

STORMWATER CALCULATIONS

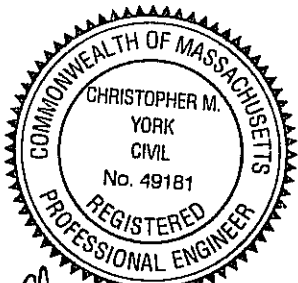
FOR: STEVE McCONNELL
PROPOSED SINGLE FAMILY DWELLING
LOT 4B DONAHUE COURT
NEWBURYPORT, MA

PREPARED BY:

MILLENNIUM ENGINEERING, INC.
62 ELM STREET
SALISBURY, MA 01952
(978) 463-8980

FEBRUARY 6, 2018

REV. JULY 11, 2018



Christopher M. York
7-11-18

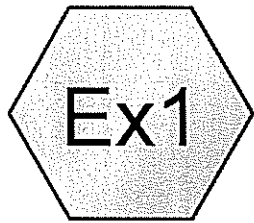
CONCLUSIONS

The results of these calculations indicate the proposed stormwater management systems for the proposed development are capable of storing and treating the runoff for the 2-year, 10-year and 100-year storm events.

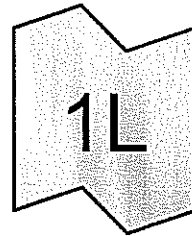
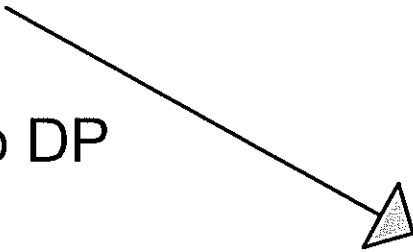
The peak flow rates in this analysis have been conservatively estimated for both the pre- and post-development conditions. Based on the results of the analyses described herein, the proposed development will not increase the runoff rate leaving the site. The proposed storm water management facilities shown on the Site Plan will produce no adverse storm water runoff impacts under the storms analyzed.

Condition	2-year	10-year	100-year
Pre-Development	2.2	5.2	13.0
Post Development	1.9	4.9	12.4

PRE-DEVELOPMENT DRAINAGE CALCULATIONS



Exist. Flow to DP



Design Point



M173263-Existing

Type III 24-hr 2-Year Rainfall=3.10"

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Summary for Subcatchment Ex1: Exist. Flow to DP

Runoff = 2.17 cfs @ 12.16 hrs, Volume= 8,452 cf, Depth> 0.92"

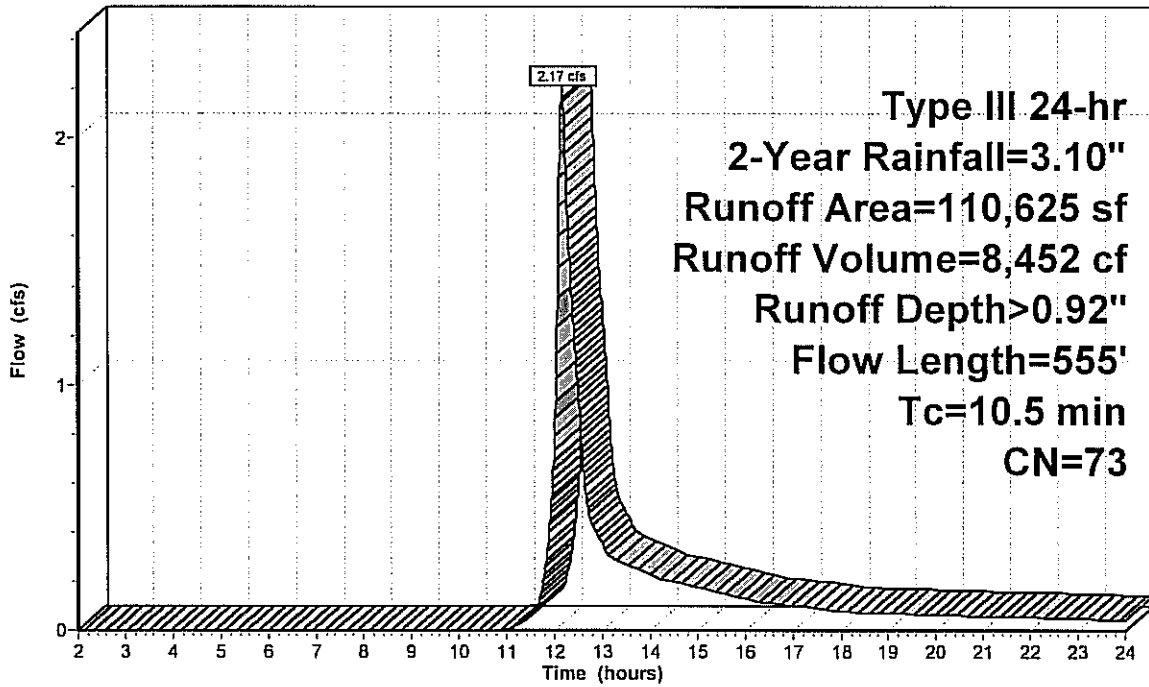
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
2,964	98	Buildings
* 105	98	Brick Walk
2,633	90	Gravel roads, HSG C/D
51,836	76	Woods, Fair, HSG C/D
5,480	36	Woods, Fair, HSG A
12,187	49	50-75% Grass cover, Fair, HSG A
35,420	79	50-75% Grass cover, Fair, HSG C
110,625	73	Weighted Average
107,556		97.23% Pervious Area
3,069		2.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	95	0.0830	0.29		Sheet Flow, Grass: Short n= 0.150 P2= 3.10"
0.5	130	0.0830	4.64		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
0.7	60	0.0830	1.44		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.5	40	0.0830	1.44		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
3.4	230	0.0500	1.12		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
10.5	555	Total			

Subcatchment Ex1: Exist. Flow to DP

Hydrograph



Runoff

Type III 24-hr
2-Year Rainfall=3.10"
Runoff Area=110,625 sf
Runoff Volume=8,452 cf
Runoff Depth>0.92"
Flow Length=555'
Tc=10.5 min
CN=73

M173263-Existing

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Type III 24-hr 2-Year Rainfall=3.10"

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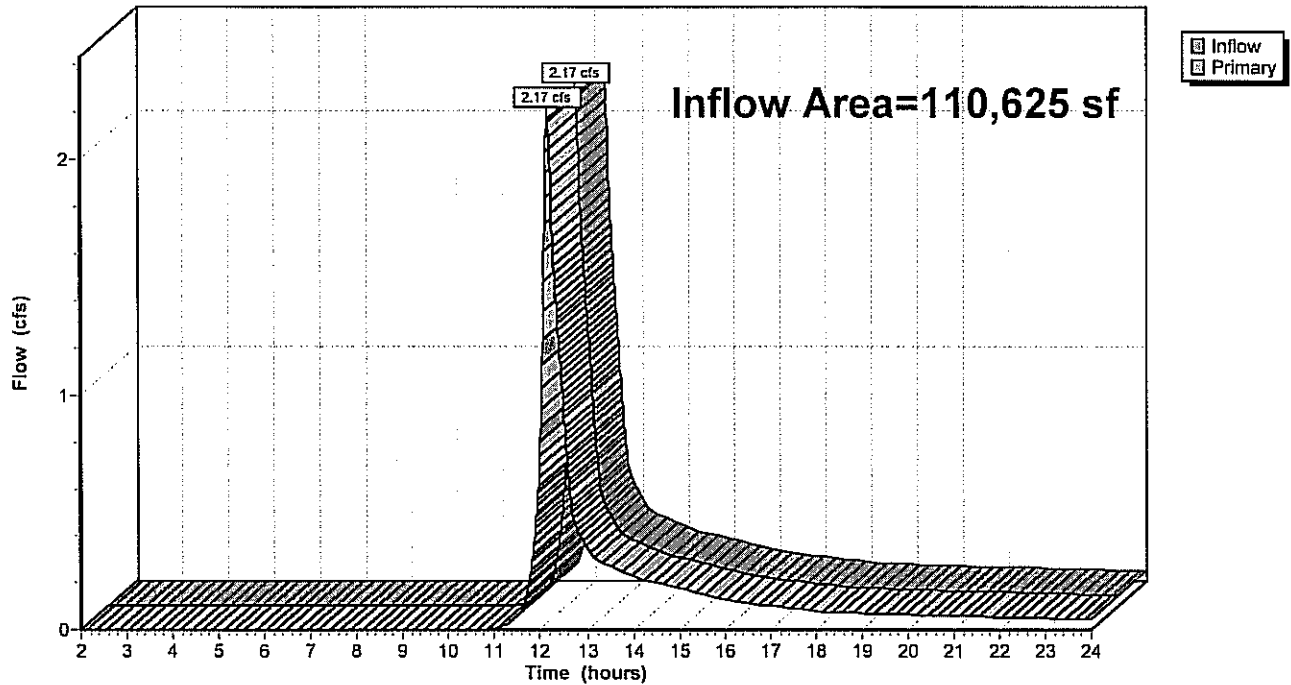
Summary for Link 1L: Design Point

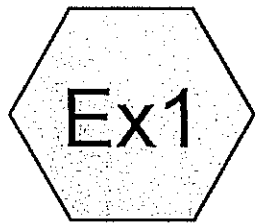
Inflow Area = 110,625 sf, 2.77% Impervious, Inflow Depth > 0.92" for 2-Year event
Inflow = 2.17 cfs @ 12.16 hrs, Volume= 8,452 cf
Primary = 2.17 cfs @ 12.16 hrs, Volume= 8,452 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 2.00-24.00 hrs, dt= 0.01 hrs

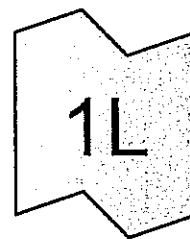
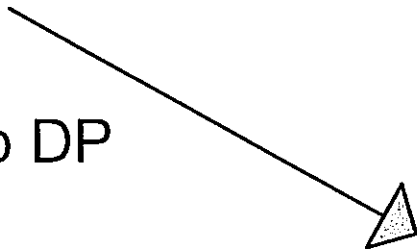
Link 1L: Design Point

Hydrograph





Exist. Flow to DP



Design Point



M173263-Existing

Type III 24-hr 10-Year Rainfall=4.70"

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Summary for Subcatchment Ex1: Exist. Flow to DP

Runoff = 5.17 cfs @ 12.15 hrs, Volume= 18,833 cf, Depth> 2.04"

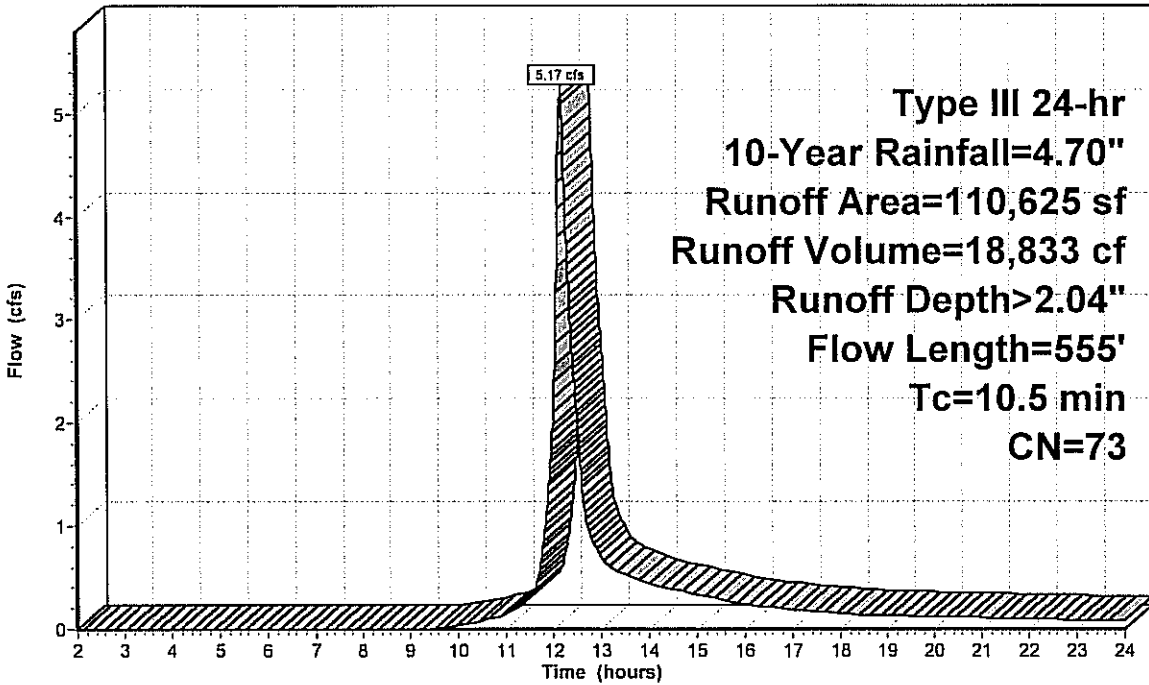
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
2,964	98	Buildings
* 105	98	Brick Walk
2,633	90	Gravel roads, HSG C/D
51,836	76	Woods, Fair, HSG C/D
5,480	36	Woods, Fair, HSG A
12,187	49	50-75% Grass cover, Fair, HSG A
35,420	79	50-75% Grass cover, Fair, HSG C
110,625	73	Weighted Average
107,556		97.23% Pervious Area
3,069		2.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	95	0.0830	0.29		Sheet Flow, Grass: Short n= 0.150 P2= 3.10"
0.5	130	0.0830	4.64		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
0.7	60	0.0830	1.44		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.5	40	0.0830	1.44		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
3.4	230	0.0500	1.12		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
10.5	555	Total			

Subcatchment Ex1: Exist. Flow to DP

Hydrograph



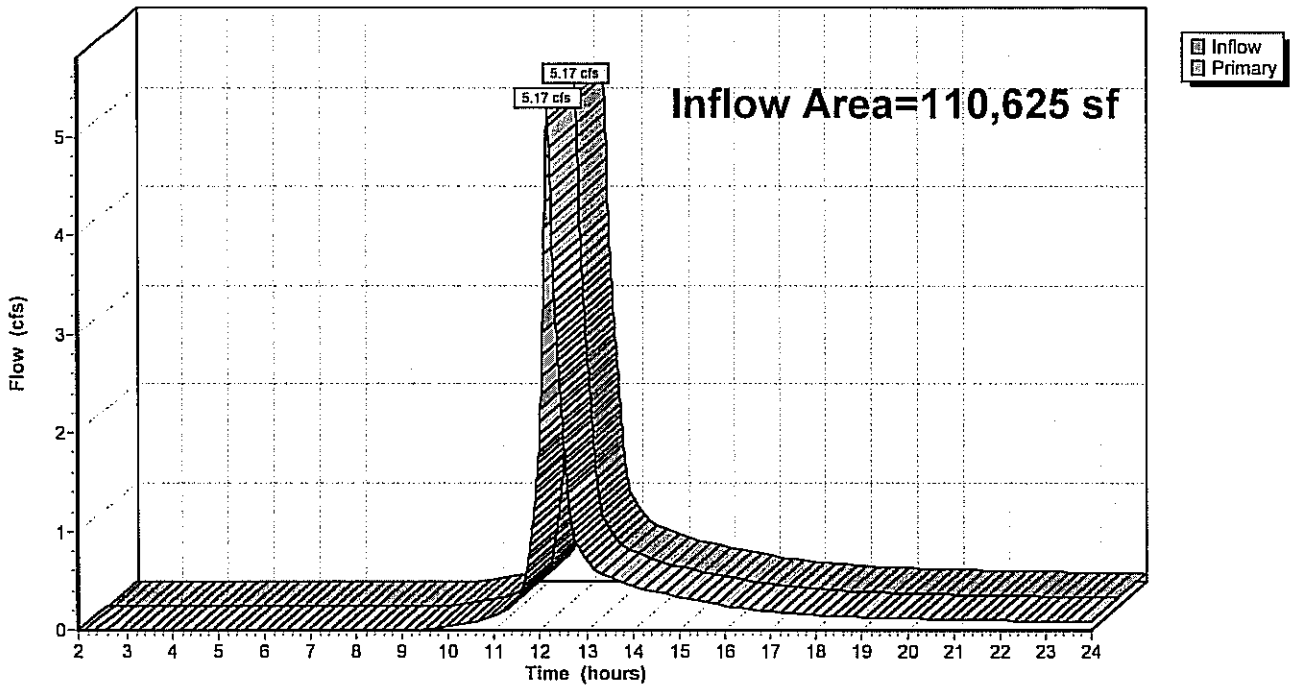
Summary for Link 1L: Design Point

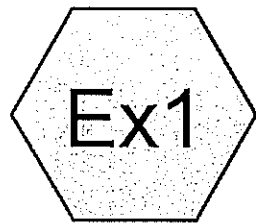
Inflow Area = 110,625 sf, 2.77% Impervious, Inflow Depth > 2.04" for 10-Year event
Inflow = 5.17 cfs @ 12.15 hrs, Volume= 18,833 cf
Primary = 5.17 cfs @ 12.15 hrs, Volume= 18,833 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 2.00-24.00 hrs, dt= 0.01 hrs

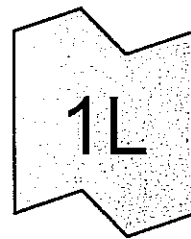
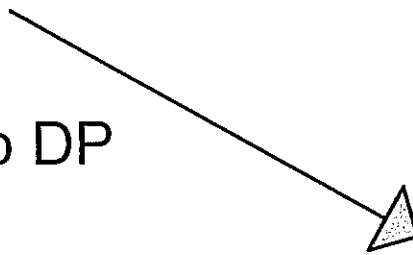
Link 1L: Design Point

Hydrograph





Exist. Flow to DP



Design Point



M173263-Existing

Type III 24-hr 100-Year Rainfall=8.30"

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Summary for Subcatchment Ex1: Exist. Flow to DP

Runoff = 12.98 cfs @ 12.15 hrs, Volume= 46,708 cf, Depth> 5.07"

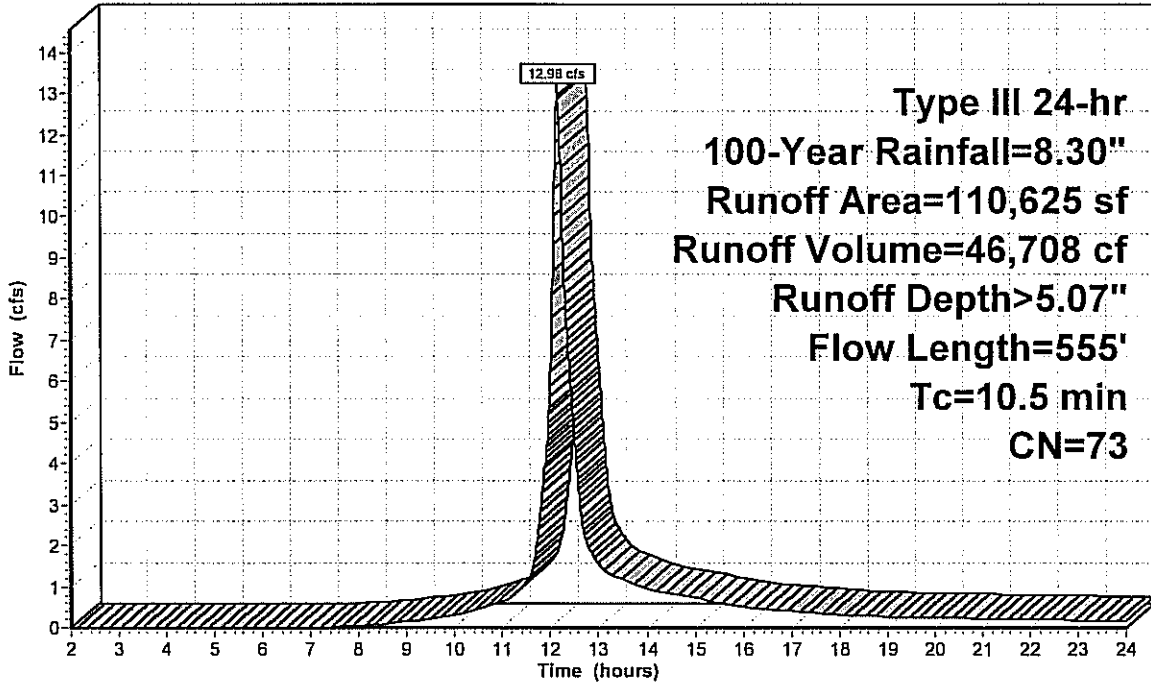
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100-Year Rainfall=8.30"

Area (sf)	CN	Description
2,964	98	Buildings
* 105	98	Brick Walk
2,633	90	Gravel roads, HSG C/D
51,836	76	Woods, Fair, HSG C/D
5,480	36	Woods, Fair, HSG A
12,187	49	50-75% Grass cover, Fair, HSG A
35,420	79	50-75% Grass cover, Fair, HSG C
110,625	73	Weighted Average
107,556		97.23% Pervious Area
3,069		2.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	95	0.0830	0.29		Sheet Flow, Grass: Short n= 0.150 P2= 3.10"
0.5	130	0.0830	4.64		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
0.7	60	0.0830	1.44		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.5	40	0.0830	1.44		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
3.4	230	0.0500	1.12		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
10.5	555	Total			

Subcatchment Ex1: Exist. Flow to DP

Hydrograph



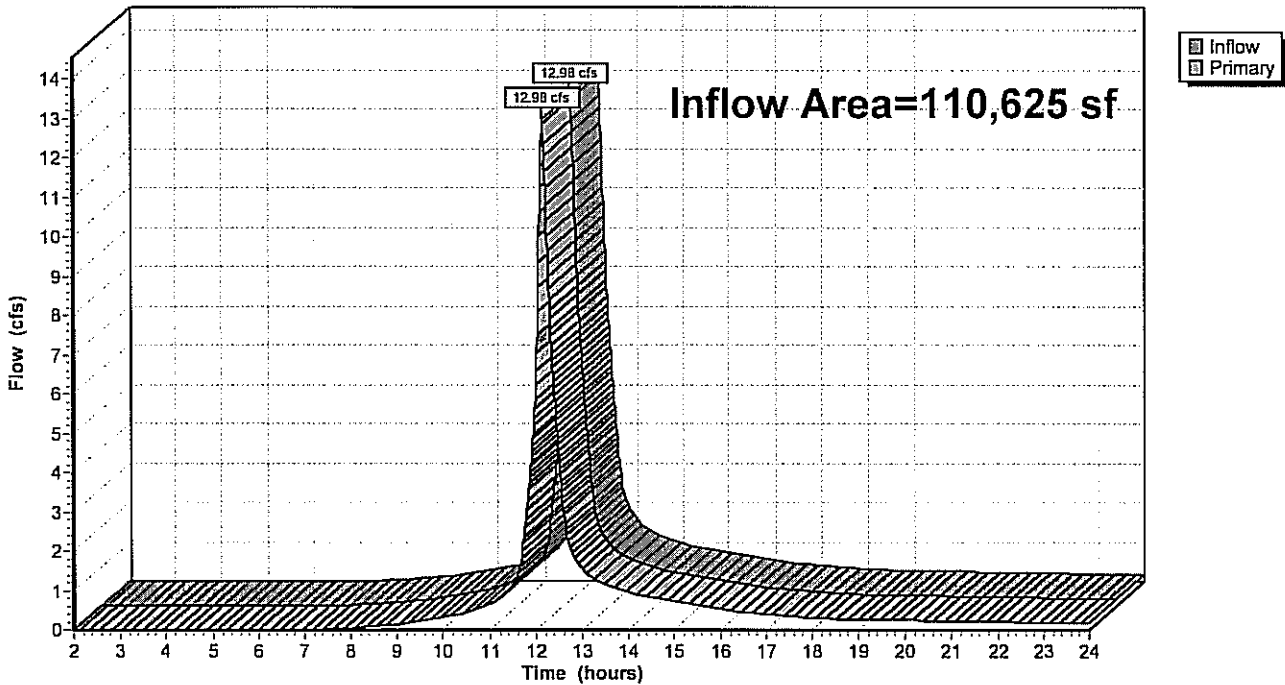
Summary for Link 1L: Design Point

Inflow Area = 110,625 sf, 2.77% Impervious, Inflow Depth > 5.07" for 100-Year event
Inflow = 12.98 cfs @ 12.15 hrs, Volume= 46,708 cf
Primary = 12.98 cfs @ 12.15 hrs, Volume= 46,708 cf, Atten= 0%, Lag= 0.0 min

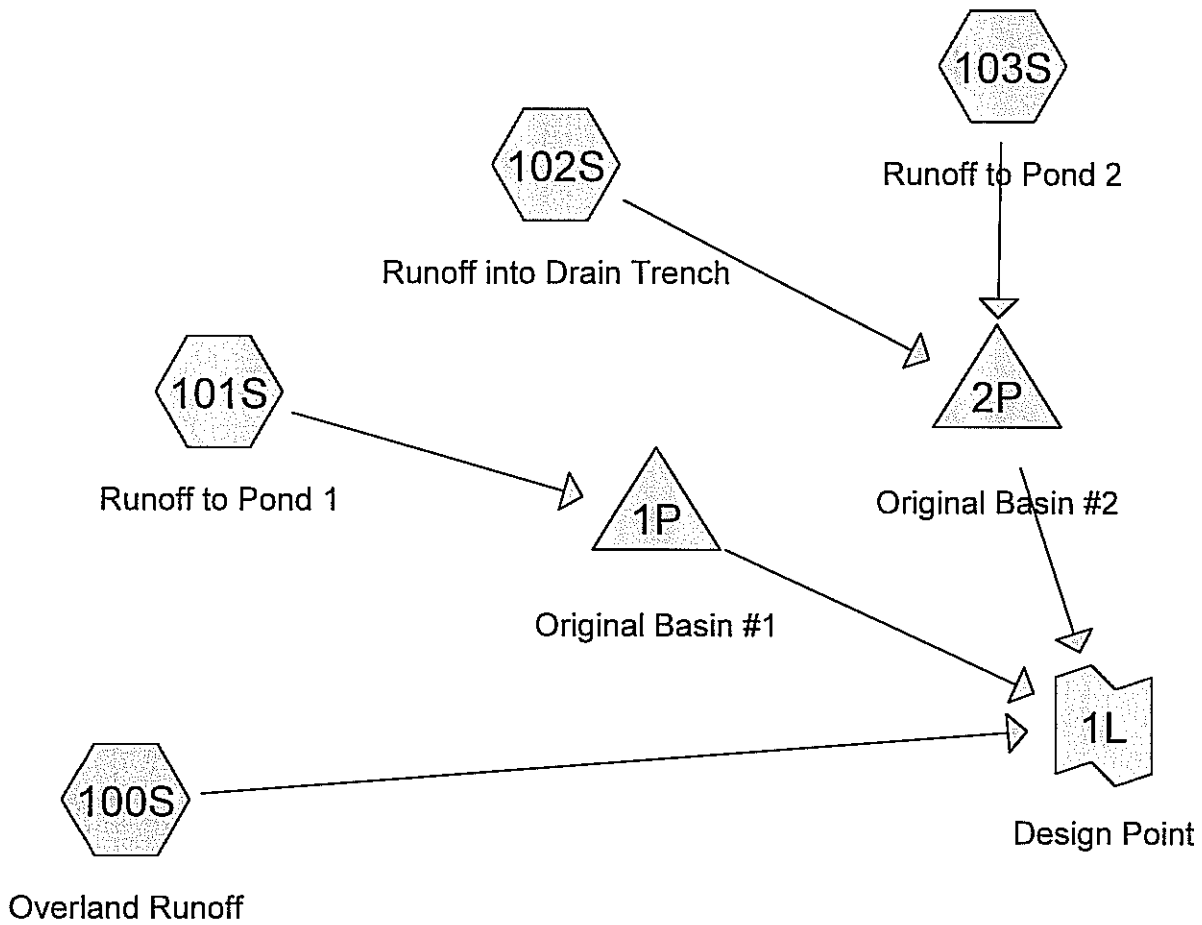
Primary outflow = Inflow, Time Span= 2.00-24.00 hrs, dt= 0.01 hrs

Link 1L: Design Point

Hydrograph



POST-DEVELOPMENT DRAINAGE CALCULATIONS



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Type III 24-hr 2-Year Rainfall=3.10"

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Summary for Subcatchment 100S: Overland Runoff

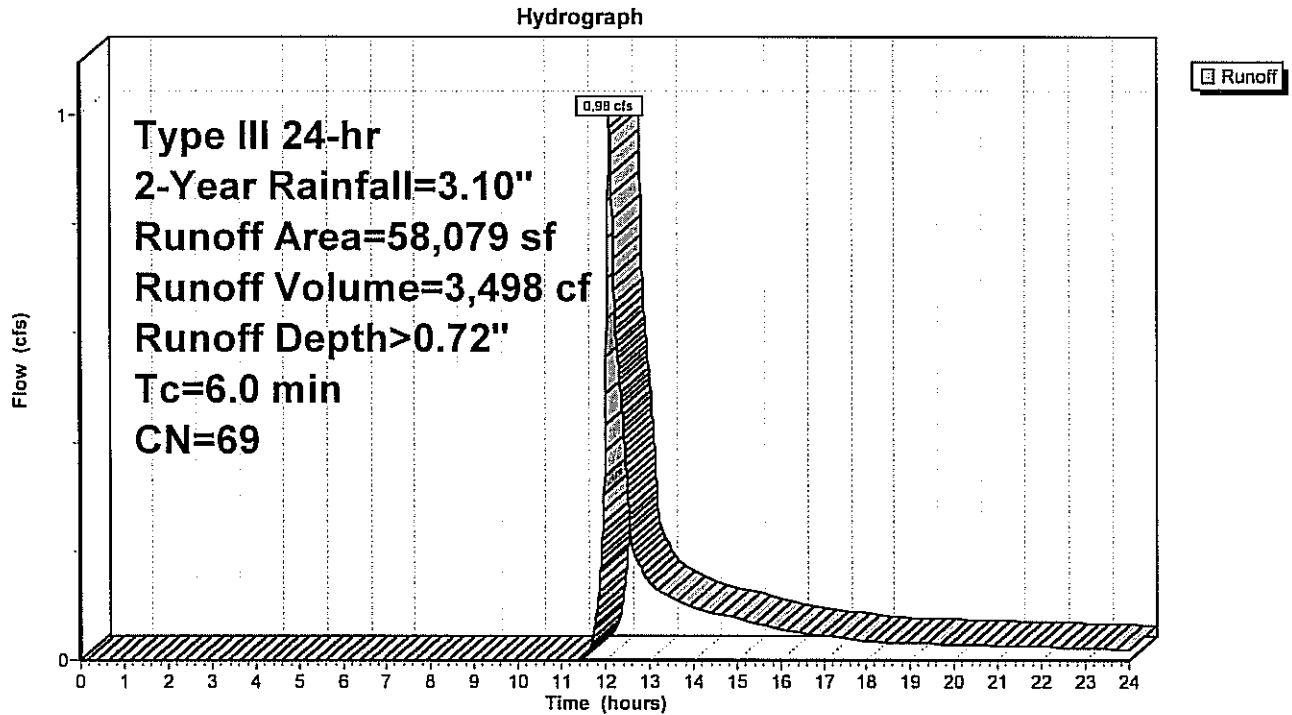
Runoff = 0.98 cfs @ 12.10 hrs, Volume= 3,498 cf, Depth> 0.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
4,982	49	50-75% Grass cover, Fair, HSG A
5,379	36	Woods, Fair, HSG A
15,910	73	Woods, Fair, HSG C
29,358	74	>75% Grass cover, Good, HSG C
* 2,450	98	Roofs
58,079	69	Weighted Average
55,629		95.78% Pervious Area
2,450		4.22% Impervious Area

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

Subcatchment 100S: Overland Runoff



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Type III 24-hr 2-Year Rainfall=3.10"

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Summary for Subcatchment 101S: Runoff to Pond 1

Runoff = 0.54 cfs @ 12.09 hrs, Volume= 1,679 cf, Depth> 1.39"

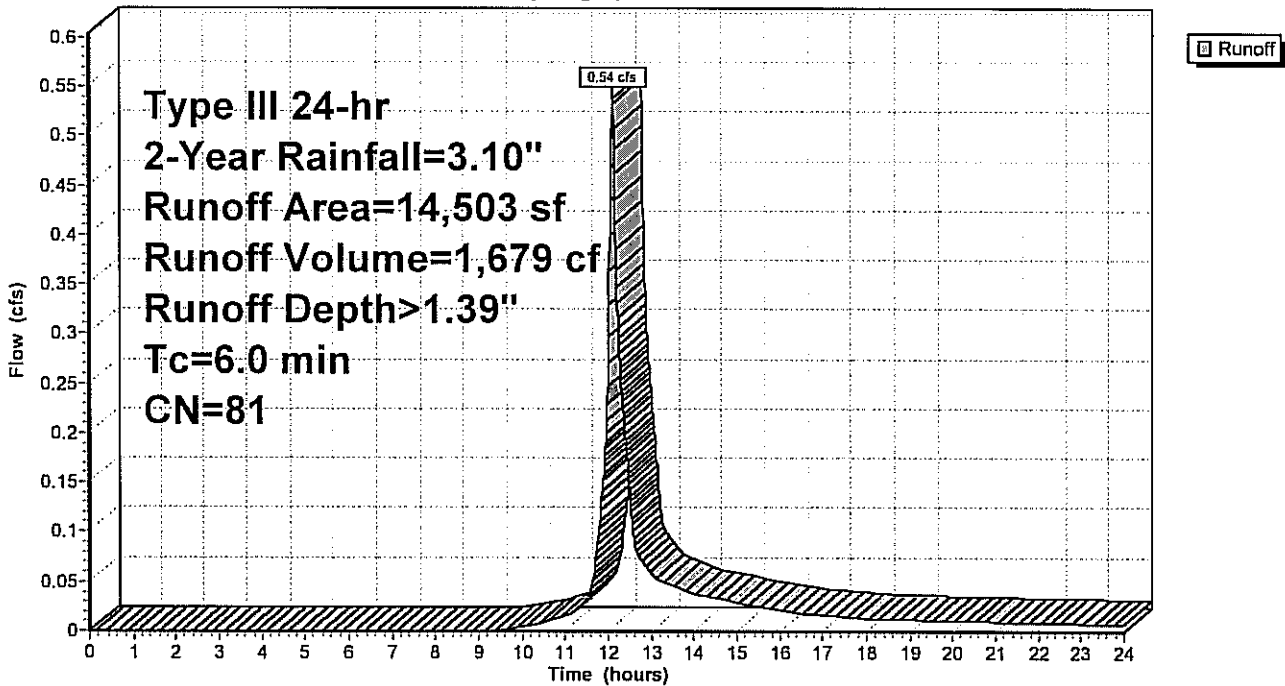
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
8,760	74	>75% Grass cover, Good, HSG C
1,413	73	Woods, Fair, HSG C
* 2,500	98	Driveway
* 1,830	98	Roofs
14,503	81	Weighted Average
10,173		70.14% Pervious Area
4,330		29.86% Impervious Area

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

Subcatchment 101S: Runoff to Pond 1

Hydrograph



M173263-Proposed

Type III 24-hr 2-Year Rainfall=3.10"

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Summary for Pond 1P: Original Basin #1

Inflow Area = 14,503 sf, 29.86% Impervious, Inflow Depth > 1.39" for 2-Year event
 Inflow = 0.54 cfs @ 12.09 hrs, Volume= 1,679 cf
 Outflow = 0.35 cfs @ 12.19 hrs, Volume= 1,678 cf, Atten= 35%, Lag= 5.8 min
 Discarded = 0.09 cfs @ 12.19 hrs, Volume= 1,286 cf
 Primary = 0.26 cfs @ 12.19 hrs, Volume= 392 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Peak Elev= 56.57' @ 12.19 hrs Surf.Area= 487 sf Storage= 238 cf
 Flood Elev= 58.00' Surf.Area= 916 sf Storage= 1,226 cf

Plug-Flow detention time= 8.5 min calculated for 1,677 cf (100% of inflow)
 Center-of-Mass det. time= 8.3 min (848.6 - 840.3)

Volume	Invert	Avail.Storage	Storage Description		
#1	56.00'	1,226 cf	Custom Stage Data (Conic) Listed below (Recalc)		
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
56.00	349	0	0	349	
57.00	605	471	471	616	
58.00	916	755	1,226	942	

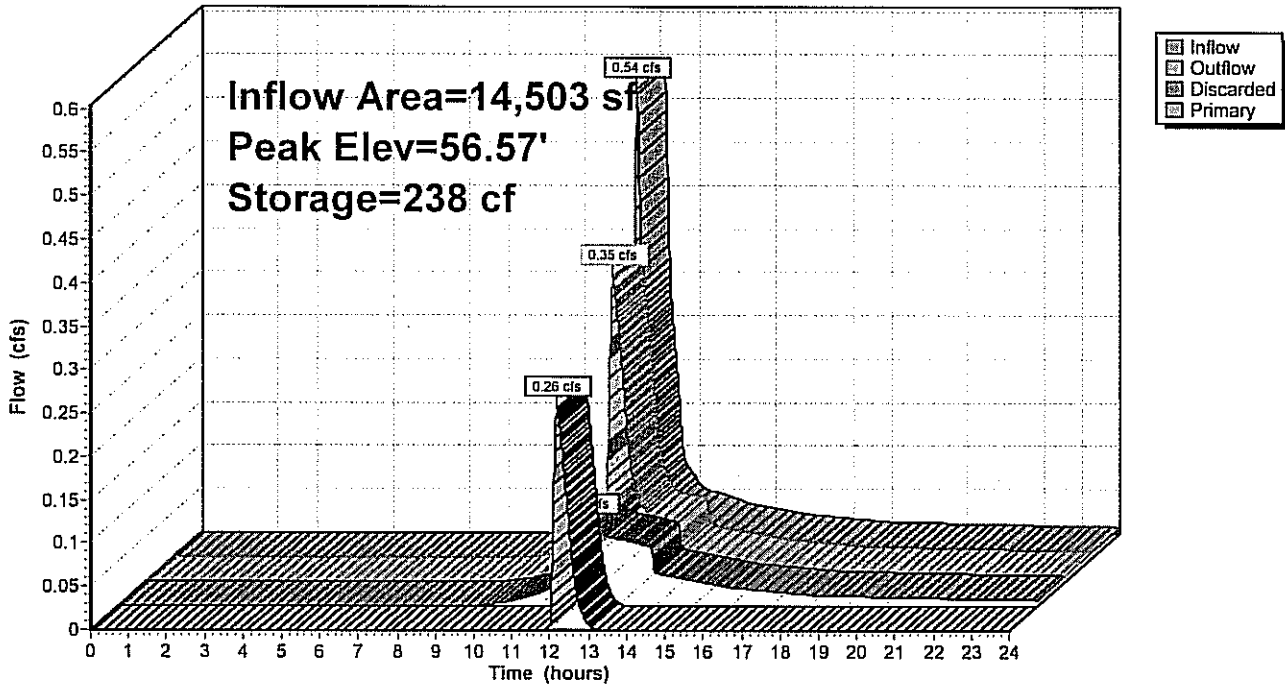
Device	Routing	Invert	Outlet Devices
#1	Discarded	56.00'	8.270 in/hr Exfiltration over Surface area
#2	Primary	56.20'	6.0" Round Culvert L= 15.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 56.20' / 56.00' S= 0.0133 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.09 cfs @ 12.19 hrs HW=56.57' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.09 cfs)

Primary OutFlow Max=0.26 cfs @ 12.19 hrs HW=56.57' (Free Discharge)
 ↑2=Culvert (Inlet Controls 0.26 cfs @ 1.64 fps)

Pond 1P: Original Basin #1

Hydrograph



Summary for Subcatchment 102S: Runoff into Drain Trench

Runoff = 0.74 cfs @ 12.10 hrs, Volume= 2,462 cf, Depth> 0.92"

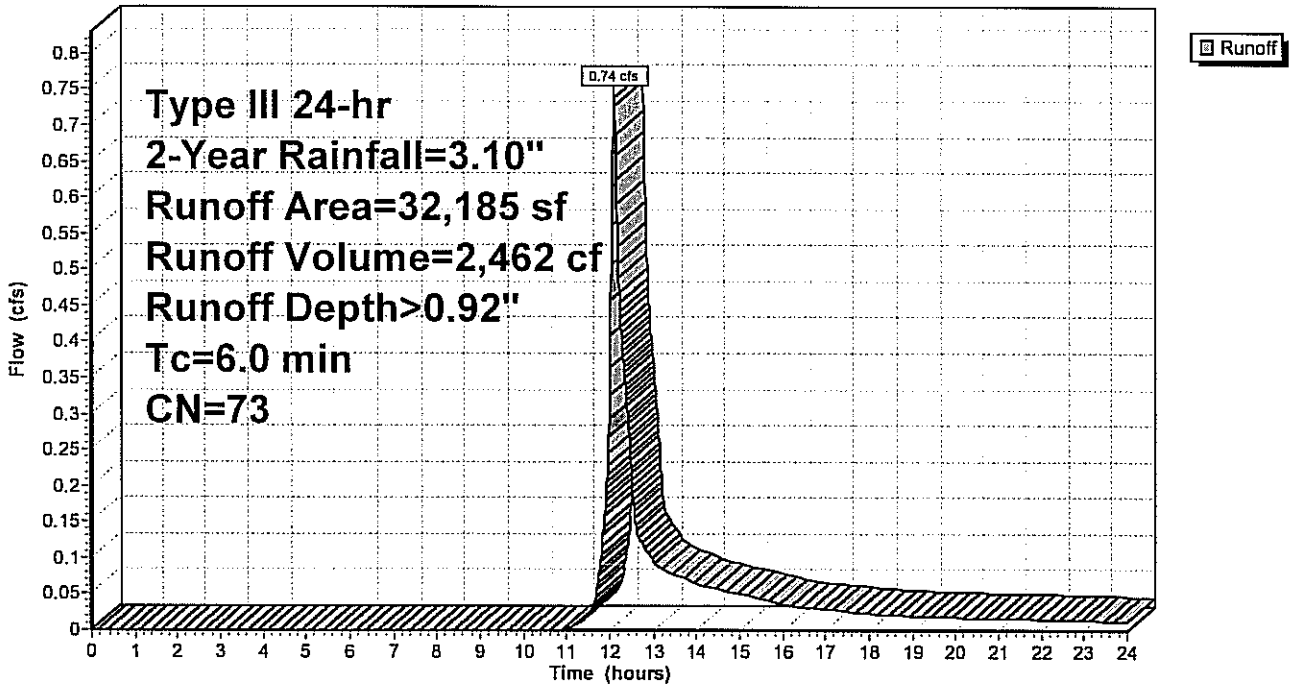
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
7,276	49	50-75% Grass cover, Fair, HSG A
12,022	79	50-75% Grass cover, Fair, HSG C
2,220	74	>75% Grass cover, Good, HSG C
6,817	73	Woods, Fair, HSG C
* 3,850	98	Impervious Areas
32,185	73	Weighted Average
28,335		88.04% Pervious Area
3,850		11.96% Impervious Area

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

Subcatchment 102S: Runoff into Drain Trench

Hydrograph



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Type III 24-hr 2-Year Rainfall=3.10"

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Summary for Subcatchment 103S: Runoff to Pond 2

Runoff = 0.19 cfs @ 12.09 hrs, Volume= 587 cf, Depth> 1.20"

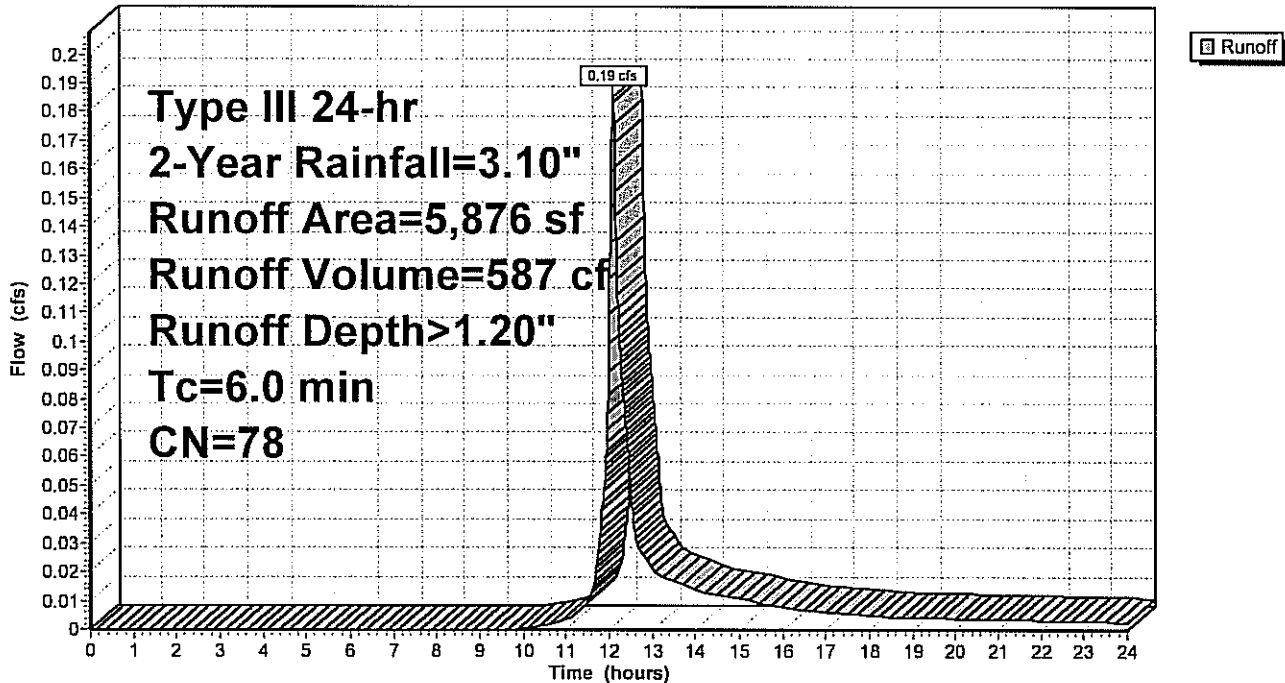
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
4,776	74	>75% Grass cover, Good, HSG C
1,100	98	Impervious Areas
5,876	78	Weighted Average
4,776		81.28% Pervious Area
1,100		18.72% Impervious Area

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

Subcatchment 103S: Runoff to Pond 2

Hydrograph



M173263-Proposed

Type III 24-hr 2-Year Rainfall=3.10"

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Summary for Pond 2P: Original Basin #2

Inflow Area = 38,061 sf, 13.01% Impervious, Inflow Depth > 0.96" for 2-Year event
 Inflow = 0.93 cfs @ 12.10 hrs, Volume= 3,049 cf
 Outflow = 0.77 cfs @ 12.15 hrs, Volume= 2,994 cf, Atten= 17%, Lag= 3.3 min
 Primary = 0.77 cfs @ 12.15 hrs, Volume= 2,994 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Peak Elev= 50.75' @ 12.15 hrs Surf.Area= 381 sf Storage= 219 cf
 Flood Elev= 52.20' Surf.Area= 740 sf Storage= 1,029 cf

Plug-Flow detention time= 16.6 min calculated for 2,994 cf (98% of inflow)
 Center-of-Mass det. time= 6.5 min (869.9 - 863.4)

Volume	Invert	Avail.Storage	Storage Description		
#1	50.00'	1,029 cf	Custom Stage Data (Conic) Listed below (Recalc)		
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
50.00	214	0	0	214	
51.00	448	324	324	456	
52.20	740	706	1,029	766	

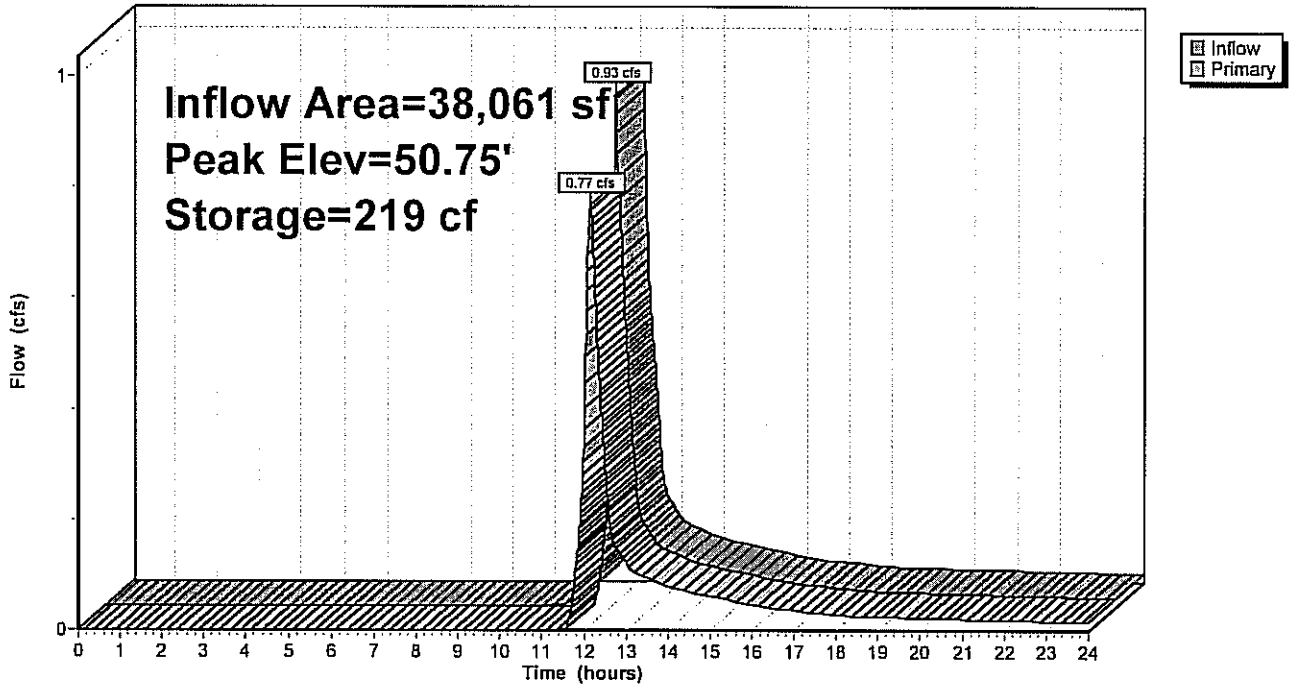
Device	Routing	Invert	Outlet Devices	
#1	Primary	48.30'	12.0" Round Culvert L= 59.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 48.30' / 46.50' S= 0.0305 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf	
#2	Device 1	50.20'	9.5" W x 4.0" H Vert. Orifice/Grate C= 0.600	
#3	Device 1	51.20'	11.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads	

Primary OutFlow Max=0.77 cfs @ 12.15 hrs HW=50.75' (Free Discharge)

- ↑ 1=Culvert (Passes 0.77 cfs of 5.28 cfs potential flow)
- ↑ 2=Orifice/Grate (Orifice Controls 0.77 cfs @ 2.95 fps)
- ↑ 3=Orifice/Grate (Controls 0.00 cfs)

Pond 2P: Original Basin #2

Hydrograph



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Type III 24-hr 2-Year Rainfall=3.10"

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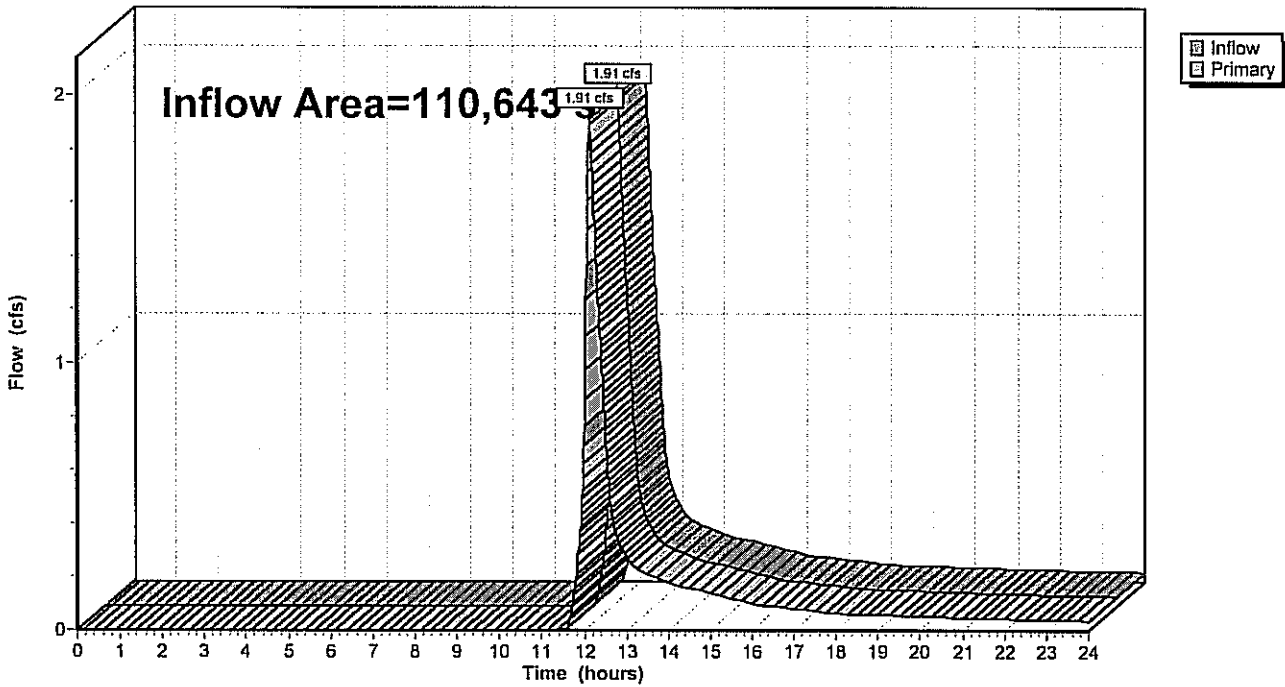
Summary for Link 1L: Design Point

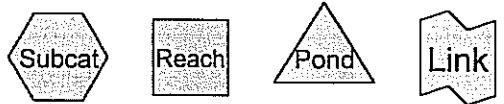
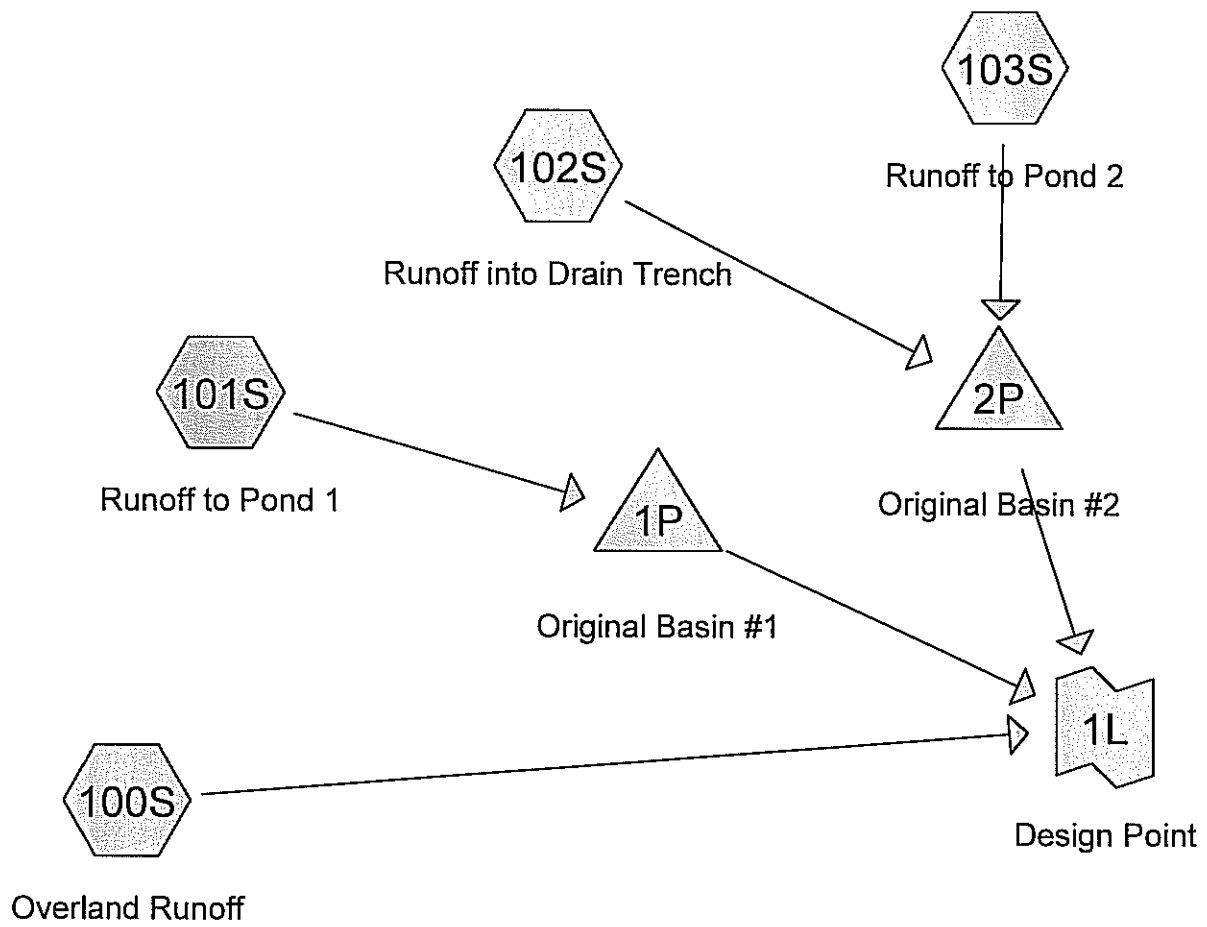
Inflow Area = 110,643 sf, 10.60% Impervious, Inflow Depth > 0.75" for 2-Year event
Inflow = 1.91 cfs @ 12.12 hrs, Volume= 6,884 cf
Primary = 1.91 cfs @ 12.12 hrs, Volume= 6,884 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 1L: Design Point

Hydrograph





Summary for Subcatchment 100S: Overland Runoff

Runoff = 2.64 cfs @ 12.09 hrs, Volume= 8,421 cf, Depth> 1.74"

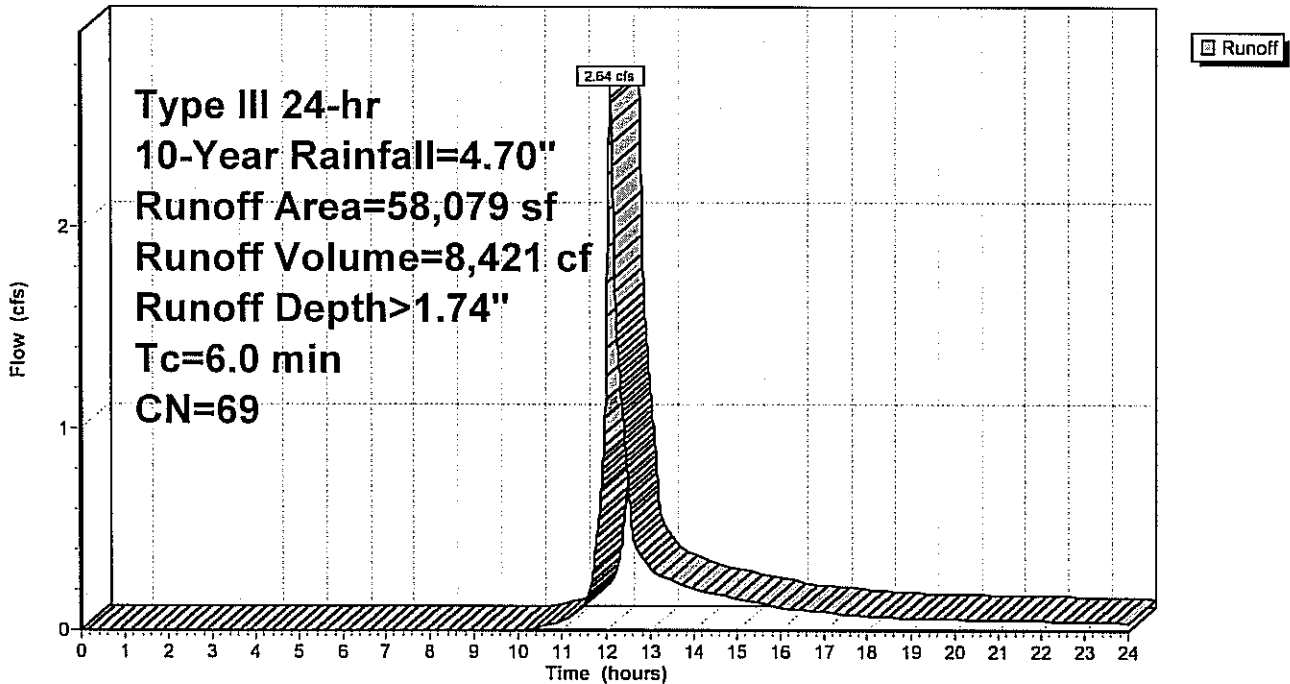
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
4,982	49	50-75% Grass cover, Fair, HSG A
5,379	36	Woods, Fair, HSG A
15,910	73	Woods, Fair, HSG C
29,358	74	>75% Grass cover, Good, HSG C
* 2,450	98	Roofs
58,079	69	Weighted Average
55,629		95.78% Pervious Area
2,450		4.22% Impervious Area

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

Subcatchment 100S: Overland Runoff

Hydrograph



M173263-Proposed

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Type III 24-hr 10-Year Rainfall=4.70"

Printed 7/11/2018

Summary for Subcatchment 101S: Runoff to Pond 1

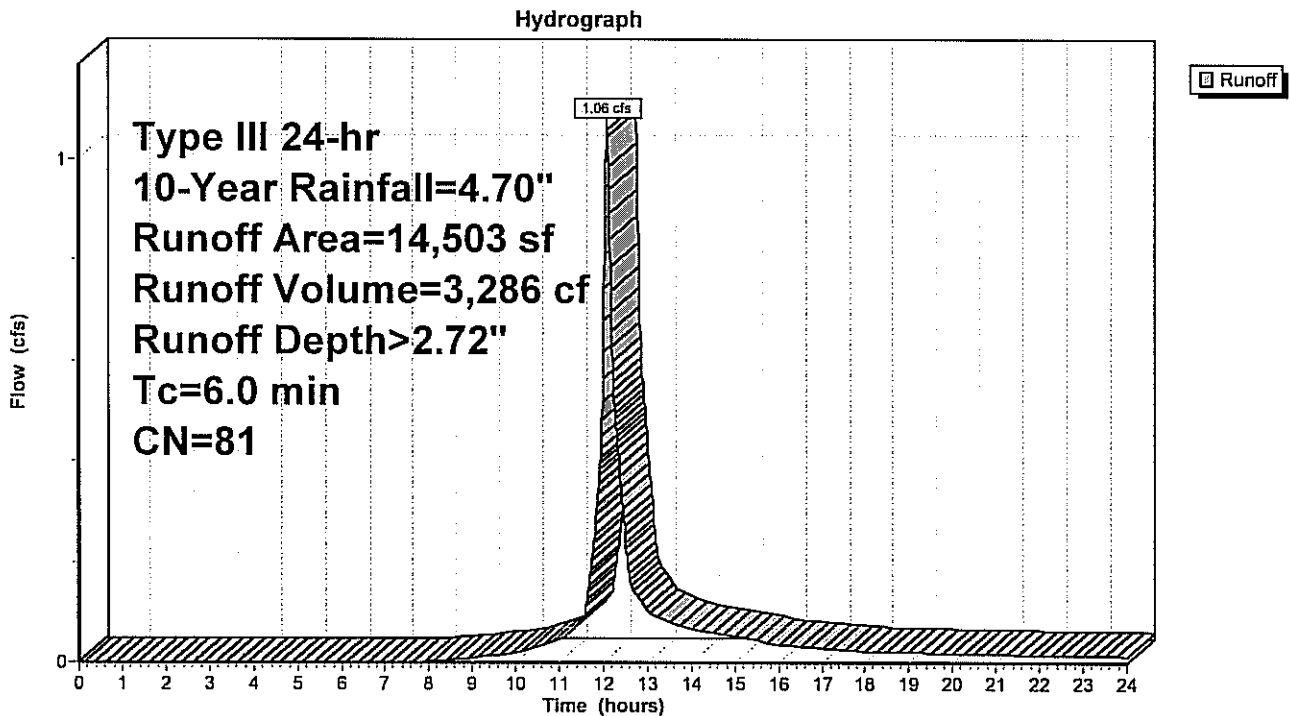
Runoff = 1.06 cfs @ 12.09 hrs, Volume= 3,286 cf, Depth> 2.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
8,760	74	>75% Grass cover, Good, HSG C
1,413	73	Woods, Fair, HSG C
* 2,500	98	Driveway
* 1,830	98	Roofs
14,503	81	Weighted Average
10,173		70.14% Pervious Area
4,330		29.86% Impervious Area

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

Subcatchment 101S: Runoff to Pond 1



M173263-Proposed

Type III 24-hr 10-Year Rainfall=4.70"

Prepared by Millennium Engineering, Inc.

Printed 7/12/2018

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Summary for Pond 1P: Original Basin #1

Inflow Area = 14,503 sf, 29.86% Impervious, Inflow Depth > 2.72" for 10-Year event
 Inflow = 1.06 cfs @ 12.09 hrs, Volume= 3,286 cf
 Outflow = 0.66 cfs @ 12.19 hrs, Volume= 3,285 cf, Atten= 38%, Lag= 6.1 min
 Discarded = 0.12 cfs @ 12.19 hrs, Volume= 2,071 cf
 Primary = 0.55 cfs @ 12.19 hrs, Volume= 1,214 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Peak Elev= 56.99' @ 12.19 hrs Surf.Area= 601 sf Storage= 463 cf
 Flood Elev= 58.00' Surf.Area= 916 sf Storage= 1,226 cf

Plug-Flow detention time= 9.5 min calculated for 3,285 cf (100% of inflow)
 Center-of-Mass det. time= 9.3 min (830.3 - 821.0)

Volume	Invert	Avail.Storage	Storage Description		
#1	56.00'	1,226 cf	Custom Stage Data (Conic) Listed below (Recalc)		
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
56.00	349	0	0	349	
57.00	605	471	471	616	
58.00	916	755	1,226	942	

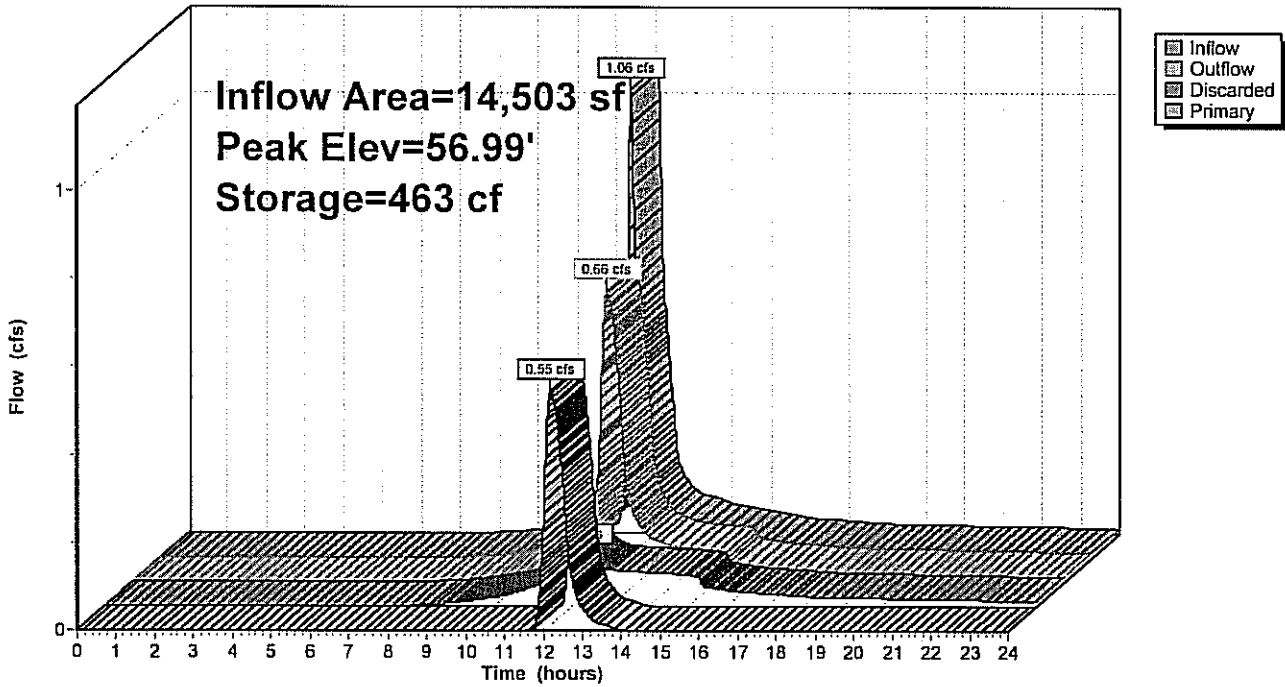
Device	Routing	Invert	Outlet Devices
#1	Discarded	56.00'	8.270 in/hr Exfiltration over Surface area
#2	Primary	56.20'	6.0" Round Culvert L= 15.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 56.20' / 56.00' S= 0.0133 ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.12 cfs @ 12.19 hrs HW=56.99' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=0.55 cfs @ 12.19 hrs HW=56.99' (Free Discharge)
 ↑2=Culvert (Inlet Controls 0.55 cfs @ 2.78 fps)

Pond 1P: Original Basin #1

Hydrograph



Summary for Subcatchment 102S: Runoff into Drain Trench

Runoff = 1.76 cfs @ 12.09 hrs, Volume= 5,485 cf, Depth> 2.05"

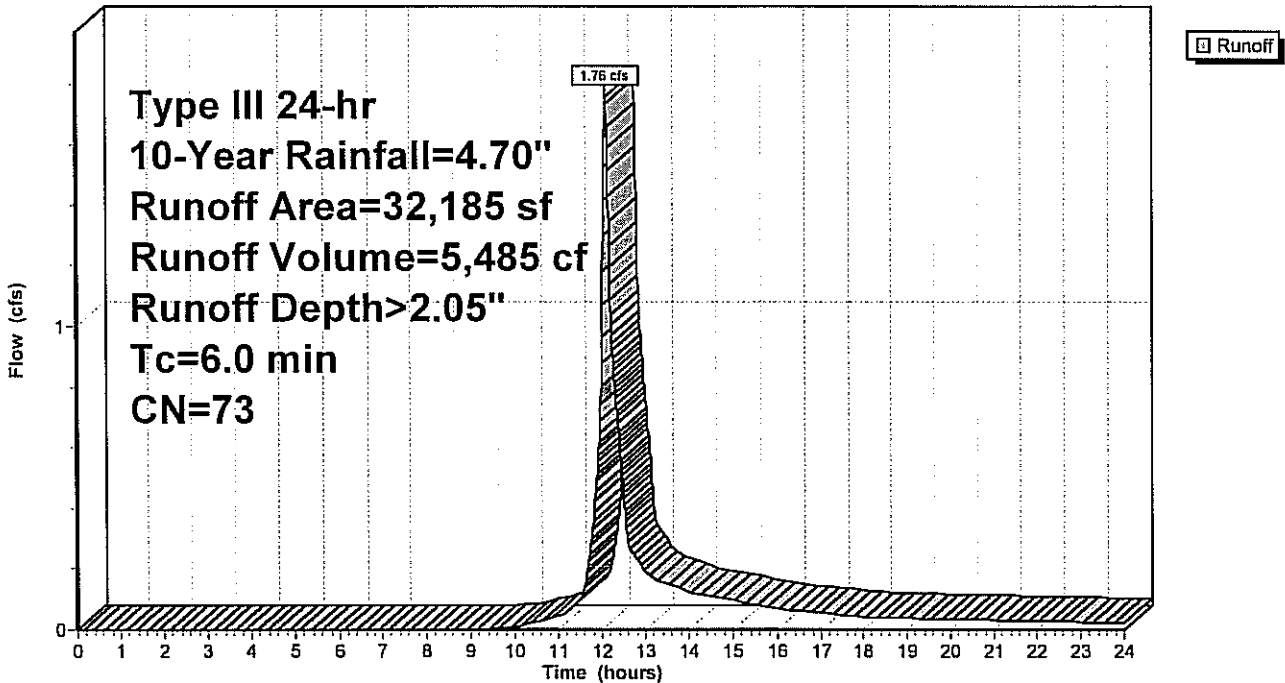
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
7,276	49	50-75% Grass cover, Fair, HSG A
12,022	79	50-75% Grass cover, Fair, HSG C
2,220	74	>75% Grass cover, Good, HSG C
6,817	73	Woods, Fair, HSG C
* 3,850	98	Impervious Areas
32,185	73	Weighted Average
28,335		88.04% Pervious Area
3,850		11.96% Impervious Area

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

Subcatchment 102S: Runoff into Drain Trench

Hydrograph



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Type III 24-hr 10-Year Rainfall=4.70"

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Summary for Subcatchment 103S: Runoff to Pond 2

Runoff = 0.39 cfs @ 12.09 hrs, Volume= 1,203 cf, Depth> 2.46"

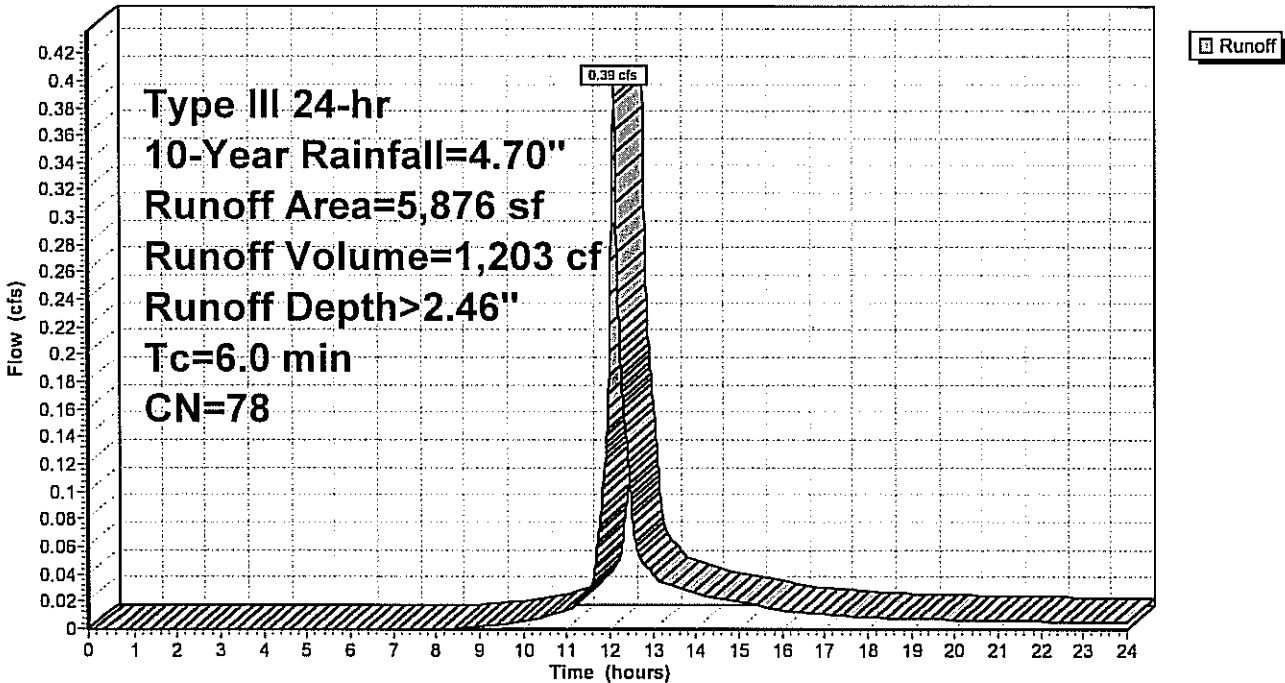
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
4,776	74	>75% Grass cover, Good, HSG C
* 1,100	98	Impervious Areas
5,876	78	Weighted Average
4,776		81.28% Pervious Area
1,100		18.72% Impervious Area

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

Subcatchment 103S: Runoff to Pond 2

Hydrograph



M173263-Proposed

Type III 24-hr 10-Year Rainfall=4.70"

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Summary for Pond 2P: Original Basin #2

Inflow Area = 38,061 sf, 13.01% Impervious, Inflow Depth > 2.11" for 10-Year event
 Inflow = 2.14 cfs @ 12.09 hrs, Volume= 6,688 cf
 Outflow = 1.93 cfs @ 12.13 hrs, Volume= 6,628 cf, Atten= 10%, Lag= 2.4 min
 Primary = 1.93 cfs @ 12.13 hrs, Volume= 6,628 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Peak Elev= 51.37' @ 12.13 hrs Surf.Area= 531 sf Storage= 506 cf
 Flood Elev= 52.20' Surf.Area= 740 sf Storage= 1,029 cf

Plug-Flow detention time= 10.7 min calculated for 6,628 cf (99% of inflow)
 Center-of-Mass det. time= 5.4 min (845.4 - 840.0)

Volume	Invert	Avail.Storage	Storage Description		
#1	50.00'	1,029 cf	Custom Stage Data (Conic) Listed below (Recalc)		
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
50.00	214	0	0	214	
51.00	448	324	324	456	
52.20	740	706	1,029	766	

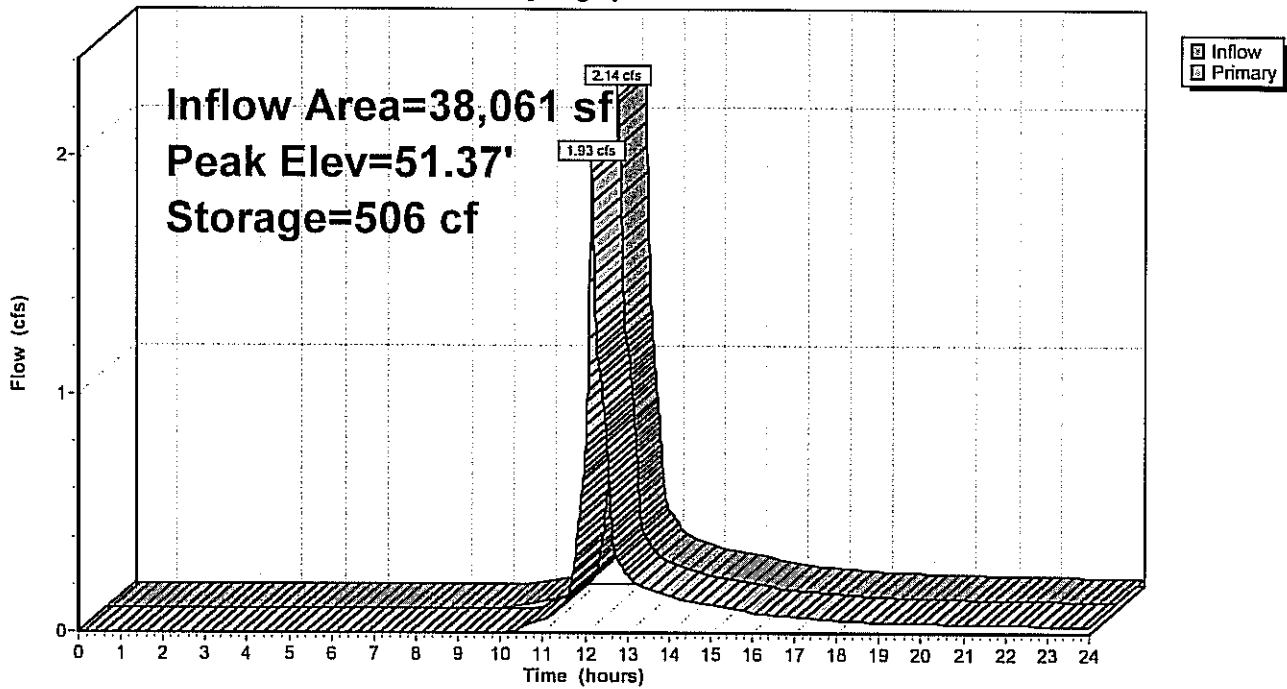
Device	Routing	Invert	Outlet Devices	
#1	Primary	48.30'	12.0" Round Culvert L= 59.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 48.30' / 46.50' S= 0.0305 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf	
#2	Device 1	50.20'	9.5" W x 4.0" H Vert. Orifice/Grate C= 0.600	
#3	Device 1	51.20'	11.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads	

Primary OutFlow Max=1.93 cfs @ 12.13 hrs HW=51.37' (Free Discharge)

- 1=Culvert (Passes 1.93 cfs of 6.06 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 1.26 cfs @ 4.83 fps)
- 3=Orifice/Grate (Weir Controls 0.67 cfs @ 1.36 fps)

Pond 2P: Original Basin #2

Hydrograph



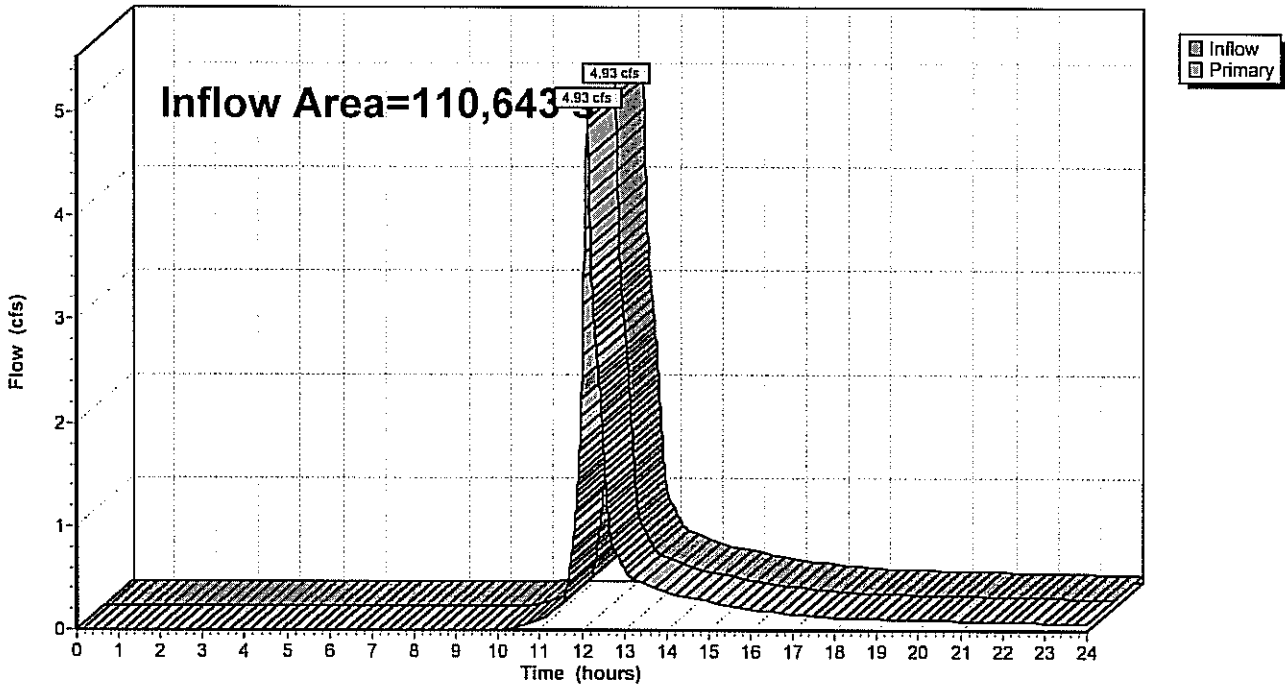
Summary for Link 1L: Design Point

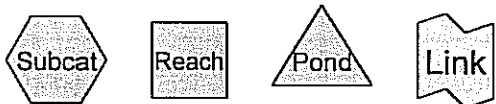
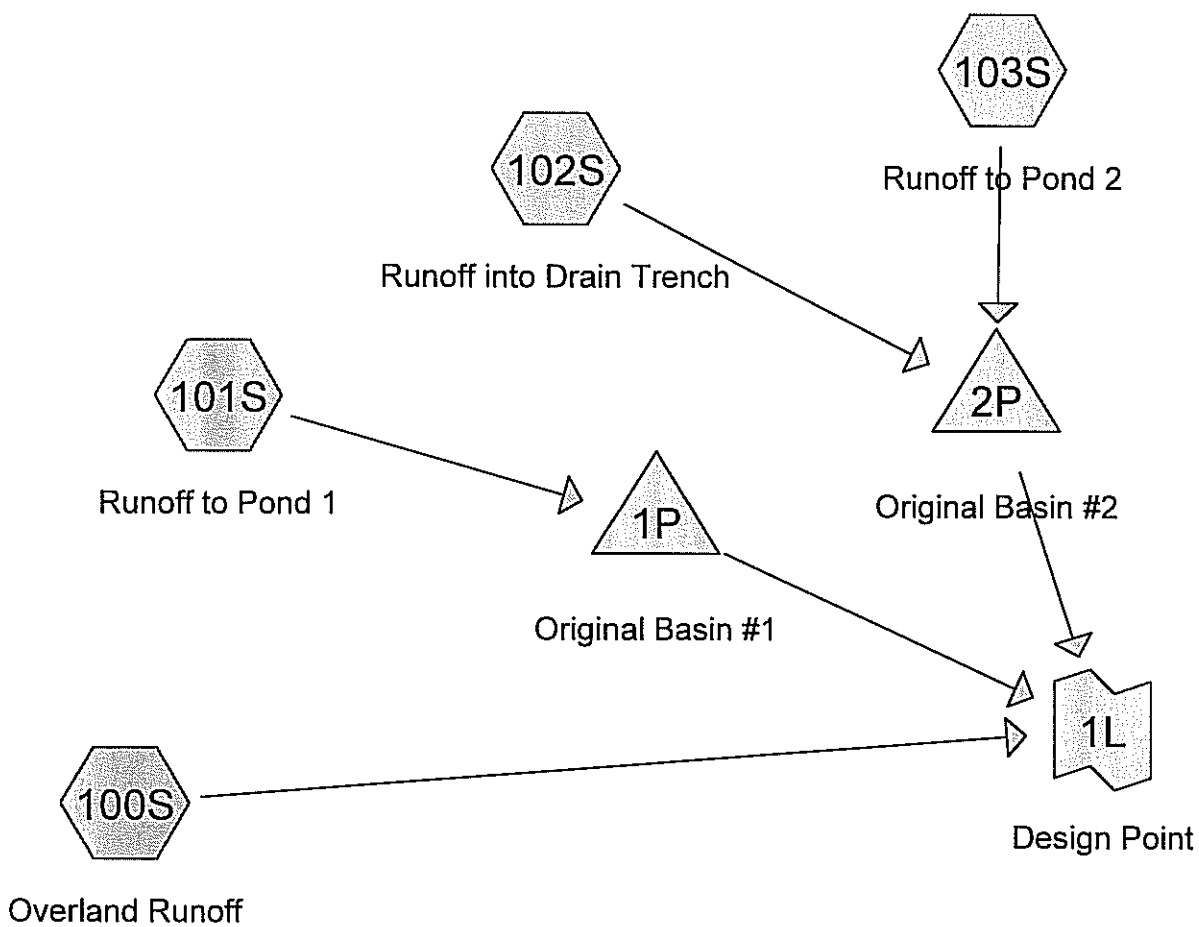
Inflow Area = 110,643 sf, 10.60% Impervious, Inflow Depth > 1.76" for 10-Year event
Inflow = 4.93 cfs @ 12.12 hrs, Volume= 16,263 cf
Primary = 4.93 cfs @ 12.12 hrs, Volume= 16,263 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 1L: Design Point

Hydrograph





M173263-Proposed

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Type III 24-hr 100-Year Rainfall=8.30"

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Summary for Subcatchment 100S: Overland Runoff

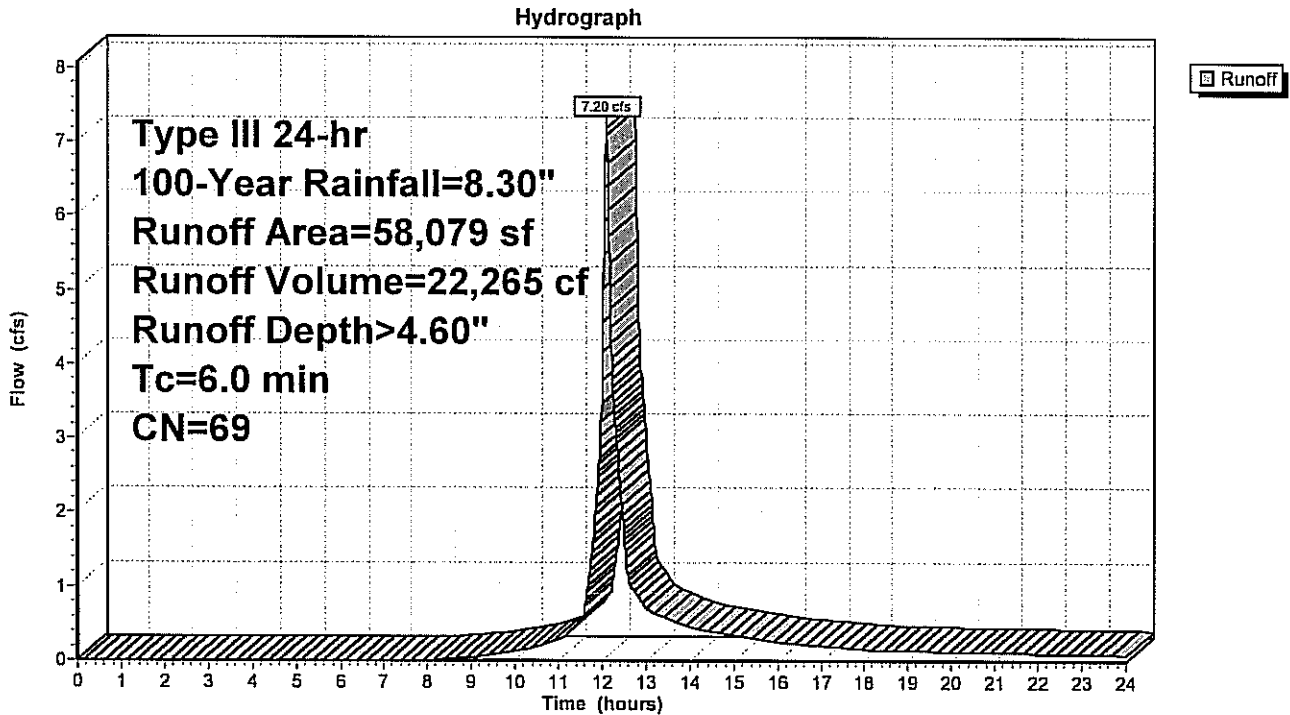
Runoff = 7.20 cfs @ 12.09 hrs, Volume= 22,265 cf, Depth> 4.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.30"

Area (sf)	CN	Description
4,982	49	50-75% Grass cover, Fair, HSG A
5,379	36	Woods, Fair, HSG A
15,910	73	Woods, Fair, HSG C
29,358	74	>75% Grass cover, Good, HSG C
* 2,450	98	Roofs
58,079	69	Weighted Average
55,629		95.78% Pervious Area
2,450		4.22% Impervious Area

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

Subcatchment 100S: Overland Runoff



M173263-Proposed

Type III 24-hr 100-Year Rainfall=8.30"

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Summary for Subcatchment 101S: Runoff to Pond 1

Runoff = 2.30 cfs @ 12.09 hrs, Volume= 7,276 cf, Depth> 6.02"

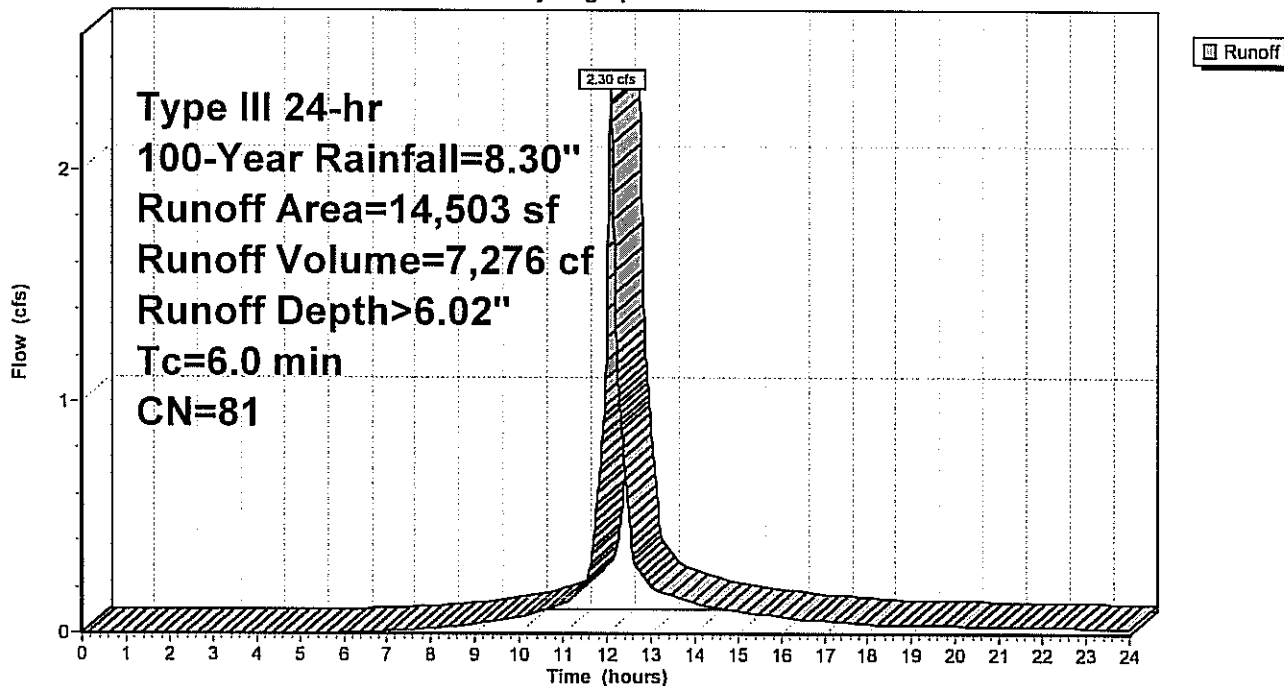
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100-Year Rainfall=8.30"

Area (sf)	CN	Description
8,760	74	>75% Grass cover, Good, HSG C
1,413	73	Woods, Fair, HSG C
* 2,500	98	Driveway
* 1,830	98	Roofs
14,503	81	Weighted Average
10,173		70.14% Pervious Area
4,330		29.86% Impervious Area

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

Subcatchment 101S: Runoff to Pond 1

Hydrograph



M173263-Proposed

Type III 24-hr 100-Year Rainfall=8.30"

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Summary for Pond 1P: Original Basin #1

Inflow Area = 14,503 sf, 29.86% Impervious, Inflow Depth > 6.02" for 100-Year event
 Inflow = 2.30 cfs @ 12.09 hrs, Volume= 7,276 cf
 Outflow = 1.10 cfs @ 12.25 hrs, Volume= 7,273 cf, Atten= 52%, Lag= 9.7 min
 Discarded = 0.17 cfs @ 12.25 hrs, Volume= 3,540 cf
 Primary = 0.92 cfs @ 12.25 hrs, Volume= 3,733 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Peak Elev= 57.98' @ 12.25 hrs Surf.Area= 910 sf Storage= 1,211 cf
 Flood Elev= 58.00' Surf.Area= 916 sf Storage= 1,226 cf

Plug-Flow detention time= 12.7 min calculated for 7,273 cf (100% of inflow)
 Center-of-Mass det. time= 12.5 min (811.0 - 798.5)

Volume	Invert	Avail.Storage	Storage Description		
#1	56.00'	1,226 cf	Custom Stage Data (Conic) Listed below (Recalc)		
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
56.00	349	0	0	349	
57.00	605	471	471	616	
58.00	916	755	1,226	942	

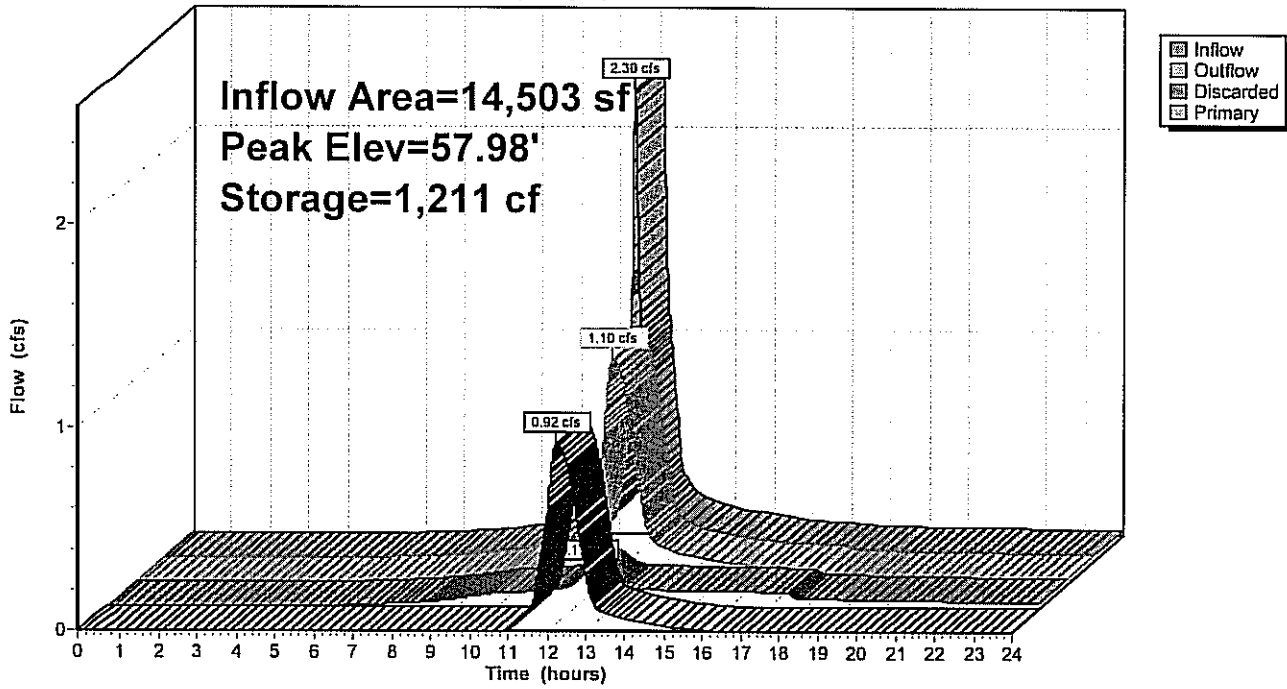
Device	Routing	Invert	Outlet Devices
#1	Discarded	56.00'	8.270 in/hr Exfiltration over Surface area
#2	Primary	56.20'	6.0" Round Culvert L= 15.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 56.20' / 56.00' S= 0.0133 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.17 cfs @ 12.25 hrs HW=57.98' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.17 cfs)

Primary OutFlow Max=0.92 cfs @ 12.25 hrs HW=57.98' (Free Discharge)
 ↑2=Culvert (Inlet Controls 0.92 cfs @ 4.71 fps)

Pond 1P: Original Basin #1

Hydrograph



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Type III 24-hr 100-Year Rainfall=8.30"

Printed 7/11/2018

Summary for Subcatchment 102S: Runoff into Drain Trench

Runoff = 4.39 cfs @ 12.09 hrs, Volume= 13,601 cf, Depth> 5.07"

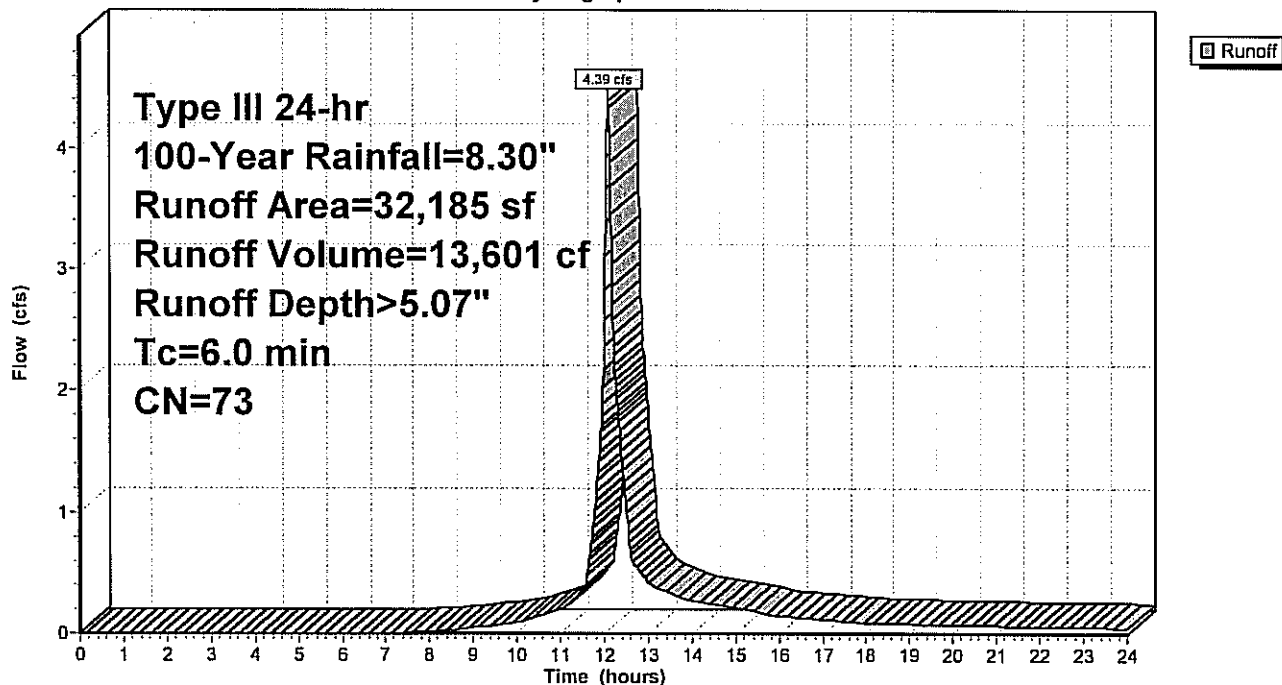
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.30"

Area (sf)	CN	Description
7,276	49	50-75% Grass cover, Fair, HSG A
12,022	79	50-75% Grass cover, Fair, HSG C
2,220	74	>75% Grass cover, Good, HSG C
6,817	73	Woods, Fair, HSG C
* 3,850	98	Impervious Areas
32,185	73	Weighted Average
28,335		88.04% Pervious Area
3,850		11.96% Impervious Area

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

Subcatchment 102S: Runoff into Drain Trench

Hydrograph



M173263-Proposed

Type III 24-hr 100-Year Rainfall=8.30"

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Summary for Subcatchment 103S: Runoff to Pond 2

Runoff = 0.89 cfs @ 12.09 hrs, Volume= 2,773 cf, Depth> 5.66"

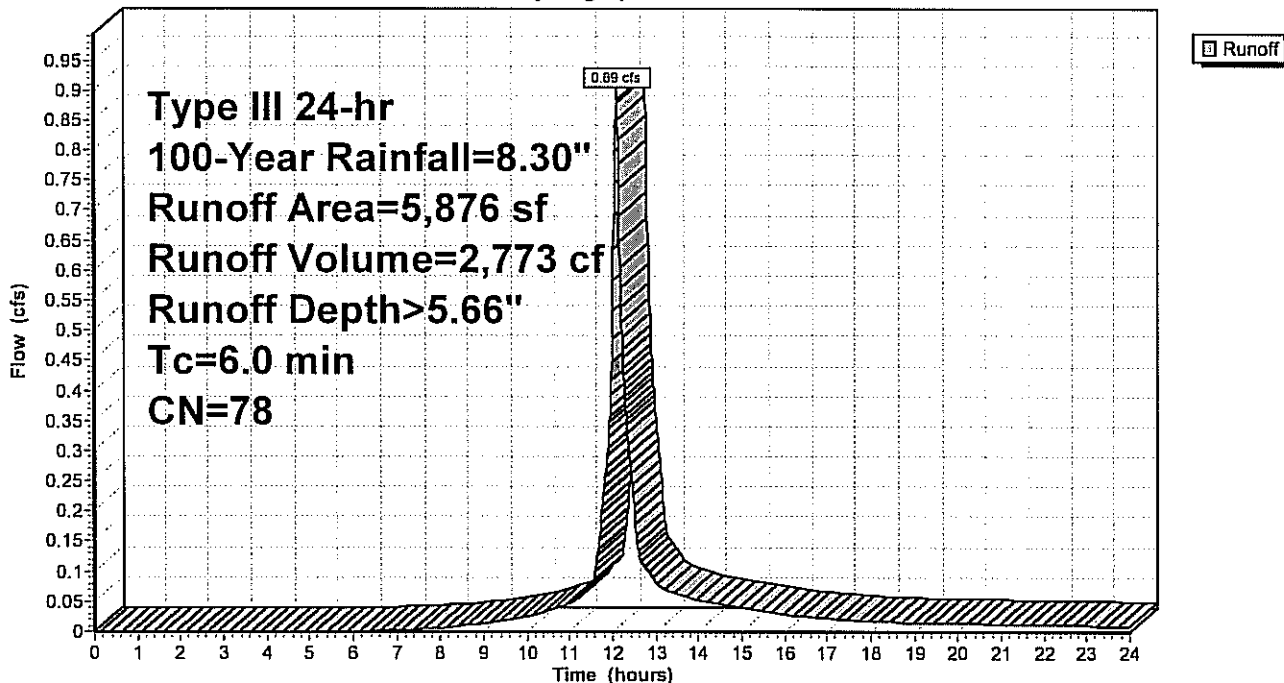
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100-Year Rainfall=8.30"

Area (sf)	CN	Description
4,776	74	>75% Grass cover, Good, HSG C
* 1,100	98	Impervious Areas
5,876	78	Weighted Average
4,776		81.28% Pervious Area
1,100		18.72% Impervious Area

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

Subcatchment 103S: Runoff to Pond 2

Hydrograph



M173263-Proposed

Type III 24-hr 100-Year Rainfall=8.30"

Prepared by Millennium Engineering, Inc.

Printed 7/11/2018

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Summary for Pond 2P: Original Basin #2

Inflow Area = 38,061 sf, 13.01% Impervious, Inflow Depth > 5.16" for 100-Year event
 Inflow = 5.28 cfs @ 12.09 hrs, Volume= 16,374 cf
 Outflow = 4.57 cfs @ 12.13 hrs, Volume= 16,307 cf, Atten= 13%, Lag= 2.8 min
 Primary = 4.57 cfs @ 12.13 hrs, Volume= 16,307 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Peak Elev= 52.06' @ 12.13 hrs Surf.Area= 701 sf Storage= 925 cf
 Flood Elev= 52.20' Surf.Area= 740 sf Storage= 1,029 cf

Plug-Flow detention time= 6.8 min calculated for 16,307 cf (100% of inflow)
 Center-of-Mass det. time= 4.2 min (818.6 - 814.4)

Volume	Invert	Avail.Storage	Storage Description	
#1	50.00'	1,029 cf	Custom Stage Data (Conic) Listed below (Recalc)	
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
50.00	214	0	0	214
51.00	448	324	324	456
52.20	740	706	1,029	766

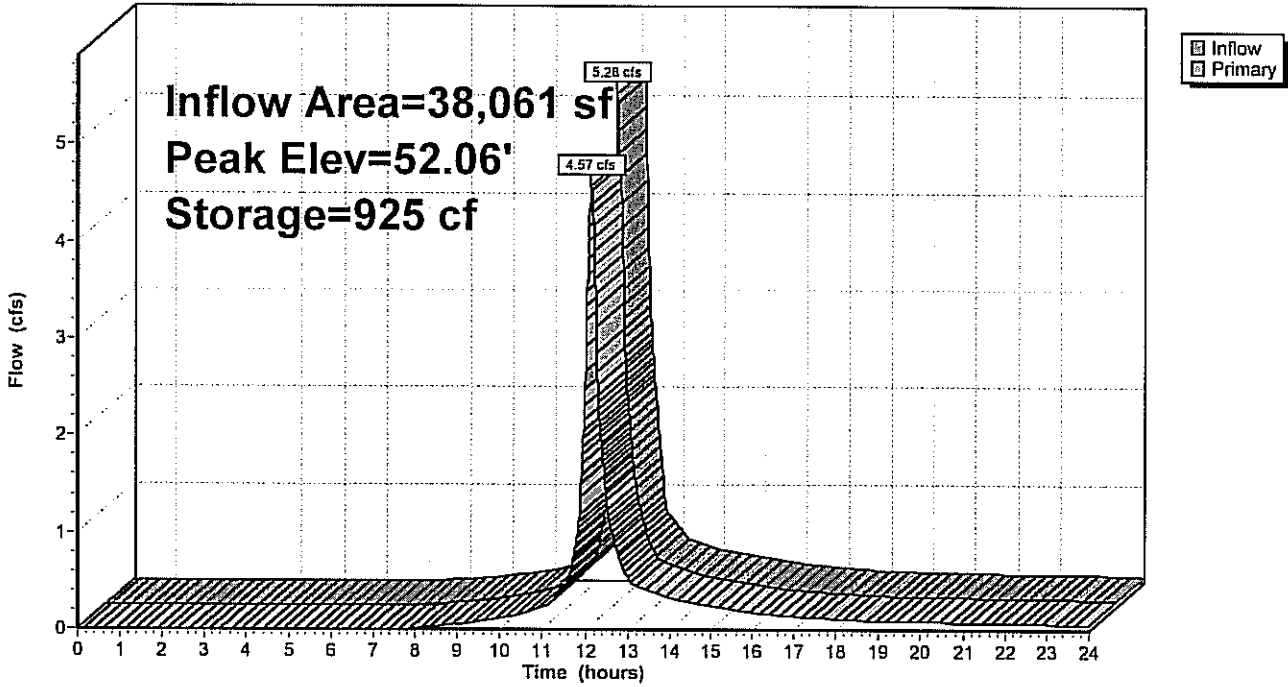
Device	Routing	Invert	Outlet Devices
#1	Primary	48.30'	12.0" Round Culvert L= 59.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 48.30' / 46.50' S= 0.0305 ' / Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	50.20'	9.5" W x 4.0" H Vert. Orifice/Grate C= 0.600
#3	Device 1	51.20'	11.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=4.57 cfs @ 12.13 hrs HW=52.05' (Free Discharge)

- ↑ 1=Culvert (Passes 4.57 cfs of 6.82 cfs potential flow)
- ↑ 2=Orifice/Grate (Orifice Controls 1.63 cfs @ 6.26 fps)
- ↑ 3=Orifice/Grate (Orifice Controls 2.94 cfs @ 4.45 fps)

Pond 2P: Original Basin #2

Hydrograph



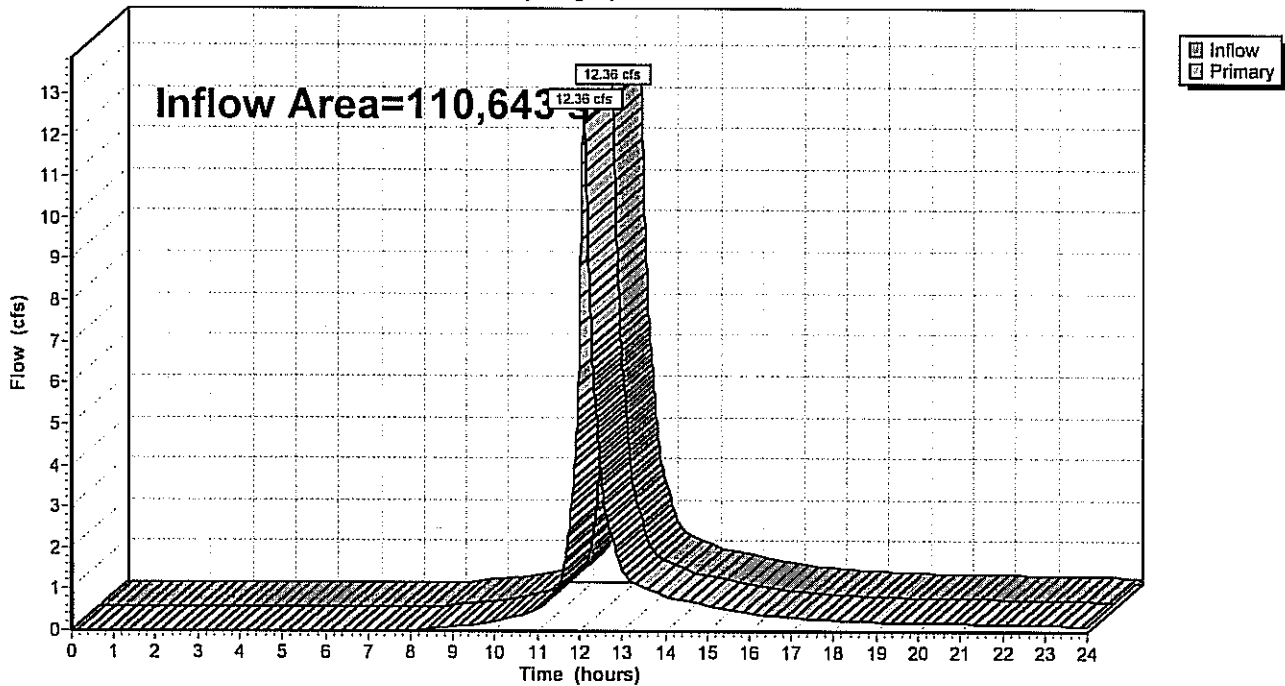
Summary for Link 1L: Design Point

Inflow Area = 110,643 sf, 10.60% Impervious, Inflow Depth > 4.59" for 100-Year event
Inflow = 12.36 cfs @ 12.10 hrs, Volume= 42,305 cf
Primary = 12.36 cfs @ 12.10 hrs, Volume= 42,305 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 1L: Design Point

Hydrograph



WATERSHED PLANS