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PRELIMINARY STORMWATER MANAGEMENT PLAN

PL201900127
PL2019-127
Skywater Tech Foundry
2401 and 2411 East 86th Street

FOR

ICE CASTLE

BLOOMINGTON, MN

PREPARED BY:

BRADY BUSSELMAN & JOSH BALZER

07/23/2019

Stormwater Report Approval
Rate Control
Volume Control
Water Quality

Steven W. Segar, PE
07/30/2019

PL201900127
PL2019-127

PROJECT INTRODUCTION

The proposed project is located a few blocks south of highway 494 and just east of E Old Shakopee Road in Bloomington, MN. The project will add an approximately 37,784 sf (footprint) building expansion to the existing building structure. Improvements will be made to the parking lot area as well. The project is located within the Lower Minnesota River Watershed District (LMRWD) and the City of Bloomington is the permitting authority. Rate control, volume control and water quality are required onsite.

EXISTING CONDITIONS

The existing site contains a large industrial building with associated parking lot. Impervious surfaces cover most of the site. The soils in the area are known to be generally type B silty sand soils. It is assumed until further exploration that these sands may be classified as HSG type B and are well suited for infiltration. Stormwater runoff onsite generally drains overland to a series of catch basins which flow to the north side of the site where they discharge to an existing stormwater basin. The basin outlet flows to the east where the ultimate discharge point is the Minnesota river.

PROPOSED CONDITIONS

The proposed development includes building expansion and parking lot improvements. New or fully re-constructed impervious surfaces onsite will be minimized by maintaining original parking lot grades and drainage patterns to the maximum extent practicable. Mill and overlay is proposed for the majority of the parking lot area. Some utilities will be re-routed or added to service the site and the proposed building addition. Stormwater runoff will be routed to an underground infiltration system to provide rate control, volume control and water quality improvements to the site.

RATE CONTROL

The City of Bloomington and LMRWD require rate control for the 2-, 10-, and 100-year design storms. Runoff rate control calculations were performed in HydroCAD using the Atlas 14 rainfall depths and MSE 3 rainfall distribution. The proposed site improvements are a benefit to the surrounding area because the overall impervious area on the site is reduced. The reduction in impervious area from the existing to the proposed condition and replacing parking lot with a flat-roofed building will help to lower the runoff rates on the site. The proposed site also includes an underground infiltration basin that will reduce runoff rates as well. However, the intent of the infiltration basin is to function as a means of water quality and volume control and not necessarily rate control. Rate control was analyzed by modeling in Hydrocad without the use of the infiltration basin. The results of the analysis are summarized in the tables below. Detailed calculations and drainage maps may be found in the appendices.

Maximum Rate of Runoff (cfs)

Storm Event	Total Existing	Total Proposed
2-year	17.65	15.58
10-year	27.45	25.17
100-year	49.79	47.07

WATER QUALITY

The City of Bloomington states that for projects that disturb land greater than 50 cy or 5,000 sf, all stormwater runoff from disturbed areas shall be treated to at least 60% total phosphorus removal and at least 90% for total suspended solids removal. Water quality will be met onsite through the use of an underground infiltration system.

To evaluate the water quality requirements for the disturbed portion of the site, a MIDS model has been developed. Under the site information tab, the proposed disturbed impervious and proposed disturbed pervious areas were inputted to the appropriate boxes under the Land Cover section, which indicates the total area being evaluated. The proposed underground infiltration basin was modeled in the MIDS program and the total impervious and pervious areas that drain to the proposed infiltration basin were assigned to that basin. It should be noted that the actual drainage area to the proposed infiltration basin has a greater amount of impervious than the disturbed impervious area. For the purposes of determining the water quality, only the total amount of disturbed impervious area is modeled as flowing to the basin because the additional impervious area beyond what is required is expected to bypass the infiltration basin.

Nutrient Analysis

BMP	TSS Removal (%)	TP Removal (%)
Underground Infiltration Basin	90	90

VOLUME REDUCTION

The City of Bloomington requires that the proposed site will retain on-site a volume equivalent to 1.1 inches of runoff from the new and/or fully reconstructed impervious area. The city also requires that pre-treatment be provided and that water levels draw down in 48 hours or less.

$$Required\ Infiltration\ Volume(ft^3) = V_{inf} = 1(in) * \frac{1\ ft}{12\ in} * New\ Impervious\ Area\ (ft^2)$$

$$V_{inf}(ft^3) = 1.1(in) * \frac{1\ ft}{12\ in} * 67{,}000(\ ft^2) = 6{,}142\ ft^3$$

Volume Control Analysis		
New/ Fully Reconstructed Impervious Surface	67,000	sf
Design Infiltration/Filtration Rainfall Event	1.1	in
Required Infiltration/Filtration Volume	**6,142**	**cf**
Maximum Allowable Infiltration Rate	0.45	in/hr
Required Drawdown Time	48	hrs
Maximum Live Storage Depth	**1.8**	**ft**
Provided Volume Below Outlet	**6,472**	**cf**

STORM SEWER CONVEYANCE

Storm sewer capacity has been analyzed with a spreadsheet utilizing manning's equation and the rational method. The spreadsheet has been attached to the report and can be found in Appendix D. The proposed storm sewer has been analyzed up to CBMH 102. As noted in the rate control section, runoff rates are reduced by the proposed project improvements. Therefore, storm sewer to the west of CBMH 102 is intended to match the existing pipes that were already servicing the site. The majority of the pipe heading to the north of the site was found to be 24" pipe at 1.00%. However, it was found that the existing pipe between STMH 100, STMH 100-A and the existing STMH decreased in slope downstream to 0.8%. In order to correct this existing problem, a 27" pipe at 0.8% has been proposed to prevent any future capacity issues. Our scope did not include analysis of existing pipes downstream or upstream of the project area.

Emergency Overflow

In the event of a clog in the system or a rainfall event larger than the design events, the grading plan has been designed with emergency overflows to convey runoff through the site.

Stormwater System Operations & Maintenance

An operations and maintenance agreement will be prepared if required at final design.

Erosion & Sediment Control

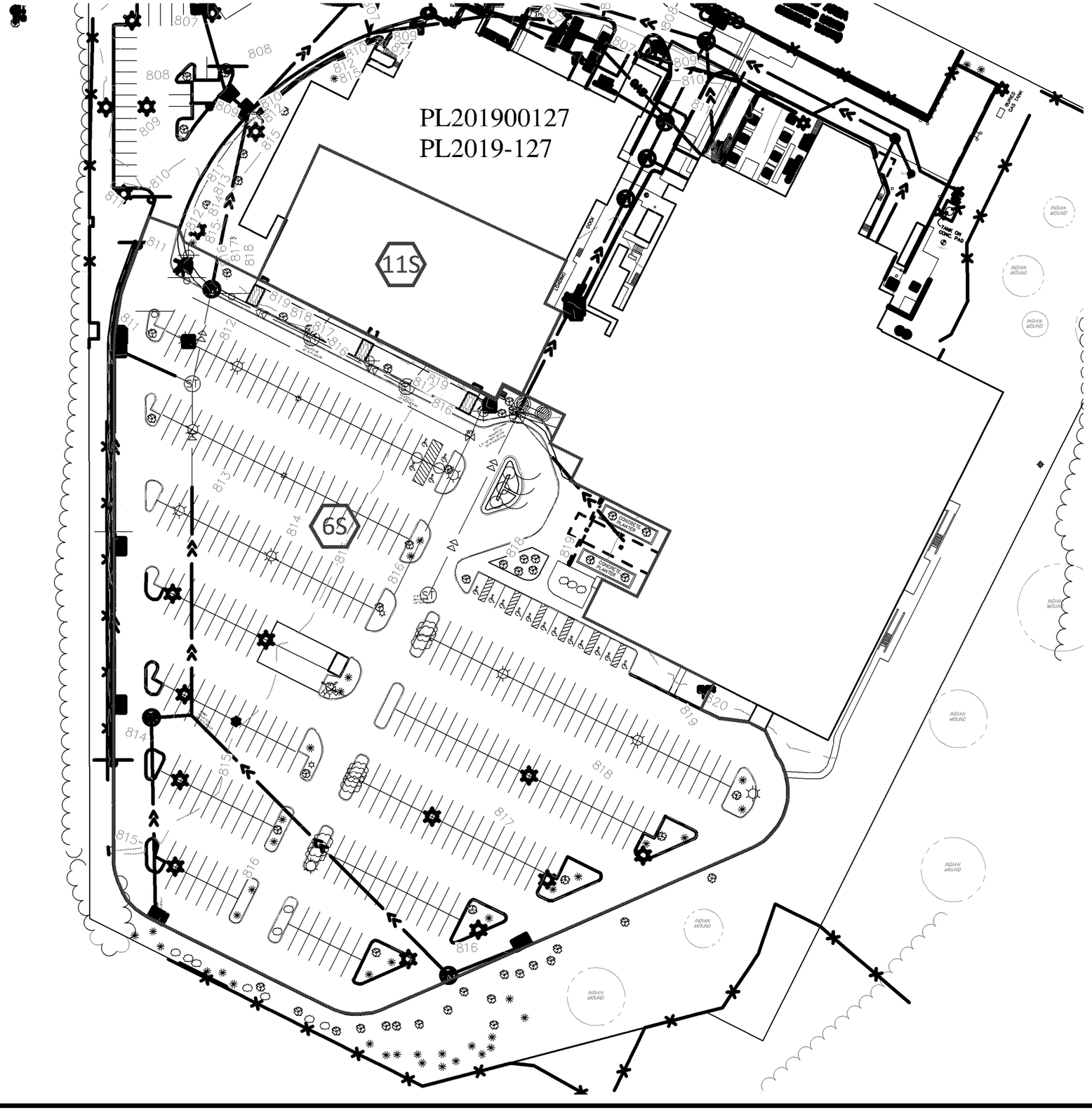
A comprehensive Stormwater Pollution Prevention Plan (SWPPP) meeting the requirements of the 2018 MPCA NPDES permit will be included in the site development final design plan set.

Summary

The proposed Ice Castle project will meet the requirements of the Lower Minnesota River Watershed, the City of Bloomington, and the MPCA through construction of an underground infiltration system. The proposed improvements will reduce the site impervious area and the infiltration basin BMP will provide the required rate control, volume control and water quality improvements prior to discharging stormwater runoff from the site to downstream receiving waters.

If you have any questions, comments, or additional information regarding this report, please contact me at bbusselman@sambatek.com or 763-476-6010.

APPENDIX A – DRAINAGE DIAGRAMS



LEGEND

- XX — LINK
- XX — POND
- XX — REACH
- XX — SUB-CATCHMENT

NORTH

0 NTS

SCALE IN FEET

Sambatek
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12800 Whitewater Drive, Suite 300
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763.476.6010 telephone
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Engineering | Surveying | Planning | Environmental

Client

Project
ICE CASTLE

Location
BLOOMINGTON, MN

Certification

Summary
Approved: BDB Drawn: JEB

Revision History

No.	Date	By	Submittal / Rev.

Sheet Title
EXISTING DRAINAGE MAP

Sheet No. Revision
1/2

Project No. 21846

PL201900127
PL2019-127

PROPOSED BUILDING ADDITION
71,000 S.F.
FFE=821.1
LFE=806.1

2S

10P

9S

LEGEND

- XX — LINK
- XX — POND
- XX — REACH
- XX — SUB-CATCHMENT

NORTH

0 NTS

SCALE IN FEET

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BLOOMINGTON, MN

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Summary
Approved: BDB Drawn: JEB

Revision History
No. Date By Submittal / Rev.

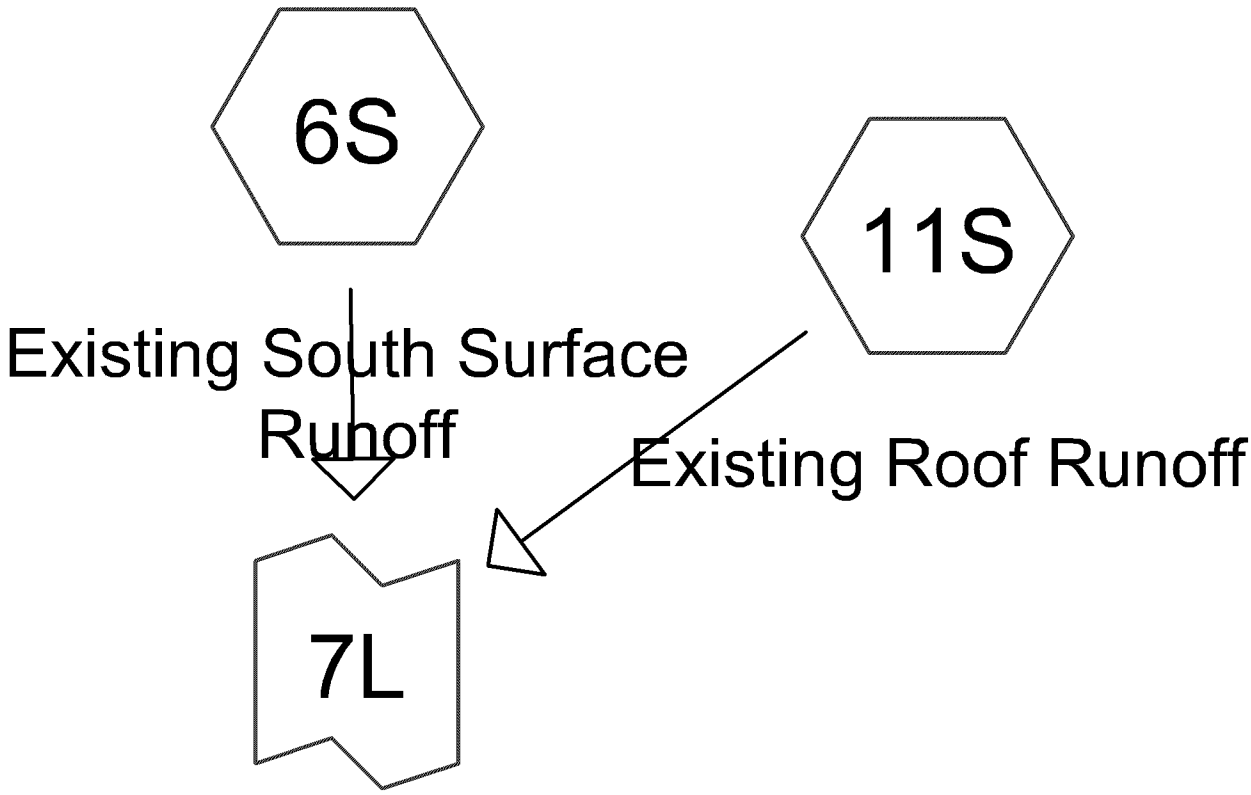
Sheet Title
PROPOSED DRAINAGE MAP

Sheet No. Revision
2/2

Project No. 21846

APPENDIX B – HYDROCAD CALCULATIONS

PL201900127
PL2019-127



Subcat Reach Pond Link

Routing Diagram for 21846-Ice Castle 2019-07-23
Prepared by {enter your company name here}, Printed 7/23/2019
HydroCAD® 10.00-20 s/n 01876 © 2017 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.451	61	>75% Grass cover, Good, HSG B (6S)
4.348	98	Paved parking, HSG B (6S)
0.594	98	Roofs, HSG B (11S)
5.392	**95**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
5.392	HSG B	6S, 11S
0.000	HSG C	
0.000	HSG D	
0.000	Other	
5.392		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.451	0.000	0.000	0.000	0.451	>75% Grass cover, Good	6S
0.000	4.348	0.000	0.000	0.000	4.348	Paved parking	6S
0.000	0.594	0.000	0.000	0.000	0.594	Roofs	11S
0.000	**5.392**	**0.000**	**0.000**	**0.000**	**5.392**	**TOTAL AREA**	

Time span=0.00-84.00 hrs, dt=0.01 hrs, 8401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment6S: Existing South Runoff Area=209,022 sf 90.61% Impervious Runoff Depth=2.28"
Tc=10.0 min CN=95 Runoff=16.01 cfs 0.913 af

Subcatchment11S: Existing Roof Runoff Runoff Area=25,863 sf 100.00% Impervious Runoff Depth=2.60"
Tc=15.0 min CN=98 Runoff=1.80 cfs 0.129 af

Link 7L: Existing Total Flow North Inflow=17.65 cfs 1.042 af
Primary=17.65 cfs 1.042 af

Total Runoff Area = 5.392 ac Runoff Volume = 1.042 af Average Runoff Depth = 2.32"
8.36% Pervious = 0.451 ac 91.64% Impervious = 4.942 ac

Summary for Subcatchment 6S: Existing South Surface Runoff

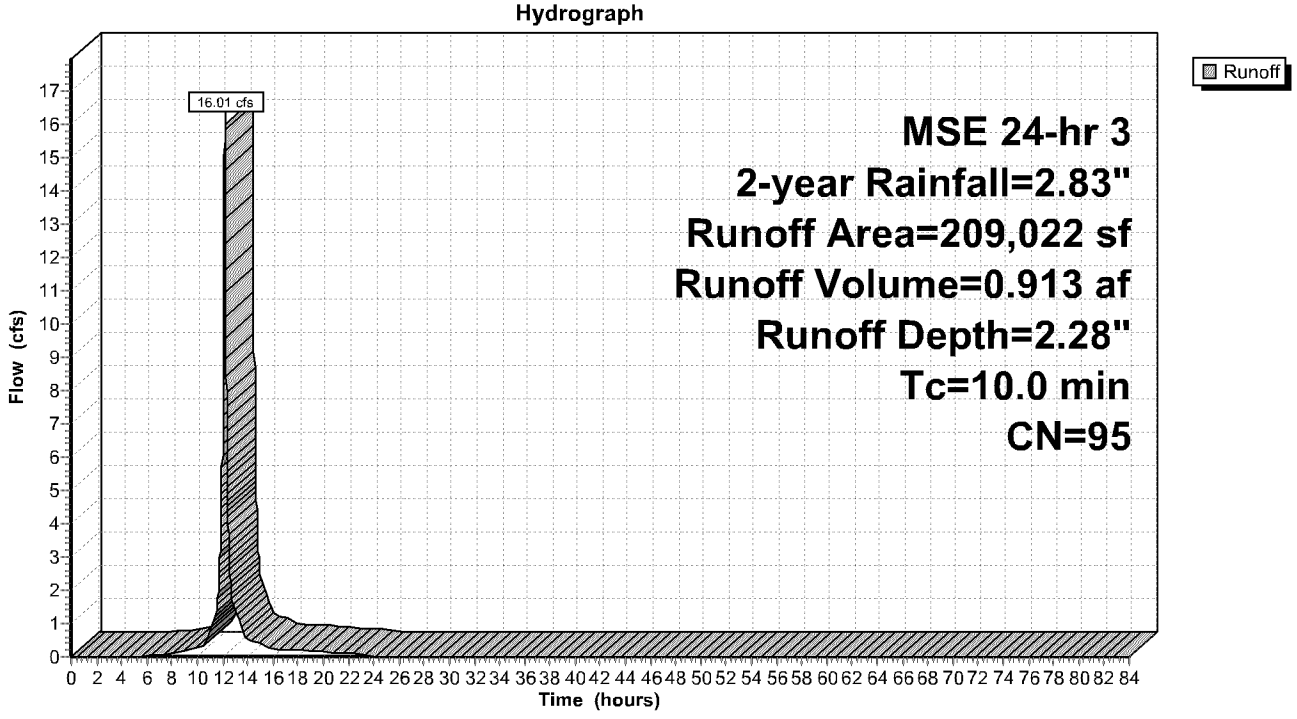
Runoff = 16.01 cfs @ 12.17 hrs, Volume= 0.913 af, Depth= 2.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-84.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-year Rainfall=2.83"

Area (sf)	CN	Description
189,392	98	Paved parking, HSG B
19,630	61	>75% Grass cover, Good, HSG B
209,022	95	Weighted Average
19,630		9.39% Pervious Area
189,392		90.61% Impervious Area

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

Subcatchment 6S: Existing South Surface Runoff



Summary for Subcatchment 11S: Existing Roof Runoff

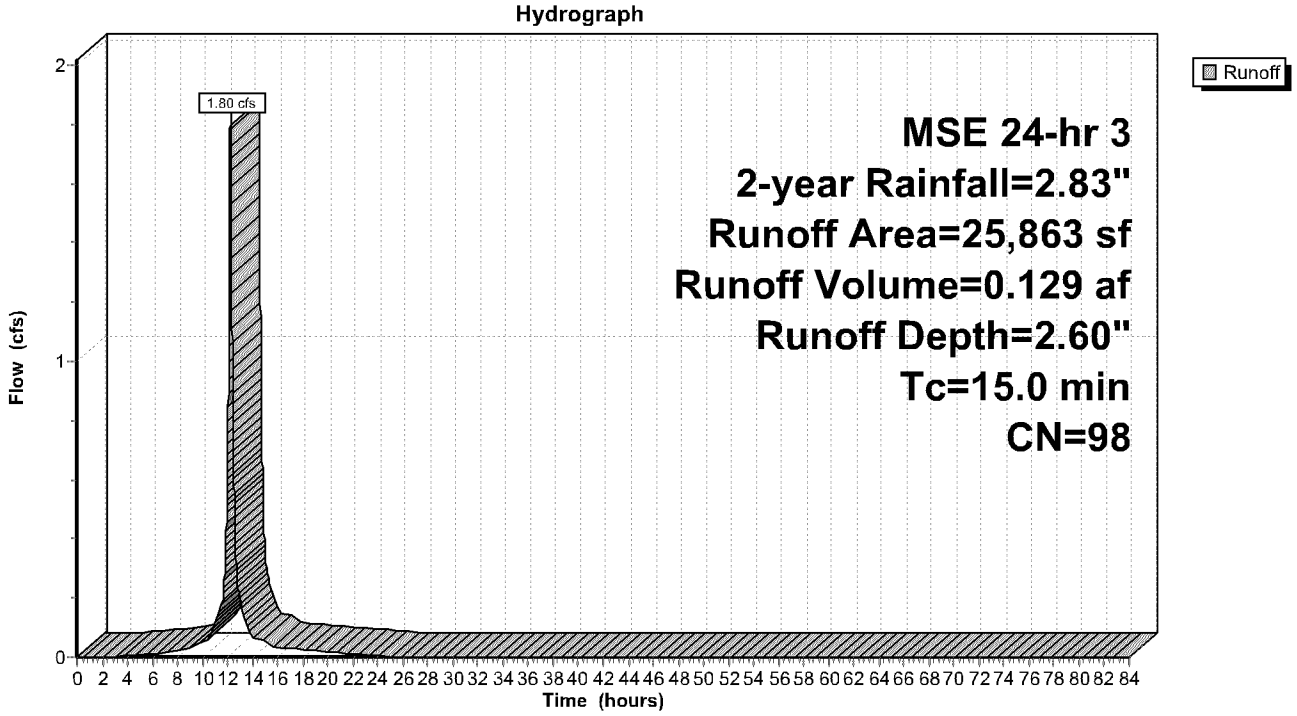
Runoff = 1.80 cfs @ 12.22 hrs, Volume= 0.129 af, Depth= 2.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-84.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-year Rainfall=2.83"

Area (sf)	CN	Description
25,863	98	Roofs, HSG B
25,863		100.00% Impervious Area

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

Subcatchment 11S: Existing Roof Runoff

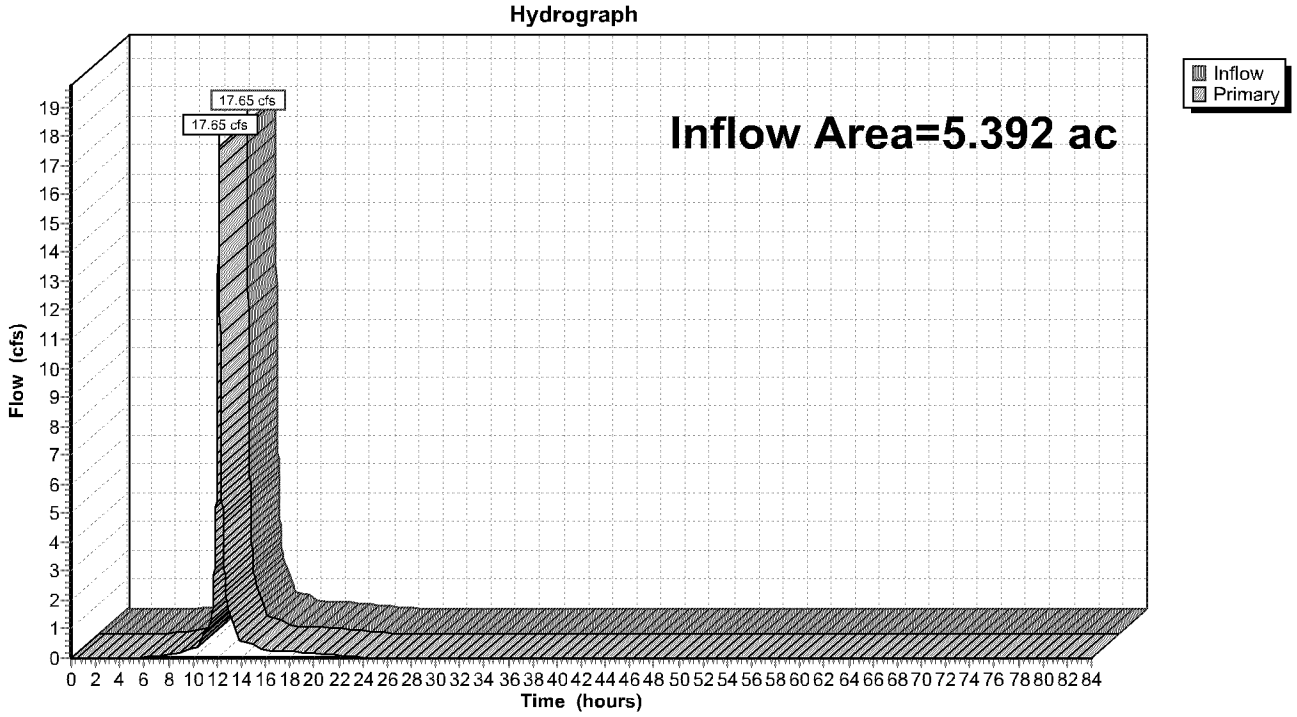


Summary for Link 7L: Existing Total Flow North

Inflow Area = 5.392 ac, 91.64% Impervious, Inflow Depth = 2.32" for 2-year event
Inflow = 17.65 cfs @ 12.17 hrs, Volume= 1.042 af
Primary = 17.65 cfs @ 12.17 hrs, Volume= 1.042 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-84.00 hrs, dt= 0.01 hrs

Link 7L: Existing Total Flow North



Time span=0.00-84.00 hrs, dt=0.01 hrs, 8401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment6S: Existing South Runoff Area=209,022 sf 90.61% Impervious Runoff Depth=3.67"
Tc=10.0 min CN=95 Runoff=24.98 cfs 1.467 af

Subcatchment11S: Existing Roof Runoff Runoff Area=25,863 sf 100.00% Impervious Runoff Depth=4.00"
Tc=15.0 min CN=98 Runoff=2.73 cfs 0.198 af

Link 7L: Existing Total Flow North Inflow=27.45 cfs 1.665 af
Primary=27.45 cfs 1.665 af

Total Runoff Area = 5.392 ac Runoff Volume = 1.665 af Average Runoff Depth = 3.70"
8.36% Pervious = 0.451 ac 91.64% Impervious = 4.942 ac

Summary for Subcatchment 6S: Existing South Surface Runoff

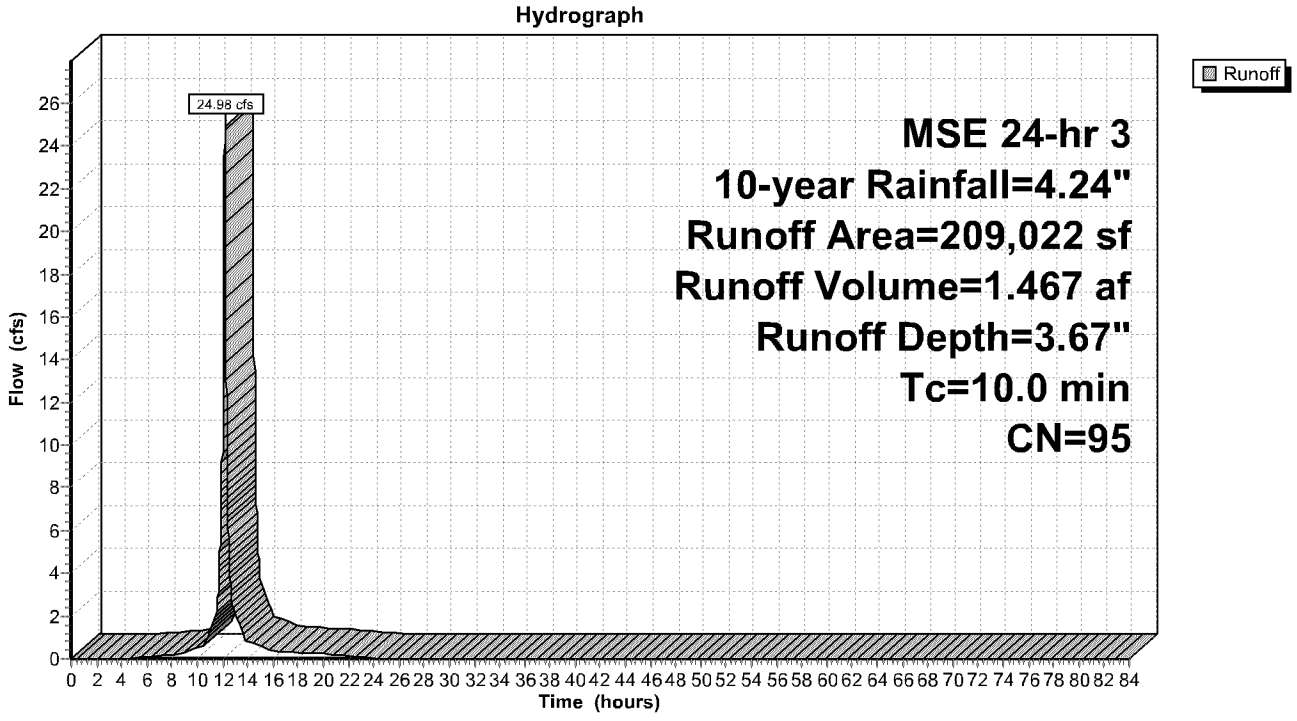
Runoff = 24.98 cfs @ 12.17 hrs, Volume= 1.467 af, Depth= 3.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-84.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-year Rainfall=4.24"

Area (sf)	CN	Description
189,392	98	Paved parking, HSG B
19,630	61	>75% Grass cover, Good, HSG B
209,022	95	Weighted Average
19,630		9.39% Pervious Area
189,392		90.61% Impervious Area

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

Subcatchment 6S: Existing South Surface Runoff



Summary for Subcatchment 11S: Existing Roof Runoff

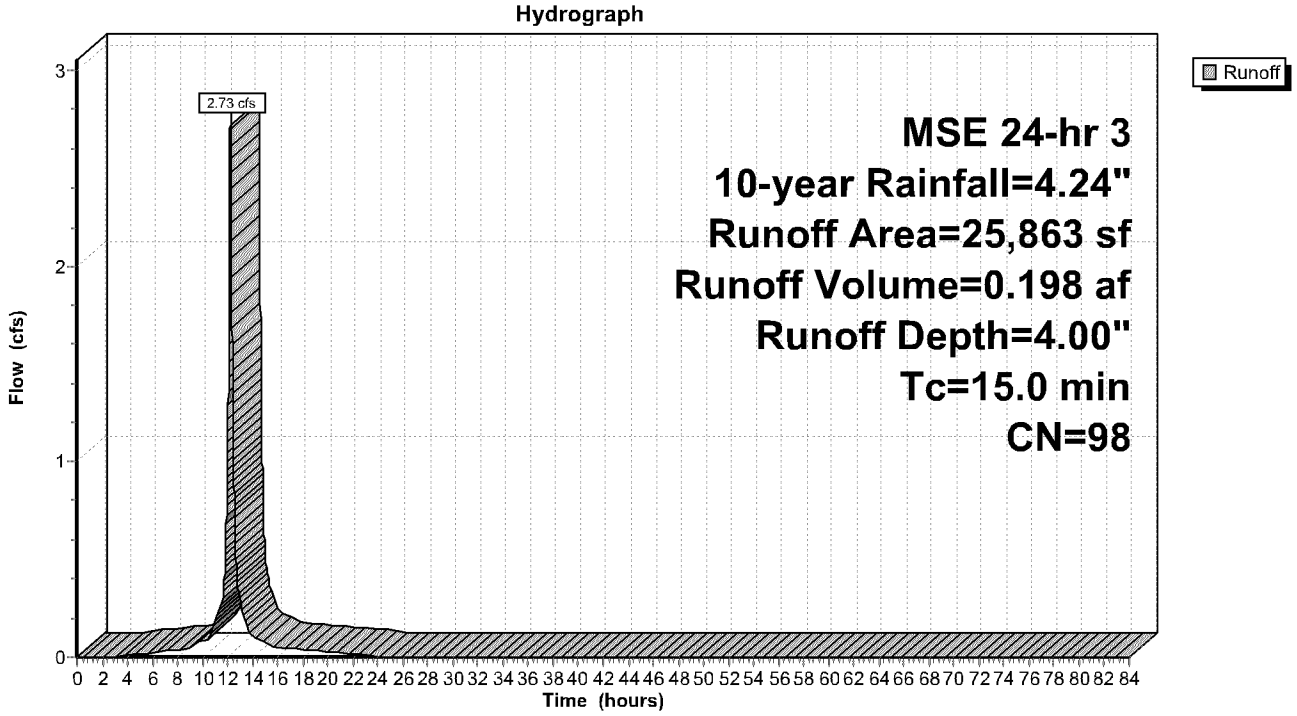
Runoff = 2.73 cfs @ 12.22 hrs, Volume= 0.198 af, Depth= 4.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-84.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-year Rainfall=4.24"

Area (sf)	CN	Description
25,863	98	Roofs, HSG B
25,863		100.00% Impervious Area

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

Subcatchment 11S: Existing Roof Runoff

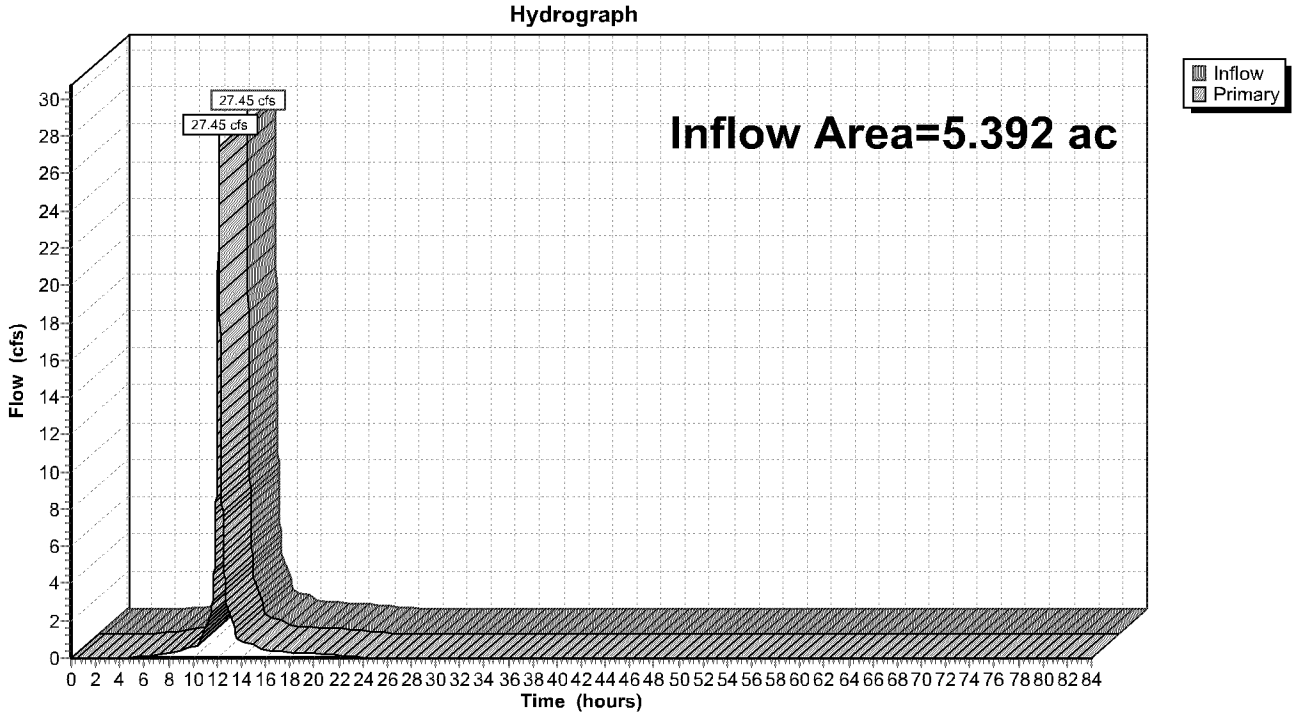


Summary for Link 7L: Existing Total Flow North

Inflow Area = 5.392 ac, 91.64% Impervious, Inflow Depth = 3.70" for 10-year event
Inflow = 27.45 cfs @ 12.17 hrs, Volume= 1.665 af
Primary = 27.45 cfs @ 12.17 hrs, Volume= 1.665 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-84.00 hrs, dt= 0.01 hrs

Link 7L: Existing Total Flow North



Time span=0.00-84.00 hrs, dt=0.01 hrs, 8401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment6S: Existing South Runoff Area=209,022 sf 90.61% Impervious Runoff Depth=6.90"
Tc=10.0 min CN=95 Runoff=45.40 cfs 2.760 af

Subcatchment11S: Existing Roof Runoff Runoff Area=25,863 sf 100.00% Impervious Runoff Depth=7.26"
Tc=15.0 min CN=98 Runoff=4.85 cfs 0.359 af

Link 7L: Existing Total Flow North Inflow=49.79 cfs 3.120 af
Primary=49.79 cfs 3.120 af

Total Runoff Area = 5.392 ac Runoff Volume = 3.120 af Average Runoff Depth = 6.94"
8.36% Pervious = 0.451 ac 91.64% Impervious = 4.942 ac

Summary for Subcatchment 6S: Existing South Surface Runoff

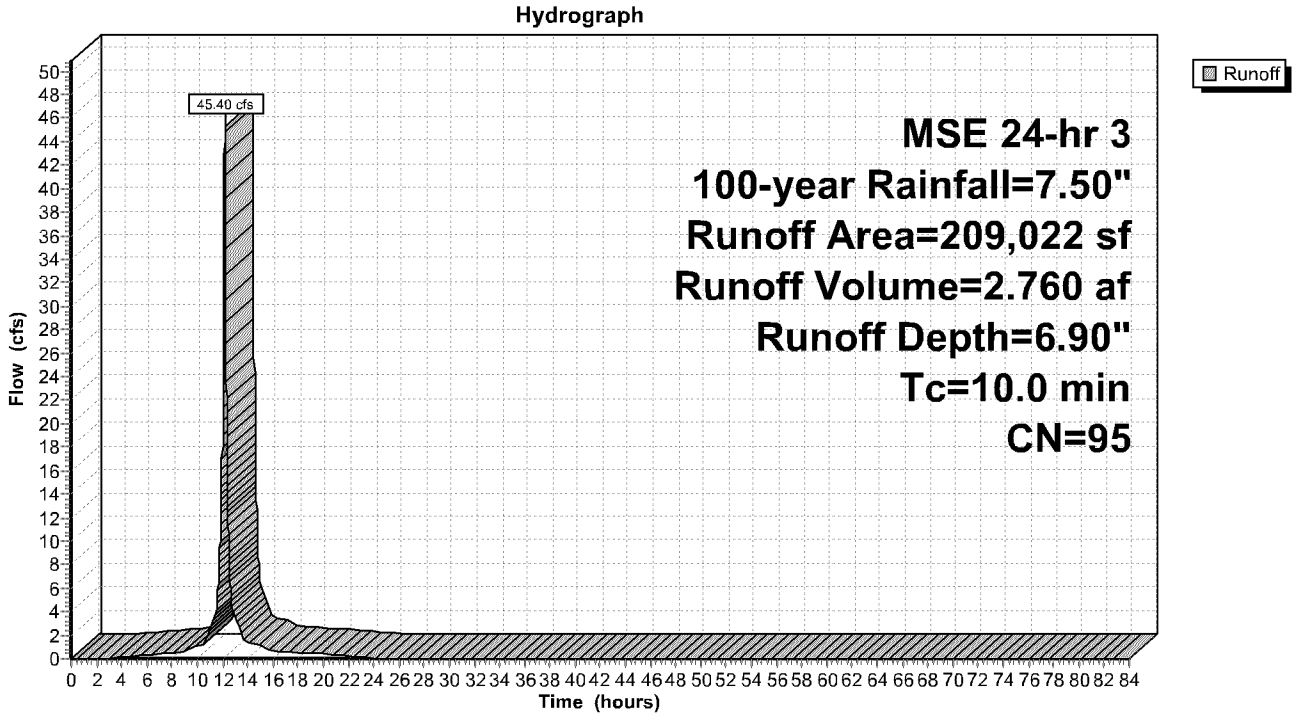
Runoff = 45.40 cfs @ 12.17 hrs, Volume= 2.760 af, Depth= 6.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-84.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-year Rainfall=7.50"

Area (sf)	CN	Description
189,392	98	Paved parking, HSG B
19,630	61	>75% Grass cover, Good, HSG B
209,022	95	Weighted Average
19,630		9.39% Pervious Area
189,392		90.61% Impervious Area

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

Subcatchment 6S: Existing South Surface Runoff



Summary for Subcatchment 11S: Existing Roof Runoff

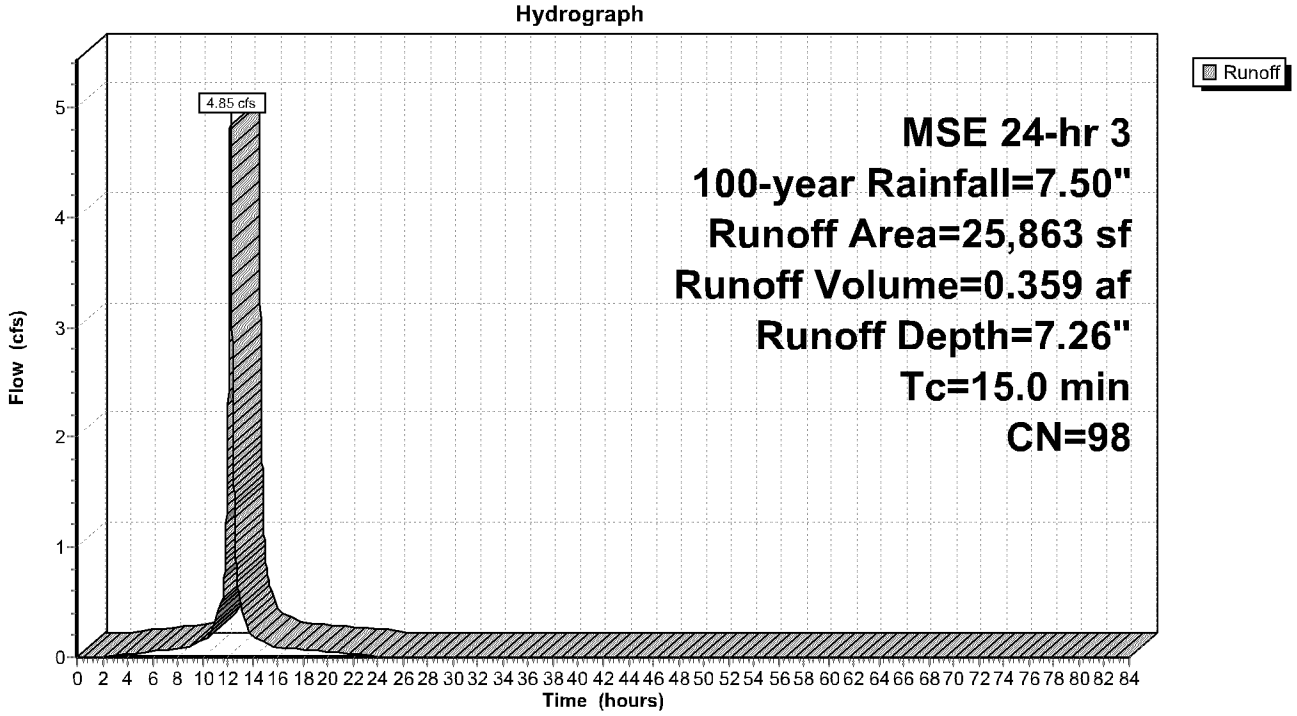
Runoff = 4.85 cfs @ 12.22 hrs, Volume= 0.359 af, Depth= 7.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-84.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-year Rainfall=7.50"

Area (sf)	CN	Description
25,863	98	Roofs, HSG B
25,863		100.00% Impervious Area

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

Subcatchment 11S: Existing Roof Runoff

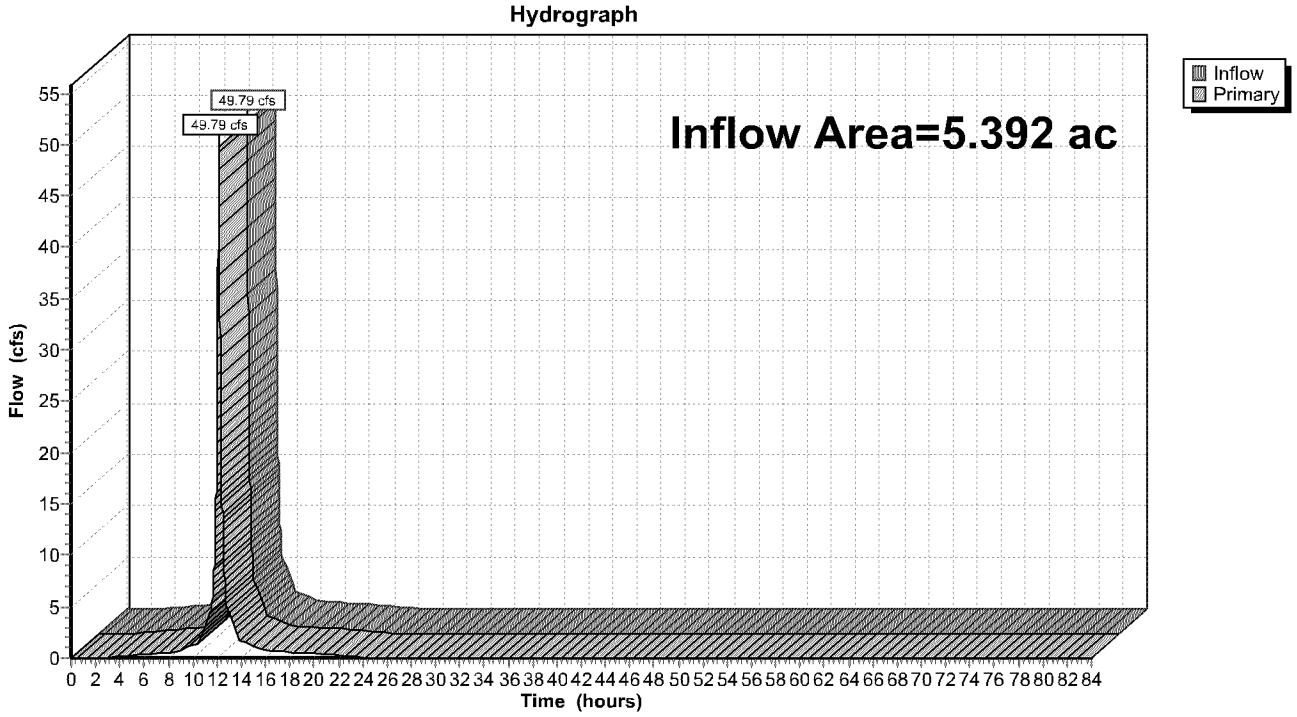


Summary for Link 7L: Existing Total Flow North

Inflow Area = 5.392 ac, 91.64% Impervious, Inflow Depth = 6.94" for 100-year event
Inflow = 49.79 cfs @ 12.17 hrs, Volume= 3.120 af
Primary = 49.79 cfs @ 12.17 hrs, Volume= 3.120 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-84.00 hrs, dt= 0.01 hrs

Link 7L: Existing Total Flow North



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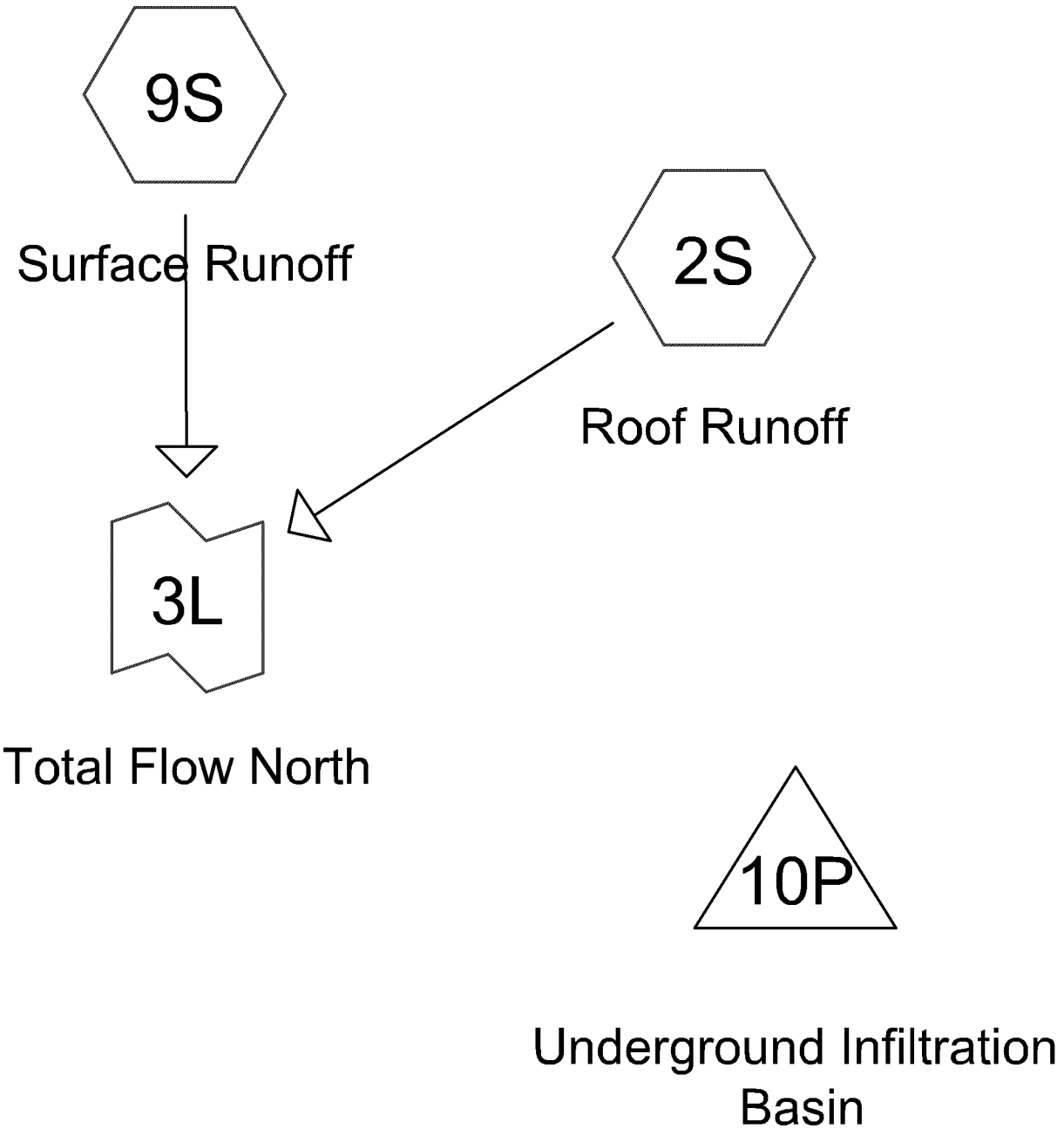


Subcat Reach Pond Link

Routing Diagram for 21846-Ice Castle 2019-07-23
Prepared by {enter your company name here}, Printed 7/23/2019
HydroCAD® 10.00-20 s/n 01876 © 2017 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.809	61	>75% Grass cover, Good, HSG B (9S)
3.188	98	Paved parking, HSG B (9S)
1.394	98	Roofs, HSG B (2S)
5.392	**92**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
5.392	HSG B	2S, 9S
0.000	HSG C	
0.000	HSG D	
0.000	Other	
5.392		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.809	0.000	0.000	0.000	0.809	>75% Grass cover, Good	9S
0.000	3.188	0.000	0.000	0.000	3.188	Paved parking	9S
0.000	1.394	0.000	0.000	0.000	1.394	Roofs	2S
0.000	**5.392**	**0.000**	**0.000**	**0.000**	**5.392**	**TOTAL AREA**	

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	10P	809.70	808.83	87.0	0.0100	0.013	24.0	0.0	0.0

Time span=0.00-84.00 hrs, dt=0.01 hrs, 8401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment2S: Roof Runoff Runoff Area=60,737 sf 100.00% Impervious Runoff Depth=2.60"
Tc=15.0 min CN=98 Runoff=4.24 cfs 0.302 af

Subcatchment9S: Surface Runoff Runoff Area=174,148 sf 79.75% Impervious Runoff Depth=1.91"
Tc=10.0 min CN=91 Runoff=11.67 cfs 0.637 af

Pond 10P: Underground Infiltration Basin Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af

Link 3L: Total Flow North Inflow=15.58 cfs 0.939 af
Primary=15.58 cfs 0.939 af

Total Runoff Area = 5.392 ac Runoff Volume = 0.939 af Average Runoff Depth = 2.09"
15.01% Pervious = 0.809 ac 84.99% Impervious = 4.583 ac

Summary for Subcatchment 2S: Roof Runoff

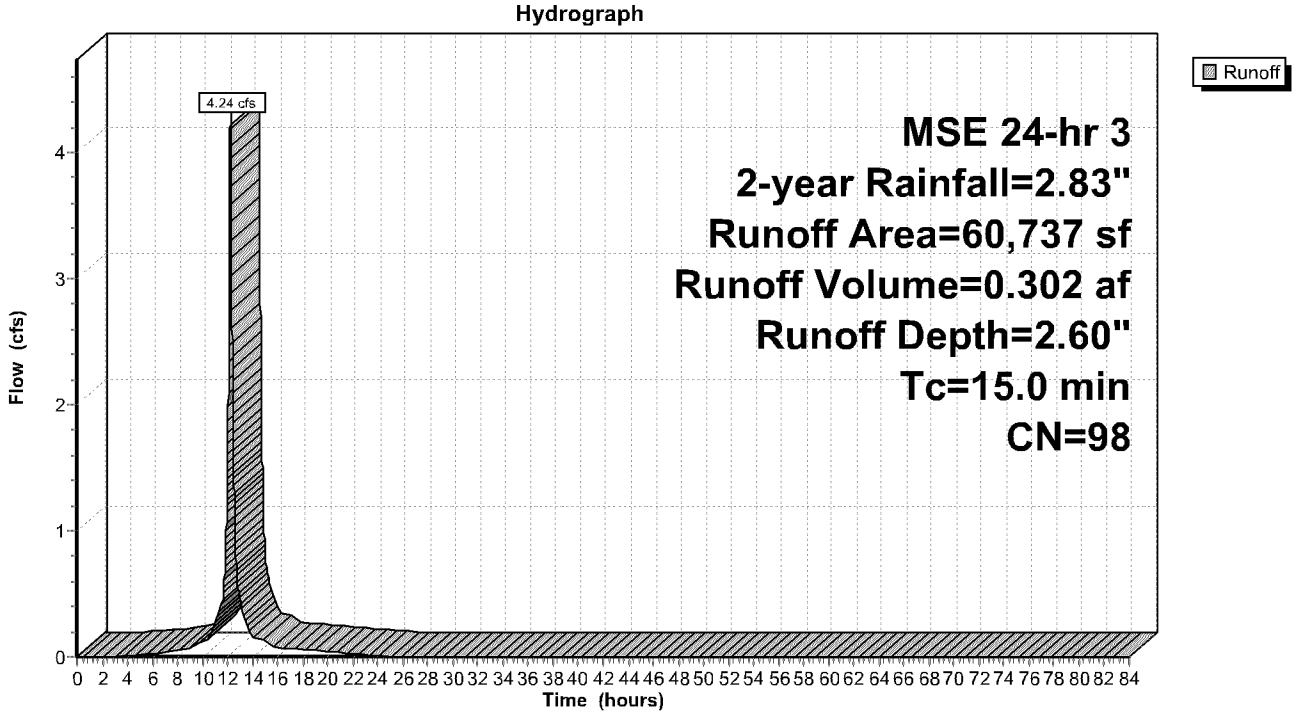
Runoff = 4.24 cfs @ 12.22 hrs, Volume= 0.302 af, Depth= 2.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-84.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-year Rainfall=2.83"

Area (sf)	CN	Description
34,874	98	Roofs, HSG B
25,863	98	Roofs, HSG B
60,737	98	Weighted Average
60,737		100.00% Impervious Area

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

Subcatchment 2S: Roof Runoff



Summary for Subcatchment 9S: Surface Runoff

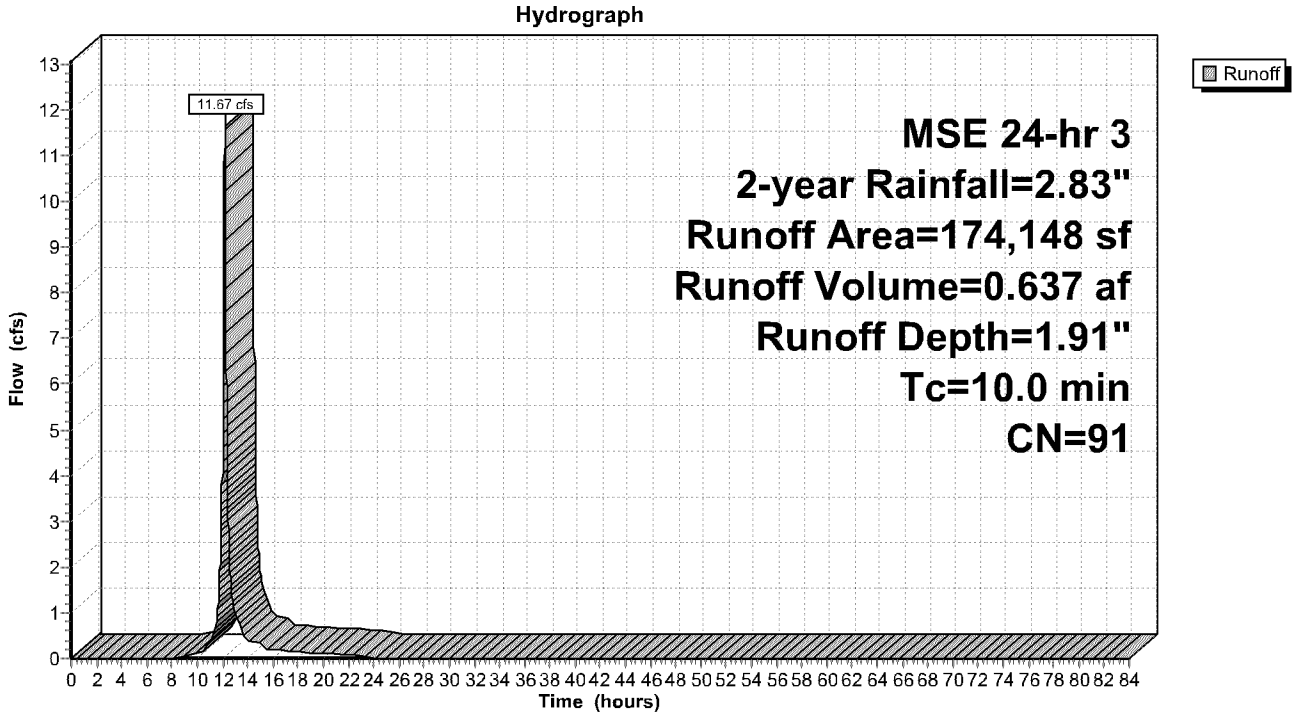
Runoff = 11.67 cfs @ 12.17 hrs, Volume= 0.637 af, Depth= 1.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-84.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-year Rainfall=2.83"

Area (sf)	CN	Description
14,160	61	>75% Grass cover, Good, HSG B
121,638	98	Paved parking, HSG B
21,099	61	>75% Grass cover, Good, HSG B
17,251	98	Paved parking, HSG B
174,148	91	Weighted Average
35,259		20.25% Pervious Area
138,889		79.75% Impervious Area

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

Subcatchment 9S: Surface Runoff



Summary for Pond 10P: Underground Infiltration Basin

[43] Hint: Has no inflow (Outflow=Zero)

Volume	Invert	Avail.Storage	Storage Description
#1A	807.90'	4,224 cf	**68.17'W x 88.64'L x 2.33'H Field A** 14,099 cf Overall - 3,538 cf Embedded = 10,561 cf x 40.0% Voids
#2A	808.40'	3,538 cf	**ADS_StormTech SC-310 +Cap** x 240 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 20 Rows of 12 Chambers
		7,762 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	807.90'	**0.450 in/hr Exfiltration over Surface area**
#2	Primary	809.70'	**24.0" Round Culvert** L= 87.0' Ke= 0.500 Inlet / Outlet Invert= 809.70' / 808.83' S= 0.0100 '/' Cc= 0.900 n= 0.013, 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 10P: Underground Infiltration Basin - Chamber Wizard Field A

Chamber Model = ADS_StormTechSC-310 +Cap (ADS StormTech®SC-310 with cap length)
Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf
Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap

34.0" Wide + 6.0" Spacing = 40.0" C-C Row Spacing

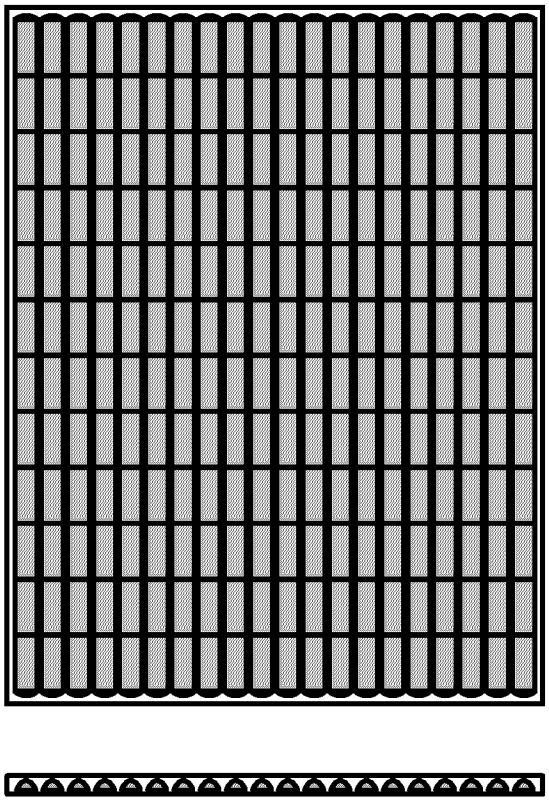
12 Chambers/Row x 7.12' Long +0.60' Cap Length x 2 = 86.64' Row Length +12.0" End Stone x 2 = 88.64' Base Length
20 Rows x 34.0" Wide + 6.0" Spacing x 19 + 12.0" Side Stone x 2 = 68.17' Base Width
6.0" Base + 16.0" Chamber Height + 6.0" Cover = 2.33' Field Height

240 Chambers x 14.7 cf = 3,538.1 cf Chamber Storage

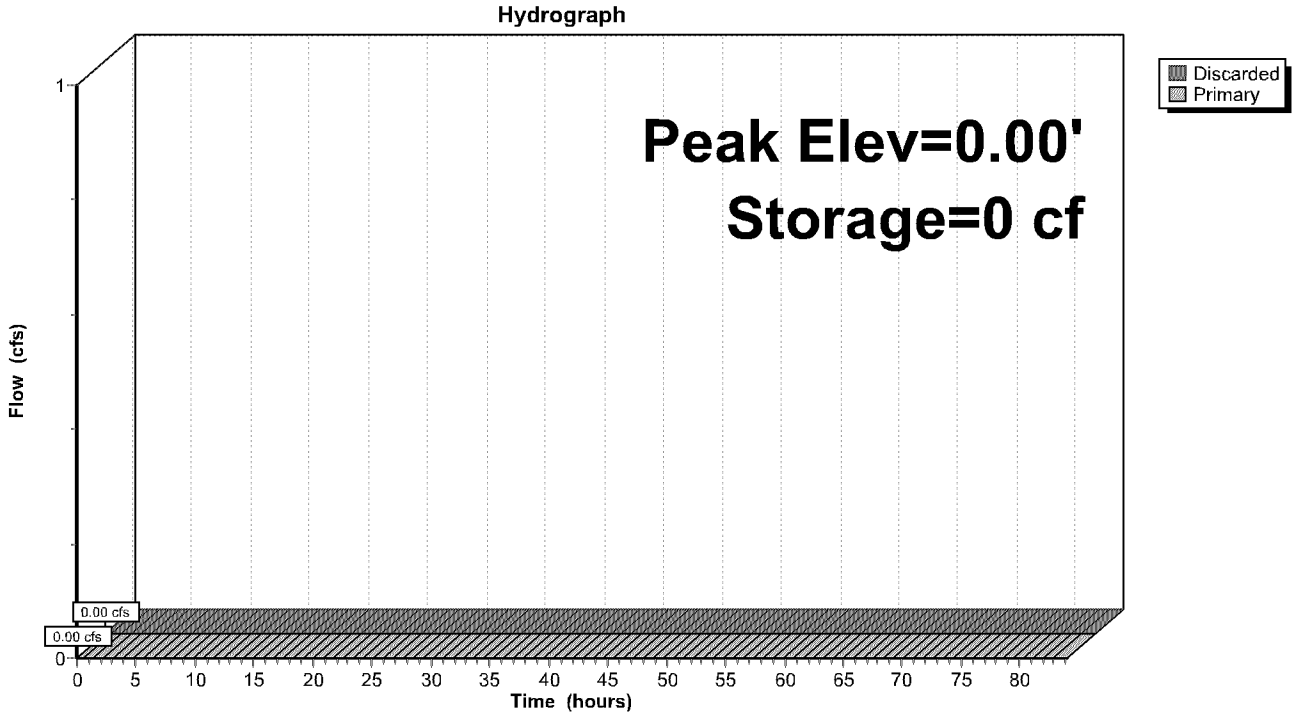
14,098.7 cf Field - 3,538.1 cf Chambers = 10,560.6 cf Stone x 40.0% Voids = 4,224.2 cf Stone Storage

Chamber Storage + Stone Storage = 7,762.3 cf = 0.178 af
Overall Storage Efficiency = 55.1%
Overall System Size = 88.64' x 68.17' x 2.33'

240 Chambers
522.2 cy Field
391.1 cy Stone



Pond 10P: Underground Infiltration Basin



Stage-Area-Storage for Pond 10P: Underground Infiltration Basin

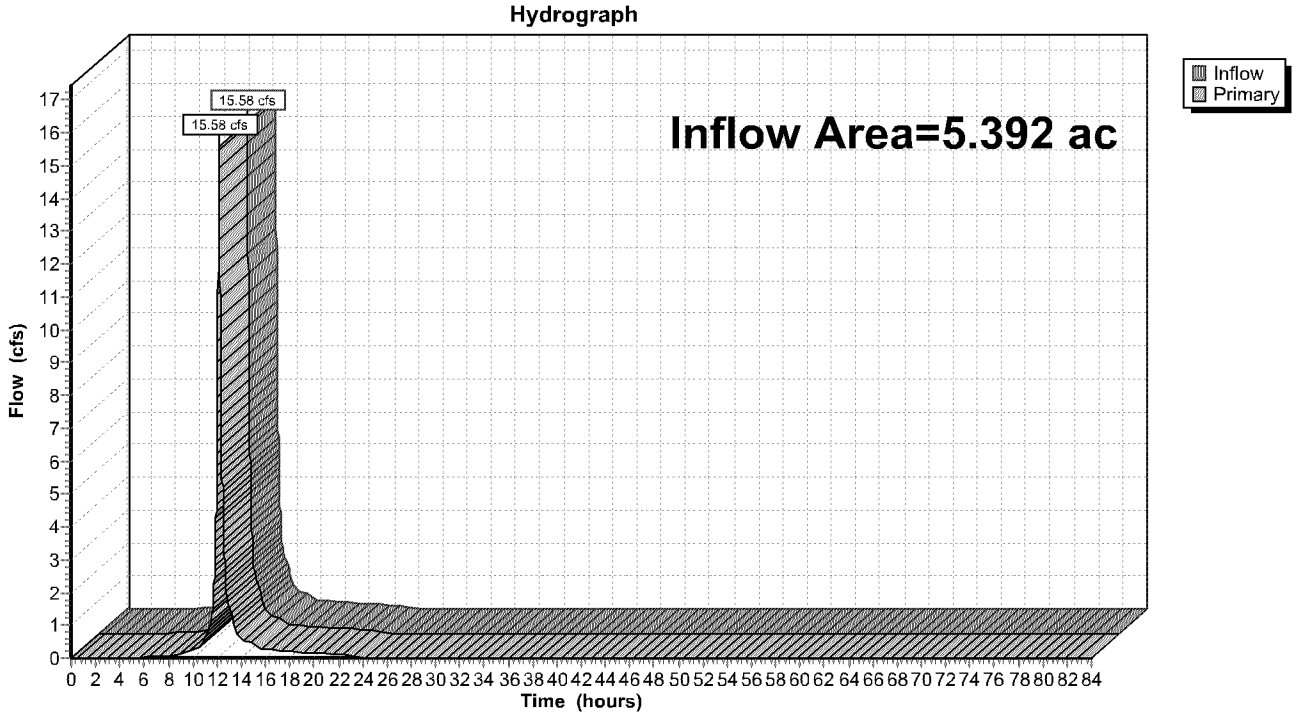
Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
807.90	**6,042**	0
807.95	6,042	121
808.00	6,042	242
808.05	6,042	363
808.10	6,042	483
808.15	6,042	604
808.20	6,042	725
808.25	6,042	846
808.30	6,042	967
808.35	6,042	1,088
808.40	6,042	1,208
808.45	6,042	1,453
808.50	6,042	1,696
808.55	6,042	1,938
808.60	6,042	2,178
808.65	6,042	2,416
808.70	6,042	2,652
808.75	6,042	2,885
808.80	6,042	3,116
808.85	6,042	3,344
808.90	6,042	3,569
808.95	6,042	3,791
809.00	6,042	4,009
809.05	6,042	4,224
809.10	6,042	4,436
809.15	6,042	4,643
809.20	6,042	4,845
809.25	6,042	5,043
809.30	6,042	5,234
809.35	6,042	5,420
809.40	6,042	5,599
809.45	6,042	5,768
809.50	6,042	5,926
809.55	6,042	6,073
809.60	6,042	6,211
809.65	6,042	6,344
809.70	6,042	6,472
809.75	6,042	6,594
809.80	6,042	6,715
809.85	6,042	6,836
809.90	6,042	6,957
809.95	6,042	7,078
810.00	6,042	7,198
810.05	6,042	7,319
810.10	6,042	7,440
810.15	6,042	7,561
810.20	6,042	**7,682**
810.25	6,042	**7,762**
810.30	6,042	7,762
810.35	6,042	7,762
810.40	6,042	7,762
810.45	6,042	7,762
810.50	6,042	7,762
810.55	6,042	7,762
810.60	6,042	7,762
810.65	6,042	7,762
810.70	6,042	7,762
810.75	6,042	7,762
810.80	6,042	7,762
810.85	6,042	7,762
810.90	6,042	7,762
810.95	6,042	7,762
811.00	6,042	7,762
811.05	6,042	7,762
811.10	6,042	7,762
811.15	6,042	7,762
811.20	6,042	7,762
811.25	6,042	7,762
811.30	6,042	7,762
811.35	6,042	7,762
811.40	6,042	7,762
811.45	6,042	7,762
811.50	6,042	7,762
811.55	6,042	7,762
811.60	6,042	7,762
811.65	6,042	7,762
811.70	6,042	7,762

Summary for Link 3L: Total Flow North

Inflow Area = 5.392 ac, 84.99% Impervious, Inflow Depth = 2.09" for 2-year event
Inflow = 15.58 cfs @ 12.18 hrs, Volume= 0.939 af
Primary = 15.58 cfs @ 12.18 hrs, Volume= 0.939 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-84.00 hrs, dt= 0.01 hrs

Link 3L: Total Flow North



Time span=0.00-84.00 hrs, dt=0.01 hrs, 8401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment2S: Roof Runoff Runoff Area=60,737 sf 100.00% Impervious Runoff Depth=4.00"
Tc=15.0 min CN=98 Runoff=6.40 cfs 0.465 af

Subcatchment9S: Surface Runoff Runoff Area=174,148 sf 79.75% Impervious Runoff Depth=3.25"
Tc=10.0 min CN=91 Runoff=19.28 cfs 1.082 af

Pond 10P: Underground Infiltration Basin Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af

Link 3L: Total Flow North Inflow=25.17 cfs 1.547 af
Primary=25.17 cfs 1.547 af

Total Runoff Area = 5.392 ac Runoff Volume = 1.547 af Average Runoff Depth = 3.44"
15.01% Pervious = 0.809 ac 84.99% Impervious = 4.583 ac

Summary for Subcatchment 2S: Roof Runoff

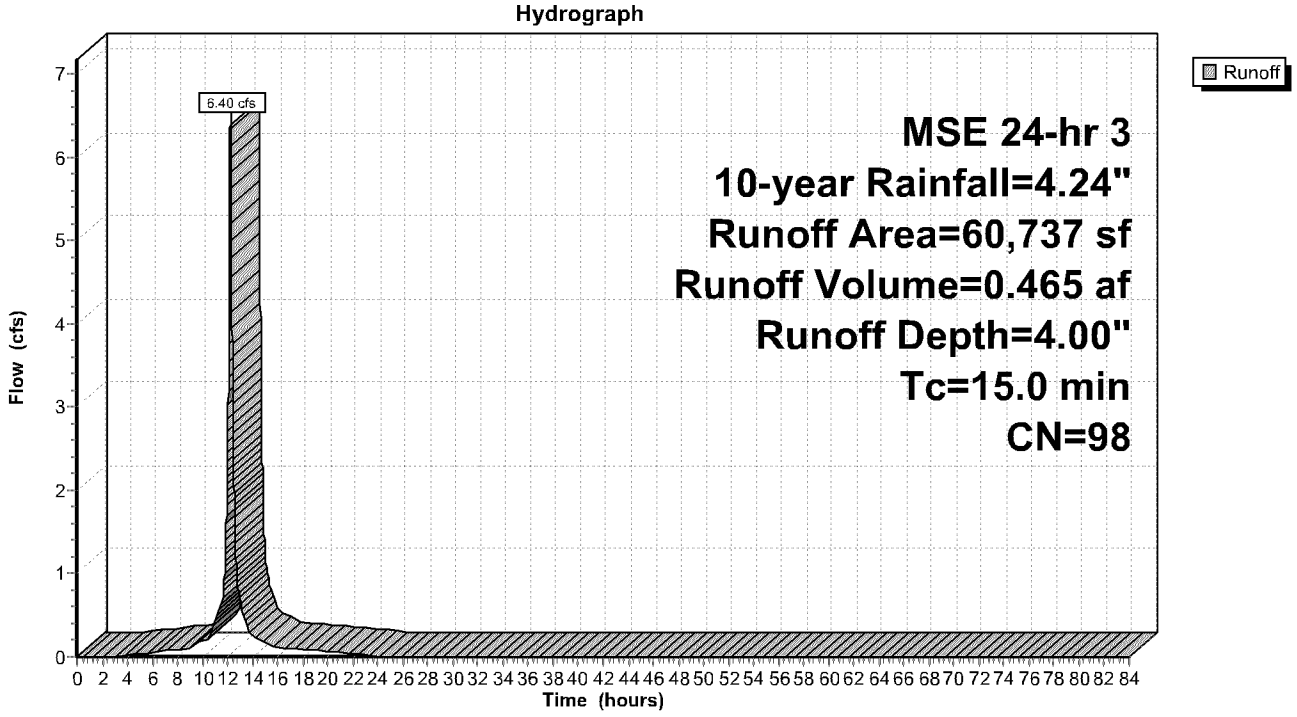
Runoff = 6.40 cfs @ 12.22 hrs, Volume= 0.465 af, Depth= 4.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-84.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-year Rainfall=4.24"

Area (sf)	CN	Description
34,874	98	Roofs, HSG B
25,863	98	Roofs, HSG B
60,737	98	Weighted Average
60,737		100.00% Impervious Area

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

Subcatchment 2S: Roof Runoff



Summary for Subcatchment 9S: Surface Runoff

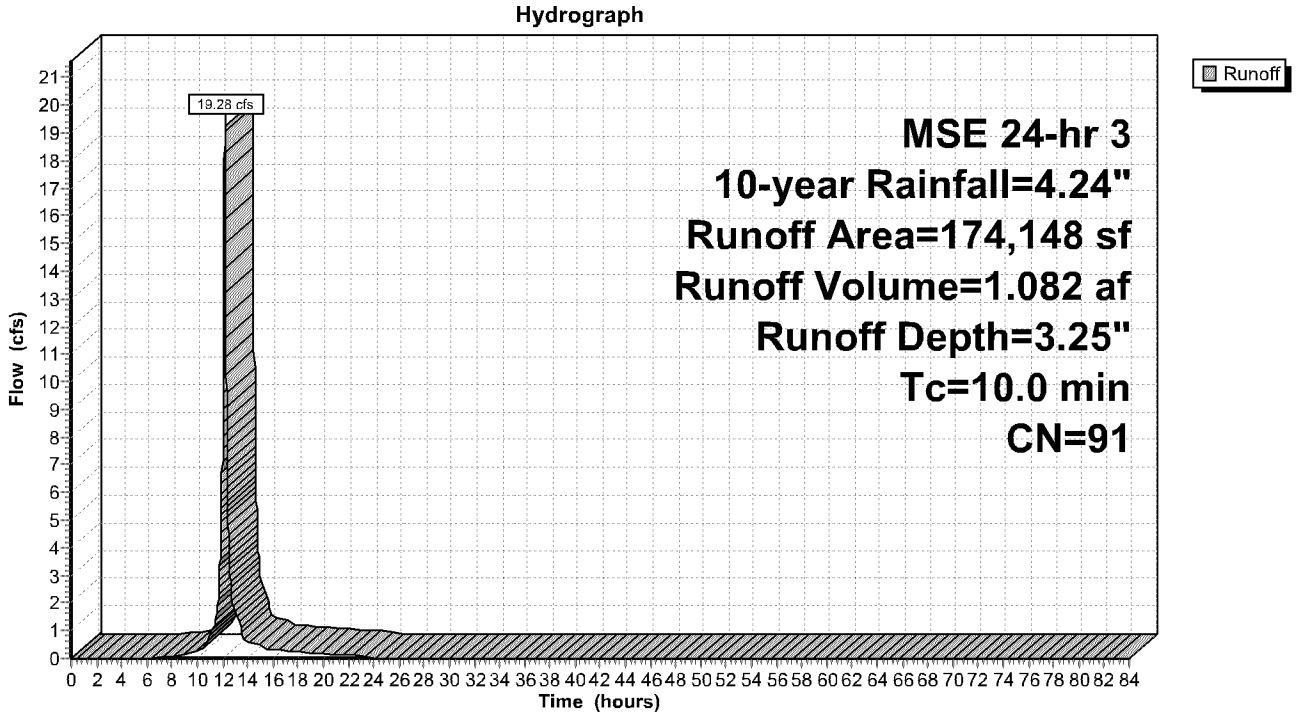
Runoff = 19.28 cfs @ 12.17 hrs, Volume= 1.082 af, Depth= 3.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-84.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-year Rainfall=4.24"

Area (sf)	CN	Description
14,160	61	>75% Grass cover, Good, HSG B
121,638	98	Paved parking, HSG B
21,099	61	>75% Grass cover, Good, HSG B
17,251	98	Paved parking, HSG B
174,148	91	Weighted Average
35,259		20.25% Pervious Area
138,889		79.75% Impervious Area

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

Subcatchment 9S: Surface Runoff



Summary for Pond 10P: Underground Infiltration Basin

[43] Hint: Has no inflow (Outflow=Zero)

Volume	Invert	Avail.Storage	Storage Description
#1A	807.90'	4,224 cf	**68.17'W x 88.64'L x 2.33'H Field A** 14,099 cf Overall - 3,538 cf Embedded = 10,561 cf x 40.0% Voids
#2A	808.40'	3,538 cf	**ADS_StormTech SC-310 +Cap** x 240 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 20 Rows of 12 Chambers
		7,762 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	807.90'	**0.450 in/hr Exfiltration over Surface area**
#2	Primary	809.70'	**24.0" Round Culvert** L= 87.0' Ke= 0.500 Inlet / Outlet Invert= 809.70' / 808.83' S= 0.0100 '/' Cc= 0.900 n= 0.013, 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 10P: Underground Infiltration Basin - Chamber Wizard Field A

Chamber Model = ADS_StormTechSC-310 +Cap (ADS StormTech®SC-310 with cap length)
Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf
Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap

34.0" Wide + 6.0" Spacing = 40.0" C-C Row Spacing

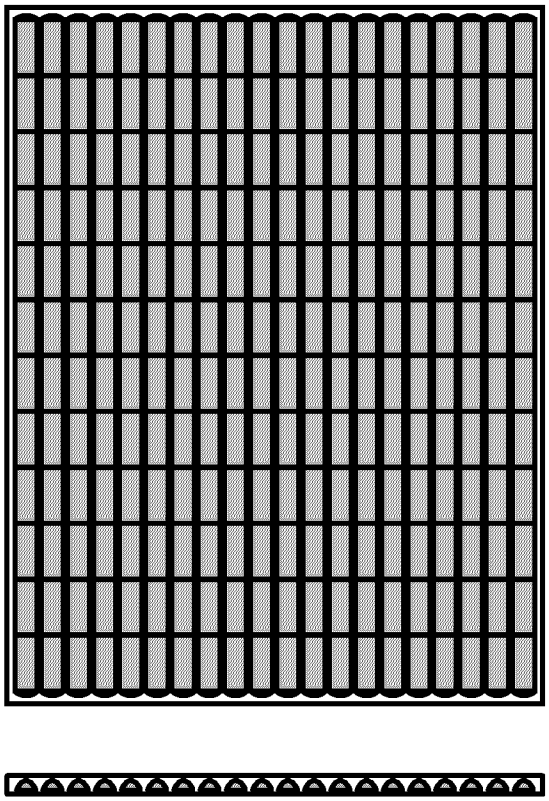
12 Chambers/Row x 7.12' Long +0.60' Cap Length x 2 = 86.64' Row Length +12.0" End Stone x 2 = 88.64' Base Length
20 Rows x 34.0" Wide + 6.0" Spacing x 19 + 12.0" Side Stone x 2 = 68.17' Base Width
6.0" Base + 16.0" Chamber Height + 6.0" Cover = 2.33' Field Height

240 Chambers x 14.7 cf = 3,538.1 cf Chamber Storage

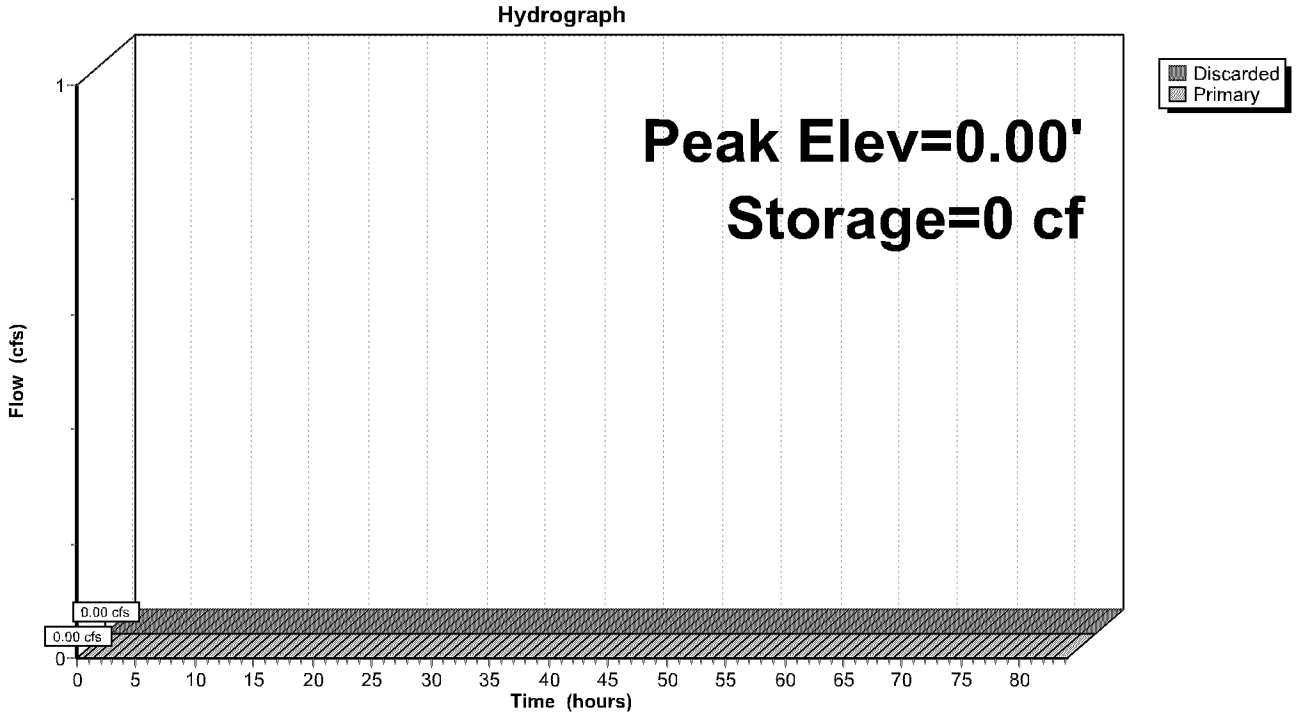
14,098.7 cf Field - 3,538.1 cf Chambers = 10,560.6 cf Stone x 40.0% Voids = 4,224.2 cf Stone Storage

Chamber Storage + Stone Storage = 7,762.3 cf = 0.178 af
Overall Storage Efficiency = 55.1%
Overall System Size = 88.64' x 68.17' x 2.33'

240 Chambers
522.2 cy Field
391.1 cy Stone



Pond 10P: Underground Infiltration Basin



Stage-Area-Storage for Pond 10P: Underground Infiltration Basin

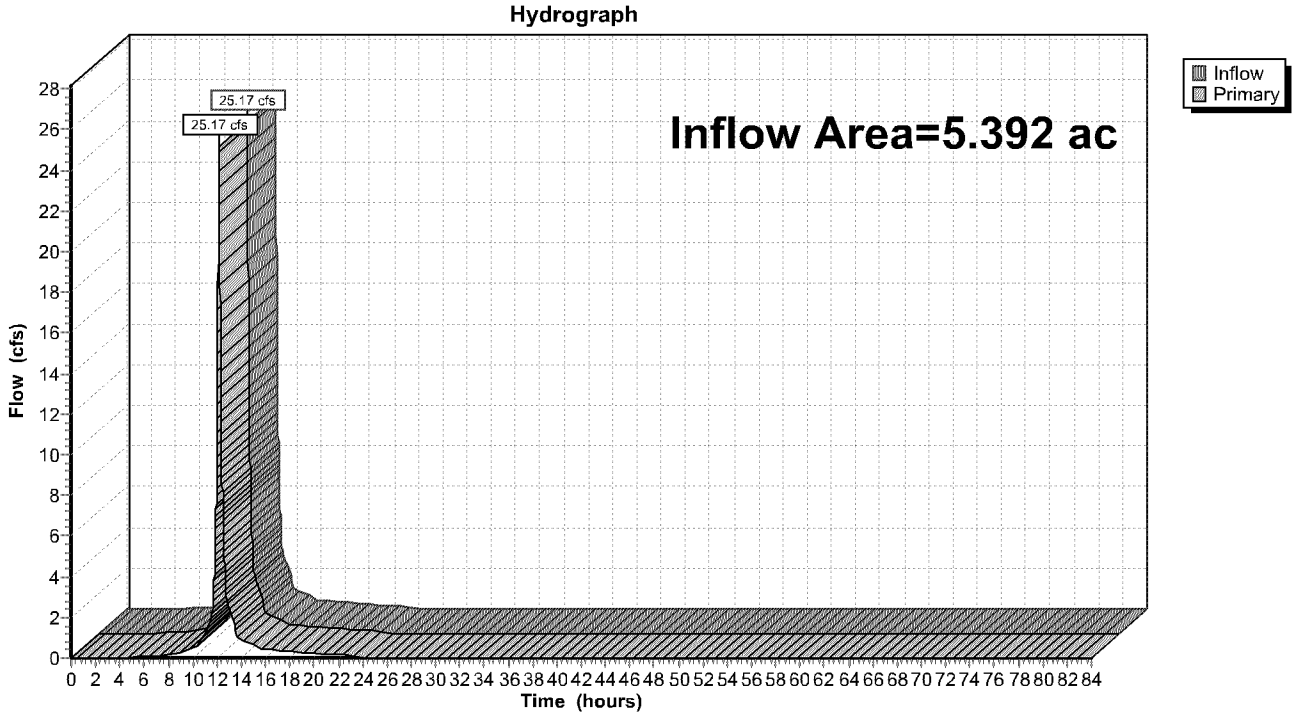
Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
807.90	**6,042**	0
807.95	6,042	121
808.00	6,042	242
808.05	6,042	363
808.10	6,042	483
808.15	6,042	604
808.20	6,042	725
808.25	6,042	846
808.30	6,042	967
808.35	6,042	1,088
808.40	6,042	1,208
808.45	6,042	1,453
808.50	6,042	1,696
808.55	6,042	1,938
808.60	6,042	2,178
808.65	6,042	2,416
808.70	6,042	2,652
808.75	6,042	2,885
808.80	6,042	3,116
808.85	6,042	3,344
808.90	6,042	3,569
808.95	6,042	3,791
809.00	6,042	4,009
809.05	6,042	4,224
809.10	6,042	4,436
809.15	6,042	4,643
809.20	6,042	4,845
809.25	6,042	5,043
809.30	6,042	5,234
809.35	6,042	5,420
809.40	6,042	5,599
809.45	6,042	5,768
809.50	6,042	5,926
809.55	6,042	6,073
809.60	6,042	6,211
809.65	6,042	6,344
809.70	6,042	6,472
809.75	6,042	6,594
809.80	6,042	6,715
809.85	6,042	6,836
809.90	6,042	6,957
809.95	6,042	7,078
810.00	6,042	7,198
810.05	6,042	7,319
810.10	6,042	7,440
810.15	6,042	7,561
810.20	6,042	**7,682**
810.25	6,042	**7,762**
810.30	6,042	7,762
810.35	6,042	7,762
810.40	6,042	7,762
810.45	6,042	7,762
810.50	6,042	7,762
810.55	6,042	7,762
810.60	6,042	7,762
810.65	6,042	7,762
810.70	6,042	7,762
810.75	6,042	7,762
810.80	6,042	7,762
810.85	6,042	7,762
810.90	6,042	7,762
810.95	6,042	7,762
811.00	6,042	7,762
811.05	6,042	7,762
811.10	6,042	7,762
811.15	6,042	7,762
811.20	6,042	7,762
811.25	6,042	7,762
811.30	6,042	7,762
811.35	6,042	7,762
811.40	6,042	7,762
811.45	6,042	7,762
811.50	6,042	7,762
811.55	6,042	7,762
811.60	6,042	7,762
811.65	6,042	7,762
811.70	6,042	7,762

Summary for Link 3L: Total Flow North

Inflow Area = 5.392 ac, 84.99% Impervious, Inflow Depth = 3.44" for 10-year event
Inflow = 25.17 cfs @ 12.18 hrs, Volume= 1.547 af
Primary = 25.17 cfs @ 12.18 hrs, Volume= 1.547 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-84.00 hrs, dt= 0.01 hrs

Link 3L: Total Flow North



Time span=0.00-84.00 hrs, dt=0.01 hrs, 8401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment2S: Roof Runoff Runoff Area=60,737 sf 100.00% Impervious Runoff Depth=7.26"
Tc=15.0 min CN=98 Runoff=11.39 cfs 0.844 af

Subcatchment9S: Surface Runoff Runoff Area=174,148 sf 79.75% Impervious Runoff Depth=6.43"
Tc=10.0 min CN=91 Runoff=36.64 cfs 2.143 af

Pond 10P: Underground Infiltration Basin Peak Elev=0.00' Storage=0 cf
Discarded=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af

Link 3L: Total Flow North Inflow=47.07 cfs 2.986 af
Primary=47.07 cfs 2.986 af

Total Runoff Area = 5.392 ac Runoff Volume = 2.986 af Average Runoff Depth = 6.65"
15.01% Pervious = 0.809 ac 84.99% Impervious = 4.583 ac

Summary for Subcatchment 2S: Roof Runoff

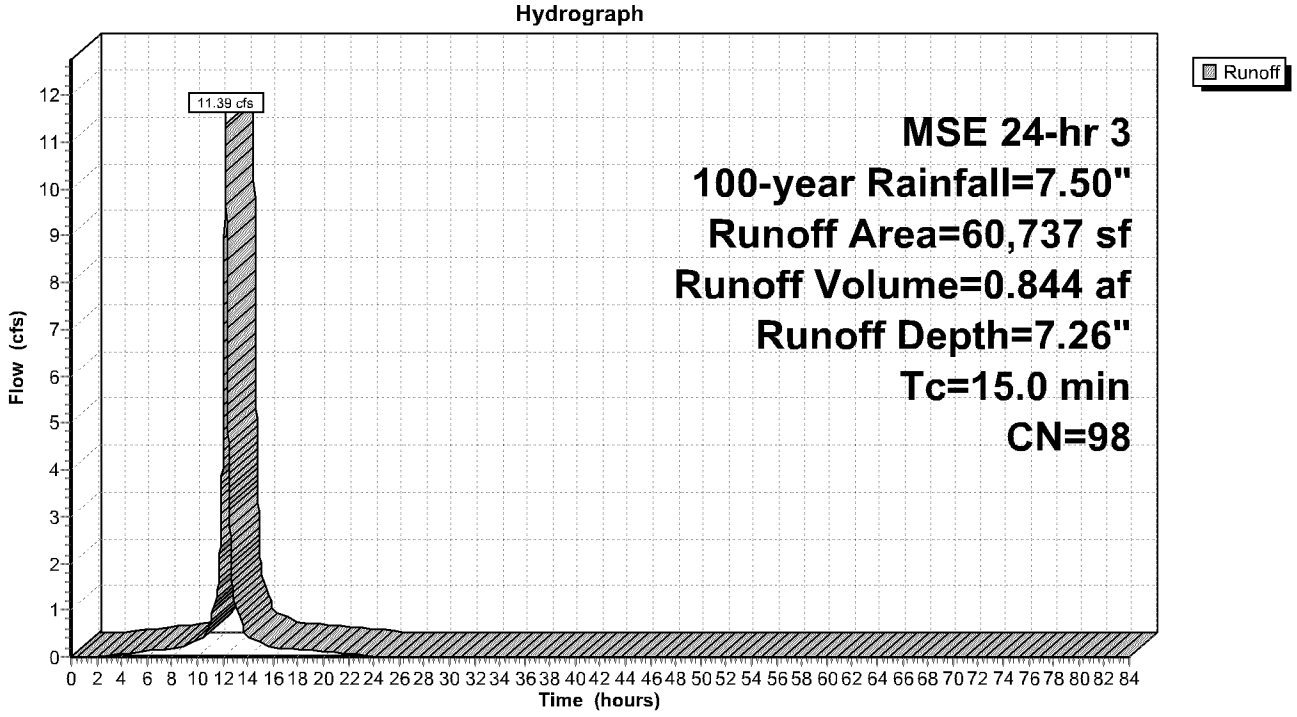
Runoff = 11.39 cfs @ 12.22 hrs, Volume= 0.844 af, Depth= 7.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-84.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-year Rainfall=7.50"

Area (sf)	CN	Description
34,874	98	Roofs, HSG B
25,863	98	Roofs, HSG B
60,737	98	Weighted Average
60,737		100.00% Impervious Area

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

Subcatchment 2S: Roof Runoff



Summary for Subcatchment 9S: Surface Runoff

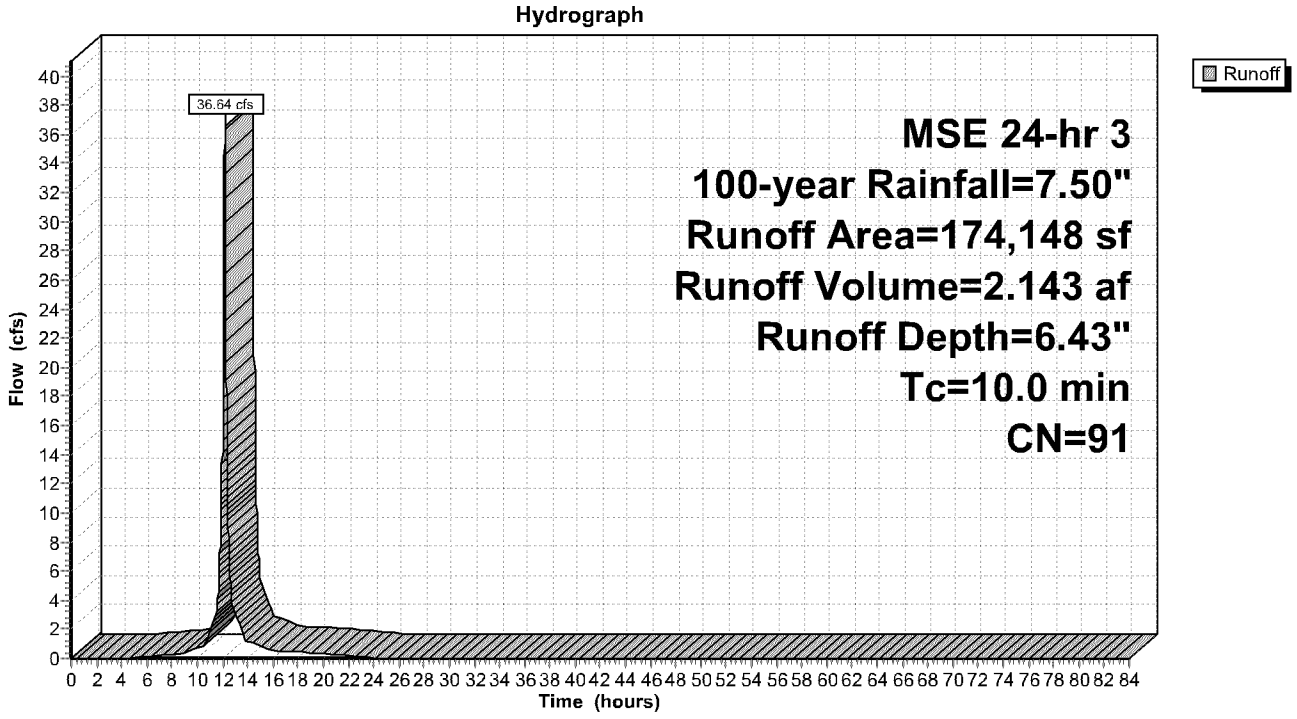
Runoff = 36.64 cfs @ 12.17 hrs, Volume= 2.143 af, Depth= 6.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-84.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-year Rainfall=7.50"

Area (sf)	CN	Description
14,160	61	>75% Grass cover, Good, HSG B
121,638	98	Paved parking, HSG B
21,099	61	>75% Grass cover, Good, HSG B
17,251	98	Paved parking, HSG B
174,148	91	Weighted Average
35,259		20.25% Pervious Area
138,889		79.75% Impervious Area

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

Subcatchment 9S: Surface Runoff



Summary for Pond 10P: Underground Infiltration Basin

[43] Hint: Has no inflow (Outflow=Zero)

Volume	Invert	Avail.Storage	Storage Description
#1A	807.90'	4,224 cf	**68.17'W x 88.64'L x 2.33'H Field A** 14,099 cf Overall - 3,538 cf Embedded = 10,561 cf x 40.0% Voids
#2A	808.40'	3,538 cf	**ADS_StormTech SC-310 +Cap** x 240 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 20 Rows of 12 Chambers
		7,762 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	807.90'	**0.450 in/hr Exfiltration over Surface area**
#2	Primary	809.70'	**24.0" Round Culvert** L= 87.0' Ke= 0.500 Inlet / Outlet Invert= 809.70' / 808.83' S= 0.0100 '/' Cc= 0.900 n= 0.013, 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 10P: Underground Infiltration Basin - Chamber Wizard Field A

Chamber Model = ADS_StormTechSC-310 +Cap (ADS StormTech®SC-310 with cap length)
Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf
Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap

34.0" Wide + 6.0" Spacing = 40.0" C-C Row Spacing

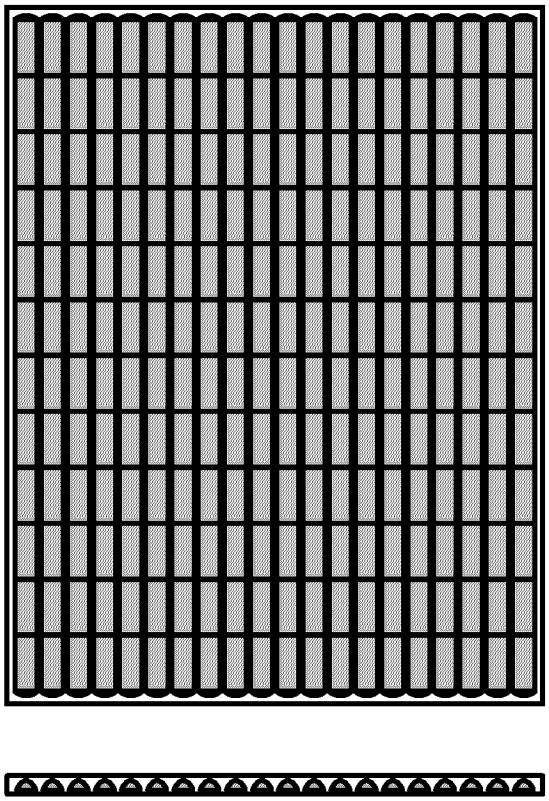
12 Chambers/Row x 7.12' Long +0.60' Cap Length x 2 = 86.64' Row Length +12.0" End Stone x 2 = 88.64' Base Length
20 Rows x 34.0" Wide + 6.0" Spacing x 19 + 12.0" Side Stone x 2 = 68.17' Base Width
6.0" Base + 16.0" Chamber Height + 6.0" Cover = 2.33' Field Height

240 Chambers x 14.7 cf = 3,538.1 cf Chamber Storage

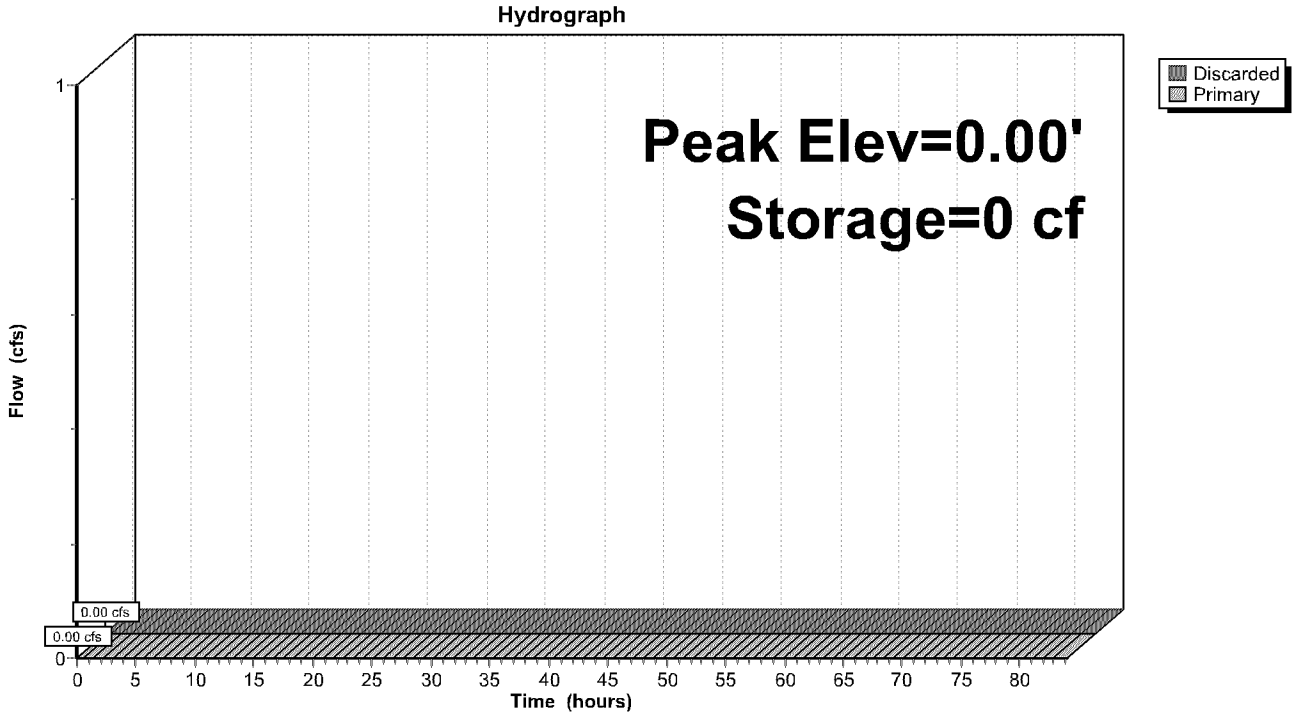
14,098.7 cf Field - 3,538.1 cf Chambers = 10,560.6 cf Stone x 40.0% Voids = 4,224.2 cf Stone Storage

Chamber Storage + Stone Storage = 7,762.3 cf = 0.178 af
Overall Storage Efficiency = 55.1%
Overall System Size = 88.64' x 68.17' x 2.33'

240 Chambers
522.2 cy Field
391.1 cy Stone



Pond 10P: Underground Infiltration Basin



Stage-Area-Storage for Pond 10P: Underground Infiltration Basin

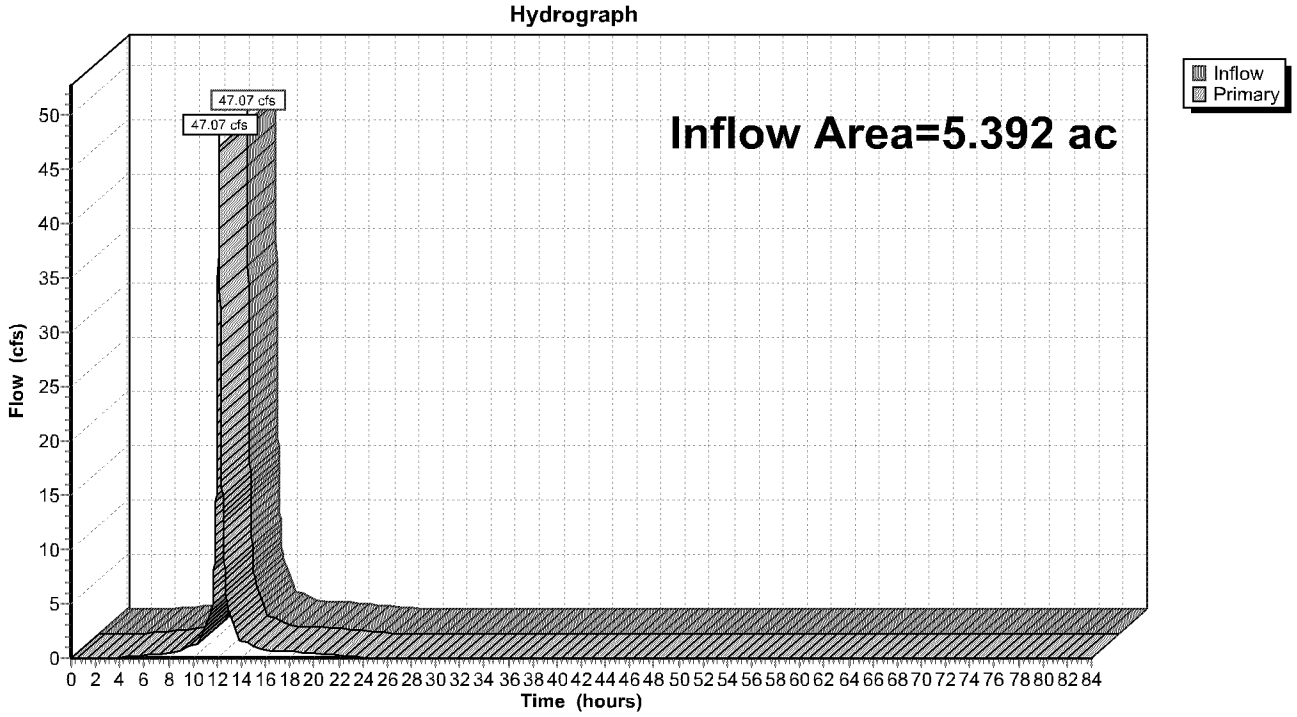
Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
807.90	**6,042**	0
807.95	6,042	121
808.00	6,042	242
808.05	6,042	363
808.10	6,042	483
808.15	6,042	604
808.20	6,042	725
808.25	6,042	846
808.30	6,042	967
808.35	6,042	1,088
808.40	6,042	1,208
808.45	6,042	1,453
808.50	6,042	1,696
808.55	6,042	1,938
808.60	6,042	2,178
808.65	6,042	2,416
808.70	6,042	2,652
808.75	6,042	2,885
808.80	6,042	3,116
808.85	6,042	3,344
808.90	6,042	3,569
808.95	6,042	3,791
809.00	6,042	4,009
809.05	6,042	4,224
809.10	6,042	4,436
809.15	6,042	4,643
809.20	6,042	4,845
809.25	6,042	5,043
809.30	6,042	5,234
809.35	6,042	5,420
809.40	6,042	5,599
809.45	6,042	5,768
809.50	6,042	5,926
809.55	6,042	6,073
809.60	6,042	6,211
809.65	6,042	6,344
809.70	6,042	6,472
809.75	6,042	6,594
809.80	6,042	6,715
809.85	6,042	6,836
809.90	6,042	6,957
809.95	6,042	7,078
810.00	6,042	7,198
810.05	6,042	7,319
810.10	6,042	7,440
810.15	6,042	7,561
810.20	6,042	**7,682**
810.25	6,042	**7,762**
810.30	6,042	7,762
810.35	6,042	7,762
810.40	6,042	7,762
810.45	6,042	7,762
810.50	6,042	7,762
810.55	6,042	7,762
810.60	6,042	7,762
810.65	6,042	7,762
810.70	6,042	7,762
810.75	6,042	7,762
810.80	6,042	7,762
810.85	6,042	7,762
810.90	6,042	7,762
810.95	6,042	7,762
811.00	6,042	7,762
811.05	6,042	7,762
811.10	6,042	7,762
811.15	6,042	7,762
811.20	6,042	7,762
811.25	6,042	7,762
811.30	6,042	7,762
811.35	6,042	7,762
811.40	6,042	7,762
811.45	6,042	7,762
811.50	6,042	7,762
811.55	6,042	7,762
811.60	6,042	7,762
811.65	6,042	7,762
811.70	6,042	7,762

Summary for Link 3L: Total Flow North

Inflow Area = 5.392 ac, 84.99% Impervious, Inflow Depth = 6.65" for 100-year event
Inflow = 47.07 cfs @ 12.18 hrs, Volume= 2.986 af
Primary = 47.07 cfs @ 12.18 hrs, Volume= 2.986 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-84.00 hrs, dt= 0.01 hrs

Link 3L: Total Flow North



APPENDIX C – MIDS CALCULATOR RESULTS FOR WATER QUALITY

Project Information

PL201900127
PL2019-127

Calculator Version:	Version 3: January 2017
Project Name:	ICE CASTLE
User Name / Company Name:	SAMBATEK
Date:	2019-07-18
Project Description:	
Construction Permit?:	Yes

Site Information

Retention Requirement (inches):	1.1
Site's Zip Code:	55425
Annual Rainfall (inches):	31.7
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		0.688			0.688
			Impervious Area (acres)		1.585
				Total Area (acres)	2.273

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		0.478			0.478
			Impervious Area (acres)		1.585
				Total Area (acres)	2.063

PL201900127
PL2019-127

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	6329	ft3
Volume removed by BMPs towards performance goal:	6329	ft3
Percent volume removed towards performance goal	**100**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	3.9071	acre-ft
Annual runoff volume removed by BMPs:	3.5138	acre-ft
Percent annual runoff volume removed:	**90**	**%**
Post development annual particulate P load:	1.754	lbs
Annual particulate P removed by BMPs:	1.577	lbs
Post development annual dissolved P load:	1.435	lbs
Annual dissolved P removed by BMPs:	1.29	lbs
Percent annual total phosphorus removed:	**90**	**%**
Post development annual TSS load:	579.2	lbs
Annual TSS removed by BMPs:	520.9	lbs
Percent annual TSS removed:	**90**	**%**

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
1 - Underground infiltration	6472	6329	6329	0	100

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 (%)
1 - Underground infiltration	3.8072	0	3.5137	0.2935	92

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Underground infiltration	1.7087	0	1.577	0.1317	92

PL201900127
PL2019-127

Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Underground infiltration	1.398	0	1.2902	0.1078	92

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Underground infiltration	564.38	0	520.88	43.5	92

BMP Schematic

APPENDIX D – STORM SEWER SPREADSHEET

PL201900127

PL2019-127

Sambatek

Stormwater Design Worksheet

Project:	Ice Castle	
Client:		
Sambatek #:	21846	
Date:	7/23/2019	
Engineer:	jb	
Rainfall:		10 year
County:		Hennepin
Region:		Hennepin

Notes

> User inputs are in colored cells

> Spreadsheet will automatically combine areas and flows based on structure name

> User will have to manually update the Tc value at junctions (greater of the tributaries)

> When inserting additional rows, copy THE ENTIRE row (click on the row nubmer on the far left)

> Rows beginning with a green cell indicate the first structure in a run, yellow cells indicate a downstream structure

>Structure depth turns red if not between 3 an

>Last lower invert turns red if not equal to goo

Structure From	To	Tributary Area (sf)	Impervious (%)	Tributary Area (ac)	Runoff Coeff. (C)	Sum CA (ac)	T_c (min)	Time of Flow (min)	Intensity (in/hr)	Runoff (cfs)	Length (lf)	Pipe Diameter (in)	Slope (%)	Pipe Manning's n	Pipe Capacity (cfs)	Velocity (fps) Full	Velocity (fps) Actual	Depth of Flow	Rim	Upper Invert	Drop Thru Pipe	Lower Invert	Drop Thru Structure	Structure Depth	Pipe Cover at U/S MH (ft)	Pipe Cover at D/S MH (ft)
Pipe Run 1														RCP												
RD 1	106	3929	100%	0.09	0.95	0.086	7.00	0.28	6.613	**0.57**	72	10	2.00%	0.013	**3.10**	5.7	4.3	0.24562	815.10	815.10	1.44	813.66		0.00	-0.83	3.41
106	105	2512	100%	0.06	0.95	0.140	7.28	0.13	6.506	**0.91**	37	12	2.00%	0.013	**5.04**	6.4	4.9	0.3	817.90	813.66	0.74	812.92		4.24	3.24	3.98
105	104	1330	100%	0.03	0.95	0.169	7.40	0.38	6.458	**1.09**	90	15	1.00%	0.013	**6.46**	5.3	3.9	0.35	817.90	812.92	0.90	812.02		4.98	3.73	3.98
104	103	1575	10%	0.04	0.46	0.516	7.78	0.29	6.311	**3.26**	93	15	1.00%	0.013	**6.46**	5.3	5.3	0.6	817.25	812.02	0.93	811.09		5.23	3.98	3.56
103	102	5143	0%	0.12	0.40	1.226	8.08	0.12	6.203	**7.61**	61	15	2.00%	0.013	**9.13**	7.4	8.3	0.9	815.90	811.09	1.22	809.87		4.81	3.56	3.68
102	Basin	5802	0%	0.13	0.40	1.942	8.20	0.01	6.164	**11.97**	9	15	4.00%	0.013	**12.92**	10.5	11.9	0.9	814.80	809.87	0.36	809.51		4.93	3.68	-810.76
																						end				
Pipe Run 2														RCP												
104b	104a	8559	90%	0.20	0.90	0.176	7.00	0.59	6.613	**1.16**	143	12	1.00%	0.013	**3.56**	4.5	4.0	0.39066	818.10	815.10	1.43	813.67		3.00	2.00	3.03
104a	104	7529	90%	0.17	0.90	0.331	7.59	0.17	6.385	**2.11**	49	12	1.00%	0.013	**3.56**	4.5	4.7	0.6	817.70	813.67	0.49	813.18		4.03	3.03	-814.18
Pipe Run 3														RCP												
RD2	103	30368	100%	0.70	0.95	0.662	15.00	0.13	4.580	**3.03**	54	12	2.00%	0.013	**5.04**	6.4	6.7	0.56218			1.08	-1.08		0.00	-1.00	0.08
Pipe Run 4														RCP												
RD3	102	30368	100%	0.70	0.95	0.662	15.00	0.13	4.580	**3.03**	54	12	2.00%	0.013	**5.04**	6.4	6.7	0.56218			1.08	-1.08		0.00	-1.00	0.08