

STORMWATER REPORT

Proposed Single Family Dwelling
41 Kelsey Road
Boxford, Massachusetts

February 25, 2020
Revised March 12, 2020

Owner/Applicant:
ADVA Construction/Design, LLC
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W&S Project Data
BOXF-0074
SWPPPkelsey#41_R.dwg
Existing.hcp
Proposed_R.hcp
p:\BOXF-0074(41 kelsey road)\drainage\stormwater_report_r.docx



Standard 10

All illicit discharges to the stormwater management system are prohibited.

Illicit Discharge Compliance Statement

No connection between the stormwater and wastewater management systems is proposed. Per requirements of Standard 10 it is herein stated that there are no proposed illicit discharges into the Stormwater Management System to be constructed as shown on the site plan.

The Applicant is willing to have his contractor uncover the 3" diameter "Black Pipe" located at the northwestern property corner to be able to ascertain the origin of the pipe. However, should the pipe cross onto the abutter's property the search will terminate at the property line and the responsibility would lie with them to investigate further should the Town require.

1.8 Conclusion

Examining the following Peak Rate of Runoff and Basin Performance tables, the proposed stormwater management system is effective for mitigating the peak flow rates and volume of runoff from the limit of the watershed analysis for the 2, 10, 25, 50 and 100-year storm events using the NOAA Atlas 14 rainfall data.

Table 1.0: Peak Rate of Runoff | Comparison Location 3L (Total flow from watershed)

Description	2 Year	10 Year	25 Year	50 Year	100 Year
Existing Peak Rate of Runoff (cfs)	1.8	6.9	10.8	13.9	17.4
Proposed Peak Rate of Runoff (cfs)	1.8	6.9	10.7	13.8	17.3
Decrease	0.0	0.0	-0.1	-0.1	-0.1

Table 2.0: Volume of Runoff | Comparison Location 3L (Total flow from watershed)

Description	2 Year	10 Year	25 Year	50 Year	100 Year
Existing volume of Runoff (ac-ft)	0.207	0.610	0.918	1.163	1.444
Proposed Peak Rate of Runoff (cfs)	0.207	0.607	0.912	1.156	1.436
Decrease	0.0	-0.003	-0.006	-0.007	-0.008

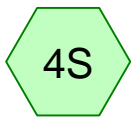
1.9 HydroCAD Data



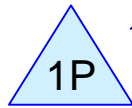
POST-1



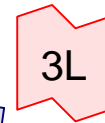
POST-2



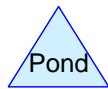
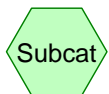
POST-DRIVE



Sloping Infiltration
Trench



Total flow from within
the limit of watershed
analysis discharging to
Kelsey Road



Routing Diagram for POST-DEVELOPMENT_R

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POST-DEVELOPMENT_R

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Page 2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
111,282	65	2 acre lots, 12% imp, HSG B (1S)
43,651	61	>75% Grass cover, Good, HSG B (1S, 2S, 4S)
4,232	98	Unconnected pavement, HSG B (4S)
2,371	98	Unconnected roofs, HSG B (1S, 2S)
39,972	55	Woods, Good, HSG B (1S, 2S)
201,508	63	TOTAL AREA

POST-DEVELOPMENT_R

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Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
201,508	HSG B	1S, 2S, 4S
0	HSG C	
0	HSG D	
0	Other	
201,508		TOTAL AREA

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Type III 24-hr 2 yr Rainfall=3.26"

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Summary for Subcatchment 1S: POST-1

Runoff = 1.25 cfs @ 12.19 hrs, Volume= 6,315 cf, Depth= 0.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.26"

Area (sf)	CN	Adj	Description
111,282	65		2 acre lots, 12% imp, HSG B
18,972	55		Woods, Good, HSG B
417	98		Unconnected roofs, HSG B
8,000	61		>75% Grass cover, Good, HSG B
138,671	64	63	Weighted Average, UI Adjusted
124,900			90.07% Pervious Area
13,771			9.93% Impervious Area
417			3.03% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	50	0.0600	0.11		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.26"
0.8	185	0.0600	3.94		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
1.5	315	0.0460	3.45		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
10.2	550	Total			

POST-DEVELOPMENT_R

Type III 24-hr 2 yr Rainfall=3.26"

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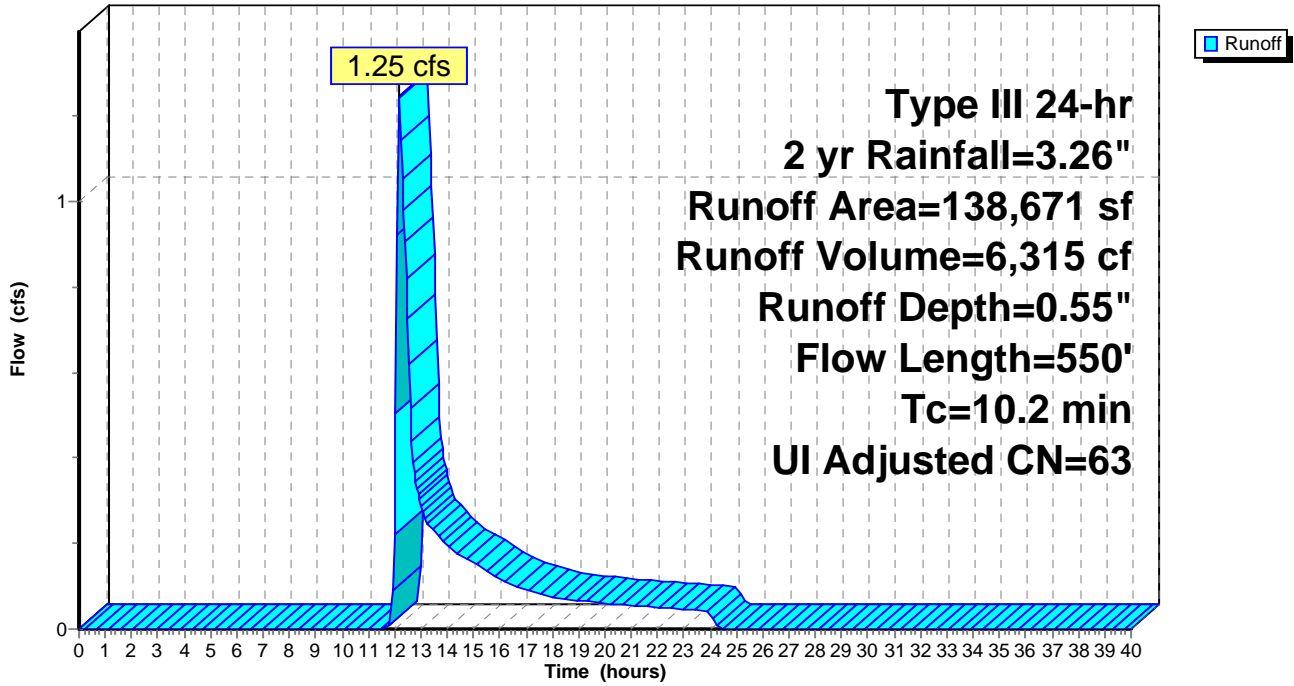
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Subcatchment 1S: POST-1

Hydrograph



POST-DEVELOPMENT_R

Type III 24-hr 2 yr Rainfall=3.26"

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Summary for Subcatchment 2S: POST-2

Runoff = 0.31 cfs @ 12.17 hrs, Volume= 1,916 cf, Depth= 0.40"

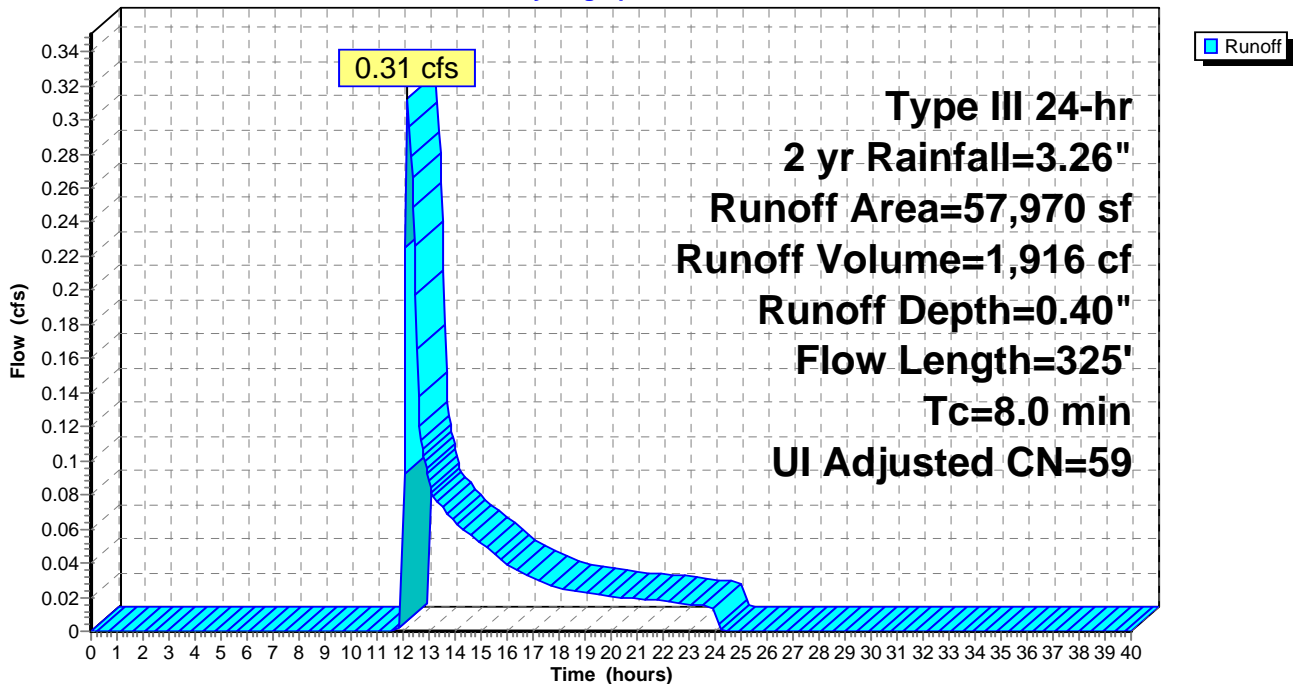
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.26"

Area (sf)	CN	Adj	Description
21,000	55		Woods, Good, HSG B
35,016	61		>75% Grass cover, Good, HSG B
1,954	98		Unconnected roofs, HSG B
57,970	60	59	Weighted Average, UI Adjusted
56,016			96.63% Pervious Area
1,954			3.37% Impervious Area
1,954			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	50	0.0120	0.12		Sheet Flow, Grass: Short n= 0.150 P2= 3.26"
0.5	75	0.0230	2.44		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
0.7	200	0.0900	4.83		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
8.0	325	Total			

Subcatchment 2S: POST-2

Hydrograph



POST-DEVELOPMENT_R

Type III 24-hr 2 yr Rainfall=3.26"

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Summary for Subcatchment 4S: POST-DRIVE

Runoff = 0.31 cfs @ 12.09 hrs, Volume= 1,015 cf, Depth= 2.50"

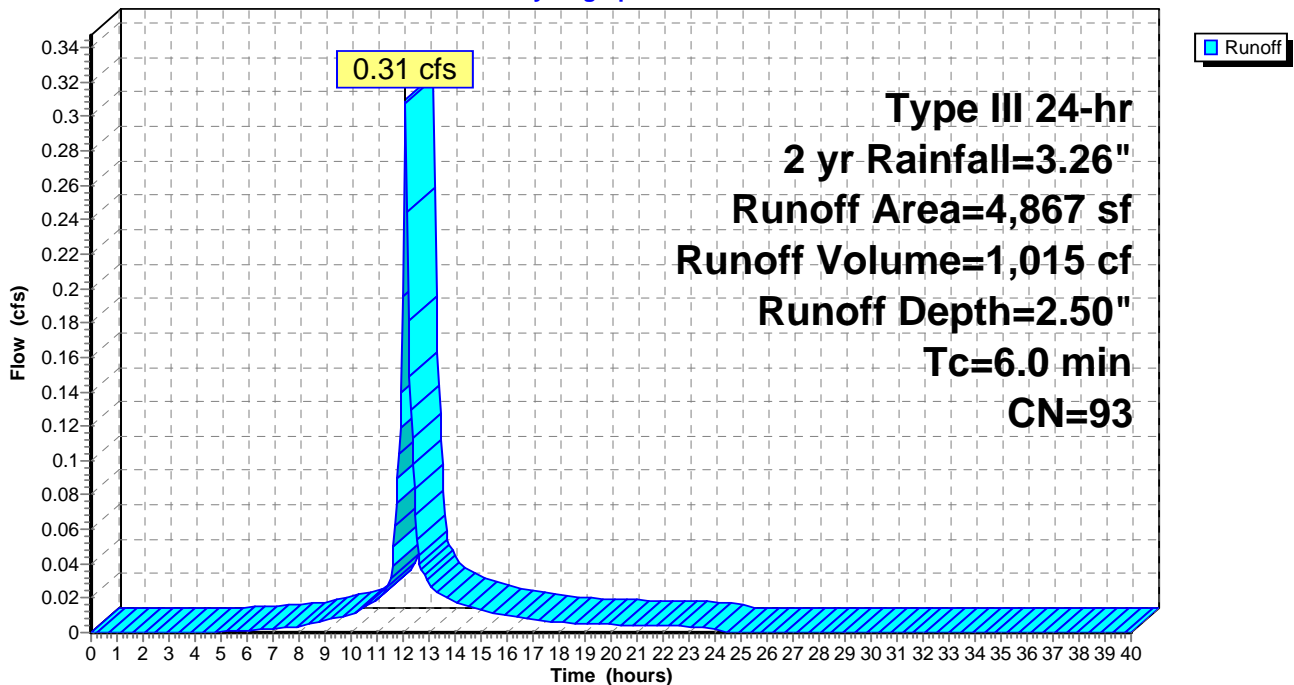
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.26"

Area (sf)	CN	Description
4,232	98	Unconnected pavement, HSG B
635	61	>75% Grass cover, Good, HSG B
4,867	93	Weighted Average
635		13.05% Pervious Area
4,232		86.95% Impervious Area
4,232		100.00% Unconnected

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

Subcatchment 4S: POST-DRIVE

Hydrograph



POST-DEVELOPMENT_R

Type III 24-hr 2 yr Rainfall=3.26"

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Summary for Pond 1P: Sloping Infiltration Trench

Inflow Area = 4,867 sf, 86.95% Impervious, Inflow Depth = 2.50" for 2 yr event
 Inflow = 0.31 cfs @ 12.09 hrs, Volume= 1,015 cf
 Outflow = 0.31 cfs @ 12.09 hrs, Volume= 1,015 cf, Atten= 0%, Lag= 0.1 min
 Discarded = 0.00 cfs @ 12.09 hrs, Volume= 240 cf
 Primary = 0.31 cfs @ 12.09 hrs, Volume= 776 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
 Peak Elev= 109.03' @ 12.09 hrs Surf.Area= 134 sf Storage= 60 cf

Plug-Flow detention time= 64.1 min calculated for 1,014 cf (100% of inflow)
 Center-of-Mass det. time= 64.8 min (856.8 - 792.0)

Volume	Invert	Avail.Storage	Storage Description
#1	106.75'	480 cf	36.0" W x 24.0" H Box Pipe Storage L= 200.0' S= 0.0510 '/' 1,200 cf Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	109.00'	25.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32
#2	Discarded	106.75'	1.020 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.00 cfs @ 12.09 hrs HW=109.03' (Free Discharge)
 ↳ **2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.30 cfs @ 12.09 hrs HW=109.03' TW=0.00' (Dynamic Tailwater)
 ↳ **1=Broad-Crested Rectangular Weir** (Weir Controls 0.30 cfs @ 0.44 fps)

POST-DEVELOPMENT_R

Type III 24-hr 2 yr Rainfall=3.26"

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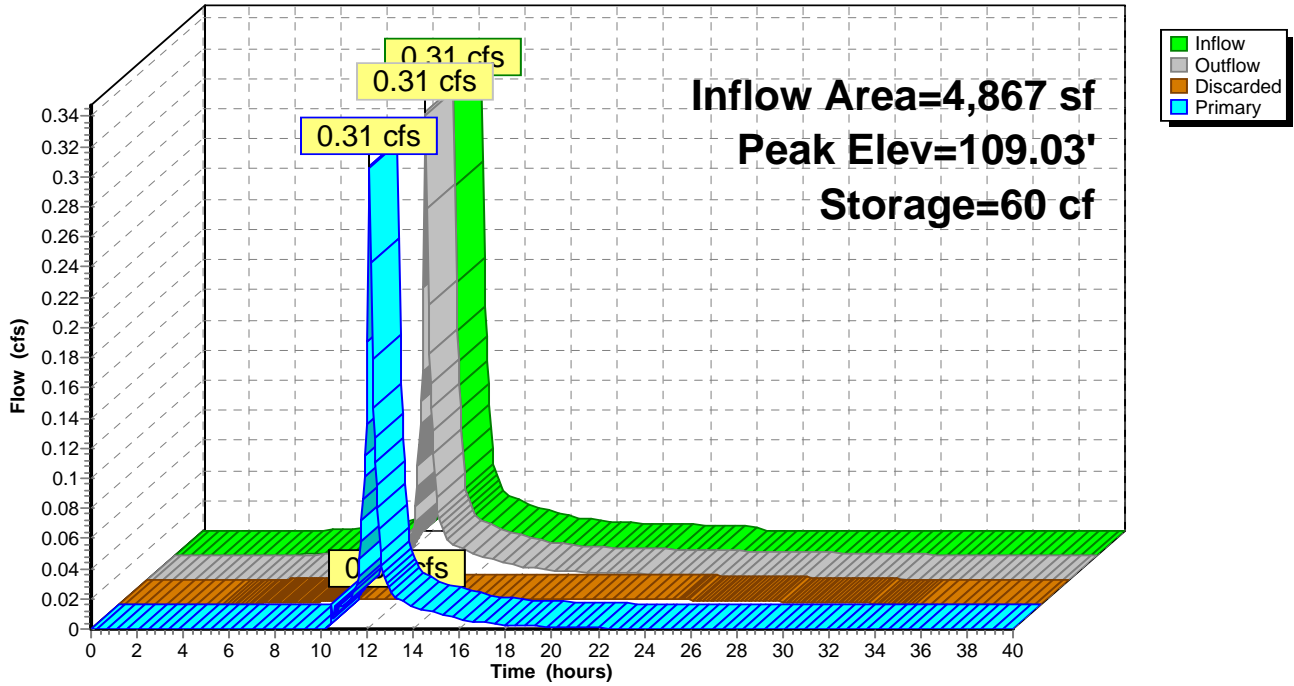
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Pond 1P: Sloping Infiltration Trench

Hydrograph



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Type III 24-hr 2 yr Rainfall=3.26"

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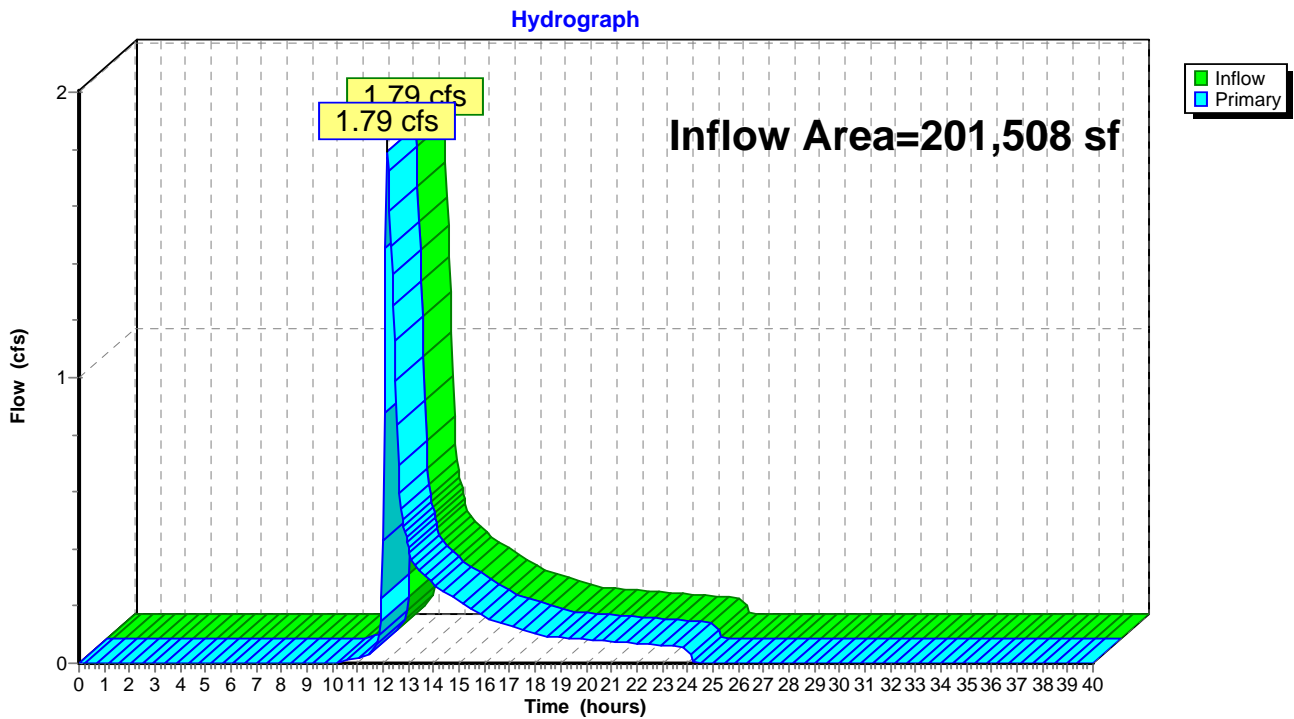
Page 10

Summary for Link 3L: Total flow from within the limit of watershed analysis discharging to Kelsey Road

Inflow Area = 201,508 sf, 9.90% Impervious, Inflow Depth = 0.54" for 2 yr event
Inflow = 1.79 cfs @ 12.17 hrs, Volume= 9,006 cf
Primary = 1.79 cfs @ 12.17 hrs, Volume= 9,006 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Link 3L: Total flow from within the limit of watershed analysis discharging to Kelsey Road



POST-DEVELOPMENT_R

Type III 24-hr 10 yr Rainfall=5.15"

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Summary for Subcatchment 1S: POST-1

Runoff = 4.82 cfs @ 12.16 hrs, Volume= 18,544 cf, Depth= 1.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10 yr Rainfall=5.15"

Area (sf)	CN	Adj	Description
111,282	65		2 acre lots, 12% imp, HSG B
18,972	55		Woods, Good, HSG B
417	98		Unconnected roofs, HSG B
8,000	61		>75% Grass cover, Good, HSG B

138,671	64	63	Weighted Average, UI Adjusted
124,900			90.07% Pervious Area
13,771			9.93% Impervious Area
417			3.03% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	50	0.0600	0.11		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.26"
0.8	185	0.0600	3.94		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
1.5	315	0.0460	3.45		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
10.2	550	Total			

POST-DEVELOPMENT_R

Type III 24-hr 10 yr Rainfall=5.15"

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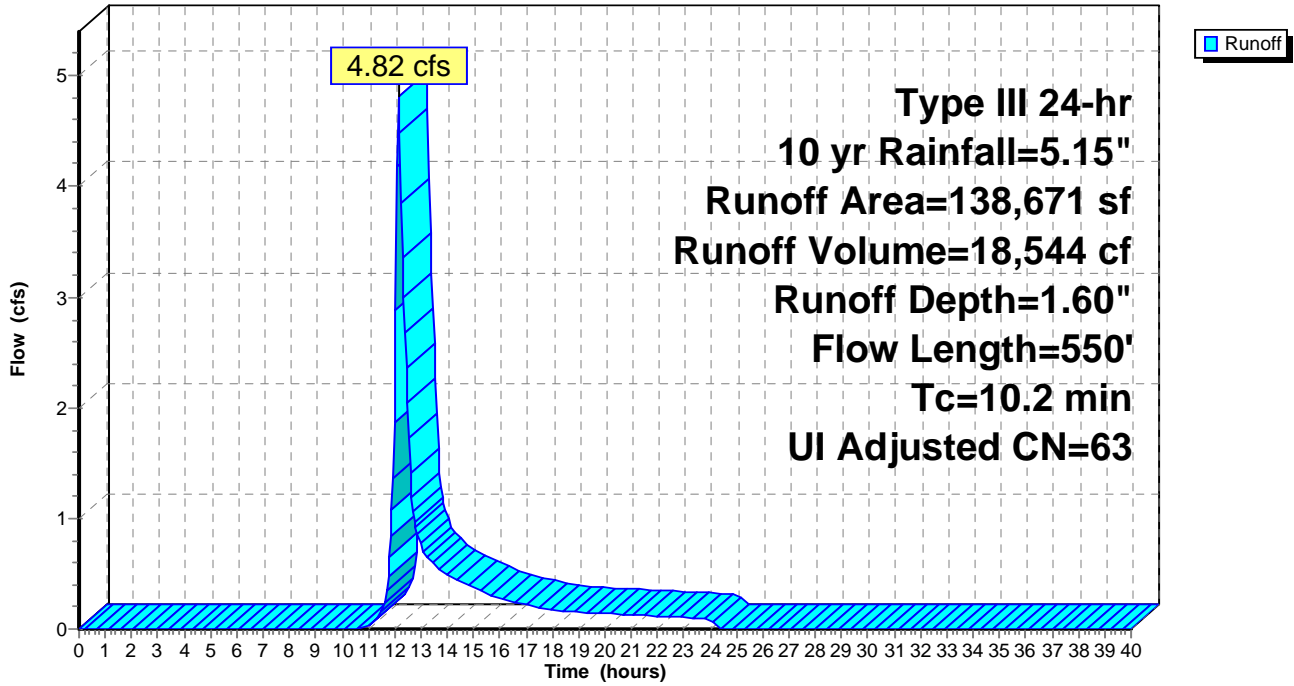
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Subcatchment 1S: POST-1

Hydrograph



POST-DEVELOPMENT_R

Type III 24-hr 10 yr Rainfall=5.15"

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Summary for Subcatchment 2S: POST-2

Runoff = 1.67 cfs @ 12.13 hrs, Volume= 6,378 cf, Depth= 1.32"

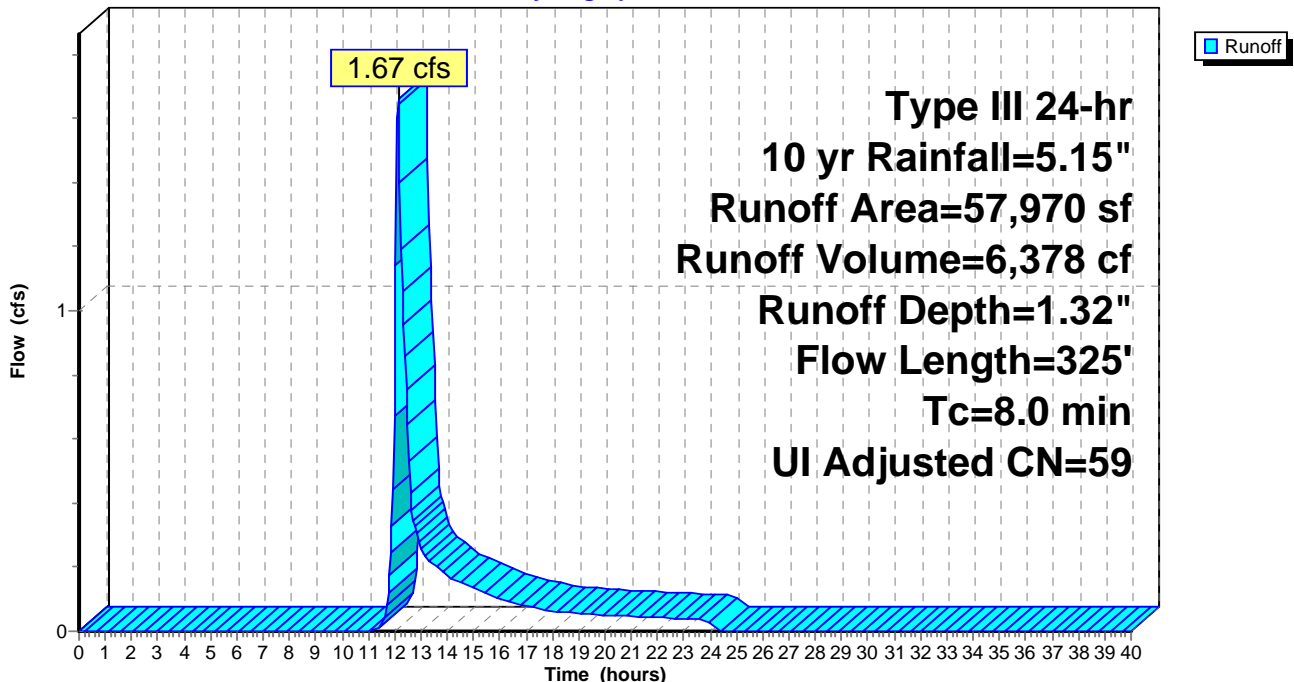
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=5.15"

Area (sf)	CN	Adj	Description
21,000	55		Woods, Good, HSG B
35,016	61		>75% Grass cover, Good, HSG B
1,954	98		Unconnected roofs, HSG B
57,970	60	59	Weighted Average, UI Adjusted
56,016			96.63% Pervious Area
1,954			3.37% Impervious Area
1,954			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	50	0.0120	0.12		Sheet Flow, Grass: Short n= 0.150 P2= 3.26"
0.5	75	0.0230	2.44		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
0.7	200	0.0900	4.83		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
8.0	325	Total			

Subcatchment 2S: POST-2

Hydrograph



POST-DEVELOPMENT_R

Type III 24-hr 10 yr Rainfall=5.15"

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Summary for Subcatchment 4S: POST-DRIVE

Runoff = 0.52 cfs @ 12.09 hrs, Volume= 1,762 cf, Depth= 4.35"

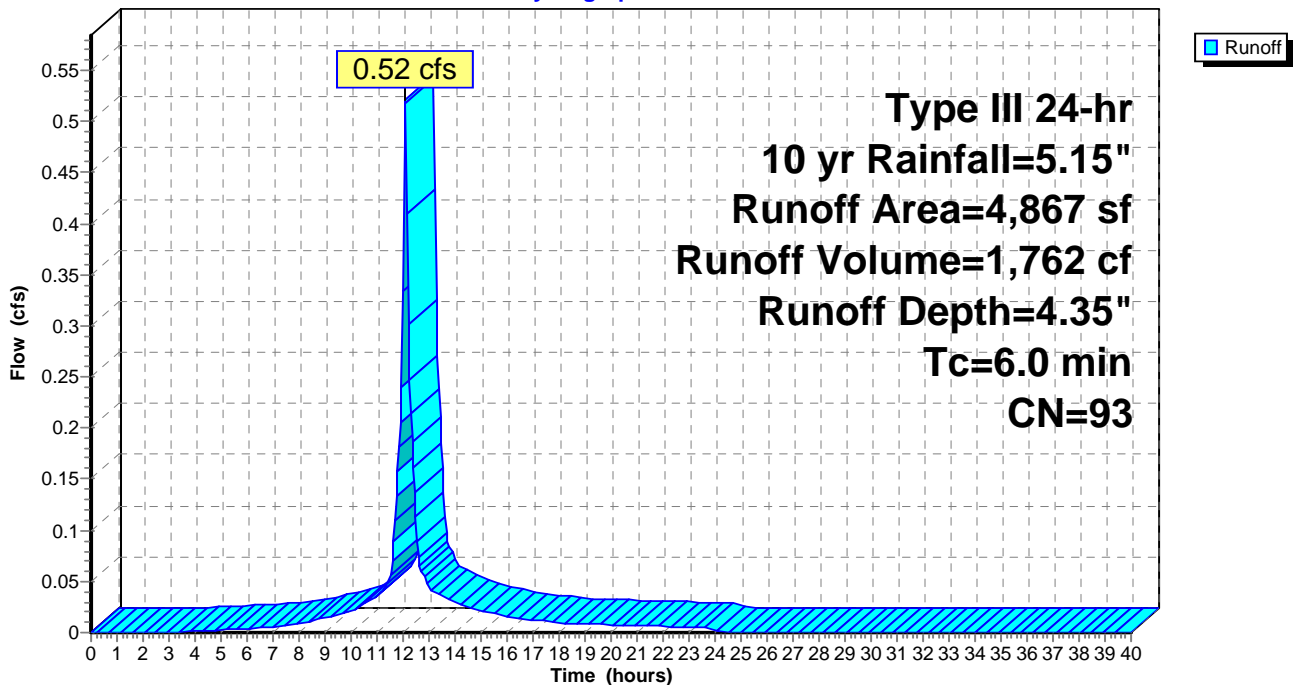
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=5.15"

Area (sf)	CN	Description
4,232	98	Unconnected pavement, HSG B
635	61	>75% Grass cover, Good, HSG B
4,867	93	Weighted Average
635		13.05% Pervious Area
4,232		86.95% Impervious Area
4,232		100.00% Unconnected

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

Subcatchment 4S: POST-DRIVE

Hydrograph



POST-DEVELOPMENT_R

Type III 24-hr 10 yr Rainfall=5.15"

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Summary for Pond 1P: Sloping Infiltration Trench

Inflow Area = 4,867 sf, 86.95% Impervious, Inflow Depth = 4.35" for 10 yr event
 Inflow = 0.52 cfs @ 12.09 hrs, Volume= 1,762 cf
 Outflow = 0.52 cfs @ 12.09 hrs, Volume= 1,762 cf, Atten= 0%, Lag= 0.0 min
 Discarded = 0.00 cfs @ 12.09 hrs, Volume= 261 cf
 Primary = 0.52 cfs @ 12.09 hrs, Volume= 1,501 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
 Peak Elev= 109.04' @ 12.09 hrs Surf.Area= 135 sf Storage= 61 cf

Plug-Flow detention time= 40.5 min calculated for 1,760 cf (100% of inflow)
 Center-of-Mass det. time= 41.2 min (818.6 - 777.4)

Volume	Invert	Avail.Storage	Storage Description
#1	106.75'	480 cf	36.0" W x 24.0" H Box Pipe Storage L= 200.0' S= 0.0510 '/' 1,200 cf Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	109.00'	25.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32
#2	Discarded	106.75'	1.020 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.00 cfs @ 12.09 hrs HW=109.04' (Free Discharge)
 ↳ **2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.51 cfs @ 12.09 hrs HW=109.04' TW=0.00' (Dynamic Tailwater)
 ↳ **1=Broad-Crested Rectangular Weir** (Weir Controls 0.51 cfs @ 0.53 fps)

POST-DEVELOPMENT_R

Type III 24-hr 10 yr Rainfall=5.15"

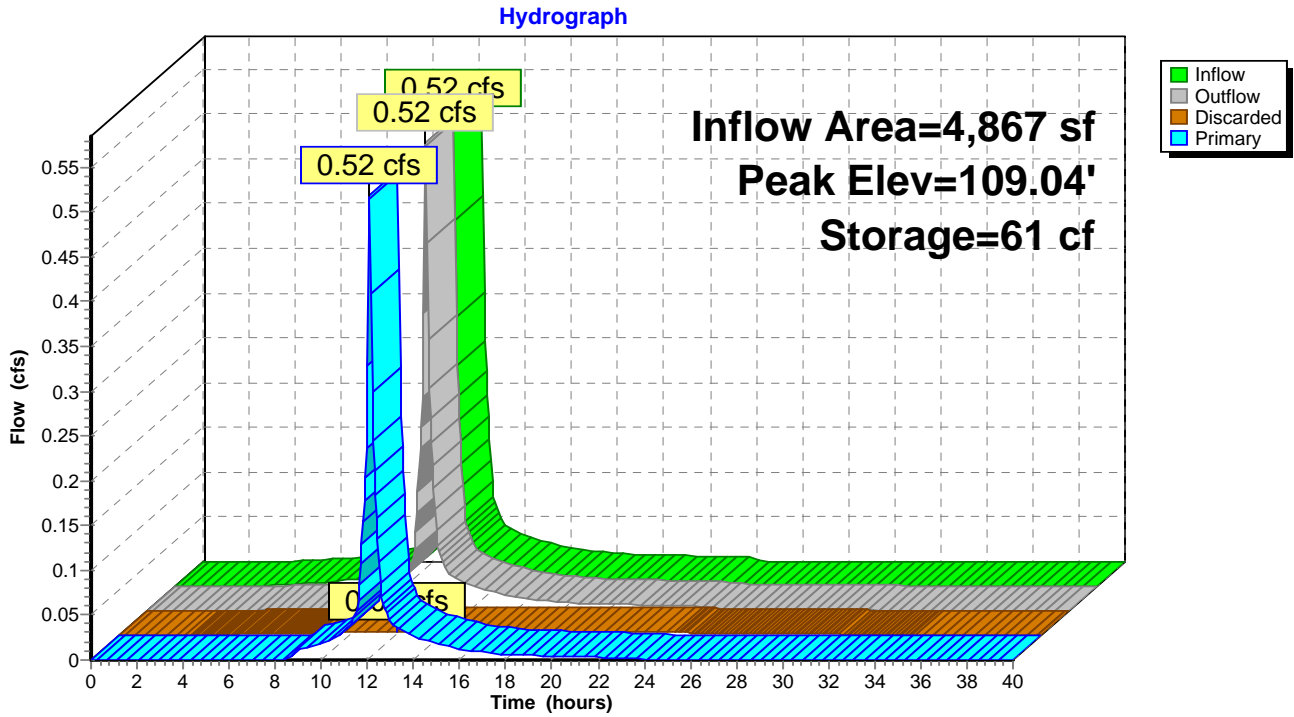
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Pond 1P: Sloping Infiltration Trench



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Type III 24-hr 10 yr Rainfall=5.15"

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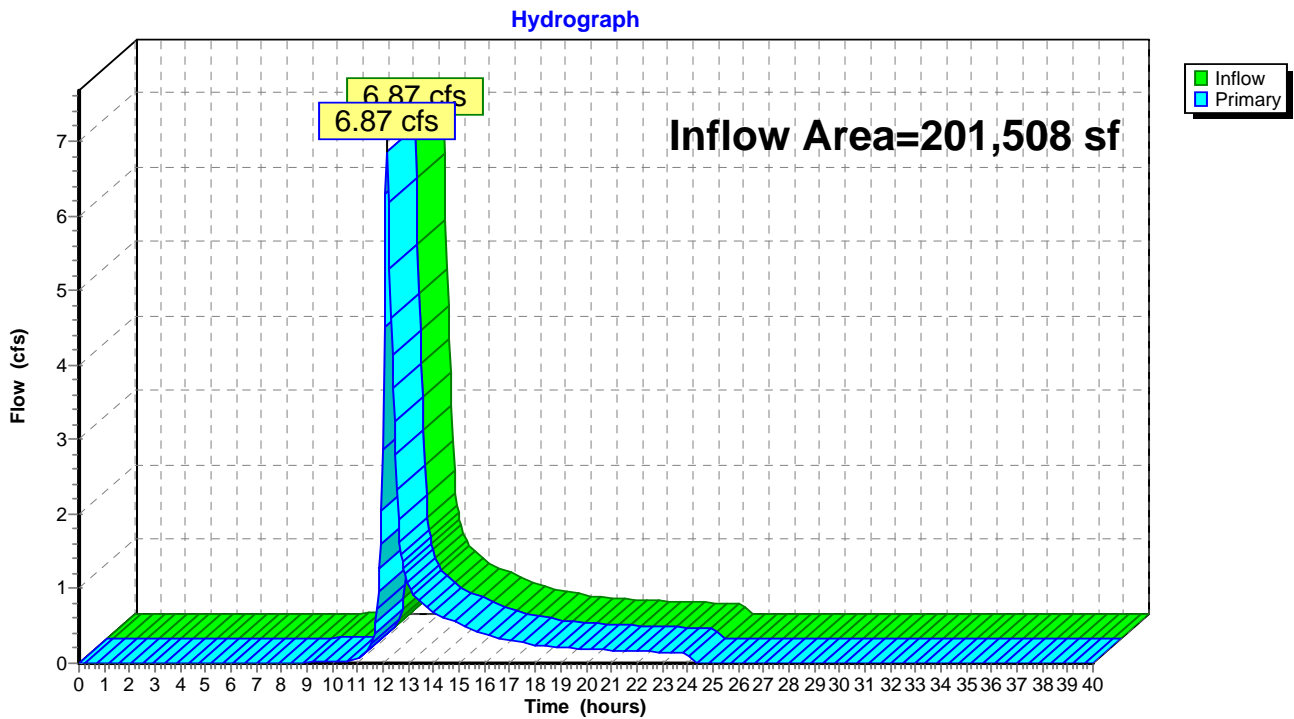
Page 17

Summary for Link 3L: Total flow from within the limit of watershed analysis discharging to Kelsey Road

Inflow Area = 201,508 sf, 9.90% Impervious, Inflow Depth = 1.57" for 10 yr event
Inflow = 6.87 cfs @ 12.15 hrs, Volume= 26,423 cf
Primary = 6.87 cfs @ 12.15 hrs, Volume= 26,423 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Link 3L: Total flow from within the limit of watershed analysis discharging to Kelsey Road



POST-DEVELOPMENT_R

Type III 24-hr 25 yr Rainfall=6.33"

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Summary for Subcatchment 1S: POST-1

Runoff = 7.51 cfs @ 12.15 hrs, Volume= 27,849 cf, Depth= 2.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25 yr Rainfall=6.33"

Area (sf)	CN	Adj	Description
111,282	65		2 acre lots, 12% imp, HSG B
18,972	55		Woods, Good, HSG B
417	98		Unconnected roofs, HSG B
8,000	61		>75% Grass cover, Good, HSG B
138,671	64	63	Weighted Average, UI Adjusted
124,900			90.07% Pervious Area
13,771			9.93% Impervious Area
417			3.03% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	50	0.0600	0.11		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.26"
0.8	185	0.0600	3.94		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
1.5	315	0.0460	3.45		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
10.2	550	Total			

POST-DEVELOPMENT_R

Type III 24-hr 25 yr Rainfall=6.33"

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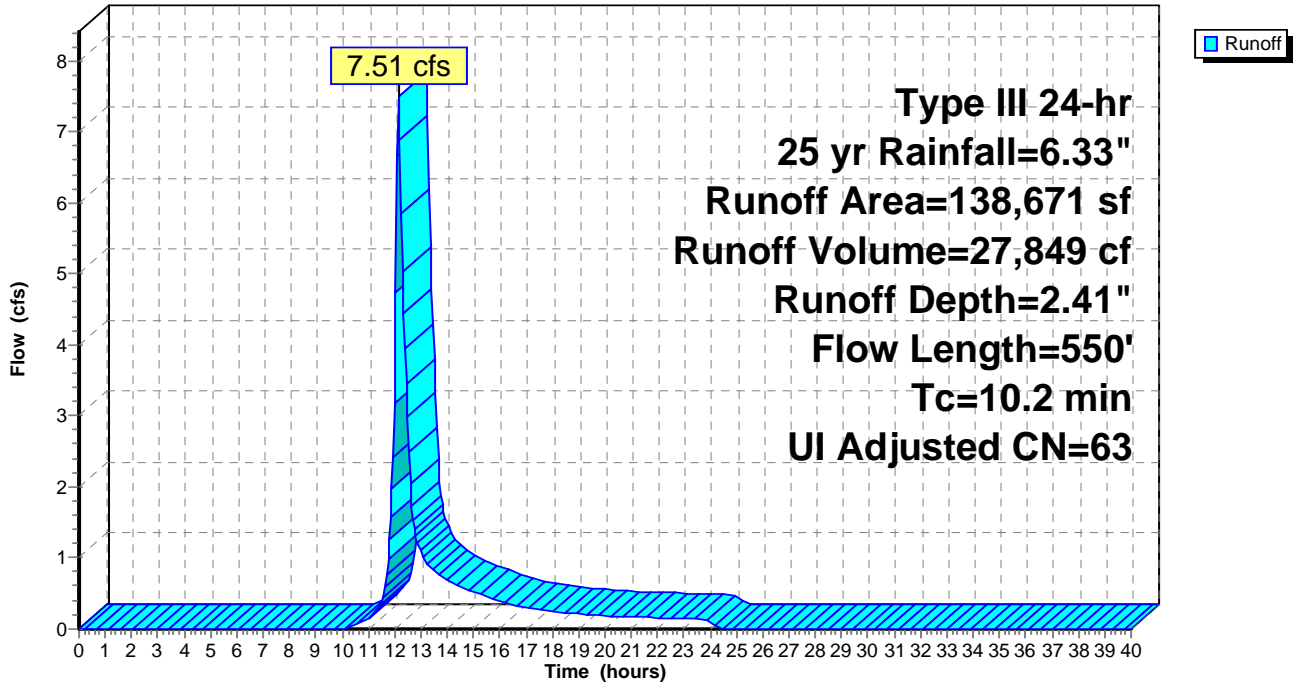
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Subcatchment 1S: POST-1

Hydrograph



POST-DEVELOPMENT_R

Type III 24-hr 25 yr Rainfall=6.33"

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Summary for Subcatchment 2S: POST-2

Runoff = 2.78 cfs @ 12.12 hrs, Volume= 9,916 cf, Depth= 2.05"

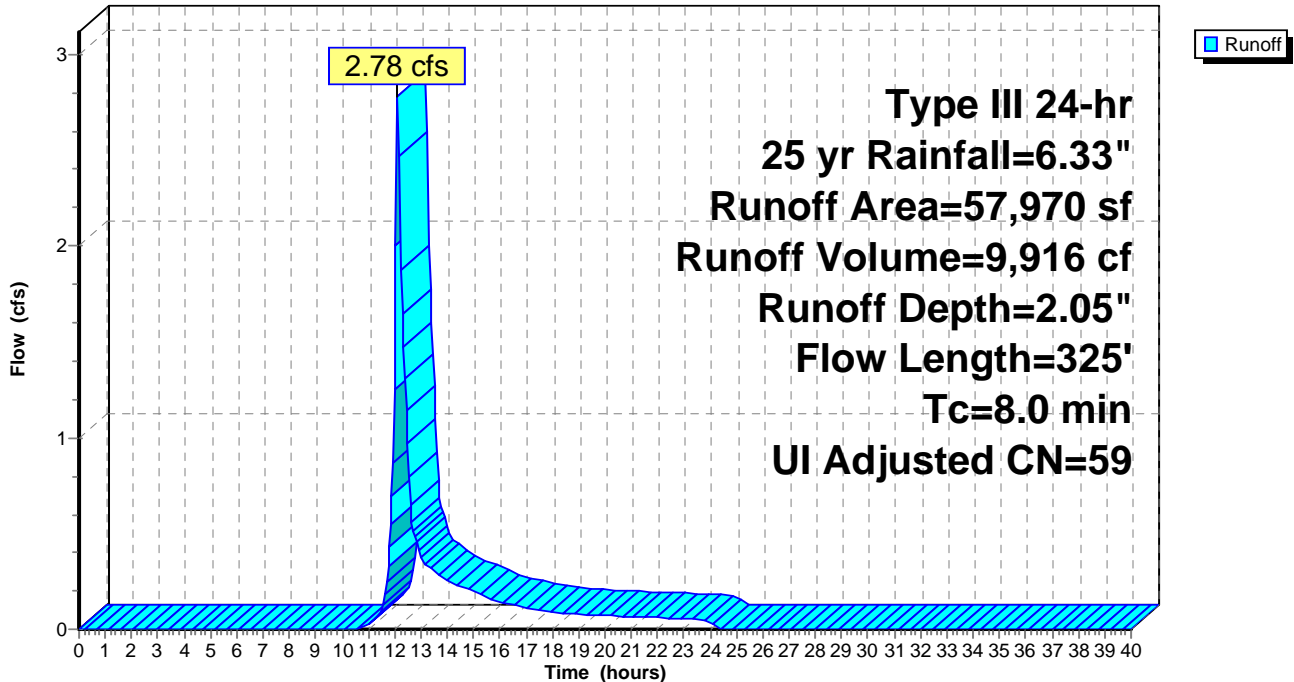
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=6.33"

Area (sf)	CN	Adj	Description
21,000	55		Woods, Good, HSG B
35,016	61		>75% Grass cover, Good, HSG B
1,954	98		Unconnected roofs, HSG B
57,970	60	59	Weighted Average, UI Adjusted
56,016			96.63% Pervious Area
1,954			3.37% Impervious Area
1,954			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	50	0.0120	0.12		Sheet Flow, Grass: Short n= 0.150 P2= 3.26"
0.5	75	0.0230	2.44		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
0.7	200	0.0900	4.83		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
8.0	325	Total			

Subcatchment 2S: POST-2

Hydrograph



POST-DEVELOPMENT_R

Type III 24-hr 25 yr Rainfall=6.33"

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Summary for Subcatchment 4S: POST-DRIVE

Runoff = 0.65 cfs @ 12.09 hrs, Volume= 2,234 cf, Depth= 5.51"

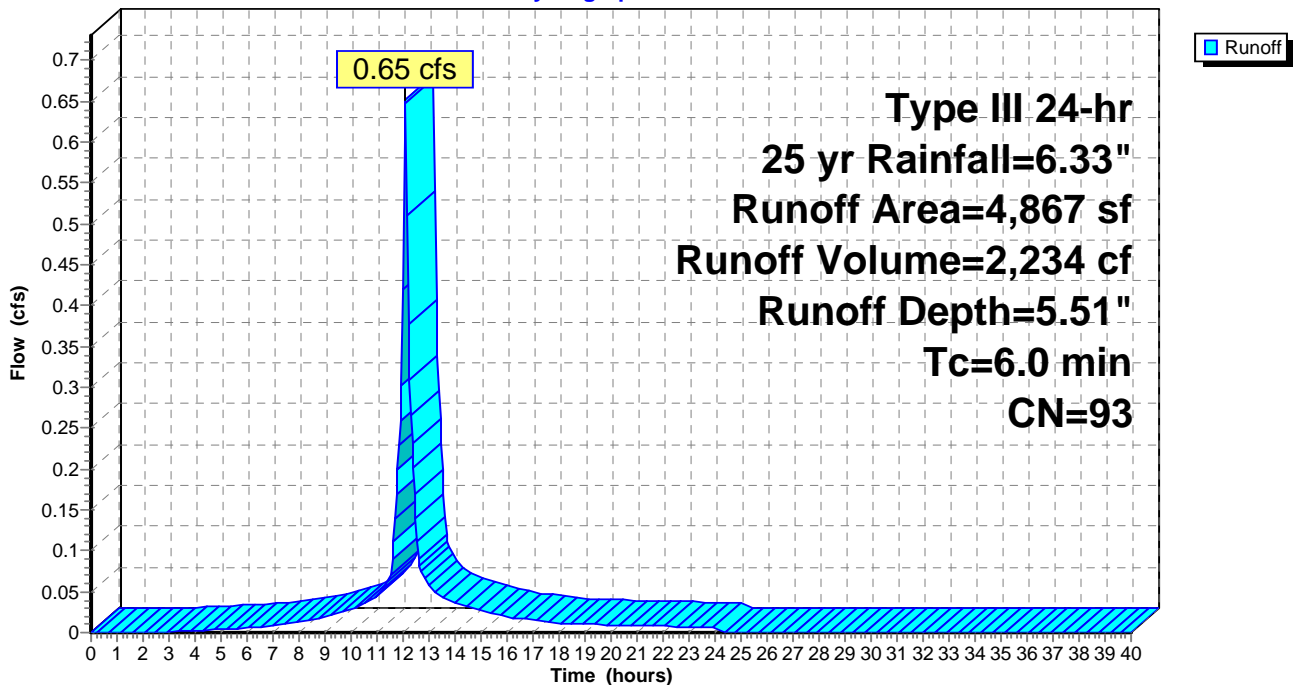
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=6.33"

Area (sf)	CN	Description
4,232	98	Unconnected pavement, HSG B
635	61	>75% Grass cover, Good, HSG B
4,867	93	Weighted Average
635		13.05% Pervious Area
4,232		86.95% Impervious Area
4,232		100.00% Unconnected

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

Subcatchment 4S: POST-DRIVE

Hydrograph



POST-DEVELOPMENT_R

Type III 24-hr 25 yr Rainfall=6.33"

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Summary for Pond 1P: Sloping Infiltration Trench

Inflow Area = 4,867 sf, 86.95% Impervious, Inflow Depth = 5.51" for 25 yr event
 Inflow = 0.65 cfs @ 12.09 hrs, Volume= 2,234 cf
 Outflow = 0.65 cfs @ 12.09 hrs, Volume= 2,234 cf, Atten= 0%, Lag= 0.0 min
 Discarded = 0.00 cfs @ 12.09 hrs, Volume= 271 cf
 Primary = 0.65 cfs @ 12.09 hrs, Volume= 1,963 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
 Peak Elev= 109.05' @ 12.09 hrs Surf.Area= 135 sf Storage= 61 cf

Plug-Flow detention time= 33.3 min calculated for 2,231 cf (100% of inflow)
 Center-of-Mass det. time= 34.0 min (805.5 - 771.5)

Volume	Invert	Avail.Storage	Storage Description
#1	106.75'	480 cf	36.0" W x 24.0" H Box Pipe Storage L= 200.0' S= 0.0510 '/' 1,200 cf Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	109.00'	25.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32
#2	Discarded	106.75'	1.020 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.00 cfs @ 12.09 hrs HW=109.04' (Free Discharge)
 ↖**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.63 cfs @ 12.09 hrs HW=109.04' TW=0.00' (Dynamic Tailwater)
 ↖**1=Broad-Crested Rectangular Weir** (Weir Controls 0.63 cfs @ 0.57 fps)

POST-DEVELOPMENT_R

Type III 24-hr 25 yr Rainfall=6.33"

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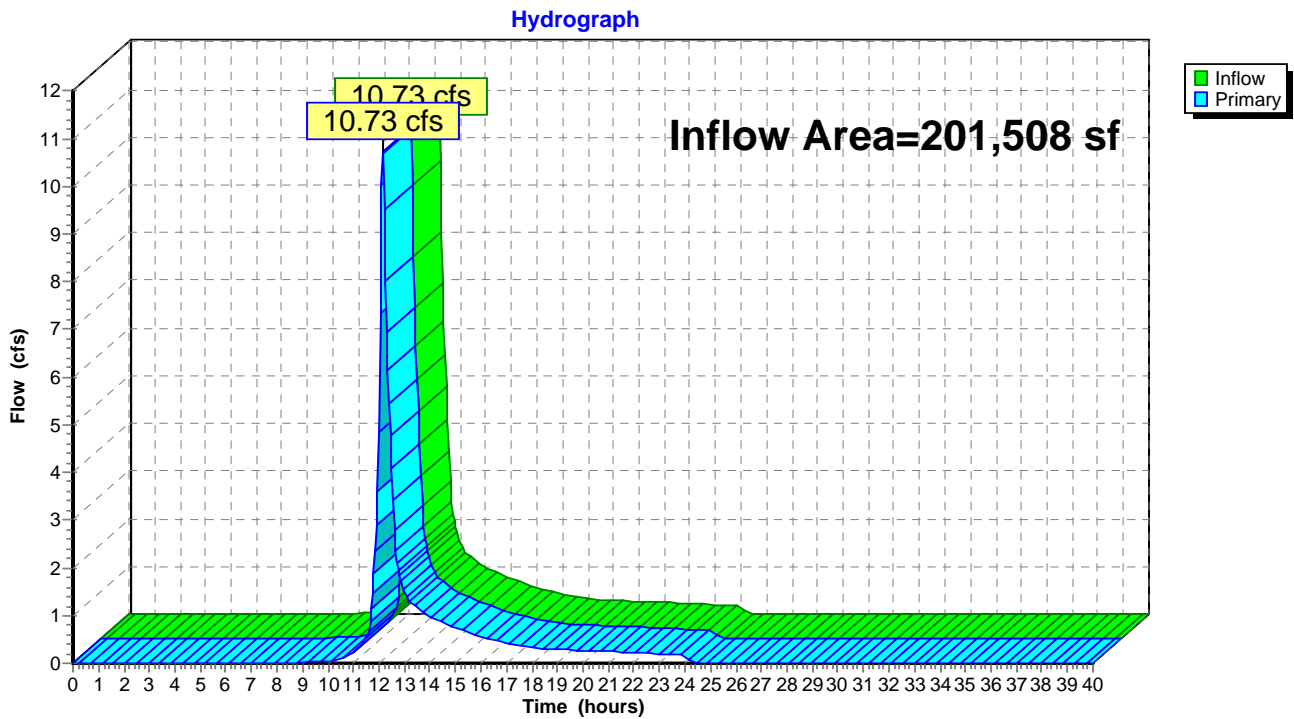
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Summary for Link 3L: Total flow from within the limit of watershed analysis discharging to Kelsey Road

Inflow Area = 201,508 sf, 9.90% Impervious, Inflow Depth = 2.37" for 25 yr event
Inflow = 10.73 cfs @ 12.14 hrs, Volume= 39,729 cf
Primary = 10.73 cfs @ 12.14 hrs, Volume= 39,729 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Link 3L: Total flow from within the limit of watershed analysis discharging to Kelsey Road



POST-DEVELOPMENT_R

Type III 24-hr 50 yr Rainfall=7.20"

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Summary for Subcatchment 1S: POST-1

Runoff = 9.64 cfs @ 12.15 hrs, Volume= 35,260 cf, Depth= 3.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 yr Rainfall=7.20"

Area (sf)	CN	Adj	Description
111,282	65		2 acre lots, 12% imp, HSG B
18,972	55		Woods, Good, HSG B
417	98		Unconnected roofs, HSG B
8,000	61		>75% Grass cover, Good, HSG B

138,671	64	63	Weighted Average, UI Adjusted
124,900			90.07% Pervious Area
13,771			9.93% Impervious Area
417			3.03% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	50	0.0600	0.11		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.26"
0.8	185	0.0600	3.94		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
1.5	315	0.0460	3.45		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
10.2	550	Total			

POST-DEVELOPMENT_R

Type III 24-hr 50 yr Rainfall=7.20"

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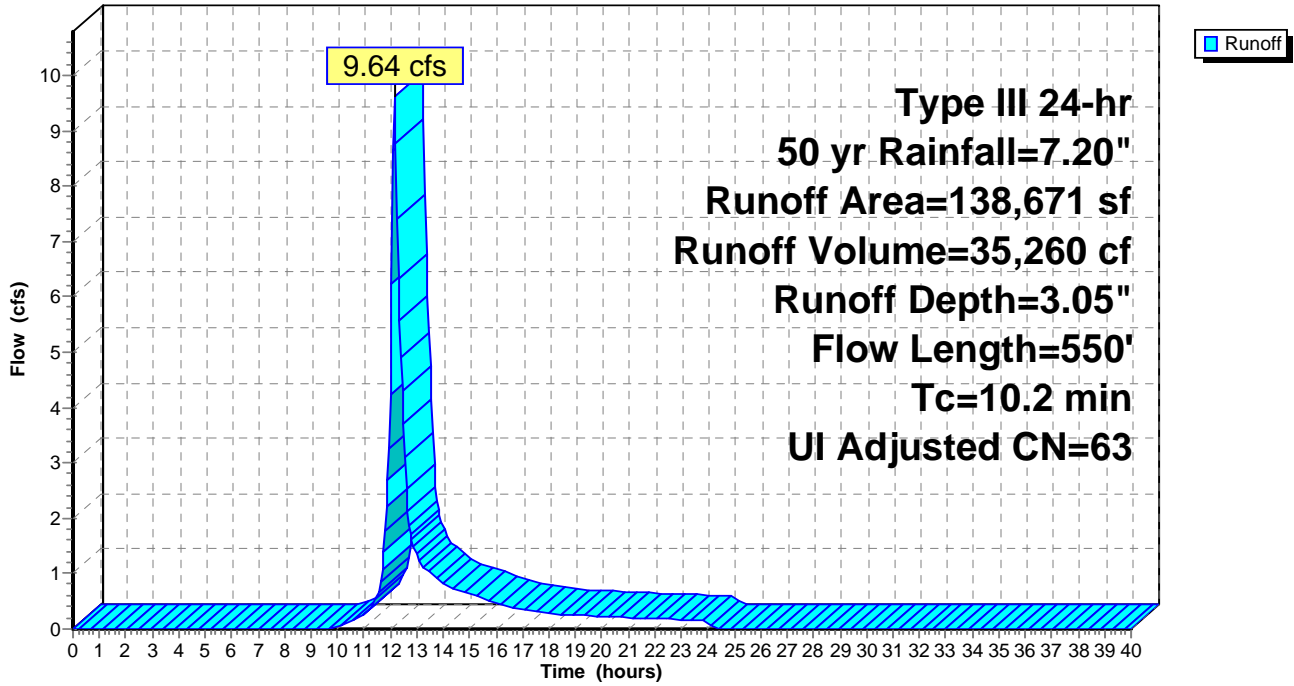
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Subcatchment 1S: POST-1

Hydrograph



POST-DEVELOPMENT_R

Type III 24-hr 50 yr Rainfall=7.20"

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Summary for Subcatchment 2S: POST-2

Runoff = 3.67 cfs @ 12.12 hrs, Volume= 12,781 cf, Depth= 2.65"

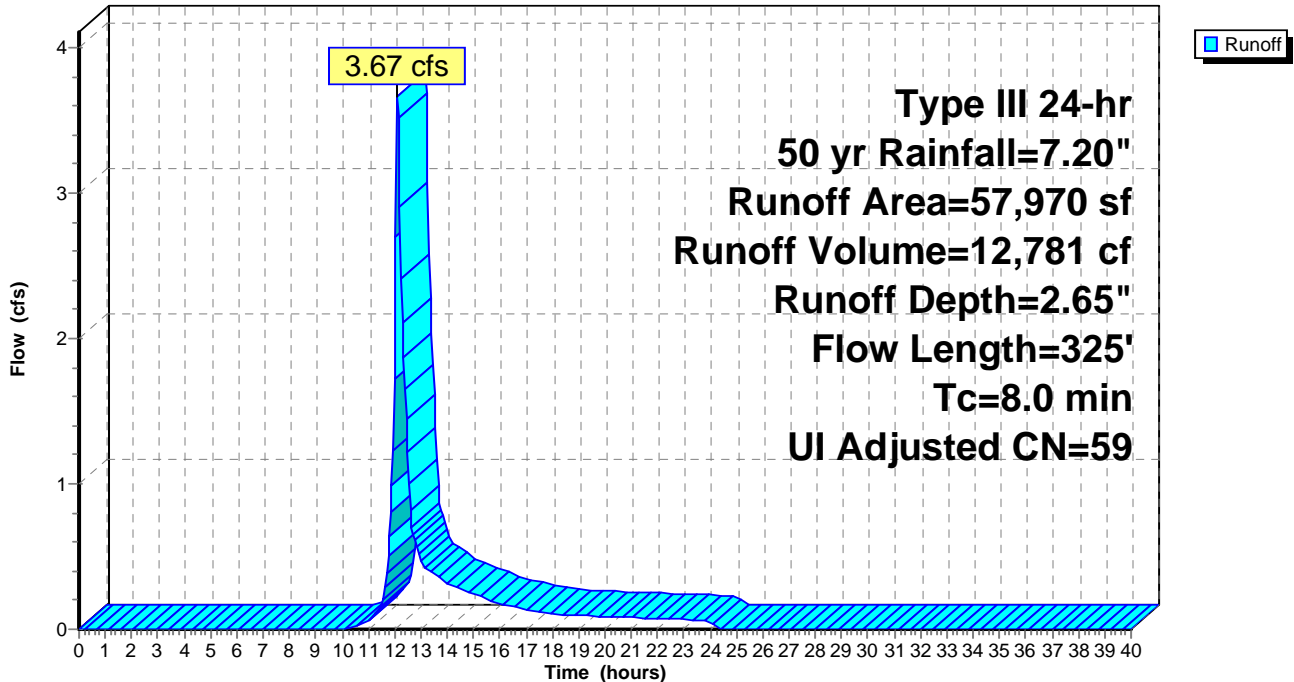
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 yr Rainfall=7.20"

Area (sf)	CN	Adj	Description
21,000	55		Woods, Good, HSG B
35,016	61		>75% Grass cover, Good, HSG B
1,954	98		Unconnected roofs, HSG B
57,970	60	59	Weighted Average, UI Adjusted
56,016			96.63% Pervious Area
1,954			3.37% Impervious Area
1,954			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	50	0.0120	0.12		Sheet Flow, Grass: Short n= 0.150 P2= 3.26"
0.5	75	0.0230	2.44		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
0.7	200	0.0900	4.83		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
8.0	325	Total			

Subcatchment 2S: POST-2

Hydrograph



POST-DEVELOPMENT_R

Type III 24-hr 50 yr Rainfall=7.20"

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Summary for Subcatchment 4S: POST-DRIVE

Runoff = 0.75 cfs @ 12.09 hrs, Volume= 2,583 cf, Depth= 6.37"

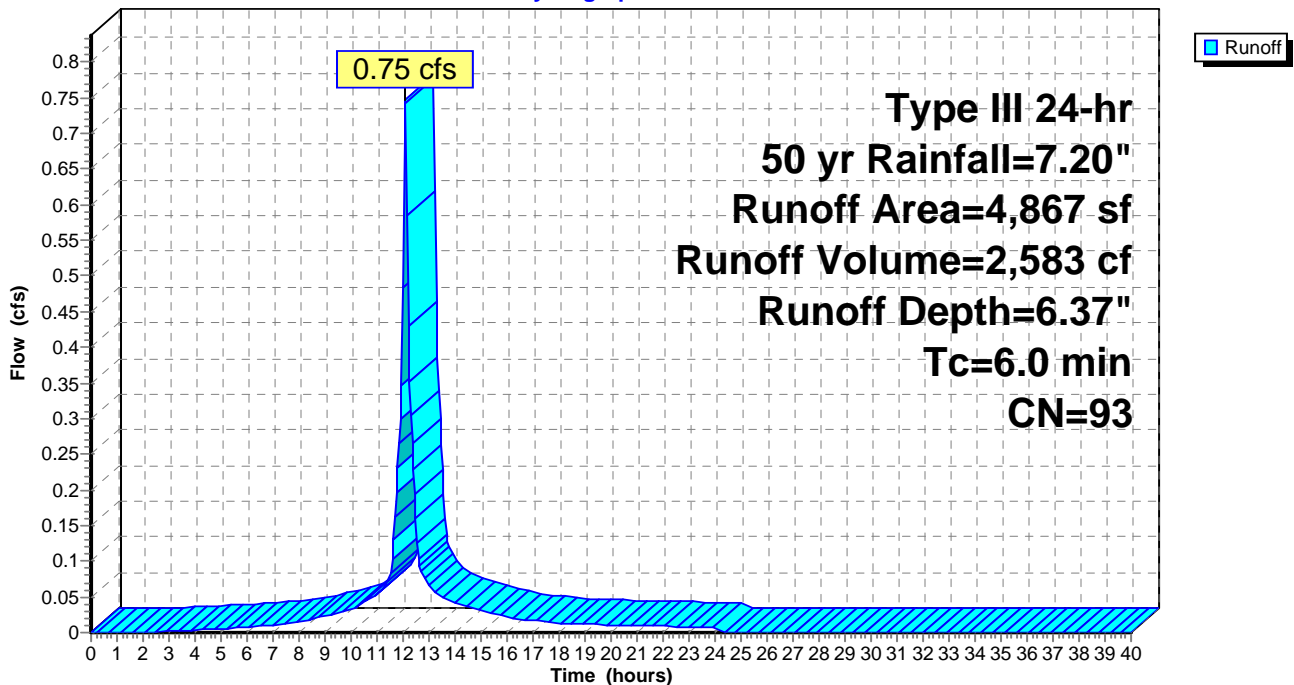
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 yr Rainfall=7.20"

Area (sf)	CN	Description
4,232	98	Unconnected pavement, HSG B
635	61	>75% Grass cover, Good, HSG B
4,867	93	Weighted Average
635		13.05% Pervious Area
4,232		86.95% Impervious Area
4,232		100.00% Unconnected

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

Subcatchment 4S: POST-DRIVE

Hydrograph



POST-DEVELOPMENT_R

Type III 24-hr 50 yr Rainfall=7.20"

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Summary for Pond 1P: Sloping Infiltration Trench

Inflow Area = 4,867 sf, 86.95% Impervious, Inflow Depth = 6.37" for 50 yr event
 Inflow = 0.75 cfs @ 12.09 hrs, Volume= 2,583 cf
 Outflow = 0.75 cfs @ 12.09 hrs, Volume= 2,583 cf, Atten= 0%, Lag= 0.0 min
 Discarded = 0.00 cfs @ 12.09 hrs, Volume= 277 cf
 Primary = 0.75 cfs @ 12.09 hrs, Volume= 2,307 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
 Peak Elev= 109.05' @ 12.09 hrs Surf.Area= 135 sf Storage= 61 cf

Plug-Flow detention time= 29.5 min calculated for 2,580 cf (100% of inflow)
 Center-of-Mass det. time= 30.2 min (798.2 - 768.1)

Volume	Invert	Avail.Storage	Storage Description
#1	106.75'	480 cf	36.0" W x 24.0" H Box Pipe Storage L= 200.0' S= 0.0510 '/' 1,200 cf Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	109.00'	25.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32
#2	Discarded	106.75'	1.020 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.00 cfs @ 12.09 hrs HW=109.05' (Free Discharge)
 ↗**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.73 cfs @ 12.09 hrs HW=109.05' TW=0.00' (Dynamic Tailwater)
 ↗**1=Broad-Crested Rectangular Weir** (Weir Controls 0.73 cfs @ 0.59 fps)

POST-DEVELOPMENT_R

Type III 24-hr 50 yr Rainfall=7.20"

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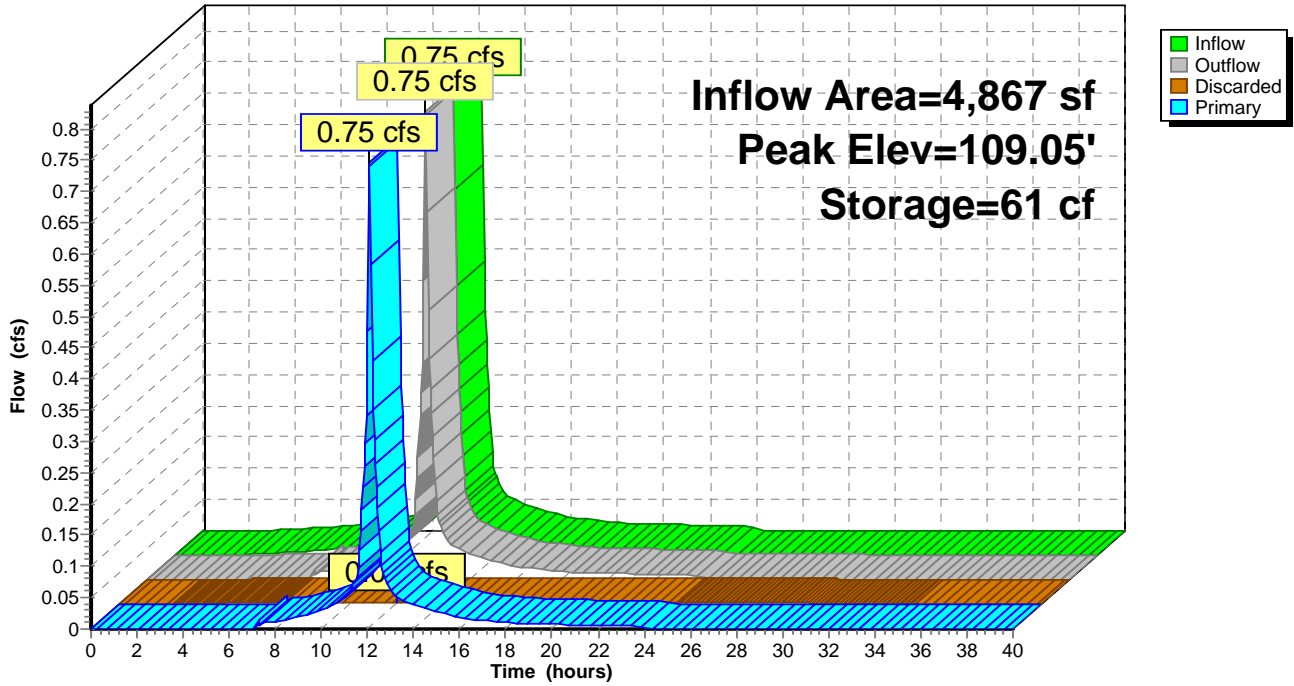
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Pond 1P: Sloping Infiltration Trench

Hydrograph



POST-DEVELOPMENT_R

Type III 24-hr 50 yr Rainfall=7.20"

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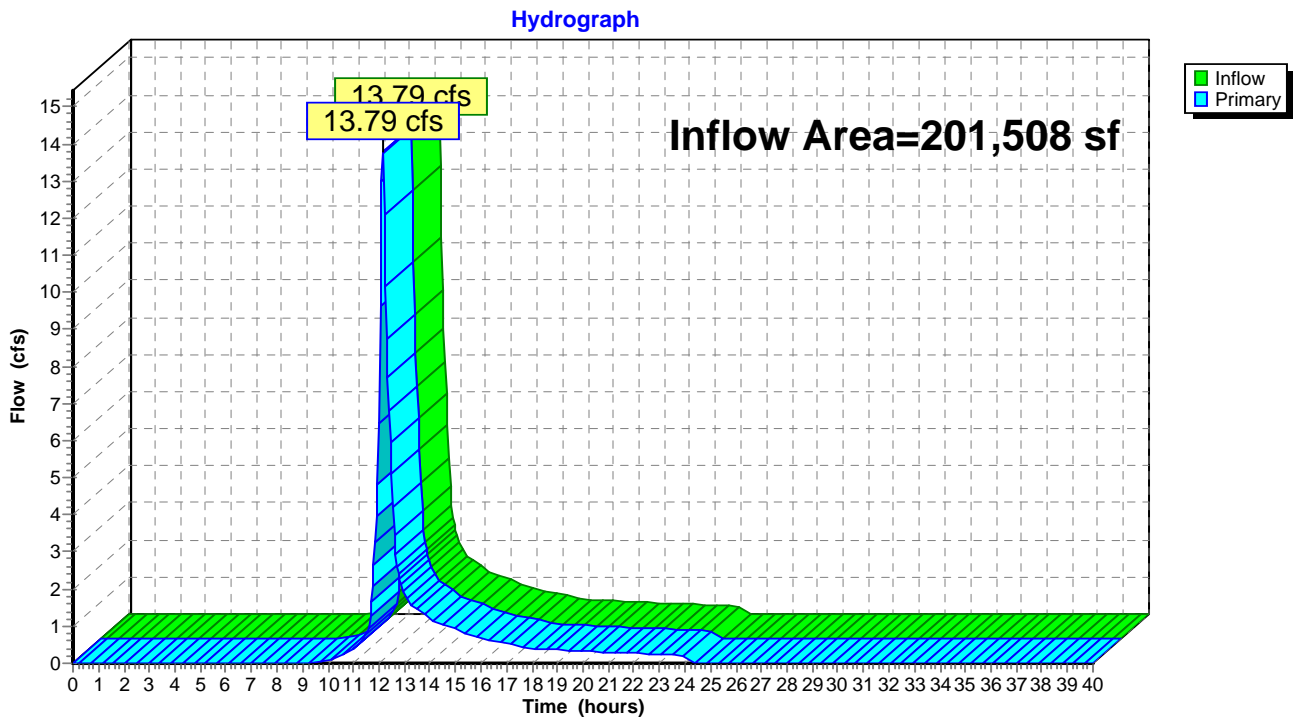
Page 31

Summary for Link 3L: Total flow from within the limit of watershed analysis discharging to Kelsey Road

Inflow Area = 201,508 sf, 9.90% Impervious, Inflow Depth = 3.00" for 50 yr event
Inflow = 13.79 cfs @ 12.14 hrs, Volume= 50,348 cf
Primary = 13.79 cfs @ 12.14 hrs, Volume= 50,348 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Link 3L: Total flow from within the limit of watershed analysis discharging to Kelsey Road



POST-DEVELOPMENT_R

Type III 24-hr 100 yr Rainfall=8.15"

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Summary for Subcatchment 1S: POST-1

Runoff = 12.06 cfs @ 12.15 hrs, Volume= 43,762 cf, Depth= 3.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=8.15"

Area (sf)	CN	Adj	Description
111,282	65		2 acre lots, 12% imp, HSG B
18,972	55		Woods, Good, HSG B
417	98		Unconnected roofs, HSG B
8,000	61		>75% Grass cover, Good, HSG B
138,671	64	63	Weighted Average, UI Adjusted
124,900			90.07% Pervious Area
13,771			9.93% Impervious Area
417			3.03% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	50	0.0600	0.11		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.26"
0.8	185	0.0600	3.94		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
1.5	315	0.0460	3.45		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
10.2	550	Total			

POST-DEVELOPMENT_R

Type III 24-hr 100 yr Rainfall=8.15"

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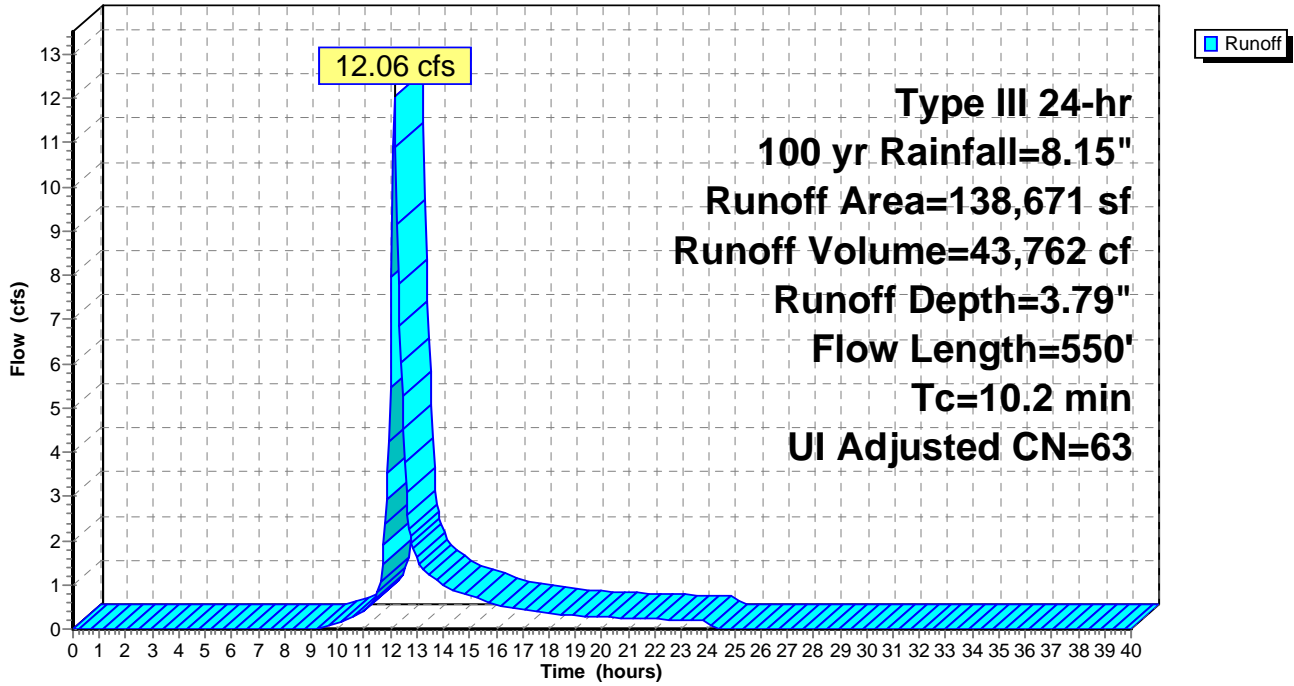
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Subcatchment 1S: POST-1

Hydrograph



POST-DEVELOPMENT_R

Type III 24-hr 100 yr Rainfall=8.15"

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Summary for Subcatchment 2S: POST-2

Runoff = 4.70 cfs @ 12.12 hrs, Volume= 16,104 cf, Depth= 3.33"

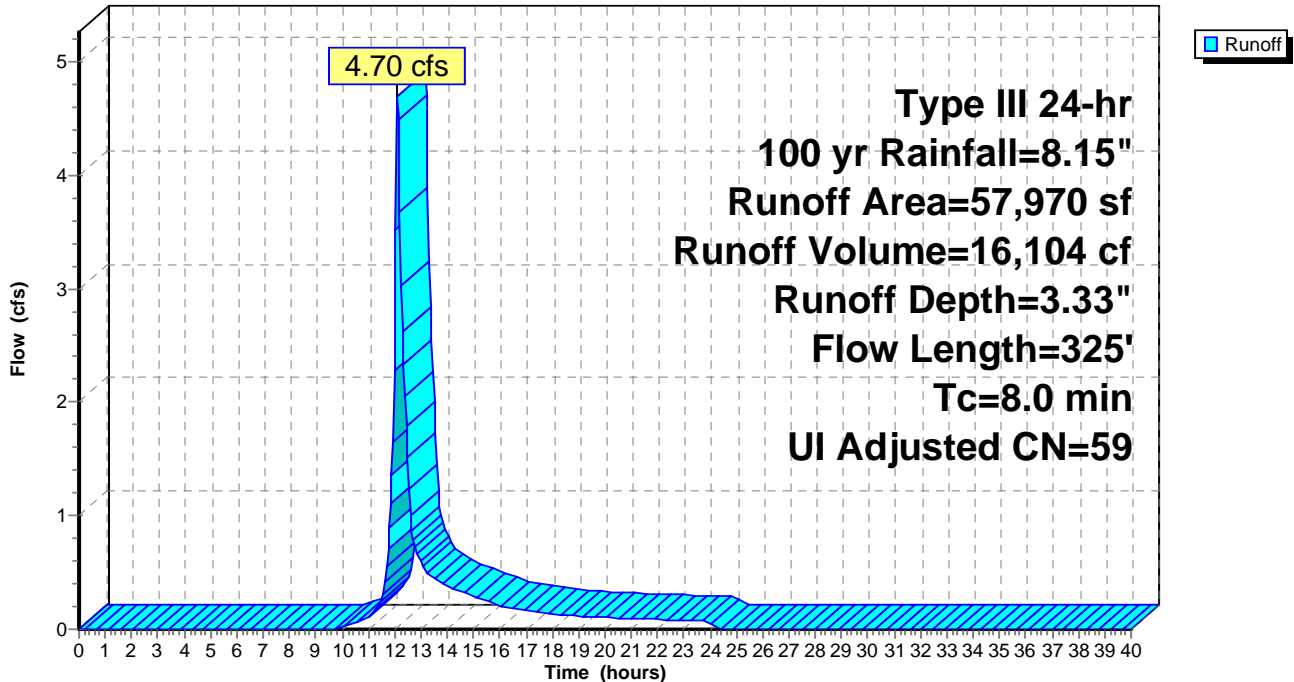
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=8.15"

Area (sf)	CN	Adj	Description
21,000	55		Woods, Good, HSG B
35,016	61		>75% Grass cover, Good, HSG B
1,954	98		Unconnected roofs, HSG B
57,970	60	59	Weighted Average, UI Adjusted
56,016			96.63% Pervious Area
1,954			3.37% Impervious Area
1,954			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	50	0.0120	0.12		Sheet Flow, Grass: Short n= 0.150 P2= 3.26"
0.5	75	0.0230	2.44		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
0.7	200	0.0900	4.83		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
8.0	325	Total			

Subcatchment 2S: POST-2

Hydrograph



POST-DEVELOPMENT_R

Type III 24-hr 100 yr Rainfall=8.15"

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Summary for Subcatchment 4S: POST-DRIVE

Runoff = 0.85 cfs @ 12.09 hrs, Volume= 2,965 cf, Depth= 7.31"

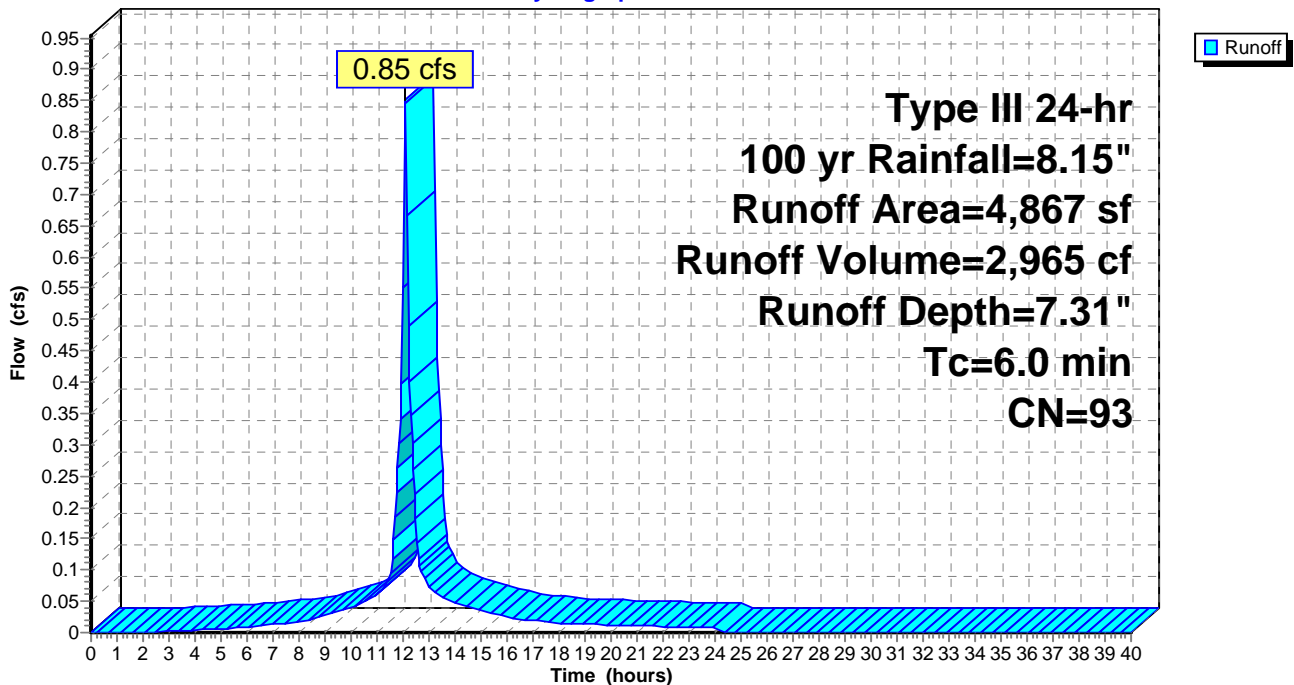
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=8.15"

Area (sf)	CN	Description
4,232	98	Unconnected pavement, HSG B
635	61	>75% Grass cover, Good, HSG B
4,867	93	Weighted Average
635		13.05% Pervious Area
4,232		86.95% Impervious Area
4,232		100.00% Unconnected

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

Subcatchment 4S: POST-DRIVE

Hydrograph



POST-DEVELOPMENT_R

Type III 24-hr 100 yr Rainfall=8.15"

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Summary for Pond 1P: Sloping Infiltration Trench

Inflow Area = 4,867 sf, 86.95% Impervious, Inflow Depth = 7.31" for 100 yr event
 Inflow = 0.85 cfs @ 12.09 hrs, Volume= 2,965 cf
 Outflow = 0.85 cfs @ 12.09 hrs, Volume= 2,965 cf, Atten= 0%, Lag= 0.0 min
 Discarded = 0.00 cfs @ 12.09 hrs, Volume= 282 cf
 Primary = 0.85 cfs @ 12.09 hrs, Volume= 2,683 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs / 3
 Peak Elev= 109.05' @ 12.09 hrs Surf.Area= 136 sf Storage= 61 cf

Plug-Flow detention time= 26.3 min calculated for 2,962 cf (100% of inflow)
 Center-of-Mass det. time= 26.9 min (791.8 - 764.9)

Volume	Invert	Avail.Storage	Storage Description
#1	106.75'	480 cf	36.0" W x 24.0" H Box Pipe Storage L= 200.0' S= 0.0510 '/' 1,200 cf Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	109.00'	25.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32
#2	Discarded	106.75'	1.020 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.00 cfs @ 12.09 hrs HW=109.05' (Free Discharge)
 ↖**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.83 cfs @ 12.09 hrs HW=109.05' TW=0.00' (Dynamic Tailwater)
 ↖**1=Broad-Crested Rectangular Weir** (Weir Controls 0.83 cfs @ 0.62 fps)

POST-DEVELOPMENT_R

Type III 24-hr 100 yr Rainfall=8.15"

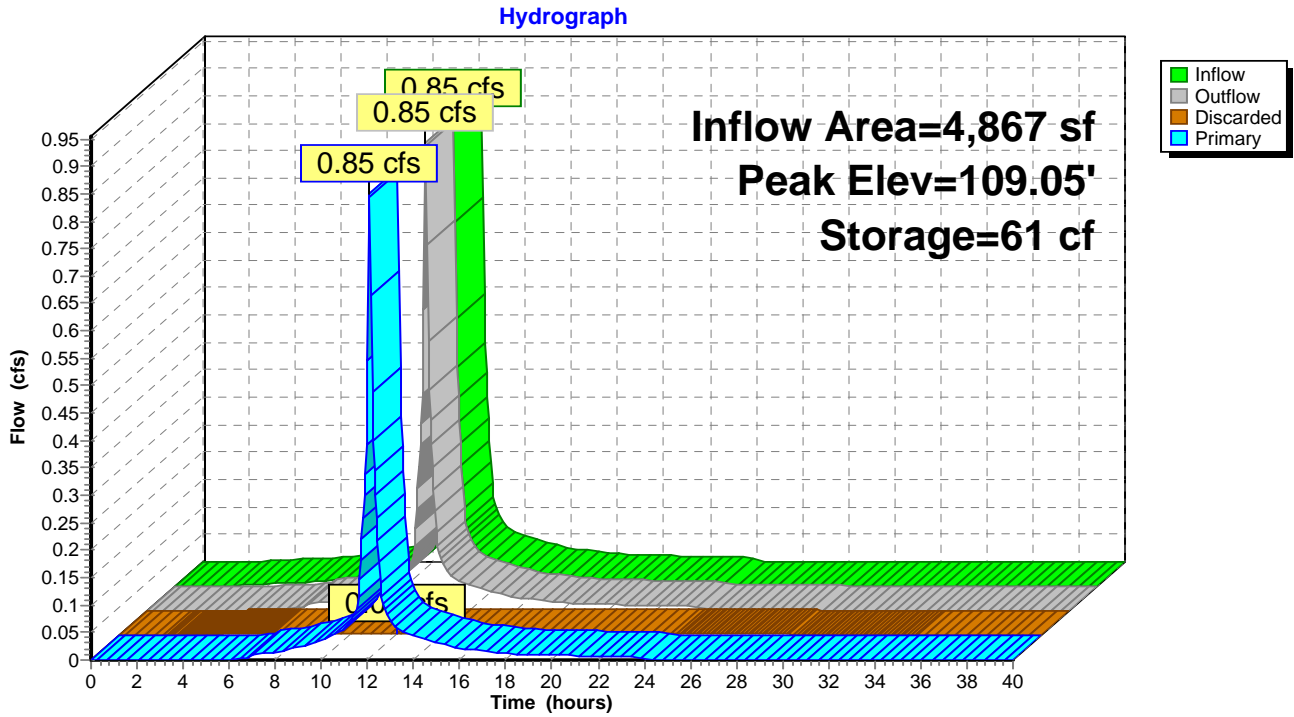
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Pond 1P: Sloping Infiltration Trench



POST-DEVELOPMENT_R

Type III 24-hr 100 yr Rainfall=8.15"

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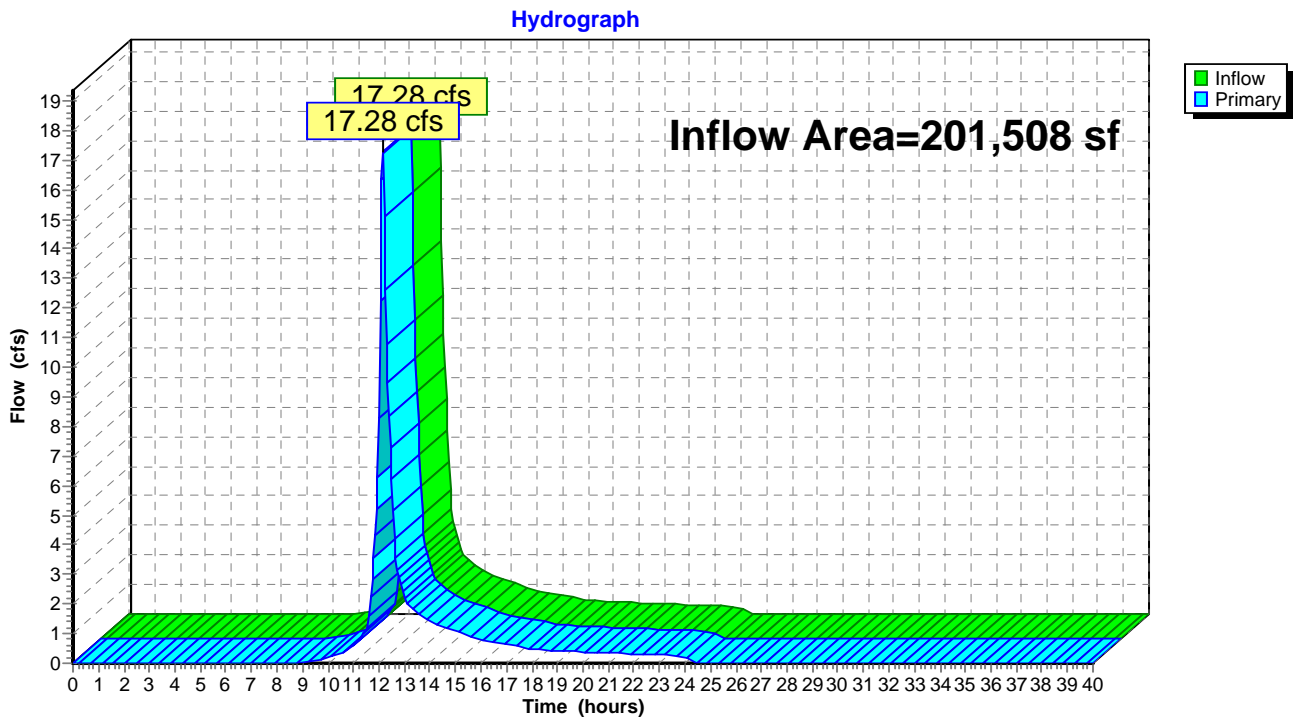
Page 38

Summary for Link 3L: Total flow from within the limit of watershed analysis discharging to Kelsey Road

Inflow Area = 201,508 sf, 9.90% Impervious, Inflow Depth = 3.72" for 100 yr event
Inflow = 17.28 cfs @ 12.14 hrs, Volume= 62,548 cf
Primary = 17.28 cfs @ 12.14 hrs, Volume= 62,548 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

Link 3L: Total flow from within the limit of watershed analysis discharging to Kelsey Road



2 | Stormwater Report Compliance Calculations

2.1 Standard 1 | No Untreated Discharges or Erosion to Wetlands

Untreated Discharges

To document compliance that new discharges are adequately treated refer to calculations for DEP Stormwater Management Standards 4 through 6.

2.2 Standard 2 | Peak Rate Attenuation

Refer to Peak Rate of Runoff table above

2.3 Standard 3 | Stormwater Recharge

Groundwater Recharge:

Groundwater Recharge quality is provided through one (1) stormwater best management practice.

- 1) Stone Infiltration Trench

Groundwater Volume:

$$V_{gw \text{ required}} = (D_{gw})(A_{imp})$$

$$D = 0.35 \text{ in}$$

$$\text{Total GW required} = (6,690 \text{ ft}^2) (0.35) / 12 = 195.1 \text{ ft}^3$$

Volume provided in the Stone Infiltration Trench = 480 s.f.; Okay

2.4 Standard 4 | Water Quality

Water Quality:

Water quality is provided through one (1) stormwater best management practice.

- 1) Stone Infiltration Trench

Water Quality Volume:

$$V_{wq \text{ required}} = (D_{wq})(A_{imp})$$

$$D_{wq} = 0.5 \text{ in}$$

$$\text{Total WQV required} = (6690 \text{ ft}^2) (0.5) / 12 = 278.8 \text{ ft}^3$$

Volume provided in the Stone Infiltration Trench = 480 s.f.; Okay

TSS Removal:

- Stone Infiltration Trench = 80% (per Stormwater Handbook)

2.5 Standard 5 | Land Uses with Higher Potential Pollutant Loading

This project is not considered a LUHPPL.

