Stormwater Narrative

Luther Bloomington Acura
BAA14041

LANDFORM

PL201800121
PL2018-121

Stormwater Narrative

Luther Bloomington Acura

Bloomington, MN

LANDFORM

March 30, 2018

I hereby certify that this plan was prepared by me, or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the state of MINNESOTA.

03-30-2018

Steven E. Sabraski
License No. 47165

Date

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APPENDICIES

EXISTING SITE CONDTIONS

The site encompasses approximately 6.34 acres located at 7801 Lyndale Avenue S. and 511 78th Street West in the City of Bloomington, MN.

The parcel is currently occupied by two commercial buildings. The topography of the site is primarily gently sloping terrain from west to east with elevations ranging from 851 to 847. The site is covered by several structures and paved parking areas.

Soils are generally uniformly graded sand with gravel or gravelly sands along with silt gravelly sands (SP-SM). The infiltration rate used for design is 0.45 in/hour based on the above listed soils and align with the Minnesota Stormwater Manual Guidelines.

PROPOSED DEVELOPMENT

The proposed redevelopment will consist of renovating the easterly structure to repurpose it into an Acura car dealership. The renovation will consist of removing 3,395 s.f. of the existing structure and modifications to provide a 33,001 s.f. building footprint that includes a showroom, office space, and shop area among other amenities. There will also be new concrete walks, a parking lot with landscape islands, drive aisles, utilities, and an underground stormwater detention and infiltration system to meet City and Watershed stormwater requirements. The current site consists of three parcels that will be combined into one prior to development. For analysis, the evaluated drainage areas consist of only the proposed disturbed area plus the existing area draining to CB#1, all of which drains to MNDOT ROW. Note, the area draining to CB#1 will not be disturbed.

JURISDICTIONAL BODIES AND REQUIREMENTS

The City of Bloomington, Nine Mile Creek Watershed District (NMCWD), Minnesota Department of Transportation (MNDOT), and Minnesota Pollution Control Agency (MPCA) have review jurisdiction over storm water runoff from the proposed redevelopment at this site.

City of Bloomington

The City of Bloomington requires the proposed peak discharge rate from the 2, 10, and 100-year 24-hour rainfall events be at or below the existing peak discharge rates. Sites creating one or more acres of impervious surface shall capture and retain on site 1.0 inch of runoff from the new and/or fully reconstructed impervious surfaces.

Nine Mile Creek Watershed District

The NMCWD requires that the peak discharge rates for developments be at or below existing rates for the 2, 10, and 100-year, 24-hour rainfall events. Volume control must be provided in the amount equivalent to 1-inch of runoff over the entire impervious surface. Developments must incorporate effective nonpoint source pollution-reduction BMPs to achieve 90% TSS removal and 60% phosphorus removal.

MPCA

The state National Pollutant Discharge Elimination System (NPDES) requires retention on site of 1-inch of runoff from all new impervious surfaces where they replace one (1) of more acres of vegetation or pervious surface.

MNDOT

MNDOT requires all drainage entering MNDOT ROW to match or decrease rate in the proposed condition.

Net Requirements

The peak discharge rates for developmens be at or below existing rates for the 2, 10, and 100-year, 24-hour rainfall events. Volume control must be provided in the amount equivalent to 1-inch of runoff over the entire impervious surface. Developments must incorporate effective nonpoint source pollution-reduction BMPs to achieve 90% TSS removal and 60% phosphorus removal.

EXISTING SITE DRAINAGE PATTERNS

The majority of the site drains to a lift station in the heart of the site (Subcatchment 1S), while there is direct discharge on the east and west side of the site that drains to the east and south side of the site, respectively.

Refer to Appendix A for additional information.

PROPOSED ON-SITE STORM WATER MANAGEMENT

The design goal of the proposed drainage plan is to follow the existing drainage patterns to the extent possible and to meet the City of Bloomington, NMCWD, MNDOT, and the MPCA's stormwater requirements.

Rate Control

An underground infiltration and detention system is proposed to meet all rate control requirements set forth from all Authorities Having Jurisdiction. Table 1 compares the existing and proposed peak discharge rates for the four storms. In all cases the proposed rates are lower than the existing rates. Refer to Appendix D for the stormwater modeling.

Table 1 - Peak Discharge Rates

Event	Existing Runoff Rate (cfs)	Proposed Runoff Rate (cfs)
2-year (2.84")	7.71	5.27
10-year (4.25")	11.70	8.73
100-year (7.49")	19.47	17.12

Discharge to MNDOT ROW from CB#1 has an outlet capacity of 7.43 CFS. The proposed peak discharge rate for the 10-year event is 6.89 CFS. The is less than the capacity of the pipe.

Abstraction / Infiltration

We are proposing an underground infiltration system composed of prefabricated chambers to accommodate the retention requirement of 1" over the entire impervious surface of disturbed area. The proposed disturbed area is approximately 91,962 s.f. (total area [124,963 s.f.] less final building footprint [33,001 s.f.]) and, of the disturbed area, 72,471 s.f. is impervious. The total site is 6.34 acres (276,377 s.f.) and the disturbed area is roughly 33.3% of the total site, therefore NMCWD and the City of Bloomington only requires treatment of the disturbed impervious area. The overall infiltration requirement is 6,040 c.f. (72,471 s.f. / 1"/12" per foot). A design infiltration rate of 0.45 in/hr allows 1.8' of elevation change from the bottom of the system to the outlet/overflow invert to drawdown on 48 hours. Due to voids in rock storage below and around the system, the equivalent outlet elevation is 3.06'. This elevation is based on the footprint of the infiltration system (5,053.6 s.f.) multiplied by 1.8', resulting in 9096.5 c.f. of volume. This volume is then compared to the stage storage table of the infiltration system and aligns with an elevation of 845.56. The bottom of the rock base is 842.50, and the outlet/overflow invert is 845.56. See development plans and Appendices C and D for more information.

Water Quality

Water quality treatment will be provided by the underground infiltration system. The system will be composed of prefabricated arch chambers and isolator rows. Modeling was done using MIDS for the proposed condition, analyzing removal efficiencies of the total suspended solids and total phosphorous on an average annual basis.

A conservative approach was utilized in evaluating treated area for water quality. Direct discharge catchments do not drain into the infiltration system, but half of the roof of the final building footprint is being treated. The building is not part of the disturbed area but counts towards the treatment requirement. Subcatchment 4S has a total of 88,530 s.f. draining to the infiltration system, of that, 80,234 s.f. is impervious. Thus, the infiltration system is treating an impervious area than what is required (72,471 s.f.). The pervious treatment area is the difference of total treated area and the disturbed impervious area (88,530 s.f – 72,471 s.f. = 16,059 s.f.).

The overall removals for the proposed site was conservatively calculated at 95% for total phosphorous and 98% for total suspended solids. Furthermore, as part of the Lyndale Avenue Bridge Project, 78.2% of TSS removal is achieved for a 2.5" - 24 Hour Water Quality Rain Event for this site. Refer to Appendix G for the MIDS Summary.

TEMPORARY STORMWATER MANAGEMENT

To minimize erosion and sedimentation, silt fence, inlet protection, street sweeping, and stabilized rock constriction entrances will be implemented as part of the temporary erosion and sediment control plan.

CONCLUSION

Our design meets and exceeds all AHJ's requirements for rate control, volume control, and water quality treatment.

CONTACT INFORMATION

This document was prepared by:

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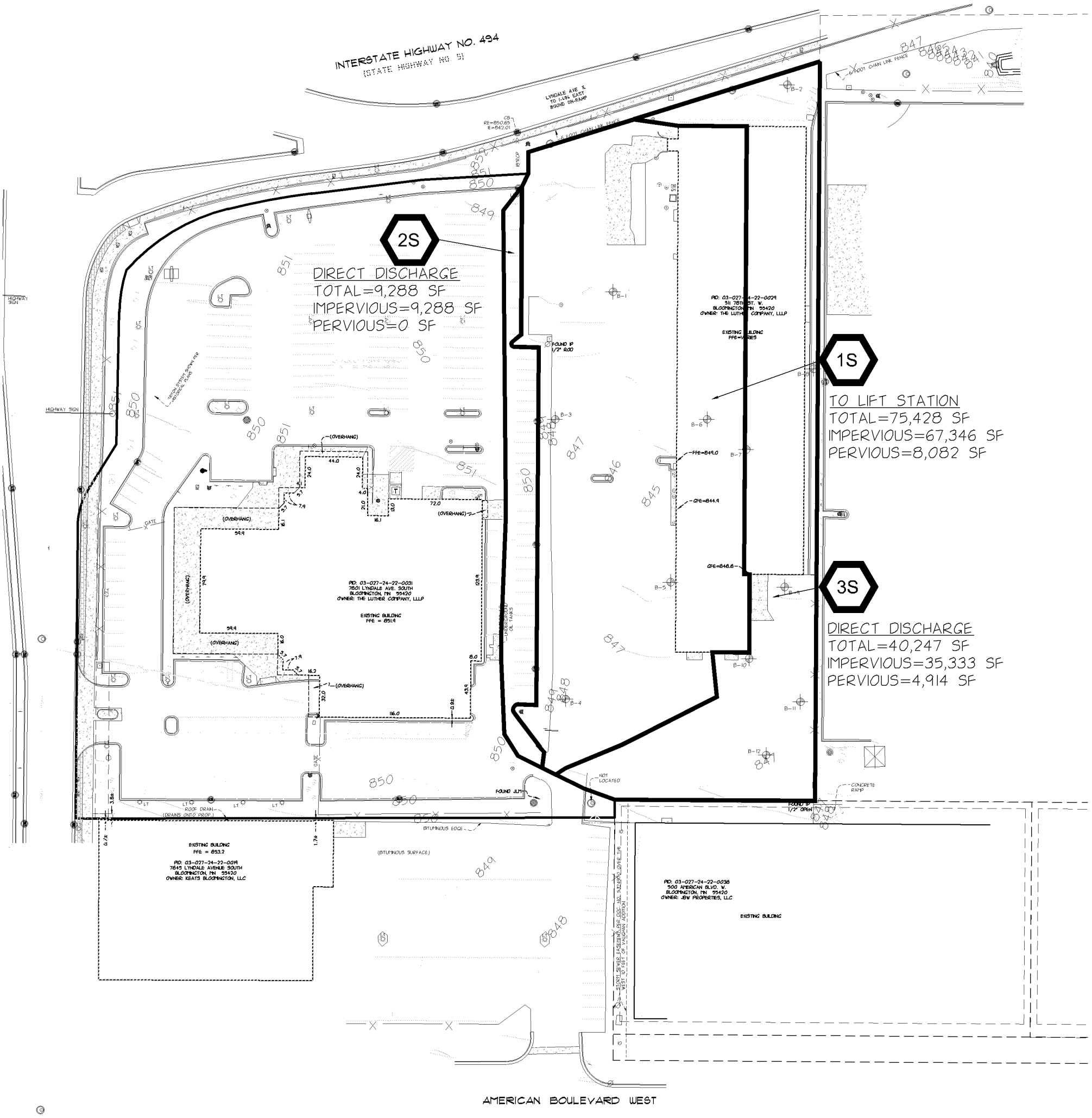
Please direct any questions regarding this stormwater narrative to Steve Sabraski at ssabraski@landform.net or 612.638.0243.

APPENDIX A: EXISTING DRAINAGE MAP

PL201800121
PL2018-121



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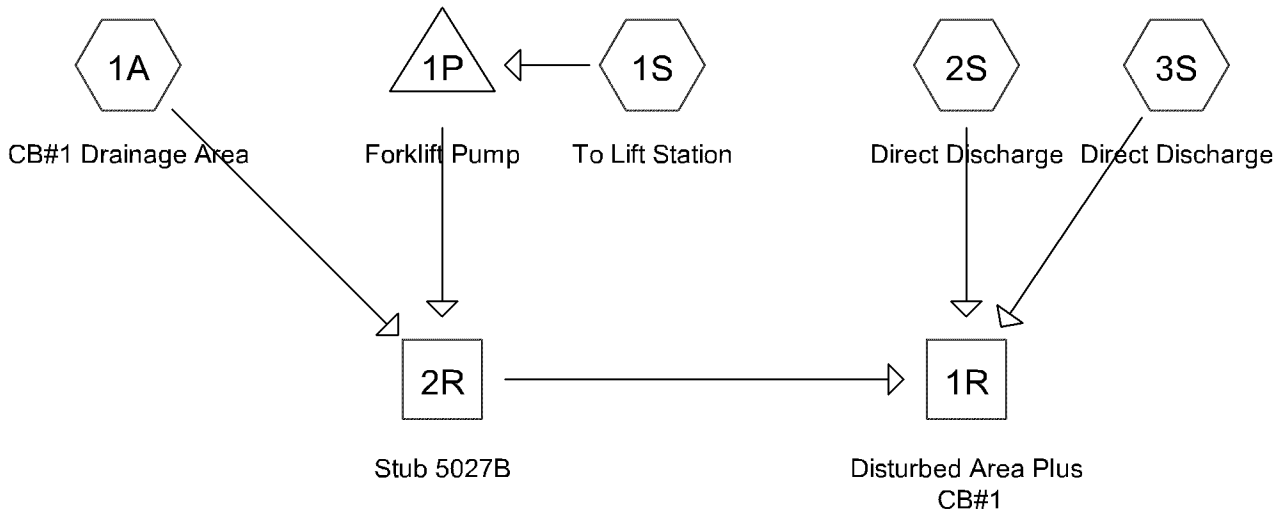
EXISTING DRAINAGE MAP

ACURA - SUBARU • BLOOMINGTON, MN

03.14.2018

APPENDIX B: EXISTING HYDROCAD MODEL



Subcat Reach Pond Link

Routing Diagram for BAA14041 Existing Conditions
Prepared by {enter your company name here}, Printed 3/29/2018

BAA14041 Existing Conditions

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.373	61	>75% Grass cover, Good, HSG B (1A, 1S, 3S)
0.654	98	Paved parking & roofs (1A)
0.213	98	Paved parking, HSG A (2S)
2.357	98	Paved parking, HSG B (1S, 3S)
3.597	**94**	**TOTAL AREA**

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1A: CB#1 Drainage Area Runoff Area=31,706 sf 89.79% Impervious Runoff Depth>2.06"
Tc=5.0 min CN=94 Runoff=2.69 cfs 0.125 af

Subcatchment 1S: To Lift Station Runoff Area=75,428 sf 89.29% Impervious Runoff Depth>2.06"
Tc=5.0 min CN=94 Runoff=6.40 cfs 0.297 af

Subcatchment 2S: Direct Discharge Runoff Area=9,288 sf 100.00% Impervious Runoff Depth>2.42"
Tc=5.0 min CN=98 Runoff=0.86 cfs 0.043 af

Subcatchment 3S: Direct Discharge Runoff Area=40,247 sf 87.79% Impervious Runoff Depth>1.97"
Tc=5.0 min CN=93 Runoff=3.31 cfs 0.152 af

Reach 1R: Disturbed Area Plus CB#1 Inflow=7.71 cfs 0.632 af
Outflow=7.71 cfs 0.632 af

Reach 2R: Stub 5027B Avg. Flow Depth=0.73' Max Vel=4.15 fps Inflow=3.58 cfs 0.437 af
18.0" Round Pipe n=0.013 L=44.0' S=0.0050 '/' Capacity=7.43 cfs Outflow=3.54 cfs 0.438 af

Pond 1P: Forklift Pump Peak Elev=845.90' Storage=4,320 cf Inflow=6.40 cfs 0.297 af
Outflow=0.90 cfs 0.312 af

Total Runoff Area = 3.597 ac Runoff Volume = 0.617 af Average Runoff Depth = 2.06"
10.36% Pervious = 0.373 ac 89.64% Impervious = 3.224 ac

Summary for Subcatchment 1A: CB#1 Drainage Area

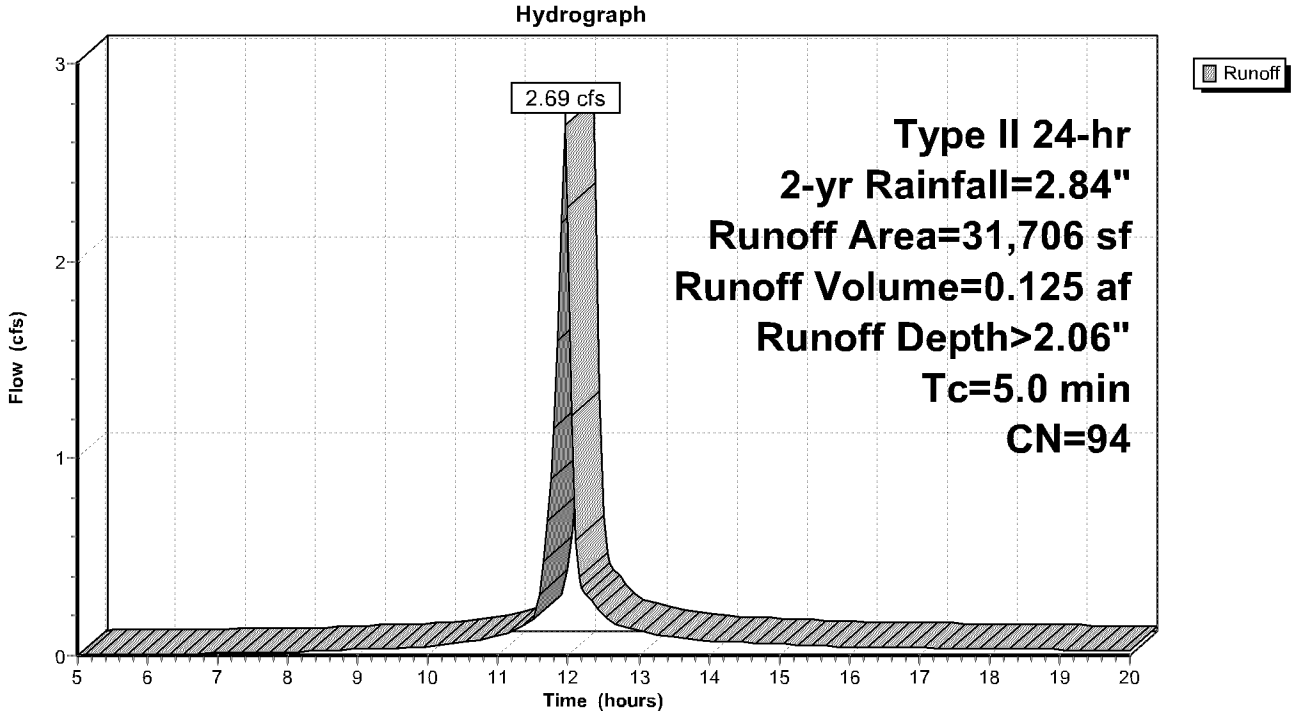
Runoff = 2.69 cfs @ 11.95 hrs, Volume= 0.125 af, Depth> 2.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.84"

Area (sf)	CN	Description
3,237	61	>75% Grass cover, Good, HSG B
28,469	98	Paved parking & roofs
31,706	94	Weighted Average
3,237		10.21% Pervious Area
28,469		89.79% Impervious Area

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

Subcatchment 1A: CB#1 Drainage Area



Summary for Subcatchment 1S: To Lift Station

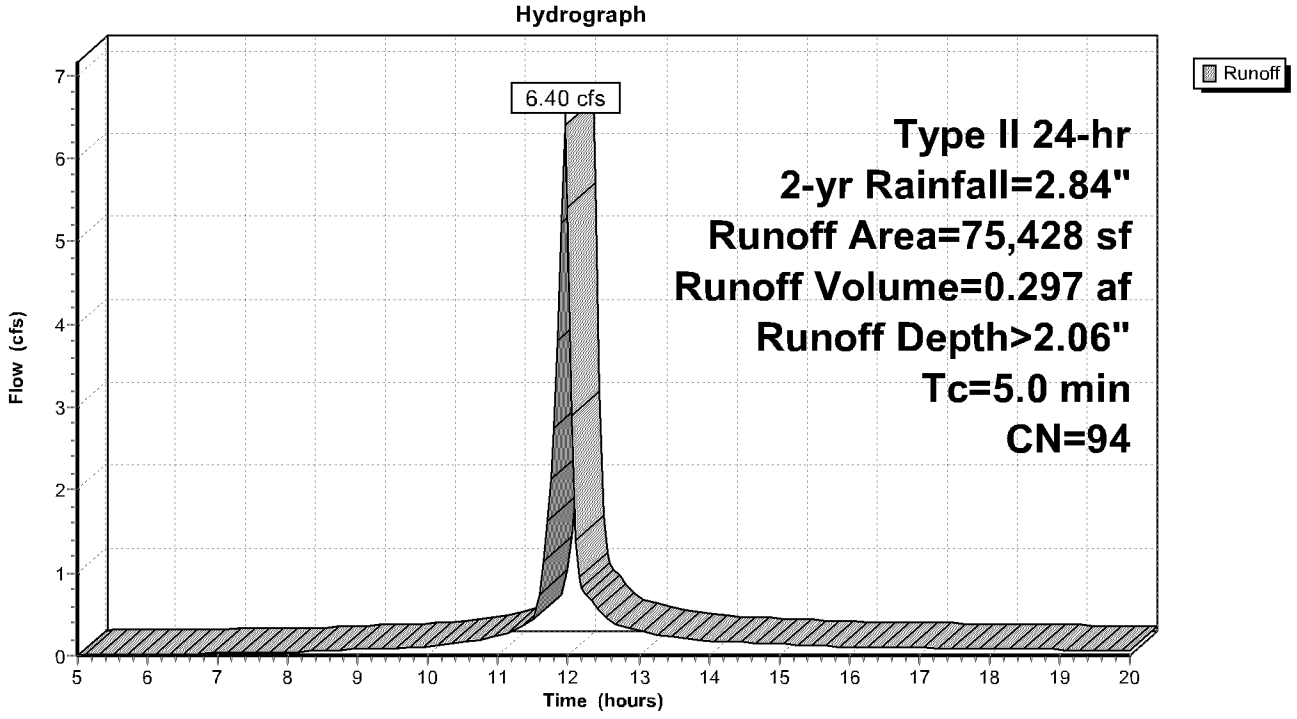
Runoff = 6.40 cfs @ 11.95 hrs, Volume= 0.297 af, Depth> 2.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.84"

Area (sf)	CN	Description
8,082	61	>75% Grass cover, Good, HSG B
67,346	98	Paved parking, HSG B
75,428	94	Weighted Average
8,082		10.71% Pervious Area
67,346		89.29% Impervious Area

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

Subcatchment 1S: To Lift Station



Summary for Subcatchment 2S: Direct Discharge

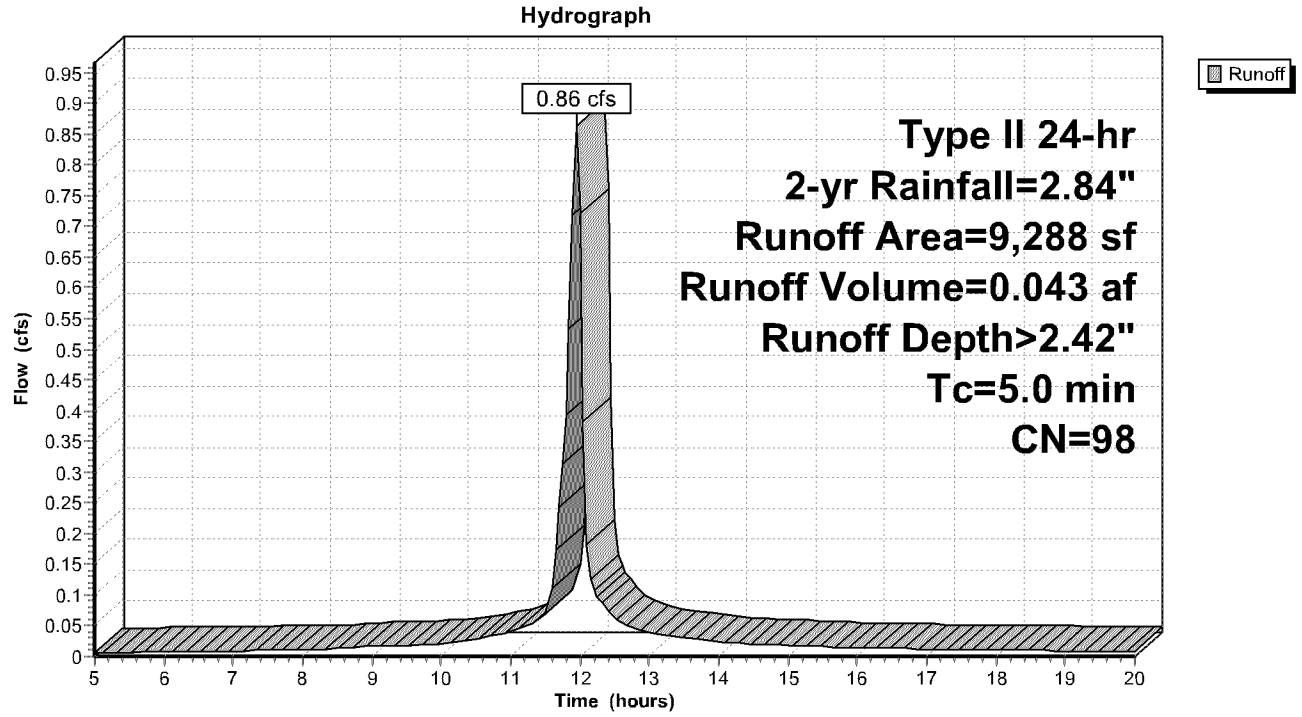
Runoff = 0.86 cfs @ 11.95 hrs, Volume= 0.043 af, Depth> 2.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.84"

Area (sf)	CN	Description
9,288	98	Paved parking, HSG A
9,288		100.00% Impervious Area

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

Subcatchment 2S: Direct Discharge



Summary for Subcatchment 3S: Direct Discharge

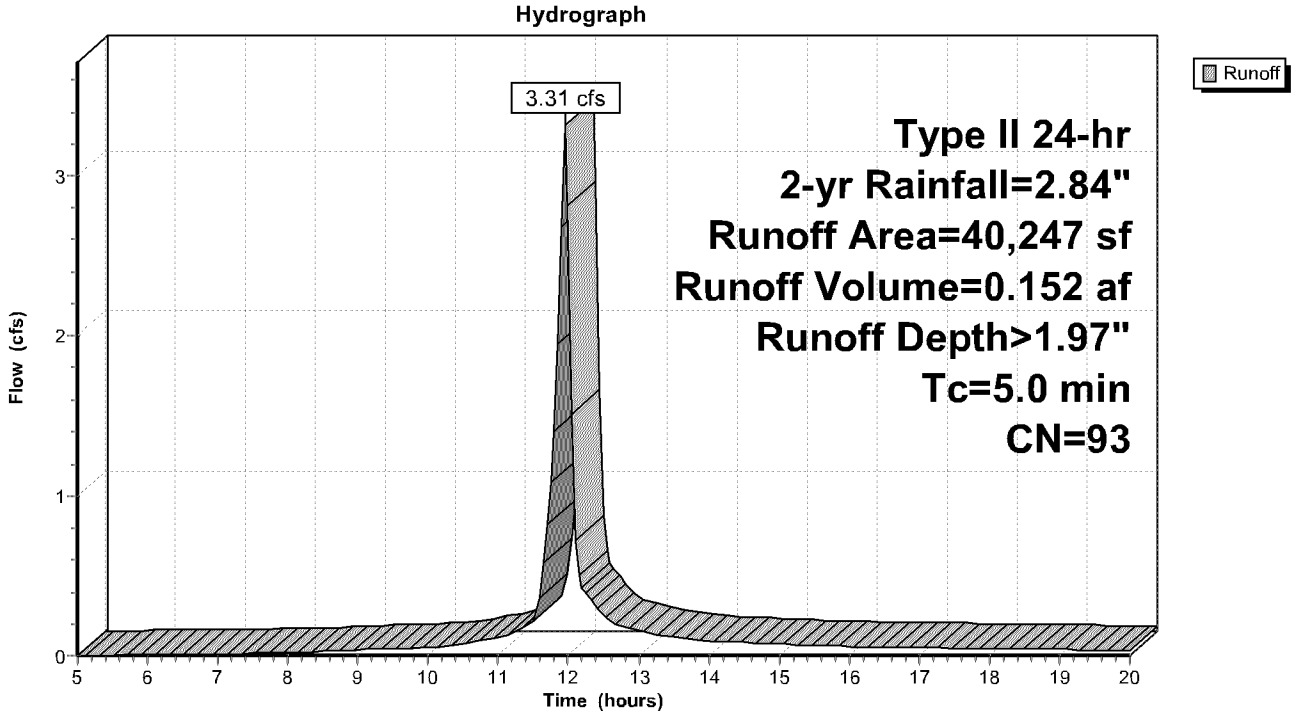
Runoff = 3.31 cfs @ 11.95 hrs, Volume= 0.152 af, Depth> 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.84"

Area (sf)	CN	Description
35,333	98	Paved parking, HSG B
4,914	61	>75% Grass cover, Good, HSG B
40,247	93	Weighted Average
4,914		12.21% Pervious Area
35,333		87.79% Impervious Area

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

Subcatchment 3S: Direct Discharge

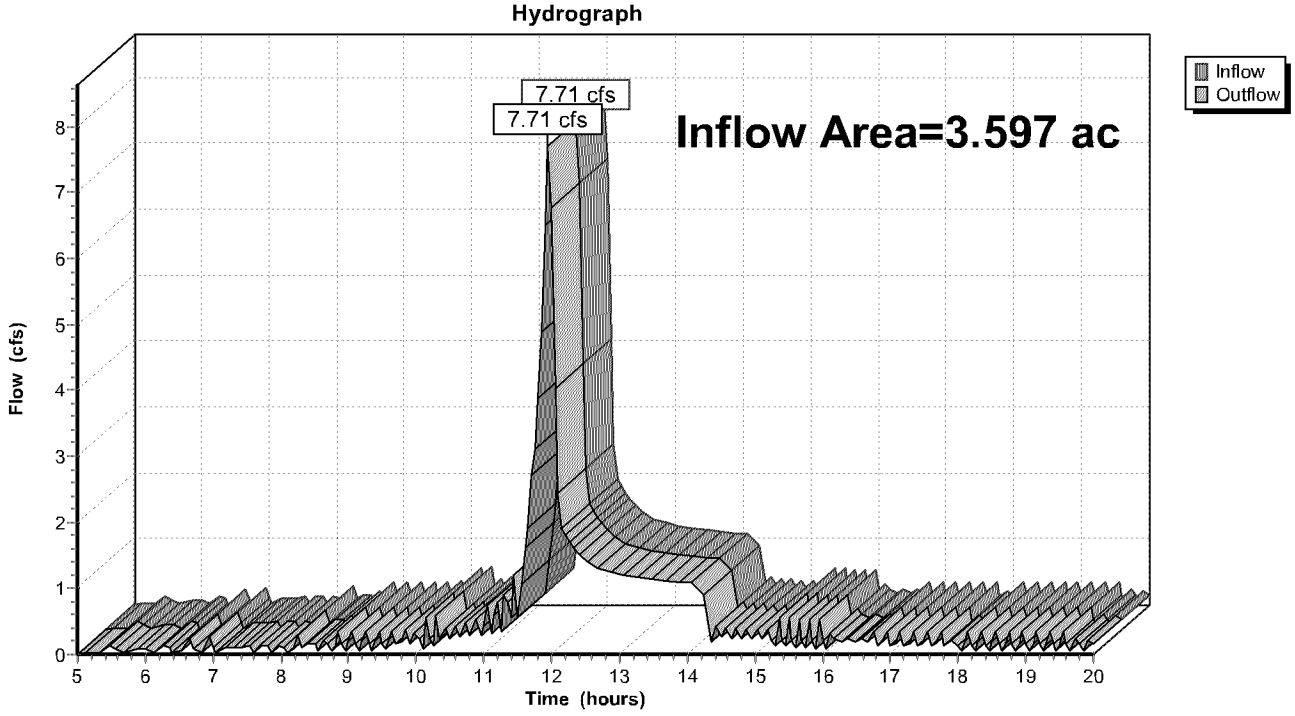


Summary for Reach 1R: Disturbed Area Plus CB#1

Inflow Area = 3.597 ac, 89.64% Impervious, Inflow Depth > 2.11" for 2-yr event
Inflow = 7.71 cfs @ 11.95 hrs, Volume= 0.632 af
Outflow = 7.71 cfs @ 11.95 hrs, Volume= 0.632 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach 1R: Disturbed Area Plus CB#1



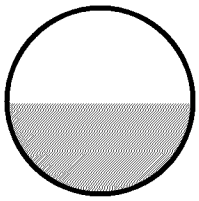
Summary for Reach 2R: Stub 5027B

Inflow Area = 2.459 ac, 89.43% Impervious, Inflow Depth > 2.13" for 2-yr event
Inflow = 3.58 cfs @ 11.95 hrs, Volume= 0.437 af
Outflow = 3.54 cfs @ 11.96 hrs, Volume= 0.438 af, Atten= 1%, Lag= 0.2 min

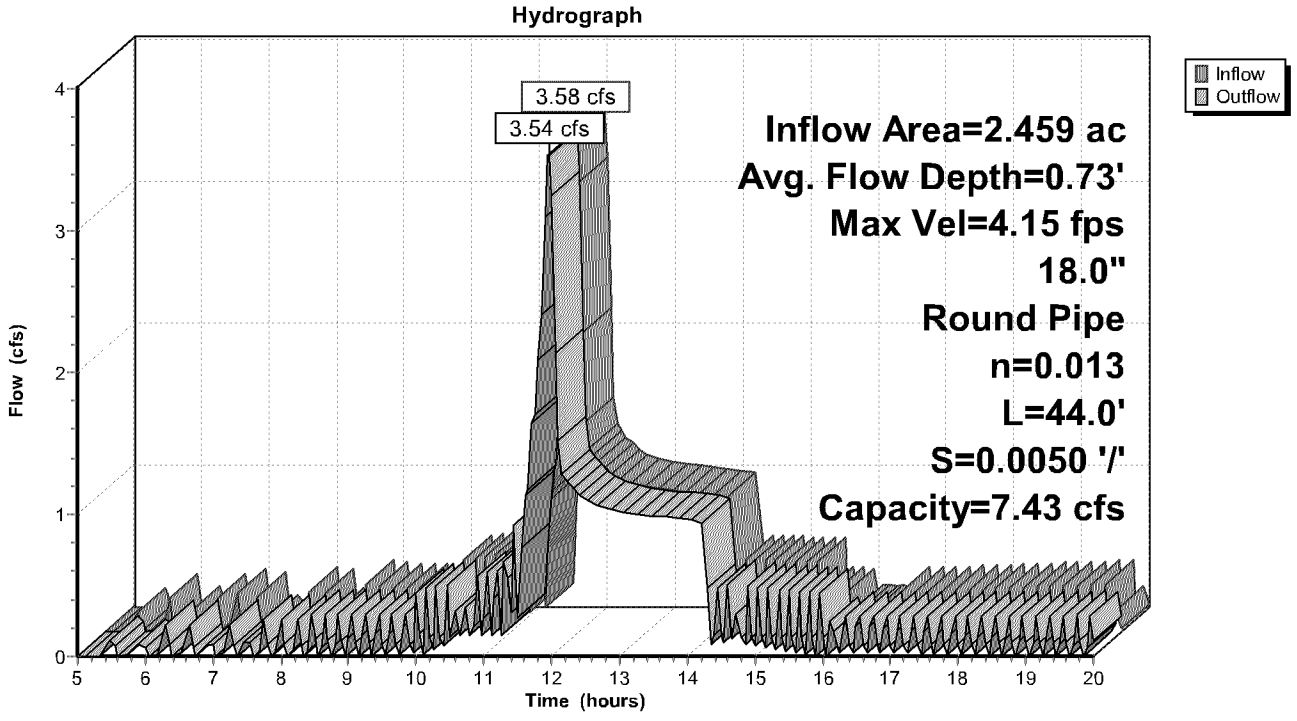
Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.15 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.82 fps, Avg. Travel Time= 0.4 min

Peak Storage= 37 cf @ 11.96 hrs
Average Depth at Peak Storage= 0.73'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 7.43 cfs

18.0" Round Pipe
n= 0.013 Concrete pipe, straight & clean
Length= 44.0' Slope= 0.0050 '/'
Inlet Invert= 842.23', Outlet Invert= 842.01'



Reach 2R: Stub 5027B



Summary for Pond 1P: Forklift Pump

Inflow Area = 1.732 ac, 89.29% Impervious, Inflow Depth > 2.06" for 2-yr event
Inflow = 6.40 cfs @ 11.95 hrs, Volume= 0.297 af
Outflow = 0.90 cfs @ 12.17 hrs, Volume= 0.312 af, Atten= 86%, Lag= 13.3 min
Primary = 0.90 cfs @ 12.17 hrs, Volume= 0.312 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 845.90' @ 12.17 hrs Surf.Area= 7,200 sf Storage= 4,320 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 28.6 min (781.9 - 753.3)

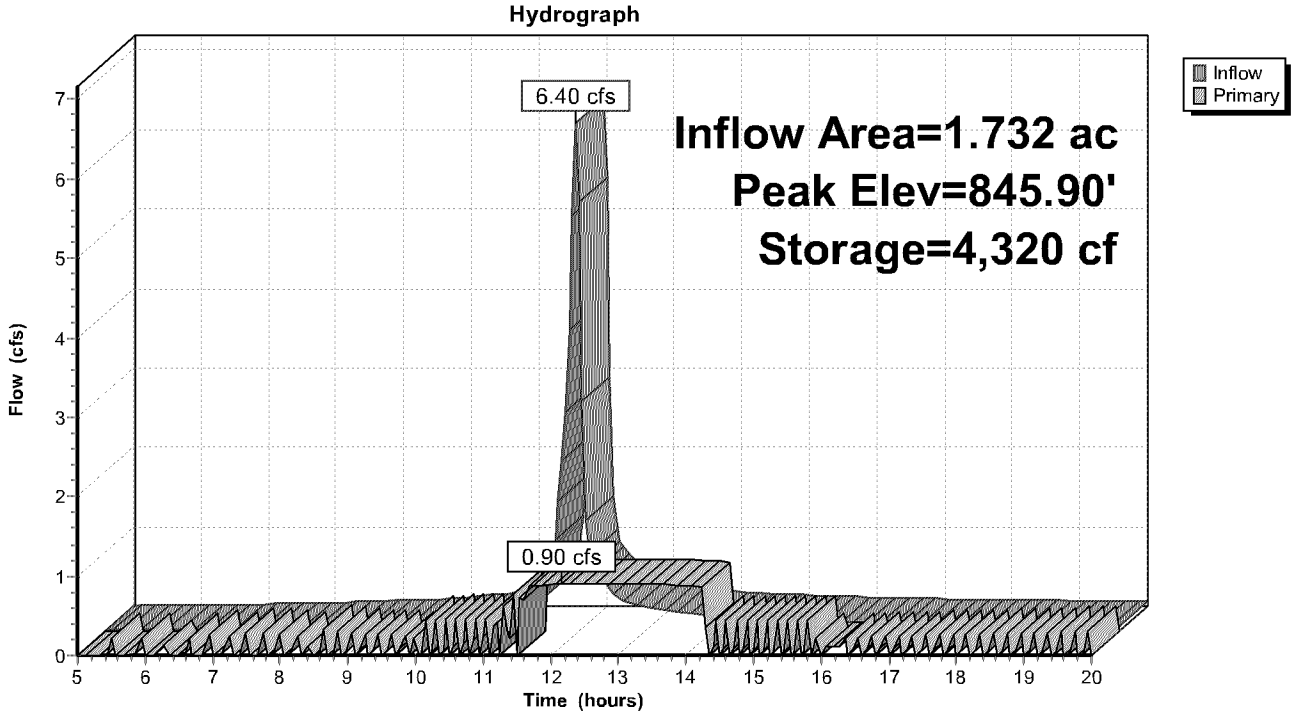
Volume	Invert	Avail.Storage	Storage Description
#1	838.00'	477,378 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
#2	839.00'	8 cf	**4.0" Round Pipe Storage** L= 92.0'
		477,386 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
838.00	20	0	0
844.70	20	134	134
845.70	5,752	2,886	3,020
847.00	15,187	13,610	16,630
855.00	100,000	460,748	477,378

Device	Routing	Invert	Outlet Devices
#1	Primary	839.00'	**Pump** Discharges@843.65' Turns Off@838.01' 4.0" Diam. x 243.0' Long Discharge, Hazen-Williams C= 130 Flow (gpm)= 0.0 100.0 200.0 350.0 450.0 Head (feet)= 46.00 38.50 33.50 26.00 19.00 -Loss (feet)= 0.00 1.83 6.59 18.59 29.60 =Lift (feet)= 46.00 36.67 26.91 7.41 -10.60

Primary OutFlow Max=0.90 cfs @ 12.17 hrs HW=845.90' TW=842.65' (Dynamic Tailwater)
↑—**1=Pump** (Pump Controls 0.90 cfs)

Pond 1P: Forklift Pump



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1A: CB#1 Drainage Area Runoff Area=31,706 sf 89.79% Impervious Runoff Depth>3.34"
Tc=5.0 min CN=94 Runoff=4.23 cfs 0.203 af

Subcatchment 1S: To Lift Station Runoff Area=75,428 sf 89.29% Impervious Runoff Depth>3.34"
Tc=5.0 min CN=94 Runoff=10.07 cfs 0.482 af

Subcatchment 2S: Direct Discharge Runoff Area=9,288 sf 100.00% Impervious Runoff Depth>3.69"
Tc=5.0 min CN=98 Runoff=1.30 cfs 0.066 af

Subcatchment 3S: Direct Discharge Runoff Area=40,247 sf 87.79% Impervious Runoff Depth>3.25"
Tc=5.0 min CN=93 Runoff=5.28 cfs 0.250 af

Reach 1R: Disturbed Area Plus CB#1 Inflow=11.70 cfs 1.014 af
Outflow=11.70 cfs 1.014 af

Reach 2R: Stub 5027B Avg. Flow Depth=0.92' Max Vel=4.53 fps Inflow=5.13 cfs 0.698 af
18.0" Round Pipe n=0.013 L=44.0' S=0.0050 '/' Capacity=7.43 cfs Outflow=5.12 cfs 0.699 af

Pond 1P: Forklift Pump Peak Elev=846.34' Storage=8,146 cf Inflow=10.07 cfs 0.482 af
Outflow=0.90 cfs 0.496 af

Total Runoff Area = 3.597 ac Runoff Volume = 1.001 af Average Runoff Depth = 3.34"
10.36% Pervious = 0.373 ac 89.64% Impervious = 3.224 ac

Summary for Subcatchment 1A: CB#1 Drainage Area

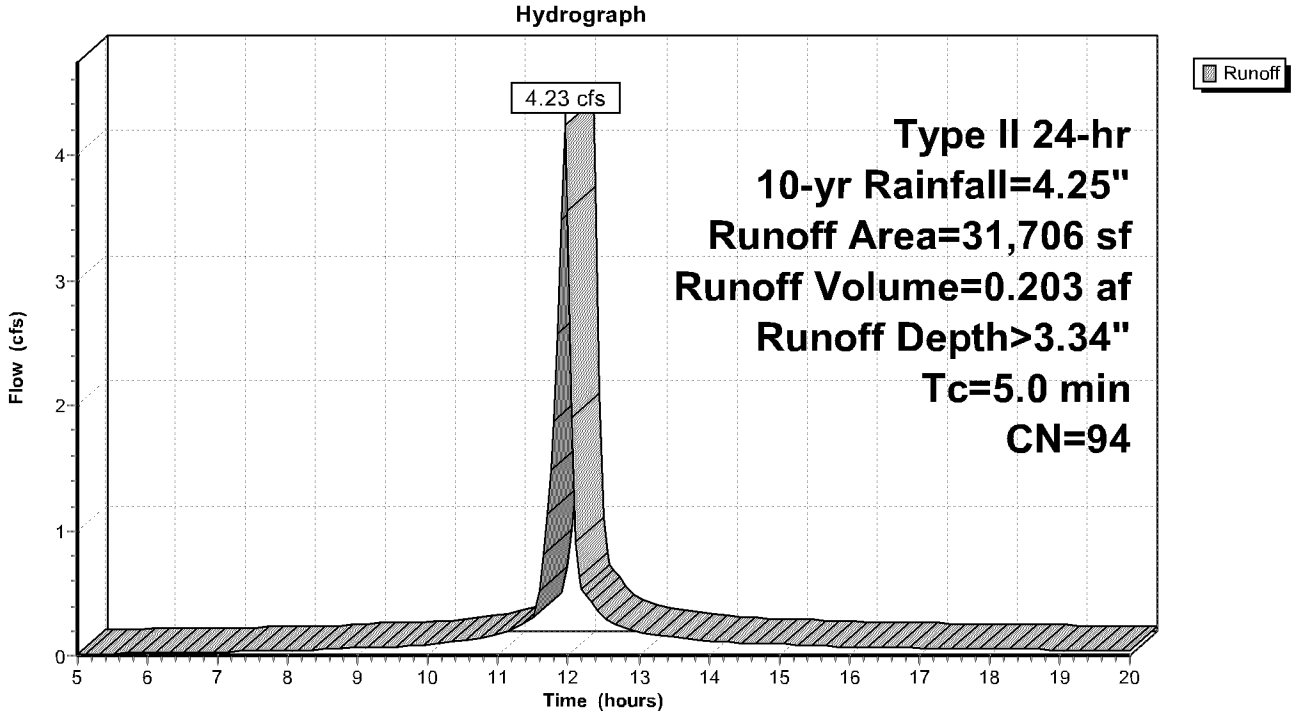
Runoff = 4.23 cfs @ 11.95 hrs, Volume= 0.203 af, Depth> 3.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.25"

Area (sf)	CN	Description
3,237	61	>75% Grass cover, Good, HSG B
28,469	98	Paved parking & roofs
31,706	94	Weighted Average
3,237		10.21% Pervious Area
28,469		89.79% Impervious Area

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

Subcatchment 1A: CB#1 Drainage Area



Summary for Subcatchment 1S: To Lift Station

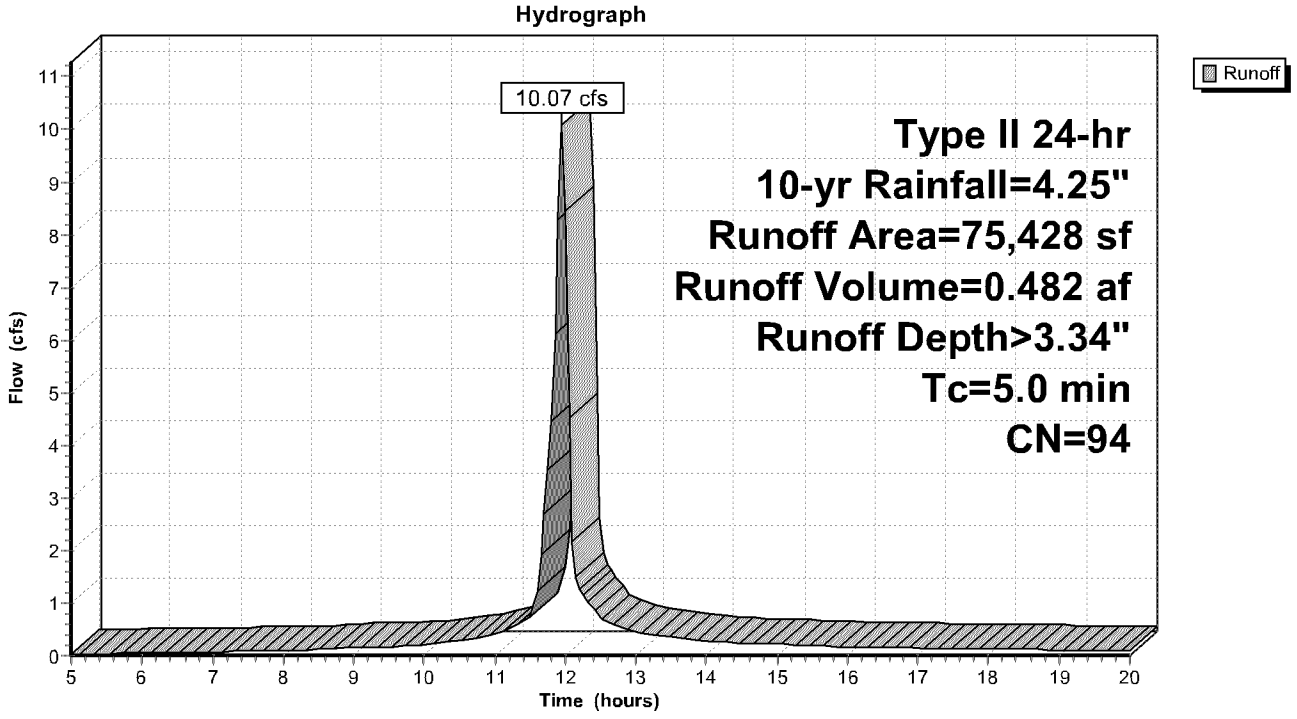
Runoff = 10.07 cfs @ 11.95 hrs, Volume= 0.482 af, Depth> 3.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.25"

Area (sf)	CN	Description
8,082	61	>75% Grass cover, Good, HSG B
67,346	98	Paved parking, HSG B
75,428	94	Weighted Average
8,082		10.71% Pervious Area
67,346		89.29% Impervious Area

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

Subcatchment 1S: To Lift Station



Summary for Subcatchment 2S: Direct Discharge

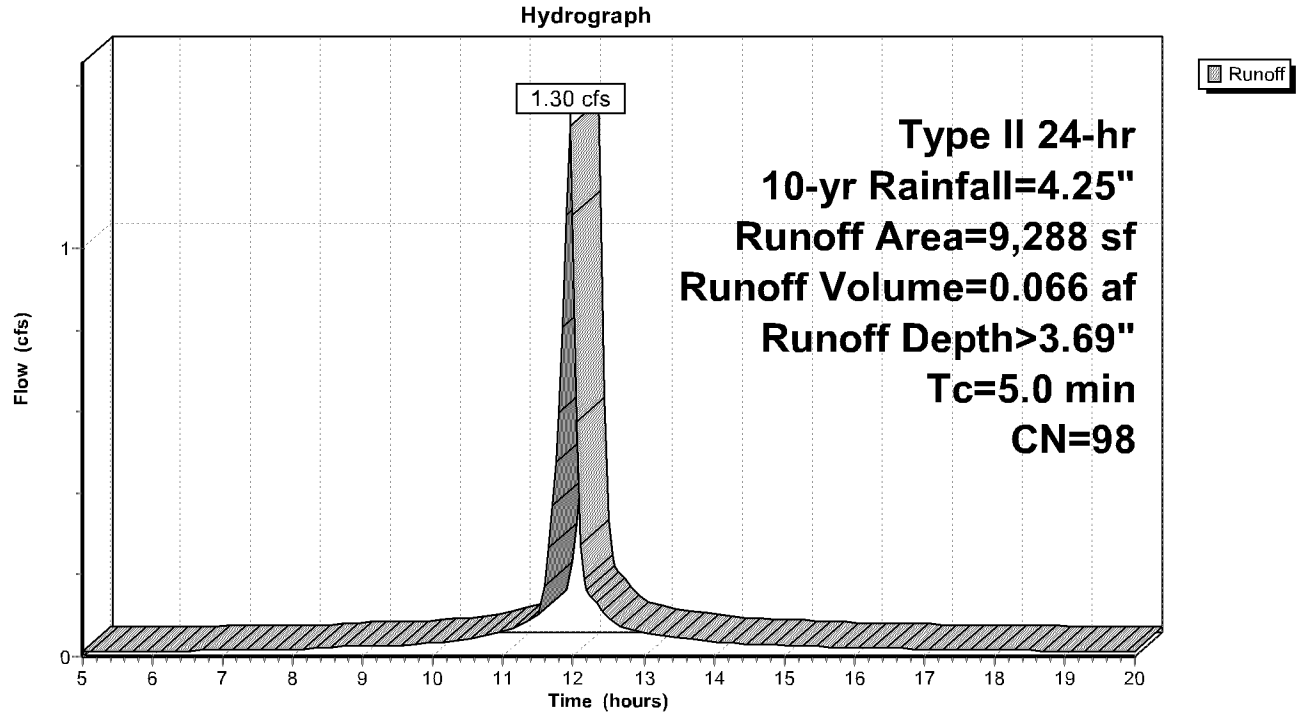
Runoff = 1.30 cfs @ 11.95 hrs, Volume= 0.066 af, Depth> 3.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.25"

Area (sf)	CN	Description
9,288	98	Paved parking, HSG A
9,288		100.00% Impervious Area

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

Subcatchment 2S: Direct Discharge



Summary for Subcatchment 3S: Direct Discharge

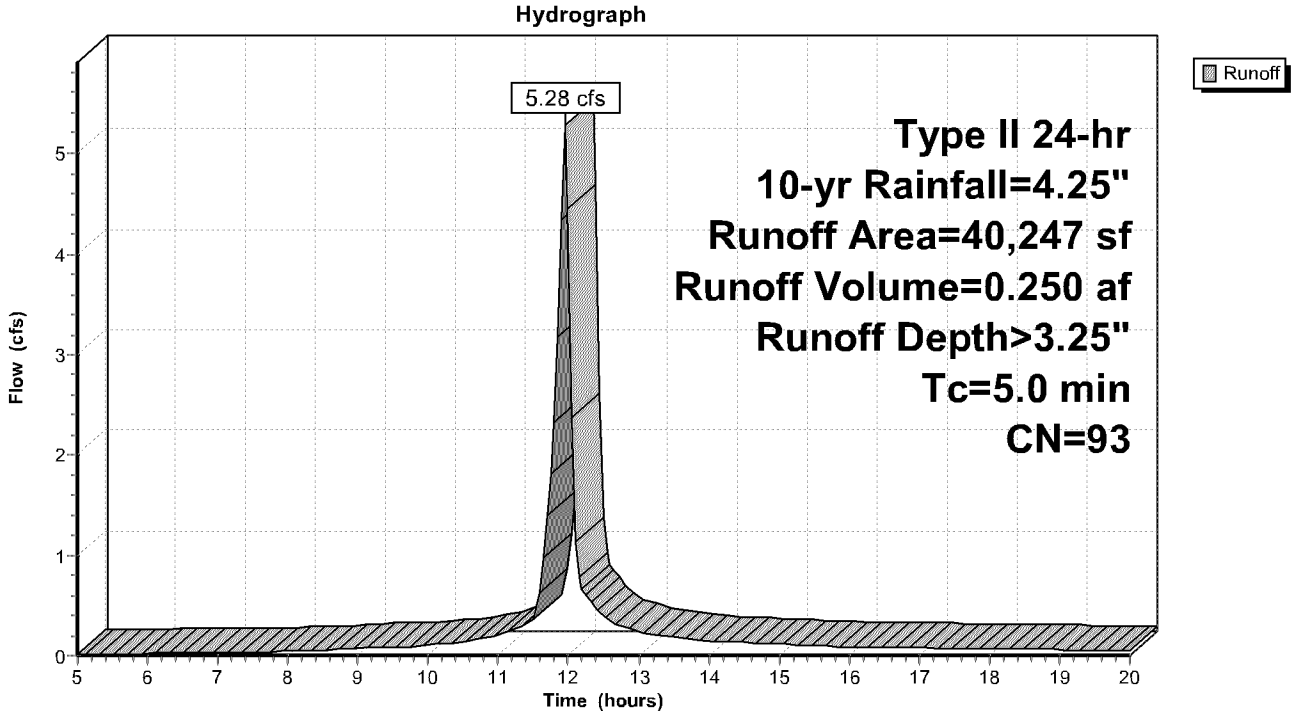
Runoff = 5.28 cfs @ 11.95 hrs, Volume= 0.250 af, Depth> 3.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.25"

Area (sf)	CN	Description
35,333	98	Paved parking, HSG B
4,914	61	>75% Grass cover, Good, HSG B
40,247	93	Weighted Average
4,914		12.21% Pervious Area
35,333		87.79% Impervious Area

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

Subcatchment 3S: Direct Discharge

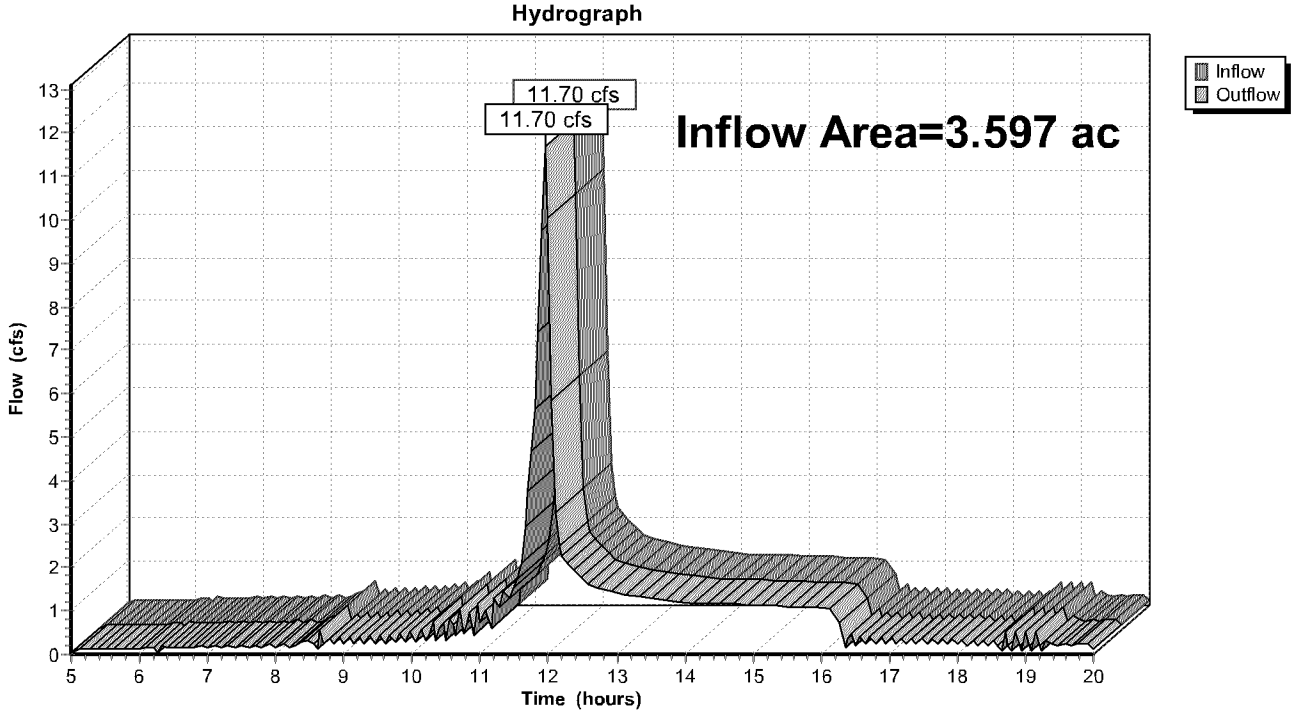


Summary for Reach 1R: Disturbed Area Plus CB#1

Inflow Area = 3.597 ac, 89.64% Impervious, Inflow Depth > 3.38" for 10-yr event
Inflow = 11.70 cfs @ 11.95 hrs, Volume= 1.014 af
Outflow = 11.70 cfs @ 11.95 hrs, Volume= 1.014 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach 1R: Disturbed Area Plus CB#1



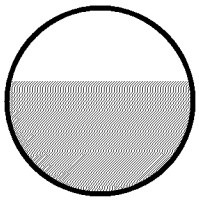
Summary for Reach 2R: Stub 5027B

Inflow Area = 2.459 ac, 89.43% Impervious, Inflow Depth > 3.41" for 10-yr event
Inflow = 5.13 cfs @ 11.95 hrs, Volume= 0.698 af
Outflow = 5.12 cfs @ 11.95 hrs, Volume= 0.699 af, Atten= 0%, Lag= 0.1 min

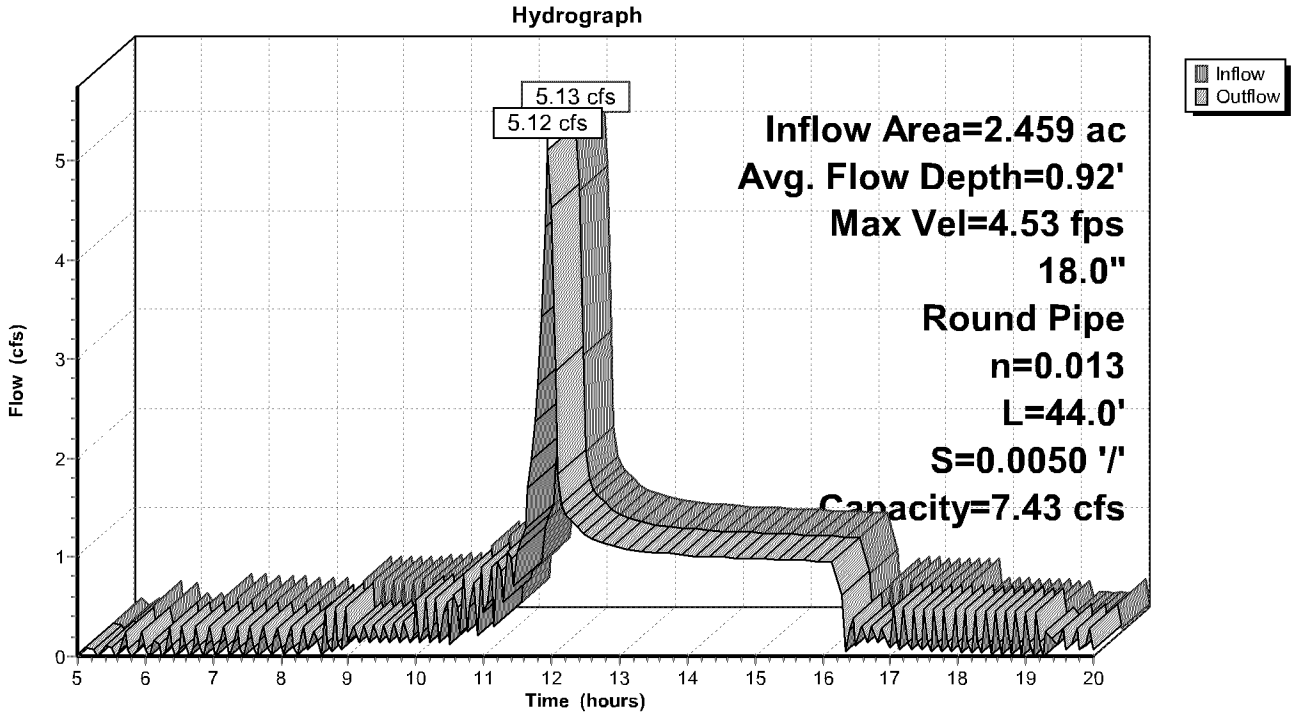
Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.53 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.18 fps, Avg. Travel Time= 0.3 min

Peak Storage= 50 cf @ 11.95 hrs
Average Depth at Peak Storage= 0.92'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 7.43 cfs

18.0" Round Pipe
n= 0.013 Concrete pipe, straight & clean
Length= 44.0' Slope= 0.0050 '/'
Inlet Invert= 842.23', Outlet Invert= 842.01'



Reach 2R: Stub 5027B



Summary for Pond 1P: Forklift Pump

Inflow Area = 1.732 ac, 89.29% Impervious, Inflow Depth > 3.34" for 10-yr event
Inflow = 10.07 cfs @ 11.95 hrs, Volume= 0.482 af
Outflow = 0.90 cfs @ 12.41 hrs, Volume= 0.496 af, Atten= 91%, Lag= 27.3 min
Primary = 0.90 cfs @ 12.41 hrs, Volume= 0.496 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 846.34' @ 12.41 hrs Surf.Area= 10,363 sf Storage= 8,146 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 61.1 min (805.4 - 744.3)

Volume	Invert	Avail.Storage	Storage Description
#1	838.00'	477,378 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
#2	839.00'	8 cf	**4.0" Round Pipe Storage** L= 92.0'
		477,386 cf	Total Available Storage

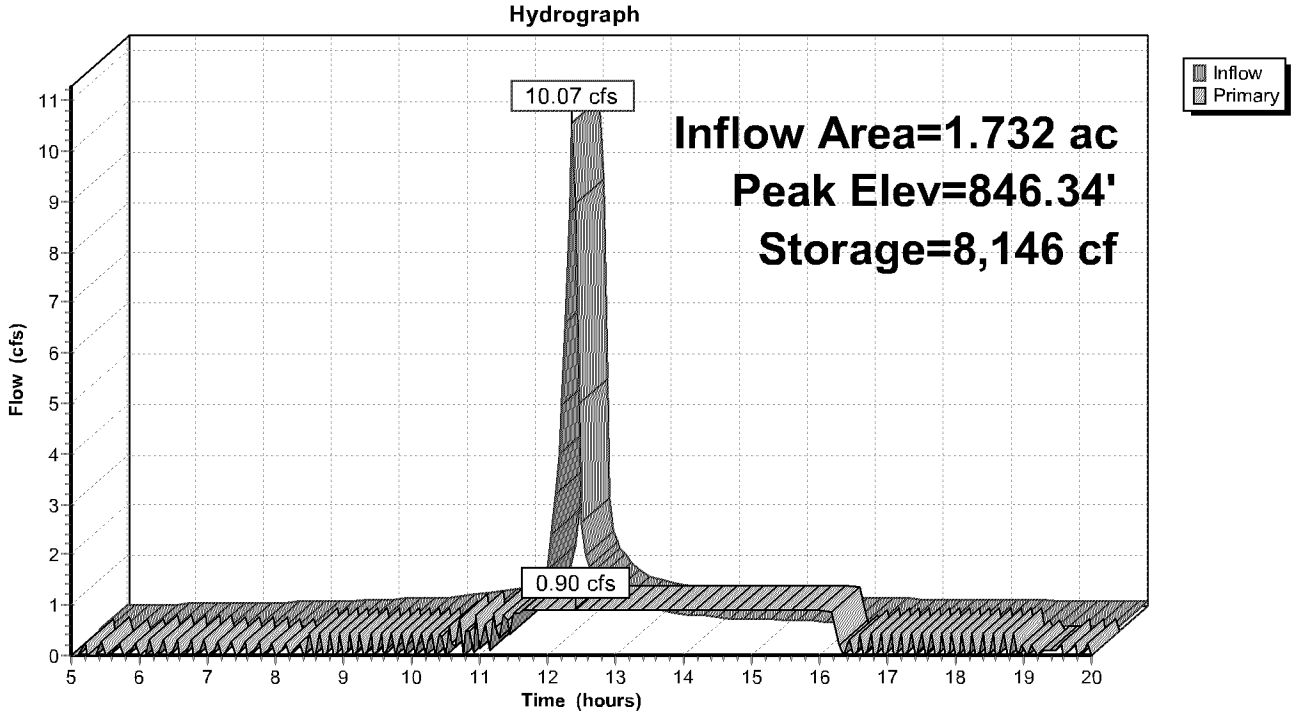
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
838.00	20	0	0
844.70	20	134	134
845.70	5,752	2,886	3,020
847.00	15,187	13,610	16,630
855.00	100,000	460,748	477,378

Device	Routing	Invert	Outlet Devices
#1	Primary	839.00'	**Pump** Discharges@843.65' Turns Off@838.01'

4.0" Diam. x 243.0' Long Discharge, Hazen-Williams C= 130
Flow (gpm)= 0.0 100.0 200.0 350.0 450.0
Head (feet)= 46.00 38.50 33.50 26.00 19.00
-Loss (feet)= 0.00 1.83 6.59 18.59 29.60
=Lift (feet)= 46.00 36.67 26.91 7.41 -10.60

Primary OutFlow Max=0.90 cfs @ 12.41 hrs HW=846.34' TW=842.65' (Dynamic Tailwater)
↑—**1=Pump** (Pump Controls 0.90 cfs)

Pond 1P: Forklift Pump



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1A: CB#1 Drainage Area Runoff Area=31,706 sf 89.79% Impervious Runoff Depth>6.30"
Tc=5.0 min CN=94 Runoff=7.72 cfs 0.382 af

Subcatchment 1S: To Lift Station Runoff Area=75,428 sf 89.29% Impervious Runoff Depth>6.30"
Tc=5.0 min CN=94 Runoff=18.37 cfs 0.909 af

Subcatchment 2S: Direct Discharge Runoff Area=9,288 sf 100.00% Impervious Runoff Depth>6.60"
Tc=5.0 min CN=98 Runoff=2.30 cfs 0.117 af

Subcatchment 3S: Direct Discharge Runoff Area=40,247 sf 87.79% Impervious Runoff Depth>6.21"
Tc=5.0 min CN=93 Runoff=9.74 cfs 0.478 af

Reach 1R: Disturbed Area Plus CB#1 Inflow=19.47 cfs 1.803 af
Outflow=19.47 cfs 1.803 af

Reach 2R: Stub 5027B Avg. Flow Depth=1.50' Max Vel=4.79 fps Inflow=8.63 cfs 1.208 af
18.0" Round Pipe n=0.013 L=44.0' S=0.0050 '/' Capacity=7.43 cfs Outflow=7.45 cfs 1.208 af

Pond 1P: Forklift Pump Peak Elev=847.10' Storage=18,162 cf Inflow=18.37 cfs 0.909 af
Outflow=0.91 cfs 0.826 af

Total Runoff Area = 3.597 ac Runoff Volume = 1.886 af Average Runoff Depth = 6.29"
10.36% Pervious = 0.373 ac 89.64% Impervious = 3.224 ac

Summary for Subcatchment 1A: CB#1 Drainage Area

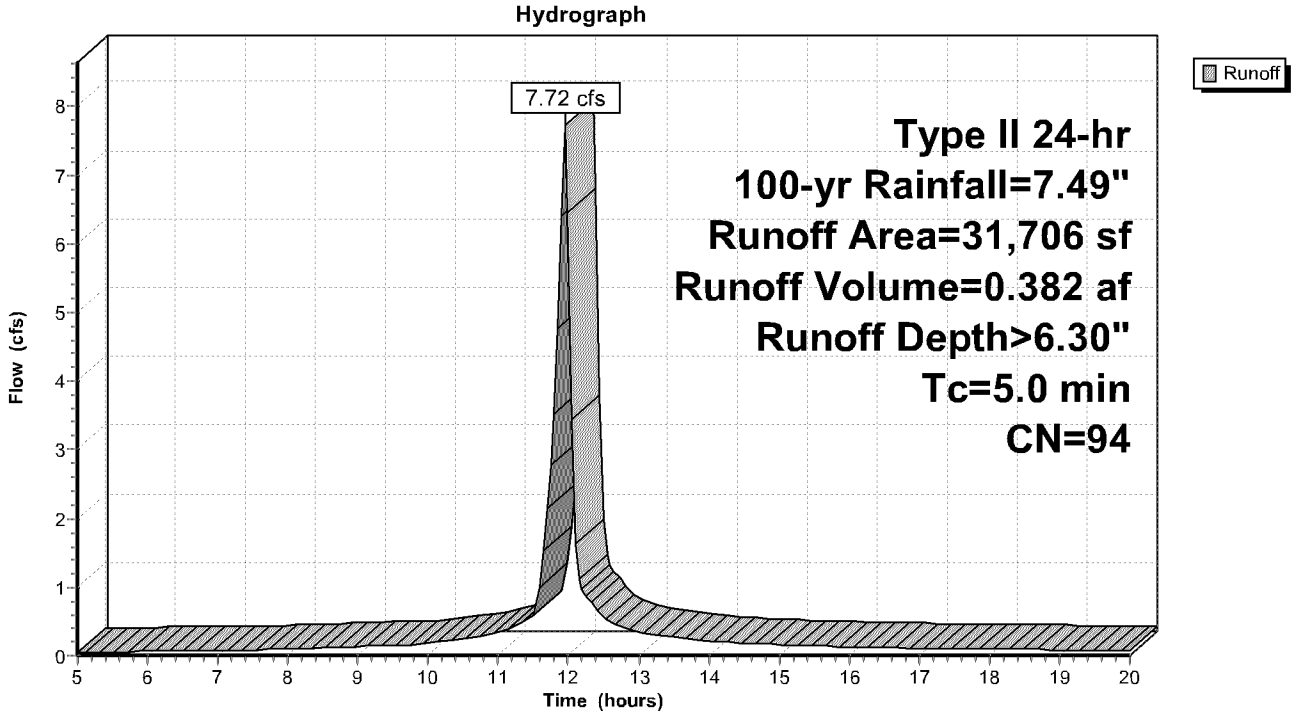
Runoff = 7.72 cfs @ 11.95 hrs, Volume= 0.382 af, Depth> 6.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=7.49"

Area (sf)	CN	Description
3,237	61	>75% Grass cover, Good, HSG B
28,469	98	Paved parking & roofs
31,706	94	Weighted Average
3,237		10.21% Pervious Area
28,469		89.79% Impervious Area

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

Subcatchment 1A: CB#1 Drainage Area



Summary for Subcatchment 1S: To Lift Station

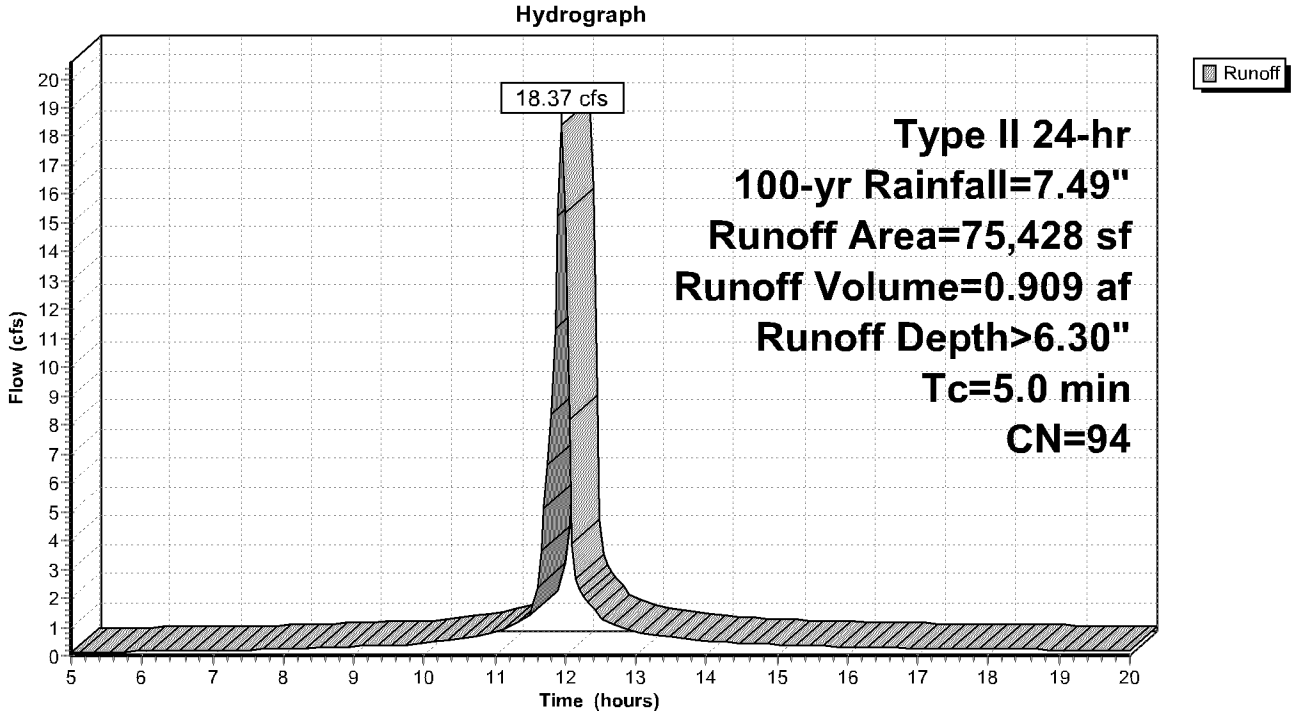
Runoff = 18.37 cfs @ 11.95 hrs, Volume= 0.909 af, Depth> 6.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=7.49"

Area (sf)	CN	Description
8,082	61	>75% Grass cover, Good, HSG B
67,346	98	Paved parking, HSG B
75,428	94	Weighted Average
8,082		10.71% Pervious Area
67,346		89.29% Impervious Area

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

Subcatchment 1S: To Lift Station



Summary for Subcatchment 2S: Direct Discharge

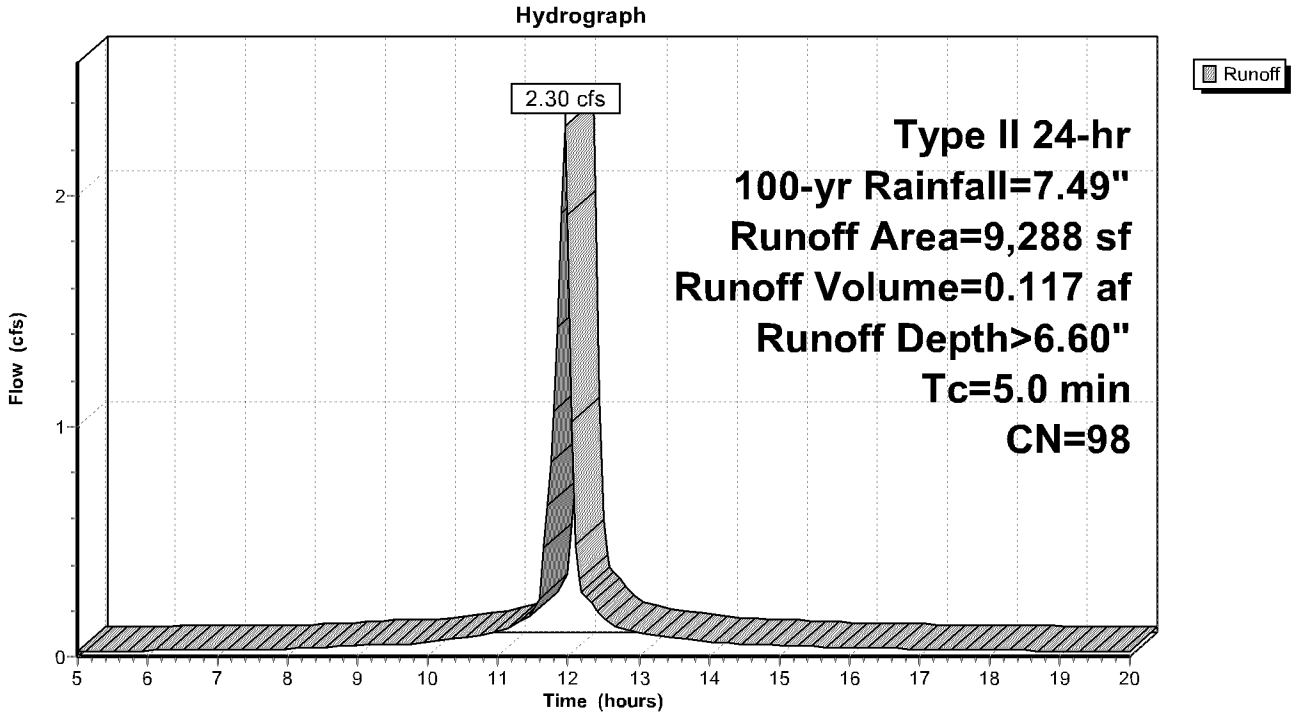
Runoff = 2.30 cfs @ 11.95 hrs, Volume= 0.117 af, Depth> 6.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=7.49"

Area (sf)	CN	Description
9,288	98	Paved parking, HSG A
9,288		100.00% Impervious Area

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

Subcatchment 2S: Direct Discharge



Summary for Subcatchment 3S: Direct Discharge

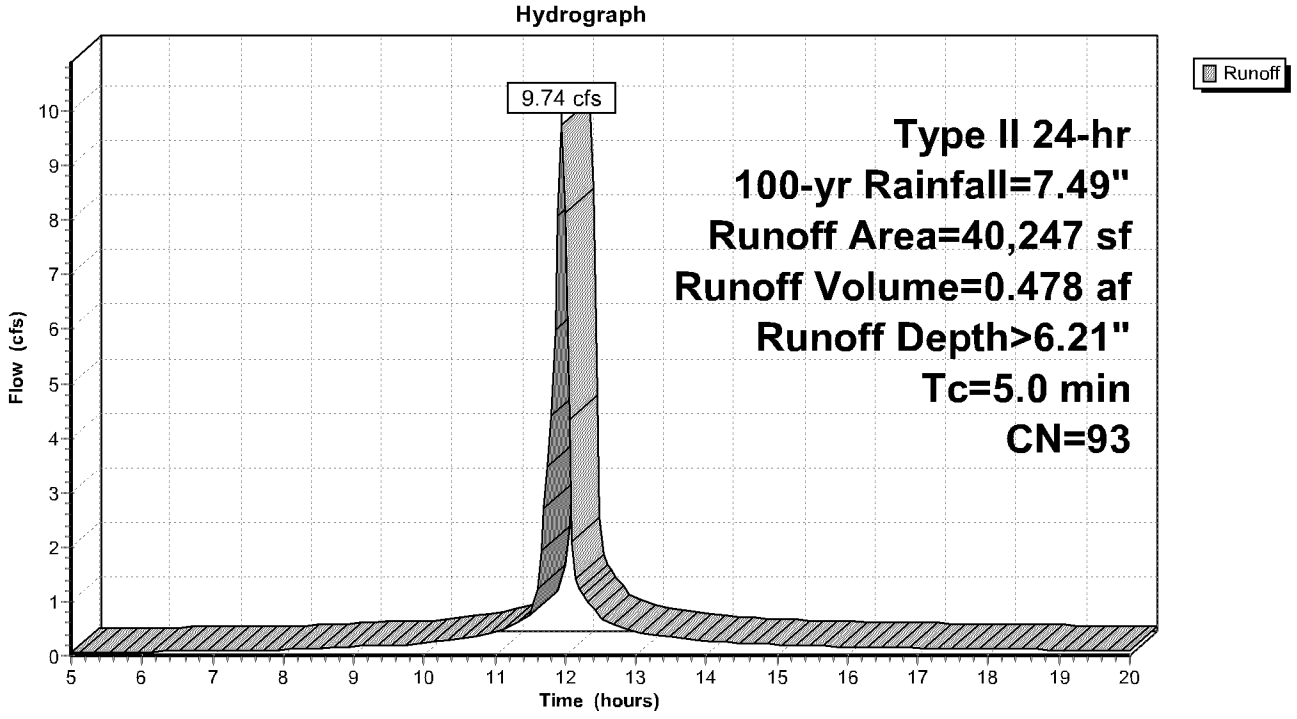
Runoff = 9.74 cfs @ 11.95 hrs, Volume= 0.478 af, Depth> 6.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=7.49"

Area (sf)	CN	Description
35,333	98	Paved parking, HSG B
4,914	61	>75% Grass cover, Good, HSG B
40,247	93	Weighted Average
4,914		12.21% Pervious Area
35,333		87.79% Impervious Area

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

Subcatchment 3S: Direct Discharge

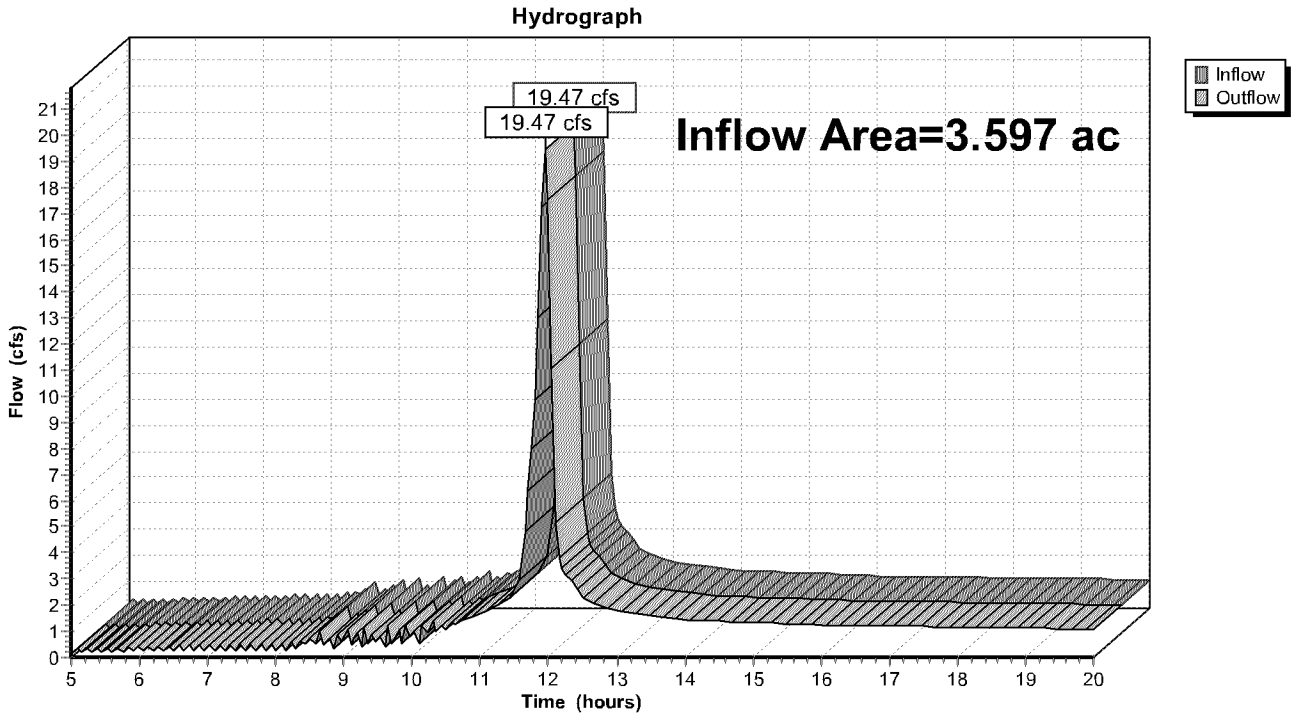


Summary for Reach 1R: Disturbed Area Plus CB#1

Inflow Area = 3.597 ac, 89.64% Impervious, Inflow Depth > 6.02" for 100-yr event
Inflow = 19.47 cfs @ 11.95 hrs, Volume= 1.803 af
Outflow = 19.47 cfs @ 11.95 hrs, Volume= 1.803 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach 1R: Disturbed Area Plus CB#1



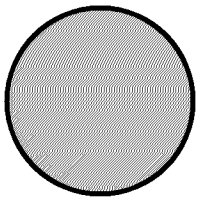
Summary for Reach 2R: Stub 5027B

Inflow Area = 2.459 ac, 89.43% Impervious, Inflow Depth > 5.90" for 100-yr event
Inflow = 8.63 cfs @ 11.95 hrs, Volume= 1.208 af
Outflow = 7.45 cfs @ 11.98 hrs, Volume= 1.208 af, Atten= 14%, Lag= 1.5 min

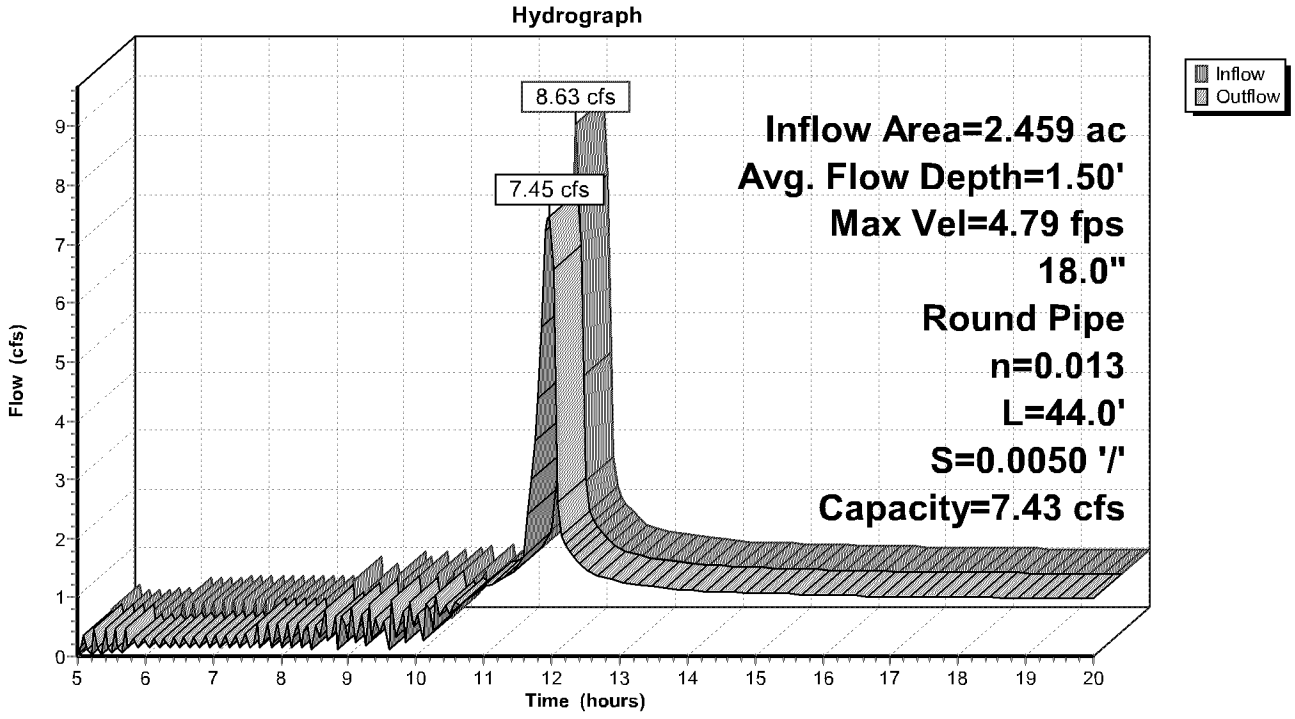
Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.79 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.71 fps, Avg. Travel Time= 0.3 min

Peak Storage= 79 cf @ 11.98 hrs
Average Depth at Peak Storage= 1.50'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 7.43 cfs

18.0" Round Pipe
n= 0.013 Concrete pipe, straight & clean
Length= 44.0' Slope= 0.0050 '/'
Inlet Invert= 842.23', Outlet Invert= 842.01'



Reach 2R: Stub 5027B



Summary for Pond 1P: Forklift Pump

Inflow Area = 1.732 ac, 89.29% Impervious, Inflow Depth > 6.30" for 100-yr event
Inflow = 18.37 cfs @ 11.95 hrs, Volume= 0.909 af
Outflow = 0.91 cfs @ 12.89 hrs, Volume= 0.826 af, Atten= 95%, Lag= 56.5 min
Primary = 0.91 cfs @ 12.89 hrs, Volume= 0.826 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 847.10' @ 12.89 hrs Surf.Area= 16,216 sf Storage= 18,162 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 122.1 min (857.6 - 735.5)

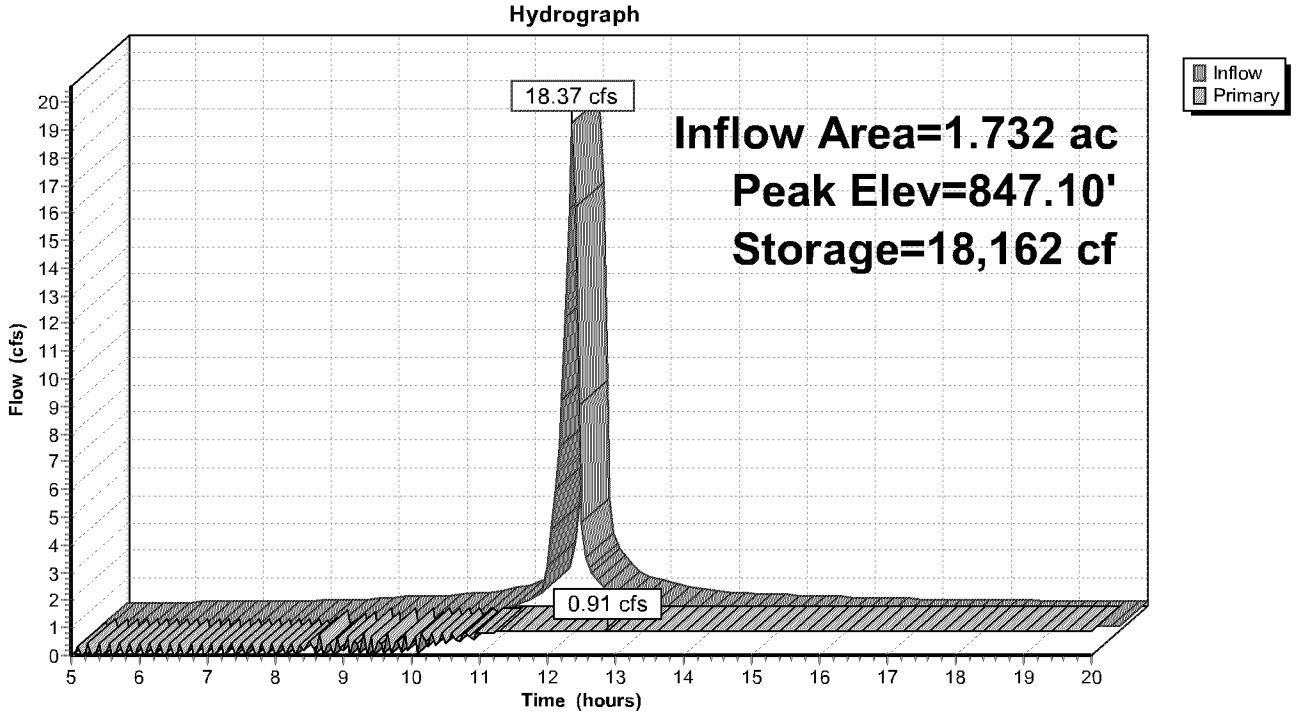
Volume	Invert	Avail.Storage	Storage Description
#1	838.00'	477,378 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
#2	839.00'	8 cf	**4.0" Round Pipe Storage** L= 92.0'
		477,386 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
838.00	20	0	0
844.70	20	134	134
845.70	5,752	2,886	3,020
847.00	15,187	13,610	16,630
855.00	100,000	460,748	477,378

Device	Routing	Invert	Outlet Devices
#1	Primary	839.00'	**Pump** Discharges@843.65' Turns Off@838.01' 4.0" Diam. x 243.0' Long Discharge, Hazen-Williams C= 130 Flow (gpm)= 0.0 100.0 200.0 350.0 450.0 Head (feet)= 46.00 38.50 33.50 26.00 19.00 -Loss (feet)= 0.00 1.83 6.59 18.59 29.60 =Lift (feet)= 46.00 36.67 26.91 7.41 -10.60

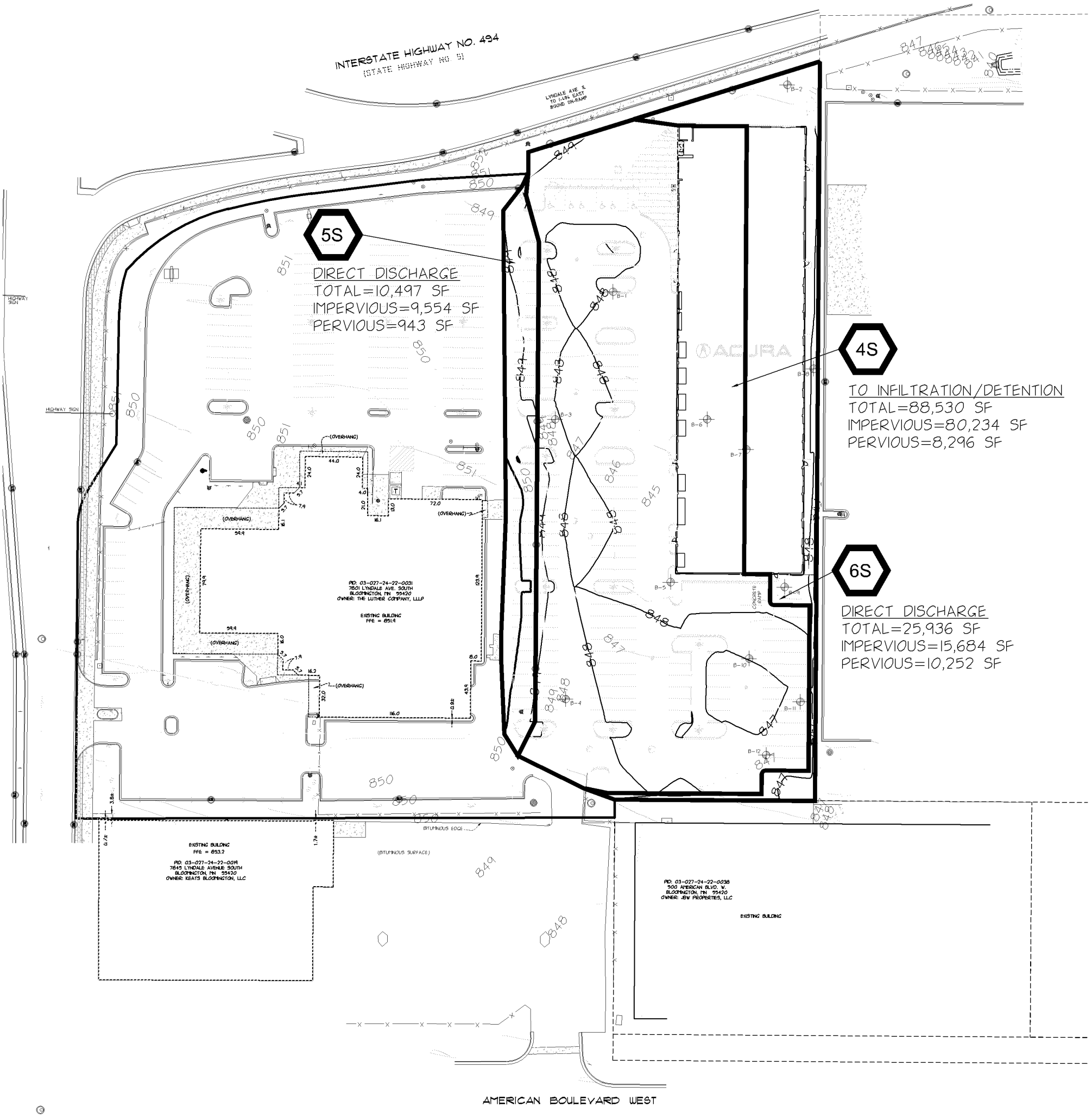
Primary OutFlow Max=0.91 cfs @ 12.89 hrs HW=847.10' TW=842.65' (Dynamic Tailwater)
↑—**1=Pump** (Pump Controls 0.91 cfs)

Pond 1P: Forklift Pump



APPENDIX C: PROPOSED DRAINAGE MAP

PL201800121
PL2018-121



LANDFORM

NORTH

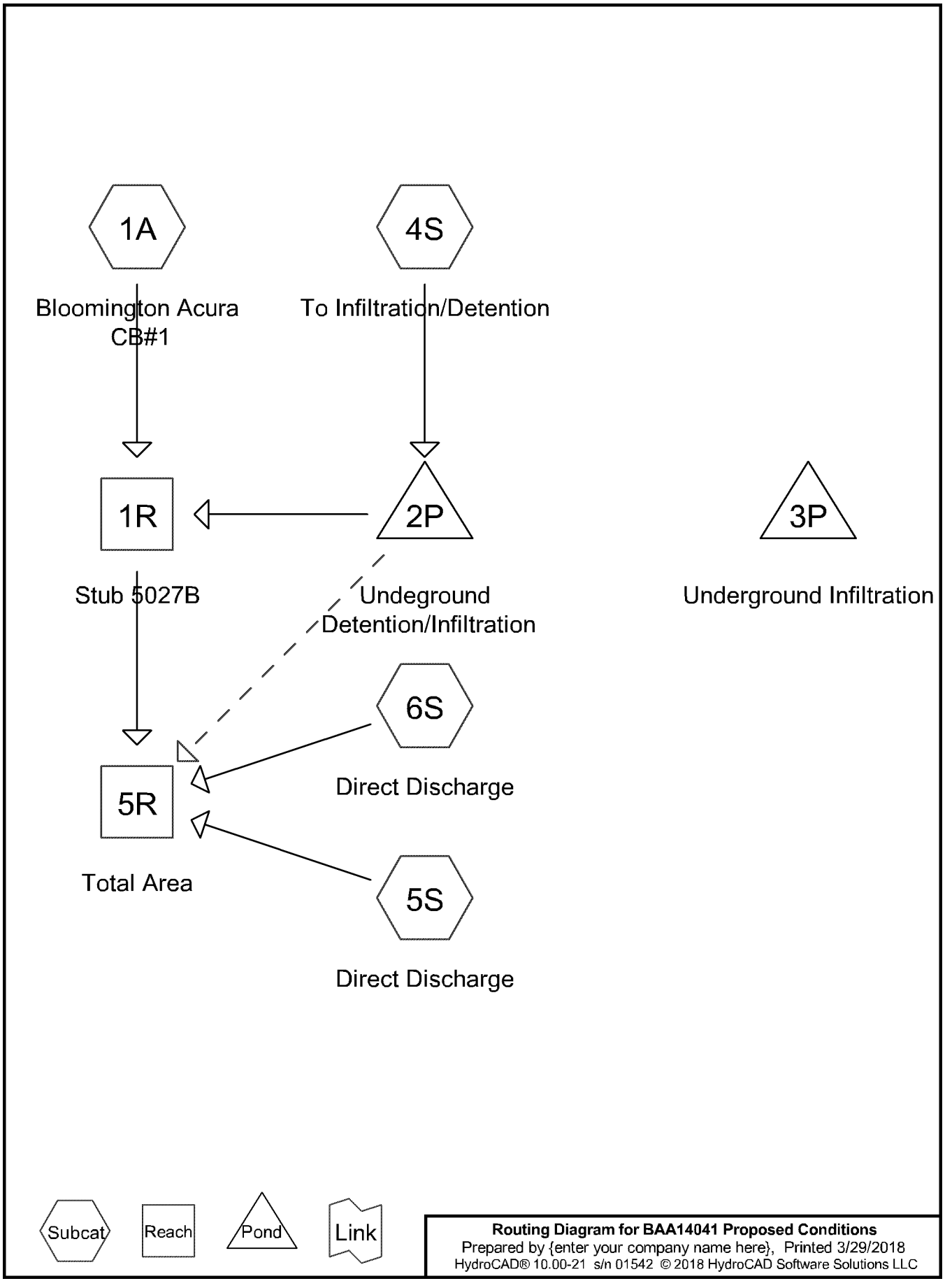
0 60

PROPOSED DRAINAGE MAP

ACURA - SUBARU • BLOOMINGTON, MN

03.30.2018

APPENDIX D: PROPOSED HYDROCAD MODEL


1A
Bloomington Acura CB#1
4S
To Infiltration/Detention
1R
Stub 5027B
2P
Undeground Detention/Infiltration
3P
Underground Infiltration
6S
Direct Discharge
5R
Total Area
5S
Direct Discharge
Subcat
Reach
Pond
Link
Routing Diagram for BAA14041 Proposed Conditions
Prepared by {enter your company name here}, Printed 3/29/2018
HydroCAD® 10.00-21 s/n 01542 © 2018 HydroCAD Software Solutions LLC

BAA14041 Proposed Conditions

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.522	61	>75% Grass cover, Good, HSG B (1A, 4S, 5S, 6S)
0.654	98	Paved parking & roofs (1A)
2.421	98	Paved parking, HSG B (4S, 5S, 6S)
3.597	**93**	**TOTAL AREA**

Time span=0.00-120.00 hrs, dt=0.01 hrs, 12001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1A: Bloomington Acura CB#1 Runoff Area=31,706 sf 89.79% Impervious Runoff Depth=2.20"
Tc=5.0 min CN=94 Runoff=2.75 cfs 0.133 af

Subcatchment 4S: To Infiltration/Detention Runoff Area=88,530 sf 90.63% Impervious Runoff Depth=2.29"
Tc=5.0 min CN=95 Runoff=7.90 cfs 0.388 af

Subcatchment 5S: Direct Discharge Runoff Area=10,497 sf 91.02% Impervious Runoff Depth=2.29"
Tc=0.0 min CN=95 Runoff=1.09 cfs 0.046 af

Subcatchment 6S: Direct Discharge Runoff Area=25,936 sf 60.47% Impervious Runoff Depth=1.32"
Tc=0.0 min CN=83 Runoff=1.73 cfs 0.065 af

Reach 1R: Stub 5027B Avg. Flow Depth=0.68' Max Vel=4.03 fps Inflow=3.14 cfs 0.412 af
18.0" Round Pipe n=0.013 L=44.0' S=0.0050 '/' Capacity=7.43 cfs Outflow=3.13 cfs 0.412 af

Reach 5R: Total Area Inflow=5.27 cfs 0.524 af
Outflow=5.27 cfs 0.524 af

Pond 2P: Undeground Detention/Infiltration Peak Elev=844.50' Storage=8,925 cf Inflow=7.90 cfs 0.388 af
Discarded=0.05 cfs 0.109 af Primary=0.49 cfs 0.279 af Secondary=0.00 cfs 0.000 af Outflow=0.54 cfs 0.388 af

Pond 3P: Underground Infiltration Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af

Total Runoff Area = 3.597 ac Runoff Volume = 0.633 af Average Runoff Depth = 2.11"
14.51% Pervious = 0.522 ac 85.49% Impervious = 3.075 ac

Summary for Subcatchment 1A: Bloomington Acura CB#1

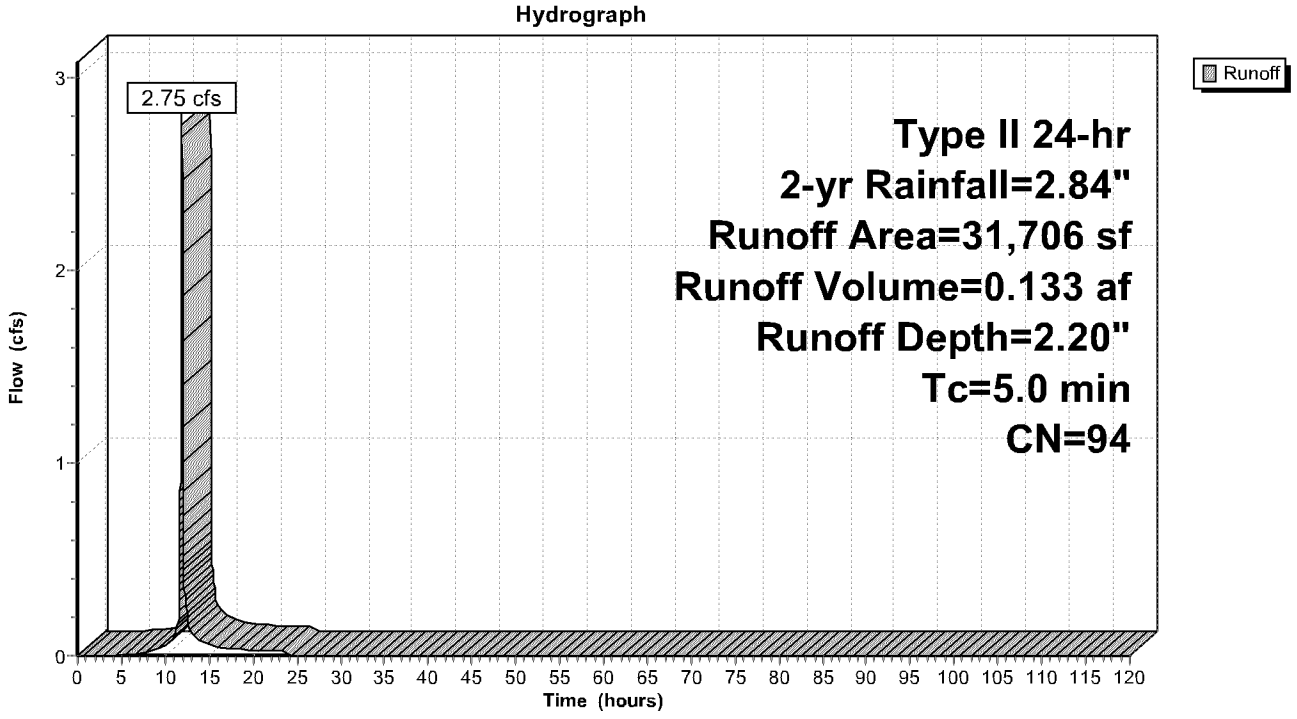
Runoff = 2.75 cfs @ 11.96 hrs, Volume= 0.133 af, Depth= 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-yr Rainfall=2.84"

Area (sf)	CN	Description
3,237	61	>75% Grass cover, Good, HSG B
28,469	98	Paved parking & roofs
31,706	94	Weighted Average
3,237		10.21% Pervious Area
28,469		89.79% Impervious Area

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

Subcatchment 1A: Bloomington Acura CB#1



Summary for Subcatchment 4S: To Infiltration/Detention

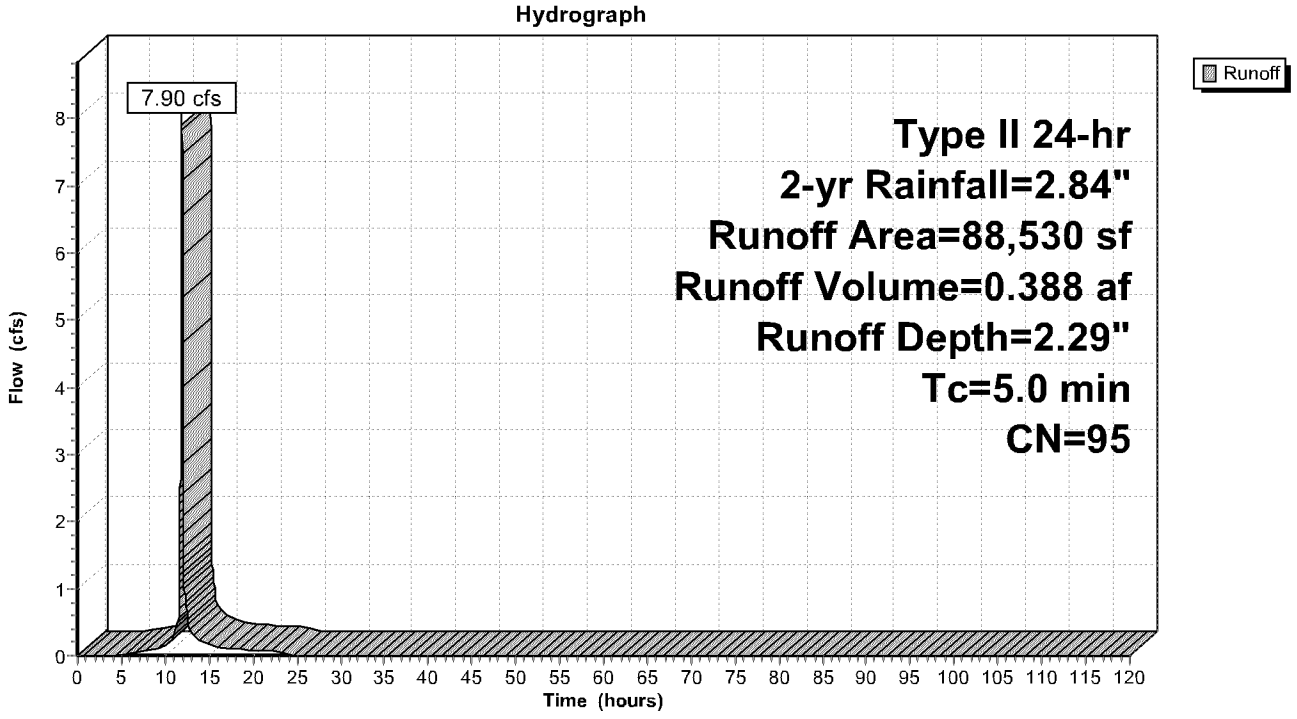
Runoff = 7.90 cfs @ 11.96 hrs, Volume= 0.388 af, Depth= 2.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-yr Rainfall=2.84"

Area (sf)	CN	Description
80,234	98	Paved parking, HSG B
8,296	61	>75% Grass cover, Good, HSG B
88,530	95	Weighted Average
8,296		9.37% Pervious Area
80,234		90.63% Impervious Area

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

Subcatchment 4S: To Infiltration/Detention



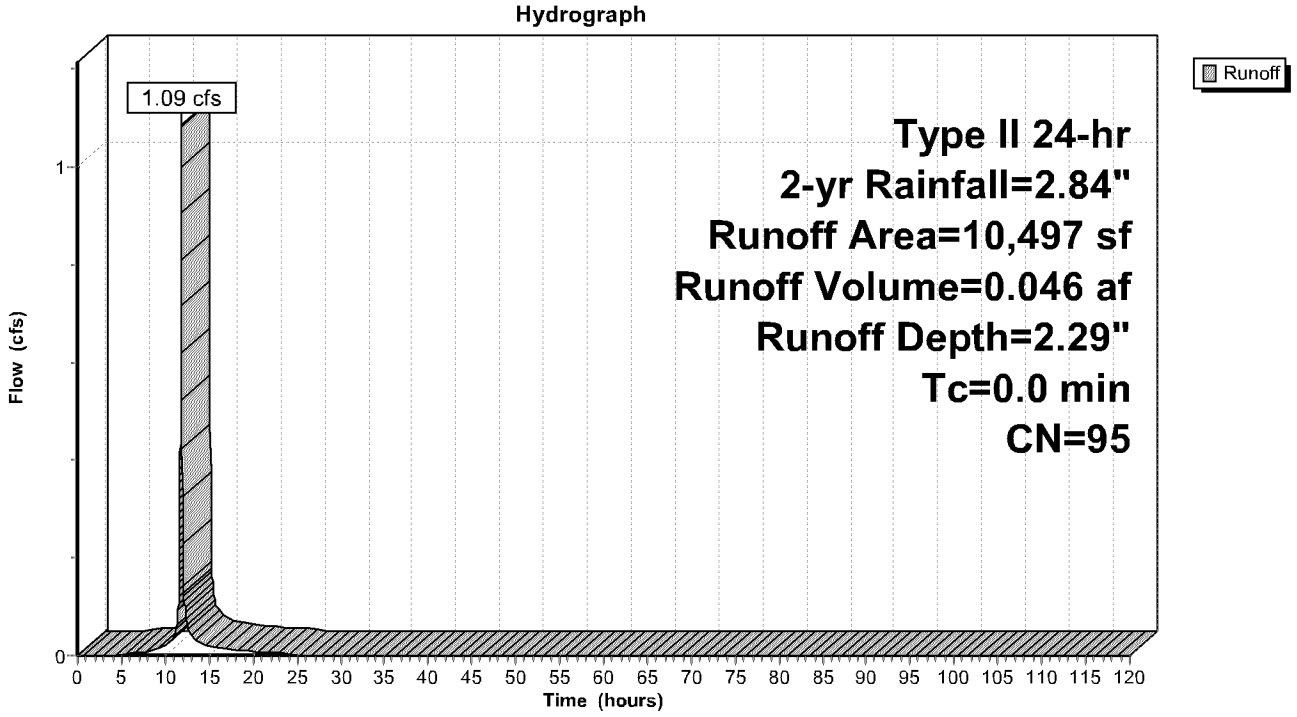
Summary for Subcatchment 5S: Direct Discharge

Runoff = 1.09 cfs @ 11.90 hrs, Volume= 0.046 af, Depth= 2.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-yr Rainfall=2.84"

Area (sf)	CN	Description
9,554	98	Paved parking, HSG B
943	61	>75% Grass cover, Good, HSG B
10,497	95	Weighted Average
943		8.98% Pervious Area
9,554		91.02% Impervious Area

Subcatchment 5S: Direct Discharge



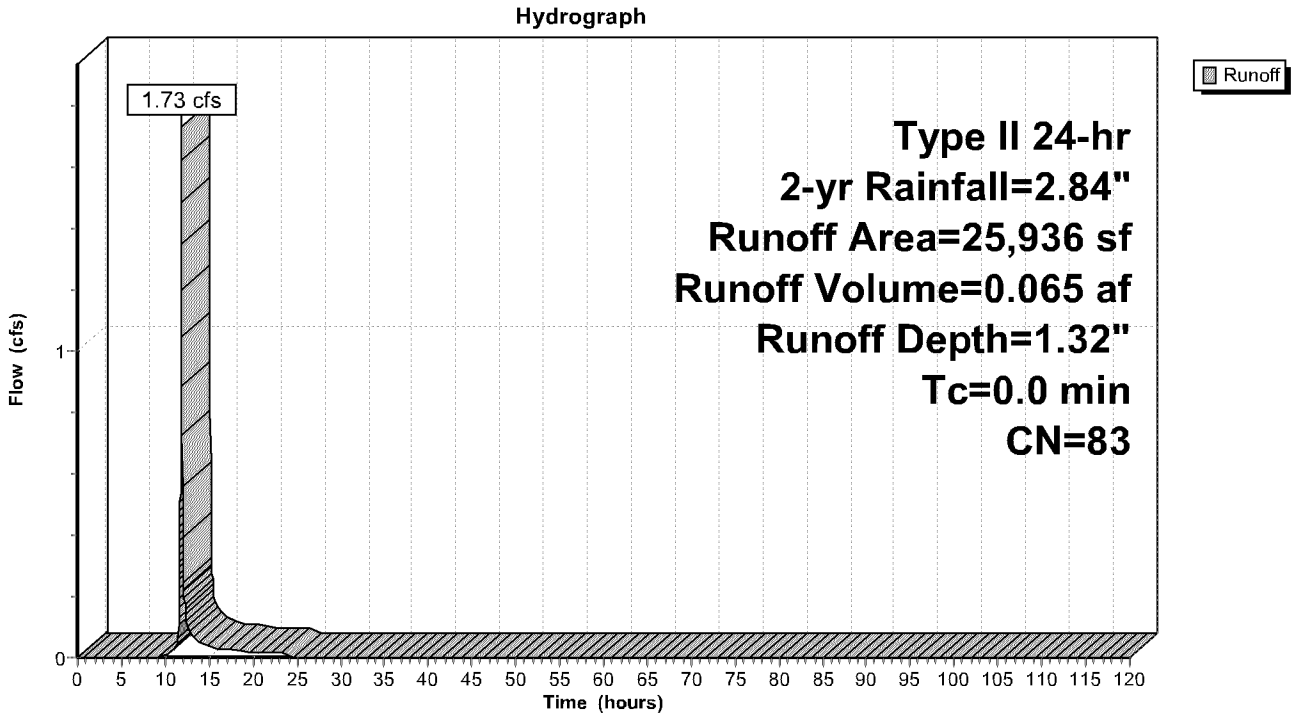
Summary for Subcatchment 6S: Direct Discharge

Runoff = 1.73 cfs @ 11.90 hrs, Volume= 0.065 af, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-yr Rainfall=2.84"

Area (sf)	CN	Description
15,684	98	Paved parking, HSG B
10,252	61	>75% Grass cover, Good, HSG B
25,936	83	Weighted Average
10,252		39.53% Pervious Area
15,684		60.47% Impervious Area

Subcatchment 6S: Direct Discharge



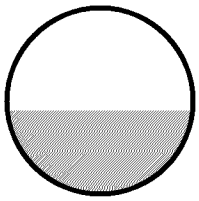
Summary for Reach 1R: Stub 5027B

Inflow Area = 2.760 ac, 90.41% Impervious, Inflow Depth = 1.79" for 2-yr event
Inflow = 3.14 cfs @ 11.96 hrs, Volume= 0.412 af
Outflow = 3.13 cfs @ 11.96 hrs, Volume= 0.412 af, Atten= 0%, Lag= 0.3 min

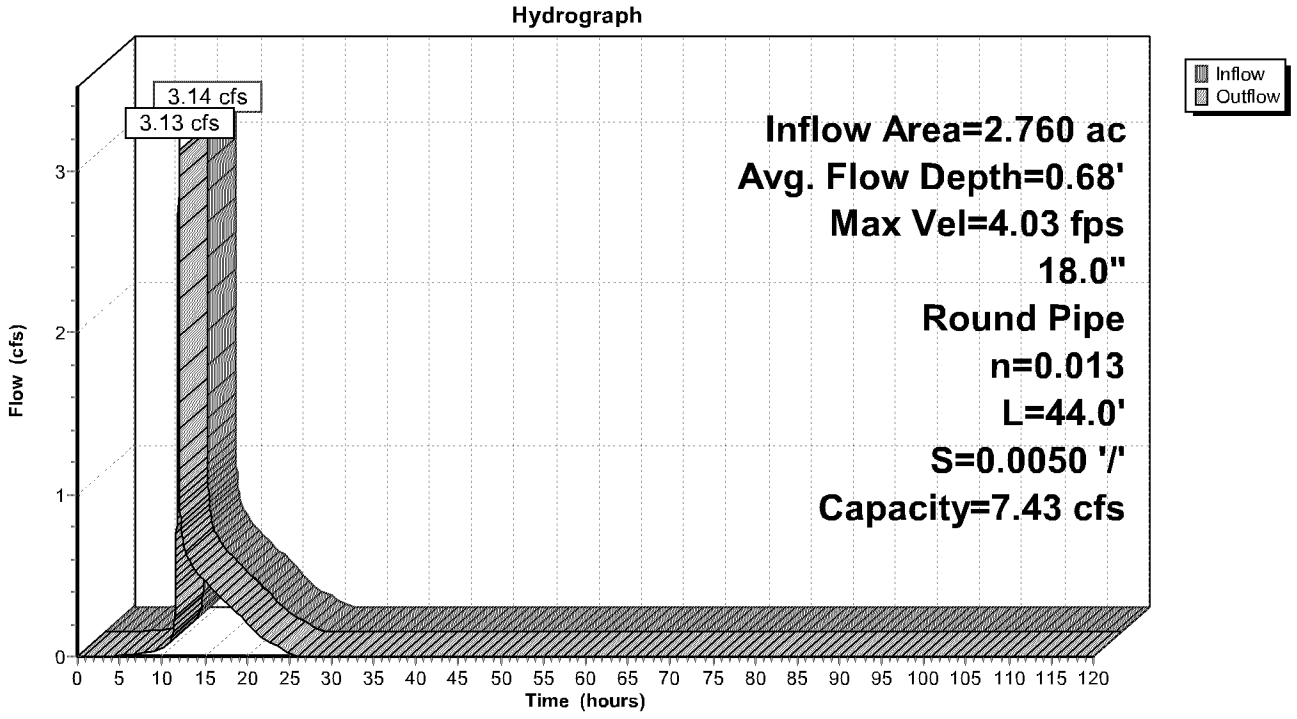
Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.03 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.52 fps, Avg. Travel Time= 0.5 min

Peak Storage= 34 cf @ 11.96 hrs
Average Depth at Peak Storage= 0.68'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 7.43 cfs

18.0" Round Pipe
n= 0.013 Concrete pipe, straight & clean
Length= 44.0' Slope= 0.0050 '/'
Inlet Invert= 842.23', Outlet Invert= 842.01'



Reach 1R: Stub 5027B

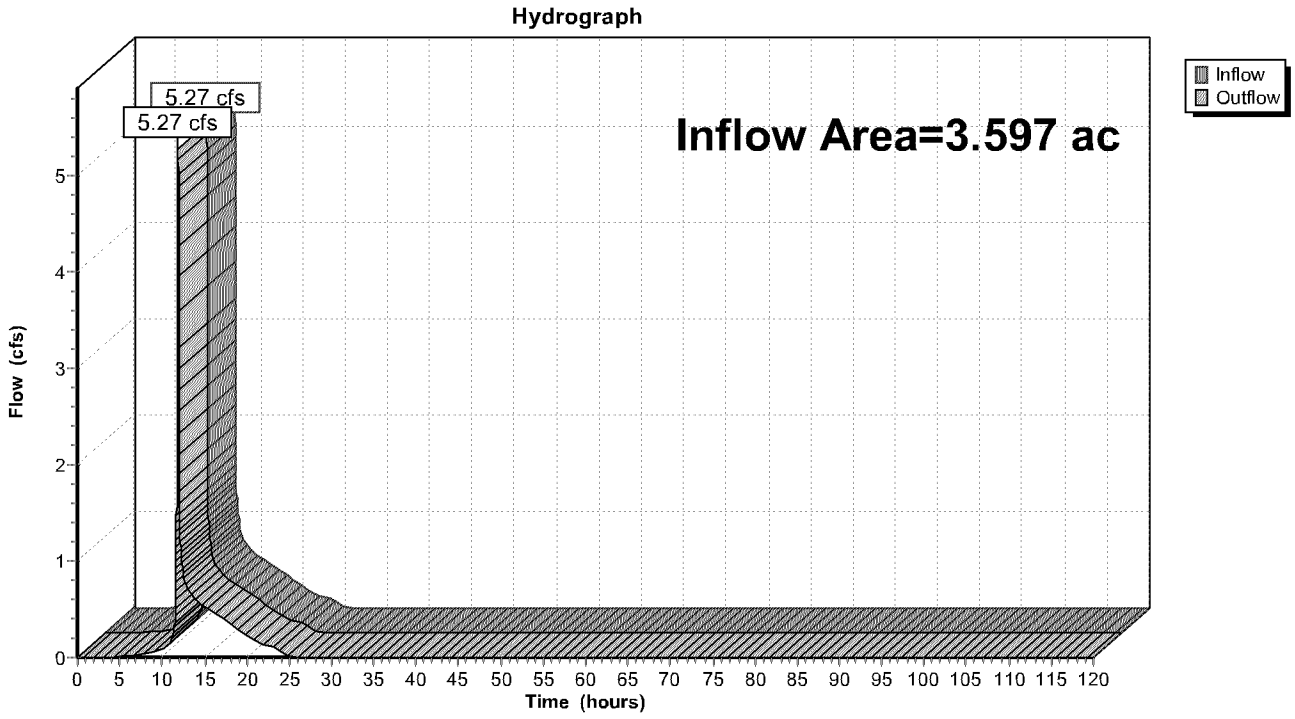


Summary for Reach 5R: Total Area

Inflow Area = 3.597 ac, 85.49% Impervious, Inflow Depth = 1.75" for 2-yr event
Inflow = 5.27 cfs @ 11.90 hrs, Volume= 0.524 af
Outflow = 5.27 cfs @ 11.90 hrs, Volume= 0.524 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs

Reach 5R: Total Area



Summary for Pond 2P: Undeground Detention/Infiltration

Inflow Area = 2.032 ac, 90.63% Impervious, Inflow Depth = 2.29" for 2-yr event
Inflow = 7.90 cfs @ 11.96 hrs, Volume= 0.388 af
Outflow = 0.54 cfs @ 12.53 hrs, Volume= 0.388 af, Atten= 93%, Lag= 34.6 min
Discarded = 0.05 cfs @ 12.53 hrs, Volume= 0.109 af
Primary = 0.49 cfs @ 12.53 hrs, Volume= 0.279 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 844.50' @ 12.53 hrs Surf.Area= 4,672 sf Storage= 8,925 cf

Plug-Flow detention time= 227.4 min calculated for 0.388 af (100% of inflow)
Center-of-Mass det. time= 227.4 min (1,007.9 - 780.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	842.50'	0 cf	**12.00'W x 267.00'L x 3.50'H Field A** -Impervious 11,214 cf Overall - 3,927 cf Embedded = 7,287 cf x 0.0% Voids
#2A	843.00'	3,927 cf	**CMP Round 30** x 39 Inside #1 Effective Size= 30.0"W x 30.0"H => 4.91 sf x 20.00'L = 98.2 cf Overall Size= 30.0"W x 30.0"H x 20.00'L 3 Rows of 13 Chambers 10.00' Header x 4.91 sf x 2 = 98.2 cf Inside
#3B	842.50'	4,116 cf	**30.00'W x 153.14'L x 3.50'H Field B** 16,079 cf Overall - 5,788 cf Embedded = 10,291 cf x 40.0% Voids
#4B	843.00'	5,788 cf	**ADS_StormTech SC-740 +Cap** x 126 Inside #3 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 6 Rows of 21 Chambers
#5	843.00'	12,836 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		26,667 cf	Total Available Storage

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

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
843.00	78	0	0
846.50	78	273	273
847.00	2,822	725	998
848.00	20,853	11,838	12,836

Device	Routing	Invert	Outlet Devices
#1	Primary	843.00'	**12.0" Round Culvert** L= 102.0' Ke= 0.500 Inlet / Outlet Invert= 843.00' / 842.23' S= 0.0075 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Device 1	843.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	843.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.80 1.80 4.00 Width (feet) 0.00 0.00 4.00 4.00
#4	Discarded	842.50'	**0.450 in/hr Exfiltration over Surface area**

			Conductivity to Groundwater Elevation = 825.00'
#5	Secondary	847.25'	**Asymmetrical Weir, C= 3.27**
			Offset (feet) 0.00 58.50 61.50 64.50 67.50 90.50
			Elev. (feet) 848.03 847.58 847.25 847.25 847.58 848.03

Discarded OutFlow Max=0.05 cfs @ 12.53 hrs HW=844.50' (Free Discharge)
└**4=Exfiltration** (Controls 0.05 cfs)

Primary OutFlow Max=0.49 cfs @ 12.53 hrs HW=844.50' (Free Discharge)
└**1=Culvert** (Passes 0.49 cfs of 3.28 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.49 cfs @ 5.56 fps)
  └**3=Custom Weir/Orifice** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=842.50' (Free Discharge)
└**5=Asymmetrical Weir** (Controls 0.00 cfs)

Pond 2P: Undeground Detention/Infiltration - Chamber Wizard Field A

Chamber Model = CMP Round 30 (Round Corrugated Metal Pipe)
Effective Size= 30.0"W x 30.0"H => 4.91 sf x 20.00'L = 98.2 cf
Overall Size= 30.0"W x 30.0"H x 20.00'L

30.0" Wide + 15.0" Spacing = 45.0" C-C Row Spacing

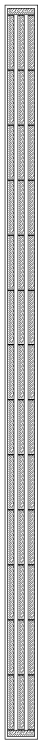
13 Chambers/Row x 20.00' Long +2.50' Header x 2 = 265.00' Row Length +12.0" End Stone x 2 = 267.00' Base Length
3 Rows x 30.0" Wide + 15.0" Spacing x 2 + 12.0" Side Stone x 2 = 12.00' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

39 Chambers x 98.2 cf + 10.00' Header x 4.91 sf x 2 = 3,927.0 cf Chamber Storage

11,214.0 cf Field - 3,927.0 cf Chambers = 7,287.0 cf Stone x 0.0% Voids = 0.0 cf Stone Storage

Chamber Storage = 3,927.0 cf = 0.090 af
Overall Storage Efficiency = 35.0%
Overall System Size = 267.00' x 12.00' x 3.50'

39 Chambers
415.3 cy Field
269.9 cy Stone



Pond 2P: Undeground Detention/Infiltration - Chamber Wizard Field B

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

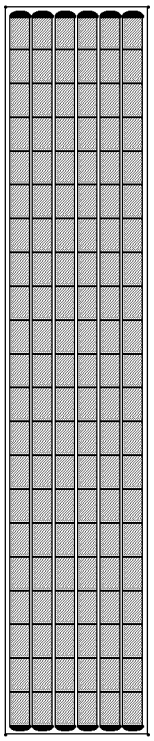
21 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 151.14' Row Length +12.0" End Stone x 2 = 153.14' Base Length
6 Rows x 51.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 30.00' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

126 Chambers x 45.9 cf = 5,788.4 cf Chamber Storage

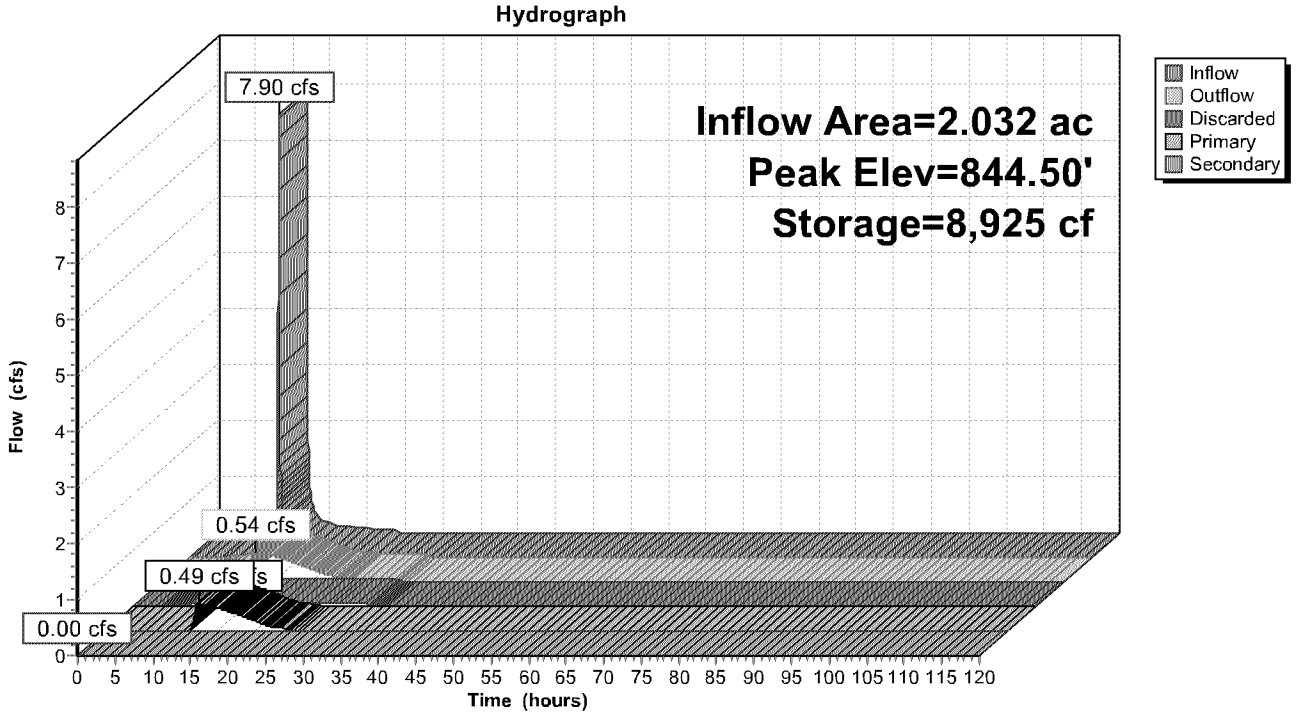
16,079.4 cf Field - 5,788.4 cf Chambers = 10,290.9 cf Stone x 40.0% Voids = 4,116.4 cf Stone Storage

Chamber Storage + Stone Storage = 9,904.8 cf = 0.227 af
Overall Storage Efficiency = 61.6%
Overall System Size = 153.14' x 30.00' x 3.50'

126 Chambers
595.5 cy Field
381.1 cy Stone



Pond 2P: Undeground Detention/Infiltration



Summary for Pond 3P: Underground Infiltration

Volume	Invert	Avail.Storage	Storage Description
#1A	842.50'	4,116 cf	**30.00'W x 153.14'L x 3.50'H Field A** 16,079 cf Overall - 5,788 cf Embedded = 10,291 cf x 40.0% Voids
#2A	843.00'	5,788 cf	**ADS_StormTech SC-740 +Cap** x 126 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 6 Rows of 21 Chambers
		9,905 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	842.50'	**0.450 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 825.00'
#2	Primary	845.00'	**24.0" Round Culvert** L= 20.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 845.00' / 844.80' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
↑—**2=Culvert** (Controls 0.00 cfs)

Pond 3P: Underground Infiltration - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

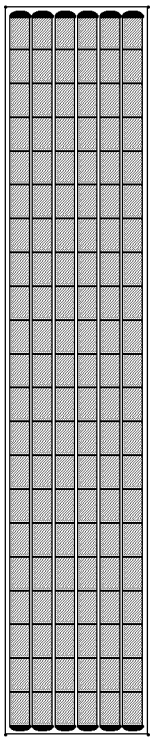
21 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 151.14' Row Length +12.0" End Stone x 2 = 153.14' Base Length
6 Rows x 51.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 30.00' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

126 Chambers x 45.9 cf = 5,788.4 cf Chamber Storage

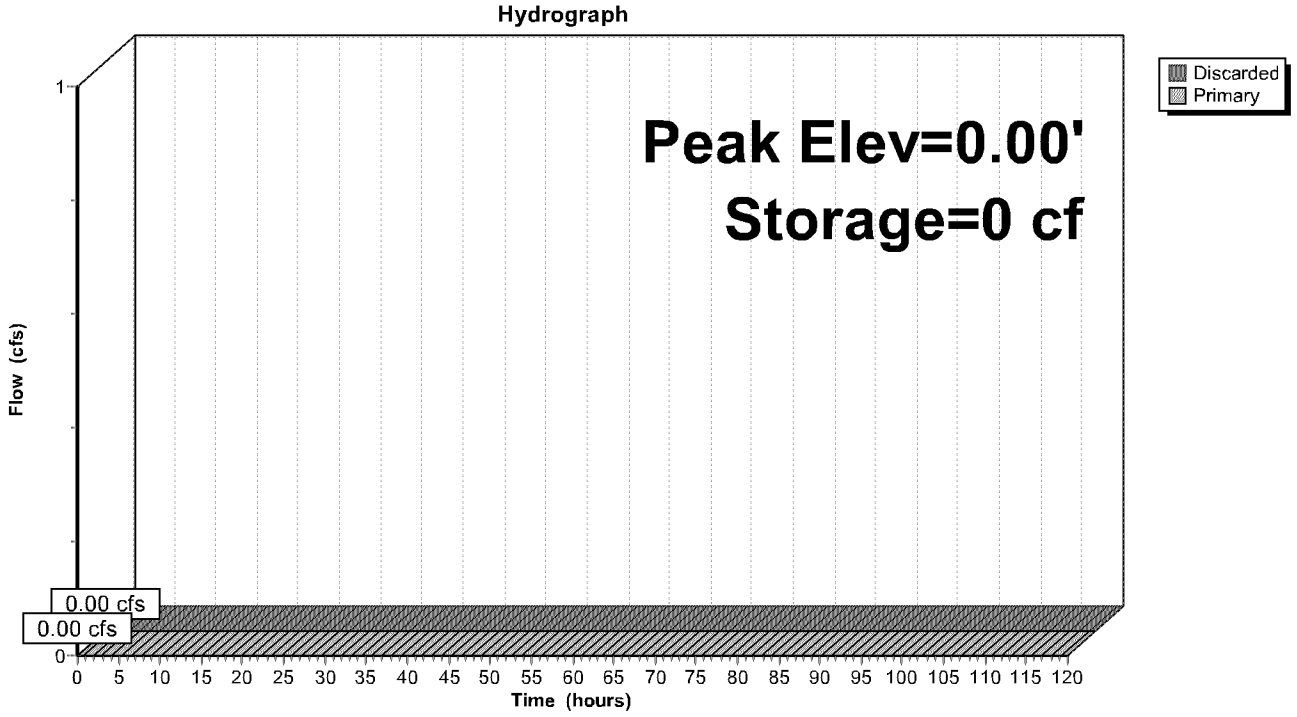
16,079.4 cf Field - 5,788.4 cf Chambers = 10,290.9 cf Stone x 40.0% Voids = 4,116.4 cf Stone Storage

Chamber Storage + Stone Storage = 9,904.8 cf = 0.227 af
Overall Storage Efficiency = 61.6%
Overall System Size = 153.14' x 30.00' x 3.50'

126 Chambers
595.5 cy Field
381.1 cy Stone



Pond 3P: Underground Infiltration



Time span=0.00-120.00 hrs, dt=0.01 hrs, 12001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1A: Bloomington Acura CB#1 Runoff Area=31,706 sf 89.79% Impervious Runoff Depth=3.57"
Tc=5.0 min CN=94 Runoff=4.33 cfs 0.217 af

Subcatchment 4S: To Infiltration/Detention Runoff Area=88,530 sf 90.63% Impervious Runoff Depth=3.68"
Tc=5.0 min CN=95 Runoff=12.27 cfs 0.623 af

Subcatchment 5S: Direct Discharge Runoff Area=10,497 sf 91.02% Impervious Runoff Depth=3.68"
Tc=0.0 min CN=95 Runoff=1.68 cfs 0.074 af

Subcatchment 6S: Direct Discharge Runoff Area=25,936 sf 60.47% Impervious Runoff Depth=2.50"
Tc=0.0 min CN=83 Runoff=3.20 cfs 0.124 af

Reach 1R: Stub 5027B Avg. Flow Depth=1.15' Max Vel=4.78 fps Inflow=6.97 cfs 0.717 af
18.0" Round Pipe n=0.013 L=44.0' S=0.0050 '/' Capacity=7.43 cfs Outflow=6.89 cfs 0.717 af

Reach 5R: Total Area Inflow=8.73 cfs 0.915 af
Outflow=8.73 cfs 0.915 af

Pond 2P: Undeground Detention/Infiltration Peak Elev=845.30' Storage=12,542 cf Inflow=12.27 cfs 0.623 af
Discarded=0.06 cfs 0.122 af Primary=4.18 cfs 0.501 af Secondary=0.00 cfs 0.000 af Outflow=4.23 cfs 0.623 af

Pond 3P: Underground Infiltration Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af

Total Runoff Area = 3.597 ac Runoff Volume = 1.038 af Average Runoff Depth = 3.46"
14.51% Pervious = 0.522 ac 85.49% Impervious = 3.075 ac

Summary for Subcatchment 1A: Bloomington Acura CB#1

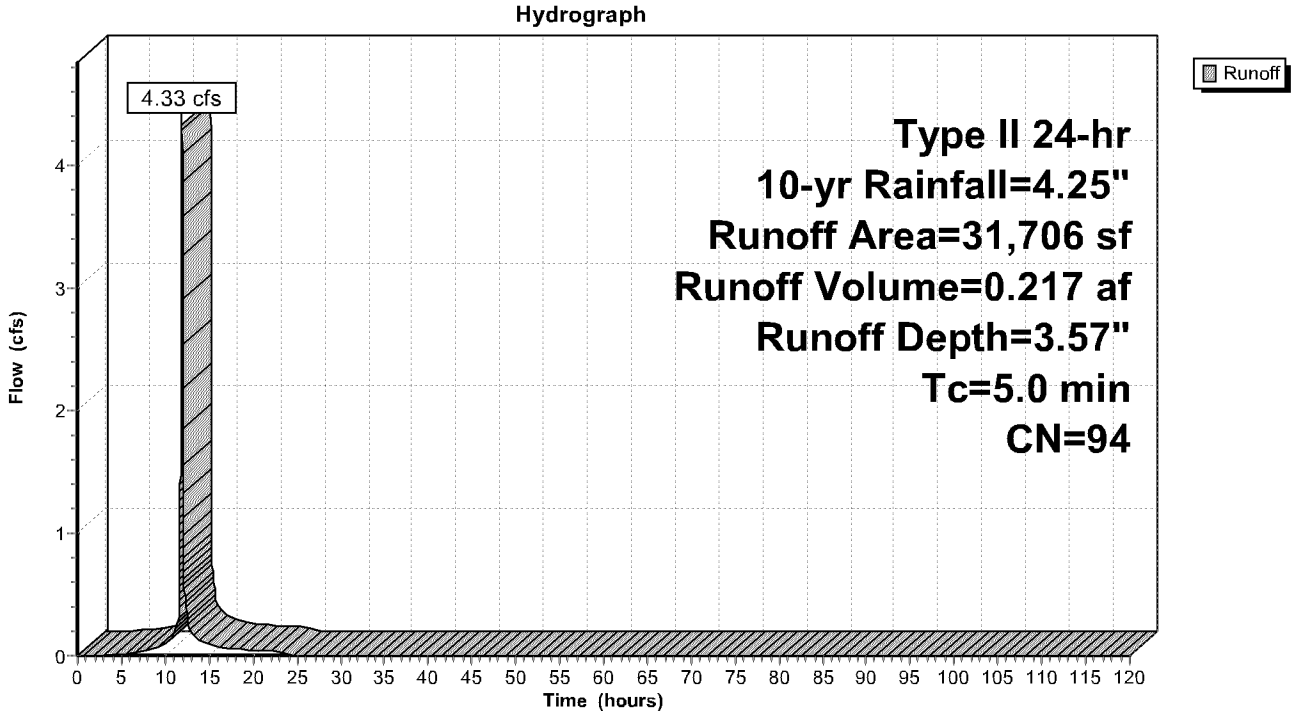
Runoff = 4.33 cfs @ 11.96 hrs, Volume= 0.217 af, Depth= 3.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-yr Rainfall=4.25"

Area (sf)	CN	Description
3,237	61	>75% Grass cover, Good, HSG B
28,469	98	Paved parking & roofs
31,706	94	Weighted Average
3,237		10.21% Pervious Area
28,469		89.79% Impervious Area

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

Subcatchment 1A: Bloomington Acura CB#1



Summary for Subcatchment 4S: To Infiltration/Detention

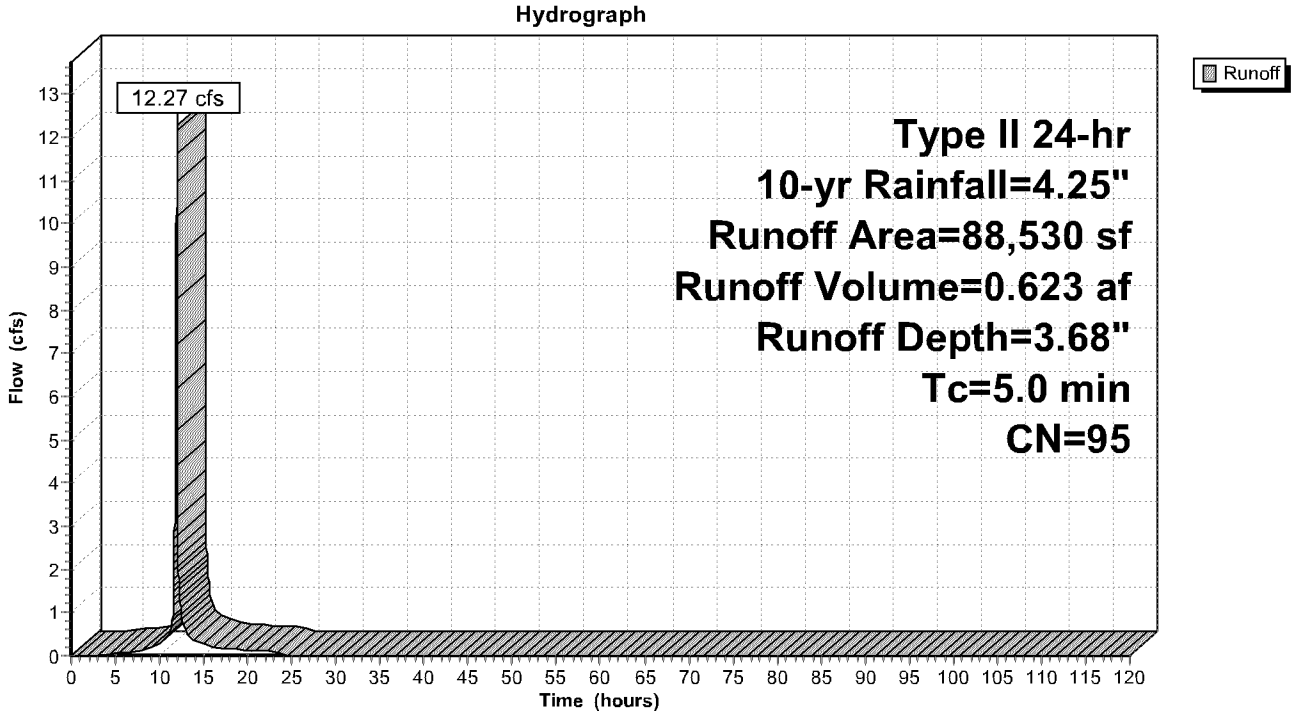
Runoff = 12.27 cfs @ 11.96 hrs, Volume= 0.623 af, Depth= 3.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-yr Rainfall=4.25"

Area (sf)	CN	Description
80,234	98	Paved parking, HSG B
8,296	61	>75% Grass cover, Good, HSG B
88,530	95	Weighted Average
8,296		9.37% Pervious Area
80,234		90.63% Impervious Area

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

Subcatchment 4S: To Infiltration/Detention



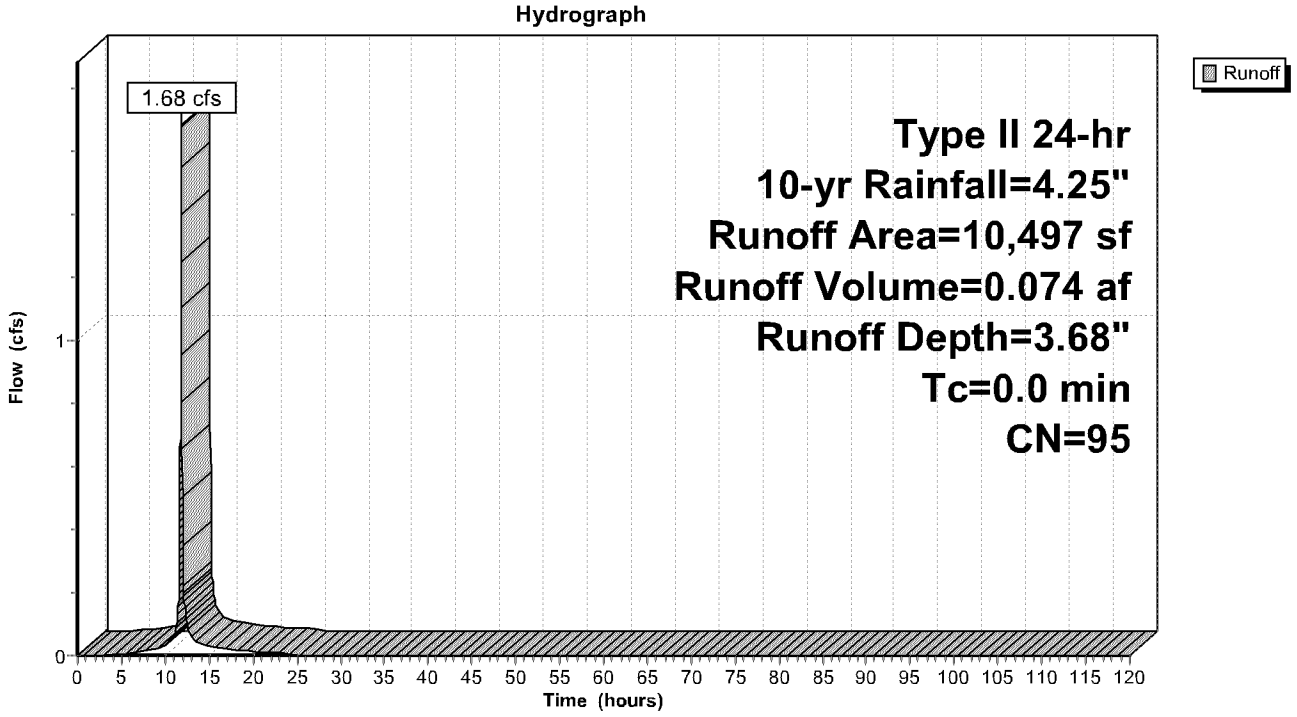
Summary for Subcatchment 5S: Direct Discharge

Runoff = 1.68 cfs @ 11.90 hrs, Volume= 0.074 af, Depth= 3.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-yr Rainfall=4.25"

Area (sf)	CN	Description
9,554	98	Paved parking, HSG B
943	61	>75% Grass cover, Good, HSG B
10,497	95	Weighted Average
943		8.98% Pervious Area
9,554		91.02% Impervious Area

Subcatchment 5S: Direct Discharge



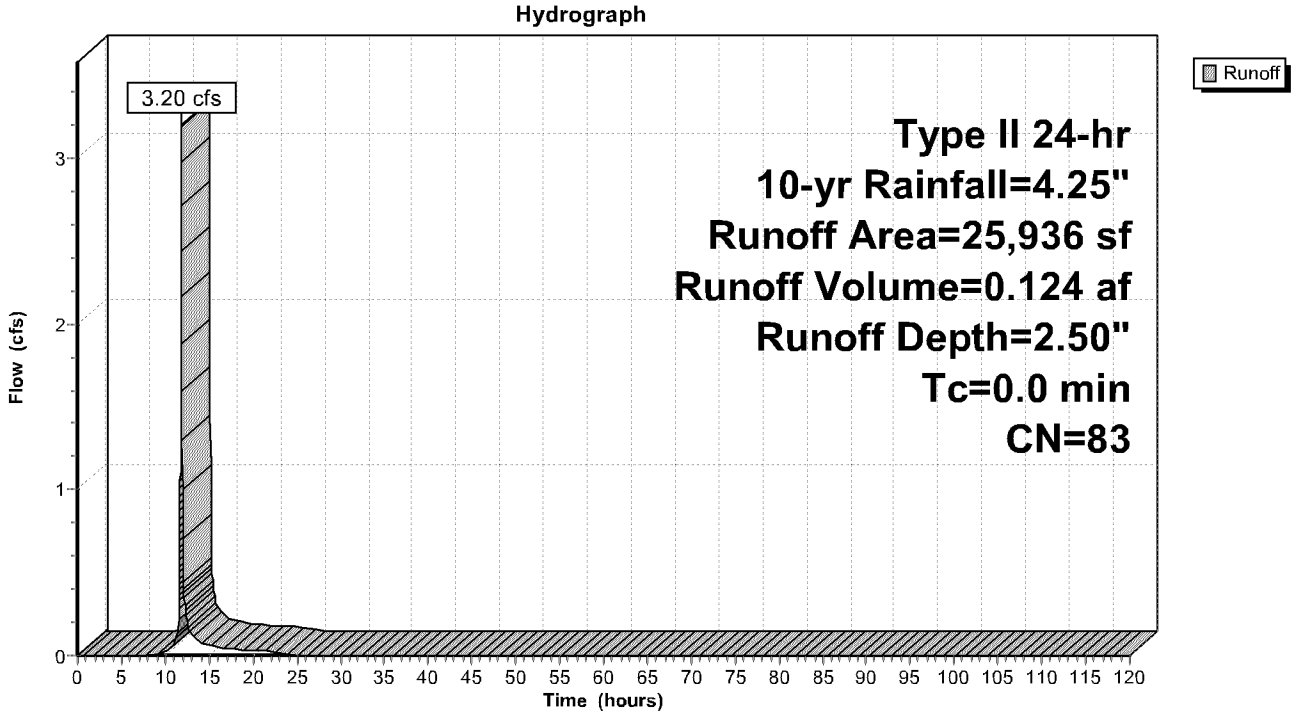
Summary for Subcatchment 6S: Direct Discharge

Runoff = 3.20 cfs @ 11.90 hrs, Volume= 0.124 af, Depth= 2.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 10-yr Rainfall=4.25"

Area (sf)	CN	Description
15,684	98	Paved parking, HSG B
10,252	61	>75% Grass cover, Good, HSG B
25,936	83	Weighted Average
10,252		39.53% Pervious Area
15,684		60.47% Impervious Area

Subcatchment 6S: Direct Discharge



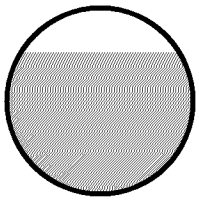
Summary for Reach 1R: Stub 5027B

Inflow Area = 2.760 ac, 90.41% Impervious, Inflow Depth = 3.12" for 10-yr event
Inflow = 6.97 cfs @ 12.02 hrs, Volume= 0.717 af
Outflow = 6.89 cfs @ 12.02 hrs, Volume= 0.717 af, Atten= 1%, Lag= 0.3 min

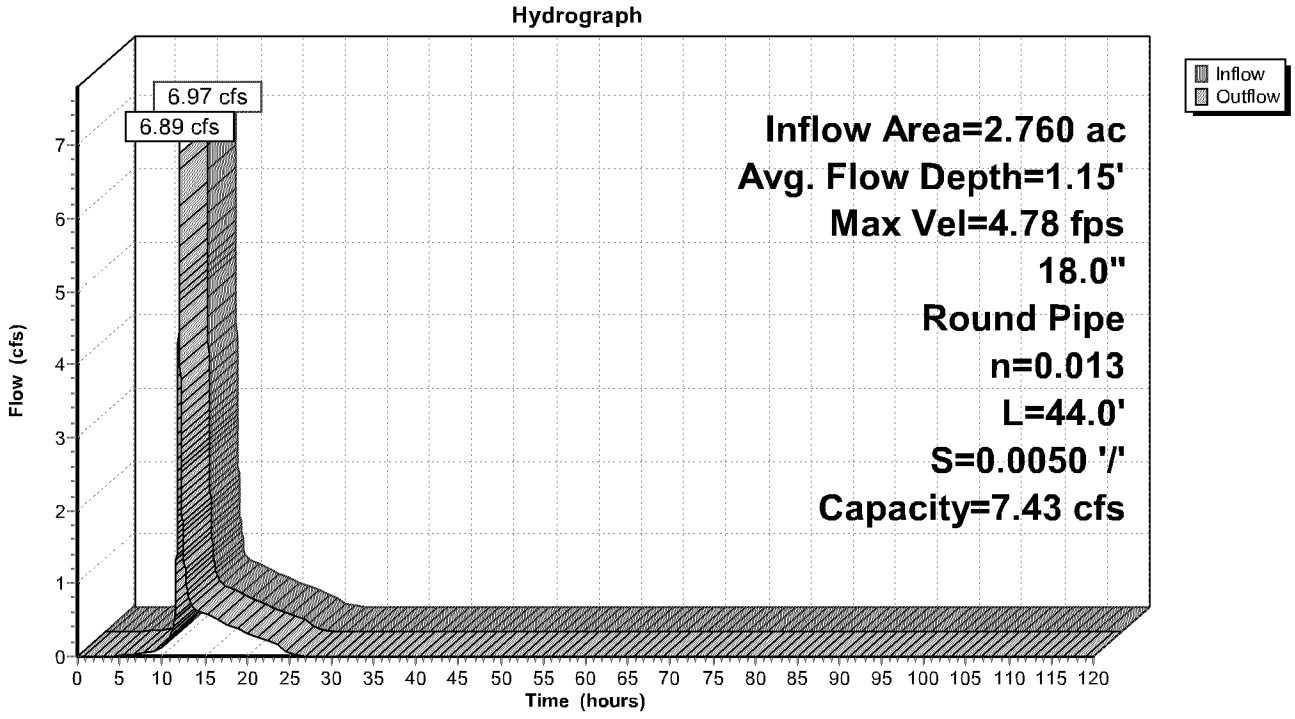
Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.78 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.72 fps, Avg. Travel Time= 0.4 min

Peak Storage= 64 cf @ 12.02 hrs
Average Depth at Peak Storage= 1.15'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 7.43 cfs

18.0" Round Pipe
n= 0.013 Concrete pipe, straight & clean
Length= 44.0' Slope= 0.0050 '/'
Inlet Invert= 842.23', Outlet Invert= 842.01'



Reach 1R: Stub 5027B

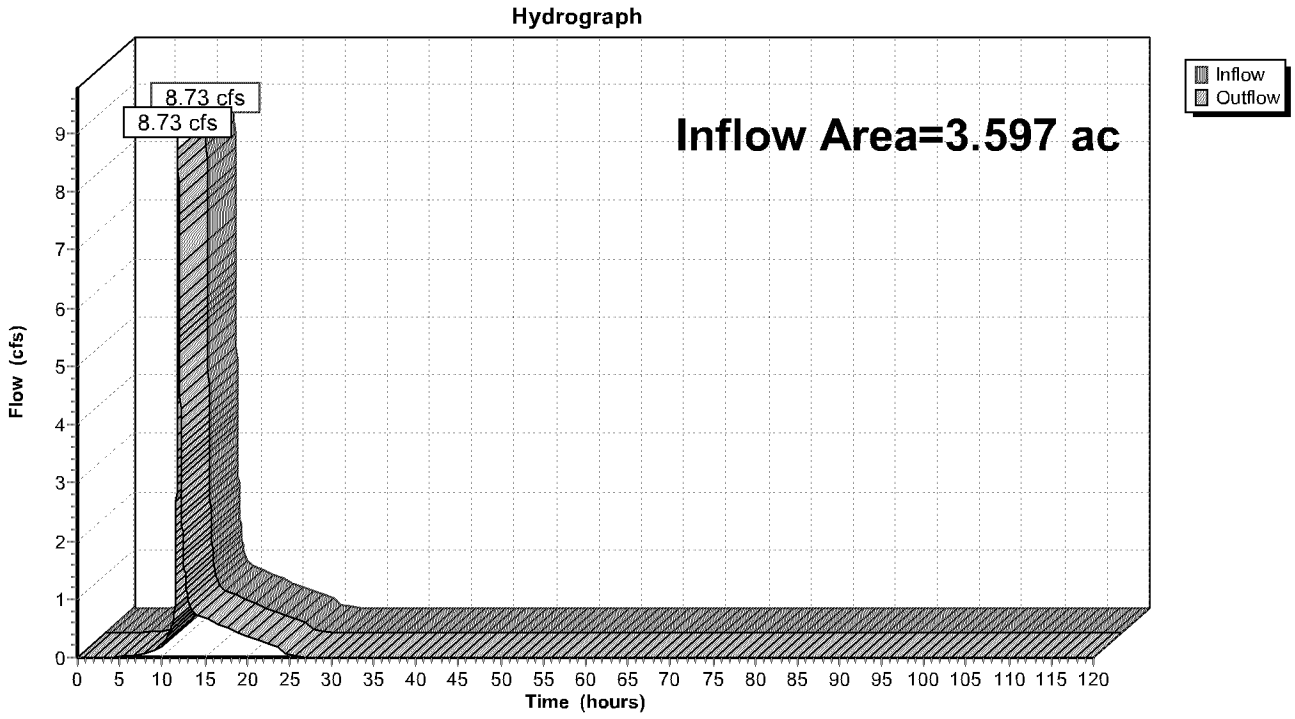


Summary for Reach 5R: Total Area

Inflow Area = 3.597 ac, 85.49% Impervious, Inflow Depth = 3.05" for 10-yr event
Inflow = 8.73 cfs @ 11.90 hrs, Volume= 0.915 af
Outflow = 8.73 cfs @ 11.90 hrs, Volume= 0.915 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs

Reach 5R: Total Area



Summary for Pond 2P: Undeground Detention/Infiltration

Inflow Area = 2.032 ac, 90.63% Impervious, Inflow Depth = 3.68" for 10-yr event
Inflow = 12.27 cfs @ 11.96 hrs, Volume= 0.623 af
Outflow = 4.23 cfs @ 12.06 hrs, Volume= 0.623 af, Atten= 65%, Lag= 6.4 min
Discarded = 0.06 cfs @ 12.06 hrs, Volume= 0.122 af
Primary = 4.18 cfs @ 12.06 hrs, Volume= 0.501 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 845.30' @ 12.06 hrs Surf.Area= 4,672 sf Storage= 12,542 cf

Plug-Flow detention time= 203.1 min calculated for 0.623 af (100% of inflow)
Center-of-Mass det. time= 203.1 min (971.3 - 768.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	842.50'	0 cf	**12.00'W x 267.00'L x 3.50'H Field A** -Impervious 11,214 cf Overall - 3,927 cf Embedded = 7,287 cf x 0.0% Voids
#2A	843.00'	3,927 cf	**CMP Round 30** x 39 Inside #1 Effective Size= 30.0"W x 30.0"H => 4.91 sf x 20.00'L = 98.2 cf Overall Size= 30.0"W x 30.0"H x 20.00'L 3 Rows of 13 Chambers 10.00' Header x 4.91 sf x 2 = 98.2 cf Inside
#3B	842.50'	4,116 cf	**30.00'W x 153.14'L x 3.50'H Field B** 16,079 cf Overall - 5,788 cf Embedded = 10,291 cf x 40.0% Voids
#4B	843.00'	5,788 cf	**ADS_StormTech SC-740 +Cap** x 126 Inside #3 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 6 Rows of 21 Chambers
#5	843.00'	12,836 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		26,667 cf	Total Available Storage

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

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
843.00	78	0	0
846.50	78	273	273
847.00	2,822	725	998
848.00	20,853	11,838	12,836

Device	Routing	Invert	Outlet Devices
#1	Primary	843.00'	**12.0" Round Culvert** L= 102.0' Ke= 0.500 Inlet / Outlet Invert= 843.00' / 842.23' S= 0.0075 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Device 1	843.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	843.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.80 1.80 4.00 Width (feet) 0.00 0.00 4.00 4.00
#4	Discarded	842.50'	**0.450 in/hr Exfiltration over Surface area**

			Conductivity to Groundwater Elevation = 825.00'
#5	Secondary	847.25'	**Asymmetrical Weir, C= 3.27**
			Offset (feet) 0.00 58.50 61.50 64.50 67.50 90.50
			Elev. (feet) 848.03 847.58 847.25 847.25 847.58 848.03

Discarded OutFlow Max=0.06 cfs @ 12.06 hrs HW=845.30' (Free Discharge)
└**4=Exfiltration** (Controls 0.06 cfs)

Primary OutFlow Max=4.18 cfs @ 12.06 hrs HW=845.30' (Free Discharge)
└**1=Culvert** (Barrel Controls 4.18 cfs @ 5.32 fps)
  ├**2=Orifice/Grate** (Passes < 0.61 cfs potential flow)
  └**3=Custom Weir/Orifice** (Passes < 4.57 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=842.50' (Free Discharge)
└**5=Asymmetrical Weir** (Controls 0.00 cfs)

Pond 2P: Undeground Detention/Infiltration - Chamber Wizard Field A

Chamber Model = CMP Round 30 (Round Corrugated Metal Pipe)
Effective Size= 30.0"W x 30.0"H => 4.91 sf x 20.00'L = 98.2 cf
Overall Size= 30.0"W x 30.0"H x 20.00'L

30.0" Wide + 15.0" Spacing = 45.0" C-C Row Spacing

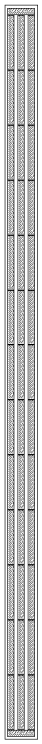
13 Chambers/Row x 20.00' Long +2.50' Header x 2 = 265.00' Row Length +12.0" End Stone x 2 = 267.00' Base Length
3 Rows x 30.0" Wide + 15.0" Spacing x 2 + 12.0" Side Stone x 2 = 12.00' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

39 Chambers x 98.2 cf + 10.00' Header x 4.91 sf x 2 = 3,927.0 cf Chamber Storage

11,214.0 cf Field - 3,927.0 cf Chambers = 7,287.0 cf Stone x 0.0% Voids = 0.0 cf Stone Storage

Chamber Storage = 3,927.0 cf = 0.090 af
Overall Storage Efficiency = 35.0%
Overall System Size = 267.00' x 12.00' x 3.50'

39 Chambers
415.3 cy Field
269.9 cy Stone



Pond 2P: Undeground Detention/Infiltration - Chamber Wizard Field B

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

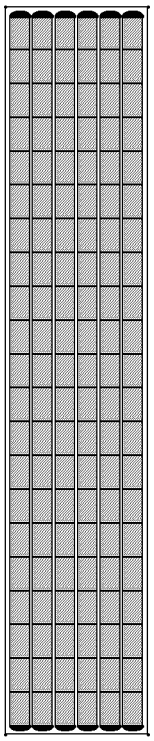
21 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 151.14' Row Length +12.0" End Stone x 2 = 153.14' Base Length
6 Rows x 51.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 30.00' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

126 Chambers x 45.9 cf = 5,788.4 cf Chamber Storage

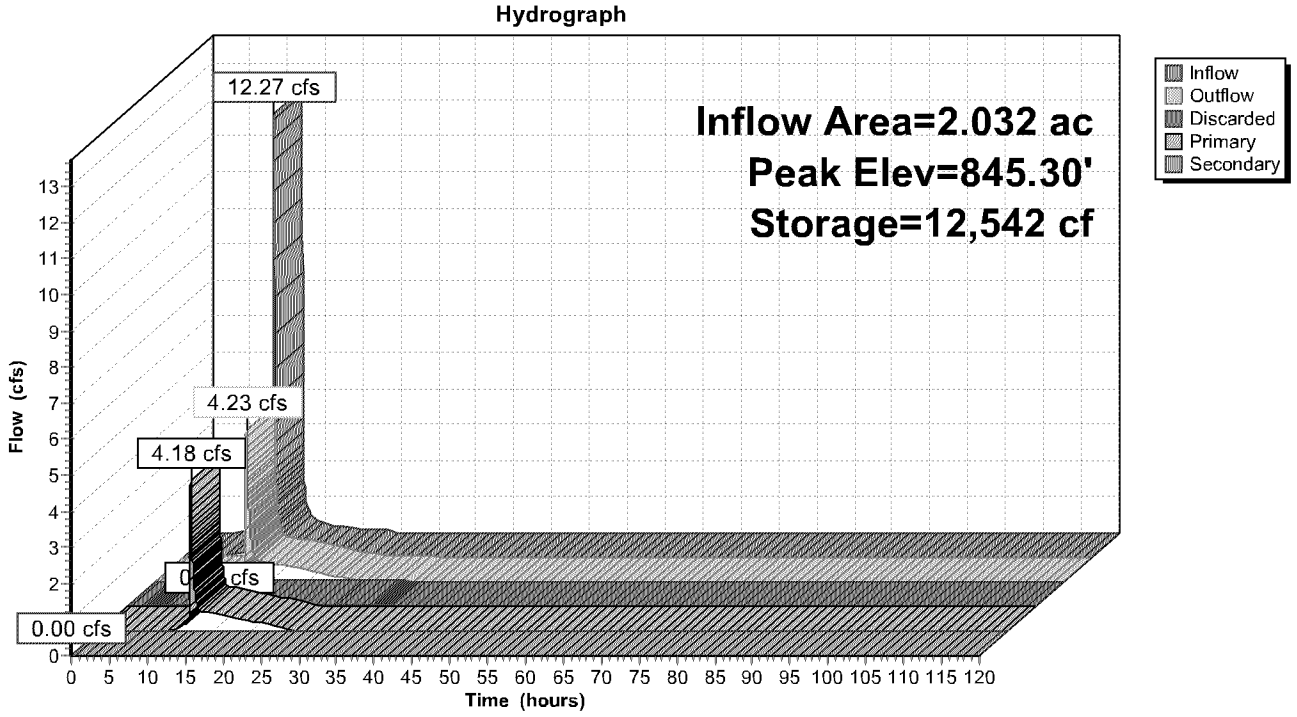
16,079.4 cf Field - 5,788.4 cf Chambers = 10,290.9 cf Stone x 40.0% Voids = 4,116.4 cf Stone Storage

Chamber Storage + Stone Storage = 9,904.8 cf = 0.227 af
Overall Storage Efficiency = 61.6%
Overall System Size = 153.14' x 30.00' x 3.50'

126 Chambers
595.5 cy Field
381.1 cy Stone



Pond 2P: Undeground Detention/Infiltration



Summary for Pond 3P: Underground Infiltration

Volume	Invert	Avail.Storage	Storage Description
#1A	842.50'	4,116 cf	**30.00'W x 153.14'L x 3.50'H Field A** 16,079 cf Overall - 5,788 cf Embedded = 10,291 cf x 40.0% Voids
#2A	843.00'	5,788 cf	**ADS_StormTech SC-740 +Cap** x 126 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 6 Rows of 21 Chambers
		9,905 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	842.50'	**0.450 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 825.00'
#2	Primary	845.00'	**24.0" Round Culvert** L= 20.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 845.00' / 844.80' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
↑—**2=Culvert** (Controls 0.00 cfs)

Pond 3P: Underground Infiltration - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

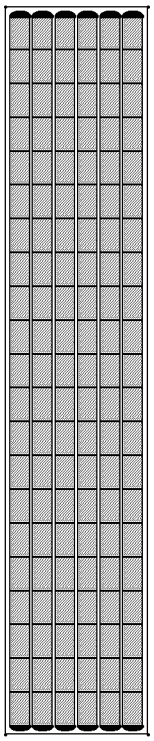
21 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 151.14' Row Length +12.0" End Stone x 2 = 153.14' Base Length
6 Rows x 51.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 30.00' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

126 Chambers x 45.9 cf = 5,788.4 cf Chamber Storage

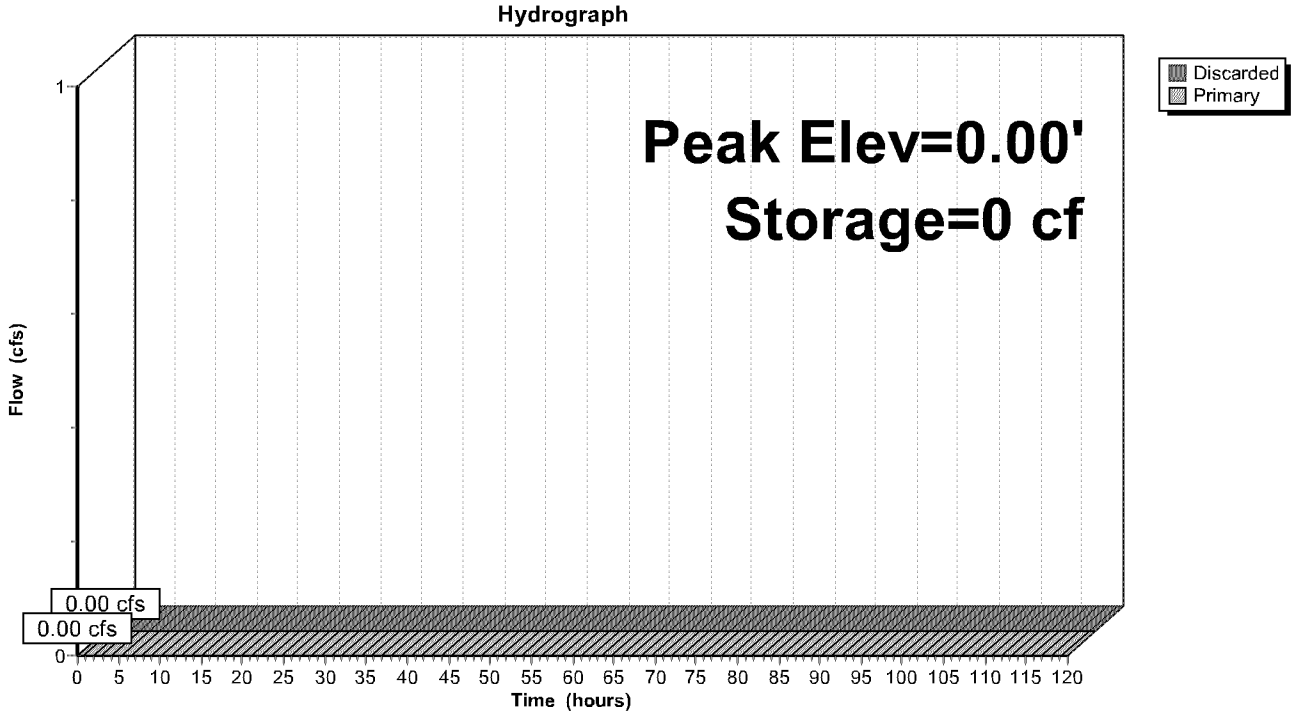
16,079.4 cf Field - 5,788.4 cf Chambers = 10,290.9 cf Stone x 40.0% Voids = 4,116.4 cf Stone Storage

Chamber Storage + Stone Storage = 9,904.8 cf = 0.227 af
Overall Storage Efficiency = 61.6%
Overall System Size = 153.14' x 30.00' x 3.50'

126 Chambers
595.5 cy Field
381.1 cy Stone



Pond 3P: Underground Infiltration



Time span=0.00-120.00 hrs, dt=0.01 hrs, 12001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1A: Bloomington Acura CB#1 Runoff Area=31,706 sf 89.79% Impervious Runoff Depth=6.77"
Tc=5.0 min CN=94 Runoff=7.89 cfs 0.411 af

Subcatchment 4S: To Infiltration/Detention Runoff Area=88,530 sf 90.63% Impervious Runoff Depth=6.89"
Tc=5.0 min CN=95 Runoff=22.16 cfs 1.168 af

Subcatchment 5S: Direct Discharge Runoff Area=10,497 sf 91.02% Impervious Runoff Depth=6.89"
Tc=0.0 min CN=95 Runoff=3.03 cfs 0.138 af

Subcatchment 6S: Direct Discharge Runoff Area=25,936 sf 60.47% Impervious Runoff Depth=5.49"
Tc=0.0 min CN=83 Runoff=6.66 cfs 0.272 af

Reach 1R: Stub 5027B Avg. Flow Depth=1.50' Max Vel=4.78 fps Inflow=13.83 cfs 1.374 af
18.0" Round Pipe n=0.013 L=44.0' S=0.0050 '/' Capacity=7.43 cfs Outflow=7.80 cfs 1.374 af

Reach 5R: Total Area Inflow=17.12 cfs 1.846 af
Outflow=17.12 cfs 1.846 af

Pond 2P: Undeground Detention/Infiltration Peak Elev=847.62' Storage=20,067 cf Inflow=22.16 cfs 1.168 af
Discarded=0.21 cfs 0.143 af Primary=6.09 cfs 0.963 af Secondary=4.38 cfs 0.061 af Outflow=10.68 cfs 1.168 af

Pond 3P: Underground Infiltration Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af

Total Runoff Area = 3.597 ac Runoff Volume = 1.989 af Average Runoff Depth = 6.64"
14.51% Pervious = 0.522 ac 85.49% Impervious = 3.075 ac

Summary for Subcatchment 1A: Bloomington Acura CB#1

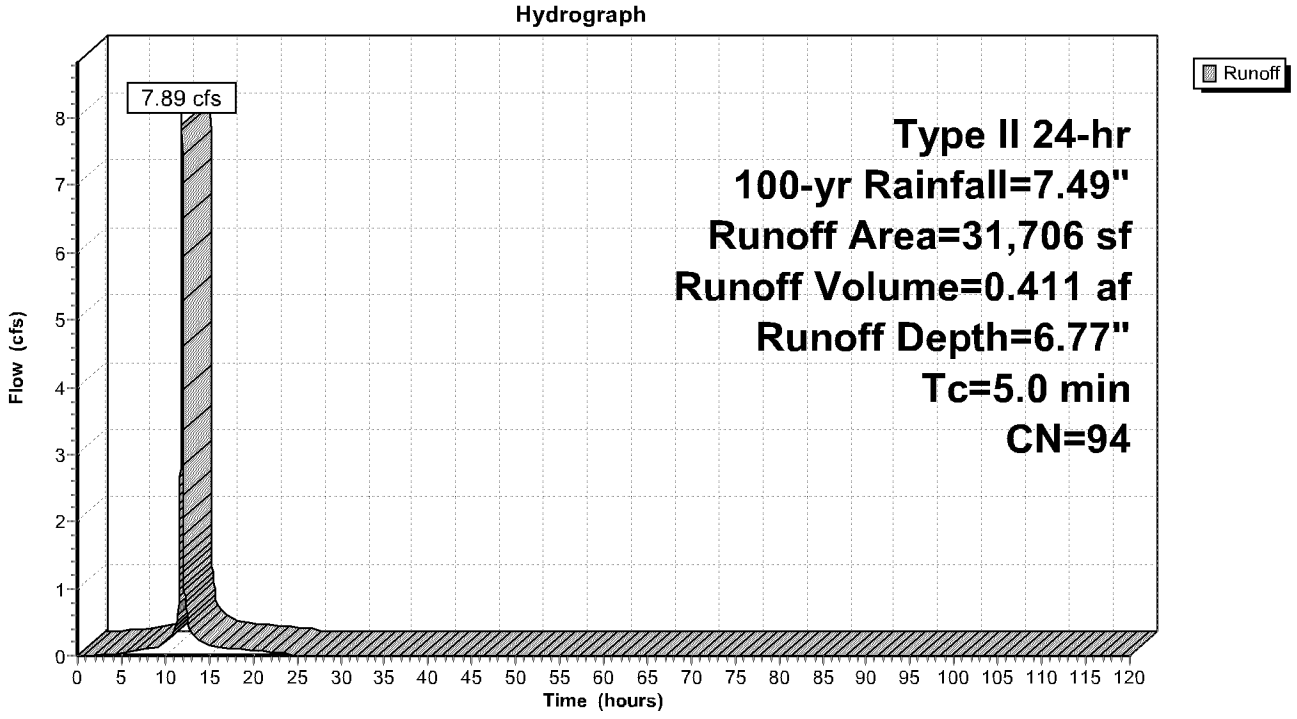
Runoff = 7.89 cfs @ 11.96 hrs, Volume= 0.411 af, Depth= 6.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=7.49"

Area (sf)	CN	Description
3,237	61	>75% Grass cover, Good, HSG B
28,469	98	Paved parking & roofs
31,706	94	Weighted Average
3,237		10.21% Pervious Area
28,469		89.79% Impervious Area

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

Subcatchment 1A: Bloomington Acura CB#1



Summary for Subcatchment 4S: To Infiltration/Detention

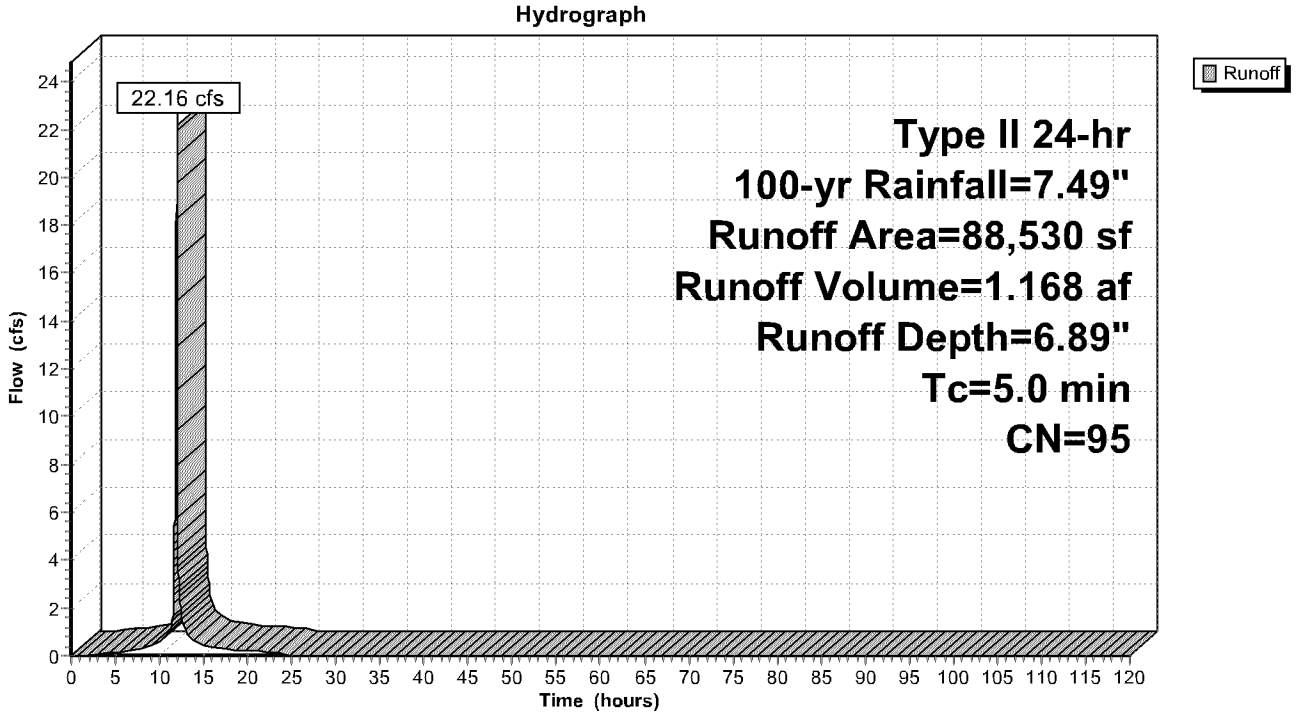
Runoff = 22.16 cfs @ 11.96 hrs, Volume= 1.168 af, Depth= 6.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=7.49"

Area (sf)	CN	Description
80,234	98	Paved parking, HSG B
8,296	61	>75% Grass cover, Good, HSG B
88,530	95	Weighted Average
8,296		9.37% Pervious Area
80,234		90.63% Impervious Area

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

Subcatchment 4S: To Infiltration/Detention



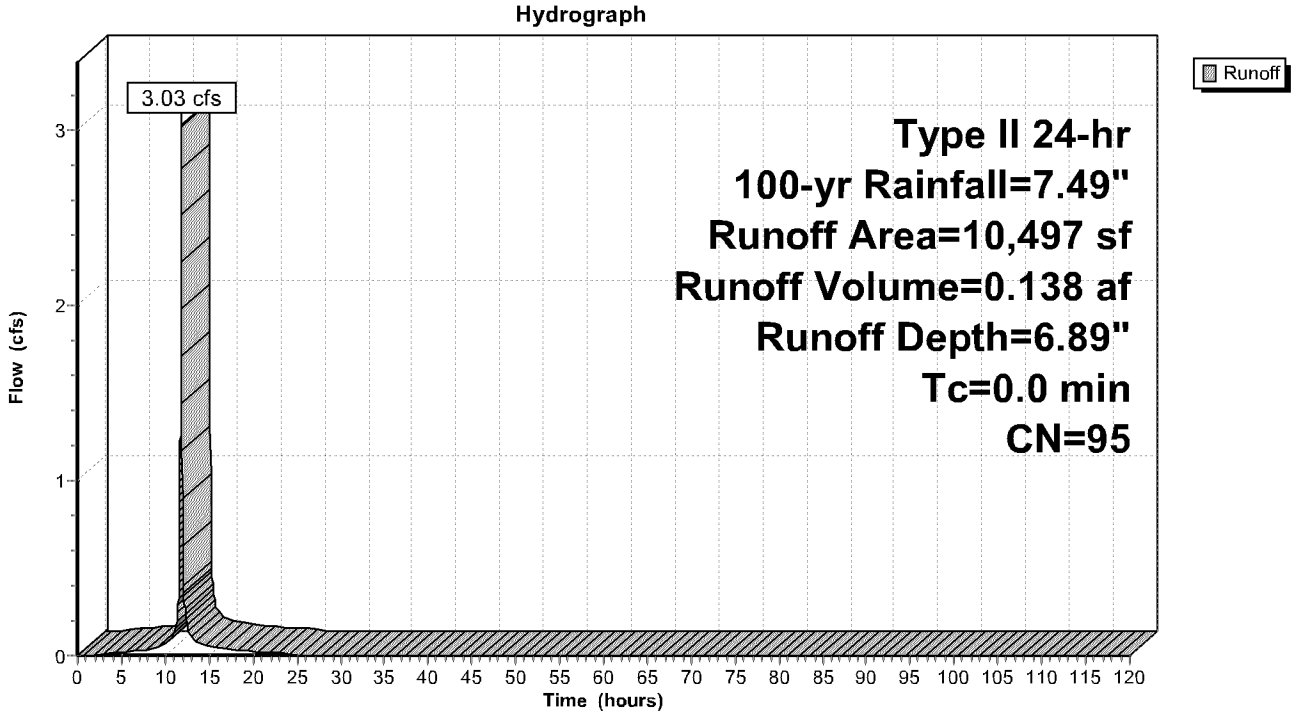
Summary for Subcatchment 5S: Direct Discharge

Runoff = 3.03 cfs @ 11.90 hrs, Volume= 0.138 af, Depth= 6.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=7.49"

Area (sf)	CN	Description
9,554	98	Paved parking, HSG B
943	61	>75% Grass cover, Good, HSG B
10,497	95	Weighted Average
943		8.98% Pervious Area
9,554		91.02% Impervious Area

Subcatchment 5S: Direct Discharge



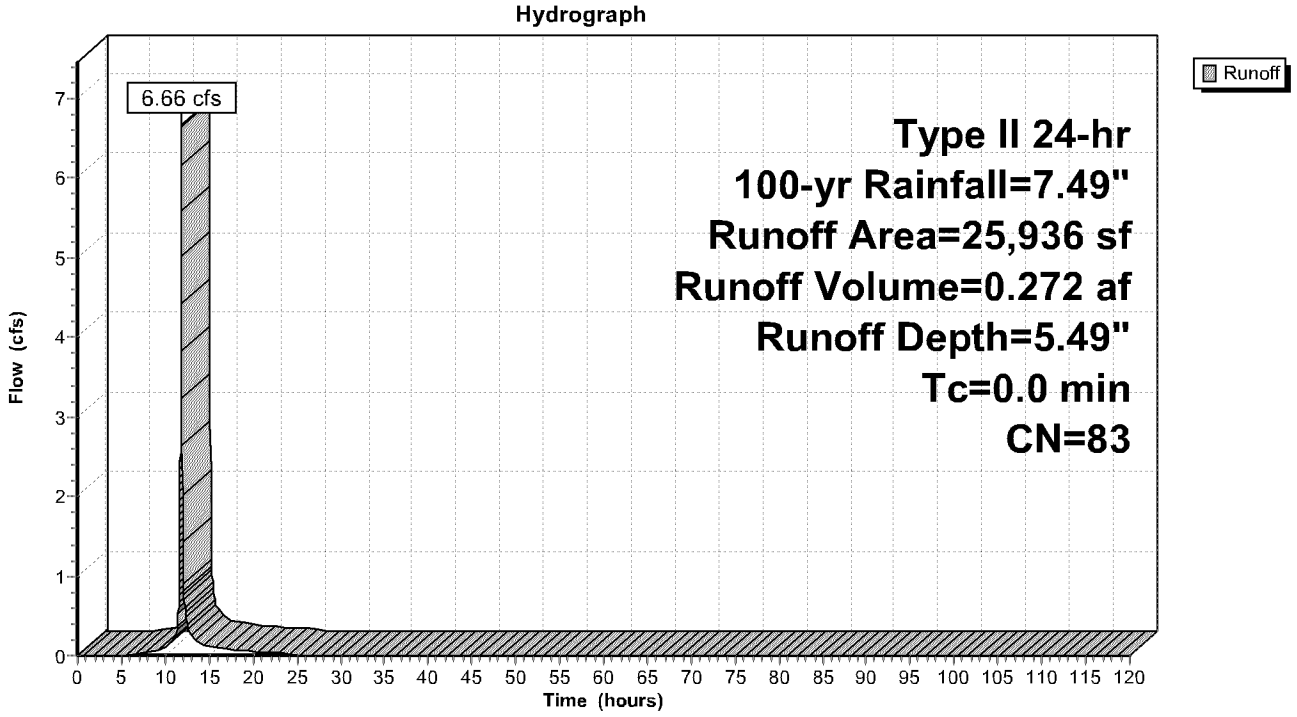
Summary for Subcatchment 6S: Direct Discharge

Runoff = 6.66 cfs @ 11.90 hrs, Volume= 0.272 af, Depth= 5.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=7.49"

Area (sf)	CN	Description
15,684	98	Paved parking, HSG B
10,252	61	>75% Grass cover, Good, HSG B
25,936	83	Weighted Average
10,252		39.53% Pervious Area
15,684		60.47% Impervious Area

Subcatchment 6S: Direct Discharge



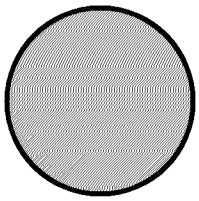
Summary for Reach 1R: Stub 5027B

Inflow Area = 2.760 ac, 90.41% Impervious, Inflow Depth = 5.98" for 100-yr event
Inflow = 13.83 cfs @ 11.96 hrs, Volume= 1.374 af
Outflow = 7.80 cfs @ 11.84 hrs, Volume= 1.374 af, Atten= 44%, Lag= 0.0 min

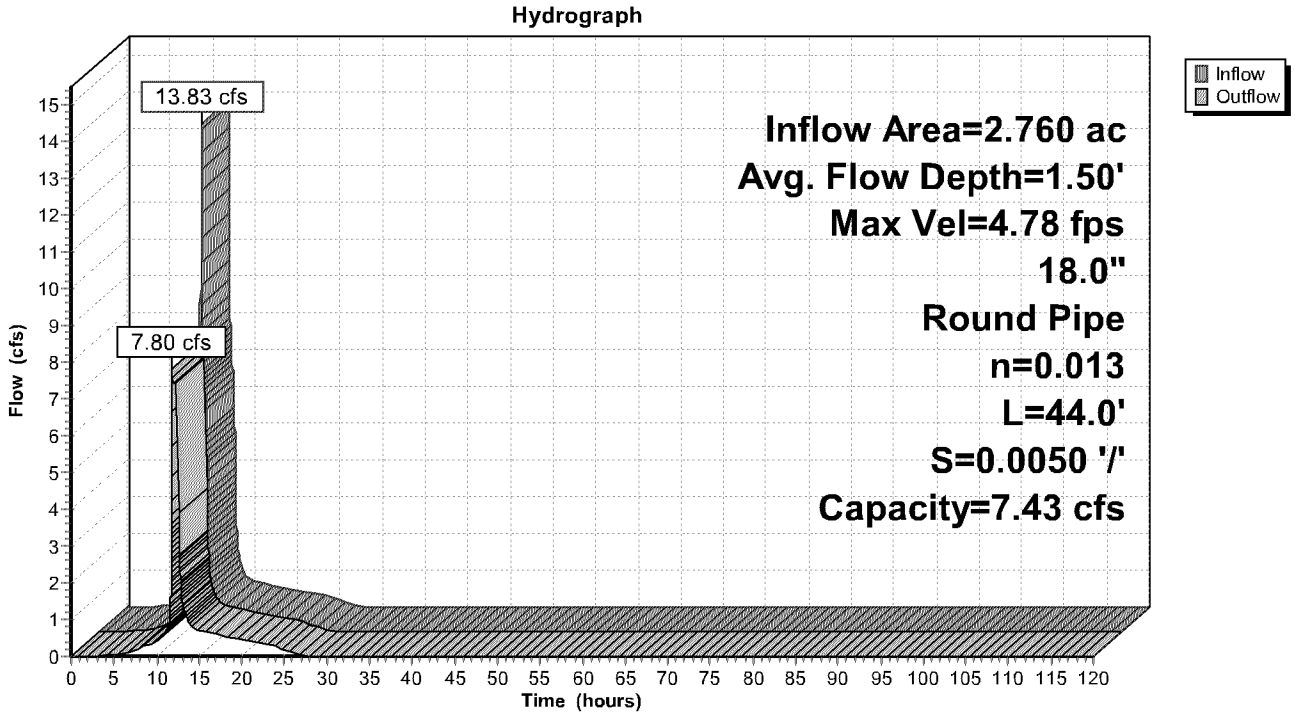
Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.78 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.97 fps, Avg. Travel Time= 0.4 min

Peak Storage= 78 cf @ 11.85 hrs
Average Depth at Peak Storage= 1.50'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 7.43 cfs

18.0" Round Pipe
n= 0.013 Concrete pipe, straight & clean
Length= 44.0' Slope= 0.0050 '/'
Inlet Invert= 842.23', Outlet Invert= 842.01'



Reach 1R: Stub 5027B

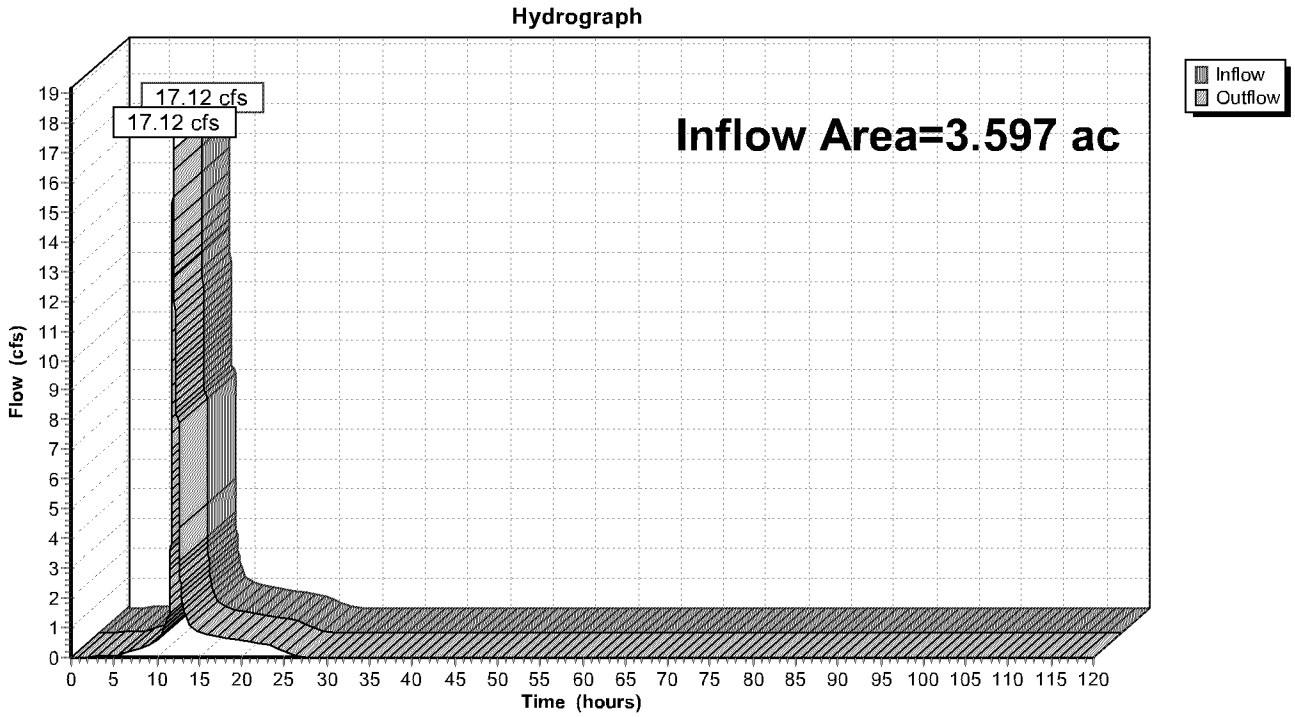


Summary for Reach 5R: Total Area

Inflow Area = 3.597 ac, 85.49% Impervious, Inflow Depth = 6.16" for 100-yr event
Inflow = 17.12 cfs @ 11.90 hrs, Volume= 1.846 af
Outflow = 17.12 cfs @ 11.90 hrs, Volume= 1.846 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs

Reach 5R: Total Area



Summary for Pond 2P: Undeground Detention/Infiltration

Inflow Area = 2.032 ac, 90.63% Impervious, Inflow Depth = 6.89" for 100-yr event
Inflow = 22.16 cfs @ 11.96 hrs, Volume= 1.168 af
Outflow = 10.68 cfs @ 12.04 hrs, Volume= 1.168 af, Atten= 52%, Lag= 5.2 min
Discarded = 0.21 cfs @ 12.04 hrs, Volume= 0.143 af
Primary = 6.09 cfs @ 12.04 hrs, Volume= 0.963 af
Secondary = 4.38 cfs @ 12.04 hrs, Volume= 0.061 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 847.62' @ 12.04 hrs Surf.Area= 18,624 sf Storage= 20,067 cf

Plug-Flow detention time= 156.0 min calculated for 1.167 af (100% of inflow)
Center-of-Mass det. time= 156.0 min (909.8 - 753.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	842.50'	0 cf	**12.00'W x 267.00'L x 3.50'H Field A** -Impervious 11,214 cf Overall - 3,927 cf Embedded = 7,287 cf x 0.0% Voids
#2A	843.00'	3,927 cf	**CMP Round 30** x 39 Inside #1 Effective Size= 30.0"W x 30.0"H => 4.91 sf x 20.00'L = 98.2 cf Overall Size= 30.0"W x 30.0"H x 20.00'L 3 Rows of 13 Chambers 10.00' Header x 4.91 sf x 2 = 98.2 cf Inside
#3B	842.50'	4,116 cf	**30.00'W x 153.14'L x 3.50'H Field B** 16,079 cf Overall - 5,788 cf Embedded = 10,291 cf x 40.0% Voids
#4B	843.00'	5,788 cf	**ADS_StormTech SC-740 +Cap** x 126 Inside #3 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 6 Rows of 21 Chambers
#5	843.00'	12,836 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		26,667 cf	Total Available Storage

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

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
843.00	78	0	0
846.50	78	273	273
847.00	2,822	725	998
848.00	20,853	11,838	12,836

Device	Routing	Invert	Outlet Devices
#1	Primary	843.00'	**12.0" Round Culvert** L= 102.0' Ke= 0.500 Inlet / Outlet Invert= 843.00' / 842.23' S= 0.0075 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Device 1	843.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	843.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.80 1.80 4.00 Width (feet) 0.00 0.00 4.00 4.00
#4	Discarded	842.50'	**0.450 in/hr Exfiltration over Surface area**

			Conductivity to Groundwater Elevation = 825.00'
#5	Secondary	847.25'	**Asymmetrical Weir, C= 3.27**
			Offset (feet) 0.00 58.50 61.50 64.50 67.50 90.50
			Elev. (feet) 848.03 847.58 847.25 847.25 847.58 848.03

Discarded OutFlow Max=0.21 cfs @ 12.04 hrs HW=847.62' (Free Discharge)
└**4=Exfiltration** (Controls 0.21 cfs)

Primary OutFlow Max=6.09 cfs @ 12.04 hrs HW=847.62' (Free Discharge)
└**1=Culvert** (Barrel Controls 6.09 cfs @ 7.75 fps)
  ├**2=Orifice/Grate** (Passes < 0.89 cfs potential flow)
  └**3=Custom Weir/Orifice** (Passes < 55.66 cfs potential flow)

Secondary OutFlow Max=4.29 cfs @ 12.04 hrs HW=847.62' (Free Discharge)
└**5=Asymmetrical Weir** (Weir Controls 4.29 cfs @ 1.18 fps)

Pond 2P: Undeground Detention/Infiltration - Chamber Wizard Field A

Chamber Model = CMP Round 30 (Round Corrugated Metal Pipe)
Effective Size= 30.0"W x 30.0"H => 4.91 sf x 20.00'L = 98.2 cf
Overall Size= 30.0"W x 30.0"H x 20.00'L

30.0" Wide + 15.0" Spacing = 45.0" C-C Row Spacing

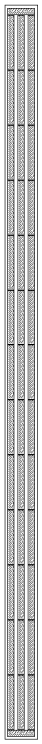
13 Chambers/Row x 20.00' Long +2.50' Header x 2 = 265.00' Row Length +12.0" End Stone x 2 = 267.00' Base Length
3 Rows x 30.0" Wide + 15.0" Spacing x 2 + 12.0" Side Stone x 2 = 12.00' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

39 Chambers x 98.2 cf + 10.00' Header x 4.91 sf x 2 = 3,927.0 cf Chamber Storage

11,214.0 cf Field - 3,927.0 cf Chambers = 7,287.0 cf Stone x 0.0% Voids = 0.0 cf Stone Storage

Chamber Storage = 3,927.0 cf = 0.090 af
Overall Storage Efficiency = 35.0%
Overall System Size = 267.00' x 12.00' x 3.50'

39 Chambers
415.3 cy Field
269.9 cy Stone



Pond 2P: Undeground Detention/Infiltration - Chamber Wizard Field B

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

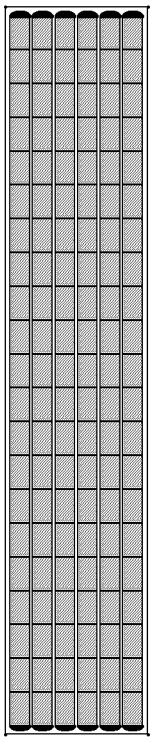
21 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 151.14' Row Length +12.0" End Stone x 2 = 153.14' Base Length
6 Rows x 51.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 30.00' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

126 Chambers x 45.9 cf = 5,788.4 cf Chamber Storage

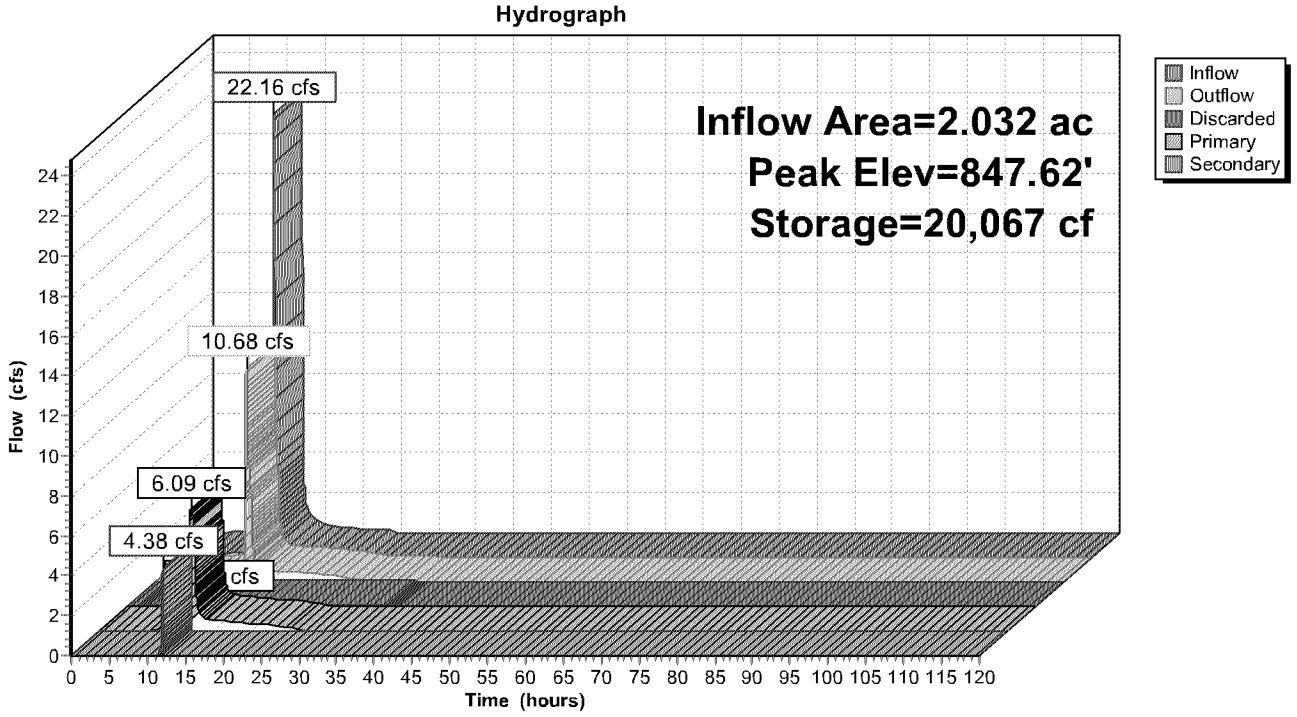
16,079.4 cf Field - 5,788.4 cf Chambers = 10,290.9 cf Stone x 40.0% Voids = 4,116.4 cf Stone Storage

Chamber Storage + Stone Storage = 9,904.8 cf = 0.227 af
Overall Storage Efficiency = 61.6%
Overall System Size = 153.14' x 30.00' x 3.50'

126 Chambers
595.5 cy Field
381.1 cy Stone



Pond 2P: Undeground Detention/Infiltration



Summary for Pond 3P: Underground Infiltration

Volume	Invert	Avail.Storage	Storage Description
#1A	842.50'	4,116 cf	**30.00'W x 153.14'L x 3.50'H Field A** 16,079 cf Overall - 5,788 cf Embedded = 10,291 cf x 40.0% Voids
#2A	843.00'	5,788 cf	**ADS_StormTech SC-740 +Cap** x 126 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 6 Rows of 21 Chambers
		9,905 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	842.50'	**0.450 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 825.00'
#2	Primary	845.00'	**24.0" Round Culvert** L= 20.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 845.00' / 844.80' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
↑—**2=Culvert** (Controls 0.00 cfs)

Pond 3P: Underground Infiltration - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

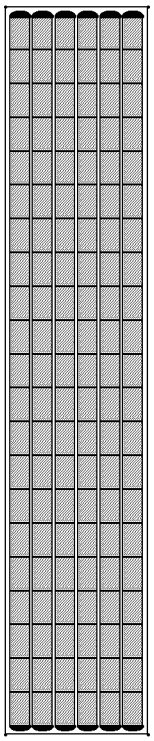
21 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 151.14' Row Length +12.0" End Stone x 2 = 153.14' Base Length
6 Rows x 51.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 30.00' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

126 Chambers x 45.9 cf = 5,788.4 cf Chamber Storage

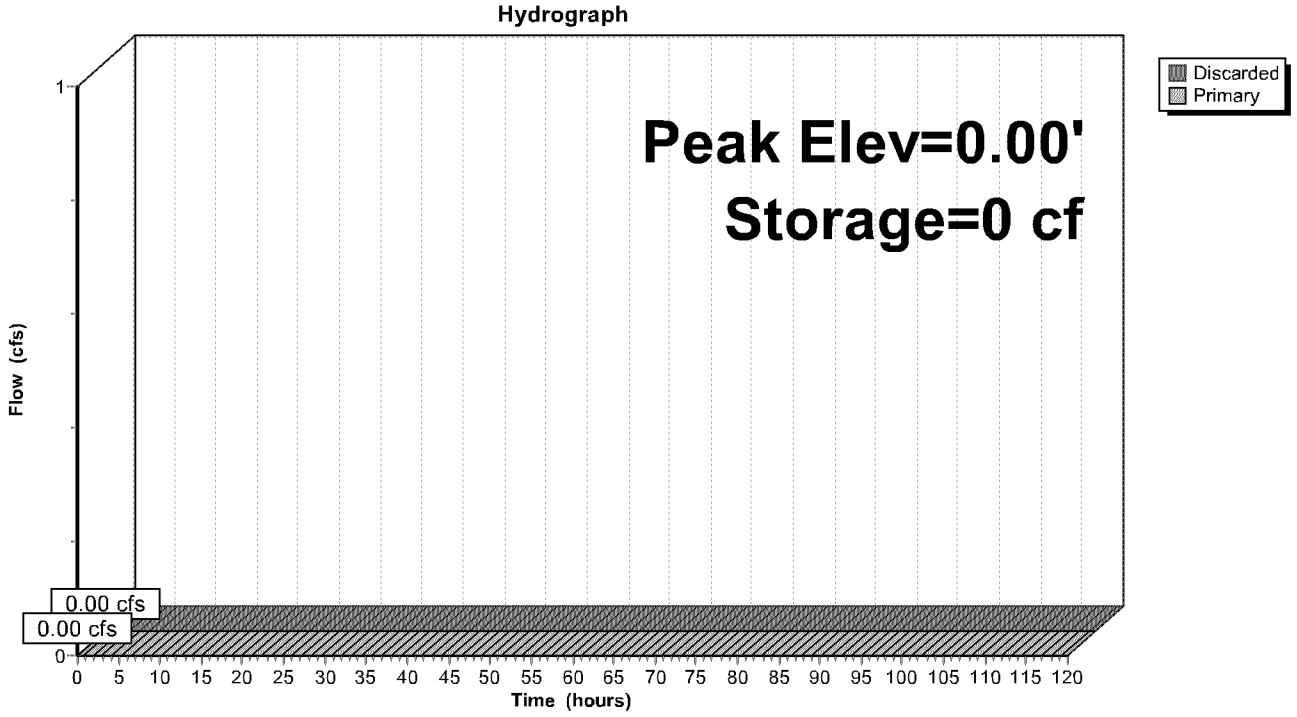
16,079.4 cf Field - 5,788.4 cf Chambers = 10,290.9 cf Stone x 40.0% Voids = 4,116.4 cf Stone Storage

Chamber Storage + Stone Storage = 9,904.8 cf = 0.227 af
Overall Storage Efficiency = 61.6%
Overall System Size = 153.14' x 30.00' x 3.50'

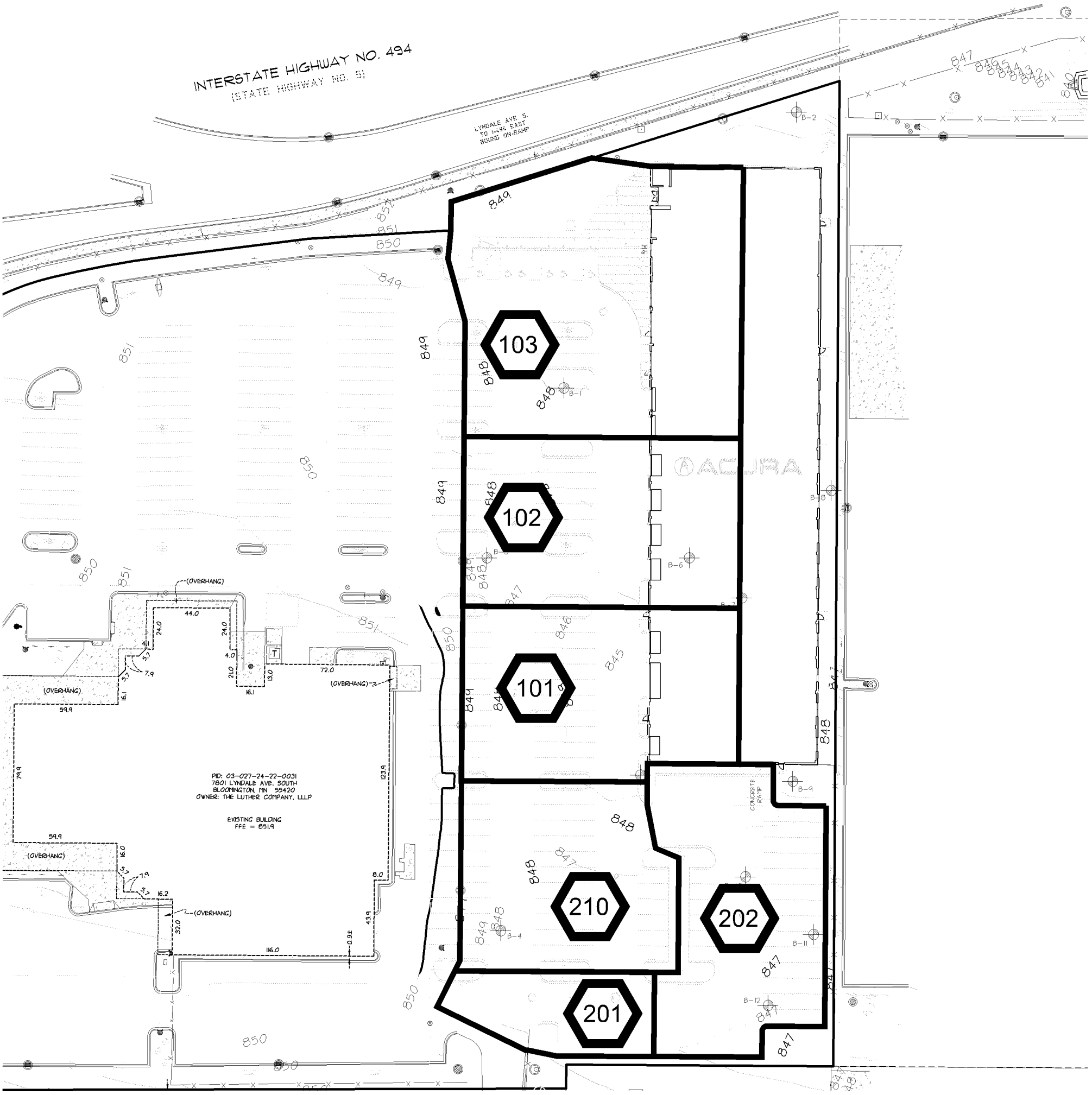
126 Chambers
595.5 cy Field
381.1 cy Stone



Pond 3P: Underground Infiltration



APPENDIX E: STORM SEWER DRAINAGE AREA MAP



STORM SEWER DRAINAGE AREAS			
STRUCTURE #	AREA	PERVIOUS AREA	IMPERVIOUS AREA
101	15,499	621	14,878
102	15,679	980	14,699
103	25,294	3,944	21,350
201	5,129	505	4,624
202	14,425	1,192	13,233
210	13,069	1,054	12,015

LANDFORM

STORM SEWER DRAINAGE MAP

ACURA - SUBARU • BLOOMINGTON, MN

03.30.2018

APPENDIX F: STORM SEWER PIPE SIZING

LANDFORM
From Site to Finish

MINNESOTA STORM SEWER DESIGN CALCULATIONS

DATE:	03/15/18
PROJECT NAME:	Acura - Subaru
PROJECT NUMBER:	BAA14041
PROJECT CITY:	Bloomington
PROJECT COUNTY:	Hennepin
PROJECT ENGINEER:	SES

STORM FREQUENCY:	10 Years
CALCULATIONS BY:	JDB
MN ATLAS 14 REGION:	Hennepin

Segment		A - Trib. Areas		C - Coef.		Tc - Time of Conc.			I - Intensity		Q - Rate		Pipe								Upstream Structure						Downstream Structure						Comments
From	To	CB (Ac.)	Pipe (Ac.)	CB Indiv.	Pipe Avg.	CB (Min.)	Pipe (Min.)	Total (Min.)	CB (In/Hr)	Total (In/Hr)	CB (CFS)	Pipe (CFS)	Len. (Ft.)	Dia. (In.)	Grade (%)	Mat'l.	Man's. n	Vel. (Ft/S)	Cap. (CFS)	Excess Cap.	Structure	Top Rim	Invert	Build (Ft.)	Size (In.)	Casting	Structure	Top Rim	Inlet	Match	Drop (Ft.)	Build (Ft.)	
CB 103	CBMH 102	0.58	0.58	0.83	0.83	5.0	0.4	5.4	7.69	7.69	3.7	3.7	102	15	0.75	RCP	0.013	4.6	5.6	1.9	CB 103	847.21	844.84	2.38			CBMH 102	847.21	844.07	8/10ths		3.14	
CBMH 102	CBMH 101	0.36	0.94	0.90	0.86	5.0	0.3	5.7	7.69	7.69	2.5	6.2	99	18	0.75	RCP	0.013	5.1	9.1	2.9	CBMH 102	847.21	843.87	3.34			CBMH 101	847.46	843.13	8/10ths		4.33	
CBMH 101	MH 100	0.36	1.30	0.92	0.88	5.0	0.1	5.7	7.69	7.69	2.5	8.7	17	18	0.75	RCP	0.013	5.1	9.1	0.4	CBMH 101	847.46	843.13	4.33			MH 100	847.81	843.00	Invert		4.81	
CB 202	CBMH 201	0.33	0.33	0.94	0.94	5.0	0.4	5.4	7.69	7.69	2.4	2.4	87	12	0.60	RCP	0.013	3.5	2.8	0.4	CB 202	846.46	844.06	2.40			CBMH 201	847.46	843.54	8/10ths		3.92	
CBMH 201	MH 200	0.12	0.75	0.88	0.91	5.0	0.2	5.6	7.69	7.69	0.8	5.2	48	15	0.70	RCP	0.013	4.4	5.4	0.2	CBMH 201	847.46	843.34	4.12			MH 200	848.17	843.00	Invert		5.17	
CB 210	CBMH 201	0.30	0.30	0.89	0.89	5.0	0.2	5.2	7.69	7.69	2.1	2.1	70	12	1.30	RCP	0.013	5.2	4.1	2.0	CB 210	846.96	844.45	2.51			CBMH 201	847.46	843.54	8/10ths		3.92	

APPENDIX G: MIDS SUMMARY

PL201800121
PL2018-121

Project Information

Calculator Version:	Version 3: January 2017
Project Name:	Luther Wentworth Storage Lot
User Name / Company Name:	Landform
Date:	2017-04-18
Project Description:	Redevelopment of site into a parking lot Total Disturbed Area = 91,962 SF - 2.11 AC
Construction Permit?:	Yes

Site Information

Retention Requirement (inches):	1.
Site's Zip Code:	55420
Annual Rainfall (inches):	31.5
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed		0.447		0	0.447
			Impervious Area (acres)		1.663
			Total Area (acres)		2.11

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed		0.368			0.368
			Impervious Area (acres)		1.663
			Total Area (acres)		2.031

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	6037	ft3
Volume removed by BMPs towards performance goal:	6037	ft^3
Percent volume removed towards performance goal	**100**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	3.9436	acre-ft
Annual runoff volume removed by BMPs:	3.7622	acre-ft
Percent annual runoff volume removed:	**95**	**%**
Post development annual particulate P load:	1.77	lbs
Annual particulate P removed by BMPs:	1.688	lbs
Post development annual dissolved P load:	1.448	lbs
Annual dissolved P removed by BMPs:	1.382	lbs
Percent annual total phosphorus removed:	**95**	**%**
Post development annual TSS load:	584.6	lbs
Annual TSS removed by BMPs:	574.8	lbs
Percent annual TSS removed:	**98**	**%**

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
Underground Infiltration	9096	6037	6037	0	100
Underground System - Header Row Sedim	0	6037	0	6037	0

Annual Volume Summary

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)
Underground Infiltration	0	3.9063	3.7623	0.144	96
Underground System - Header Row Sedim	3.9063	0	0	3.9063	0

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
Underground Infiltration	0	1.7531	1.6885	0.0646	96
Underground System - Header Row Sedim	1.7531	0	0	1.7531	0

Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
Underground Infiltration	0	1.4344	1.3815	0.0529	96
Underground System - Header Row Sedim	1.4344	0	0	1.4344	0

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
Underground Infiltration	0	115.81	111.54	4.2700000000	96
Underground System - Header Row Sedim	579.07	0	463.26	115.81	80

BMP Schematic