Sullivan Engineering Group, LLC
Civil Engineers & Land Development Consultants

February 29, 2024

Town of Wakefield
Conservation Commission

Re: 84 Preston St, Wakefield
Drainage Design

This drainage study was conducted at 84 Preston Street, Wakefield due to the applicant seeking to demolish an existing garage and construct a new duplex house, paved driveways, and site work within 100 feet of a wetland.

The drainage design looks to collect 2,352 sf of the proposed house roof area (the entire roof area). The roof area will be conveyed via 4" HDPE Roof drains directly to the proposed infiltration fields. The infiltration fields shall consist of Cultec contactor 100HD units with crushed stone bedding/surrounding and will be sited 5 feet off the proposed slab construction due to limited site area. The drainage field has an emergency overflow from the field in the form of a 4" NDS pop-up emitter. The seasonal high groundwater table was estimated based on the intermittent stream and a soil exfiltration rate of 2.41 in/hr was used for a "B" soil per the NRCS soil maps (attached). The drainage infiltration system is sited 2 feet above the seasonal high groundwater table.

HydroCAD calculations are attached which show that the drywell is sized properly for the 2, 10, 25 and 100 year storm event. The following is a summary of the pre-development and post-development peak rates and volumes of stormwater runoff.

Storm Event	Predevelopment		Postdevelopment	
	Peak Rate (cfs)	Volume (AF)	Peak Rate (cfs)	Volume (AF)
2 Year	0.24	0.018	0.13	0.010
10 Year	0.55	0.040	0.34	0.025
25 Year	0.76	0.055	0.48	0.039
100 Year	1.10	0.080	0.91	0.060

If you have any questions or comments please feel free to contact me.

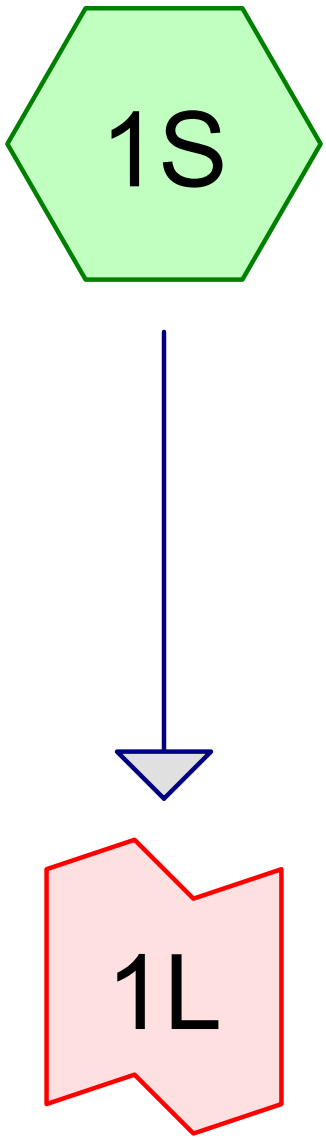
Very Truly Yours,

2-29-24

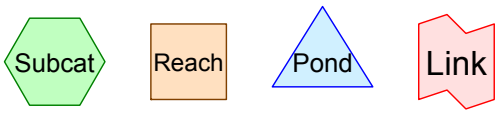
John (Jack) D. Sullivan III, PE

Attachment: HydroCAD report
NRCS soil map
NOAA Atlas 14 Precipation Table
TSS removal worksheet

PO Box 2004 Woburn, MA 01888 (781) 854-8644 email: jacksull53@comcast.net



Predevelopment - offsite



Drainage Diagram for 84 Preston Street, Wakefield (Predevelopment)
Prepared by Sullivan Engineering Group, LLC 2/29/2024
HydroCAD® 7.00 s/n 001433 © 1986-2003 Applied Microcomputer Systems

Time span=5.00-24.00 hrs, dt=0.05 hrs, 381 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Runoff Area=8,000 sf Runoff Depth=1.17"
Tc=6.0 min CN=75 Runoff=0.24 cfs 0.018 af

Link 1L: Predevelopment - offsite Inflow=0.24 cfs 0.018 af
Primary=0.24 cfs 0.018 af

Total Runoff Area = 0.184 ac Runoff Volume = 0.018 af Average Runoff Depth = 1.17"

Subcatchment 1S:

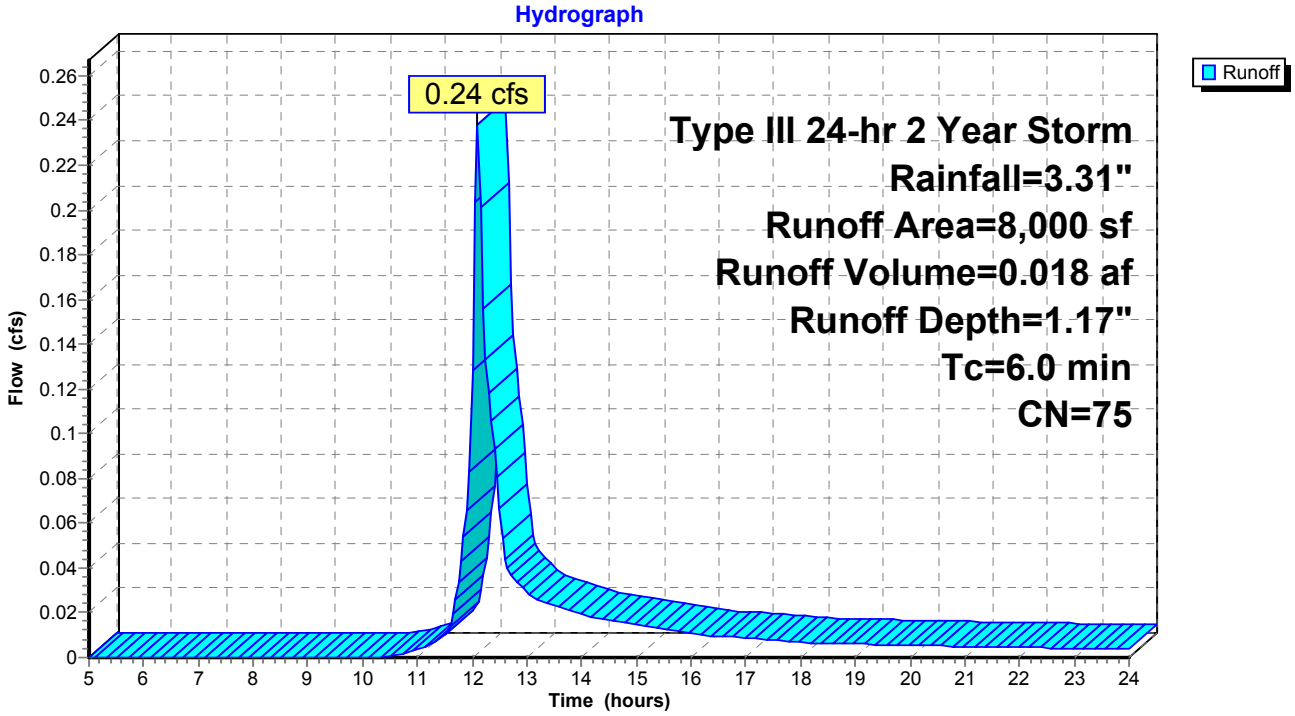
Runoff = 0.24 cfs @ 12.10 hrs, Volume= 0.018 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Storm Rainfall=3.31"

Area (sf)	CN	Description
762	98	Existing Garage
1,324	98	driveway/walkways
1,300	60	Woods, Fair, HSG B
4,614	69	50-75% Grass cover, Fair, HSG B
8,000	75	Weighted Average

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

Subcatchment 1S:

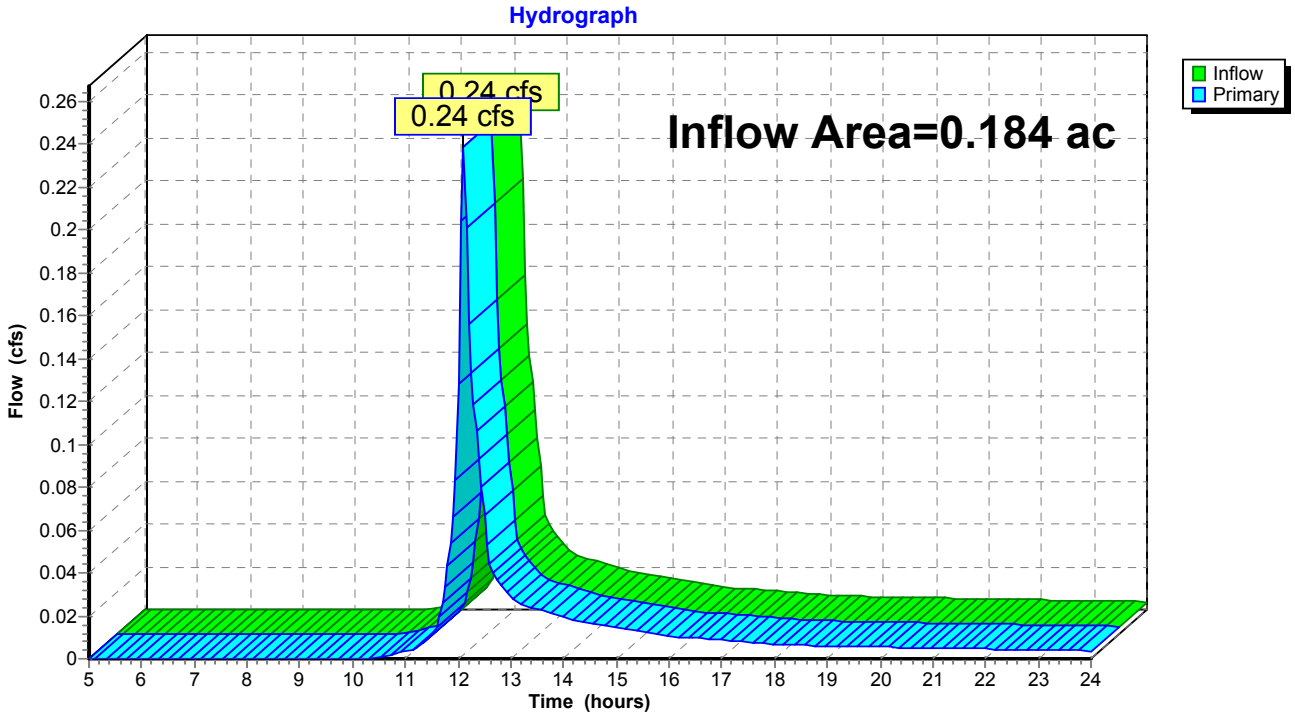


Link 1L: Predevelopment - offsite

Inflow Area = 0.184 ac, Inflow Depth = 1.17" for 2 Year Storm event
Inflow = 0.24 cfs @ 12.10 hrs, Volume= 0.018 af
Primary = 0.24 cfs @ 12.10 hrs, Volume= 0.018 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

Link 1L: Predevelopment - offsite



Time span=5.00-24.00 hrs, dt=0.05 hrs, 381 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Runoff Area=8,000 sf Runoff Depth=2.61"
Tc=6.0 min CN=75 Runoff=0.55 cfs 0.040 af

Link 1L: Predevelopment - offsite Inflow=0.55 cfs 0.040 af
Primary=0.55 cfs 0.040 af

Total Runoff Area = 0.184 ac Runoff Volume = 0.040 af Average Runoff Depth = 2.61"

Subcatchment 1S:

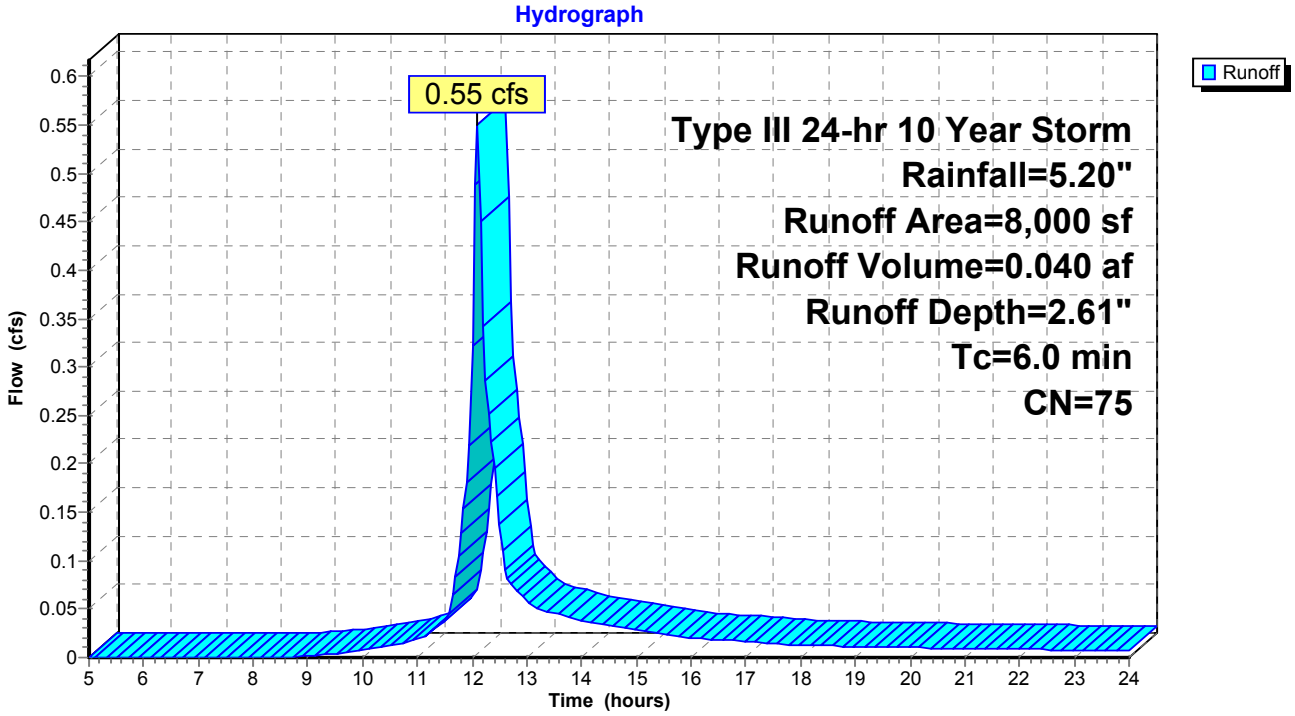
Runoff = 0.55 cfs @ 12.09 hrs, Volume= 0.040 af, Depth= 2.61"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Storm Rainfall=5.20"

Area (sf)	CN	Description
762	98	Existing Garage
1,324	98	driveway/walkways
1,300	60	Woods, Fair, HSG B
4,614	69	50-75% Grass cover, Fair, HSG B
8,000	75	Weighted Average

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

Subcatchment 1S:

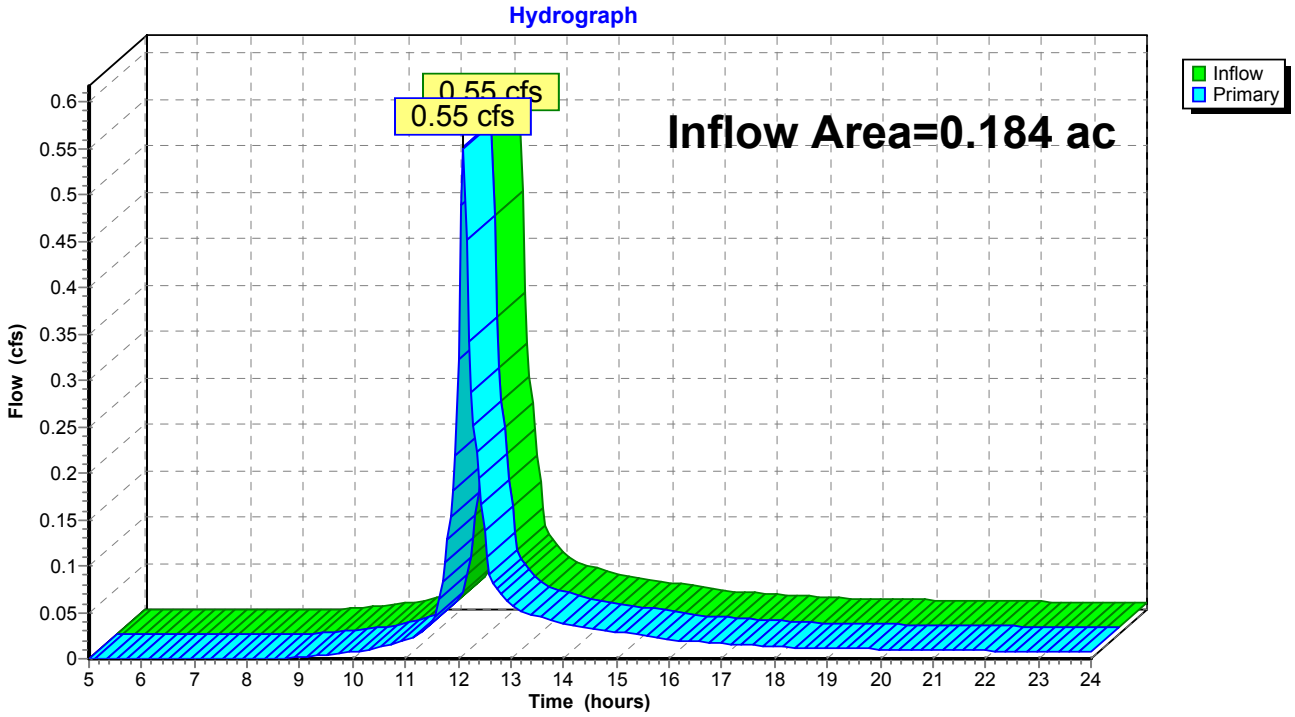


Link 1L: Predevelopment - offsite

Inflow Area = 0.184 ac, Inflow Depth = 2.61" for 10 Year Storm event
Inflow = 0.55 cfs @ 12.09 hrs, Volume= 0.040 af
Primary = 0.55 cfs @ 12.09 hrs, Volume= 0.040 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

Link 1L: Predevelopment - offsite



Time span=5.00-24.00 hrs, dt=0.05 hrs, 381 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Runoff Area=8,000 sf Runoff Depth=3.61"
Tc=6.0 min CN=75 Runoff=0.76 cfs 0.055 af

Link 1L: Predevelopment - offsite Inflow=0.76 cfs 0.055 af
Primary=0.76 cfs 0.055 af

Total Runoff Area = 0.184 ac Runoff Volume = 0.055 af Average Runoff Depth = 3.61"

Subcatchment 1S:

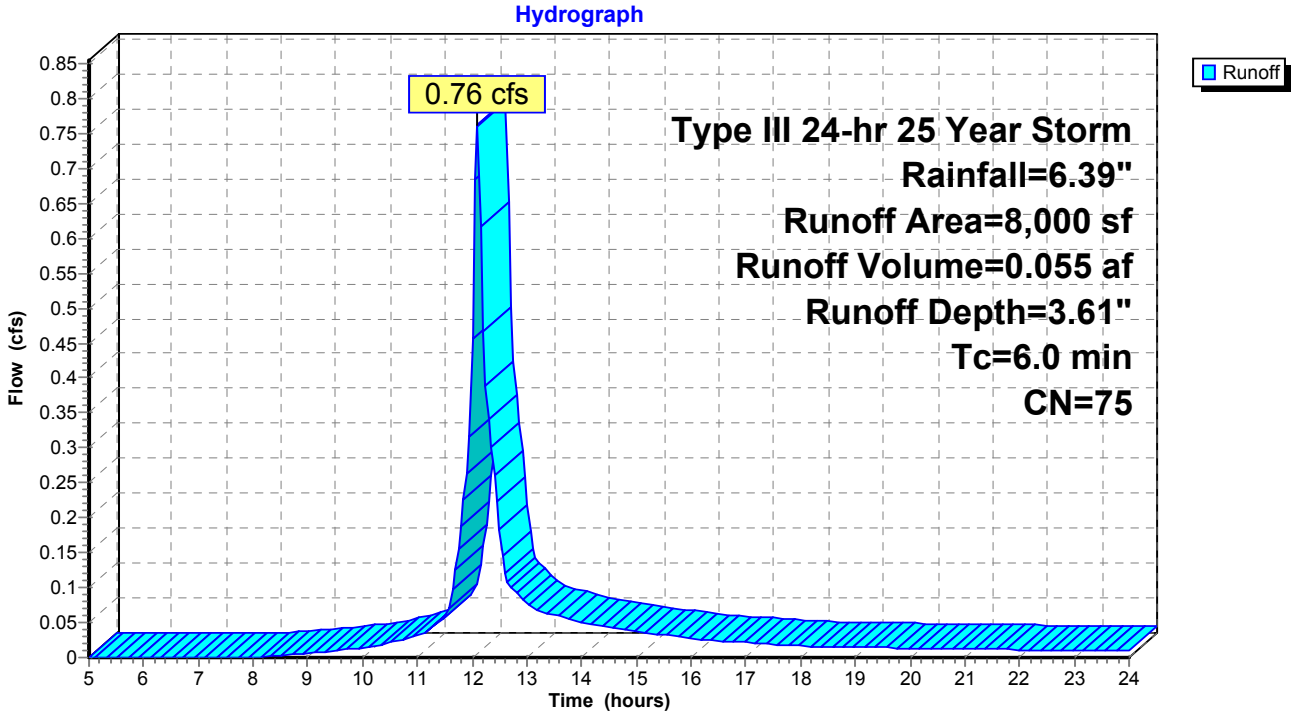
Runoff = 0.76 cfs @ 12.09 hrs, Volume= 0.055 af, Depth= 3.61"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=6.39"

Area (sf)	CN	Description
762	98	Existing Garage
1,324	98	driveway/walkways
1,300	60	Woods, Fair, HSG B
4,614	69	50-75% Grass cover, Fair, HSG B
8,000	75	Weighted Average

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

Subcatchment 1S:

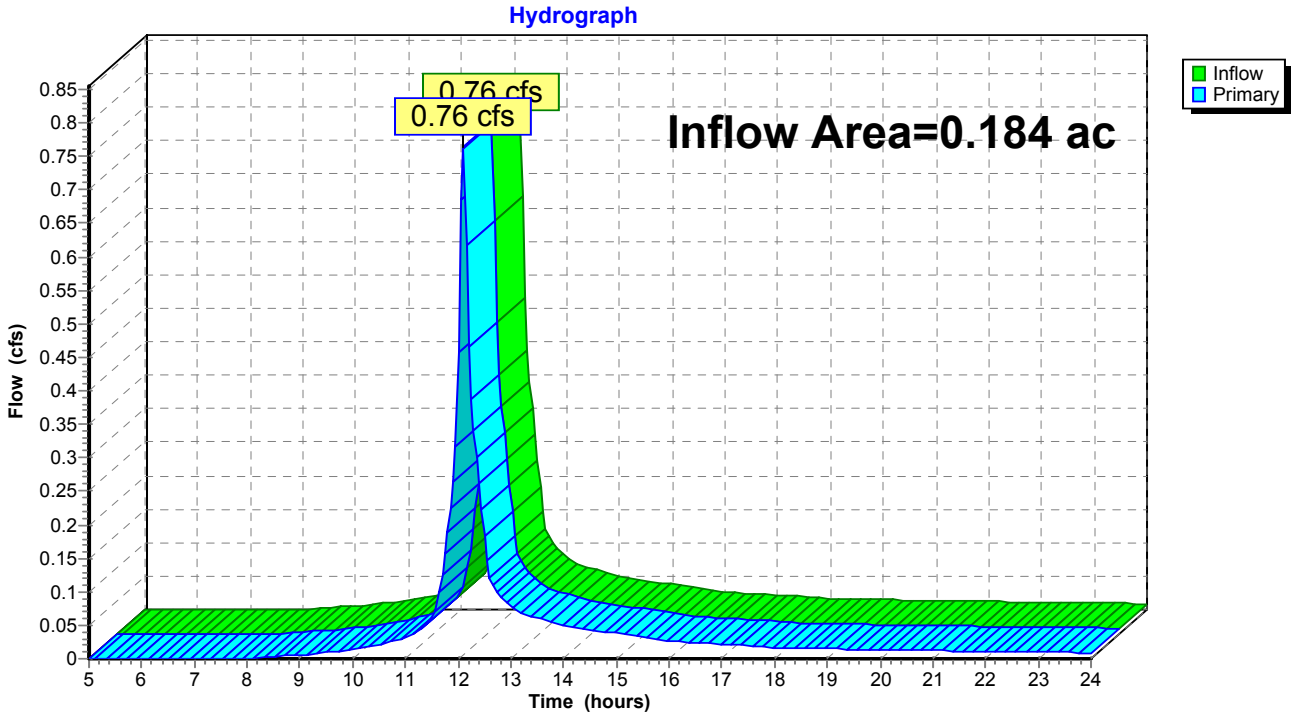


Link 1L: Predevelopment - offsite

Inflow Area = 0.184 ac, Inflow Depth = 3.61" for 25 Year Storm event
Inflow = 0.76 cfs @ 12.09 hrs, Volume= 0.055 af
Primary = 0.76 cfs @ 12.09 hrs, Volume= 0.055 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

Link 1L: Predevelopment - offsite



Time span=5.00-24.00 hrs, dt=0.05 hrs, 381 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Runoff Area=8,000 sf Runoff Depth=5.24"
Tc=6.0 min CN=75 Runoff=1.10 cfs 0.080 af

Link 1L: Predevelopment - offsite Inflow=1.10 cfs 0.080 af
Primary=1.10 cfs 0.080 af

Total Runoff Area = 0.184 ac Runoff Volume = 0.080 af Average Runoff Depth = 5.24"

Subcatchment 1S:

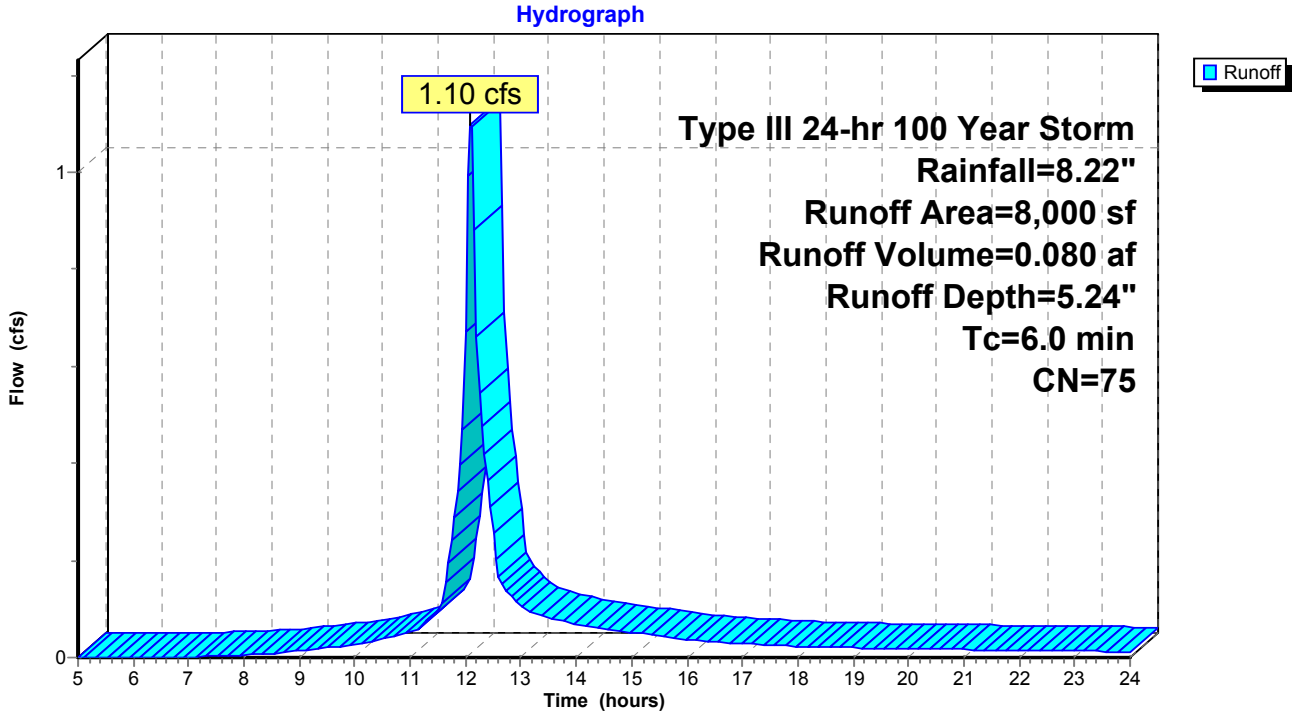
Runoff = 1.10 cfs @ 12.09 hrs, Volume= 0.080 af, Depth= 5.24"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=8.22"

Area (sf)	CN	Description
762	98	Existing Garage
1,324	98	driveway/walkways
1,300	60	Woods, Fair, HSG B
4,614	69	50-75% Grass cover, Fair, HSG B
8,000	75	Weighted Average

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

Subcatchment 1S:

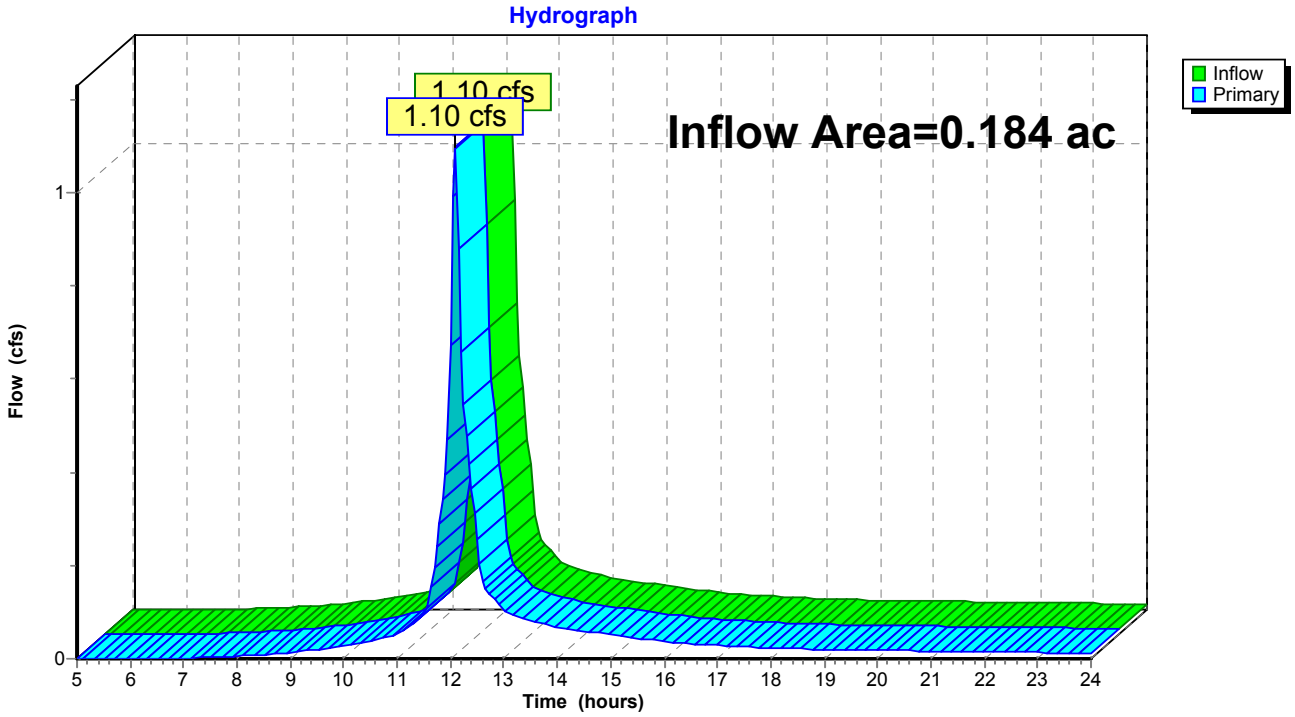


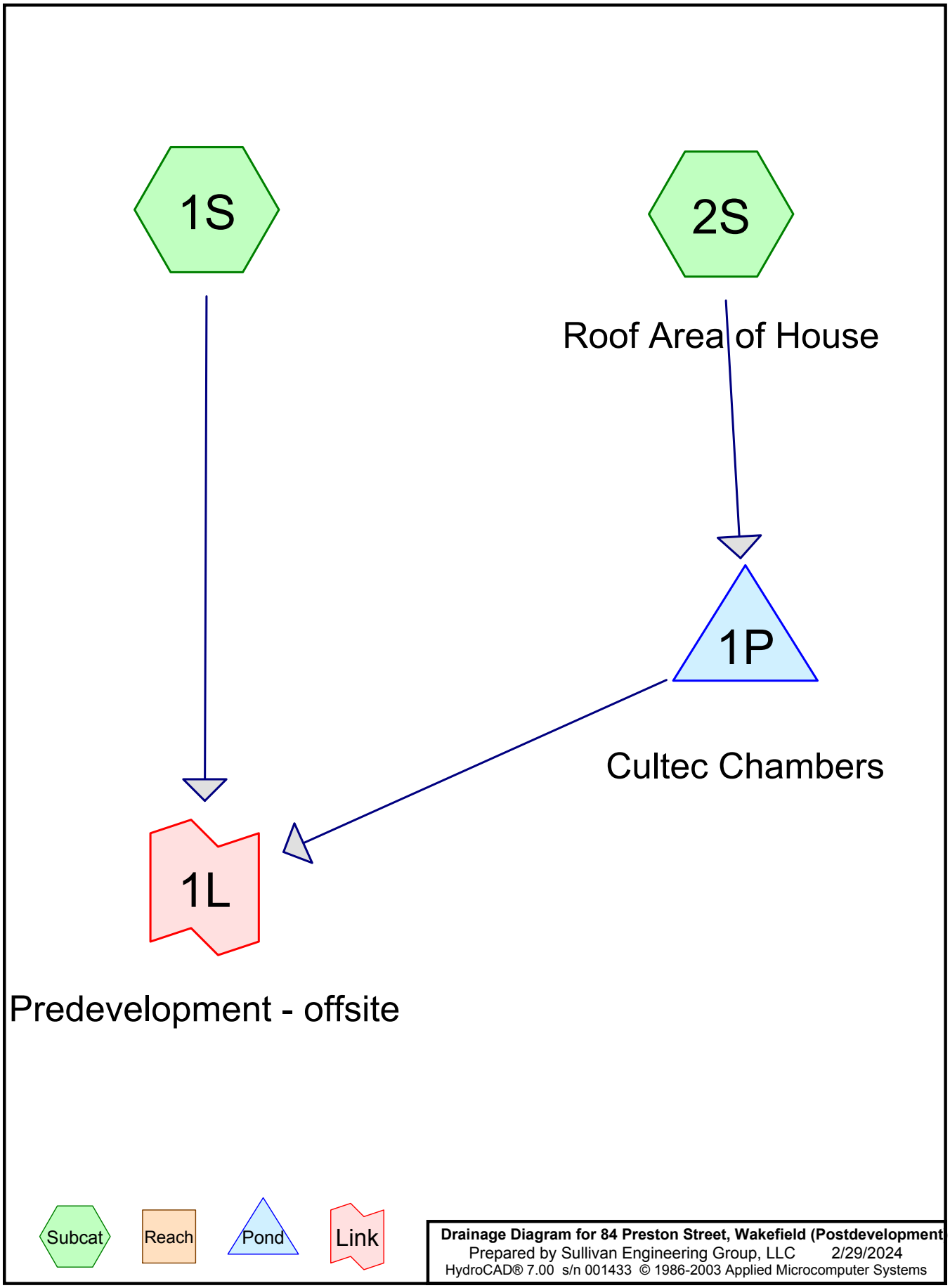
Link 1L: Predevelopment - offsite

Inflow Area = 0.184 ac, Inflow Depth = 5.24" for 100 Year Storm event
Inflow = 1.10 cfs @ 12.09 hrs, Volume= 0.080 af
Primary = 1.10 cfs @ 12.09 hrs, Volume= 0.080 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

Link 1L: Predevelopment - offsite





Drainage Diagram for 84 Preston Street, Wakefield (Postdevelopment)
Prepared by Sullivan Engineering Group, LLC 2/29/2024
HydroCAD® 7.00 s/n 001433 © 1986-2003 Applied Microcomputer Systems

Time span=5.00-24.00 hrs, dt=0.05 hrs, 381 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Runoff Area=5,648 sf Runoff Depth=0.94"
Tc=6.0 min CN=71 Runoff=0.13 cfs 0.010 af

Subcatchment 2S: Roof Area of House Runoff Area=2,352 sf Runoff Depth=3.02"
Tc=6.0 min CN=98 Runoff=0.17 cfs 0.014 af

Pond 1P: Cultec Chambers Peak Elev=99.41' Storage=187 cf Inflow=0.17 cfs 0.014 af
Discarded=0.02 cfs 0.014 af Primary=0.00 cfs 0.000 af Outflow=0.02 cfs 0.014 af

Link 1L: Predevelopment - offsite Inflow=0.13 cfs 0.010 af
Primary=0.13 cfs 0.010 af

Total Runoff Area = 0.184 ac Runoff Volume = 0.024 af Average Runoff Depth = 1.55"

Subcatchment 1S:

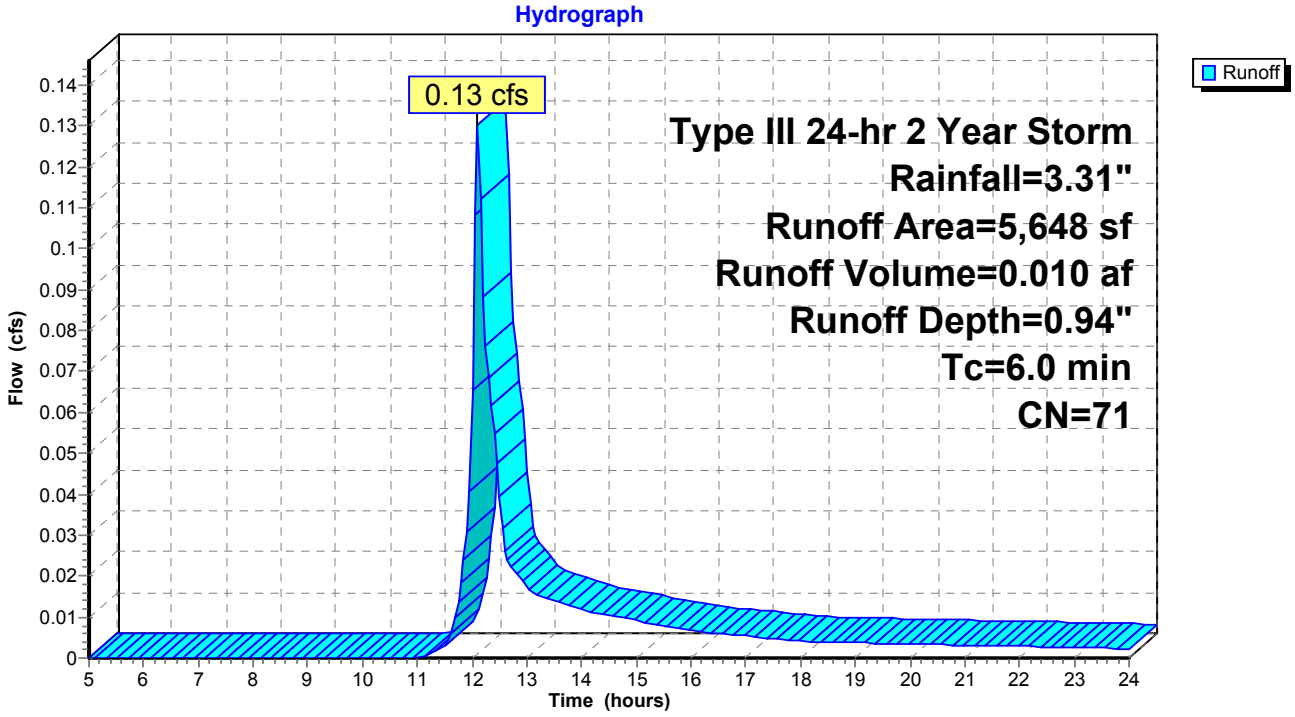
Runoff = 0.13 cfs @ 12.10 hrs, Volume= 0.010 af, Depth= 0.94"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Storm Rainfall=3.31"

Area (sf)	CN	Description
1,300	60	Woods, Fair, HSG B
3,548	69	50-75% Grass cover, Fair, HSG B
800	98	driveway/walkways
5,648	71	Weighted Average

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

Subcatchment 1S:



Subcatchment 2S: Roof Area of House

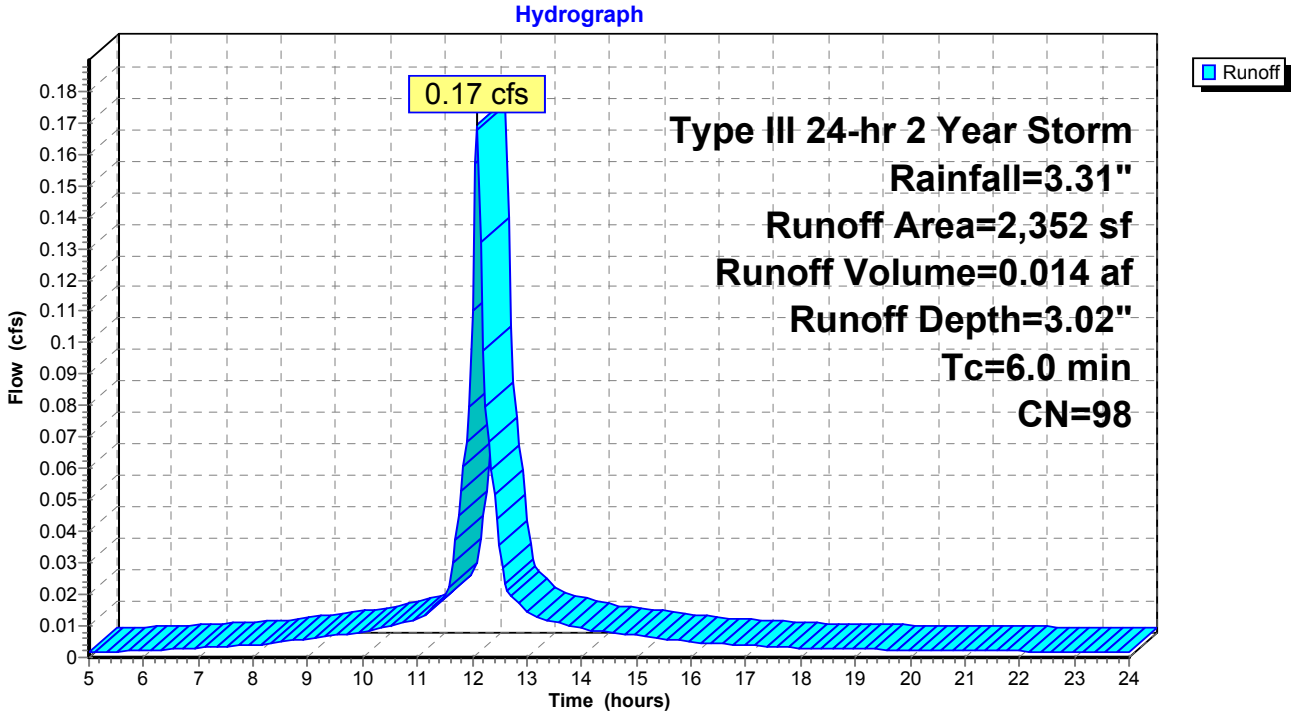
Runoff = 0.17 cfs @ 12.09 hrs, Volume= 0.014 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Storm Rainfall=3.31"

Area (sf)	CN	Description
2,352	98	Roof Area of House

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

Subcatchment 2S: Roof Area of House



Pond 1P: Cultec Chambers

Inflow Area =	0.054 ac,	Inflow Depth =	3.02"	for	2 Year Storm event
Inflow =	0.17 cfs @	12.09 hrs,	Volume=	0.014 af	
Outflow =	0.02 cfs @	11.60 hrs,	Volume=	0.014 af,	Atten= 88%, Lag= 0.0 min
Discarded =	0.02 cfs @	11.60 hrs,	Volume=	0.014 af	
Primary =	0.00 cfs @	5.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 99.41' @ 12.67 hrs Surf.Area= 368 sf Storage= 187 cf
Plug-Flow detention time= 59.1 min calculated for 0.014 af (100% of inflow)
Center-of-Mass det. time= 58.5 min (823.9 - 765.5)

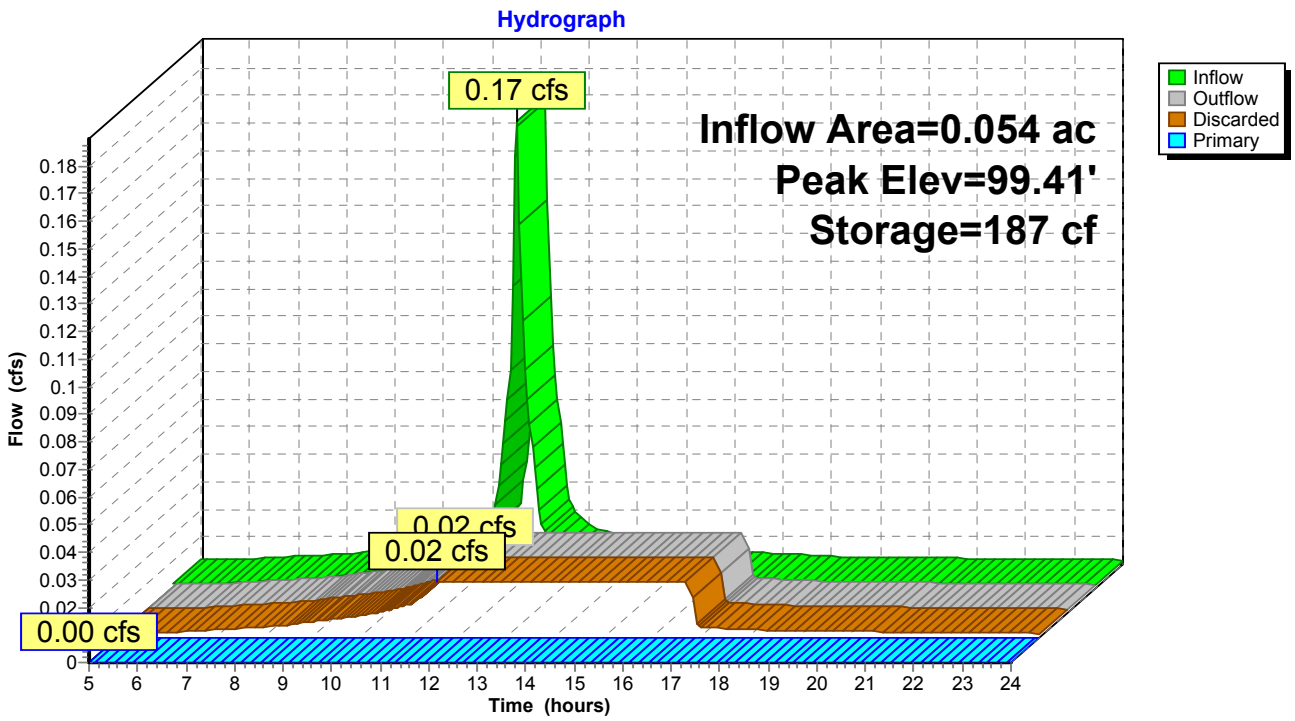
#	Invert	Avail.Storage	Storage Description
1	98.50'	233 cf	**4.00'W x 46.00'L x 2.04'H Prismatoid** x 2 751 cf Overall - 168 cf Embedded = 583 cf x 40.0% Voids
2	99.00'	168 cf	**32.1"W x 12.0"H x 7.50'L Cultec C-100** x 12 Inside #1
		401 cf	Total Available Storage

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.003347 fpm Exfiltration over entire Surface area**
2	Primary	100.00'	**4.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Discarded OutFlow Max=0.02 cfs @ 11.60 hrs HW=98.52' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=98.50' (Free Discharge)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 1P: Cultec Chambers

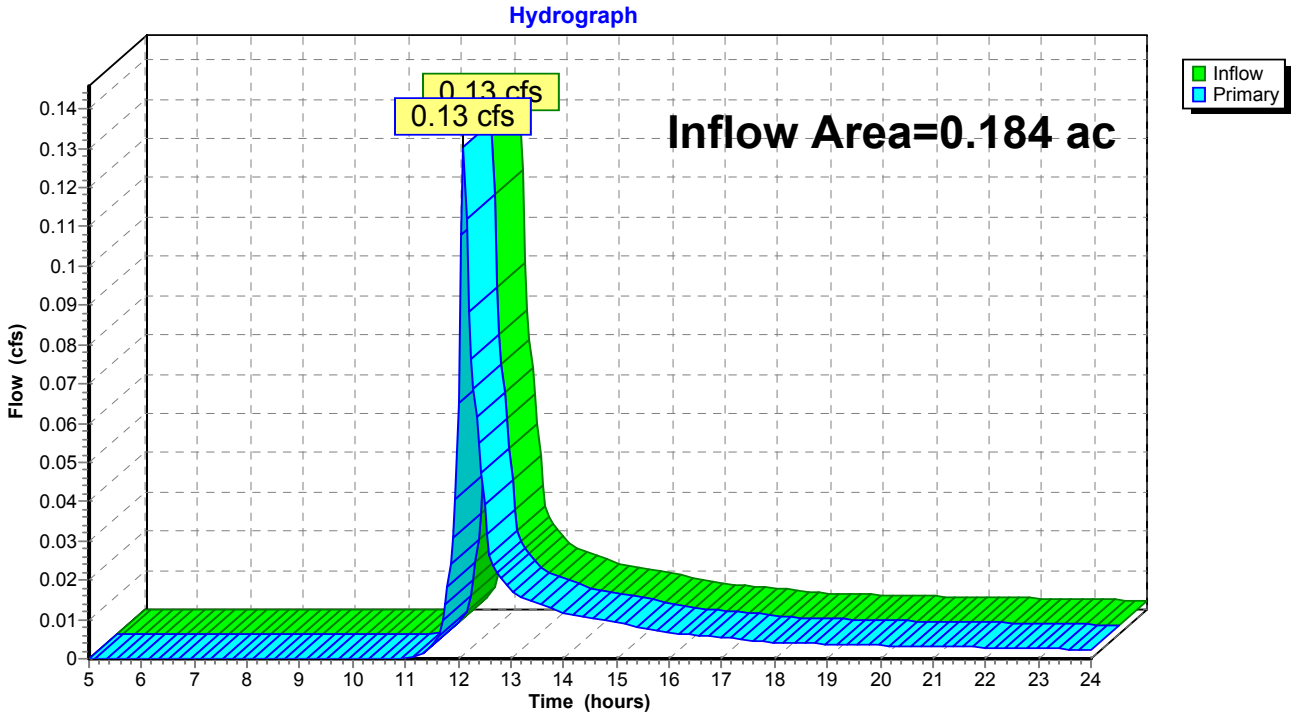


Link 1L: Predevelopment - offsite

Inflow Area = 0.184 ac, Inflow Depth = 0.67" for 2 Year Storm event
Inflow = 0.13 cfs @ 12.10 hrs, Volume= 0.010 af
Primary = 0.13 cfs @ 12.10 hrs, Volume= 0.010 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

Link 1L: Predevelopment - offsite



Time span=5.00-24.00 hrs, dt=0.05 hrs, 381 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Runoff Area=5,648 sf Runoff Depth=2.27"
Tc=6.0 min CN=71 Runoff=0.34 cfs 0.024 af

Subcatchment 2S: Roof Area of House Runoff Area=2,352 sf Runoff Depth=4.83"
Tc=6.0 min CN=98 Runoff=0.27 cfs 0.022 af

Pond 1P: Cultec Chambers Peak Elev=100.05' Storage=329 cf Inflow=0.27 cfs 0.022 af
Discarded=0.02 cfs 0.021 af Primary=0.04 cfs 0.001 af Outflow=0.06 cfs 0.022 af

Link 1L: Predevelopment - offsite Inflow=0.34 cfs 0.025 af
Primary=0.34 cfs 0.025 af

Total Runoff Area = 0.184 ac Runoff Volume = 0.046 af Average Runoff Depth = 3.02"

Subcatchment 1S:

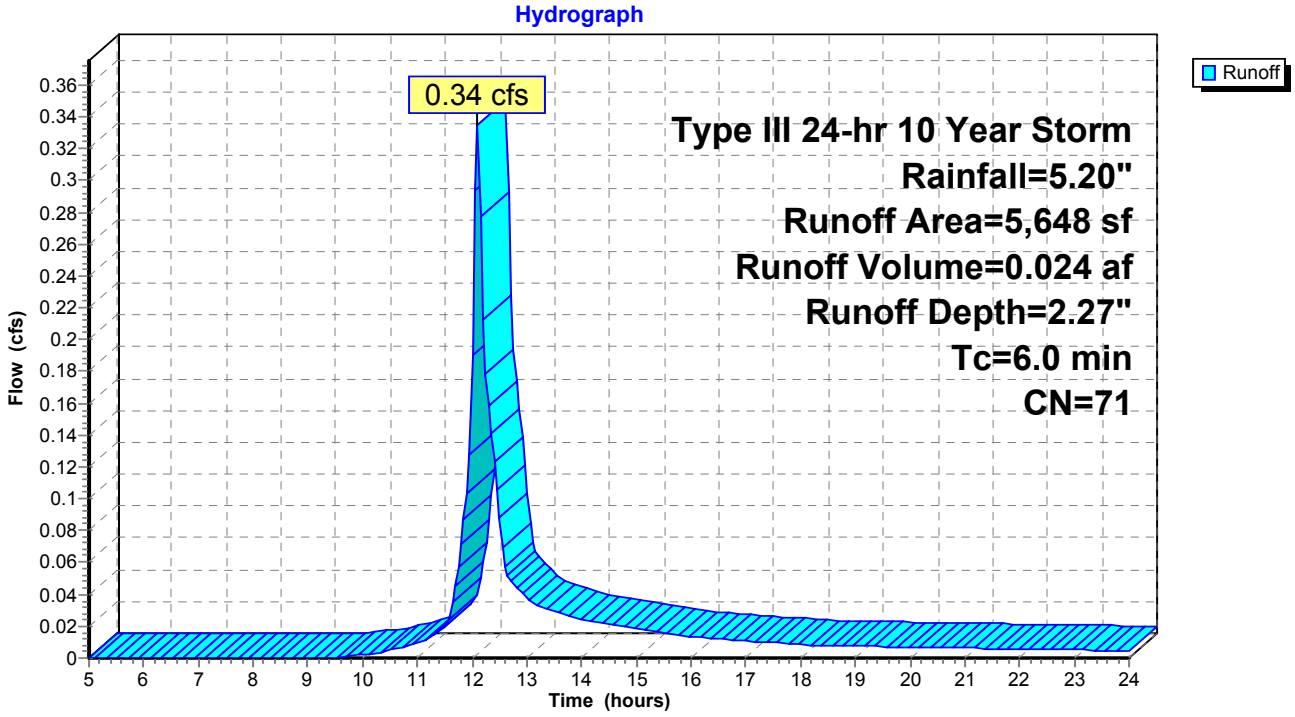
Runoff = 0.34 cfs @ 12.10 hrs, Volume= 0.024 af, Depth= 2.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Storm Rainfall=5.20"

Area (sf)	CN	Description
1,300	60	Woods, Fair, HSG B
3,548	69	50-75% Grass cover, Fair, HSG B
800	98	driveway/walkways
5,648	71	Weighted Average

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

Subcatchment 1S:



Subcatchment 2S: Roof Area of House

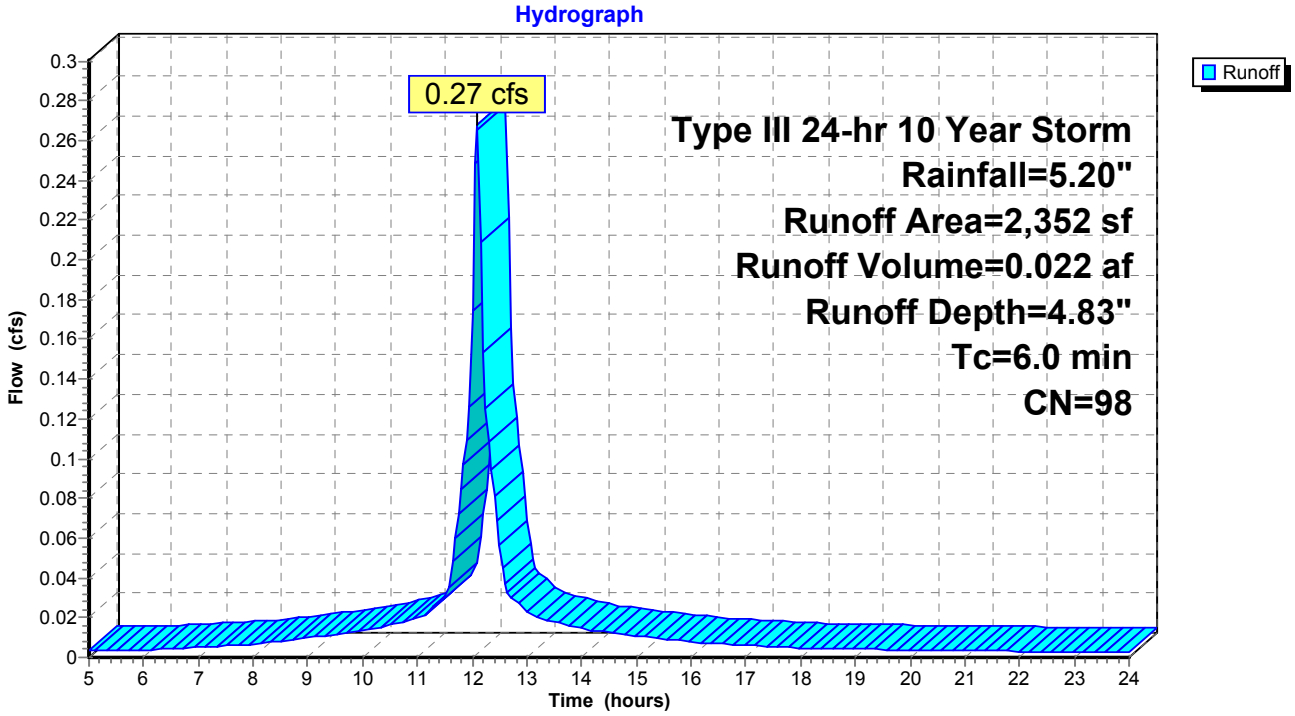
Runoff = 0.27 cfs @ 12.09 hrs, Volume= 0.022 af, Depth= 4.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Storm Rainfall=5.20"

Area (sf)	CN	Description
2,352	98	Roof Area of House

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

Subcatchment 2S: Roof Area of House



Pond 1P: Cultec Chambers

Inflow Area =	0.054 ac,	Inflow Depth =	4.83"	for	10 Year Storm event
Inflow =	0.27 cfs @	12.09 hrs,	Volume=	0.022 af	
Outflow =	0.06 cfs @	12.49 hrs,	Volume=	0.022 af,	Atten= 77%, Lag= 24.2 min
Discarded =	0.02 cfs @	11.15 hrs,	Volume=	0.021 af	
Primary =	0.04 cfs @	12.49 hrs,	Volume=	0.001 af	

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 100.05' @ 12.49 hrs Surf.Area= 368 sf Storage= 329 cf
Plug-Flow detention time= 111.5 min calculated for 0.022 af (100% of inflow)
Center-of-Mass det. time= 111.0 min (872.9 - 761.8)

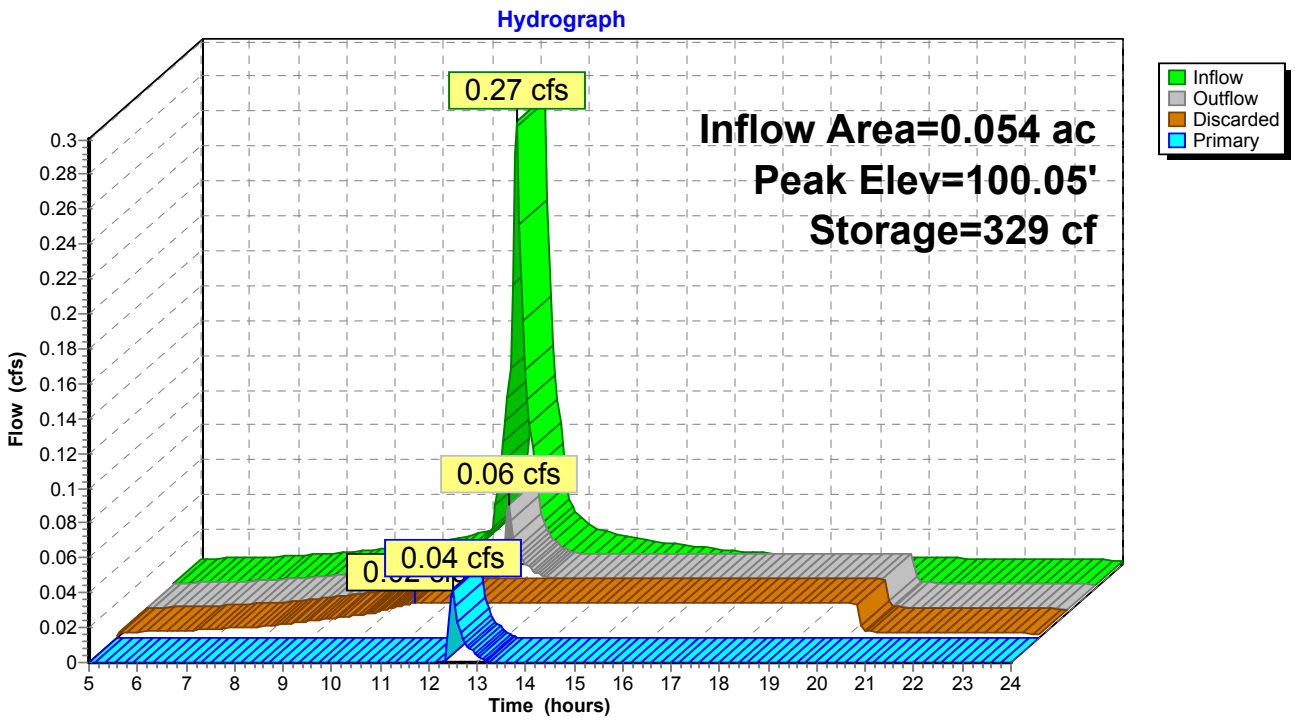
#	Invert	Avail.Storage	Storage Description
1	98.50'	233 cf	**4.00'W x 46.00'L x 2.04'H Prismatoid** x 2 751 cf Overall - 168 cf Embedded = 583 cf x 40.0% Voids
2	99.00'	168 cf	**32.1"W x 12.0"H x 7.50'L Cultec C-100** x 12 Inside #1
		401 cf	Total Available Storage

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.003347 fpm Exfiltration over entire Surface area**
2	Primary	100.00'	**4.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Discarded OutFlow Max=0.02 cfs @ 11.15 hrs HW=98.52' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.04 cfs @ 12.49 hrs HW=100.05' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 0.04 cfs @ 0.7 fps)

Pond 1P: Cultec Chambers

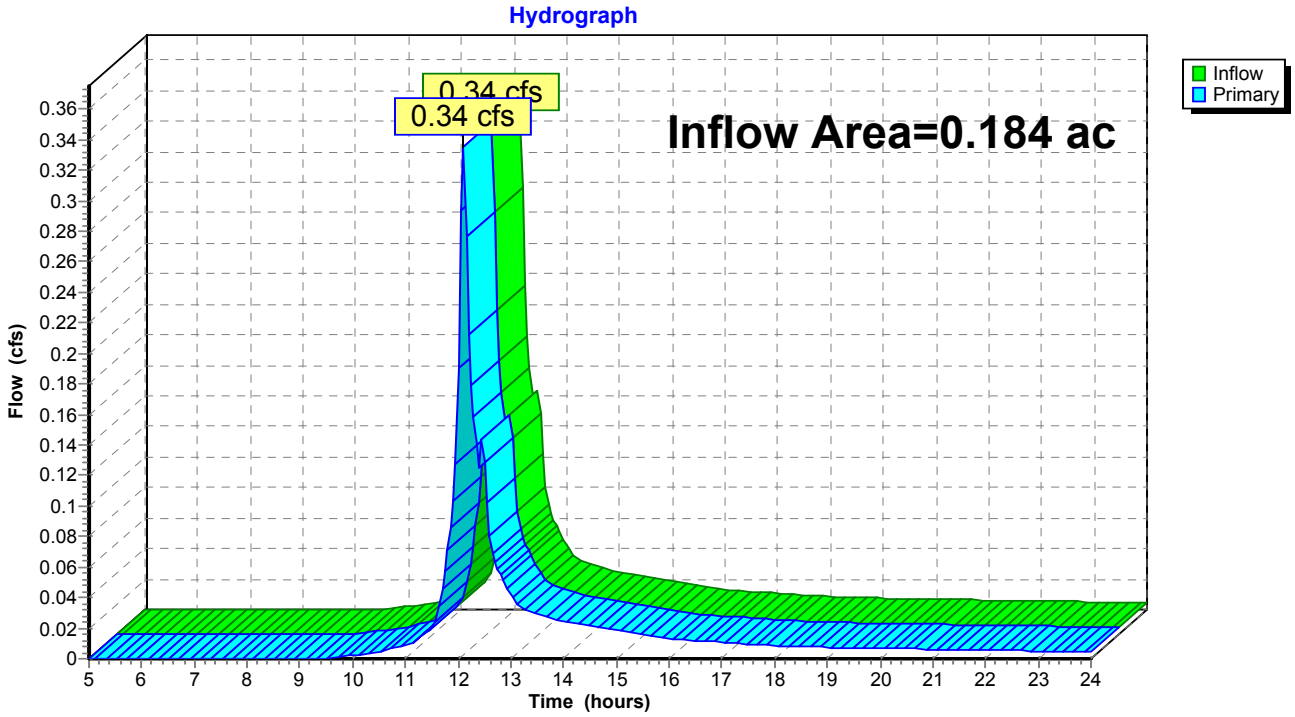


Link 1L: Predevelopment - offsite

Inflow Area = 0.184 ac, Inflow Depth = 1.66" for 10 Year Storm event
Inflow = 0.34 cfs @ 12.10 hrs, Volume= 0.025 af
Primary = 0.34 cfs @ 12.10 hrs, Volume= 0.025 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

Link 1L: Predevelopment - offsite



Time span=5.00-24.00 hrs, dt=0.05 hrs, 381 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Runoff Area=5,648 sf Runoff Depth=3.21"
Tc=6.0 min CN=71 Runoff=0.48 cfs 0.035 af

Subcatchment 2S: Roof Area of House Runoff Area=2,352 sf Runoff Depth=5.96"
Tc=6.0 min CN=98 Runoff=0.33 cfs 0.027 af

Pond 1P: Cultec Chambers Peak Elev=100.13' Storage=340 cf Inflow=0.33 cfs 0.027 af
Discarded=0.02 cfs 0.023 af Primary=0.15 cfs 0.004 af Outflow=0.17 cfs 0.027 af

Link 1L: Predevelopment - offsite Inflow=0.48 cfs 0.039 af
Primary=0.48 cfs 0.039 af

Total Runoff Area = 0.184 ac Runoff Volume = 0.062 af Average Runoff Depth = 4.02"

Subcatchment 1S:

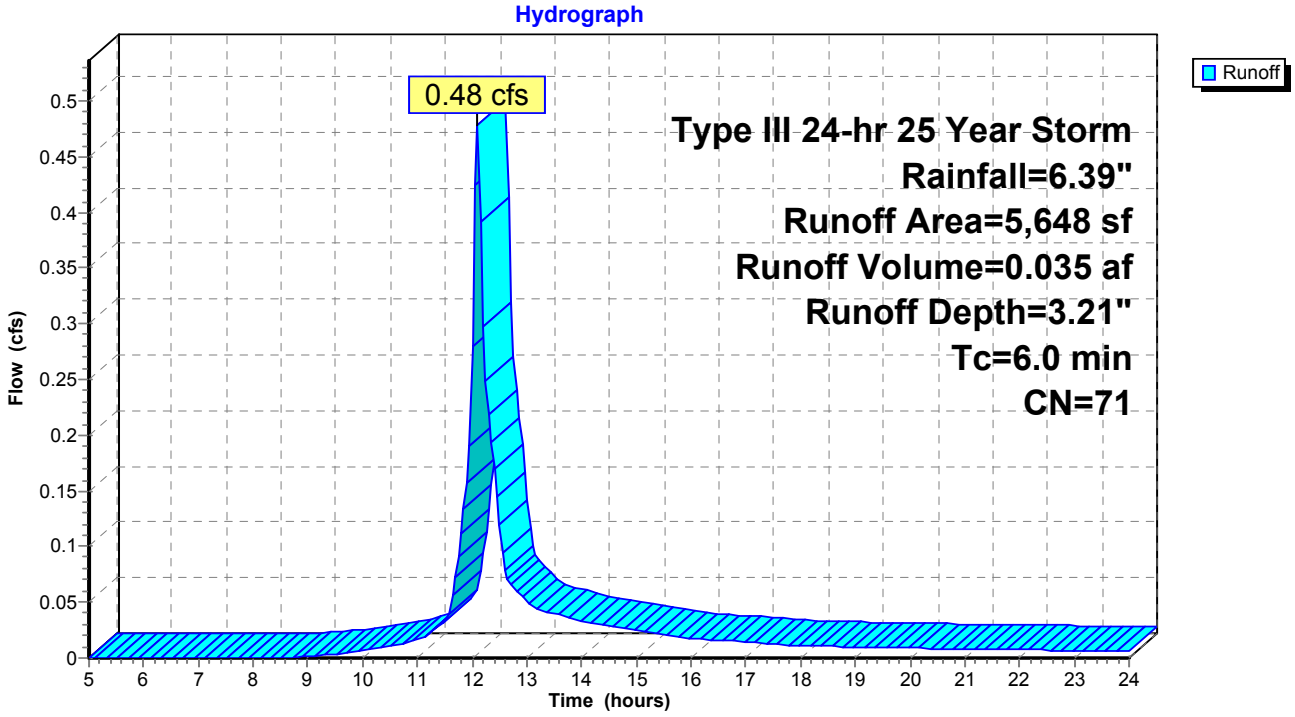
Runoff = 0.48 cfs @ 12.09 hrs, Volume= 0.035 af, Depth= 3.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=6.39"

Area (sf)	CN	Description
1,300	60	Woods, Fair, HSG B
3,548	69	50-75% Grass cover, Fair, HSG B
800	98	driveway/walkways
5,648	71	Weighted Average

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

Subcatchment 1S:



Subcatchment 2S: Roof Area of House

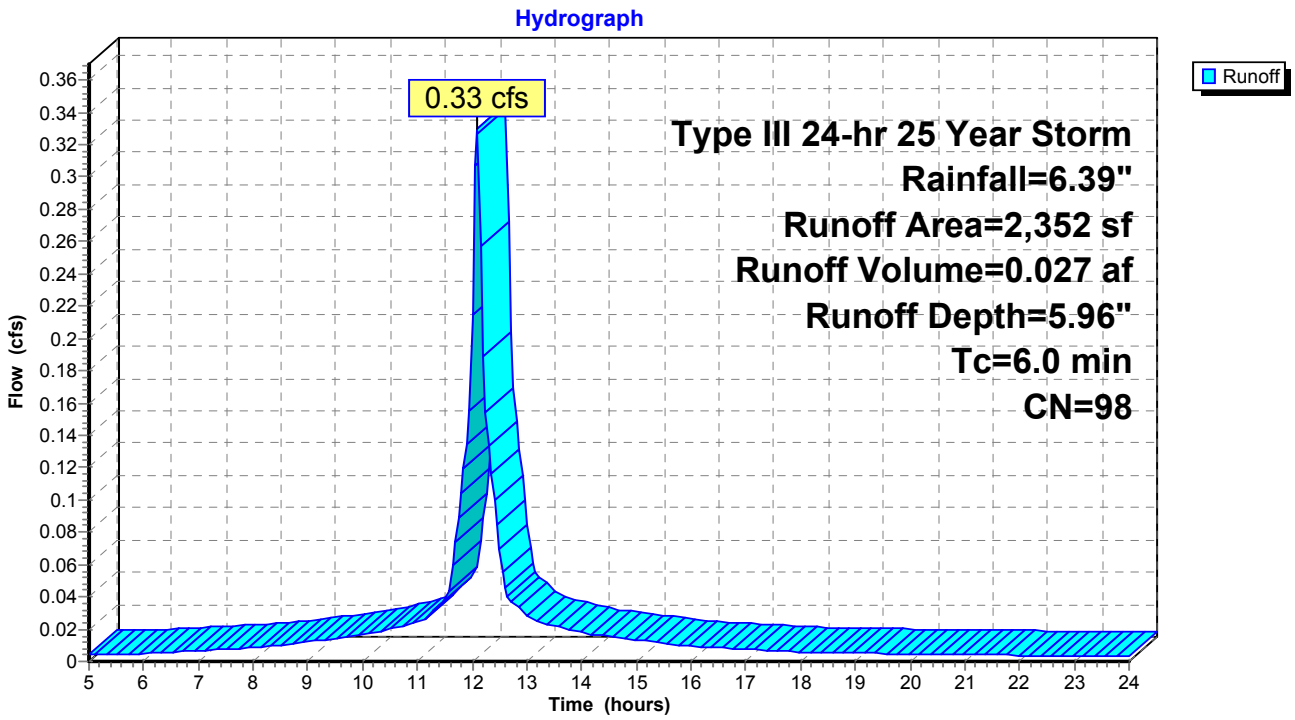
Runoff = 0.33 cfs @ 12.09 hrs, Volume= 0.027 af, Depth= 5.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=6.39"

Area (sf)	CN	Description
2,352	98	Roof Area of House

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

Subcatchment 2S: Roof Area of House



Pond 1P: Cultec Chambers

Inflow Area =	0.054 ac,	Inflow Depth =	5.96"	for	25 Year Storm event
Inflow =	0.33 cfs @	12.09 hrs,	Volume=	0.027 af	
Outflow =	0.17 cfs @	12.26 hrs,	Volume=	0.027 af,	Atten= 48%, Lag= 10.7 min
Discarded =	0.02 cfs @	10.60 hrs,	Volume=	0.023 af	
Primary =	0.15 cfs @	12.26 hrs,	Volume=	0.004 af	

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 100.13' @ 12.26 hrs Surf.Area= 368 sf Storage= 340 cf
Plug-Flow detention time= 103.6 min calculated for 0.027 af (100% of inflow)
Center-of-Mass det. time= 102.9 min (863.6 - 760.8)

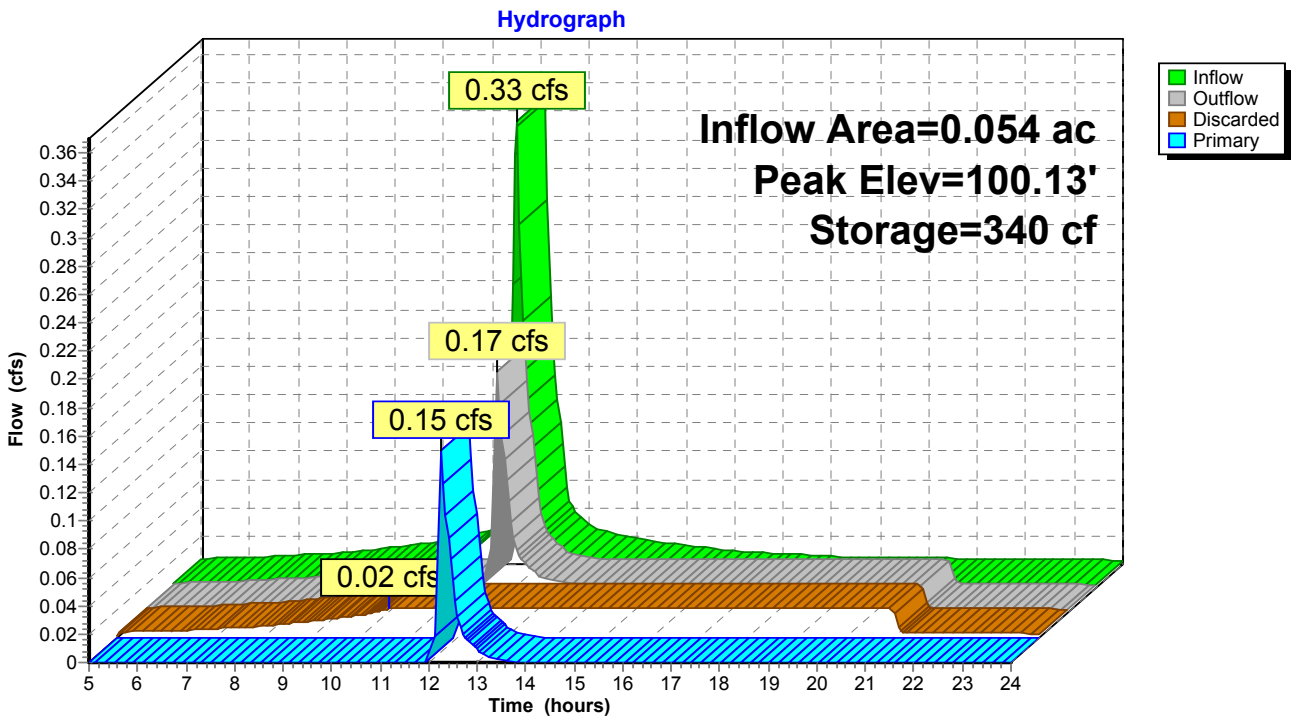
#	Invert	Avail.Storage	Storage Description
1	98.50'	233 cf	**4.00'W x 46.00'L x 2.04'H Prismatoid** x 2 751 cf Overall - 168 cf Embedded = 583 cf x 40.0% Voids
2	99.00'	168 cf	**32.1"W x 12.0"H x 7.50'L Cultec C-100** x 12 Inside #1
		401 cf	Total Available Storage

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.003347 fpm Exfiltration over entire Surface area**
2	Primary	100.00'	**4.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Discarded OutFlow Max=0.02 cfs @ 10.60 hrs HW=98.52' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.15 cfs @ 12.26 hrs HW=100.12' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 0.15 cfs @ 1.1 fps)

Pond 1P: Cultec Chambers

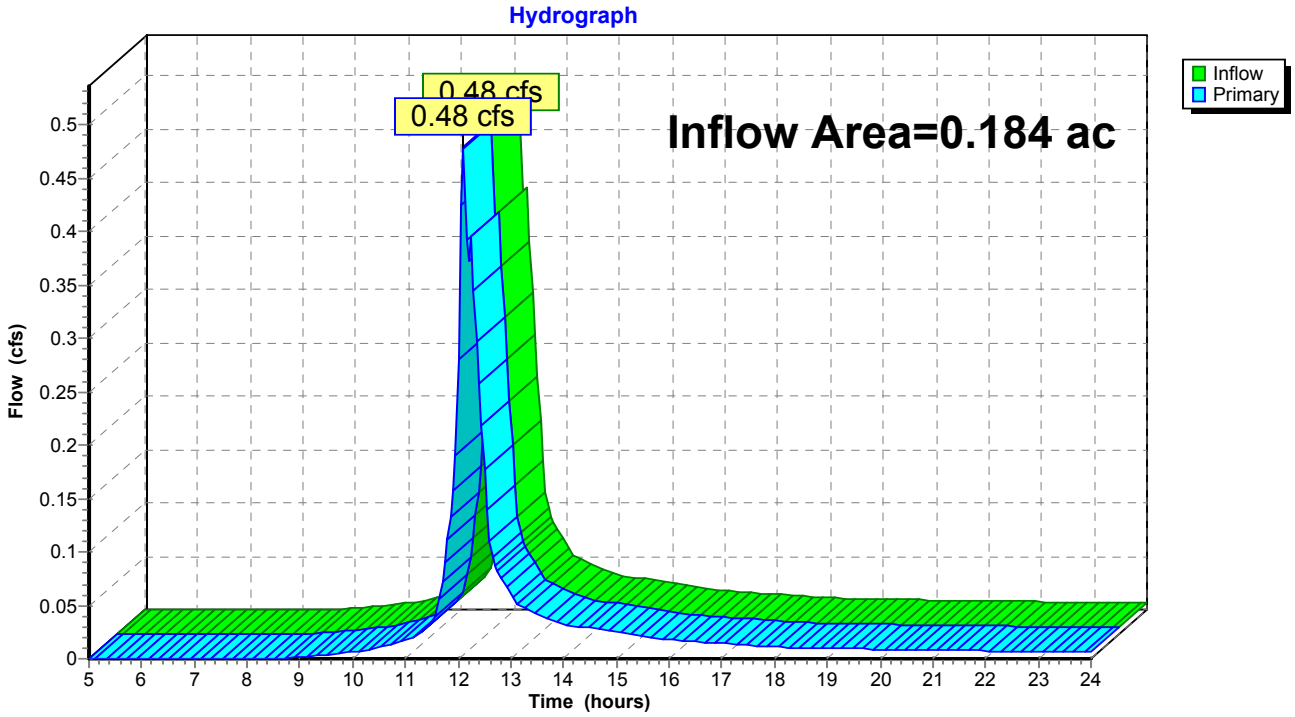


Link 1L: Predevelopment - offsite

Inflow Area = 0.184 ac, Inflow Depth = 2.52" for 25 Year Storm event
Inflow = 0.48 cfs @ 12.09 hrs, Volume= 0.039 af
Primary = 0.48 cfs @ 12.09 hrs, Volume= 0.039 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

Link 1L: Predevelopment - offsite



Time span=5.00-24.00 hrs, dt=0.05 hrs, 381 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Runoff Area=5,648 sf Runoff Depth=4.77"
Tc=6.0 min CN=71 Runoff=0.71 cfs 0.052 af

Subcatchment 2S: Roof Area of House Runoff Area=2,352 sf Runoff Depth=7.70"
Tc=6.0 min CN=98 Runoff=0.43 cfs 0.035 af

Pond 1P: Cultec Chambers Peak Elev=100.38' Storage=377 cf Inflow=0.43 cfs 0.035 af
Discarded=0.02 cfs 0.026 af Primary=0.26 cfs 0.009 af Outflow=0.28 cfs 0.035 af

Link 1L: Predevelopment - offsite Inflow=0.91 cfs 0.060 af
Primary=0.91 cfs 0.060 af

Total Runoff Area = 0.184 ac Runoff Volume = 0.086 af Average Runoff Depth = 5.63"

Subcatchment 1S:

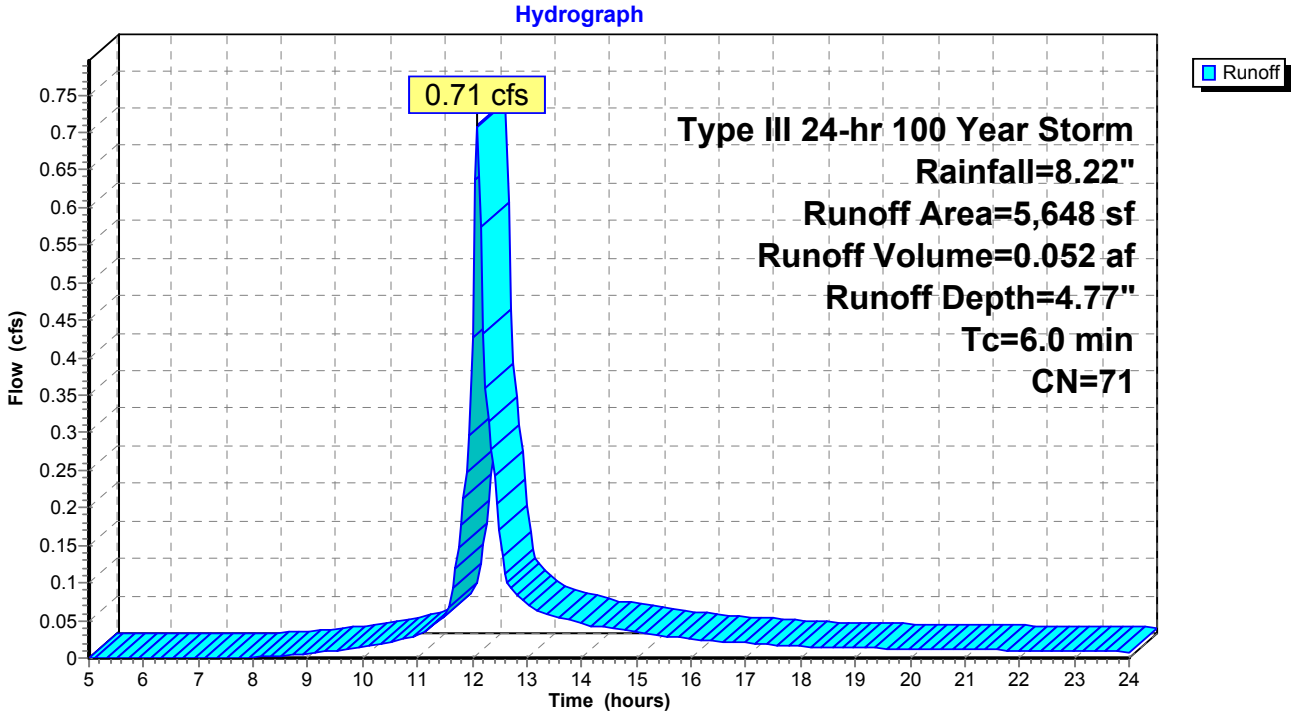
Runoff = 0.71 cfs @ 12.09 hrs, Volume= 0.052 af, Depth= 4.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=8.22"

Area (sf)	CN	Description
1,300	60	Woods, Fair, HSG B
3,548	69	50-75% Grass cover, Fair, HSG B
800	98	driveway/walkways
5,648	71	Weighted Average

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

Subcatchment 1S:



Subcatchment 2S: Roof Area of House

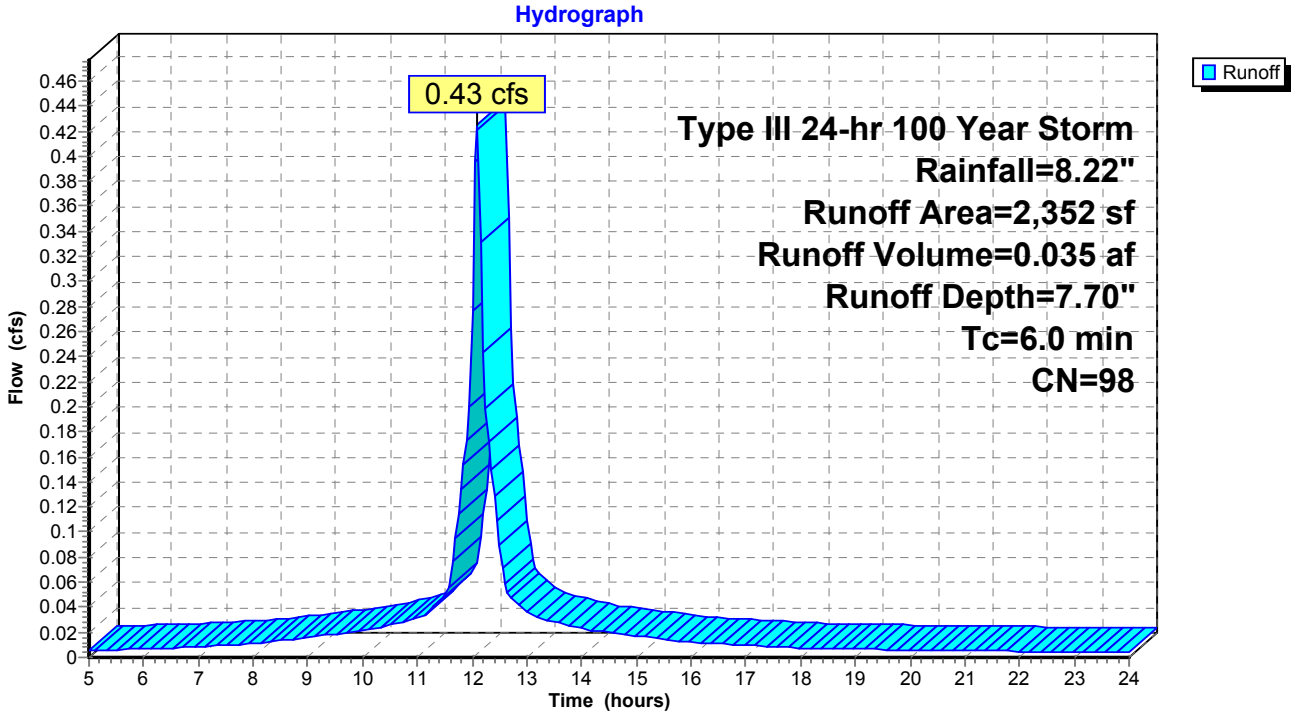
Runoff = 0.43 cfs @ 12.09 hrs, Volume= 0.035 af, Depth= 7.70"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=8.22"

Area (sf)	CN	Description
2,352	98	Roof Area of House

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

Subcatchment 2S: Roof Area of House



Pond 1P: Cultec Chambers

Inflow Area =	0.054 ac,	Inflow Depth =	7.70"	for	100 Year Storm event
Inflow =	0.43 cfs @	12.09 hrs,	Volume=	0.035 af	
Outflow =	0.28 cfs @	12.18 hrs,	Volume=	0.035 af,	Atten= 34%, Lag= 5.9 min
Discarded =	0.02 cfs @	9.95 hrs,	Volume=	0.026 af	
Primary =	0.26 cfs @	12.18 hrs,	Volume=	0.009 af	

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 100.38' @ 12.18 hrs Surf.Area= 368 sf Storage= 377 cf
Plug-Flow detention time= 94.5 min calculated for 0.035 af (100% of inflow)
Center-of-Mass det. time= 94.0 min (853.8 - 759.8)

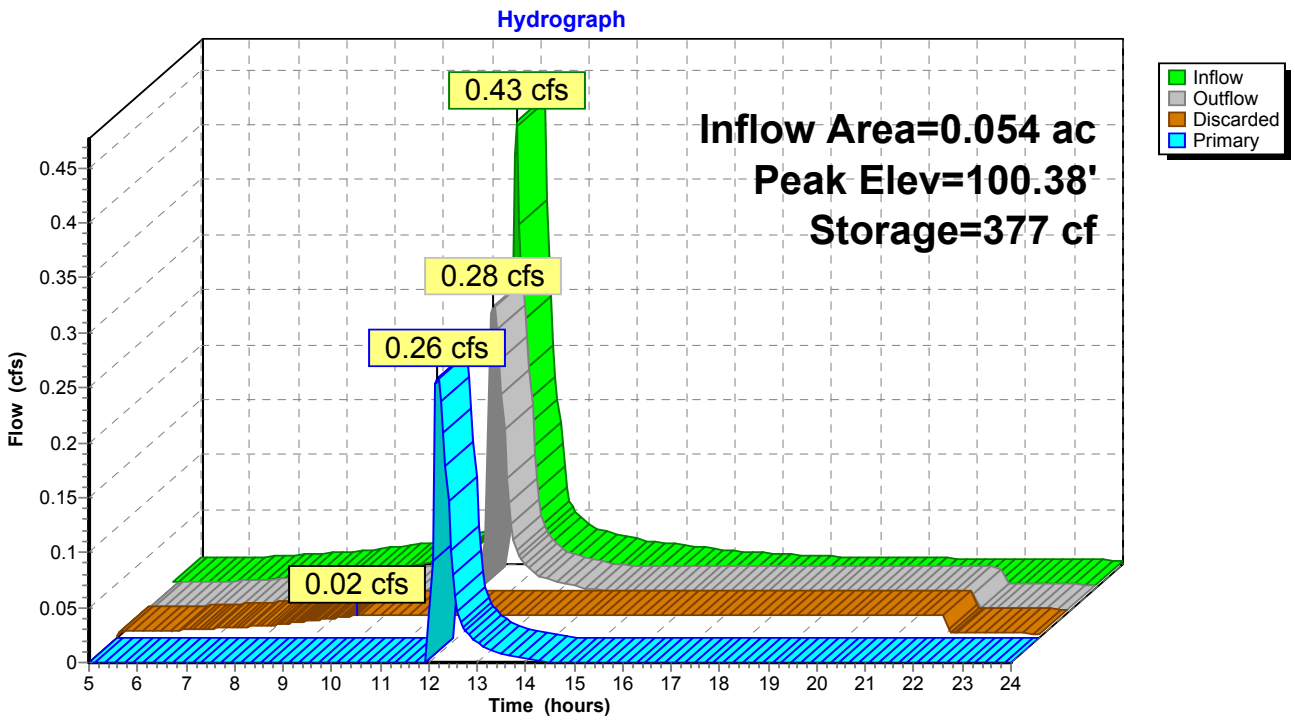
#	Invert	Avail.Storage	Storage Description
1	98.50'	233 cf	**4.00'W x 46.00'L x 2.04'H Prismatoid** x 2 751 cf Overall - 168 cf Embedded = 583 cf x 40.0% Voids
2	99.00'	168 cf	**32.1"W x 12.0"H x 7.50'L Cultec C-100** x 12 Inside #1
		401 cf	Total Available Storage

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.003347 fpm Exfiltration over entire Surface area**
2	Primary	100.00'	**4.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Discarded OutFlow Max=0.02 cfs @ 9.95 hrs HW=98.52' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.26 cfs @ 12.18 hrs HW=100.37' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 0.26 cfs @ 2.9 fps)

Pond 1P: Cultec Chambers

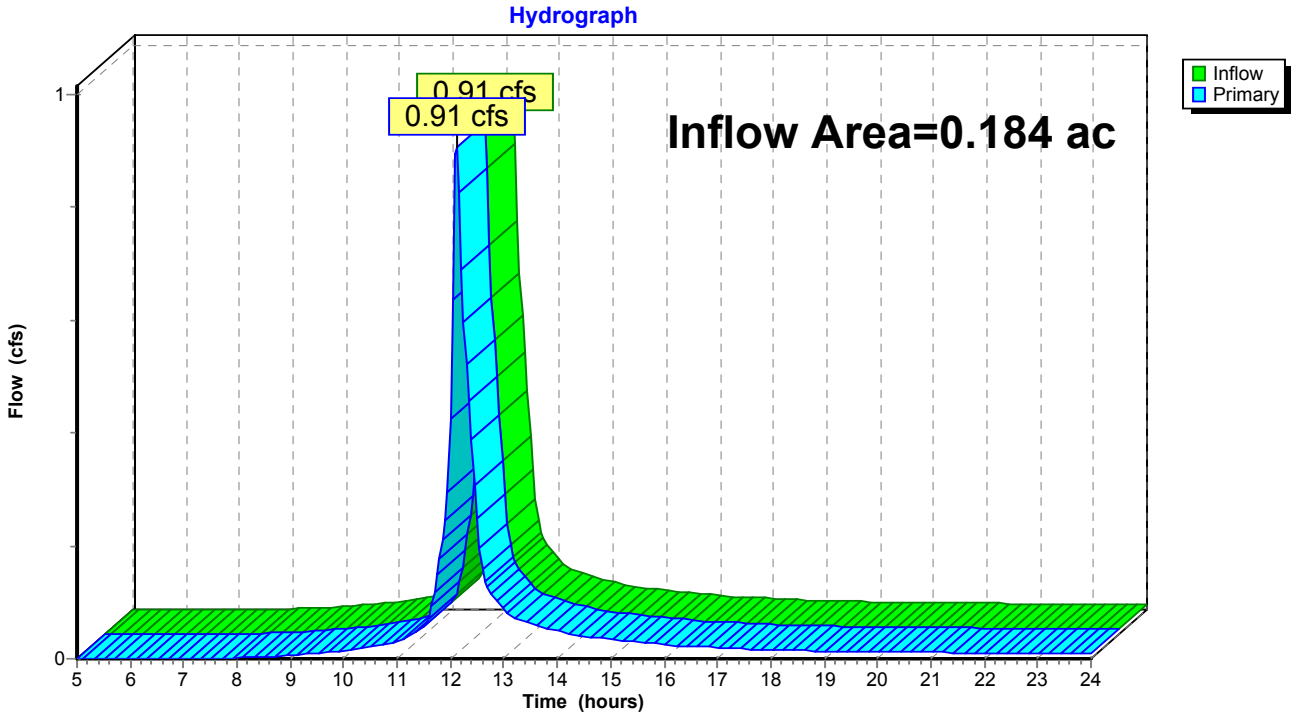


Link 1L: Predevelopment - offsite

Inflow Area = 0.184 ac, Inflow Depth = 3.94" for 100 Year Storm event
Inflow = 0.91 cfs @ 12.11 hrs, Volume= 0.060 af
Primary = 0.91 cfs @ 12.11 hrs, Volume= 0.060 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

Link 1L: Predevelopment - offsite



Soil Map—Middlesex County, Massachusetts

Map Scale: 1:2,130 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 100 200 400 600

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

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

Special Point Features

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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 23, Sep 12, 2023

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

Date(s) aerial images were photographed: Mar 1, 2023—Sep 1, 2023

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
52A	Freetown muck, 0 to 1 percent slopes	3.6	16.2%
602	Urban land	0.7	3.3%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	15.3	69.1%
631C	Charlton-Urban land-Hollis complex, 3 to 15 percent slopes, rocky	2.5	11.4%
Totals for Area of Interest		**22.2**	**100.0%**

NOAA Atlas 14, Volume 10, Version 3
Location name: Wakefield, Massachusetts, USA*
Latitude: 42.5097°, Longitude: -71.0595°
Elevation: 62 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.309 (0.237-0.393)	0.373 (0.286-0.475)	0.478 (0.366-0.612)	0.566 (0.431-0.727)	0.686 (0.508-0.925)	0.776 (0.565-1.07)	0.872 (0.620-1.25)	0.986 (0.661-1.44)	1.16 (0.747-1.74)	1.30 (0.822-2.00)
10-min	0.437 (0.336-0.556)	0.528 (0.405-0.673)	0.677 (0.517-0.866)	0.801 (0.609-1.03)	0.972 (0.720-1.31)	1.10 (0.799-1.51)	1.24 (0.878-1.77)	1.40 (0.935-2.03)	1.64 (1.06-2.47)	1.84 (1.16-2.83)
15-min	0.514 (0.395-0.655)	0.622 (0.477-0.792)	0.798 (0.611-1.02)	0.944 (0.718-1.21)	1.14 (0.847-1.54)	1.29 (0.941-1.78)	1.45 (1.03-2.08)	1.64 (1.10-2.39)	1.93 (1.25-2.90)	2.17 (1.37-3.33)
30-min	0.707 (0.543-0.900)	0.856 (0.657-1.09)	1.10 (0.840-1.40)	1.30 (0.989-1.67)	1.58 (1.17-2.12)	1.78 (1.30-2.46)	2.00 (1.42-2.88)	2.27 (1.52-3.30)	2.66 (1.72-4.01)	3.00 (1.90-4.61)
60-min	0.900 (0.692-1.15)	1.09 (0.836-1.39)	1.40 (1.07-1.79)	1.66 (1.26-2.13)	2.01 (1.49-2.71)	2.27 (1.65-3.13)	2.55 (1.82-3.67)	2.89 (1.94-4.21)	3.40 (2.20-5.12)	3.83 (2.42-5.88)
2-hr	1.16 (0.897-1.47)	1.42 (1.10-1.80)	1.84 (1.42-2.34)	2.19 (1.67-2.79)	2.67 (1.99-3.58)	3.02 (2.22-4.15)	3.41 (2.45-4.89)	3.89 (2.61-5.62)	4.63 (3.00-6.92)	5.28 (3.35-8.04)
3-hr	1.35 (1.05-1.70)	1.65 (1.28-2.08)	2.15 (1.66-2.72)	2.56 (1.97-3.26)	3.12 (2.34-4.18)	3.54 (2.61-4.86)	4.00 (2.89-5.73)	4.57 (3.08-6.58)	5.47 (3.55-8.14)	6.26 (3.98-9.48)
6-hr	1.74 (1.36-2.18)	2.14 (1.67-2.68)	2.78 (2.16-3.49)	3.31 (2.56-4.19)	4.05 (3.05-5.38)	4.59 (3.40-6.24)	5.18 (3.76-7.36)	5.92 (4.00-8.45)	7.08 (4.61-10.4)	8.09 (5.16-12.2)
12-hr	2.22 (1.75-2.76)	2.72 (2.14-3.39)	3.54 (2.77-4.42)	4.21 (3.28-5.29)	5.14 (3.89-6.78)	5.82 (4.33-7.86)	6.57 (4.78-9.24)	7.49 (5.09-10.6)	8.92 (5.83-13.1)	10.1 (6.49-15.1)
24-hr	2.67 (2.12-3.30)	3.31 (2.62-4.09)	4.34 (3.42-5.39)	5.20 (4.08-6.49)	6.39 (4.87-8.38)	7.26 (5.44-9.74)	8.22 (6.02-11.5)	9.41 (6.42-13.2)	11.3 (7.40-16.4)	12.9 (8.27-19.0)
2-day	3.03 (2.42-3.72)	3.83 (3.05-4.70)	5.13 (4.07-6.32)	6.20 (4.90-7.69)	7.69 (5.91-10.0)	8.77 (6.62-11.7)	9.97 (7.38-14.0)	11.5 (7.89-16.1)	14.0 (9.23-20.2)	16.2 (10.5-23.8)
3-day	3.32 (2.66-4.06)	4.18 (3.34-5.11)	5.57 (4.44-6.84)	6.73 (5.33-8.31)	8.32 (6.42-10.8)	9.49 (7.20-12.7)	10.8 (8.02-15.1)	12.5 (8.55-17.3)	15.2 (10.0-21.8)	17.6 (11.4-25.7)
4-day	3.60 (2.89-4.38)	4.48 (3.59-5.46)	5.92 (4.73-7.24)	7.11 (5.65-8.75)	8.76 (6.77-11.4)	9.96 (7.57-13.2)	11.3 (8.41-15.7)	13.0 (8.96-18.0)	15.8 (10.5-22.6)	18.3 (11.8-26.6)
7-day	4.36 (3.52-5.29)	5.28 (4.26-6.41)	6.78 (5.45-8.26)	8.02 (6.41-9.82)	9.73 (7.56-12.5)	11.0 (8.37-14.5)	12.4 (9.22-17.0)	14.2 (9.77-19.5)	17.0 (11.3-24.1)	19.5 (12.6-28.2)
10-day	5.06 (4.10-6.12)	6.00 (4.86-7.27)	7.55 (6.09-9.16)	8.83 (7.08-10.8)	10.6 (8.24-13.5)	11.9 (9.07-15.5)	13.3 (9.90-18.1)	15.1 (10.4-20.6)	17.9 (11.9-25.3)	20.4 (13.2-29.2)
20-day	7.04 (5.74-8.45)	8.08 (6.58-9.70)	9.77 (7.94-11.8)	11.2 (9.02-13.5)	13.1 (10.2-16.5)	14.6 (11.1-18.7)	16.1 (11.9-21.4)	17.9 (12.4-24.2)	20.4 (13.6-28.5)	22.5 (14.7-32.1)
30-day	8.68 (7.11-10.4)	9.79 (8.01-11.7)	11.6 (9.47-13.9)	13.1 (10.6-15.8)	15.2 (11.9-19.0)	16.8 (12.8-21.3)	18.4 (13.5-24.1)	20.1 (14.1-27.1)	22.5 (15.1-31.2)	24.3 (15.9-34.5)
45-day	10.8 (8.86-12.8)	12.0 (9.82-14.3)	13.9 (11.4-16.6)	15.5 (12.6-18.6)	17.7 (13.9-22.0)	19.5 (14.8-24.5)	21.2 (15.5-27.4)	22.8 (16.0-30.6)	25.0 (16.8-34.5)	26.6 (17.4-37.5)
60-day	12.6 (10.4-14.9)	13.8 (11.4-16.4)	15.8 (13.0-18.9)	17.5 (14.3-21.0)	19.8 (15.6-24.5)	21.7 (16.6-27.1)	23.4 (17.2-30.1)	25.1 (17.6-33.4)	27.1 (18.3-37.3)	28.5 (18.7-40.1)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical

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

Version 1, Automated: Mar. 4, 2008

Location: 84 Preston St, Wakefield

TSS Removal Calculation Worksheet

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

Total TSS Removal = **80%**

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

Project:
Prepared By: **JDS**
Date: **2/29/24**

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1