
ATTACHMENT H
WATER BALANCE CALCULATIONS

Water Balance Calculation

Project: Nagog Water Treatment Plant

Location: Acton, MA

Date: November 18, 2015

Calculation By: Adam Kran, P.E.

Groundwater Zone 4 - Watershed Protection Area

The HydroCAD calculations included in the Stormwater Report (Attachment G) show that the peak rate of stormwater runoff decreases after development.

Storm Event	Existing Conditions	Developed Conditions
2-year	0.08 cfs	0.06 cfs
10-year	1.41 cfs	1.35 cfs
100-year	10.24 cfs	10.04 cfs

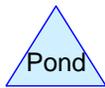
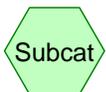
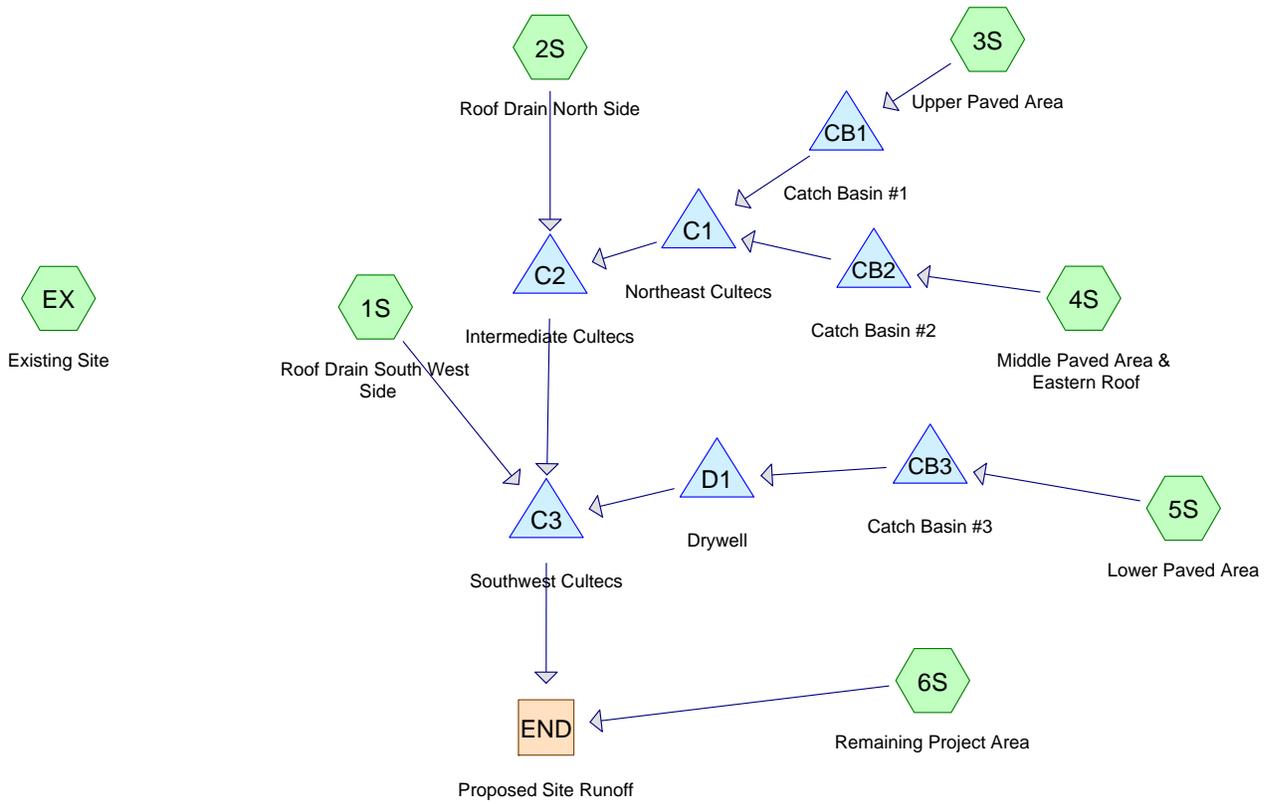
The HydroCAD calculations for Standard 2 were modified to run for 48 hours to obtain the complete hydrographs and stormwater runoff volumes. The calculations, which are included in this Attachment, show that the total volume of stormwater runoff decreases after development.

Storm Event	Existing Conditions	Developed Conditions
2-year	2,050 cf	1,525 cf
10-year	10,605 cf	9,608 cf
100-year	47,019 cf	45,676 cf

The excess stormwater retained on site in the post-development condition is expected to infiltrate into the ground and recharge the aquifer.

In addition, the developed site will have a new septic system. The existing site does not have a septic system. The proposed septic system, which is rated for 20 gallons per day, will provide additional groundwater recharge.

In summary, there is expected to be more groundwater recharge in the post-development condition as a result of additional stormwater recharge and septic system flow.



Routing Diagram for Nagog HydroCAD - 2015-11-18 - Water Balance

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Nagog HydroCAD - 2015-11-18 - Water Balance

Type III 24-hr 2-YEAR Rainfall=3.06"

Prepared by Environmental Partners Group

Printed 11/18/2015

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Page 2

Time span=0.10-48.00 hrs, dt=0.02 hrs, 2396 points x 3
 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 1S: Roof Drain South West Runoff Area=2,749 sf 100.00% Impervious Runoff Depth=2.83"
 Flow Length=50' Slope=0.1300 '/' Tc=6.0 min CN=98 Runoff=0.19 cfs 648 cf

Subcatchment 2S: Roof Drain North Side Runoff Area=3,230 sf 100.00% Impervious Runoff Depth=2.83"
 Flow Length=50' Slope=0.1300 '/' Tc=6.0 min CN=98 Runoff=0.22 cfs 761 cf

Subcatchment 3S: Upper Paved Area Runoff Area=10,259 sf 69.83% Impervious Runoff Depth=1.64"
 Tc=6.0 min CN=85 Runoff=0.45 cfs 1,401 cf

Subcatchment 4S: Middle Paved Area & Runoff Area=4,232 sf 100.00% Impervious Runoff Depth=2.83"
 Tc=6.0 min CN=98 Runoff=0.29 cfs 997 cf

Subcatchment 5S: Lower Paved Area Runoff Area=3,960 sf 100.00% Impervious Runoff Depth=2.83"
 Tc=6.0 min CN=98 Runoff=0.27 cfs 933 cf

Subcatchment 6S: Remaining Project Area Runoff Area=217,642 sf 3.80% Impervious Runoff Depth=0.08"
 Flow Length=562' Tc=15.9 min CN=49 Runoff=0.06 cfs 1,525 cf

Subcatchment EX: Existing Site Runoff Area=242,195 sf 7.17% Impervious Runoff Depth=0.10"
 Flow Length=562' Tc=15.9 min CN=50 Runoff=0.08 cfs 2,050 cf

Reach END: Proposed Site Runoff Inflow=0.06 cfs 1,525 cf
 Outflow=0.06 cfs 1,525 cf

Pond C1: Northeast Cultecs Peak Elev=232.17' Storage=0.025 af Inflow=0.74 cfs 2,361 cf
 Discarded=0.00 cfs 0 cf Primary=0.16 cfs 1,991 cf Outflow=0.16 cfs 1,991 cf

Pond C2: Intermediate Cultecs Peak Elev=230.35' Storage=313 cf Inflow=0.33 cfs 2,752 cf
 Discarded=0.06 cfs 2,007 cf Primary=0.14 cfs 746 cf Outflow=0.20 cfs 2,752 cf

Pond C3: Southwest Cultecs Peak Elev=230.33' Storage=0.012 af Inflow=0.45 cfs 1,934 cf
 Discarded=0.12 cfs 1,934 cf Primary=0.00 cfs 0 cf Outflow=0.12 cfs 1,934 cf

Pond CB1: Catch Basin #1 Peak Elev=233.56' Storage=27 cf Inflow=0.45 cfs 1,401 cf
 6.0" Round Culvert n=0.012 L=20.0' S=0.0600 '/' Outflow=0.45 cfs 1,382 cf

Pond CB2: Catch Basin #2 Peak Elev=233.35' Storage=24 cf Inflow=0.29 cfs 997 cf
 6.0" Round Culvert n=0.012 L=75.0' S=0.0160 '/' Outflow=0.29 cfs 978 cf

Pond CB3: Catch Basin #3 Peak Elev=233.34' Storage=24 cf Inflow=0.27 cfs 933 cf
 6.0" Round Culvert n=0.012 L=115.0' S=0.0050 '/' Outflow=0.27 cfs 914 cf

Pond D1: Drywell Peak Elev=231.63' Storage=35 cf Inflow=0.27 cfs 914 cf
 Discarded=0.01 cfs 374 cf Primary=0.26 cfs 541 cf Outflow=0.27 cfs 914 cf

Total Runoff Area = 484,267 sf Runoff Volume = 8,316 cf Average Runoff Depth = 0.21"
90.30% Pervious = 437,284 sf 9.70% Impervious = 46,983 sf

Summary for Subcatchment 1S: Roof Drain South West Side

Runoff = 0.19 cfs @ 12.08 hrs, Volume= 648 cf, Depth= 2.83"

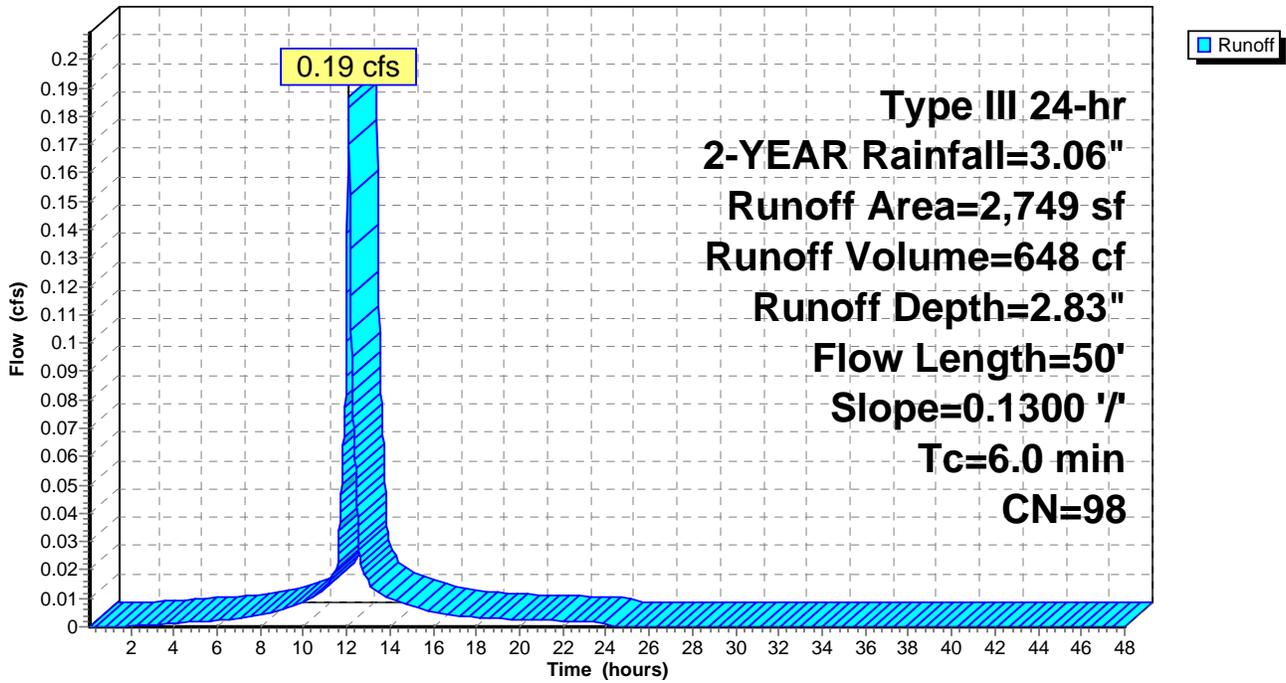
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
 Type III 24-hr 2-YEAR Rainfall=3.06"

Area (sf)	CN	Description
2,749	98	Roofs, HSG A
2,749		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1300	0.14		Sheet Flow, sheet flow Woods: Light underbrush n= 0.400 P2= 3.06"

Subcatchment 1S: Roof Drain South West Side

Hydrograph



Summary for Subcatchment 2S: Roof Drain North Side

Runoff = 0.22 cfs @ 12.08 hrs, Volume= 761 cf, Depth= 2.83"

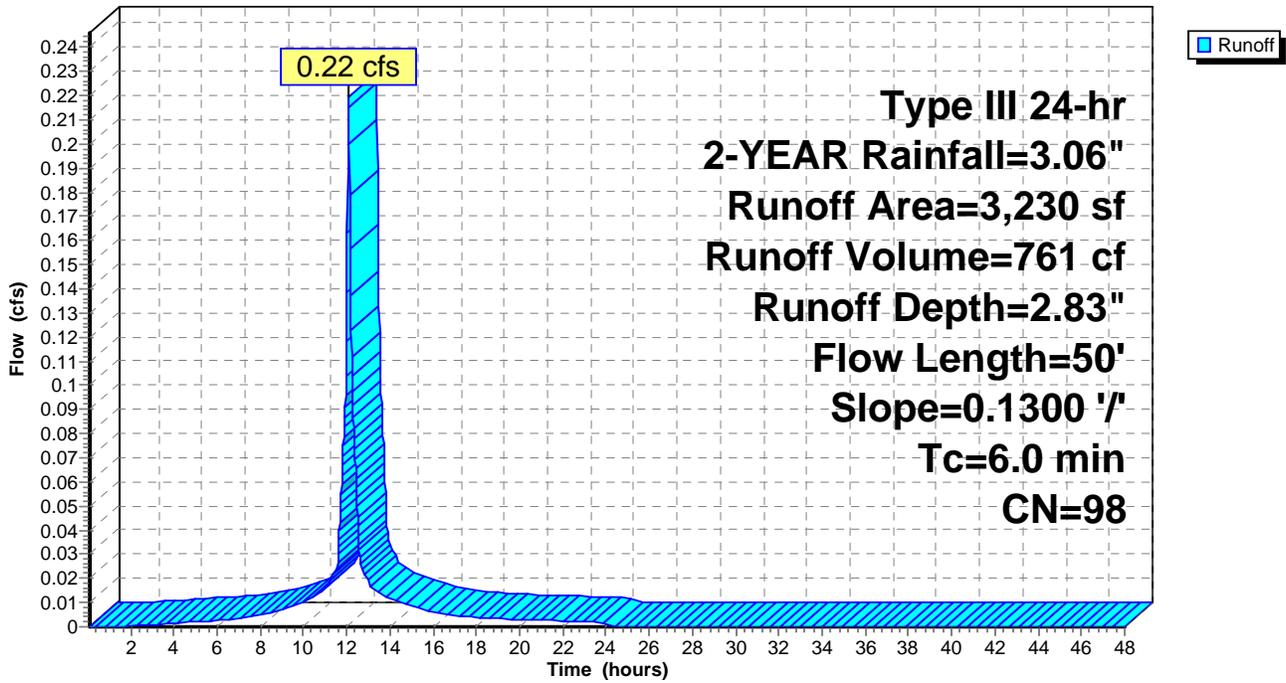
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-YEAR Rainfall=3.06"

Area (sf)	CN	Description
3,230	98	Roofs, HSG A
3,230		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1300	0.14		Sheet Flow, sheet flow Woods: Light underbrush n= 0.400 P2= 3.06"

Subcatchment 2S: Roof Drain North Side

Hydrograph



Summary for Subcatchment 3S: Upper Paved Area

Runoff = 0.45 cfs @ 12.09 hrs, Volume= 1,401 cf, Depth= 1.64"

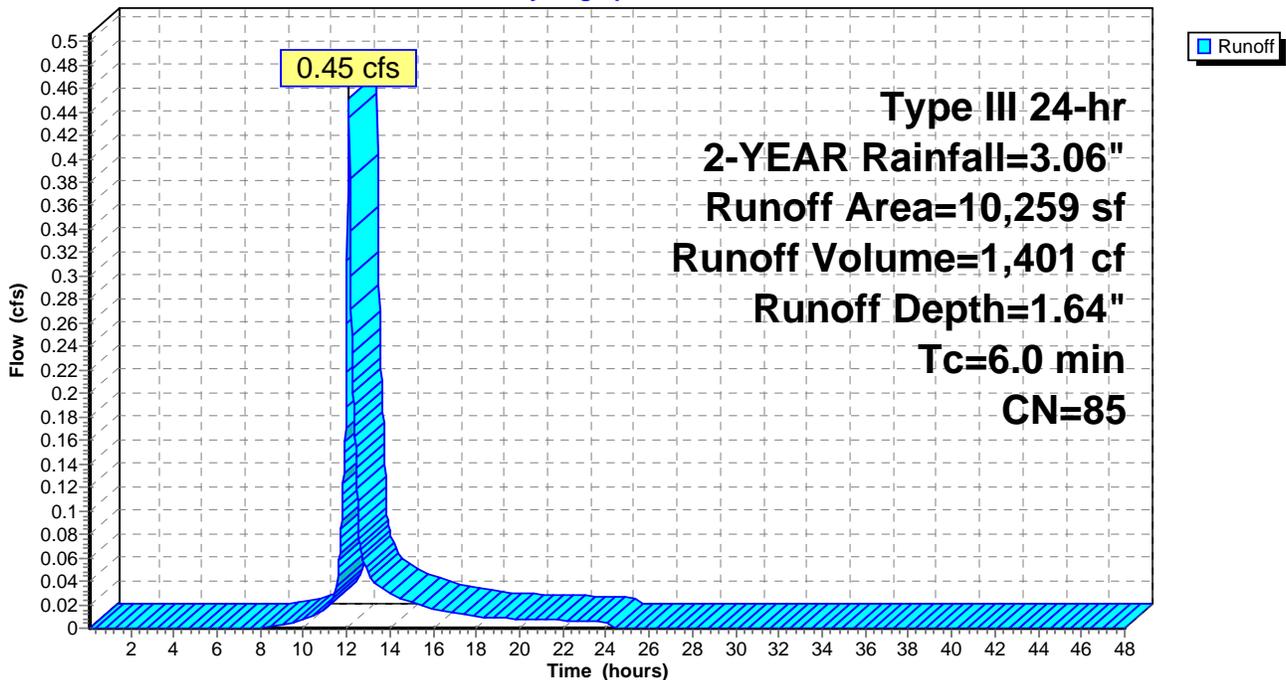
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
 Type III 24-hr 2-YEAR Rainfall=3.06"

Area (sf)	CN	Description
7,164	98	Paved parking, HSG A
1,956	49	50-75% Grass cover, Fair, HSG A
441	49	50-75% Grass cover, Fair, HSG A
* 698	76	Gravel roads, HSG A (rip rap)
10,259	85	Weighted Average
3,095		30.17% Pervious Area
7,164		69.83% Impervious Area

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

Subcatchment 3S: Upper Paved Area

Hydrograph



Summary for Subcatchment 4S: Middle Paved Area & Eastern Roof

Runoff = 0.29 cfs @ 12.08 hrs, Volume= 997 cf, Depth= 2.83"

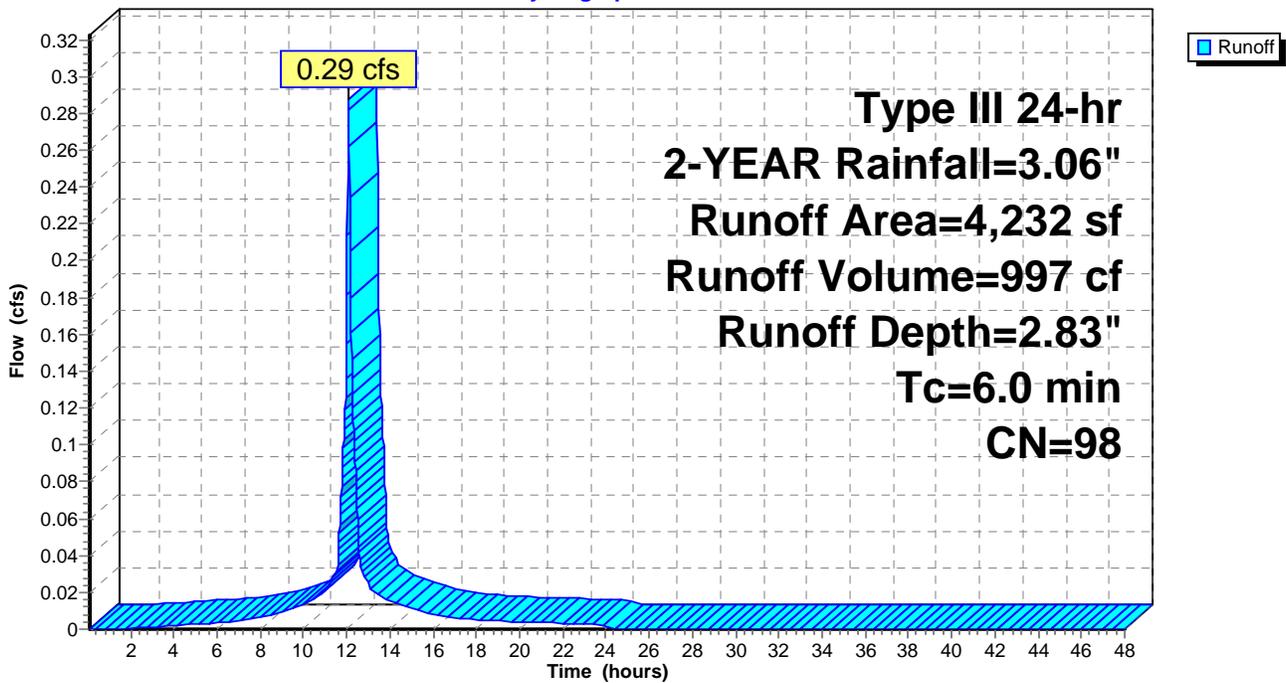
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-YEAR Rainfall=3.06"

Area (sf)	CN	Description
2,572	98	Paved parking, HSG A
1,660	98	Roofs, HSG A
4,232	98	Weighted Average
4,232		100.00% Impervious Area

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

Subcatchment 4S: Middle Paved Area & Eastern Roof

Hydrograph



Summary for Subcatchment 5S: Lower Paved Area

Runoff = 0.27 cfs @ 12.08 hrs, Volume= 933 cf, Depth= 2.83"

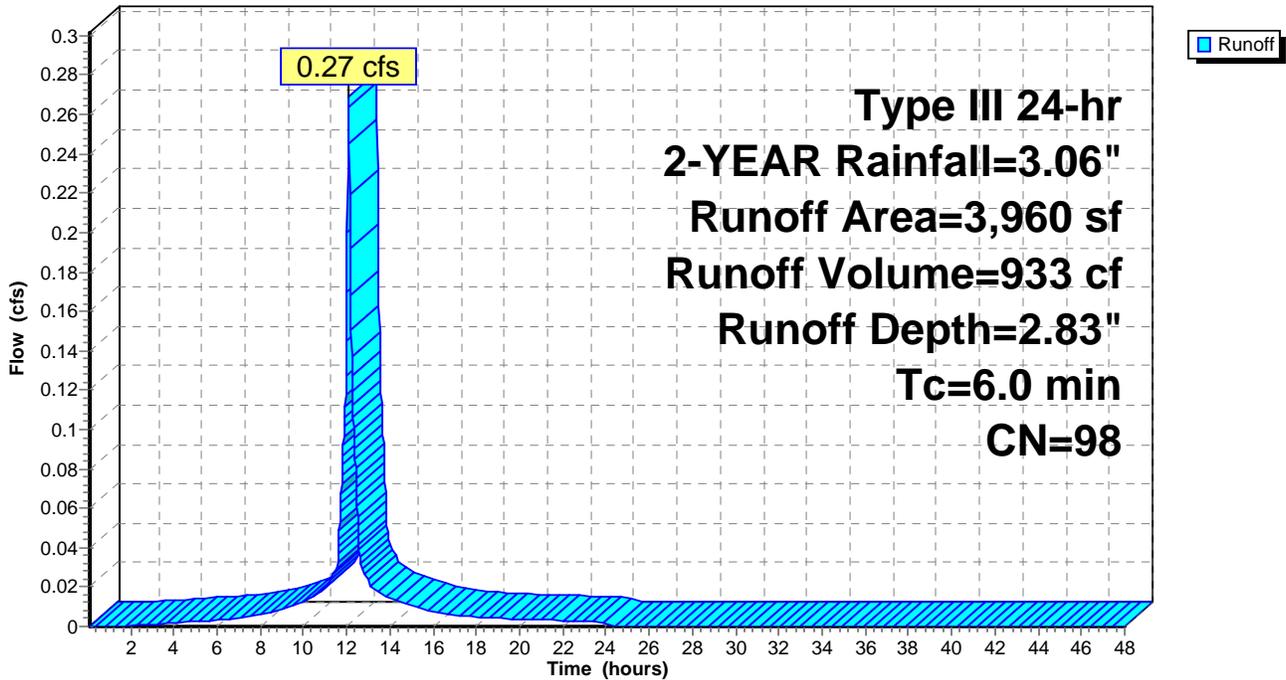
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
 Type III 24-hr 2-YEAR Rainfall=3.06"

Area (sf)	CN	Description
3,960	98	Paved parking, HSG A
3,960		100.00% Impervious Area

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

Subcatchment 5S: Lower Paved Area

Hydrograph



Summary for Subcatchment 6S: Remaining Project Area

Runoff = 0.06 cfs @ 14.72 hrs, Volume= 1,525 cf, Depth= 0.08"

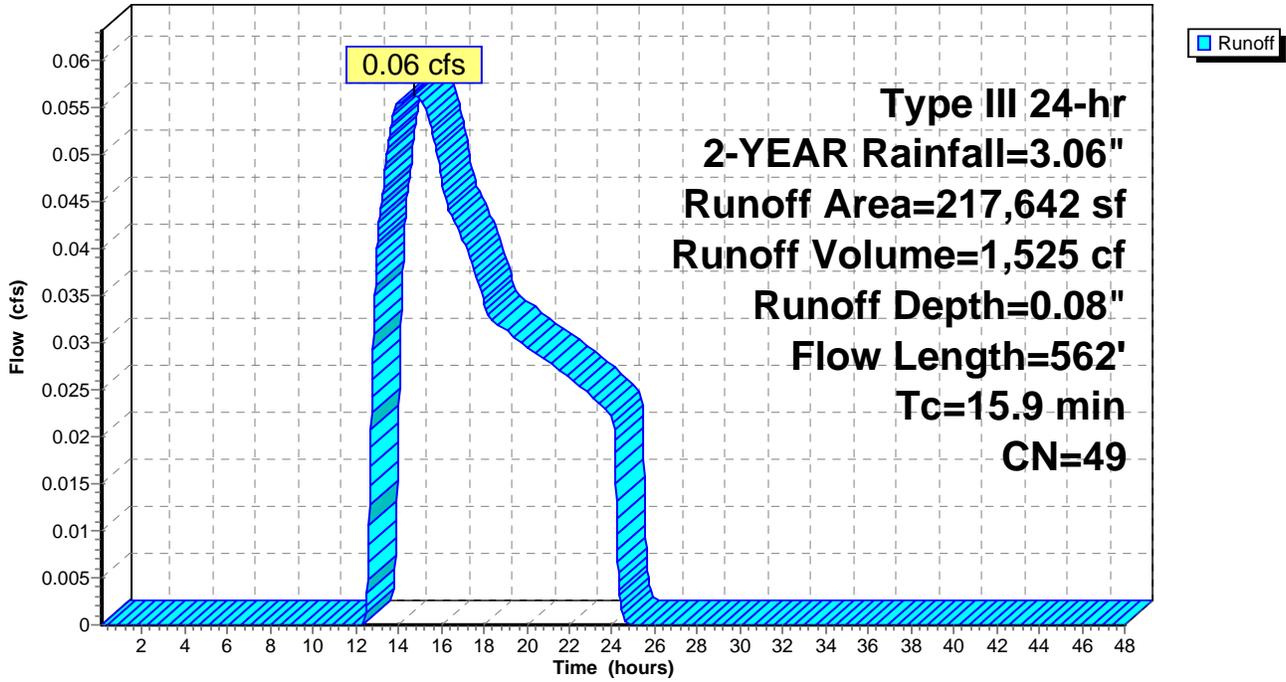
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-YEAR Rainfall=3.06"

Area (sf)	CN	Description
2,763	49	50-75% Grass cover, Fair, HSG A
9,597	76	Gravel roads, HSG A
8,274	98	Paved parking, HSG A
7,927	49	50-75% Grass cover, Fair, HSG A
27,757	78	Meadow, non-grazed, HSG D
28,946	77	Woods, Good, HSG D
78,485	30	Woods, Good, HSG A
39,143	30	Meadow, non-grazed, HSG A
11,968	30	Woods, Good, HSG A
* 2,782	76	Gravel roads, HSG A (RIP RAP)
217,642	49	Weighted Average
209,368		96.20% Pervious Area
8,274		3.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		Sheet Flow, sheet flow Woods: Light underbrush n= 0.400 P2= 3.06"
0.3	36	0.1676	2.05		Shallow Concentrated Flow, woods pre grass strip Woodland Kv= 5.0 fps
0.1	10	0.1000	2.21		Shallow Concentrated Flow, grass strips (both) Short Grass Pasture Kv= 7.0 fps
0.0	12	0.0833	5.86		Shallow Concentrated Flow, pavement Paved Kv= 20.3 fps
6.7	440	0.0480	1.10		Shallow Concentrated Flow, rip rap Woodland Kv= 5.0 fps
0.1	14	0.1667	2.86		Shallow Concentrated Flow, grass strip Short Grass Pasture Kv= 7.0 fps
15.9	562	Total			

Subcatchment 6S: Remaining Project Area

Hydrograph



Summary for Subcatchment EX: Existing Site

Runoff = 0.08 cfs @ 13.84 hrs, Volume= 2,050 cf, Depth= 0.10"

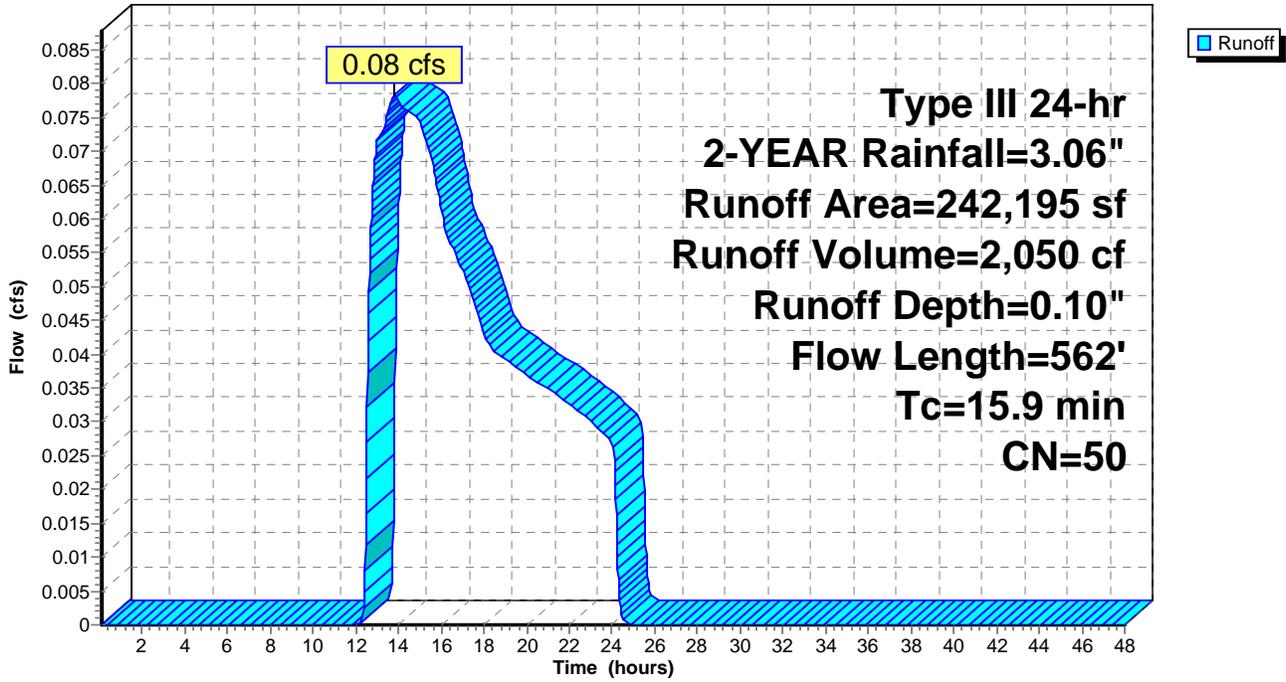
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-YEAR Rainfall=3.06"

Area (sf)	CN	Description
11,475	49	50-75% Grass cover, Fair, HSG A
3,181	76	Gravel roads, HSG A
17,374	98	Paved parking, HSG A
4,242	49	50-75% Grass cover, Fair, HSG A
8,728	49	50-75% Grass cover, Fair, HSG A
* 3,480	76	Gravel roads, HSG A (RIP RAP)
59,405	77	Woods, Good, HSG D
82,915	30	Woods, Good, HSG A
9,737	30	Woods, Good, HSG A
41,658	30	Woods, Good, HSG A
242,195	50	Weighted Average
224,821		92.83% Pervious Area
17,374		7.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		Sheet Flow, sheet flow Woods: Light underbrush n= 0.400 P2= 3.06"
0.3	36	0.1676	2.05		Shallow Concentrated Flow, woods Woodland Kv= 5.0 fps
0.0	12	0.1000	6.42		Shallow Concentrated Flow, pavement Paved Kv= 20.3 fps
0.1	10	0.1000	2.21		Shallow Concentrated Flow, grass strip (both) Short Grass Pasture Kv= 7.0 fps
6.7	440	0.0480	1.10		Shallow Concentrated Flow, rip rap Woodland Kv= 5.0 fps
0.1	14	0.1667	2.86		Shallow Concentrated Flow, final grass strip Short Grass Pasture Kv= 7.0 fps
15.9	562	Total			

Subcatchment EX: Existing Site

Hydrograph



Summary for Reach END: Proposed Site Runoff

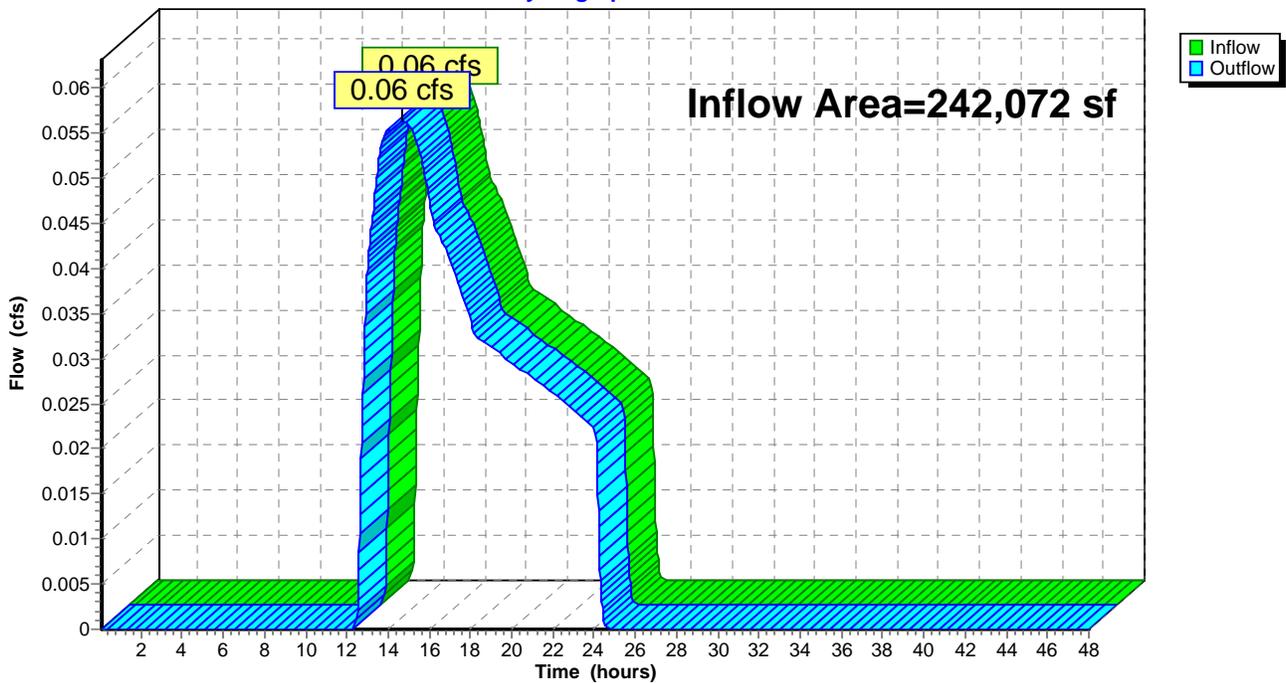
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 242,072 sf, 12.23% Impervious, Inflow Depth = 0.08" for 2-YEAR event
Inflow = 0.06 cfs @ 14.72 hrs, Volume= 1,525 cf
Outflow = 0.06 cfs @ 14.72 hrs, Volume= 1,525 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 3

Reach END: Proposed Site Runoff

Hydrograph



Summary for Pond C1: Northeast Cultecs

Inflow Area = 14,491 sf, 78.64% Impervious, Inflow Depth = 1.95" for 2-YEAR event
 Inflow = 0.74 cfs @ 12.09 hrs, Volume= 2,361 cf
 Outflow = 0.16 cfs @ 13.05 hrs, Volume= 1,991 cf, Atten= 79%, Lag= 57.5 min
 Discarded = 0.00 cfs @ 0.10 hrs, Volume= 0 cf
 Primary = 0.16 cfs @ 13.05 hrs, Volume= 1,991 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 232.17' @ 12.53 hrs Surf.Area= 0.046 ac Storage= 0.025 af

Plug-Flow detention time= 203.6 min calculated for 1,990 cf (84% of inflow)
 Center-of-Mass det. time= 137.4 min (943.3 - 805.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	231.17'	0.018 af	14.50'W x 84.75'L x 2.54'H Field A 0.072 af Overall - 0.020 af Embedded = 0.052 af x 35.0% Voids
#2A	231.67'	0.020 af	Cultec R-150XLHD x 32 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 4 rows
#3B	231.17'	0.012 af	14.50'W x 54.00'L x 2.54'H Field B 0.046 af Overall - 0.013 af Embedded = 0.033 af x 35.0% Voids
#4B	231.67'	0.013 af	Cultec R-150XLHD x 20 Inside #3 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 4 rows
		0.062 af	Total Available Storage

Storage Group A created with Chamber Wizard
 Storage Group B created with Chamber Wizard

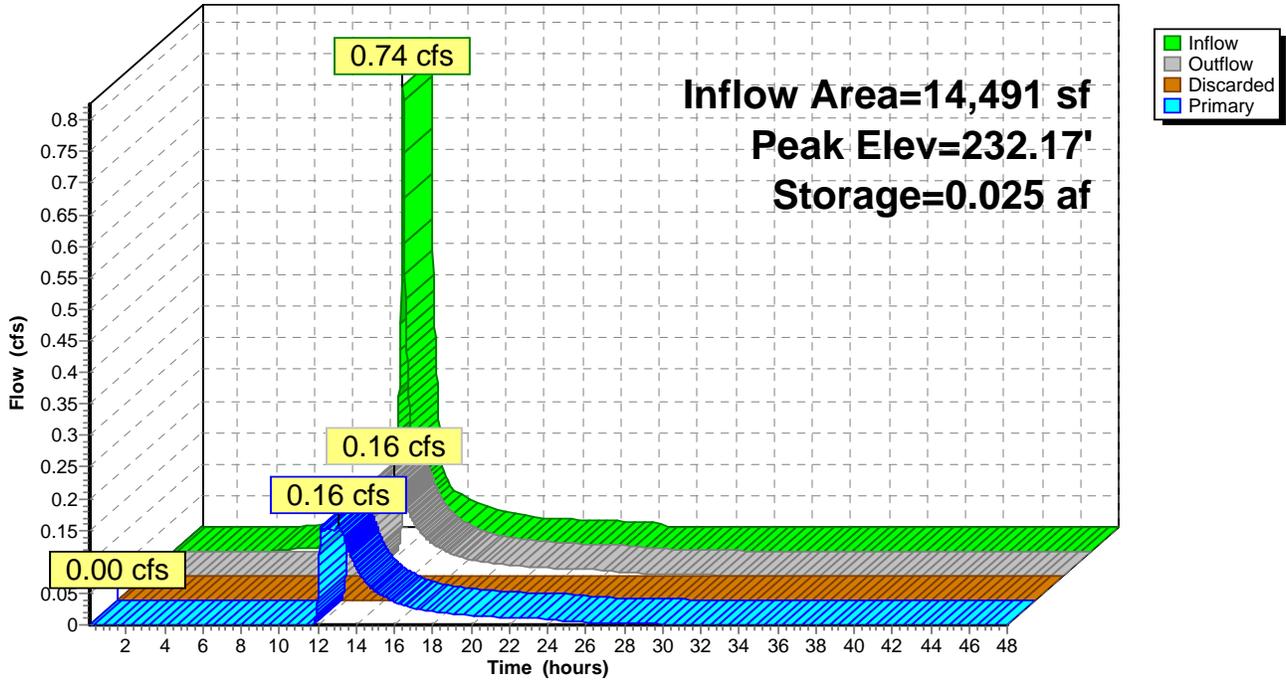
Device	Routing	Invert	Outlet Devices
#1	Discarded	231.17'	0.090 in/hr Exfiltration X 0.00 over Surface area Phase-In= 0.01'
#2	Primary	231.67'	4.0" Round Culvert L= 145.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 231.67' / 230.95' S= 0.0050 '/ Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#3	Primary	232.33'	8.0" Round Culvert L= 145.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 232.33' / 231.44' S= 0.0061 '/ Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Discarded OutFlow Max=0.00 cfs @ 0.10 hrs HW=231.17' (Free Discharge)
 ↳1=Exfiltration (Controls 0.00 cfs)

Primary OutFlow Max=0.16 cfs @ 13.05 hrs HW=232.09' TW=230.33' (Dynamic Tailwater)
 ↳2=Culvert (Barrel Controls 0.16 cfs @ 1.83 fps)
 ↳3=Culvert (Controls 0.00 cfs)

Pond C1: Northeast Cultecs

Hydrograph



Summary for Pond C2: Intermediate Cultecs

Inflow Area = 17,721 sf, 82.53% Impervious, Inflow Depth > 1.86" for 2-YEAR event
 Inflow = 0.33 cfs @ 12.11 hrs, Volume= 2,752 cf
 Outflow = 0.20 cfs @ 12.48 hrs, Volume= 2,752 cf, Atten= 38%, Lag= 22.4 min
 Discarded = 0.06 cfs @ 13.35 hrs, Volume= 2,007 cf
 Primary = 0.14 cfs @ 12.48 hrs, Volume= 746 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 230.35' @ 13.35 hrs Surf.Area= 392 sf Storage= 313 cf
 Flood Elev= 233.94' Surf.Area= 392 sf Storage= 950 cf

Plug-Flow detention time= 28.5 min calculated for 2,752 cf (100% of inflow)
 Center-of-Mass det. time= 28.5 min (920.4 - 891.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	228.78'	447 cf	16.00'W x 24.50'L x 4.54'H Field A 1,780 cf Overall - 503 cf Embedded = 1,277 cf x 35.0% Voids
#2A	229.78'	503 cf	Cultec R-330XLHD x 9 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
		950 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	228.78'	5.100 in/hr Exfiltration over Wetted area Phase-In= 0.01'
#2	Primary	230.00'	8.0" Round Culvert L= 10.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 230.00' / 230.00' S= 0.0000 1/ S= 0.0000 1/ Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

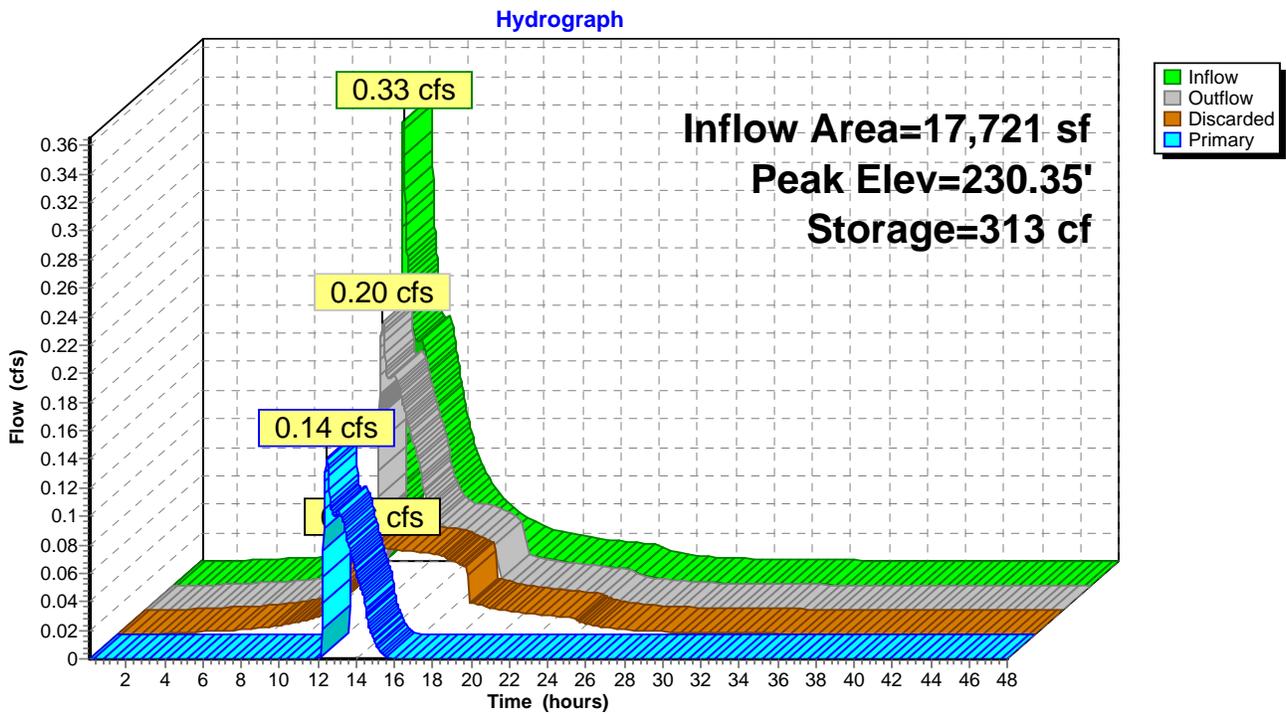
Discarded OutFlow Max=0.06 cfs @ 13.35 hrs HW=230.35' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=0.14 cfs @ 12.48 hrs HW=230.30' TW=230.15' (Dynamic Tailwater)

↑**2=Culvert** (Barrel Controls 0.14 cfs @ 1.37 fps)

Pond C2: Intermediate Cultecs



Summary for Pond C3: Southwest Cultecs

Inflow Area = 24,430 sf, 87.33% Impervious, Inflow Depth = 0.95" for 2-YEAR event
 Inflow = 0.45 cfs @ 12.09 hrs, Volume= 1,934 cf
 Outflow = 0.12 cfs @ 13.41 hrs, Volume= 1,934 cf, Atten= 74%, Lag= 79.1 min
 Discarded = 0.12 cfs @ 13.41 hrs, Volume= 1,934 cf
 Primary = 0.00 cfs @ 0.10 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 230.33' @ 13.41 hrs Surf.Area= 0.017 ac Storage= 0.012 af

Plug-Flow detention time= 42.3 min calculated for 1,933 cf (100% of inflow)
 Center-of-Mass det. time= 42.3 min (808.9 - 766.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	229.07'	0.003 af	6.33'W x 24.50'L x 3.71'H Field A 0.013 af Overall - 0.004 af Embedded = 0.009 af x 35.0% Voids
#2A	229.74'	0.004 af	Cultec R-330XLHD x 3 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 1 rows
#3B	229.07'	0.011 af	11.17'W x 52.50'L x 3.71'H Field B 0.050 af Overall - 0.017 af Embedded = 0.033 af x 35.0% Voids
#4B	229.74'	0.017 af	Cultec R-330XLHD x 14 Inside #3 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 2 rows
		0.036 af	Total Available Storage

Storage Group A created with Chamber Wizard
 Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	229.07'	5.100 in/hr Exfiltration over Wetted area Phase-In= 0.01'
#2	Primary	230.68'	8.0" Round Culvert L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 230.68' / 230.48' S= 0.0100 1/ S= 0.0100 1/ Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

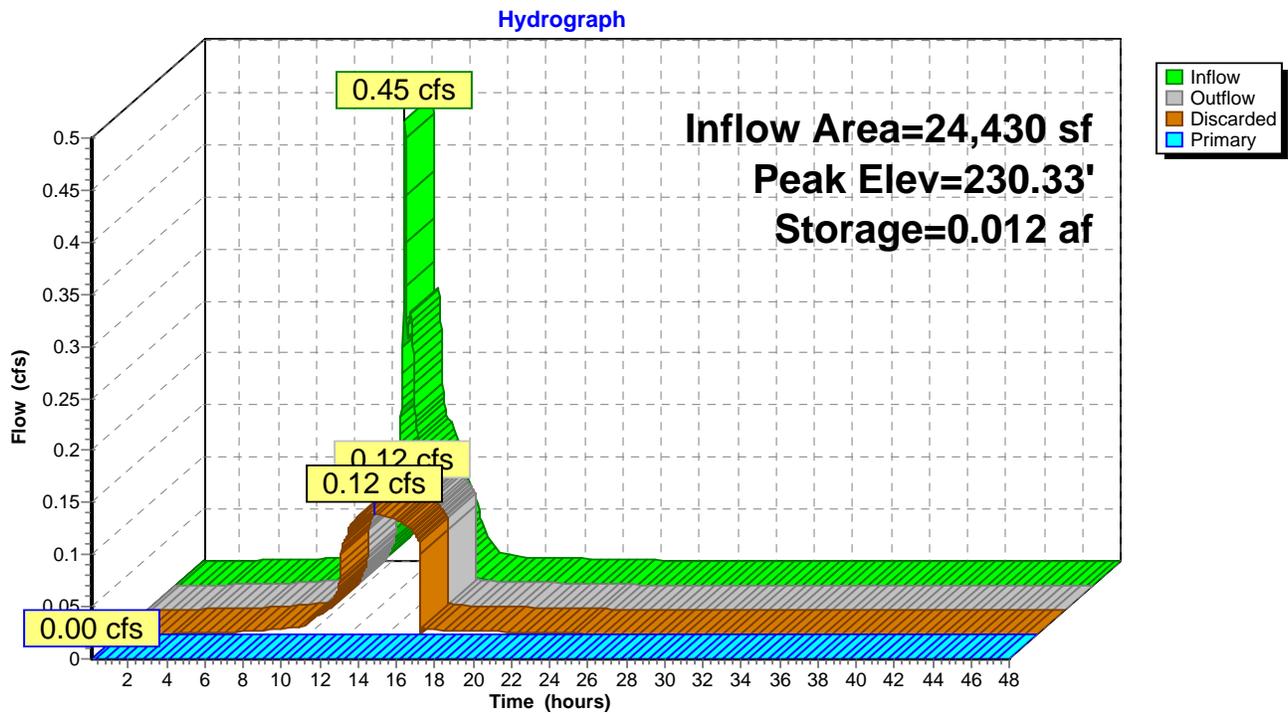
Discarded OutFlow Max=0.12 cfs @ 13.41 hrs HW=230.33' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=0.00 cfs @ 0.10 hrs HW=229.07' TW=0.00' (Dynamic Tailwater)

↑**2=Culvert** (Controls 0.00 cfs)

Pond C3: Southwest Cultecs



Summary for Pond CB1: Catch Basin #1

Inflow Area = 10,259 sf, 69.83% Impervious, Inflow Depth = 1.64" for 2-YEAR event
 Inflow = 0.45 cfs @ 12.09 hrs, Volume= 1,401 cf
 Outflow = 0.45 cfs @ 12.10 hrs, Volume= 1,382 cf, Atten= 0%, Lag= 0.4 min
 Primary = 0.45 cfs @ 12.10 hrs, Volume= 1,382 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 233.56' @ 12.10 hrs Surf.Area= 13 sf Storage= 27 cf

Plug-Flow detention time= 12.6 min calculated for 1,382 cf (99% of inflow)
 Center-of-Mass det. time= 4.3 min (832.4 - 828.1)

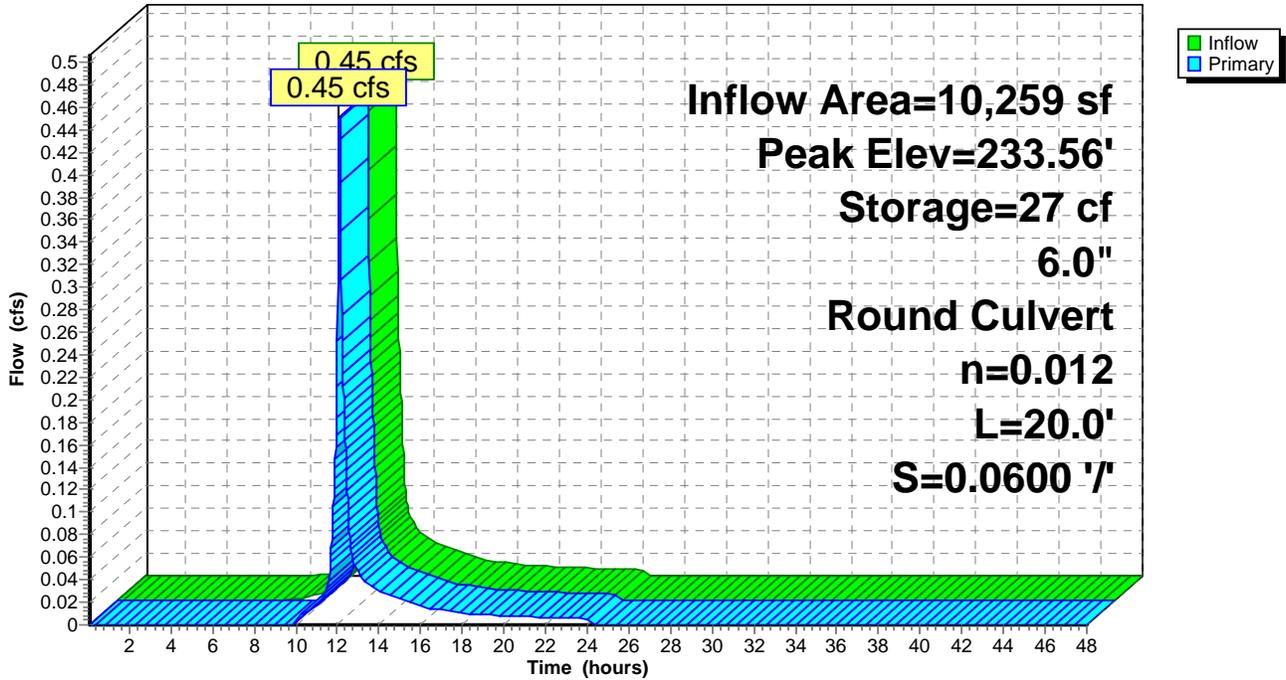
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	464 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	3,335	419	464

Device	Routing	Invert	Outlet Devices
#1	Primary	232.95'	6.0" Round Culvert L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 232.95' / 231.75' S= 0.0600 ' S= 0.0600 ' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.45 cfs @ 12.10 hrs HW=233.56' TW=231.96' (Dynamic Tailwater)
 ↑1=Culvert (Inlet Controls 0.45 cfs @ 2.28 fps)

Pond CB1: Catch Basin #1

Hydrograph



Summary for Pond CB2: Catch Basin #2

Inflow Area = 4,232 sf, 100.00% Impervious, Inflow Depth = 2.83" for 2-YEAR event
 Inflow = 0.29 cfs @ 12.08 hrs, Volume= 997 cf
 Outflow = 0.29 cfs @ 12.09 hrs, Volume= 978 cf, Atten= 0%, Lag= 0.2 min
 Primary = 0.29 cfs @ 12.09 hrs, Volume= 978 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 233.35' @ 12.09 hrs Surf.Area= 13 sf Storage= 24 cf

Plug-Flow detention time= 23.2 min calculated for 978 cf (98% of inflow)
 Center-of-Mass det. time= 11.1 min (768.4 - 757.3)

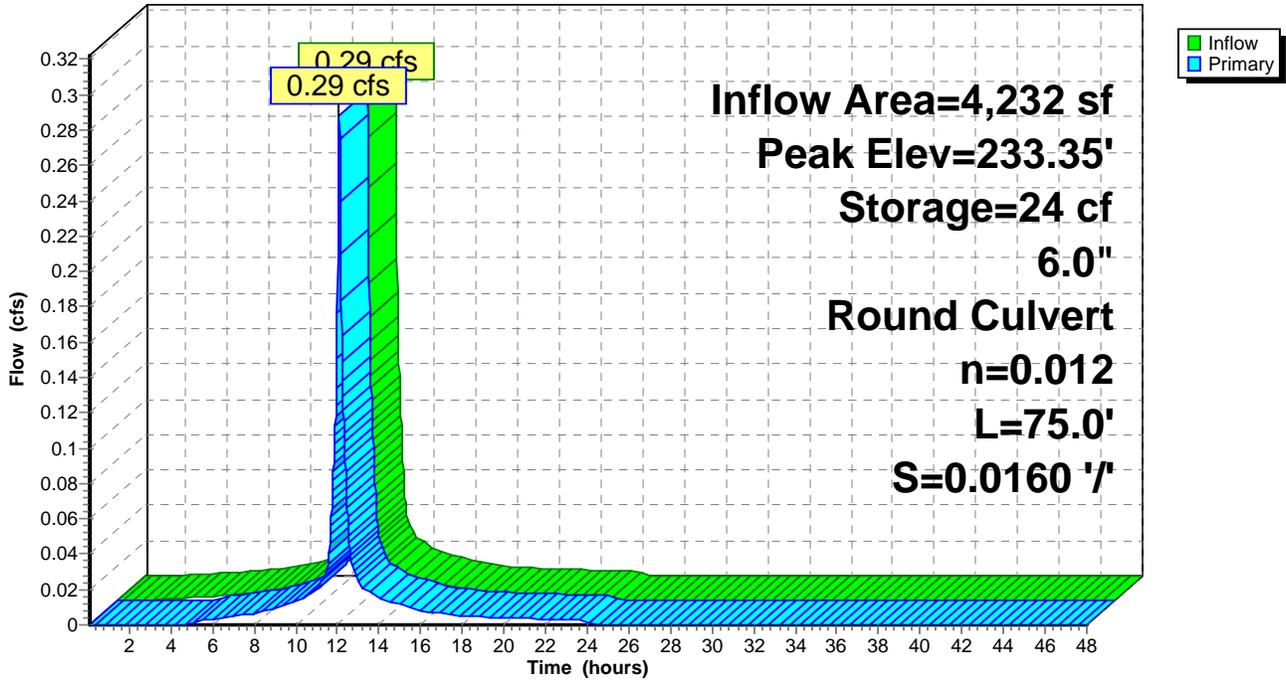
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	258 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	1,690	213	258

Device	Routing	Invert	Outlet Devices
#1	Primary	232.95'	6.0" Round Culvert L= 75.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 232.95' / 231.75' S= 0.0160 ' S= 0.0160 ' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.29 cfs @ 12.09 hrs HW=233.35' TW=231.94' (Dynamic Tailwater)
 ↑1=Culvert (Inlet Controls 0.29 cfs @ 1.70 fps)

Pond CB2: Catch Basin #2

Hydrograph



Summary for Pond CB3: Catch Basin #3

Inflow Area = 3,960 sf, 100.00% Impervious, Inflow Depth = 2.83" for 2-YEAR event
 Inflow = 0.27 cfs @ 12.08 hrs, Volume= 933 cf
 Outflow = 0.27 cfs @ 12.09 hrs, Volume= 914 cf, Atten= 0%, Lag= 0.2 min
 Primary = 0.27 cfs @ 12.09 hrs, Volume= 914 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 233.34' @ 12.09 hrs Surf.Area= 13 sf Storage= 24 cf

Plug-Flow detention time= 24.7 min calculated for 914 cf (98% of inflow)
 Center-of-Mass det. time= 11.8 min (769.2 - 757.3)

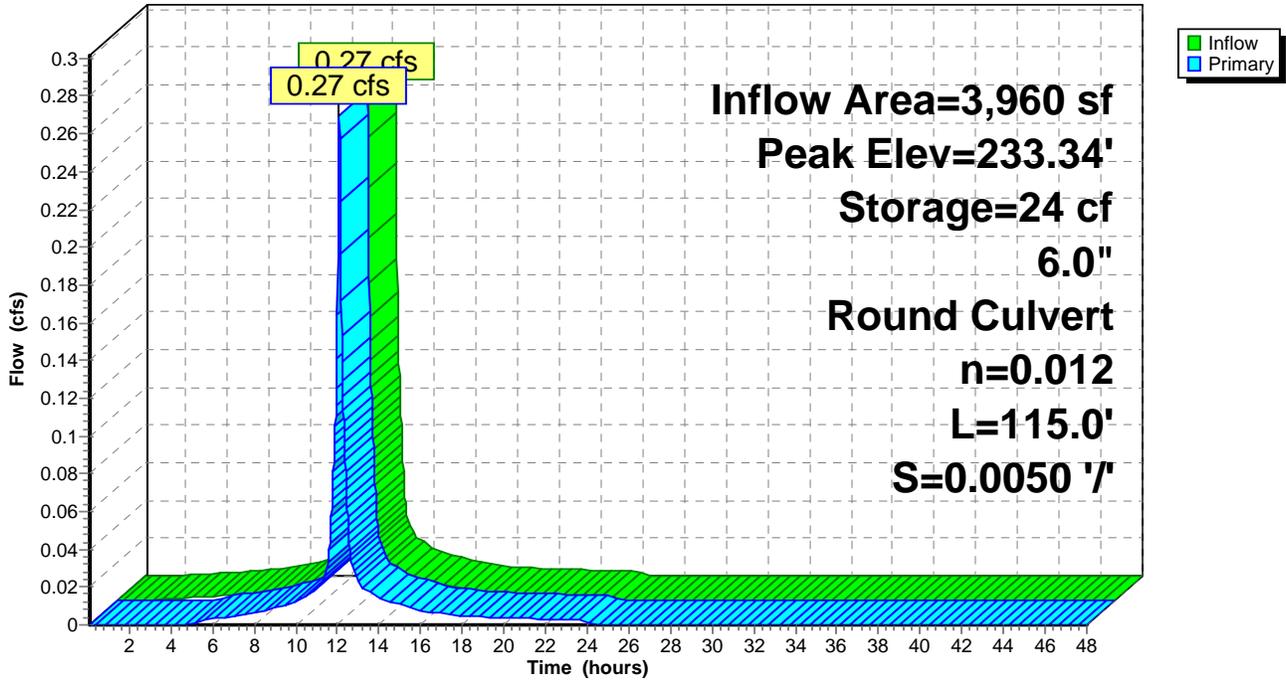
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	293 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	1,963	247	293

Device	Routing	Invert	Outlet Devices
#1	Primary	232.95'	6.0" Round Culvert L= 115.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 232.95' / 232.38' S= 0.0050 '/ Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.27 cfs @ 12.09 hrs HW=233.34' TW=231.62' (Dynamic Tailwater)
 ↑1=Culvert (Barrel Controls 0.27 cfs @ 2.22 fps)

Pond CB3: Catch Basin #3

Hydrograph



Summary for Pond D1: Drywell

Inflow Area = 3,960 sf, 100.00% Impervious, Inflow Depth = 2.77" for 2-YEAR event
 Inflow = 0.27 cfs @ 12.09 hrs, Volume= 914 cf
 Outflow = 0.27 cfs @ 12.09 hrs, Volume= 914 cf, Atten= 0%, Lag= 0.4 min
 Discarded = 0.01 cfs @ 12.09 hrs, Volume= 374 cf
 Primary = 0.26 cfs @ 12.09 hrs, Volume= 541 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 231.63' @ 12.09 hrs Surf.Area= 33 sf Storage= 35 cf

Plug-Flow detention time= 19.4 min calculated for 914 cf (100% of inflow)
 Center-of-Mass det. time= 19.4 min (788.5 - 769.2)

Volume	Invert	Avail.Storage	Storage Description
#1	230.00'	98 cf	5.00'D x 5.00'H Vertical Cone/Cylinder Inside #2 141 cf Overall - 6.0" Wall Thickness = 98 cf
#2	230.00'	9 cf	6.50'D x 5.00'H Vertical Cone/Cylinder 166 cf Overall - 141 cf Embedded = 25 cf x 35.0% Voids
		107 cf	Total Available Storage

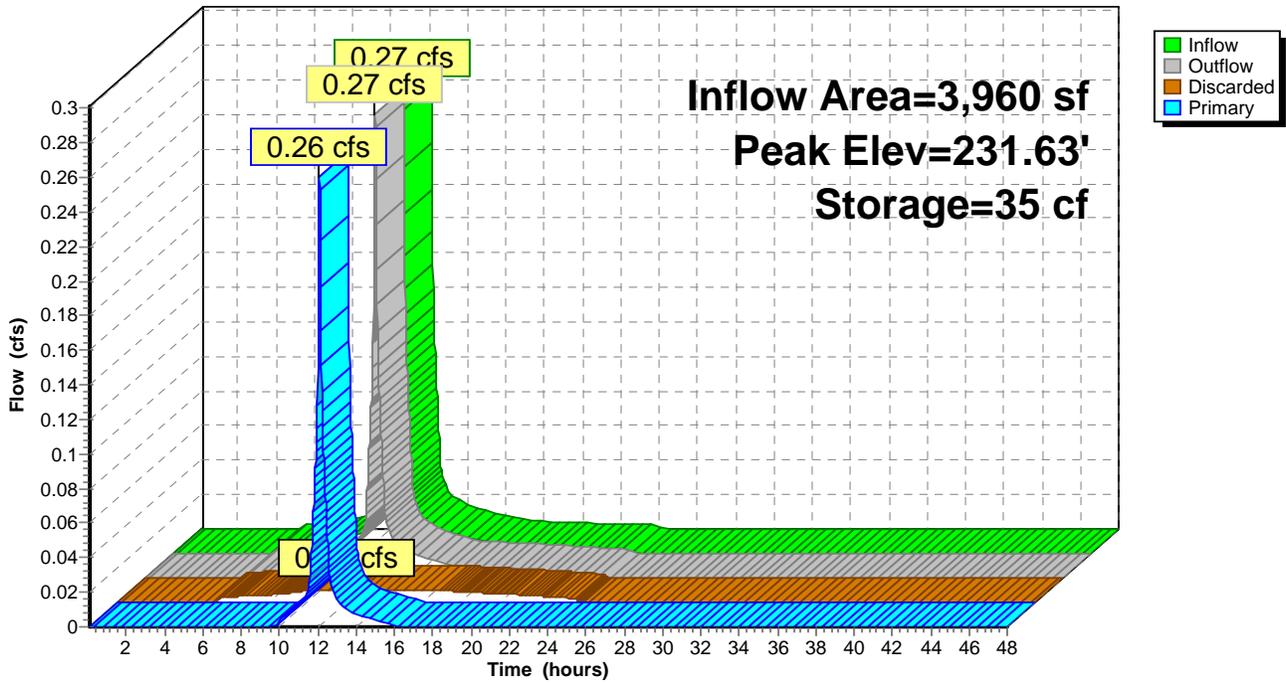
Device	Routing	Invert	Outlet Devices
#1	Primary	231.25'	6.0" Round Culvert L= 5.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 231.25' / 231.00' S= 0.0500 ' /' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf
#2	Discarded	230.00'	5.100 in/hr Exfiltration over Wetted area Phase-In= 0.01'

Discarded OutFlow Max=0.01 cfs @ 12.09 hrs HW=231.62' (Free Discharge)
 ↳ **2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.26 cfs @ 12.09 hrs HW=231.62' TW=229.71' (Dynamic Tailwater)
 ↳ **1=Culvert** (Inlet Controls 0.26 cfs @ 1.64 fps)

Pond D1: Drywell

Hydrograph



Nagog HydroCAD - 2015-11-18 - Water Balance

Type III 24-hr 10 year Rainfall=4.57"

Prepared by Environmental Partners Group

Printed 11/18/2015

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Time span=0.10-48.00 hrs, dt=0.02 hrs, 2396 points x 3
 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 1S: Roof Drain South West Runoff Area=2,749 sf 100.00% Impervious Runoff Depth=4.33"
 Flow Length=50' Slope=0.1300 '/' Tc=6.0 min CN=98 Runoff=0.28 cfs 993 cf

Subcatchment 2S: Roof Drain North Side Runoff Area=3,230 sf 100.00% Impervious Runoff Depth=4.33"
 Flow Length=50' Slope=0.1300 '/' Tc=6.0 min CN=98 Runoff=0.33 cfs 1,167 cf

Subcatchment 3S: Upper Paved Area Runoff Area=10,259 sf 69.83% Impervious Runoff Depth=2.97"
 Tc=6.0 min CN=85 Runoff=0.81 cfs 2,542 cf

Subcatchment 4S: Middle Paved Area & Runoff Area=4,232 sf 100.00% Impervious Runoff Depth=4.33"
 Tc=6.0 min CN=98 Runoff=0.43 cfs 1,528 cf

Subcatchment 5S: Lower Paved Area Runoff Area=3,960 sf 100.00% Impervious Runoff Depth=4.33"
 Tc=6.0 min CN=98 Runoff=0.41 cfs 1,430 cf

Subcatchment 6S: Remaining Project Area Runoff Area=217,642 sf 3.80% Impervious Runoff Depth=0.48"
 Flow Length=562' Tc=15.9 min CN=49 Runoff=1.09 cfs 8,708 cf

Subcatchment EX: Existing Site Runoff Area=242,195 sf 7.17% Impervious Runoff Depth=0.53"
 Flow Length=562' Tc=15.9 min CN=50 Runoff=1.41 cfs 10,605 cf

Reach END: Proposed Site Runoff Inflow=1.35 cfs 9,608 cf
 Outflow=1.35 cfs 9,608 cf

Pond C1: Northeast Cultecs Peak Elev=232.61' Storage=0.040 af Inflow=1.24 cfs 4,032 cf
 Discarded=0.00 cfs 0 cf Primary=0.39 cfs 3,662 cf Outflow=0.39 cfs 3,662 cf

Pond C2: Intermediate Cultecs Peak Elev=231.11' Storage=536 cf Inflow=0.49 cfs 4,829 cf
 Discarded=0.07 cfs 2,643 cf Primary=0.34 cfs 2,185 cf Outflow=0.41 cfs 4,829 cf

Pond C3: Southwest Cultecs Peak Elev=231.04' Storage=0.021 af Inflow=0.94 cfs 4,128 cf
 Discarded=0.13 cfs 3,228 cf Primary=0.31 cfs 900 cf Outflow=0.44 cfs 4,128 cf

Pond CB1: Catch Basin #1 Peak Elev=234.37' Storage=37 cf Inflow=0.81 cfs 2,542 cf
 6.0" Round Culvert n=0.012 L=20.0' S=0.0600 '/' Outflow=0.81 cfs 2,523 cf

Pond CB2: Catch Basin #2 Peak Elev=233.54' Storage=26 cf Inflow=0.43 cfs 1,528 cf
 6.0" Round Culvert n=0.012 L=75.0' S=0.0160 '/' Outflow=0.43 cfs 1,510 cf

Pond CB3: Catch Basin #3 Peak Elev=233.49' Storage=26 cf Inflow=0.41 cfs 1,430 cf
 6.0" Round Culvert n=0.012 L=115.0' S=0.0050 '/' Outflow=0.40 cfs 1,411 cf

Pond D1: Drywell Peak Elev=231.78' Storage=38 cf Inflow=0.40 cfs 1,411 cf
 Discarded=0.01 cfs 462 cf Primary=0.39 cfs 949 cf Outflow=0.40 cfs 1,411 cf

Total Runoff Area = 484,267 sf Runoff Volume = 26,973 cf Average Runoff Depth = 0.67"
90.30% Pervious = 437,284 sf 9.70% Impervious = 46,983 sf

Summary for Subcatchment 1S: Roof Drain South West Side

Runoff = 0.28 cfs @ 12.08 hrs, Volume= 993 cf, Depth= 4.33"

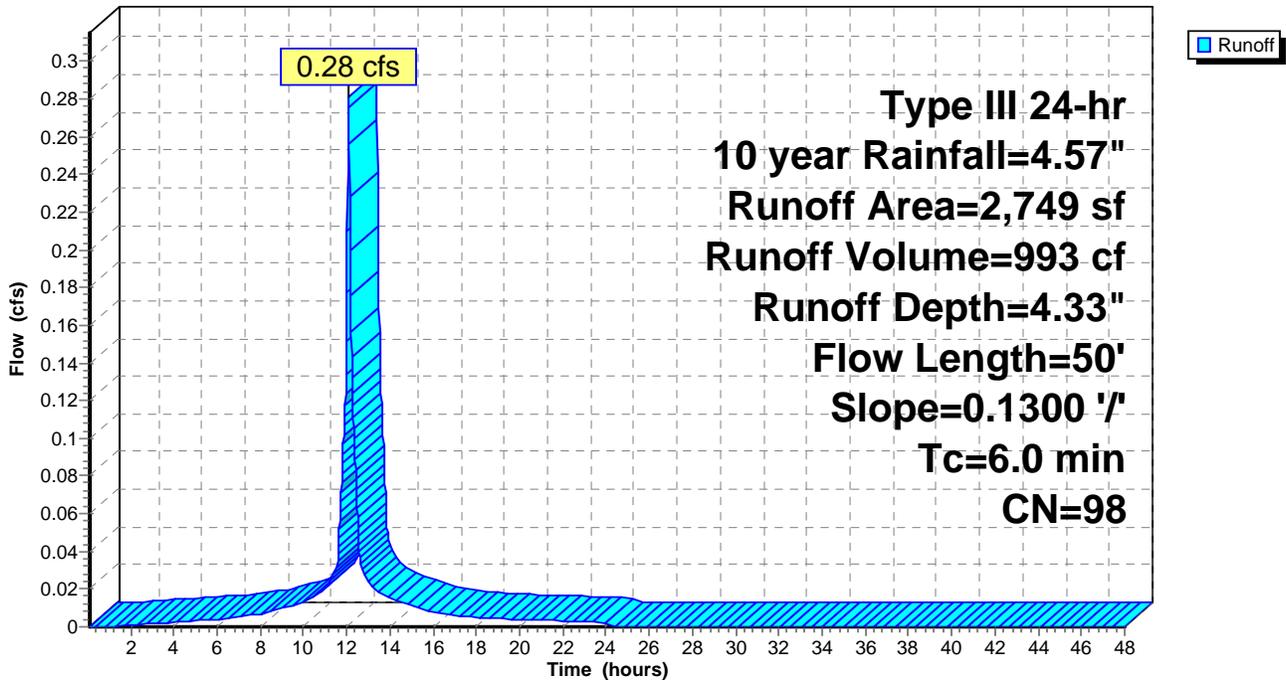
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 year Rainfall=4.57"

Area (sf)	CN	Description
2,749	98	Roofs, HSG A
2,749		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1300	0.14		Sheet Flow, sheet flow Woods: Light underbrush n= 0.400 P2= 3.06"

Subcatchment 1S: Roof Drain South West Side

Hydrograph



Summary for Subcatchment 2S: Roof Drain North Side

Runoff = 0.33 cfs @ 12.08 hrs, Volume= 1,167 cf, Depth= 4.33"

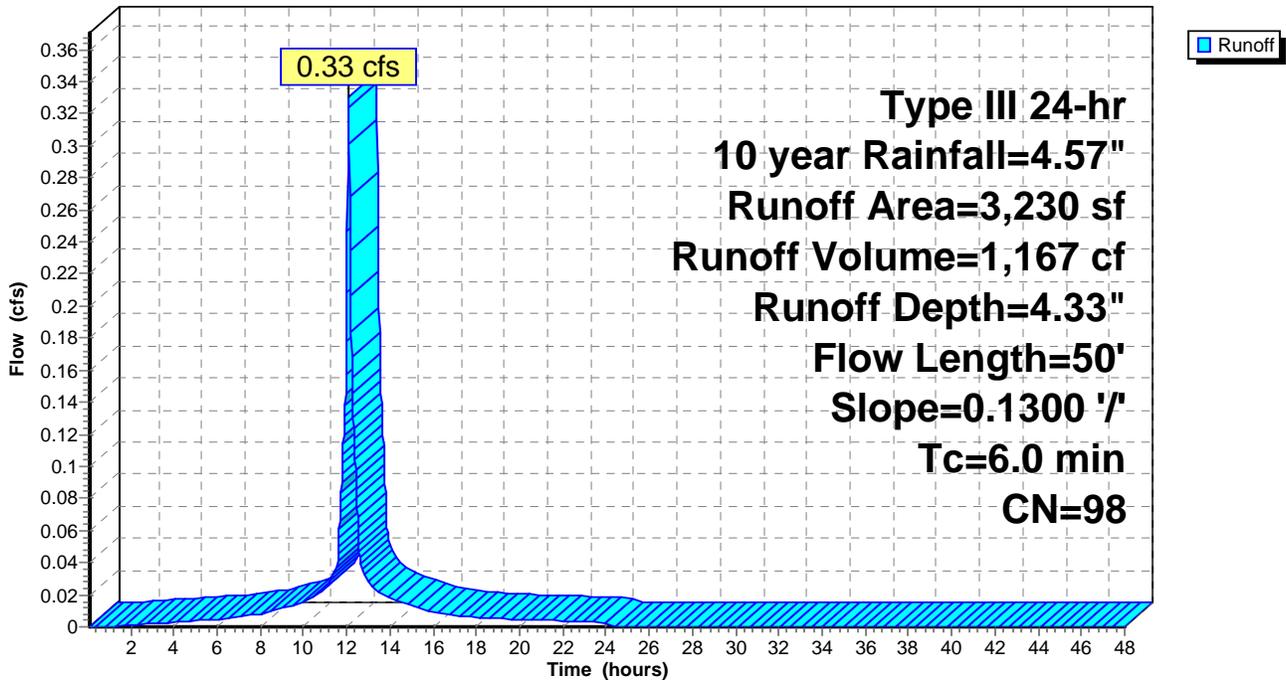
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
 Type III 24-hr 10 year Rainfall=4.57"

Area (sf)	CN	Description
3,230	98	Roofs, HSG A
3,230		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1300	0.14		Sheet Flow, sheet flow Woods: Light underbrush n= 0.400 P2= 3.06"

Subcatchment 2S: Roof Drain North Side

Hydrograph



Summary for Subcatchment 3S: Upper Paved Area

Runoff = 0.81 cfs @ 12.09 hrs, Volume= 2,542 cf, Depth= 2.97"

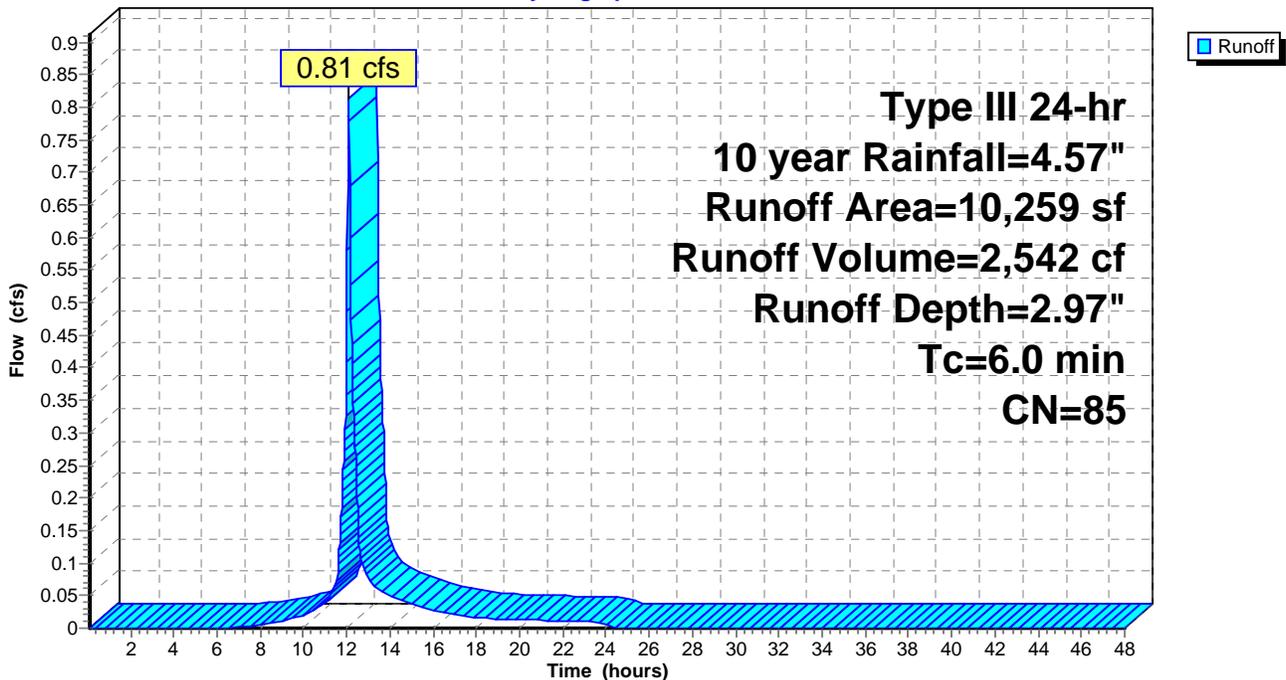
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 year Rainfall=4.57"

Area (sf)	CN	Description
7,164	98	Paved parking, HSG A
1,956	49	50-75% Grass cover, Fair, HSG A
441	49	50-75% Grass cover, Fair, HSG A
* 698	76	Gravel roads, HSG A (rip rap)
10,259	85	Weighted Average
3,095		30.17% Pervious Area
7,164		69.83% Impervious Area

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

Subcatchment 3S: Upper Paved Area

Hydrograph



Summary for Subcatchment 4S: Middle Paved Area & Eastern Roof

Runoff = 0.43 cfs @ 12.08 hrs, Volume= 1,528 cf, Depth= 4.33"

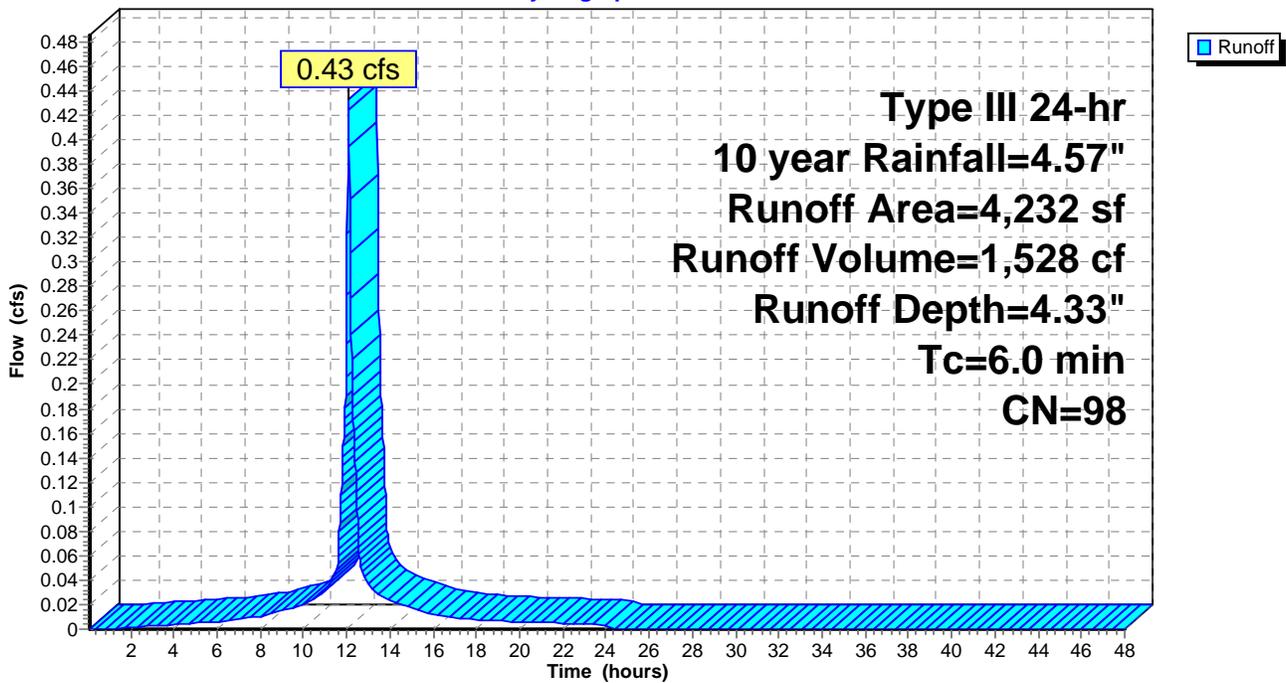
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
 Type III 24-hr 10 year Rainfall=4.57"

Area (sf)	CN	Description
2,572	98	Paved parking, HSG A
1,660	98	Roofs, HSG A
4,232	98	Weighted Average
4,232		100.00% Impervious Area

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

Subcatchment 4S: Middle Paved Area & Eastern Roof

Hydrograph



Summary for Subcatchment 5S: Lower Paved Area

Runoff = 0.41 cfs @ 12.08 hrs, Volume= 1,430 cf, Depth= 4.33"

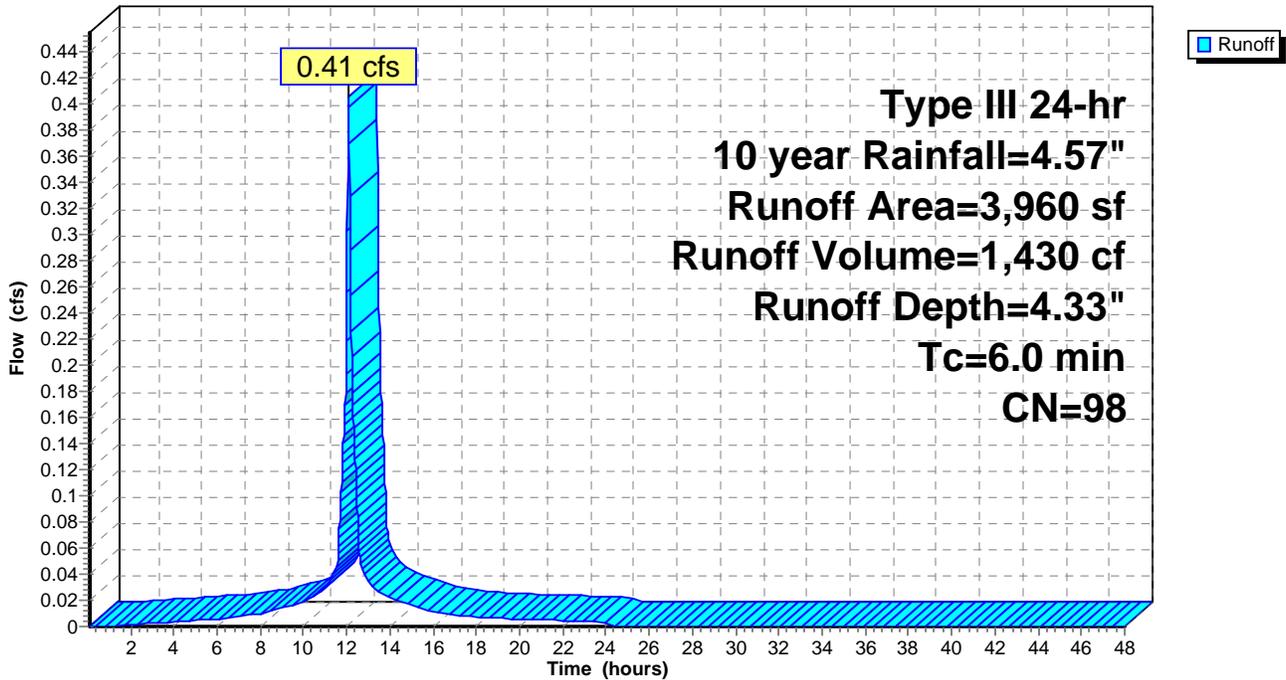
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
 Type III 24-hr 10 year Rainfall=4.57"

Area (sf)	CN	Description
3,960	98	Paved parking, HSG A
3,960		100.00% Impervious Area

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

Subcatchment 5S: Lower Paved Area

Hydrograph



Summary for Subcatchment 6S: Remaining Project Area

Runoff = 1.09 cfs @ 12.42 hrs, Volume= 8,708 cf, Depth= 0.48"

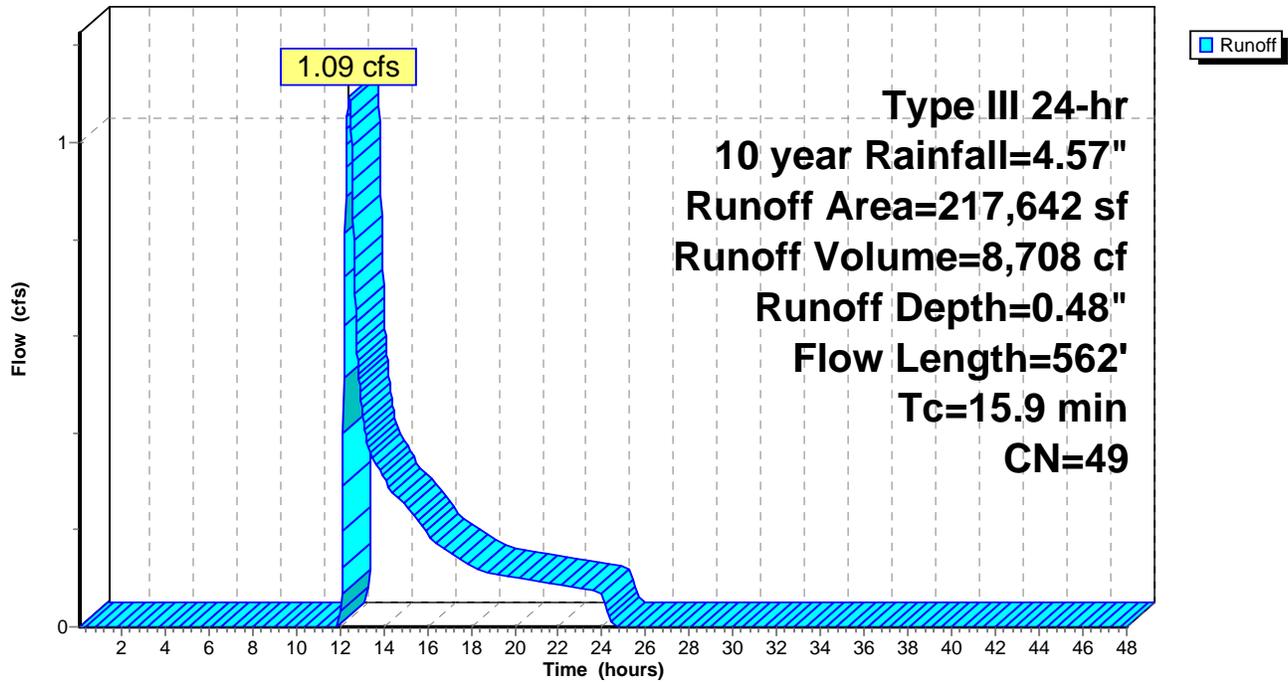
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 year Rainfall=4.57"

Area (sf)	CN	Description
2,763	49	50-75% Grass cover, Fair, HSG A
9,597	76	Gravel roads, HSG A
8,274	98	Paved parking, HSG A
7,927	49	50-75% Grass cover, Fair, HSG A
27,757	78	Meadow, non-grazed, HSG D
28,946	77	Woods, Good, HSG D
78,485	30	Woods, Good, HSG A
39,143	30	Meadow, non-grazed, HSG A
11,968	30	Woods, Good, HSG A
* 2,782	76	Gravel roads, HSG A (RIP RAP)
217,642	49	Weighted Average
209,368		96.20% Pervious Area
8,274		3.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		Sheet Flow, sheet flow Woods: Light underbrush n= 0.400 P2= 3.06"
0.3	36	0.1676	2.05		Shallow Concentrated Flow, woods pre grass strip Woodland Kv= 5.0 fps
0.1	10	0.1000	2.21		Shallow Concentrated Flow, grass strips (both) Short Grass Pasture Kv= 7.0 fps
0.0	12	0.0833	5.86		Shallow Concentrated Flow, pavement Paved Kv= 20.3 fps
6.7	440	0.0480	1.10		Shallow Concentrated Flow, rip rap Woodland Kv= 5.0 fps
0.1	14	0.1667	2.86		Shallow Concentrated Flow, grass strip Short Grass Pasture Kv= 7.0 fps
15.9	562	Total			

Subcatchment 6S: Remaining Project Area

Hydrograph



Summary for Subcatchment EX: Existing Site

Runoff = 1.41 cfs @ 12.39 hrs, Volume= 10,605 cf, Depth= 0.53"

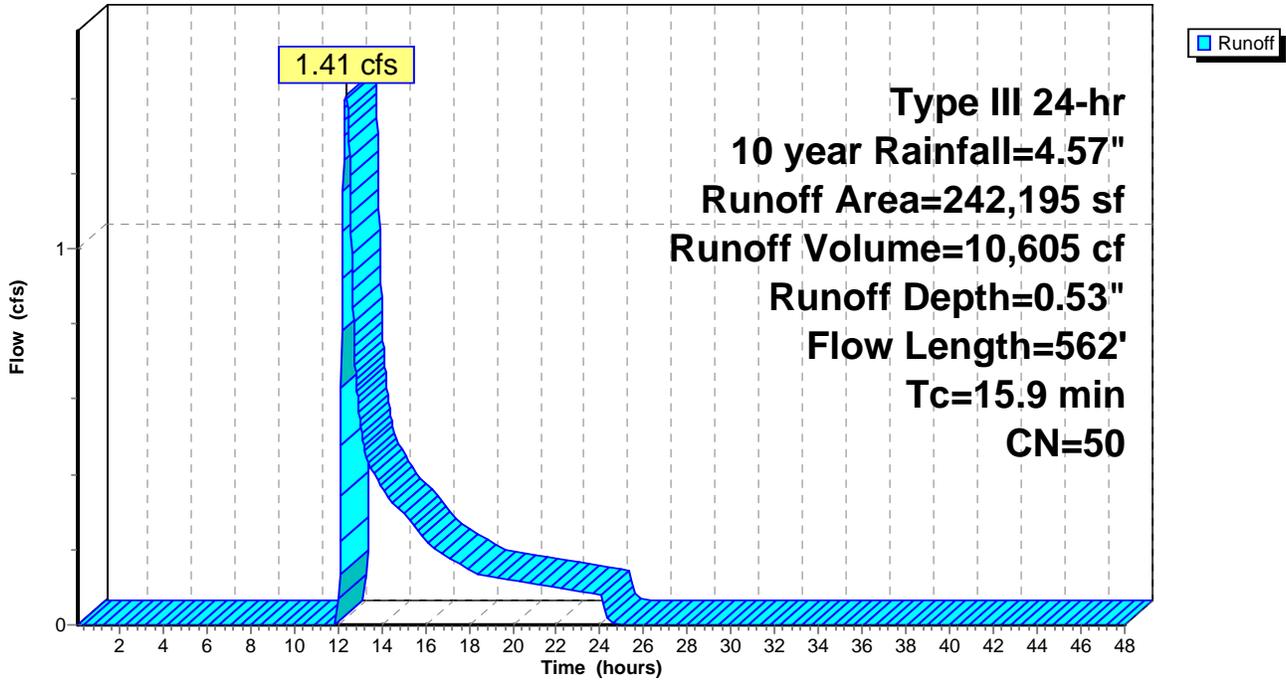
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 year Rainfall=4.57"

Area (sf)	CN	Description
11,475	49	50-75% Grass cover, Fair, HSG A
3,181	76	Gravel roads, HSG A
17,374	98	Paved parking, HSG A
4,242	49	50-75% Grass cover, Fair, HSG A
8,728	49	50-75% Grass cover, Fair, HSG A
* 3,480	76	Gravel roads, HSG A (RIP RAP)
59,405	77	Woods, Good, HSG D
82,915	30	Woods, Good, HSG A
9,737	30	Woods, Good, HSG A
41,658	30	Woods, Good, HSG A
242,195	50	Weighted Average
224,821		92.83% Pervious Area
17,374		7.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		Sheet Flow, sheet flow Woods: Light underbrush n= 0.400 P2= 3.06"
0.3	36	0.1676	2.05		Shallow Concentrated Flow, woods Woodland Kv= 5.0 fps
0.0	12	0.1000	6.42		Shallow Concentrated Flow, pavement Paved Kv= 20.3 fps
0.1	10	0.1000	2.21		Shallow Concentrated Flow, grass strip (both) Short Grass Pasture Kv= 7.0 fps
6.7	440	0.0480	1.10		Shallow Concentrated Flow, rip rap Woodland Kv= 5.0 fps
0.1	14	0.1667	2.86		Shallow Concentrated Flow, final grass strip Short Grass Pasture Kv= 7.0 fps
15.9	562	Total			

Subcatchment EX: Existing Site

Hydrograph



Summary for Reach END: Proposed Site Runoff

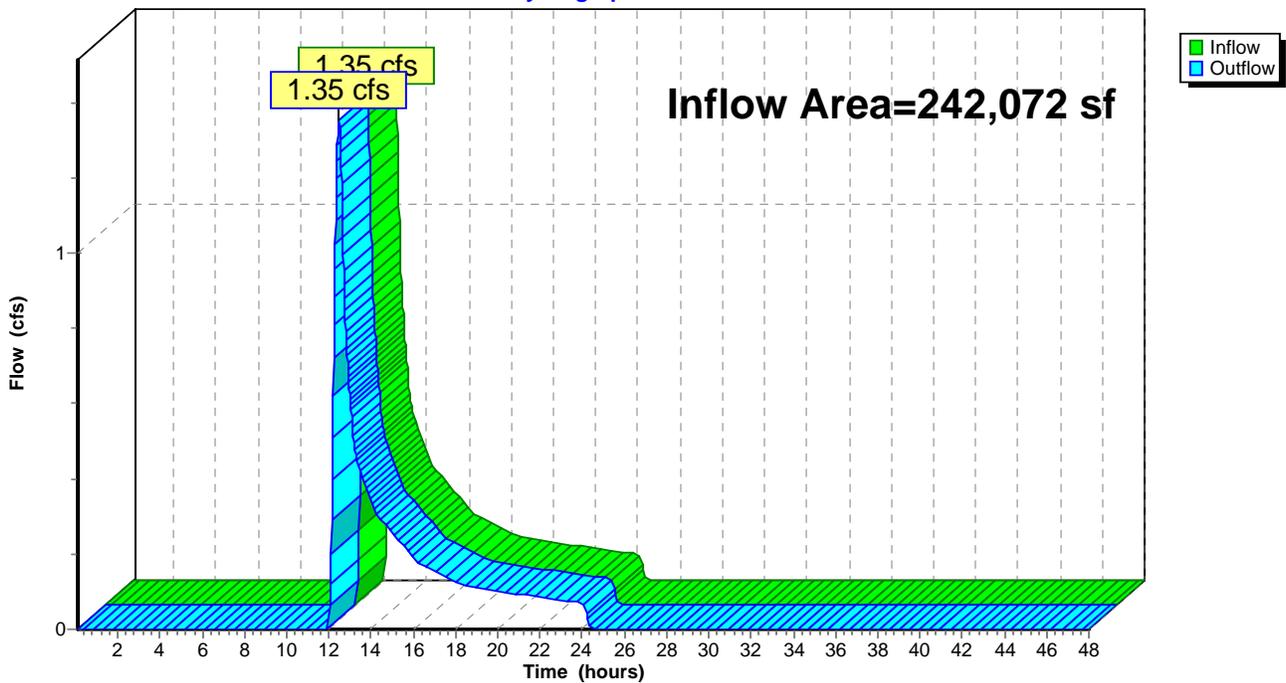
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 242,072 sf, 12.23% Impervious, Inflow Depth = 0.48" for 10 year event
Inflow = 1.35 cfs @ 12.47 hrs, Volume= 9,608 cf
Outflow = 1.35 cfs @ 12.47 hrs, Volume= 9,608 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 3

Reach END: Proposed Site Runoff

Hydrograph



Summary for Pond C1: Northeast Cultecs

Inflow Area = 14,491 sf, 78.64% Impervious, Inflow Depth = 3.34" for 10 year event
 Inflow = 1.24 cfs @ 12.09 hrs, Volume= 4,032 cf
 Outflow = 0.39 cfs @ 12.41 hrs, Volume= 3,662 cf, Atten= 69%, Lag= 18.8 min
 Discarded = 0.00 cfs @ 0.10 hrs, Volume= 0 cf
 Primary = 0.39 cfs @ 12.41 hrs, Volume= 3,662 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 232.61' @ 12.41 hrs Surf.Area= 0.046 ac Storage= 0.040 af

Plug-Flow detention time= 165.2 min calculated for 3,662 cf (91% of inflow)
 Center-of-Mass det. time= 119.1 min (912.2 - 793.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	231.17'	0.018 af	14.50'W x 84.75'L x 2.54'H Field A 0.072 af Overall - 0.020 af Embedded = 0.052 af x 35.0% Voids
#2A	231.67'	0.020 af	Cultec R-150XLHD x 32 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 4 rows
#3B	231.17'	0.012 af	14.50'W x 54.00'L x 2.54'H Field B 0.046 af Overall - 0.013 af Embedded = 0.033 af x 35.0% Voids
#4B	231.67'	0.013 af	Cultec R-150XLHD x 20 Inside #3 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 4 rows
		0.062 af	Total Available Storage

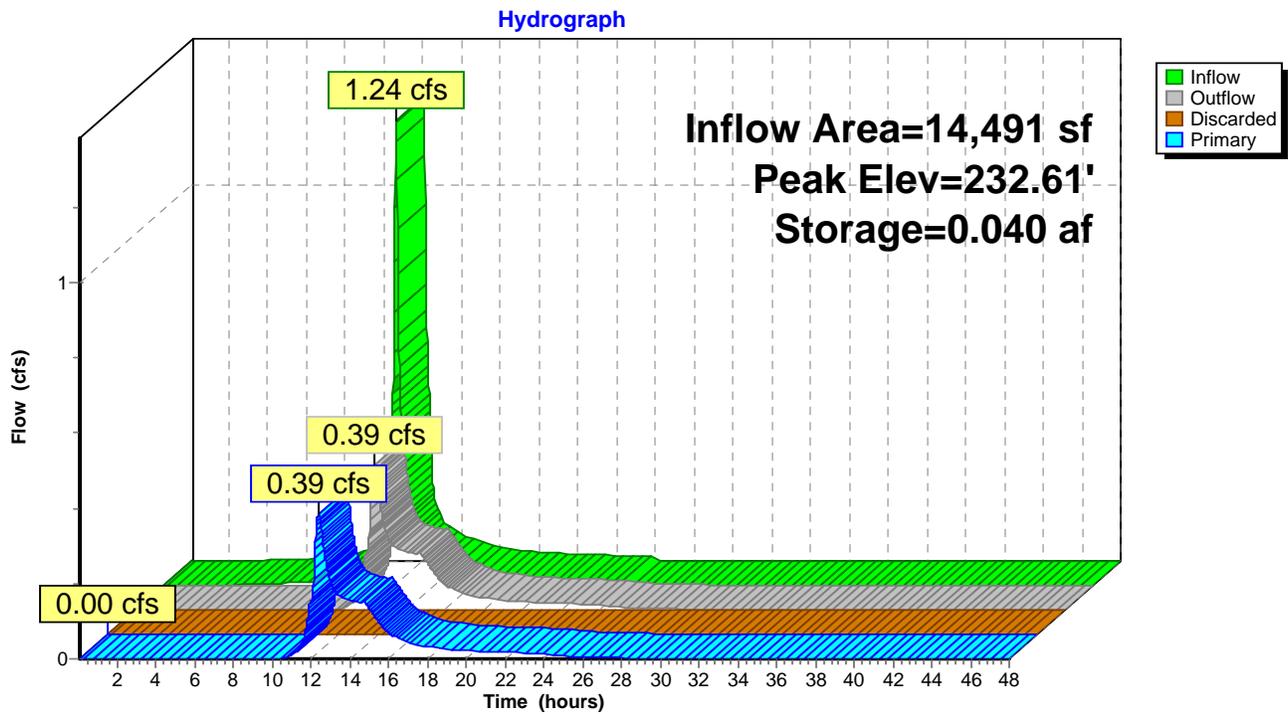
Storage Group A created with Chamber Wizard
 Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	231.17'	0.090 in/hr Exfiltration X 0.00 over Surface area Phase-In= 0.01'
#2	Primary	231.67'	4.0" Round Culvert L= 145.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 231.67' / 230.95' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#3	Primary	232.33'	8.0" Round Culvert L= 145.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 232.33' / 231.44' S= 0.0061 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Discarded OutFlow Max=0.00 cfs @ 0.10 hrs HW=231.17' (Free Discharge)
 ↳1=Exfiltration (Controls 0.00 cfs)

Primary OutFlow Max=0.39 cfs @ 12.41 hrs HW=232.61' TW=231.02' (Dynamic Tailwater)
 ↳2=Culvert (Barrel Controls 0.19 cfs @ 2.14 fps)
 ↳3=Culvert (Inlet Controls 0.20 cfs @ 1.43 fps)

Pond C1: Northeast Cultecs



Summary for Pond C2: Intermediate Cultecs

Inflow Area = 17,721 sf, 82.53% Impervious, Inflow Depth > 3.27" for 10 year event
 Inflow = 0.49 cfs @ 12.34 hrs, Volume= 4,829 cf
 Outflow = 0.41 cfs @ 12.52 hrs, Volume= 4,829 cf, Atten= 17%, Lag= 10.4 min
 Discarded = 0.07 cfs @ 12.55 hrs, Volume= 2,643 cf
 Primary = 0.34 cfs @ 12.52 hrs, Volume= 2,185 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 231.11' @ 12.55 hrs Surf.Area= 392 sf Storage= 536 cf
 Flood Elev= 233.94' Surf.Area= 392 sf Storage= 950 cf

Plug-Flow detention time= 31.3 min calculated for 4,827 cf (100% of inflow)
 Center-of-Mass det. time= 31.3 min (904.2 - 872.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	228.78'	447 cf	16.00'W x 24.50'L x 4.54'H Field A 1,780 cf Overall - 503 cf Embedded = 1,277 cf x 35.0% Voids
#2A	229.78'	503 cf	Cultec R-330XLHD x 9 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
		950 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	228.78'	5.100 in/hr Exfiltration over Wetted area Phase-In= 0.01'
#2	Primary	230.00'	8.0" Round Culvert L= 10.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 230.00' / 230.00' S= 0.0000 1/ S= 0.0000 1/ Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Discarded OutFlow Max=0.07 cfs @ 12.55 hrs HW=231.11' (Free Discharge)

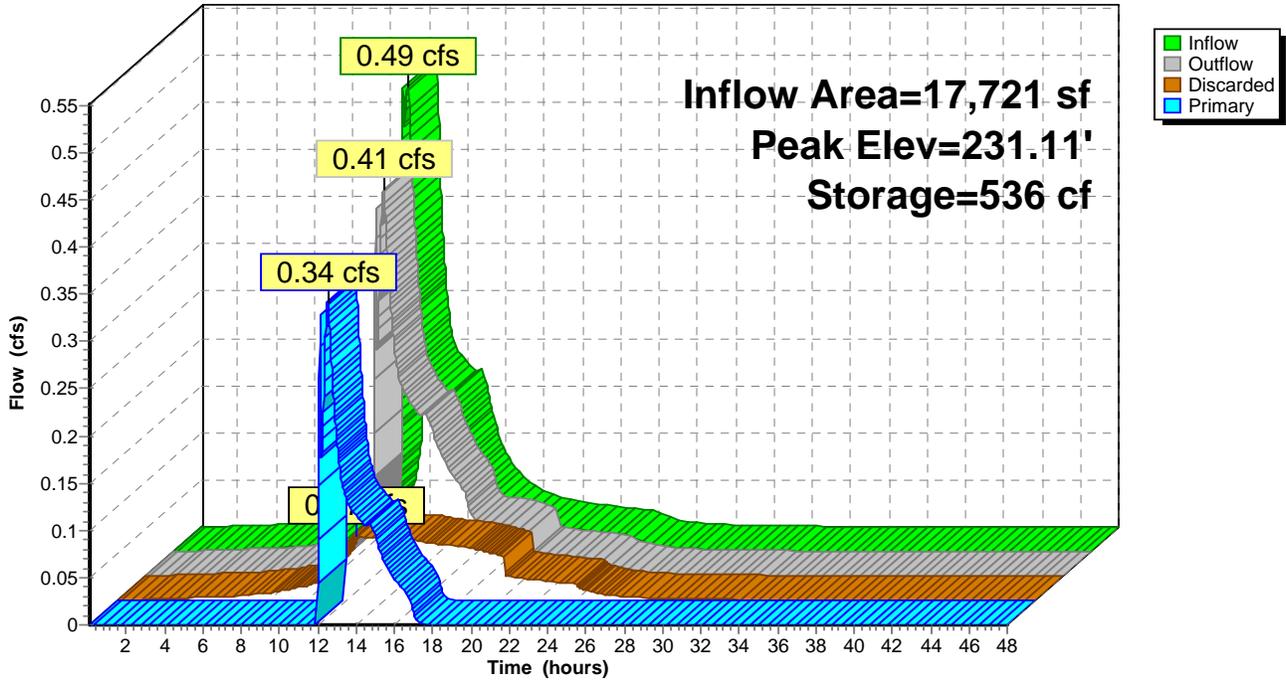
↳ **1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=0.34 cfs @ 12.52 hrs HW=231.10' TW=231.04' (Dynamic Tailwater)

↳ **2=Culvert** (Inlet Controls 0.34 cfs @ 0.98 fps)

Pond C2: Intermediate Cultecs

Hydrograph



Summary for Pond C3: Southwest Cultecs

Inflow Area = 24,430 sf, 87.33% Impervious, Inflow Depth = 2.03" for 10 year event
 Inflow = 0.94 cfs @ 12.11 hrs, Volume= 4,128 cf
 Outflow = 0.44 cfs @ 12.56 hrs, Volume= 4,128 cf, Atten= 53%, Lag= 26.6 min
 Discarded = 0.13 cfs @ 12.56 hrs, Volume= 3,228 cf
 Primary = 0.31 cfs @ 12.56 hrs, Volume= 900 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 231.04' @ 12.56 hrs Surf.Area= 0.017 ac Storage= 0.021 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. time= 53.1 min (835.9 - 782.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	229.07'	0.003 af	6.33'W x 24.50'L x 3.71'H Field A 0.013 af Overall - 0.004 af Embedded = 0.009 af x 35.0% Voids
#2A	229.74'	0.004 af	Cultec R-330XLHD x 3 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 1 rows
#3B	229.07'	0.011 af	11.17'W x 52.50'L x 3.71'H Field B 0.050 af Overall - 0.017 af Embedded = 0.033 af x 35.0% Voids
#4B	229.74'	0.017 af	Cultec R-330XLHD x 14 Inside #3 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 2 rows
		0.036 af	Total Available Storage

Storage Group A created with Chamber Wizard
 Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	229.07'	5.100 in/hr Exfiltration over Wetted area Phase-In= 0.01'
#2	Primary	230.68'	8.0" Round Culvert L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 230.68' / 230.48' S= 0.0100 1/ Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Discarded OutFlow Max=0.13 cfs @ 12.56 hrs HW=231.04' (Free Discharge)

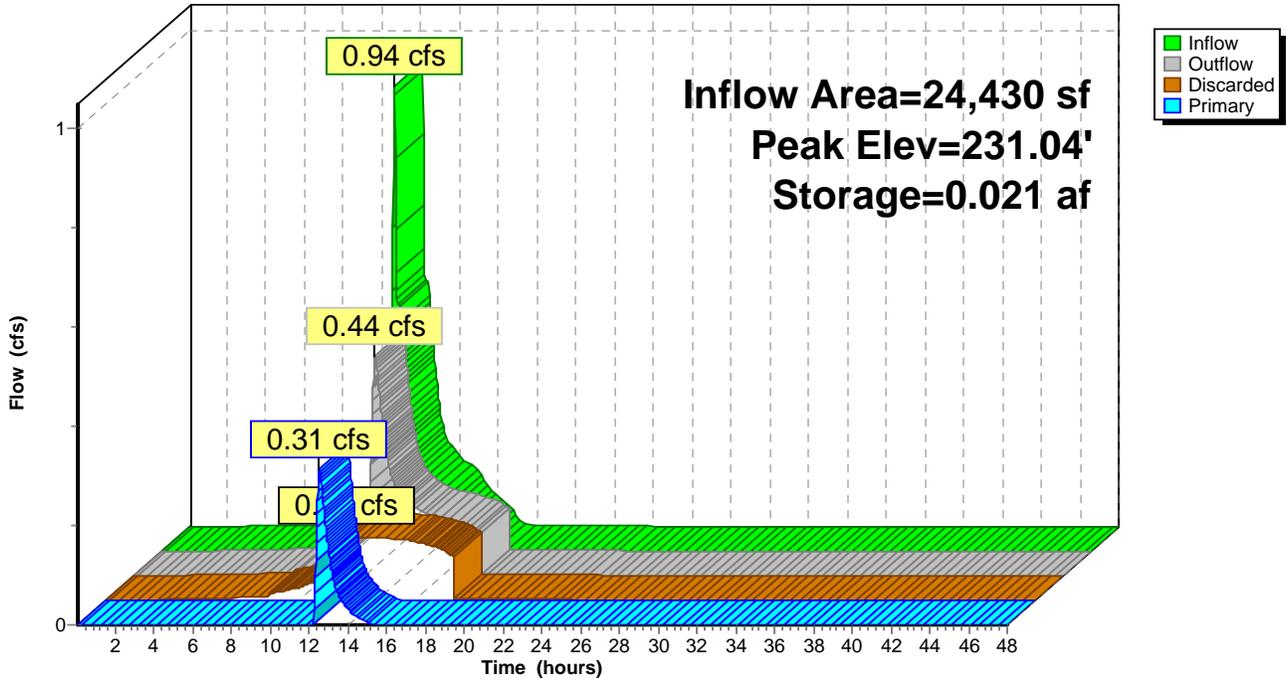
↑**1=Exfiltration** (Exfiltration Controls 0.13 cfs)

Primary OutFlow Max=0.31 cfs @ 12.56 hrs HW=231.04' TW=0.00' (Dynamic Tailwater)

↑**2=Culvert** (Inlet Controls 0.31 cfs @ 1.62 fps)

Pond C3: Southwest Cultecs

Hydrograph



Summary for Pond CB1: Catch Basin #1

Inflow Area = 10,259 sf, 69.83% Impervious, Inflow Depth = 2.97" for 10 year event
 Inflow = 0.81 cfs @ 12.09 hrs, Volume= 2,542 cf
 Outflow = 0.81 cfs @ 12.10 hrs, Volume= 2,523 cf, Atten= 1%, Lag= 0.6 min
 Primary = 0.81 cfs @ 12.10 hrs, Volume= 2,523 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 234.37' @ 12.10 hrs Surf.Area= 13 sf Storage= 37 cf

Plug-Flow detention time= 8.0 min calculated for 2,523 cf (99% of inflow)
 Center-of-Mass det. time= 3.2 min (814.2 - 811.1)

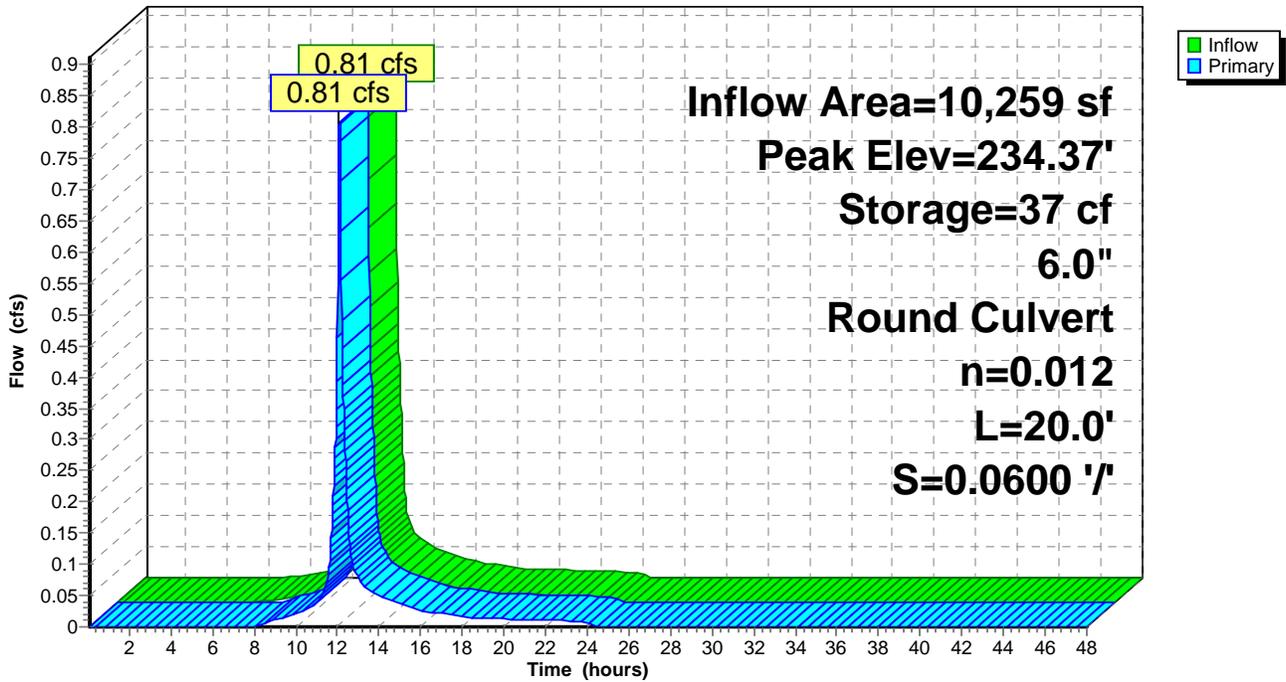
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	464 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	3,335	419	464

Device	Routing	Invert	Outlet Devices
#1	Primary	232.95'	6.0" Round Culvert L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 232.95' / 231.75' S= 0.0600 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.81 cfs @ 12.10 hrs HW=234.36' TW=232.30' (Dynamic Tailwater)
 ↑1=Culvert (Inlet Controls 0.81 cfs @ 4.10 fps)

Pond CB1: Catch Basin #1

Hydrograph



Summary for Pond CB2: Catch Basin #2

Inflow Area = 4,232 sf, 100.00% Impervious, Inflow Depth = 4.33" for 10 year event
 Inflow = 0.43 cfs @ 12.08 hrs, Volume= 1,528 cf
 Outflow = 0.43 cfs @ 12.09 hrs, Volume= 1,510 cf, Atten= 0%, Lag= 0.3 min
 Primary = 0.43 cfs @ 12.09 hrs, Volume= 1,510 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 233.54' @ 12.09 hrs Surf.Area= 13 sf Storage= 26 cf

Plug-Flow detention time= 16.6 min calculated for 1,510 cf (99% of inflow)
 Center-of-Mass det. time= 8.1 min (757.7 - 749.5)

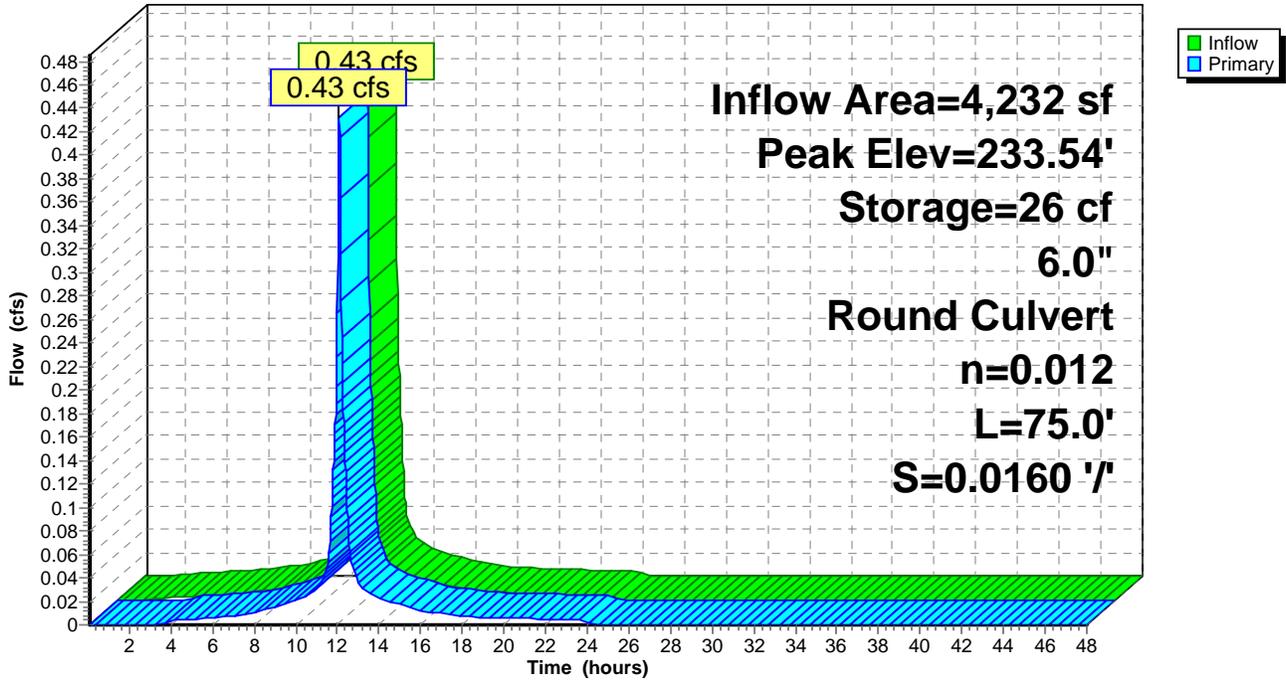
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	258 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	1,690	213	258

Device	Routing	Invert	Outlet Devices
#1	Primary	232.95'	6.0" Round Culvert L= 75.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 232.95' / 231.75' S= 0.0160 ' S Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.43 cfs @ 12.09 hrs HW=233.53' TW=232.28' (Dynamic Tailwater)
 ↑1=Culvert (Inlet Controls 0.43 cfs @ 2.19 fps)

Pond CB2: Catch Basin #2

Hydrograph



Summary for Pond CB3: Catch Basin #3

Inflow Area = 3,960 sf, 100.00% Impervious, Inflow Depth = 4.33" for 10 year event
 Inflow = 0.41 cfs @ 12.08 hrs, Volume= 1,430 cf
 Outflow = 0.40 cfs @ 12.09 hrs, Volume= 1,411 cf, Atten= 0%, Lag= 0.3 min
 Primary = 0.40 cfs @ 12.09 hrs, Volume= 1,411 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 233.49' @ 12.09 hrs Surf.Area= 13 sf Storage= 26 cf

Plug-Flow detention time= 17.7 min calculated for 1,411 cf (99% of inflow)
 Center-of-Mass det. time= 8.7 min (758.2 - 749.5)

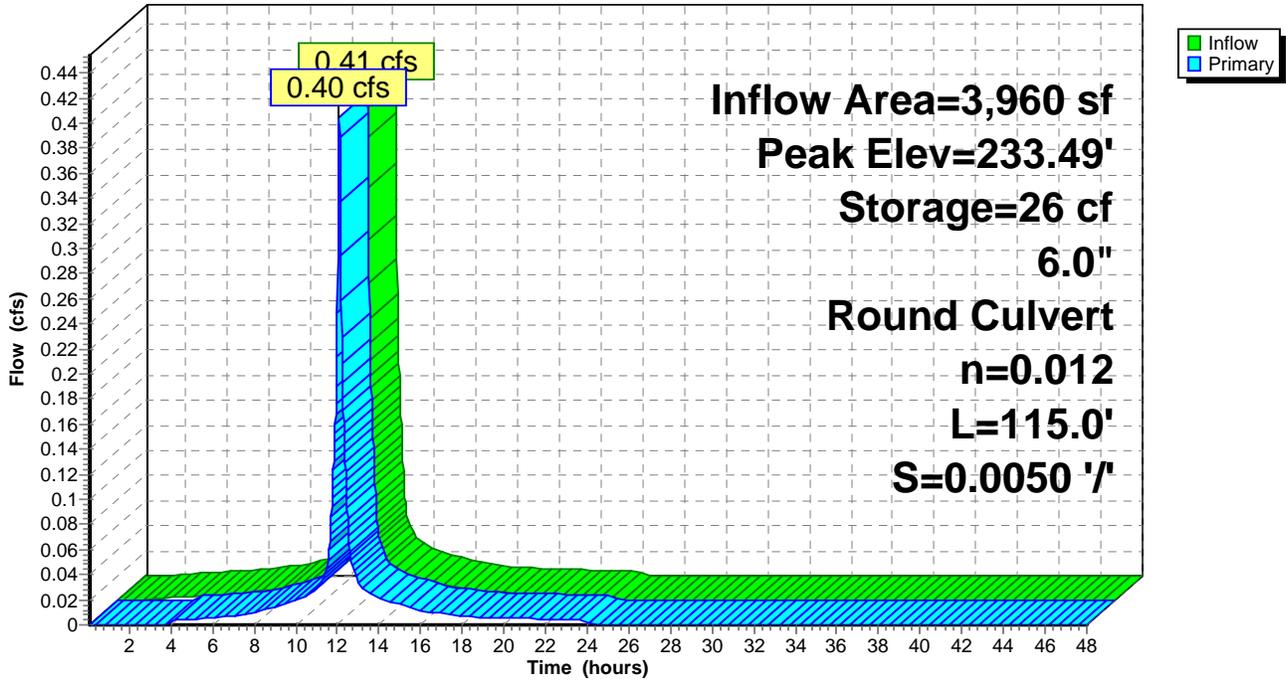
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	293 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	1,963	247	293

Device	Routing	Invert	Outlet Devices
#1	Primary	232.95'	6.0" Round Culvert L= 115.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 232.95' / 232.38' S= 0.0050 ' / ' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.40 cfs @ 12.09 hrs HW=233.49' TW=231.77' (Dynamic Tailwater)
 ↑1=Culvert (Inlet Controls 0.40 cfs @ 2.04 fps)

Pond CB3: Catch Basin #3

Hydrograph



Summary for Pond D1: Drywell

Inflow Area = 3,960 sf, 100.00% Impervious, Inflow Depth = 4.28" for 10 year event
 Inflow = 0.40 cfs @ 12.09 hrs, Volume= 1,411 cf
 Outflow = 0.40 cfs @ 12.10 hrs, Volume= 1,411 cf, Atten= 0%, Lag= 0.5 min
 Discarded = 0.01 cfs @ 12.10 hrs, Volume= 462 cf
 Primary = 0.39 cfs @ 12.10 hrs, Volume= 949 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 231.78' @ 12.10 hrs Surf.Area= 33 sf Storage= 38 cf

Plug-Flow detention time= 17.8 min calculated for 1,411 cf (100% of inflow)
 Center-of-Mass det. time= 17.8 min (776.1 - 758.2)

Volume	Invert	Avail.Storage	Storage Description
#1	230.00'	98 cf	5.00'D x 5.00'H Vertical Cone/Cylinder Inside #2 141 cf Overall - 6.0" Wall Thickness = 98 cf
#2	230.00'	9 cf	6.50'D x 5.00'H Vertical Cone/Cylinder 166 cf Overall - 141 cf Embedded = 25 cf x 35.0% Voids
		107 cf	Total Available Storage

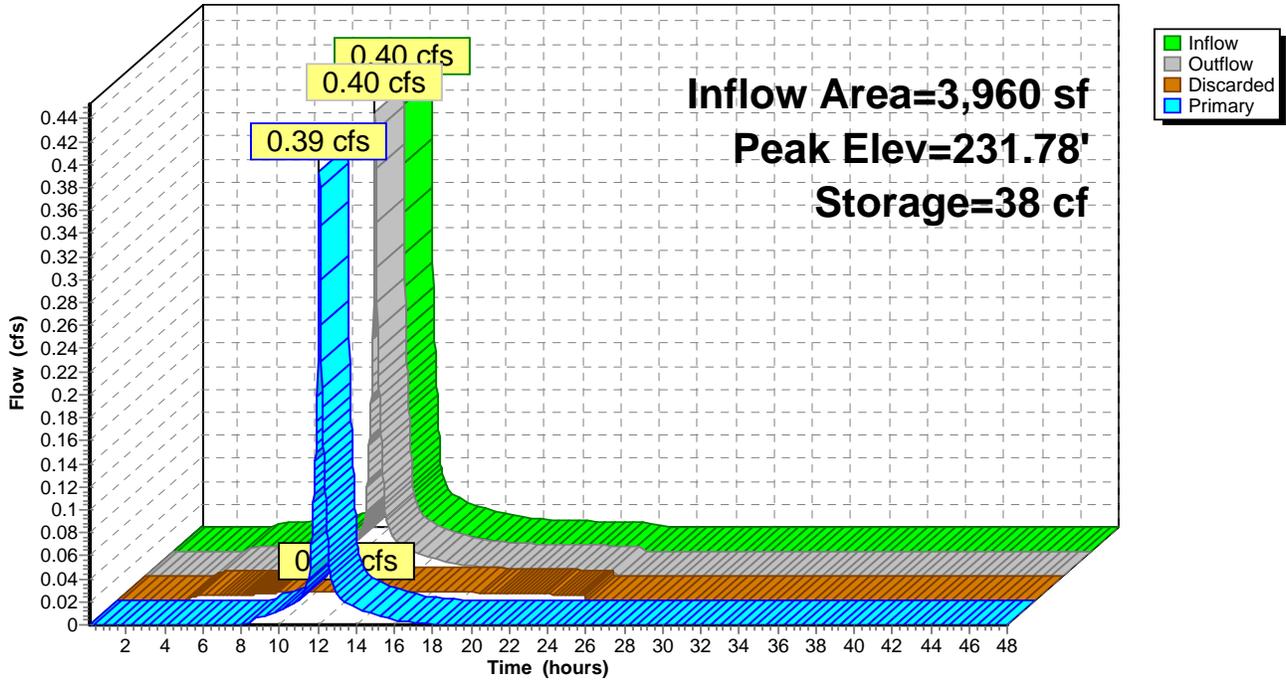
Device	Routing	Invert	Outlet Devices
#1	Primary	231.25'	6.0" Round Culvert L= 5.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 231.25' / 231.00' S= 0.0500 '/ n= 0.012, Flow Area= 0.20 sf
#2	Discarded	230.00'	5.100 in/hr Exfiltration over Wetted area Phase-In= 0.01'

Discarded OutFlow Max=0.01 cfs @ 12.10 hrs HW=231.78' (Free Discharge)
 ↳ **2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.39 cfs @ 12.10 hrs HW=231.78' TW=230.09' (Dynamic Tailwater)
 ↳ **1=Culvert** (Inlet Controls 0.39 cfs @ 2.00 fps)

Pond D1: Drywell

Hydrograph



Nagog HydroCAD - 2015-11-18 - Water Balance

Type III 24-hr 100 year Rainfall=8.13"

Prepared by Environmental Partners Group

Printed 11/18/2015

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Time span=0.10-48.00 hrs, dt=0.02 hrs, 2396 points x 3
 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 1S: Roof Drain South West Runoff Area=2,749 sf 100.00% Impervious Runoff Depth=7.89"
 Flow Length=50' Slope=0.1300 '/ Tc=6.0 min CN=98 Runoff=0.50 cfs 1,807 cf

Subcatchment 2S: Roof Drain North Side Runoff Area=3,230 sf 100.00% Impervious Runoff Depth=7.89"
 Flow Length=50' Slope=0.1300 '/ Tc=6.0 min CN=98 Runoff=0.59 cfs 2,124 cf

Subcatchment 3S: Upper Paved Area Runoff Area=10,259 sf 69.83% Impervious Runoff Depth=6.34"
 Tc=6.0 min CN=85 Runoff=1.68 cfs 5,419 cf

Subcatchment 4S: Middle Paved Area & Runoff Area=4,232 sf 100.00% Impervious Runoff Depth=7.89"
 Tc=6.0 min CN=98 Runoff=0.77 cfs 2,783 cf

Subcatchment 5S: Lower Paved Area Runoff Area=3,960 sf 100.00% Impervious Runoff Depth=7.89"
 Tc=6.0 min CN=98 Runoff=0.72 cfs 2,604 cf

Subcatchment 6S: Remaining Project Area Runoff Area=217,642 sf 3.80% Impervious Runoff Depth=2.22"
 Flow Length=562' Tc=15.9 min CN=49 Runoff=8.66 cfs 40,318 cf

Subcatchment EX: Existing Site Runoff Area=242,195 sf 7.17% Impervious Runoff Depth=2.33"
 Flow Length=562' Tc=15.9 min CN=50 Runoff=10.24 cfs 47,019 cf

Reach END: Proposed Site Runoff Inflow=10.04 cfs 45,676 cf
 Outflow=10.04 cfs 45,676 cf

Pond C1: Northeast Cultecs Peak Elev=233.61' Storage=0.061 af Inflow=1.79 cfs 8,164 cf
 Discarded=0.00 cfs 0 cf Primary=1.03 cfs 7,794 cf Outflow=1.03 cfs 7,794 cf

Pond C2: Intermediate Cultecs Peak Elev=232.78' Storage=876 cf Inflow=1.46 cfs 9,917 cf
 Discarded=0.08 cfs 3,690 cf Primary=1.12 cfs 6,227 cf Outflow=1.20 cfs 9,917 cf

Pond C3: Southwest Cultecs Peak Elev=232.11' Storage=0.032 af Inflow=1.96 cfs 10,052 cf
 Discarded=0.16 cfs 4,694 cf Primary=1.39 cfs 5,358 cf Outflow=1.55 cfs 10,052 cf

Pond CB1: Catch Basin #1 Peak Elev=235.19' Storage=296 cf Inflow=1.68 cfs 5,419 cf
 6.0" Round Culvert n=0.012 L=20.0' S=0.0600 '/ Outflow=1.06 cfs 5,400 cf

Pond CB2: Catch Basin #2 Peak Elev=234.51' Storage=39 cf Inflow=0.77 cfs 2,783 cf
 6.0" Round Culvert n=0.012 L=75.0' S=0.0160 '/ Outflow=0.75 cfs 2,764 cf

Pond CB3: Catch Basin #3 Peak Elev=234.82' Storage=43 cf Inflow=0.72 cfs 2,604 cf
 6.0" Round Culvert n=0.012 L=115.0' S=0.0050 '/ Outflow=0.71 cfs 2,585 cf

Pond D1: Drywell Peak Elev=232.46' Storage=53 cf Inflow=0.71 cfs 2,585 cf
 Discarded=0.01 cfs 568 cf Primary=0.68 cfs 2,017 cf Outflow=0.69 cfs 2,585 cf

Total Runoff Area = 484,267 sf Runoff Volume = 102,073 cf Average Runoff Depth = 2.53"
90.30% Pervious = 437,284 sf 9.70% Impervious = 46,983 sf

Summary for Subcatchment 1S: Roof Drain South West Side

Runoff = 0.50 cfs @ 12.08 hrs, Volume= 1,807 cf, Depth= 7.89"

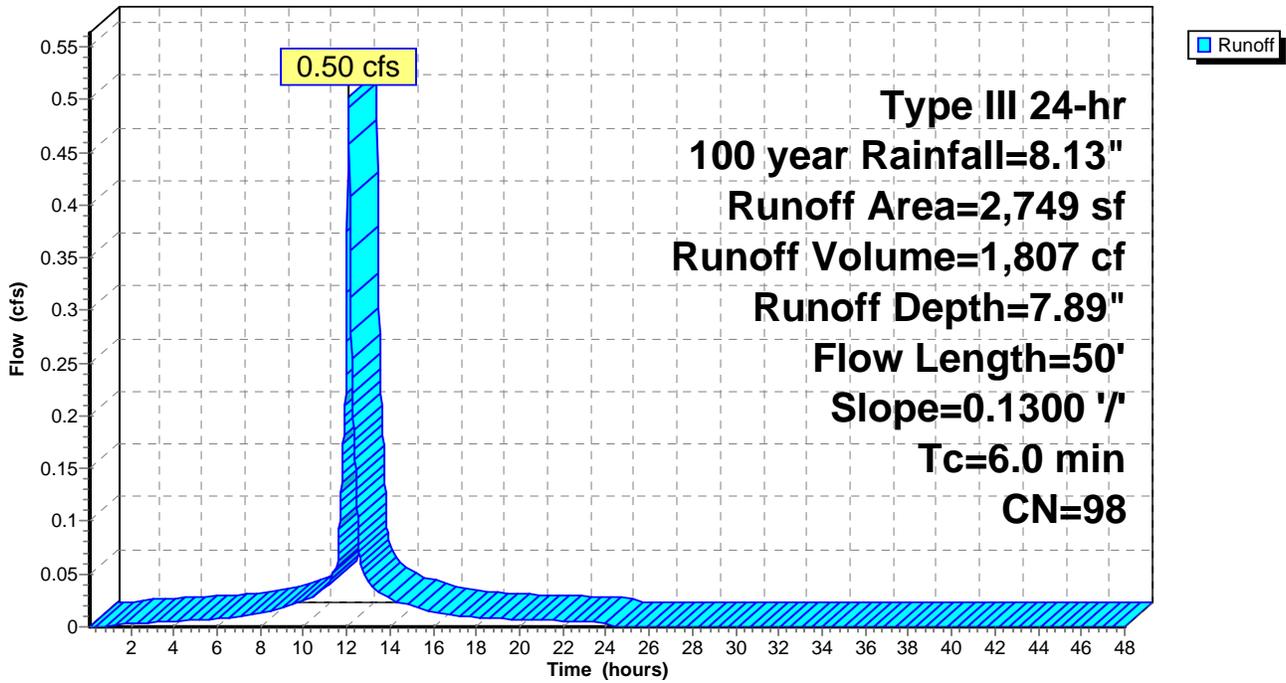
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
 Type III 24-hr 100 year Rainfall=8.13"

Area (sf)	CN	Description
2,749	98	Roofs, HSG A
2,749		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1300	0.14		Sheet Flow, sheet flow Woods: Light underbrush n= 0.400 P2= 3.06"

Subcatchment 1S: Roof Drain South West Side

Hydrograph



Summary for Subcatchment 2S: Roof Drain North Side

Runoff = 0.59 cfs @ 12.08 hrs, Volume= 2,124 cf, Depth= 7.89"

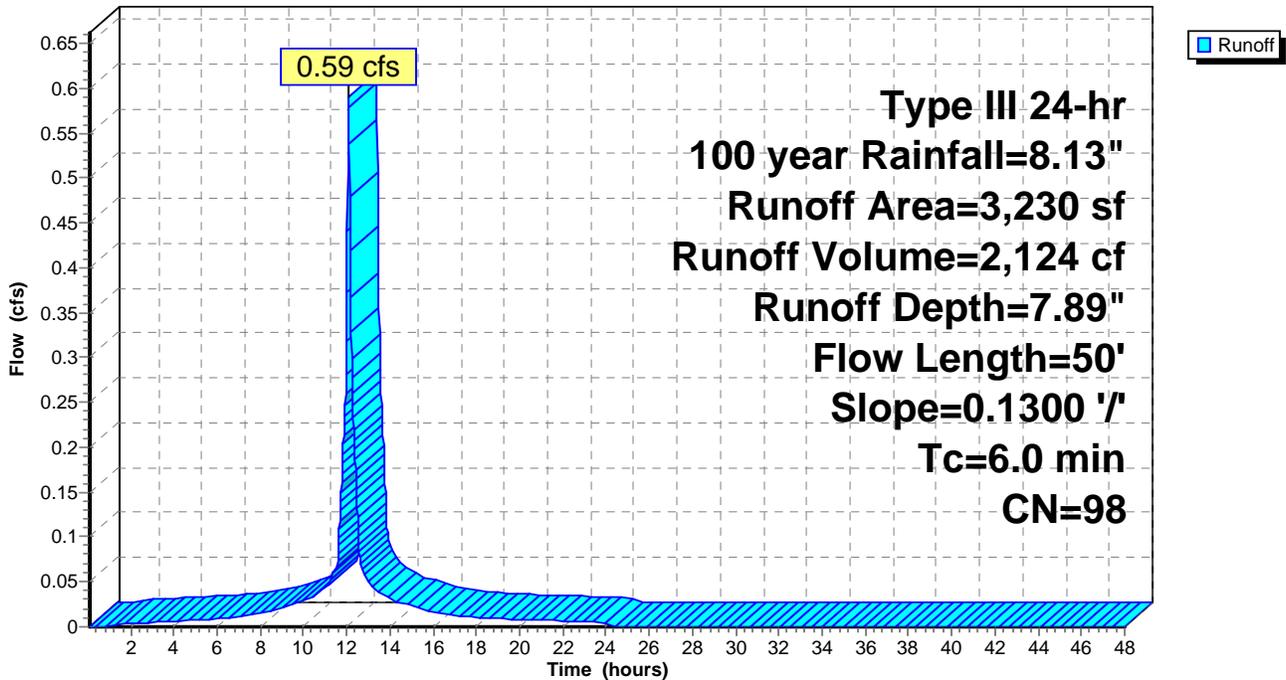
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 year Rainfall=8.13"

Area (sf)	CN	Description
3,230	98	Roofs, HSG A
3,230		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1300	0.14		Sheet Flow, sheet flow Woods: Light underbrush n= 0.400 P2= 3.06"

Subcatchment 2S: Roof Drain North Side

Hydrograph



Summary for Subcatchment 3S: Upper Paved Area

Runoff = 1.68 cfs @ 12.09 hrs, Volume= 5,419 cf, Depth= 6.34"

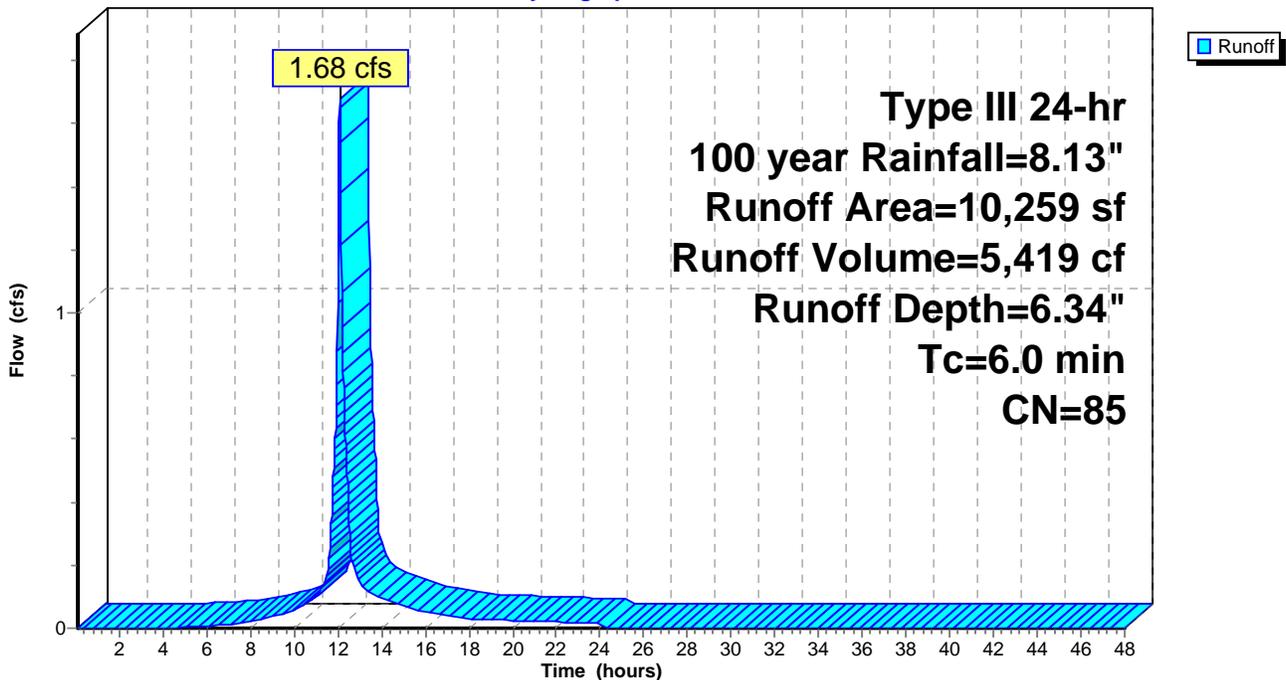
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
 Type III 24-hr 100 year Rainfall=8.13"

Area (sf)	CN	Description
7,164	98	Paved parking, HSG A
1,956	49	50-75% Grass cover, Fair, HSG A
441	49	50-75% Grass cover, Fair, HSG A
* 698	76	Gravel roads, HSG A (rip rap)
10,259	85	Weighted Average
3,095		30.17% Pervious Area
7,164		69.83% Impervious Area

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

Subcatchment 3S: Upper Paved Area

Hydrograph



Summary for Subcatchment 4S: Middle Paved Area & Eastern Roof

Runoff = 0.77 cfs @ 12.08 hrs, Volume= 2,783 cf, Depth= 7.89"

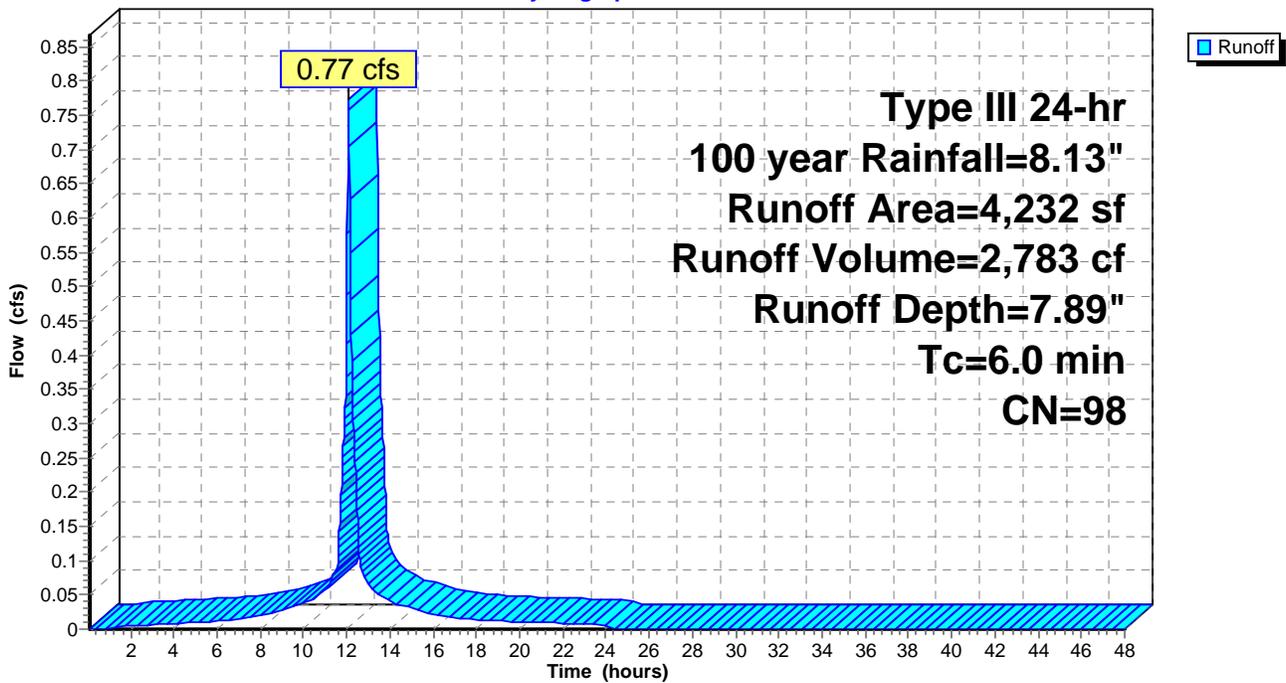
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
 Type III 24-hr 100 year Rainfall=8.13"

Area (sf)	CN	Description
2,572	98	Paved parking, HSG A
1,660	98	Roofs, HSG A
4,232	98	Weighted Average
4,232		100.00% Impervious Area

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

Subcatchment 4S: Middle Paved Area & Eastern Roof

Hydrograph



Summary for Subcatchment 5S: Lower Paved Area

Runoff = 0.72 cfs @ 12.08 hrs, Volume= 2,604 cf, Depth= 7.89"

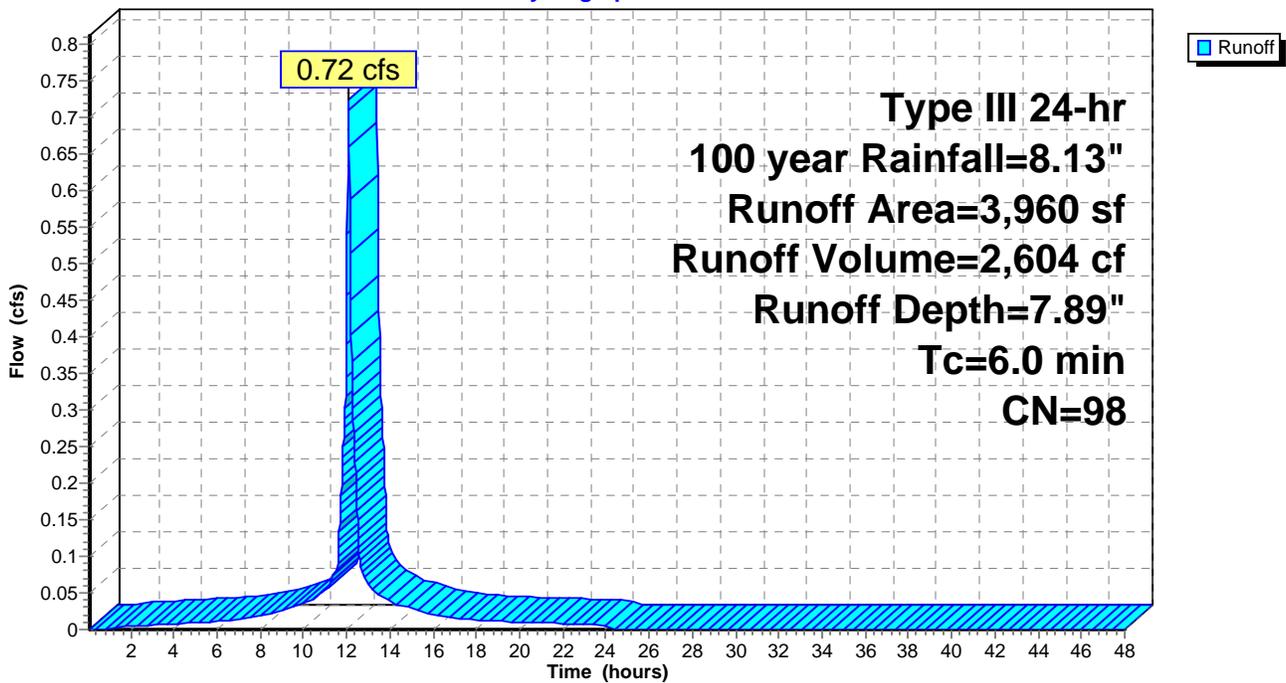
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
 Type III 24-hr 100 year Rainfall=8.13"

Area (sf)	CN	Description
3,960	98	Paved parking, HSG A
3,960		100.00% Impervious Area

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

Subcatchment 5S: Lower Paved Area

Hydrograph



Summary for Subcatchment 6S: Remaining Project Area

Runoff = 8.66 cfs @ 12.24 hrs, Volume= 40,318 cf, Depth= 2.22"

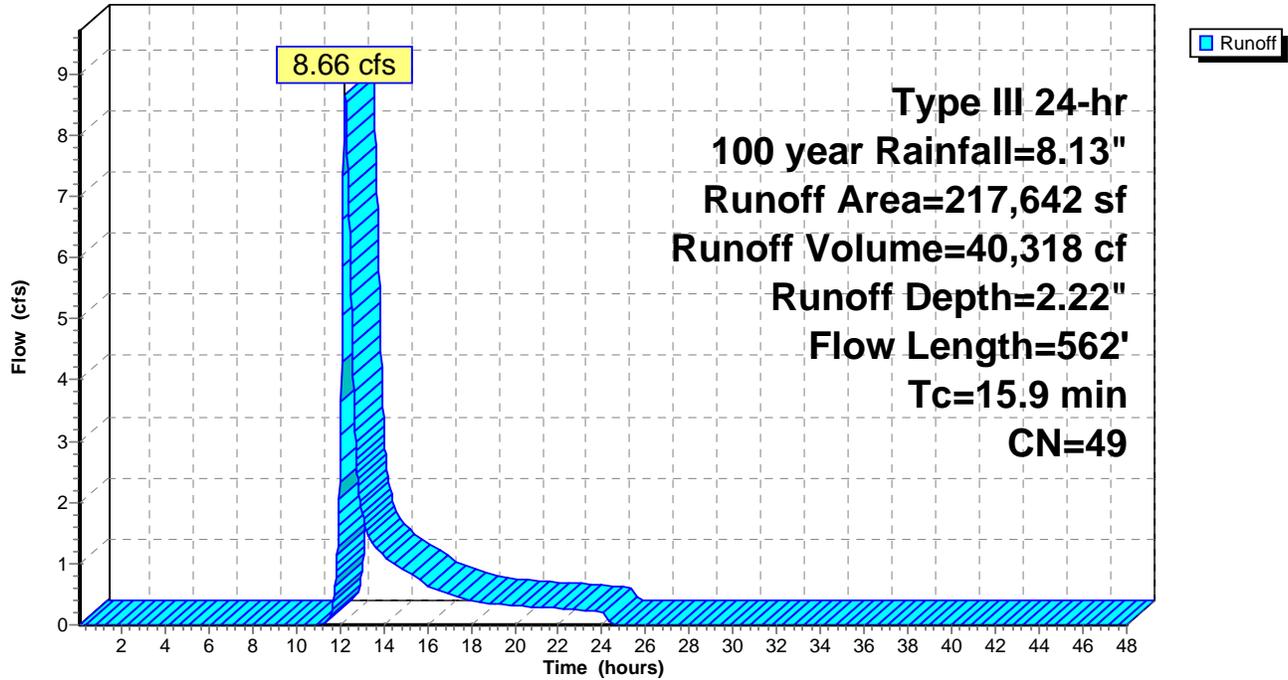
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
 Type III 24-hr 100 year Rainfall=8.13"

Area (sf)	CN	Description
2,763	49	50-75% Grass cover, Fair, HSG A
9,597	76	Gravel roads, HSG A
8,274	98	Paved parking, HSG A
7,927	49	50-75% Grass cover, Fair, HSG A
27,757	78	Meadow, non-grazed, HSG D
28,946	77	Woods, Good, HSG D
78,485	30	Woods, Good, HSG A
39,143	30	Meadow, non-grazed, HSG A
11,968	30	Woods, Good, HSG A
* 2,782	76	Gravel roads, HSG A (RIP RAP)
217,642	49	Weighted Average
209,368		96.20% Pervious Area
8,274		3.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		Sheet Flow, sheet flow Woods: Light underbrush n= 0.400 P2= 3.06"
0.3	36	0.1676	2.05		Shallow Concentrated Flow, woods pre grass strip Woodland Kv= 5.0 fps
0.1	10	0.1000	2.21		Shallow Concentrated Flow, grass strips (both) Short Grass Pasture Kv= 7.0 fps
0.0	12	0.0833	5.86		Shallow Concentrated Flow, pavement Paved Kv= 20.3 fps
6.7	440	0.0480	1.10		Shallow Concentrated Flow, rip rap Woodland Kv= 5.0 fps
0.1	14	0.1667	2.86		Shallow Concentrated Flow, grass strip Short Grass Pasture Kv= 7.0 fps
15.9	562	Total			

Subcatchment 6S: Remaining Project Area

Hydrograph



Summary for Subcatchment EX: Existing Site

Runoff = 10.24 cfs @ 12.24 hrs, Volume= 47,019 cf, Depth= 2.33"

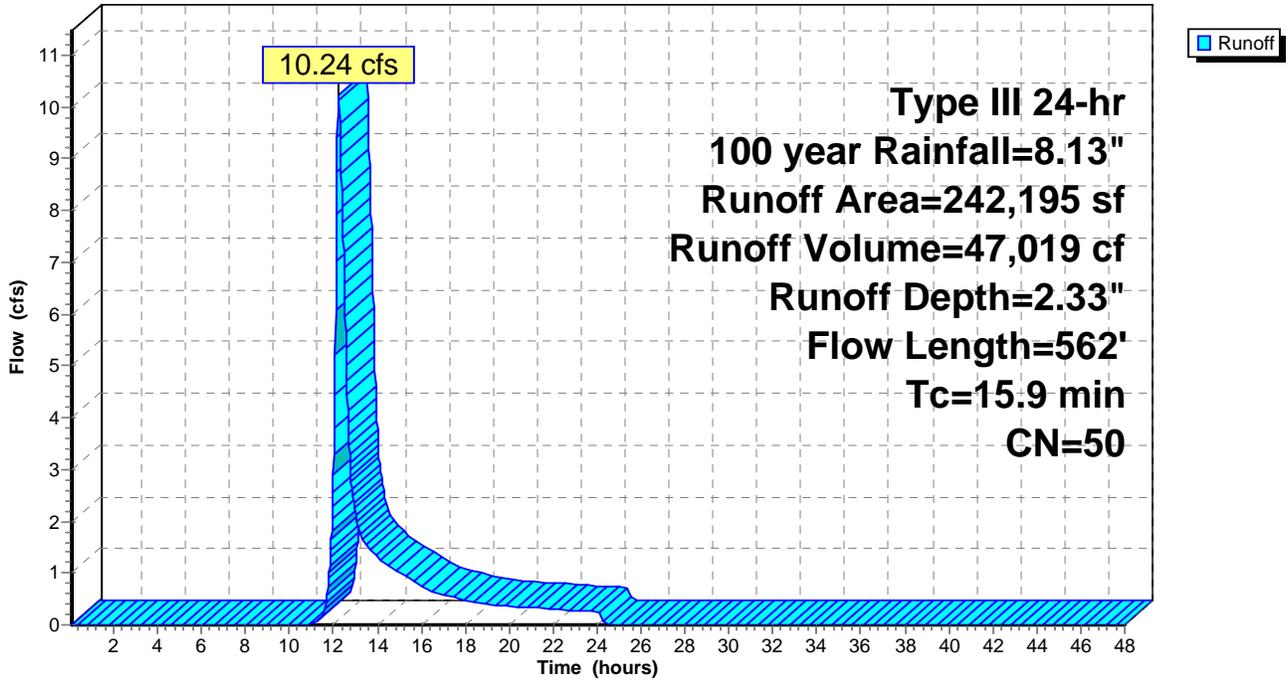
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 year Rainfall=8.13"

Area (sf)	CN	Description
11,475	49	50-75% Grass cover, Fair, HSG A
3,181	76	Gravel roads, HSG A
17,374	98	Paved parking, HSG A
4,242	49	50-75% Grass cover, Fair, HSG A
8,728	49	50-75% Grass cover, Fair, HSG A
* 3,480	76	Gravel roads, HSG A (RIP RAP)
59,405	77	Woods, Good, HSG D
82,915	30	Woods, Good, HSG A
9,737	30	Woods, Good, HSG A
41,658	30	Woods, Good, HSG A
242,195	50	Weighted Average
224,821		92.83% Pervious Area
17,374		7.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		Sheet Flow, sheet flow Woods: Light underbrush n= 0.400 P2= 3.06"
0.3	36	0.1676	2.05		Shallow Concentrated Flow, woods Woodland Kv= 5.0 fps
0.0	12	0.1000	6.42		Shallow Concentrated Flow, pavement Paved Kv= 20.3 fps
0.1	10	0.1000	2.21		Shallow Concentrated Flow, grass strip (both) Short Grass Pasture Kv= 7.0 fps
6.7	440	0.0480	1.10		Shallow Concentrated Flow, rip rap Woodland Kv= 5.0 fps
0.1	14	0.1667	2.86		Shallow Concentrated Flow, final grass strip Short Grass Pasture Kv= 7.0 fps
15.9	562	Total			

Subcatchment EX: Existing Site

Hydrograph



Summary for Reach END: Proposed Site Runoff

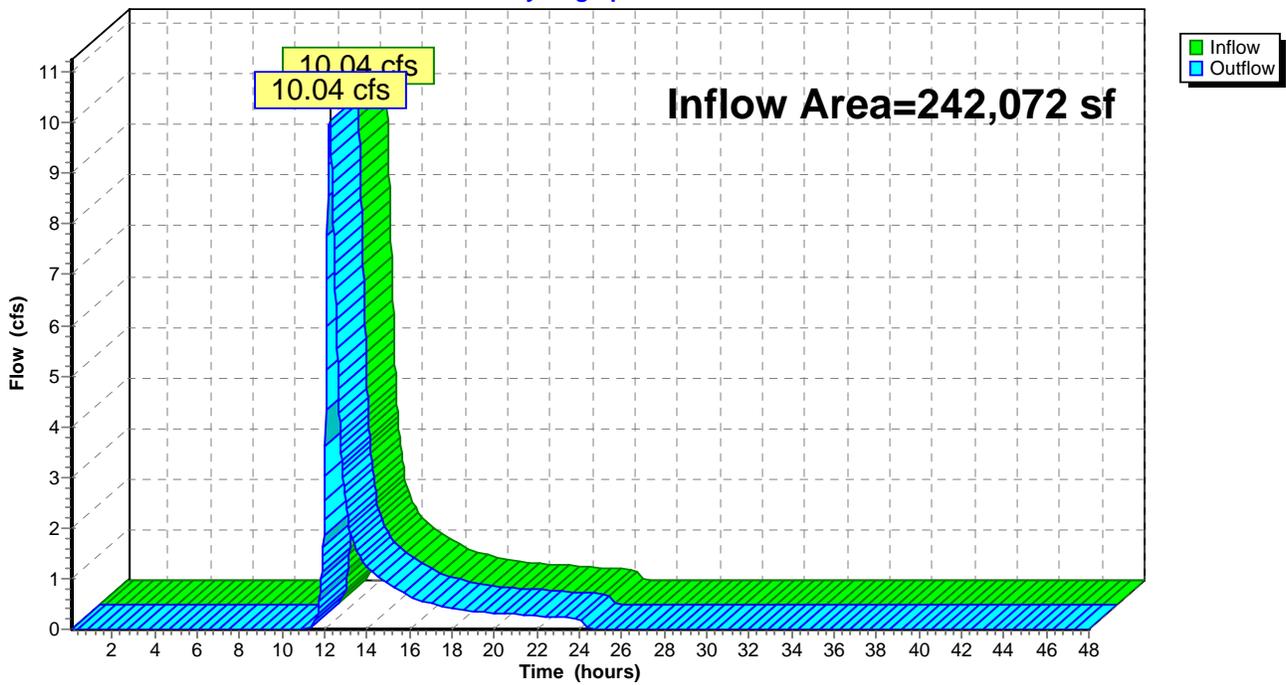
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 242,072 sf, 12.23% Impervious, Inflow Depth = 2.26" for 100 year event
Inflow = 10.04 cfs @ 12.24 hrs, Volume= 45,676 cf
Outflow = 10.04 cfs @ 12.24 hrs, Volume= 45,676 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 3

Reach END: Proposed Site Runoff

Hydrograph



Summary for Pond C1: Northeast Cultecs

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=1)

Inflow Area = 14,491 sf, 78.64% Impervious, Inflow Depth = 6.76" for 100 year event
 Inflow = 1.79 cfs @ 12.10 hrs, Volume= 8,164 cf
 Outflow = 1.03 cfs @ 12.44 hrs, Volume= 7,794 cf, Atten= 43%, Lag= 20.5 min
 Discarded = 0.00 cfs @ 0.10 hrs, Volume= 0 cf
 Primary = 1.03 cfs @ 12.44 hrs, Volume= 7,794 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 233.61' @ 12.43 hrs Surf.Area= 0.046 ac Storage= 0.061 af

Plug-Flow detention time= 114.2 min calculated for 7,794 cf (95% of inflow)
 Center-of-Mass det. time= 88.0 min (865.0 - 777.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	231.17'	0.018 af	14.50'W x 84.75'L x 2.54'H Field A 0.072 af Overall - 0.020 af Embedded = 0.052 af x 35.0% Voids
#2A	231.67'	0.020 af	Cultec R-150XLHD x 32 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 4 rows
#3B	231.17'	0.012 af	14.50'W x 54.00'L x 2.54'H Field B 0.046 af Overall - 0.013 af Embedded = 0.033 af x 35.0% Voids
#4B	231.67'	0.013 af	Cultec R-150XLHD x 20 Inside #3 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 4 rows
		0.062 af	Total Available Storage

Storage Group A created with Chamber Wizard
 Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	231.17'	0.090 in/hr Exfiltration X 0.00 over Surface area Phase-In= 0.01'
#2	Primary	231.67'	4.0" Round Culvert L= 145.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 231.67' / 230.95' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#3	Primary	232.33'	8.0" Round Culvert L= 145.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 232.33' / 231.44' S= 0.0061 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Discarded OutFlow Max=0.00 cfs @ 0.10 hrs HW=231.17' (Free Discharge)

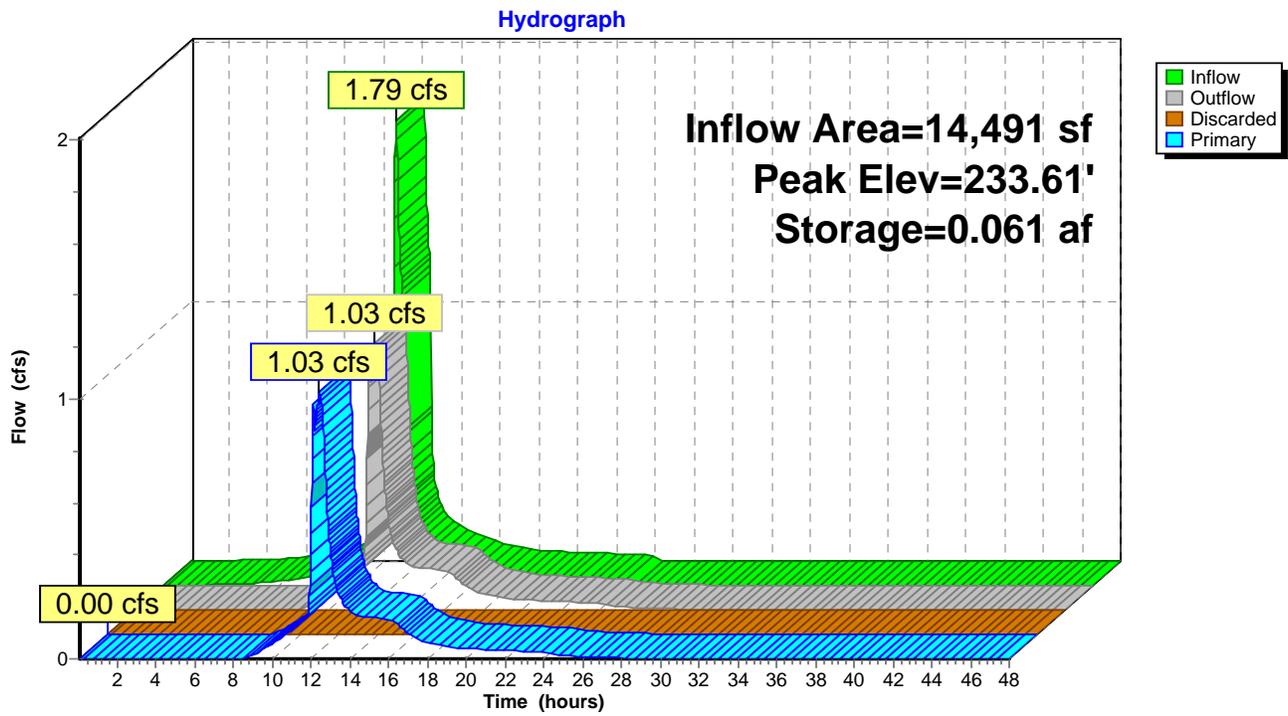
↳ **1=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=1.03 cfs @ 12.44 hrs HW=233.61' TW=232.76' (Dynamic Tailwater)

↳ **2=Culvert** (Outlet Controls 0.15 cfs @ 1.70 fps)

↳ **3=Culvert** (Outlet Controls 0.88 cfs @ 2.52 fps)

Pond C1: Northeast Cultecs



Summary for Pond C2: Intermediate Cultecs

Inflow Area = 17,721 sf, 82.53% Impervious, Inflow Depth > 6.72" for 100 year event
 Inflow = 1.46 cfs @ 12.13 hrs, Volume= 9,917 cf
 Outflow = 1.20 cfs @ 12.45 hrs, Volume= 9,917 cf, Atten= 18%, Lag= 19.4 min
 Discarded = 0.08 cfs @ 12.37 hrs, Volume= 3,690 cf
 Primary = 1.12 cfs @ 12.45 hrs, Volume= 6,227 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 232.78' @ 12.37 hrs Surf.Area= 392 sf Storage= 876 cf
 Flood Elev= 233.94' Surf.Area= 392 sf Storage= 950 cf

Plug-Flow detention time= 26.4 min calculated for 9,917 cf (100% of inflow)
 Center-of-Mass det. time= 26.4 min (864.8 - 838.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	228.78'	447 cf	16.00'W x 24.50'L x 4.54'H Field A 1,780 cf Overall - 503 cf Embedded = 1,277 cf x 35.0% Voids
#2A	229.78'	503 cf	Cultec R-330XLHD x 9 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
		950 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	228.78'	5.100 in/hr Exfiltration over Wetted area Phase-In= 0.01'
#2	Primary	230.00'	8.0" Round Culvert L= 10.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 230.00' / 230.00' S= 0.0000 1/ S= 0.0000 1/ Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Discarded OutFlow Max=0.08 cfs @ 12.37 hrs HW=232.78' (Free Discharge)

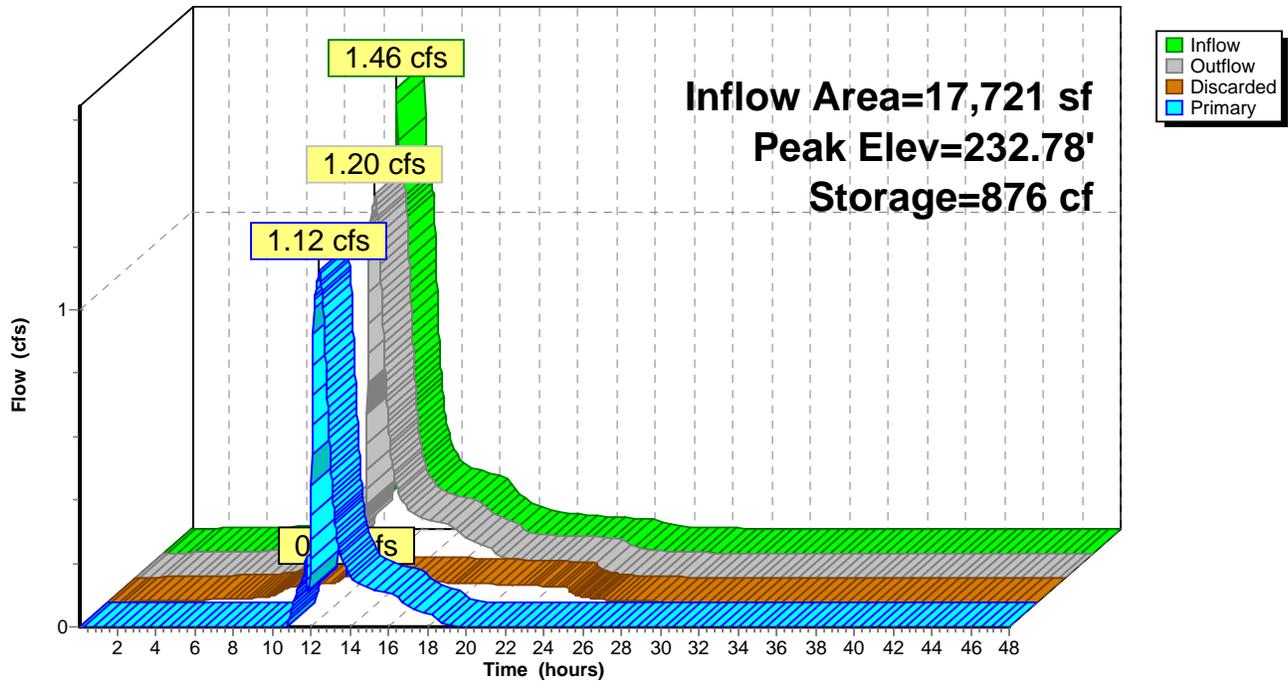
↳ **1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=1.12 cfs @ 12.45 hrs HW=232.76' TW=232.04' (Dynamic Tailwater)

↳ **2=Culvert** (Inlet Controls 1.12 cfs @ 3.21 fps)

Pond C2: Intermediate Cultecs

Hydrograph



Summary for Pond C3: Southwest Cultecs

Inflow Area = 24,430 sf, 87.33% Impervious, Inflow Depth = 4.94" for 100 year event
 Inflow = 1.96 cfs @ 12.14 hrs, Volume= 10,052 cf
 Outflow = 1.55 cfs @ 12.30 hrs, Volume= 10,052 cf, Atten= 21%, Lag= 9.9 min
 Discarded = 0.16 cfs @ 12.30 hrs, Volume= 4,694 cf
 Primary = 1.39 cfs @ 12.30 hrs, Volume= 5,358 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 232.11' @ 12.30 hrs Surf.Area= 0.017 ac Storage= 0.032 af

Plug-Flow detention time= 34.6 min calculated for 10,048 cf (100% of inflow)
 Center-of-Mass det. time= 34.6 min (812.8 - 778.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	229.07'	0.003 af	6.33'W x 24.50'L x 3.71'H Field A 0.013 af Overall - 0.004 af Embedded = 0.009 af x 35.0% Voids
#2A	229.74'	0.004 af	Cultec R-330XLHD x 3 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 1 rows
#3B	229.07'	0.011 af	11.17'W x 52.50'L x 3.71'H Field B 0.050 af Overall - 0.017 af Embedded = 0.033 af x 35.0% Voids
#4B	229.74'	0.017 af	Cultec R-330XLHD x 14 Inside #3 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 2 rows
		0.036 af	Total Available Storage

Storage Group A created with Chamber Wizard
 Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	229.07'	5.100 in/hr Exfiltration over Wetted area Phase-In= 0.01'
#2	Primary	230.68'	8.0" Round Culvert L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 230.68' / 230.48' S= 0.0100 1/ Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Discarded OutFlow Max=0.16 cfs @ 12.30 hrs HW=232.11' (Free Discharge)

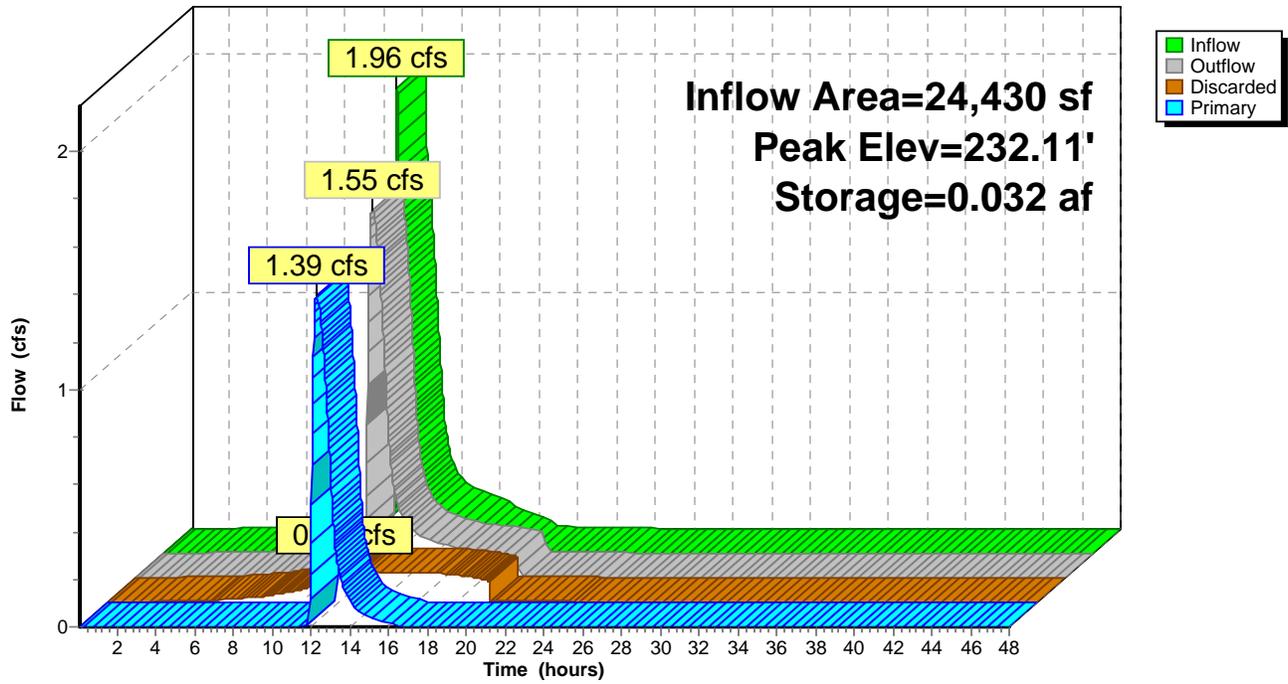
↑**1=Exfiltration** (Exfiltration Controls 0.16 cfs)

Primary OutFlow Max=1.39 cfs @ 12.30 hrs HW=232.11' TW=0.00' (Dynamic Tailwater)

↑**2=Culvert** (Inlet Controls 1.39 cfs @ 3.99 fps)

Pond C3: Southwest Cultecs

Hydrograph



Summary for Pond CB1: Catch Basin #1

Inflow Area = 10,259 sf, 69.83% Impervious, Inflow Depth = 6.34" for 100 year event
 Inflow = 1.68 cfs @ 12.09 hrs, Volume= 5,419 cf
 Outflow = 1.06 cfs @ 12.17 hrs, Volume= 5,400 cf, Atten= 37%, Lag= 5.2 min
 Primary = 1.06 cfs @ 12.17 hrs, Volume= 5,400 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 235.19' @ 12.18 hrs Surf.Area= 2,578 sf Storage= 296 cf

Plug-Flow detention time= 5.1 min calculated for 5,398 cf (100% of inflow)
 Center-of-Mass det. time= 2.9 min (792.8 - 789.9)

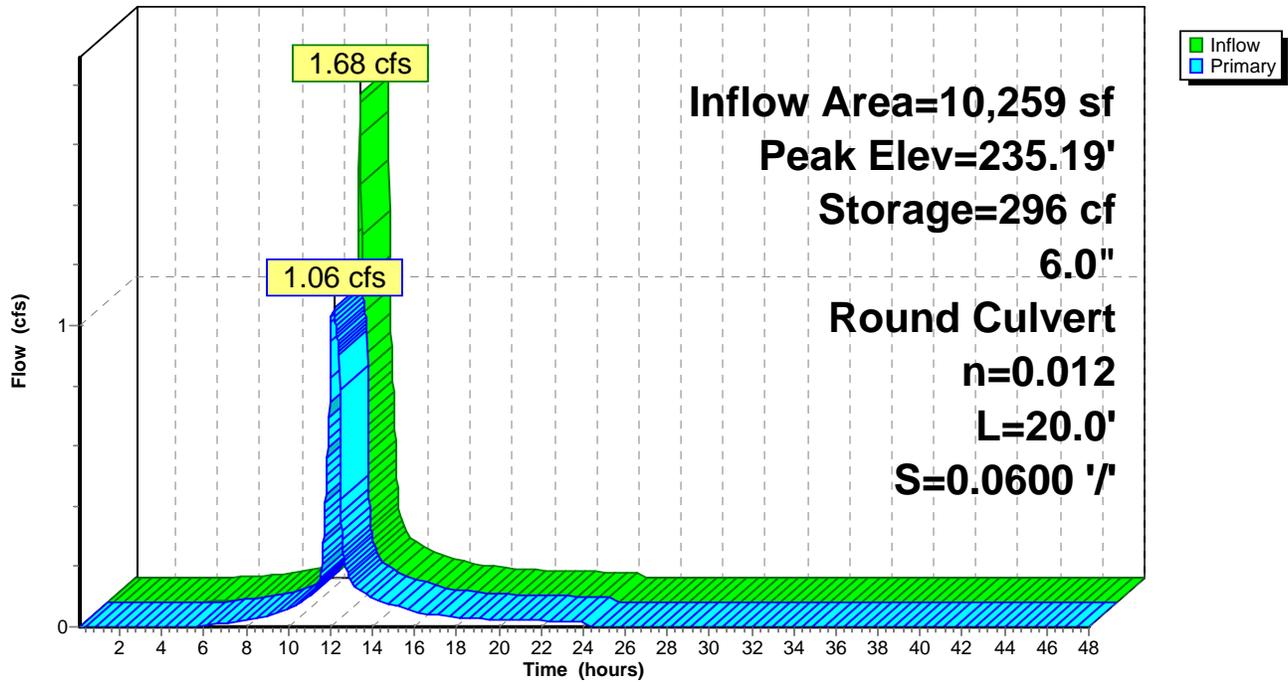
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	464 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	3,335	419	464

Device	Routing	Invert	Outlet Devices
#1	Primary	232.95'	6.0" Round Culvert L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 232.95' / 231.75' S= 0.0600 ' S= 0.0600 ' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=1.05 cfs @ 12.17 hrs HW=235.19' TW=233.15' (Dynamic Tailwater)
 ↑1=Culvert (Inlet Controls 1.05 cfs @ 5.36 fps)

Pond CB1: Catch Basin #1

Hydrograph



Summary for Pond CB2: Catch Basin #2

Inflow Area = 4,232 sf, 100.00% Impervious, Inflow Depth = 7.89" for 100 year event
 Inflow = 0.77 cfs @ 12.08 hrs, Volume= 2,783 cf
 Outflow = 0.75 cfs @ 12.10 hrs, Volume= 2,764 cf, Atten= 3%, Lag= 0.8 min
 Primary = 0.75 cfs @ 12.10 hrs, Volume= 2,764 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 234.51' @ 12.11 hrs Surf.Area= 13 sf Storage= 39 cf

Plug-Flow detention time= 9.7 min calculated for 2,763 cf (99% of inflow)
 Center-of-Mass det. time= 5.1 min (746.1 - 741.0)

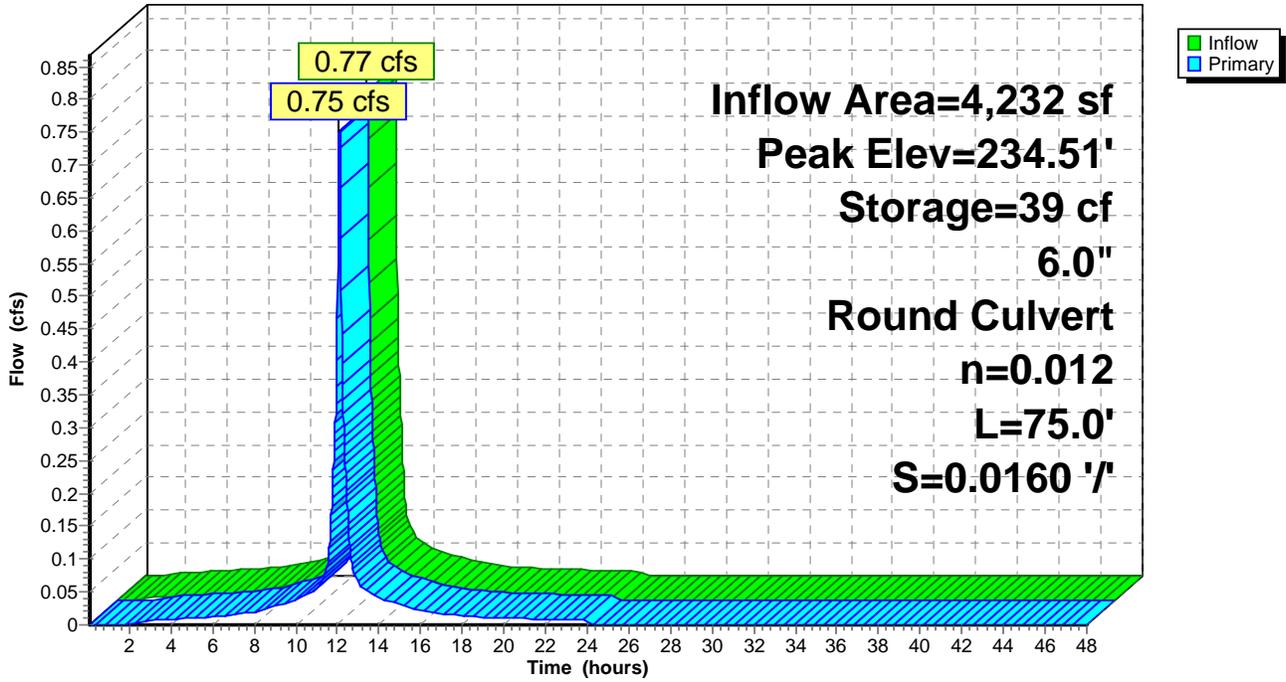
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	258 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	1,690	213	258

Device	Routing	Invert	Outlet Devices
#1	Primary	232.95'	6.0" Round Culvert L= 75.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 232.95' / 231.75' S= 0.0160 ' S= 0.0160 ' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.75 cfs @ 12.10 hrs HW=234.49' TW=232.92' (Dynamic Tailwater)
 ↑1=Culvert (Outlet Controls 0.75 cfs @ 3.81 fps)

Pond CB2: Catch Basin #2

Hydrograph



Summary for Pond CB3: Catch Basin #3

Inflow Area = 3,960 sf, 100.00% Impervious, Inflow Depth = 7.89" for 100 year event
 Inflow = 0.72 cfs @ 12.08 hrs, Volume= 2,604 cf
 Outflow = 0.71 cfs @ 12.10 hrs, Volume= 2,585 cf, Atten= 2%, Lag= 1.1 min
 Primary = 0.71 cfs @ 12.10 hrs, Volume= 2,585 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 234.82' @ 12.10 hrs Surf.Area= 13 sf Storage= 43 cf

Plug-Flow detention time= 10.7 min calculated for 2,585 cf (99% of inflow)
 Center-of-Mass det. time= 5.4 min (746.4 - 741.0)

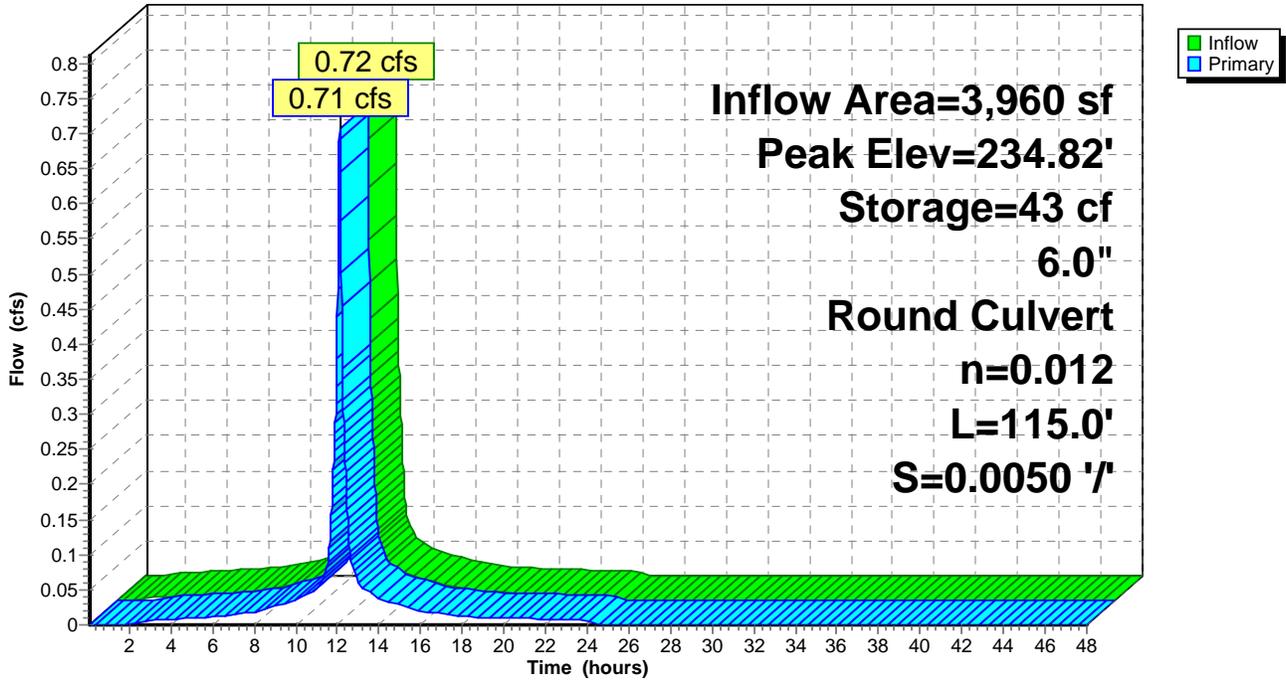
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	293 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	1,963	247	293

Device	Routing	Invert	Outlet Devices
#1	Primary	232.95'	6.0" Round Culvert L= 115.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 232.95' / 232.38' S= 0.0050 '/ Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.71 cfs @ 12.10 hrs HW=234.82' TW=232.34' (Dynamic Tailwater)
 ↑1=Culvert (Barrel Controls 0.71 cfs @ 3.60 fps)

Pond CB3: Catch Basin #3

Hydrograph



Summary for Pond D1: Drywell

Inflow Area = 3,960 sf, 100.00% Impervious, Inflow Depth = 7.83" for 100 year event
 Inflow = 0.71 cfs @ 12.10 hrs, Volume= 2,585 cf
 Outflow = 0.69 cfs @ 12.10 hrs, Volume= 2,585 cf, Atten= 3%, Lag= 0.1 min
 Discarded = 0.01 cfs @ 12.15 hrs, Volume= 568 cf
 Primary = 0.68 cfs @ 12.10 hrs, Volume= 2,017 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 232.46' @ 12.15 hrs Surf.Area= 33 sf Storage= 53 cf

Plug-Flow detention time= 13.8 min calculated for 2,585 cf (100% of inflow)
 Center-of-Mass det. time= 13.8 min (760.2 - 746.4)

Volume	Invert	Avail.Storage	Storage Description
#1	230.00'	98 cf	5.00'D x 5.00'H Vertical Cone/Cylinder Inside #2 141 cf Overall - 6.0" Wall Thickness = 98 cf
#2	230.00'	9 cf	6.50'D x 5.00'H Vertical Cone/Cylinder 166 cf Overall - 141 cf Embedded = 25 cf x 35.0% Voids
		107 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	231.25'	6.0" Round Culvert L= 5.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 231.25' / 231.00' S= 0.0500 '/ Cc= 0.900 n= 0.012, Flow Area= 0.20 sf
#2	Discarded	230.00'	5.100 in/hr Exfiltration over Wetted area Phase-In= 0.01'

Discarded OutFlow Max=0.01 cfs @ 12.15 hrs HW=232.46' (Free Discharge)
 ↳ **2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.67 cfs @ 12.10 hrs HW=232.35' TW=231.53' (Dynamic Tailwater)
 ↳ **1=Culvert** (Inlet Controls 0.67 cfs @ 3.43 fps)

Pond D1: Drywell

Hydrograph

