LOUCKS

CREEKVIEW
EAST PARKING LOT

Stormwater Management Report

Bloomington, MN

07/09/18

I hereby certify that this report
was prepared by me or under my direct
supervision, and that I am a duly Registered
Professional Engineer under the laws of
the State of Minnesota

Vicki J. VanDell, P.E.

Date: 7/09/18 Reg. No. 41352

STORMWATER MANAGEMENT REPORT
CREEKVIEW FRAUNENSHUH PARKING LOT ADDITION
BLOOMINGTON, MN

TABLE OF CONTENTS

Summary

This is a project in the Northwest portion of the City of Bloomington MN. The site is between I-494 and West 78th St. The existing site consists of a wooded lot between office parks. The proposed use is a parking lot. The project includes construction of a parking lot totaling seven stalls with a pathway connecting back to the sidewalk. The surrounding site to the north is W 78th St and residential, the south side of the site is South Fork Ninemile Creek and I-494, and to the east and west are office buildings. This site is 0.26 acres. The development will also include an infiltration basin for storm water treatment.

Existing

The existing site consists of a wooded area with moderate underbrush. The site drains to the southeast into the South Fork Ninemile Creek. The existing soils, per soils report dated 10/26/1987 shows silty sand for the top 4'and poorly graded sand with silt soils from 4' to 9' deep.

Proposed

The proposed site will include a seven stall parking lot with a paved path connecting to the existing sidewalk on the west side of the project. We are proposing an infiltration basin treatment system to account for rate control as well as water quality treatment.

Stormwater Management Requirements

- **Rate Retention:**
  The Nine Mile Water Shed requires a rate retention of 1.1" of runoff from the regulated imperious surface of the parcel.

- **Rate Control:**
  The Nine Mile Creek Watershed District requirements state that discharge rates leaving the site must not exceed the current rates for the 2, 10 and 100-year, critical duration (24-hour) storm events.

Rainfall Frequency	Rainfall (Inches)
2-Year 24-Hour	2.86
10-Year 24-Hour	4.26
100-Year 24-Hour	7.32

- **Water Quality:**
  Nine Mile Creek Watershed District requirements state the water quality treatment provide for at least 90 percent annual removal efficiency for total suspended solids from site runoff. Onsite retention systems may be included in demonstrating compliance with the total suspended solids and total phosphorus removal requirements.

Rate Control

We are proposing an infiltration basin to meet the rate control requirements. Storm water will discharge to the basin where it will be held back until it can discharge into the South Fork Nine Mile Creek.

EXISTING

Drainage Area	2-YR. (2.86") (CFS)	10-Yr. (4.26") (CFS)	100-Yr. (7.32") (CFS)
DA-1	0.08	0.29	0.90
Total	**0.08**	**0.29**	**0.90**

PROPOSED

Drainage Area	2-YR. (2.86") (CFS)	10-Yr. (4.26") (CFS)	100-Yr. (7.32") (CFS)
DA-2	.01	.05	0.16
P-1	0.00	0.00	0.74
Total	**0.01**	**0.05**	**0.90**

DIFFERENCE

	2-YR. (2.86") (CFS)	10-Yr. (4.26") (CFS)	100-Yr. (7.32") (CFS)
Total	**0.07**	**0.24**	**0.0**

Retention

We have an impervious area requiring 500 C.F. of storage and we are providing 2,310 C.F. of storage. Therefore, we exceed the retention requirements.

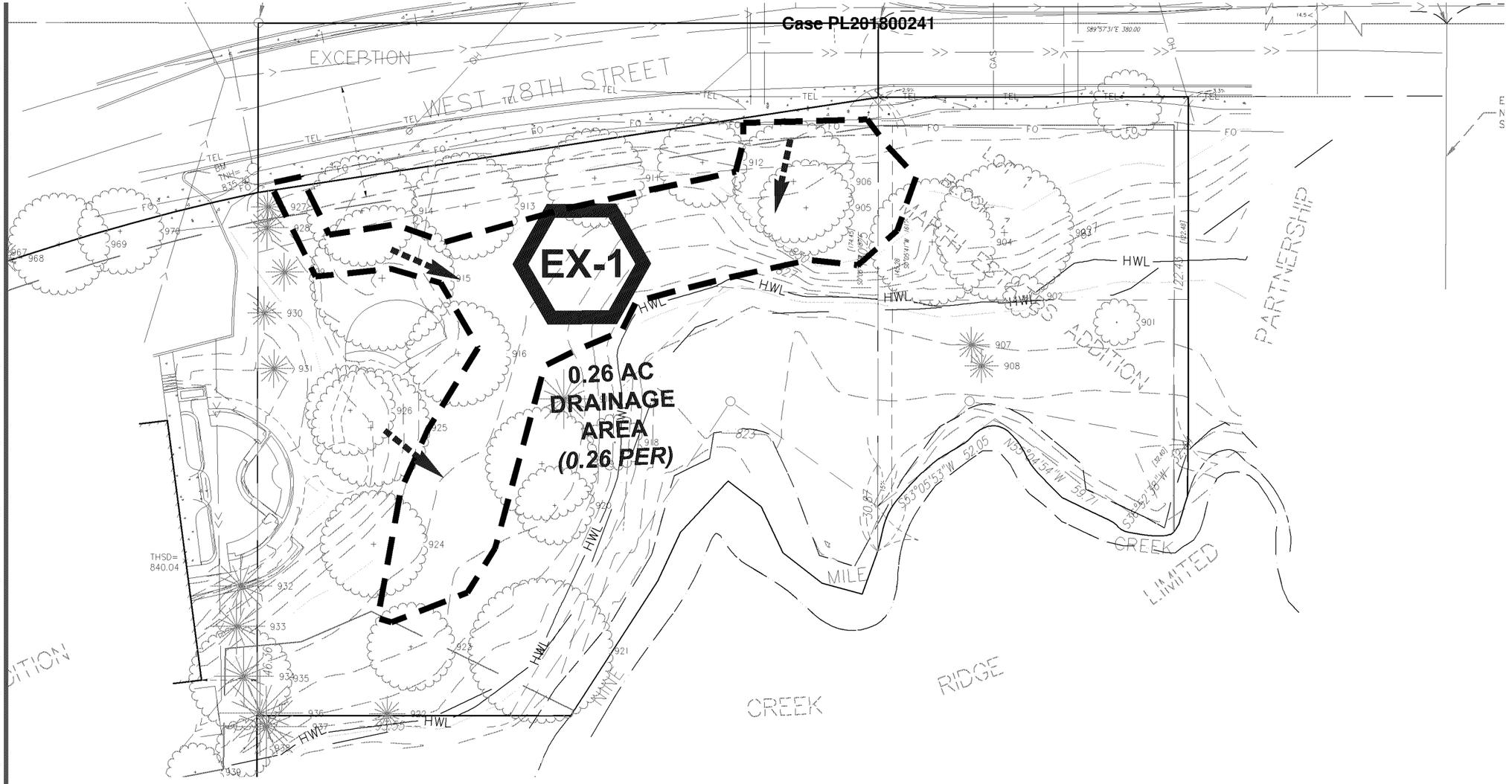
Water Quality

We are proposing an infiltration basin. Storm water will discharge to the south into the South Fork Nine Mile creek drainage area. The soils report attached states that the soils are B soils with an infiltration rate of 0.45 inches/hour per the Minnesota Stormwater Manual. The infiltration depth for soils with an infiltration rate of 0.45in/hr using the 48-hr draw-down requirement is 1.8-ft. The surface infiltration basin has a depth of 1.8-ft for infiltration. We are meeting the retention requirements and therefore meet the Water quality requirements as well.

Erosion Control

Best Management Practices will be followed for all erosion control measures. Silt fence will be used around the perimeter of the site where the green area drains off-site. The catch basins will have inlet protection. The flared end sections will be installed with rip rap at the outlets. We will have a rock construction entrance to reduce the amount of sediment leaving the site. Additional information on erosion control can be found in the Plan Set.

Case PL201800241



LEGEND

- SUBCATCHMENT
- INFILTRATION BASIN
- SITE DISCHARGE

0 40 80

SCALE IN FEET

Creekview East
Parking Lot

Frauenshuh

2101 West 78th Street
MINNEAPOLIS, MN 55423

LOUCKS

PLANNING
CIVIL ENGINEERING
LAND SURVEYING
LANDSCAPE ARCHITECTURE
ENVIRONMENTAL

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CADD QUALIFICATION

CADD files prepared by the Consultant for this project are instruments of the Consultant professional services for use solely with respect to this project. These CADD files shall not be used on other projects, for additions to this project, or for completion of this project by others without written approval by the Consultant. With the Consultant's approval, others may be permitted to obtain copies of the CADD drawing files for information and reference only. All intentional or unintentional revisions, additions, or deletions to these CADD files shall be made at the full risk of that party making such revisions, additions or deletions and that party shall hold harmless and indemnify the Consultant from any & all responsibilities, claims, and liabilities.

SUBMITTAL/REVISIONS

PROFESSIONAL SIGNATURE

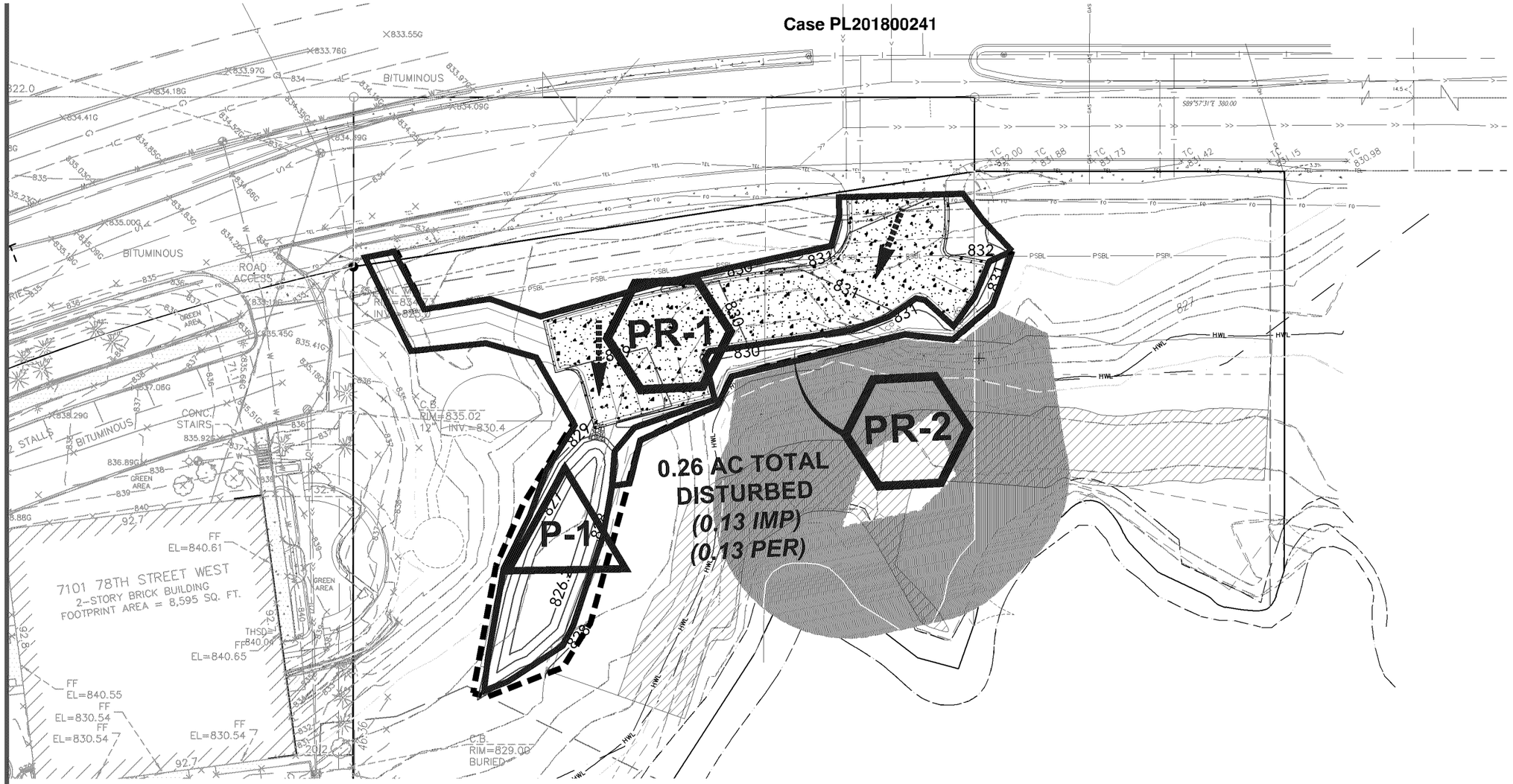
QUALITY CONTROL

C2-1 SITE PLAN
C3-1 GRADING & DRAINAGE PLAN

EXISTING
DRAINAGE
AREA MAP

H1-1

Case PL201800241



0 40 80

SCALE IN FEET

LEGEND

X SUBCATCHMENT

X INFILTRATION BASIN

SITE DISCHARGE

Creekview East Parking Lot

Frauenshuh

7101 West 78th Street
MINNEAPOLIS, MN 55439

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SUBMITTAL/REVISIONS

PROFESSIONAL SIGNATURE

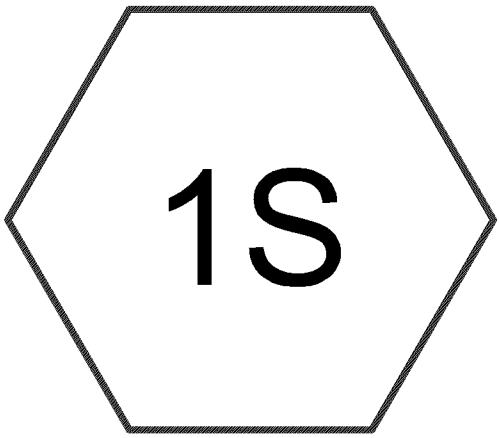
QUALITY CONTROL

C2-1 SITE PLAN
C3-1 GRADING & DRAINAGE PLAN

PROPOSED DRAINAGE AREA MAP

H2-1

Plotted: 07/09/2018 3:48 PM W:\2014\14004\CADD DATA\CIVIL...dwg Sheet Files\H2-1 PROPOSED DRAINAGE MAP



DA1

Subcat Reach Pond Link

Routing Diagram for Existing Drainage
Prepared by {enter your company name here}, Printed 7/9/2018

Existing Drainage

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.260	65	Woods/grass comb., Fair, HSG B (1S)
0.260	**65**	**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 Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DA1 Runoff Area=11,314 sf 0.00% Impervious Runoff Depth>0.38"
Flow Length=133' Tc=22.3 min CN=65 Runoff=0.08 cfs 0.008 af

Total Runoff Area = 0.260 ac Runoff Volume = 0.008 af Average Runoff Depth = 0.38"
100.00% Pervious = 0.260 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: DA1

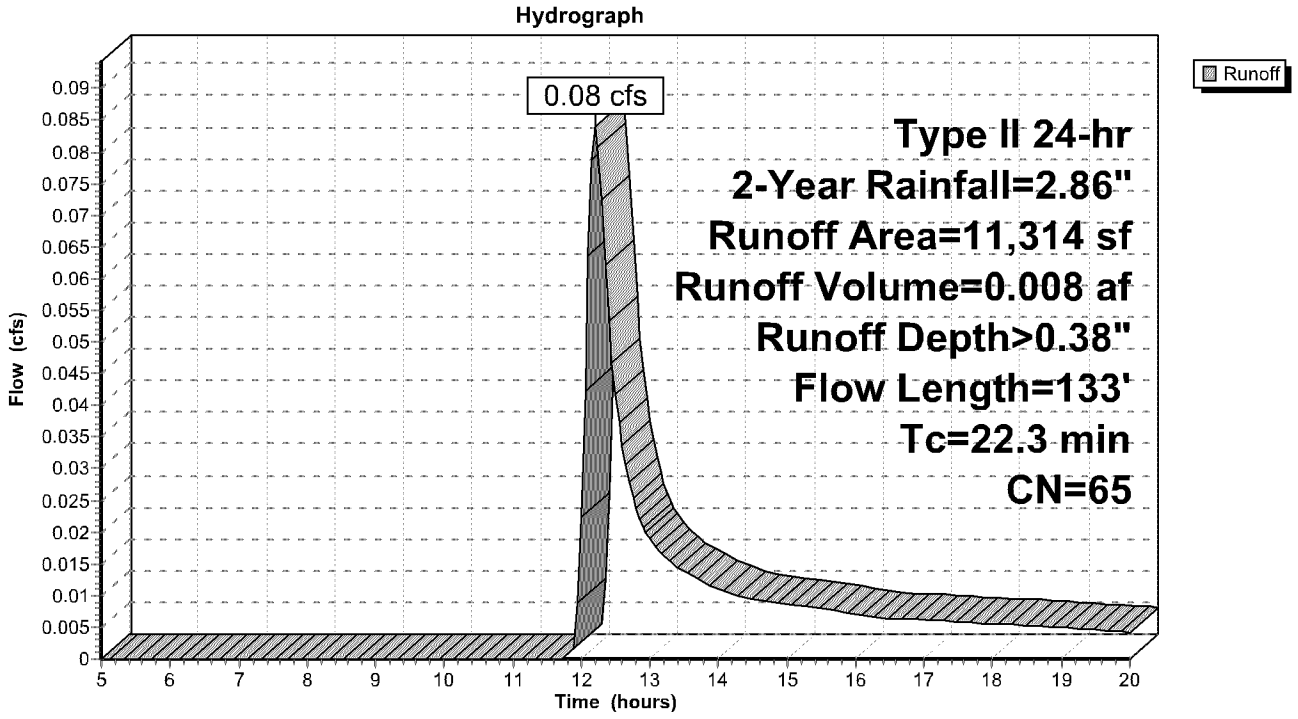
Runoff = 0.08 cfs @ 12.21 hrs, Volume= 0.008 af, Depth> 0.38"

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-Year Rainfall=2.86"

Area (sf)	CN	Description
11,314	65	Woods/grass comb., Fair, HSG B
11,314		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	7	0.1240	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.86"
16.8	98	0.0410	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.86"
4.2	28	0.1070	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.86"
22.3	133	Total			

Subcatchment 1S: DA1



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 Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DA1 Runoff Area=11,314 sf 0.00% Impervious Runoff Depth>1.05"
Flow Length=133' Tc=22.3 min CN=65 Runoff=0.29 cfs 0.023 af

Total Runoff Area = 0.260 ac Runoff Volume = 0.023 af Average Runoff Depth = 1.05"
100.00% Pervious = 0.260 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: DA1

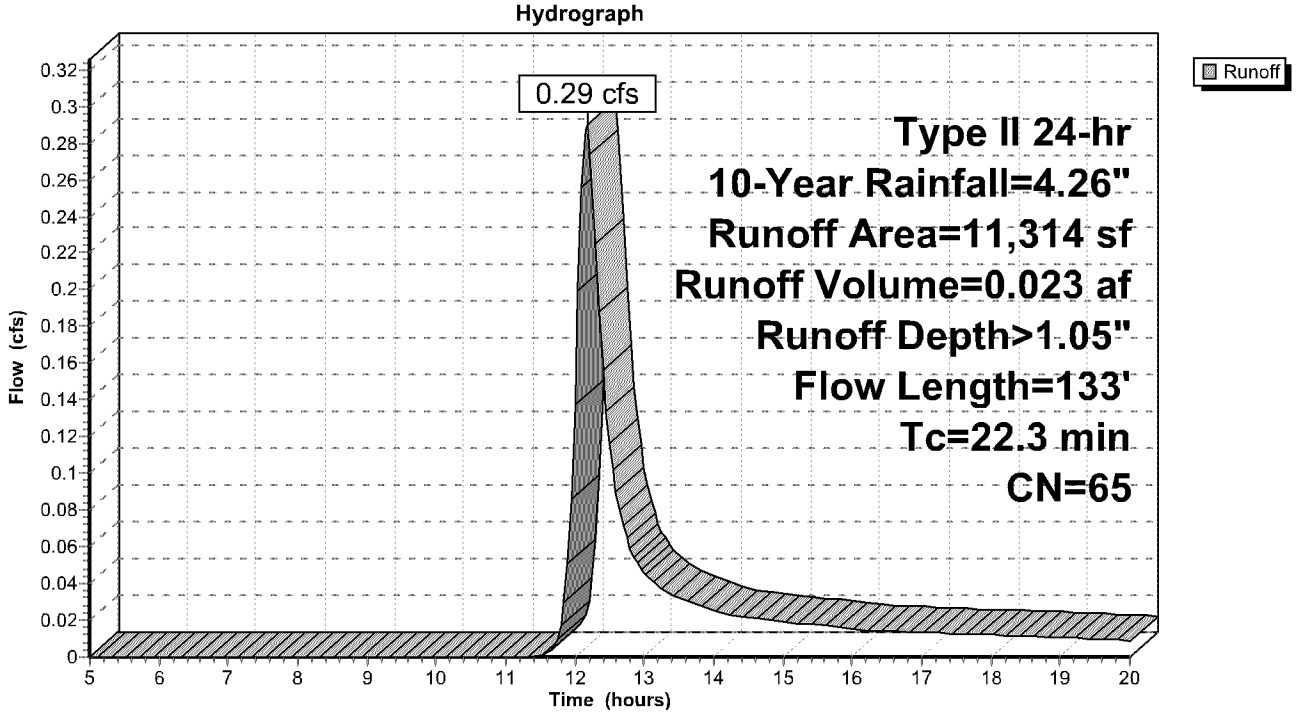
Runoff = 0.29 cfs @ 12.17 hrs, Volume= 0.023 af, Depth> 1.05"

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-Year Rainfall=4.26"

Area (sf)	CN	Description
11,314	65	Woods/grass comb., Fair, HSG B
11,314		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	7	0.1240	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.86"
16.8	98	0.0410	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.86"
4.2	28	0.1070	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.86"
22.3	133	Total			

Subcatchment 1S: DA1



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 Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DA1 Runoff Area=11,314 sf 0.00% Impervious Runoff Depth>3.05"
Flow Length=133' Tc=22.3 min CN=65 Runoff=0.90 cfs 0.066 af

Total Runoff Area = 0.260 ac Runoff Volume = 0.066 af Average Runoff Depth = 3.05"
100.00% Pervious = 0.260 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: DA1

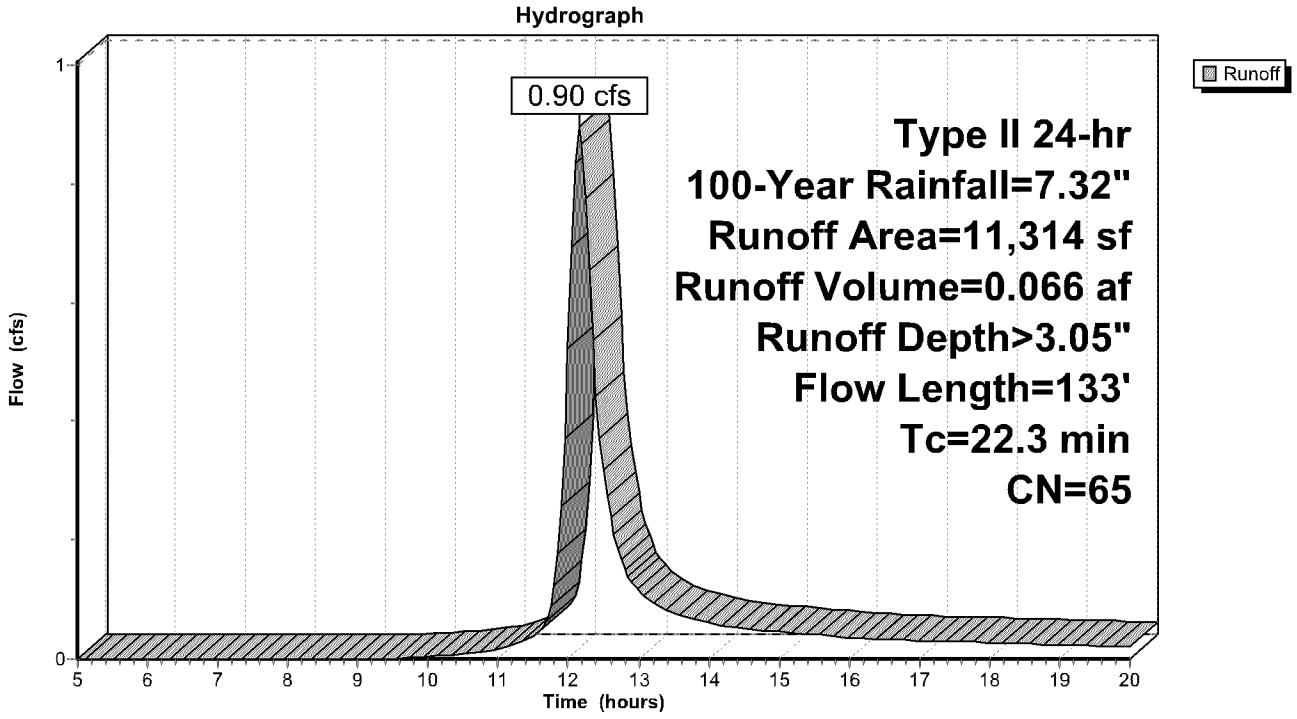
Runoff = 0.90 cfs @ 12.16 hrs, Volume= 0.066 af, Depth> 3.05"

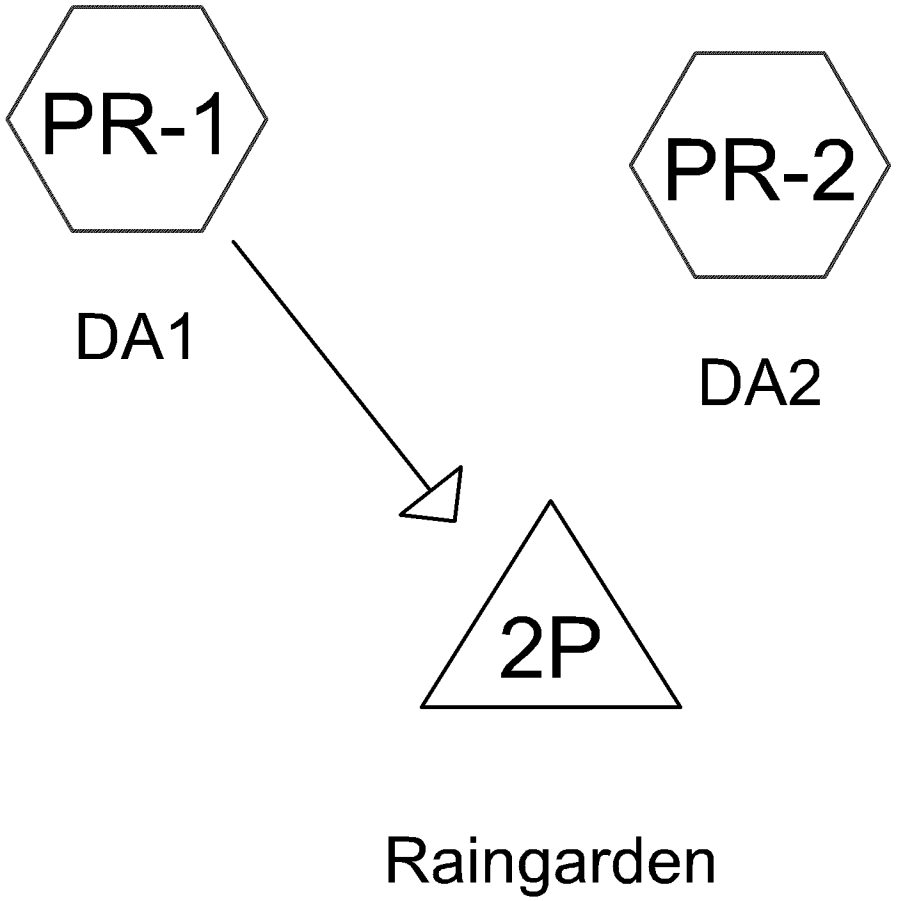
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.32"

Area (sf)	CN	Description
11,314	65	Woods/grass comb., Fair, HSG B
11,314		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	7	0.1240	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.86"
16.8	98	0.0410	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.86"
4.2	28	0.1070	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.86"
22.3	133	Total			

Subcatchment 1S: DA1





Subcat Reach Pond Link

Routing Diagram for 14004 Proposed Drainage
Prepared by {enter your company name here}, Printed 7/9/2018
HydroCAD® 10.00-21 s/n 02676 © 2018 HydroCAD Software Solutions LLC

14004 Proposed Drainage

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.027	61	>75% Grass cover, Good, HSG B (PR-2)
0.125	98	Paved parking, HSG B (PR-1)
0.107	65	Woods/grass comb., Fair, HSG B (PR-1)
0.259	**81**	**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 Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PR-1: DA1 Runoff Area=10,111 sf 54.04% Impervious Runoff Depth>1.23"
Flow Length=163' Tc=2.5 min CN=83 Runoff=0.60 cfs 0.024 af

Subcatchment PR-2: DA2 Runoff Area=0.027 ac 0.00% Impervious Runoff Depth>0.27"
Flow Length=10' Slope=0.3330 '/' Tc=0.5 min CN=61 Runoff=0.01 cfs 0.001 af

Pond 2P: Raingarden Peak Elev=826.92' Storage=682 cf Inflow=0.60 cfs 0.024 af
Discarded=0.01 cfs 0.009 af Primary=0.00 cfs 0.000 af Outflow=0.01 cfs 0.009 af

Total Runoff Area = 0.259 ac Runoff Volume = 0.024 af Average Runoff Depth = 1.13"
51.59% Pervious = 0.134 ac 48.41% Impervious = 0.125 ac

Summary for Subcatchment PR-1: DA1

[49] Hint: Tc<2dt may require smaller dt

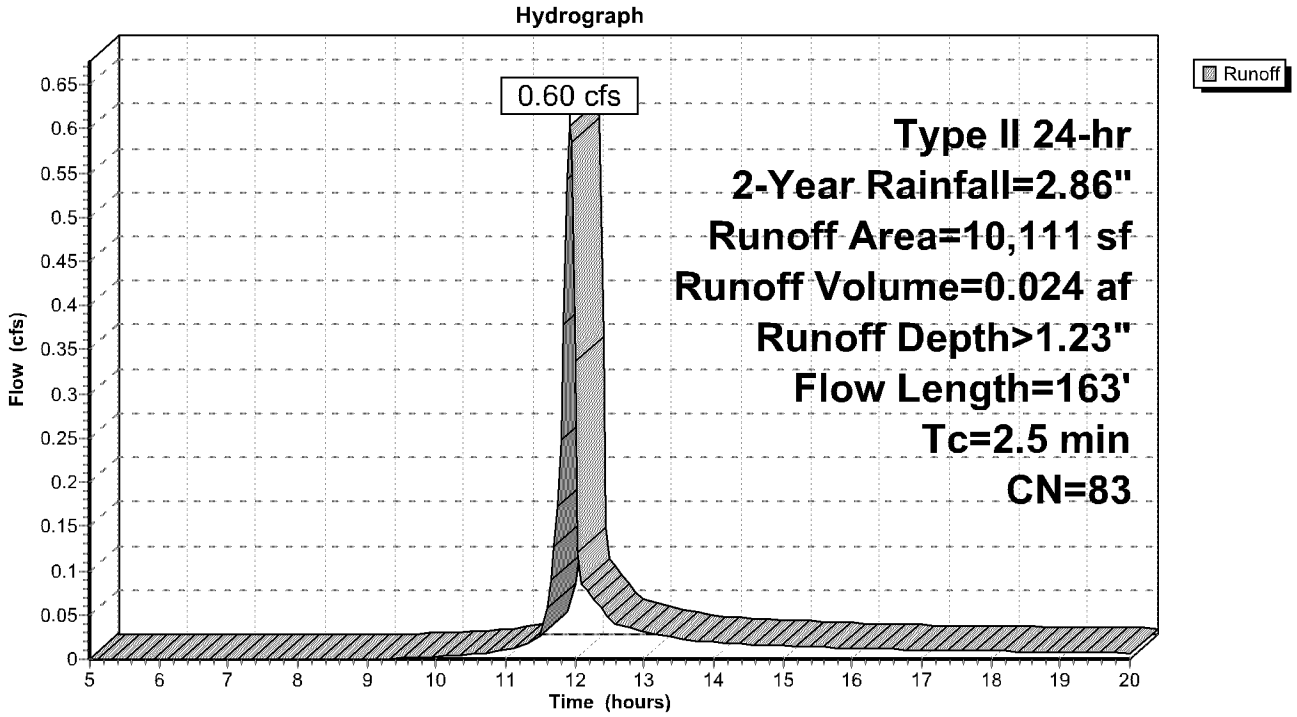
Runoff = 0.60 cfs @ 11.93 hrs, Volume= 0.024 af, Depth> 1.23"

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-Year Rainfall=2.86"

Area (sf)	CN	Description
4,647	65	Woods/grass comb., Fair, HSG B
5,464	98	Paved parking, HSG B
10,111	83	Weighted Average
4,647		45.96% Pervious Area
5,464		54.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	21	0.0150	0.85		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.86"
0.4	24	0.0200	0.98		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.86"
1.0	70	0.0200	1.21		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.86"
0.7	48	0.0250	1.23		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.86"
2.5	163	Total			

Subcatchment PR-1: DA1



Summary for Subcatchment PR-2: DA2

[49] Hint: Tc<2dt may require smaller dt

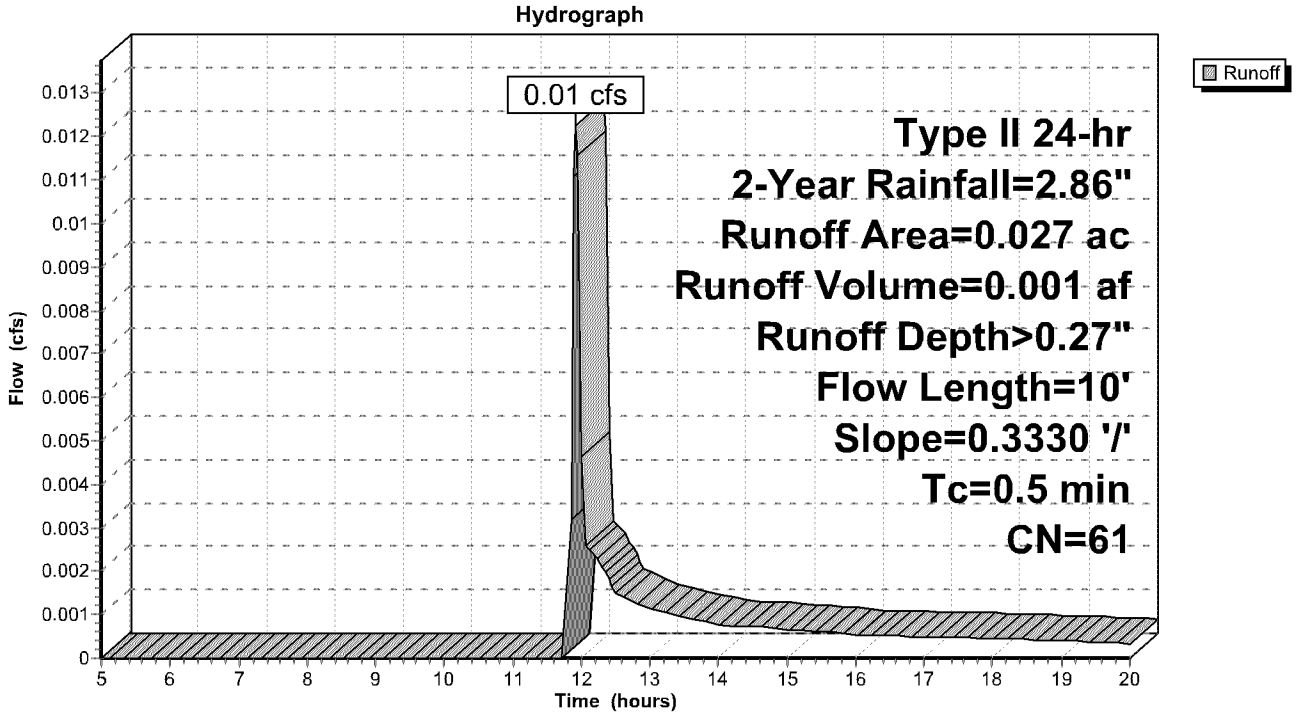
Runoff = 0.01 cfs @ 11.93 hrs, Volume= 0.001 af, Depth> 0.27"

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-Year Rainfall=2.86"

Area (ac)	CN	Description
0.027	61	>75% Grass cover, Good, HSG B
0.027		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	10	0.3330	0.31		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.86"

Subcatchment PR-2: DA2



Summary for Pond 2P: Raingarden

Inflow Area = 0.232 ac, 54.04% Impervious, Inflow Depth > 1.23" for 2-Year event
Inflow = 0.60 cfs @ 11.93 hrs, Volume= 0.024 af
Outflow = 0.01 cfs @ 15.84 hrs, Volume= 0.009 af, Atten= 98%, Lag= 234.3 min
Discarded = 0.01 cfs @ 15.84 hrs, Volume= 0.009 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 826.92' @ 15.84 hrs Surf.Area= 1,185 sf Storage= 682 cf

Plug-Flow detention time= 228.7 min calculated for 0.009 af (38% of inflow)
Center-of-Mass det. time= 142.1 min (930.9 - 788.9)

Volume	Invert	Avail.Storage	Storage Description
#1	826.20'	2,310 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

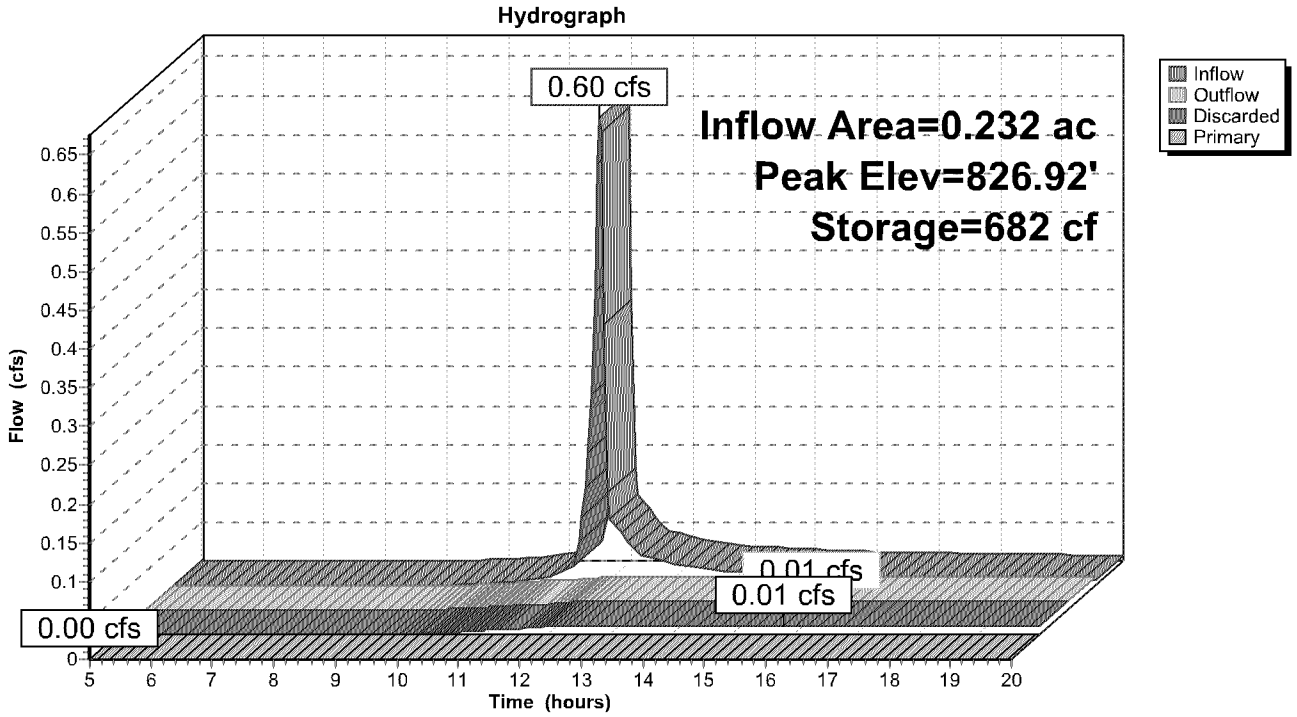
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
826.20	730	158.0	0	0	730
827.00	1,243	184.0	780	780	1,451
828.00	1,835	211.0	1,529	2,310	2,322

Device	Routing	Invert	Outlet Devices
#1	Primary	828.00'	**5.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	826.20'	**0.450 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.01 cfs @ 15.84 hrs HW=826.92' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=826.20' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Raingarden



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 Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PR-1: DA1 Runoff Area=10,111 sf 54.04% Impervious Runoff Depth>2.33"
Flow Length=163' Tc=2.5 min CN=83 Runoff=1.11 cfs 0.045 af

Subcatchment PR-2: DA2 Runoff Area=0.027 ac 0.00% Impervious Runoff Depth>0.84"
Flow Length=10' Slope=0.3330 '/' Tc=0.5 min CN=61 Runoff=0.05 cfs 0.002 af

Pond 2P: Raingarden Peak Elev=827.48' Storage=1,443 cf Inflow=1.11 cfs 0.045 af
Discarded=0.02 cfs 0.012 af Primary=0.00 cfs 0.000 af Outflow=0.02 cfs 0.012 af

Total Runoff Area = 0.259 ac Runoff Volume = 0.047 af Average Runoff Depth = 2.18"
51.59% Pervious = 0.134 ac 48.41% Impervious = 0.125 ac

Summary for Subcatchment PR-1: DA1

[49] Hint: Tc<2dt may require smaller dt

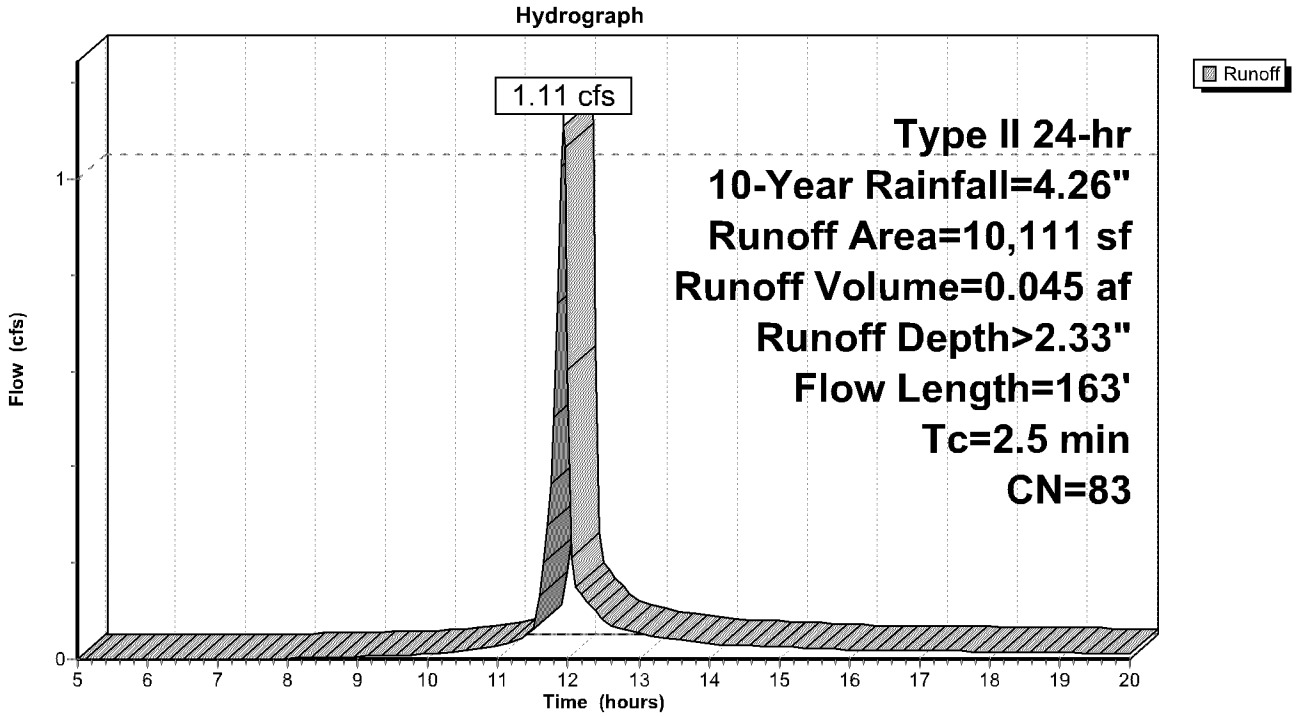
Runoff = 1.11 cfs @ 11.93 hrs, Volume= 0.045 af, Depth> 2.33"

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-Year Rainfall=4.26"

Area (sf)	CN	Description
4,647	65	Woods/grass comb., Fair, HSG B
5,464	98	Paved parking, HSG B
10,111	83	Weighted Average
4,647		45.96% Pervious Area
5,464		54.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	21	0.0150	0.85		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.86"
0.4	24	0.0200	0.98		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.86"
1.0	70	0.0200	1.21		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.86"
0.7	48	0.0250	1.23		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.86"
2.5	163	Total			

Subcatchment PR-1: DA1



Summary for Subcatchment PR-2: DA2

[49] Hint: Tc<2dt may require smaller dt

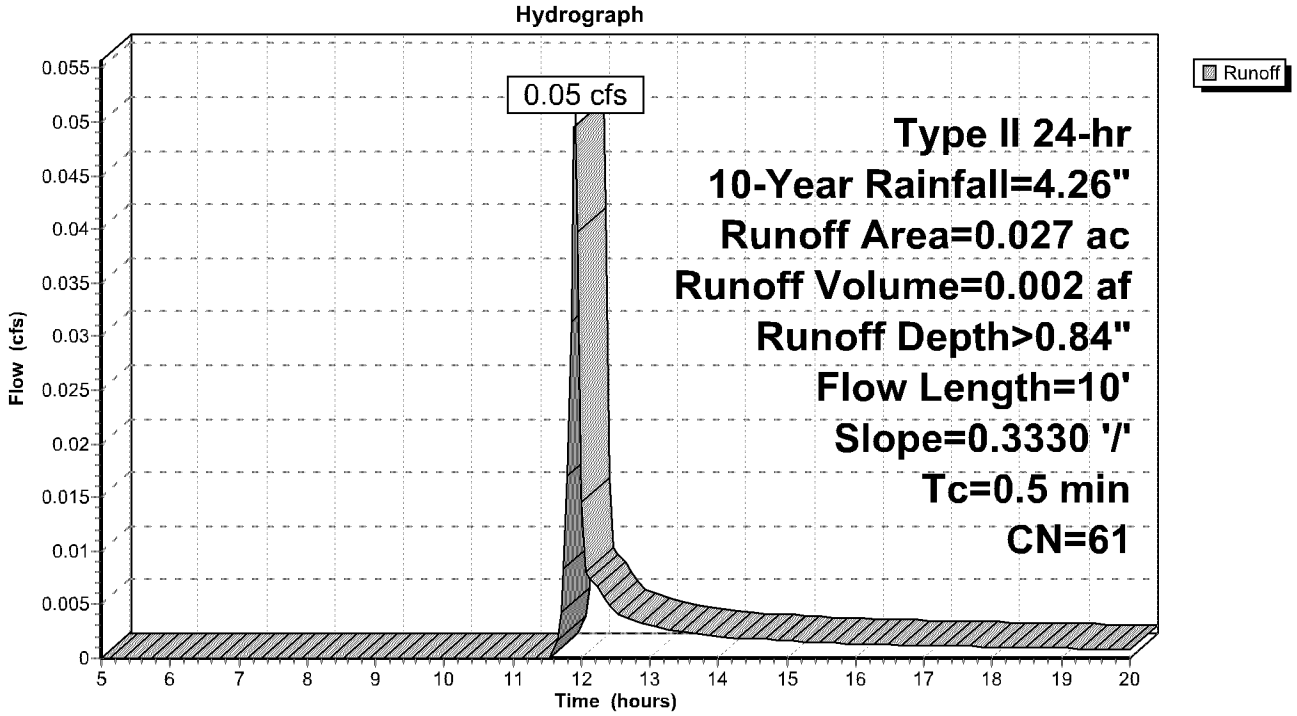
Runoff = 0.05 cfs @ 11.91 hrs, Volume= 0.002 af, Depth> 0.84"

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-Year Rainfall=4.26"

Area (ac)	CN	Description
0.027	61	>75% Grass cover, Good, HSG B
0.027		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	10	0.3330	0.31		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.86"

Subcatchment PR-2: DA2



Summary for Pond 2P: Raingarden

Inflow Area = 0.232 ac, 54.04% Impervious, Inflow Depth > 2.33" for 10-Year event
Inflow = 1.11 cfs @ 11.93 hrs, Volume= 0.045 af
Outflow = 0.02 cfs @ 17.92 hrs, Volume= 0.012 af, Atten= 99%, Lag= 359.2 min
Discarded = 0.02 cfs @ 17.92 hrs, Volume= 0.012 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 827.48' @ 17.92 hrs Surf.Area= 1,514 sf Storage= 1,443 cf

Plug-Flow detention time= 225.7 min calculated for 0.012 af (27% of inflow)
Center-of-Mass det. time= 131.3 min (906.2 - 774.9)

Volume	Invert	Avail.Storage	Storage Description
#1	826.20'	2,310 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

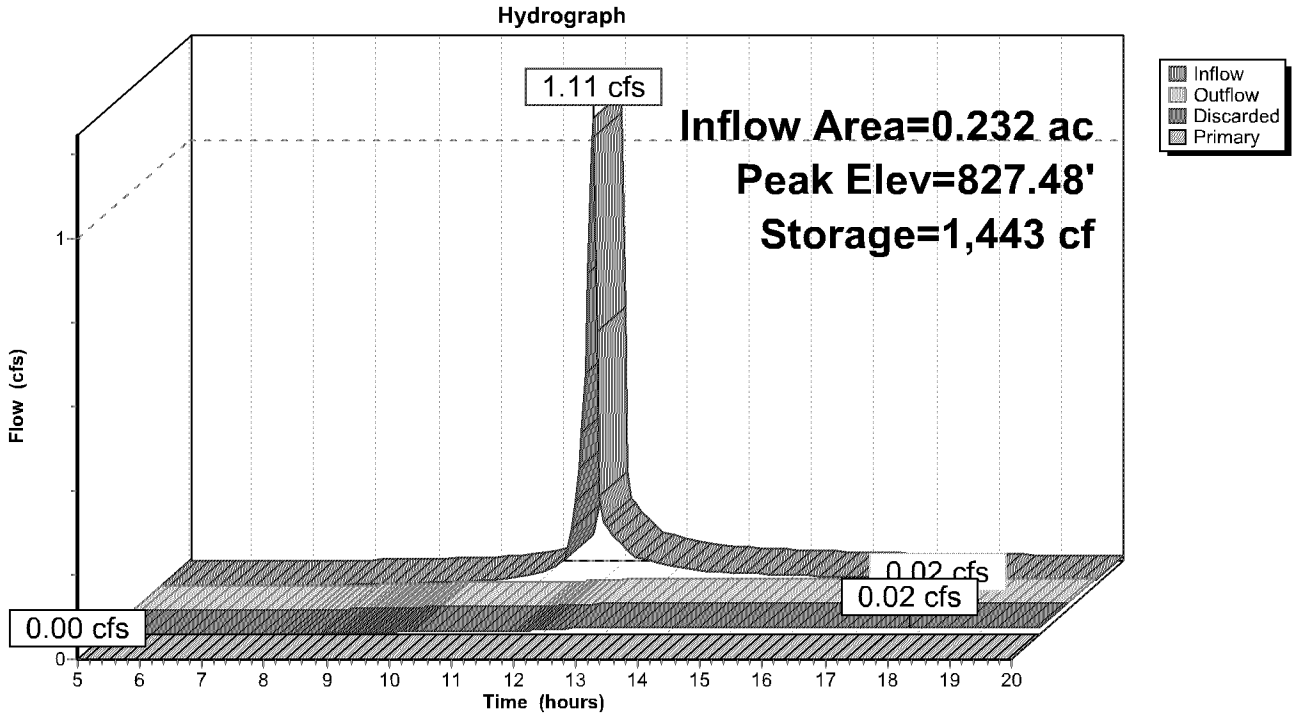
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
826.20	730	158.0	0	0	730
827.00	1,243	184.0	780	780	1,451
828.00	1,835	211.0	1,529	2,310	2,322

Device	Routing	Invert	Outlet Devices
#1	Primary	828.00'	**5.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	826.20'	**0.450 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.02 cfs @ 17.92 hrs HW=827.48' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=826.20' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Raingarden



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 Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PR-1: DA1 Runoff Area=10,111 sf 54.04% Impervious Runoff Depth>5.00"
Flow Length=163' Tc=2.5 min CN=83 Runoff=2.25 cfs 0.097 af

Subcatchment PR-2: DA2 Runoff Area=0.027 ac 0.00% Impervious Runoff Depth>2.68"
Flow Length=10' Slope=0.3330 '/' Tc=0.5 min CN=61 Runoff=0.16 cfs 0.006 af

Pond 2P: Raingarden Peak Elev=828.16' Storage=2,310 cf Inflow=2.25 cfs 0.097 af
Discarded=0.02 cfs 0.017 af Primary=0.74 cfs 0.027 af Outflow=0.76 cfs 0.044 af

Total Runoff Area = 0.259 ac Runoff Volume = 0.103 af Average Runoff Depth = 4.75"
51.59% Pervious = 0.134 ac 48.41% Impervious = 0.125 ac

Summary for Subcatchment PR-1: DA1

[49] Hint: Tc<2dt may require smaller dt

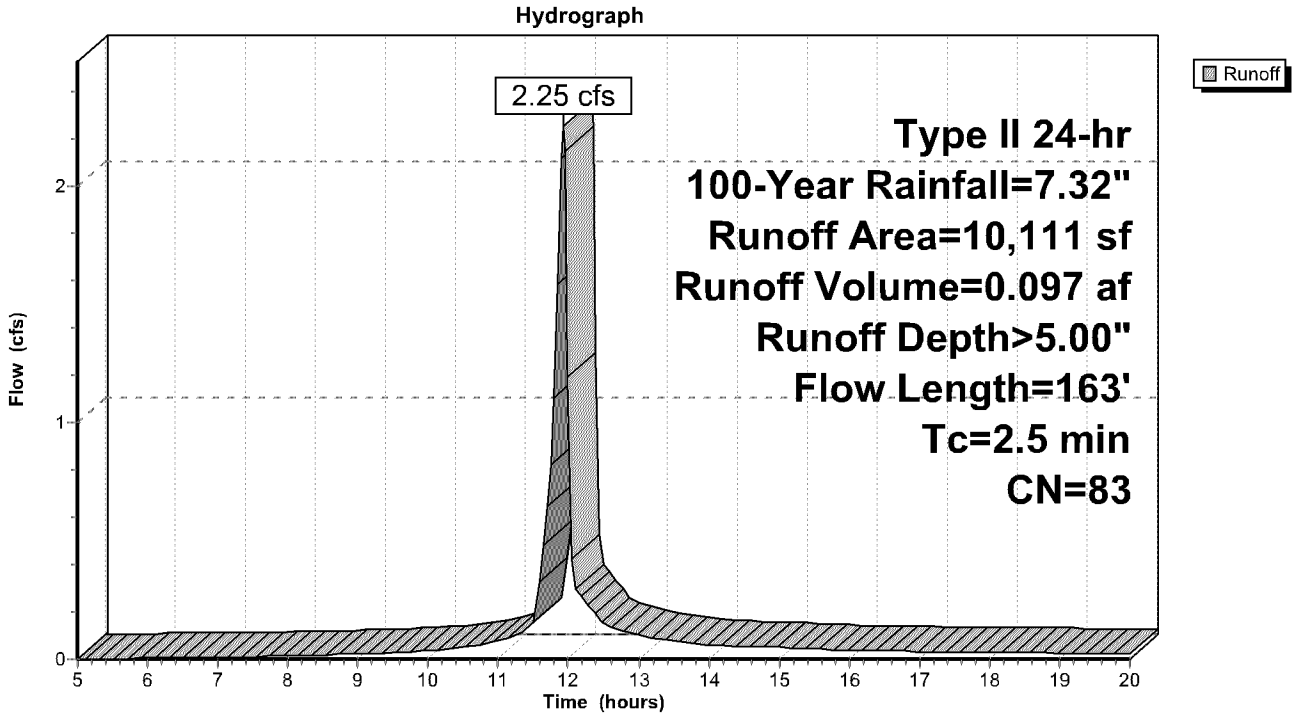
Runoff = 2.25 cfs @ 11.93 hrs, Volume= 0.097 af, Depth> 5.00"

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-Year Rainfall=7.32"

Area (sf)	CN	Description
4,647	65	Woods/grass comb., Fair, HSG B
5,464	98	Paved parking, HSG B
10,111	83	Weighted Average
4,647		45.96% Pervious Area
5,464		54.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	21	0.0150	0.85		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.86"
0.4	24	0.0200	0.98		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.86"
1.0	70	0.0200	1.21		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.86"
0.7	48	0.0250	1.23		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.86"
2.5	163	Total			

Subcatchment PR-1: DA1



Summary for Subcatchment PR-2: DA2

[49] Hint: Tc<2dt may require smaller dt

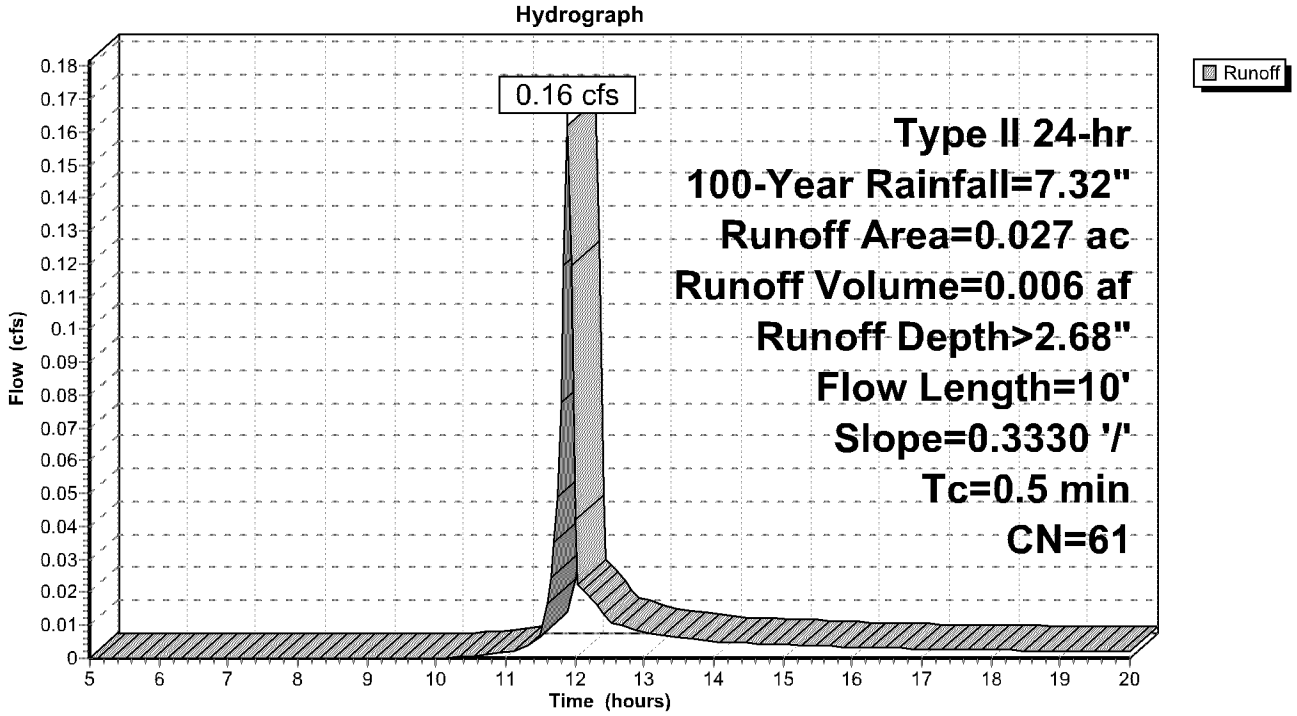
Runoff = 0.16 cfs @ 11.90 hrs, Volume= 0.006 af, Depth> 2.68"

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-Year Rainfall=7.32"

Area (ac)	CN	Description
0.027	61	>75% Grass cover, Good, HSG B
0.027		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	10	0.3330	0.31		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.86"

Subcatchment PR-2: DA2



Summary for Pond 2P: Raingarden

[93] Warning: Storage range exceeded by 0.16'
[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=77)

Inflow Area = 0.232 ac, 54.04% Impervious, Inflow Depth > 5.00" for 100-Year event
Inflow = 2.25 cfs @ 11.93 hrs, Volume= 0.097 af
Outflow = 0.76 cfs @ 12.05 hrs, Volume= 0.044 af, Atten= 66%, Lag= 7.4 min
Discarded = 0.02 cfs @ 12.05 hrs, Volume= 0.017 af
Primary = 0.74 cfs @ 12.05 hrs, Volume= 0.027 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 828.16' @ 12.05 hrs Surf.Area= 1,835 sf Storage= 2,310 cf

Plug-Flow detention time= 162.2 min calculated for 0.044 af (45% of inflow)
Center-of-Mass det. time= 77.7 min (835.1 - 757.4)

Volume	Invert	Avail.Storage	Storage Description
#1	826.20'	2,310 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

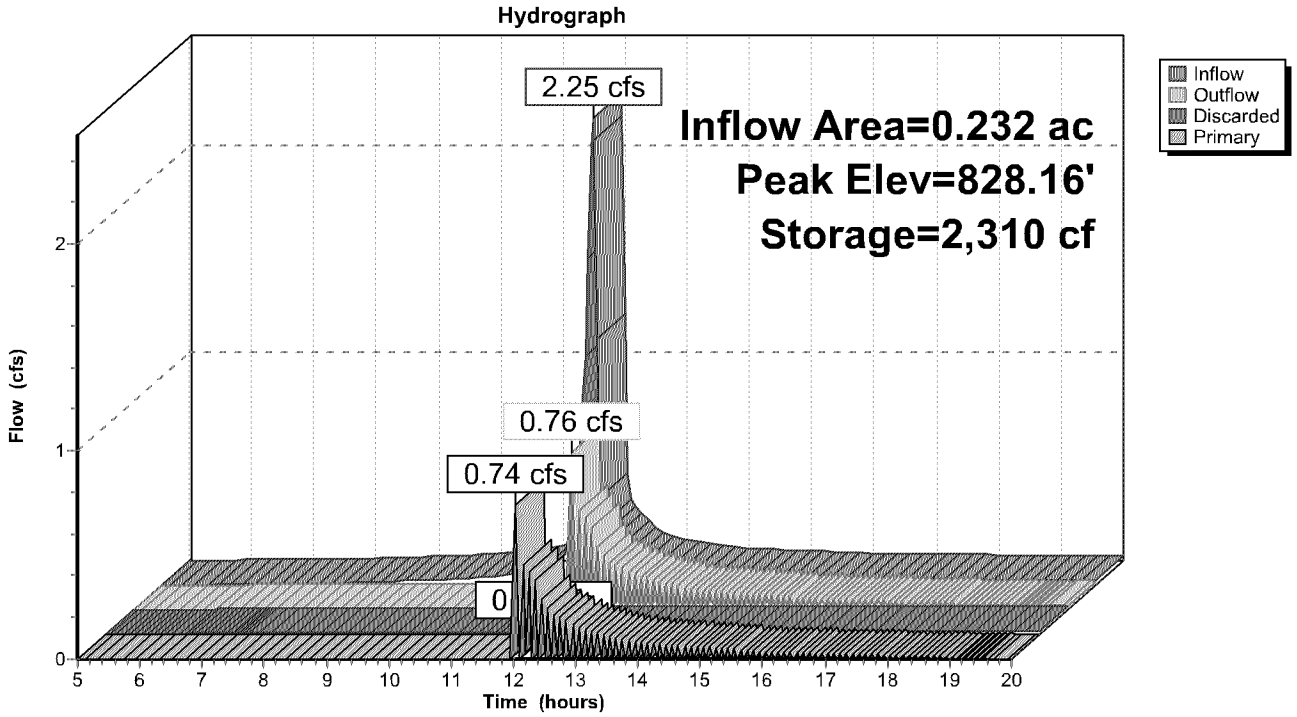
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
826.20	730	158.0	0	0	730
827.00	1,243	184.0	780	780	1,451
828.00	1,835	211.0	1,529	2,310	2,322

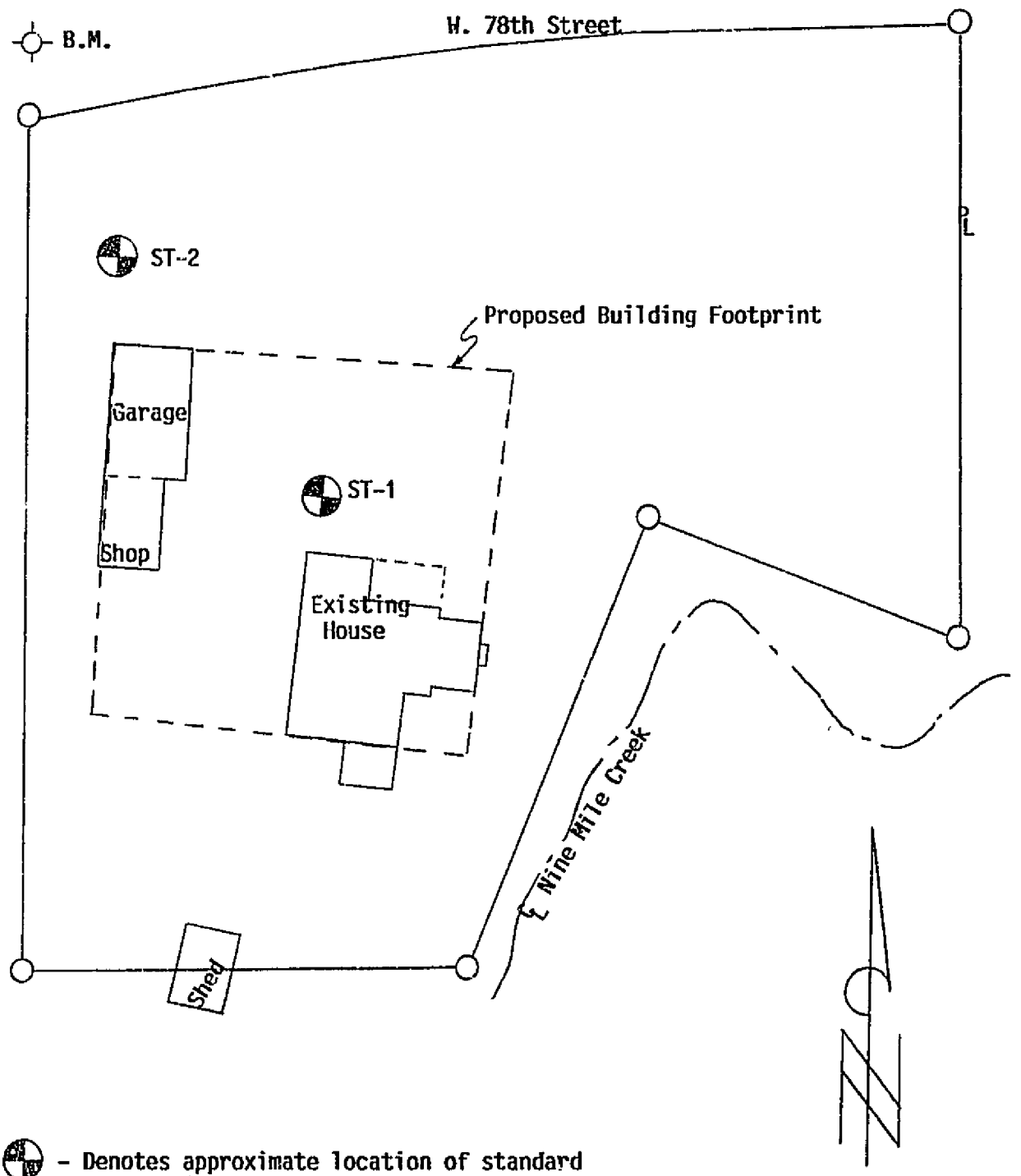
Device	Routing	Invert	Outlet Devices
#1	Primary	828.00'	**5.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	826.20'	**0.450 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.02 cfs @ 12.05 hrs HW=828.16' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.74 cfs @ 12.05 hrs HW=828.16' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.74 cfs @ 0.93 fps)

Pond 2P: Raingarden





- Denotes approximate location of standard penetration test borings.

BRAUN

87-831 PRELIMINARY FOUNDATION INVESTIGATION
7001 W. 78th St.
Bloomington, MN

Date: 10/28/87	Revised: ---	Drawn: PDB	Scale: 1" = 35'±

LOG OF BORING

BRAUN ENGINEERING TESTING

PROJECT: 87-831 PRELIMINARY FOUNDATION INVESTIGATION 7001 West 78th Street Bloomington, MN	BORING: ST-1 LOCATION: See Attached Sketch. DATE: 10/26/87 SCALE: 1" = 4'

Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM D2488)	BPF	WL	Tests or Notes
95.6	0					
~~95.3~~	~~3~~	~~SC~~	~~CLAYEY SAND, fine to medium-~~ *			
		SM	SILTY SAND, fine to medium-grained, brown, moist, loose. (Coarse Alluvium)	9		Surface elevations referenced to the top of the hydrant located near the northwest property corner on W. 78th St.. Assumed elevation = 100.0'.
91.6	4					
		SP-SM	POORLY GRADED SAND with SILT, fine to medium-grained, with some Gravel, with lenses of waterbearing WELL GRADED SAND with SILT, brown, moist, loose to medium dense. (Glacial Outwash)	11 10		*grained, black, moist. (Topsoil)
86.6	9					
		SP	POORLY GRADED SAND, fine to medium-grained, with a trace of Gravel, brown, waterbearing, loose. (Glacial Outwash)	10		
83.6	12					
		SC-SM	SILTY CLAYEY SAND, fine to medium-grained, with a trace of Gravel, gray, wet, loose. (Glacial Till)	9 9		
76.6	19					
75.1	20.5	SC-SM	SILTY CLAYEY SAND, fine to medium-grained, with a trace **	15		**of Gravel, gray, wet medium dense. (Glacial Till)
			END OF BORING. Water level down 7.5' with 7.5' of hollow-stem auger in the ground. Water level not encountered to cave-in depth of 9' immediately after withdrawal of auger. Water level not encountered to cave-in depth of 8' 1/2 hour later. Boring then backfilled.			

(See Report and Standard Plates for evaluation and descriptive terminology.)

LOG OF BORING

BRAUN ENGINEERING TESTING

PROJECT: 87-831 PRELIMINARY FOUNDATION INVESTIGATION 7001 West 78th Street Bloomington, MN	BORING: ST-2 LOCATION: See Attached Sketch. DATE: 10/26/87 SCALE: 1" = 4'

Elev.	Depth	ASTM D2487 Symbol	Description of Materials (ASTM D2488)	BPF	WL	Tests or Notes
93.5	0		AGGREGATE PAVEMENT.			
93.0	.5	SC	CLAYEY SAND, fine to medium-*			*grained, black. (Topsoil)
		SC-SM	SILTY CLAYEY SAND, fine-grained, with some iron-staining, brown, wet, medium dense. (Coarse Alluvium)	14		
89.5	4					
		SM	SILTY SAND, very fine-grained, grayish-brown, wet, loose. (Coarse Alluvium)	10		
86.5	7					
		SC-SM	SILTY CLAYEY SAND, fine-grained, with a trace of Gravel, brown and gray, wet, loose to medium dense. (Glacial Till)	11 10 10		
79.5	14					
		SC-SM	SILTY CLAYEY SAND, fine to medium-grained, with a trace of Gravel, gray, wet, medium dense. (Glacial Till)	12		
73.0	20.5			14		
			END OF BORING. Water level down 7.5' with 7.5' of hollow-stem auger in the ground. Water level not encountered to cave-in depth of 7' immediately after withdrawal of auger. Water level not encountered to cave-in depth of 7' 2 hours later. Boring then backfilled.			

(See Report and Standard Plates for evaluation and descriptive terminology.)