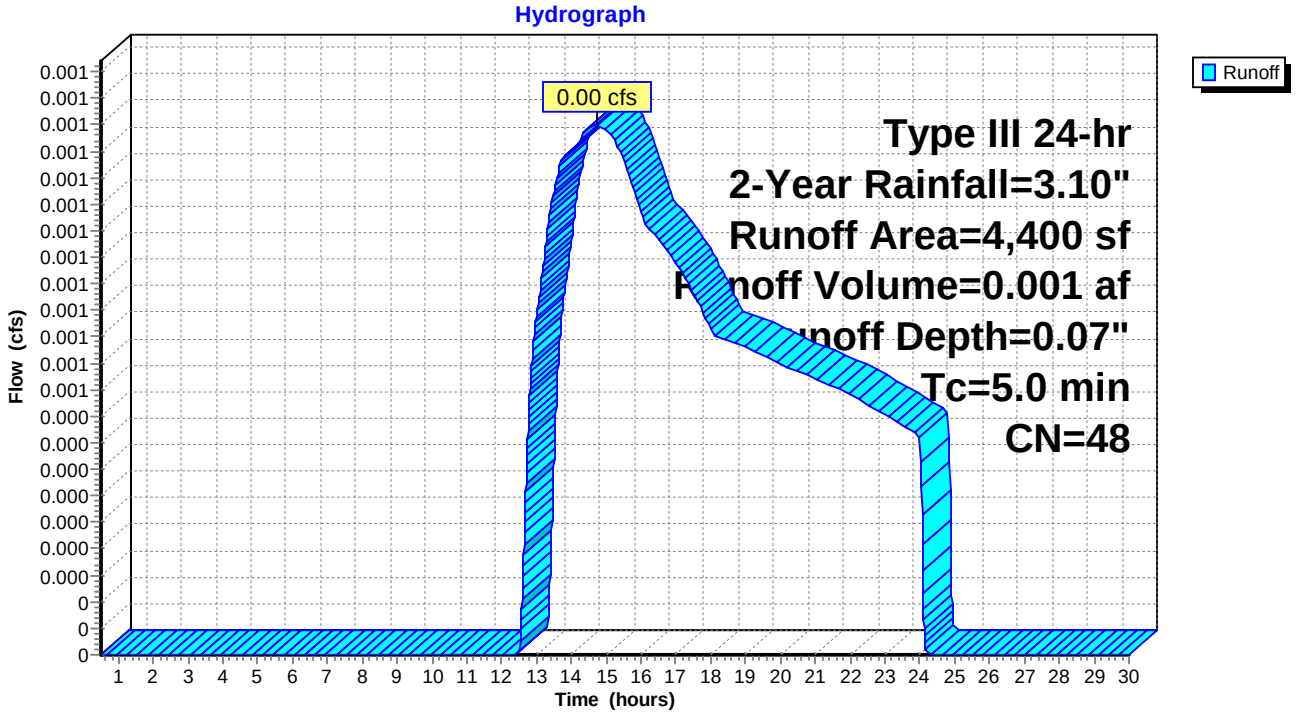
Runoff = 0.00 cfs @ 14.74 hrs, Volume= 0.001 af, Depth= 0.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

	Area (sf)	CN	Description
*	291	98	Garage Roof (Portion)
*	408	98	Patio
	3,701	39	>75% Grass cover, Good, HSG A
	4,400	48	Weighted Average
	3,701		84.11% Pervious Area
	699		15.89% Impervious Area

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

Subcatchment E2: Southwest Abutter



Summary for Subcatchment E3: Northwest Abutter

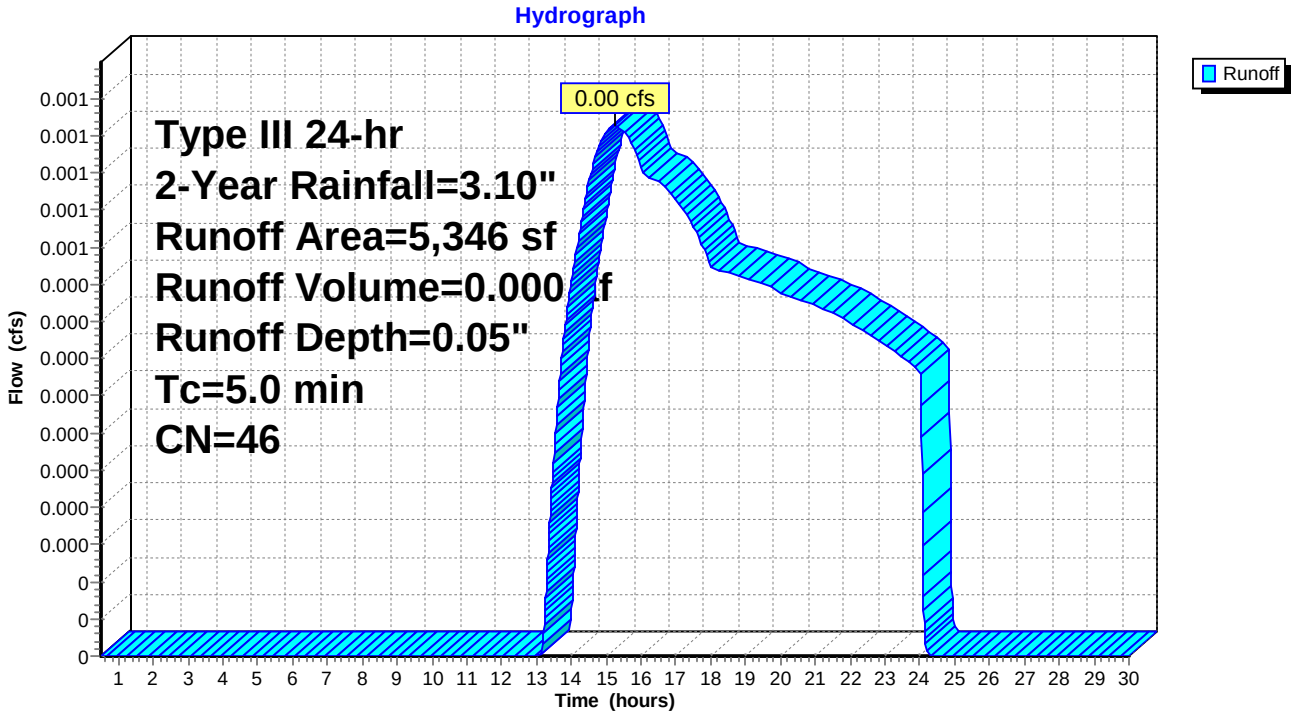
Runoff = 0.00 cfs @ 15.26 hrs, Volume= 0.000 af, Depth= 0.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

	Area (sf)	CN	Description
*	314	98	Garage Roof (Portion)
*	193	98	Driveway (portion)
*	98	98	Walk
	4,741	39	>75% Grass cover, Good, HSG A
	5,346	46	Weighted Average
	4,741		88.68% Pervious Area
	605		11.32% Impervious Area

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

Subcatchment E3: Northwest Abutter



Summary for Subcatchment P1: Southeast Abutter

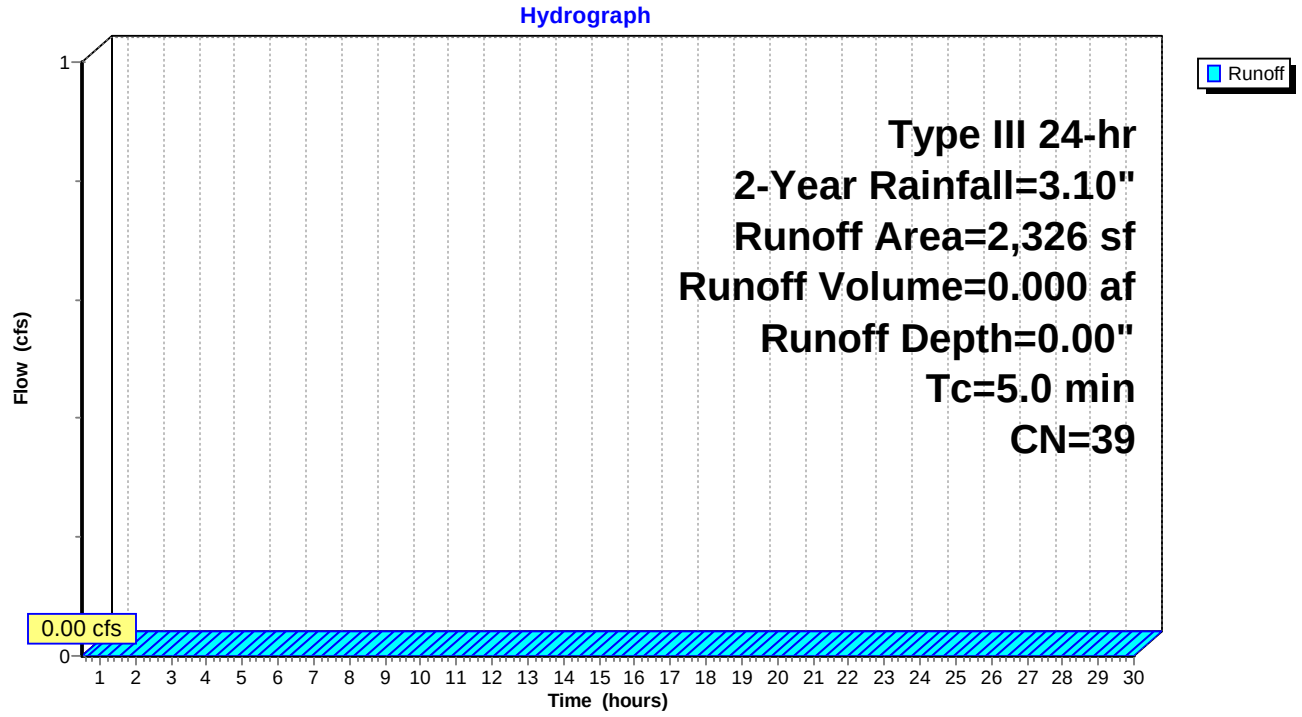
Runoff = 0.00 cfs @ 0.50 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
2,326	39	>75% Grass cover, Good, HSG A
2,326		100.00% Pervious Area

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

Subcatchment P1: Southeast Abutter



Summary for Subcatchment P2: Southwest Abutter

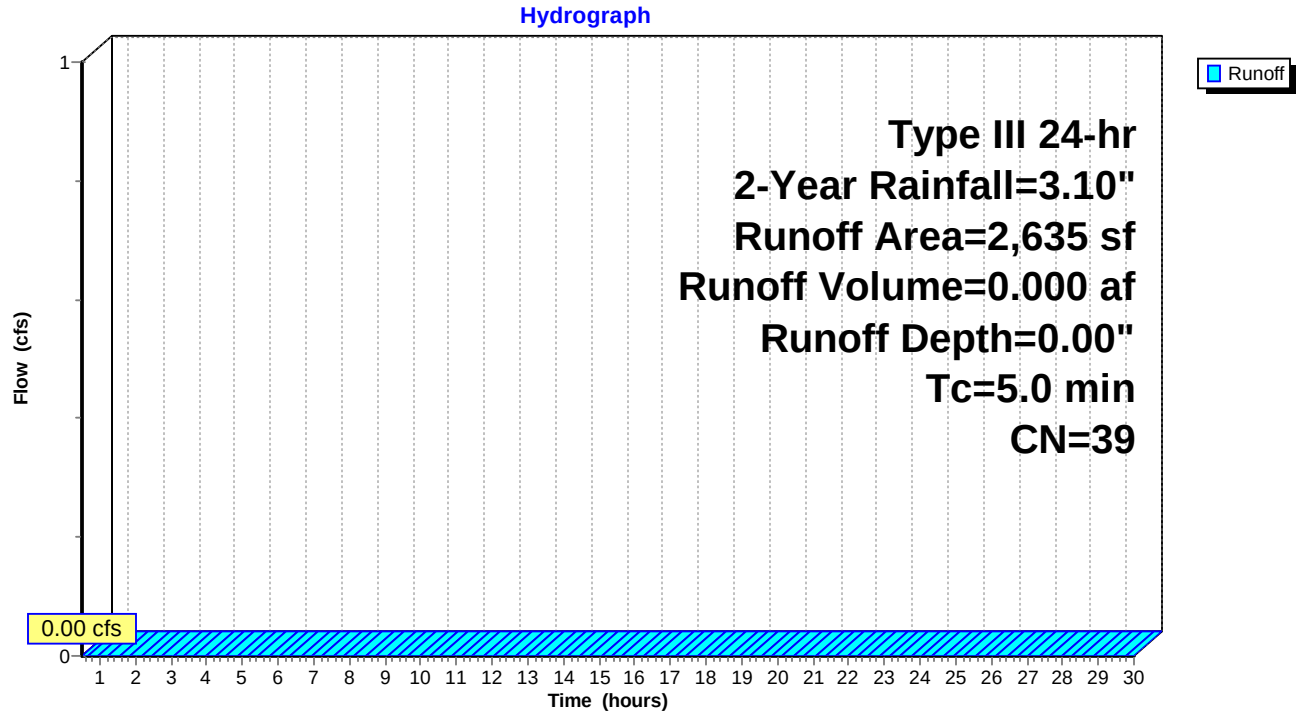
Runoff = 0.00 cfs @ 0.50 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
2,635	39	>75% Grass cover, Good, HSG A
2,635		100.00% Pervious Area

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

Subcatchment P2: Southwest Abutter



Summary for Subcatchment P3: Northwest Abutter

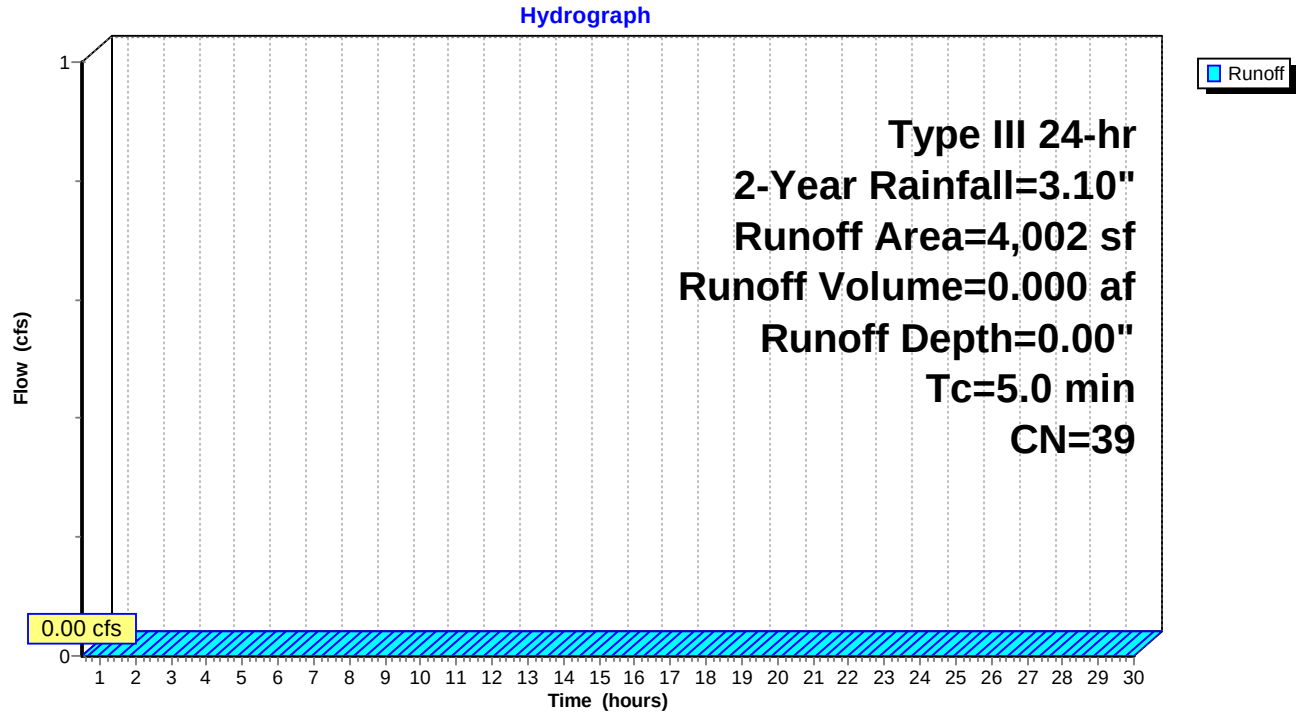
Runoff = 0.00 cfs @ 0.50 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
4,002	39	>75% Grass cover, Good, HSG A
4,002		100.00% Pervious Area

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

Subcatchment P3: Northwest Abutter



Summary for Subcatchment PD: Prop. Driveway

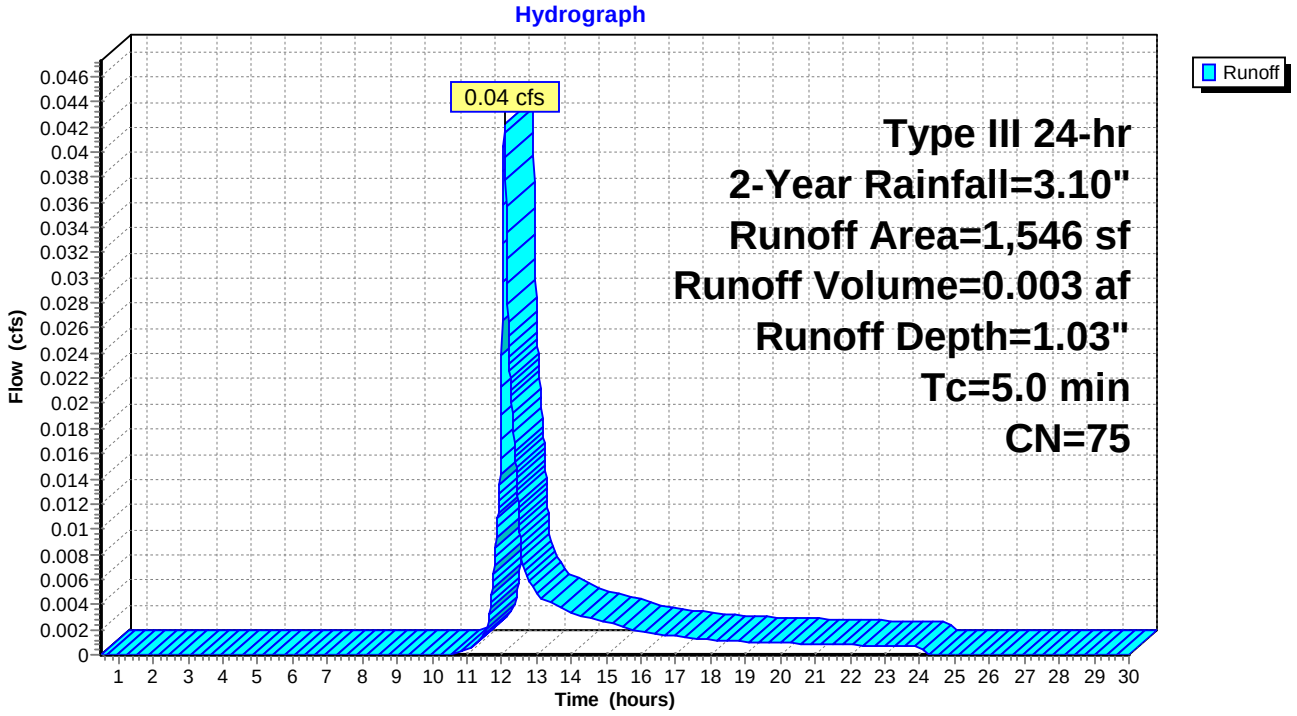
Runoff = 0.04 cfs @ 12.08 hrs, Volume= 0.003 af, Depth= 1.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

	Area (sf)	CN	Description
*	812	98	Paved Driveway
*	125	98	Walks
	609	39	>75% Grass cover, Good, HSG A
	1,546	75	Weighted Average
	609		39.39% Pervious Area
	937		60.61% Impervious Area

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

Subcatchment PD: Prop. Driveway



Summary for Subcatchment PR: Prop. Roof

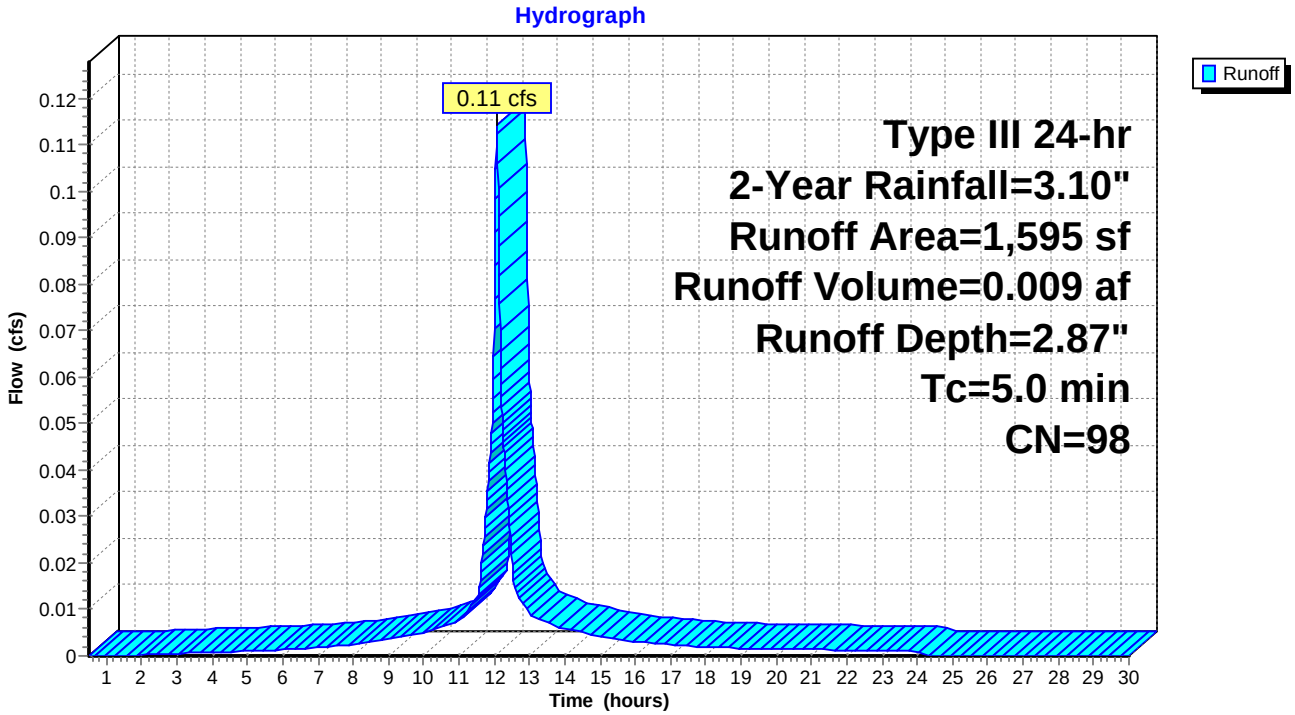
Runoff = 0.11 cfs @ 12.07 hrs, Volume= 0.009 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

	Area (sf)	CN	Description
*	1,595	98	Prop. Roof
	1,595		100.00% Impervious Area

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

Subcatchment PR: Prop. Roof



Summary for Pond INF: Inf. System

Inflow Area = 0.148 ac, 57.85% Impervious, Inflow Depth = 1.14" for 2-Year event
Inflow = 0.17 cfs @ 12.08 hrs, Volume= 0.014 af
Outflow = 0.03 cfs @ 11.76 hrs, Volume= 0.014 af, Atten= 84%, Lag= 0.0 min
Discarded = 0.03 cfs @ 11.76 hrs, Volume= 0.014 af

Routing by Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Peak Elev= 102.71' @ 12.61 hrs Surf.Area= 0.011 ac Storage= 0.004 af

Plug-Flow detention time= 39.6 min calculated for 0.014 af (100% of inflow)
Center-of-Mass det. time= 39.6 min (845.9 - 806.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	101.75'	0.013 af	**15.00'W x 32.00'L x 5.25'H Field A** 0.058 af Overall - 0.020 af Embedded = 0.038 af x 35.0% Voids
#2A	102.75'	0.015 af	**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 2 Rows of 7 Chambers
		0.028 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	101.75'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.03 cfs @ 11.76 hrs HW=101.80' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Pond INF: Inf. System - Chamber Wizard Field A

Chamber Model = 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

54.0" Wide + 24.0" Spacing = 78.0" C-C Row Spacing

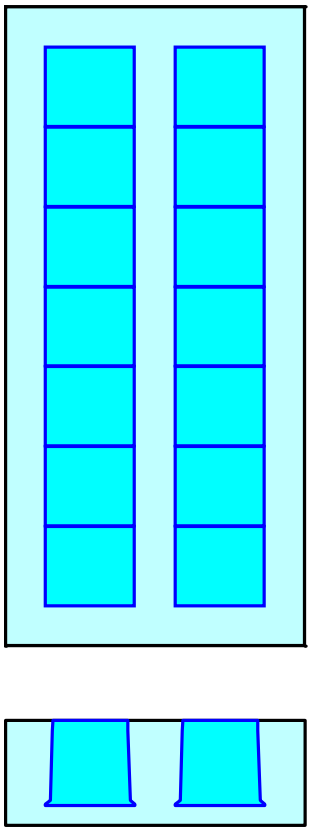
7 Chambers/Row x 4.00' Long = 28.00' Row Length +24.0" End Stone x 2 = 32.00' Base Length
2 Rows x 54.0" Wide + 24.0" Spacing x 1 + 24.0" Side Stone x 2 = 15.00' Base Width
12.0" Base + 51.0" Chamber Height = 5.25' Field Height

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

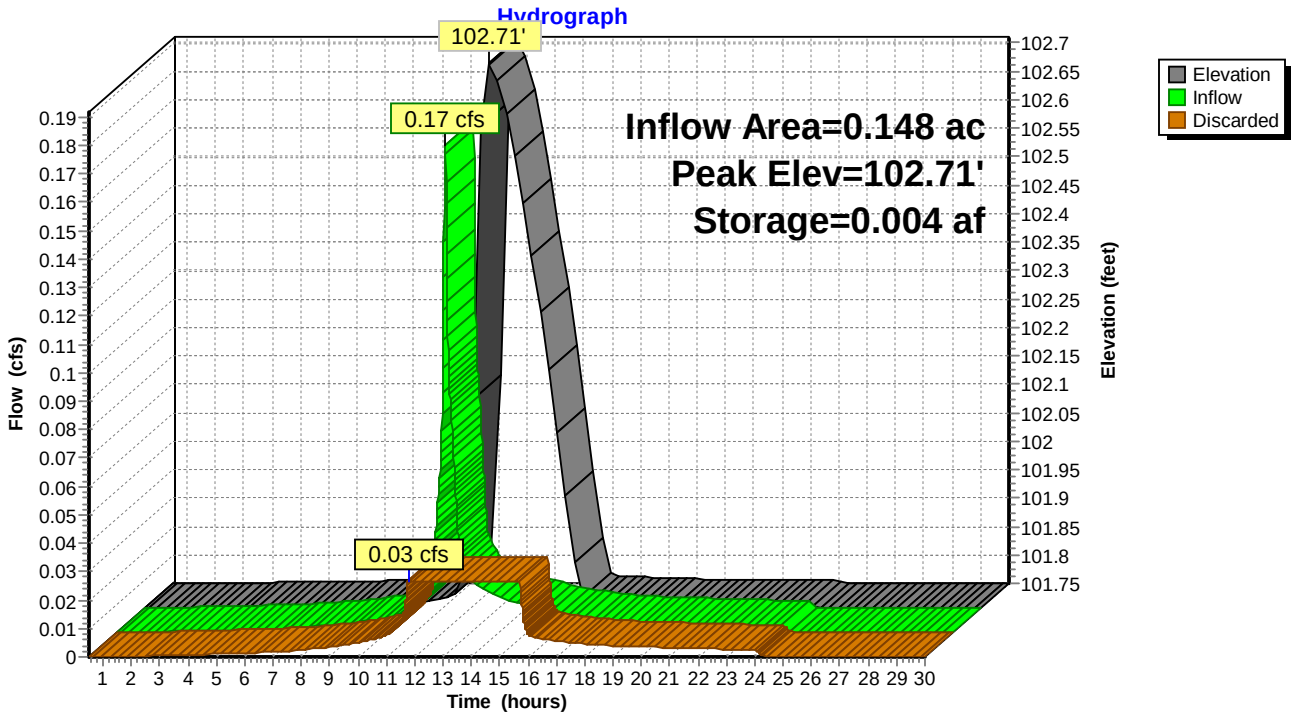
2,520.0 cf Field - 872.6 cf Chambers = 1,647.4 cf Stone x 35.0% Voids = 576.6 cf Stone Storage

Chamber Storage + Stone Storage = 1,225.9 cf = 0.028 af
Overall Storage Efficiency = 48.6%
Overall System Size = 32.00' x 15.00' x 5.25'

14 Chambers
93.3 cy Field
61.0 cy Stone



Pond INF: Inf. System



Summary for Subcatchment AD: Abutter- Prop. Driveway

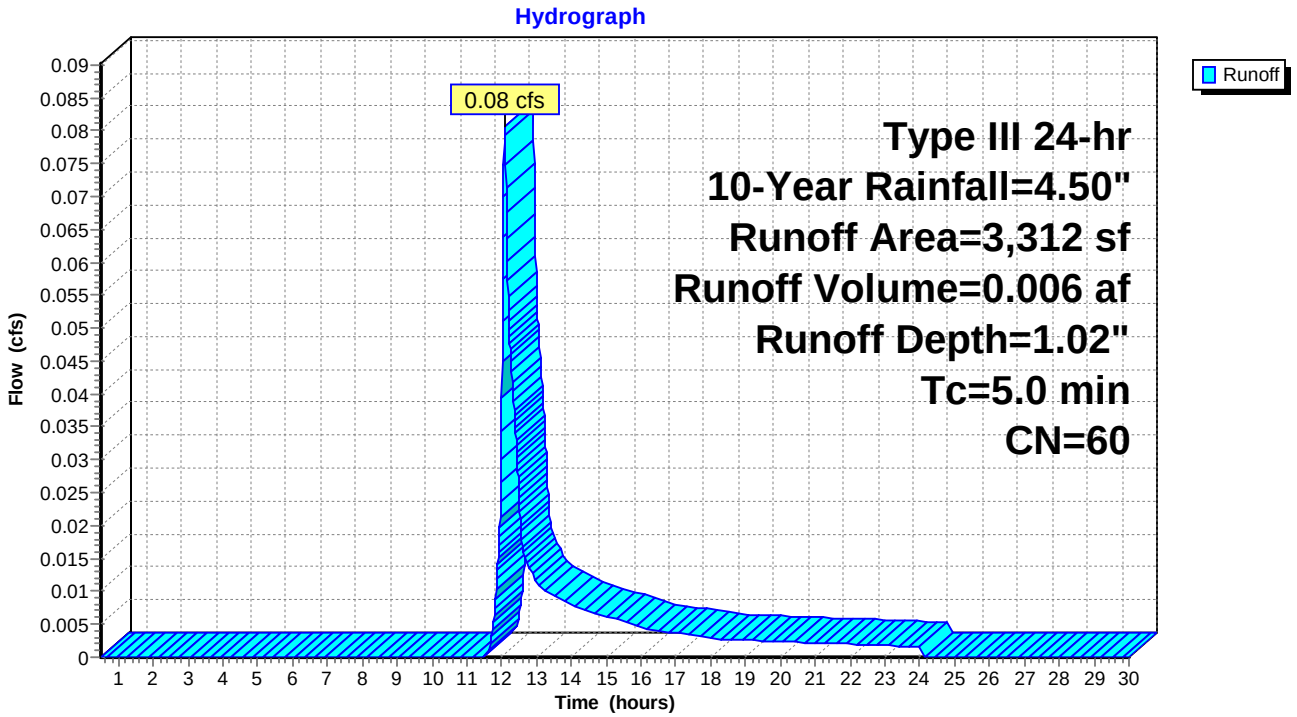
Runoff = 0.08 cfs @ 12.09 hrs, Volume= 0.006 af, Depth= 1.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	1,201	98	Paved Driveway
	2,111	39	>75% Grass cover, Good, HSG A
	3,312	60	Weighted Average
	2,111		63.74% Pervious Area
	1,201		36.26% Impervious Area

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

Subcatchment AD: Abutter- Prop. Driveway



Summary for Subcatchment E1: Southeast Abutter

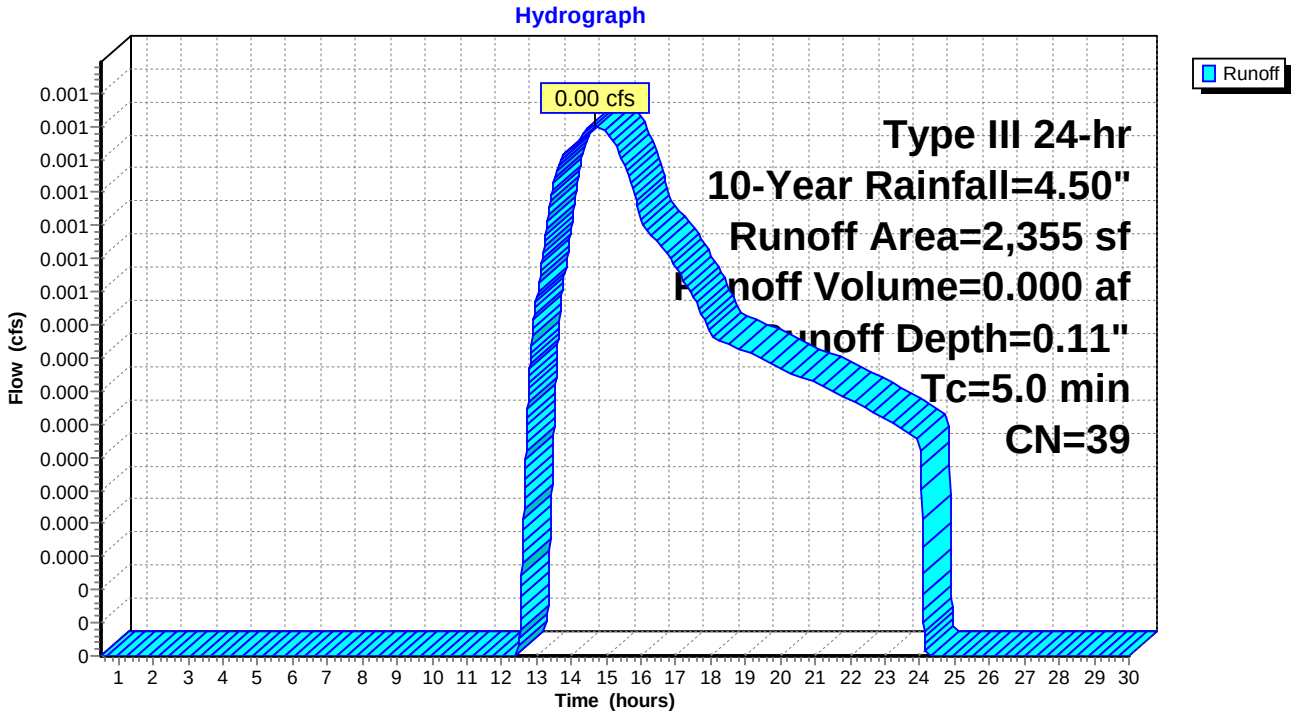
Runoff = 0.00 cfs @ 14.68 hrs, Volume= 0.000 af, Depth= 0.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
2,355	39	>75% Grass cover, Good, HSG A
2,355		100.00% Pervious Area

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

Subcatchment E1: Southeast Abutter



Summary for Subcatchment E2: Southwest Abutter

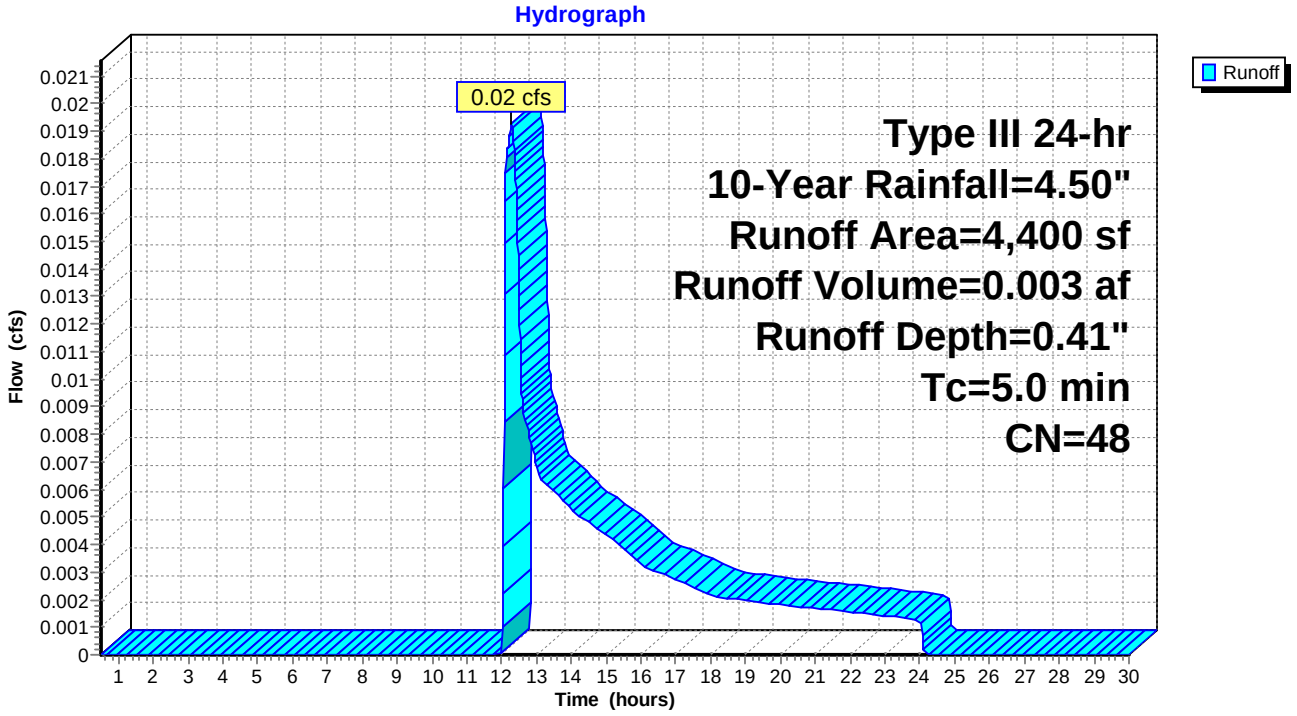
Runoff = 0.02 cfs @ 12.28 hrs, Volume= 0.003 af, Depth= 0.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	291	98	Garage Roof (Portion)
*	408	98	Patio
	3,701	39	>75% Grass cover, Good, HSG A
	4,400	48	Weighted Average
	3,701		84.11% Pervious Area
	699		15.89% Impervious Area

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

Subcatchment E2: Southwest Abutter



Summary for Subcatchment E3: Northwest Abutter

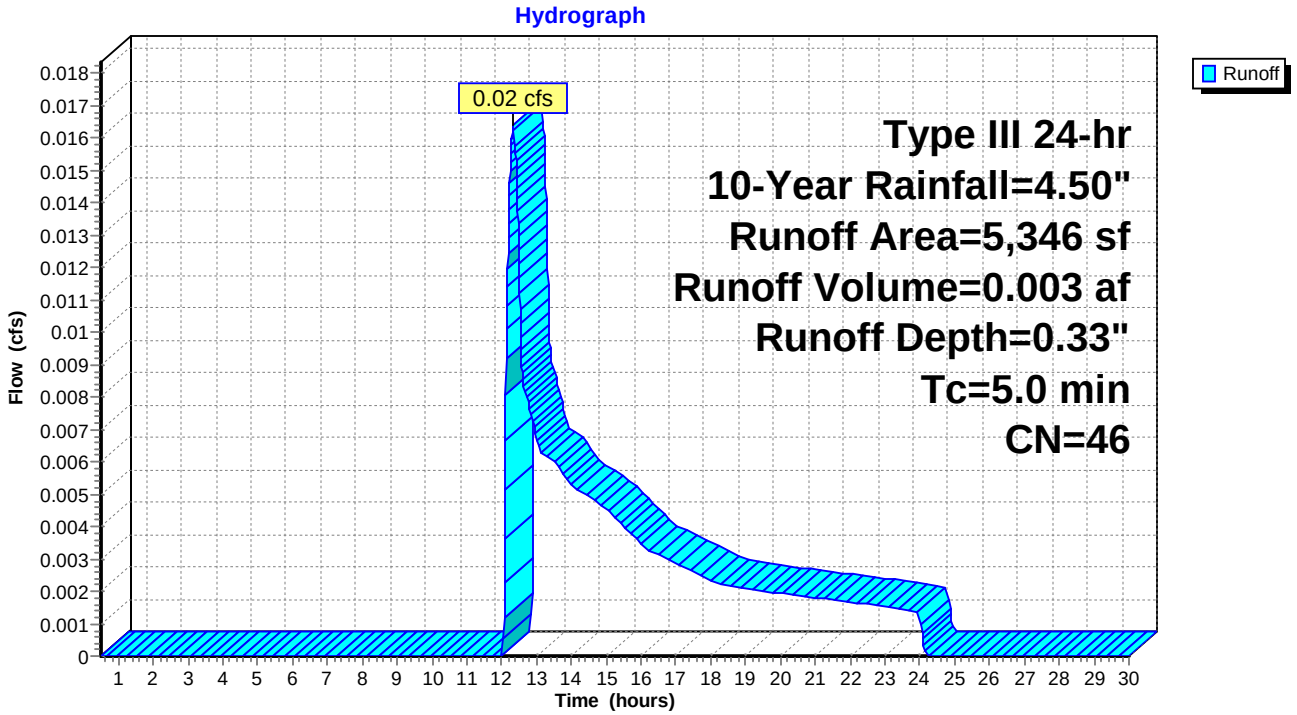
Runoff = 0.02 cfs @ 12.33 hrs, Volume= 0.003 af, Depth= 0.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	314	98	Garage Roof (Portion)
*	193	98	Driveway (portion)
*	98	98	Walk
	4,741	39	>75% Grass cover, Good, HSG A
	5,346	46	Weighted Average
	4,741		88.68% Pervious Area
	605		11.32% Impervious Area

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

Subcatchment E3: Northwest Abutter



Summary for Subcatchment P1: Southeast Abutter

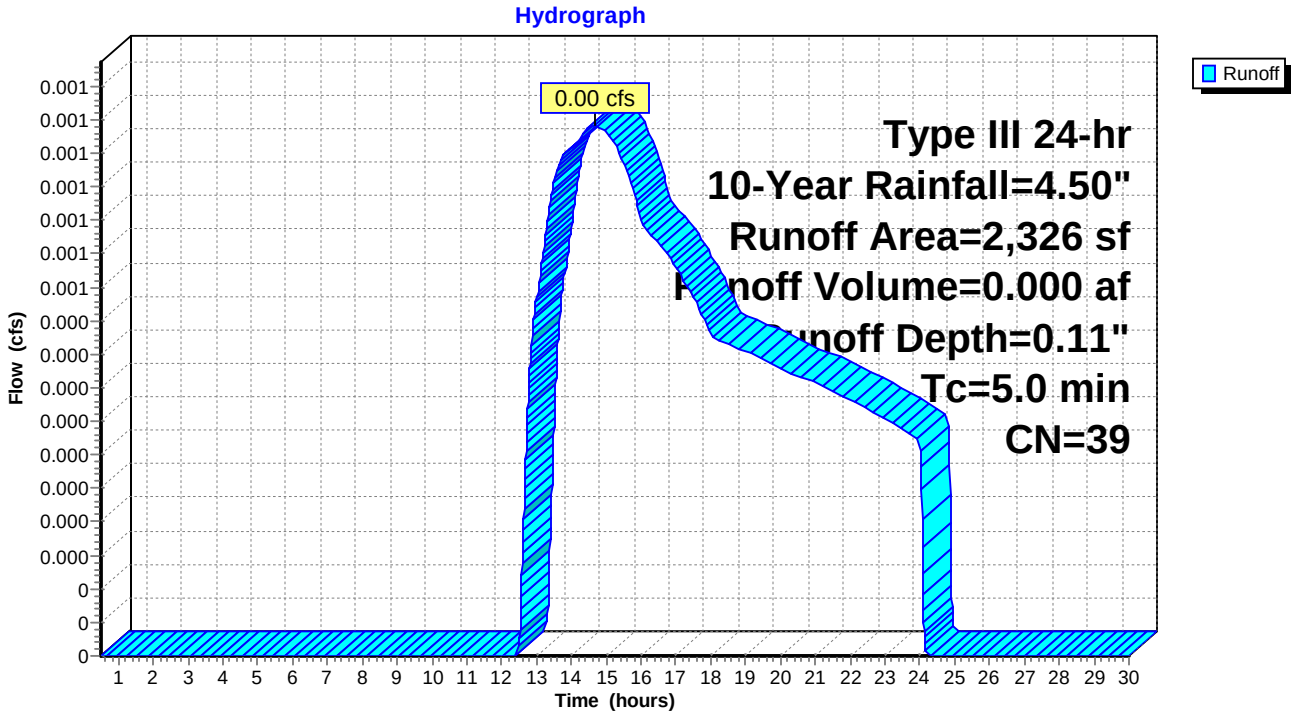
Runoff = 0.00 cfs @ 14.68 hrs, Volume= 0.000 af, Depth= 0.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
2,326	39	>75% Grass cover, Good, HSG A
2,326		100.00% Pervious Area

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

Subcatchment P1: Southeast Abutter



Summary for Subcatchment P2: Southwest Abutter

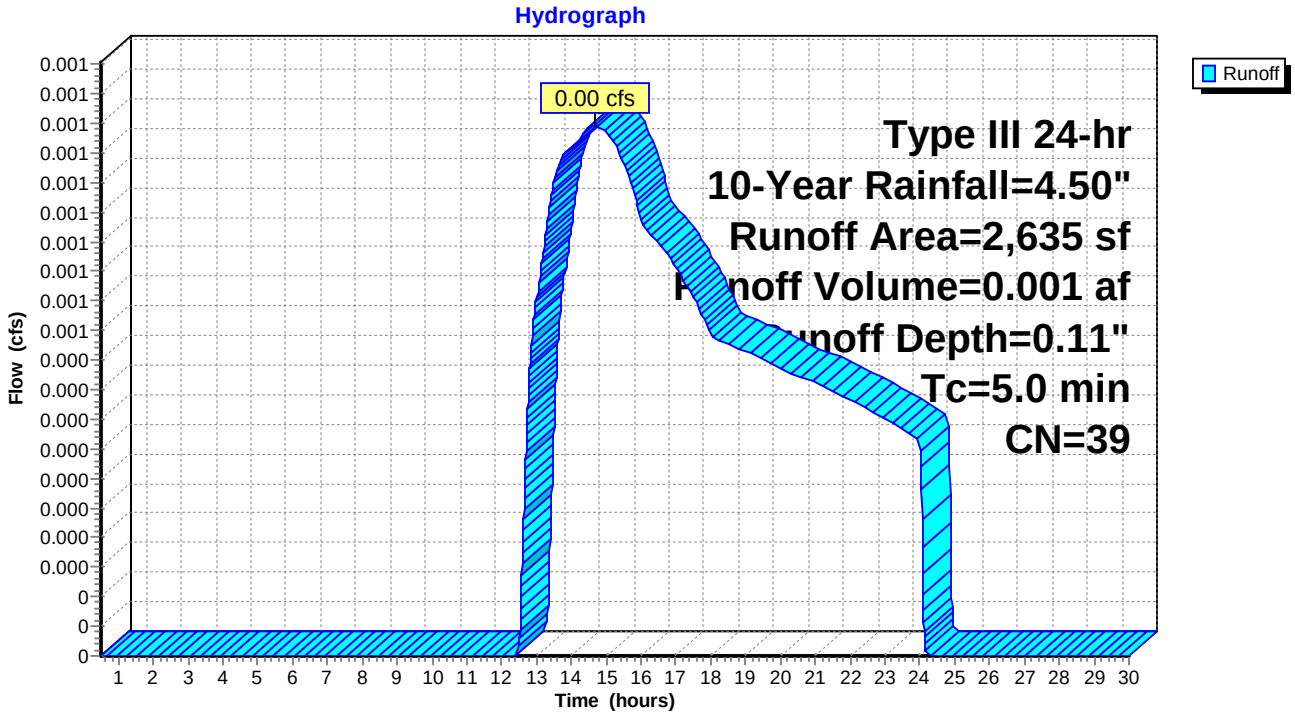
Runoff = 0.00 cfs @ 14.68 hrs, Volume= 0.001 af, Depth= 0.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
2,635	39	>75% Grass cover, Good, HSG A
2,635		100.00% Pervious Area

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

Subcatchment P2: Southwest Abutter



Summary for Subcatchment P3: Northwest Abutter

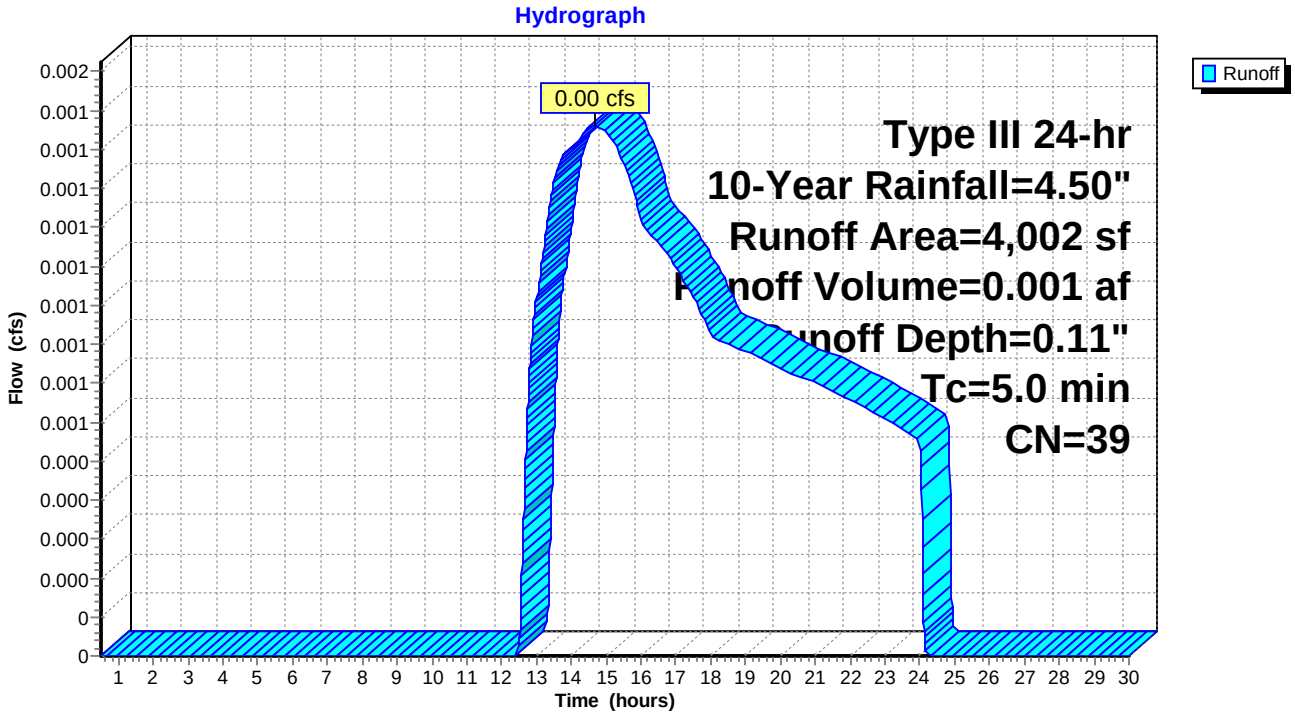
Runoff = 0.00 cfs @ 14.68 hrs, Volume= 0.001 af, Depth= 0.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
4,002	39	>75% Grass cover, Good, HSG A
4,002		100.00% Pervious Area

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

Subcatchment P3: Northwest Abutter



Summary for Subcatchment PD: Prop. Driveway

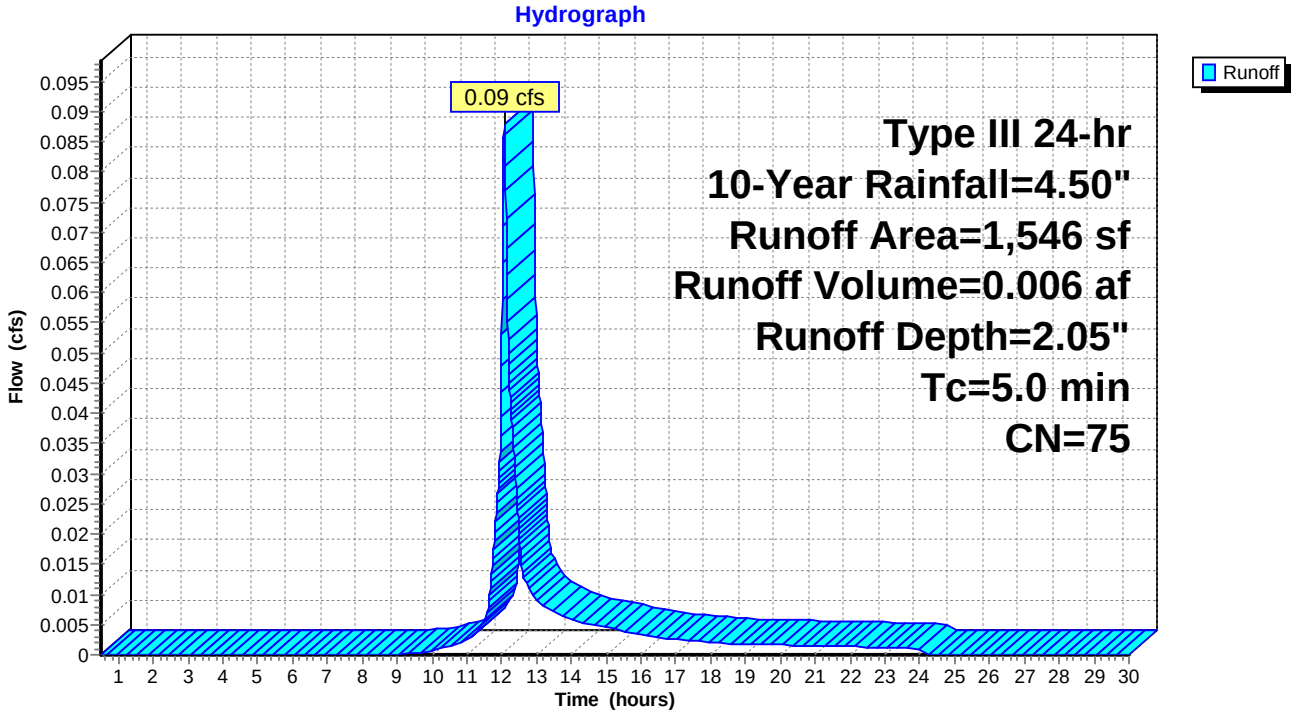
Runoff = 0.09 cfs @ 12.08 hrs, Volume= 0.006 af, Depth= 2.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	812	98	Paved Driveway
*	125	98	Walks
	609	39	>75% Grass cover, Good, HSG A
	1,546	75	Weighted Average
	609		39.39% Pervious Area
	937		60.61% Impervious Area

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

Subcatchment PD: Prop. Driveway



Summary for Subcatchment PR: Prop. Roof

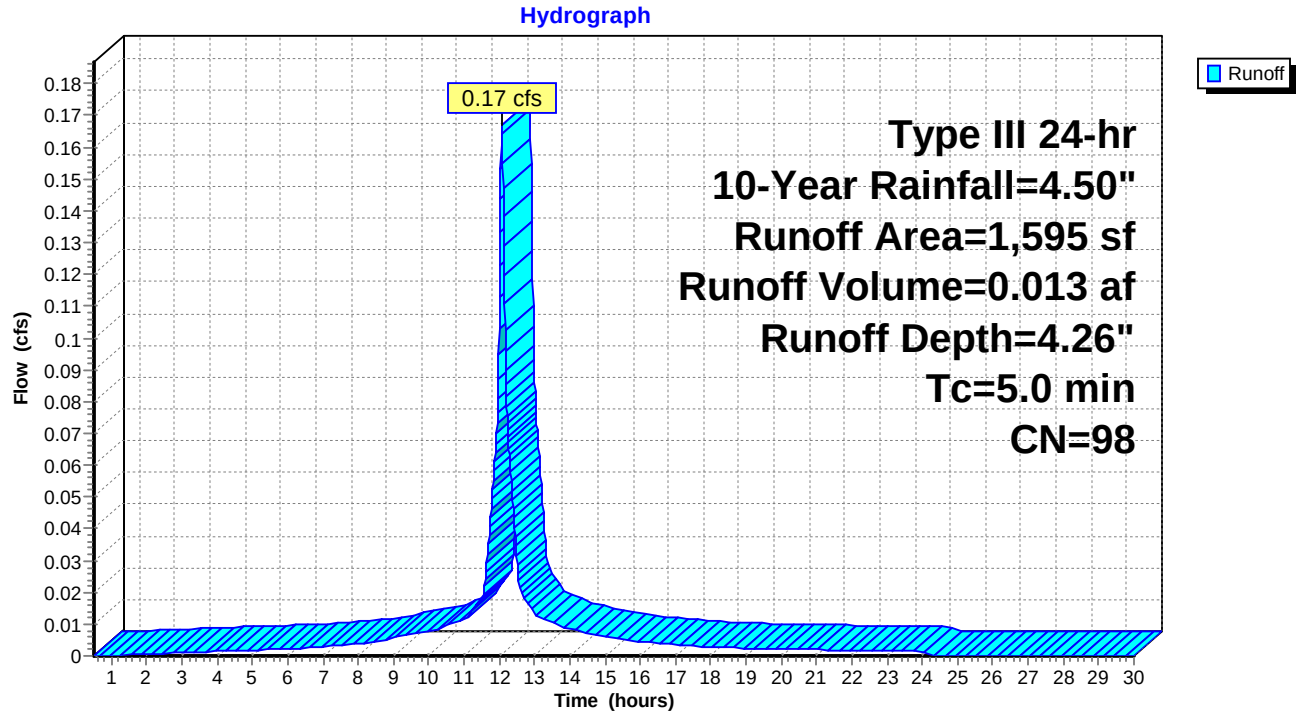
Runoff = 0.17 cfs @ 12.07 hrs, Volume= 0.013 af, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	1,595	98	Prop. Roof
	1,595		100.00% Impervious Area

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

Subcatchment PR: Prop. Roof



Summary for Pond INF: Inf. System

Inflow Area = 0.148 ac, 57.85% Impervious, Inflow Depth = 2.07" for 10-Year event
Inflow = 0.33 cfs @ 12.08 hrs, Volume= 0.026 af
Outflow = 0.03 cfs @ 11.63 hrs, Volume= 0.026 af, Atten= 92%, Lag= 0.0 min
Discarded = 0.03 cfs @ 11.63 hrs, Volume= 0.026 af

Routing by Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Peak Elev= 103.64' @ 13.52 hrs Surf.Area= 0.011 ac Storage= 0.009 af

Plug-Flow detention time= 129.0 min calculated for 0.026 af (100% of inflow)
Center-of-Mass det. time= 129.0 min (933.2 - 804.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	101.75'	0.013 af	**15.00'W x 32.00'L x 5.25'H Field A** 0.058 af Overall - 0.020 af Embedded = 0.038 af x 35.0% Voids
#2A	102.75'	0.015 af	**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 2 Rows of 7 Chambers
		0.028 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	101.75'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.03 cfs @ 11.63 hrs HW=101.80' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Pond INF: Inf. System - Chamber Wizard Field A

Chamber Model = 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

54.0" Wide + 24.0" Spacing = 78.0" C-C Row Spacing

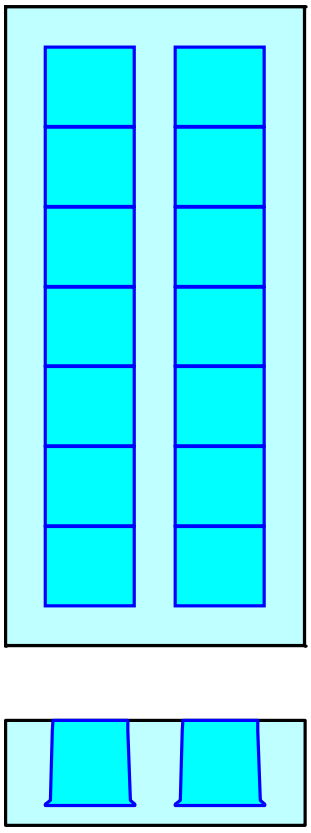
7 Chambers/Row x 4.00' Long = 28.00' Row Length +24.0" End Stone x 2 = 32.00' Base Length
2 Rows x 54.0" Wide + 24.0" Spacing x 1 + 24.0" Side Stone x 2 = 15.00' Base Width
12.0" Base + 51.0" Chamber Height = 5.25' Field Height

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

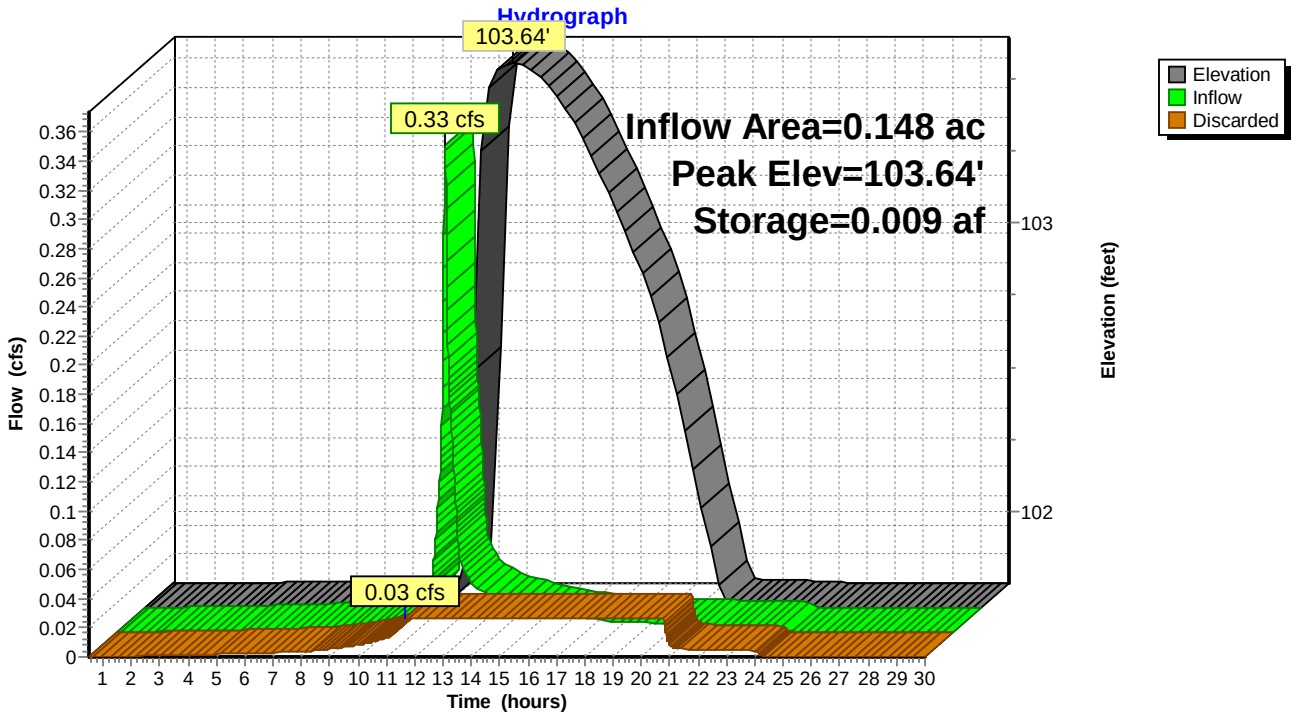
2,520.0 cf Field - 872.6 cf Chambers = 1,647.4 cf Stone x 35.0% Voids = 576.6 cf Stone Storage

Chamber Storage + Stone Storage = 1,225.9 cf = 0.028 af
Overall Storage Efficiency = 48.6%
Overall System Size = 32.00' x 15.00' x 5.25'

14 Chambers
93.3 cy Field
61.0 cy Stone



Pond INF: Inf. System



Summary for Subcatchment AD: Abutter- Prop. Driveway

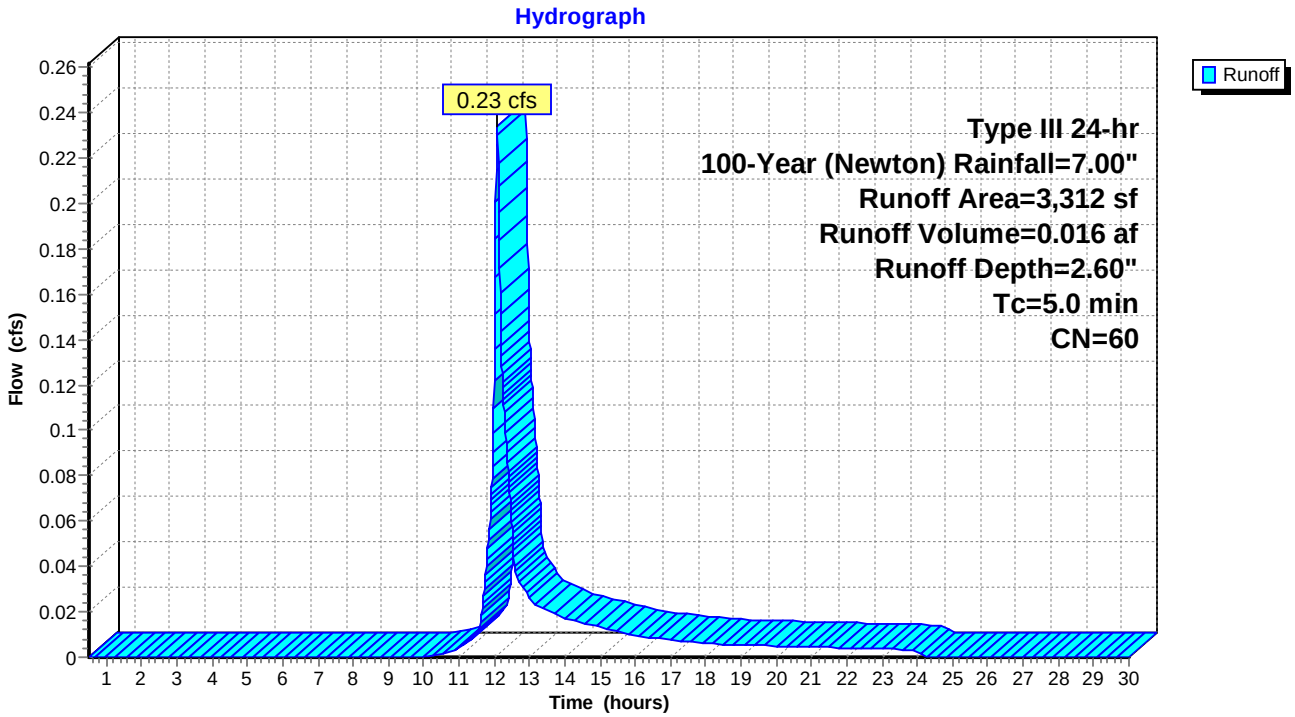
Runoff = 0.23 cfs @ 12.08 hrs, Volume= 0.016 af, Depth= 2.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year (Newton) Rainfall=7.00"

	Area (sf)	CN	Description
*	1,201	98	Paved Driveway
	2,111	39	>75% Grass cover, Good, HSG A
	3,312	60	Weighted Average
	2,111		63.74% Pervious Area
	1,201		36.26% Impervious Area

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

Subcatchment AD: Abutter- Prop. Driveway



Summary for Subcatchment E1: Southeast Abutter

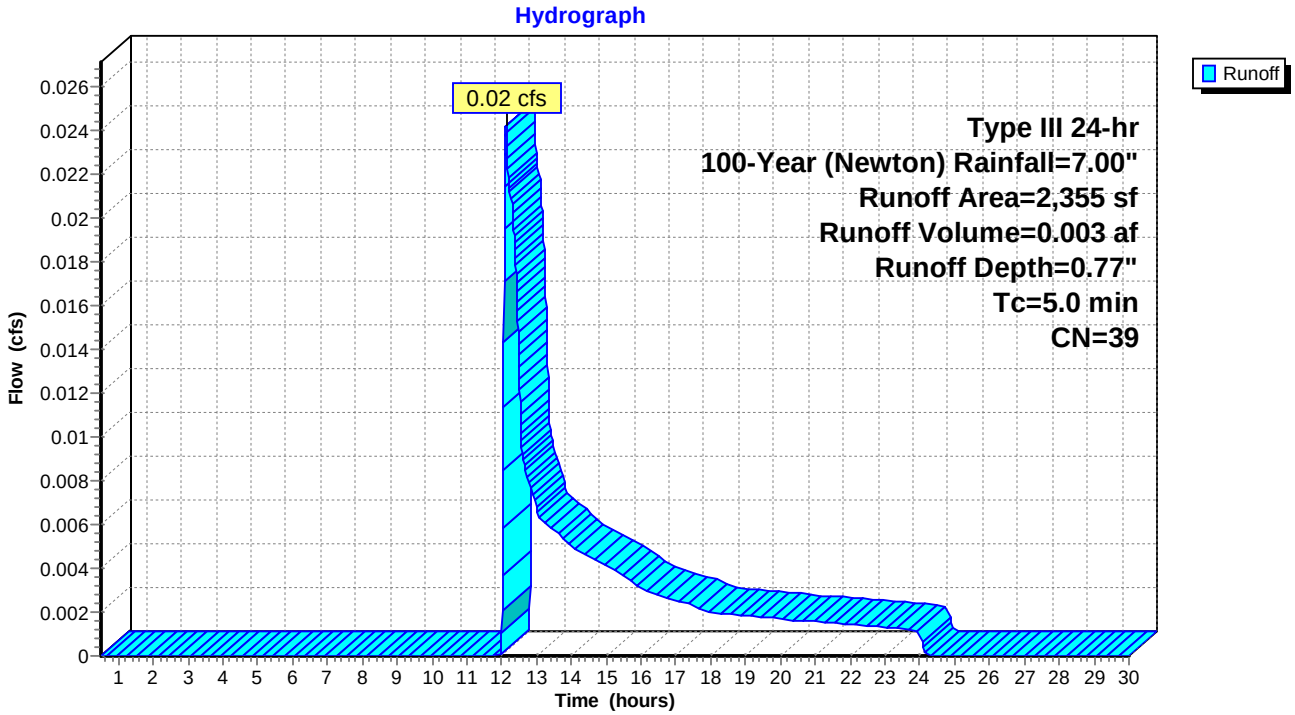
Runoff = 0.02 cfs @ 12.12 hrs, Volume= 0.003 af, Depth= 0.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year (Newton) Rainfall=7.00"

Area (sf)	CN	Description
2,355	39	>75% Grass cover, Good, HSG A
2,355		100.00% Pervious Area

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

Subcatchment E1: Southeast Abutter



Summary for Subcatchment E2: Southwest Abutter

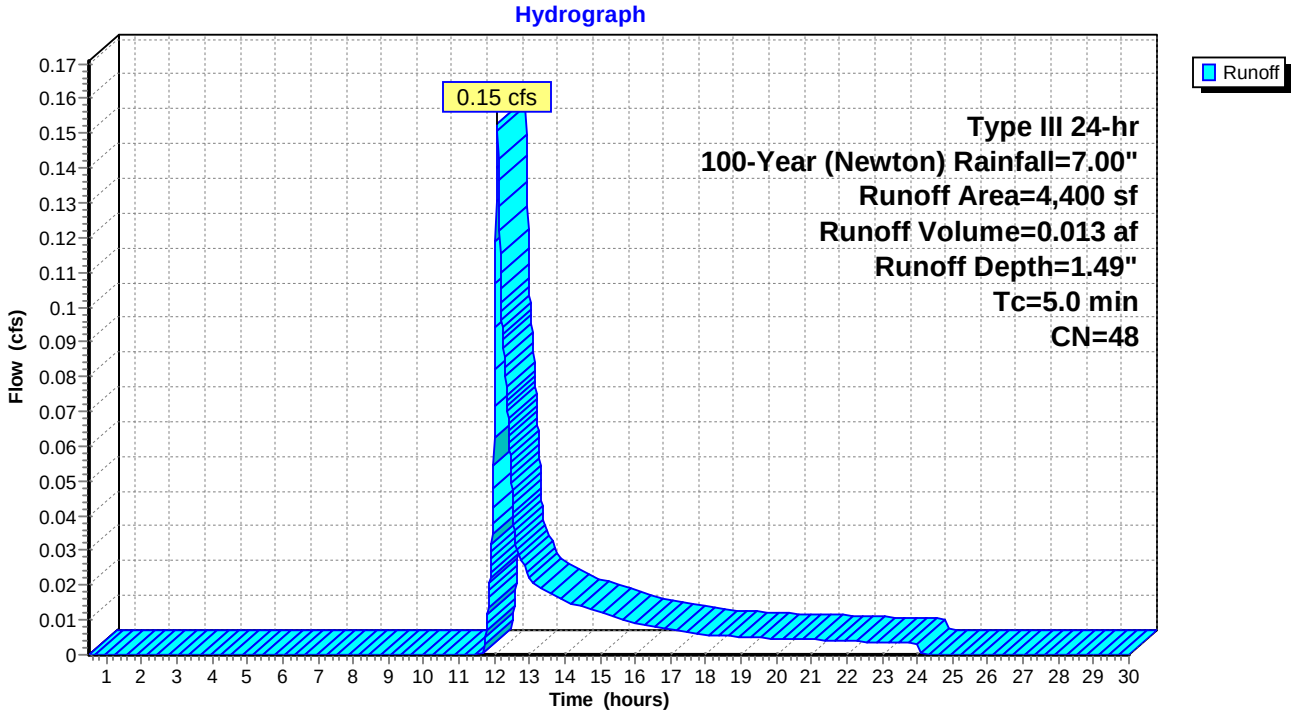
Runoff = 0.15 cfs @ 12.09 hrs, Volume= 0.013 af, Depth= 1.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year (Newton) Rainfall=7.00"

	Area (sf)	CN	Description
*	291	98	Garage Roof (Portion)
*	408	98	Patio
	3,701	39	>75% Grass cover, Good, HSG A
	4,400	48	Weighted Average
	3,701		84.11% Pervious Area
	699		15.89% Impervious Area

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

Subcatchment E2: Southwest Abutter



Summary for Subcatchment E3: Northwest Abutter

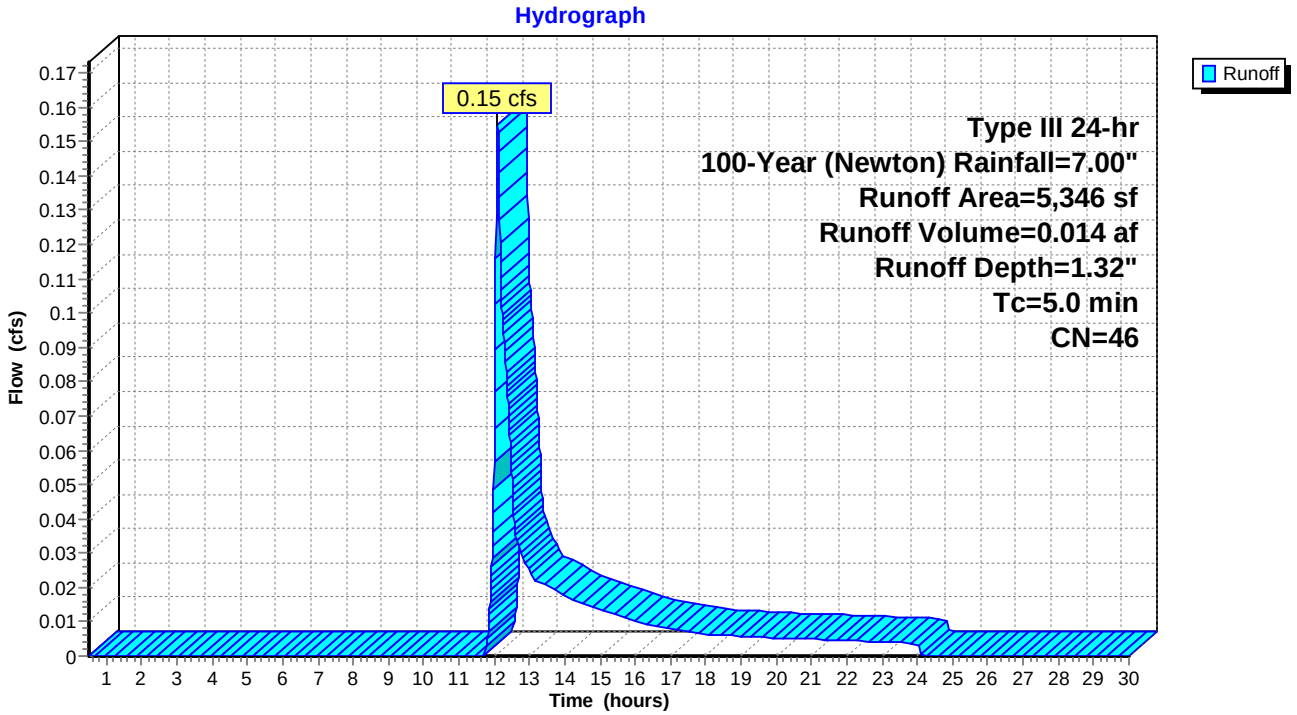
Runoff = 0.15 cfs @ 12.09 hrs, Volume= 0.014 af, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year (Newton) Rainfall=7.00"

	Area (sf)	CN	Description
*	314	98	Garage Roof (Portion)
*	193	98	Driveway (portion)
*	98	98	Walk
	4,741	39	>75% Grass cover, Good, HSG A
	5,346	46	Weighted Average
	4,741		88.68% Pervious Area
	605		11.32% Impervious Area

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

Subcatchment E3: Northwest Abutter



Summary for Subcatchment P1: Southeast Abutter

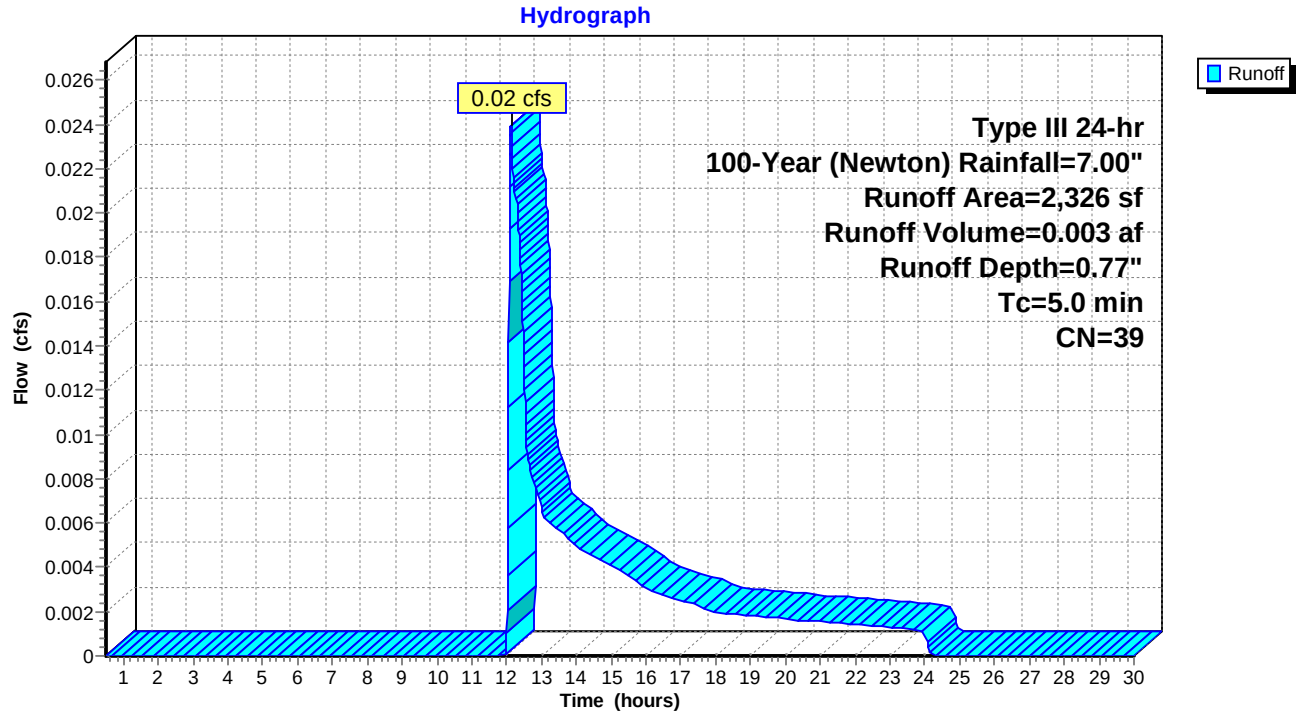
Runoff = 0.02 cfs @ 12.12 hrs, Volume= 0.003 af, Depth= 0.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year (Newton) Rainfall=7.00"

Area (sf)	CN	Description
2,326	39	>75% Grass cover, Good, HSG A
2,326		100.00% Pervious Area

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

Subcatchment P1: Southeast Abutter



Summary for Subcatchment P2: Southwest Abutter

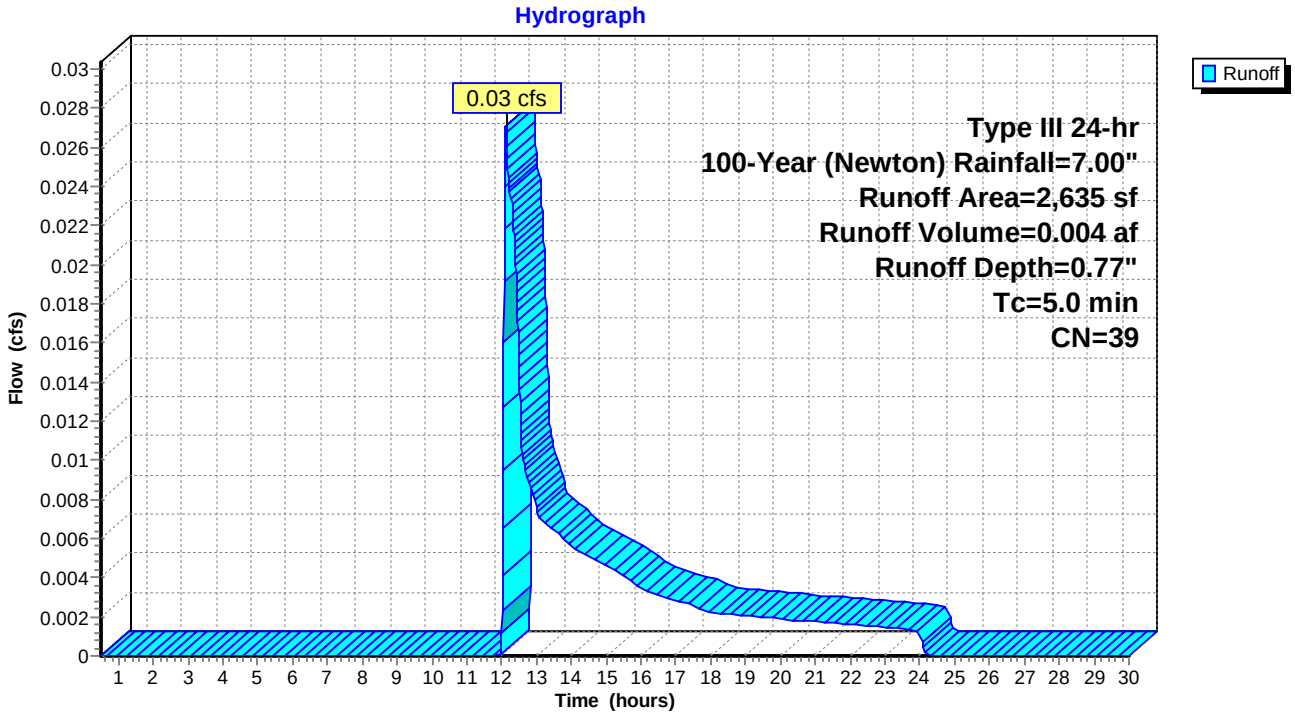
Runoff = 0.03 cfs @ 12.12 hrs, Volume= 0.004 af, Depth= 0.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year (Newton) Rainfall=7.00"

Area (sf)	CN	Description
2,635	39	>75% Grass cover, Good, HSG A
2,635		100.00% Pervious Area

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

Subcatchment P2: Southwest Abutter



Summary for Subcatchment P3: Northwest Abutter

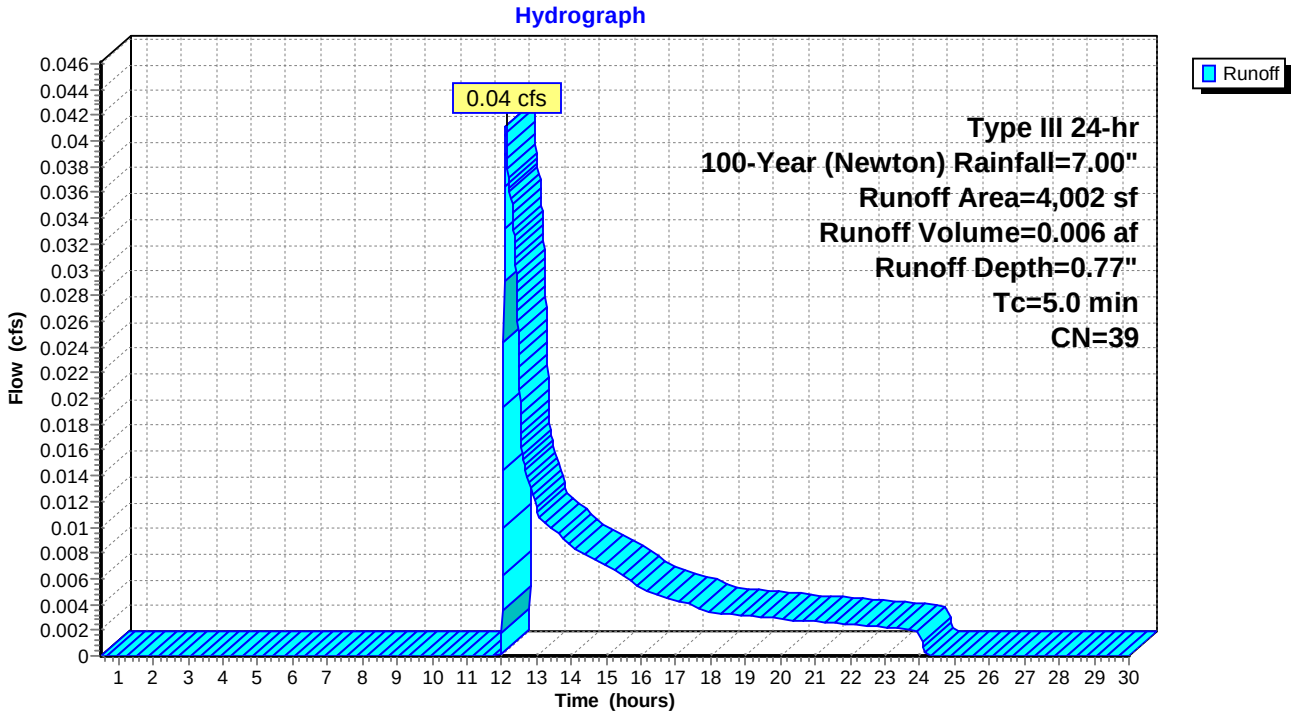
Runoff = 0.04 cfs @ 12.12 hrs, Volume= 0.006 af, Depth= 0.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year (Newton) Rainfall=7.00"

Area (sf)	CN	Description
4,002	39	>75% Grass cover, Good, HSG A
4,002		100.00% Pervious Area

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

Subcatchment P3: Northwest Abutter



Summary for Subcatchment PD: Prop. Driveway

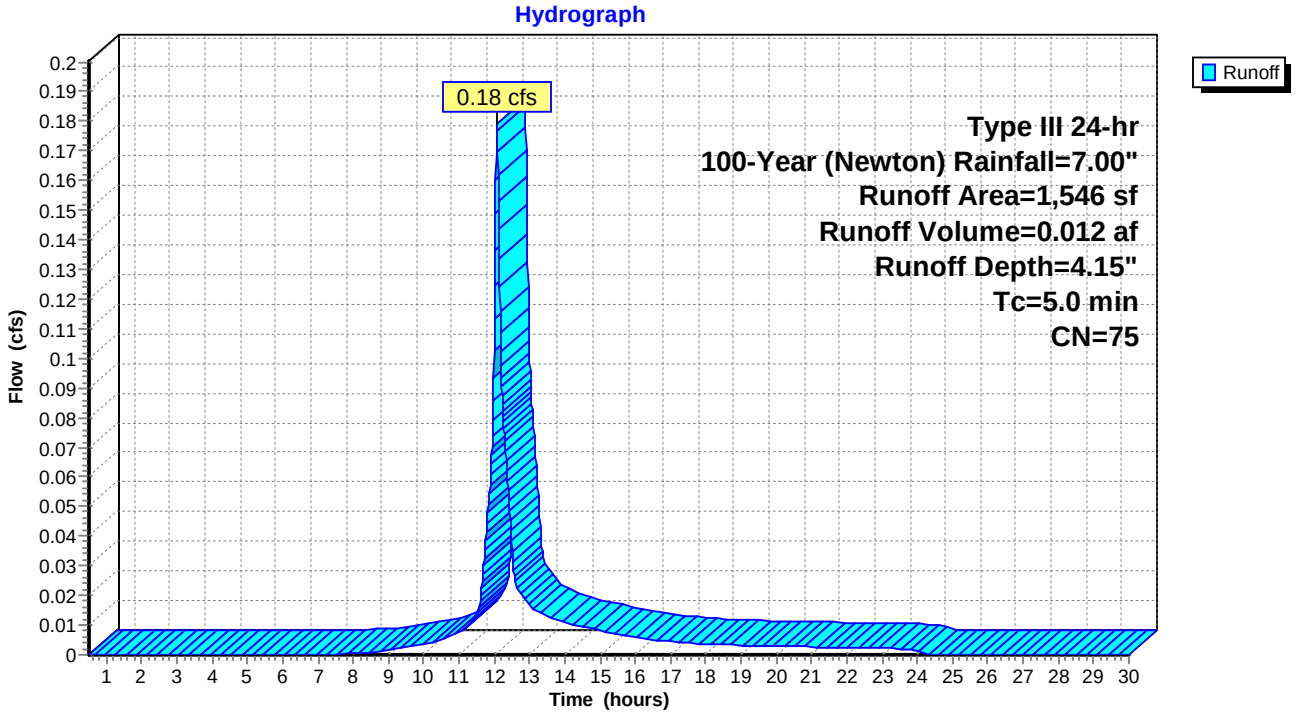
Runoff = 0.18 cfs @ 12.07 hrs, Volume= 0.012 af, Depth= 4.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year (Newton) Rainfall=7.00"

	Area (sf)	CN	Description
*	812	98	Paved Driveway
*	125	98	Walks
	609	39	>75% Grass cover, Good, HSG A
	1,546	75	Weighted Average
	609		39.39% Pervious Area
	937		60.61% Impervious Area

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

Subcatchment PD: Prop. Driveway



Summary for Subcatchment PR: Prop. Roof

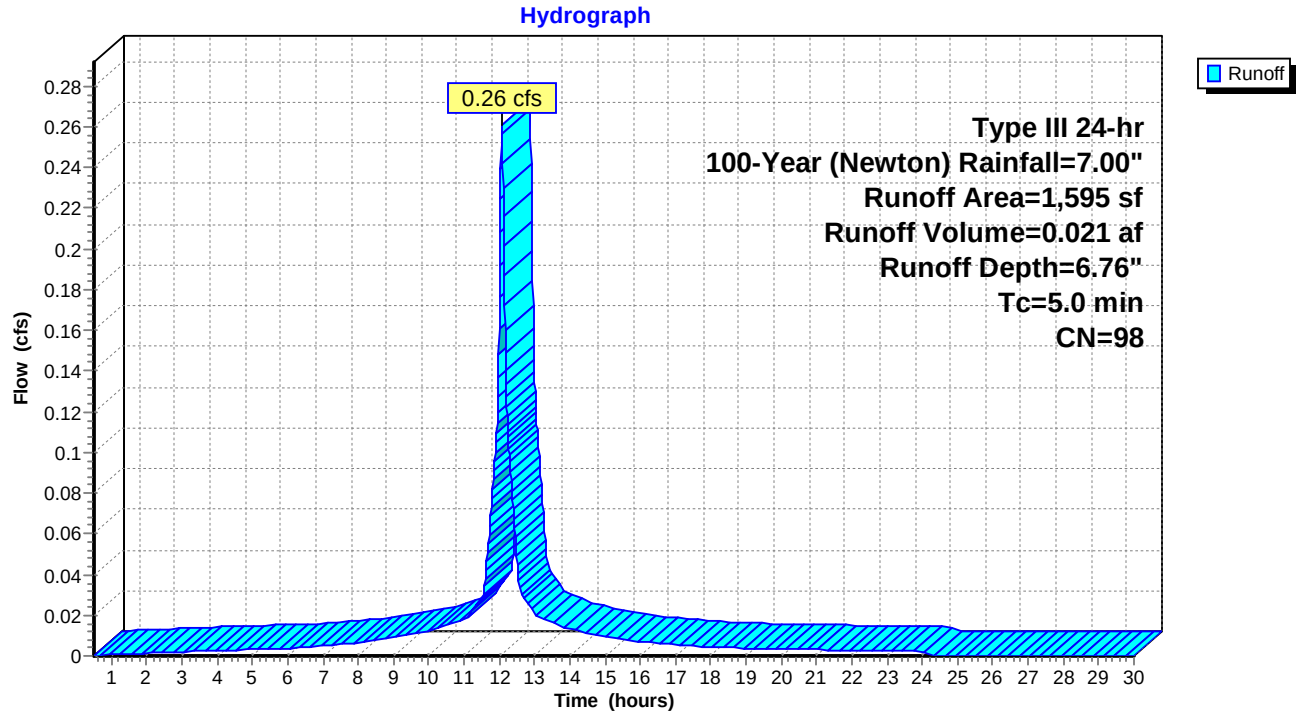
Runoff = 0.26 cfs @ 12.07 hrs, Volume= 0.021 af, Depth= 6.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year (Newton) Rainfall=7.00"

	Area (sf)	CN	Description
*	1,595	98	Prop. Roof
	1,595		100.00% Impervious Area

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

Subcatchment PR: Prop. Roof



Summary for Pond INF: Inf. System

Inflow Area = 0.148 ac, 57.85% Impervious, Inflow Depth = 4.00" for 100-Year (Newton) event
Inflow = 0.67 cfs @ 12.07 hrs, Volume= 0.049 af
Outflow = 0.03 cfs @ 10.92 hrs, Volume= 0.047 af, Atten= 96%, Lag= 0.0 min
Discarded = 0.03 cfs @ 10.92 hrs, Volume= 0.047 af

Routing by Stor-Ind method, Time Span= 0.50-30.00 hrs, dt= 0.01 hrs
Peak Elev= 106.19' @ 15.52 hrs Surf.Area= 0.011 ac Storage= 0.025 af

Plug-Flow detention time= 377.3 min calculated for 0.047 af (96% of inflow)
Center-of-Mass det. time= 352.2 min (1,150.2 - 798.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	101.75'	0.013 af	**15.00'W x 32.00'L x 5.25'H Field A** 0.058 af Overall - 0.020 af Embedded = 0.038 af x 35.0% Voids
#2A	102.75'	0.015 af	**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 2 Rows of 7 Chambers
		0.028 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	101.75'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.03 cfs @ 10.92 hrs HW=101.80' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Pond INF: Inf. System - Chamber Wizard Field A

Chamber Model = 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

54.0" Wide + 24.0" Spacing = 78.0" C-C Row Spacing

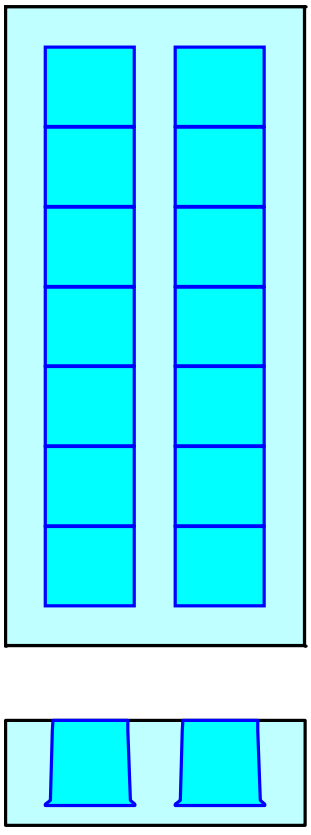
7 Chambers/Row x 4.00' Long = 28.00' Row Length +24.0" End Stone x 2 = 32.00' Base Length
2 Rows x 54.0" Wide + 24.0" Spacing x 1 + 24.0" Side Stone x 2 = 15.00' Base Width
12.0" Base + 51.0" Chamber Height = 5.25' Field Height

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

2,520.0 cf Field - 872.6 cf Chambers = 1,647.4 cf Stone x 35.0% Voids = 576.6 cf Stone Storage

Chamber Storage + Stone Storage = 1,225.9 cf = 0.028 af
Overall Storage Efficiency = 48.6%
Overall System Size = 32.00' x 15.00' x 5.25'

14 Chambers
93.3 cy Field
61.0 cy Stone



Pond INF: Inf. System