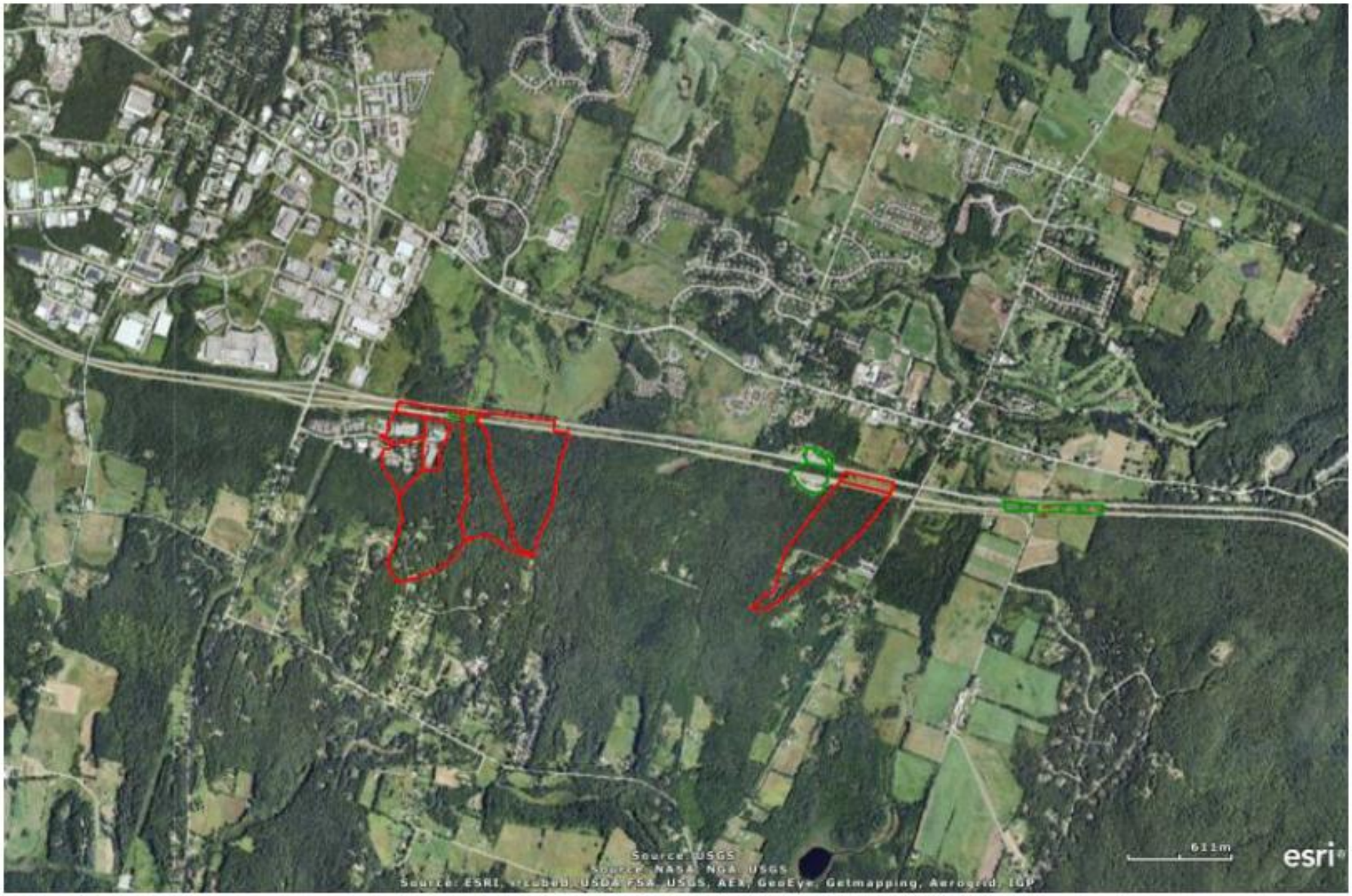
APPENDIX D

VTRANS I-89 BMP SITES

AERIAL MAPS AND CPv BMP MODELS

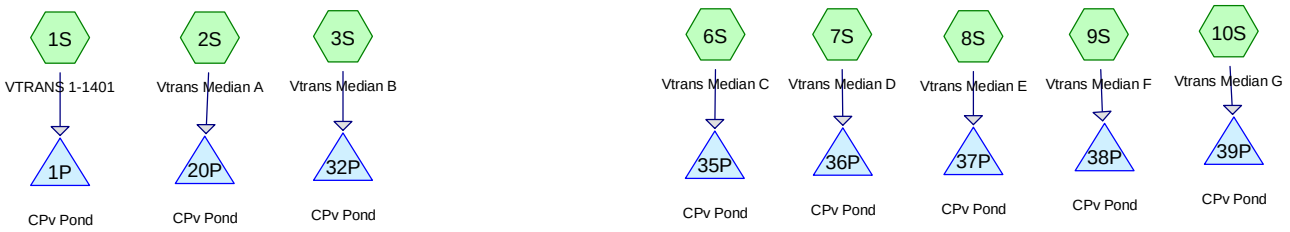
WILLISTON AND VTRANS

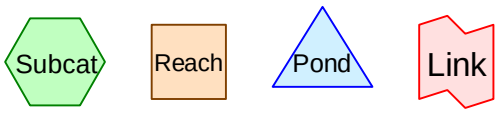
POTENTIAL BMP DRAINAGE AREAS



TOWN OF WILLISTON PARCELS

VTRANS I-89 SITES





Routing Diagram for Vtrans BMPs
Prepared by DuBois& King, Inc., Printed 2/1/2012
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Summary for Subcatchment 1S: VTRANS 1-1401

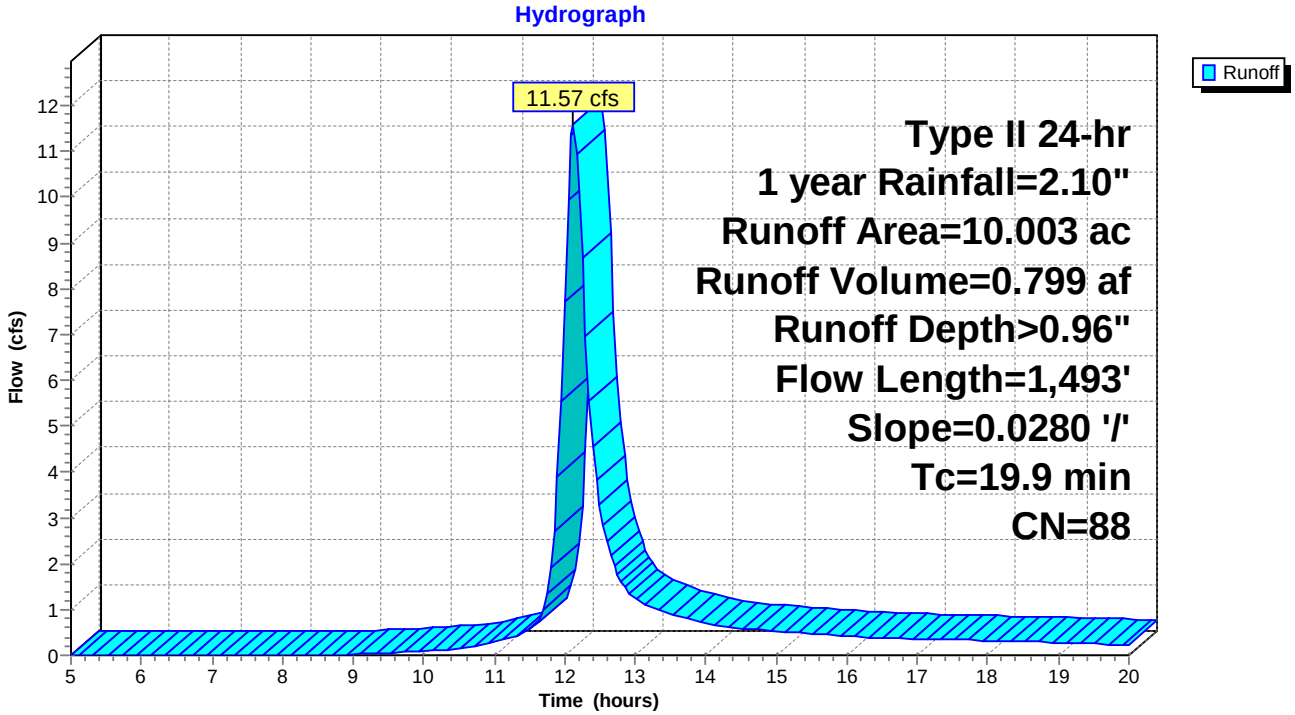
Runoff = 11.57 cfs @ 12.13 hrs, Volume= 0.799 af, Depth> 0.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 year Rainfall=2.10"

Area (ac)	CN	Description
2.693	72	Woods/grass comb., Good, HSG C
7.310	94	Urban commercial, 85% imp, HSG C
10.003	88	Weighted Average
3.789		37.88% Pervious Area
6.213		62.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.9	1,493	0.0280	1.25		**Lag/CN Method,**

Subcatchment 1S: VTRANS 1-1401



Summary for Subcatchment 2S: Vtrans Median A

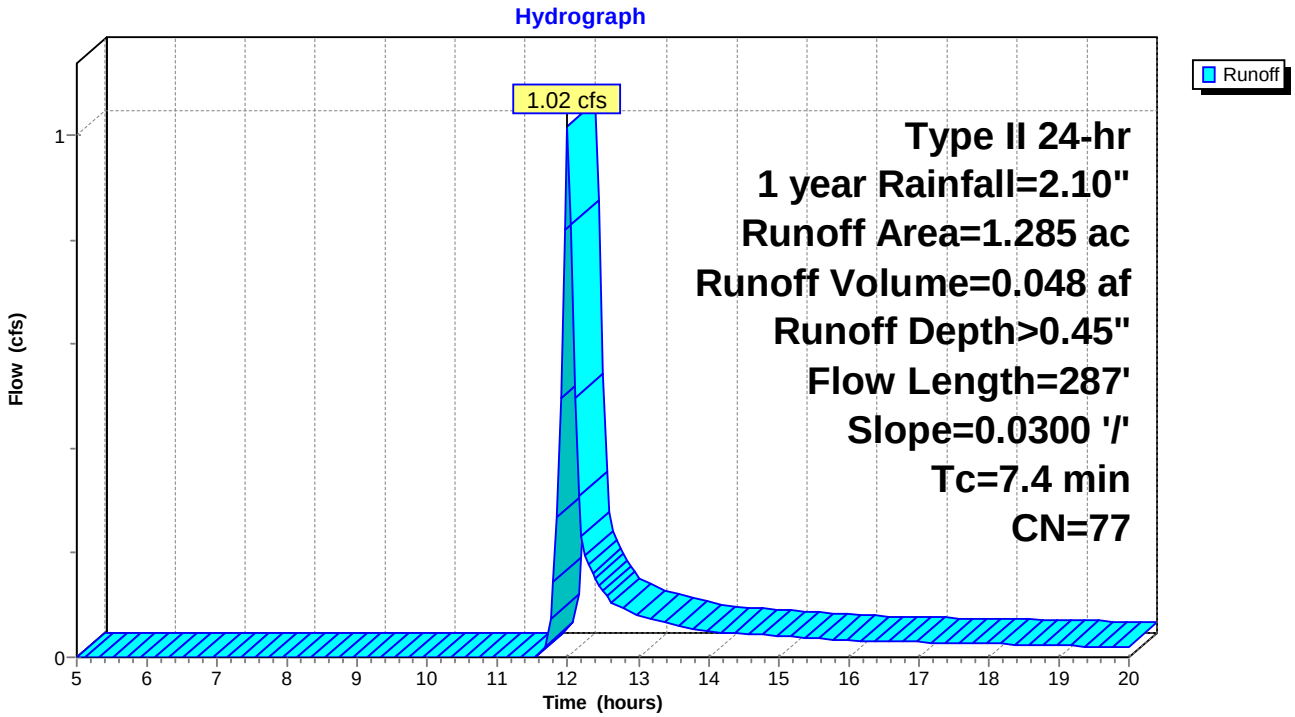
Runoff = 1.02 cfs @ 12.00 hrs, Volume= 0.048 af, Depth> 0.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 year Rainfall=2.10"

Area (ac)	CN	Description
0.285	98	Paved parking, HSG C
1.000	71	Meadow, non-grazed, HSG C
1.285	77	Weighted Average
1.000		77.82% Pervious Area
0.285		22.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	287	0.0300	0.65		**Lag/CN Method,**

Subcatchment 2S: Vtrans Median A



Summary for Subcatchment 3S: Vtrans Median B

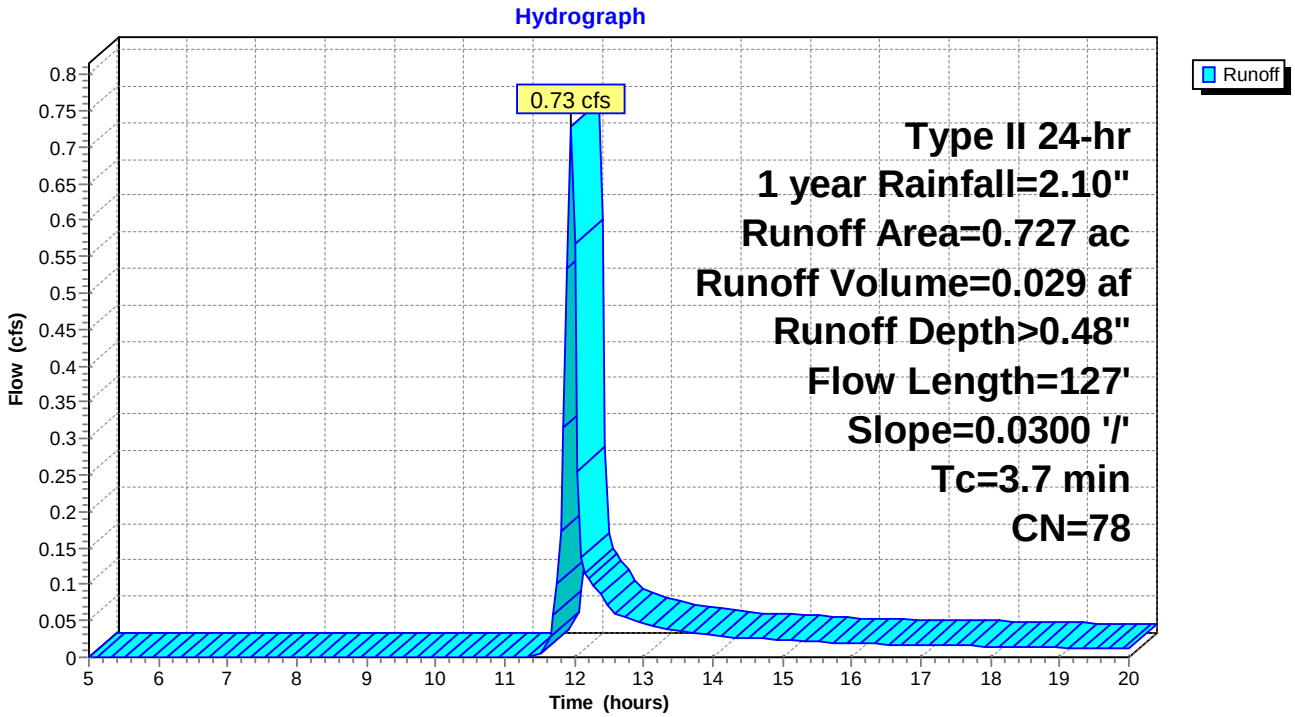
Runoff = 0.73 cfs @ 11.95 hrs, Volume= 0.029 af, Depth> 0.48"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 year Rainfall=2.10"

Area (ac)	CN	Description
0.197	98	Paved parking, HSG C
0.530	71	Meadow, non-grazed, HSG C
0.727	78	Weighted Average
0.530		72.90% Pervious Area
0.197		27.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	127	0.0300	0.57		**Lag/CN Method,**

Subcatchment 3S: Vtrans Median B



Summary for Subcatchment 6S: Vtrans Median C

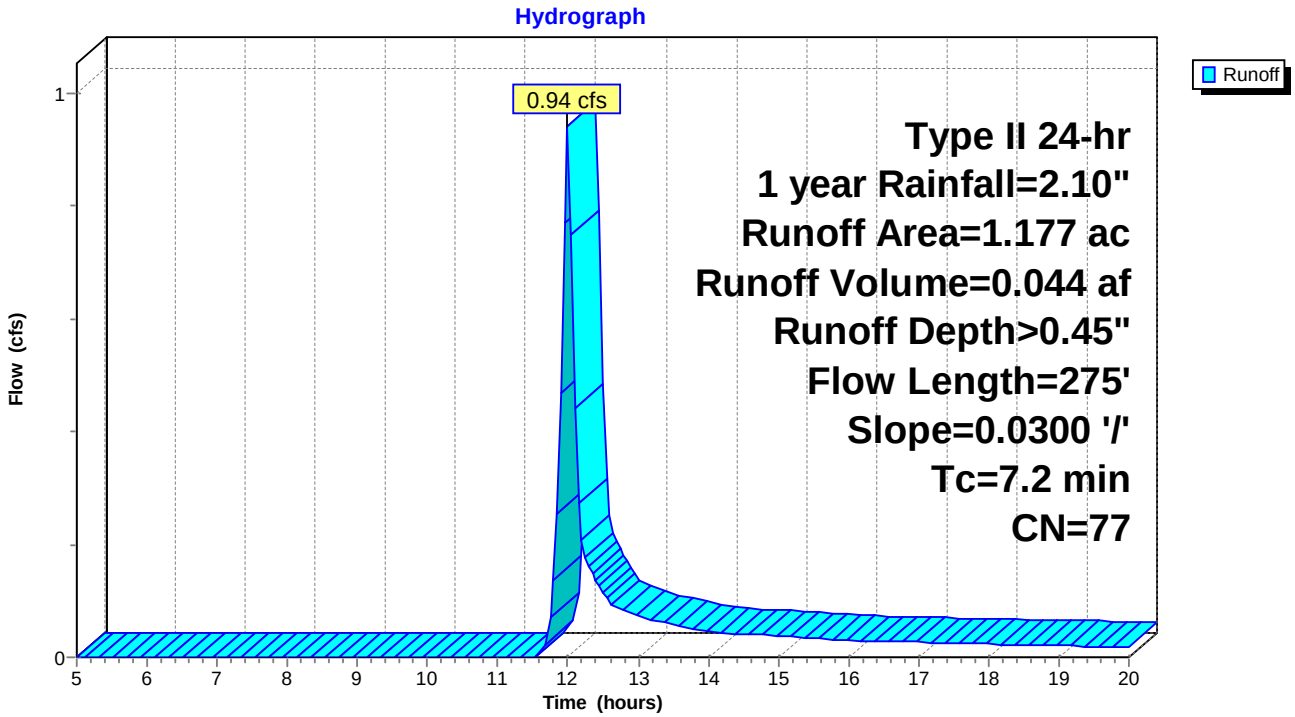
Runoff = 0.94 cfs @ 12.00 hrs, Volume= 0.044 af, Depth> 0.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 year Rainfall=2.10"

Area (ac)	CN	Description
0.277	98	Paved parking, HSG C
0.900	71	Meadow, non-grazed, HSG C
1.177	77	Weighted Average
0.900		76.47% Pervious Area
0.277		23.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	275	0.0300	0.64		**Lag/CN Method,**

Subcatchment 6S: Vtrans Median C



Summary for Subcatchment 7S: Vtrans Median D

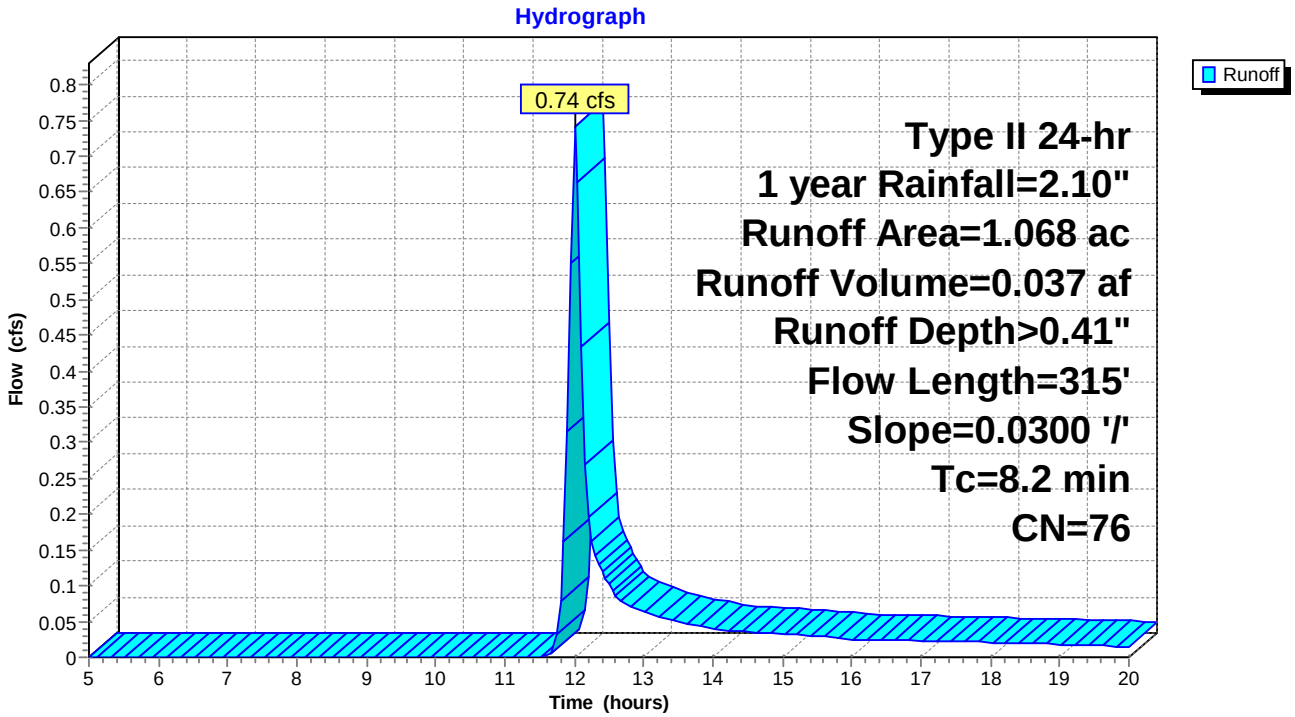
Runoff = 0.74 cfs @ 12.01 hrs, Volume= 0.037 af, Depth> 0.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 year Rainfall=2.10"

Area (ac)	CN	Description
0.178	98	Paved parking, HSG C
0.890	71	Meadow, non-grazed, HSG C
1.068	76	Weighted Average
0.890		83.33% Pervious Area
0.178		16.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	315	0.0300	0.64		**Lag/CN Method,**

Subcatchment 7S: Vtrans Median D



Summary for Subcatchment 8S: Vtrans Median E

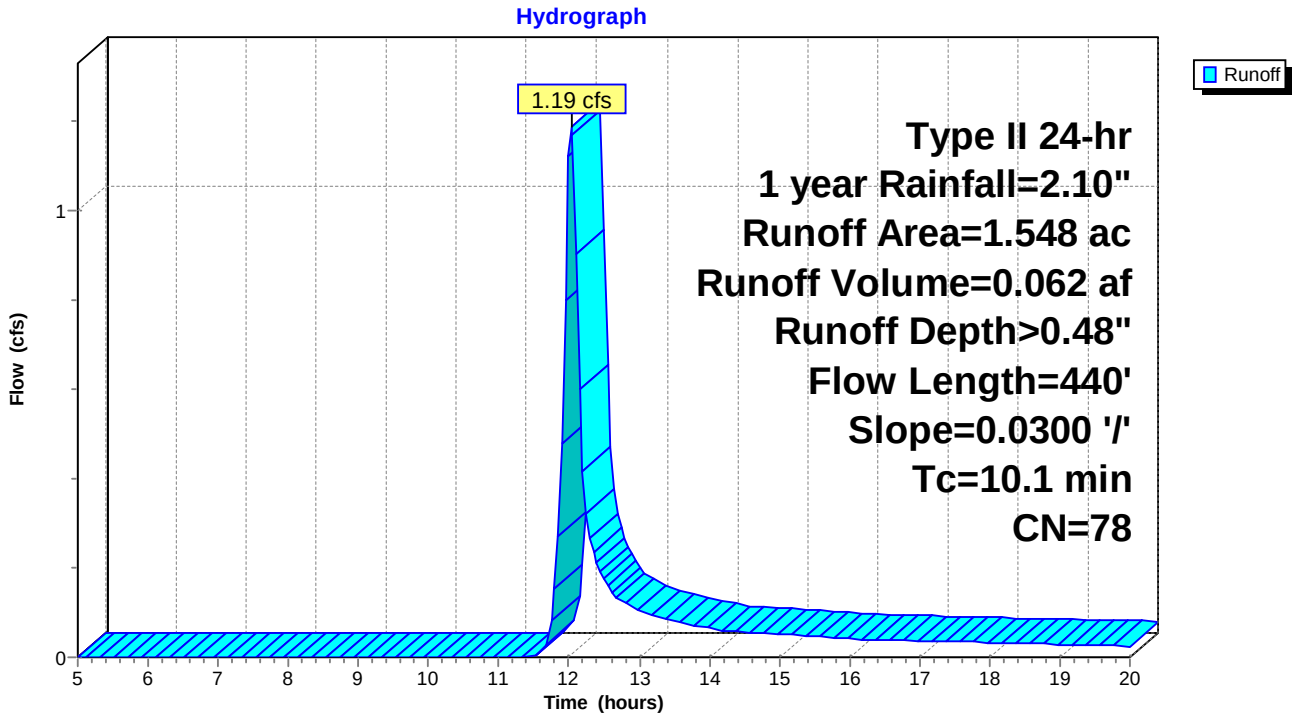
Runoff = 1.19 cfs @ 12.03 hrs, Volume= 0.062 af, Depth> 0.48"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 year Rainfall=2.10"

Area (ac)	CN	Description
0.388	98	Paved parking, HSG C
1.160	71	Meadow, non-grazed, HSG C
1.548	78	Weighted Average
1.160		74.94% Pervious Area
0.388		25.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	440	0.0300	0.73		**Lag/CN Method,**

Subcatchment 8S: Vtrans Median E



Summary for Subcatchment 9S: Vtrans Median F

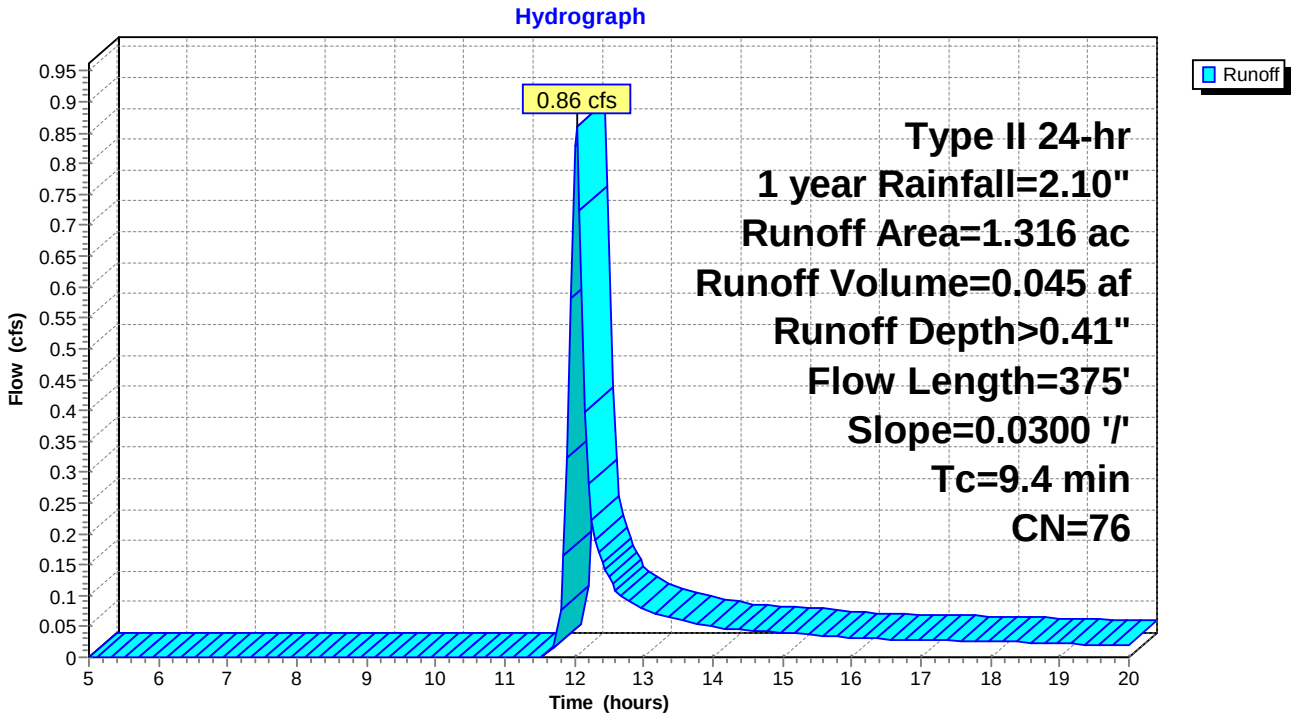
Runoff = 0.86 cfs @ 12.03 hrs, Volume= 0.045 af, Depth> 0.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 year Rainfall=2.10"

Area (ac)	CN	Description
0.256	98	Paved parking, HSG C
1.060	71	Meadow, non-grazed, HSG C
1.316	76	Weighted Average
1.060		80.55% Pervious Area
0.256		19.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	375	0.0300	0.66		**Lag/CN Method,**

Subcatchment 9S: Vtrans Median F



Summary for Subcatchment 10S: Vtrans Median G

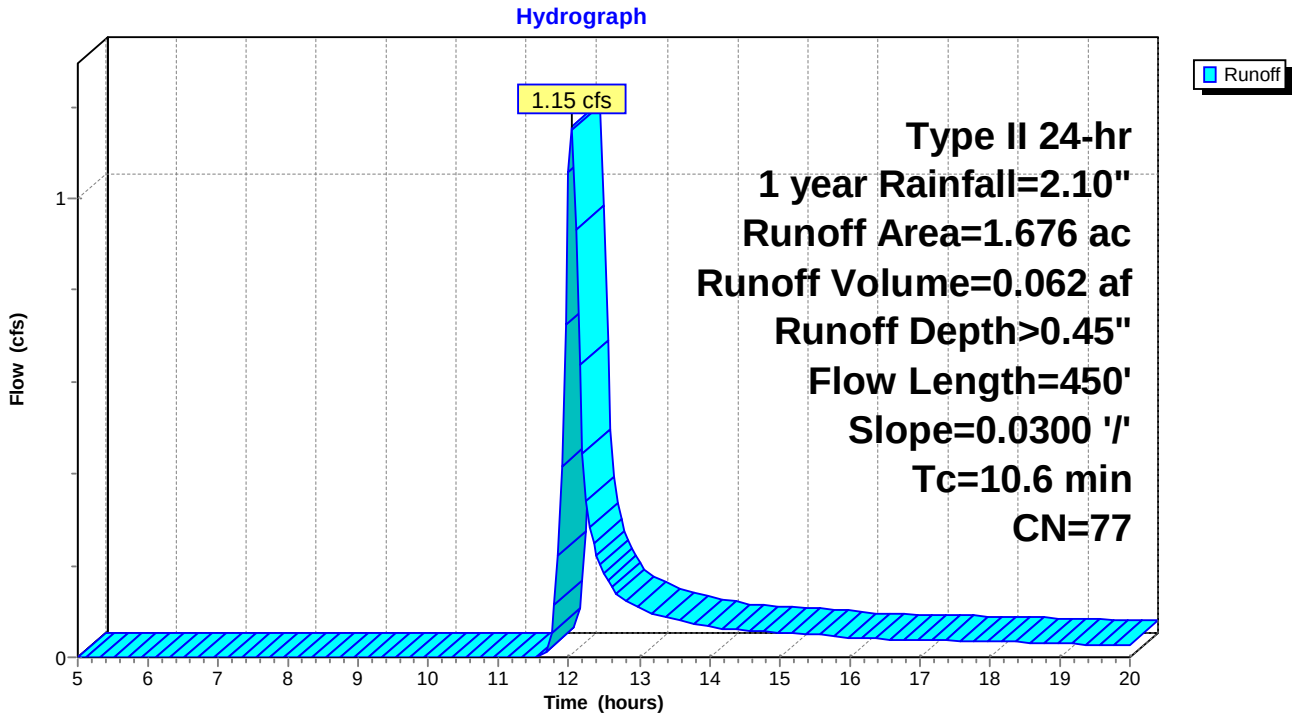
Runoff = 1.15 cfs @ 12.04 hrs, Volume= 0.062 af, Depth> 0.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 year Rainfall=2.10"

Area (ac)	CN	Description
0.366	98	Paved parking, HSG C
1.310	71	Meadow, non-grazed, HSG C
1.676	77	Weighted Average
1.310		78.16% Pervious Area
0.366		21.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.6	450	0.0300	0.71		**Lag/CN Method,**

Subcatchment 10S: Vtrans Median G



Summary for Pond 1P: CPv Pond

Inflow Area = 10.003 ac, 62.12% Impervious, Inflow Depth > 0.96" for 1 year event
Inflow = 11.57 cfs @ 12.13 hrs, Volume= 0.799 af
Outflow = 0.04 cfs @ 20.00 hrs, Volume= 0.024 af, Atten= 100%, Lag= 472.2 min
Primary = 0.04 cfs @ 20.00 hrs, Volume= 0.024 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 480.91' @ 20.00 hrs Surf.Area= 0.850 ac Storage= 0.775 af

Plug-Flow detention time= 341.8 min calculated for 0.024 af (3% of inflow)
Center-of-Mass det. time= 176.9 min (975.7 - 798.8)

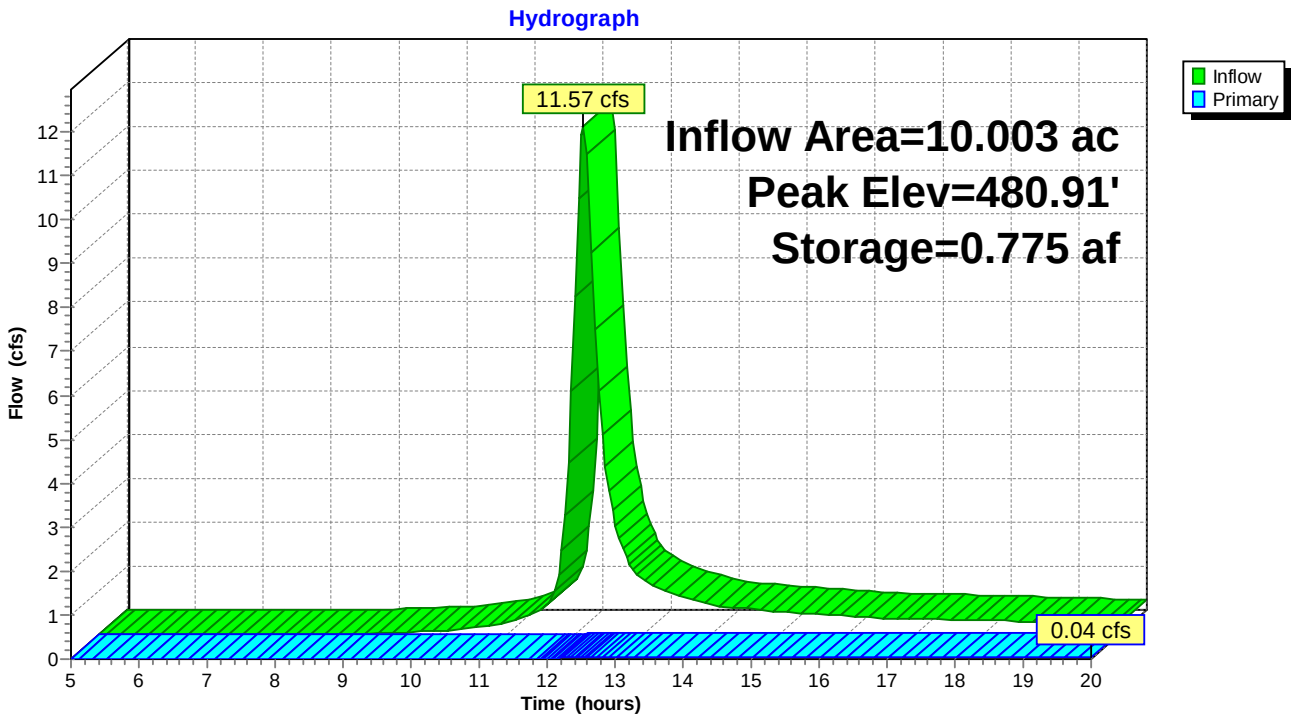
Volume	Invert	Avail.Storage	Storage Description
#1	480.00'	1.700 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
480.00	0.850	0.000	0.000
481.00	0.850	0.850	0.850
482.00	0.850	0.850	1.700

Device	Routing	Invert	Outlet Devices
#1	Primary	480.00'	**2.0" Round Culvert** L= 10.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 480.00' / 480.00' S= 0.0000 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.02 sf
#2	Primary	481.00'	**5.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=0.04 cfs @ 20.00 hrs HW=480.91' (Free Discharge)
└─**1=Culvert** (Barrel Controls 0.04 cfs @ 1.84 fps)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: CPv Pond



Summary for Pond 20P: CPv Pond

Inflow Area = 1.285 ac, 22.18% Impervious, Inflow Depth > 0.45" for 1 year event
Inflow = 1.02 cfs @ 12.00 hrs, Volume= 0.048 af
Outflow = 0.01 cfs @ 20.00 hrs, Volume= 0.004 af, Atten= 99%, Lag= 480.0 min
Primary = 0.01 cfs @ 20.00 hrs, Volume= 0.004 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 0.93' @ 20.00 hrs Surf.Area= 4,136 sf Storage= 1,889 cf

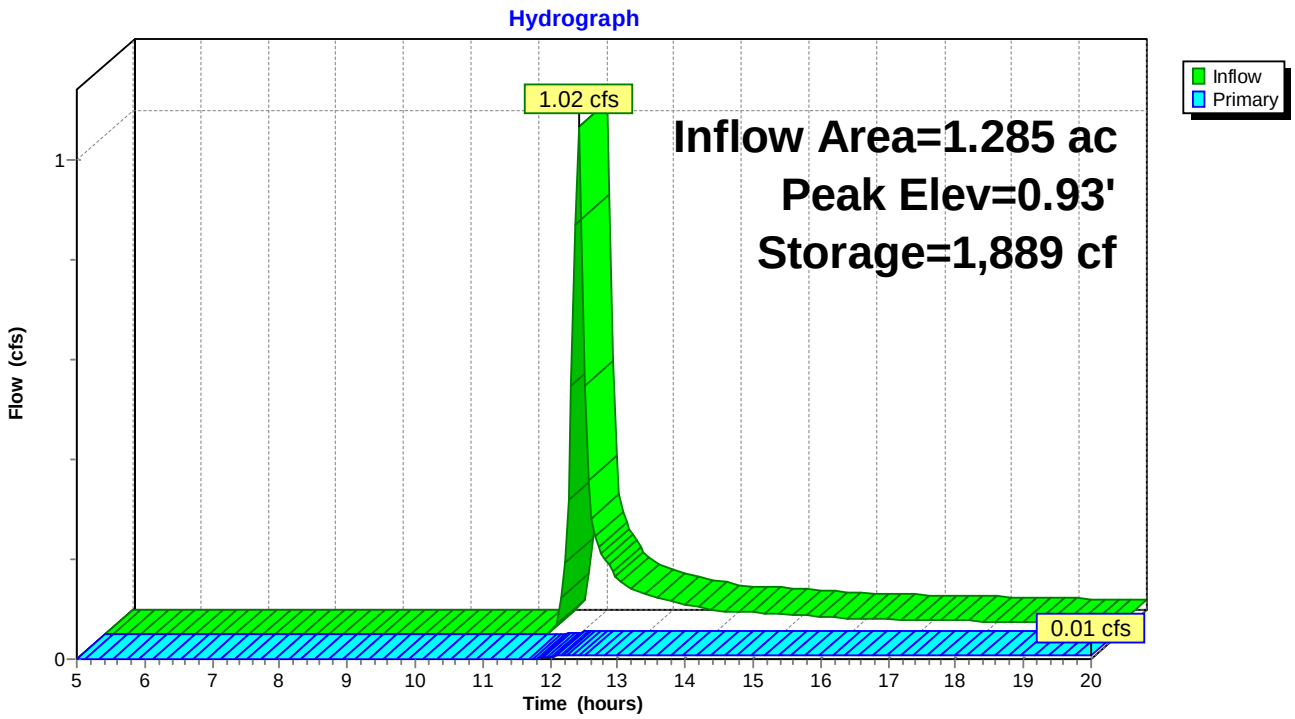
Plug-Flow detention time= 253.4 min calculated for 0.004 af (9% of inflow)
Center-of-Mass det. time= 142.0 min (964.7 - 822.7)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	5,040 cf	**306.00'L x 1.50'H Prismatoid Z=7.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**1.0" Round Culvert** L= 10.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.01 sf
#2	Primary	1.50'	**5.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=0.01 cfs @ 20.00 hrs HW=0.93' (Free Discharge)
└─**1=Culvert** (Barrel Controls 0.01 cfs @ 1.28 fps)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 20P: CPv Pond



Summary for Pond 32P: CPv Pond

Inflow Area = 0.727 ac, 27.10% Impervious, Inflow Depth > 0.48" for 1 year event
Inflow = 0.73 cfs @ 11.95 hrs, Volume= 0.029 af
Outflow = 0.01 cfs @ 20.00 hrs, Volume= 0.004 af, Atten= 99%, Lag= 482.9 min
Primary = 0.01 cfs @ 20.00 hrs, Volume= 0.004 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 0.86' @ 20.00 hrs Surf.Area= 2,573 sf Storage= 1,088 cf

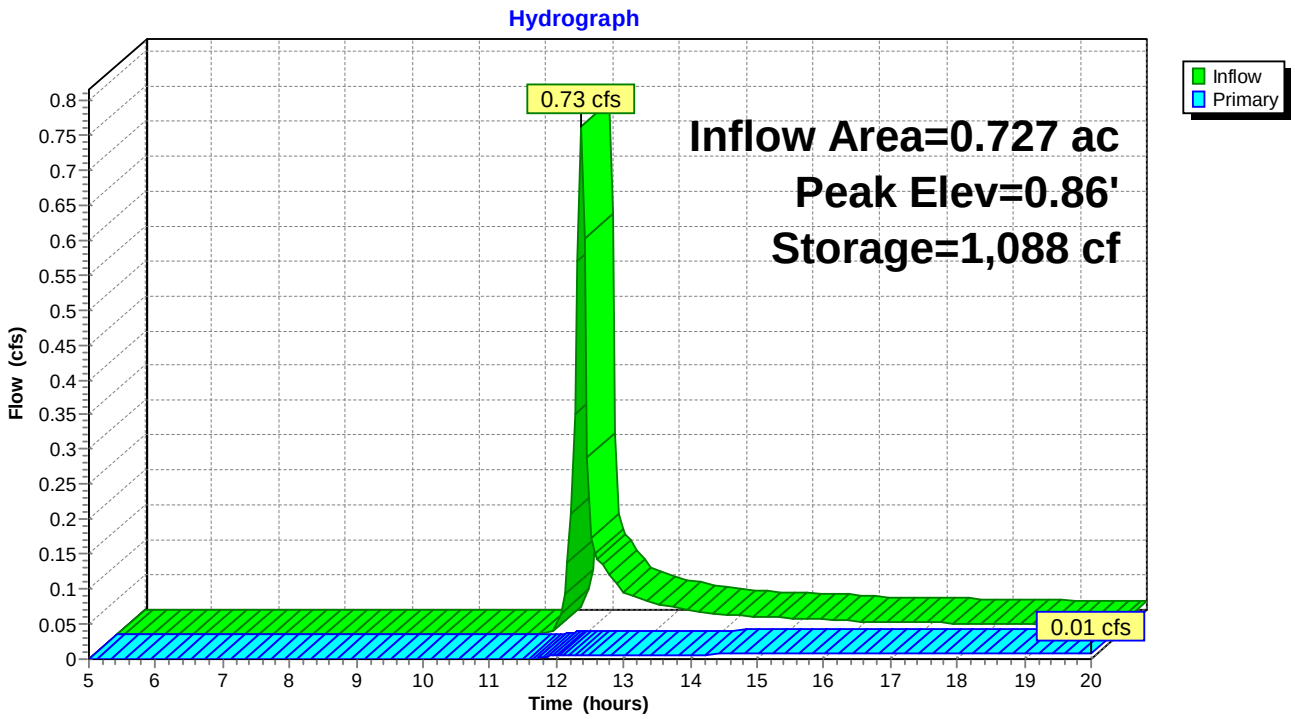
Plug-Flow detention time= 251.5 min calculated for 0.004 af (15% of inflow)
Center-of-Mass det. time= 145.1 min (961.9 - 816.8)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	3,390 cf	**201.24'L x 1.50'H Prismatoid Z=7.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**1.0" Round Culvert** L= 10.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.01 sf
#2	Primary	1.50'	**5.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=0.01 cfs @ 20.00 hrs HW=0.86' (Free Discharge)
└─**1=Culvert** (Barrel Controls 0.01 cfs @ 1.23 fps)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 32P: CPv Pond



Summary for Pond 35P: CPv Pond

Inflow Area = 1.177 ac, 23.53% Impervious, Inflow Depth > 0.45" for 1 year event
Inflow = 0.94 cfs @ 12.00 hrs, Volume= 0.044 af
Outflow = 0.01 cfs @ 20.00 hrs, Volume= 0.005 af, Atten= 99%, Lag= 480.1 min
Primary = 0.01 cfs @ 20.00 hrs, Volume= 0.005 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1.04' @ 20.00 hrs Surf.Area= 3,358 sf Storage= 1,702 cf

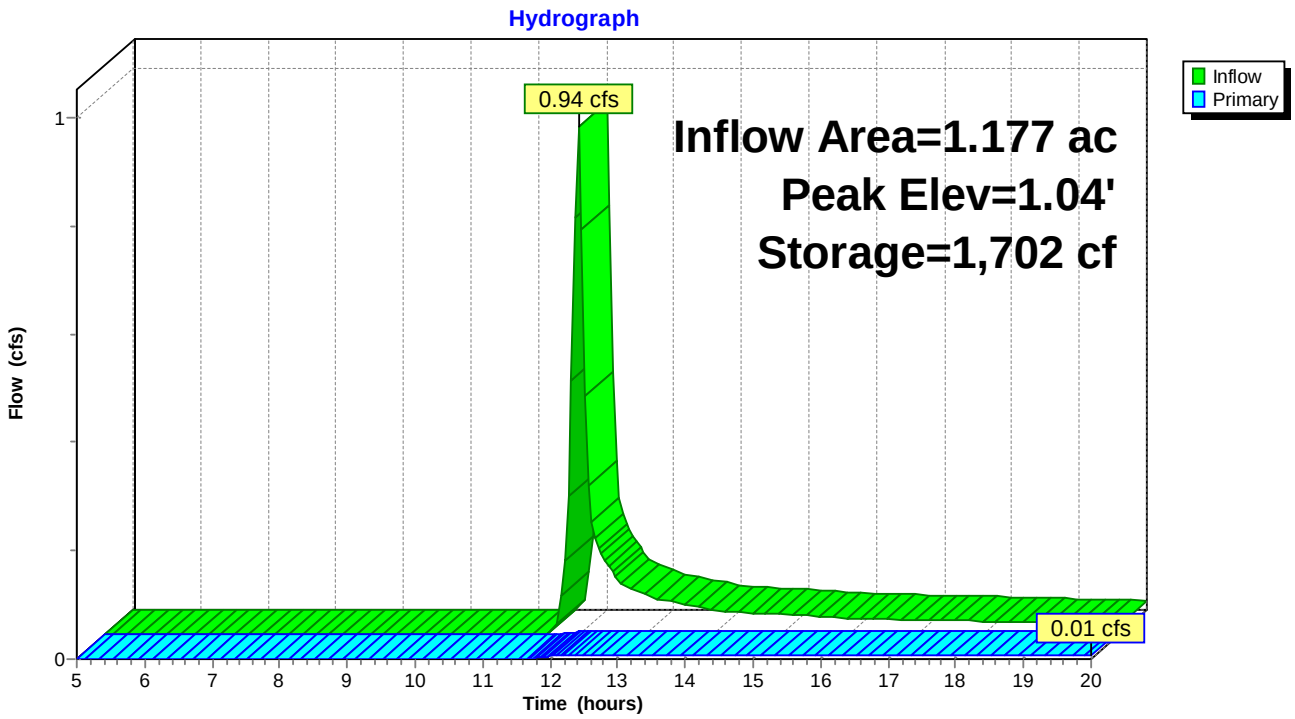
Plug-Flow detention time= 252.4 min calculated for 0.005 af (11% of inflow)
Center-of-Mass det. time= 141.6 min (964.2 - 822.6)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	3,642 cf	**217.25'L x 1.50'H Prismatoid Z=7.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**1.0" Round Culvert** L= 10.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.01 sf
#2	Primary	1.50'	**5.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=0.01 cfs @ 20.00 hrs HW=1.04' (Free Discharge)
└─**1=Culvert** (Barrel Controls 0.01 cfs @ 1.36 fps)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 35P: CPv Pond



Summary for Pond 36P: CPv Pond

Inflow Area = 1.068 ac, 16.67% Impervious, Inflow Depth > 0.41" for 1 year event
Inflow = 0.74 cfs @ 12.01 hrs, Volume= 0.037 af
Outflow = 0.01 cfs @ 20.00 hrs, Volume= 0.004 af, Atten= 99%, Lag= 479.4 min
Primary = 0.01 cfs @ 20.00 hrs, Volume= 0.004 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 0.93' @ 20.00 hrs Surf.Area= 3,063 sf Storage= 1,404 cf

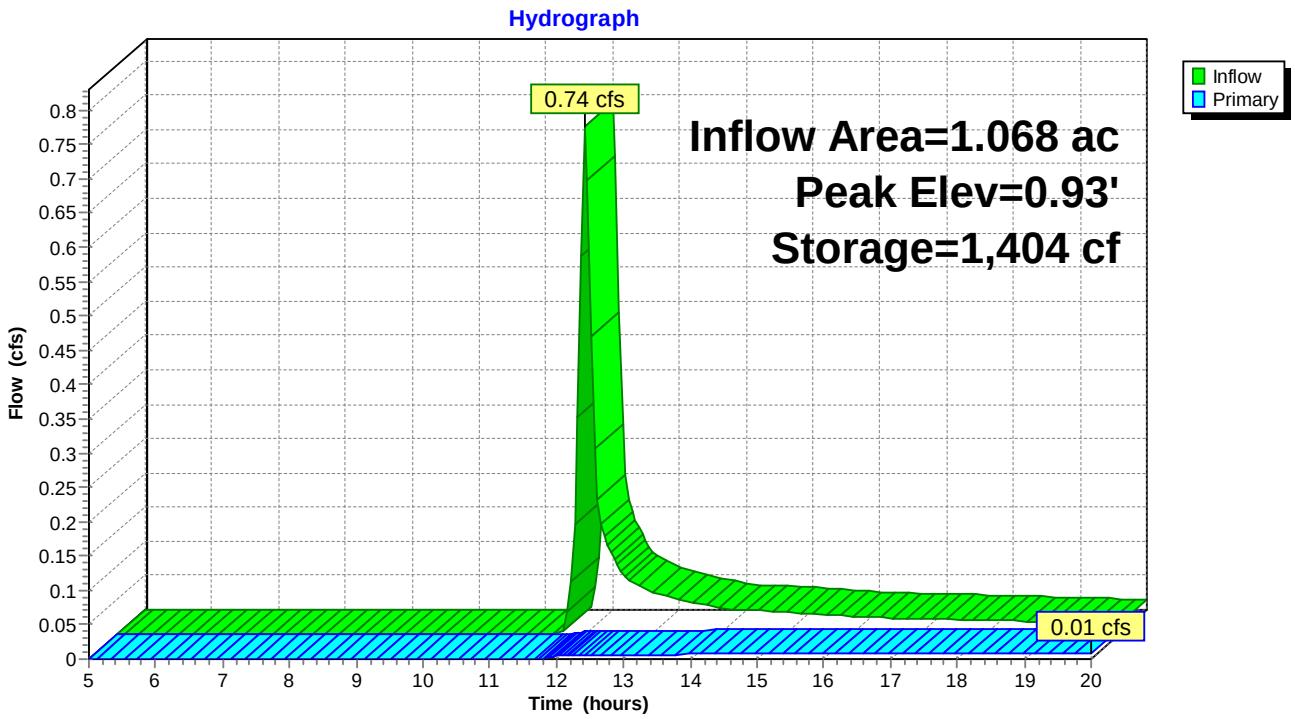
Plug-Flow detention time= 250.6 min calculated for 0.004 af (12% of inflow)
Center-of-Mass det. time= 138.8 min (965.4 - 826.6)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	3,705 cf	**221.26'L x 1.50'H Prismatoid Z=7.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**1.0" Round Culvert** L= 10.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.01 sf
#2	Primary	1.50'	**5.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=0.01 cfs @ 20.00 hrs HW=0.93' (Free Discharge)
└─**1=Culvert** (Barrel Controls 0.01 cfs @ 1.28 fps)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 36P: CPv Pond



Summary for Pond 37P: CPv Pond

Inflow Area = 1.548 ac, 25.06% Impervious, Inflow Depth > 0.48" for 1 year event
Inflow = 1.19 cfs @ 12.03 hrs, Volume= 0.062 af
Outflow = 0.01 cfs @ 20.00 hrs, Volume= 0.005 af, Atten= 99%, Lag= 478.1 min
Primary = 0.01 cfs @ 20.00 hrs, Volume= 0.005 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1.06' @ 20.00 hrs Surf.Area= 4,799 sf Storage= 2,500 cf

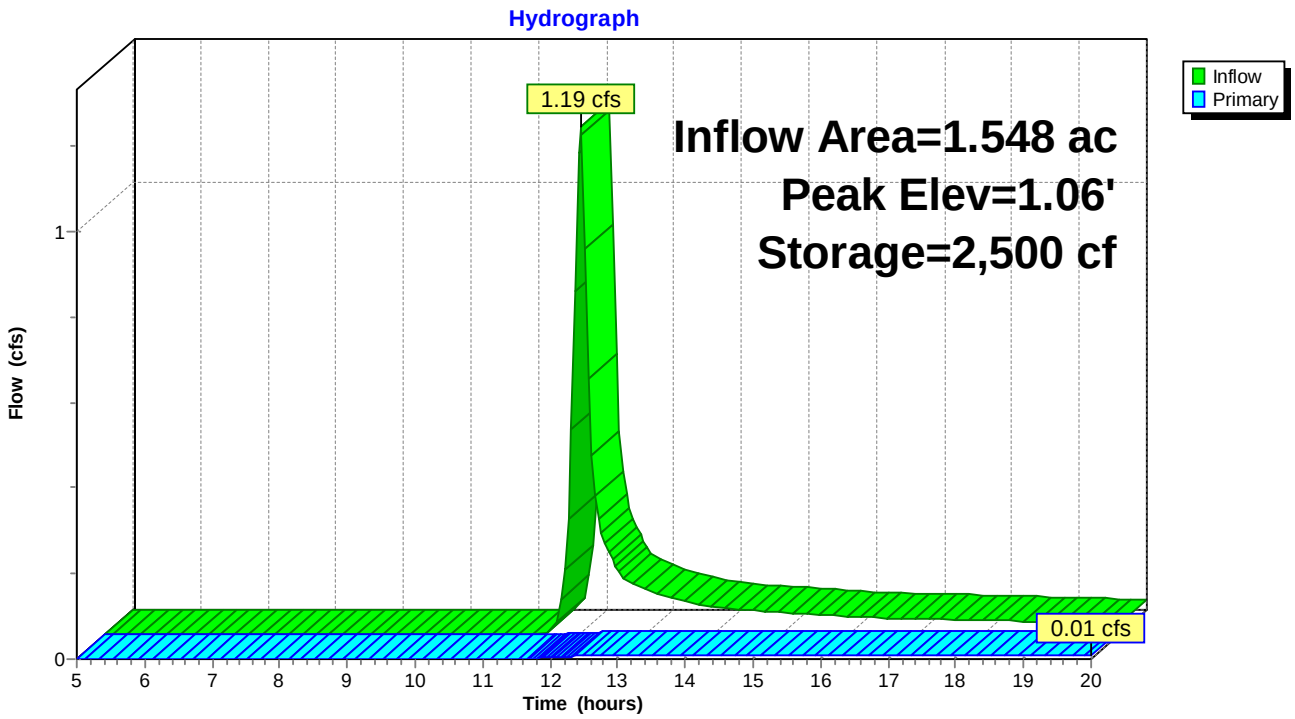
Plug-Flow detention time= 252.9 min calculated for 0.005 af (8% of inflow)
Center-of-Mass det. time= 143.4 min (964.8 - 821.5)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	5,090 cf	**309.18'L x 1.50'H Prismatoid Z=7.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**1.0" Round Culvert** L= 10.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.01 sf
#2	Primary	1.50'	**5.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=0.01 cfs @ 20.00 hrs HW=1.06' (Free Discharge)
└─**1=Culvert** (Barrel Controls 0.01 cfs @ 1.37 fps)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 37P: CPv Pond



Summary for Pond 38P: CPv Pond

Inflow Area = 1.316 ac, 19.45% Impervious, Inflow Depth > 0.41" for 1 year event
Inflow = 0.86 cfs @ 12.03 hrs, Volume= 0.045 af
Outflow = 0.01 cfs @ 20.00 hrs, Volume= 0.004 af, Atten= 99%, Lag= 478.4 min
Primary = 0.01 cfs @ 20.00 hrs, Volume= 0.004 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 0.91' @ 20.00 hrs Surf.Area= 3,954 sf Storage= 1,776 cf

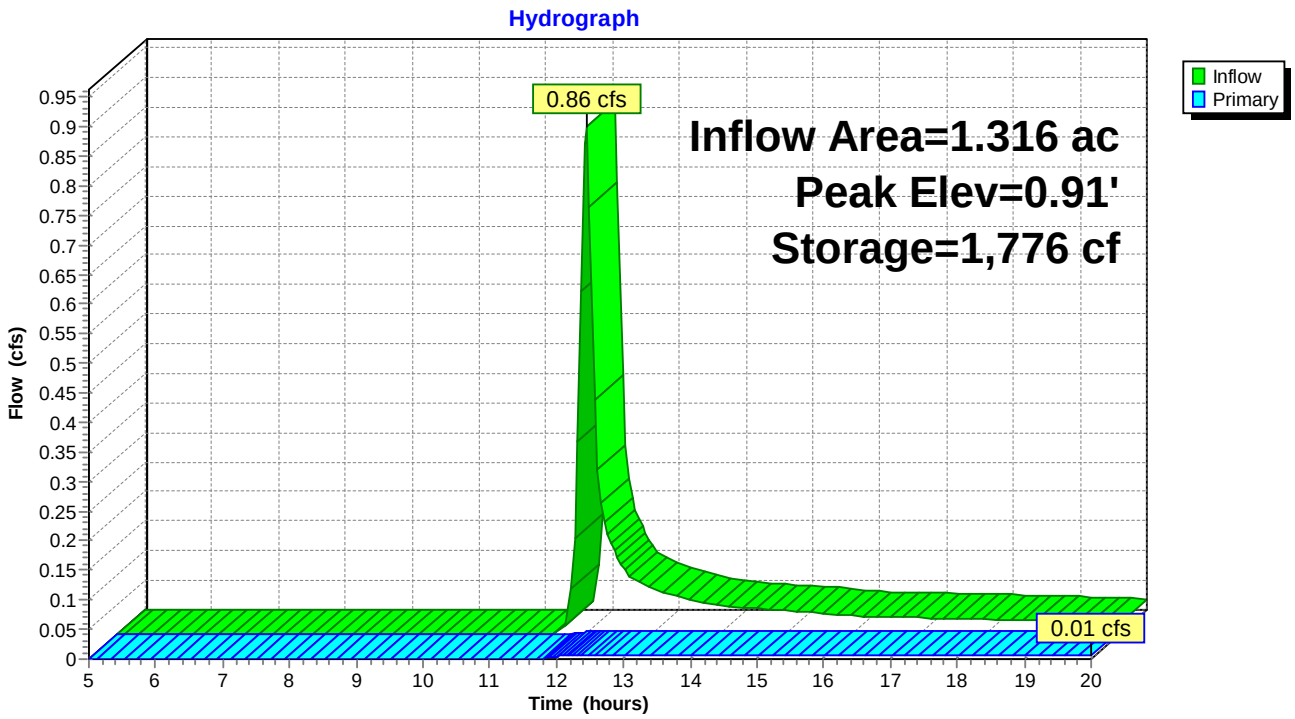
Plug-Flow detention time= 251.6 min calculated for 0.004 af (10% of inflow)
Center-of-Mass det. time= 138.7 min (966.2 - 827.5)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	4,902 cf	**297.26'L x 1.50'H Prismatoid Z=7.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**1.0" Round Culvert** L= 10.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.01 sf
#2	Primary	1.50'	**5.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=0.01 cfs @ 20.00 hrs HW=0.91' (Free Discharge)
└─**1=Culvert** (Barrel Controls 0.01 cfs @ 1.26 fps)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 38P: CPv Pond



Summary for Pond 39P: CPv Pond

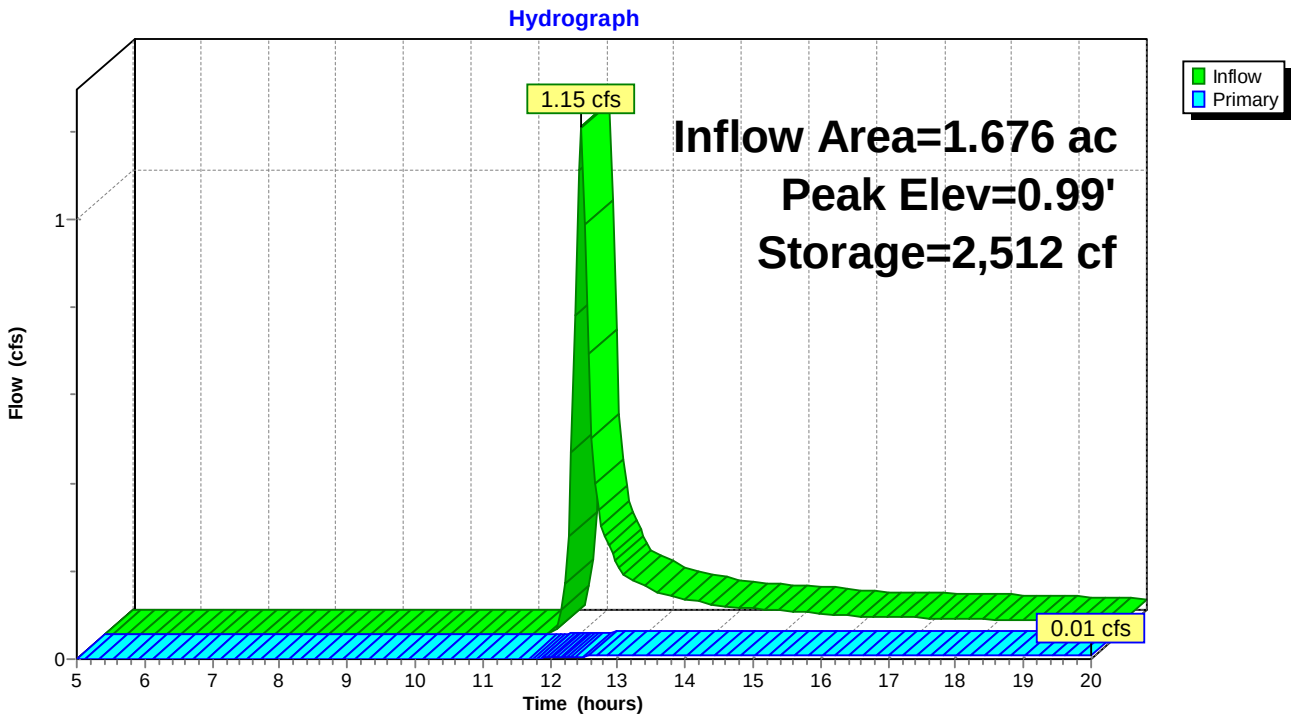
Inflow Area = 1.676 ac, 21.84% Impervious, Inflow Depth > 0.45" for 1 year event
Inflow = 1.15 cfs @ 12.04 hrs, Volume= 0.062 af
Outflow = 0.01 cfs @ 20.00 hrs, Volume= 0.005 af, Atten= 99%, Lag= 477.6 min
Primary = 0.01 cfs @ 20.00 hrs, Volume= 0.005 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 0.99' @ 20.00 hrs Surf.Area= 5,141 sf Storage= 2,512 cf

Plug-Flow detention time= 252.8 min calculated for 0.005 af (7% of inflow)
Center-of-Mass det. time= 141.0 min (966.0 - 825.0)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	5,846 cf	**357.15'L x 1.50'H Prismatoid Z=7.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**1.0" Round Culvert** L= 10.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.01 sf
#2	Primary	1.50'	**5.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=0.01 cfs @ 20.00 hrs HW=0.99' (Free Discharge)
└─**1=Culvert** (Barrel Controls 0.01 cfs @ 1.32 fps)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 39P: CPv Pond